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MODERN TRENDS IN GRAPHIC DESIGN: INTERACTION OF AESTHETICS AND TECHNOLOGY

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СУЧАСНІ ТЕНДЕНЦІЇ В ГРАФІЧНОМУ ДИЗАЙНІ: ВЗАЄМОДІЯ ЕСТЕТИКИ ТА ТЕХНОЛОГІЙ

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Abstract
The article examines the main trends in modern graphic design, including the integration of artificial intelligence, 3D graphics, adaptive and inclusive design, as well as the impact of digital technologies on the aesthetics and functionality of graphic solutions. Changes in visual styles, the emergence of new design tools and their impact on brand identity are explored.

Анотація
У статті розглядаються основні тенденції сучасного графічного дизайну, зокрема інтеграція штучного інтелекту, 3D-графіки, адаптивного та інклюзивного дизайну, а також вплив цифрових технологій на естетику та функціональність графічних рішень. Досліджуються зміни у візуальних стилях, поява нових дизайнерських інструментів та їхній вплив на створення бренд-ідентичності.

Keywords: graphic design, aesthetics, functionality, innovative technologies, interactivity, 3D graphics.
Ключові слова: графічний дизайн, естетика, функціональність, інноваційні технології, інтерактивність, 3D-графіка.

Постановка проблеми та аналіз основних досліджень. З моменту свого виникнення графічний дизайн зазнав значних трансформацій та став потужним інструментом для створення справжніх шедеврів. В сучасному світі в графічному дизайні активно використовуються цифрові технології, що робить його ще більш популярним та актуальним.

На сьогоднішній день графічний дизайн виступає однією із динамічних сфер розвитку культури суспільства, який забезпечує комунікацію в соціумі.

Процеси, які сприяли розвитку даного дизайну призвели до створення єдиних його стандартів. Ці стандарти передбачали однакові підходи до вирішення комунікації та схожі засоби проєктування. Проте в останні роки прослідковується активний розвиток графічного дизайну з акцентуацією на особливості національної культури [1].

Сучасний графічний дизайн перебуває на перетині естетики та технологій, де цифрові інновації значно розширюють можливості візуальної комунікації. Однією з ключових тенденцій є використання штучного інтелекту та генеративного дизайну, що дозволяє створювати унікальні та адаптивні графічні рішення. Мінімалізм залишається популярним, проте його доповнюють яскраві градієнти, 3D-елементи та неоморфізм, які надають

дизайну глибини та інтерактивності. Динамічні айдентики та анімовані логотипи стають все більш затребуваними завдяки розвитку цифрових платформ і соціальних мереж. Водночас адаптивний та інклюзивний дизайн набуває важливості, забезпечуючи доступність та зручність взаємодії для широкої аудиторії. Поєднання візуальної естетики з технологічними інструментами, такими як VR/AR, інтерактивна типографіка та блокчейн для автентифікації цифрового мистецтва, формує нові стандарти графічного дизайну, які не лише відображають сучасні тренди, а й визначають його майбутній розвиток.

У зарубіжній науці багато пишуть про вплив цифрових технологій, включаючи 4IR, на аудіо) візуальну культуру і дизайн індустрію. Це дослідницька традиція, започаткована класиками медіадетермінізму (М. МакКлюен, Д. Чендлер, Г. Інніс, М. Кастельс та ін.) та розвинена у роботах таких сучасних авторів, як Н. Ашерян, Т. Гей, М. Маццоне, С. Фарамарзі, В. Чен та ін. Особливо варто відмітити аналітичні огляди та праці С. Джанка та Р. Метт (2015), присвячену новому підходові до впровадження 3D цифрових технологій у дизайносвіту, чи А. Рані (2018), що осмислює внесок цифрових технологій у розвиток художньої творчості на сучасному етапі, чи Р. Даса (2023) про роль сучасних цифрових технологій у трансформації індустрії графічного дизайну. Українські автори теж працюють у цьому напрямку, про що свідчать статті І. Рижової, Є. Антипенка, К. Северін, Т. Пасічної та І. Бобровського (2023) та ін [1].

Метою роботи є дослідження спрямоване на аналіз сучасних тенденцій у графічному дизайні, зокрема на взаємодію естетичних принципів та новітніх технологій. Визначення ключових напрямів розвитку графічного дизайну, оцінку їхнього впливу на професійну діяльність дизайнерів та можливості адаптації до майбутніх змін у цій сфері.

Виклад основного матеріалу. Сучасні дизайнерські інструменти, такі як штучний інтелект, нейромережі та автоматизовані системи, сприяють оптимізації процесів та підвищенню ефективності роботи. Поєднання естетики та технологій створює нові вектори розвитку у графічному дизайні, які варто досліджувати.

Основними тенденціями у графічному дизайні є штучний інтелект та генеративний дизайн. Використання алгоритмів штучного інтелекту у створенні графічного контенту дозволяє автоматизувати процеси, генерувати унікальні візуальні рішення та спрощувати адаптацію дизайну під різні платформи. Генеративний дизайн, заснований на алгоритмах, сприяє створенню адаптивних та динамічних графічних об'єктів. Наприклад, інструменти на основі штучного інтелекту, такі як DALL-E та Midjourney, дозволяють миттєво створювати зображення за текстовими запитами, що кардинально змінює підхід до ілюстрацій та рекламної графіки.

Завдяки технологічним досягненням дизайнери отримують унікальні можливості для створення глибоких та реалістичних зображень. Одним із найбільш прогресивних напрямів у дизайні є 3D-графіка, яка використовується в рекламі, веб-дизайні, гейм-девелопменті та мультимедійному контенті. Паралельно з цим розвивається неоморфізм – стиль, що поєднує мінімалізм і тривимірні ефекти освітлення. Взаємодія цих стилів відкриває нові можливості у створенні унікальних візуальних продуктів, однак також ставить перед дизайнерами низку викликів.

Тривимірна графіка базується на математичних алгоритмах, що дозволяють будувати моделі об’єктів у тривимірному просторі. Процес створення 3D-графіки складається з кількох основних етапів: моделювання, текстурування, освітлення та рендерингу. Моделювання передбачає створення форми об’єкта за допомогою полігональних сіток або скульптингу. Текстурування додає деталізацію поверхням об’єкта, роблячи їх реалістичнішими. Освітлення визначає, як світло впливає на об’єкти, створюючи тіні, відбиття та глибину. Завершальним етапом є рендеринг – процес обробки зображення, що перетворює цифрові моделі у фотореалістичні зображення. Сучасні програми, такі як Blender, Cinema 4D та Autodesk 3Ds Max, Autodesk Maya, дозволяють створювати складні 3D-сцени, які інтегруються у цифрові продукти.

Неоморфізм – це відносно новий напрям у дизайні, що став популярним завдяки поєднанню мінімалізму та реалістичних світлотіньових ефектів. Основними характеристиками цього стилю є м’які тіні, пастельні кольори, однорідні фони та ефекти випуклості чи втисненості елементів. Завдяки цим особливостям неоморфні інтерфейси виглядають об’ємно, але залишаються легкими для сприйняття. Найчастіше цей стиль використовується у веб-дизайні та мобільних інтерфейсах, надаючи UI-елементам природний вигляд. Однак однією з головних проблем неоморфізму є недостатній контраст між елементами, що може впливати на доступність контенту для користувачів із вадами зору.

Попри те, що 3D-графіка та неоморфізм мають різні технічні підходи, їх взаємодія відкриває нові горизонти у дизайні. Тривимірні елементи дозволяють зробити неоморфні інтерфейси більш реалістичними та глибокими, надаючи їм додаткового об’єму.

Комбінація 3D-графіки та неоморфізму має низку переваг. По-перше, вона сприяє створенню реалістичних візуальних ефектів, що покращують користувацький досвід. По-друге, це відкриває нові можливості для бренд-дизайну, допомагаючи створювати унікальні айдентики. По-третє, інтеграція 3D-графіки робить неоморфні елементи більш виразними та доступними для користувачів. Однак існують і певні виклики: використання складної графіки може впливати на продуктивність веб-ресурсів, а недосконалий контраст неоморфних елементів може ускладнювати їхнє сприйняття. Тому для ефективного застосування цих стилів необхідно ретельно враховувати технічні обмеження та потреби користувачів.

Однак ефективне використання цих стилів вимагає зваженого підходу, з урахуванням доступності, продуктивності та загальної концепції дизайну. Подальший розвиток технологій, таких як VR та AR, може ще більше розширити можливості інтеграції 3D-графіки та неоморфізму у цифровий простір.

Віртуальна реальність (VR) та доповнена реальність (AR) змінюють підходи до дизайну, пропонуючи нові можливості взаємодії з візуальним контентом. З появою VR та AR дизайнери отримали доступ до інноваційних методів створення інтерактивного контенту. Віртуальна реальність дозволяє користувачам повністю зануритися у штучно створене середовище, тоді як доповнена реальність інтегрує цифрові елементи у фізичний простір. Ці технології значно розширюють межі дизайну, надаючи нові засоби для візуальної комунікації, симуляцій та навчання.

Графічний дизайн зазнав значних змін завдяки можливостям VR та AR. Традиційні двовимірні композиції поступаються місцем інтерактивним 3D-елементам, що змінюють спосіб сприйняття візуальної інформації. VR дає змогу створювати повністю занурювальні середовища, що використовуються у візуальному мистецтві, бренд-дизайні та рекламі. AR, у свою чергу, дозволяє інтегрувати динамічний контент у реальний світ, що застосовується в мобільних додатках, маркетингових кампаніях і цифровій навігації [6].

Однією з ключових сфер впровадження VR/AR є UX/UI-дизайн. Використання VR змінює парадигму користувацьких інтерфейсів, переносячи взаємодію у тривимірний простір [2]. Користувачі можуть навігувати, взаємодіяти з об’єктами та отримувати інформацію в інтуїтивний спосіб. AR у UX-дизайні дозволяє створювати адаптивні інтерфейси, що реагують на контекст використання, покращуючи користувацький досвід у сферах роздрібної торгівлі, медицини та освіти.

Розвиток VR та AR у дизайні спрямований на створення ще більш інтерактивних та персоналізованих рішень. Зростаюча обчислювальна потужність пристроїв, удосконалення технологій машинного навчання та розвиток 5G сприяють покращенню якості віртуального та доповненого досвіду. У перспективі VR/AR можуть стати невід’ємною частиною цифрового дизайну, відкриваючи нові можливості у сфері креативних індустрій.

Використання VR та AR розширює можливості взаємодії з візуальним контентом, створюючи інтерактивний досвід для користувачів. Бренди та маркетингові кампанії активно впроваджують ці технології для залучення аудиторії. Наприклад, IKEA створила додаток IKEA Place, що дозволяє віртуально розміщувати меблі у просторі за допомогою AR.

Завдяки адаптивності, інтерактивності та використанню новітніх технологій бренди можуть створювати унікальні користувацькі враження, зберігаючи при цьому свою ідентичність та конкурентоспроможність.

Це дозволяє брендам бути гнучкими, інтерактивними та більш ефективними у цифровому середовищі. Наприклад, Google та Spotify використовують змінні логотипи, які реагують на події та культурні особливості.

Динамічний бренд-дизайн є сучасним підходом до формування візуальної ідентичності, що дозволяє брендам залишатися актуальними в умовах швидкозмінного цифрового середовища. На відміну від традиційного статичного брендингу, який базується на незмінних логотипах, кольорах та шрифтах, динамічний бренд-дизайн передбачає змінність, інтерактивність та адаптивність у взаємодії з аудиторією.

Одним із ключових аспектів динамічного дизайну є можливість персоналізації та модифікації візуальної айдентики залежно від контексту використання, цільової аудиторії чи платформи. Це може включати змінні логотипи, адаптивну кольорову гаму, гнучкі типографічні рішення та інтерактивні елементи, що змінюються відповідно до ситуації. Такий підхід забезпечує впізнаваність бренду, водночас дозволяючи йому органічно інтегруватися у різні комунікаційні канали.

Важливою складовою динамічного бренд-дизайну є використання анімації, відеографіки та інших інтерактивних рішень, що підвищують залучення аудиторії. В епоху цифрових платформ, таких як соціальні мережі, мобільні додатки та вебсайти, можливість змінювати та налаштовувати бренд-елементи у реальному часі створює унікальний досвід взаємодії з користувачами.

Попри численні переваги, динамічний бренд-дизайн також має свої виклики. Збереження послідовності та впізнаваності бренду в умовах постійних змін потребує ретельно продуманої системи дизайн-правил. Надмірна гнучкість може призвести до втрати єдності в комунікації, що ускладнює ідентифікацію бренду серед конкурентів.

Використання алгоритмів і штучного інтелекту у створенні динамічного дизайну відкриває нові можливості для автоматизації брендових комунікацій. Наприклад, системи на основі штучного інтелекту можуть адаптувати візуальну айдентику відповідно до уподобань користувачів або навіть їхньої поведінки в інтернеті.

Висновок. Незважаючи на існуючі виклики, подальший розвиток технологій відкриває нові можливості для інтеграції цих підходів у цифровий дизайн, сприяючи створенню інтерфейсів майбутнього, що враховують різноманітні потреби користувачів. Впровадження цих технологій відкриває перед дизайнерами нові перспективи у створенні унікальних та адаптивних рішень.

Інтеграція штучного інтелекту, 3D-графіки, адаптивного дизайну та VR/AR визначає напрямки розвитку галузі та створює передумови для формування нових стандартів у графічному дизайні майбутнього. Завдяки технологічному прогресу дизайнери отримують нові інструменти для реалізації креативних ідей, що сприяє еволюції візуального мистецтва та комунікації.

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BIOLOGICAL SCIENCES

DYNAMICS OF CHANGES IN THE CONCENTRATION OF CAROTENOIDS AND CHLOROPHYLL DURING CULTIVATION OF MICROALGAE DUNALIELLA SALINA UNDER VARIOUS CONDITIONS OF LIGHTING AND NaCl CONCENTRATION

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ДИНАМИКА ИЗМЕНЕНИЯ КОНЦЕНТРАЦИИ КАРОТИНОИДОВ И ХЛОРОФИЛЛА ПРИ КУЛЬТИВИРОВАНИИ МИКРОВОДОРОСЛИ *DUNALIELLA SALINA* ПРИ РАЗЛИЧНЫХ УСЛОВИЯХ ОСВЕЩЁННОСТИ И КОНЦЕНТРАЦИИ NACL

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Abstract

The present study is dedicated to how the amounts of carotenoids and chlorophyll changed in the microalga Dunaliella salina found that lighting conditions and the amount of NaCl had a big impact on their contents. We observe an increase in carotenoids synthesis at high illumination, which is associated with the photoprotective function. An increase in the concentration of NaCl also stimulates the formation of carotenoids that adapt cells to stress conditions. In contrast, the concentration of chlorophyll decreases at high NaCl concentrations, indicating a decrease in photosynthetic activity. These results emphasize the importance of optimizing cultivation conditions to increase biomass and target metabolites.

Аннотация

Изучение изменений концентрации каротиноидов и хлорофилла в микроводоросли Dunaliella salina показало значительное влияние условий освещённости и концентрации NaCl на их содержание. При повышенной освещённости наблюдается увеличение синтеза каротиноидов, что связано с фотозащитной функцией. Увеличение концентрации NaCl также стимулирует образование каротиноидов, адаптирующих клетки к стрессовым условиям. Напротив, концентрация хлорофилла уменьшается при высоких концентрациях NaCl, что указывает на снижение фотосинтетической активности. Эти результаты подчёркивают важность оптимизации условий культивирования для повышения биомассы и целевых метаболитов.

Keywords: biomass, β-carotene, salt tolerance, biotechnology, photosynthetic pigments

Ключевые слова: биомасса, β-каротин, солеустойчивость, биотехнология, фотосинтетические пигменты

ВВЕДЕНИЕ

Микроводоросли являются важной группой организмов, играющих ключевую роль в первичном производстве и биогеохимических циклах в водных экосистемах. Среди них особое внимание привлекает Dunaliella salina, обитающая в экстремальных условиях соленых водоемов. Микроводоросль Dunaliella salina является объектом многочисленных исследований благодаря своей способности

накапливать значительные количества каротиноидов и хлорофилла в экстремальных условиях. Эти пигменты играют ключевую роль в фотосинтетическом процессе и обеспечивают защиту клеток от окислительного стресса. В последние годы внимание ученых привлекает изучение динамики изменения концентрации этих пигментов при различных условиях освещённости и концентрации NaCl.

Исследования показывают, что концентрация каротиноидов и хлорофилла в клетках Dunaliella salina значительно варьируется в зависимости от условий культивирования. В работе Боровкова и Гудвиловича [1] было установлено, что максимальное содержание фотосинтетических пигментов в биомассе D. salina достигается при удельной скорости протока среды 0,14 сут–1, а с увеличением скорости от 0,14 до 0,42 сут–1 оно снижается на 30%. Это свидетельствует о важности оптимизации условий культивирования для достижения максимальной продуктивности.

Другие исследования также подтверждают значительное влияние условий освещённости и концентрации NaCl на содержание пигментов в клетках Dunaliella salina. Например, в работе Лелекова и соавторов [2] было показано, что при изменении условий освещённости и концентрации NaCl наблюдаются значительные изменения в концентрации хлорофилла и каротиноидов. Эти данные подчеркивают важность комплексного подхода к изучению влияния различных факторов на биохимический состав микроводорослей.

Кроме того, исследования показывают, что Dunaliella salina обладает высокой адаптивной способностью к изменяющимся условиям окружающей среды. В работе Черновой и соавторов [3] было установлено, что при квазинепрерывном культивировании D. salina достигается наибольшая продуктивность по биомассе, пигментам и протеину при удельной скорости протока 0,32 сут–1. Это свидетельствует о возможности регулирования содержания пигментов и протеина с помощью варьирования условий культивирования.

Таким образом, литературные данные подтверждают, что динамика изменения концентрации каротиноидов и хлорофилла в клетках Dunaliella salina зависит от условий освещённости и концентрации NaCl. Оптимизация этих условий позволяет достигать максимальной продуктивности и содержания пигментов, что имеет важное значение для биотехнологических приложений.

Целью настоящего исследования является анализ динамики изменения концентрации каротиноидов и хлорофилла при культивировании Dunaliella salina в различных условиях освещённости и концентрации NaCl.

МАТЕРИАЛЫ И МЕТОДЫ

Определение содержания каротиноидов в экстрактах D. salina.

Определение каротиноидов проводили согласно [4]. Для этого, 50 мл суспензии микроводорослей фильтруют через мембранный фильтр Millipore диаметром 5 см и размером пор 3 мкм. Фильтр, с осевшим водорослями помещали в бюкс и добавляли 5 мл ацетона. Нитроцеллюлозный фильтр и пигменты микроводорослей растворяется в 90% ацетоне. Смесь интенсивно встряхивают до полного растворения содержимого. Затем ацетоновый экстракт профильтровывают на стеклянном фильтре и в нём определяют на спектрофотометре поглощение света при 480 нм, что соответствует максимуму поглощения каротиноидов. Затем измеряют поглощение при длине волны 750 нм. Это нужно для введения поправки на неспецифическое поглощение и рассеяние света экстрактом. Из величины поглощения при 480 нм вычитают поглощение при 750 нм.

Параллельно определяют количество сухой биомассы в объёме 50 мл. это делают, как указано выше, измеряя оптическую плотность суспензии микроводорослей при 550 нм и по калибровочному графику определяют количество биомассы.

Концентрацию суммарных каротиноидов рассчитывали по формуле:

$$C = \frac{4 \times D \times V}{m},$$

где: D - оптическая плотность при 480 нм с поправкой, V – объем экстракта в мл, m – масса сухой биомассы в этом объёме в граммах, 4 – коэффициент экстинции для каротиноидов.

Определение концентрации хлорофиллов в экстрактах D. salina.

Данный метод описан в работе [4].

Спиртовый или ацетоновый экстракт из биомассы получали, как описано выше.

Спектрофотометрирование производят в кварцевых кюветах при длинах волн 663, 645 и 630 *нм,* что соответствует максимуму поглощения света хлорофиллами ***a, b*** и ***c***, а также 750 нм. Последний максимум поглощения снимают для введения поправки на неспецифическое поглощение и рассеяние света экстрактом. Его величину отнимают от экстинкций соответствующих пигментов.

Количество хлорофиллов рассчитывают по формулам для двухлучевой спектрофотометрии пигментов.

$$Chl_a\ (мг/л) = 11{,}6\ (E_{665}) - 0{,}14\ (E_{630}) - 1{,}31\ (E_{645}),$$

$$Chl_b\ (мг/л) = 20{,}7\ (E_{645}) - 4{,}34\ (E_{665}) - 4{,}42\ (E_{630}),$$

$$Chl_c\ (мг/л) = 55{,}0\ (E_{630}) - 16{,}3\ (E_{645}) - 4{,}64\ (E_{665}).$$

Где Chl_a, $Chl_ь$, Chl_c — концентрации соответствуюих хлорофиллов **a**, **b** и ***c.***

В плане унификации расчетных формул лучше для этой цели применять формулы, рекомендованные рабочей группой № 17 при ЮНЕСКО:

В тех и других уравнениях E_{663}, E_{665}, E_{645} и E_{630} — экстинкции с поправкой на рассеяние и неспецифическое поглощение света экстрактом.

Первые уравнения основаны на коэффициентах экстинкции для хлорофилла a, равных 91,9 *л/г • см* при 665 нм, для хлорофилла b — 52,2 *л/г см* при 645 нм и для хлорофилла *c* — 19,5 *л/г см* при 630 *нм.*

Коэффициенты экстинкции, использованные во вторых формулах, равны для хлорофилла ***a*** 89,31 *л/г • см* при 663 *нм,* для хлорофилла **b** — 52,14 *л/г • см* при 645 нм и для хлорофилла ***c*** — 19,44 *л/г см* при 630 нм. Как видно из приведенных цифр, коэффициенты совпадают. Исходя из этого данные, вычисленные по тем и другим формулам, должны быть вполне сравнимы.

Расчет содержания пигментов в суспензии биомассы или сухой биомассе делают по формулам как указано для каротиноидов:

$$C = Cx\frac{V \times n}{m}$$

Porra [5] проанализировал большое количество уравнений по определению хлорофиллов и предложил своё уравнение для экстрактов биомассы в 80% ацетоне.

Chl_a *(nmol/ml)* = 13,7 $E_{663,6}$ — 2,8 $E_{646,6}$,

Chl_b *(nmol/ml)* = 22,4 $E_{646,6}$ — 5,4 $E_{663,6}$

РЕЗУЛЬТАТЫ И ОБСУЖДЕНИЯ

На рисунках 1, 2 и 3 представлена динамика изменения содержания каротинов при различных освещённостях и концентрации NaCl.

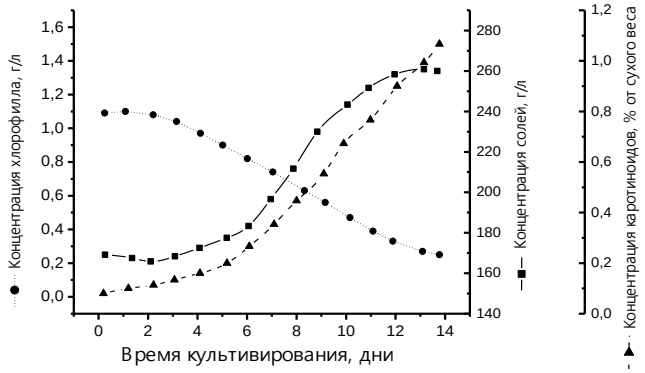

Рис. 1. Динамика изменения концентрации солей (треугольники), каротиноидов (квадраты), и биомассы (кружки) при культивировании микроводоросли Dunaliella salina AR-1. при освещении 20000 лк (360 µMol s-1m-2). Температура среды 35°C.

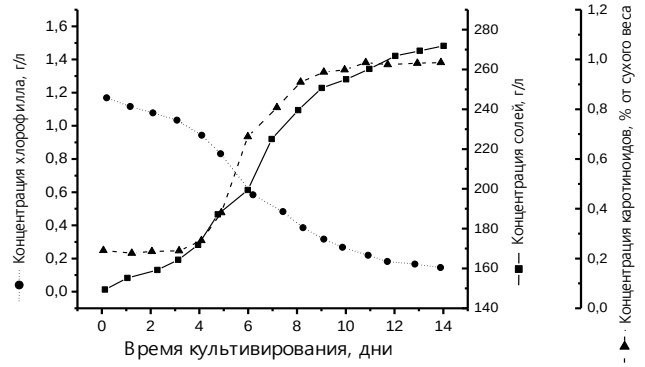

Рис. 2. Динамика изменения концентрации солей (треугольники), каротиноидов (квадраты), и биомассы (кружки) при культивировании микроводоросли Dunaliella salina AR-1. при освещении 40000 лк (720 µMol s-1m-2). Температура среды 39°C.

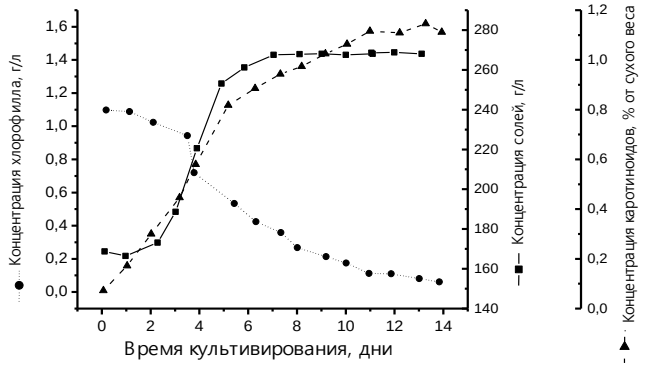

Рис. 3. Динамика изменения концентрации солей (треугольники), каротиноидов, и биомассы (кружки) при культивировании микроводоросли Dunaliella salina AR-1. при освещении 60000 лк (1080 µMol s-1m-2). Температура среды 43°C.

Как видно из рисунков, увеличение интенсивности освещения приводит к увеличению температуры среды и более высокой скорости увеличения концентрации солей в среде. Прямо пропорционально увеличению концентрации солей увеличи-

вается и содержание каротиноидов. Если при освещении 20000 лк (360 μMol $s^{-1}m^{-2}$) максимальное содержание каротинов наступает на 12 – 13 день инкубации, то при освещении 40000 лк (720 μMol $s^{-1}m^{-2}$) – уже на 9 день. А при освещении 60000 лк (1080 μMol $s^{-1}m^{-2}$) максимальная концентрация каротина получается на 6 -7 день.

Из проведенных данных эксперимента выявляется закономерность, что чем выше освещение и температура, тем быстрее происходит биосинтез каротина.

Кроме того, по мере увеличения концентрации соли уменьшается концентрация клеток в среде за счёт концентрации их на дне (флокуляция). Причём, клетки собираются в круг, на дне, где наиболее большая освещённость. Это явление можно будет использовать на практике при сборе биомассы.

Так же по литературным источникам известно, что для увеличения накопления каротина используют облучение коротковолновыми участками спектра солнечного света. Показано [6], что накопление каротина у *Dunaliella bardawil* происходит как защитная реакция против облучения коротковолновыми участками спектра солнечного света, так как наиболее высокие уровни накопления каротина наблюдаются при облучении синим светом.

Средние уровни накопления β-каротина наблюдаются при белом свете, а самое низкое накопление характерно для красного света. Усиленное накопление β-каротина защищает клетку от высокой радиации через адсорбцию синего света, поскольку при высокой концентрации синего света происходит фото деструкция хлорофилла и наступает смерть клеток.

