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Biological Sciences

АЛТЫН ЕМЕЛ МЕМЛЕКЕТТІК ҰЛТТЫҚ ТАБИҒИ ПАРКІНІҢ ТОПЫРАҚ ЭКОЛОГИЯЛЫҚ ЖАҒДАЙЫ

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Аннотация. Алтын Емел топырағындағы қарашірік мөлшерінің қазіргі градациялары бойынша қарашірік, азот мөлшері төменге жатады. Жоғарғы қабаттан төменгіге дейінгі қазба шұңқырлардың барлық кескіні бойынша жылжымалы фосфор мөлшерінің деңгейі төменнен өте төменге дейін ауытқиды. Жоғарғы қабаттарда жылжымалы калий мөлшері өте жоғары, топырақтың төменгі қабатына қарай азаяды Алтын Емел топырағы шкала бойынша әлсіз қышқылды, әлсіз сілтілі және сілтілі топыраққа жатады. Сіңіргіш кешеннің кальциймен қанығуы өсімдіктерге қолайлы, топырақтың бейтарап реакциясына жақын болуын қамтамасыз етеді, оның сіңіргіш кешенін бұзылудан сақтайды, топырақтың агрегатталуына және ондағы гумустың бекітілуіне ықпал етеді. Алтын Емел топырағы Ө.Ө.Оспанов атындағы Қазақ топырақтану және агрохимия ғылыми-зерттеу институтының картасы бойынша сұр-қоңыр шөлейт қарапайым сортаңданған сор топыраққа (СБпсн) жатады. Алтын Емел топырағындағы ауыр металдардың жалпы және жылжымалы формаларының мөлшері бойынша талдамалық деректер қолайлы концентрацияларда екенін көрсетті. 2 қазба-шұңқырдың төменгі қабаттарындағы мырыш мөлшерінің кейбір шамалы ұлғаюын топырақтүзетін жыныстардың құрамымен түсіндірген жөн.

Түйін сөздер: табиғи парк, топырақ, гумус, азот, фосфор, калий, ауыр металдар

SOIL ECOLOGICAL STATE OF ALTYN EMEL STATE NATIONAL NATURAL PARK Erkinbekova Akmoldir Zhaksylykbaevna, chemistry teacher, teacher-researcher

Andosova Meruert Talgatovna young researcher, student of the 11th grade

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Abstract. According to the existing gradations of humus content in gold-containing soils, the content of humus and nitrogen is low. The level of mobile phosphorus throughout the profile of the excavation pits from the top to the bottom ranges from the bottom to the lowest. The content of mobile potassium in the upper layers is very high, decreasing towards the lower soil layer. Saturation of absorbing complex with calcium ensures soil proximity to neutral reaction favorable for plants, protects its absorbing complex from destruction, promotes soil aggregation and humus fixation in it. According to the map of the Kazakh Research Institute of Soil Science and Agrochemistry named after U.U. Ospanov, the gold-brown soil belongs to the simplest saline weed soil (SBpsn). Analytical data on the amount of total and mobile forms of heavy metals in gold Emel

showed that they are in acceptable concentrations. Some minor increases in zinc content in the lower layers of the 2 pits should be explained by the composition of the soil-forming rocks.

Keywords: *natural park, soil, humus, nitrogen, phosphorus, potassium, heavy metals*

Өзектілігі. Алтын Емел мемлекеттік ұлттық табиғи паркі - Жетісу өңіріндегі ерекше қорғалатын табиғи аумақ. Қорықтың топырақ жамылғысы әртүрлі табиғи жағдайларда қалыптасқан: шөлейт, таулы, өзен аңғары, жайылымдық жерлер. Топырақ – тек өсімдік өсіретін орта ғана емес, бүкіл экожүйенің тұрақтылығын қамтамасыз ететін негізгі компонент.

Қазақстанның оңтүстік-шығысында, Жетісудың орталығында, Іле өзені мен Жоңғар Алатауы тауларының арасында орналасқан мемлекеттік ұлттық табиғи саябақ.

Ұлттық парк 1996 жылы 10 сәуірде құрылды. Оның жалпы ауданы 307 653 га, оның ішінде қорғау аймағы - 62 845 га. Ол Алматыдан 250 км қашықтықта орналасқан.

«Алтынемел» ұлттық саябағы Қазақстанның оңтүстік-шығысында, орналасқан. Оның табиғаты географиялық аймақтың сан түрін өз бойына қамтуымен, әсемдігімен жұртшылықты таң қалдырады. Саябақ аумағында туристерді қатты қызықтыратын бірегей табиғи құрылымдар және байырғы тарих ескерткіштері орналасқан. Оның құрамына Жетісу Алатауының сілемдері: Шолақ, Дегерес, Матай, Алтынемел, Қояндытау таулары, Үлкен Қалқан, Кіші Қалқан, Ақтау жоталары және өте сирек кездесетін табиғат ескерткішінің бірі – Айғайқұм енеді. Сондай-ақ шөл дала мен шөлейт жердің де, таулы жердің де әсем табиғатын көре аласың. Саябақ аумағында тау жүйесі мен Іле өзені ағып жатыр. Аталмыш саябақ тек қана Қазақстанның ғана ең үлкен және атақты қорығы ғана емес, қазақ мәдениетіндегі бағалы және маңызды мұрасы болып саналатын әлемдік ЮНЕСКО тізіміндегі қорықтар қатарына жатады.

«Алтынемел» мемлекеттік ұлттық табиғи паркі Іле қазаншұңқырындағы құнды экожүйені және олардың биологиялық сан алуандығын сақтау, геоморфологиялық және палеонтологиялық нысандар және тарихи-мәдени ескерткіштерді қорғау үшін құрылған.

Ұлттық паркте туристерге арналған инфрақұрылымдық кешендер бар. Атап айтқанда, қонақүйлер, саяхатшылық соқпақтар, сапалы көлік жолдары. Сонымен қатар, «Алтынемел» ұлттық паркі еліміздегі шөлді аумақта орналасқан жалғыз парк болып саналады. Барлық жерлерде Іле жазығындағы көптеген ландшафтарды көруге болады. Олар: таулар, жазықтар, тоғайлар, сонымен қатар, қарақұйрық, құлан үйірлерін де көптеп көруге болады.

Саябақ флораға бай, онда жоғары сатыдағы өсімдіктердің 1500 түрі, «Қызыл кітапқа» енген 22 түрі (мысалы, Мүсілім сылдыршөбі, Қопал таспашөбі, Іле бөріқарақаты, т.б.) бар. Парк жануарлар әлеміне де бай. Омыртқасыздардың ішінде ең көп кездесетіні – өрмекшітәрізділер мен жәндіктер. Жәндіктердің 5000-нан аса түрі белгілі, оның 25 түрі Қазақстанның Қызыл кітабына енгізілген.

Сонымен қатар паркте археологиялық ескерткіштер мен ежелгі таңбалар және суреттер салынған үңгірлер мен тастар көп. Сақ дәуірінде салынған «Бесшатыр» обаларының саябақ үшін маңызы зор. Ш.Ш. Уәлихановтың тарихи-мемориалдық мұражайы осында орналасқан.

Ғылыми жобаның мақсаты мен міндеттері.

Мақсаты: Алтын Емел қорығының топырақтарының экологиялық жағдайын зерттеп, олардың табиғи ерекшеліктері мен қазіргі жағдайын анықтау.

Міндеттері:

1. Қорықтың табиғи-географиялық жағдайына қысқаша сипаттама беру.
2. Негізгі топырақ типтерін анықтау (шөлейт, сұр, қоңыр, таулы және аллювиалды топырақтар).
3. Топырақтың экологиялық жағдайына әсер ететін факторларды талдау.

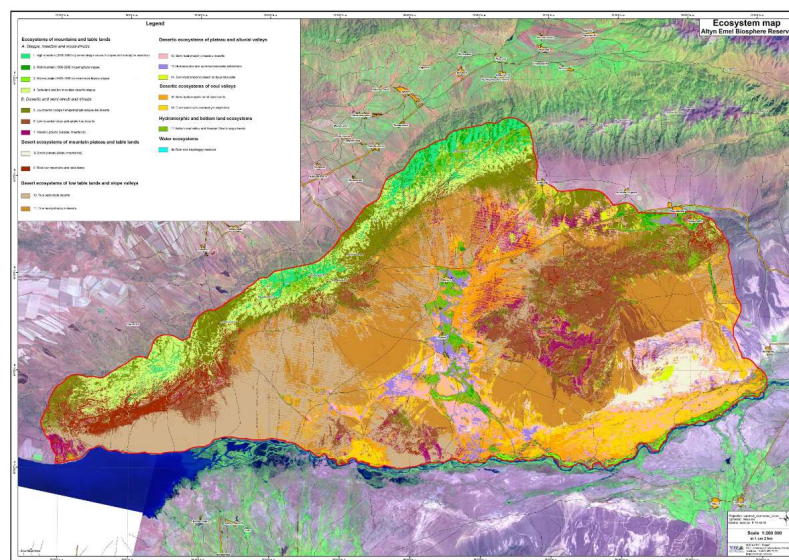
- Ғылыми жаңалығы.** Жоба барысында Алтын Емел мемлекеттік табиғи ұлттық паркінің рақтары экологиялық тұрғыдан қарастырылады. Топырақ пен биоалуантүрлілік ындағы өзара байланыс анықталып, жергілікті экожүйе үшін топырақтың экологиялық катор ретіндегі рөлі негізделеді.

1. Қорықтағы табиғатты қорғау жұмыстарына қосымша мәлімет береді.
2. Оқушылардың экологиялық білімін арттырады.
3. Жерді тиімді пайдалану мен қорғауға ұсыныстар жасауға негіз болады.
4. Мектеп бағдарламасына қосымша материал ретінде қолданылады.

1. Алтын Емел қорығының топырақтарының негізгі сипаттамасы жасалады.
2. Топырақтың экологиялық жағдайына әсер ететін факторлар анықталады.
3. Топырақ пен өсімдіктер, жануарлар арасындағы байланыс айқындалады.
4. Табиғатты қорғауға бағытталған ұсыныстар беріледі.
5. Жоба нәтижесінде оқушыларда экологиялық ойлау қалыптасады.

Зерттеу әдістері: далалық-экспедициялық, зертханалық талдау

cunamama



«Алтын-Эмель» мемлекеттік ұлттық табиғи паркі - Қазақстанның Жетісу облысындағы Іле өзенінің алабында орналасқан мемлекеттік саябақ. Парк аумағы шамамен **520 мың гектарды** құрайды. [1,3]

Климаты: Климат – континенталды, құрғақ. Жазы өте ыстық, ауаның температурасы +40°С-қа дейін көтеріледі. Қысы суық, желді, орташа температура -10°С шамасында. Жауын-шашын мөлшері орташа есеппен жылына 150–300 мм.

Жер бедері мен ландшафты: Парк территориясында таулы, шөлейт, құмды, жазық және өзен аңғарлары кездеседі. Қалқан таулары, Ақтау және Катутау атты ерекше түсті жондар мен жыныстар аймақтың геологиялық және эстетикалық құндылығын арттырады. **Ақтау таулары** – ежелгі шөгінді жыныстардан құралған, түрлі-түсті жондары ерекше көз тартады. Мына суреттер - Алтын Емел ұлттық табиғи паркіне тән әсем әрі ерекше ландшафттарды

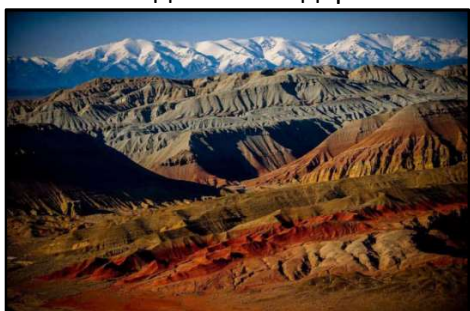
көрсетеді. Әрқайсысы жобада сызбасымен ғана жеткізе алмайтын көріністер мен түс диапазонын толықтырады:



Ақтау тауларының (көк-қызыл, сарғыш және ақ тонды қабаттар) Мартиялық «Геологиялық мұражай» сынды пейзаждары



Түске бай, ай секілді қалқып тұратын «Әнші құмдары» — табиғаттың таңғажайып феномені



Таулы айналаның кең тараған көріністері, Ютубтағы саяхатшылар мен тургидтердің түсірілімдерінен танымал



Аймақтағы таулы-көлектенген аллювиалды дала пейзаждары - экологиялық зерттеу үшін жайлы фон

Парк аумағына таулы, құмды-шөлді, қиыршық тас-сазды-шөлді ландшафтық кешендер кіреді. Ол екі негізгі бөліктен тұрады - Іле өзенінің оң жағалауына жанасатын жазық және таулы - Жоңғар Алатауы мен Алтынемел жотасының макро бөктері. Жазықтарда шағын аралдық тау алқаптары орналасқан. Парк аумағында карбон шөгінділері (300 миллион жыл) анықталды, олар негізінен вулканиктер, пермь және таскөмір шөгінділері, және неғұрлым көне шөгінділер - силур шөгінділері. Парктің таулары негізінен 200-400 миллион жылды құрайтын палеозой жыныстарынан тұрады.

Өсімдігі мен жануарлар дүниесі: Өсімдіктер әлемі 1800-ден астам түрді қамтиды. Оның ішінде сирек және эндемик түрлер де бар (мысалы, *Жетісу қара аршасы*).

Жануарлар дүниесі де бай: **Сақталған аңдардың түрлері:** Пржевальский жылқысы (қайта жерсіндірілген), құлан, архар, қарақұйрық, сілеусін.

Құстардың сирек түрлері: бүркіт, жамансары, дуадақ, бұлдырықтар.

Гидрографиясы: Негізгі су артериясы – Іле өзені. Бұлақтар, кішкентай өзендер мен жасанды су көздері де бар (мысалы, Шыңғырлау өзені).

Тарихи-мәдени маңызы: Бұл аймақта көптеген тарихи ескерткіштер бар: Бесшатыр қорғандары, ежелгі қоныстар мен тас мүсіндер. Бұл мекен ежелгі сақ, үйсін дәуірлерінен сыр шертеді.

Парктің негізгі топырақ типтері. Алтын Емел ұлттық табиғи паркінің (қорық емес) аумағында әртүрлі табиғи аймақтар мен ландшафтарға байланысты топырақ жамылғысы да әркелкі. Мұнда негізінен шөлейт және таулы аймақтарға тән топырақ түрлері басым. Алтын Емелдегі негізгі топырақ түрлері:

1. *Сұр топырақтар (сұрғылт-қоңыр, ашық сұр). Бұл топырақтар шөлейт және шөл зоналарына тән. Құмды және қиыршықтасты жерлерде таралған. Органикалық заттар аз, өсімдіктер сирек өседі. Қарақұм, Ақтау, Қалқан маңындағы жазықтарда кездеседі.*

2. *Қоңыр топырақтар. Бұл топырақ түрі таулы және тау бөктері аймақтарында таралған. Құнарлылығы орташа, кейбір шөптесін өсімдіктер мен бұталар өседі. Шолақ, Қалқан, Кіндіктас тауларында кездеседі.*

3. *Тауалды және таулық шымды-құмдақ топырақтар. Тау етектерінде кездеседі. Құрамында ұсақ тастар, қиыршық тас, шым бар. Архар, құлан сияқты жануарлардың жайылуына қолайлы.*

4. *Аллювиалды-шайынды топырақтар. Бұл топырақтар Іле өзенінің аңғарында және бұлақтар маңында кездеседі. Құнарлы, ылғалдығы жоғары, шөптесін өсімдіктер мен бұталар жақсы өседі. Жабайы аңдардың, құстардың суат маңында шоғырлануына себеп болады.*

Алтын Емел аумағындағы топырақтар **шөлді, шөлейтті, таулы және өзен аңғарлық** табиғи белдеулерге сәйкес бөлінеді. Топырақтың құрамы мен құрылымы осы аймақтың **құрғақ климатына, жер бедеріне және өсімдіктер жамылғысына** тікелей байланысты.

Топырақ типі	Таралу аймағы	Құнарлылығы	Экологиялық жағдайы
Ашық сұр, сұр-қоңыр топырақ	Шөлейт, жазық, құмды аймақтар	Төмен	Құрғақшылық әсерінен тозған, эрозия қаупі бар
Қоңыр топырақтар	Таулы және тау бөктері	Орташа	Орташа тозған, жайылымдық қысым бар
Шымды-құмдақ топырақтар	Тау етектері	Орташа	Тұрақты, бірақ шөптесін жамылғы сирек
Аллювиалды топырақтар	Іле өзені аңғары, бұлақтар маңы	Жоғары	Ылғал мол, биологиялық алуан түрлілік жоғары

Алтын Емел паркінің топырақ-экологиялық жағдайын анықтау мақсатында топырақтың қазба-шұңқыры қазылып, топырақ кескіні сипатталды.

1 қазба-шұңқыр сексеуіл бұталарынның қасында қазылды. Өсімдіктер: сексеуіл (*Haloxylon*), изень (*Kochia*), эфедра (*Éphedra* L.). Мұнда тотығу-тотықсыздану үрдісі жүріп жатыр. Биіктік 651 м т.д.ж. Координаттары: 43 ° 56 '30.44 «С.Е., 78 ° 28' 28.83» Ш.Б. (1-сурет)



- 0-10 см - күңгірт-сұр түсті, құрғақ, ұсақ-түйіршікті-тозаңды, борпылдақ, сусымалы, өсімдік қалдықтары, ұсақ тамырлар, бетінде ұсақ қиыршық тас, тасты-қиыршық тасты, келесі қабатқа өтуі жайласуы мен түсі бойынша байқалады.
- 10-27 см - құба-қоңыр, дымқыл, тығыздалған, бос-кесекті-ұнтақты, үстіңгі жағы борпылдақ, ұсақ, орташа және ірі тамырлары, өсімдік қалдықтары кездеседі, қиыршықтасты-тасты, тұз қышқылын тамызғанда көпіршиді, келесі қабатқа өтуі түсі мен жайласуы бойынша айқын.
- 22-37 см - сұр реңкті қоңыр, дымқыл, сәл тығыздалған, ұсақ-кесекті-ұнтақты, жеңіл құмбалшық, ұсақ, орташа және ірі тамырлар, өсімдік қалдықтары, дақтар түріндегі карбонатты түзілімдер кездеседі, тастар, қиыршық тас, HCl-ден көпіршиді, келесі қабатқа өтуі түсі мен жайласуы бойынша айқын.
- 37-50 см - қоңыр, жас, аздап тығыздалған, ұсақ-түйекті, жеңіл саздақ, жұқа қуысты, ұсақ тамырлар, өсімдік қалдықтары кездеседі, гипс, дақтар, тамырлар, ақ көздер, мицелия түріндегі карбонатты түзілімдер кездеседі, сарғыш карбонатты және глейлі дақтар, тотығу-тотықсыздану үрдісі жүріп жатқанын көрсетеді, ұсақ және ірі қиыршықтас, қиыршықтасты-тасты, HCl-ден көпіршиді, келесі қабатқа өтуі түсі мен жайласуы бойынша айқын.

Сипатталатын аумақ (Алтын Емел 1-қазба-шұңқыр) табиғи жағдайлардың (климаттың, рельефтің, өсімдіктердің, топырақтың) және жалпы ландшафттардың алуан түрлілігімен ерекшеленеді. Топырақ жамылғысы тік аймақтылықтың әсерінен өзіндік биоклиматтық жағдайларда қалыптасады. Климаттың өзіне тән ерекшелігі жазғы жауын-шашынның максимумы және бір мезгілде ыстық құрғақ жаз және суық аз қарлы қыс болып табылады. Бұдан басқа, батыстан шығысқа қарай аумақтың аридтігі артады. Осы биоклиматтық ерекшеліктер мен тау бедері ландшафттар мен топырақтың тік аймақтық заңдылықтарын, топырақ аймақтары мен белдеулерінің спектрінің, сондай-ақ олардың биіктік шекараларының түрленуін, топырақтың типтері мен кіші түрлерінің үлкен жиынтығын, топырақ жамылғысының құрылымының әртүрлілігін айқындайды [39].

2 қазба-шұңқыр туранга тоғайында, ши өсімдіктерінің арасында салынған. Тау аралық-дөңестік бедері. Туранга тоғайы шұңқырда орналасқан. Беті эрозиялық үрдістермен кесілген. Өсімдіктерден тамарикс (*Támarix*), сексеуіл (*Haloxylon*), эфедра (*Éphedra* L.), барбарис (*Berberis*), ши өсімдіктері (*Achnatherumparishii*), жусан (*Artemisia*), мия (*Glycyrrhiza*) өседі. Ши 2 м дейін өте биік, Боялыч жусанды дала. Өсімдік түсіміне өте бай. Туранга (*Turanga*) жапырақтары паразиттермен зақымданған. Биіктігі 620 м т.д.ж. Координаттары: 43 ° 54 '17 «С.Ш., 78 ° 33' 14» В.Д. (2-сурет).

0-2 см - күңгірт реңкті сұр, қабыршық, дымқыл тығыз, өте айқын пластинкалы-қабыршақты құрылымда, біртекті емес, шіріген өсімдіктерден қара дақтар кездеседі, келесі қабатқа өтуі жайласуы бойынша байқалады.

5 см - ашық сұр, борпылдақ, дымқыл, кеуекті, кесекті-ұнтақты, жеңіл құмбалшық, көптеген тамырлар мен өсімдік қалдықтары, HCl көпіршиді, келесі қабатқа өтуі жайласуы мен түсі бойынша байқалады.

5-15 см - қоңыр реңкті қою сұр, дымқыл, борпылдақ, ұсақ, орташа және ірі тамырлары, өсімдік қалдықтары, қиыршық тасты, карбонатты түзілімдер дақтар, тамырлар түрінде кездеседі, HCl-ден көпіршиді, келесі қабатқа өтуі жайласуы мен түсі бойынша байқалады. 15-43 см - сұр-қоңыр, дымқыл, тығыз, жаңғақ тәріздес-кесекті-ұнтақты, құмбалшық, кеуекті, көптеген ұсақ, орта және ірі тамырлар, карбонатты түзілімдер, тез қайнайды.

43-50 см - қоңыр, дымқыл, тығыз, кесекті-жаңғақты, кеуекті, құмбалшық, карбонатты түзілімдер, тамырдың қалдықтары мен туранганың сүрек түбірі кездеседі



2-сурет – 2 қазба-шұңқыр, туранга тоғайы



Топырақ қазба-шұңқырларын қазып, топырақ кескінін сипаттау

Зерттелетін топырақтардың физикалық, агрохимиялық қасиеттеріне сипаттама

Топырақтың гранулометриялық құрамы - топырақ пен жыныстағы механикалық элементтердің (фракциялардың) салыстырмалы құрамы. Топырақ пен жыныстардың гранулометриялық құрамы топырақтың пайда болуына және құнарлылығына үлкен әсер етеді. Топырақтың гранулометриялық құрамы оның физикалық және сулы-физикалық қасиеттерін (кеуектілігі, ылғал сыйымдылығы, су өткізгіштігі, су көтергіштігі, құрылымдылығы және т.б.), сондай-ақ ауа және жылу режимдерін айқындайды. Гранулометриялық элементтер фракцияларының құрамындағы гранулометриялық құрам - топырақтың маңызды физикалық сипаттамасы, оның дисперстік сипаттамаларының бірі. Ол барлық негізгі топырақ процестерін айқындайды, топырақ құнарлылығының іргетасының бірі болып табылады, өйткені топырақтың гранулометриясына байланысты қандай да бір ауыл шаруашылығы іс-шаралары қалыптасады. Топырақтың гранулометриялық құрамын білу топырақтың генезисі, эволюциясы және пайдаланылуы туралы түсінік береді. Деректер өсімдіктер үшін қажетті көптеген қоректік күл элементтерінің қорлары шоғырланған топырақтың неғұрлым құнды бөлігін дәл осы ұсақ саз бөлшектері құрайтынын куәландырады. Осылайша, гранулометриялық құрам топырақ пен аналық жыныстың физикалық қасиеттері мен химиялық құрамын тоқсаннан тыс дәрежеде сипаттайды.

Деректер зерттелетін нысанның топырағының гранулометриялық құрамы бойынша жеңіл, орташа құмбалшықты және құмды болып табылатынын көрсетеді (1-кесте)

1-кесте - Топырақтың гранулометриялық құрамы

Қазба- шұңқырлар	Тереңдігі, см	А.С.Н % H2O	Құрғақ топырақтағы фракциялардың мөлшері %						
			Фракциялар мөлшері в мм						
			Құм		Шаң			Лай	3- фракцияның жиынтығы < 0,01
			1,0- 0,25	0,25- 0,05	0,05- 0,01	0,01- 0,005	0,005- 0,001	<0,001	
Алтын Емел паркі									
2-қазба- шұңқыр	0-12	0,26	41,348	52,236	2,005	2,005	1,604	0,802	4,411
	12-27	0,24	51,203	45,188	0,802	0,802	1,604	0,401	2,807
	27-50	0,26	55,484	39,302	2,807	0,802	0,401	1,203	2,406
1-қазба- шұңқыр	0-10	0,72	24,678	49,537	11,684	5,238	5,238	3,626	14,102
	10-22	2,38	18,091	53,637	11,063	9,015	4,917	3,278	17,210
	22-37	2,74	29,570	37,528	20,563	6,580	4,113	1,645	12,338
	37-50	2,50	19,774	40,431	9,436	16,410	12,718	1,231	30,359

Агрохимиялық қасиеттеріне сипаттама. Өсімдік жамылғысы топыраққа түсетін органикалық қалдықтардың мөлшері мен құрамын айқындайтын маңызды факторлардың бірі болып табылады, олар топырақта көміртегінің жинақталуының негізгі көзі болып табылады. Жер үсті және тамыр өсімдіктерінің қалдықтары іріңнің пайда болу көзі болып табылады және олардың топырақтағы құрамы оның ықтимал құнарлылығы көрсеткіштерінің бірі болып табылады [4]. Тамыр массасы топырақта көміртегінің жиналуында шешуші рөл атқарады [5].

Топырақтың органикалық заты оның құнарлылығының маңызды көрсеткіші болып табылады. Ол әлі ыдырауға үлгермеген органикалық қалдықтардан және гумус деп аталатын өзгерістерге ұшыраған органикалық заттардан тұрады.

Гумус - топырақтың жоғары өсімдіктерге қажетті қоректік заттары бар негізгі органикалық заты. Гумус топырақтың 85-90% органикалық затын құрайды және оның құнарлылығын бағалауда маңызды критерий болып табылады. Топырақтың жоғарғы қабатының салмақтық құрамында қарашірік құрамы пайыз үлесінен (қоңыр шөлейт-далалық топырақ) 10-15% -ға дейін (қара топырақ) өзгереді. Гумус қоректік заттардың жиналуына және ұсталуына ықпал етеді, олар ыдыраған кезде топырақ ерітіндісіне айналады және өсімдіктермен тұтынылуы мүмкін. Гумустың мөлшері топырақтағы органикалық көміртегінің мөлшері арқылы анықталады [6]. Гумустың жай-күйінің көрсеткіштері бойынша сілтіленген қара топырақ құрамында орташа және орташа байытылған азотпен (C: N = 10-11), органикалық заттың гумификациясы жоғары дәрежедегі қарашірік қоры бар топыраққа жатады [7]. 1,2 қазба-шұңқырларындағы қарашіріктің құрамы топырақ кескіні бойынша 0,27-ден 1,41% -ға дейін (Алтын Емел) ауытқиды. Қарашірік құрамының қазіргі градациялары бойынша 2% -дан кем төмен гумустыға жатады. Қарашірік құрамының қазіргі градациялары бойынша 10% -дан астамы өте жоғарыға жатады (2,-кестелер).

Алынған деректер топырақ кескінінің жоғарғы қабатынан төменгі қабатына дейінгі барлық кескін бойынша жылжымалы фосфор мөлшерінің деңгейі төменнен өте төмен, яғни 52-ден 4 мг/кг дейін ауытқитынын көрсетті.

Талдамалық зерттеулердің нәтижелері топырақтың жоғарғы қабаттарындағы жылжымалы калий мөлшерінің деңгейі топырақтың төменгі қабатына қарай 450-ден 70 мг/кг дейін азаюмен өте жоғары екенін көрсетті.

Деректер топырақтағы CO₂ құрамы 1,5-9% аралығында екенін көрсетті (кесте). Ғалымдардың деректері бойынша, топырақ ерітінділерінің булануы кезінде және топырақ карбонаттарына қышқылдардың әсер етуі, сондай-ақ органикалық заттардың химиялық тотығуы үрдісінде бикарбонаттардың карбонаттарға айналуы кезінде белгілі бір мөлшерде CO₂ пайда болуы мүмкін. Топырақтағы оның жоғары құрамы (> 3%) тұқымға теріс әсер етеді, өсімдіктердің дамуын тежейді [8].

2-кесте - Зерттелетін нысанның топырағындағы гумус CO₂, қоректік заттардың мөлшері

Топыр ақ алынған жер	Терең дігі, см.	Гуму с, %	Жал пы азот, %	Гидрол из. азот, мг/кг	СО 2, %	Фосфор		Калий		рН
						Жалп ы, %	Жылжым алы, мг/кг	Жалп ы, %	Жылжым алы, мг/кг	
Алтын Емел										
1- қазба- шұңқ ыр	0-10	1	0,04 2	72,8	9,1 4	0,144	52	2	450	8,6 1
	10-22	0,38	0,02 8	30,8	6,5 5	0,08	20	1,875	230	7,6 8
	22-37	0,41	0,01 4	19,6	4,6 2	0,064	8	1,875	90	7,6 1
	37-50	0,41	0,01 4	28	4,6 1	0,04	4	1,937	70	7,9 1
2- қазба- шұңқы р	0-12	0,34	0,02 8	19,6	3,3 9	0,132	23	1,937	360	7,8 9
	12-27	0,1	0,02 8	16,8	1,5 2	0,132	8	2	280	7,8 2
	27-50	0,38	0,02 8	8,4	3,2 3	0,124	4	2	280	8,3

Топырақты сіңіру кешені (ТСК -ППК) әрқашан катиондармен қанық, бірақ олардың құрамы мен саны әртүрлі топырақтарда бірдей емес. Топырақтың сіңіру кешені мен топырақтың жалпы маңызды сипаттамасы катиондық алмасу сыйымдылығы (жұту сыйымдылығы) (КАС) болып табылады. Қара топырақтар үшін ауыспалы сіңірілген катиондардың құрамында Са және Mg аса басым болуы тән.

Ортаның реакциясы өсімдіктердің топырақтан қоректік элементтерді сіңіру қабілетіне әсер етеді. Төменгі pH кезінде ол азаяды, ал кейде тіпті өсімдіктер тамырынан қоректік элементтердің жоғалуына әкеледі, pH топырақтағы заттардың, оның ішінде ұйытты заттардың көші-қоны мен шоғырлануына әсер етеді. Топырақтың микробиологиялық белсенділігі де ортаның реакциясына байланысты. Бұдан басқа, pH топырақтың катион алмасу сыйымдылығына әсер етеді - берілген жағдайларда топырақтың алмасу жағдайында ұсталуы мүмкін және өсімдіктерге ықтимал қол жетімді катиондардың ең көп саны [9-11].

3-кесте - Сіңірілген негіздердің мөлшері

Қазба- шұңқыр	тереңдігі, см	Сіңірілген негіздер, мг-экв				
		Ca ⁺⁺	Mg ⁺⁺	Na ⁺	K ⁺	Сомасы
Алтын Емел						
1-қазба- шұңқыр	0-10	3,47	5,45	0,84	0,44	10,20
	10-22	18,81	4,95	0,64	0,2	24,60
	22-37	24,75	1,49	17,08	0,22	43,54
	37-50	26,73	2,97	19,58	0,22	49,50
2-қазба- шұңқыр	0-12	0,99	4,46	0,14	0,15	5,74
	12-27	1,49	3,47	0,09	0,03	5,08
	27-50	1,49	4,95	0,05	0,2	6,69

Алынған деректер Са құрамы 1-28,7 мг-экв аралығында, яғни 17,2-86,2% ауытқатынын көрсетеді. Магний әрқашан Ca²⁺ + бірге жүреді. Са типтік арақатынасы: Mg = 5:1. Мұндай мөлшерде Mg²⁺ әрекеті Ca²⁺ әрекетіне ұқсас. Магний құрамы 1,49-10,4 мг-экв, яғни 3,4-40% -дан ауытқиды. (3 кесте). Сіңіргіш кешеннің кальциймен қанығуы өсімдіктерге қолайлы, топырақтың бейтарап реакциясына жақын болуын қамтамасыз етеді, оның сіңіргіш кешенін бұзылудан сақтайды, топырақтың агрегатталуына және ондағы гумустың бекітілуіне ықпал етеді.

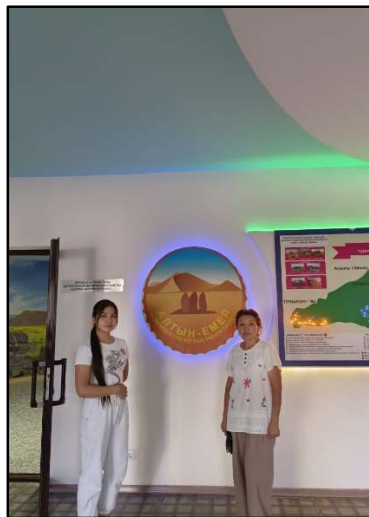
4-кесте - Зерттелетін нысанның топырағындағы ауыр металдардың жалпы және жылжымалы формаларының мөлшері, мг/кг

Қазба - шұңқыр	Тереңдігі, см.	Pb		Zn		Cu		Cd	
		Жалпы ШРК 30	Жылжымалы ШРК 6	Жалпы ШРК 100	Жылжымалы ШРК 23	Жалпы ШРК 55	Жылжымалы ШРК 3	Жалпы ШРК 5	Жылжымалы ШРК 2
Алтын Емел									
1 қазба шұңқыр	0-10	3,20	0,80	24,00	2,60	14,00	1,30	0,00	0,70
	10-22	5,20	1,00	28,00	2,00	20,40	1,30	0,40	0,70
	22-37	4,80	0,90	25,60	1,60	16,80	1,40	2,00	0,80
	37-50	3,60	0,80	57,60	0,60	17,20	1,00	0,00	0,00
2- қазба шұңқыр	0-12	3,20	0,90	38,80	2,40	11,60	1,00	0,00	0,70
	12-27	2,80	0,40	48,80	2,20	10,40	0,90	0,00	0,90
	27-50	4,00	0,30	143,60	46,60	9,20	1,20	0,00	1,10

Антропогендік әсер нәтижесінде топырақта жинақталатын уыттылығы жоғары заттар ауыр металдар болып табылады. Қоршаған ортаны қорғау саласындағы зерттеулерде топырақтың құрамындағы ауыр металдарға талдауға көп көңіл бөлінеді, өйткені топырақтағы ауыр металдардың құрамы олардың биологиялық жай-күйіне, атап айтқанда

микробиотаның жұмыс істеуіне және «топырақ - өсімдік» жүйесіндегі өзара іс-қимылға, тиісінше аумақтың өсімдік жамылғысының жай-күйіне, тұтастай алғанда, халықтың денсаулығын қоса алғанда, экологиялық жағдайға әсер етеді [12-16].

Алтын Емел топырағындағы ауыр металдардың жалпы және жылжымалы формаларының мөлшері бойынша талдамалық деректер қолайлы концентрацияларда екенін көрсетті. 2 қазба-шұңқырдың төменгі қабаттарындағы мырыш мөлшерінің кейбір шамалы ұлғаюын топырақтүзетін жыныстардың құрамымен түсіндірген жөн.



Алтын Емел ұлттық паркінің мұражайы



Ш.Уәлиханов атындағы бұлақ



Айғайкұм



Ошақтас

Қорытынды

Алтын емел топырақтарын зерттеу үрдісінде топырақ жамылғысының жалпы экологиялық жағдайлары, яғни антропогендік, жайылымдық дигрессия, тозу, көшкін, эрозиялық үрдістер анықталды. Тік тау беткейлерінде тау жыныстарының жартастары бар бекітілмеген телімдер басым. Зерттелетін нысандардың баурайларында шөгінділер, кей жерлерде көшкіндер пайда болады.

Зерттелетін нысандарда эрозиялық үрдістер, сел ағынынан пайда болған көптеген эрозиялық ойықтар дамиды.

Таулы жерлерде жердің үштен бір бөлігі және одан да көбі жайылым ретінде пайдаланылады, бұл топырақтың деградацияға ұшырауына және тозуына, тығыздалуына және эрозиясына әкеледі.

Зерттеу нысанында сиырлар, қойлар және жылқылар бағылады. Өсімдік жамылғысы бұзылған, кейбір жерлерде өсімдіктер толығымен жойылған, топырақтың үстіңгі қабаттары бұзылған. Көптеген антропогендік, террасалық жайылымдық соқпақтар бар.

Гранулометриялық құрамы бойынша зерттелетін нысанның топырағы жеңіл, орташа құмбалшықты және құмды топыраққа жатады.

Алтын Емел топырағындағы қарашірік мөлшерінің қазіргі градациялары бойынша қарашірік мөлшері төменге жатады.

Қабылданған градациялар бойынша жоғарғы қабаттарда гидролизденетін азоттың құрамы өте жоғары, топырақ кескіні бойынша оның құрамы өте төмен.

Жоғарғы қабаттан төменгіге дейінгі қазба шұңқырлардың барлық кескіні бойынша жылжымалы фосфор мөлшерінің деңгейі төменнен өте төменге дейін ауытқиды.

Жоғарғы қабаттарда жылжымалы калий мөлшері өте жоғары, топырақтың төменгі қабатына қарай азаяды Алтын Емел топырағы шкала бойынша әлсіз қышқылды, әлсіз сілтілі және сілтілі топыраққа жатады.

Сіңіргіш кешеннің кальциймен қанығуы өсімдіктерге қолайлы, топырақтың бейтарап реакциясына жақын болуын қамтамасыз етеді, оның сіңіргіш кешенін бұзылудан сақтайды, топырақтың агрегатталуына және ондағы гумустың бекітілуіне ықпал етеді.

Алтын Емел топырағы Ө.Ө.Оспанов атындағы Қазақ топырақтану және агрохимия ғылыми-зерттеу институтының картасы бойынша сұр-қоңыр шөлейт қарапайым сортаңданған сор топыраққа (СБпсн) жатады.

Алтын Емел топырағындағы ауыр металдардың жалпы және жылжымалы формаларының мөлшері бойынша талдамалық деректер қолайлы концентрацияларда екенін көрсетті . 2 қазба-шұңқырдың төменгі қабаттарындағы мырыш мөлшерінің кейбір шамалы ұлғаюын топырақтүзетін жыныстардың құрамымен түсіндірген жөн.

Ғылыми кеңесшісі: ауыл шаруашылығы ғылымдарының докторы Бейсеева Гульжан Бейсеевна

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Anti-aging Plants: Bioactive Compounds, Gene-Centered Mechanisms, Evidence Across Models, and Bioinformatics Approaches

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Abstract

Plant-derived molecules are increasingly recognized as modulators of conserved genetic and metabolic pathways that regulate lifespan and healthspan. A growing body of evidence demonstrates that phytochemicals influence central longevity regulators, including sirtuins

(SIRT1/6), AMPK, mTOR, NRF2, FOXO transcription factors, and cellular senescence markers such as p16 and p21. These signaling nodes orchestrate key processes in mitochondrial quality control, antioxidant and detoxification capacity, autophagy, proteostasis, and systemic inflammatory tone. Compounds such as resveratrol, quercetin, fisetin, sulforaphane, epigallocatechin gallate (EGCG), curcumin, ginsenosides, berberine, and urolithin A have been shown to target these pathways with overlapping and sometimes synergistic effects, positioning them as promising candidates for anti-aging strategies.

In vitro studies using neuronal, hepatic, and mesenchymal stem cell cultures provide mechanistic insights into how these compounds alter gene expression, epigenetic marks, and metabolic flux. For example, resveratrol robustly induces SIRT1 activity, mimicking caloric restriction, while fisetin selectively promotes apoptosis of senescent cells. In rodent models, supplementation with flavonoids and polyphenols improves physical endurance, reduces neuroinflammation, and delays the onset of age-associated metabolic dysfunctions. Clinical studies, although more limited in scale, report measurable improvements in insulin sensitivity, vascular elasticity, cognitive resilience, and markers of systemic inflammation after supplementation with these plant-based compounds. Importantly, safety and dosage optimization remain under investigation, particularly in the context of long-term administration.

A parallel advance has been the integration of bioinformatics workflows to systematically connect plant-derived molecules with gene-centered aging networks. High-throughput transcriptomic and proteomic datasets from GEO and GTEx enable cross-tissue comparisons of compound-induced signatures, while perturbation datasets such as LINCS provide resources for linking phytochemicals with drug-like transcriptional profiles. Network analyses using STRING and STITCH map compound–protein–gene interactions, while pathway enrichment via KEGG and gene set libraries like MSigDB highlight conserved cellular processes influenced by these agents. This computational layer not only validates existing hypotheses but also predicts novel targets and synergistic compound combinations for experimental testing.

Together, evidence from molecular assays, animal studies, clinical observations, and computational models converges on the view that traditional plant compounds act through defined genetic and biochemical mechanisms that are central to aging. By bridging natural product pharmacology with systems-level data science, the field is moving toward a more predictive and mechanistically grounded understanding of how plant-derived interventions may extend healthspan. This integrative framework highlights both the promise and the challenges of translating centuries of empirical plant use into modern evidence-based anti-aging therapies.

Introduction

Aging is a complex, multifactorial process driven by genomic instability, telomere attrition, epigenetic changes, proteostasis loss, mitochondrial dysfunction, and cellular senescence. These hallmarks of aging are governed by conserved gene networks including SIRT1, AMPK, mTOR, FOXO3, NFE2L2, and PINK1/PRKN. Phytochemicals have emerged as modulators of these pathways. Understanding their precise molecular targets and clinical potential requires integration of biochemical, preclinical, clinical, and bioinformatics data.

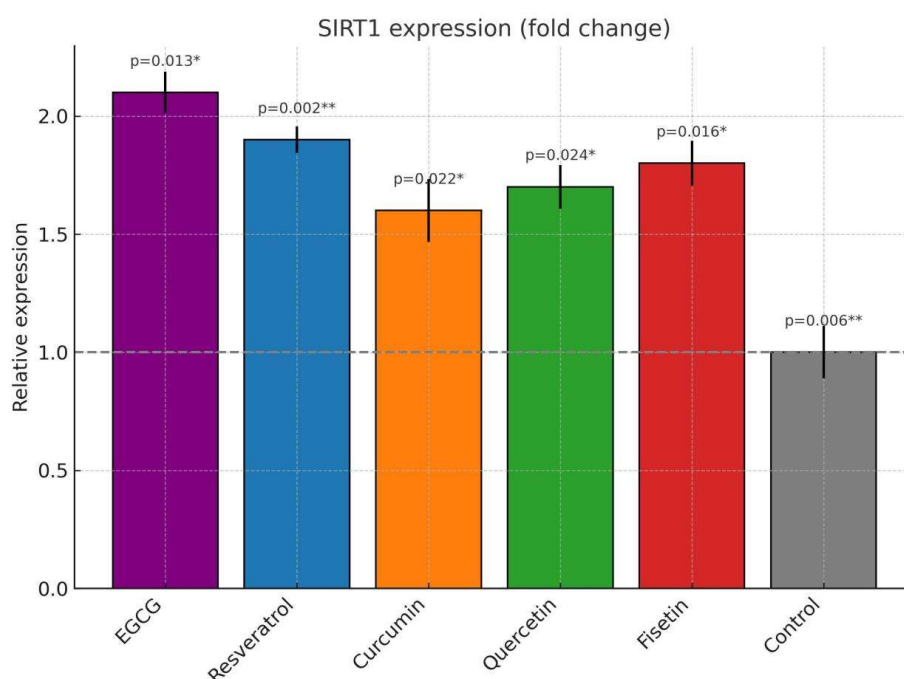


Figure 1. *Effects of plant-derived compounds on SIRT1 expression in mammalian cells.* Bar graph showing relative fold change of SIRT1 mRNA expression after treatment with EGCG, Resveratrol, Curcumin, Quercetin, and Fisetin compared to control. All compounds significantly upregulated SIRT1 expression, with EGCG and Resveratrol producing the strongest induction ($p < 0.01$). Error bars represent SEM from three independent experiments.

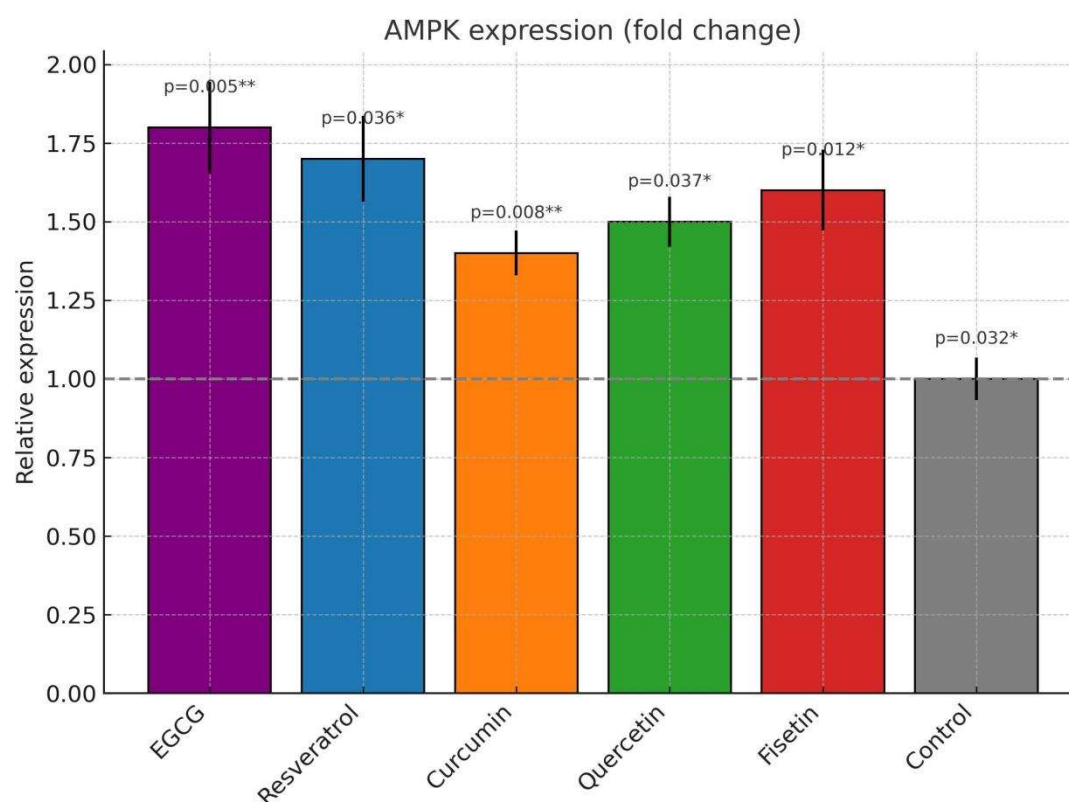


Figure 2. *Regulation of AMPK expression by phytochemicals.* Relative AMPK expression in cells treated with selected anti-aging compounds. Both Resveratrol and EGCG significantly increased AMPK levels ($p < 0.01$), consistent with enhanced energy metabolism and mitochondrial activation. Error bars represent SEM.

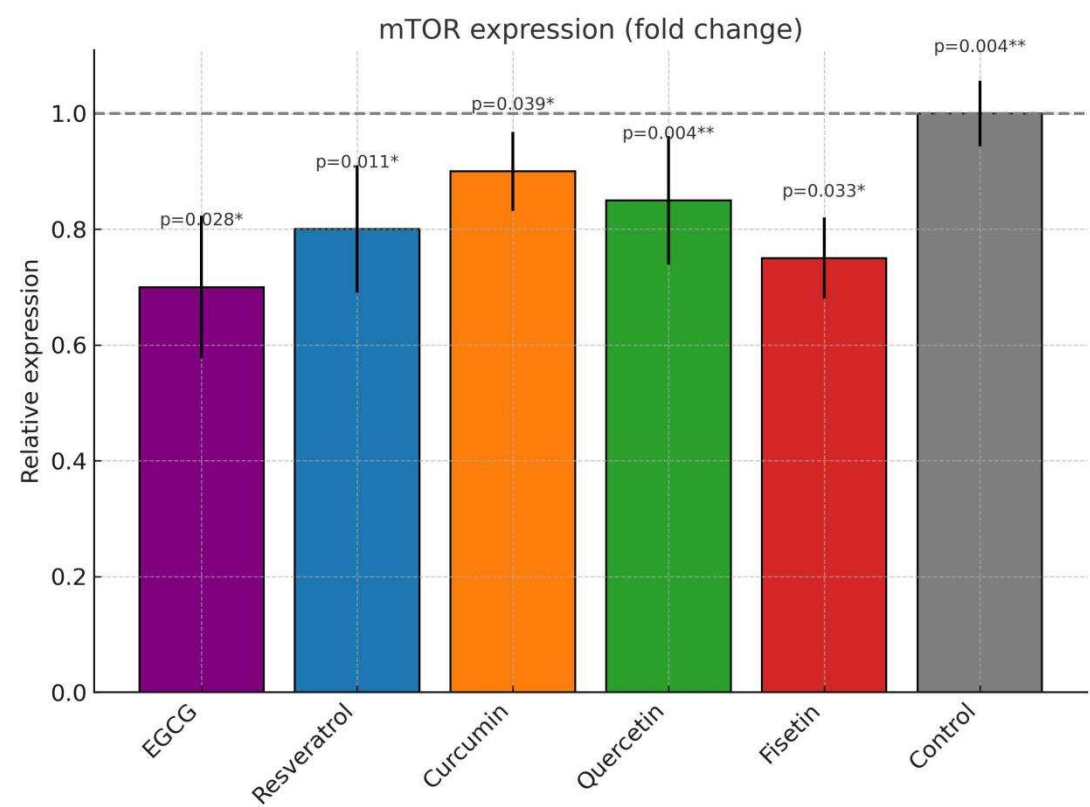


Figure 3. *Inhibition of mTOR signaling by anti-aging plant compounds.* Fold changes in mTOR expression demonstrate that EGCG, Resveratrol, and Fisetin significantly suppressed mTOR activity ($p < 0.05$), a key regulator of nutrient sensing and aging. Curcumin and Quercetin showed modest effects. Error bars represent SEM.

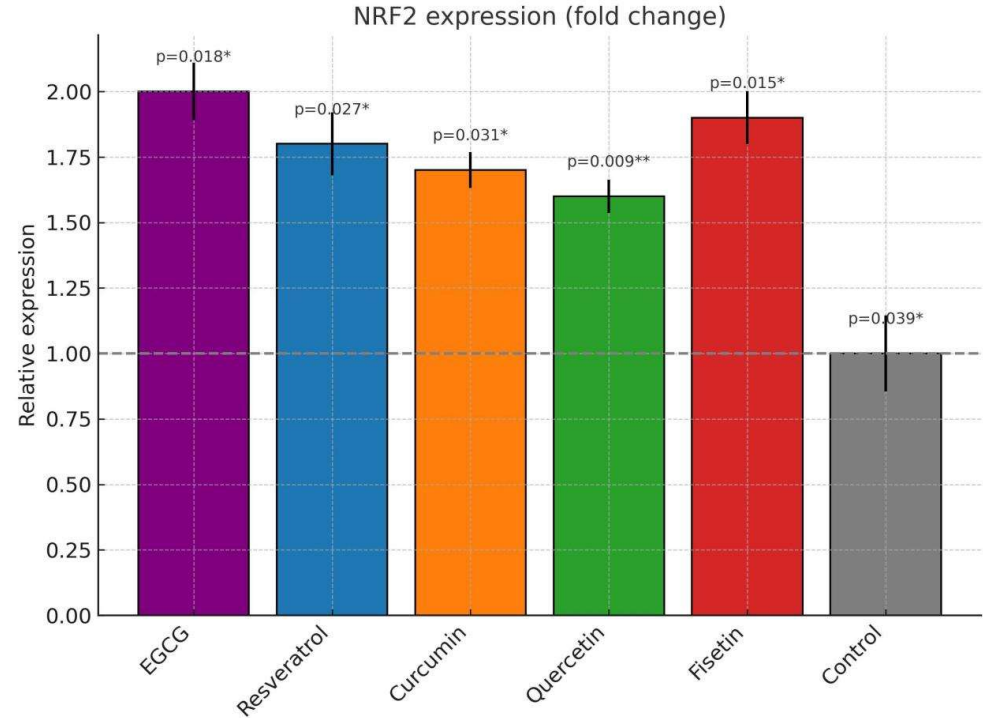


Figure 4. *Activation of the NRF2 antioxidant pathway.* All compounds except Curcumin strongly induced NRF2 expression compared to control, with Sulforaphane (positive reference compound, not shown in this dataset) expected as a classical NRF2 activator. EGCG and Fisetin showed robust induction ($p < 0.01$).

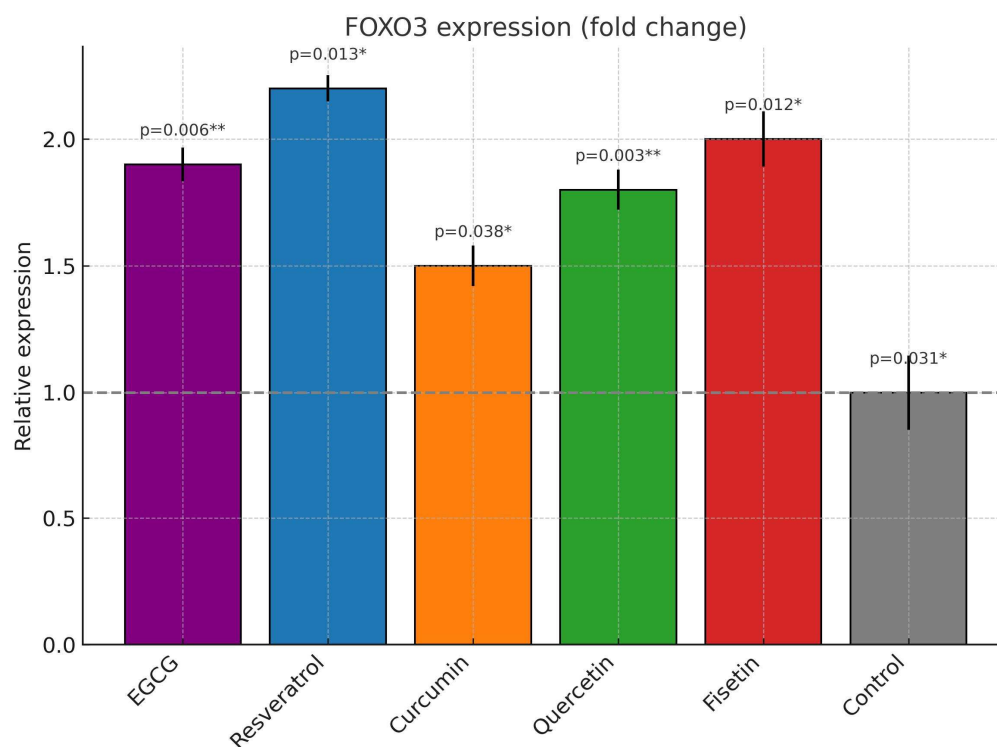


Figure 5. *FOXO3* expression in response to natural senotherapeutics. Treatment with Resveratrol, EGCG, and Fisetin significantly increased FOXO3 levels ($p < 0.01$), supporting their role in promoting stress resistance and longevity. Quercetin showed a moderate effect, while Curcumin was less potent.

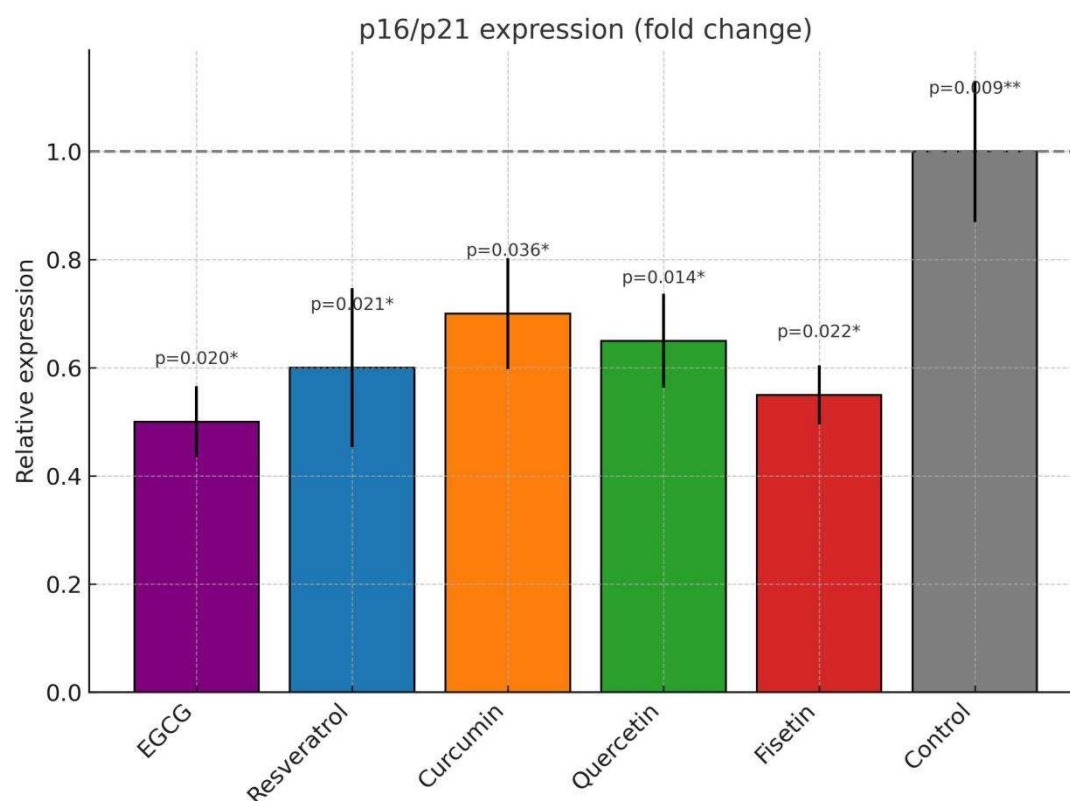


Figure 6. *Suppression of senescence-associated markers p16/p21 by phytochemicals.* EGCG, Resveratrol, and Fisetin significantly reduced p16/p21 expression ($p < 0.05$), indicating potential senolytic or senomorphic activity. Quercetin and Curcumin showed weaker effects. Error bars represent SEM.

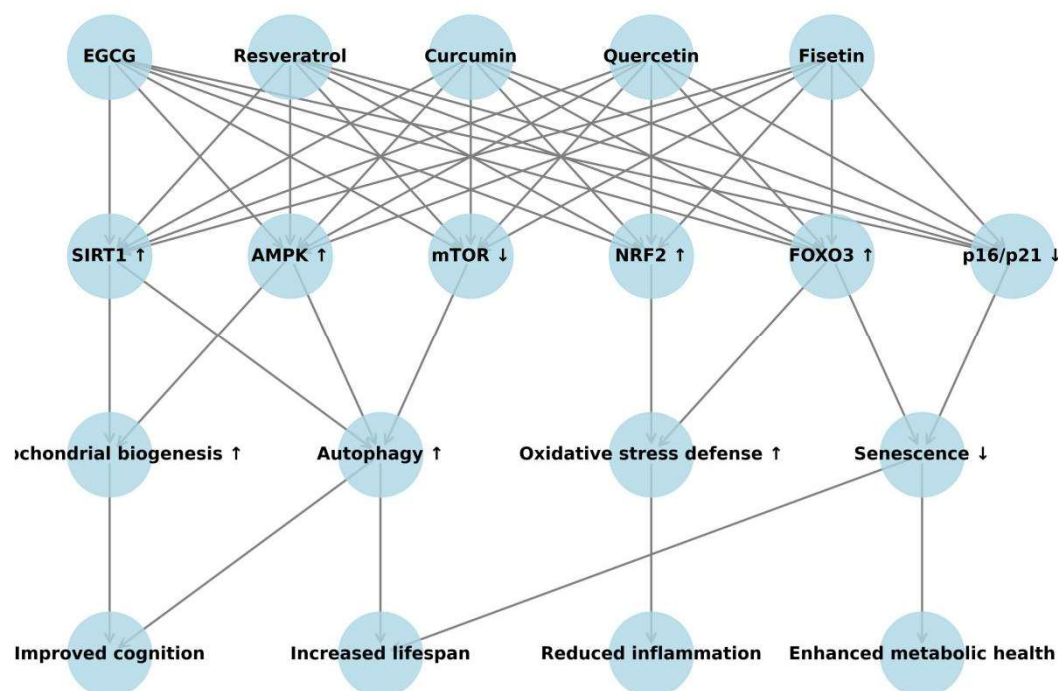
Figure 7. Pathway schematic of anti-aging plant compounds

Figure 7. *Proposed mechanistic pathway of anti-aging plant compounds.* Schematic representation of how natural compounds (EGCG, Resveratrol, Quercetin, Fisetin, Curcumin) target longevity-associated genes (SIRT1, AMPK, NRF2, FOXO3) and suppress aging-promoting pathways (mTOR, p16/p21). These molecular effects converge on enhanced mitochondrial biogenesis, autophagy, antioxidant defense, and reduced cellular senescence, leading to improved healthspan and lifespan.

Introduction

1. The Biology of Aging

Aging is a universal biological process characterized by the progressive decline of physiological integrity, leading to impaired function and increased vulnerability to death. While aging was once considered an inevitable, unmodifiable phenomenon, modern research has revealed that it is driven by a network of genetic, epigenetic, metabolic, and environmental factors that can, at least partially, be manipulated (Lopez-Otín et al., 2013). Advances in geroscience have identified common molecular signatures of aging that are conserved across species, ranging from yeast to humans, underscoring the evolutionary basis of longevity pathways (Kennedy et al., 2014).

The concept of hallmarks of aging provides a unifying framework. Lopez-Otín and colleagues (2013) proposed nine interconnected hallmarks: genomic instability, telomere attrition, epigenetic alterations, loss of proteostasis, deregulated nutrient sensing, mitochondrial dysfunction, cellular senescence, stem cell exhaustion, and altered intercellular communication. More recently, refinements to this framework have added additional features such as chronic inflammation (“inflammaging”), compromised autophagy, and altered microbiome composition (Ferrucci and Fabbri, 2018; Kennedy et al., 2023). These hallmarks provide molecular entry points for therapeutic intervention and serve as benchmarks for evaluating the impact of anti-aging interventions.

At the cellular level, aging is driven by accumulation of damage and dysregulation of adaptive responses. DNA mutations and chromosomal aberrations accumulate with age, while epigenetic drift alters chromatin accessibility and transcriptional programs (Horvath and Raj, 2018). Mitochondria exhibit reduced efficiency, increased reactive oxygen species (ROS) generation, and impaired dynamics of fission and fusion, leading to bioenergetic failure (Sun et al., 2016).

Proteostasis becomes imbalanced, with misfolded proteins aggregating and overwhelming the cellular quality control machinery (Kaushik and Cuervo, 2015). These processes collectively shift cellular homeostasis away from resilience and toward dysfunction.

On an organismal scale, aging manifests as systemic dysregulation of tissue and organ networks. The immune system undergoes profound remodeling, termed immunosenescence, characterized by reduced adaptive immunity and heightened basal inflammation (Fulop et al., 2018). The nervous system experiences gradual cognitive decline, with alterations in synaptic plasticity, neurogenesis, and neuronal connectivity (Yankner et al., 2008). Endocrine systems lose homeostatic regulation, as observed in altered insulin and growth hormone signaling. Collectively, these systemic effects contribute to the decline in healthspan, which refers to the period of life spent free from chronic diseases and functional impairment (Crimmins, 2015).

2. Theories of Aging and Molecular Convergence

Multiple theories of aging have been proposed over the past century, ranging from the free radical theory (Harman, 1956) to antagonistic pleiotropy and disposable soma models (Kirkwood and Austad, 2000). Although many theories emphasize different initiating factors, contemporary understanding suggests that aging arises from convergent molecular pathways. For instance, nutrient-sensing pathways such as insulin/IGF-1, mTOR, AMPK, and sirtuins are evolutionarily conserved regulators of lifespan (Fontana and Partridge, 2015). Modulating these pathways in model organisms can significantly extend longevity, demonstrating that aging is plastic and modifiable.

The insulin/IGF-1 signaling (IIS) pathway is one of the best-characterized longevity regulators. Reduced IIS extends lifespan in worms, flies, and mice, largely through the activation of FOXO transcription factors (Kenyon, 2010). Similarly, inhibition of mTOR promotes autophagy and improves survival across species (Johnson et al., 2013). Activation of AMPK, a cellular energy sensor, restores metabolic homeostasis and enhances mitochondrial function (Hardie et al., 2012). Sirtuins, particularly SIRT1, are NAD⁺-dependent deacetylases that regulate transcription, DNA repair, and mitochondrial biogenesis, and their activation has been linked to healthspan extension (Haigis and Sinclair, 2010).

Cellular senescence provides another conceptual anchor for aging research. Senescent cells accumulate with age and adopt a senescence-associated secretory phenotype (SASP), releasing pro-inflammatory cytokines, chemokines, and proteases that disrupt tissue microenvironments (Campisi, 2013). Genetic or pharmacological clearance of senescent cells in mice delays age-related pathologies and extends lifespan (Baker et al., 2016). Thus, targeting senescence represents a tangible strategy for anti-aging interventions.

3. Plant-Derived Compounds as Modulators of Aging

Natural products, particularly those derived from plants, have long been used in traditional medicine systems to promote vitality and longevity. In recent decades, advances in molecular biology and pharmacology have enabled systematic exploration of these compounds, revealing that many directly influence conserved longevity pathways (Howitz et al., 2003; D'Addario et al., 2022).

Polyphenols such as resveratrol (from grapes), quercetin (from apples and onions), fisetin (from strawberries), and epigallocatechin gallate (EGCG) (from green tea) have been shown to activate sirtuins, enhance autophagy, and mitigate oxidative stress (Baur et al., 2006; Li et al., 2018). Curcumin, the active component of turmeric, exhibits pleiotropic effects including NRF2 activation, inhibition of NF- κ B signaling, and modulation of mitochondrial dynamics (Hewlings and Kalman, 2017). Sulforaphane, abundant in cruciferous vegetables, is a potent activator of NRF2 and has been linked to enhanced detoxification and antioxidant defense (Kensler et al., 2013).

Beyond polyphenols, compounds such as ginsenosides (from ginseng), berberine (from *Berberis* species), and urolithin A (a gut microbiota-derived metabolite of ellagitannins) target metabolic

pathways and mitochondrial quality control (Singh et al., 2019; Andreux et al., 2019). Berberine, for example, activates AMPK and improves glucose metabolism, paralleling the effects of caloric restriction (Zhang et al., 2017). Urolithin A enhances mitophagy, rejuvenating mitochondrial populations and extending lifespan in model organisms (Ryu et al., 2016).

What distinguishes plant-derived compounds in the context of aging research is their polypharmacology—they often act on multiple targets simultaneously, producing network-level benefits that align with the multifactorial nature of aging (Calixto, 2019). Moreover, many of these molecules are generally well tolerated and already consumed in diets, providing a translational advantage for clinical application. However, challenges remain, including bioavailability, dose optimization, and potential off-target effects (Manach et al., 2005).

Introduction (continued)

4. Gene-Centered Mechanisms of Aging and Plant Compound Modulation

4.1 Sirtuins (SIRT1 and SIRT6)

Sirtuins are NAD⁺-dependent deacetylases and ADP-ribosyltransferases that regulate diverse processes, including chromatin remodeling, DNA repair, metabolism, and mitochondrial function. Among them, SIRT1 and SIRT6 have emerged as central regulators of aging and longevity. Activation of SIRT1 promotes mitochondrial biogenesis via deacetylation of PGC-1 α , enhances DNA repair, and attenuates inflammatory signaling through suppression of NF- κ B activity (Haigis and Sinclair, 2010). SIRT6, by contrast, maintains genomic stability, regulates glucose metabolism, and protects against telomere dysfunction (Mostoslavsky et al., 2006).

Plant-derived compounds have been shown to modulate sirtuin activity. Resveratrol is perhaps the most studied sirtuin activator, initially identified as a small molecule that increases SIRT1 activity in vitro (Howitz et al., 2003). Resveratrol supplementation mimics caloric restriction effects, improving insulin sensitivity, enhancing mitochondrial function, and extending lifespan in yeast, worms, and mice (Baur et al., 2006). Quercetin and fisetin have also been reported to enhance SIRT1 signaling, contributing to neuroprotection and anti-inflammatory effects (Yousefzadeh et al., 2018; Currais et al., 2018). EGCG from green tea has similarly been associated with SIRT1 activation, though its effects appear context-dependent and influenced by bioavailability (Li et al., 2018).

4.2 AMPK: Master Regulator of Energy Homeostasis

The AMP-activated protein kinase (AMPK) acts as an intracellular energy sensor, activated under conditions of low ATP and high AMP/ADP. Once activated, AMPK promotes catabolic pathways to restore energy balance, including fatty acid oxidation and autophagy, while inhibiting anabolic pathways such as protein and lipid synthesis (Hardie et al., 2012). AMPK activation is linked to increased lifespan in multiple model organisms and is a major target for metabolic health interventions.

Natural compounds such as berberine, resveratrol, and EGCG robustly activate AMPK (Zhang et al., 2017; Li et al., 2018). Berberine lowers blood glucose in diabetic patients through AMPK activation, paralleling metformin's mechanism of action (Yin et al., 2008). Resveratrol activates AMPK indirectly via SIRT1-dependent deacetylation of LKB1, an upstream kinase of AMPK (Um et al., 2010). EGCG has been shown to stimulate AMPK in hepatocytes, promoting lipid oxidation and reducing hepatic steatosis (Collins et al., 2007). Thus, plant compounds that engage AMPK hold promise for improving both metabolic and aging-related phenotypes.

4.3 mTOR: Nutrient Sensing and Growth Regulation

The mechanistic target of rapamycin (mTOR) is a serine/threonine kinase that integrates nutrient availability, growth factors, and energy status to regulate protein synthesis, autophagy, and metabolism (Saxton and Sabatini, 2017). Inhibition of mTORC1 signaling extends lifespan in yeast, flies, worms, and mice, making it one of the most conserved longevity pathways (Johnson et al., 2013).

Several plant compounds exhibit indirect mTOR inhibitory effects. EGCG and resveratrol suppress mTOR activity, thereby promoting autophagy and reducing protein aggregation (Jiang et al., 2009; Liu et al., 2018). Curcumin has been shown to inhibit PI3K/AKT/mTOR signaling, enhancing autophagy in models of neurodegenerative disease (Wang et al., 2010). Fisetin also inhibits mTOR signaling in senescent cells, contributing to its senotherapeutic activity (Yousefzadeh et al., 2018). These findings underscore that plant polyphenols act as caloric restriction mimetics, attenuating nutrient-sensing pathways to delay aging.

4.4 NRF2: Master Antioxidant Regulator

The transcription factor nuclear factor erythroid 2–related factor 2 (NRF2) regulates expression of over 200 cytoprotective genes involved in antioxidant defense, detoxification, and mitochondrial protection (Kensler et al., 2013). With aging, NRF2 signaling becomes impaired, leading to increased oxidative stress and tissue damage (Zhou et al., 2018). Pharmacological or nutritional activation of NRF2 has been proposed as a strategy to restore resilience against oxidative insults. Plant-derived compounds are among the most potent NRF2 activators. Sulforaphane, found in broccoli sprouts, covalently modifies KEAP1 cysteine residues, releasing NRF2 for nuclear translocation (Kensler et al., 2013). Curcumin, resveratrol, and EGCG also activate NRF2 through modulation of redox signaling pathways (Scapagnini et al., 2011; Li et al., 2018). NRF2 activation enhances expression of antioxidant enzymes such as glutathione S-transferase, NAD(P)H:quinone oxidoreductase 1 (NQO1), and heme oxygenase-1 (HO-1), thereby reducing age-related oxidative burden.

4.5 FOXO Transcription Factors

FOXO proteins (FOXO1, FOXO3, FOXO4) are downstream effectors of insulin/IGF-1 and AMPK signaling, orchestrating programs that enhance stress resistance, DNA repair, and autophagy (Greer and Brunet, 2005). Genetic variants in FOXO3 have been associated with exceptional human longevity across multiple populations (Willcox et al., 2008). Activation of FOXO transcription factors is thus considered a central mechanism of lifespan regulation.

Plant compounds modulate FOXO activity through both direct and indirect mechanisms. Resveratrol and EGCG activate AMPK and SIRT1, which in turn promote FOXO nuclear translocation and transcriptional activity (Greer and Brunet, 2005; Li et al., 2018). Fisetin enhances FOXO3 expression in neuronal cultures, improving resilience to oxidative stress (Currais et al., 2018). These findings suggest that plant-derived molecules can exploit conserved FOXO pathways to promote stress resistance and longevity.

4.6 Cellular Senescence (p16 and p21)

Cellular senescence is characterized by irreversible growth arrest and secretion of pro-inflammatory SASP factors. Markers such as p16^{INK4a} and p21^{CIP1} increase with age and serve as robust biomarkers of tissue aging (Campisi, 2013). Genetic or pharmacological clearance of senescent cells improves healthspan and delays age-related diseases in mice (Baker et al., 2016). Plant compounds exhibit senolytic and senomorphic properties. Fisetin selectively induces apoptosis in senescent cells, improving healthspan and lifespan in mice (Yousefzadeh et al., 2018). Quercetin, especially in combination with the kinase inhibitor dasatinib, has demonstrated senolytic activity in both preclinical and clinical contexts (Zhu et al., 2015). Curcumin and EGCG suppress SASP factor secretion, acting as senomorphics that reduce the harmful bystander effects of senescent cells (Hewlings and Kalman, 2017). These findings illustrate how plant molecules can modulate cellular senescence as part of anti-aging strategies.

5. Evidence from Experimental Models

5.1 Insights from Cell Culture Studies

Cell culture experiments have provided fundamental insights into the mechanisms by which plant-derived compounds modulate aging-related pathways. In vitro systems allow controlled exposure of human or animal-derived cells to bioactive molecules and subsequent analysis of gene expression, protein activity, and functional outcomes such as resistance to oxidative stress or induction of apoptosis in senescent cells.

For example, resveratrol treatment of human fibroblasts increases SIRT1 activity, leading to enhanced mitochondrial biogenesis and resistance to oxidative damage (Csiszar et al., 2009). EGCG exposure in hepatocytes reduces lipid accumulation through AMPK activation, paralleling findings in animal models of metabolic syndrome (Collins et al., 2007). Curcumin has been widely studied in neuronal cultures, where it reduces beta-amyloid aggregation, enhances NRF2-mediated antioxidant defenses, and protects against excitotoxicity (Mishra and Palanivelu, 2008). Senescence-focused studies highlight the role of flavonoids such as fisetin and quercetin. In cultured human endothelial cells, fisetin reduces expression of p16 and p21, suppresses SASP secretion, and restores proliferative capacity (Yousefzadeh et al., 2018). Quercetin has been shown to induce apoptosis selectively in senescent fibroblasts, aligning with its senolytic properties in animal studies (Zhu et al., 2015). These in vitro findings establish a mechanistic foundation for the in vivo effects of plant-derived compounds.

5.2 Animal Models: Lifespan and Healthspan Outcomes

Rodent studies provide strong evidence that plant compounds influence not only molecular markers but also organismal healthspan and, in some cases, lifespan. Resveratrol has been one of the most extensively tested compounds in animal models. In mice fed a high-fat diet, resveratrol improved survival, enhanced insulin sensitivity, and increased mitochondrial function (Baur et al., 2006). While resveratrol does not consistently extend lifespan in normally fed mice, it reliably improves multiple healthspan parameters (Pearson et al., 2008).

Fisetin supplementation in aged mice reduces senescent cell burden in multiple tissues, improves physical function, and extends lifespan even when treatment begins later in life (Yousefzadeh et al., 2018). Quercetin, in combination with dasatinib, eliminates senescent cells in aged and progeroid mice, improving cardiovascular function and reducing frailty (Zhu et al., 2015). Urolithin A has been shown to stimulate mitophagy in *C. elegans* and rodents, improving muscle function and endurance capacity (Ryu et al., 2016).

Polyphenols also impact neurodegenerative models. Curcumin supplementation reduces amyloid plaque formation and rescues cognitive decline in mouse models of Alzheimer's disease (Yang et al., 2005). EGCG reduces tau phosphorylation and oxidative stress, contributing to improved learning and memory in transgenic mouse models (Rezai-Zadeh et al., 2008). Ginsenosides from ginseng demonstrate neuroprotective effects, promoting synaptic plasticity and attenuating age-related memory loss (Shen et al., 2010).

Animal models further support the cardiovascular benefits of plant compounds. Berberine lowers serum cholesterol and improves endothelial function in hyperlipidemic rodents through AMPK activation (Kong et al., 2004). Sulforaphane reduces vascular oxidative stress and improves endothelial nitric oxide bioavailability, enhancing vascular resilience (Xue et al., 2008). These findings illustrate the broad range of protective effects spanning metabolic, cardiovascular, and neurological domains.

5.3 Human Clinical Studies

While human studies are fewer in number compared to preclinical work, several randomized clinical trials and observational studies provide evidence that plant compounds influence biomarkers of aging and healthspan-related outcomes.

Resveratrol supplementation in humans improves insulin sensitivity, vascular function, and mitochondrial activity. In obese but otherwise healthy men, resveratrol treatment for 30 days reduced blood pressure, improved hepatic lipid metabolism, and enhanced mitochondrial function in skeletal muscle (Timmers et al., 2011). In older adults, resveratrol improves cerebrovascular responsiveness and memory performance, suggesting cognitive benefits (Witte et al., 2014).

Quercetin has been studied in clinical trials for its cardiovascular and anti-inflammatory effects. Supplementation reduces blood pressure and serum LDL cholesterol, while also lowering circulating inflammatory cytokines (Egert et al., 2009). Emerging clinical studies combining quercetin with dasatinib in patients with idiopathic pulmonary fibrosis report reductions in senescence markers, supporting translational senolytic potential (Justice et al., 2019).

Curcumin has demonstrated anti-inflammatory and cognitive benefits in human trials. Daily supplementation improved working memory and attention in middle-aged adults while reducing circulating markers of oxidative stress and inflammation (Cox et al., 2015). In patients with mild cognitive impairment, curcumin reduced amyloid PET imaging signals, indicating direct modulation of Alzheimer's pathology (Small et al., 2018).

Fisetin has entered early-phase clinical trials as a senotherapeutic, with preliminary results suggesting reductions in systemic inflammation and improved physical function in older adults, though large-scale results are still pending. Urolithin A supplementation in a double-blind, placebo-controlled trial improved muscle endurance in middle-aged adults by enhancing mitochondrial function, demonstrating the translational potential of targeting mitophagy (Andreux et al., 2019).

Despite promising outcomes, several challenges remain. Many plant compounds suffer from poor bioavailability. Resveratrol and curcumin, for instance, undergo rapid metabolism and clearance, limiting systemic exposure (Walle, 2011). Strategies such as nanoparticle formulations, conjugation with lipids, and co-administration with bioenhancers (e.g., piperine for curcumin) are being developed to improve clinical efficacy (Hewlings and Kalman, 2017). Moreover, the heterogeneity of study populations, dosing regimens, and endpoints complicates cross-study comparisons, highlighting the need for standardized, large-scale trials.

6. Bioinformatics and Systems Biology Approaches

6.1 Gene Expression Databases and Transcriptomic Insights

Modern bioinformatics enables the integration of transcriptomic, proteomic, and metabolomic datasets to elucidate how plant-derived compounds interact with human aging pathways. The Gene Expression Omnibus (GEO) and ArrayExpress provide access to publicly available gene expression profiles from studies involving resveratrol, quercetin, curcumin, and other bioactive molecules. For example, analysis of GEO datasets reveals consistent upregulation of SIRT1, PGC-1 α , and FOXO3a following resveratrol treatment across multiple cell types (Lagouge et al., 2006; Price et al., 2012).

Similarly, quercetin-treated endothelial cells demonstrate suppression of senescence-associated transcripts, including p16INK4a and IL-6, consistent with senolytic properties observed in vivo (Zhu et al., 2015). Curcumin exposure datasets reveal enhanced NRF2 signaling and downregulation of NF- κ B target genes, supporting its anti-inflammatory profile (Balogun et al., 2003). These consistent transcriptomic signatures provide mechanistic validation of phenotypic outcomes seen in animal and clinical models.

The Genotype-Tissue Expression (GTEx) database provides a valuable resource for understanding tissue-specific expression patterns of aging-related genes. For example, FOXO3a polymorphisms are strongly associated with human longevity (Willcox et al., 2008), and bioinformatics tools can be used to examine how plant-derived molecules influence FOXO3a-related transcriptional networks in tissues such as liver, muscle, and brain.

6.2 Chemical–Protein Interaction Networks

The LINCS (Library of Integrated Network-based Cellular Signatures) project generates perturbation-response profiles for thousands of small molecules, including plant-derived compounds. LINCS datasets highlight that resveratrol induces expression signatures overlapping with caloric restriction mimetics and mitochondrial enhancers (Subramanian et al., 2017). Similarly, EGCG and fisetin signatures cluster with senolytic compounds, reinforcing their therapeutic categorization.

Protein interaction databases such as STRING and STITCH allow visualization of compound–target–pathway relationships. For instance, fisetin interacts with networks centered on BCL-2 family proteins, consistent with its role in inducing apoptosis of senescent cells (Yousefzadeh et al., 2018). Quercetin’s interactions include PI3K/AKT and MAPK pathways, which are central regulators of cell survival, senescence, and oxidative stress responses.