Также было показано, что синий и присутствующий в спектре Солнца ультрафиолетовый А (320-400 нм) свет инициируют синтез каротиноидов через активирование рецепторов синего света: криптохромов и фототропинов [7].

Относительно более короткой области ультрафиолетового света (УФ В 280-320 нм) данные в литературе противоречивы. Большинство авторов указывает на ингибирующее действие УФ В на накопление каротиноидов. С другой стороны, каротиноиды поглощают ультрафиолет и в области УФ В, тем самым защищая водоросли от вредного действия ультрафиолета. Вопрос изучения действия УФ А и УФ В усложняется, отсутствием источников излучения только УФ А или УФ В. Существуют источники суммарного света УФ А + УФ В, и даже УФ А + УФ В + УФ С, поэтому экспериментаторам приходиться подбирать дополнительные светофильтры [7].

Для исследования вопроса: можно ли для увеличения содержания каротинов при инкубации дуналиеллы добавлять свет из доступных источников ультрафиолета, мы в дополнение источника белого света в 20000 лк (360 μMol $s^{-1}m^{-2}$) обрабатывали инкубационную среду мягким ультрафиолетом УФ А и УФ В, с интенсивностью 2000 лк (36 μMol $s^{-1}m^{-2}$) от светолечебного облучателя УФО-ИК-250 «Солис». Результаты представлены на рис. 4.

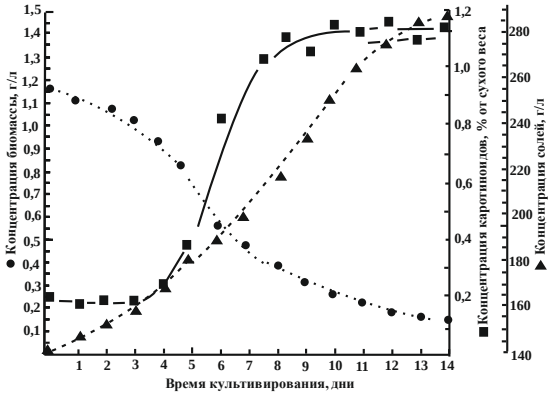

Рис. 4. Динамика изменения концентрации солей (треугольники), каротиноидов (квадраты), и биомассы (кружки) при культивировании микроводоросли Dunaliella salina AR-1. при освещении 20000 лк (360 μMol s-1m-2) и добавлении ультрафиолетового света диапазона УФ А + УФ В.

Из рисунка видно, что когда добавляли слабое ультрафиолетовое облучение 2 000 лк, скорость накопления каротиноидов в микроводоросли увеличивается почти в 2 раза, по сравнению только с облучением белым светом 20 000 лк. Этот факт даёт основание предположить, что слабой ультрафиолетовой подстветкой можно увеличивать скорость каротиногенеза и при промышленном производстве каротинов из дуналиеллы.

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PUBLIC EDUCATIONAL ACTIVITIES OF CURRENTLY PROTECTED NATURAL AREAS IN FORMING ECOLOGICAL CULTURE OF THE POPULATION

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ХАЛЫҚТЫҢ ЭКОЛОГИЯЛЫҚ МӘДЕНИЕТІН ҚАЛЫПТАСТЫРУДЫҢ ҚАЗІРГІ ЕРЕКШЕ ҚОРҒАЛАТЫН ТАБИҒИ АУМАҚТАРДЫ ҚОҒАМДЫҚ АҒАРТУ ЖҰМЫСТАРЫ

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Abstract

This article focuses on the role of protected natural areas (PNA) in forming the ecological culture of the population. Nowadays, environmental issues have taken on a global scale, and the need for a responsible attitude towards nature has grown significantly. PNAs play an important role in enhancing the ecological culture of the population through educational activities.

The study examines the effectiveness of environmental education programs and activities. Based on data obtained using surveys, interviews, and observation methods, the current state of environmental education efforts in PNAs is analyzed.

Additionally, the article identifies factors influencing the success of environmental education initiatives and provides recommendations for PNAs. It proposes ways to develop ecological culture through the use of new technologies and innovative approaches.

Аңдатпа

Бұл мақала халықтың экологиялық мәдениетін қалыптастыруда ерекше қорғалатын табиғи аумақтардың (ЕҚТА) рөлін зерттеуге арналған. Қазіргі таңда экологиялық мәселелер жаһандық сипатқа ие болып, адамдардың табиғатқа жауапты қатынасының қажеттілігі артып келеді. ЕҚТА-лар экологиялық ағарту жұмыстарын жүргізу арқылы халықтың экологиялық мәдениетін арттыруда маңызды рөл атқарады.

Зерттеуде экологиялық ағарту бағдарламалары мен іс-шараларының тиімділігі қарастырылады. Сауалнама, сұхбат және бақылау әдістерін қолдану арқылы алынған мәліметтер негізінде ЕҚТА-лардың экологиялық ағарту жұмыстарының қазіргі жағдайы талданады.

Сонымен қатар, мақалада экологиялық ағарту жұмыстарының табыстылығына әсер ететін факторлар анықталып, ЕҚТА-лар үшін ұсыныстар беріледі. Жаңа технологиялар мен инновациялық тәсілдерді пайдалану арқылы экологиялық мәдениетті қалыптастырудың жолдары ұсынылады.

Keywords: environmental education activities, protected natural areas, natural resources, ecological culture.
Кілт сөздер:экологиялық ағарту жұмыстары, ерекше қорғалатын табиғи аумақтар, табиғат ресурстары, экологиялық мәдениет.

Ағартушылық қызмет қоғамда болып жатқан кез келген өзгерістерге барынша икемді әрі сезімтал. Әрине, ағартушылық қоғам сұранысына белсенді жауап береді, бірақ ол сонымен бірге қоғамды қалыптастырушы және қоғамды дамыту бағытын белгілейтін фактор болып табылады.

Экологиялық ағартушылық, барынша өткір және өзекті болғанымен, бүгінде ең тұрақсыз, әлсіз және көптеген сыртқы факторларға тәуелді болып табылады. Соңғы бірнеше жылда еліміздің азаматтарының және, атап айтқанда, жастардың осы тақырыпқа деген қызығушылығы сөзсіз артып келеді, бұл қызығушылық ақпараттық тұрғыдан да, белсенділік тұрғыдан да байқалады.

«Экологиялық ағарту» ұғымы ғылыми-педагогикалық әдебиеттерде белсенді түрде қолданылады. А. А. Нестерова мен М. И. Макаров өз зерттеулерінде бұл ұғымды балалар мен жастардың экологиялық мәдениетін олардың білімдік-ақпараттық, іс-әрекет-технологиялық және этика-психологиялық компоненттерінің бірлігінде қалыптастыруға бағытталған шаралар мен іс-шаралар жүйесі ретінде анықтайды. Бұлар билік органдары, білім беру және мәдениет мекемелері, бұқаралық ақпарат құралдары, коммерциялық емес ұйымдар және қоғамдық қозғалыстар арқылы жүзеге асырылады.[1]

Ерекше қорғалатын табиғи аумақтардың қызметін қолдауға жергілікті халықты тарту қажеттілігі 1992 жылы Каракаста өткен IV Әлемдік Қорықтар Конгресінде атап өтілгендей, әлемдегі барлық ерекше қорғалатын табиғи аумақтар үшін ең маңызды міндеттердің бірі болып табылады. Соңғы жылдары мамандарға қорықтар мен ұлттық парктер қоғамның табиғатты сақтау мәселелеріне, түрлік әртүрлілікті қорғауға, сирек және бағалы өсімдіктер мен жануарлар түрлерін сақтауға деген көзқарасын шынайы түрде өзгерте алатын маңызды рөл атқаратыны анық бола бастады.

Ерекше қорғалатын табиғи аумақтардың экологиялық-ағартушылық әлеуеті өте үлкен. Біріншіден, ең құнды табиғи аумақтарды қорғай отырып, қорықтар мен ұлттық парктер адамдарға сақталатын табиғаттың сұлулығы мен байлығын сауатты түрде көрсете алады, сондай-ақ қоршаған жергілікті халықты, ең алдымен мектеп оқушыларын, тікелей табиғатты қорғау қызметіне тартуға мүмкіндік береді. Екіншіден, қорықтар мен ұлттық парктердің құрамында биология, экология, орман шаруашылығы саласындағы білікті мамандар жұмыс істейді. Жылдар бойы жекелеген түрлердің экологиясын зерттеу, табиғи экожүйелердегі өзгерістерді қадағалау, бұл процестерді адамдар жиі түпкілікті бүлдірген немесе игерген ортада орын алған жағдайлармен салыстыру арқылы жабайы табиғатты, биологиялық әртүрліліктің барлығын сақтау және табиғат қорғау шараларының қажеттілігін халыққа анық көрсетуге болады. Үшіншіден, қорықтар мен ұлттық парктерде экологиялық ағартушылықты жүзеге асыру үшін материалдық база бар немесе құрылуда: табиғат мұражайлары, келушілер орталықтары, экологиялық соқпақтар, ашық аспан астындағы экспозициялар және т.б. (1)Каждый заповедник и национальный парк разрабатывает свою стратегию ведения эколо-го-просветительской работы, опираясь как на собственный эколого-образовательный потенциал, так и на реальные возможности региона, в котором он расположен. Под образовательным потенциалом (ОП) заповедника или национального парка понимается совокупность природных, культурно-исторических и социально-экономических ресурсов для экологического образования и просвещения населения. Образовательный потенциал с педагогической точки зрения можно рассматривать в единстве обучающего, воспитательного и развивающего компонентов.

Көптеген қорғалатын аумақтардың тәжірибесі көрсеткендей, ересек халықпен жүргізілетін экологиялық-ағартушылық жұмыс әрдайым дүниетаным мен мінез-құлық стереотиптерінің өзгеруіне әкелмейді. Ересек адам – белгілі бір өмірлік басымдықтары мен әлеуметтік мәртебесі қалыптасқан тұлға. Ересек адамның санасында экологиялық мәселелер көбінесе соңғы орындардың бірін алады, ал негізгі өмірлік басымдықтар денсаулық, отбасы, отбасылық материалдық әл-ауқат, балаларға және олардың болашағына қамқорлық болып табылады. [2]

Мемлекет басшысы Қасым-Жомарт Тоқаевтың тапсырмасы бойынша Үкімет «Таза Қазақстан» экологиялық мәдениетті дамыту тұжырымдамасын 2024–2029 жылдарға бекітті. Тиісті қаулыға Премьер-Министр Олжас Бектенов қол қойды.

«Таза Қазақстан» тұжырымдамасы экологиялық мәдениетті дамытуға арналған түрлі әдістер мен тәсілдерді қамтитын кешенді тәсілді көздейді. Негізгі бағыттар экологиялық ойлау, жауапты мінез-құлық (оның ішінде оны ынталандыру шаралары), экологиялық білім беру және ақпараттандыруды қамтиды.

Тұжырымдаманы жүзеге асыру азаматтардың экология туралы хабардарлығын арттыруға, экологиялық дағдыларды қалыптастыруға және халықтың экологиялық бастамаларға қатысуын жандандыруға мүмкіндік береді.

Нысаналы көрсеткіштерге сәйкес, 2029 жылға қарай коммуналдық қалдықтарды қайта өңдеу деңгейін 25%-дан 38%-ға дейін, ал экологиялық тәрбиені нығайту бойынша іс-шараларға тартылған оқушылар үлесін 15%-дан 40%-ға дейін ұлғайту жоспарлануда. Сондай-ақ, азаматтардың экологиялық өмір сапасына қанағаттану көрсеткіші 55,8%-дан 64,7%-ға дейін артуы күтіледі. [3]

Экотуристік маршруттардағы келушілердің экологиялық ағартушылық және білім беру қызметі экологиялық білімді тарату (насихаттау), келушілерді қоршаған ортаның жай-күйі, табиғи ресурстарды пайдалану, экологиялық заңнама туралы ақпараттандыру, сондай-ақ оларды табиғатқа ұқыпты қарауға тәрбиелеуден тұрады. [4]

Биоәртүрлілікті сақтау – бұл этика-философиялық, әлеуметтік-экономикалық және құқықтық аспектілері бар күрделі мәселе; оны шешу бүкіл әлемдік қауымдастықтағы мәдениет пен ағартушылықтың даму деңгейіне көп жағдайда тәуелді.

XXI ғасырдың басында Ақмола, Шығыс Қазақстан, Алматы және Оңтүстік Қазақстан облыстарында 4 мемлекеттік ұлттық табиғи парк (МҰТП) және 1 мемлекеттік табиғи қорық құрылды. Сонымен қатар, қолданыстағы мемлекеттік табиғи қорықтардың аумақтары

кеңейтілді. Қорықтар Қазақстан аумағында мекендейтін сүтқоректілердің жалпы санының 78%-ын құрайтын 140 түрді бақылау және қорғау жұмыстарын жүргізеді. МҰТП негізгі міндеттері табиғи кешендерді қорғау және сақтау, ғылыми және білім беру іс-шараларын өткізу, сондай-ақ рекреациялық қызмет болып табылады. [5]

Ерекше қорғалатын табиғи аумақтардың экологиялық-ағартушылық қызметінің тиімділігінің көрсеткіштерінің бірі - бұл туған өлкенің табиғаты мен ерекше қорғалатын аумақтардың бірегей құндылығы туралы білім мен түсініктерді кеңейту, жергілікті экологиялық мәселелер және оларды шешу жолдары туралы хабардарлықты арттыру, қорық ісі идеяларын халықтың кең ауқымы арасында қолдау, жергілікті тұрғындардың экологиялық мәселелерді шешуге және табиғатты қорғау қызметін қолдауға қызығушылығы мен дайындығын қамтамасыз ету болып табылады. [6]

Ұсынымдар:

Саяси емес бағыттағы балалар қозғалысын құру, ең алдымен мектеп оқушыларын қорықтар мен ұлттық парктер бастамасымен тірі табиғатты, ұлттық табиғи мұраны сақтау идеясы аясында біріктіру – бұл қорғалатын аумақтар үшін өз болашағын қамтамасыз етіп, табиғатты қорғау ісінде одақтастар тәрбиелеу мүмкіндігі. [7]

Келушілерге экологиялық ағартушылықты келесі жерлерде ұйымдастыруға болады: визит-орталықтар, табиғат мұражайлары, өлкетану мұражайлары, экотехнологиялық шаруашылықтар және ерекше қорғалатын табиғи аумақтардың (ЕҚТА) жанында орналасқан басқа да нысандар. Бұл жерлерде келушілерге ЕҚТА туралы, алдағы экотуристік маршрут туралы алдын ала ақпарат беріледі, жарнамалық-ақпараттық баспа және/немесе компьютерлік өнімдер таратылады. Келушілерге экологиялық ағартушылық жүргізу барысында аралық ресурстар қолданылады. Экомаршрут бойында білікті натуралист-гидтер міндетті түрде танымдық әңгімелер, дәрістер, тақырыптық квесттер, шеберлік сабақтар, экологиялық-ағартушылық және басқа да іс-шаралар өткізеді.

Экотуристік маршрут бойына ақпараттық стендтер, оның ішінде маршруттағы мінез-құлық ережелері, мүсіндер, шағын саябақтар, құстар мен жануарларға арналған қоректендіру алаңдары орналастырылады. Бұл адамның табиғатпен біртұтас болуын қамтамасыз етеді, сондай-ақ табиғат әуесқойларына құстар мен жануарлармен жақынырақ танысуға мүмкіндік береді. Экосоқпақтар мен маршруттар ұзақ демалыс және фотосессиялар үшін арнайы алаңдармен жабдықталады. Жақын маңда түрлі шөптерден жасалған хош иісті бөліктер ұйымдастырылады, олар келушілерді жағымды хош иістерімен қызықтырады. Мұндай соқпақтар мен маршруттарды ұйымдастыру табиғи ортада ақпаратты және мінез-құлық нормаларын еркін меңгеруге бағытталған. Білімді меңгеру маршрут бойымен қозғалыс кезінде демалыс пен танымның органикалық үйлесімі нәтижесінде жүзеге асады. [4]

Экологиялық білім тек білім беріп қана қоймай, дүниетанымды қалыптастырып, табиғатты қорғау мен табиғатты ұтымды пайдалану мүддесінде өз әлеуметтік ортасына әсер ете алатын «экологиялық таза» және әлеуметтік белсенді тұлғаны, белсенді азаматтық ұстанымы бар тұлғаны қалыптастыруға ықпал етуі тиіс.

Ерекше қорғалатын табиғи аумақтар халықтың экологиялық мәдениетін қалыптастыруда негізгі рөл атқарады, өйткені олар табиғатты қорғау және білім беру функцияларын үйлестіреді. Білім беру мекемелері мен бұқаралық ақпарат құралдарымен ынтымақтастықты күшейту, сондай-ақ заманауи технологияларды пайдалану олардың тиімділігін айтарлықтай арттыра алады.

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CHEMICAL SCIENCES

PHYSICO-CHEMICAL STUDY OF PHASE EQUILIBRIUM AND GLASS FORMATION IN THE As_2Se_3-$TlPr_2Se_4$ SYSTEM AND STUDY OF ELECTRICAL CONDUCTIVITY OF GLASSY ALLOYS

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Abstract

Using physicochemical methods of analysis (DTA, MSA, X-ray diffraction, as well as determination of microhardness and density), the phase equilibrium in the As_2Se_3-$TlPr_2Se_4$ system was studied and its T-x phase diagram was constructed. As a result, it was found that the As_2Se_3-$TlPr_2Se_4$ system is quasi-binary and belongs to the eutectic type. The eutectic formed between the As_2Se_3 and $TlPr_2Se_4$ compounds has a composition of 10 mol. % $TlPr_2Se_4$ and a temperature of 270ºC. It was found that the solubility of the system is 2 mol. % $TlPr_2Se$ based on the As_2Se_3 compound and 3.5 mol. % As_2Se_3 based on the $TlPr_2Se_4$ compound at room temperature. The glassy field of 15 mol. % $TlPr_2Se_4$ was determined based on As_2Se_3 upon slow cooling in the system. The temperature dependence of electrical conductivity of 5, 10 and 15 mol. % $TlPr_2Se_4$ glass alloys based on As_2Se_3 was studied.

Keywords: phase equilibrium, glass, eutectic, quasi-binary, microhardness.

Introduction

Arsenic compounds, As_2S_3 (As_2Se_3), are classical glassy semiconductors. Arsenic chalcogenides and their ternary and more complex phases are materials with photovoltaic [1-6], luminescent [7,8] properties and are widely used in IR optics [9,10], color television [11,12] and memory centers [13-15]. Recently, glassy semiconductor fibers based on chalcogenides As_2S_3 (As_2Se_3) [16-20] have been widely studied.

The $TlPr_2Se_4$ compound was obtained as a result of a chemical reaction between the TlSe and Pr_2Se_3 compounds. The TlSe compound and the phases obtained on its basis are materials with photovoltaic properties [3,21-24]. Ternary phases based on the compound Pr_2Se_3 are semiconductor materials with thermoelectric [25] and magnetic [26] properties. A large number of systems consisting of arsenic chalcogenides have been studied in the literature [27–32].

The aim of this work is to construct a T-x phase diagram by studying the phase equilibrium and glass formation in the As_2Se_3-$TlPr_2Se_4$ system, as well as to study the electrical conductivity properties of the obtained phases.

The data for the As_2Se_3 and $TlPr_2Se_4$ compounds are as follows: The As_2Se_3 compound melts congruently at 380ºC and crystallizes in the monoclinic syngony, the lattice parameters are: a = 12.053; b = 9.890; c = 4.277 Å, β = 90º28′, space group P21/n [33]. The microhardness and density of the As_2Se_3 compound in the glassy state are: ρ = 4.618 g/cm^3 and Hμ = 1280-1400 MPa, respectively [33]. The $TlPr_2Se_4$ compound melts at 1290ºC and crystallizes in the rhombic syngony, lattice parameters: a = 7.98; b = 9.88; c = 11.19 Å, density ρ = 7.42 g/cm^3, microhardness Hμ = 2150 MPa [34].

Experimental part

Alloys of the As_2Se_3-$TlPr_2Se_4$ system were synthesized from the components As_2Se_3 and $TlPr_2Se_4$ in a quartz ampoule with air evacuation to a pressure of 0.133 MPa. They were synthesized in the temperature range of 800-1200ºC. To achieve equilibrium, the alloys were heat treated at a temperature of 270°C for 500 hours.

Crystallized alloys were studied using the methods of physicochemical analysis DTA, X-ray phase analysis, MSA, as well as determination of microhardness and density.

Differential-thermal analysis of the alloys was carried out on an NTR-73 pyrometer using a chromel-aluminum thermocouple with a heating rate of 9°C/min. X-ray phase analysis was carried out on an X-ray diffractometer D2 PHASER. Microstructural analysis was carried out on a metallographic microscope MIM-8. Microhardness was measured using a PMT-3 device. The density of the alloys of the system was determined by pucnometric weighing, toluene was used as the working fluid. Physical measurements were carried out using the compensation method [35].

Results and discussion

Alloys of the As_2Se_3-$TlPr_2Se_4$ system in the range of 0-20 mol. % $TlPr_2Se_4$ are glassy and represent shiny black substances. The remaining alloys are gray-black substances. Alloys rich in the As_2Se_3 compound are resistant to water, air and organic solvents. They dissolve well in hot acid HNO_3 and alkalis (NaOH, KOH). Alloys rich in the $TlPr_2Se_4$ compound dissolve well in strong acids (HNO_3, H_2SO_4).

Alloys of the As_2Se_3-$TlPr_2Se_4$ system were studied in glass and crystalline form using physicochemical methods of analysis. Thermal analysis of alloys 0-30 mol. % $TlPr_2Se_4$ before heat treatment showed that the softening temperature Tg is observed on the thermograms of the alloys. Alloys in the range of 0–15 mol.% $TlPr_2Se_4$ are glassy, and alloys in the range of 15–30 mol.% $TlPr_2Se_4$ are glassy-crystalline. The remaining alloys are in the crystalline state.

After crystallization of the alloys of the system for 700 hours at 190°C, the softening temperature disappears from their thermograms, and instead, temperature

effects corresponding to the solidus and liquidus are observed. The temperature effects observed in the thermograms of glassy alloys are irreversible.

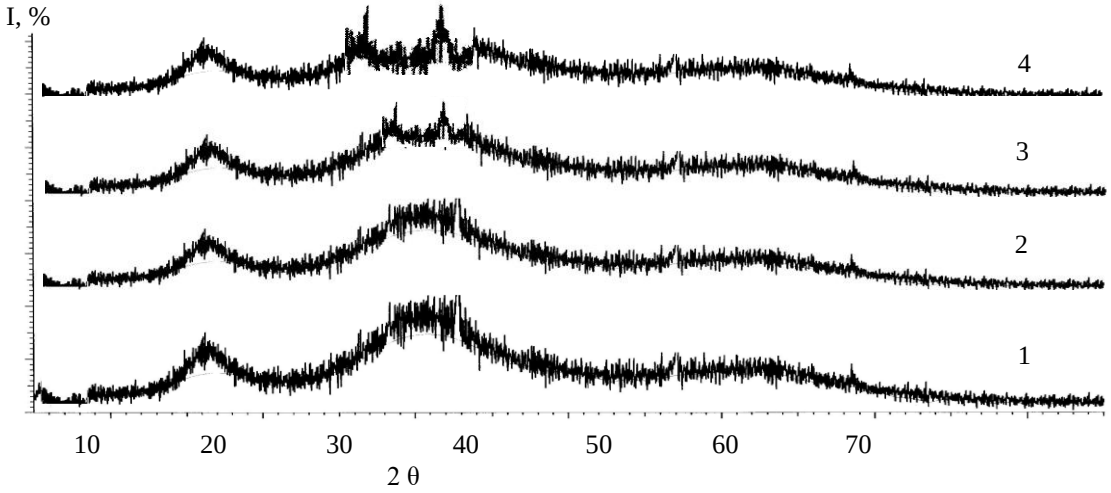
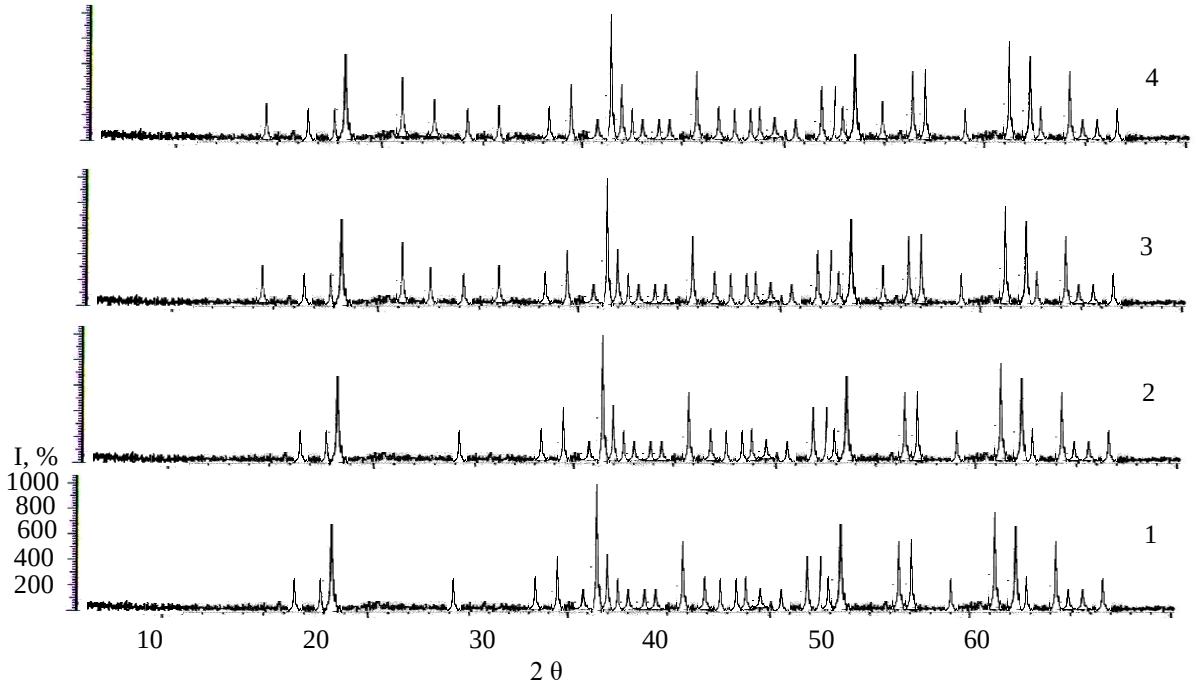


Fig. 1. Diffraction patterns of alloys of the As_2Se_3-$TlPr_2Se_4$ system from the glassy region.



1- As_2Se_3, 2-5 mol %, 3-10 mol %, 4-15 mol % $TlP_{r2}Se_4$.

Fig. 2. Diffraction patterns of crystalline alloys of the As_2Se_3-$TlPr_2Se_4$ system.
1- As_2Se_3, 2-5 mol %, 3-10 mol %, 4-15 mol % $TlPr_2Se_4$.

Microstructural analysis (MSA) of glassy alloys of the As_2Se_3-$TlPr_2Se_4$ system shows that the phases that make up the glassy alloys are opaque and look like a single phase, which makes it difficult to detect the phase boundary and solid solution. After crystallization of the samples, the phase boundaries inside them become clear. To confirm the results of differential-thermal and microstructural analysis, X-ray phase analysis of samples from different regions of the system was carried out in both the glassy and crystalline states.

As a result of the X-ray phase analysis, it was established that no diffraction maxima were found on the diffractograms of glassy samples (Fig. 1). After a long thermal treatment, diffraction maxima are observed on the diffractograms of the samples (Fig. 2). This indicates that the vitreous alloys of the system are completely crystallized after heat treatment.