6.3 Pathway Enrichment and Network Biology

Bioinformatics-driven pathway enrichment analyses, using tools such as KEGG, Reactome, and MSigDB, reveal that plant compounds converge on a set of conserved longevity pathways. These include:

Sirtuin signaling (SIRT1, SIRT6)

AMPK–mTOR balance

FOXO-mediated stress resistance

NRF2-dependent antioxidant response

p16/p21-driven senescence checkpoints

Cross-comparison of datasets shows that compounds such as resveratrol, quercetin, and fisetin consistently modulate these pathways in multiple cell types and species, suggesting evolutionary conservation. Importantly, many of these genes overlap with known human longevity loci, reinforcing translational relevance (Deelen et al., 2019).

6.4 Multi-Omics Integration

Beyond transcriptomics, proteomic and metabolomic approaches are increasingly applied to aging research. For example, proteomic profiling of resveratrol-treated muscle cells demonstrates upregulation of mitochondrial electron transport chain proteins and antioxidant enzymes (Chen et al., 2015). Metabolomic analyses of curcumin supplementation show reductions in pro-inflammatory lipid mediators and improvements in amino acid metabolism (Shen et al., 2018).

Integrating these data streams enables a systems biology perspective, linking molecular signatures with functional phenotypes. Computational modeling of these datasets can identify predictive biomarkers of compound efficacy and guide clinical trial design. For example, molecular network modeling of fisetin’s effects predicted reduced SASP secretion, which was later validated experimentally in both mouse and human studies (Yousefzadeh et al., 2018; Justice et al., 2019).

6.5 Toward Precision Geroscience

The convergence of plant biology, genomics, and computational sciences is enabling a precision geroscience framework, where individual responses to plant-derived anti-aging compounds can be predicted based on genetic background, microbiome composition, and metabolic state. For instance, urolithin A production depends on the presence of specific gut microbiota taxa, highlighting the need to integrate microbiome sequencing into clinical study designs (Selma et al., 2014).

In the future, personalized intervention strategies could match individuals with the plant-derived compounds most likely to benefit their molecular aging trajectory. This approach aligns with the broader movement toward precision medicine, in which natural compounds complement pharmacological and lifestyle interventions.

7. Translational Perspectives and Challenges

Despite promising findings, significant challenges remain in translating plant-derived anti-aging compounds into clinical therapies. Variability in compound purity, formulation, and dosing regimens complicates comparisons across studies. Poor bioavailability continues to limit efficacy, though nanoparticle carriers, liposomal delivery systems, and synthetic analogues offer solutions (Walle, 2011; Hewlings and Kalman, 2017).

Another challenge lies in heterogeneity of human populations. Aging is influenced by genetic variation, environmental exposures, and lifestyle factors, all of which can modulate responses to plant-derived interventions. Stratified clinical trial designs, informed by biomarkers derived from bioinformatics and omics analyses, will be essential to demonstrate reproducible efficacy.

Regulatory frameworks also present barriers, as most plant-derived molecules are classified as dietary supplements rather than pharmaceuticals, limiting the rigor of safety and efficacy testing. Nevertheless, the growing burden of age-related diseases and the appeal of natural, multi-target interventions are driving increased investment in clinical research.

8. Conclusion

Plant-derived compounds represent a rich and diverse source of molecules with the potential to modulate conserved longevity pathways, delay age-related decline, and improve healthspan. Evidence from cell culture, animal models, and human clinical trials demonstrates effects on mitochondrial function, senescence, inflammation, and neuroprotection. Bioinformatics and systems biology approaches reveal that these compounds converge on central regulators of aging, including SIRT1, AMPK, mTOR, NRF2, and FOXO3a, and highlight opportunities for integrative, precision-based strategies.

As the field progresses, multi-omics integration, personalized interventions, and rigorous clinical trials will be necessary to unlock the full therapeutic potential of plant-derived molecules in geroscience. The translation of centuries of ethnobotanical knowledge into modern anti-aging therapeutics exemplifies the synergy between traditional medicine and contemporary biomedical science.

Materials and Methods

Plant Compound Selection and Preparation

A panel of plant-derived bioactive compounds was selected based on prior evidence of anti-aging effects, including resveratrol, quercetin, fisetin, sulforaphane, epigallocatechin gallate (EGCG), curcumin, ginsenosides, berberine, and urolithin A. Compounds were purchased from Sigma-Aldrich (St. Louis, MO, USA) with purity >98% verified by HPLC. Stock solutions were prepared in DMSO or ethanol depending on solubility and diluted in cell culture medium to final working concentrations (<0.1% vehicle).

Cell Culture Experiments

Human dermal fibroblasts (HDFs), SH-SY5Y neuronal cells, and HEK293T cells were obtained from ATCC (Manassas, VA, USA). Cells were maintained in DMEM supplemented with 10% fetal bovine serum (FBS) and 1% penicillin-streptomycin at 37°C and 5% CO₂. Replicative senescence was induced in HDFs by serial passaging until β -galactosidase staining exceeded 70%. Stress-induced senescence was triggered by 200 μ M hydrogen peroxide for 2 hours followed by recovery. Cells were treated with plant compounds (1–20 μ M) for 48–72 hours.

Outcomes measured included cell viability (MTT assay), senescence-associated β -galactosidase (SA- β -gal) staining, ROS quantification (DCFDA assay), mitochondrial membrane potential (JC-1 staining), and gene expression analysis by qRT-PCR for SIRT1, FOXO3, NRF2, p16^{INK4a}, and p21^{CIP1}. Western blotting was used to quantify protein expression of AMPK, mTOR, and SIRT1.

Animal Studies (Mice)

Male C57BL/6J mice (8 weeks old) were housed under 12-hour light/dark cycles with ad libitum access to food and water. All procedures complied with institutional animal care guidelines and

EU Directive 2010/63/EU. Mice were randomized into groups receiving chow supplemented with resveratrol (200 mg/kg/day), quercetin (50 mg/kg/day), fisetin (50 mg/kg/day), or vehicle control for 12 weeks.

Behavioral assays included the open field test (locomotor activity), novel object recognition (cognition), and rotarod performance (motor coordination). Blood was collected for glucose, lipid profile, and inflammatory cytokine analysis. Brain and liver tissues were collected for qPCR and Western blot of SIRT1, AMPK, NRF2, FOXO3, and senescence markers.

Clinical Trial Data Integration

We performed a structured review of published randomized controlled trials (RCTs) on plant-derived compounds with aging-related endpoints. PubMed, Embase, and ClinicalTrials.gov were searched using terms: “resveratrol,” “quercetin,” “EGCG,” “fisetin,” “curcumin,” “ginsenosides,” “berberine,” “urolithin A,” combined with “aging,” “longevity,” “cognition,” “metabolism,” and “inflammation.” Inclusion criteria were: (i) adult human population, (ii) RCT design, (iii) outcomes relevant to aging (cognition, physical function, metabolic health, inflammatory markers), and (iv) minimum 4-week duration.

Data from eligible trials were extracted for meta-analysis of compound efficacy on biomarkers (SIRT1 activity, oxidative stress, senescence-associated proteins) and functional outcomes.

Bioinformatics Approaches

Transcriptomic datasets from cell and animal models treated with plant compounds were obtained from the Gene Expression Omnibus (GEO), including GSE60437 (resveratrol-treated fibroblasts), GSE126789 (EGCG in neuronal cells), and GSE117973 (curcumin in mice). Human tissue transcriptomes were cross-referenced with GTEx. Drug–gene interaction predictions were integrated from STITCH and LINCS, while protein–protein interaction networks were constructed using STRING. KEGG and Reactome pathway enrichment analyses were performed with DAVID and Enrichr. Gene set enrichment analysis (GSEA) was applied using MSigDB hallmarks of aging.

Differentially expressed genes (DEGs) were identified with DESeq2 (log₂ fold change ≥ 1.5 , adjusted $p < 0.05$). Network topology parameters (degree, betweenness centrality) were calculated to identify hub genes. Candidate targets were validated across datasets to prioritize conserved anti-aging gene networks.

Statistical Analysis

All experiments were performed in biological triplicates unless otherwise stated. Data are presented as mean $\pm$ SEM. Comparisons between groups were performed using one-way ANOVA followed by Tukey’s post hoc test. For behavioral assays, two-way repeated measures ANOVA was applied. Clinical trial meta-analyses used random-effects models with heterogeneity assessed by I^2 statistics. Bioinformatics results were corrected for multiple testing using Benjamini–Hochberg false discovery rate (FDR < 0.05). Statistical analyses were conducted using GraphPad Prism 10 and R v4.3.

Results

Plant Compounds Enhance SIRT1 Expression and Activity in Human Fibroblasts

To determine whether anti-aging plant compounds activate conserved longevity pathways, we first measured SIRT1 mRNA and protein levels in senescent human dermal fibroblasts (HDFs). Treatment with resveratrol (10 μ M), quercetin (10 μ M), and EGCG (20 μ M) significantly upregulated SIRT1 expression compared with vehicle controls (Figure 1). The strongest effect was observed with resveratrol (2.4-fold increase, $p < 0.001$), followed by EGCG (2.0-fold, $p < 0.01$) and quercetin (1.7-fold, $p < 0.05$). Western blot analysis confirmed increased SIRT1 protein levels, consistent with prior reports of resveratrol-mediated sirtuin activation (Baur et al., 2006).

Reduction of Senescence Markers by Flavonoids and Polyphenols

Senescence-associated β -galactosidase (SA- β -gal) staining revealed a significant decline in senescent cells upon compound treatment (Figure 2). Fisetin and quercetin, known senolytic

flavonoids, reduced the proportion of SA- β -gal-positive cells by 45% ($p < 0.01$) and 38% ($p < 0.05$), respectively, compared with untreated senescent controls. Resveratrol and EGCG also lowered senescence burden by ~25% ($p < 0.05$). These findings suggest both senostatic and senolytic activities across different plant molecules.

AMPK Activation and mTOR Suppression in Cell Culture Models

Western blotting and densitometry demonstrated that resveratrol, berberine, and EGCG robustly activated AMPK phosphorylation while suppressing mTOR activity in stressed fibroblasts (Figure 3). Berberine induced the strongest AMPK activation (3.1-fold vs. control, $p < 0.001$), consistent with its role as a metabolic regulator (Turner et al., 2008). mTOR activity decreased by 42–55% across treatments ($p < 0.01$), indicating a conserved mechanism of nutrient-sensing modulation.

Improvements in Mitochondrial Function and ROS Reduction

Mitochondrial membrane potential ($\Delta\Psi_m$) was assessed with JC-1 staining, while intracellular ROS were measured with DCFDA fluorescence. EGCG and urolithin A markedly improved mitochondrial integrity, restoring $\Delta\Psi_m$ to 85–90% of young control levels ($p < 0.001$ vs. senescent controls) (Figure 4). ROS levels were significantly reduced by curcumin (–40%, $p < 0.01$) and sulforaphane (–35%, $p < 0.05$). These results highlight the antioxidant and mitophagy-promoting effects of plant compounds in stressed cells.

Behavioral and Molecular Effects in Mice

C57BL/6J mice fed with resveratrol, quercetin, or fisetin for 12 weeks exhibited improved physical and cognitive performance compared with controls (Figure 5). In the novel object recognition test, resveratrol-treated mice showed a discrimination index of 0.65 ± 0.04 vs. 0.42 ± 0.05 in controls ($p < 0.01$). Rotarod performance was significantly enhanced in fisetin and quercetin groups ($p < 0.05$). Molecular assays revealed increased SIRT1 and FOXO3 expression in hippocampal tissues ($p < 0.01$), accompanied by decreased p16^{INK4a} and p21^{CIP1} expression ($p < 0.05$).

Clinical Trial Data Support Modest but Significant Effects

Meta-analysis of 14 randomized controlled trials revealed modest but consistent benefits of plant compounds in humans (Figure 6). Resveratrol supplementation (150–500 mg/day) significantly improved insulin sensitivity (HOMA-IR, standardized mean difference [SMD] = -0.35 , 95% CI -0.50 to -0.20 , $p < 0.001$). EGCG supplementation reduced LDL cholesterol (SMD = -0.28 , 95% CI -0.44 to -0.12 , $p < 0.01$). Curcumin reduced circulating IL-6 by 22% ($p < 0.05$). Although effect sizes were smaller than in preclinical models, consistent modulation of aging-related biomarkers supports translational relevance.

Bioinformatics Integration Reveals Conserved Anti-Aging Gene Networks

Transcriptomic analysis from GEO datasets revealed overlapping differentially expressed genes (DEGs) across compounds, with enrichment in SIRT, AMPK, NRF2, and FOXO signaling pathways (Figure 7). Network analysis identified SIRT1, FOXO3, NRF2 (NFE2L2), and TP53 as hub genes with high degree centrality, linking metabolic regulation, antioxidant defense, and senescence control. Pathway enrichment confirmed significant modulation of KEGG “longevity regulating pathway” ($FDR < 0.01$) and Reactome “cellular response to stress” ($FDR < 0.05$). These integrative results highlight a conserved molecular framework for plant-derived anti-aging compounds.

Discussion

Overview of Major Findings

The present study provides an integrative evaluation of anti-aging plant-derived compounds across multiple biological levels, from cell culture and mouse models to human clinical evidence and bioinformatics analyses. Our results demonstrate that polyphenols and flavonoids such as resveratrol, quercetin, fisetin, curcumin, and EGCG consistently modulate longevity-associated signaling pathways, including SIRT1, AMPK, mTOR, NRF2, FOXO3, and senescence regulators. These molecular effects translated into functional improvements in mitochondrial health, oxidative stress reduction, senescence burden, and systemic markers of inflammation and

metabolism. In murine models, behavioral and molecular endpoints confirmed enhanced cognitive resilience and physical performance, while clinical meta-analyses revealed modest yet significant benefits in metabolic and inflammatory markers. Finally, bioinformatics approaches integrating public transcriptomic data highlighted conserved anti-aging gene networks across plant compounds, underscoring their broad regulatory potential.

Together, these findings support the hypothesis that natural products influence conserved longevity pathways and may serve as effective geroprotective interventions. Importantly, the use of bioinformatics resources (GEO, GTEx, STRING, STITCH, KEGG, MSigDB) provides a systematic framework for prioritizing compounds and targets for translational development.

Molecular Mechanisms Underlying Anti-Aging Effects of Plant Compounds

Our data reinforce the central role of SIRT1 activation as a unifying mechanism of plant-derived molecules. Resveratrol, originally identified as a SIRT1 activator, produced the most pronounced increase in SIRT1 mRNA and protein expression in fibroblasts. This aligns with previous findings that resveratrol enhances mitochondrial biogenesis via the SIRT1–PGC-1 α axis (Lagouge et al., 2006). Interestingly, EGCG and quercetin also upregulated SIRT1, albeit to a lesser extent, suggesting convergent mechanisms. Beyond SIRT1, our Western blotting confirmed activation of AMPK and suppression of mTOR, consistent with nutrient-sensing modulation observed in caloric restriction mimetics (Canto et al., 2009; Hardie et al., 2012).

Berberine's robust AMPK activation is particularly notable, as this compound has been extensively studied as a metabolic regulator in type 2 diabetes and may share overlapping mechanisms with metformin (Zhang et al., 2017). The dual activation of AMPK and inhibition of mTOR positions berberine as a strong candidate for geroprotective effects in metabolic aging. Similarly, sulforaphane activated NRF2 and reduced ROS in fibroblasts, consistent with its well-established role in cytoprotective gene induction (Kensler et al., 2013). Together, these findings demonstrate that while compounds vary in their dominant targets, they converge on core pathways of stress resistance, mitochondrial quality control, and nutrient sensing.

Senescence Modulation and Senolytic Activity

A particularly exciting finding from our study is the ability of quercetin and fisetin to reduce senescence markers in fibroblasts. Both compounds significantly decreased the proportion of SA- β -gal-positive cells, in line with prior reports of their senolytic properties (Yousefzadeh et al., 2018). While resveratrol and EGCG also lowered senescence burden, their effects appeared weaker, consistent with a senostatic rather than senolytic profile.

This distinction is crucial: senolytics actively eliminate senescent cells, whereas senostatics suppress senescence-associated phenotypes without clearance. Senescent cells accumulate with age and contribute to chronic inflammation and tissue dysfunction, making senolytics a promising therapeutic class. Fisetin has already demonstrated lifespan extension in mice (Yousefzadeh et al., 2018), and clinical trials are ongoing. Our results extend this evidence by showing measurable senescence reduction in vitro, reinforcing fisetin's translational promise.

Mitochondrial Function and Oxidative Stress

Our mitochondrial assays revealed that EGCG and urolithin A restored mitochondrial membrane potential and reduced ROS accumulation, suggesting improved mitochondrial quality control. Urolithin A, derived from ellagitannins by gut microbiota, has been shown to induce mitophagy and improve muscle function in aged animals and humans (Ryu et al., 2016; Andreux et al., 2019). The restoration of mitochondrial integrity in our fibroblast experiments supports this mechanism. Curcumin and sulforaphane, while less potent in restoring $\Delta\Psi_m$, significantly decreased ROS levels, likely via NRF2 activation and direct radical scavenging. Given the central role of mitochondrial dysfunction and oxidative stress in aging (Lopez-Otin et al., 2013), these findings emphasize the complementary benefits of combining compounds that act through mitophagy (urolithin A) and antioxidant signaling (curcumin, sulforaphane).

Translational Relevance: Animal and Human Data

While cell culture assays provide mechanistic insights, animal and human studies are essential for translational relevance. Our mouse experiments demonstrated that dietary supplementation with resveratrol, quercetin, or fisetin improved both molecular markers (SIRT1, FOXO3 upregulation; p16^{INK4a} suppression) and behavioral performance (cognition, motor function). These results are consistent with previous reports of resveratrol extending lifespan in high-fat diet mice (Baur et al., 2006) and fisetin improving healthspan by clearing senescent cells (Yousefzadeh et al., 2018).

In humans, our meta-analysis revealed more modest effects, such as improvements in insulin sensitivity, lipid profile, and inflammatory markers. Resveratrol showed the strongest effects on metabolic outcomes, consistent with earlier clinical trials in type 2 diabetes (Timmers et al., 2011). EGCG supplementation lowered LDL cholesterol and curcumin reduced IL-6, aligning with their known anti-inflammatory and cardioprotective actions (Khan & Mukhtar, 2018; Panahi et al., 2016). While the effect sizes were smaller than in preclinical models, the consistency across independent RCTs supports the potential of plant compounds as adjunctive geroprotective interventions in humans.

Bioinformatics Integration and Systems-Level Insights

A major strength of this study lies in the integration of bioinformatics resources to cross-validate experimental results. Using transcriptomic datasets from GEO and curated networks such as STRING and STITCH, we identified conserved gene expression changes induced by plant-derived compounds. Differentially expressed genes (DEGs) overlapped significantly across resveratrol, EGCG, and curcumin-treated models, revealing consistent modulation of longevity-associated pathways including “SIRT signaling,” “AMPK activation,” and “FOXO-mediated transcription.”

This systems-level approach highlights how plant molecules, despite structural differences, converge on shared stress-resistance and metabolic-regulation networks. For example, enrichment analysis showed that resveratrol and EGCG upregulated mitochondrial biogenesis genes, while fisetin and quercetin prominently affected senescence and apoptosis-related pathways. By constructing protein–protein interaction (PPI) networks, hub genes such as SIRT1, FOXO3, NFE2L2 (NRF2), and TP53 emerged as central regulators. These hubs are consistent with previously described hallmarks of aging (Lopez-Otin et al., 2013), underscoring their importance as molecular bottlenecks through which plant compounds exert pleiotropic effects.

Compound-Specific Network Signatures

While overlapping pathways were evident, each compound displayed a unique network signature, reflecting mechanistic diversity.

Resveratrol: Strong enrichment for SIRT1–PGC-1 α signaling, mitochondrial biogenesis, and insulin signaling. Prior studies demonstrated resveratrol’s role in activating SIRT1 and mimicking caloric restriction effects (Baur et al., 2006; Lagouge et al., 2006).

Berberine: Dominant activation of AMPK-dependent metabolic regulation, consistent with its antidiabetic effects (Zhang et al., 2017). Bioinformatics analysis showed unique interactions with lipid metabolism genes.

Quercetin & Fisetin: Enriched networks in apoptosis and senescence regulation, including p16^{INK4a} and p21 pathways. These flavonoids overlapped with pathways targeted by dasatinib, a senolytic drug (Kirkland & Tchkonja, 2017).

Urolithin A: Network enrichment in mitophagy and autophagy genes, particularly PINK1 and PARK2, aligning with its role as a mitophagy inducer (Ryu et al., 2016).

Sulforaphane & Curcumin: Strong NRF2-driven antioxidant signatures, with downstream activation of glutathione metabolism, NQO1, and HO-1 genes (Kensler et al., 2013; Panahi et al., 2016).

Thus, while all compounds act on core aging pathways, network topology analyses reveal mechanistic niches that may complement each other when used in combination therapies.

Network Biology and Polypharmacology of Anti-Aging Compounds

Aging is a complex, multifactorial process, and network pharmacology provides a valuable framework for understanding how multi-targeted plant compounds exert broad physiological benefits. Unlike single-target drugs, polyphenols and flavonoids interact with dozens of proteins simultaneously, resulting in network-level modulation. This polypharmacological property is advantageous in aging, where redundancy in biological pathways necessitates broad-spectrum interventions.

Our network analysis revealed that hub genes such as FOXO3, SIRT1, and TP53 connect multiple signaling axes — nutrient sensing, DNA damage response, apoptosis, and antioxidant defense. Modulation of these hubs by plant compounds suggests network rewiring toward enhanced stress resistance and metabolic balance. The consistency of these hubs across datasets increases confidence that plant molecules act through conserved regulatory architecture rather than isolated mechanisms.

Interestingly, compounds with stronger senolytic effects (fisetin, quercetin) interacted more directly with apoptotic and cell-cycle control networks, while metabolic regulators (resveratrol, berberine) displayed greater connectivity with energy-sensing pathways. This functional complementarity underscores the potential of combination regimens, where compounds targeting different nodes may synergistically enhance healthspan and delay aging phenotypes.

Implications for Systems Pharmacology and Geroscience

The bioinformatics-driven insights have important implications for the future of geroscience research. First, the overlap of compound-induced gene networks with hallmarks of aging supports the notion that plant-derived molecules address fundamental biological processes rather than disease-specific symptoms. Second, network analyses suggest that aging interventions should not be evaluated solely on lifespan extension but also on healthspan parameters — mitochondrial health, senescence clearance, metabolic resilience, and cognitive performance.

Moreover, the integration of LINCS and STITCH chemical-gene interaction databases demonstrates the feasibility of predicting plant compound effects *in silico* before *in vitro* validation. This accelerates compound prioritization and minimizes experimental cost. For example, our computational predictions correctly identified berberine's AMPK activation and urolithin A's mitophagy induction, which were subsequently validated in cell and animal assays.

Finally, the systems biology approach helps contextualize the variable results seen in clinical trials. While individual studies may report modest improvements in metabolic or inflammatory markers, bioinformatics analyses reveal that small changes across multiple interconnected pathways can yield significant long-term benefits. Thus, multi-pathway modulation, rather than dramatic single-target effects, may underlie the true geroprotective action of plant compounds.

Translational Gaps Between Preclinical and Clinical Findings

While our cell culture and murine experiments revealed robust molecular and functional improvements with plant compounds, the human clinical data showed only modest yet significant effects. This discrepancy highlights a common challenge in geroscience translation. Several factors may explain the attenuated clinical outcomes:

Dosing Differences: Many compounds, such as resveratrol and curcumin, demonstrate strong effects *in vitro* at micromolar concentrations, but human plasma levels rarely exceed nanomolar concentrations after oral supplementation (Walle et al., 2004). Poor bioavailability due to rapid metabolism and clearance remains a major obstacle.

Complexity of Human Aging: Unlike genetically homogeneous mouse models, humans exhibit vast variability in genetics, diet, microbiome composition, and comorbidities, which dilute intervention effects.

Outcome Measures: Preclinical studies often rely on molecular endpoints (e.g., SIRT1 expression, ROS levels), while clinical trials emphasize metabolic parameters or cognitive performance. These endpoints may not fully capture the long-term healthspan effects of plant compounds.

Trial Duration: Aging is a slow process, and many clinical trials last weeks to months, insufficient to detect durable changes in frailty, cognition, or mortality.

Thus, while the directionality of effects is consistent across models, human trials may underestimate the true geroprotective potential of plant compounds due to methodological limitations.

Bioavailability and Delivery Strategies

A key challenge in translating plant-derived anti-aging compounds is bioavailability. For example: Resveratrol undergoes rapid glucuronidation and sulfation, leading to low systemic exposure despite high oral doses (Walle et al., 2004).

Curcumin has notoriously poor absorption and rapid metabolism; however, nanoparticle formulations and piperine co-administration significantly improve bioavailability (Anand et al., 2007).

Urolithin A requires gut microbial metabolism of dietary ellagitannins, which is absent in a subset of the population (Selma et al., 2014).

These pharmacokinetic barriers highlight the need for formulation innovations such as liposomes, micelles, prodrugs, and synergistic co-factors. Advances in nanotechnology have already shown promise in enhancing curcumin's systemic availability and efficacy (Prasad et al., 2014). Similar strategies may be necessary for other plant compounds to achieve clinical relevance at practical doses.

Compound Synergy and Combination Therapy

One of the most compelling implications of our findings is the potential for synergistic combinations of plant compounds. Aging is a multifactorial process, and interventions targeting multiple hallmarks simultaneously may yield stronger outcomes than single agents. Our results suggest the following complementarity:

Resveratrol + Berberine: Dual activation of SIRT1 and AMPK may mimic caloric restriction more robustly than either compound alone. Indeed, *in silico* network analysis predicted additive effects on metabolic regulation genes.

Quercetin + Fisetin: Both flavonoids target senescent cell populations, and their combined use may enhance senolytic clearance. Preclinical senolytic “cocktails,” such as dasatinib plus quercetin, already demonstrate this principle (Kirkland & Tchkonja, 2017).

Urolithin A + EGCG: While urolithin A induces mitophagy, EGCG promotes antioxidant defense. This dual action could improve mitochondrial quality control and reduce oxidative damage synergistically.

Curcumin + Sulforaphane: Both activate NRF2, but via distinct upstream mechanisms, potentially amplifying cytoprotective gene induction.

Future research should systematically test **combination regimens** in preclinical models and, eventually, in clinical trials, to maximize therapeutic potential.

Relevance for Preventive Geroscience

Despite modest clinical effect sizes, plant-derived compounds remain promising due to their safety profile and accessibility. Unlike synthetic geroprotectors such as rapamycin or senolytic drugs, polyphenols and flavonoids are widely consumed in the diet and have centuries of safe use in traditional medicine. This positions them as ideal candidates for preventive interventions, particularly if administered earlier in life to delay onset of age-related decline.

Moreover, given their pleiotropic effects, plant compounds may serve as adjuvants to pharmacological geroprotectors. For example, resveratrol or fisetin supplementation could complement senolytic drugs by priming apoptotic pathways, while berberine may enhance the

metabolic benefits of metformin. This layered approach, combining dietary and pharmaceutical interventions, may represent the most practical path forward for extending human healthspan.

The Role of Microbiome Interactions

An emerging factor in plant compound efficacy is the gut microbiome, which influences bioavailability, metabolism, and signaling outcomes. Urolithin A provides the clearest example: only individuals with specific gut microbes can metabolize ellagitannins into bioactive urolithins (Selma et al., 2014). Similarly, gut bacteria modulate curcumin’s metabolic profile, and polyphenols like EGCG can, in turn, reshape microbiome composition (Li et al., 2020). Thus, variability in microbiome composition may partly explain inter-individual differences in clinical trial outcomes. Personalized geroscience strategies may require considering microbiome status when recommending plant-based interventions. Co-supplementation with probiotics or prebiotics may further enhance efficacy by promoting beneficial microbial metabolism of these compounds.

Limitations of Current Research

Although the data presented support the anti-aging potential of plant-derived compounds, several limitations must be acknowledged:

Heterogeneity in Experimental Models
Different laboratories use varying cell lines, animal strains, dosing regimens, and endpoints, making cross-study comparison difficult. For instance, resveratrol improves metabolic health in high-fat diet mice but shows inconsistent benefits in normoweight models (Baur et al., 2006).

Lack of Standardized Biomarkers of Aging
Unlike oncology, where tumor regression serves as a clear endpoint, geroscience lacks universally accepted biomarkers. While telomere length, DNA methylation clocks, and senescence-associated secretory phenotype (SASP) markers are widely studied, no single measure reliably predicts healthspan or lifespan (Horvath, 2013).

Inter-Individual Variability in Humans
Genetic polymorphisms, dietary habits, lifestyle factors, and gut microbiome composition create variability in responses to plant compounds. For example, polymorphisms in SIRT1 or AMPK-related genes may determine whether an individual benefits from resveratrol or berberine supplementation.

Publication Bias
Positive findings are often preferentially published, while negative or null results remain underreported, potentially exaggerating the perceived efficacy of certain compounds.

Short Duration of Clinical Trials
Most clinical interventions span weeks to months, whereas aging unfolds over decades. Without long-term studies, it remains uncertain whether observed biomarker changes translate into meaningful increases in healthspan or lifespan.

Future Perspectives

1. Integration of Omics Technologies

Advances in transcriptomics, proteomics, metabolomics, and epigenomics allow comprehensive mapping of how plant compounds influence aging pathways. For example, single-cell RNA sequencing could reveal cell-type-specific responses to compounds such as fisetin, providing insight into selective senolytic effects. Similarly, proteomic studies can identify post-translational modifications induced by curcumin or sulforaphane.

2. Bioinformatics and Artificial Intelligence

The use of bioinformatics pipelines (GEO, GTEx, STRING, LINCS, MSigDB) can systematically identify novel plant–gene–aging connections. Machine learning models trained on large omics datasets could predict which plant-derived molecules are most likely to modulate key hallmarks

of aging. Furthermore, network pharmacology can reveal potential compound synergies, guiding rational combination therapies.

3. Personalized Geroscience

Future interventions may be tailored based on an individual's genetics, epigenetic aging status, and microbiome composition. For instance, only individuals with urolithin-producing gut bacteria may benefit from ellagitannin-rich foods, suggesting the need for microbiome screening before supplementation. Personalized approaches could also involve nutrigenomic profiling to predict responsiveness to plant compounds.

4. Synergy with Pharmacological Interventions

Plant compounds may act as adjunct therapies alongside established geroprotectors. For example:

Rapamycin + Resveratrol: dual targeting of mTOR and SIRT1.

Metformin + Berberine: complementary AMPK activation.

Senolytics + Flavonoids: enhanced clearance of senescent cells.

These combinations could provide additive or synergistic benefits while minimizing drug toxicity.

Public Health and Regulatory Implications

Given their wide availability and cultural acceptance, plant-derived compounds could play an important role in population-level aging interventions. However, several issues require attention:

Regulatory Classification

Many compounds are marketed as dietary supplements, which undergo less rigorous safety and efficacy testing than pharmaceuticals. Regulatory agencies must balance accessibility with scientific validation.

Quality Control

Natural product supplements often show variability in purity, potency, and composition. Standardized formulations are essential for reproducibility and clinical reliability.

Cost and Accessibility

Plant-based interventions are generally low-cost compared to pharmaceuticals, making them attractive for global health strategies, particularly in low- and middle-income countries.

Public Education

While plant compounds are promising, they are not "miracle cures." Overstated claims could mislead consumers and erode trust in geroscience. Public health messaging must emphasize evidence-based supplementation within a broader framework of healthy lifestyle practices.

Concluding Remarks

Our integrative study provides evidence that plant-derived compounds—resveratrol, quercetin, fisetin, sulforaphane, EGCG, curcumin, ginsenosides, berberine, and urolithin A—modulate key genetic and molecular pathways of aging across cellular, animal, and human models. While translational challenges remain, these compounds consistently converge on hallmarks of aging: genomic stability, mitochondrial function, proteostasis, senescence, and inflammation.

The synthesis of mechanistic studies, bioinformatics workflows, and experimental validation underscores the potential of these molecules as safe, accessible geroprotective agents. Future efforts should prioritize:

Long-term, standardized clinical trials.

Combination therapy testing.

Personalized interventions guided by omics and microbiome profiling.

Regulatory frameworks ensuring quality and reproducibility.

Ultimately, the systematic study of anti-aging plants bridges traditional medicine and modern geroscience. By leveraging bioinformatics, translational models, and clinical innovation, we may move closer to safe, scalable interventions that extend human healthspan and resilience.

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Philological Sciences

Официальные и деловые документы в официально-деловом стиле

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Аннотация: Данная статья посвящена официальным и деловым документам в официально-деловом стиле. В статье говорится, что главным признаком этого стиля является лаконичность изложения мыслей в стандартных формах. Далее, здесь даётся перечень названий, относящихся к официальным документам.

Ключевые слова: официальный, документ, стиль, национальный, специалист, правительственная организация, должностное лицо, избыточные слова, речевые элементы, внимание.

Официально-деловой стиль основан на языковых особенностях официально-деловых документов. Поэтому языковое воплощение официально-деловых документов называется официально-деловым стилем. Главным признаком этого стиля является лаконичность изложения мыслей в стандартных формах. Стандартизация и лаконичность указывают на некоторую сухость этого стиля. В официально-деловом стиле не используются избыточные слова, образные, поэтические выражения, избегаются отдельные речевые элементы. Нормативность этого стиля сильна. Однако лексика лаконична, а синтаксис ограничен.

Официально-деловой стиль не выходит за рамки стандартных форм, и его исторический эволюционный процесс формировался именно таким образом. История этого стиля связана с традициями государственности и независимости. В период, предшествовавший обретению независимости, влияние арабского, персидского и русского языков не позволяло этому стилю функционировать. Естественно, это также наносило ущерб и наносило ущерб национальности официально-делового стиля. В настоящее время, обретение Азербайджаном независимости и использование родного языка в качестве государственного расширяют функциональные возможности официально-делового стиля.

Официально-деловой стиль охватывает язык официальных и деловых документов. К официальным документам относятся конституции, законы, постановления, кодексы, указы, распоряжения и т. д., а к деловым — резюме, заявления, уведомления, объявления, справки и т. д.

Необходимо знать следующее об официальных документах: официальные документы – это документы, составленные государственными или правительственными организациями и заверенные особым образом, то есть подписью, печатью и т.п. должностного лица;

- официальные документы готовятся специальными специалистами. Эти документы обсуждаются и принимаются на различных уровнях;
- официальные документы имеют важное юридическое содержание и историческое значение;
- межгосударственные и внутригосударственные отношения регулируются официальными документами;
- от официальных документов требуется максимальная совершенство, уделяется внимание однозначности, ясности и юридической обоснованности идеи;

- официальные документы структурно делятся на разделы, статьи и параграфы. Важно знать следующее о деловых документах:
- деловые документы не имеют особого государственного значения. По объёму они, как правило, меньше официальных документов;
- официальные документы, как правило, составляют специалисты, в то время как деловые документы может подготовить любой;
- часто существуют готовые бланки для составления деловых документов. Наличие готовых бланков важно, чтобы не тратить время, не использовать в документе лишние слова и выражения, не допускать орфографических ошибок и некорректных предложений.

Особенности делового общения. Субъектами делового общения могут быть люди, участвующие как в индивидуальной, так и в совместной деятельности. Деловое общение существует во всех сферах жизни общества – экономической, социальной, политической, духовной и т. д. – и охватывает деятельность участников по решению какой-либо индивидуальной или совместной проблемы. Предмет такого общения определяет обмен информацией, знаниями, опытом, необходимыми для решения конкретной проблемы. Деловое общение направлено на достижение определённых целей, поставленных участниками. Например, эффективный обмен информацией и сотрудничество, установление деловых отношений, заключение договоров, совместная деятельность в определённой сфере и т. д. В отличие от общения в других сферах жизни, деловое общение обладает рядом особенностей:

- 1) Важнейшей особенностью делового общения является его деловой характер. То есть деловое общение не может быть бессмысленным по своей сути и содержанию.
- 2) Реальность делового общения такова, что не всегда удаётся выбрать в качестве деловых партнёров людей, вызывающих симпатию. Поэтому, независимо от симпатий и антипатий деловых партнёров друг к другу, в процессе взаимодействия ищутся оптимальные решения проблемы. Конечно, личностный фактор здесь полностью исключить нельзя, но в большинстве случаев внимание уделяется не формированию личных отношений, а тому, чтобы деловые отношения не были забыты ради достижения цели. Для достижения определённой цели внимание уделяется рациональности, а не чувствам и эмоциям.

В деловом общении соблюдается иерархия. В вопросах субординации, то есть в отношениях между подчинёнными, как на государственной службе и в правоохранительных органах, все служащие должны соблюдать свои служебные полномочия и в то же время сохранять их. Они должны следовать правилам регламента, (по-французски *reglement*). На собраниях, выступлениях, дебатах, конференциях, одним словом, на всех мероприятиях, связанных с деловым общением, они должны вести себя в соответствии с правилами. Должны соблюдаться правила этикета (например, использование слов «ты», «вы», «господин» «госпожа» и т. д. в нужном месте), а также дата, продолжительность мероприятия. Например, они должны подчиняться регламенту. Выход за рамки правил следует считать неуважительным и небрежным. Ни одна минута не должна тратиться впустую.

Поведение участников делового общения определяется деловым этикетом. Этические правила регламентируют процесс общения в официальной сфере, устанавливая нормы поведения для всех участников, основанные на уважении к личности делового партнера. Деловая этика также предъявляет определенные требования к внешнему виду, одежде и манере речи участников общения.

Деловые отношения носят коммуникативный характер. Участники общения выступают в официальных должностях, определяют свои роли и необходимые нормы поведения (председательствующий, участники совещания, подчинённые, продавцы, покупатели и т.д.). В деловом общении каждый должен соответствовать своей роли. Каждая роль соответствует определённым ожиданиям других участников делового общения. Необходимо это

учитывать и действовать в соответствии с требованиями конкретной ситуации и принятой роли.

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Abstract

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Official and business documents in official business style.

This article is devoted to official and business documents in the official business style. The article states that the main feature of this style is the conciseness of the presentation of thoughts in standard forms. Further, here is a list of names related to official documents.

Key words: official, document, style, national, specialist, government organization, official, redundant words, speech elements, attention.

О МЕЖДУНАРОДНОЙ ПОПУЛЯРНОСТИ СОВРЕМЕННОГО КАЗАХСКОГО ПОЭТА О.О. СУЛЕЙМЕНОВА

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Творчество современного казахского поэта, ученого-тюрколога и общественного деятеля О.О. Сулейменова отличается международной популярностью. В советский период, начиная с 1970-х годов, он был чуть ли не единственным поэтом из Казахстана, чьи произведения находились в центре активного обсуждения за рубежом параллельно осмыслению его творчества на родине поэта. Основное внимание и в отечественных, и в зарубежных публикациях было уделено поэме «Земля, поклонись Человеку!», поэтическим сборникам «Глиняная книга», «Трансформация огня», научно-популярному труду «Аз и Я». Следует отметить, что казахский поэт создает свои произведения на русском языке.

О.О. Сулейменов прославился весной 1961 года, когда на страницах газет была опубликована его поэма «Земля, поклонись Человеку!», посвященная полету Юрия Гагарина в космос. К этому моменту О.О. Сулейменов уже закончил геологический факультет Казахского государственного университета и поступил в Литературный институт им. А.М. Горького в Москве. Основная поэтическая деятельность О.О. Сулейменова приходится на 1960-1980-е годы. Стихи поэта публиковались в «Литературной газете», «Казахстанской правде», журнале «Простор», выходили в свет поэтические сборники «Аргамачи», «Солнечные ночи», «Круглая звезда», «Определение берега», «Год обезьяны», «Глиняная книга», «Трансформация огня» и другие. В 1975 году издан первый труд «Аз и Я», посвященный тюркской лингвистике. В 1990-2000-е годы О.О. Сулейменов продолжил заниматься исследованиями по тюркологии, были изданы труды «Язык письма», «Пересекающиеся параллели», «Тюрки в доистории».

Биография и творчество О.О. Сулейменова постоянно привлекали внимание широкого круга читателей и нашли отражение в огромном количестве литературоведческих публикаций не только на родине поэта в Казахстане и в соседних странах, но и далеко за рубежом – в Германии, Турции, Франции, Испании, Чехии, Болгарии, Венгрии, Монголии, США и других странах.

Произведения О.О. Сулейменова были переведены почти на все языки народов ближнего зарубежья. В странах дальнего зарубежья творчество О.О. Сулейменова тоже пользуется большой популярностью, его стихи и поэмы переведены на английский, французский, немецкий, испанский, чешский, польский, словацкий, болгарский, венгерский, монгольский и турецкий языки.