If we consider the crystalline and glassy state of the system As_2Se_3-$TlPr_2Se_4$ with As_2Se_3, 5, 10 and 15 mol. % $TlPr_2Se_4$, then you can see that noticeable changes in the diffractograms of samples As_2Se_3 and 5

mol. % $TlPr_2Se_4$ is not observed. However, on the diffractograms of samples 10 and 15 mol. % $TlPr_2Se_4$ additional small diffraction lines are observed.

Thus, the results of DTA and microstructural analysis were confirmed by the X-ray phase analysis method.

Based on the results of complex physicochemical analysis methods, the T-x phase diagram of the As_2Se_3-$TlPr_2Se_4$ system was constructed (Fig. 3). The As_2Se_3-$TlPr_2Se_4$ system is quasi-binary and eutectic. The eutectic formed in the system has a composition of 10 mol. % $TlPr_2Se_4$ and a temperature of 270°C. In the system at room temperature, solid solutions based on the As_2Se_3 compound reach up to 2 mol. % $TlPr_2Se_4$, and based on $TlPr_2Se_4$ - up to 3.5 mol. % As_2Se_3. The glass formation region based on As_2Se_3 during slow cooling extends to 15 mol. % $TlPr_2Se_4$ in the As_2Se_3-$TlPr_2Se_4$ system.

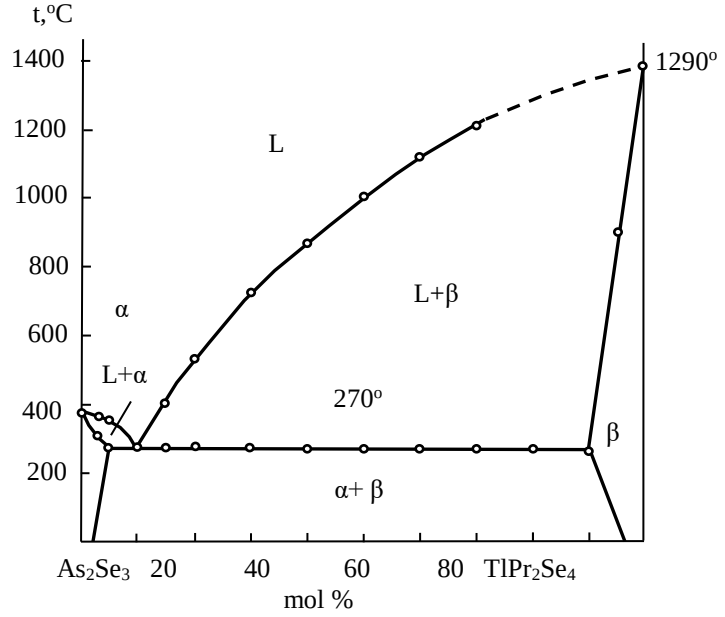


Fig. 3. T-x phase diagram of the As_2Se_3-$TlPr_2Se_4$ system.

The microhardness and density of the As_2Se_3-$TlPr_2Se_4$ system alloys were also studied in the glassy and crystalline states and are given in Tables 1 and 2. Thermal effects, density and microhardness of the alloys in the glassy state are given in Table 1.

When measuring the microhardness of the alloys, two different microhardness values were obtained. One of them corresponds to the microhardness of the α-solid solution obtained on the basis of the As_2Se_3 compound, and the other - to the β-solid solution obtained on the basis of $TlPr_2Se_4$.

Table 1.

Composition, results of DTA, density and microhardness measurements of alloys of the As_2Se_3 - $TlPr_2Se_4$ system (in glassy form)

Composition, mol %		Thermal effects, °C	Density, q/cm³	Microhardness, MPa	
As_2Se_3	$TlPr_2Se_4$			α	β
				P=0.15 N	
100	0,0	180.380	4,62	1380	–
97	3,0	180,260,375	4,65	1390	
95	5,0	180,270.360	4,72	1390	–
90	10	185,270	4,90	1400	–
85	15	185,270,400	5,04	1400	
80	20	190,270,530	5,17	1400	–
70	30	190,270,730	5,45	1400	–
60	40	270,825	5,74	-	2180
50	50	270,1010	6,02	-	2180
40	60	270,1125	6,30	–	2180
30	70	270,1220	6,58	–	2180
20	80	270	6,86	–	2180
10	90	270	7,30	–	2180
5.0	95	910	7,45	–	2170
0.0	100	1290	7,42	–	2150

Table 2.

Composition, results of DTA, density and microhardness measurements of alloys of the As_2Se_3 - $TlPr_2Se_4$ system (in crystal form)

Composition, mol %		Thermal effects, °C	Density, q/cm^3	Microhardness, MPa	
As_2Se_3	$TlPr_2Se_4$			α	β
				P=0.10 N	P=0.20 N
100	0,0	380	5,10	860	–
97	3,0	260,375	5,18	900	
95	5,0	320.360	5,25	900	–
90	10	270	5,33	Eutec.	Eutec.
85	15	270,400	5,44	–	–
80	20	270,530	5,56	–	–
70	30	270,730	5,80	–	2180
60	40	270,825	6,03	–	2180
50	50	270,1010	6,26	–	2180
40	60	270,1125	6,49	–	2180
30	70	270,1220	6,72	–	2180
20	80	270	6,96	–	2180
10	90	270	7,19	–	2180
5.0	95	910	7.48	–	2170
0.0	100	1290	7,42	–	2150

The microhardness of the glass of the α-solid solution obtained on the basis of As_2Se_3 varies in the range of (1380-1400) MPa. The microhardness of the β-solid solution based on $TlPr_2Se_4$ is (2150 - 2180) MPa. After crystallization of the samples, the microhardness of the α-solid solution alloys obtained on the basis of As_2Se_3 was (860-900) MPa. Since the β-solid solution alloys based on $TlPr_2Se_4$ are in the crystalline state, the microhardness of the alloys remained unchanged (2150 - 2180) MPa. The temperature dependence of the electrical conductivity of glasses of the As_2Se_3-$TlPr_2Se_4$, As_2Se_3, 5, 10 and 15 mol. % $TlPr_2Se_4$ system was studied (Fig. 4). Samples of the specified composition were cooled equally slowly.

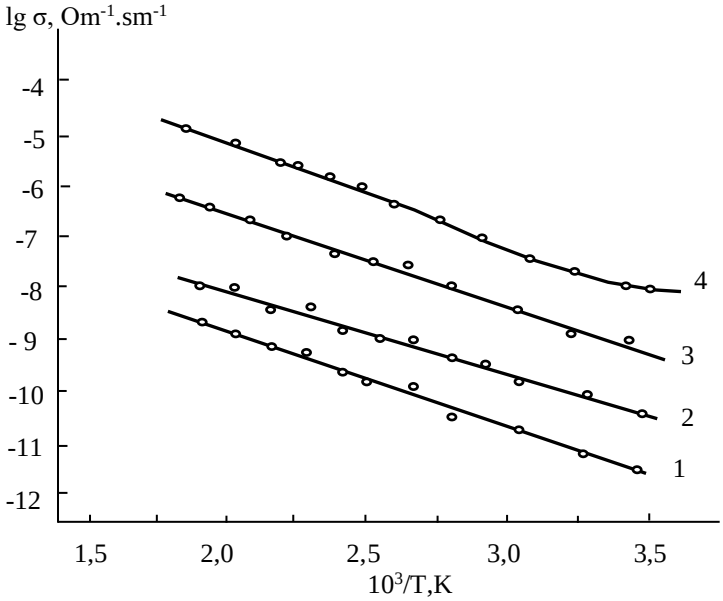


Fig. 4. Diffraction patterns of crystalline alloys of the As_2Se_3-$TlPr_2Se_4$ system. 1- As_2Se_3, 2-5 mol. %, 3-10 mol. %, 4-15 mol. % $TlPr_2Se_4$.

As can be seen from the temperature dependence graph of electrical conductivity, the electrical conductivity of As_2Se_3 samples, 5, 10 and 15 mol % $TlPr_2Se_4$ increases linearly depending on temperature and composition. Electrical conductivity is achieved by means of an electronic mechanism.

Conclusion

To study the phase equilibrium in the As_2Se_3-$TlPr_2Se_4$ system, alloys were synthesized in a wide range of concentrations and then subjected to heat treatment at a temperature of 270°C for 700 hours. Then the alloys were studied using the methods of physicochemical analysis (DTA, MSA, X-ray diffraction, as well as determination of microhardness and density) and the T-x phase diagram of the As_2Se_3-$TlPr_2Se_4$ system was constructed. It was found that the As_2Se_3-$TlPr_2Se_4$ system is quasi-binary and belongs to the eutectic type. The eutectic formed between the As_2Se_3 and $TlPr_2Se_4$ compounds has a composition of 10 mol. % $TlPr_2Se_4$

and a temperature of 270°C. It was found that the solubility of the system is 2 mol. % based on the As_2Se_3 compound and 3.5 mol. % based on the $TlPr_2Se_4$ compound at room temperature. The glassy field of 15 mol. % $TlPr_2Se_4$ was determined based on As_2Se_3 during slow cooling in the system. The dependence of the electrical conductivity of the As_2Se_3-$TlPr_2Se_4$ system and glass alloys containing As_2Se_3, 5, 10 and 15 mol. % $TlPr_2Se_4$ on temperature and composition was studied. The indicated glassy alloys are high-resistance semiconductors.

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PHASE EQUILIBRIUM AND X-RAY ANALYSIS OF SOLID SOLUTION ALLOYS IN THE In-SrSe SYSTEM

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Abstract

The nature of chemical interaction in the In-SrSe system was studied and its phase diagram was constructed using physicochemical methods of analysis (DTA, X-ray diffraction, microstructural analysis, as well as density and microhardness measurements). It was found that the In-SrSe system is a quasi-binary section of the In-Sr-Se ternary system and belongs to the eutectic type. A degenerate eutectic is formed between In and SrSe, the temperature of which is 150°C. In the In-SrSe system, solid solutions based on the SrSe compound make up 5 at. % In. The dependence of the microhardness of the alloys on the composition was studied. It was found that there are two types of microhardness values in the system. The microhardness value of 150 MPa corresponds to the microhardness of the In element, and the value (1240-1270) MPa corresponds to the microhardness of the α-solid solution based on SrSe. The dependence of the melt densities on the composition changes monotonically. An X-ray structural analysis of the solid solution alloy $(SrSe)_{1-x}(In)_x$ (x=0.02; 0.05) was performed and the lattice parameters were calculated. In the system, 95 and 98 mol. % SrSe solid solution alloys based on the SrSe compound crystallize in a cubic syngony with lattice parameters *a*=6.257 Å and *a*=6.274 Å, respectively.

Keywords: alloy, system, solid solution, microhardness, quasibinary.

Introduction

In the literature, the elements of the main II subgroup have high reactivity. In the literature [1–4], ternary systems involving calcium chalcogenides were studied. Since strontium chalcogenides are very difficult to obtain and study, the ternary system with their participation has been little studied. The authors of [5–8] studied the following systems: SrS–GaS, SrSe–GaSe (InSe), and SrSe–Ga_2Se_3 (In_2Se_3). In the SrX–MeX systems (Me=Ga,In; X=S,Se,Te), compounds containing $SrMeX_2$, $SrMe_2X_4$, and $SrMe_4X_7$ are formed. Materials with luminescent properties were obtained by adding rare earth elements as activators to compounds containing $CaMeX_2$, $CaMe_2X_4$, and $CaMe_4X_7$ [9–11]. A number of internal sections of the ternary system Ca-Ga(In)-Se(Te) were studied by us earlier [12–19]. Most of these systems are quasi-binary or partially quasi-binary. The In-SrSe system was studied for the first time.

The aim of this work is to study the nature of chemical interactions in the In-SrSe system, construct a phase diagram and identify solid solution regions using X-ray diffraction. The In-SrSe system is studied for the first time. The In element melts at 156ºC and crystallizes in the tetragonal system with lattice parameters *a*=3.252; *c*=4.946 Å, density d=7.36 g/cm^3 [20]. The SrSe compound melts congruently at 1600ºC, crystallizes in the cubic syngony, lattice parameter: *a*= 6.243 Å, sp. gr. Fm3m, density ρ=4.50 g/cm^3 [21].

Experimental part

To synthesize In-SrSe system alloys from element compounds, SrSe was first synthesized. The Sr element is retained in oil because it oxidizes when in contact with air. To synthesize the SrSe compound, Sr and Se are calculated in stoichiometric composition. First, Se is weighed and poured into a quartz ampoule, and the Sr element is degreased in a vacuum using a BOX setup. Then it is weighed on scales and placed in an ampoule with selenium, the air is pumped out to a pressure of 0.133 Pa and the neck is sealed, melting it in an arc flame. It should be noted that excess temperature during synthesis melts and destroys the quartz ampoule, releasing a large amount of energy. Thus, SrSe is synthesized as follows. The ampoule with the substance is placed in a furnace, the temperature is increased to the melting point of indium (156°C) and maintained for 2 days, while the process is continued with constant stirring. Strontium gradually begins to transform into SrSe. At the next stage, the temperature in the furnace is increased to 300°C and maintained for 24 hours.

At the next stage, the furnace temperature was increased to 1200°C for 2 hours, and then the temperature was reduced to 1000°C and maintained for 3 hours. After synthesis, the sample was obtained in the form of a heterogeneous powder. To obtain the full composition of the SrSe compound, the sample was finely ground and pressed to 200 atm. and obtained in the form of a tablet. Then, the sample was subjected to a solid-phase reaction in an evacuated quartz ampoule at a temperature of 800°C for 100 hours. The composition of the SrSe compound was refined using X-ray diffraction analysis. Then, alloys of the In-SrSe system were synthesized from the In and SrSe components at a temperature of 1000-1200°C in an ampoule with air suction to

a pressure of 0.133 Pa. The synthesized alloys were homogenized at a temperature of 350°C for 150 hours.

The alloys in the equilibrium state were studied by differential- thermal analysis (DTA), X-ray diffraction (XRD), microstructure (MSA), as well as determination of density and microhardness.

Differential-thermal analysis (DTA) was carried out on a low-frequency Kurnakov pyrometer. The heating rate of the alloys was 10°C/min. Chromel-alumel was used as a thermocouple.

X-ray structural analysis of the alloys was carried out on a D2 PHASER X-ray diffractometer. A CuKα electrode was used as an irradiator. Microhardness was measured using a PMT-3 metallographic microscope. During the measurements, the dependence of microhardness on weight was studied.

Microstructural analysis (MSA) was carried out on an MIM-8 microscope. For this, the alloys were polished to a shine and their structure was examined under a microscope. To clarify the phase boundaries, a solution of 5 ml HNO_3 + 5 ml H_2O_2 was used as a etching agent. The densities of the alloys of the system were determined by the pycnometric method, using toluene as a filling solution.

Results and discussion

Alloys were synthesized to study the phase equilibrium in the In-SrSe system. The synthesized alloys have a silvery color in the concentration range of 0–30 mol. % SrSe, gradually changing from gray to black as the amount of the SrSe compound increases. The behavior of the system's alloys under the influence of the external environment was studied. Indium-rich alloys do not change in air, water and organic solvents, but alloys containing 30–100 mol.% SrSe gradually hydrolyze when exposed to open air for a long time, absorbing moisture from the air. All In-SrSe systems dissolve well in strong acids (HCl, HNO_3). The equilibrium alloys were studied using physico-chemical analysis methods.

As a result of differential thermal analysis, two endothermic effects are present on the thermograms of the alloys. To clarify the results of differential thermal analysis, a microstructural analysis of the alloys was carried out. It was found that in the In-SrSe system there is a single-phase and a two-phase field.

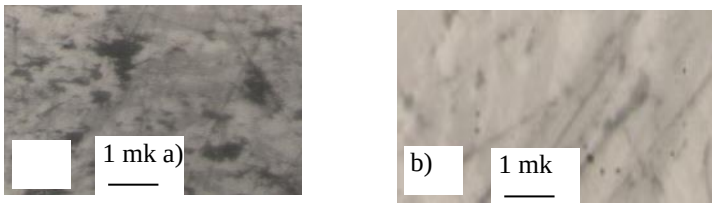

Fig. 1.
Microstructure of In-SrSe system alloys.
a) - 50 mol. %, b) -95 mol. % SrSe.

Difference-thermal analysis showed that the thermograms of the alloys exhibit two endothermic effects. To clarify the results of differential thermal analysis, microstructural analysis of the alloys was performed. It was found that the In-SrSe system has a single-phase and a two-phase field. Figure 1 shows the microstructure images of alloys containing 50 and 95 mol. % SrSe. As can be seen from Figure 1a, the alloy with a concentration of 50 mol. % SrSe is two-phase. The alloy with 95 mol. % SrSe is a solid solution alloy based on SrSe and is single-phase (Fig. 1b).

X-ray structural analysis of In-SrSe alloys was carried out for alloys containing 50, 95 and 98 mol. % SrSe and compared with the X-ray diffraction patterns of the initial components (Fig. 2). It was found that the diffraction maxima observed in the diffraction pattern of the 50 mol. % SrSe alloy consist of a mixture of diffraction lines of the initial components. The diffraction patterns of alloys containing 95 and 98 mol. % SrSe do not differ much in intensity and interplanar distances from the diffraction lines of the SrSe compound. This indicates that these alloys are solid solution alloys based on SrSe.

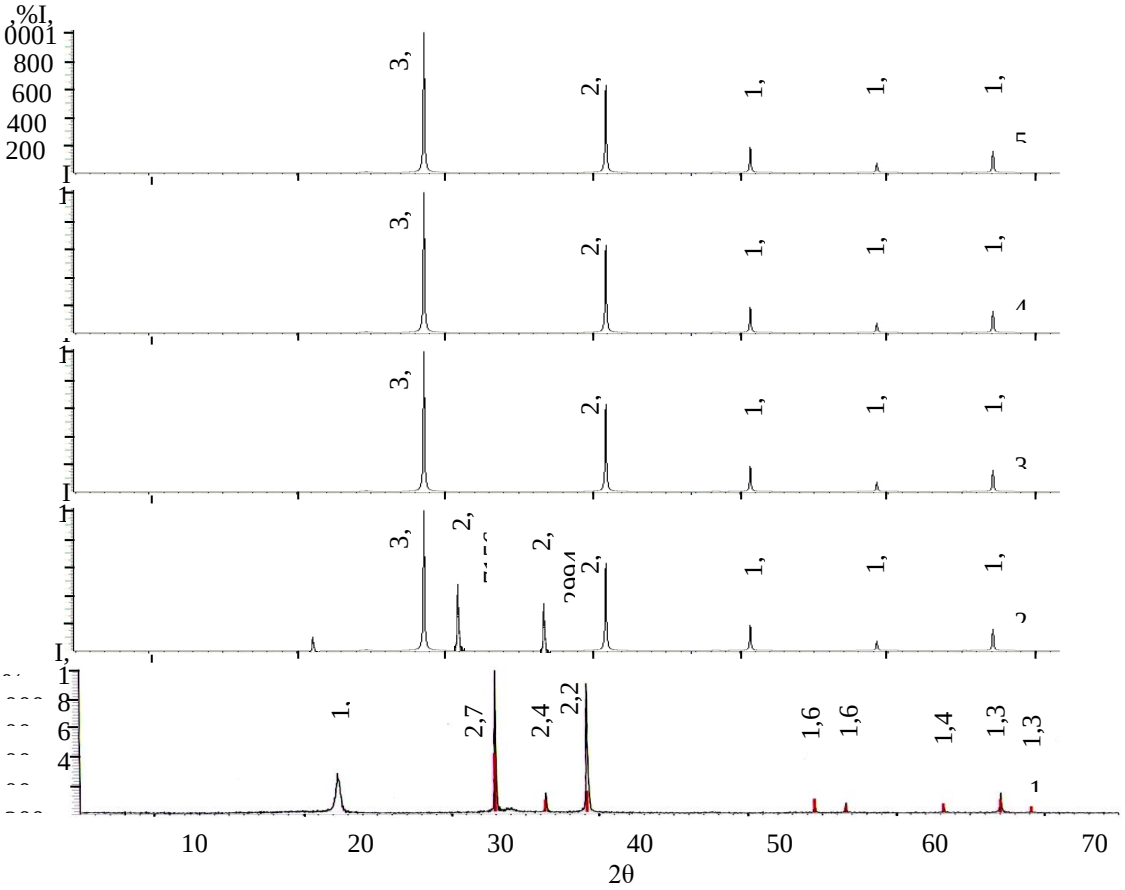

Fig. 2. Diffraction patterns of alloys of the In - SrSe system.
1-In, 2-50 mol. %, 3-95 mol. %. 4-98 mol. %, 5-100 mol. % SrSe.

As a result of X-ray structural analysis of 95 and 98 mol. % SrSe solid solution alloys based on the SrSe compound, their crystal lattice parameters were calculated (Table 1). Solid solution alloys based on the SrSe compound with a content of 95 and 98 mol. % SrSe crystallize in the cubic syngony as SrSe with lattice parameters a=6.257 Å and a=6.274 Å, respectively.

Table 1.

X-ray data of SrSe-based solid solution alloys in the In-SrSe system

SrSe			98 % SrSe- 2 % In			95 % CaSe- 5 % In		
I,%	d, Å	hkl	I,%	d, Å	hkl	I,%	d, Å	hkl
100	3,1168	200	100	3,1280	111	100	3,1373	111
64	2,2053	220	64	2,2124	200	64	2,2184	200
20	1,7999	222	20	2,1,8063	220	18	1,8110	220
8	1,5588	400	8	1,5642	311	6	1,5684	311
16	1,3950	420	16	1,3980	222	14	1,4029	222

Based on the results of complex physicochemical analysis, a phase diagram of the In – SrSe system was constructed (Fig. 3).

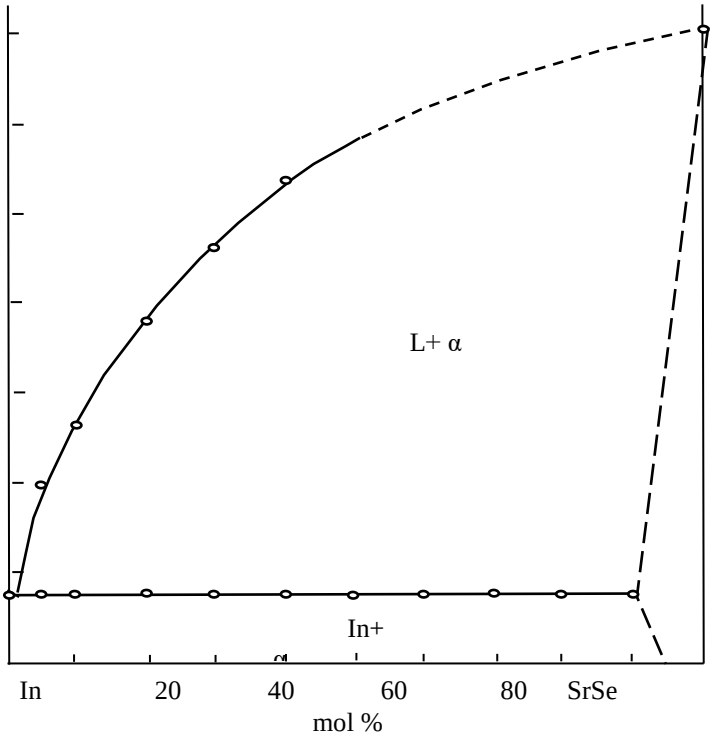

Fig. 3. Phase diagram of the In – SrSe system.

It was found that the In – SrSe system is a quasi-binary section of the Sr-In-Se ternary system. In the In – SrSe system, a degenerate eutectic is formed on the SrSe side, the temperature of which is 150°C. In the system, the In and SrSe components form a degenerate eutectic between themselves, the content is ~3 mol SrSe, the temperature is 150 °C. In the system, solid solutions based on SrSe reach up to 5 mol. % In at room temperature. In the range of SrSe concentrations in the system from 3 to 100 mol. %, crystals of the α-solid solution based on SrSe begin to precipitate along the liquidus curve. Below the liquidus curve, there is a two-phase region consisting of L + α. In the range of SrSe concentrations in the system of 3–95 mol. % below the solidus line, two-phase alloys consisting of (In+α) crystallize.

The dependence of the density and microhardness of the In – SrSe system on the composition is given in Table 2. As a result of measuring the microhardness of the alloys of the system, two types of microhardness values were obtained. The microhardness value of 150 MPa corresponds to the microhardness of In, and the value (1240-1250) MPa corresponds to the microhardness of the SrSe compound. The dependence of the densities of the alloys of the system on the composition changes monotonically.

Cədvəl 2.

In–SrSe sisteminin ərintilərinin tərkibi, DTA, mikrobərkliklərinin və sıxlıqlarının tərkibdən asılılığı

Composition, mol %		Thermal effects. ºC	Density, q/cm^3	Microhardness , MPa	
In	SrSe			In	α
				P=0,10 N	P=0,15 N
100	0,0	156	7,36	150	-
95	5,0	150,400	7,20	150	-
90	10	150,525	7,05	150	-
80	20	150,760	6,79	150	-
70	30	150,925	6,50	150	-
60	40	150,1130	6,22	150	1250
50	50	150	5,98	-	1250
40	60	150	5,64	-	1250
30	70	150	5,36	-	1250
20	80	150	5,07	-	1250
10	90	150	4,79	-	1250
0,0	100	1600	4,50	-	1240

Conclusion

As a result of complex physicochemical studies, a phase diagram of the In-SrSe system was constructed. The phase diagram of the system is quasi-binary, of the degenerate eutectic type, with a composition of ~3 mol. % SrSe and a temperature of 150°C. Based on the results of microstructural analysis, it was found that a uniform field based on SrSe is observed in the system. In the In-SrSe system, a solid solution with a concentration of 5 mol. % In was obtained at room temperature based on the SrSe compound. The dependence of the density and microhardness of the alloys of the system on the composition was studied. X-ray structural analysis of the solid solution alloys $(SrSe)_{1-x}(In)_x$ (x=0.02; 0.05) was carried out and the lattice parameters were calculated. It was found that 95 and 98 mol. % SrSe of solid solution alloys based on the SrSe compound crystallize in a cubic syngony with lattice parameters *a*=6.257 Å and *a*=6.274 Å, respectively.

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ECONOMIC SCIENCES

ISSUES OF INCREASING THE EFFICIENCY OF INTERNAL AUDIT IN THE REPUBLIC OF UZBEKISTAN

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Abstract

In developed countries, corporations pay great attention to improving the efficiency of corporate governance and risk management. In this process, the importance of identifying cases of fraud and eliminating them through the effective organization of the internal audit service in corporate structures increases. In particular, “the internal audit service in regions of the world identified from 11% to 23% of fraud cases” [7]. Therefore, it is necessary to pay special attention to internal audit and eliminate its problems in theoretical, methodological and practical aspects, widely use digital technologies, achieve the unification of internal audit standards and their implementation throughout the world.

In various countries of the world, special attention is paid to scientific research aimed at improving the methodological foundations of internal audit in the context of economic globalization. This study addresses the issues of planning internal audit inspections in joint stock companies, identifying risks associated with fraud, improving the quality of internal audit inspections, and drawing up internal audit reports. It should be recognized that in the field of research, improvements have been simultaneously achieved in the process of identifying and eliminating cases of fraud in internal audit, the use of analytical procedures in internal audit audits, and assessing the effectiveness of the internal control system. However, pressing issues related to the organization of internal audit methodology in joint-stock companies at the level of international standards have not yet been fully resolved.

Keywords: internal audit, corporate governance, risk-oriented internal audit, internal audit effectiveness, IPSIA, risk management.

1. Introduction.

In modern conditions of a market economy, investors prefer to invest in efficiently managed companies that respond to emerging risks in a timely manner. Internal audit plays a significant role in the successful organization of risk management processes and corporate governance systems by management. In the case of effective organization of activities, internal audit actively assists in assessing risks and finding countermeasures. In this article we will consider the areas of effectiveness of internal audit in the Republic of Uzbekistan.

In the Republic of Uzbekistan, in order to increase the efficiency of corporate governance, a number of measures have been developed to improve the work of the internal audit service. In particular, much attention is paid to improving the professional training and level of knowledge of employees of the internal audit service. In particular, the definition of the task “Creating a system for advanced training and certification of internal audit service personnel” [5] requires the organization of an internal audit service in joint-stock companies based on international standards. These tasks determine the importance of improving the internal audit methodology in joint-stock companies, organizing a certification system for internal auditors based on international requirements, reducing risks associated with cases of fraud, increasing the efficiency of internal audit by redistributing the risks of control tools among responsibility centers, and using internal and external benchmarking methods in the process of collecting evidence.

To a certain extent, this study serves to implement the tasks defined in decrees of the President of the Republic of Uzbekistan dated January 28, 2022 No PD-60 "On the Development Strategy of New Uzbekistan for 2022-2026", No PD-4720 "On measures to introduce modern corporate governance methods in joint-stock Companies", resolutions of the President of the Republic of Uzbekistan dated February 24 2020 No PD-4611 "On additional measures for the transition to International Financial Reporting Standards", Dated September 19, 2018, No PO-3946 "On measures for the further development of auditing activities in the Republic of Uzbekistan", Resolution No 280 dated May 5, 2021 "On measures to improve the training system for employees of the internal Audit service", as well as other regulatory legal acts related to this area.

“Based on the results of the first half of 2021, the volume of services provided in the digital economy amounted to seven trillion 200 billion sums, exports of computer programming services amounted to 17 million 500 thousand dollars. Until 2022, it is planned to implement 268 projects in Uzbekistan aimed at developing the Electronic Government system, telecommunications, the Technology Park of software products and information technologies, as well as the introduction of digital technologies in other industries” [6].

Literature review

In conditions of active development of economic relations, the role of internal audit is increasing both in government agencies and in commercial enterprises. Since internal audit is a means of successful enterprise

management, the quality of this system serves to increase the efficiency of the business entity. Internal audit (IA) is a complex process consisting of various aspects, and a number of domestic and foreign scientists have conducted scientific research in this area. A risk-oriented IA is organized with the aim of effectively organizing this service. Also, in an effective organization of IA, the main role is played by its organization on the basis of International Professional Standards for Internal Auditing (IPSIA). The task of the head of the internal audit service is to organize and conduct a risk-based audit based on the IPPF, which meets the ethical and qualification requirements of the IPSIA "The International Professional Standards of Internal Auditing (Standards) are one of the components of the International Framework for the Professional Practice of Internal Auditing (IFPPIA) developed by International Institute of Internal Auditors" [8], which internal auditors around the world have used in their daily work since 1947. IPPF is the basis of interstate legislative and regulatory acts in the field of internal audit; on the basis of IPPF, relevant recommendations of industry regulators in many countries of the world are formed.

The standards are set out as principles and provide a framework for conducting IA. The structure of the standards consists of quality standards and performance standards. The standards also specify the mission of internal audit. Several studies were reviewed and the authors concluded that internal audit effectiveness is related to compliance with standards.

Khaled Ali Endaya and Mustafa Mohd Hanefah, in their scientific studies, also determined the effectiveness of the IA service in complying with the IPSIA. The author also argues that the effectiveness of internal audit can only be achieved when the activities of both internal audit department and its auditors are supported by members of the organization. This support includes the allocation of appropriate human and material resources to internal audit, as well as the overall tone in the acceptance and evaluation of the internal audit department and its auditors, as well as the implementation of the recommendations of the internal audit department [13].

Aaron Cohen & Gabriel Sayag, as a result of scientific research, identified the principle of independence as the main link in the effective organization of the internal audit service [9].

As a result of their research, Douglas F. Prawittm, Jason L. Smith, David A. Wood concluded that the measure of overall internal audit quality is based on auditing standards, which provide guidance to external auditors in assessing the extent to which they can rely on the work of internal audit services. According to the authors, internal audit performance plays an important role in the quality of externally reported financial performance, an essentially untapped but potentially promising area for future research[11].

Research by Maric Arena and Giovanni Azzone examines the organizational determinants of internal audit effectiveness in the "mission" of internal audit and its central role in corporate governance. Based on data from 153 Italian companies, the authors concluded that internal audit effectiveness is influenced by: characteristics of the internal audit team, audit processes and activities, and organizational relationships. The effectiveness of internal audit increases, in particular, when the ratio between the number of internal auditors and the staff increases, the chief audit manager joins the institute of internal auditors, the company adopts control risk self-assessment methods, and the audit committee participates in the activities of internal auditors" [14].

But in any case, for the effectiveness of internal audit activities, the specification of goals and objectives is required.

2. Materials and Methods

In general, like any other activity, specifying the goals and objectives of internal audit increases the effectiveness of its activities.

Internal audit is an important management tool for assessing the reliability and effectiveness of the internal control system in a joint-stock company, managing enterprise risks, and achieving the goals and objectives set for the joint-stock company.

When organizing internal audit, the regulatory framework, internal regulations of joint-stock companies, job descriptions of employees of the internal audit service, and a program for identifying and assessing fraud in internal audit are important for the effective organization of its activities. In addition, the organizational structure of the internal audit service plays an important role in Improving the quality of internal audit and organizing audit at the international level based on the implementation of professional standards for internal auditing are more closely related to scientific work in this area. Internal audit conducts inspections, collects and analyzes audit evidence in the structural divisions of the joint-stock company in order to conduct an independent assessment and give an opinion on reliability and efficiency.

In the Republic of Uzbekistan, internal audit in joint stock companies is organized on the basis of the following regulatory documents (Table 1).

Table 1

Analysis of regulatory documents regulating the internal audit service in joint-stock companies [17]

No.	Document's name	Issues studied
1.	Law of the Republic of Uzbekistan No. LRU-370 "On joint stock companies and protection of shareholders' rights"	Requirements for organizing an internal audit service in joint-stock companies, accountability of internal audit, proposed transactions with an affiliate of the company, tasks of internal audit
2.	Regulations on internal audit at enterprises	Main tasks, functions, rights and responsibilities of the internal audit service, requirements for the internal audit service
3.	Regulations on the procedure for certification of an employee of the internal audit service	Qualification requirements for certification, list of documents provided, requirements for exams to obtain a certificate, qualification requirements for obtaining a certificate, registration and issuance of a certificate, conditions for validity and revocation of a certificate
4.	International Standards of Internal Auditing and Auditing Standards	Conducting audits at the level of international requirements, using generally accepted standards
5.	Code of Ethics for Auditors	Professional competence, reliability, independence, integrity, objectivity, principle of confidentiality, etc.

In the corporate governance system, internal audit implements risk-oriented internal audit in order to facilitate the adoption of effective management decisions as a result of the application of internal audit methods and processes by collecting information from the structural divisions of the company to ensure its independence.

In studies by Matyjewicz & D'Arcangelo, 2004; Beasley et al., 2005; Jackson, 2005, examines the role of internal audit in risk management and argues that through its links to risk management, internal audit helps managers understand what may prevent them from achieving their expected goals.

Internal audit in the field of risk management in a joint stock company must carry out the following activities:

- checking the sufficiency and compliance of the elements of the risk management system (goals and objectives, infrastructure, organization of processes, regulation, methodological support, mutual influence of structural units in the risk management system, reports);
- checking the completeness and reliability of risk identification by management at all levels of management;
- checking the effectiveness of control procedures and other risk management measures, including the use of resources allocated for these purposes;
- analysis of risk data (violations identified during internal audit inspections, cases of failure to achieve goals, legal proceedings, etc.).

Based on the results of the risk assessment, internal audit selects methods for managing significant risks (Figure 1).

Figure 1. Risk management methods in internal audit20

As a result of our research, we came to the conclusion that redistributing the risks of controls across responsibility centers reduces the risk of controls and increases the effectiveness and quality of internal audit work in joint-stock companies.

Also, in risk management in joint-stock companies, special attention is required to operational risk. Operational risk is the risk associated with the implementation of business processes of a joint stock company. Operational risk can arise as a result of errors made by employees when implementing business processes, cases of fraud, errors in information systems and technologies, as well as as a result of external events. The following can be identified as operational

[17] Разработано автором по результатам исследований.
[20] Разработано автором по результатам исследований.

risk factors: cases of external and internal fraud; errors in financial reporting, failures in business processes, failures in information and technical systems, damage to material goods and property, industrial accidents, violation of contractual relations with customers, etc.

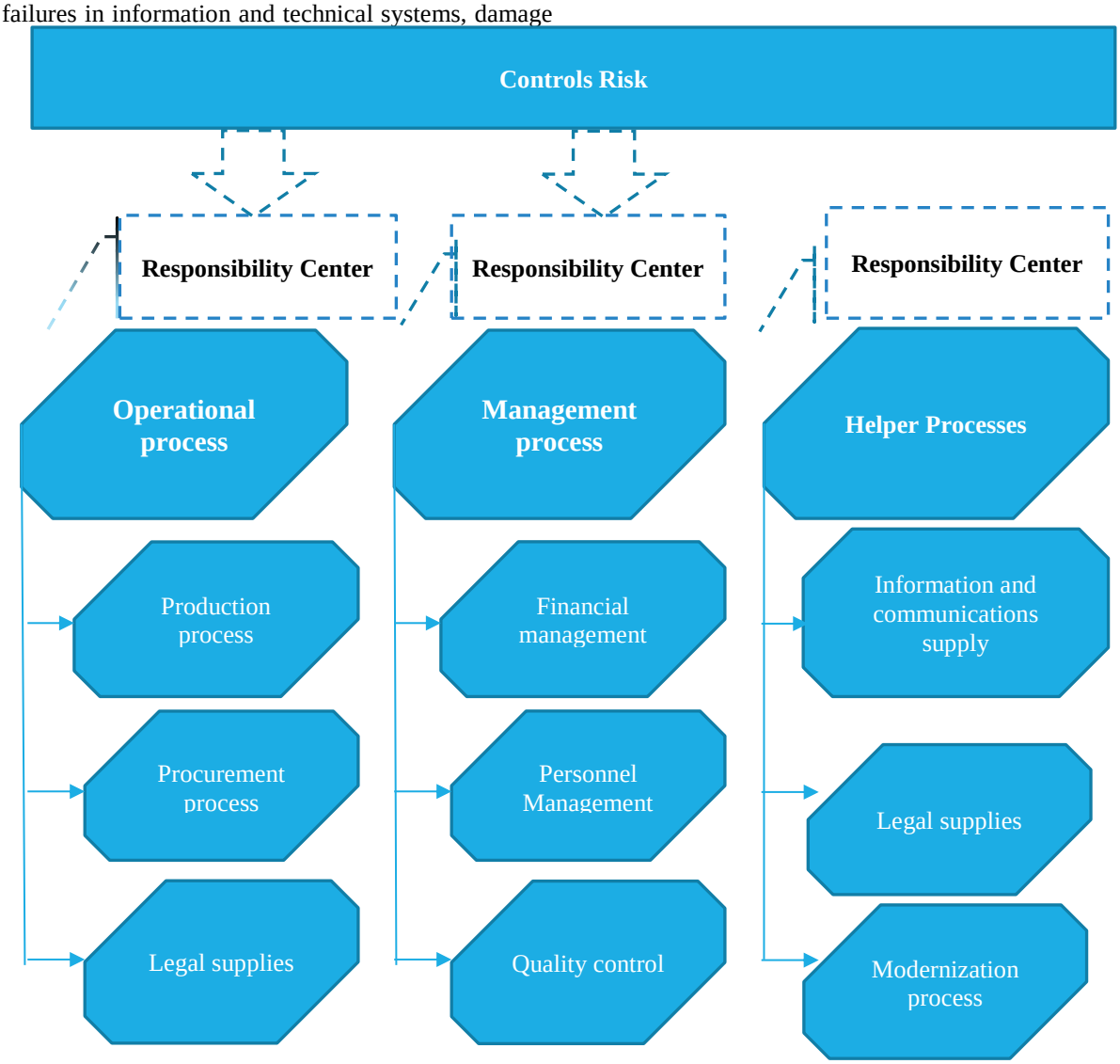

Figure 2. Redistribution of control risk to the center of responsibility.

Also, in risk management in joint-stock companies, special attention is required to operational risk. Operational risk is the risk associated with the implementation of business processes of a joint stock company. Operational risk can arise as a result of errors made by employees when implementing business processes, cases of fraud, errors in information systems and technologies, as well as as a result of external events. The following can be identified as operational risk factors: cases of external and internal fraud; errors in financial reporting, failures in business processes, failures in information and technical systems, damage to material goods and property, industrial accidents, violation of contractual relations with customers, etc.

Minimizing operational risk is one of the methods of its management, and to minimize it in a joint stock company it is necessary to plan, implement and improve measures to establish control over them by analyzing business processes. Therefore, in the research work it was proposed to include control over the reduction of operational risks in joint-stock companies as part of the criteria for internal assessment of the quality of the internal audit service (Figure 3).

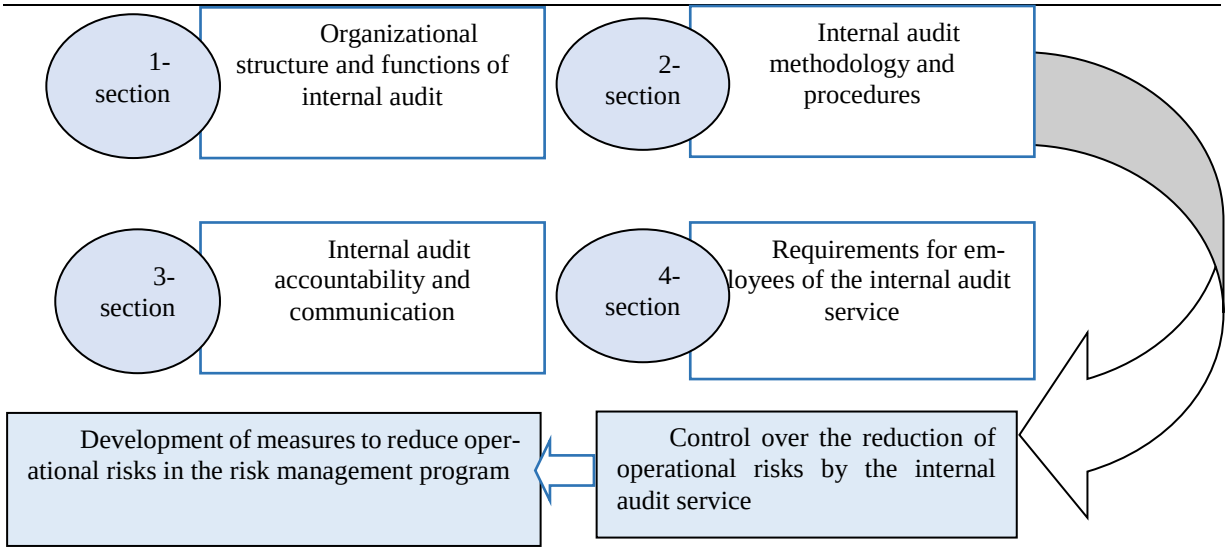

Figure 3. Procedure for assessing the control of the internal audit service over the reduction of operational risk40

The inclusion of control over the reduction of operational risks in joint-stock companies in the criteria for internal assessment of the quality of work of the internal audit service helps to assess the quality of the work of internal auditors and reduce operational risks in business processes.

Analysis of the quality of internal audit work in joint-stock companies is an important means of monitoring and managing risks associated with the company's activities. This allows us to determine how effectively internal audit fulfills its tasks and ensures the correct and timely identification of shortcomings and errors in activities. Analysis of the quality of internal audit work also helps to improve risk management processes, which reduces the likelihood of financial losses for joint-stock companies. This gives owners and management a clearer understanding of what risks exist and how they can be effectively managed.

In addition, analyzing the quality of internal audit work helps improve the credibility of shareholders, banks, investors and other stakeholders, such as rating agencies. It can serve as an indicator of proper risk assessment and management, as well as an indicator of the effectiveness of internal controls. Thus, it is not an exaggeration to consider that analysis of the quality of internal audit work is an important tool that provides shareholders and managers with objective information about the financial condition of a joint-stock company and helps them make correct and informed decisions. In our opinion, the main directions for analyzing the quality of internal audit work in joint-stock companies should be the following (Table 2).

Table 2

Directions for analyzing the quality of internal audit work [28]

No.	Directions for analyzing the quality of internal audit work	Essence
1.	Full coverage of the quality management system	The internal auditor must use a systematic approach when conducting internal audits
2.	Ensuring compliance of internal audit with legislation and international standards	Internal audit reviews should be conducted in accordance with international and national standards
3.	Risk identification and assessment	Internal audit must have appropriate risk assessment strategies
4.	Documentation	Internal audit documentation should contain detailed records of all procedures undertaken during the audit, from evidence obtained and results to recommendations.
5.	Communication with employees	The internal auditor must be truly communicative in order to treat employees fairly
6.	Analysis of results	The internal auditor must review the audit process and its results
7.	Including economic security issues in internal audit	Internal audit should include issues and requirements of economic security
8.	Development of recommendations for improving activities	The internal audit should lead to the formation of a list of recommendations to improve the quality of work and make economically rational decisions

[40] Разработано автором по результатам исследований.
[28] Разработано автором по результатам исследований.

When analyzing the quality of internal audit work, attention not only to the results of its activities, but also to issues of risk management, economic security, conducting internal audits in accordance with international standards of professional practice when assessing the quality of internal audit work and the implementation of these standards in the practice of the Republic of Uzbekistan helps to improve the efficiency of the service internal audit.

The international standards used and recognized today in the practice of developed countries in organizing internal audit include the following (Figure 4).

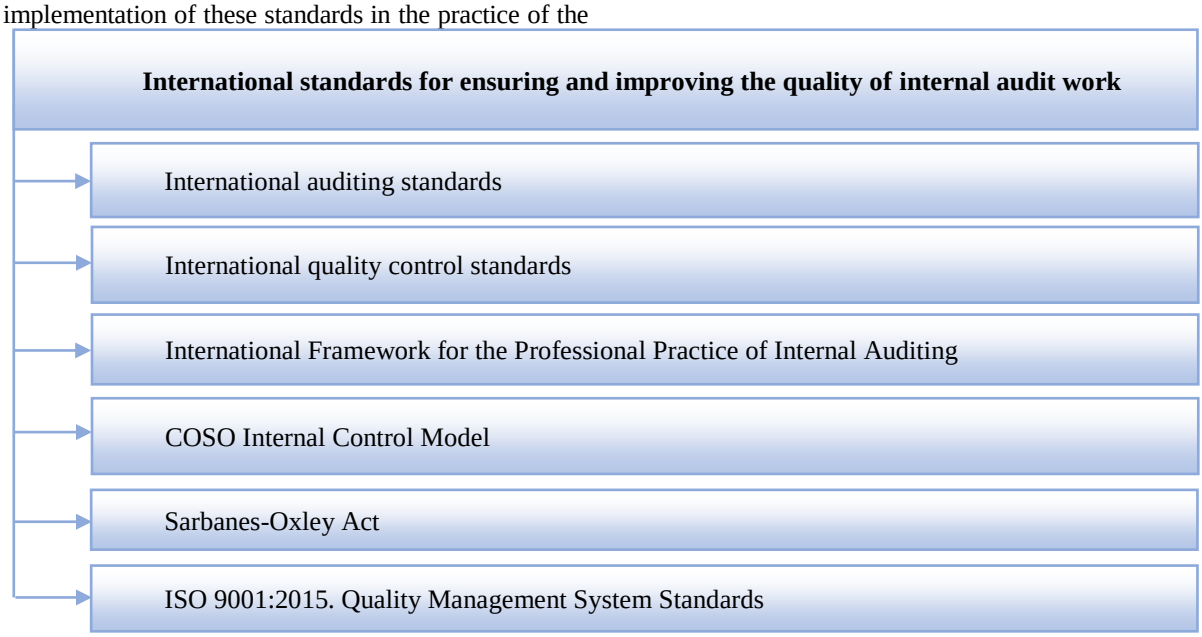

Figure 4. International standards for ensuring and improving the quality of internal audit work29

Organizing internal audit audits based on these standards, helping to ensure and improve the quality of its work, defining in the Regulations "On the Internal Audit Service" of the company the requirements of legislation and standards, procedures and criteria for assessing the quality of internal audit work, allows you to control the quality of internal audit work and improve it over time. by eliminating identified deficiencies.

3. Results

As a result of a study conducted to improve the internal audit methodology in joint stock companies, the following conclusions were made:

1. The internal audit service plays an important role in ensuring the effectiveness of corporate governance in joint-stock companies, protecting the rights of shareholders and achieving the goals of the company. The Internal Audit Service contributes to the development of society by conscientiously, objectively and impartially carrying out the tasks defined in its annual work plan.

2. The implementation of business processes in joint stock companies is always associated with risk. In fact, one of the important features of entrepreneurial activity is its risk-based nature. The internal audit service must also take these aspects into account in its activities. Therefore, it is important to organize a risk-oriented internal audit in joint-stock companies.

3. It is necessary to regularly analyze the financial position and financial results of joint-stock companies, identify missed opportunities and improve areas of business development.

When analyzing performance results, it is advisable to use complex methods, in particular econometric modeling methods. In this study, through econometric modeling, the factors influencing return on assets were studied, and the factors influencing it and the level of their influence were specified.

4. When improving the internal audit methodology in joint-stock companies, it is important to specify the purpose, objectives and organizational foundations of internal audit, the procedure for its implementation, internal audit methods, technology and tools used in the internal audit process. As a result of the study, an improved model for organizing internal audit in joint-stock companies was developed.

5. Organizing internal audit in joint stock companies in a risk-oriented manner helps prevent risks and possible damage as a result of timely identification of risks and the application of measures to eliminate them. As a result of the study, the organization of risk-oriented internal audit in joint-stock companies and a risk management procedure were proposed.

6. It is necessary to analyze the quality of work of the internal audit service. This, in turn, improves the quality of work of the internal audit service. However, the procedure for assessing the quality of internal audit work in joint-stock companies has not been fully developed. During the study, directions for analyzing the quality of internal audit work were developed. Determining directions and effective organization of business processes helps improve the quality of work of the internal audit service.

5. Conclusion

Based on the above, we can conclude that as a result of improving internal audit in the corporate

[29] Разработано автором по результатам исследований.

governance system, optimal organization of business processes and improvement of the legal framework for internal audit, making effective management decisions, as well as organizing internal audit based on international standards creates conditions and opportunities for attracting foreign investors.

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ALTERNATIVE SCENARIOS FOR INCREASING THE COMPETITIVENESS OF CONSTRUCTION INDUSTRY ENTERPRISES

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Abstract
The article develops alternative scenarios (inertial, pessimistic, and optimistic) for increasing the competitiveness of construction industry enterprises. Furthermore, in the medium-term perspective, improving the efficiency of using the potential of the construction industry in Andijan region requires not only the region's resource potential, but also prioritizing the development of innovative product production along with the production of high-tech products. This can be achieved by enhancing the technical and technological aspects of the production chain and increasing the competitiveness of local construction enterprises.

Keywords: construction industry, inertial, pessimistic and optimistic scenarios, resource potential, pure construction materials, high-tech product manufacturing, production chain, competitiveness of construction enterprises

INTRODUCTION. In the context of New Uzbekistan, it is important to focus on enhancing the efficiency of utilizing the potential of the construction industry, among other sectors of the national economy, in order to achieve sustainable development. This is aimed at increasing the competitiveness of domestic manufacturing enterprises at both national and global levels. Additionally, development strategies have been developed for each sector, and their implementation is being carried out in phases based on roadmaps formed from relevant measures.

Currently, under the implementation of the New Uzbekistan Development Strategy, which is planned for the medium-term future, the volume of construction works in the country has sharply increased within the framework of the "Obod qishloq" ("Prosperous village") and "Obod makhalla" ("Prosperous neighborhood") programs [1]. This has made it possible to support the production of construction industry products through a demand-stimulating mechanism. In particular, the goal of the "Uzbekistan – 2030" strategy to "develop the 'driver' sectors of the industry and fully activate the industrial potential of regions" [2], which includes increasing the production of construction materials by two times and expanding the production of new types of energy-efficient materials, has been set. This requires developing scientifically grounded alternative development scenarios for increasing the efficiency of using the potential of construction enterprises in each region of the republic and ensuring the competitiveness of these enterprises.

LITERATURE REVIEW. In recent years, the practice of evaluating the competitiveness of construction industry enterprises through the volume of added value created in the sector has been adopted in the development of alternative scenarios for the future prospects of the construction industry. Specifically, the scientific research conducted by A. Gosh [5], A. Lecan [7], S. Mihai [8], F. Simoni [9], J.G. Bekes [3], V. De-Araujo [4], and T. Omotayo [6] is based on methodologies in this area.

Table 1

TOP 10 companies producing high value-added products in the global construction industry market, 2023 [10, pp. 49]

TOP	Company name	Country	Market turnover (million USD)
1	CHINA STATE CONSTRUCTION ENGINEERING CORP. LTD. (CSCEC)	China	319,949
2	CHINA RAILWAY GROUP LTD. (CREC)	China	178,434
3	CHINA RAILWAY CONSTRUCTION CORP. LTD. (CRCC)	China	160,713
4	CHINA COMMUNICATIONS CONSTRUCTION GROUP LTD. (CCCC)	China	107,144
5	METALLURGICAL CORPORATION OF CHINA LTD (MCC)	China	89,518
6	POWER CONSTRUCTION CORP OF CHINA	China	86,063
7	VINCI	China	74,459
8	BOUYGUES	China	60,591
9	CHINA ENERGY ENGINEERING CORP	China	57,342
10	SHANGHAI CONSTRUCTION GROUP (SCG)	China	43,021

According to the report prepared by the international organization "Deloitte Organization" on the development forces of the global construction industry, in 2023, eight construction industry enterprises from China, producing construction products with high added value, were included in the global TOP-10 list in terms of the volume of construction goods and services in the international market (see Table 1).

RESEARCH METHODOLOGY. The general strategy for economic development outlined in the works of the President of the Republic of Uzbekistan Sh.M. Mirziyoyev, The laws of the Republic of Uzbekistan, Government decisions, as well as foreign experiences dedicated to increasing the competitiveness of construction industry enterprises in the national economy, and used of logical, monographic, scientific abstraction, and comparative analysis methods have been employed.

ANALYSIS AND RESULTS. At the same time, China accounted for 53.5% of the global construction goods and services market turnover and the capitalization of enterprises, which demonstrates that it has a national construction industry with a high level of competitiveness. In terms of innovative activity, the USA (9.0%) and Japan (8.8%) contributed a combined 17.8% of the global construction goods and services market turnover (see Figure 1). These global trends in the construction goods and services market show that the global competitiveness of Chinese construction companies has been achieved due to the production of high-added-value products.