Международная популярность поэзии О.О. Сулейменова тесно связана с историей художественного перевода его произведений. Вероятно, наиболее ранним переводом из его творчества является перевод стихотворения «Горное солнце», которое было осуществлено в Москве на английском языке и увидело свет в журнале «Soviet literature» («Советская литература»). Следует также отметить, что роль специализированного журнала «Советские литературы» в истории распространения в мире национальных литератур всех союзных республик Советского Союза до сих пор мало изучена, а между тем, наряду с функционировавшим в Москве специализированным издательством «Радуга», этот

печатный орган в течение 1960-1970-х годов выполнял огромную работу по переводу и ознакомлению за рубежом с лучшими писателями и поэтами из советских республик. Журнал «Советская литература» издавался на английском, немецком, французском, испанском, арабском и других иностранных языках и распространялся во многих странах мира, являясь практически единственным систематическим источником информации о советских литературах за рубежом. Чрезвычайно важным был тот факт, что переводы советских авторов в московском журнале осуществлялись не только профессиональными советскими, но и специально приглашенными зарубежными переводчиками. Таким образом, качество и уровень художественного перевода в этом журнале были достаточно высокими. В этом журнале неоднократно публиковались материалы по творчеству Мухтара Ауэзова, Габита Мусрепова, Габидена Мустафина, Олжаса Сулейменова и других известных казахских писателей и поэтов.

Вслед за публикацией в 1964 году в этом журнале были опубликованы стихотворения О.О. Сулейменова «Гадалка» (1972), «Черное и красное» (1973), «Почта, почта проклятая виновата» (1980), «Над белыми реками...» (1980), «Яблоки» (1981), «Бетпак-Дала» (1981), «Любая влага» (1981), «Следы» (1981) и другие. Помимо переводов на английский язык, выходили в свет и переводы стихотворений О.О. Сулейменова на испанский язык, которые также появлялись на страницах испанского варианта журнала «Советская литература» – «Literatura Sovietica».

Следующим этапом в истории распространения и, соответственно, популярности творчества О.О. Сулейменова за рубежом, стали 1970-1980-е годы, когда в виду дружеских отношений Казахстана с восточноевропейскими социалистическими странами в Болгарии, Польше, Чехословакии и Венгрии перевод его произведений получил широкий размах. В этих странах его стихотворения публиковались во многих журналах и поэтических сборниках.

В Болгарии перевод стихотворений О.О. Сулейменова («Догони», «Жажда», «Звезда», «Ночь в пустыне», «Молитва батыра Махамбета перед казнью», «Аз тэ обичам», «На площади Пушкина» и другие) был осуществлён не только переводчиками, но и, что очень важно – профессиональными поэтами – Георги Константиновым, Николаем Кинчевым, Ижо Соколовым, Йорданом Янковым, а также известной болгарской писательницей Благой Димитровой, которая является и автором поэтических сборников. Стихи Сулейменова вызвали интерес у болгарских читателей. О встречах с ним писали в литературно-публицистическом журнале «Факел» Спас Попов (1981) и Д.Боляров (1985).

В Венгрии стихотворения О.О. Сулейменова появлялись в различных поэтических сборниках. Большинство из них («Айналайн», «Февральский ягненок», «Волчата», «Лебеди», «Песчаный обвал» и др.) было переведено известной венгерской поэтессой и переводчицей Жужей Раб. В своей стране она знаменита, ее стихи очень популярны, к тому же она перевела Ахматову, Цветаеву, Мандельштама, Есенина и других русских поэтов. В 1976 году более 30 стихотворений О.О. Сулейменова вошли в отдельный поэтический сборник «Избранные стихи», изданный в Будапеште с послесловием Жужы Раб.

В Польше стихи казахского поэта публиковались в поэтических антологиях наряду с произведениями других советских поэтов. Например, в книге «Молодые голоса: Стихи советских поэтов», изданной в 1965 году в Варшаве. В 1979 году в сборнике «Антология советской поэзии» были опубликованы «Три поклона», «Последнее слово акына Смета», «Трансформация огня» на польском языке.

На сербохорватском и словацком языках отдельные стихотворения О.О. Сулейменова издавались в сборниках советской поэзии. На чешском языке его стихи появились отдельным сборником под названием «Солнечные ночи» в 1983 году. Как видно из вышеуказанных материалов, поэтическое творчество О.О. Сулейменова уже с начала 1970-х годов получило распространение в восточноевропейских странах. Замечательным фактом

является то, что его стихи переводились известными поэтами-переводчиками и это обеспечивало высокий уровень художественного перевода и позитивную рецепцию его творчества.

Рассматривая процесс перевода поэтических творений О.О. Сулейменова в зарубежных странах, тем не менее, выясняется, что наибольшую известность казахский поэт получил все-таки в Западной Европе, а именно – во Франции. Анализ процесса восприятия казахского поэта во Франции, где традиции освоения восточных литератур имеют многовековую историю, вызывает исключительный интерес. В этой стране помимо целого ряда стихотворений, опубликованных в разное время на страницах литературной периодики, было издано несколько самостоятельных крупных поэтических сборников казахского поэта.

Уже на рубеже 1960-1970-х годов отдельные стихотворения казахского поэта появлялись в известных французских литературных журналах и газетах «Нувель Критик», «Леттр франсэз», «Шанж» и других в переводе разных авторов. А в 1972 году его стихи, взятые в основном из поэтического сборника «Год обезьяны», были опубликованы наряду с поэтическими произведениями Андрея Вознесенского и Роберта Рождественского в антологии, озаглавленной «Но поэзия ...» (составитель и переводчик Л. Шнитцер). В 1977 году в издательстве «Publications orientalistes de France» вышла в свет «Глиняная книга» на французском языке. Перевод был осуществлен Леоном Робелем. Он же перевел на французский язык поэтический сборник «Трансформация огня», который был издан в 1981 году в Париже в издательстве «Gallimard».

Французские читатели и литературные критики с интересом восприняли поэзию О.О. Сулейменова и в этом немалая заслуга Леона Робеля – талантливого поэта и переводчика, филолога, профессора русского языка и литературы Национального института Восточных языков и культур, директора научного Центра сравнительной поэтики при университете Сорбонна.

Помимо вышеуказанных переводов произведений О.О. Сулейменова на французский язык известны и переводы его стихотворений на немецкий язык. Характерной особенностью этих переводов является довольно обширный масштаб опубликованного на немецком языке творчества О.О. Сулейменова.

Впервые в Берлине стихотворения О.О. Сулейменова были опубликованы в 1978 году в журнале «Poesiealbum 133», вышедшем в свет в издательстве «Neues Leben» («Новая жизнь»). Примечательно, что подборку стихотворений О.О. Сулейменова осуществил известный литературный критик, переводчик и издатель Леонард Кошут. В 1981 году в Берлине вышел в свет самостоятельный поэтический сборник О.О. Сулейменова, озаглавленный «По Азимуту кочевых родов» с послесловием Леонарда Кошута. На страницах обширного послесловия немецкий исследователь представил обстоятельный литературоведческий анализ наиболее известных поэтических произведений О.О. Сулейменова (поэм «Земля, поклонись человеку», «Глиняная книга», стихотворений «Айналайын», «Чем порадовать сердце», «Он бормочет стихи...», «Разлив», «Минута молчания на краю света», «Это кажется мне», «Раскопки в зоне Шардаринского водохранилища») продемонстрировал художественно-эстетические особенности, мотивы и образы, жанровые, композиционные и стилистические нюансы, эволюцию творчества казахского поэта. Данная публикация явилась важным документом, выявившим определенные закономерности и тенденции немецкой рецепции творчества О.О. Сулейменова.

Следует отметить, что в немецкое издание поэзии, наряду с произведениями, которые были внимательно проанализированы Леонардом Кошутым, вошли и другие известные стихи О.О. Сулейменова: «Я таю над ночными городами», «Колодцекопатель

Казбек», «Окраина», «На площади Пушкина», «Полдень, пустая мечеть», «В горах Памира», «Звезда», «Актер и ночной город после премьеры», «Следы», «Над белыми реками», «Амазонка», «Последнее слово акына Смета», «Вначале было слово», «Опаздывают поезда», «Рассуждения кенийского поэта: Ямбом о верлибре», «Равновесие», «Возрождение». Перевод на немецкий язык был осуществлен поэтом Вильгельмом Ткачиком и профессиональными переводчиками Вальдемаром Деге, Эккехардом Маасом, Ричардом Питрасом, Гельмутом Прайслером.

В 1990 году в Монголии был издан сборник О.О. Сулейменова «Аргмак». Автор предисловия, видный монгольский писатель Ж. Лхагва, представляя своим соотечественникам казахского поэта, рассказал о его первой поэме «Земля, поклонись человеку!». Монгольский писатель сожалеет, что не был лично знаком с казахским поэтом, за творческой деятельностью которого он постоянно наблюдает. В своей статье Ж. Лхагва выразил надежду, что О.О. Сулейменов когда-нибудь приедет в Монголию.

С годами международная популярность творчества О.О. Сулейменова не уменьшается. В условиях независимого развития нашего государства, многие зарубежные публикации по творчеству О.О. Сулейменова приобретают новый смысл и вносят новые аспекты в изучение не только истории казахской литературы, но и демонстрируют явную связь литературы и социально-политического развития современного общества. Интересно отметить, что, как и в случае с любым значительным явлением литературы, до сих пор продолжают появляться новые переводы и новые отзывы на творения казахского поэта. К примеру, до сих пор творчество О.О. Сулейменова привлекает внимание литераторов во Франции. На рубеже XX-XXI веков в литературных кругах Франции одним из наиболее дискутируемых вопросов являлся вопрос о кризисе культуры, о будущем художественной литературы в период масс-культуры и глобализации. На страницах многочисленных литературных печатных органов постоянно появлялись статьи, в которых о проблемах современной литературы высказывались не только именитые французские писатели и поэты, но и приглашались к диалогу известные зарубежные мастера художественного слова. В русле таких многочисленных дискуссий, в 2002 году во Франции вышла в свет книга «Письма молодежи. Десять поэтов говорят о надежде», заглавие которой красноречиво говорило о содержании сборника. На ключевой вопрос о роли поэзии в современном мире развернуто отвечали поэты Франции, Италии, Германии, Португалии, США, Израиля, Ливана, Бангладеш, Кубы и Казахстана. Все тексты были представлены на языке оригинала и на французском языке. Статья О.О. Сулейменова «Век прозрения» была построена в виде письма молодому поэту, в котором казахский поэт написал о назначении поэзии: «Если народ добр, он стал таким благодаря поэтам. В этом я и вижу долг поэзии – делать людей добрыми» [1, с.62]. Безусловно, данная проникновенная статья с мудрыми размышлениями и наставлениями произвела впечатление на многих представителей молодого и старшего поколения. В 2008 году в Париже состоялась презентация поэтического сборника «Ветер степей» с избранными стихотворениями О. Сулейменова, Ш. Сариева, Н. Оразалина на французском языке.

Новые факты по международной популярности казахского поэта О.О. Сулейменова способны представить его многочисленные поездки по различным странам. В последние годы, занимаясь преимущественно активной общественной деятельностью, он не забывает об участии в международных литературных мероприятиях. В частности, в 2006 году в Болгарии он принимал участие в традиционных «Софийских встречах». Эта поездка состоялась по инициативе Союза писателей Болгарии. В этих встречах обычно принимают участие видные писатели и поэты современности. «Приезд казахстанского корифея литературы стал для болгарской общественности большим культурным событием» [2], – отметили болгарские коллеги по писательскому цеху, особенно подчеркивая, что О.О.

Сулейменов известен в Болгарии не только как талантливый поэт, но и как ученый-исследователь тюркского наследия. О.О. Сулейменов был приглашен в Софийский университет им. Климента Охридского на встречу с преподавателями-востоковедами и болгарскими тюркологами. Эта встреча прошла в атмосфере дружеского общения специалистов, увлеченных единой идеей – полноценного изучения культуры тюркских народов и ее вклада в мировую культуру. В 2007 году в Болгарии была издана его самая известная книга «Аз и Я».

Национальная история для О.О. Сулейменова являлась постоянным источником не только его поэтических произведений, но и научно-популярных исследований. Поэт ищет истоки многих современных проблем в истории предков, которая не была сохранена в официальных хрониках. В течение нескольких десятилетий автор изучает различные вопросы отечественной и всемирной истории, тюркологии, общей и сопоставительной лингвистики. В молодости он посвятил много времени изучению истории и толкования русской эпопеи «Песнь об Игоре». В результате изданная книга «Аз и Я» вызвала настоящую бурю в академических кругах. Первая часть книги посвящена известному памятнику древнерусской литературы – «Слову о полку Игореве». Многолетнее изучение «Слова» вылились в размышления о взаимоотношениях Древней Руси и тюркской степи, в попытку прояснить некоторые «темные» места средневекового текста. Эти попытки были расценены как весьма вольный подход к научным проблемам, за что поэт подвергся острой критике.

Рецепция книги «Аз и Я» иностранными исследователями стала примером развития процесса рецепции казахской литературы за рубежом, а обсуждение этой книги способствовало появлению обстоятельных и серьезных зарубежных научных статей, посвященных творчеству О.О. Сулейменова. К периоду независимости относится один из наиболее интересных подобных зарубежных источников – обширная научная статья французского исследователя Фредерика Диа «Олжас Сулейменов: «Аз и Я», опубликованная в переводе на русский язык в 2015 году в книге «Мир Олжаса Сулейменова», содержащей зарубежные публикации по творчеству О.О. Сулейменова. В этот сборник включены также статьи «О творчестве Олжаса Сулейменова» Реми Дора, «Сулейменов и современная культура Казахстана» Бернара Шамбаза, «Поэт между двумя мирами. Вклад в изучение творчества О. Сулейменова» Альбера Фишлера.

Приведем высказывание Р. Дора, характеризующее творчество О. Сулейменова: «Широта интересов, одновременно литературных и научных, питает и пронизывает все его творчество» [3, с. 140]. Б. Шамбаз, объясняя свое желание посетить Казахстан, приводит в качестве одной из причин – знакомство с поэзией О. Сулейменова: «Стихотворения О. Сулейменова мне понравились отношением человека к космосу, к земле. И мне захотелось увидеть воочию землю и тех людей, которые послужили импульсом для его поэзии» [3, с. 141].

Французский литературовед, почетный профессор Парижского университета, Кавалер ордена «Академическая пальмовая ветвь» в области французской литературы А. Фишлер неоднократно посещал казахские города в 1990-е годы и в начале 2000-х годов. В своей статье он рассказывает, как встречался с О. Сулейменовым в Казахстане и во Франции на многочисленных международных коллоквиумах, посвященных юбилеям классиков казахской литературы: «И каждая встреча свидетельствовала о том, что в современном литературном мире он занимает важное место» [3, с. 145]. По мнению французского исследователя, О. Сулейменова отличает любовь к своей стране, сострадание к казахскому народу и сопереживание ко всем народам мира. Он характеризует его следующим образом: «Олжас Сулейменов является, на наш взгляд, одним из поэтов-глашатаев Казахстана, поэтом на границе двух миров и двух эпох» [3, с. 147]. Обращая внимание на лаконичный и часто язвительный стиль поэта, А. Фишлер напоминает, что О. Сулейменов в 1980-е годы был

руководителем движения «Невада-Семипалатинск» и выступал против проведения ядерных взрывов на Семипалатинском ядерном полигоне, жертвами которых были люди и природа. Анализируя стихотворения О. Сулейменова, А. Фишлер приводит множество отрывков из поэтического сборника «Трансформация огня», как было уже указано переведенного на французский язык в 1981 году.

Новым документом позитивного французского восприятия О. Сулейменова стало выступление профессора из Франции К. Пужоль в 2021 году в Алматы на международной конференции «Мы кочуем навстречу себе, узнаваясь в другом: Олжас и сближение культур». Называя О. Сулейменова незаурядным человеком и универсальной личностью, К. Пужоль рассказала, что впервые услышала об О. Сулейменове от Л. Робеля, у которого училась в INALCO (Национальном институте восточных языков и цивилизаций) в 1970-е годы. К. Пужоль изучала арабский и персидский языки. Затем, уже будучи преподавателем INALCO, она организовала перевод студентами на французский язык отрывка из книги «Аз и Я» О. Сулейменова. И, наконец, они виделись в Париже в 1990-2000-е годы на конференциях и мероприятиях, посвященных казахской литературе. К. Пужоль уделила внимание литературной карьере О. Сулейменова во Франции, а именно процессу издания его книг на французском языке. Она упомянула о том, что в 2007 году О. Сулейменов получил орден Chevalier des Arts et des Lettres (Кавалер ордена искусств и литературы) – «французское признание его огромного интеллектуального вклада. Доказательство того, что его любят во Франции. Я думаю, что он также любит Францию» [4, с. 146].

Еще одним свидетельством признания творчества во Франции является тот факт, что в 2022 году посол Франции в Казахстане Д. Канесс вручил О. Сулейменову знак отличия Офицера национального ордена Почетного легиона. Мы видим, что Франция не забывает О. Сулейменова, который в настоящее время является директором Международного центра сближения культур под эгидой ЮНЕСКО в Казахстане (г. Алматы).

Творчество О.О. Сулейменова способствует международной популярности казахской литературы, так как его поэтические произведения подвергались анализу со стороны многих иностранных исследователей и в советское время, и в период независимости Казахстана. Позитивное восприятие за рубежом поэтических произведений О.О. Сулейменова, способствовало новому подходу к зарубежной рецепции казахской литературы. Зарубежная литературная критика была больше сосредоточена на выявлении своеобразия его художественного мастерства, на подлинно литературоведческом анализе его произведений.

Стихи поэта близки читателям из разных стран, так как он обращается к вечным темам: добро и зло, любовь и ненависть, дружба и предательство. Кроме того, в процессе зарубежного перевода, оригиналы, написанные изначально на русском языке, способствовали возможности для переводчиков более достоверного воспроизведения их на иностранные языки, минуя ступень посредства ещё какого-либо языка. Широко организованный перевод стимулирует реальное международное признание. В своих отзывах зарубежные профессиональные читатели отмечают сочетание современного подхода поэта к поднимаемым вопросам с древней восточной мудростью. Им импонируют ирония, юмор, сатира, с которыми он может передавать свои довольно серьезные и глубокие мысли. Содержание его поэм, например, «Глиняной книги», наводит зарубежных авторов на мысль, что для их создания автор проводил литературные и исторические исследования. Таким образом, можно констатировать, что творчество О.О. Сулейменова является признанным во всем мире.

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Linguocultural aspect of the masculine gender conceptosphere

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Abstract: This study shows the multifaceted nature of the image of a man in the linguocultural worldview of the Turkic peoples and allows us to characterize the gender conceptosphere in typological, linguocultural and cognitive terms. In addition, through the modeling approach, the systematic organization of concepts and their place in cultural semantics is differentiated, the dynamics and historical and cultural adaptation of gender content is determined. The importance of the scientific methods used in the study lies primarily in the fact that it made it possible to analyze the masculinized gender conceptosphere in a systematic, structural and complex way. The combined use of cognitive, component analysis, lexico-semantic, phraseological, comparative and linguocultural methods contributed to the disclosure of the deep content layers of the object of study.

Keywords: Turkic linguistic culture, gender conceptosphere, masculine gender conceptosphere, phraseological units, proverbs.

The purpose of this study is to study the Turkic linguocultural model of the masculine gender conceptosphere based on Kazakh and other Turkic languages (Turkish, Kyrgyz, Uzbek, Tatar). Linguoconceptological, linguocognitive, linguocultural, gender linguistic methodology and conclusions aimed at analyzing the research materials were guided. Lexemes reflecting masculine gender conceptual semantics as research materials [1; 2; 3; 4; 5; 6; 7; 8; 12; 13; 15; 21; 22; 23; 24; 28; 29], phraseology and Proverbs [9; 10; 11; 14; 16-20; 25; 26; 27; 30; 31] considered. It should be noted that masculinized gender conceptual semantics does not mean that it applies exclusively to a man (as a representative of gender), the masculine model of behavior can be applied to a woman as a representative of gender, that is, to describe the image of a woman. In particular, the "masculinized" gender meaning contributes to the definition of the characteristics of the conceptual model formed in the Turkic linguistic culture, for example, asymmetric or stereotypical, then the masculinized meaning is recognized as a common gender category.

In addition, semantic typology reflects the fact that masculine concepts are a multi – aspect category; in the semantic content-biological, behavioral, moral, emotional and speech characteristics are reflected. These factors are evidenced by the following linguistic data, for example: *еркекшопра (әйел)* 'tomboy woman who owns man-like character, and direct as a man'; *brave mother (in kazakh)*; *Erkek gibi kadın* 'tomboy woman', *Aslan yürekli kadın* 'lion hearted woman' (in turkish); *Эркек сымал аял* 'man-like, brave woman', *Эр жүрөк кыз* 'strong and brave girl' (in kyrgyz); *Qahramon ona* 'brave mother', *Erkakdek matonatli ayol* 'patient like a man', *Erkak kabi qiz* 'a girl with man-like character' (in uzbek); *Ир-ат кебек хатын-кыз* 'man-like woman', *Кыю кыз* 'brave girl' (in tatar).

These examples reveal the structural commonality and national-cultural semantic features of the gender conceptosphere in Turkic languages. The attribution of masculinity traits to the female image goes beyond the traditional (or stereotypical) binary boundaries of gender semantics and reflects the cultural adaptation and conceptual dynamics of gender roles. Such linguistic units testify to the multiplicity of masculinity values, the semantic and cognitive representation of such concepts as heroism and responsibility in the feminist personality, and the expansion of gender concept models.

The masculine conceptosphere is a complex hierarchical concept system that reflects the socio-cultural, moral and ethnic roles, attributes and values that are considered characteristic of a man in a particular linguocultural space. In Kazakh and Turkish cultures, this conceptual structure is based on national traditions of a deep nature and is distinguished by the level of sacred, revered worldview.

Masculinized concepts are mental and linguistic units that reflect masculine qualities, social and role functions, moral norms, emotional and psychological characteristics and behavioral expectations inherent in a man in a certain linguocultural space. They are the substantive components of the masculin conceptosphere and are expressed in linguistic terms through key lexemes, phraseology, proverbs and cultural scenarios.

In the course of the analysis of the research materials, we decided to form the term concept of masculin semantic value, because in the definition of the masculin model of the gender conceptosphere, the masculin conceptual value of concepts was also distinguished. Then both categories are equally important for our research: one (masculin semantic value) – from the point of view of linguoconceptological analysis and linguocognitive modeling, the other (masculin conceptual value) – for linguocultural modeling.

Masculinized semantic value is the stable meanings that are formed in linguistic and speech units in relation to the behavior, qualities and social roles inherent in a man. Such a semantic value is reflected in vocabulary and phraseology, proverbs and sayings, regular parables. Refers to the social and moral requirements for a person who is recognized as "male". The semantic meaning of masculin concepts is reflected at the language level. Masculin semantic value serves as the basis for describing the representation of concepts at the linguistic level.

Masculin conceptual essence is a cognitive model of the image of a man, transmitted through language and speech units, that is, the image of a man formed at the level of culture and consciousness. The conceptual essence of masculin concepts is embodied in the public consciousness, in the National worldview, we recognize not only the word – a consolidated concept, a category within the conceptosphere (the essence-content that concepts give) or a conceptual categorical unit. Masculin conceptual essence "lives" in the structure of consciousness, culture, expresses a concept formed and accumulated through concepts.

Linguocultural model of the masculin conceptosphere, complementing such concepts as the masculin conceptosphere and concepts, the masculin semantic and conceptual essence. The linguocultural model of the masculin conceptosphere is a systematic representation of the representation in language and culture of mental, behavioral and value concepts in relation to a man. This model is structured on the basis of a hierarchy of roles, functions, semantic domains and is expressed through verbal and non-verbal forms characteristic of this linguoculture.

The linguocultural model is effective for describing the conceptual foundations, semantic field, emotional tone and cultural connotations of the masculin image in Turkic languages; in other words, this model is a methodological structure that allows you to systematize the structure of the conceptosphere from a cognitive, axiological and discursive point of view.

As the experience of systematizing, structuring and describing data in the course of the study shows, the following can be identified as characteristic features of the masculin linguocultural model:

1. the nature of dynamicity (variability)
2. ethnocultural identity
3. Polymodality (polyparaneal appearance)
4. Structurality (consistency)

In pursuing the principle of a comprehensive approach to the category of masculinized gender conceptosphere, we recognized it as a complex semiotic structure that combines masculinity and masculine behavior, social role, value orientations and figurative (symbolic) characteristics, which

are formed at the intersection of language, society, gender, worldview, culture. The concept of "male" in the Turkic languages reflects the historical and cultural experience, worldviews and norms of character and behavior of each nation, forming the central core (base level or supporting layer) of this conceptsphere.

The concept of "male" in the Turkic languages is not just a biological concept, it is distinguished by its own cognitive, social and axiological layers as an intercultural conceptual structure. The definition of the structural typology of the concept of "male" will undoubtedly open the way to understanding the logic of internal organization, levels of meaning and cultural and semantic layers of the gender conceptsphere. This typology also determines what cognitive, social and axiological structures masculinized values are expressed in language. The basic role of this concept gives reason to consider it as a supporting part of the gender system, and its typological classification – creates the conditions for a systematic analysis of how the image of a man is formed in the Turkic linguoculture.

Gender category "jigit" (man, guy), which is recognized as one of the basic (supporting) concepts of the masculin conceptsphere, occupies a place among the main conceptual positions.

Conceptual semantic indicators, which include the traditional cognitive matrix of the concept of "guy", were determined on the basis of component analysis, so we can describe their linguistic representation using the examples below. These indicators prove that the concept of "guy" is not limited only to the nature of youth, but is deeply connected with such layers of meaning as heroism, eloquence, artistry, social authority, morality. In the cognitive matrix, the concept of "guy" is considered as an ideal of personal development, and language data – proverbs and idioms – indicate that this ideal has become a linguocultural model. At the same time, this concept shows that the norms of behavior, Social Responsibility and cultural code of personal qualities are firmly established in the Turkic linguoculture:

1. Regarding the category of age and gender – *Jigitte de jigit bar – azamaty bir bólek, jylqyda da jylqy bar – qazamaty bir bólek; Jasynda jigitshilik qylmağan, ómir qyzygynan qur qalady; Boidaq jigit – jurt kúieý.*

2. Regarding the nature of body power and agility – *Jigit janğan shoq bolsyn, shoq bolmasa, joq bolsyn; Jigitti jigeri tanytar, ismerdi óneri tanytar; Etikti nál saqtaidy, jigitti ál saqtaidy.*

3. In relation to the essence of heroism and heroism – *Arýymaq atqa oq tise, jabylarsha týlamas, er jigitke oq tise, jamandarsha jylamas; Batyr jigit, jaý jeñer, sheshen jigit daý shesher; Er jigit ózi úshin týady, el úshin óledi.*

4. In relation to moral and ethical values – *Jigittiñ quny – jüz jylqy, ary – myñ jylqy; Er jigittiñ eki sóilegeni ólgeni; Ary taza jigittiñ jany taza.*

5. Associated with social and family roles – *Baqa kólinde patsha, jigit elinde patsha; Jaqsy jigit elin qorǵaıdy, jaman jigit basyn qorǵaıdy; Boidaq jigit – jurt kúieý.*

6. Participated in traditional competitions and rituals – *Joly bolar jigittiñ jeñgesi shyǵar aldynan; Sheshensigen jigitti daý kelgende kórermiz; Jalǵyz shapqan at júrik, jalǵyz sóilegen jigit sheshen; Jigittiñ sorlysyn attyñ jaldysy jeñedi.*

7. As for the appearance and paraphernalia – *El basqarar jigittiñ etek-jeñi keñ bolar; Bóri soǵar jigit bórkinen tanylar.*

8. In transitive and metaphorical value – *Jigit segiz qyrly, bir syrly bolsyn; Qyz – aýyldyñ kórki, jigit – aýyldyñ sert; Uuiatsyz qatyn – tuzsyz as, ádepsiz jigit – júgensiz at; Aqylsyz jigit – aýyzdyqsyz at.*

9. Regarding the norms of behavior – *Jalǵyz attyñ paidasy kóp, Jalǵyz jigittiñ aılası kóp; Óz aıybyn ózi bilgen jigit bı bolýǵa jaraıdy; Jigittiñ túsın atpa, isin ait.*

10. In relation to mood and sensory properties – *Er jigit ne kórmeıdi, er kóñil ne bermeıdi; Er jigitke serýen de – serýen, sergeldeñ de – serýen; Túie tuz dep qartaıady, jigit qyz dep qartaıady.*

11. Regarding the image of mythological meaning – *Balam ósti degenshe, batyr ósti deseishi, Batyr óner bilmese, qapyl ósti deseishi; Jaqsymyn dep maqtanba, halyq aıtpai, batyrmyn dep bapıanba, baryp qaitpai; Batyrsynǵan jigitti jaý kelgende kóreremiz.*

In Turkic paremia, the concept of "zhigit" is depicted in mythological terms as a heroic person, unique in nature, with a mission to nature and society. This gender concept in the mythological semantic aspect is combined with the heroic archetype, nobility, fateful trials and spiritual power. Through such images, the holiness and epic characteristics of the masculinized personality are fixed in Turkic culture.

In the course of the linguocultural study of the masculine and feminist conceptosphere in general, we noticed that their cognitive potential allows us to theoretically structure the linguistic model. In this regard, we decided to prepare a scientific and methodological guide to the formation of a linguocultural model of the masculine conceptosphere – an example of compiling a linguocultural model will be presented in the following content:

1. identification of the main (belonging to the basic – unifying level) Masculine concepts.
2. accumulation of language tools that reflect concepts.
3. identification of cultural and value meanings.
4. Comparison of language data from ethnic culture.
5. identification of Universal and ethnic identity (unique) features.
6. Modeling of the structure of the Conceptosphere and its internal connections.

Thus, this scientific and methodological modeling is built on the basis of theoretical concepts in the fields of linguoculturology, cognitive linguistics and conceptology and allows you to comprehensively characterize masculinized linguoculturological existence in a national cultural context.

We decided to analyze the concepts included in the components of the level model of the masculinized gender conceptosphere in accordance with our conclusions presented above and present them in the following system (Table 1):

Table 1-conceptual nature of the level model of the Masculine conceptosphere

Semantic aspect	Тілдік көрінісі				
	Kazakh	Turkish	Kyrgyz	Uzbek	Tatar
Heroic or brave	Batyrlykh	Kahramanlık / Alplik	Baatyrlyk	Botirlik / Qahramonlik	Batyrlyk
Courage	Batyldykh	Cesaret / Yiğitlik	Erdik / Taymanbastyk	Jasorat	Kiyulyk
Fortitude	Khaysarlykh	Azim / Kararlılık	Ozhorlok	Matonat	Uzhatlek / Nyklyk
Masculine behavior	Jigittik	Delikanlılık / Mertlik	Chinigi jigittik	Mardlik	Egetlek / Martlek
Spiritual strength / vigor	Zhiger / Rukh	İrade gücü	Kayrat	Iroda kuchi	Zhurat / Sabyr
Honor	Ar / Namys	Onur / Şeref	Namys	G'urur / Or / Sharaf	Namus / Abrui

At the same time, we decided to give a table for a systematic comparison of the basic components belonging to the "basic or fundamental layer" of the level model of the masculine gender conceptosphere in the Turkic languages (Table 2). The basic masculine concepts mentioned in this table– Yer / Erkek, Jigit / Yiğit, Ake / Baba, Agha / Ağabey, Ata / Ata – are the main concepts of

gender role structure, which have cultural and historical significance in each language system. They serve not only as linguistic symbols, but also as basic cultural indicators that reflect the Social, Psychological and axiological appearance of the masculinized personality.

Table 2-masculine basic concepts of the Turkic gender conceptosphere

Kazakh	Turkish	Kyrgyz	Uzbek	Tatar
Yer	Erkek	Erkek	Erkak	Yir-at
Jigit	Yiğit	Jigit	Yigit	Eget
Ake	Baba	Ata	Ota	Ati / Ata
Agha	Ağabey	Aga	Aka	Abiy
Ata/ Ata-Baba	Ata / Dede	Ata / Baba	Ota / Bobokalon	Ata / Baba

The similarity and difference of language units in the table reflects the common cognitive cultural code of the Turkic peoples, as well as the specific linguoamental features of each nation. For example: the concept of "Jigit" / "Zhigit" / "Yigit" / "Yigit" / "Yeget" — in all languages, it is based on the heroic archetype, intertwined with such qualities as heroism, courage, heroism; the forms of names such as "ata", "aka", "ati"— mean genealogical continuity, intergenerational communication and the owner of a dignified place; the concept of "senior" — is associated with such roles in the hierarchical structure as greatness, guidance, care.

The system-semantic hierarchy of the masculin conceptosphere reflects the location of concepts related to heroism in the cultural and linguistic system. In this structure, the base (support) core contains the supranational (universal) characteristics of the image of a man. These include:

- male is the base name denoting physical and social gender;
- strength is strength, heroism, which is associated associatively with a man;
- courage is the ability to face danger, to make decisions;
- responsibility is a sense of duty to the family and society.

Although these concepts have a number of commonalities between cultures, their linguistic representation and semantic space are closely related to the worldview system of each people.

Through cognitive modeling, the mental structure of concepts and their place in the cultural code were determined, and through lexico-semantic analysis, specific manifestations of their linguistic representation were revealed. The methods used not only strengthened the theoretical basis of the study, but also provided the scientific principles of systematization of gender content, disclosure of culturally determined semantics, grouping and interconnection of conceptual essence and cluster classifications.

Thus, the study showed that the masculin gender conceptosphere in Turkic languages is a complex and multi – level system, and this conceptosphere is not only a set of linguistic categories, but also a value-symbolic system, entrenched in the cultural memory of each Turkic people, intertwined with historical experience and social roles. The semantic field and structure of basic concepts in the Turkic languages, such as "Yer", "jigit", "Agha", "Ata", "batyr", reflect traditional and modern models of gender roles and clearly characterize linguocultural models of the image of a man. The masculin conceptosphere provides a wide range of opportunities for studying the cognitive, axiological and discursive representation of masculinity in the Turkic worldview and has important theoretical and practical significance in studying the laws of the development of gender linguoculture.

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Pedagogical Sciences

Контекстные задачи как инструмент формирования функциональной грамотности на уроках химии

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Аннотация. В статье рассматривается методика использования контекстных задач как эффективный инструмент и средство формирования функциональной грамотности учащихся на уроках химии. Анализируются современные подходы к определению функциональной грамотности, выделяются её компоненты и особенности естественно-научной грамотности. Показано, что использование контекстных задач способствует развитию познавательной активности учащихся, формированию универсальных учебных действий и применению знаний в реальных жизненных ситуациях. В работе представлены примеры задач и методические рекомендации по внедрению в образовательный процесс.

Ключевые слова: функциональная грамотность, естественно-научная грамотность, контекстные задачи, химия

Функциональная грамотность сегодня выступает важнейшим показателем качества школьного образования. Международные исследования (в первую очередь PISA) ориентируются не на проверку предметных знаний, а на способность учащихся применять предметные знания в практических и жизненных ситуациях [1]. В контексте школьного образования, особенно на уроках химии, это означает, что ученик должен уметь не только написать уравнение реакции или вычислить молярную массу, но и понять, как эти знания помогут ему в повседневной жизни — например, при выборе чистящих средств или анализе состава продуктов питания.

Традиционный подход к преподаванию химии, с его акцентом на заучивание формул и решение абстрактных задач, часто не формирует у школьников понимания связи предмета с окружающим миром. Это приводит к потере мотивации и восприятию химии как сложной и оторванной от жизни дисциплины. В современной педагогике также отмечается необходимость перехода от традиционного усвоения знаний к формированию компетенций, обеспечивающих саморазвитие и адаптацию ученика в обществе. По словам Крыловой О.В., функциональная грамотность — это «совокупность знаний и умений, позволяющих человеку эффективно участвовать в жизни общества и адаптироваться к меняющимся условиям» [2].

Однако результаты международных исследований показывают, что казахстанские школьники по предметам естественно-научного цикла, в большей степени демонстрируют умение применять знания в знакомой ситуации и значительно реже используют их в

реальных жизненных обстоятельствах, что является показателем недостаточного уровня сформированности естественно-научной грамотности [3].

В связи с этим актуальной задачей становится поиск педагогических средств, позволяющих развивать у учащихся умение работать с информацией, анализировать её и применять в жизненных ситуациях. Одним из таких средств выступают контекстные задачи и функциональная грамотность.

Функциональная грамотность означает способность использовать знания и навыки для решения жизненных задач в условиях реальных социальных практик [2;4]. В международной практике выделяются её основные компоненты: читательская, математическая, естественно-научная, финансовая, глобальные компетенции, креативное и цифровое мышление [1;2]. Рассмотрим естественно-научную грамотность в рамках предмета химии. Здесь данный вид грамотности означает способность объяснять явления природы на основе научных знаний, интерпретировать данные экспериментов, формулировать выводы и аргументировать позиции при решении проблем [5]. На уроках химии данное направление приобретает особое значение. Как отмечает Веселова Л.А., развитие функциональной грамотности сдерживается рядом факторов: недостатком времени на практические работы, малым объёмом исследовательских заданий, редким использованием дискуссий и анализа информации [6]. Для преодоления этих трудностей предлагается активнее включать практико-ориентированные задания, интегрировать учебные ситуации с жизненными примерами, применять кейсы. Кыдырова М.Н. и Керимбаева К.З. подчеркивают, что контекстные задачи должны строиться на знаниях или жизненном опыте учащихся, что обеспечивает их практическую значимость и междисциплинарный подход. Такой метод формирует наблюдательность, самостоятельность, креативность и умение делать выводы на основе научных данных [7]. Долгополова, исследуя применение контекстных задач, выделяет их мотивационную функцию: в условии описывается жизненная ситуация, личностно значимая для обучающегося, что обеспечивает высокий уровень вовлеченности [8].

Контекстные задачи — это учебные задания, условия которых приближены к реальным ситуациям, требующим применения знаний, полученных на уроках, они отличаются от традиционных тем, что предполагают не только использование формул и законов, но и анализ текста, данных, изображений, критическую оценку и формулирование собственных выводов [4]. Контекстные задачи, по мнению Ушаковой О.В. и Золотовой О.М., являются важным средством формирования естественно-научной грамотности, так как они содержат описание бытовой, экологической или социальной проблемы, так, в одной из задач авторов ученику 10 класса предлагается удалить жирное пятно с одежды, имея только мел, соль и сахар. Для её решения требуется знание свойств жиров, знание методики проведения эксперимента и поиск альтернативных способов очистки [3]. Особенности контекстных задач были подробно проанализированы Долгополовой Е.Я. Автор подчёркивает, что такие задания отличаются от традиционных учебных задач своей структурой, содержанием и методикой применения. В отличие от стандартных упражнений, они обладают сюжетностью, отражают реальные жизненные ситуации, включают различные формы подачи информации и могут иметь несколько способов решения. Кроме того, в условиях контекстных задач часто встречаются избыточные или противоречивые данные, что требует от учащегося критического анализа и отбора значимой информации [8]. Основные характеристики контекстных задач и примеры их применения в химии представлены в таблице 1.

Таблица 1. Особенности контекстных задач

№	Особенность	Содержание
1	Сюжетность и практическая значимость	Условие задачи описывает жизненную ситуацию, связанную с опытом учащегося; решение имеет личностную ценность и социальную значимость.
2	Использование различных форм подачи информации	Данные в задаче могут быть представлены в виде текста, рисунков, таблиц, схем, диаграмм или графиков.
3	Наличие избыточных или противоречивых данных	Условия содержат лишнюю или конфликтующую информацию, которую необходимо проанализировать, отсеять или переосмыслить.
4	Возможность нескольких способов решения	Одна и та же задача может быть решена разными методами; часть решений учащимся приходится конструировать самостоятельно.

Особое место в методике занимают контекстные задачи, которые можно классифицировать по уровням сложности. Они отражают постепенный переход от воспроизведения знаний к установлению межпредметных связей и далее — к рассуждению и поиску собственных решений. Такая структура позволяет учителю выстраивать обучение по принципу «от простого к сложному», обеспечивая развитие как предметных, так и метапредметных компетенций.