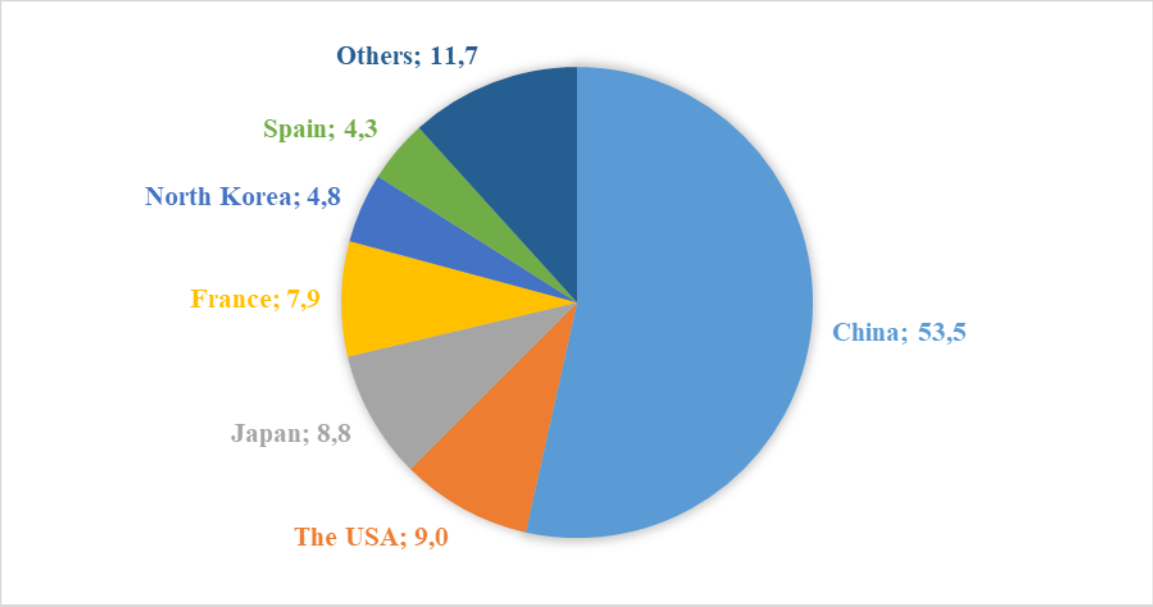

Figure 1. Share of National Construction Industry Sectors in the Global Construction Market by Product and Service Turnover and Capitalization Volume, as a Percentage of Total, 2023 [10, pp. 49]

Based on the analysis provided above, the next step is to develop alternative scenarios for increasing the competitiveness of local construction enterprises in the Andijan region in the coming years using a multiple regression-correlation model. In this case, the value of the added value created in the regional construction industry will be conditionally defined as an indicator that describes the competitiveness level of local construction enterprises, which will serve as the dependent variable in the model. The independent variables affecting the dependent variable are the number of local construction enterprises (x1), which participate in the competition, and the volume of construction works completed in the region (x2), which serves to stimulate demand for construction products. The data necessary to conduct the multiple regression-correlation analysis are presented in Table 2.

Table2:

Necessary Data for Multiple Regression-Correlation Analysis to Enhance the Competitiveness of Construction Industry Enterprises in Andijan Region [11]

Years	The volume of added value created in the construction industry, in billion soums. (*y*)	The number of active enterprises and organizations in the construction industry, in units. (x_1)	Volume of construction work performed, in billion soums. (x_2)
2010 y	146,8	1955	345,3
2011 y	244,5	1978	534,4
2012 y	297,4	2086	672,9
2013 y	417,6	2100	862,7
2014 y	510,8	2237	1131,8
2015 y	600,8	2339	1341,9
2016 y	705,4	2265	1578,0
2017 y	1348,9	2119	1782,9
2018 y	2043,4	2418	2819,5
2019 y	2539,7	2747	3539,1
2020 y	3044,6	3071	4673,0
2021 y	3571,2	3132	5657,8
2022 y	4099,8	3378	6864,1
2023 y	4428,6	2111	7384,3

In order to develop alternative scenarios for improving the competitiveness of local construction enterprises, a multiple regression model should be developed based on the multiple regression-correlation analysis hypothesis outlined as follows (1) function:

$$y = b_0 + b_1 x_1 + b_2 x_2 \qquad (1)$$

"The values of "$b_0; b_1; b_2$" in the given multiple regression model function are determined using the least squares method. These values serve as the vector coefficients for the independent variables (x_i) in the multiple regression model. Based on the least squares method, the vector coefficients of the independent variables in the model are determined using the following formula (2):"

$$s = (X^T X)^{-1} X^T Y \qquad (2)$$

"Using the least squares method mentioned above, the vector coefficients of the independent variables (x_i) are determined based on the data provided in table 2. The formula (3.2) should be used to calculate the resulting factor (y), the independent variables "(x_i) " and the vector coefficient values given above by forming the matrices for the "X^T" values (see Appendices 7-9). In the next step, based on the formed matrices, the values for "$X^T X$" and "$X^T Y$" in the least squares function (3.2) are calculated (see Appendices 10-11), and the value of "$(X^T X)^{-1}$" is determined as follows based on Appendix 10:"

$$(X^T X)^{-1} = \begin{array}{|c|c|c|}\hline 3,1014 & -0,00143 & 0,000157 \\ \hline -0,00143 & 1,0E\text{-}6 & 0 \\ \hline 0,000157 & 0 & 0 \\ \hline \end{array}$$

In order to develop alternative scenarios for improving the competitiveness of local construction enterprises, a multiple regression model should be developed based on the multiple regression-correlation analysis hypothesis outlined as follows (1) function:

$$Y(X) = \begin{array}{|c|c|c|}\hline 3,1014 & -0,00143 & 0,000157 \\ \hline -0,00143 & 1,0E\text{-}6 & 0 \\ \hline 0,000157 & 0 & 0 \\ \hline \end{array} * \begin{array}{|c|}\hline 23999,5 \\ \hline 64922293,4 \\ \hline 115669864,68 \\ \hline \end{array} = \begin{array}{|c|}\hline -326,6881 \\ \hline 0,1318 \\ \hline 0,615 \\ \hline \end{array}$$

Based on the calculations performed, we obtained a multiple regression model with the following form:

$$y = -326,6881 + 0,1318x_1 + 0,615x_2$$

Based on the developed multiple regression model, the following conclusions can be made:

The volume of added value created in the construction industry of Andijan region is interrelated with the activities of local production enterprises and the volume of construction work carried out in the region. That is, based on the consumption of construction products produced by local enterprises in the internal construction market of the region, the execution of construction works in the region has served to stimulate market demand for local enterprise products. The reason for this is that if the development trends of construction work carried out in the region and the activities of local construction enterprises and organizations

are not taken into account, the volume of added value created in the construction industry of the region is explained by the presence of a negative development vector.

The increase in the number of enterprises and organizations engaged in economic activities in the construction industry of Andijan region has led to a positive development vector, although the volume of added value created in the construction industry of the region is small. This situation indicates that the volume of added value of goods and services produced by local construction industry enterprises is low or the degree of assimilation of the product production chain by them is insufficient. It is important to note that the volume of added value created in the construction sector of the region is lower than that of other regional industrial sectors. This situation suggests the need to prioritize programs aimed at increasing the efficiency of utilizing the potential of the region's construction industry in the coming years. Through this, the creation of high added-value products by local construction enterprises, including increasing the level of assimilation of the product production chain in the specialization of the region's districts and cities in the construction industry, will lead to achieving higher competitiveness.

The increase in the volume of construction works in Andijan region has also resulted in a positive development vector for the volume of added value created in the construction industry of the region. According to the calculations, the increase in the volume of construction works has resulted in the added value created in the region's construction industry being 4.7 times higher than the development vector achieved due to the increase in the number of enterprises and organizations engaged in economic activities in the sector. This indicates that the level of development and competitiveness of construction services provision is higher in the region compared to product manufacturing in the construction industry.

In the next stage, based on the results of the developed multi-factor regression model, the conclusions should be reinforced through correlation analysis aimed at identifying the internal relationships between the result factor and the independent variables in the formed hypothesis. The correlation coefficient between the selected factors in the hypothesis will be determined using the following (3) function:

$$r_{xy} = \frac{\overline{x \cdot y} - \overline{x} \cdot \overline{y}}{s(x) \cdot s(y)} \quad (3)$$

Using the correlation coefficient determination function (3) mentioned above, we will evaluate the degree of internal correlation between the result factor and each independent variable:

The degree of internal correlation between the volume of added value created in the construction industry of the region and the number of active enterprises and organizations engaged in economic activities in the sector:

$$r_{yx_1} = \frac{4637306.671 - 2424 \cdot 1714.25}{449.676 \cdot 1493.115} = 0.718$$

According to calculations, the development trend of the added value created in the construction industry of the region has a strong internal correlation with the number of active enterprises and organizations engaged in economic activities in the sector, according to the Chedevk scale, with the correlation coefficient being 0.718. This indicates that the added value created in the construction industry of the region, in 28.2% of cases, is mainly generated by active construction enterprises and organizations. In this context, it is worth noting that according to the multiple regression model, the added value has a low additional growth vector due to this factor, which suggests the need to prioritize the development of high-tech product manufacturing in the sector.

The degree of internal correlation between the added value created in the construction industry of the region and the volume of construction works being carried out in the region:

$$r_{yx_2} = \frac{8262133.191 - 2799.121 \cdot 1714.25}{2339.527 \cdot 1493.115} = 0.992$$

Thus, the degree of internal correlation between the added value created in the construction industry of the region and the volume of construction works being carried out in the region is 27.6% higher than the correlation with the number of enterprises and organizations engaged in economic activities in the sector. According to the Chedok scale**,** there is a significantly strong internal correlation between them, with the correlation coefficient being 0.992. Based on this result, it can be concluded that the hypothesis of the formulated multiple regression model is correctly structured.

In the formulated multiple regression-correlation model, the internal correlation between the number of active enterprises and organizations operating in the region's construction industry and the volume of construction works carried out in the region:

$$r_{x_1x_2} = \frac{7525412.736 - 2799.121 \cdot 2424}{2339.527 \cdot 449.676} = 0.704$$

According to the results of determining the internal correlation between independent variables in the multiple regression-correlation model, it was found that there is a strong correlation between the number of active enterprises and organizations operating in the construction industry of the region and the volume of construction works performed in the region, according to the Chedok scale. The correlation coefficient expressing this was found to be 0.704. This situation indicates that the additional growth vector coefficient of the added value created in the local construction industry, achieved due to the volume of construction works performed in the region, is 29.6%, which corresponds to the region's non-residents.

Table 3

Correlation Analysis Matrix for Increasing the Competitiveness of the Construction Industry in Andijan Region

–	*y*	x_1	x_2
y	1	0,7178	0,9916
x_1	0,7178	1	0,7037
x_2	0,9916	0,7037	1

Based on the results of the conducted multiple correlation analysis, the correlation analysis matrix is presented in Table 3.6 in the following form, and the following conclusions have been reached:

The consistency and similarity of the results from the conducted multiple regression-correlation analysis indicate that the hypothesis formed regarding the improvement of the competitiveness of construction industry enterprises in the region is correct. This situation suggests that the conclusions obtained from the calculations, based on economic-mathematical methods, are scientifically proven.

In the construction industry of Andijan region, giving priority to increasing the level of integration in the production chain through the production of high-tech products by enterprises will enhance the competitiveness of local enterprises.

The development of the construction industry in the region, including the increase in the volume of construction work carried out in the region, has resulted in over two-thirds of the potential demand in the regional construction market being met by local enterprises. This situation indicates that there is an opportunity to expand the market coverage of enterprises by improving the efficiency of utilizing the development potential of the local construction industry;

The results of the conducted multiple regression-correlation analysis confirm that the increase in the added value created in the construction industry of the region serves as a basis for determining the alternative scenarios for improving the competitiveness of the region's construction enterprises, which can be used as a performance indicator in the development of alternative scenarios.

In the development of alternative scenarios to increase the competitiveness of construction enterprises in Andijan region, it is necessary to calculate the percentage change in the added value created in the construction industry based on the elasticity coefficient by considering the 1% change in the independent variables of the hypothesis formed in the multiple regression-correlation analysis. This will be done using the following function:

$$E_i = b_i \cdot \frac{\overline{x_i}}{\overline{y}} \quad (4)$$

To determine the change in the added value in the local construction industry as a result of a 1% change in the number of active enterprises and organizations in the construction industry, we apply the elasticity coefficient formula:

The degree of change in the added value of the local construction industry as a result of a 1.0% change in the number of operating enterprises and organizations in the construction industry of the region is calculated.

$$0.132 \cdot \frac{2424}{1714.25} = 0.186$$

According to the calculations, the degree of change in the added value of the local construction industry resulting from a 1.0% change in the number of operating enterprises and organizations in the construction industry of the region shows a positive trend, with the elasticity coefficient being 0.186. This situation further proves that the proportion of high-tech products in the product range produced by local construction industry enterprises is low, or the level of integration in the production chain is low.

Similarly, the degree of change in the added value of the local construction industry as a result of a 1.0% increase in the volume of construction works carried out in the region is:

$$0.615 \cdot \frac{2799.121}{1714.25} = 1.004$$

Thus, it was found that a 1% increase in the volume of construction works in the region leads to a positive trend in the change in the added value of the local construction industry, with the elasticity coefficient of 1.004. This further confirms the validity of the conclusions drawn from the multivariate regression-correlation analysis.

Based on the economic-mathematical methods used, it was concluded that, in the coming years, the added value created in the sector can be used as an indicator to describe the competitiveness of construction enterprises in Andijan region when developing forecast indicators for improving the competitiveness of local construction enterprises.

Based on this, medium-term forecasts were developed for the improvement of the competitiveness of construction enterprises in Andijan region, considering three different development scenarios: inertial, pessimistic, and optimistic.

The formulas used for the calculations of the forecast indicators for each scenario are presented in Table 4.

Scenario name	Forecast indicator calculation function
Inercion scenario	$y = 11{,}606x^2 + 161{,}86x - 362{,}1$
Pessimistic scenario	$y = -0{,}3376x^2 + 329{,}12x - 762{,}06$
Optimistic scenario	$y = 23{,}549x^2 - 5{,}4017x + 37{,}864$

The first forecast indicators are based on the inertial scenario, which assumes that the trends in the development of the construction industry enterprises and the level of competitiveness in Andijan region from 2010 to 2023 will continue unchanged. This scenario is based on the assumption of changes in time factors. According to the results of the forecast calculations for improving the competitiveness of construction enterprises in the region under the inertial scenario, it was determined that by 2028, the volume of added value created in the region's construction industry could increase by 48.1% compared to 2023 (see Figure 2).

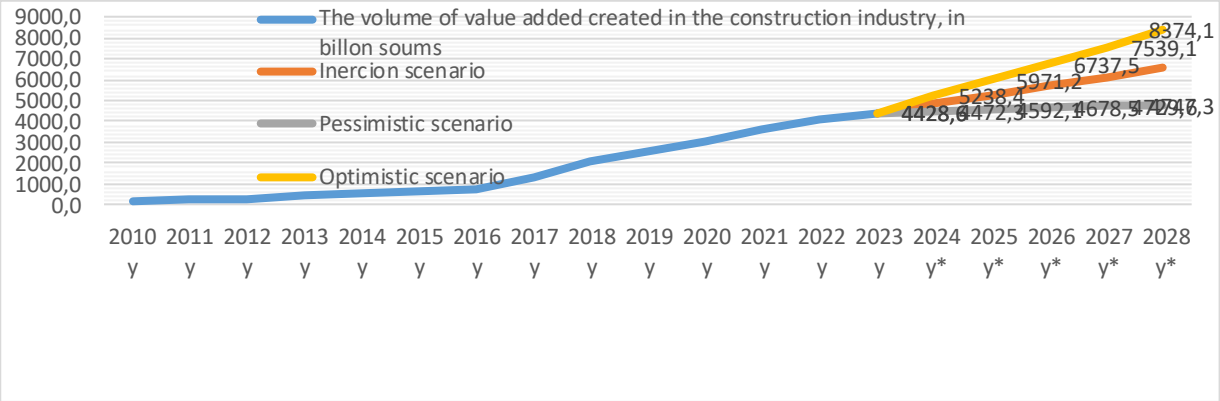

Figure 2. Prognostic indicators of alternative scenarios for improving the competitiveness of construction enterprises in Andijan region

In pessimistic scenarios, the level of integration in the product manufacturing chain of construction enterprises in Andijan region is expected to remain at its current state. Additionally, the share of high-tech products in the total construction product volume is not expected to change, with a focus on their moral obsolescence. The trends in the market turnover of goods and services produced by local enterprises will change primarily due to the increase in the volume of construction work. According to the forecast developed under this scenario, by 2028, the volume of added value created in the region's construction industry may increase by 7.2% compared to 2023. In the medium-term future, the growth rate of the added value created in the regional construction industry will be due to the increase in demand in the construction market, and the competitiveness of enterprises is not expected to increase. On the contrary, there is a high likelihood that the region will lag behind global development trends.

In the development of forecast indicators for improving the competitiveness of construction enterprises in Andijan region based on optimistic scenarios, priority is given to increasing the level of integration in the production of high-tech products, including the integration of the construction product manufacturing chain. This is achieved by raising the existing trends from 2010-2023 by an additional 5.0%, improving the technological shifts and innovation activity in the local construction industry. According to the optimistic scenario, it was determined that by 2028, the volume of added value created in the construction industry of Andijan region could increase by 89.1% compared to 2023.

In general, in the medium-term, in order to improve the effectiveness of using the potential of the Andijan region's construction industry, not only the region's resource potential, but also the integration of the production chain in technical and technological aspects, along with the production of high-tech products, should be prioritized. This will contribute to the improvement of the competitiveness of local construction enterprises by developing the production of innovative products.

CONCLUSIONS AND RECOMMENDATIONS: We believe that it is appropriate to focus attention on the expected outcomes in improving the effectiveness of the competitiveness of construction industry enterprises. Therefore, in the medium-term, based on the inertial, pessimistic, and optimistic scenarios for improving the competitiveness of construction enterprises in Andijan region, we came to the following conclusions:

In accordance with the inertial scenario, the activities and competitiveness of construction enterprises in Andijan region will change based on the time factor according to the existing trends of 2010-2023. Through

the inertial scenario, it is expected that the volume of added value created by the construction enterprises will increase by 48.1% by 2028 compared to 2023.

In the pessimistic scenario, the level of change in the production chain of construction enterprises in Andijan region will prioritize the moral obsolescence of the products, as the share of high-tech products in the total construction product volume remains unchanged. Only the increase in construction work volume will affect the market turnover of goods and services. According to this scenario, by 2028, the volume of added value created in the region's construction industry will increase by 7.2% compared to 2023. However, the competitiveness of the enterprises will not increase, and there is a high likelihood of falling behind global development trends.

In the optimistic scenario, priority will be given to improving the technological shifts and innovation activity in the local construction industry by increasing the integration of the high-tech product manufacturing chain by an additional 5.0% based on the trends from 2010-2023. As a result, it is expected that by 2028, the volume of added value created in the construction industry of Andijan region will increase by 89.1% compared to 2023.

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DEVELOPMENT OF A METHODOLOGY FOR ASSESSING THE RELATIONSHIP BETWEEN THE FACTORS OF REPRODUCTION OF HUMAN CAPITAL IN THE BELARUSIAN VILLAGE

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РАЗРАБОТКА МЕТОДИКИ ОЦЕНКИ ВЗАИМОСВЯЗИ МЕЖДУ ФАКТОРАМИ ВОСПРОИЗВОДСТВА ЧЕЛОВЕЧЕСКОГО КАПИТАЛА БЕЛОРУССКОГО СЕЛА

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Abstract

The article contains a methodology for assessing the relationship between groups of factors for the renewal of human capital in rural areas of Belarus, within the framework of which dependencies between individual indicators of human capital reproduction were established, through canonical correlation analysis connections between their groups were identified and the type of relationships were determined, integral indicators for each group of factors were calculated based on factor analysis and an assessment of their impact on individual indicators of human capital in the Belarusian village was carried out.

Аннотация

Статья содержит методику оценки взаимосвязи между группами факторов возобновления человеческого капитала сельской местности Беларуси, в рамках которой установлены зависимости между отдельными показателями воспроизводства человеческого капитала, путем канонического корреляционного анализа выявлены связи между их группами и определен тип взаимосвязей, рассчитаны интегральные показатели по каждой группе факторов на основе факторного анализа и проведена оценка их влияния на отдельные показатели человеческого капитала белорусского села.

Keywords: rural human capital of the village, factors of reproduction of rural human capital, canonical correlation analysis, factor analysis, integral indicators, impact assessment.

Ключевые слова: человеческий капитал села, факторы воспроизводства человеческого капитала села, канонический корреляционный анализ, факторный анализ, интегральные показатели, оценка влияния.

Введение. На современном этапе развития Беларуси происходит трансформация экономики под влиянием новых социально-экономических и информационно-технологических условий, оказывающих воздействие на формирование и использование человеческого капитала. Особенно уязвимым является состояние человеческих ресурсов сельских территорий, характеризующихся депопуляцией населения, ухудшением его здоровья, низким уровнем квалификации работников. Для стабилизации ситуации в республике разработан ряд нормативно-правовых актов, направленных на развитие человеческого капитала села, однако для их эффективной реализации необходимо понимание причин, обусловивших существование негативных тенденций его воспроизводства. Нужно учитывать, что среди них существуют факторы, которые как способствуют количественному и качественному наращиванию человеческих ресурсов сельской местности, так и сдерживают его. Таким образом, обоснование направлений развития человеческого капитала сельской местности следует осуществлять, исходя из тенденций изменения основных факторов, влияющих на его воспроизводство, и выявленных проблем. Поэтому логическим шагом, по нашему мнению, является установление причинно-следственных связей между факторами воспроизводства человеческого капитала сельских территорий Беларуси и оценка их влияния на отдельные показатели человеческого капитала села. Частично это было сделано автором в [1], однако в данной статье описан доработанный вариант методики с использованием статистических данных 2023 г.

Основная часть. Для установления взаимодействия между факторами воспроизводства человеческого капитала сельской местности предлагается следующая методика.

1. Определение групп факторов, влияющих на возобновление человеческого капитала сельских территорий. На основе обобщения подходов ученых предложена классификация факторов воспроизводства человеческого капитала села, включающая социальные (*C*), демографические (*D*), структурные (*S*), культурные (*K*), мезоэкономические (*E*), макроэкономические (*M*) факторы.

2. Выявление наборов показателей по каждой группе факторов. Информационной базой исследования являются данные по сельской местности Национального статистического комитета Республики Беларусь с 2000 по 2023 гг. [2]. Использование данных официальной статистики снижает субъективный фактор, присущий

экспертным оценкам. Для анализа выбрано 25 индикаторов, отражающих взаимосвязи формирования и развития человеческого капитала сельских территорий. Показатели, отсутствующие в данных Национального статистического комитета Республики Беларусь с 2019 г., рассчитаны путем краткосрочного прогноза с использованием модели авторегрессии. Выбранные показатели распределены по группам факторов следующим образом:

− демографические факторы – естественная и миграционная убыль населения, ожидаемая продолжительность предстоящей жизни при рождении;

− структурные факторы – коэффициенты старения, потенциальной и пенсионной нагрузки;

− культурные – число клубов и библиотек;

− социальные – число розничных торговых объектов, стационарных больничных организаций, самостоятельных поликлиник и амбулаторий, аптек, автозаправочных единиц, учреждений дошкольного и общего среднего образования, обеспеченность жильем;

− мезоэкономические – доля трудовых ресурсов в общей численности населения, удельный вес занятого населения в сельском и лесном хозяйстве в численности всех занятых в экономике страны, доля малообеспеченного населения;

− макроэкономические – ВВП, номинальная начисленная среднемесячная заработная плата, объемы промышленного производства и производства сельскохозяйственной продукции, индекс сельскохозяйственной продукции, индекс цен.

3. Преобразование абсолютных показателей в относительные методом унификации данных с целью устранения автокорелляции, поскольку исходные данные представляли собой временные ряды. Это обеспечило многомерное нормальное распределение статистических данных, что удовлетворяет предпосылкам применения канонического корреляционного анализа.

4. Установление корреляционных зависимостей между показателями групп факторов воспроизводства человеческого капитала белорусского села.

Для оценки линейной взаимосвязи между показателями *X* и *Y* (показатели в факторных группах) использовался выборочный коэффициент корреляции Пирсона. В результате расчетов определяются направление и уровень связи между переменными. Интерпретация коэффициента корреляции осуществляется по шкале Чеддока следующим образом:

− слабая положительная связь – $0{,}01 < r \leq 0{,}29$;

− умеренная положительная связь – $0{,}30 < r \leq 0{,}69$;

− сильная положительная связь – $0{,}70 < r \leq 1$;

− слабая отрицательная связь – – $0{,}01 < r \leq -0{,}29$;

− умеренная отрицательная связь – – $0{,}30 < r \leq -0{,}69$;

− сильная отрицательная связь – – $0{,}70 < r \leq -1$ [3, с. 78].

Значимость коэффициента корреляции проверяется с помощью критерия Стьюдента. Проверяется гипотеза $H_0 : \rho_{XY} = 0$ (корреляция равна 0) против альтернативной $H_1 : \rho_{XY} \neq 0$. Для проверки гипотезы используется t-статистика с $df = n - 2$ степенями свободы. На уровне значимости α гипотеза H_0 отклоняется в пользу H_1, если $P(t) < \alpha$, где $P(t) = 1 - F_{df}(t)$ – *p*-значение, $F_{df}(t)$ – функция *t*-распределения Стьюдента с *df* степенями свободы.

В случае, если *p*-значение не превышает 0,05, считается, что связь между переменными является статистически значимой, в том числе ее можно разделить на три уровня: низкая статистическая значимость ($0{,}01 < p \leq 0{,}05$); средняя статистическая значимость ($0{,}001 < p \leq 0{,}01$); высокая статистическая значимость ($p \leq 0{,}001$).

Расчеты проведены с помощью пакета прикладных программ Statistica 12.0, приложения Microsoft Excel. Наше исследование позволило установить, что в большинстве случаев между показателями выявлена умеренная связь низкой статистической значимости. Определены показатели с сильной положительной взаимосвязью, среди которых показатели, имеющие прямое соотношение, например, число клубов и публичных библиотек, ожидаемая продолжительность жизни и доля населения 65 лет и старше, ВВП и номинальная начисленная среднемесячная заработная плата и др. Особого внимания заслуживает тот факт, что рост доли занятого населения в сельском и лесном хозяйстве сопровождается ростом доли малообеспеченного населения, что связано с низким уровнем заработной платы в белорусском агросекторе. Отрицательная корреляция высокой статистической значимости установлена для коэффициентов потенциальной и пенсионной нагрузки, стационарных больничных организаций и поликлиник, темпов прироста демографических показателей (естественный и миграционный прирост сельского населения), а также розничных торговых объектов и ВВП.

5. Выявление зависимостей между группами показателей воспроизводства человеческого капитала сельской местности Беларуси методом канонического корреляционного анализа.

Канонический корреляционный анализ выполнен с помощью модуля Canonocal Analysis в пакете прикладных программ Statistica 12.0. В результате нами рассчитаны канонические переменные для каждой пары групп показателей, которым соответствуют максимальные канонические коэффициенты корреляции.

Наши расчеты позволили определить взаимосвязь между всеми группами рассматриваемых показателей, при этом уровень их влияния друг на друга различный. Если величина канонической корреляции близка к 1, то можно говорить о тесной взаимосвязи между группами. Анализ показал высокую каноническую корреляцию для большинства факторных групп показателей воспроизводства человеческого капитала сельских

белорусских территорий. Умеренная каноническая корреляция выявлена между культурными и структурными, макроэкономическими, мезоэкономическими факторами, а также демографическими и группами культурных и макроэкономических факторов.