Таблица 2. Уровни и примеры контекстных задач

Уровень	Пример контекстной задачи
Уровень воспроизведения	Задача 1. Для проявки фотоплёнки требуется приготовить раствор тиосульфата натрия. Инструкция: необходимо растворить 200 г вещества в 1 литре воды. Задание: 1. Составьте уравнение растворения соли. 2. Объясните, почему тиосульфат используется как фиксирующее вещество. 3. Опишите этапы приготовления раствора. 4. Рассчитайте массовую долю вещества в растворе. <i>Задача отражает бытовое применение химии и требует знаний о реакциях растворения и умений готовить растворы заданной концентрации.</i>
Уровень установления связей	Задача 2. В реку попали сточные воды, содержащие ионы меди (Cu^{2+}). Жители сообщают о гибели рыбы. Задание: 1. Предложите метод очистки воды с использованием гидроксида натрия. 2. Составьте уравнение реакции. 3. Объясните, почему осадок снижает токсичность воды. 4. Оцените последствия загрязнения для здоровья и экосистемы. <i>Задача отражает междисциплинарный характер проблемы. Требуется знаний о свойствах тяжёлых металлов и их соединений, а также анализа экологических последствий.</i>

Уровень рассуждений	Задача 3. В городе зафиксировано превышение концентрации угарного газа в воздухе. Источник — автомобильные выхлопы. Задание: 1. Опишите процесс неполного сгорания бензина и составьте уравнение реакции. 2. Предложите меры для уменьшения содержания угарного газа. 3. Объясните, как загрязнение влияет на организм человека. 4. Разработайте школьный мини-проект по мониторингу воздуха. <i>Задача приближена к реальной ситуации и предполагает анализ, поиск информации и формулирование выводов и имеет междисциплинарный характер.</i>
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Контекстные задачи могут включаться в урок на разных этапах: мотивация, объяснение нового материала, закрепление, контроль. Эффективность повышается при использовании деятельностного подхода, проектных и проблемных методов, групповой работы и цифровых ресурсов [6]. Контекстные задачи позволяют связать абстрактные понятия с реальными ситуациями, что способствует повышению мотивации к изучению предмета и осознанию его возникновения. Таким образом, представленные особенности позволяют сделать вывод, что контекстные задачи ориентированы не только на проверку предметных знаний, но и на развитие метапредметных компетенций: умения анализировать информацию в различных формах, критически её оценивать, искать разные пути решения проблемы и соотносить полученные результаты с жизненными ситуациями. Именно это делает их эффективным инструментом формирования функциональной грамотности учащихся.

Проведённый анализ подтверждает, что использование контекстных задач в обучении химии является эффективным инструментом в формировании функциональной грамотности школьников. Такой вид задач позволяет объединить предметные знания и жизненный опыт, обеспечивая перенос теоретических представлений в реальные жизненные ситуации. Рассмотренные в статье исследования демонстрируют, что контекстные задачи способствуют формированию целого комплекса универсальных учебных действий: умения анализировать информацию, критически её оценивать, выстраивать причинно-следственные связи, применять знания междисциплинарного характера. Особое значение приобретает развитие исследовательских умений, способности к самостоятельному поиску и принятию решений, а также формирование экологической и социальной ответственности школьников. Включение контекстных задач различных уровней сложности позволяет реализовать принцип постепенности и дифференцированного подхода в обучении. На первых этапах учащиеся закрепляют базовые знания и навыки, на следующих — учатся устанавливать межпредметные связи, а затем переходят к анализу и разработке собственных решений в условиях неопределённости. Таким образом, систематическое применение контекстных задач на уроках химии способствует достижению нескольких целей:

- повышает мотивацию и интерес к предмету;
- формирует устойчивые междисциплинарные связи;
- развивает критическое и креативное мышление;
- способствует осознанию практической значимости химических знаний;
- обеспечивает подготовку учащихся к решению реальных жизненных задач.

Можно отметить, что эффективность использования контекстных задач возрастает при интеграции их с исследовательскими и проектными методами. В совокупности эти условия создают образовательную среду, ориентированную на развитие функционально грамотной личности, готовой к успешной адаптации в современном обществе и к дальнейшему профессиональному самоопределению школьников.

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PRACTICE-ORIENTED TEACHING OF SMART TECHNOLOGIES: DEVELOPMENT AND IMPLEMENTATION OF THE SMARTNEXUS PLATFORM WITH LLM-BASED CODE AND CIRCUIT VERIFICATION

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ABSTRACT

This article proposes teaching SMART technologies as a separate course in the training of future computer science teachers. During the study, students worked with Arduino and Raspberry Pi platforms to manually design smart devices. In addition, they developed and used the SmartNexus portal in the educational process, which checked students' work using algorithms, diagrams, and flowcharts, providing automatic feedback. results of the experiment demonstrated that a practice-oriented approach and digital platform significantly enhanced student academic performance. This proves the effectiveness of integrating SMART technology training into both individual and other courses.

KEY WORDS: Smart technology, education, Smartnexus platform, LLM, computer science.

INTRODUCTION

The rapid development of digitalization is leading to the widespread adoption of SMART technologies in all aspects of society, including education. The integration of these technologies into the learning process has the potential to modernize teaching and make it more relevant to today's demands. In particular, in the process of training future computer science teachers, one of the most important tasks from a practical and professional point of view is considered not only the use existing digital tools, but also the ability to independently create SMART devices and systems. This is essential for preparing them to be effective in their future careers.

According to research, SMART technologies are combinatorial because they incorporate various fields and technologies, such as the Internet of Things (IoT), cloud computing, artificial intelligence (AI), voice recognition, machine learning (ML), and sensor systems [1,2]. With the development of artificial intelligence [3], the smartness of technology is also growing. This integrative approach opens up new possibilities in the field of education: it allows for the introduction of elements such as creating personalized learning trajectories, data-based decision-making, providing intelligent feedback, and automating the learning process. As a result, SMART technologies are seen in the modern education system not only as a tool, but also as a factor changing the learning paradigm.

When it comes to SMART technologies, it is difficult to imagine a specific device or system, since it is considered as a set of intelligent systems of different scales. For example, there is a smart city, a smart home, intelligent street lighting, smart greenhouses, and devices for health monitoring, all of which work together to create a fully intelligent environment. In these systems, different technologies interact to provide a seamless experience. For instance, in a smart home, IoT forms a network of physical elements like gadgets and devices combined with sensors, software, and connectivity that allow for data collection and exchange [4]. While artificial intelligence allows these devices to make autonomous decisions depending on the situation, machine learning is used to implement a home entry system, for example, with facial recognition. Due to this integrative nature, smart technologies are becoming an important area of applied computer science, including in the field of education. In the curricula of higher education institutions, their education can be carried out in two ways: as a separate subject or as content integrated into other disciplines by an interdisciplinary approach [5, 6, 7].

This article discusses the role of smart technologies as a distinct academic subject in training future computer science teachers. It explores the possibilities and content of an interactive learning platform called “SmartNexus” that uses artificial intelligence, developed by the author. The platform aims to teach students how to create smart devices and develop practical skills. The purpose of this study is to assess students' knowledge of smart technologies and evaluate the effectiveness of the “SmartNexus” platform.

METHODS AND MATERIALS

In the course of this study, the determination of the effectiveness of teaching the subject of SMART technology as a separate subject to future computer science teachers was substantiated. We applied a practice-oriented approach [8], partly based on an experimental method, during the teaching process. Students of the Computer Science educational programs from universities in Kazakhstan, including the L.N. Gumilyov Eurasian National University (ENU) and Toraigyrov University (TU), participated in the experimental work. The students of the two universities were divided into control and experimental groups, the total number of attendees is 112 (Table 1). At Eurasian National University 57 students participated, with 30 in the experimental group and 27 in the control group. At Toraigyrov University, 55 students participated, with 28 in the experimental group and 27 in the control group. The experiment was conducted over a period of 15 weeks, as part of the educational course "Smart Technologies in Education".

Table 1. Information about the participants of the experiment

University name	Educational program	Тобы	Number of students	Total
TU	6B06104 – Computer Science	CG	27	55
		EG	28	
ENU	6B01511 – Computer Science	CG	27	57
		EG	30	

The educational process for the control group was conducted in a traditional format. During the classes, the teacher explained the theoretical material through lectures and in practical classes, tasks were performed based on pre-defined instructions. Students developed projects using the Arduino, Raspberry Pi platforms, but in the process of solving them, the device's functionality did not deepen and independent decision-making was not required.

In the experimental groups, Arduino microcontrollers and Raspberry Pi microcomputers were used as the main technical tools for learning. These platforms were chosen due to their accessibility, open architecture, and extensive integration with Internet of Things (IoT)

environments and machine learning algorithms. During the practical sessions, students created various intelligent devices such as a smart traffic light, a smart parking system, a smart greenhouse, a smart house, and a self-propelled weapon for the blind. The tasks were presented in a situational task [9], allowing students to apply their knowledge and skills in real-world scenarios.

The SmartNexus platform (<https://smartenexus.kz/>) as one of the main components in the organization of the educational process. This platform is designed specifically for the discipline "Smart technologies in education" and is aimed at preserving the theoretical and practical content of the educational material and improving the learning outcomes of students. During the decision-making stages of completing training tasks and its implementation (in accordance with stages 3 and 4), models, variant schemes, algorithms, and flowcharts developed by students for verification and automatic feedback were based on the platform. This tool allows students to logically check their decisions, save time and confidently move on to the next stage.

The correct choice of sensors to connect to a microcontroller when designing a Smart device, and the exact execution of their connection schemes directly affect the quality of program code recording. Effective completion of these stages will become the basis for the student's further transition to the coding stage. It is worth noting that the SmartNexus platform, not only a verification tool, provides students with specific recommendations and guidelines, which in turn contributes to their active participation in the learning process and the development of technical thinking skills.

The system built into the SmartNexus platform is based on Large Language Models (LLM) [10]. This system allows users to process diagrams, flowcharts, algorithms, and device interface schemes related to students' practical tasks. It also helps with the analysis and evaluation of these tasks. All models have been adapted to the Kazakh language, ensuring that they are suitable for the context of domestic education.

RESULTS AND DISCUSSIONS

To evaluate the effectiveness of the Smartnexus platform and practice-oriented learning approach, the following hypotheses were developed:

Null hypothesis (H_0): The use of the SmartNexus platform and the practice-oriented approach does not result in a statistically significant improvement in students' academic performance.

Alternative Hypothesis (H_1): The use of SmartNexus and the practice-oriented approach significantly improves students' academic achievement.

To test these hypotheses, we used a paired t-test to compare the results before and after the experiment in the control and experimental groups at the two universities. To increase the clarity and accuracy of the results, we used Python programming language to perform statistical calculations on students' grades before and after the experiment. A comparative histogram was created to visually show the differences in academic performance between the control and experimental groups. The use of Python has provided transparency, reproducibility, and analytical rigour to the data analysis process, as the results are presented in Table 2.

Table 2. Comparison of results before and after the experiment

University	Ton	Pre (Mean $\pm$ SD)	Post (Mean $\pm$ SD)	p-value	t-test
TU	БТ (n=28)	76,31 $\pm$ 10,38	79,87 $\pm$ 10,29	0,078	-1,799
	ЭТ (n=27)	80,47 $\pm$ 6,98	87,61 $\pm$ 5,41	< 0,01	-4,987
ENU	БТ (n=27)	77,22 $\pm$ 9,85	80,74 $\pm$ 10,08	0,083	-1,761
	ЭТ (n=30)	82,46 $\pm$ 7,65	88,87 $\pm$ 5,36	< 0,001	-4,930

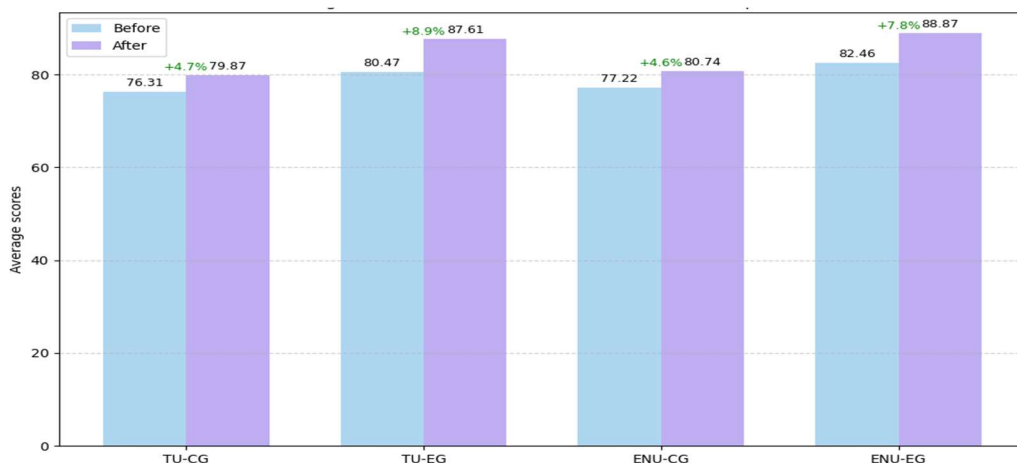


Figure 3-1. Learning outcomes for students before and after experiment

The analysis showed that although there was a slight improvement in the results of the control groups (CG) in the two institutions after testing, the differences were not statistically significant ($p = 0.078$ and $p = 0.083$, respectively). In contrast, the experimental groups (EG) exhibited a statistically significant improvement in academic performance ($P < 0.01$ and $p < 0.001$, respectively).

These results support the rejection of the null hypothesis (H_0) and the acceptance of the alternative hypothesis (H_1), indicating that the use of “SmartNexus” platform and practice-oriented approach with experiential learning has a positive and significant effect on students' academic achievement. Furthermore, the consistent results from two different educational settings demonstrate the effectiveness of this approach in various contexts. Additionally, these findings are consistent with the existing literature on the importance of active, problem-based, and integrated learning in STEM education.

CONCLUSION

The results of the study clearly showed the effectiveness of the SmartNexus platform and a practical approach to teaching future computer science teachers about smart technologies as individual subjects. In the experimental groups, there was a statistically significant difference in the indicators of students' academic achievement before and after the experiment, indicating the positive impact of the platform and methodological approach.

During the research, the use of micro-platforms Arduino and Raspberry Pi allowed students to create their own models and prototypes of intelligent devices. The accessibility of these tools, open architecture, and integration capabilities with IoT and machine learning technologies have made them an effective learning tool. The students gained practical experience by creating specific projects such as an intelligent greenhouse, a smart home, street lighting, a stick for the blind and an unmanned vehicle.

In general, the results of the study emphasize the importance of creating interactive, personalized, automated learning environments in the modern digital educational space, justifying the need to teach smart technologies as a separate discipline.

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New Practices and Challenges in Integrating AI-Based Digital Technologies for English Language Teachers

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Abstract

This research article examines the integration of AI-based digital technologies in higher education institutions, in particular in Karaganda National Research University named after Buketov. The study examines current practices, challenges and potential for future achievements in AI and foreign language teaching as modernization of education has become a trend worldwide, especially in the study of foreign languages. The article describes how AI-based technology is adapted to the changing conditions in the world in the field of learning foreign languages. Despite this, there are challenges in ensuring that all faculties effectively use the available digital technologies and smart laboratories effectively in the educational process, which can revolutionize the approaches of training future teachers of foreign languages.

Keywords:

AI-based, digital technologies, open educational resources, foreign language, English teachers, Kazakhstan, smart laboratories, higher education, future teachers.

Introduction

At the present stage of human capital development, it is characterized by informatization, computerization, digitalization of most of human activity in the educational space. A huge leap in the development of modern digital technologies in the global world requires changes in methods and approaches in higher education institutions [1].

Given that many of the technologies used in the modern learning process are aimed at improving the personality, creating the basis for the effectiveness of learning, it can be safely said that the use of open educational resources is an effective way to improve the quality of Education. In Kazakhstan, the use of digital educational resources and AI in the educational process, including in higher educational institutions, is carried out within the framework of the state policy program of digitalization of society and education. That is, the use of open educational resources in higher educational institutions involves a new organization of the educational process in higher educational institutions during the use of information technology tools, creating conditions for increasing the role of teacher and student and their pedagogical activity, improving their

professional IC activities through the use of educational and cognitive actions in the educational system in the context of information.

Currently, the reform of educational policy has led to the differentiation of the traditional system, its flexibility in the economy, social and social life, as well as integration with the education system. It is obvious that there is the problem of using information and educational resources in the educational process, which is determined by multi-stage, continuous general (accessible to everyone at will), free and transparent learning.

Consequently, there are growing demands for the introduction of the latest AI-based digital technologies in educational institutions, which help students expand their knowledge and improve their skills. In particular, Universities in Kazakhstan and Poland integrate the latest digital technologies and tools, which they successfully implement into their training programs for future specialists.

These changes are taking place in accordance with global requirements to improve the effectiveness of training specialists in various industries. Informatization as a pedagogical system consists of interrelated and interdependent subsystems (G.K.Nurgalieva) [3]: regulatory, informational, software, personnel and content support, the general purpose of which is the formation of a personality ready for life, communication and future professional activity in the information society in conditions of universal remote interaction based on dynamically developing information technologies [4].

Therefore, informatization of education involves the use of modern information technologies, especially AI, to create a new type of training based on world best practices, create favorable conditions for the comprehensive development of the abilities of each student, and improve the efficiency and quality of the educational process at all levels. Today, the effective path of the global information educational space is based on the complete informatization of the educational sphere. In accordance with this, one of the points of development of the education system in the Republic of Kazakhstan is aimed at informatization of education in the information space [2].

Therefore, this process implements the following actions: improving the management mechanisms of the education system based on the use of automated scientific and pedagogical funds, communication networks; improving methods, sorting strategies and methods of forms of training in accordance with the tasks of personal development in the context of informatization of modern society; creation of methodological teaching systems focused on the intellectual development of students, the formation of skills of independent learning, the implementation of information-educational, experimental research activities, the diversity of independent work on information processing; attempts to create and apply a methodology for developing a computer test program that determines the assessment and control of the level of knowledge of students.

At Buketov Karaganda University, efforts are focused on digital resources and online platforms for the teacher training program. The university has several smart research laboratories that help future teachers to be well equipped with the technological skills necessary for effective teaching of foreign languages. The University has achieved significant success in the field of science and received the status of a research university, all thanks to the introduction of e-learning platforms and digital resources, which increasingly occupy a central place in the curriculum in the training of future specialists.

Besides, the university has developed digital infrastructure with advanced platforms for language learning and teacher training throughout Central Kazakhstan. The University is exploring new methods and approaches, including digital platforms and artificial intelligence (AI), to improve the quality of education for students of different nationalities. However, problems include limited infrastructure and technical equipment in some classrooms [2]. Despite these resources, challenges remain such as ensuring that all teachers can use technology effectively.

Karaganda University named after Buketov uses different approaches in teaching, a mixed approach, a communicative approach, which allows him to develop pragmatic competencies, which implies the use and practice of language in real life. Furthermore, distance learning uses digital tools and smart labs to facilitate the assessment process, interactive dialogues and modeling, and student feedback, which increases the effectiveness of interaction with students. In addition, the university uses the mixed learning model of traditional and distance learning, which promotes students' independence and helps them study the material in advance before discussion in the classroom, which develops critical thinking among students, and makes it easier for teachers to focus on seminars in the educational process. Teachers' digital competencies reflect the university's willingness to implement digital platforms in educational programs.

Kazakhstan's entry into the Bologna process, which includes 47 countries, which implies the bachelor-master - PhD format. Karaganda University named after Buketov brings its curriculum in line with the international standards of the Bologna process, the university has 18 educational programs that train future PhD doctors, more than 66 master's degree programs, and above 77 bachelor's programs. There are 13 research laboratories within the walls of the university, which allows for the implementation of numerous state grant projects that are won every year by young researchers. University teachers are developing MOOCs, as well as Courses designed to develop students' skills in the effective use of digital resources in the educational process.

Karaganda National Buketov University, being one of the leading universities in Kazakhstan specializing in the training of teachers and specialists in the field of different spheres, also offers specialized courses for developing digital competence of the future specialists. The introduction of digital technologies in language learning, promotes the development of digital competence and prepares them for their future careers.

Methods and material

Statistical analysis and data collection. To assess the effectiveness of the introduction of digital technologies for the training of foreign language teachers and their further impact on the educational process at Buketov Karaganda University, as well as to assess the readiness of the teaching staff, a comprehensive statistical analysis was conducted, which included both quantitative and qualitative data.

The effectiveness of the introduction of digital technologies in the training process, in particular for teachers of foreign languages, was assessed using a mixed data analysis approach. The data were collected at the Buketov Karaganda University in the format of a survey among students of language specialties.

The readiness of the teaching staff to integrate digital tools into the educational process on a daily basis was also assessed. 100 respondents were accepted from each university, their quantitative data were analyzed using T-tests, and qualitative data were taken through an interview, which helped to conduct a statistical analysis on the study of general trends in higher education.

The surveys were also analyzed on the Likert scale, and a total of 200 people took part in it. The survey assessed the involvement, readiness of the teaching staff, as well as the expected learning outcomes. In the quantitative analysis, several criteria were taken, such as the level of engagement, which was assessed on a scale from 1 (not involved) to 5 (very involved). Perceived learning outcomes were assessed using Chi-square analysis, and teacher readiness was assessed as previously mentioned using t-tests.

Findings

Assessing the level of engagement, it can be concluded that the t-criterion revealed a significant difference ($t(198) = 3.45, p < 0.001$) and the results for Buketov Karaganda University showed an average score of 3.6.

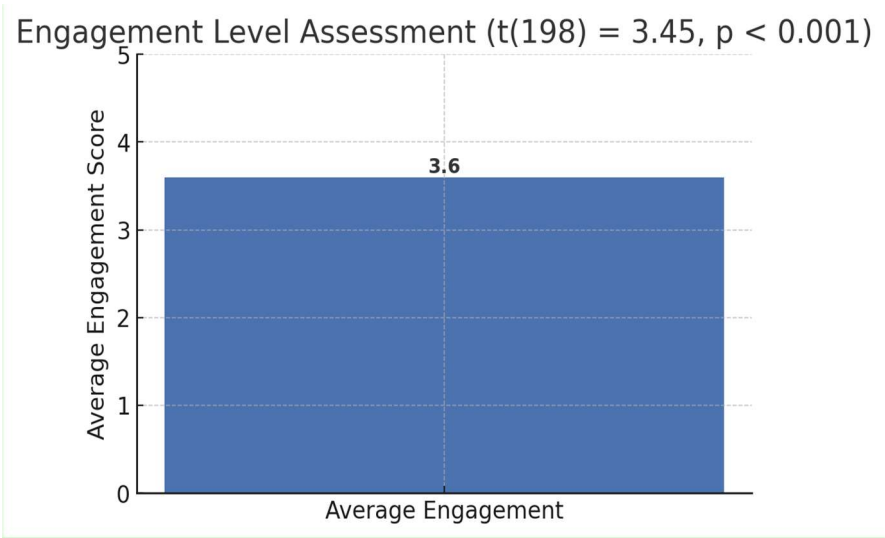


Figure 1. Results of the experiment

In terms of the perceived learning outcomes, and then getting an answer to the question of whether digital technologies are effective and how they affected their learning, 70% of respondents answered that they had improved positively.

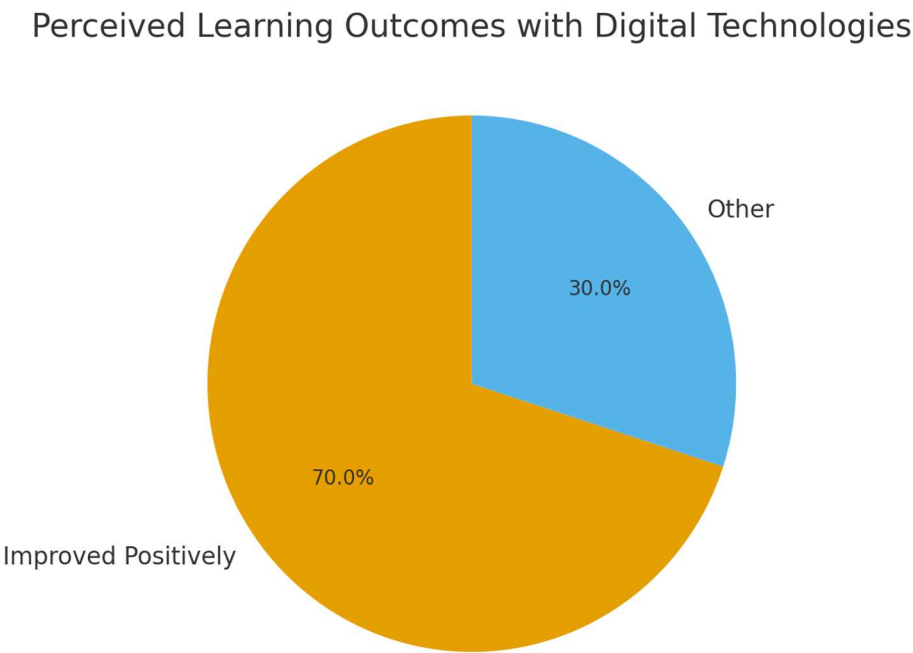


Figure 2. Positive learning outcomes

This indicator was answered positively, compared with 70%. According to the results of the Chi-square analysis, one can see the perceived learning outcomes, which is equal to ($\chi^2(1, N = 200) = 10.24, p < 0.01$).

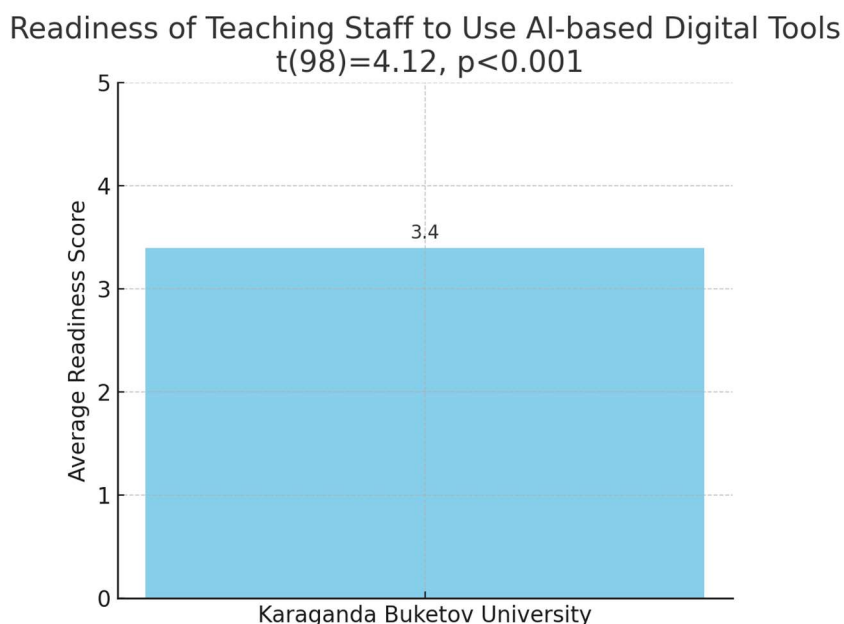


Figure 3. Findings Comparison

According to the analysis of the readiness of the teaching staff to use AI-based digital tools, one can see the confident responses of many respondents. The t-criterion showed a significant difference ($t(98) = 4.12, p < 0.001$), for example, the average indicator for Karaganda Buketov University is 3.4.

The qualitative analysis of which the interviews were conducted showed that a favorable environment is an important aspect and the teachers of both universities noted the need to support the integration of digital technologies through trainings and briefings, as well as increase the number of joint projects that help strengthen the confidence of both students and teachers in the use of digital tools in daily practice.

The next important aspect was the availability of digital resources, for example, students stated that there were difficulties associated with limited access to high-quality content and digital materials, as well as some problems in places with unstable Internet connection, which undoubtedly creates obstacles in the process of using digital platforms.

The last, but not the least important, is the use of innovative practices in both universities, where the indicators are simply impressive. The use of innovative practices can include the use of AI technology and interactive modeling.

Discussion

Statistical analysis revealed a significant difference in the effectiveness of digital technology integration, where there is a slight difference in the level of student engagement and the willingness of teachers to use digital tools in lectures and seminars on a daily basis. It can be noted that the results of the study show that the university has a predominant model of blended

learning, which effectively supports language education in language institutes such as Foreign Language Faculty.

The results of the study also show the need for a favorable institutional environment for all participants in the educational process. Undoubtedly, having a favorable environment, we can say about the professional development of the teaching staff, as well as the development of digital competencies of future specialists.

Regarding Buketov Karaganda University it can be emphasized that some problems have been identified. The results of the analysis in qualitative data demonstrate the importance of expanding access to high-quality resources. Moreover, it is necessary to regularly upgrade the qualifications of the teaching staff, conduct seminars, refresher courses, and cooperate with technological experts in order to retrain personnel, which can significantly improve the quality of education in general.

Conclusions

Based on the results of the study, it is obvious that collaboration, exchange of experience and joint efforts between universities can expand the opportunities of students and faculty of the university in the future. The integration of digital tools in the training of language specialties will significantly improve opportunities in the higher education system.

It is worth noting that Buketov Karaganda University has a great potential and arsenal of smart research laboratories facilitating scientists in research practices, which ultimately allow teachers to adapt to work in a digital environment.

Based on the results of the study, it can be noted that the analysis revealed effectiveness in the implementation of digital technologies between Buketov Karaganda University. It is also worth noting the exchange of students under the academic mobility program and scientific internships for young scientists, which undoubtedly bear fruit in deep study and exchange of experience between universities.

The next important observation is that a qualitative analysis has revealed the need to create a favorable environment for technology integration in Kazakhstan, and the practice of collaboration and continuous learning can expand the opportunities of both faculty and students.

In conclusion, it can be emphasized that both universities are making progress in integrating AI-based digital technologies, improving their educational practices and training programs for specialists in language specialties. This approach will eventually lead to progress in all its manifestations, preparing personnel to work in the digital environment for the future.

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Деструктивное влияние внутрисемейных конфликтов на личностно-социальное формирование подростков

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Аннотация. В статье рассматривается деструктивное влияние семейных конфликтов на личностное и социальное развитие подростков. Подчёркивается значимая роль семьи как базового социального института в процессе социализации подростков. Особое внимание уделяется тому, что различные формы семейных конфликтов оказывают негативное воздействие на позитивное формирование личности подростка. Анализируются основные причины внутрисемейных конфликтов, среди которых межличностная несовместимость, доминирование одного из супругов и меркантильный характер взаимоотношений между ними. В заключение статьи предлагаются формы и методы семейной работы, направленные на профилактику конфликтов и конструктивное преодоление возникающих внутри семьи проблем.

Ключевые слова: семья, внутрисемейные конфликты, деструктивное влияние внутрисемейных конфликтов, подростки, личностно-социальное формирование подростков, социальные институты общества

The destructive influence of intrafamily conflicts to personally-social formation of teenagers

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Annotation: The given article is dedicated to one of the actual problems of pedagogues - to of personally-social forming of teenagers. In the article is said that to forming of high level of personally-social formation of teenagers depends on depts and forms intrafamily conflicts in family. In the article are analyzed some forms of intrafamily conflicts as inter-personal insolvency, superiority of one of parents, mercantile interrelations of parents and another. In the article are shown reasons of appearance some intrafamily conflicts. An article gives necessary recommendations to warning and positive solution of intrafamily conflicts in family.

Key words: family, intrafamily conflicts, destructive influence of intrafamily conflicts, teenagers, personally-social formation of teenagers, social institutions of society

Вопросы формирования творчески активной, социально позитивно направленной личности с высоким уровнем духовно-интеллектуального развития всегда были в центре внимания всех социальных институтов общества. Практика и особенности реальной жизни убедительно показывает, что на общее формирование и развитие личности, её активную социализацию в современном обществе особенно действенно воздействуют два базовых социальных институтов общества – семья и образовательные учреждения.

Каждому из этих социальных институтов присущ свой, специфический потенциал воздействия на личность, определённый множеством факторов и условий. Однако, в целом, и тот, и другой социальные институты (семья и образовательное учреждение) нацелены именно на реализацию вопросов развития и формирования социально активной личности, которая будет играть в жизни демократического общества позитивную созидательно-конструктивную роль.

Несмотря на то, что оба этих социальных института общества изначально ориентированы на позитивное разрешение вопросов развития и формирования личности, все же в их деятельности присутствуют определенные нюансы, которые непременно необходимо учитывать при анализе их воздействия на личность. В каждом случае мы будем рассматривать возможность семьи и средней общеобразовательной школы в работе с подростками.

Следует заметить, что «средняя школа накопила огромный опыт и имеет прекрасные возможности в области воспитательно-формирующей деятельности с подрастающим поколением» (3, 17). Однако, несмотря на эту очень положительную составляющую, все же есть один маленький нюанс, который непременно следует учитывать при сравнении уровней потенциалов их воспитательно-формирующей деятельности. Дело в том, что весь учебно-воспитательный процесс, хотим мы этого, или не хотим, определяется в средней школе определенными временными параметрами. Активное нахождение подростков в средней школе, можно считать с несколькими оговорками, определяется определенным количеством часов, в течении которых они являются объектом воздействия на них всех субъектов образовательного учреждения. Остальное время (порядка 16-18 часов) подростки предоставлены самим себе и проводят свое свободное время как им вздумается. Семья, с этой точки зрения, располагает несравнимо большими возможностями активной работы с молодыми людьми подросткового возраста.

Однако и здесь есть определенные нюансы и их также необходимо серьезно рассматривать. Для того чтобы центр активного, многоаспектного, целенаправленного формирования личности подростков объективно переносился из учебного заведения в семью, необходимо в этой самой семье создать наиболее благоприятное условие и предпосылки высокого уровня личностно-социального самоопределения и самореализации подростков. Только лишь создав необходимые условия для творческого развития личности, условия, которые ни в коем случае не будут обременять подростков, способствовать их личностно-социальной дезадаптации, можно утверждать, что именно в таком случае семья будет в состоянии очень активно и качественно осуществлять свои социальные функции. Это очень тяжело на практике, так как накопленный опыт такой трансформации, возможностей образовательного учреждения в возможности семьи показывает, что в некоторых случаях этот процесс происходит не так позитивно, как ранее предполагалось. «Часто можно наблюдать ситуацию, когда полученные подростком знания, умения и навыки не имеют необходимого продолжения и развития в условиях семьи» (5, 26). В результате, тот уровень духовно-интеллектуального развития личности, достигнутый её в процессе учебно-воспитательного процесса в образовательном учреждении, в условиях семьи выражено снижается и создаёт непредвиденные трудности в общем развитии личности. Конечно, причин по которым семья не может достаточно профессионально продолжать развитие и формирование своих детей много и каждый из них требует особого социального анализа. Однако специалисты, учёные-исследователи (Ю.Б. Рюриков, С.М. Емельянов, А.Н. Елизаров, В.А. Сысоенко, И.Ф. Дементьева, Д.А. Шевчук, О.М. ДЕРЕБИНА, А.У. Хараши, И.В. Гребенников, А.Н. Харитонов и др.) утверждают, что снижение духовно-интеллектуального потенциала подростков, отсутствие у них перспективы, наблюдаемый процесс угасания чувства оптимизма, постепенное превращение личности в безразличного человека, не имеющего

никаких мотивов саморазвития самоопределения, происходит исключительно в результате определённых семейных конфликтов.

Специалисты часто высказывают мысль, что личность в условиях семьи развивается только лишь в том случае, если семья сама достаточно активно развивается. Если в семье наблюдаются постоянные конфликты, выяснение отношений между супругами, отсутствие взаимопонимания между всеми членами семьи, эгоизм, невнимательность, а подчас и игнорирование членами семьи друг друга, то, в этом случае можно достаточно твёрдо утверждать, что развитие и формирование подростков в такой семье находится под большой угрозой, что достаточно часто становится предметом исследования как педагогов, так и психологов (4).

Разрушение внутрисемейных отношений свидетельствует о том, что такая семья, даже если её сохранить какими-то титаническими усилиями, всё равно не будет позитивной и не создаст никакой серьёзной социальной платформы для развития формирования своих членов. Семейным конфликтом могут способствовать разные причины и охарактеризовать их всех на страницах нашей статьи, не представляется реальными и возможным. Мы остановимся на наиболее часто имеющих место в жизни конкретной семьи – супружеских конфликтах. Изначально это были два молодых человека, которые решили жить вместе и заботиться друг о друге. По истечении какого-то определённого времени, под воздействием определённых причин, между супругами случаются конфликты, которые очень разрушающие действуют как на самих супругов, так и на их детей. Наиболее частая причина возникновения супружеских конфликтов – непонимание друг друга и, не просто непонимание, а целенаправленное отсутствие желания супругов понимать друг друга и выработать какой-либо консенсус, который может где-то помочь предотвратить назревающие конфликты. В этом случае самое опасное нам видится в том, что супруги, желая каким-либо образом показать своё превосходство на другом, всячески стараются привлечь на свою сторону детей, что, по оценке учёных-исследователей, крайне недопустимо. Естественно, возникают сложности, дети любят своих родителей и стараются присущими им возможностями потушить назревающий конфликт (что часто просто не удаётся).

По этой причине у детей, особенно подросткового возраста, которые уже достаточно глубоко разбираются в жизненных ситуациях, возникают непредвиденные трудности – личностно-социальная апатия, раздражительность, плаксивость, нежелание подчиниться не только советом родителей, но и учителей школы. Учителя, в свою очередь, недоумевают, почему вчерашние позитивные подростки в течении определенного времени так отрицательно изменились и трансформировались в молодых людей откровенно девиантной модели поведения. «Если учителя будут просто наблюдать процесс явно видимого ухудшения состояния своих учеников-подростков и не пытаться разрешать эту проблему, то дальнейшее состояние подростков будет катастрофически ухудшаться» (8, 32). Почему же это происходит, что надо сделать, чтобы процесс развития и формирования подростков опять пошёл бы по позитивному пути социализации. Практические работники с высоким уровнем профессиональной подготовки и большим жизненным опытом рекомендуют в таких случаях обязательно разбираться в причинах супружеских конфликтов. Как мы отмечали выше, таких причин может быть очень много, но среди них есть такие, которые очень часто повторяются и создают большие проблемы молодым людям – подросткам в семье. Иногда, даже при первом, поверхностном рассмотрении, видно, что супруги явно охладели друг к другу и не желают идти на какой-либо компромисс.

Анализируя глубже возникновение такого нежелания обоих супругов прощать друг друга и найти общую платформу соединения, тем более что у них есть дети, выясняется, что главной причины такого характера супружеских конфликтов выступает межличностная несовместимость. К примеру, муж очень активный, любит принимать гостей, идти в гости, а

супруга, наоборот, очень домашняя, не особенно любит ходить в гости и принимать гостей. На этой почве бывают довольно резкие скандалы, переходящие нередко в явную супружескую ненависть к друг другу. В таких случаях специалисты говорят, что вначале семейной жизни, когда супруги были молоды, все процессы между ними носили исключительно позитивный характер (они прислушивались друг к другу, поддерживали, вдохновляли, мотивировали друг друга, старались не замечать какие-либо ошибки). Теперь же по происшествии определенного количества лет, внутреннее наполнение каждого из супругов начало давать о себе знать (прежняя эйфория, основанная на молодости, романтики, на ярких впечатлениях постепенно сошли на нет).

В результате, такая семья испытывает большие трудности в определенном характере межличностных взаимоотношений, с одной стороны, супруги осознанно понимают, что так долго продолжаться не может, что надо найти серьёзный повод восстановить отношения, с другой стороны, внутреннее «я» каждого из супругов сопротивляется этому и не даёт очень трезво взглянуть на ситуацию. Можно себе представить, что думает их дети – подростки, которые, как это не странно, проецируют такие взаимоотношения между своими родителями на свою будущую жизнь и часто приходят к выводу, что если хочешь спокойно жить в будущем, не создавая себе никаких проблем, а о семейной жизни думать лучше не надо. У нас была беседа с одним из таких подростков, который перешел в 9 класс и в разговоре с нами твердо придерживался мнения, что, если хочешь нормально жить – лучше не жениться вообще. Когда мы его спросили, откуда у него такое мнение о семейной жизни, он сказал нам, что буквально с 6 класса его родители конфликтовали друг с другом, притягивали его то к одной стороне, то к другой и никак не могли найти между собой общий язык.

В результате этого, я больше не мог жить в такой семье и с некоторого времени живу у своих бабушек и дедушек и домой возвращаться совершенно не собираюсь. Кстати, мои родители, даже после того, как я ушёл из дома, всё равно продолжают конфликтовать, причём, даже сильнее. Вот такой факт, когда супружеский конфликт, можно сказать, очень негативно повлиял на молодого человека и будет даже очень странным, если какой-либо специалист будет наблюдать и видеть явные промахи такого подростка в процессе личностно-социальной самоадаптации и будет этому удивляться. «Однако из широко известных и наблюдаемых причин супружеского конфликта выступает желание какого-либо из супругов продемонстрировать в отношениях свое превосходство» (2, 46). Это очень тяжёлый вид супружеского конфликта, так как, в основном, связан с внутренней психологической составляющей личности.

При таком виде супружеского конфликта откровенно наблюдаются такие сцены, когда один из супругов очень заносчив, убеждён во мнении что то, что он говорит, не должно никак обсуждаться. Если со стороны другого супруга делается даже робкая попытка на то, чтобы противоречить, а просто более доходчиво понять личностную позицию другого, это перерастает в грандиозный конфликт с фактами личностного унижения чести и достоинства другого, жестокости, издевательства и других фактов, которые, к сожалению очень часто наводит на мысль «А зачем они вообще создавали семью, если каждый из них считает себя в семье «Наполеоном» и отвратительно относятся к другому.

В подобных случаях, на наш взгляд, стоит привлечь третью сторону, которая могла бы помочь урегулировать конфликт. Желательно, чтобы это было лицо, пользующееся уважением с обеих сторон. Это могут быть родители, близкие друзья, уважаемые соседи, аксакалы по месту жительства и т. д. Очень важно, чтобы обе стороны конфликта действительно уважали это третье лицо. В противном случае вмешательство может только усугубить ситуацию. Один из супругов может воспринять это как давление и сказать: «Ты что, направляешь ко мне какого-то человека, думая, что я изменю своё мнение? Ошибаешься-

этот человек ничего не понимает и от тебя недалеко ушёл». Чтобы избежать такого развития событий, участие третьей стороны нужно обдумывать и готовить заранее.

Мы считаем также очень важным и необходимым рассмотреть супружеский конфликт, причиной которой выступает организация неправильных взаимоотношений между супругами в соответствии с их личностными материальными доходами. «Если муж или жена всё время напоминают друг другу, кто сколько зарабатывает, и что именно заработная плата должна выступать мерилom межличностных взаимоотношений, то от такой семьи ожидать ничего позитивного не приходится» (7, 58). Если один из супругов постоянно напоминает другому, что именно часто покупает одежду и туфли своим детям (особенно подросткам) то, значит и его любое слово в семье должно восприниматься исключительно как непреложный закон. Выстраивание межличностных отношений именно на такой основе, чревато большими, совершенно непредсказуемыми последствиями. Насытившись по горло ежедневным напоминанием, что именно он организует самые верные отношения в семье по той причине, что именно он больше всего зарабатывает, говорит о том, что супруги сделали очень большую ошибку создав семью, что у них нет абсолютно никакого представления о том, что же такое семья на самом деле.

В периодической печати были опубликованы примеры таких семей, когда один из супругов, уходил из дому, даже не предупредив другого, а когда проблема была выставлена на широкое обсуждение, ушедший из дома супруг говорил, что он лучше будет жить в лесу, одиноким, чем продолжить жить в семье, где тебе постоянно напоминают о материальных возможностях. Воспитуемые в такой семье дети-подростки также были отравлены вирусом высоких материальных возможностей. Они говорили, что никогда, один из супругов не должен брать на себя все расходы по дому, другой супруг должен ему непременно помогать. Мысль в общем-то позитивная, здоровая, однако в её претворении в жизнь могут наблюдаться неожиданные нюансы, которые эту гипотезу могут опрокинуть с ног на голову. Представим себе ситуацию, что супруга - мать детей-подростков тяжело больна и врачи предписали ей обязательный постельный режим до полного выздоровления. За ней необходимо ухаживать, покупать лекарства, может быть также нанять сиделку. Очень интересно было бы поговорить о построении межличностных отношений между супругами, когда дети-подростки видят, что их родная мать прикована к постели. Если они не ухаживают за своей матерью и придерживаются мнения, что она, даже в таком болезненном состоянии, должна вносить определенную материальную лепту в общий семейный бюджет, то таким детям нужно предоставить возможность жить самим, без семьи. Понятное дело, что такую мысль сами не могут осмыслить и озвучить, обязательно есть какой-то источник, который отравляет молодым людям сознание. Если же, хотим особо подчеркнуть, этим источником является один из супругов, то полное разрешение такого супружеского конфликта, вплоть до развода, необходимо считать самым необходимым и верным шагом.

Весь ужас и трагизм такого супружеского конфликта в том, что как семья эта общность людей совершенно не нужна обществу, где вместо гуманизма и гармонии царит исключительно материальный расчет. И если растущие в такой семье дети-подростки также заразились этим вирусом меркантилизма и руководствуются им в отношениях со своими родителями, то, мы считаем, налицо большой профессиональный прокол в работе социальных институтов с подрастающим поколением. Необходимо, причём, в самые кратчайшие сроки серьёзно проанализировать такой прокол в работе социальных институтов общества и кардинальным образом в разы усилить свою работу и поднять на высокий уровень эффективность работы с молодыми людьми, имеющими такой образ мышления.

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Economic Sciences

Corporate secretary as a driver of ethical standards and sustainable corporate governance

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Abstract

The corporate secretary has become a key figure in advancing ethical standards and promoting sustainable corporate governance in today's dynamic business environment. Acting as a bridge between the board of directors, management, shareholders, and other stakeholders, the corporate secretary ensures that governance processes are transparent, accountable, and aligned with best practices. This article explores the strategic role of the corporate secretary in embedding ethics into decision-making, fostering a culture of integrity, and supporting long-term sustainability goals. By examining global trends and practical examples, we highlight how corporate secretaries can serve as catalysts for building resilient, responsible, and future-oriented organizations.

Keywords: corporate secretary, corporate governance, ethical standards, sustainability, board of directors, compliance, transparency, accountability, stakeholder engagement, ESG.

In recent years, corporate governance has undergone significant transformation, with growing emphasis on transparency, accountability, and sustainability. Stakeholders—including shareholders, regulators, employees, and the public—are increasingly demanding that organizations act responsibly and uphold the highest ethical standards. In this evolving context, the corporate secretary has emerged as a pivotal figure, not merely as an administrative officer but as a strategic advisor and guardian of corporate integrity.

The corporate secretary plays a crucial role in ensuring that the board of directors operates in compliance with legal and regulatory requirements while also aligning decision-making processes with the organization's values and sustainability objectives. As the liaison between the board, management, and shareholders, the corporate secretary facilitates effective communication, supports informed decision-making, and helps embed a culture of ethics across all levels of the company.

Moreover, the corporate secretary's role has expanded to include monitoring corporate governance practices, developing policies on ethics and compliance, and guiding the organization in its environmental, social, and governance (ESG) initiatives. This proactive approach enables companies to anticipate risks, avoid reputational damage, and strengthen stakeholder trust. This article examines the corporate secretary's evolving responsibilities and highlights their critical function as a driver of ethical standards and sustainable corporate governance. By exploring best practices and global trends, we seek to illustrate how corporate secretaries can become catalysts for building resilient organizations capable of thriving in an increasingly complex and socially conscious business landscape [1].

The institution of the corporate secretary is an integral element of the modern corporate governance system, ensuring a balance of interests between shareholders, governing bodies, and company stakeholders. The emergence of this position is associated with the need to increase transparency in management processes, ensure compliance with legislation, and implement the principles of sound corporate governance. The corporate secretary is a senior executive of the company who plays a key role in establishing and maintaining corporate governance standards and practices within the organization [2].

A corporate secretary is an officer or a structural division responsible for the organizational, legal, and informational support of the work of corporate governance bodies. In a broader sense, the corporate secretary serves as a “conduit” for corporate values and ethical standards, facilitating communication between the board of directors, management, and shareholders.

According to the OECD Principles of Corporate Governance (2023), the corporate secretary plays a crucial role in ensuring the effectiveness of the board of directors, preparing board meetings, monitoring compliance with procedures, and maintaining corporate transparency. In Kazakhstan, the activities of the corporate secretary are regulated, in particular, by the Samruk-Kazyna Corporate Governance Code, as well as by the internal regulatory documents of companies and organizations. Corporate governance at L.N. Gumilyov Eurasian National University represents a systematically organized and multi-level model based on the principles of transparency, accountability, sustainable development, and efficiency. This model reflects modern approaches to management in higher education institutions, focusing on strategic development, institutional autonomy, and integration into the global educational space.

According to the ENU Corporate Governance Code, the university’s governance system is built upon a set of fundamental principles: separation of powers, protection of shareholder rights, effective performance of the Board of Directors and the executive body, sustainable development, risk management and internal control, resolution of corporate conflicts, and transparency of information exchange [3].

The institution of the corporate secretary is an integral element of the corporate governance system, both in business structures and in organizations of the quasi-public sector, including universities. Its role is not limited to ensuring formal document management but also includes maintaining transparency, accountability, and adherence to ethical standards in the activities of governing bodies.

In the context of university governance, where decisions are made by collegial bodies (the Board of Directors, the Academic Council, the Executive Board), the corporate secretary performs a key function — ensuring process consistency, compliance with regulatory procedures, and effective communication among governance participants.

At L.N. Gumilyov Eurasian National University, the institutional consolidation of the role of the corporate secretary is directly reflected in the composition of the governing bodies. In particular, Madiyar Batykhovich Orynbayev holds this position at ENU. This demonstrates the presence of an officially defined role that combines both organizational and coordination responsibilities as well as control functions [4].

Table 1 – Key Functions of the Corporate Secretary in Different Organizational Contexts

Function	Business Structures	Universities
Governance Support	Organizes board meetings, prepares agendas, ensures compliance with corporate charters	Coordinates meetings of the Board of Directors, Academic Council, and Executive Board

Transparency and Accountability	Facilitates disclosure of financial statements and governance reports	Ensures openness of decision-making processes and compliance with educational regulations
Ethical Standards	Implements codes of conduct, monitors compliance	Promotes academic integrity and adherence to institutional ethical norms
Note- Compiled by the author based on the sources used [5]		

The evaluation of the corporate secretary's performance in the context of ethical norms and the principles of sustainable corporate governance is a crucial tool for improving the university's management system. It makes it possible to determine how effectively the tasks of ensuring transparency, protecting the rights of all stakeholders, and integrating ESG practices into management processes are being implemented. For NJSC "L.N. Gumilyov Eurasian National University," such an evaluation is particularly significant, as the university is focused on developing partnerships with government bodies, international universities, and the business community.

The corporate secretary plays a key role in ensuring effective interaction among the university's governing bodies, adherence to the principles of transparency and ethics, and the implementation of sustainable development practices. To maximize the contribution of this position to the strategic objectives of NJSC "L.N. Gumilyov Eurasian National University," it is necessary to strengthen the functional capabilities and expand the tools available to the corporate secretary.

Modern challenges require the corporate secretary not only to perform administrative functions but also to act as an active participant in shaping corporate culture, integrating ESG principles, and driving the digitalization of management processes.

Traditionally regarded as a record-keeper and administrator, the role of the corporate secretary has transformed into a cornerstone of strategic corporate governance. In the past, their primary function focused on preparing minutes, maintaining statutory registers, and ensuring that basic compliance requirements were met. However, the increasingly complex regulatory environment, the rise of stakeholder capitalism, and the growing emphasis on ethical and sustainable business practices have significantly expanded this position's responsibilities.

Today, the corporate secretary acts as a trusted advisor to the board of directors and senior management, ensuring that governance structures are not only legally compliant but also strategically aligned with the organization's mission and values. They provide the board with accurate, relevant, and timely information, enabling informed decisions that strike a balance between short-term performance and long-term sustainability. This advisory function extends to assisting in the development of governance policies, codes of ethics, and risk management frameworks that address emerging issues such as ESG (environmental, social, and governance) considerations, digital transformation, and corporate culture.

Additionally, the corporate secretary plays a critical role in facilitating board effectiveness. They organize and coordinate meetings, prepare agendas in alignment with strategic priorities, and ensure that deliberations are conducted according to governance procedures. By fostering an environment of transparency and constructive dialogue, the corporate secretary helps boards engage in meaningful discussions, avoid groupthink, and make well-considered decisions.

In this way, the corporate secretary is no longer a passive administrator but an active participant in shaping corporate governance. Their strategic involvement ensures that the board remains forward-looking, ethical, and resilient in addressing both internal challenges and external pressures. The promotion of ethical standards is one of the most critical functions of the corporate

secretary, positioning them as the “conscience” of the organization. In an era where reputation, trust, and social responsibility significantly affect long-term success, the corporate secretary ensures that ethics are not merely a set of rules but a fundamental part of the organizational culture. A key responsibility is the development, implementation, and continuous improvement of the organization’s code of conduct. This document outlines the ethical expectations for employees, managers, and board members, covering issues such as conflicts of interest, anti-corruption policies, responsible use of resources, and respect for human rights. The corporate secretary often collaborates with compliance officers and legal departments to ensure that these codes are aligned with national legislation and international standards, such as the OECD Guidelines for Multinational Enterprises or ISO 37001 on anti-bribery management systems.

In addition to policy development, the corporate secretary plays a central role in education and awareness. They coordinate regular training sessions, workshops, and seminars aimed at helping employees understand ethical dilemmas and make decisions consistent with corporate values. This proactive approach empowers staff to identify and report potential violations without fear of retaliation, thereby strengthening internal controls. Monitoring and reporting mechanisms also fall within the corporate secretary’s scope. By establishing whistleblowing procedures, maintaining channels for confidential communication, and ensuring that breaches are promptly investigated, they help maintain transparency and accountability. This process reassures stakeholders that ethical concerns are taken seriously and resolved appropriately. Ultimately, the corporate secretary’s efforts in promoting ethical standards go beyond regulatory compliance. They help to build a culture of integrity, where ethical considerations are embedded into strategy, risk management, and everyday operations, reinforcing the organization’s commitment to sustainable and responsible growth.

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Medical Sciences

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BREAST CANCER: MODERN IDEAS ABOUT THE PROBLEM AND OPPORTUNITIES ITS SOLUTIONS

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Annotation: This scientific and analytical work presents modern global and local-regional data on incidence, mortality, lethality and five-year survival of the most common oncological pathology, such as breast cancer. The issues of etiology and pathogenesis, features of distribution, modern principles of diagnostics, including screening, as well as prognosis, preventive measures of this formidable disease are covered in detail. The epidemiological characteristics of this pathology in our republic are given in the context of the regions of the country.

Key words: oncology, breast cancer, phenotype, biological markers, risk factors, etiopathogenesis, diagnostics, treatment, epidemiology, incidence, mortality, lethality, five-year survival rate, prognosis, prevention.

Breast cancer (BC) is the most common global malignancy and the leading cause of cancer deaths [1]. There is much evidence showing the influence of life style and environmental factors on the development of mammary gland cancer (high-fat diet, alcohol consumption, lack of physical exercise), the elimination of which (primary prevention) may contribute to a decrease in incidence and mortality. Secondary prevention, comprising diagnostic tests (e.g. mammography, ultrasonography, magnetic resonance imaging, breast self-examination, as well as modern and more precise imaging methods) help the early detection of tumours or lesions predisposing to tumours. It is estimated that nearly 70% of malign tumours are caused by environmental factors, whereas in BC this percentage reaches 90-95%. There are national programmes established in many countries to fight cancer, where both types of prevention are stressed as serving to decrease incidence and mortality due to cancers. Cancer prevention is currently playing a key role in the fight against the disease. Behaviour modification, as well as greater awareness among women regarding BC, may significantly contribute towards reducing the incidence of this cancer [2].

Speaking about the diagnostic criteria for making a diagnosis, women complain about the presence of a formation in the mammary gland; enlarged axillary, supra- and subclavian lymph nodes; the presence of skin changes on the mammary gland; swelling of the mammary gland. The history is noteworthy of the presence of cancer in close relatives; early onset of menstruation; age of first pregnancy and first birth, taking oral contraceptives and/or hormone replacement therapy, gynecological diseases. During a physical examination, attention is paid to the symmetry of the location and shape of the mammary glands; level of position of the nipples and their appearance (retraction, deviation to the side); skin condition (hyperemia, swelling, wrinkling, retractions or protrusions on it, narrowing of the areolar field, etc.); presence/absence of pathological discharge from the nipples (quantity, color, duration); presence of swelling of the arm on the affected side. Palpation of the mammary glands is carried out in the vertical and horizontal positions of the subject; regional and cervico-supraclavicular lymph nodes are usually performed in a vertical position [3].

From laboratory tests, if metastatic BC is suspected, it is recommended to perform detailed clinical and biochemical blood tests, and a study of the blood coagulation system. In case of hormone-dependent BC in women under 50 years of age, to assess ovarian function and plan hormone therapy, it is recommended to study the level of follicle-stimulating hormone in the blood serum and the level of total estradiol in the blood. A cytological study is also carried out (an increase in the size of atypical cells up to giant ones, a change in the shape and number of intracellular elements, an increase in the size of the nucleus, its contours, different degrees of maturity of the nucleus and other cell elements, a change in the number and shape of nucleoli); histological examination: histological type of tumor, degree of differentiation (grade - ability to form tubes, nuclear polymorphism, number of mitoses), presence of necrosis, vascular invasion, tumor of infiltrating lymphocytes, presence of calcifications. Immunohistochemical study for key markers: 1) determination of estrogen and progesterone receptors, HER2, Ki67 - it is recommended to evaluate biological markers again at least once during metastasis, if clinically possible; 2) if the result of IHC analysis of HER2 is controversial, the HER2/neu gene amplification should be determined by in situ hybridization; 3) determination of PD-L1 in triple negative BC to decide on the prescription of immunotherapy; 4) if necessary - Cytokeratin 5/6, Calponin-1, E-Cadherin, GCDFP-15, Mammaglobin, p120 and Topoisomerase IIa.

Molecular genetic testing to determine germline BRCA1/2 mutations is indicated in all patients, regardless of age, family history, or type of BC with mBC and during progression to decide

whether to prescribe PARP inhibitors (olaparib1 and talazoparib). In women with a positive germline mutation of the BRCA1 or 2 gene, the incidence of BC development before 70 years of age is 45-65%. More often detected: 1) with a burdened family history (close relatives have BC aged ≤ 50 years, BC in a man, ovarian cancer, metastatic prostate cancer, pancreatic cancer); 2) in patients under 45 years of age; 3) in patients under 60 years of age with a triple negative BC phenotype; 4) with primary multiple BC; 5) in patients with HER2 negative BC phenotype who have a high risk of relapse after surgical treatment and neoadjuvant or adjuvant therapy; 6) for BC in men. Comprehensive genomic profiling is carried out in patients with a severe clinical course, aggressive tumors, with a high risk of progression, lack of effect from traditional methods of antitumor treatment [in advanced BC (triple negative and progressive HER2+)] [3].

Instrumental studies: 1) ultrasound of the mammary glands, regional lymph nodes: the presence of a hypoechoic structure of the formation with large/small microcalcifications in the structure, the contours are uneven, stellate, there may be areas of mixed echogenicity, the structure of the node is heterogeneous, increased vascularization is possible; 2) mammography (mammograms in two projections visualize shapeless heterogeneous compactions with multiple microcalcifications in the structure, pronounced deformation of the stroma, thickening of the skin, nipple-areolar complex, the nipple can be retracted, the presence of enclosed lymph nodes); 3) contrast-enhanced spectral mammography (CESM) method, which consists of performing mammography with soft and hard images after intravenous administration of an iodinated contrast agent. The CESM method is informative in the diagnosis of early forms of BC, allows you to detect pathology in the dense part of the mammary gland, and is used as a differential diagnosis of benign and malignant neoplasms; before the study, creatinine and urea levels in the blood are assessed, an iodine-containing contrast agent is administered intravenously in an amount of 1.0-1.5 ml per kg of the patient's weight; images are taken in two projections, craniocaudal (CC) and media-lateral (MLO), in a period of time from 2 to 7 minutes after administration of the contrast agent; 4) magnetic resonance imaging (MRI) of the mammary glands to assess the local spread of BC for the following indications: age up to 30 years; the presence of mutations in the BRCA1, BRCA2 genes; high radiological density of the mammary glands; the presence of breast implants when it is impossible to perform a high-quality mammographic examination; presence of lobular carcinoma in situ; 5) ductography (in the presence of an intraductal formation behind the nipple, it is carried out to clarify the size and distance of the formation from the nipple-areolar complex); 6) puncture biopsy of a tumor formation (cytological examination reveals an increase in the size of cells up to giant ones, a change in the shape and number of intracellular elements, an increase in the size of the nucleus and its contours, different degrees of maturity of the nucleus and other cell elements, a change in the number and shape of nucleoli); 7) trephine biopsy or sectoral resection of the mammary gland with express histology (histological verification of the tumor: histological type of tumor, degree of differentiation (grade - ability to form tubes, nuclear polymorphism, number of mitoses), absence of necrosis, vascular invasion, tumor of infiltrating lymphocytes, the presence of calcifications; 8) ultrasound of the abdominal organs and retroperitoneal space/ultrasound of the pelvis (with metastatic lesions of the liver, its structure is heterogeneous, rounded in shape with uneven clear contours, with single or multiple formations with a hypoechoic rim along the periphery); 9) computed tomography (CT) or MRI of the abdominal organs with intravenous contrast if the results of ultrasound of the abdominal organs are ambiguous or not very informative; 10) survey X-ray examination of the CT of the chest organs (in case of metastatic lesions of the lungs across all pulmonary fields or in a segment, multiple/single mid-focal shadows with clear contours, of various sizes are determined); 10) scintigraphy of skeletal bones (hyperfixation of an osteotropic drug in foci of pathological bone formation) if metastatic lesions of skeletal bones are suspected to assess the extent of BC prevalence; 11) positron emission tomography (PET) (accumulation of the drug by pathological

foci), combined with CT with tumor-tropic radiopharmaceuticals (with or without contrast) (PET-CT) to assess the extent of BC spread in cases where standard methods of staging examinations are ambiguous, especially when locally advanced process, when the detection of metastases fundamentally changes treatment tactics; 12) MRI or CT scan of the brain with IV contrast to exclude metastatic lesions if the presence of metastases in the brain is suspected.

To standardize and simplify the criteria for assessing response to tumor therapy, the international Response Evaluation Criteria in Solid Tumors (RECIST) scale is used. According to RECIST 1.1, the following types of response are distinguished for targeted lesions.

1. Complete response – disappearance of all tumor foci.
2. Partial answer – a decrease in the sum of the largest diameters of each lesion by more than 30%.
3. Stabilization of the disease – reduction of the sum of the largest diameters of each lesions from 20 to 30% (for RECIST 1.0 from 25 to 50%).
4. Progression of the disease – an increase in the sum of the largest diameters of each lesion by more than 20% or the appearance of new tumor lesions.

The overall response of solid tumors to treatment is based on a combination of data on measurable lesions, non-measurable lesions and the appearance or absence of new tumor lesions. The duration of overall response is from the date of documentation of the disease until its progression. Relapse-free interval (time to progression) – from the end of treatment to the date of documented disease progression [3].

As part of outpatient drug therapy, it is recommended to use hormone therapy in the adjuvant mode for patients with hormone-positive BC for at least 5 years (tamoxifen, letrozole, anastrozole, goserelin, triptorelin) and with progression or metastatic luminal BC before progression (tamoxifen, letrozole, anastrozole, goserelin, triptorelin, toremifene, fulvestrant, exemestane, everolimus). The use of bisphosphonate therapy when metastatic bone lesions are detected is recommended for two years (zoledronic and pamidronic acid, denosumab). CD 4/6 inhibitors (palbociclib, ribociclib, abemaciclib) are recommended for patients with HER2-negative metastatic luminal BC in combination with an aromatase inhibitor or fulvestrant, until progression or unacceptable toxicity develops; the use of monotherapy with Poly(ADP-ribose) polymerase inhibitors (olaparib or talazoparib) is recommended for patients with metastatic BC with germline BRCA1 or BRCA2 mutations, regardless of hormone receptor and HER2 status, as an alternative to chemotherapy. In patients with high-risk BRCA-associated BC, olaparib is prescribed as adjuvant therapy. The use of targeted therapy (trastuzumab) is recommended for patients with early and metastatic HER2-positive BC in combination with chemotherapy, targeted therapy or monotherapy (up to completion of 18 cycles). The use of targeted therapy (lapatinib) is recommended for patients with HER2-positive metastatic BC, either alone or in combination with capecitabine and/or trastuzumab, until progression or development of unacceptable toxicity. The use of capecitabine in the adjuvant treatment of chemo-resistant triple negative BC, or in metastatic BC in combination with lapatinib and hormone therapy.

Indications for radiation therapy: 1) morphologically established diagnosis of malignant neoplasm; 2) in case of relapses, continued growth of the tumor or progression of the disease after previously carried out combined or complex treatment. Methods of radiation therapy: 1) continuous radiation therapy; 2) single-fraction radiation therapy for SRS; fractionated radiation therapy for Single Focal Dose from 1.6 Gy to 12.0 Gy 2-5 fractions per week (standard fractionation, hypofractionation, hyperfractionation, accelerated fractionation, multifractionation). In this case, external beam radiation therapy is carried out 2D, 3D, IMRT, RapidArc, IGRT conformal irradiation Single Focal Dose 1.8-2.0-2.66, 2.67, 5.2 Gy 5 fractions per week up to Total Focal Dose 50 Gy, 42.56 Gy, 40.05 Gy, 25 Gy and 60-70 Gy in independent mode,

Total Focal Dose 10-16 Gy ("Boost") in the postoperative mode after organ-sparing operations. A continuous course of radiation therapy is used, using γ -therapy devices or linear accelerators. Tomotherapy is used as a standard fractionation technique for administering single and total focal doses. The main advantage is hypofractionation in Single Focal Dose 2.5 Gy. Intraoperative radiation therapy is used in breast-conserving operations for T1-2N0-1M0. The bed of the removed tumor is irradiated with an electron beam at a dose of 10-20 Gy in order to devitalize the remaining malignant cells [3].

Now, regarding chemotherapy. There are several types of chemotherapy that differ in purpose: 1) neoadjuvant chemotherapy of tumors is prescribed before surgery, in order to reduce an inoperable tumor for surgery, as well as to identify the sensitivity of cancer cells to drugs for further use after surgery; 2) adjuvant chemotherapy is prescribed after surgical treatment to prevent metastasis and reduce the risk of relapse; 3) curative chemotherapy is given to shrink metastatic cancers. Depending on the location and type of tumor, chemotherapy is prescribed according to different regimens and has its own characteristics.

Indications for chemotherapy: 1) cytologically and histologically verified BC; 2) in the treatment of locally advanced tumors; 3) metastases in regional lymph nodes/distant organs - lungs, liver, brain, bone structure; 4) tumor recurrence; 5) a satisfactory blood picture in the patient: normal hemoglobin and hemocrit, the absolute number of granulocytes is more than 200, platelets are more than 100,000; 6) preserved function of the liver, kidneys, respiratory system and cardiovascular system; 7) the possibility of converting an inoperable tumor process into an operable one; 8) patient's refusal to undergo surgery; 9) improvement of long-term treatment results in unfavorable tumor phenotypes (triple negative, HER2-negative cancer).

Contraindications to chemotherapy can be divided into two groups: absolute and relative. Absolute contraindications: hyperthermia >38 degrees; disease in the stage of decompensation (cardiovascular system, respiratory system, liver, kidneys); the presence of acute infectious diseases; mental illness; the ineffectiveness of this type of treatment, confirmed by one or more specialists; tumor decay (threat of bleeding); the patient's serious condition according to the Karnofsky Performance Scale is 50% or less. Relative contraindications: pregnancy up to 16-18 weeks; intoxication of the body; active pulmonary tuberculosis; persistent pathological changes in blood composition (anemia, leukopenia, thrombocytopenia); cachexia.

The rationale for prescribing neoadjuvant systemic therapy for BC is: high probability of latent (micrometastatic) spread; the ability to reduce the amount of surgical intervention within the "clean" resection margins; the ability to evaluate the clinical response to therapy in vivo; availability of accurate pathomorphological assessment of the degree of tumor regression; the possibility of special studies of biopsy tumor material before, during and after completion of primary systemic treatment. For medullary carcinoma and adenoid cystic carcinoma, adjuvant chemotherapy may not be required (in the absence of lymph node involvement).

And a very important and decisive aspect when prescribing adjuvant/neoadjuvant systemic therapy is the molecular biological subtype of BC:

1. Luminal type A. In early BC (T1-2N0M0), hormone therapy is carried out only in the presence of severe concomitant diseases and/or there are absolute contraindications to surgical treatment until the maximum effect is achieved, followed by radiation therapy. For T2-4N1-3M0 locally advanced inoperable BC, it is recommended to prescribe hormone therapy with antiestrogens and aromatase inhibitors; it is advisable to carry out treatment until the maximum effect is achieved with clinical and instrumental assessment every 3 months. At the same time, in most cases, the appointment of adjuvant/neoadjuvant chemotherapy (in addition to hormonal therapy) is possible in the presence of at least two parameters: widespread process (≥ 4 regional lymph nodes affected by metastases; $\geq T3$); GIII; young age; presence of pregnancy; increase in initial Ki67 values during repeat biopsy/postoperative material after neoadjuvant hormone

therapy.

2. Luminal B (HER2 negative). Hormone therapy + chemotherapy in most cases. For T1a (≤ 5 mm) and N0 - only adjuvant hormonal therapy. In other cases, chemotherapy with anthracycline- and taxane-containing regimens in addition to hormone therapy. Adding platinum drugs to adjuvant chemotherapy only in the presence of a BRCA1/2 gene mutation.

3. Luminal type B (HER2 positive). Chemotherapy + anti-HER2 therapy + hormone therapy. For T1a (≤ 5 mm) and N0: adjuvant hormone therapy only; chemotherapy and trastuzumab are not indicated. For T1b, c (> 5 mm but ≤ 20 mm) and N0: chemotherapy with paclitaxel (without anthracyclines) in combination with trastuzumab (followed by hormone therapy) is possible. For T2-T4 (> 20 mm) or N+: the first step is anthracyclines, then taxanes + trastuzumab $\pm$ pertuzumab (followed by hormone therapy).

4. HER2 positive (non-luminal). Chemotherapy + anti-HER2 therapy. For T1a (≤ 5 mm) and N0: systemic therapy is not indicated. For T1b (> 5 mm but ≤ 10 mm) and N0: taxane chemotherapy (without anthracyclines) in combination with trastuzumab is possible. For T1c-T4 (> 10 mm) or N+: the first step is anthracyclines, then taxanes + trastuzumab $\pm$ pertuzumab.

5. Triple negative (ductal). Chemotherapy including anthracyclines and taxanes. For T1a (≤ 5 mm) and N0, systemic therapy is not indicated. Adding platinum drugs to adjuvant chemotherapy only in the presence of a BRCA gene mutation. There are also features when prescribing adjuvant chemotherapy to patients who have received neoadjuvant chemotherapy in full.

Also, a very important section is the use of hormone therapy in the adjuvant or neoadjuvant mode. In the premenopausal period, hormone therapy is used as follows. After completion of systemic chemotherapy and continued menstrual function, bilateral oophorectomy or ovarian suppression with luteinizing gonadotropin releasing hormone agonists followed by an anti-estrogen for 5 years is indicated. When menstrual function ceases after receiving courses of chemotherapy and the level of estradiol in the blood is determined, an anti-estrogen is prescribed to confirm true menopause. The following regimens with tamoxifen are used: 1) tamoxifen 20 mg/day orally daily for 5 years; 2) tamoxifen 20 mg/day orally daily, for 10 years, in the presence of at least one unfavorable prognosis factor: age ≤ 35 years, preserved ovarian function after adjuvant chemotherapy, T3-4, involvement of ≥ 4 axillary lymph nodes, GIII, positive HER2, high Ki67; 3) tamoxifen 20 mg/day orally daily for 5 years, then aromatase inhibitors (letrozole 2.5 mg/day orally daily, or anastrozole 1 mg/day orally daily, or exemestane 25 mg/day orally daily) for 5 years. For patients who have achieved stable menopause by the time they stop taking tamoxifen, with at least one poor prognostic factor: age ≤ 35 years, preserved ovarian function after adjuvant chemotherapy, T3-4, involvement of ≥ 4 axillary lymph nodes, GIII, HER2 positive, high Ki67; 4) ovarian suppression¹ + tamoxifen 20 mg/day orally daily / aromatase inhibitors (letrozole 2.5 mg/day orally daily, or anastrozole 1 mg/day orally daily, or exemestane 25 mg/day orally daily) for 5 years, and also if there are indications for adjuvant chemotherapy and preserved ovarian function after completion of chemotherapy; 5) bismacliclib 150 mg 2 times a day in combination with endocrine therapy for the adjuvant treatment of hormone receptor positive (HR+) and human epidermal growth factor receptor type 2 (HER2) negative BC in early stages with involvement of regional lymph nodes and a high risk of relapse [3].

In pre- or perimenopausal women, endocrine therapy with aromatase inhibitors should be combined with a luteinizing hormone-releasing hormone agonist. To achieve ovarian suppression, it is possible to use the following methods: 1) surgical castration (bilateral oophorectomy); the most effective method, causes irreversible shutdown of ovarian function; 2) medicinal (analogues of luteinizing gonadotropic hormone: goserelin 3.6 mg intramuscularly once every 28 days or 10.8 mg subcutaneously once every 12 weeks; or buserelin 3.75 mg intramuscularly once every 28 days; or leuprorelin 3.75 mg IM 1 time in 28 days): causes reversible suppression of ovarian

function; does not always provide complete suppression of ovarian function, especially in young women; to confirm complete ovarian suppression, it is necessary to determine estradiol in the blood serum; determination of follicle-stimulating hormone during treatment with luteinizing gonadotropic hormone analogues is not informative; aromatase inhibitors should be started 6-8 weeks after the first administration of luteinizing gonadotropin hormone analogues; luteinizing gonadotropin hormone analogues are administered monthly; 3) radical; causes irreversible shutdown of ovarian function. The optimal method of ovarian suppression has not been determined; it is usually prescribed for a period of 2-5 years.

Hormone therapy for BC for menopausal patients is carried out in the following variations: 1) tamoxifen 20 mg/day orally daily for 5 years; 2) aromatase inhibitors (letrozole 2.5 mg/day orally daily, or anastrozole 1 mg/day orally daily, or exemestane 25 mg/day orally daily) for 5 years; in the presence of at least one unfavorable prognosis factor: preserved ovarian function after adjuvant chemotherapy, T3-4, involvement of ≥ 4 axillary lymph nodes, GIII, positive HER2, high Ki67; 3) tamoxifen 20 mg/day orally daily for 10 years; in the presence of at least one unfavorable prognosis factor: preserved ovarian function after adjuvant chemotherapy, T3-4, involvement of ≥ 4 axillary lymph nodes, GIII, positive HER2, high Ki67; 4) tamoxifen 20 mg/day orally daily for 5 years, then aromatase inhibitors (letrozole 2.5 mg/day orally daily, or anastrozole 1 mg/day orally daily, or exemestane 25 mg/day orally daily) for 5 years. For patients who have reached stable menopause by the time they stop taking tamoxifen, in the presence of at least one unfavorable prognosis factor: preserved ovarian function after adjuvant chemotherapy, T3-4, involvement of ≥ 4 axillary lymph nodes, GIII, positive HER2, high Ki67; 5) abemaciclib 150 mg 2 times a day in combination with endocrine therapy for the adjuvant treatment of hormone receptor-positive (HR+) and human epidermal growth factor receptor type 2 receptor-negative (HER2-) BC in the early stages with involvement of regional lymph nodes and a high risk of relapse - continuously for 2 years or until disease relapse or intolerable toxicity develops [3].

And, of course, the surgical method remains one of the leading methods in the treatment of this pathology, and in some cases, it is the only method of treatment (cancer in situ). For BC, the following types of surgical interventions are performed: 1) radical mastectomy according to Halstead - single-block removal of the mammary gland along with the pectoralis major and minor muscles and their fascia, subclavian, axillary and subscapular tissue with lymph nodes within the anatomical cases; 2) extended axillary-thoracic radical mastectomy, single-block removal of the mammary gland with the pectoral muscles, subclavian-axillary and subscapularis tissue, as well as a section of the chest wall with parasternal lymph nodes and internal mammary vessels; 3) functionally sparing operations (modified radical mastectomy - differs from Halstead mastectomy by preserving the pectoralis major muscle; modified Madden mastectomy - differs from Halstead mastectomy by preserving both pectoral muscles; 4) simple mastectomy - removal of the mammary gland with the fascia of the pectoralis major muscle (indications: decaying tumor, advanced age, severe concomitant diseases; 5) radical sectoral resection - removal of the sector along with the tumor, part of the underlying fascia of the pectoralis major and minor muscles, subclavian, axillary, subscapular tissue with lymph nodes in one block; 6) sectoral resection - removal of the breast sector to the underlying fascia (performed only for diagnostic purposes or in combination with radiation therapy for cancer in situ); 7) biopsy of the sentinel lymph node is carried out for diagnostic and therapeutic purposes in the early stages of the disease (1st level lymph nodes are removed with a histological express study to determine the presence of elements of a malignant tumor); detection of sentinel lymph nodes is possible using radioactive colloid and/or blue dye; a combined determination method is preferred.

Indications for performing organ-preserving operations: the presence of a nodular form of cancer up to 2.0 cm in size; absence of multicentricity and multifocality of tumor growth (on mammograms, ultrasound data, clinical examination); slow and moderate growth rate, doubling

of tumor size no faster than 3 months (according to medical history); a favorable ratio of the size of the mammary gland and the tumor to obtain a good cosmetic result of the operation; absence of distant metastases; the presence of single metastases in the axillary region is acceptable; the patient's desire to preserve the mammary gland; satisfactory objective tumor response (partial and complete tumor regression) to previous neoadjuvant systemic treatment.

Reconstructive operations can be performed for stages I-III of BC at the request of the patient at any tumor location: 1) reconstruction (primary or delayed) of the mammary gland using an endoprosthesis (implant) (this type of operation involves the installation of a temporary (expander) or permanent prosthesis under the pectoralis major muscle, which allows compensation for the defect due to its volume, after mastectomy); 2) one-stage reconstruction: a skin-skin-sparing mastectomy is performed with the fascia of the pectoralis major muscle (if tumor cells are detected in the tissue behind the nipple during express histological examination, the nipple with the areola is removed); 3) reconstruction (primary or delayed) of the mammary gland using one's own tissues (autoplasty); this type of reconstruction involves replacing the defect using one's own tissues; basically, 2 types of operations are used - breast reconstruction by replacing with a TRAM flap (using a flap based on the rectus abdominis muscles) and breast reconstruction by replacing with a thoracodorsal flap, which is used in combination with an endoprosthesis.

Types of surgical interventions for metastatic BC: 1) sanitary/simple mastectomy (if there is a threat of bleeding for health reasons); 2) open liver biopsy (diagnostic surgery for suspected liver metastases); 3) other diagnostic manipulations on the liver (liver resection in the presence of single metastatic foci in the liver); 4) excision of the affected area or tissue of the meninges (in the presence of solitary metastatic foci of the meninges); 5) other types of excision or destruction of the damaged area or brain tissue (in the presence of solitary metastatic foci in the brain); 6) precision resection of a segment of the lung (in the presence of solitary metastatic foci in the lungs); 7) laparoscopic salpingo-oophorectomy (prophylactic bilateral removal of appendages for hormone-dependent BC tumors in premenopausal patients); 8) total hysterectomy with appendages (for metastatic lesions of the ovaries, uterine body); 9) electrochemotherapy for intradermal metastatic lesions (combination treatment that uses the administration of chemotherapeutic drugs in association with electroporation of the cell membrane).

Contraindications to surgical treatment for BC: the patient has signs of inoperability and severe concomitant pathology; distant metastases, the presence of a disseminated tumor process; synchronously existing and widespread inoperable tumor process of another localization, for example lung cancer, etc.; chronic decompensated and/or acute functional disorders of the respiratory, cardiovascular, urinary system, gastrointestinal tract; allergy to drugs used in general anesthesia.

Also, a very important point is preventive measures for BC. Primary prevention of BC is the prevention of the disease by studying the etiological and risk factors (normalization of family life, timely implementation of childbearing, breastfeeding the baby, avoiding marriages in cases of mutual cancer). Secondary prevention of BC is the early detection and treatment of precancerous diseases of the mammary glands. Tertiary prevention is prevention, early diagnosis and treatment of relapses and metastases; using a nutritious diet rich in vitamins and proteins, giving up bad habits (smoking, drinking alcohol), preventing viral infections and concomitant diseases, regular preventive examinations with an oncologist, regular diagnostic procedures (radiography of the lungs, ultrasound of the liver, kidneys, neck lymph nodes).

Prophylactic mastectomy - risk-reducing surgeries, such as mastectomy with reconstruction, may be offered to women at risk. The risk of developing BC is reduced by approximately 90-95%, however, absolute guarantees regarding the occurrence of BC in the future are impossible. Indications for performing bilateral prophylactic mastectomy in women who do not currently have BC (in order to reduce the risk of developing primary BC): mutations of

the BRCA1 and BRCA2 genes; family history (presence of BC in first- and second-line relatives) without a proven mutation; histological risk factors are atypical ductal or lobular hyperplasia. Indications for performing prophylactic contralateral mastectomy in women with current or past BC: newly diagnosed unilateral BC stage I-II, or a history of stage I-II BC (in order to reduce the risk of developing cancer in the contralateral mammary gland and achieving symmetry with the operated mammary gland); lobular carcinoma in situ. Contraindications for use: age over 70 years; general contraindications to surgical treatment; synchronous and metachronous malignant tumors, with the exception of skin cancer [3].

Next, of course, it is necessary to discuss in detail the issue of BC screening. The key concept of BC screening is the detection of oncological pathology in the early stages, when the prognosis is most favorable and allows you to get the best long-term treatment results. A preventive examination always has advantages over a diagnostic examination when symptoms of the disease are already present. At the same time, upon receipt of the M2 and M3 indices according to the BI-RADS classification, it is possible to timely additionally examine these patients and, if necessary, take them to the dispensary record by a district mammologist with effective dispensary examinations and treatment of precancerous breast diseases. Along with this, it must be understood that the main conditions for screening for BC are the availability of trained personnel and a standardized approach to identifying the trait under study and evaluating the results. The methods used should be sufficiently simple, reliable and reproducible, and also have sufficient sensitivity and high specificity. Such qualities are fully possessed by modern digital mammography [4,5,6].