Также для каждой канонической корреляции рассчитывается мера избыточности, показывающая, какая часть дисперсии в одном наборе переменных объясняется другим набором переменных. Далее определяется общая избыточность, которая дает возможность определить, насколько изменчивость одной группы факторов связана с вариативностью другой группы факторов [4].

6. Установление типов взаимосвязей между группами факторов воспроизводства человеческого капитала сельской местности Беларуси на основе анализа коэффициента полной избыточности.

В случае, когда величина полной избыточности составляет 60 % и более, можно сделать вывод о сильном влиянии группы показателей на другую группу, если менее 60 % – о слабом. К примеру, вариация группы структурных показателей *S* на 24,8 % объясняется вариацией группы макроэкономических показателей *M*, а изменение макроэкономических показателей на 26,1 % находится под влиянием группы *S*. Соответственно, связь между названными группами показателей для сельской местности Беларуси является слабой. В то же время определена сильная взаимосвязь социальных и демографических показателей, поскольку изменение социальной группы факторов примерно в 91,3 % объясняется изменением группы демографических факторов, а влияние демографических факторов на социальные можно оценить на уровне 76,4 %.

Исходя из этого, установлены три типа взаимосвязи между группами факторов воспроизводства человеческого капитала белорусского села.

Первый тип представляет собой взаимное сильное влияние групп факторов друг на друга, что означает зависимость изменения одной группы факторов от другой и наоборот. Такая взаимозависимость установлена для следующих парных группировок показателей:

- социальные и демографические;
- социальные и культурные;
- социальные и структурные;
- социальные и мезоэкономические;
- демографические и структурные;
- демографические и культурные;
- демографические и мезоэкономические;
- мезоэкономические и культурные.

Второй тип образуют группы факторов, между которыми определена взаимная слабая связь: структурные и макроэкономические, демографические и макроэкономические факторы, культурные и макроэкономические, мезо- и макроэкономические. Величина полной избыточности для этих групп показателей составляет менее 60 %, то есть изменение одной группы факторов не оказывает существенного воздействия на другую.

В случае взаимной сильной и слабой связи между группами переменных их влияние является однонаправленным (прямым).

Также нами выявлен третий тип взаимосвязи, включающий группы факторов, имеющих обратную связь, что предполагает сильное воздействие одной группы на другую, но влияние второй группы факторов на первую слабое (структурные и культурные, структурные и мезоэкономические, социальные и макроэкономические факторы).

На основе разработанной модели можно сделать вывод, что в воспроизводстве человеческого капитала сельской местности Беларуси ведущими являются социальные, демографические, мезоэкономические и культурные факторы, которые оказывают влияние на четыре из шести групп выделенных факторов. На втором месте по степени влияния находятся структурные факторы, так как от их изменения зависит преобразование социальных и демографических факторов. Вариативность макроэкономических факторов объясняет только динамику социальных факторов, но не оказывает существенного влияния на другие группы.

7. Расчет интегральных показателей по каждой группе факторов (мезоэкономических *IER*, макроэкономических *IMR*, демографических *IDR*, структурных *ISR*, культурных *IKR*, социальных *ICR*) согласно методологии [5] с использованием факторного анализа.

Для построения интегральных показателей по каждой группе факторов определялись некоррелируемые главные компоненты с использованием факторного анализа в ППП Statistica 12.0 (показатели для сопоставимости расчетов были унифицированы). Так, в таблице 1 приведены собственные значения (дисперсии) главных компонент, процент от общей дисперсии и кумулятивный процент дисперсии для показателей группы структурных факторов. Первый фактор объясняет 72,95 % общей дисперсии, второй фактор – 25,88 %.

Для определения количества факторов используются критерий Кайзера и критерий каменистой осыпи. Согласно критерию Кайзера отбираются факторы с собственными значениями, большими единицы. Если фактор не выделяет дисперсию, эквивалентную, по крайней мере, дисперсии одной переменной, то он опускается.

Таблица 1. **Результаты факторного анализа структурных показателей**

Номер собственного значения	Собственные значения	Процент дисперсии, %	Кумулятивный процент, %
1	2,188	72,948	72,948
2	0,776	25,877	98,825

В соответствии с критерием каменистой осыпи, предложенным Кэттелем, собственные значения, представляются в виде графика. На графике находим место, где убывание собственных значений слева направо максимально замедляется. Предполагается, что справа от этой точки находится только «факториальная осыпь».

В результате для структурных показателей по критерию Кайзера отобран один фактор, соответствующий первому собственному значению. По графику каменистой осыпи (рисунок 1) видно, что одного фактора недостаточно, так как им объясняется только 72,95 % общей дисперсии, в то время как два фактора, выделенных критерием каменистой осыпи, объясняют 98,83 %.

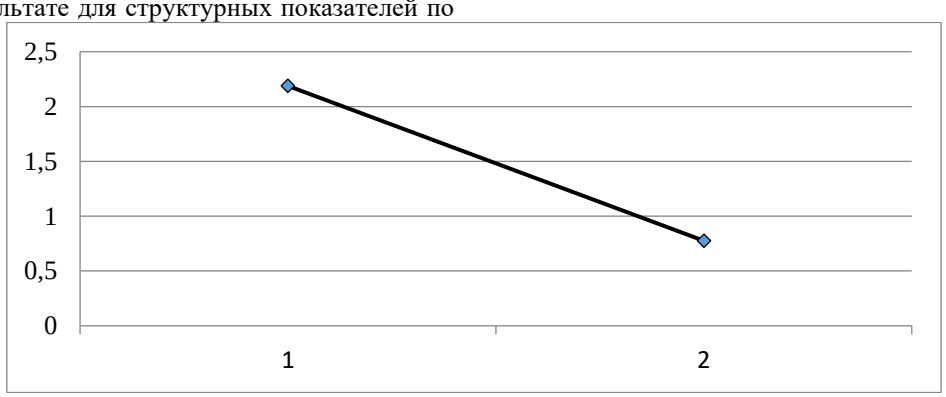

Рисунок 1 – График каменистой осыпи структурных факторов S = {S1, S2, S3}
Ось абсцисс – номер собственного значения, ось ординат – величина собственного значения

Далее определялись факторные нагрузки, которые представляют собой коэффициенты корреляции между выделяемыми общими факторами *F1* и *F2*, и показателями *S1*, *S2*, *S3*. Для выявления факторов, которые имеют высокую нагрузку для некоторых показателей, и низкими для других, осуществлено вращение варимакс. Данное вращение минимизирует число переменных с высокими нагрузками на каждый фактор. Нагрузки после варимакс для структурных факторов представлены в таблице 2.

Таблица 2.

Факторные нагрузки после варимакс для структурных факторов (значимые коэффициенты корреляции выделены жирным шрифтом)

Показатель	Фактор *F1*	Фактор *F2*
S1	-0,186	**-0,983**
S2	**0,968**	0,211
S3	**-0,977**	-0,165

В общий фактор *F1* (первая главная компонента) в качестве существенных входят структурные показатели *S2* (коэффициент потенциальной нагрузки) и *S3* (коэффициент пенсионной нагрузки). Фактор *F2* (вторая главная компонента) существенно представлен показателем *S1* (доля лиц 65 лет и старше).

По формуле 1 определялся составной показатель группы структурных факторов *S*, представляющий собой скалярное произведение главных компонент и долей дисперсий, объясненной каждой главной компонентой:

$$IS = \frac{72,948}{98,825} \times F2 + \frac{25,877}{98,825} \times F1 = 0,738F1 + 0,262F2. \quad (1)$$

Следующим шагом был расчет веса показателей с учетом составного показателя *IS* и с учетом нагрузки каждой главной компоненты (формулы 2-4):

для *S1*:

$$0,738 \cdot (–0,186) + 0,262 \cdot (– 0,983) = – 0,394, \quad (2)$$

для *S2*:

$$0,738 \cdot 0,968 + 0,262 \cdot 0,211 = 0,770, \quad (3)$$

для *S3*:

$$0,738 \cdot (– 0,977) + 0,262 \cdot (– 0,165) = – 0,765. \quad (4)$$

На основе полученных данных по формуле (5) рассчитан интегральный структурный показатель *ISR* группы *S*, который представляет собой взвешенную сумму:

$$ISR = - 0,394\ S1 + 0,770\ S2 - 0,765\ S3. \quad (5)$$

Аналогично построены интегральные показатели по группам культурных, социальных, демографических, мезоэкономических и макроэкономических факторов (таблица 3).

Таблица 3.

Интегральные показатели групп факторов

Группа факторов	Интегральный индекс
Демографические	$IDR = 0{,}797\ D1 + 0{,}404\ D2 + 0{,}795\ D3$
Структурные	$ISR = -0{,}394\ S1 + 0{,}770\ S2 - 0{,}765\ S3$
Культурные	$IKR = 0{,}719\ K1 + 0{,}695\ K2$
Социальные	$ICR = 0{,}152\ C1 + 0{,}577\ C2 - 0{,}326\ C3 + 0{,}315\ C4 - 0{,}625\ C5 - -0{,}536\ C6 + 0{,}605\ C7 + 0{,}043\ C8$
Экономические	$IER = 0{,}404\ \mathrm{E1} + 0{,}754\ \mathrm{E2} + 0{,}855\ \mathrm{E3}$
Макроэкономические	$IMR = 0{,}702\ \mathrm{M1} + 0{,}704\ \mathrm{M2} - 0{,}689\ \mathrm{M3} - 0{,}243\ \mathrm{M4} + 0{,}701\ \mathrm{M5} - 0{,}265\ \mathrm{M6}$

8. Оценка влияния интегральных показателей факторных групп на показатели человеческого капитала сельской местности Беларуси. В качестве показателей, характеризующих человеческий капитал села в зависимости от этапов его воспроизводства, рассматривались: на этапе формирования – численность сельского населения (*Y1*, тыс. чел.), на этапе накопления – доля специалистов с высшим образованием по профилю «Сельское и лесное хозяйство. Садово-парковое строительство» в общей численности выпущенных специалистов (*Y2*, %), на этапе использования – располагаемые ресурсы в расчете на одно домашнее хозяйство в сельской местности (*Y3*, до 2015 г. – тыс. руб., с 2016 г. – руб.). Для сопоставимости исследования показатели унифицированы.

Оценка влияния факторов на показатели *Y1*, *Y2*, *Y3* проводилась на основе модели множественной линейной регрессии. В качестве объясняющих переменных рассматривались интегральные показатели групп факторов. Для учета в модели мультиколлинеарности факторов использовался метод пошагового включения, подразумевающий отбор наиболее информативных показателей для включения в модель на основе коэффициента детерминации R^2. На первом шаге выбиралась переменная, который наиболее коррелирует с результативным признаком *Y*, строилась модель парной регрессии, определялся коэффициент детерминации. В рамках второго шага рассматривались информационные пары, то есть в модель добавлялась вторая переменная, и выбиралась из построенных моделей та, которая не ухудшила качество модели согласно R^2. Далее изучались информационные тройки переменных и так далее. В результате получаем модель, в которой остаются значимые переменные.

Оцененная модель регрессии для показателя *Y1* (численность сельского населения) – имеет следующий вид (формула 6):

$$Y1 = 1987,544 + 587,901\ IKR + 126,805\ ISR + 153,403\ IER\ -\ 107,373\ ICR. \quad (6)$$

На уровне значимости 0,05 полученная модель является статистически значимой, F = 460,67, p = 0,0000. Коэффициенты модели также являются статистически значимыми. Так как скорректированный коэффициент детерминации R^2_{adj} = 0,990, то изменчивость численности сельского населения *Y1* на 99 % объясняется влиянием социальных (*ICR*), структурных (*ISR*), мезоэкономических (*IER*) и культурных (*IKR*) факторов.

Оцененная модель регрессии для доли специалистов по профилю «Сельское и лесное хозяйство. Садово-парковое строительство» в общей численности выпущенных специалистов с высшим образованием (*Y2*) рассчитана по формуле (7):

$$Y2 = 7,808 - 3,806\ ICR - 2,327\ IDR - 0,831\ ISR\ . \quad (7)$$

Так как F = 24,357, p = 0,0021, то модель статистически значима, R^2_{adj} = 0,796. В данном случае на долю специалистов сельскохозяйственного профиля наиболее значимое влияние оказывают интегральные показатели социальных (*IKR*), структурных (*ISR*) и демографических факторов (*IDR*).

Оцененная модель регрессии для результирующего показателя «располагаемые ресурсы в расчете на одно домашнее хозяйство» (*Y3*) рассчитана следующим образом (формула (8)):

$$Y3 = 1500,012 + 2557,793\ IMR + 1602,720\ IER - 687,213\ IKR - 459,954\ ISR. \quad (8)$$

Так как F = 535,77, p = 0,0000, то модель статистически значима, R^2_{adj} = 0,992. Интегральные показатели макроэкономических (*IMR*), мезоэкономических (*IER*), культурных и структурных (*ISR*) факторов в 99,5 % объясняют величину располагаемых ресурсов в среднем одного сельского домохозяйства.

Заключение. Таким образом, в рамках проведенного анализа установлены наличие и типы взаимосвязи между группами факторов воспроизводства человеческого капитала белорусского села, доказано влияние мезо- и макроэкономических, социальных, культурных демографических и структурных факторов на численность сельского населения, долю специалистов сельскохозяйственного профиля с высшим образованием, располагаемые ресурсы в расчете на одно сельское домашнее хозяйство, характеризующие человеческий капитал сельской местности Беларуси.

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HISTORICAL SCIENCES

THE HISTORICAL LEGACY OF THE AGHGOYUNLU STATE, WHICH REMAINS TO THIS DAY AND HAS A SPECIAL PLACE IN THE HISTORY OF AZERBAIJANI STATEHOOD

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Abstract

Historically, this article covers the XIV-XV centuries. The state of Aghgoyunlu was created by the Turkish who lived in the east of Anatolia. Since the middle of the XV century, the leadership of the Aghgoyunlu has been in Azerbaijan. Playing a great role in the formation of the Azerbaijani people, the Aghgoyunlu occupy an important place in the history of statehood. The Aghgoyunlu, who ruled most of Anatolia, defeated the Karagoyunlu in the Battle of Mush in 1467 and captured a large area to Baghdad. In 1468, King Hassan laid the foundation of the Aghgoyunlu state. During the reign of the King Hasan, the Aghgoyunlu state became a powerful military-political state in the Near and Middle East. Since its foundation, this state left a lot of cultural heritage in the territories. In this period, science, art, crafts, architecture, etc. developed too. Up to 60 of the most advanced scientists of the East worked in the king's library. Even during the reign of King Hasan, the Holy Kuran was translated into Azerbaijani Turkish. Libraries, mosques, madrassas, baths, palaces, bridges, fortresses, covered bazaars, etc. were built in various cities of Azerbaijan in a very beautiful architectural style. has spread its history till today. The architectural monuments were built with a special plan and adapted to the vegetation. We can show these monuments the buildings in the city of Tabriz. Historical monuments are the main sources confirming the existence of Aghgoyunlu people in Anatolia. Safa Madrasa is one of the most magnificent monuments built in a complex manner in Diyarbakir. Verses from the Koran can be found in the inscriptions of the built religious monuments. The minaret of the mosque is decorated with verses from the Koran. It should be noted that Aghgoyunlu developed calligraphy. These mosques were decorated with special calligraphers' writings. Eight-pointed stars found in Turkish monuments are often found in monuments. These monuments reflect the Turkish-Islamic trace in every style. Among the monuments, tombs and grave monuments carry the history of Aghgoyunlu and their ethnicity and culture to the present day. Tombstones with figures of rams, horses and others prevail among grave monuments. Buda confirms the continuation of the ancient tradition of the Turks during the Aghgoyunlu period.

The historical monuments which were studied here are a very valuable source for studying the history of the Aghgoyun people in Anatolia, modern Azerbaijan, Iran (South Azerbaijan), both politically and culturally. By studying the monuments, we also get information about the historical, religious, social, and ethnic groups in the places where the Aghgoyun people dominate. This article provides detailed information about all the monuments belonging to the Aghgoyunlu period and explains about their modern condition, style and purpose. The topic we are discussing is very important for the study of the monuments in the areas that dominated by Aghgoyunlu.

Keywords: Aghgoyunlu, Hasan Padshah, monument, mosque, madrasa, tomb, grave.

INTRODUCTION: The Aghqoyunlu state, which holds a significant place in the history of Turkic statehood, has consistently attracted the attention of historians, archaeologists, and researchers. The historian M.Kh. Yinanchin, giving extensive information about the history of the Aghqoyunlu, referred to Gazi Ahmed Gaffari, the author of the works "Jahan ara" and "Nagaristan", and noted that the Aghqoyunlu had settled in Anatolia-Diyarbakir since ancient times. At the same time, Heydar Razı confirmed this idea. The 16th century historian Ibrahim Harir talks about the history of the Aghqoyunlu and its relations with the Seljuks in his work "Tarishi Humayuni". We get the most extensive information about the historical origin of the Aghqoyunlu from Abubakar Tehrani's work "Kitabi - Diyarbakriye". In this work, it is stated that the Aghqoyunlu were a dynasty from the Bayandur tribe of the Oghuz region. For this reason, in some sources, the Aghqoyunlu were called "Bayanduriye" or Bayandur. Z.V. Togan, while analyzing the Oghuz epic, states that the Bayandurs, like other Hun tribes, entered Azerbaijan from the 5th century through the Caucasus Derbent and lived in the Goycha and Lake Van regions. In general, the Aghgoyunlu, who settled in Eastern Anatolia in Azerbaijan, played an important role in the political, cultural, and ethnic composition of these territories. As Faruk Sumer noted, he considers the modern Turks of Eastern Anatolia to be the successors of the Garagoyunlu (Azerbaijani Turkish state - 1375-1468) and the Aghqoyunlu [T. Najafli. Baku-2012. p189.191]. As we learn about the history of the Aghqoyunlu from works, we also get acquainted with historical monuments that have survived to this day.

The historical and architectural monuments of the Bayandur-Aghgoyun period from the Oghuz tribes are discussed in this article. The Aghgoyunlu state has a special place in the history of Turks and specially in the history Azerbaijan statehood. The Aghgoyunlu state was brought to the state status by Kara Yöluk Osman Bey (1402-1431). Hasan becomes King when he turns the state into the strongest state. In 1453, he became the head of the Aghgoyunlu principality (picture 1). In the beginning, the territory of the Aghgoyunlu state, which

center was Diyarbakir, extended from the east of Mardi to the west of Urfa, from the north to Erzurum and the north of Sivas. Many cultural and architectural monuments, mosques, madrasahs, libraries, etc. were built in the areas dominated by the Aghgoyun people. These monuments are the main sources of the history of the Aghgoyun people. It should be noted that the history of the Aghgoyunlu people, who left a great mark in history, has always attracted the interest of historians, travelers, and geographers. In the article we researched and discussed about the monuments that are the main source for studying the history of the Aghgoyunlu people. It is found in Western Azerbaijan (now Armenia - the historical lands of Azerbaijan) and in Azerbaijan. It is possible to see the traces of Turkish-Islamic culture in all these monuments. The reason why the ram and horse statues on the graves are more predominant (a tradition of the Turks since ancient times) is a sign of Turkish culture.

Both Sunni and Shia mosques built during the Aghgoyunlu period were dominant in Anatolia. Some of these mosques were later restored by the Ottomans, some were destroyed, and some of them have survived to this day. Most of these mosques, built in the 15th century, have survived to this day. The feature that attracts the main attention in the architectural style of these mosques is the central and single tower mosques. The important monuments built during the rule of Aghgoyunlu also confirm that their cultural heritage prevailed in the areas they ruled. We trace the cultural heritage of the Aghgoyunlu state through monuments in all areas a part from Anatolia, especially the city of Tabriz. When we examine the architectural monuments, it becomes clear that these works in the state were under the control of the center, and architects and craftsmen were specially trained. Even in the Ottoman period, in Anatolia, with the laws of Uzun Hasan in force for many years, we can observe the exquisite design of architectural monuments. The observation of the same monument in Nakhchivan and other areas of Azerbaijan is an indicator of a single culture.

Among the surviving monuments from Aghgoyunlu, grave monuments are dominated. These monuments consist of horse and ram statues on graves. In Kars, Igdir, and Erzurum, ram statues belonging to the Aghgoyunlu period can be found. The most famous grave monuments that have come down to today are the Zeynal Bey mausoleum (monumental tomb) in Hasankeyf and the Amir Bayandur mausoleum that located in Ahlat. Along with grave monuments, this period is also famous for its castles, bridges, and baths. It was even restored in the castles built before the Aghgoyunlu during the reign of King Hasan. One issue should be specially emphasized that the Garagoyunlu architectural style is observed in many monuments. This was not a coincidence. Decorations with examples of Kufi writing in Tabriz architectural monuments can also be observed in the Aghgoyunlu monuments and the patterns were the same in both Karagoyunlu and Aghgoyunlu.

The topic that we studied is very important from the point of view of the history of the Aghgoyunlu state, and most importantly in Azetbaycan-Turkish-Islamic culture. Historical monuments carry the past to the present and keep the traces of the people and the state to which they belong in any form (even if they are destroyed).

For the study of the history of Aghgoyunlu are of great importance both written sources and historical-architectural monuments. The most valuable sources for the study of this period are found in the Topkapı Palace Archives which located in Istanbul. The letters in this archive dominate the study of Ottoman diplomatic relations with Aghgoyunlu. The history of Aghgoyunlu it is present in valuable museum exhibits. These exhibits adorn the museums of the History Museum of Azerbaijan, the Military Museum of Turkey and many countries of the world (picture 2,3,4,5,6,7,8,9,10,11). The historical heritage of the Aghgoyunlu period is also found in the Tabriz Azerbaijan Museum in Iran. The city of Tabriz (the capital of the Aghgoyunlu state) located in the northwest of Iran sheds light on the history of Aghgoyunlu with its historical monuments and museum exhibits. The ram and sheep-headed tombstones in the Tabriz Azerbaijan Museum were collected from the northwest of modern Iran in 1957 and are exhibited in the museum. The ten tombstones collected are attributed to the Garagoyunlu and Aghgoyunlu periods. Epigraphic inscriptions, drawings, seals, daggers, arrows and other signs are found on the tombstones, except for two. The seals here indicate the lineage of the tomb owner. In general, the double-headed tombstones belonging to the Garagoyunlu and Aghgoyunlu periods of Azerbaijan in Tabriz are an indicator of the pre-Islamic culture of the Turks not only in Tabriz, but also in other historical lands of Azerbaijan, and in Anatolia in general [A.Ersay. Ankara-2023.p.850-857]. Even the toteism of the Turks is found in literary works as well as in monuments. We can trace examples of this culture in many areas of Azerbaijan, especially in the Gazakh region, until the end of the 19th century. We can also see exhibits belonging to the Aghgoyunlu period in the New York Metropolitan Museum. Helmets belonging to the Aghgoyunlu period are exhibited in the museum.

The scientific novelty of topic: The material and culture samples that existed in the territory of the Aghgoyunlu state (monuments of the Aghgoyunlu period in the territories of modern Azerbaijan, Turkey, Iran) in the XİV-XV centuries have been comprehensively explained for the first time.

Research methods: The basis of the research is the chronological analysis and material culture of the historical-archaeological-architectural monuments of the reign of Aghgoyunlu (1378-1503). Similar and different features were analyzed by the historical methods. Historical-comparative, descriptive, classification and scientific-historical generalization methods were used in the study of the topic.

MAIN TEXT - The founders of Aghgoyunlu state were Turks who lived in western Anatolia in the 15th-15th centuries. We have watched Aghgoyunlu architecture, cultural monuments, and historical works in all areas dominated by Aghgoyunlu. The Aghgoyunlu people belonged to the Bayandur boys (clan) of the Oghuz Turks and lived west of the Karagoyunlu people who

settled in the east of Asia Minor [Azerbaijan history .2007. p.95]. Firstly, the territory of the Aghgoyunlu state, whose center was Diyarbakir, extended from the east of Mardin to the west of Urfa, from the north to the north of Erzurum and Sivas. In the north, from Bayburt, in the areas where the Tigris River splits into different branches, they lived a winter and steppe lifestyle. In 1467, King Hasan [Uzun Hasan-1453-1478 years] defeated the ruler of Garagoyunlu and united the territories of that state to his own state. The capital was moved from Diyarbakir to the city of Tabriz. In 1469, the territories of Iraq and Iran were included in the composition of the Aghgoyunlu state. For twelve years after 1461, Hasan expanded the territory of the Sultanate and laid the foundations of the Big Aghgoyunlu empire in the territories of Iraq, Azerbaijan, and Iran [H.I. Long market. Ottoman history. 2019. p. 95]. King Hasan, who built such a great state, went down in history not only as a ruler, but also as a person who left a cultural heritage for the future. Many cultural and architectural monuments, mosques, madrasahs, libraries, etc. were built in the areas dominated by the Aghgoyun people. These monuments preserve the heritage and history of the Aghgoyun people. are the main sources of transport. A number of sources even stated that King Hasan built a large palace complex in Tabriz. According to the sources, there were 20,000 rooms in the palace [History of Azerbaijan . 2007. p. 175].

The state of Aghgoyunlu has left a great treasure since its existence. Here we can show the laws of King Hasan (with some changes) implemented until the 1540s. These laws prepared by King Hasan had a great importance in the history of Islamic law, and the country was properly governed thanks to the laws [F.Sümer. 1989. P.274]. During the reign of Aghgoyunlu the other treasures have come down to our days are historical works written. It should be noted that the history of Aghgoyunlu people, who left a great mark in history, has always attracted the interest of historians, travelers, and geographers. Hasan Padshah always gave special importance to scientists, historians and writers in his palace. The most important source for studying the history of the state is Abu Bakr Tirhani's Kitab-i-Diyarbakiriyya. At the same time, we can show the works of Ali Kuschu, Mahmud Sorihi, Mehmet from Shiraz, Abdulhey from Nishapur, Fazlullah and other historians and writers. The famous mathematician Mahmud Can, scientist Isa Savci Masuhiddin, who received special attention during the Aghgoyunlu period, Idris Bitlisi (writer), who later worked in the Ottoman palaces, grew up in the palace of Hasan King [H. Kalesh.2021. p.2]. The Venetian letters (alliance against the Ottomans) are also of special importance for studying the foreign policy of Aghgoyunlu. Historian Ibrahim Harir, who lived in the 18th century, provides information about the places where the Aghgoyunlu tribes lived in his work "History of Humayuni". Historical and archaeological monuments confirm the views of the historian who gave extensive information about the first rule of the Aghgoyunlu in Andarbakir and other areas. The information of Gazi Ahmed Ghaffari and Heydar Razin about the settlement of the Aghgoyunlu in Diyarbakir. the monuments found also confirm.

The article is mainly dealing about the monuments, which are the main source for studying the history of the territories dominated by Aghgoyunlu. Monuments belonging to the Aghgoyunlu period can also be found in Eastern Anatolia, Tabriz (Southern Azerbaijan), Western Azerbaijan (now Armenia - historical Azerbaijan lands) and Modern Azerbaijan. Traces of Turkish-Islamic culture can be seen in all of these monuments. Ram and horse statues on graves. and the reason why it prevails more (a tradition of the Turks since ancient times) is the sign of Turkish culture. Written tombstones belonging to the Aghgoyunlu period also convey a lot of information from a historical point of view. For example, we can show the tombstones in Isfahan from the year 1497 (Hijri-815). The inscriptions on the graves are written in Arabic. The tombstones of the same shape can be found in Mardin, Hasankeyf, Erzincan. It is also found in Erzurum, Kığı and other areas. Zoomof tombstones belonging to Aghgoyunlu period can also be found in the Juga necropolis. The necropolis spans the 13th-15th centuries and is located in the territory of Gulistan village of Julfa district. There are many ram and horse-shaped tombstones belonging to the Karagoyunlu and Aghgoyunlu periods in the cemetery. Gravestones of the same shape can be found in many parts of Turkey, Azerbaijan, Western Azerbaijan (now Armenia) (places where the Aghgoyunlu people ruled), from Azerbaijan to Eastern Anatolia. These tombstones swords, various drawings, shields, daggers, etc. are found on it. These drawings are not only decorative, but also provide information about the identity and gender of the person in the grave [R. Bagırlı.Konya-2008.p30]. M. Kh. According to Yinanc's opinion, the Aghgoyun people have been attached to the sheep totem since ancient times and remained loyal to this totem even after accepting Islam.

Both Sunni and Shia mosques that built during the Aghgoyunlu period were dominant in Anatolia. Some of these mosques were later restored during the Ottoman Empire, some were destroyed, and some have survived to this day. We can point to the architectural monuments built during the Aghgoyunlu period and which have survived to this day - the Gutlug Bey mosque and the ceremonial and dervish house. This monument was built in 1389 in the Sinur village of Baybut by Fakhreddin Gutluq Bey, the father of Bayandur. The monument was renovated in 1550 and 1676 and a minaret was erected on it. Today, a part of this monument is in ruins [J.E.Woods.Istanbul-1993.p.391]. At the same time, among the mosques built during the reign of Aghgoyunlu in Anatolia, there are Jahangir mosque built by Pir Ali Bey in Bingöl, Jahangir Bey in Mardin, Hassan and Sara Khatun mosques built by Sultan Hasan in Urfa, Gulabi Bey in Erzincan, Ibrahim Bey in Mardin, Kazim Padshah in Diyarbakir. his name should be specially mentioned. Mosques were not built only by Hasan Padshah and his family members. Among the mosques that were built, there were also mosques that were built by the generals of King Hasan and the governors appointed to the cities. Most of the mosques were built in madrasahs in their courtyards. The most famous madrasas belonging to the Aghgoyunlu period are Sultan Kazim, Shahsultan, and Golbaşı madrasas in Urfa, which were built at the end of the 15th century.

We observe the most Agqoyunlu architecture and historical monuments in the areas of Mardin and Diyarbakir. During our research, we see differences in the style and luxury of Diyarbakir monuments. The fact that Diyarbakir was the capital of the Agqoyunlu is also confirmed by the historical and architectural monuments built magnificently in the city. Many of these monuments have survived to this day and have carried historical realities to the modern era. When we examine the Aghqoyunlu period monuments of Diyarbakir, we come across two types of architectural monuments. The first type of monuments belongs to the madrasah, mosque, and tomb belonging to the members of the order, which were built in a complex manner. These buildings were also built in a complex manner close to each other. The second type of architectural monuments are monuments consisting of a single small or single building. This mainly includes a single mosque, a tekke (a Sufi house), and so on. These monuments were usually built on the outskirts of the city, outside the center, and very few decorations and works are found in these types of monuments. The more magnificent buildings were built in Diyarbakir, the capital of the Aghqoyunlu dynasty in Anatolia. At the same time, very few of the second type of monuments have survived to this day. The monuments built in a complex (complex) form have survived to this day in better shape [C. Parla. Diyarbakir before the Ottomans. Diyarbakir 2004.p.283]. Among the monuments that have survived to this day and are distinguished by their architectural style, we can mention the Hoca Ahmed Mosque (1489), the Sheikh Mutahhar Mosque (1500), the Sheikh Safi Mosque (15th century). Most of the mosques built during the Aghqoyunlu dynasty (in Urfa, Diyarbakir, Mardin, Erzincan, Elazığ, Bingöl, etc.) have a madrasah section. Another monument built during the Agqoyunlu period in Diyarbakir is the Safi or Iparli Mosque and Madrasah. The monument is located in the northwest of Diyarbakir. Although no date has been found on the monument, research indicates that it was built during the Agqoyunlu period. The monument was built by Uzun Hasan (mid-15th century) at the request of Sheikh Cüneyt, the son of Sheikh Ibrahim Safi, grandfather of Shah Ismail [A.K. Kırcaalı. Samsun-2017.s12]. For this reason, it was named the Safi Mosque after the Sheikh. Although the monument is not as large as the mosques belonging to the Agqoyunlu period in Diyarbakir, it stands out with its special style, interior decoration, and stonework. The minaret of the mosque is decorated with verses from the Quran. Among the Agqoyunlu mosques that have survived to this day in Diyarbakir, the Nabi Mosque and Lala Bey Mosque also stand out with their architectural style. The monument, built in the 15th century in the Dağ Kapısı area of Diyarbakir, has hadiths of the Prophet written on some of its walls. The mosque, whose minaret collapsed, was restored by the General Directorate of Foundations of the Republic of Turkey in 1960. Lala Bey Mosque was built in the center of Diyarbakir by Lala Kazım Bey. Lala Bey ruled Diyarbakir until Diyarbakir was occupied by the Safavids in 1508. It is said that the monument was built in the late 15th century. The Nabi Mosque, a work of the Ağqoyunlu dynasty, has not survived to this day in its complete state. During the First World War, Diyarbakir was also under military rule and the Nabi Mosque became a military headquarters. About this state of the monument, Turkish scholar and writer Ali Emiri Efendi notes, “Soldiers were stationed in the mosque decorated with Chinese tiles, Many valuable tiles were torn off and destroyed, Even nothing was left of the mosque decorated with ancient carpets, The carpets there were not seen later” [Yusuf/K/H/Diyarbekir camileri.-2014.p.34]. Part of the monument - the Hanoifi section - began to collapse in 1927. In 1955, the road of the western part of Gazi Street was widened and demolished by the municipality along with the minaret. According to information, the Nabi Mosque, which was built in a complex on a very large area, consisted of the Shafi'i, Hanifi and madrasah sections. We follow the traces of the Aghqoyunlu, which was a Turkish state in every form, from the monuments that were destroyed both as a result of natural disasters and for various reasons, which have survived to this day. Another mosque built during the Aghqoyunlu period in Diyarbakir is the Hoca Ahmed Mosque.

The mosque was built in 1489 by the philanthropist Haji Ahmed. The minaret of the mosque is octagonal. Another mosque built in Diyarbakir in 1500 is the Sheikh Matar Mosque. The monument was built by the Agqoyunlu Sultan Qasim Bey. The mosque was named after him because it is located near the grave of Sheikh Matar. We can also mention the Four-Legged Minaret monument found in Diyarbakir and which has preserved its grandeur to this day. This minaret, built by Sultan Qasim (1496-1501 - Diyarbakir-Mardin) in 1500, is also called the Sheikh Mutahhar Mosque. The monument was built with white and black stones on four columns. This architectural monument is a rare building of Turkish architecture in Anatolia. The Safi Mosque, whose name we mentioned above, was also built in the same style, that is, on eight columns. This style is considered to be the forerunner of the plan applied by Mimar Sinan in Ottoman architecture. In the name of the Hamza Bey Mosque, built in Diyarbakir by Hamza Bey (1434-1444) in the Inner Castle area, we can note that the monument was destroyed during the First World War and does not exist today. In the Ağqoyunlu monuments located in Diyarbakir, we also see the religious meetings and the content of the ceremonies of this period. In general, the mihrabs, which are the main part of the mosques found in Mardin, Diyarbakir and other areas (even in monuments belonging to the Ottoman period), were a style dating back to the 15th century Ağqoyunlu period. This was a synthesis of the style belonging to the Seljuk, Artuk, and Ayyubid periods in Anatolia before the Ağqoyunlu. We see the strongest form of this style in the Safa Mosque in Diyarbakir [Yusuf K.H.Diyarbekir Camileri-2014.p.20-24]. The interior decoration of mosques and minarets with their exquisite calligraphy (Kufic writing, exquisite calligraphy of verses from the Quran, geometric compositions, nature paintings, etc.) was especially developed during the Aghqoyunlu period. The most important example that all these monuments carry to this day is a strong representation of the Turkic-Islamic culture. At the same time, ram-sheep-headed tombstones from the Garaqoyunlu (1365-1469) and Aghqoyunlu

(1403-1508) periods are found in Diyarbakir [M.Aksoy. 2019.p.104].

One of the magnificent monuments built during the Ag Qoyunlu period is Hasan Castle. The castle was built after the territory in the Persian territory was captured by Uzun Hasan. Such castles were also built in the territories of Nakhchivan, Koyulhisar, Erzurum, and Selmas. Uzun Hasan, who built the castle, also built castles from the time of Uzun Hasan and previous periods, and even the Harput Castle. This tradition, which is a historical heritage, was left to Uzun Hasan by his grandfather, Gara Yölük Osman Bey. Gara Yölük Bey had the Ergani Castle repaired in 1402-1403 and donated the key to the castle to the settlement. Some sources have other ideas about the construction of Hasan Castle, stating that it was not built by Hasan Padşah. However, in the Urfa Chronicle of 192, it is stated that the castle and Hasan Padşah Mosque were built during the Ag Qoyunlu period. Evliya Çelebid states that these monuments were built by Uzun Hasan and that they were not named after Hasan Padşah by chance. The monuments built by the Ağqoyunlu, who controlled these territories in 1404-1514, have survived to this day. The date of Hijri 965-AD 1460 on the inscription of Hasan Castle indicates that the monument was built on this date [Cihat A.K. Şanlıurfa camileri. Ankara 1993.p.34-35.; Cihat A.K. Şanlıurfada canlanan tarih. Şanlıurfa Valiliği.1990-1995.].

Most of the mosques built in Erzincan and surrounding areas were built at the end of the 15th century. The monuments that were affected by time and nature were later destroyed by earthquakes. Most of these mosques, built in the 15th century, have survived to this day. The main feature of the architectural style of these mosques is the central and single-towered mosques. Most of the mosques built during the Aghgoyunlu era (in Urfa, Diyarbakir, Mardin, Erzincan, Elazig, Bingöl, etc.) have a madrasa section. Tombs and zaviya houses built in memory of Aghgoyunlu princes, ancient baths, most of the castles were destroyed mainly in earthquakes in the region.

The tombs built on graves during the Aghgoyunlu period are very magnificent from the point of view of architecture. These tombs were built on the graves of the family members of the Aghgoyunlu ruling class. Here are the tombs of Ugurlu Mehmet in Erzincan, Hamza's tomb in Mardin, Zeynel Bey's tomb built on the left bank of the Tigris River, Halil Bey's tomb in Mush, Korkmaz's in Bayburt. We can mention the tomb of Bey. The most beautiful of these tombs (in terms of architecture) is the tomb of Zeynal Bey. This tombstone was the most beautiful of the Aghgoyunlu tomb monuments (picture 20) . The tomb was built by Hasan Padshah in 1474 for his son Zeynel, who died in the battle of Otlugbel. , there were baths and other buildings [J.E. Woods, Istanbul -1993, p. 394] . There are also three important tombs from the Aghqoyunlu period in the Mardin region. These tombs belong to Hamza Bey, son of Gara Yoluk Osman Bey, his grandson Jahangir Bey, and his son Jahangir Bey's son Gasın Bey. There is the tomb of Gutlug Bey in Bayburt, the tomb of Bayandur Bey in Ahlat, and tombs from the Aghqoyunlu period can also be found in Erzincan and Diyarbakir.

Most of the monuments-mosques belonging to the Aghgoyunlu period were built in the form of a complex [H.Gundogdu. 2015.p.567]. In all complex monuments, mosques, madrasahs, libraries and other buildings were united. The important monuments built during the rule of Aghgoyunlu also confirm that their cultural heritage prevailed in the areas they ruled. Apart from Anatolia, we trace the cultural heritage of the Aghgoyunlu state through monuments in all areas, especially the city of Tabriz. When examining the architectural monuments, it becomes clear that in the state these works were under the control of the center, and architects and masters were specially trained. In all traces, we follow the style of the Seljuks, Turkish-Islamic culture. Even in the Ottoman period, in Anatolia, with the laws of Uzun Hasan in force for many years, we can observe the exquisite design of architectural monuments. The observation of the same monument in Nakhchivan and other areas of Azerbaijan is an indicator of a single culture.

Among the historical-architectural monuments, we can mention the mansions built during the Aghgoyunlu period. The area of the mansions was large and consisted of many rooms, warehouses, kitchens, stoves and additional buildings. Even special people were appointed to carry out the internal works of the mansion. Because the mansions were very big. Among these mansions, we can point out the Ferahshah mansion in Bayburt and the Jahangir mansion built by Jahangir Bey, the brother of Hasan Padshah in Mardin. We get information about the Jahangir mosque from written sources. Because the monument has not survived. According to the information, in 1474, a traveler named Barbaro, who had to go from Cyprus to Tabriz and passed through Mardin, stayed in a guest house near the palace. Kalesh. 2021. p. 10].

We can show the bridges to another architectural monument built during the Aghgoyunlu period. These bridges were built in the 15th century. We can show the Bayandur and Hasan bridges as the most famous bridges according to their architectural style. The Bayandur bridge is a one-eyed bridge built in Ahlat. It shows that it was built during the Bey period. It is said that the bridge was built in the middle of the XV century. The bridge has survived to this day, even with ruined form. Hasan Bridge was built in the north of Erzurum. The bridge was a stone bridge and was built by Hasan King. This bridge was mostly used during military marches. This bridge facilitated the marches of the Aghgoyun people against the Georgians [Hinz W. Ankara 1992.p.97].

Among the surviving monuments from Aghgoyunlu, grave monuments dominate. These monuments consist of horse and ram statues on graves (picture 21,22,23,24,25) . These grave monuments are more common in Nakhshivan and Zangezur in many parts of Azerbaijan. In Kars, Igdir, and Erzurum, ram statues belonging to the Aghgoyunlu period can be found. The most famous grave monuments that have come down to today are the Zeynal Bey mausoleum (monumental tomb) in Hasankeyf and the Amir Bayandur mausoleum located in Ahlat. Along with grave monuments, this period is also famous for its castles,

bridges, and baths. Even during the reign of Uzun Hasan, it was restored in the castles that were built before the Aghgoyunlu. One issue should be specially emphasized that many monuments follow the Garagoyunlu architectural style. This was not a coincidence. Decorations with examples of Kufic writing in the architectural monuments of Tabriz are also observed in the Aghgoyunlu monuments. the patterns were the same in both Karagoyunlu and Aghgoyunlu, there is no significant difference in the architectural styles of the monuments belonging to both states. Few monuments from the Garagoyunlu period have survived in separate areas, i.e. in Van, while monuments from the Aghgoyunlu period have survived in Diyarbakir, Erzincan, and Mardin [B.Doğan, A.Doğanay-2017.p.653]. Tombstones with figures of sheep belonging to the Garagoyunlu and Aghgoyunlu periods show that they were a Turkmen-Turkic state and that their traditions were also preserved in the monuments [H. Keleş.2021. p.3]. Today, very few of the monuments mentioned above remain. Most of the mosques, palaces and other buildings, most of which were complex buildings (a characteristic feature of Aghgoyunlu period architecture), remained. The mosque in Erzincan was completely destroyed in the earthquake of 1939. The remains of the mosque in Mardin remain. but the mosque remains [J.E. Woods.1993. p.392].

One of the most magnificent monuments built in Mardin during the Ag Qoyunlu period is the Qasimiyya (Sultan Qasın) Madrasah. The monument was built on a large area in the north of the Mesopotamian plain. The monument covers a 30-meter-long platform and is 20 meters high. The Qasimiyya Madrasah was built after it was taken over by the Ag Qoyunlu ruler Uzun Hasan in Mardin (after the Qara Qoyunlu dynasty) and given to the management of his brother Jahangir Mirza. It is said that Jahangir Mirza's son Sultan Qasım brought many craftsmen and architects from Azerbaijan and Tabriz and had it built. Qasım Sultan, who tried to eliminate the consequences of Timur's (1336-1405) invasions, resumed the construction of Mardin. It is said that the first buildings of the monument, built in the southwest of the city, were attributed to the Artuklu period. Historian-archaeologist Alberd Gabriel states that the other buildings of the Qasimiya Madrasah were built after the Zinciriyya Madrasah [Nilgün F.Mardin 2024.p.72]. In addition to the Zinciriyya Madrasah, many buildings (madrasah, mosque, hahah, spring, etc.) were built by Aghgoyunlu Qasim Sultan. For this reason, it is called the Qasimiya Madrasah. This madrasah, which was the great work of Qasim Sultan, was the educational and scientific center of Anatolia in general. In addition to religious knowledge, secular sciences were taught in the madrasah. The madrasah was the first center where education continued until the First World War (1914-1918) [Hicran H.H, Hashim.A. Jilses-2018. p. 13]. The madrasa, which was used as a military barracks during the war, has been operating as a museum belonging to the Mardin Governorate since the 1960s and has been open for worship as a mosque since 2007. The madrasa, which was built in 1469, is one of the largest historical buildings in Mardin. The two-story madrasa also consists of a mosque section. The zawiya (dervish meeting houses) and tombs found around it indicate that the building is a complex building. The monument, which carries many historical information from the 15th century to the present, also attracts attention with its architectural secrets. The monument was built in such a way that the light is distributed evenly from sunrise to sunset. It is possible to use natural light with the sun's rays very skillfully. The reason for this kind of construction was to illuminate all the rooms in the science center. Even the doors of the classrooms were very low so that students could bow their heads as a sign of respect when approaching their teachers. This also meant that science was given great value during the Aghqoyunlu period. From this perspective, as we study the monument, we not only learn historical knowledge from the past to the present, but also the material and spiritual values left by the Aghqoyunlu, a Turkish state. These monuments preserve the traces of the Aghqoyunlu since the time of Gara Yoluk Osman Bey, when they conquered Mardin and the northern regions of Erzincan. In Erzincan, Harput, Mardin and many areas on the banks of the Tigris and Euphrates, which were completely captured until 1430, the Agqoyunlu's own line was felt in the monuments. In all the Anatolian territories captured by the Agqoyunlu, especially the capital Diyarbakir-Amid city and Mardin, many mosques, madrasas, baths, castles, and tombs were built during the reign of Hasan Sultan. This restoration and construction work were also carried out in Harput and the surrounding areas, which were under the rule of the Agqoyunlu for 40 years. Hasan Sultan, who had mints in Harput, also restored the Harput Castle. Because Harput was one of the main important centers of the Aghqoyunlu. The Italian traveler Barbaro stated this in his writings and noted, “He said that the Harput Castle is very magnificent and here Despina Khatun, the wife of Sultan Hasan (daughter of the Trabzon emperor), lives in Harput” [Zekiye.T.Elazığ-2013.s575; Walter H.Ankara 1992.s54.]. One of the monuments built in Harput during the Aghqoyunlu period is the Saray Khatun Mosque, which was built by Sara Khatun, the mother of Uzun Hasan, who is said to have ruled Harput. The monument, which consisted of only a mosque part and was built in the city’s Bugday Square, was later rebuilt in a very large form. In the area near the building, which was built as a complex-complex, typical of Agqoyunlu architecture, there was also a madrasah, a small school, a fountain, and the Cimshit Bath, which remains to this day. The monument was renovated in 1598 by Mustafa oglu during the reign of Murad III (1574-1595) and restored again in 1843. The first construction of the monument was built during the reign of Sara Khatun and was covered with wood [Hanza G. C-8.Ankara-2002.p259]. Sara Khatun Mosque is among the most visited works of the region by tourists today.

We also follow Agqoyunlu works in Hakkari. Hakkari was under the rule of the Aghqoyunlu dynasty in the second half of the 15th century. One of the most beautiful works of the Aghqoyunlu dynasty in Hakkari is the Müydan Madrasah. The Madrasah was built in 1472. The monument is currently located in the Meydan neighborhood of Hakkari. The monument was restored by the General Directorate of Foundations of Turkey [Hamza.K.2006.p72].

The period of Aghgoyunli rule is the period of further development of the unique Azerbaijani architecture. According to X.Gasimov, this period is the age of classical maturity. This period is characterized by the stability and exhaustion of Azerbaijani architecture [T.Najafli. Baku-2012. p.465]. Progress in the construction of more religious buildings can be seen both in the period of Karagoyunlu and Aghgoyunlu. After the inheritance of Garagoyunlu passed into the hands of Aghgoyunlu, the center

of Aghgoyunlu was moved from Diyarbakir to Tabriz. Hasan Padshah (Hijri-871-883, AD-1466-1478 years) built a magnificent library in Tabriz. Tabriz was at the forefront with magnificent architectural buildings even during the reign of Hasan the King. However, only a small part of the architectural monuments created during this period have survived. The Aghgoyunlu-Turkmen palace style was preserved in the architecture of Shiraz and Tabriz during the reign of King Hasan and his sons Sultan Khalil (1478) and Sultan Yaqub (1478-1490) A.Okay. Ankara. p. 350].

Although there are many memorial buildings and tombs, there was more development in religious buildings. R. Klavikhon, who was in Tabriz, told about his observations that "in this city there are very large mosques and buildings decorated with amazing carvings and networks, decorated with beautiful glass" [History of Azerbaijan resources on Baku-1989. p.320]. The fact that the city of Tabriz was the capital gave further impetus to its development. The buildings were adapted to the greenery and vegetation under the supervision of Hasan the King himself. There were large gardens in the city of Tabriz. The Garden of Nasriyya, one of the rarest and largest buildings of this period, was built by Hasan the King. One of the rarest pearls of urban planning culture was the North Garden built by Sultan Yaqub (1478-1490). The largest of the covered bazaars built in Tabriz during the reign of King Hasan was the Caesarea bazaar. This bazaar was famous as the most famous bazaar in the eastern countries. covered with an arch. X. Inalcik stated that the city of Tabriz was the most important trade center both before and during the Aghgoyunlu dynasty. Most Italian merchants came to Tabriz. Ambrosi Kontarini, who was the ambassador at that time, also provides extensive information about the trade of Tabriz. It states that there are large houses and shops similar to alcaseria in the city. And alcasar was the name of the castles or castles built in the Moorish style in Spain. Iosafat Barbaron states in his travelogue that there were multi-room caravanserais for merchants in Isfahan and Tabriz.

Tabriz Friday Mosque is one of the most beautiful architectural monuments in Tabriz. This magnificent architectural monument was built by Hasan Padshah. More information about it is provided by the travel expert Evliya Çelebi. According to information, after the death of Hasan the King, he was buried in the courtyard of this mosque. The mosque was decorated with patterns and eyebrows on all sides. The mosque was a work of art. The southern door of the building was decorated with inscriptions written in beautiful lines, carved patterns, grids, and patterns in the Greek style. Inscriptions on all the doors and windows. [T. Najafli.Baku-2012. p.469]. All these inscriptions were written in the script of Yakut Mustasim. There were two beautiful pieces of stone on both sides of the altar. [Chalabi. Baku-1997. p. 92]. During this period, the art of Islamic miniatures and calligraphy developed in Aghgoyunlu palaces. According to S.Arshari, the taliq line developed by Khaja Taj Salmani was brought to a level of art by Khaja Abulhay in Aghgoyunlu palace. This art was used in the decoration of Aghgoyunlu palaces. We can mention the brothers Abdulrahim and Abdulkarim among these art masters. Abdulrahim Sultan Khalil worked in the palace of Aghgoyunlu Yaqub when he was the governor of Shiraz.

Another architectural monument built during the Aghgoyunlu period was the palace complex built in the Sahibabad square of Tabriz. This palace was separated from the center of Tabriz by a valley. The difference of the palace was that this palace was built in a garden, a forest. The palace was called "Hashtbehisht" (Eight Heavens). the palace consisted of four large halls and many rooms. The construction of the palace began in 1478. It was completed during the reign of Sultan Yaqub. According to the information given by Fazlullah ibn Ruzbihan Khunji, this turquoise palace in the center of the Sahibabad garden was built and completed in 1486. The palace had pointed towers [Khundzhi F. Translation - T.A. Minorskoy. Baku-1987. C. 1987]. The most important information about the Hashtbehisht palace complex is provided by a Venetian merchant who traveled to Tabriz in 1506 in his travelogue. The merchant states that the palace was started to be built by Hasan Padshah [R. Bayramov. Baku. 2013. p. 26]. The Venetian merchant also states that the palace is located near the city and there is a Friday mosque surrounded by walls [T. Najafli.Baku-2012. p.470]. This mosque was very big and consisted of many rooms. The mosque was decorated with golden water. All the doors in the palace were decorated with gold and blue (picture 19) . The corridor had marble columns. At the same time, a healing house was built near the palace. During the reign of King Hasan and Sultan Yaqub, it is reported that more than a thousand patients were treated here [T. Günduz.İstanbul. 2007.s161-164; S. Ershahin. Ankara-2002. p. 228-229].

Although the monuments belonging to the Aghgoyunlu have not survived in their original state compared to the grave monuments, they are of great importance from a historical point of view. Because most of the Aghgoyunlu monuments were built as a complex. For this reason, only one of the architectural monuments built in the form of a complex has remained. Even in the monuments of Diyarbakir, mosques, madrasahs, meeting houses, tombs belonging to two different peoples belonged to one complex building. During the reign of Uzun Hasan, special attention was paid to the minaret and style of mosques. In Mardin, the ornate urban architecture belonging to the Aghgoyunlu period is most noticeable. However, the battle of Otlugbel in 1473 caused Aghgoyunlu to decline in architecture as well as in the political arena.

CONCLUSION: Based on the monuments we investigated, it is known that the monuments belonging to the Aghgoyunlu period have their own characteristics, both in terms of architecture and grave monuments. In the monuments of this period, we see that the

buildings are in the form of a complex. The minarets of the built mosques were decorated with patterns, and memorial tombs were predominant.

Aghgoyunlu states were also a cultural center in terms of geography. Following the traces of both Azerbaijani (Garagoyunlu, Aghgoyunlu, Safavi-North, South Azerbaijan) and Ottoman culture in the monuments, we see that these monuments play the role of a bridge in terms of culture.

We follow Aghgoyunlu monuments more in Diyarbakir, Mardin, Bingöl, Erzincan, Urfa, Tabriz. In the monuments, we can also see the religious meetings and the contents of the ceremonies of this period. In this period, the main buildings were square and rectangular, and the top of the buildings in the center was semi-spherical (dome). Complex buildings were built mainly in the city center. Crown-shaped entrance doors are found in mosques and many other buildings. Marble stones were used in buildings. Mosques were built very ornately from the inside. Six-, twelve-, and eight-pointed stars, vegetable patterns, and symbolic motifs are found in the decorations. Tombstones with the figures of rams and horses found in the ancient Turks are found in grave monuments.

Today, Aghgoyunlu monuments are located outside the current borders of Azerbaijan, especially the city of Tabriz. In all the monuments (in the Turt-Oghuz homeland with Aghgoyunlu territories) we see traces of Turkish-Islamic culture and these states. Today in Anatolia, Western Azerbaijan (modern Armenia), Tabriz - the city of Southern Azerbaijan (modern Iran) and other areas, we see the remains of Aghgoyunlu heritage. The topic we are researching is very important from the point of view of studying the history of the Aghgoyunlu state, and most importantly Azatbayjan-Turkish-Islamic culture. In the architectural style of the monuments, the Turkish culture, which had its roots in Central Asia in the 14th-15th centuries and was dominant in Anatolia and Azerbaijan (All Azerbaijan), played the role of a bridge, transferring it from earlier centuries to the Ottoman and Safavid periods. It is impossible to give information about the monuments of this state in just one article. The study of these monuments is an urgent issue and should always be in the center of attention. Historical monuments carry the past to the present day and in every form (even if they are destroyed) keep the traces of the people and the state to which they belong (Asadova A.V.).