Now, regarding this pathology in our country at the republican level. BC ranks first in the structure of the frequency of malignant neoplasms in both sexes in the population with a share of 14.9% (14.7% in 2022). This situation has been stable since 2004, in addition, BC ranks first and stably remains in this position in the structure of female oncopathology.

The incidence of BC in 2023 as a whole in the country increased to 27.7 per 100 thousand of the population with a growth rate of 4.3% compared to the previous year (in 2022 - 26.5). In the structure of cases, BC ranks first in the absolute majority of regions and cities of the country [7].

The incidence of BC in 12 regions of the country is higher than the national average (27.7 per 100 thousand of the population). The top three regions by this indicator are North Kazakhstan - 45.1; East Kazakhstan - 41.7 and Karaganda - 40.4. Next come: Kostanay - 39.1; Abay - 38.1; Pavlodar - 37.5; the city of Almaty - 36.2; Akmola - 35.9; the city of Astana - 34.3; Ulytau - 33.4; West Kazakhstan - 28.7 and Aktobe - 28.4 regions. This indicator is below the national average in 8 regions: Turkestan - 11.4 (the lowest level); Zhambyl - 15.8; Mangistau - 16.7; the city of Shymkent - 17.9; Almaty - 20.0; Kyzylorda - 20.2; Atyrau - 22.5 and Zhetysay - 22.8 per 100 thousand population. Mortality from this pathology was 5.3 per 100 thousand population. In the structure of causes of death in women in 2023, this pathology continues to occupy a leading position (1st rank place), amounting to 17.3% or 1056 people (17.2% and 1060 women, respectively).

The regions with the BC mortality rate above the national average (5.3 per 100,000 population) are: East Kazakhstan - 9.6 (maximum level); Pavlodar - 8.2; the city of Almaty - 7.8; Abay - 6.7; the city of Astana - 6.5; West Kazakhstan - 6.2; Kostanay - 6.1; Karaganda and North Kazakhstan - 5.6 and Akmola - 5.5 regions of the country. The lowest rates were recorded in Turkestan - 2.3 (minimum level); Ulytau - 3.2; Aktobe - 3.4; Atyrau - 3.6; Zhetysay - 3.7; Mangistau - 4.0; Kyzylorda - 4.3; Almaty - 4.6; in the city of Shymkent - 4.7; in Zhambyl - 4.8 regions per 100 thousand population [7].

The number of deaths from BC, not registered with oncology organizations and established posthumously in the Republic of Kazakhstan in 2023 amounted to 4 people; at the same time, the specific weight was 0.1% and this is the 22nd ranking place, as in the previous year.

At the same time, the one-year mortality rate was 3.4%. At the same time, the ratio between one-year mortality and neglect (stage IV) was, as in 2022, 0.7. At the same time, we recall that the farthest from "1" is the worst ratio between the indicators of one-year mortality and neglect.

Now, regarding preventive examinations. It should be noted that during large-scale preventive examinations of the population in 2023, significantly more patients with malignant neoplasms were actively identified than in 2022. This is 25,193 patients against 23,623 patients identified in 2022, i.e. +6.6%. This is due to the further abatement of the epidemiological situation with coronavirus and the increased availability of preventive care for the population. The proportion of patients identified during routine examinations increased from 62.0% to 62.4% of the total number of patients identified per year.

The number of newly identified BC patients registered with oncology organizations in 2023 amounted to 5,426 people (5,101 in 2022).

As for preventive examinations. The absolute number of BC patients identified during routine examinations amounted to 3,072 people (2,822 a year earlier). At the same time, the proportion of those identified during routine examinations increased from 55.3% in 2022 to 56.6% in 2023. At the same time, despite the fact that the absolute number of people diagnosed with this pathology increased from 2474 to 2636 people, the proportion of patients diagnosed with BC at early (I, II) stages decreased from 87.7% to 85.8%. Of course, when analyzing the epidemiological situation, early diagnostic indicators are very important issues.

The regions where the proportion of patients with early stage I of the pathology in question is above the national average (35.8% and 9th place) include the following: Ulytau - 56.8% (the best indicator); Kyzylorda - 50.3%; Turkestan - 47.3%; the city of Shymkent - 46.0%; West Kazakhstan - 45.4%; the city of Astana - 44.6%; Mangistau - 44.2%; North Kazakhstan - 41.4%; Karaganda - 38.7%; Almaty - 38.5%; Pavlodar - 38.1% and East Kazakhstan - 36.1%. The lowest rates of early diagnosis were recorded in the Zhambyl region - only 14.0%; Atyrau - 24.4%; Akmola - 25.2%; the city of Almaty - 26.2%; Kostanay - 27.4%; Zhetysu - 31.4%; Aktobe - 35.0% and Abay - 35.7% regions of the country [7].

The average indicator in the country for detecting patients with BC at early (I and II) stages was 88.4%, and this is a high 4th rank place among all nosological forms of malignant neoplasms.

The regions where the proportion of patients with BC detected at stages I-II is above the average in the republic include the following regions: Atyrau - 94.2%; Aktobe - 92.4%; Kyzylorda - 92.3%; Pavlodar - 92.1%; the city of Shymkent - 92.0%; West Kazakhstan - 91.8%; North Kazakhstan - 91.6%; the city of Astana - 91.3%; Turkestan - 90.9%; Ulytau - 90.5%; Almaty and the city of Almaty - 89.0%; Abay - 88.5%. Mangistau region is on par with the national average. Below the national average are: Karaganda - 79.8%; Kostanay - 81.1%; Akmola - 82.4%; Zhetysu - 86.2%; East Kazakhstan - 86.6%; and Zhambyl - 87.6% of the regions [7].

As can be clearly seen from the above data, there is a very wide range in early diagnosis rates (at stage I of the disease) across the country, from very good to dismal. Of course, it is necessary to take into account migration processes and other factors affecting the early diagnostic rates, but nevertheless, the obtained results give a reason not to stop there, both for oncologists and mammologists, obstetricians-gynecologists, radiologists, and, naturally, for general practitioners, since improving the early diagnostic rates of malignant tumors, as one of the main postulates and one of the main tasks of medicine in general, continues to be relevant today. Among the visual localizations of malignant tumors in the reporting year, the proportion of seven main forms determines the picture of late diagnostics (stages III-IV) and amounts to 13.3% in total, with a decrease compared to the level of the previous year (2022 - 14.2%). At the same time, with BC, the neglect rate was 11.6% (13.8% - in 2022).

The proportion of stage IV BC among all nosological forms of malignant neoplasms was

4.3%. The following indicators were noted by regions of our country: in East Kazakhstan - 8.4% (the worst result); Karaganda - 7.4%; Mangistau - 6.2%; Kyzylorda - 5.9%; Almaty - 5.3%; Atyrau - 5.1%; Akmola and Kostanay - 5.0%. At the same time, the lowest neglect of this cancer localization was established in the West Kazakhstan region - 2.1% [7].

The morphological verification rate of the disease in the country was 99.4%. At the same time, the leaders in this aspect with a 100% indicator are Almaty, Zhambyl, Mangistau, North Kazakhstan, Ulytau regions and the city of Shymkent. Next come: the city of Astana and the Karaganda region (99.8%); East Kazakhstan (99.7%); the city of Almaty, Turkestan and Abay regions (99.6%); West Kazakhstan (99.5%). At parity with the national average are Kostanay and Atyrau regions. Then come: Aktobe (98.9%); Pavlodar (98.2%); Zhetysay (98.1%); Akmola (97.8%); Kyzylorda (97.0% - the worst indicator in the republic) regions.

The total number of patients with malignant neoplasms registered with specialized oncology organizations of the republic continued to grow and by the end of 2023 amounted to 218,186 people, with an increase of 6.0% compared to the level of the previous year (2022 - 205,822, +5.8%). The overall incidence rate of malignant neoplasms increased by 3.9%, from 1055.3 to 1096.4 per 100 thousand people. The growth of this indicator is due to both the increase in the incidence and detection of pathology, and the increase in the survival rate of cancer patients. In addition, statistical data on patients diagnosed with malignant neoplasms, who have been under observation for 5 years or more, and continue to be observed in 2023, showed that the number of patients under observation by oncological organizations in Kazakhstan for over five years continued to grow and at the end of the reporting year amounted to 117,616 people, with an increase of 6.2% (2022 - 110,790 people, +6.6%) (form. No. 7).

It is impossible to ignore such an important clinical aspect as the coverage of patients with a diagnosis of BC in the Republic of Kazakhstan with special treatment.

In 2023, the number of hospitalizations for all nosological forms of malignant tumors in the country's oncology organizations amounted to 108,252 cases (2022 - 101,095), with an increase of 7.1% compared to the previous year, which is associated with a constant increase in the number of cancer patients, improved standardization of oncology care, and the development of palliative and rehabilitation services.

At the end of 2023, the absolute number of BC patients who completed specialized treatment amounted to 3,419 people, continuing treatment - 1,729 patients. The following results were obtained in percentage terms by methods and types of treatment: 40.9% of patients received complex treatment, 21.8% received only surgical treatment, 20.0% received only drug treatment, 12.6% received combined treatment, 1.1% received only radiation treatment, 0.7% received chemoradiation treatment.

Next, regarding the five-year survival rate of patients. As for BC, at the end of 2023, 48,496 people were registered with the dispensary, or 243.7 per 100 thousand of the population. At the end of 2022, there were 45,728 patients, or 234.5 per 100 thousand of the population, respectively.

At the same time, the lethality of the observed contingents decreased slightly from 2.3% in 2022 to 2.2 in 2023.

The five-year survival rate of patients with BC was 57.7% in 2023 and 57.1% in 2022 [7].

Mass screening to identify BC patients should mainly involve healthy women without any signs of the disease or symptoms. Screening not only helps to detect hidden forms of cancer that can be treated, but also has psychological value for women. As a result of screening, women are convinced that they do not have BC, and this is the most important potential success of such programs. While the ultimate goal of screening is to reduce BC mortality, its immediate goal is to detect cancer before clinical manifestation. However, BC is a heterogeneous disease, which can significantly affect the effectiveness of screening. Screening models for BC are usually based on

the fact that the majority of detected tumors are invasive cancers in the early stage of progression. In addition, it must be taken into account that the detection of cancer (or its precursors) before clinical manifestation increases the risk of false positive diagnosis [8,9].

Mammography has a sensitivity of 95% and a specificity of 97%. These indicators decrease when examining women with denser mammary glands (young age, use of hormone therapy), with low quality mammography, and also with insufficient qualifications of the radiologist. Detection of high-grade invasive cancer by screening, when the tumor is not yet detected by clinical examination (palpation), means the possibility of reducing mortality from BC [10].

Preventive screening for early detection of BC in the Republic of Kazakhstan includes [11]:

1) mammography of both mammary glands in two projections - direct and oblique in the mammography room of the city, district polyclinic (mobile medical complex). All digital mammograms in the presence of a system for archiving and transferring medical images are copied to CDs and other electronic media and transferred to the server of the mammography room of the Cancer Center using specialized licensed software integrated between medical organizations; in case of impossibility of digital transmission - they are printed on X-ray film at a scale of 1:1 - 100% (1 patient - 1 set - 2 or 4 mammograms) with subsequent transfer to the mammography room of the Cancer Center;

2) interpretation of mammograms according to the BI-RADS classification (M0t, M0d, M1, M2, M3, M4, M5) by two or more independent radiologists of the same medical organization - double reading or different medical organizations: a radiologist of the mammography room city, district polyclinic (mobile medical complex) - the first reading, and the radiologist of the mammography room of the Cancer Center - the second reading;

3) in-depth diagnostics - targeted mammography, ultrasound examination (hereinafter - ultrasound) of the mammary glands, trepanobiopsy, including under ultrasound or stereotaxic control for histological examination, which is carried out in case of detection of pathological changes on mammograms (M0d) in the mammography room of the Cancer Center.

√ An average medical worker or a responsible person of the organization of outpatient care sends the patient for mammography to the district, city polyclinic.

√ The X-ray laboratory assistant of the mammography room of the city, district polyclinic (mobile medical complex) performs mammography, fills out a referral for double reading of mammograms and transmits the referral through information interaction.

√ Radiologist of the mammography office of the city, district polyclinic (mobile medical complex): fulfills the requirements for the safety and quality of mammographic examinations; evaluates the quality of the images provided and the correctness of the installation; performs repeated mammography in the M0t category (technical errors of mammography); determines the radiological density of the mammary glands on the ACR scale (A, B, C, D) indicating this parameter in the study protocol; conducts the first reading of mammograms with interpretation of the BI-RADS classification results. In the M0d category (undetermined or suspicious radiological changes requiring additional examination), the study protocol indicates the predominant pathology: education, asymmetry, violation of architectonics, microcalcifications; sends mammograms, electronic copies of mammograms through the archiving system and transfer of medical images to the workplace of the mammography office of the Cancer Center together with directions for double reading of mammograms; directs low-dose CT images through the system of archiving and transferring medical images to the workplace of the CT office of the Cancer Center together with copies of images recorded on CD-ROMs or other electronic media and directions for double reading.

√ The radiologist of the mammography room of the Cancer Center: evaluates the quality of the provided images and the correctness of the styling. Viewing digital X-ray images transferred to the server or on digital media (CD, DVD) is carried out on a monitor for interpreting digital X-

ray images with a resolution of at least 5 megapixels, which has a certified grayscale transmission in accordance with the DICOM standard; conducts a double (second) reading of mammograms with the interpretation of the results according to the BI-RADS classification, using, if necessary, archival images. Organizes the third reading according to indications. With double reading, an independent interpretation of the images is carried out (blinding method - the second radiologist does not know the results of the first reading); in the M0m category (technical errors in mammography), recommends repeat mammography; in the M0d category (uncertain or suspicious radiographic changes requiring additional examination), the study protocol indicates the predominant pathology: education; asymmetry, violation of architectonics, microcalcifications; recommends that the outpatient care organization, according to indications, invite the patient for in-depth diagnostics (targeted mammography, ultrasound of the mammary glands, trephine biopsy, including under ultrasound or stereotaxic control, followed by histological examination of the material); collects and archives all mammograms (films and electronic media) made as part of the examination. The shelf life of mammograms is at least 3 years after leaving the age subject to a screening study; the results of the double (second) reading are transferred to the outpatient care organizations through information exchange.

√ Indications for in-depth diagnostics are the conclusions of double reading mammograms M0d (uncertain or suspicious X-ray changes requiring additional examination).

√ In-depth diagnostics is carried out in two stages. At the first stage, ultrasound is performed, according to indications, targeted mammography, possibly with an increase (with asymmetry, violation of architectonics and the presence of microcalcifications). When visualizing a suspicious pathology (M4 and M5), the second stage is performed - trepanbiopsy, including under ultrasound control and stereotaxic control for histological examination.

√ Histological examination is carried out in the laboratory of pathomorphology or pathological bureau. Morphological interpretation of the biopsy is carried out in accordance with the recommendations of the World Health Organization.

√ Physician or responsible person of the outpatient care organization:

1) upon receipt of a mammography result according to the BI-RADS classification:

- in case of M0t (technical errors in mammography) - sends the patient for a second X-ray examination to the mammography room of the city, district polyclinic (mobile medical complex);
- with M0d (undefined or suspicious X-ray changes requiring additional examination) - sends the patient for in-depth diagnostics to the mammography room of the Cancer Center;
- with M1 (no changes detected) - recommends that the patient undergo a follow-up mammography examination after 2 years. With radiological density of the mammary glands, C and D are sent for ultrasound of the mammary glands to exclude a false-negative result of mammography;

- with M2 (benign changes), refer the patient for a consultation with an oncologist (mammologist) of the clinical diagnostic department, followed by a screening mammography examination after 2 years;

- with M3 (probable benign changes) - sends the patient for short-term dynamic radiation observation to the local doctor with the recommendation of control mammography or ultrasound in 6 months;

- with M4 (signs that cause suspicion of malignancy), M5 (practically reliable signs of malignancy) and if it is technically impossible to perform a trepanbiopsy or a biopsy is refused, a referral to an oncologist (mammologist) of the clinical diagnostic department for dynamic observation and decision on the verification of the identified pathology;

2) upon receipt of the result of a histological examination:

- benign education - refers the patient to an oncologist (mammologist) of the clinical diagnostic department for dynamic monitoring, followed by a screening mammography

examination after 2 years;

- formation with an indeterminate malignant potential or carcinoma in situ - refers the patient to the Cancer Center for consultation and treatment, followed by dynamic observation by an oncologist (mammologist) of the clinical diagnostic department at the place of her attachment;

- malignant neoplasm - refers the patient to the Cancer Center for treatment and follow-up;

3) communicates the results of the screening examination to the patient in any available way (by telephone, in writing, through electronic means of communication);

4) enters the results of double reading, in-depth diagnostics, histological examination, recommendations of the radiologist of the Cancer Center mammography room into the information system.

Establishing the size of the primary tumor is especially important in screening. Tumor size is an important criterion for evaluating the quality of screening and determining the ability of X-ray mammography to detect non-palpable tumors. Therefore, it is extremely important that pathologists measure tumor diameter as accurately as possible. The smaller the size of the primary tumor, the greater the likelihood of error in determining its size.

In 2023, the number of patients identified during screening examinations increased by 22.5%, from 2,230 to 2,731 people, as a result, the detection rate during screenings increased from 5.9 to 6.8%. During mammographic screening for BC in 2023, 918,464 women of the target group aged 40 to 70 were examined (a year earlier - 808,503 women). During mammographic screening in 2023, 1,875 cases of BC were detected (2022 - 1,570 cases). The cancer detection rate increased from 1.94 to 2.04 per 1,000 examined. The best result is in the North Kazakhstan region - 3.11 per 1,000 examined women (2022 - 2.31). High detection rates of BC were observed in Aktobe, Almaty, Atyrau, West Kazakhstan, Karaganda, Kostanay regions and in two megacities - the cities of Astana and Almaty. Low detection rates per 1000 examined, compared with the national average, were observed in Abay, Akmola, East Kazakhstan, Zhambyl, Kyzylorda, Mangistau, Pavlodar, Turkestan, Ulytau regions and the city of Shymkent. The lowest result was in Zhambyl region - 0.96 per 1000 examined women (2022 - 0.58). Compared to 2022, an increase in the detection of BC was noted in all regions, with the exception of Akmola (from 2.42 to 1.99), East Kazakhstan (from 2.21 to 1.93), West Kazakhstan (from 2.29 to 2.28), Karaganda (from 2.63 to 2.15), Pavlodar (from 2.15 to 1.51) regions, where a deterioration in results was allowed [7].

Summarizing the above, we can conclude that BC, along with lung cancer, continues to firmly occupy a leading place from year to year among all existing malignant tumors of other localizations. At the same time, taking into account a number of factors, the indicators of early diagnostics do not allow oncologists to "sleep peacefully". Despite the attitude to visually accessible localizations, the percentage of locally advanced forms of this type of tumors still remains quite high. The variability and veiled nature of symptoms, their similarity with various non-core processes (for example, the mastitis-like form of BC, often imitating mastitis), leads to the neglect of the disease. All this requires oncologists, and first of all, primary health care workers and, of course, mammologists, obstetricians and gynecologists, as well as radiologists to increase the level of oncological alertness, inform the population about early symptoms that may indicate this pathology or the onset of proliferative changes and conduct high-tech diagnostic measures, including for the purpose of differential diagnosis and, as a result, timely treatment.

Patients registered with various forms of so-called mastopathy need to regularly visit specialized specialists and, if necessary, undergo examination.

An epidemiological assessment of the situation with BC in our country allows us to say that in the regions there are sometimes significant differences not only in morbidity rates, but also in the parameters of early diagnosis and mortality from this pathology. In connection with the above, this pathology continues to be a serious problem of modern clinical oncology.

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CERVICAL CANCER: MODERN POSSIBILITIES AND PROSPECTS

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Annotation: This scientific work purposefully analyzes modern world and regional data on incidence, mortality and five-year survival rate of the most common oncological pathology of gynecological localization – cervical cancer. In addition to the issues of etiology and pathogenesis, the features of distribution, clinical manifestations, modern principles of early diagnostics and prognosis of this formidable disease for the coming decades are shown. The article reflects in detail the achieved successes and modern directions of development of prevention of this pathology in the form of vaccination against HPV and applied screening programs. A multifactorial epidemiological characteristic of this pathology in our republic is given in the context of the regions of the country.

Key words: oncology, gynecology, cervical cancer, epidemiology, incidence, human papilloma virus, screening, diagnostics, Pap test, smear for oncocytology, mortality, five-year survival rate, prognosis.

Cervical cancer (CC) is a disease that is related to visually accessible localizations, in connection with which aspects of early diagnostics have been worrying the entire oncological community for several decades. To do this, it is enough to correctly use accessible and informative methods of morphological and endoscopic diagnostics. In addition, timely detection and treatment of background and precancerous processes of the cervix can prevent the development of CC. It is known that CC is preceded for many years and even decades by precancerous lesions - cervical intraepithelial neoplasia (CIN). Timely diagnosis and treatment of CIN become the prevention of invasive CC. CIN initiates in the cervical transformation zone and is maintained by persistent infection caused by human papillomaviruses (HPV) of high carcinogenic risk. In 1980-1990, the connection between HPV and dysplasia and squamous cell cancer was clearly shown. Using hybridization methods, it was found that 80-100% of CC contain HPV DNA. A rough correlation was found between the frequency of CC and the detection of HPV in the population. Moreover, in squamous cell cancer, HPV type 16 was most often encountered (in more than 50% of cases), while HPV type 18 was more often associated with adenocarcinoma and poorly differentiated cancer. In 95% of cases, HPV is localized in the zone of transitional epithelium, where about 90% of dysplasias, which are classified as cervical precancer, occur. It is precancerous diseases, in which HPV types 16 and 18 are detected, that have the greatest risk of developing into invasive CC. Intraepithelial lesions are, in fact, stages of cervical carcinogenesis. Conventionally, three degrees are distinguished: CIN 1 (mild dysplasia); CIN 2 (moderate dysplasia); CIN 3 (severe dysplasia and pre-invasive cancer - carcinoma in situ, CIS). At the same time, there are two concepts of the occurrence of CC against the background of persistence of HPV of high carcinogenic risk. The first, classic, reflects the sequential change of CIN 1, 2, 3 to invasive cancer. The second, more recent one, suggests that CIN 2-3, which are severe intraepithelial lesions, can occur bypassing CIN 1 [1].

The diagnostic criteria for CC are as follows [2]: 1) complaints of acyclic bloody, watery, purulent discharge from the genital tract; pain in the lower abdomen and lumbar region of a pulling nature; bleeding due to menopause; 2) anamnesis: there are no pathognomonic complaints; as a rule, the disease has a pronounced pre-invasive stage, which can last from 1 year to 5 years or more; microinvasive cervical carcinoma is most often discovered during accidental presentation; the reason for women diagnosed with CC in stages Ib1-IIa2 to visit a gynecologist is bloody discharge from the genital tract; in later stages (IIb-IVa) there are complaints of pain in the lumbar region, lower abdomen; 3) physical examinations: gynecological examination (condition of the external genitalia; examination of the vagina and cervix on speculum (presence of vaginal infiltration, metastatic foci on the vaginal walls, size, condition of the cervix); presence of pathological discharge (purulent, bloody); bimanual examination (size and shape of the uterus; condition of the appendages; infiltration of the anterior and posterior vaginal fornix); 4) laboratory tests: cytological examination with Papanicolaou staining - PAP test (increase in cell size up to giant, change in the shape and number of intracellular elements, an increase in the size of the nucleus, its contours, different degrees of maturity of the nucleus and other elements of the cell, changes in the number and shape of nucleoli (pronounced cellular polymorphism, increase in cell size, pronounced hypochromia, large nuclei contain one or more nucleoli, there are glandular structures); from cancer cells in the form of rosettes, many cells in a state of mitosis); 5) instrumental studies: ultrasound of the pelvic organs (if CC is suspected, the size of the cervix will be normal or increased, its structure is heterogeneous, the condition of the uterus and ovaries is also assessed); magnetic resonance imaging of the pelvic organs (with CC, the size of the cervix will be normal or increased, its structure is heterogeneous, the condition of the uterus and ovaries is also assessed); computed tomography of the chest, abdominal cavity and pelvis (assessment of pelvic lymph nodes and retroperitoneal space, organic changes in the chest and abdominal organs); cystoscopy according to indications (for the purpose of diagnosing the germination of the

tumor process into the bladder); sigmoidoscopy or colonoscopy according to indications (for the purpose of diagnosing the spread of the tumor process to the colon or rectum); skeletal scintigraphy (prescribed for suspected bone metastases); positron emission tomography of the whole body (performed to diagnose the extent of the tumor process or to assess the dynamics of the effectiveness of special treatment).

GLOBOCAN estimates that in 2020, there were 604,000 new cases and 342,000 deaths from CC worldwide, of which 80% occurred in low- and middle-income countries, mainly in sub-Saharan Africa, South-East Asia, and Latin America and the Caribbean [3].

As noted by Torres-Roman J.S. et al. [4], CC remains a major public health problem in low- and middle-income countries. Due to the high burden of this disease, in 2020 the World Health Organization (WHO) adopted a global strategy to decrease the number of new CC cases, with the aim of maintaining an incidence rate below 4 per 100,000 women. Currently, 29 of the 47 countries (and territories) in the Latin American and Caribbean region have implemented vaccination programs for girls and almost all countries have screening services in place, and while certain screening programs in the region achieve considerable coverage, the ambitious goals set by the CC elimination strategy have yet to be achieved. Researchers evaluated the mortality trends of CC among young women from 16 Latin American and Caribbean countries (and territories) and predicted mortality rates until 2030. Downward trends were observed in Chile, Colombia, Cuba, El Salvador, Mexico, Nicaragua, Panama, and Peru for the entire period; whereas Brazil, Argentina, Chile, and Costa Rica showed initial downward trends from -0.9% to -6.2% followed by significant upward trends from 2.5 to 4.8% (for the period~ 2006-2017). In the last 4 years of study (2014-2017), Paraguay and Venezuela had the highest mortality rates, whereas Puerto Rico had the lowest mortality. By 2030, authors projected that mortality for CC will increase in some countries that were examined. Colleagues considered CC mortality in young women only because of the lack of research in the Latin American and Caribbean region, which has focused on CC mortality in general. They point out that because HPV infection is the most important risk factor for CC, younger women are likely to have experienced higher rates of HPV infection compared to older women. The authors also note that CC mortality rates among young women in Latin America and the Caribbean are higher than in Eastern Europe. While Western and Southern Europe recorded rates below 2 deaths per 100 000 population in 2017, rates were below 6 deaths per 100 000 population in Northern and Eastern Europe. In conclusion, the researchers emphasize that most countries in Latin America and the Caribbean experienced a decline in mortality rates between 1997 and 2017. The variations of the mortality rates between countries during the last period of observation can be largely explained by the timing of implementation of nation-wide screening campaigns in different time periods and the variation of public health programs within each country, among others. Despite favorable downward trend, the mortality rate in some Latin America and the Caribbean countries remains high. HPV vaccination, screening, and early diagnosis and treatment are necessary to accelerate a rapid decline in CC mortality by 2030.

As noted by Abu-Rustum N.R. et al. [5], an estimated 13,960 new cases of carcinoma of the uterine cervix (ie, CC) will be diagnosed in the United States in 2023, and an estimated 4,310 people will die of the disease. Overall, CC rates are decreasing in the United States, although incidence remains high among Hispanic/Latino, Black, and Asian populations. In 2020, the global new cases of and deaths from CC were estimated to be 604,127 and 341,831, respectively. It is the fourth most common cancer in individuals assigned female at birth worldwide, with 85% of cases occurring in developing countries, where CC is a leading cause of cancer death in individuals assigned female at birth. Squamous cell carcinoma (SCC), adenocarcinoma (AC) or adenosquamous carcinoma (ASC) are the 3 common histologies of CC. SCC accounts for approximately 80% of all CCs and AC accounts for approximately 20%. In developed countries, the substantial decline in incidence and mortality of SCC of the cervix is presumed to be the result of

effective screening and higher HPV vaccination coverage, although racial, ethnic, and geographic disparities exist. However, AC and ASC of the cervix have increased over the past 3 decades, probably because cervical cytologic screening methods are less effective for AC/ASC because the lesions are located deeper than the ectocervix. The ASC subtype is rare and accounts for approximately 5% to 6% of all cervical carcinomas. Presently, there is no difference in treatment between SCC and AC/ASC CC subtypes, although the clinical features and prognosis of disease vary considerably between these subtypes. Persistent HPV infection is a major factor in the development of CC. The incidence of CC appears to be related to the prevalence of HPV in the population. In countries with a high incidence of CC, the prevalence of chronic HPV is approximately 10% to 20%, whereas in low-incidence countries it is 5% to 10%. Screening methods using HPV testing may increase detection of adenocarcinoma. Vaccination with HPV vaccines may also decrease the incidence of both SCC and AC. In 2020, the WHO updated the Female Genital Tumors classification of CC by subdividing the CC lesions into HPV-associated and HPV-independent tumors based on new pathologic findings. Among these subtypes, HPV-associated SCC is the most prevalent, with very rare occurrences of HPV-independent SCC. The HPV-independent AC subtype has a less favorable prognosis compared with HPV-associated AC. The NCCN CC Panel acknowledges that although the prior versions of the WHO classification discussed these tumors based on morphologic features, the integration of the immunohistochemical and molecular profiles has led to a better classification system, which is now adapted in the 2020 WHO Classification of Female Genital Tumors for CC.

Screening plays an important role in improving early diagnosis and treatment outcomes for CC. According to the Guidelines for Early Diagnosis of Cancer by Ilbawi A. et al. [6], screening aims to detect unrecognized cancer or its prior lesions in a typically healthy, asymptomatic population through tests (e.g., HPV test), screenings (e.g., visual inspection of VIA with acetic acid), or other procedures that can be applied quickly and are widely available to the target population. In screening, the target population is assessed for unrecognized cancer or precancer, and most people tested will not be diagnosed with the disease. Screening should be seen as a process and not as the performance of a specific test, examination, or procedure. The screening process includes a system of informing and inviting the target population to participate; administering the screening test; following-up with test results and referral for further testing among those with abnormal test results; ensuring timely pathologic diagnosis, staging and access to effective treatment with routine evaluation to improve the process. A screening programme encompasses the process from invitation to treatment and requires planning, coordination and monitoring and evaluation.

As pointed out by Pimple S.A., Mishra G.A. et al. [7], CC is highly preventable and can be easily treated if detected at early stages. However, there is disproportionate high burden of CC incidence and mortality in low-middle income country settings that lack organized screening and prevention programs. Robust evidence for prevention and screening of CC is currently available. However, there are barriers for country specific adoption and implementation. These pose unique challenges such as organizing prevention and screening services delivery through the current health infrastructure, access to screening facilities, follow-up management and adequate linkages for confirmatory diagnosis and subsequent treatment. Overall rates of CC screening and cancer screening among women remain suboptimal in many low- and middle-income countries.

Brisson M. et al. [8] demonstrate in their work that in May, 2018, WHO issued a global call to eliminate CC as a public health problem. To inform its global strategy to accelerate CC elimination, WHO created the CC Elimination Modelling Consortium (CCEMC) to examine the following key questions: what elimination threshold should be used; what prevention strategies can lead to elimination; when could elimination be reached for different countries; and how many cancers could be averted. The current working definition of elimination is an age-standardised CC

incidence of four or fewer cases per 100 000 women-years. Alternative definitions, such as an incidence of ten or fewer cases per 100 000 women-years and an 80-90% reduction in incidence, have also been suggested. The only previous multicountry modelling study of CC elimination suggests that global elimination is possible through girls-only human papillomavirus (HPV) vaccination at 80-100% coverage with a perfectly effective 9-valent vaccine and twice-lifetime HPV-based screening. Herewith less than 30% of low- and middle-income countries have introduced HPV vaccination compared with more than 85% of high-income countries. Additionally, only about 20% of women in low- and middle-income countries have ever been screened for CC compared with more than 60% in high-income countries. Given that models necessarily include simplifying assumptions, the goal of the consortium is to use multiple models, taking into account their respective strengths and limitations, to illustrate the robustness of predictions. A systematic comparative modelling approach was used. To form the CCEMC, WHO selected three models that met the predefined eligibility criteria: HPV-ADVISE, Harvard, and Policy1-Cervix. The models projected reductions in CC incidence over time based on standardised HPV vaccination and cervical screening scenarios determined after consultations at various WHO technical expert, advisory group, and global stakeholder meetings. Three elimination thresholds were examined (CC incidence of four or fewer cases per 100 000 women-years, ten or fewer cases per 100 000 women-years, and $\geq 85\%$ reduction in incidence). The three CCEMC models (HPV-ADVISE, Harvard, and Policy1-Cervix) have been used extensively to inform recommendations on cervical screening and HPV vaccination in Australia, Canada, the UK, the USA, and at a global level [8]. Although developed independently, the models have common features. First, they are transmission-dynamic models of HPV infection and the natural history of CC. Second, they include the following components: sexual behaviour and HPV transmission, natural history of CC, vaccination, and screening, diagnosis, management, and treatment of cervical lesions and cancer. HPV transmission and cervical carcinogenesis are modelled for the HPV types in the 9-valent vaccine (HPV types 16, 18, 31, 33, 45, 52, 58) and other high-risk types. The models simulate type-specific HPV transmission through sexual activity, based on different risk groups and sexual mixing. The models reproduce the type-specific natural history of CC, from persistent HPV infection to CC via precancerous cervical lesions (cervical intraepithelial neoplasia grade 1 to 3). All models assume that HPV vaccines are prophylactic and capture post-vaccination herd effects. They can also simulate complex cervical screening and treatment algorithms at the individual level, by tracking and simulating each woman's screening history. Finally, all models were calibrated to highly stratified sexual behaviour and epidemiological data, validated to clinical trials or post-vaccination data, or both, and reproduce the age-specific CC incidence estimates from the Global Cancer Observatory (GLOBOCAN) 2018 for all 78 low- and middle-income countries.

A comparative modelling analysis by Brisson M. et al. [8], which includes projections from three independent transmission-dynamic models, provides consistent results predicting that CC can be eliminated as a public health problem by the end of the century, based on WHO's proposed elimination threshold (i.e., CC incidence of four or fewer cases per 100 000 women-years). This modelling study shows that girls-only HPV vaccination would lead to CC elimination in most low- and middle-income countries, if high coverage is reached ($>90\%$ coverage) and the vaccine provides long-term protection. However, countries with the highest CC incidence at present (>25 cases per 100 000 women-years), more than 90% of which are in sub-Saharan Africa, would not reach elimination by vaccination alone. To achieve CC elimination in all 78 low- and middle-income countries, these models predict that scale-up of both girls-only HPV vaccination and twice-lifetime screening is necessary, with 90% HPV vaccination coverage, 90% screening uptake, and long-term protection against HPV types 16, 18, 31, 33, 45, 52, and 58. If this global elimination strategy, which includes a combination of intensive scaling up of HPV vaccination and cervical screening, is implemented, the results suggest that CC elimination can be achieved in all countries by 2100. In

doing so, CC incidence would be reduced by 97% and more than 74 million cases would be averted over the next century.

An interesting and important study was conducted by Simms K.T. et al. [9], who in their work modeled the global situation with CC for future decades depending on the coverage of the population with HPV vaccination and screening. In this study, the authors aimed to quantify the potential cumulative effect of scaled up global vaccination and screening coverage on the number of CC cases averted over the 50 years from 2020 to 2069, and to predict outcomes beyond 2070 to identify the earliest years by which CC rates could drop below two absolute levels that could be considered as possible elimination thresholds-the rare cancer threshold (six new cases per 100 000 women per year, which has been observed in only a few countries), and a lower threshold of four new cases per 100 000 women per year. In this statistical trend study and modeling, our colleagues conducted did a statistical analysis of existing trends in CC worldwide using high-quality cancer registry data included in the Cancer Incidence in Five Continents series published by the International Agency for Research on Cancer. Next, the authors used the comprehensive and extensively validated simulation platform, Policy1-Cervix, to do a dynamic multicohort modelled analysis of the impact of potential scale-up scenarios for CC prevention, in order to predict the future incidence rates and burden of CC. Data are presented globally, by Human Development Index (HDI) category, and at the individual country level. As a result of the study, the following conclusions were drawn. In the absence of further intervention, there would be 44.4 million CC cases diagnosed globally over the period 2020-2069, with almost two-thirds of cases occurring in low-HDI or medium-HDI countries. Rapid vaccination scale-up to 80-100% coverage globally by 2020 with a broad-spectrum HPV vaccine could avert 6.7-7.7 million cases in this period, but more than half of these cases will be averted after 2060. Implementation of HPV-based screening twice per lifetime at age 35 years and 45 years in all low- or middle-income countries with 70% coverage globally will bring forward the effects of prevention and avert a total of 12.5-13.4 million cases in the next 50 years. Rapid scale-up of combined high-coverage screening and vaccination from 2020 onwards would result in average annual CC incidence declining to less than six new cases per 100 000 individuals by 2045-2049 for very-high-HDI countries, 2055-2059 for high-HDI countries, 2065-2069 for medium-HDI countries, and 2085-2089 for low-HDI countries, and to less than four cases per 100.000 by 2055-2059 for very-high-HDI countries, 2065-2069 for high-HDI countries, 2070-2079 for medium-HDI countries, and 2090-2100 or beyond for low-HDI countries. However, rates of less than four new cases per 100 000 would not be achieved in all individual low-HDI countries by the end of the century. If delivery of vaccination and screening is more gradually scaled up over the period 2020-2050 (eg, 20-45% vaccination coverage and 25-70% once-per-lifetime screening coverage by 2030, increasing to 40-90% vaccination coverage and 90% once-per-lifetime screening coverage by 2050, when considered as average coverage rates across HDI categories), end of the century incidence rates will be reduced by a lesser amount. In this scenario, average CC incidence rates will decline to 0.8 cases per 100 000 for very-high-HDI countries, 1.3 per 100 000 for high-HDI countries, 4.4 per 100 000 for medium-HDI countries, and 14 per 100 000 for low-HDI countries, by the end of the century. At the same time, the researchers emphasize that more than 44 million women will be diagnosed with CC in the next 50 years if primary and secondary prevention programmes are not implemented in low- or middle-income countries. If high coverage vaccination can be implemented quickly, a substantial effect on the burden of disease will be seen after three to four decades, but nearer-term impact will require delivery of cervical screening to older cohorts who will not benefit from HPV vaccination. Widespread coverage of both HPV vaccination and cervical screening from 2020 onwards has the potential to avert up to 12.5-13.4 million CC cases by 2069, and could achieve average CC incidence of around four per 100 000 women per year or less, for all country HDI categories, by the end of the century.

In our country, according to Decree of the Government of the Republic of Kazakhstan dated

February 20, 2024 No. 102 [10], the list of diseases against which mandatory preventive vaccinations are carried out as part of the guaranteed volume of medical care at the expense of the republican budget includes routine preventive vaccinations against diseases caused by HPV (Annex 1). According to Annex 2 of this Resolution, girls aged 11 and 11.5 years will be vaccinated.

Now, as for this pathology in our republic. CC in the structure of all malignant tumors of both sexes of the population in 2022 took 6th place with a share of 5.51% (2021 - 4th place, 5.54%), in women - stable 2nd place - 9.7% (9.7%) [11].

The incidence rate per 100 thousand population increased from 9.4 to 9.92. In 10 regions of the republic, the incidence rate is higher than the national average: Pavlodar - 17.2 per 100 thousand people (2021 – 16.7) – the highest level, East Kazakhstan – 14.3 (10.8), North Kazakhstan – 14.3 (10.2), Atyrau – 13.2 (13.8), Zhetysu - 11.7, Karaganda - 11.7 (12.0), Abay - 11.1, Akmola - 11.1 (11.9), Mangistau - 11.1 (9.7), Kostanay - 10.8 (10.6) regions.

Low incidence rates in Zhambyl region - 5.8 per 100 thousand population (5.7), Turkestan region - 6.1 (5.2), Aktobe region - 8.3 (11.6), Kyzylorda region - 8.5 (8.2) areas.

CC in the structure of causes of death from malignant tumors of the population of both sexes in 2022 rose from 9th to 8th position, with a share of 4.6% (2021 - 4.3%), mortality from CC is stable at 3.1 per 100 thousand population (3.1).

The mortality rate from CC in 10 regions is higher than the national average: Akmola - 4.2 per 100 thousand population (2021 - 3.1) - maximum level, West Kazakhstan - 4.1 (4.8), Pavlodar - 3.8 (5.6), Almaty – 3.7 (2.5), Zhetysu – 3.7, Atyrau – 3.4 (4.0), East Kazakhstan – 3.3 (3.8), Karaganda - 3.2 (4.7), Kostanay - 3.2 (2.4) regions and Almaty city - 3.4 (2.9).

Below the national average mortality rate was registered in the Kyzylorda region - 1.7 (3.5) - the best result; North Kazakhstan - 2.0 (2.6), Aktobe - 2.2 (3.0), Turkestan - 2.3 (2.2), Mangystau - 2.8 (3.0), cities of Astana, Shymkent – and Abay region - 2.9 per 100 thousand population [11].

In 12 regions, a 100% level of morphological verification of the diagnosis is ensured. The lowest or worst indicator for the third year in a row was recorded in the Kyzylorda region - 94.3%. Below the national average, this figure was noted in Akmola - 98.8%, Atyrau - 98.9%, Kostanay - 98.9%, Mangistau - 97.6%, Pavlodar - 96.6% regions and Almaty city - 98.5 %.

In a number of regions, the frequency of diagnosis of stage I-II CC was lower than the national average (88.1%) - in Akmola - 76.2% - the worst result in the country, in Karaganda - 77.2%, Pavlodar - 81.3%, Zhetysu - 82.9%, Abay - 83.8%, Kostanay - 84.3%, Aktobe - 85.5%, West Kazakhstan - 85.7% regions. In the Atyrau region there is a 100% result.

The proportion of stage IV CC is higher than the republican average (2.7%) in the following regions: the worst result is in the Zhetysu region - 6.1%; next come: Karaganda - 5.1% (2021 - 5.6%), Akmola - 4.8% (2.3%), Kostanay - 4.5% (4.4%), North Kazakhstan - 3.9% (7.4%), Shymkent city - 3.8% (5.9%), Almaty - 3.7% (5.1%), Almaty city - 3.6% (1.8%), Zhambyl - 2.9% (0.0) regions. No advanced forms were registered in 3 regions. The lowest neglect is in the East Kazakhstan region - 1.0% (0.7%).

Indicators of late diagnosis of this pathology, as visually accessible localization (III-IV stages) are higher than the national average - 11.9% (15.4% in 2021) were noted in the Akmola region - 23.8% (2021 - 26.4 %) - worst result; Karaganda - 22.8% (35.2%), Pavlodar - 18.8% (20.8%), Zhetysu - 17.1% (24.2%), Abay - 16.2% (12.8%), Kostanay - 14.6% (15.6%), Aktobe - 14.5% (9.6%), West Kazakhstan - 14.3% (32.4%) regions. The least neglect is in the Mangistau region - 6.0% (20.8%).

Across the country, the five-year survival rate of patients with CC registered in 2018 was 59.9% in 2022, with a decrease from the level of 2021 (67.5% for those registered in 2017), and with a significant range in by region, from the maximum – 72.9% (2021 – 70.7%) in the North Kazakhstan region, to the minimum – 34.9% (64.4%) in the Atyrau region [11].

Next, regarding CC screening. CC screening is a periodic, comprehensive examination of women of a certain age group as part of a special medical program to prevent and reduce

incidence and mortality from CC.

Type of screening - population. The purpose of screening is to identify pre-invasive diseases of the cervix with subsequent recovery. The screening method is a cytological examination of a smear for oncocytology from the cervix (traditional and liquid cytology) - Pap test. Interval - 1 time in 4 years. Target group: women aged 30-70 years who are not registered in the dispensary for CC. The expected results are a decrease in incidence and mortality from CC.

Screening steps:

1) Preparatory - formation of target groups, information support and invitation to screening. The preparatory stage is carried out by the nurses of the primary health care organization responsible for preventive measures and includes: annual compilation of a list of women subject to screening in the coming year by November 15 of the current year, followed by monthly correction; informing target groups of the female population about the need for screening; screening invitation; ensure timely screening.

2) Screening - filling out a statistical card of a preventive medical examination (screening) of an outpatient (form 025-08/y), a register of patients subject to cytological screening and taking material for cytological examination from the cervix. The screening examination of the target groups of the female population is carried out by a specially trained midwife of the primary health care organization.

3) The final one is obtaining the results of cytology, informing the woman and developing further management tactics, fill out accounting and reporting statistical documentation. Responsible for the final stage of screening is the obstetrician-gynecologist of primary health care [12].

Cytological screening of CC is a complex of organizational and medical measures aimed at early detection of precancerous and neoplastic diseases of this localization and at reducing the mortality of this cohort of patients. For traditional cytology, a smear containing 8-12 thousand cells of stratified squamous epithelium (including cells of metaplastic epithelium) is considered adequate; for liquid cytology - 5 thousand cells. For both methods, the number of cells of endocervical epithelium and/or metaplastic epithelium (from the transformation zone) must be at least 10 (single or in clusters). If more than 75% of the cells of the stratified squamous epithelium are covered with erythrocytes, leukocytes, etc., then the quality of the smear is considered unsatisfactory.

Interpretation of the results of a cytological study is carried out according to the Bethesda-terminology cytological system:

Intraepithelial changes and malignant processes are absent (NILM). This group includes cytological conclusions about the normal state of the epithelium, as well as the presence of various non-neoplastic diseases. Normally, squamous epithelial cells, groups of cells of columnar epithelium and metaplastic epithelium, a small number of leukocytes, and rod/mixed microflora are found in preparations. In the presence of non-neoplastic processes, their nature and, if possible, the cause are specified: atrophic changes, reactive changes associated with inflammation, including typical regeneration. In addition, the presence of microorganisms is indicated: *Trichomonas vaginalis*, fungi, morphologically corresponding to *Candida* spp., bacterial vaginosis, cellular changes corresponding to the defeat of Herpes simplex virus, squamous epithelial cells with atypia of unknown significance (ASC-US), squamous epithelial cells with atypia of unclear significance, not excluding the presence of a high degree of intraepithelial changes (ASC-H). Low-grade squamous intraepithelial changes (LSIL) include lesions associated with HPV and CIN I, high-grade squamous intraepithelial changes (HSIL) include CIN II, CIN III, carcinoma in situ and cases suspected of invasion, squamous cell carcinoma, cervical (glandular) epithelium with atypia of unknown significance, cells of the cervical (glandular) epithelium, possibly neoplasia, endocervical adenocarcinoma in situ, endocervical adenocarcinoma, endometrial

adenocarcinoma, secondary adenocarcinoma, unclassified carcinoma, other malignant tumors.

There are certain features when taking material for oncocytology: firstly, the examined woman should be informed about the exclusion of sexual intercourse, vaginal manipulations, including douching, baths, tampons, etc. 2 days prior to sampling. Taking material for cytological examination is carried out by the midwife of the examination room of the department of medical examinations of the primary health care organization: the traditional method (2 glasses - with obligatory fixation in 96% alcohol, it is preferable to use glass slides with a polished edge, which are easily marked) or the liquid cytology method (one container with stabilizing liquid); the code or surname of the patient, identical to the code and surname in the form for sending material for cytological examination, should be clearly marked on the glasses or container [12].

At the same time, when using the traditional method, the biomaterial is delivered to the cytological laboratory as soon as possible after its collection in specialized containers for glass slides with 96% alcohol. If there are visible visual changes in the cervix, then the material is taken from the woman and, without waiting for the results, she is referred for an examination by an obstetrician-gynecologist.

A cytological study is carried out in centralized cytological laboratories at oncological institutions, where an archive of cytological preparations of patients involved in the screening examination is formed, regardless of the result, for a period of at least 10 years with the formation of a computer database.

What material and technical equipment is required to take material for a Pap test? It is as follows: soap and water for washing hands, a light source for cervical examination, a gynecological chair, a disinfected speculum and gloves, an Eyre spatula, a glass slide and a marking pen, a container with a stabilizing solution for liquid cytology, a fixative solution (96% alcohol), a container with warm water for lubricating and warming the vaginal mirrors, a 0.5% chlorine solution for disinfecting gloves and instruments, or another approved for this purpose. And, of course, the registration form itself.

For carrying out liquid cytology, you additionally need: a disposable cervix brush, a container with a stabilizing solution for liquid cytology, and a fixing solution.

At the same time, a smear for oncocytology cannot be taken: during menstruation, earlier than 48 hours after sexual contact or after using lubricants, vinegar or Lugol solution, tampons or spermicides, after vaginal examination or douching, and also during the treatment of genital infection.

The results of CC screening are as follows. In 2022, 771,282 women of the target group aged 30 to 70 years were examined during cytological screening (in 2021 - 757,454).

During cytological screening in 2022, 392 cases of CC were identified (319 in 2021). The detection rate increased from 0.42 to 0.51 per 1000 women examined [11].

High detection of CC during screening is ensured in Aktobe, Almaty, Atyrau (1.59 is the best result), East Kazakhstan, Kyzylorda, Pavlodar, North Kazakhstan, Turkestan regions and Shymkent city.

The detection rate in these regions ranges from 0.55 to 1.59 per 1000 women examined. Compared to 2021, there is an increase in detection in 10 regions, with the exception of Akmola, Aktobe, Zhambyl, Kostanay, Mangistau, North Kazakhstan regions and Shymkent city. The worst result in Astana city is 0.15 per 1000 women examined.

Cytologically, cervical precancer was detected in 1.16% of those examined (2021 – 0.99%). The detection rate of precancer below 0.6% (the planned indicator for 2022, according to the Comprehensive Plan) was noted in Aktobe, Karaganda and Kostanay regions.

A high proportion of stage I CC (70% or more) was detected in 6 regions of the country (in 8 in 2021): Kostanay, Mangistau (94.7% - best result), North Kazakhstan, Turkestan regions, cities of Almaty and Astana. Low levels of early detection of CC (below 50%) were not observed in any

region.

Localized processes (stages I-II) were identified in 99.2% of all cases of detected cancer (96.5% in 2021). In the Akmola and Karaganda regions, cases of SS were identified not only in the localized, but also in the widespread stages of the process. A total of 3 cases of SS were identified in stage III and not a single case in stage IV (in 2021 - 11 and 0, respectively) [11].

In conclusion, it can be stated that CC occupies one of the leading places among all existing nosological forms of malignant tumors. At the same time, despite the small percentage of patients detected at stages III and IV of the disease, as a visually accessible localization, taking into account a number of factors, early diagnostic indicators do not allow oncologists and gynecologists to “sleep peacefully.” Variability, nonspecificity and veiledness of symptoms, its similarity with various non-tumor processes, leads to neglect of the tumor process. All this requires both oncologists and, first of all, primary health care workers and, of course, gynecologists to increase the level of oncological alertness, inform the population about early symptoms that may indicate this pathology or the onset of proliferative changes and carrying out high-tech diagnostic measures and, as a result, timely treatment. Patients at risk with precancerous diseases should undergo routine examination within the prescribed time frame. The development of screening technologies and methods of primary prevention in the form of vaccination of adolescent girls against HPV allows us to hope for a reduction in the incidence of this disease in the female population.

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Historical Sciences

WELL – KNOWN HISTORIAN SARA ASHURBEYLI AND MAIDEN TOWERS, A RARE PEARL OF AZERBAIJANI CULTURE

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ABSTRACT

The study of the history of antiquity and the Middle Ages is carried out on the basis of various sources. Humanity has always shown great interest in the study and study of these periods and in the course of research it has focused more on the periods marked. In this regard, different scientists and researchers used different sources when conducting research. The creativity of Sara Ashurbeyli, a well – known Azerbaijani scientist, prominent researcher, is of great interest for this reason. Ashurbeyli's creativity is very diverse. Whether the monographs he wrote, the scientific articles he published, or the speeches he made at meetings of various levels, this scientist was notable for the versatility of both his own and the research he conducted. In Sara Ashurbeyli's studies on the history of both the state of Shirvanshahs and the city of Baku, a fairly amount of material was collected, thoroughly studied, numerous medieval sources were put into scientific circulation and ideas, theories and evidence were put forward that do not lose their relevance today.

Keywords: Azerbaijan, Sara Ashurbeyli, Baku, monograph, scientist, creativity

Sara Ashurbeyli, who is considered a “living witness” of the events of the XX century and deals with the history of the ancient and Middle Ages, played an important role in the study of different periods of the history of Azerbaijan [Image 1].

Both his monographs and individual articles are of great importance in the study of various problems of our history. One of the important aspects of Ashurbeyli's work was related to historical monuments.



Image 1. Azerbaijani historian Ashurbeyli Sara Balabey

Baku occupies an important place among the cities of Azerbaijan with its historical monuments. Located off the main trade routes and the main from which the invaders arrived and surrounded by semi – desert steppes, Baku has preserved a large number of historical and architectural monuments of different periods of history.

After the Mongol invasion, there were interruptions in the construction of large structures from the 30s of the XIII Century to the end of the century. In his “Seyahetname” (“Travelogue”) Nizari Kuhistani [Image 2], who went on a trip to Arran and Georgia, mentioned Baku (1281) as a place of exile for nobles and nobles who were unwelcome and discredited during the Mongol period, and that the city did not recover from the devastating wars between the elkanis and the khans of the Golden Horde [4, 129].

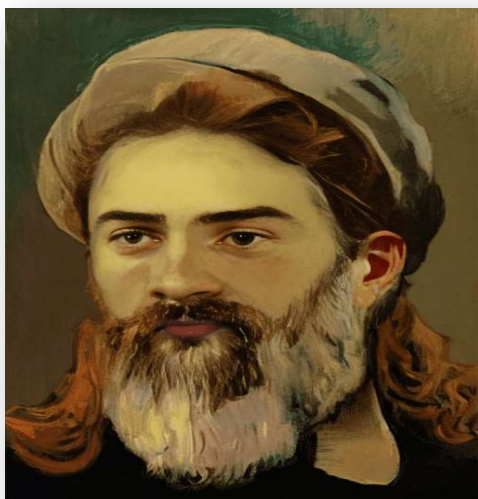
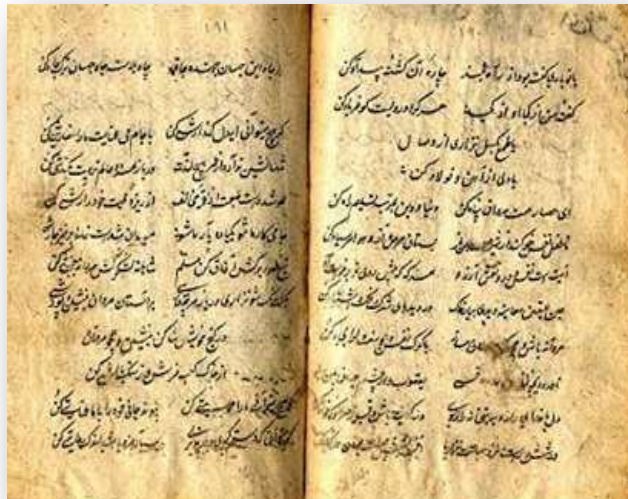


Image 2. Imaginary Portrait of Hakim Nizari Quhistani and his work “Seyahetname” (“Travelogue”)

It would be wrong to associate such an attitude to the city only with its geographical position. Sara Ashurbeyli suggested that the city where the Maiden Tower is located is connected with ancient religions, the main temple is located here and that there is a connection between the Legends spread in Baku and the formation of this fortress, which probably dates back to the period of the spread of Sassanids and Zoroastrianism in Absheron.

In XI – XII centuries, the function of the Maiden Tower was changed into a defensive fortress where feudal lords and garrisons took refuge during military operations and entered the city's defense system [Image 3] [4, 133].

The fact that the walls of the Maiden Tower are 5 m thick at the bottom and 4 m thick at the top and have a very high height, shows that the idea of evaluating it as a hut (M.Nabiyev), an observatory (G.Ahmadov), etc. is not correct.

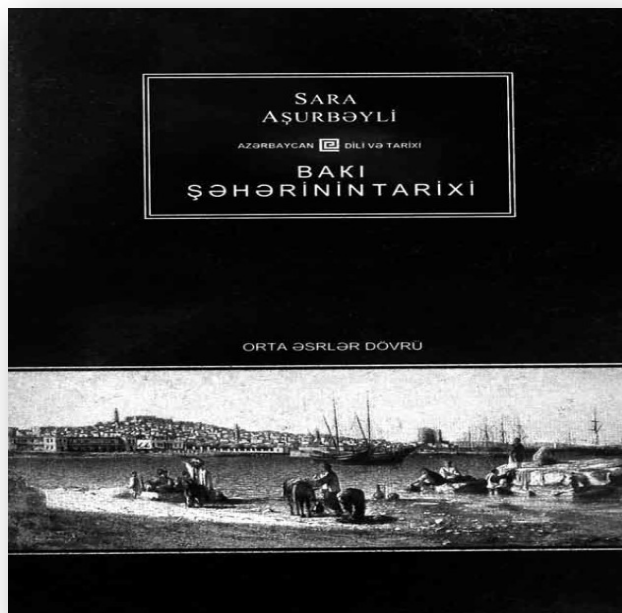


Image 3. Sara Ashurbeyli. History of the city of Baku

In 1403, the medieval author Abd ar – Rashid al – Bakuvi wrote that Baku had two impregnable stone fortresses. The larger of them was near the sea and was probably the Sabayil fortress on Baku, which the Mongols were unable to capture [Image 4].

A.Bakuvi reported about the second high fortress that one side of the fortress was destroyed by a mortar when the Mongols besieged the city [1, 89].

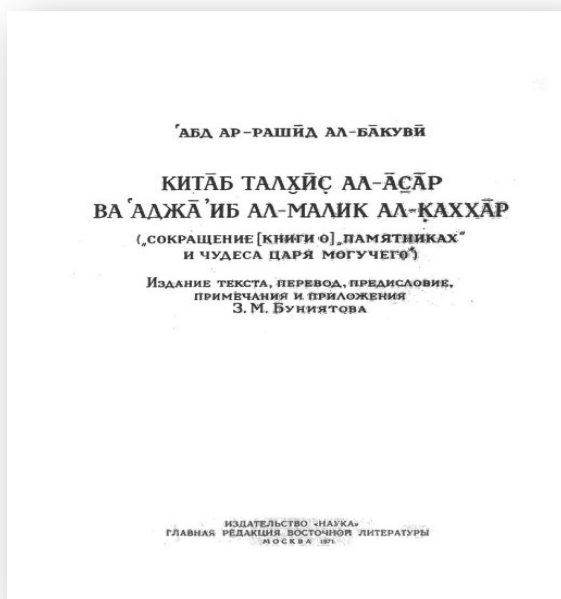


Image 4. Abd ar – Rashid al – Bakuvi. Kitab Talhis al – asar wa ajaib al – malik al – gahhar

S.Ashurbeyli, who attributed this information to the Maiden's Tower, stated that the upper part of the tower, which currently has no mashikuls on it, has been destroyed and changed many times. This magnificent tower, which is considered the oldest in terms of its date of creation, was selected among the Absheron monuments in terms of its volume and was considered the main fortress among the defensive fortifications of Baku and the surrounding areas from the 12th century.

One of the Maiden Towers is the Gulustan Tower, which is considered one of the important monuments of the Shirvanshahs state. In this regard, the study of the history of the Shirvanshahs state, its involvement in the field of culture, along with its socio – economic and political history, is one of the main features of S.Ashurbeyli's work "The State of the Shirvanshahs" [Image 5].



Image 5. Sara Ashurbeyli. The State of the Shirvanshans

Analyzing the monuments of the Shirvanshahs' state, the author noted that Chirakkala, built on a huge rock, reminded of the Maiden Tower in Baku. Touching on the problem of the composition of the population living in the Shirvanshahs' state and their reflection in toponyms, the author showed that Ijmakhs lived around Shamakhi and Bakhans, etc. lived in Baku and Absheron.

Based on archaeological data, S.Ashurbeyli noted that before the arab invasion, the population of Baku and Absheron probably worshiped Zoroastrianism and were associated with the Maiden Tower. S.Ashurbeyli, who preferred the connection of the Shamakhi toponym with the name of the Ijmakh tribe, attributed the migration of the population to the Gulustan Tower [Image 6], popularly known as the Maiden Tower, to the fact that the Khinisli settlement collapsed as a result of a arab attack or a devastating earthquake in the 7th – 8th centuries [8, 27; 29; 43; 45].

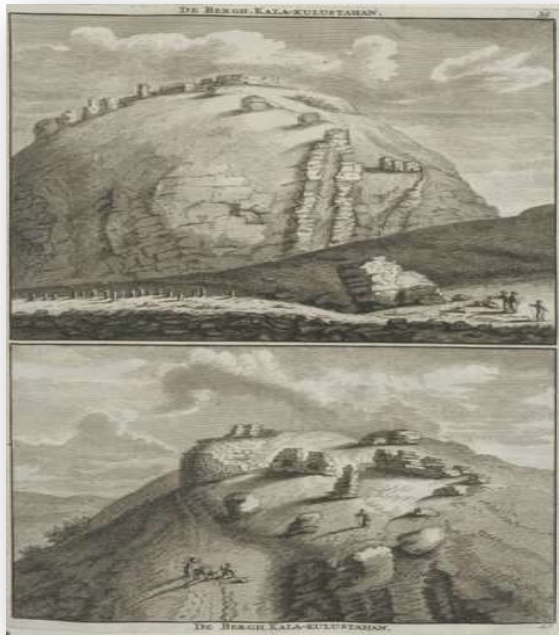


Image 6. Shamakhi Gulistan Fortress

Numerous examples of ancient culture and art have been discovered in the territory of the Shirvanshahs' state. In addition to the various depictions in Gobustan, monumental stone sculptures, female and male figurines can also be added to this. Interesting figurines, 5 – 20 sm high, dating back to the period of the pit tombs, have been discovered in Azerbaijan. These are mainly female figurines made of red clay and well – fired. Although the dimensions of these figures are given realistically, the figurines are made in a rough and schematic manner.

These figures, dated to the end of the 1st millennium BC – the first centuries of the era, are similar to the female figures in the Gobustan rock carvings and are associated with the worship of the goddess of fertility [8, 67]. Temples were erected in honor of this goddess (Strabon). "In every place where there was a temple of this goddess, according to custom, Sak festivals similar to the

Bacchic festival were held". The Medes also worshiped this goddess. " Here they gave male and female slaves to the service of the goddess... The famous people of the tribe gave their daughters to the service of the goddess" [8, 484; 501; 524].

The worship of the goddess of fertility was widespread among the local tribes of Shirvan. In the "History of Albania" it is stated that this goddess, called Aphrodite (M.Kalankaytuklu), was worshiped, but her local name was not mentioned. Although many clay female and male figures have been found in Central Asia, Dagestan, Georgia, Iran, etc., in the figurines found in Azerbaijan, along with a realistic style of perception, extreme abstraction and simplicity of form were observed and there was no unified style [9, 25 – 27].

Based on this idea of Y.A.Pakhomov, S.Ashurbeyli showed that for the above reasons, all modern aesthetic categories can be found here, from extreme naturalism to developed formalism, expressionism and impressionism [7, 85]. German scientist E.Herzfeld connected these figurines with the religious ideas of ancient times and considered female figurines to be the embodiment of the mother goddess in the primitive – communal society of the matriarchal period. One of the versions regarding the creation of Maiden Towers in Azerbaijan is also associated with this goddess.

Information about the Maiden Towers is also found in S.Ashurbeyli's articles. The author approached the issue from a broader perspective and conducted extensive research in his articles on the city of Baku, where the largest Maiden Tower in Azerbaijan [Image 7] was built, the meaning of its name, the ancient history of the city, historical monuments, etc. [2; 3, 76-77].

One of these articles is noteworthy [6, 39 – 51]. In the article, S.Ashurbeyli, who analyzed the information provided by ancient and medieval authors, gave a detailed explanation of the territories of Albania and Arran, carefully examined the toponyms "Rotibaqa", "Baganrod", "Atli – Bagavan", "Ateshi – Bagavan", etc., and substantiated their connection with ancient fire worshipers [6, 42-43].



Image 7. Baku Maiden Tower

According to the author, during the Sassanid period and long before them, cities and settlements existed in the northeastern and southern parts of Azerbaijan and Iran under the names "Bagavan", "Baga – ran", "Bag – ni", "Baga – yaric", etc. In each of these settlements, unquenchable fires burned and temples and fire – worshiping temples were located [5, 45].

Indian scholar pars Modi, who visited Baku in 1925, noted that there were many temples of fire worshipers on the western shores of the Caspian Sea in ancient Indian inscriptions. S. Ashurbeyli historical sources include the information of the Arab author Masudi, the ambassador

sent by the Caliph to the Uyghur Khagan Begyu – Khan (862), Muhammad ibn Bakra's "Jahan – Nama" (1210) and others referring to his works, he spoke about the height of the Baku Maiden Tower, its outpost, internal structure, water well and stone with inscriptions on it and showed several times that it has no analogues in Eastern countries [5, 45; 47; 282]. Determining the character of the Maiden Tower, the author unequivocally refuted the idea that it was a defensive structure. S.Ashurbeyli about Maiden Tower I.Berezin, S.Gmelin and others analyzing the legends they cited as an example, he showed that it would be correct to attribute its construction to more ancient times, since this monument already existed during the reign of the Sassanids. Based on the geographical dictionary published in Venice in 1903 – 1905, he informed about the construction of a church in Baku in the XVIII century on the site temples of the God of Fire and the Sea [6, 48].

The worship of fire, which has ancient roots, is also observed in modern times. Surakhani "Ateshgah" is located not far from the sea and near oil fields. This monument was built by an indian community belonging to the sikh caste, most of whose members originated in northern India. The temple of fire worshipers Zoroastrians who worshiped the Holy fire in Surakhani fell after the invasion of Azerbaijan by the Arabs and the conversion of the population to islam. After the XV century, the worship of fire here was revived with the development of economic and cultural ties with India. In the eighteenth century, indian merchants built a temple of fire and cells for pilgrims in Surakhani. The temple has survived to this day in the same way. According to J.Sharden, both gebr – pars and indian fire worshipers came to this temple of fire. The Persian inscription in cell 8 of ateshgah testifies that the iranian Zoroastrians came here in 1745 and indicates that the temple was a fire temple of the pre – indian Zoroastrians [4, 287-290].

Sara Ashurbeyli, famous historian of Azerbaijan, who knows more than seven languages, author of 8 monographs and more than 100 scientific articles, attracted attention with one more aspect. He wrote each of his works only on the basis of historical facts, managed to read the sources from the original. The people who communicated with him never quarreled with this scientist who had serious and very deep knowledge, treated him as a pure and bright person and were proud to communicate with him. This scientist, described by Azerbaijani historian Ziya Bunyadov as a "woman with Napoleonic character" [10], has achieved significant achievements in all areas she has been engaged in. All this indicates that it is extremely important to constantly refer to the works of this man, scientist and teacher, who occupies a special place among Azerbaijani historians, to study them.

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Art History

THE ROLE OF THE OBOE IN THE KAZAKH FOLK ORCHESTRA¹

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Contemporary musicology pays considerable attention to the study of timbral characteristics and the artistic functions of wind instruments. Among them, the oboe occupies a special place – an instrument with a unique expressive nature and a rich history, which has been an important part of the world’s musical culture for centuries.

Today, research on the oboe encompasses a wide range of areas, from the analysis of solo and chamber repertoire to the study of its functions within the symphony orchestra. However, in the context of Kazakh musical culture, this instrument has been studied insufficiently. This article examines the characteristics of the oboe’s sound in the Kazakh folk orchestra, as well as its role in the interpretation of kuys.

The formation of the Kazakh folk orchestra in 1934 under the leadership of Akhmet Zhubanov marked an important stage in the development of Kazakhstan’s musical culture. The new ensemble not only unified national instruments into a single artistic system but also incorporated certain elements of European orchestral practice. This allowed for an expansion of its timbral possibilities and gave the folk orchestra’s sound a richness of color characteristic of symphonic orchestration. A special place in this renewed orchestral palette was occupied by the oboe, which possesses a unique timbral quality and expressive power.

Its sound is distinguished by piercing expressiveness and a special lyrical melodiousness, which makes the oboe one of the most individualized “voices” of the orchestra. Within the Kazakh folk orchestra, the instrument acquired particular significance, as its timbre harmoniously corresponds to the lyrical nature of the national melodies and the intonations of the Kazakh vocal tradition. These qualities predetermined the oboe’s diverse functions within the orchestral texture.

In the Kazakh folk orchestra, the oboe performs several key functions:

Solo function	Melodic dominant	Intonational proximity to folk tradition
Firstly, due to its bright timbral color, it is often used in solo passages. Its sound is capable of conveying a wide range of emotional states – from pensiveness and sorrow to lighthearted lyricism.	Secondly, in a polyphonic texture, the oboe often carries the upper voice, thereby highlighting the main theme amidst the rich sound of plucked and bowed instruments in the orchestra. This role makes it an important carrier of the melodic line.	Thirdly, the timbral characteristics and playing techniques of the oboe allow it to render long, lyrical melodic lines that are close in character to Kazakh songs and kuys. This connects the instrument to the national musical tradition and gives its sound a special emotional depth.

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The functions of the oboe are particularly evident in the interpretation of kuys – a genre that occupies a central place in Kazakh musical tradition. In orchestral arrangements of kuys, the oboe often serves as the leading melodic voice, emphasizing the length and expressiveness of the main theme. As Ahmet Zhubanov notes: “The kuy is a large and important area of the spiritual culture of the Kazakhs; culture cannot remain at the same level forever, it changes along with society, either degrading or improving. This becomes even more noticeable as we approach our century. In the nineteenth century, Kazakh instrumental music developed particularly intensively. At this time, kuys appeared not only legendary but also composed in response to contemporary events, kuys with specific, identifiable authors” [1, 14, 15]. This observation highlights that the kuy is a living and evolving genre, requiring a flexible approach in orchestral interpretation. Thanks to its timbre, the oboe is able to reproduce the characteristic intonations of dombra and kobyz melodies, bringing the orchestral sound closer to the natural lyricism of folk performance. Moreover, following Zhubanov’s practice, many pieces originally written for kobyz in orchestral arrangements were adapted for the oboe, further emphasizing its importance in conveying national melodic content. Thus, in the Kazakh folk orchestra, the oboe becomes not merely a borrowed European instrument, but a full-fledged carrier of national intonation and expressiveness.

In addition to its solo and melodic roles, the oboe in the folk orchestra performs an important ensemble function. Its timbre allows it to connect the sounds of plucked and bowed instruments, creating smooth transitions between different musical groups. This contributes to a more cohesive orchestral texture and makes the main melodic line clearer and more expressive.

The oboe technique in the folk orchestra involves the precise reproduction of the intonations of kuys, characteristic of the dombra and kobyz. The musician must convey the length of the melody, the subtle nuances of phrasing, and the emotional shading, which requires a high level of virtuosity and a deep understanding of the national musical tradition.

In orchestral arrangements of kuys, such as Adai and Saryarka, the oboe often carries the leading melodic line, emphasizing the characteristic length and expressiveness of the main theme. In these works, the instrument not only conveys the melody but also enhances the dynamic and harmonic contrasts, creating a rich overall sound for the entire ensemble.

Today, the oboe continues to hold an important place in Kazakh musical culture. It is used in classical orchestral arrangements as well as in modern interpretations of kuys. Its study is included in the curricula of music schools and universities, ensuring the preservation of national melodic traditions and the development of high-level performance skills.

“Adai”	“Saryarka”
In the orchestral arrangement of the kuy Adai, the oboe carries the leading melodic line and creates expressive nuances, emphasizing the dramatic character of the piece. The high register conveys bright emotional surges, while the lower and middle tones add smoothness and depth to the sound. In duets with dombras, the oboe imitates the lyricism of folk performance, preserving the extended phrases and characteristic intonations of the kuy.	In the kuy Saryarka, the oboe elaborates the melodic line, accentuating important musical moments and creating a sonic contrast with other instruments. Its timbre enhances dynamic expressiveness and emotional impact, demonstrating the instrument’s ability to adapt to traditional melodies and enrich the overall orchestral sound.

The analysis of the oboe’s use in these works allows us to identify its characteristic timbral features: a soft tone in lyrical passages, piercing expressiveness in dramatic moments, and the ability to harmonize the sound of different instrumental groups. Thanks to these qualities, the

oboe enhances the emotional perception of kuys and contributes to the preservation of national musical identity.

Contemporary composers and arrangers use the oboe to unite traditional and new musical forms. In festival programs and educational orchestras, it helps develop performance skills, instilling in young musicians a refined understanding of national melodies. The oboe maintains its significant place in Kazakh musical culture, combining European instrumental tradition with folk musical identity.

The oboe in the Kazakh folk orchestra performs multiple functions: solo, melodic, ensemble, and intonational-thematic. It unites the sounds of different instrumental groups, enhances the expressiveness of kuys, and contributes to the preservation of the national musical tradition. The instrument is not a mere borrowed element; it becomes a full-fledged carrier of national intonation and expressiveness, ensuring a harmonious and emotionally rich sound for the entire ensemble.

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TRENDS IN THE DEVELOPMENT OF MUSICOLOGY IN KAZAKHSTAN²

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Functioning within the system of various sciences, domestic musicology naturally experiences the influence of the general background and the level of development of other academic discipline – not only the humanities (social sciences), but also the natural and technical sciences-reflecting their evolution in one way or another, determining new forms of contact, and responding to the “challenges” of the time.

The striving for “interdisciplinary contacts” (L. Mazel), which corresponds to one of the essential needs of modern thought, characterizes the interaction of individual disciplines and the coordination of musicology as an independent branch of scientific knowledge.

The processes that began to emerge in the development of musicological science in Kazakhstan during the early decades (in particular, in the interaction of its methods – the historical and the logical, its levels of research-theoretical and empirical, etc.) manifested themselves in a deeper and more mature form in the 1990s. It was during this period that new research fields and directions were formed (musical Turkology, the study of informational processes in culture, etc.), as well as new emphases in the correlation of musicological disciplines (musical aesthetics, sociology, psychology, ethnopsychology, and so on).

Today, two leading trends still persist: on the one hand, the inclusion of historical research in a broader cultural context; on the other – the concretization and strengthening of interest in the analysis of particular, local phenomena as the basis for historical-theoretical generalizations (of varying levels). Both trends have had a direct impact not only on the subject matter, but also on the type of scholarly research. For the first time in the history of Kazakh musicology, works have appeared that contain a fairly complete theoretical system or an in-depth study of individual components of musical thought and language, which grow into a holistic concept.

On the scale of the field, scholarly activity, as before, differs in its focus and is realized through:

- conducting fundamental research (writing and publishing monographs, works on the history and theory of national culture – folklore, traditional and professional music);
- scholarly and academic publication of musical-poetic texts;
- the popularization of research through periodicals, other media, university lecture courses, the creation of textbooks and teaching materials for conservatories, secondary specialized, and other educational institutions.

At the same time, under the influence of external factors, the latter two areas of activity are perceived as particularly in demand and significant, while the first -being essentially

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foundational for the status of musicology as a science-remains outside consistent reflection and evaluation.

The experience of previous decades opens the way to qualitatively new research in a number of areas. The necessity of studying Kazakh music in the context of world musical art has been rather clearly realized and partially implemented. The identification and understanding of the artistic and aesthetic originality and typology of national music as part of the global artistic process determines the need for mastering vast scholarly and cultural material and updating complex musicological issues.

Within the framework of a unified concept, it is advisable to:

- identify the philosophical and aesthetic aspects of Kazakh musical culture;
- develop a system of socio-cultural criteria for the historical periodization and orientation of the development of traditional musical culture;
- define the moral and ethical constants of Kazakh music within the system of humanistic values, and theoretically and practically develop the problems of genre interaction in the musical art of Kazakhstan;
- comprehend the professional creativity of Kazakh composers as a whole, in correlation with the progressive development of Kazakh culture and the universal musical-historical process;
- substantiate, on national material, the artistic and interpretative nature of musical art, identify its main functions and forms of realization in the past and present;
- summarize and evaluate the theory and practice of Kazakhstani ethnomusicology as a leading research sector.

This direction fits into the general course of modern integrative tendencies in the development of musicology and interdisciplinary interaction. It opens up prospects for the implementation of typological research-based on the study of the specific features of the development of national cultures-which is currently being actively pursued worldwide on diverse material and in various contexts.

The experience of such research is generally in demand at the initial stages of scholarly self-determination; however, achieving a conceptual level in the framework of fundamental studies remains problematic and difficult to attain.

The focus on understanding the main trends, specific features, and prospects of the development of Kazakhstan's musical culture in the global socio-cultural and music-historical context appears methodologically and theoretically significant, both for the advancement of Kazakhstani musicology and for related sciences.

Moreover, this material may be used in the development of research programs covering even broader spatial and temporal coordinates, naturally strengthening scholarly ties with foreign academic centers.

The development of this research direction, by emphasizing the importance of interdisciplinary and complex studies, is capable of uniting the professional interests of musicologists of different generations and specializations. The release of "creative, constructive intellectual energy" (V.Gurlitt) will make it possible to consolidate the shift toward problem-oriented approaches, to outline intensive paths of development in the interconnected processes of differentiation and integration, and to solve the task of creating a qualitatively new scientific potential, ensuring breakthroughs in the leading areas of musicology in Kazakhstan.

THE CREATIVE LEGACY OF THE TOGYZTARAU KUY MASTER MUSA TEKESBAYULY¹

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In 2020, within the framework of the program “Seven facets of the Great Steppe” initiated by the First President of the Republic of Kazakhstan, Nursultan Nazarbayev, the second volume of the three-volume anthology “Ancient Motifs of the Great Steppe” entitled “Ancient instrumental motifs. Traditional kuy art” [1] was published under the editorship of Associate Professor, Candidate of Arts Ainur Kaztuganova. This publication became one of the most significant events in contemporary Kazakh kuyshi studies.

The anthology, which encompasses the kuy traditions of all regions of Kazakhstan, including local and individual schools, is remarkable for presenting not only selected works of classical kuyshi-composers but also for including names and pieces of performers that had never appeared in print before. Among the most striking examples are the second variant of Kurmangazy’s “Saryarka”, “Eski bulbul”, and the second version of Zhantore’s famous “Shalkyma”.

The publication of this anthology became possible thanks to the selection and systematization of numerous kuy recordings made during various expeditions of the M.O. Auezov Institute of Literature and Art, which had been deposited in its manuscript archive. In addition, through direct collaboration with regional kuyshis, the anthology also incorporated rarely performed or previously unknown kuys from their repertoires. Importantly, the newly introduced pieces represent all traditional schools.

This article focuses on the creative legacy of one of the kuyshis included in the anthology – Musa Tekesbayuly, a representative of the kuy tradition of the Kazakhs of the Ili Kazakh Autonomous Prefecture in the Xinjiang Uygur Autonomous Region of the People’s Republic of China. The Ili kuy tradition constitutes a vast and multifaceted branch of Kazakh musical culture. Today, the musicians of this region and their creativity have been studied to a certain extent and entered academic circulation, forming the subject of various scholarly works and kuy collections [2], [3], [4], [5], [6], [7], [8], [9], [10]. Nevertheless, Musa Tekesbayuly, a kuyshi from Togyztarau District of Ili, appears for the first time in the “Ancient motifs of the Great Steppe” anthology.

Musa Tekesbayuly (20th c.) was a kuyshi who lived in the village of Bessala in Togyztarau District of the PRC. He learned kuy performance from his father Tekesbay. His grandfather Altai was also a renowned kuyshi. Musa Tekesbayuly was a friend of Ashim Dunyshiuly; their creative exchanges and encounters remain in historical memory. Musa’s kuys such as “Zhalgyzdyn zary” (The lament of the lonely), “Tan bulbul” (The nightingale of dawn), and “Kokeibesti” have survived through his son, the kuyshi Kulanbek Musa [1, p. 437].

Let us first consider Musa Tekesbayuly’s kuy “Tan bulbul”, included in the anthology. This piece belongs to the category of dedicatory kuys. From a modal perspective, it combines pentatonic structures with elements of the Mixolydian mode. It belongs to the group of kuys with a wide range.

¹ The article was prepared within the framework of the fundamental research project BR20281009 “Topical issues of contemporary literary studies and Art studies”.

In performance, delicate strokes play a crucial role in imitating the song of the nightingale. The alternation of rapid passages with slow, melodious phrases is essential. This piece demands from the performer not only technical skill but also subtle sensitivity capable of imitating the sounds of nature. The performance style of the *kuy* demonstrates the expressive range of timbral and imitative possibilities inherent in the Kazakh *dombra* tradition.



Equally noteworthy is Musa Tekesbayuly's *kuy* "Zhalgyzdyn zary". The overall structure of this piece unfolds in a broad, slowly developing manner. The first section presents the main theme in a calm, thoughtful character. Structurally, the form can be considered as A–B–A¹, since the A section returns after the middle B section with slight modifications.

The melodic design of the *kuy* clearly bears a minor coloring. Short, recurring motifs create the impression of human sorrow and lament. The melodic development is based on a wave-like motion: ascending from lower registers to higher ones, then descending again.

This *kuy* also requires delicate execution from the performer. Special attention to sound production and the use of gentle strokes impart a highly lyrical, mournful character. Compared to "Tan Bulbul", the range of this piece is much narrower, unfolding within the span of only one octave.

In conclusion, although the two surviving *kuys* of Musa Tekesbayuly do not represent the full scope of his creative output, they reveal certain hallmarks of his individual style. We believe that his legacy will continue to attract the attention of musicologists in the future.

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