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PHILOSOPHICAL SCIENCES

KARAM – DHARAM (ACTION IS WORSHIP; HINDU WISDOM)

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Abstract
To continually benefit from the harmless wonders of traditional medicine, it is essential to pay attention to its inherent components of spiritual, mental, and physical alertness. This is both a duty and an obligation. In this treatise, we have decided to share information with you on the human, national, and medical aspects of traditional spiritual medicine, focusing on the themes of action and breath.

Keywords*:* amal, furqan, namai-amal, halal, karam, dharam, sansara.

Introduction

The article presented for your attention explores the impact of our daily activities and breathing on our health. It highlights that both processes involve invisible factors that significantly affect our four major organs. Understanding these factors can greatly benefit our efforts to maintain a healthy lifestyle.

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You might find the title of the first chapter somewhat strange. You might think, "Why not provide a clear translation of the unfamiliar term 'karma' for the majority?"

Yes, at first glance, it might be challenging to understand why a seemingly abstract term is included in the title. However, the concept of "karma" has been elevated to a special doctrine in Hindu religious philosophy, and so far, its philosophical and social interpretation has not appeared in local religious literature.

In the field of religious studies, we are not only on par with others but arguably quite advanced. A thousand years ago, our great ancestor Abu Rayhan Beruni mentioned the concepts of "karma," "dharma," and "samsara" in his work "India" when Western religious scholarship was still far from analyzing these topics scientifically. Please, don't rush to conclusions!

Admittedly, dispelling some doubts that may have arisen from the introduction of this treatise is not an easy task. If I were in your place, I might have similar thoughts. However, please do not think that the author's intention is to test the reader's patience. Discussing the health and breath factors in Hindu thought without a brief history, theory, and practice of the "karma doctrine," which is still unfamiliar to most Uzbek readers, would be inappropriate.

Additionally, you might have a related objection, such as: "Instead of delving into the history and details of 'karma,' why not start directly with 'good deeds'?" Yes, that could have been an option! However...

Before diving into the topic, we considered that the conversational method used in this discussion might seem tedious to some readers. However, we chose not to follow the preferences of some objectors for a particular reason. Unlike the ideological restrictions of the recent past, we now have the freedom to explore the commonalities between various fields such as religious-philosophical teachings and medicine, grounded in human values.

Additionally, the concept of the "Book of Deeds," which serves as a standard for our religious and worldly life, is derived, according to Hindu theology, from the Vedas, which are said to have been revealed five thousand years ago. Our aim in presenting this universal perspective is to emphasize that actions based on faith, purity, and goodness are equally relevant to the health of people from all nations and beliefs.

ACTION AND BREATH

Finally, it seems we have addressed the ambiguities that may have caused questions and objections. Yet, I feel there might still be some lingering doubts about the connection between breath, the most unique and initial sign of life, and "karma," or actions.

To address this, let's delve deeper into the intricate relationship between actions and breath, and how this connection is vital for understanding our holistic well-being.

To fill in this gap, it can be confidently said that the outcomes of our activities, shaped by the guidance of perfect human virtues mentioned in the introduction of the first chapter, provide the most reliable guarantee for the continuity of mental health and the regularity of the breathing process.

From this perspective, the mental tranquility or restlessness, calmness or nervousness resulting from our positive or negative activities, even if not always physically noticeable during normal breathing, still exert their influence.

For instance, people who are content and at peace with their work typically breathe very quietly and smoothly. Conversely, in situations involving secretive or concealed activities, no matter how much a person prepares themselves mentally, their breath will still be affected by anxiety or excitement, manifesting as a sigh or a gasp. Numerous similar examples from our lives can be cited.

If we were to explore such obvious or subtle examples, paper would not suffice. Therefore, let's briefly summarize the ultimate results of our actions as follows:

THE BLESSING OR CONSEQUENCE

OF ACTIONS!

The outcomes of our daily actions, as highlighted in the title, include both blessings and consequences. These outcomes, mentioned in hadiths as "finding salvation from death" and the opposite, negligence, are just one aspect of the matter. In practice, our various temperaments, moralities, and intentions do not always show immediate results. However, whether pure or impure, lawful or unlawful, inclined towards goodness or evil, our actions will manifest their positive or negative impacts not only in the hereafter but also in our worldly life.

In the analytical prophecy of karma doctrine, the rewards of virtuous deeds and the consequences of sins can even affect one's descendants. This implies that the blessings or consequences of life, both physical and spiritual, are not just confined to the individual but may also extend to their progeny.

This fundamental principle of our actions, metaphorically speaking, serves as the barometer for both our worldly and spiritual lives.

If we consider the "blessing and consequence" concept from the perspective of our national mentality, the notion of karma or the "Book of Deeds," the rewards and consequences of good and sinful deeds, is ingrained in us from childhood with the lesson: "You reap what you sow."

Thus, the recognition that our actions have far-reaching implications underscores the importance of living a life rooted in virtue, both for our own well-being and for the generations that follow.

In our lives, the hidden inappropriate or improper deeds we commit without facing immediate consequences sometimes encourage us to new "heroic" acts. In this regard, people can be divided into two categories:

a) Those who seem to avoid misfortune no matter what they do.

b) Those who face misfortune even with the slightest wrongdoing.

It is no secret that the distinction between these two categories essentially boils down to one benefiting from the rewards of honesty and the other suffering from the consequences of sin. The only subjective difference in our understanding is that some people believe that while someone might pay for food they haven't eaten, others eat the food without any repercussions—neither choking nor suffering any ill effects.

Such thoughts and opinions about the actions of acquaintances or strangers can be found in almost every family. If some find solace in these admissions and objections, others understand the eventual outcomes of these trials and draw their own conclusions from them.

Just like the conclusions we have drawn, the Hindus resolve such issues through the concept of karma and the law of samsara—reincarnation. According to their beliefs, the consequences of one's conscious sins in their lifetime will inevitably catch up with the sinner unless forgiven by the Creator. They firmly believe that the repercussions of these sins will not spare the sinner.

Imagine that a certain Hindu fails to fulfill the responsibilities of their caste or disobeys the higher caste throughout their life. According to the doctrine, as a result of such a lifestyle, the sinner will not only be reborn but will also be reborn into a lower caste family than before.

This concept of "reincarnation" serves as both a punishment and an opportunity for the Hindu to free themselves from their sins!

Although the Hindu belief in "reincarnation" might be entirely foreign to us, we can see its core principle that no deed goes unnoticed, aligning with the truth of "what goes around comes around" that we firmly believe in. The only difference between these doctrines is the timeline of "karma." For us, a misdeed may come back to us in forty years, while for Hindus, this period might span multiple lifetimes.

Interestingly, these Eastern concepts have also caught the attention of Western psychologists in recent times. Essentially, the philosophy of "what goes around comes around" is not new to the Western mindset either. However, the precision with which this truth is addressed seems to be more refined and well-structured in our context. Given this, let's delve into the structure of the concept of action (amal).

STRUCTURE OF AMAL (ACTION)

In Islam, as in other world religions, the structure of action primarily has two characteristics: good and evil, or beneficial and harmful consequences. Despite the plethora of definitions for these traits, we will focus on the most authentic and reliable interpretations. For instance, the Quran emphasizes an intellectual approach to adhering to its verses:

"When the verses of their Lord are recited to them, they do not fall upon them deaf and blind" (Furqan, 25:73).

Similarly, a hadith urges acting according to one's heart, even when a fatwa is issued:

"Goodness is what brings peace to your soul and comfort to your heart. Sin is what wavers in your heart and causes hesitation, even if people give you their legal opinions".

As you might notice, both sacred sources highlight a crucial element: the human intellect and heart's consent. Thus, any action, regardless of its positive or negative outcomes, must be validated by the intellect and the heart.

While we have repeatedly mentioned "action" (amal), we haven't yet discussed how it transforms from a simple act to a holistic practice with a unique quality. For this, let's first understand the essence of "quality":

"It is such a flawless possession that it will never perish, age, be destroyed, decrease, or be affected by conflicts. Indeed, there are no contradictions or disagreements in it".

If we apply the idea that "there are no contradictions or disagreements" in quality to the consequences of actions, it suggests that both outcomes are the result of premeditated actions. Success or failure in any activity is always reflected in its quality.

For example, consider the betrayal of someone's trust or conflicts in transactions without mutual consent. In my thirty years of observations, whether in our country or abroad, I have seen that wealth acquired through betrayal often leads to greater losses later and can have severe consequences on one's well-being. The conclusion from these observations is that betrayal for

personal gain, whether through deliberate intent or mental calculation, carries its own repercussions—what one sows, one reaps.

No matter how we define the essence of an action, whether positive or negative, it ultimately comes down to the dichotomy of halal (lawful) or haram (unlawful) sustenance and the urges of the nafs (ego or greed). While the ultimate destination of our material needs may be clear in either direction, the return of "what goes around comes around" is beyond our control and remains obscure to us. Even though life includes both gain and loss, the unchangeable principle of predestined sustenance is such that no amount of trading or finding and losing can alter it.

As Ali (r.a.) wrote:

"***Rizquka yatlubuka fastarikh***" – "Be at peace, your sustenance will come to you."

When discussing the two poles of action—destiny and desire—let us not forget the invaluable gift of wisdom and intellect bestowed upon us to achieve divine favor. This blessing can bestow upon us unassailable wealth, success in our endeavors, and a healthy and prosperous life. To illustrate this with an anecdote I heard from philosopher Muzaffar Ortikov, let me share a symbolic story that took place in a foreign land.

"In the United States, a large company installed specialized machines to automate the production process that was previously done manually. Not long after, one of the machines broke down. Despite their best efforts, the company's engineers could not repair it. Finally, the company's management called in a renowned mechanic known for his skill and experience across America. The mechanic arrived, thoroughly inspected the machine, and then struck it twice with his small hammer, making it run smoothly again.

When it came time to discuss his fee, the mechanic asked for $102. At that time, the value of a dollar was very high, so the company manager couldn't believe such a hefty sum was warranted for just two hammer strikes and asked the mechanic:

'Are you really asking for almost a month's salary for two taps with a hammer? Where's the fairness in that?'

The mechanic replied:

'Yes, I am being fair, and that's why I'm only asking for $102: $2 for the two hammer strikes and $100 for knowing exactly where to strike, sir!'"

There are many such instructive stories around the world, and we have plenty of our own. However, where there is instruction, there is also flaw. While flaws often result from unintentional actions, they sometimes become an inseparable part of our conscious activities due to their frequent repetition. In light of this, let us compare the consequences of knowingly committing a sinful act with the karmic implications described in the teachings of Hinduism.

According to the teachings, the cycle of rebirth offers a sinner another chance to avoid repeating their sins and to cleanse themselves of previous transgressions, as granted by the divine. In Islam, unlike Hinduism, the responsibility of forsaking sins and living a virtuous life is emphasized in this life itself:

"If you commit a wrong, make amends by doing good...".

By offsetting evil deeds with good ones, the possibility arises in the heart that previously committed and subsequently repented sins can be forgiven. This hope is justified only if the past sin is not merely repented for verbally but is actively cleansed through actions inspired by faith. For:

"Faith and actions are very close to each other. They are not complete without one another".

Thus, according to the logic of the hadith, any good or bad deeds are the outward reflections of actions carried out with or without faith.

When discussing the interplay or separation of faith and actions, one cannot ignore another factor: the activity of Satan, who misguides people wherever he can. His effort to lead his captives astray is a well-known reality for all of us.

"Well, aren't there people who, despite having faith, still succumb to Satan and commit sins?" you might ask. Our response is that it is difficult to conclude definitively how many such people exist; otherwise, it might seem as though we are excluding ourselves from our conclusions.

However, it is clear that all sins, except for shirk (associating partners with God), are forgivable, provided they are not repeated after sincere repentance.

Moreover, the forgiveness of existing sins, regardless of whether the action is good or bad, depends on the sincerity of the initial intention, whether it is heartfelt or merely verbal.

The following hadith elucidates this:

"Know that there is a piece of flesh in the body; if it is sound, the whole body is sound, and if it is corrupted, the whole body is corrupted. Verily, it is the heart."

Modern psychology concludes that various psychological and consequent physical disorders do not result from external events or changes in the world but from personal flaws. This includes the notion that the "inevitable misfortunes" that constantly plague us are:

"We usually seek danger in our surroundings, whereas the primary danger lies within us, operating unnoticed. The root of this danger is misunderstanding the world, misinterpreting events, and fundamentally misunderstanding what gnaws at us internally. The calamities, tragedies, and horrors we perpetually battle in our minds are all consequences of our imperfect psyche".

Let's consider the symbolic example of the impact that unpleasant events around us can have on our psyche through the observations of Ibn Sina on the sheep and the wolf.

"Just a little way from the tied sheep, the wolf is kept in a cage — the interpretation of how the presence of the wolf can affect the animal." This scene, well-known to the older generation, is depicted in the film "Ibn Sina."

It is clear that the constant fear of the nearby wolf leaves the sheep in a state of distress, without the need for further elaboration. Similarly, the human heart, overwhelmed by daily fears, anxieties, or threatening thoughts, can be affected even more severely than the sheep.

May God protect us from such mental disturbances affecting our actions! Otherwise, we risk being

like a ship without a sail, drifting in the ocean of depression, ultimately sinking into the whirlpool of futility.

By "the whirlpool of futility," I mean engaging in tasks without any clear purpose or destination. Yes, our hands are at work, but our hearts are ruled by anxious thoughts.

The state of our protagonist, described in the verses you just read, is essentially a consequence of past mistakes or sinful actions committed thoughtlessly for personal gain. The severity of this "response" or consequence depends on how consciously these mistakes and sins were made. We believe that the various internal states depicted in the examples above, including highs and lows, inevitably affect one's health.

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POLITICAL SCIENCES

MEDIA MANIPULATION AND PROPAGANDA IN RUSSIA'S INFORMATION WARFARE AGAINST UKRAINE

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Abstract
The article examines the role of media manipulation and propaganda in Russia's information warfare against Ukraine. It analyzes the methods and tools used by the Russian Federation to influence public opinion, destabilize Ukrainian society, and achieve its geopolitical goals. The article also explores the consequences of these actions and suggests ways to counter Russian propaganda.

Keywords: Information warfare, media manipulation, propaganda, disinformation, hybrid war, Russia, Ukraine.

Itroduction.

Formulation of the problem. In the modern world, information has become one of the most powerful tools of influence. The ability to control information flows and shape public opinion allows states to achieve their political, economic, and military goals without direct military intervention. This is particularly evident in the context of hybrid warfare, where information warfare plays a crucial role in destabilizing the enemy from within.

Russia has long been using information warfare as a key component of its hybrid strategy against Ukraine. Since the annexation of Crimea in 2014, and the ongoing conflict in Eastern Ukraine, the Russian Federation has employed a wide range of media manipulation and propaganda techniques to undermine Ukrainian statehood, sow discord among the population, and justify its aggressive actions.

The purpose of the article is to analyze the methods and tools of media manipulation and propaganda used by Russia in its information warfare against Ukraine, as well as to propose effective ways to counter these actions.

Analysis of recent research and publications. The phenomenon of information warfare and propaganda has been widely studied by scholars in various fields, including political science, sociology and communication studies. Researchers such as A. Tsygankov, P. Pomerantsev and S. Kovalchuk have extensively analyzed the role of media manipulation in Russia's foreign policy [1, 2, 3]. The works of Ukrainian scholars, including O. Hrytsenko, V. Petruk, and M. Popov, have focused on the impact of Russian propaganda on Ukrainian society, and the ways to counteract it [4, 5, 6].

Presenting main material. Russia's information warfare against Ukraine is multifaceted and includes several key components. One of the most common tools of Russian propaganda is the dissemination of false information. Fake news stories are created and spread through various media channels, including social networks, to create confusion, spread fear, and undermine trust in Ukrainian authorities. For example, during the early stages of the conflict in Eastern Ukraine, Russian media repeatedly claimed that the Ukrainian government was committing genocide against Russian-speaking populations, a narrative that was later debunked but had already caused significant damage [7].

Another critical aspect of Russian propaganda is the manipulation of historical narratives. Russia actively uses historical events to justify its actions in Ukraine. By portraying Ukraine as an "artificial state" and Ukrainians as part of the "Russian world", Russian propaganda seeks to delegitimize Ukrainian sovereignty and national identity. This manipulation of history is particularly evident in the portrayal of World War II, where Russia presents itself as the sole liberator of Europe, while downplaying or ignoring the role of other nations, including Ukraine [8].

Social media platforms have become a battleground for information warfare. Russian troll farms and bots are used to amplify pro-Russian narratives, attack Ukrainian officials, and spread divisive content. These activities are often coordinated with state-controlled media to create a unified propaganda front. The use of social media allows Russia to reach a global audience and influence public opinion beyond its borders [9].

Psychological operations (PSYOP) are another tool employed by Russia to demoralize Ukrainian troops and civilians. This includes spreading rumors about the imminent collapse of the Ukrainian government, exaggerating the strength of Russian forces, and creating a sense of hopelessness among the population. These operations aim to weaken the morale of both the military and the civilian population, making it easier for Russia to achieve its objectives [10].

In the occupied territories of Crimea and Eastern Ukraine, Russia has established complete control over the information space. Local media are either shut down or forced to broadcast Russian propaganda, while access to independent Ukrainian media is restricted. This ensures that the local population is exposed only

to pro-Russian narratives, further entrenching the occupation and making it difficult for Ukraine to regain control over these regions [11].

Consequences of Russian Propaganda.

The impact of Russian propaganda on Ukrainian society has been profound. It has contributed to the polarization of society, undermined trust in state institutions, and created a sense of uncertainty and fear. Moreover, Russian propaganda has been used to justify military aggression, leading to the loss of thousands of lives and the displacement of millions of people [12].

The consequences of Russian propaganda in Ukraine are profound and multifaceted, affecting not only the political and social fabric of the country but also its security, economy and international relations. The systematic dissemination of disinformation, manipulation of historical narratives, and psychological operations have created a complex web of challenges that Ukraine must navigate to maintain its sovereignty and societal cohesion.

One of the most immediate and visible impacts of Russian propaganda is the polarization of Ukrainian society. By exploiting existing ethnic, linguistic, and regional divisions, Russian disinformation campaigns have deepened societal rifts, particularly between Ukrainian-speaking and Russian-speaking populations. For example, the narrative of "Ukrainian fascism" and the alleged persecution of Russian speakers in Ukraine has been widely propagated by Russian media, despite being debunked by independent sources. This narrative has not only fueled tensions within Ukraine but has also been used to justify Russia's military interventions in Crimea and the Eastern Ukraine. The resulting polarization undermines national unity, making it more difficult for the Ukrainian government to implement reforms and maintain stability in the face of external aggression.

Another significant consequence of Russian propaganda is the erosion of trust in state institutions and democratic processes. By spreading false information about government corruption, electoral fraud, and the incompetence of Ukrainian leaders, Russian disinformation campaigns aim to delegitimize Ukraine's political system. This erosion of trust can lead to political apathy, decreased voter turnout, and a general sense of disillusionment among the population. In the long term, this undermines the legitimacy of democratic institutions, and weakens the social contract between the government and its citizens. For instance, during the 2019 presidential elections, Russian media outlets spread rumors about voter fraud and manipulation, despite international observers confirming the elections' fairness. Such tactics not only destabilize the political landscape, but also create an environment, where authoritarian narratives can gain traction.

The psychological impact of Russian propaganda cannot be overstated. Through the use of fear-mongering, demoralization campaigns, and the spread of apocalyptic narratives, Russian disinformation seeks to create a sense of hopelessness and despair among the Ukrainian population. For example, during the early stages of the conflict in the Eastern Ukraine Russian media repeatedly claimed that the Ukrainian army was on the verge of collapse and that the government in Kyiv would soon fall. These narratives, although false, had a demoralizing effect on both civilians and military personnel, undermining their will to resist. The psychological toll of such campaigns is particularly severe in conflict zones, where the constant barrage of disinformation exacerbates the trauma of war and displacement.

In the occupied territories of Crimea and the Eastern Ukraine, the consequences of Russian propaganda are even more pronounced. By controlling the information space and suppressing independent media, Russia has effectively isolated these regions from the rest of Ukraine. Local populations are subjected to a constant stream of pro-Russian narratives that glorify the occupation and vilify the Ukrainian government. This control over information not only entrenches Russian influence but also makes it difficult for Ukraine to reintegrate these territories. The lack of access to accurate information and the prevalence of propaganda create a distorted reality for the inhabitants of these regions, making it challenging for them to make informed decisions about their future.

The economic consequences of Russian propaganda are also significant. By spreading false information about Ukraine's economic instability, corruption, and inability to manage its resources, Russian disinformation campaigns aim to deter foreign investment and undermine economic growth. For example, rumors about the imminent collapse of Ukraine's banking system or the failure of agricultural exports can create panic among investors and trading partners, leading to capital flight and reduced economic activity. Additionally, the portrayal of Ukraine as a failed state can damage its international reputation, making it more difficult to secure financial aid and support from international organizations.

On the international stage, Russian propaganda has been used to justify its aggressive actions and shift the blame onto Ukraine. By framing the conflict as a civil war or a result of Ukrainian aggression, Russia seeks to obscure its role as the aggressor and avoid accountability for its actions. This narrative has been particularly effective in shaping public opinion in countries with strong pro-Russian sentiments or those that are skeptical of Western involvement in the conflict. The spread of disinformation about Ukraine's alleged human rights abuses or its supposed alignment with extremist groups has also been used to discredit Ukraine's efforts to integrate with European and Euro-Atlantic institutions. This not only undermines Ukraine's international standing but also complicates its efforts to garner support from the global community.

The humanitarian consequences of Russian propaganda are equally alarming. By spreading false information about the intentions and actions of humanitarian organizations, Russia has sought to undermine their efforts to provide aid to conflict-affected populations. For example, Russian media has accused international organizations of supporting Ukrainian military operations or engaging in espionage, leading to increased hostility and mistrust among local populations. This not only en-

dangers the lives of humanitarian workers, but also deprives vulnerable populations of much-needed assistance.

Finally, the long-term societal impact of Russian propaganda is a cause for concern. The constant exposure to disinformation and manipulated narratives can lead to a distorted understanding of reality, particularly among younger generations. In the absence of critical media literacy, individuals may internalize false narratives and develop a skewed perception of their own history, identity, and national interests. This can have lasting implications for Ukraine's social cohesion and its ability to build a resilient and informed citizenry.

In conclusion, the consequences of Russian propaganda in Ukraine are far-reaching and multifaceted, affecting every aspect of society, from politics and security to economics and international relations. The polarization of society, erosion of trust in institutions, psychological toll, and control of information in occupied territories are just some of the challenges that Ukraine must address. To mitigate these effects, Ukraine must adopt a comprehensive approach that includes strengthening media literacy, supporting independent journalism, enhancing cybersecurity, and fostering international cooperation. Only by addressing the root causes of disinformation and building a resilient society can Ukraine hope to counter the pervasive influence of Russian propaganda and safeguard its democratic future.

Ways to Counter Russian Propaganda.

To effectively counter Russian propaganda, Ukraine and its international partners must take a comprehensive approach. *Strengthening media literacy is crucial, as educating the population about the dangers of disinformation and how to identify fake news can help mitigate the impact of propaganda.* Media literacy programs should be integrated into school curricula and public awareness campaigns [13].

Supporting independent media is another essential measure. Independent media outlets play a key role in countering propaganda by providing accurate and unbiased information. Providing financial and technical support to these outlets will help ensure that the public has access to reliable sources of information [14].

Enhancing cybersecurity is also critical, given the role of social media in spreading propaganda. Improving cybersecurity measures, including monitoring and removing fake accounts, bots, and malicious content from online platforms, can help reduce the spread of disinformation [15].

International cooperation is vital in the fight against Russian propaganda. Ukraine should work closely with its international partners to expose Russian propaganda and coordinate efforts to counter disinformation. This includes sharing intelligence, best practices, and technological tools [16].

Strengthening legal frameworks to combat disinformation and propaganda is important. Laws that hold individuals and organizations accountable for spreading fake news and inciting violence can help reduce the impact of propaganda and protect democratic values [17].

Countering Russian propaganda requires a comprehensive and multi-faceted approach that addresses both the immediate and long-term challenges posed by disinformation. Given the complexity and scale of Russia's information warfare, Ukraine must employ a combination of strategies that involve government action, civil society engagement, international cooperation, and technological innovation. Below are several key measures that can help Ukraine effectively counter Russian propaganda and build a more resilient society.

Strengthening Media Literacy and Critical Thinking. One of the most effective ways to counter propaganda is to empower citizens with the skills to critically evaluate information. Media literacy programs should be integrated into school curricula at all levels, teaching students how to identify fake news, verify sources, and understand the mechanisms of disinformation. Public awareness campaigns can also play a crucial role in educating the broader population about the dangers of propaganda and the importance of relying on credible sources. For example, initiatives like fact-checking websites and public service announcements can help raise awareness about common disinformation tactics used by Russia. By fostering a culture of critical thinking, Ukraine can reduce the susceptibility of its population to manipulative narratives.

Supporting Independent Media and Journalism. Independent media outlets are essential in providing accurate and unbiased information, which is crucial for countering propaganda. The Ukrainian government and international partners should provide financial and technical support to independent journalists and media organizations, panrticularly those operating in conflict zones, promoting investigative journalism that exposes Russian disinformation campaigns can help debunk false narratives and hold propagandists accountable. For instance, platforms like StopFake have been instrumental in exposing and refuting Russian propagada, serving as a model for other initiatives.

Enhancing Cybersecurity and Combating Online Disinformation. Given the central role of social media and online platforms in spreading propaganda, enhancing cybersecurity measures is critical. Ukraine should invest in advanced technologies to detect and remove fake accounts, bots, and malicious content from social media platforms. Collaboration with tech companies like Facebook, Twitter, and Google can help identify and dismantle networks of disinformation spreaders. Additionally, Ukraine can develop its own cybersecurity infrastructure to monitor and counter online threats in real-time. For example, the creation of a national cybersecurity center dedicated to tracking and neutralizing Russian disinformation campaigns could significantly reduce the spread of fake news.

Promoting Transparent and Accountable Governance. Transparency in government operations can help build public trust and reduce the effectiveness of propaganda that seeks to discredit state institutions. By ensuring that government decisions and actions are open to public scrutiny, Ukraine can counteract narratives of corruption and incompetence that are often propagated by Russian media. Implementing anti-corruption measures, promoting open data initiatives, and encouraging citizen participation in governance can further strengthen the legitimacy of Ukrainian institutions. For

example, the establishment of independent anti-corruption bodies and the publication of government contracts online have been steps in the right direction, but more efforts are needed to ensure accountability at all levels of government.

Fostering International Cooperation. Countering Russian propaganda is not a task that Ukraine can undertake alone. International cooperation is essential in exposing and combating disinformation on a global scale. Ukraine should work closely with its allies, including the European Union, NATO, and the United States, to share intelligence, best practices, and technological tools for countering propaganda. Multilateral organizations like the United Nations and the OSCE can also play a role in holding Russia accountable for its disinformation campaigns and raising awareness of the dangers posed by state-sponsored propaganda. For instance, initiatives like the EU's East StratCom Task Force have been effective in exposing Russian disinformation and coordinating responses across member states.

Legal and Regulatory Measures. Strengthening legal frameworks to combat disinformation and propaganda is another important step. Laws that hold individuals and organizations accountable for spreading fake news and inciting violence can help reduce the impact of propaganda. However, it is crucial to ensure that such measures do not infringe on freedom of speech or undermine press freedom. Striking the right balance between combating disinformation and upholding democratic principles is a complex but necessary task. For example, Ukraine could establish a legal framework that requires social media platforms to remove content that is proven to be false and harmful, while also protecting the rights of users to express legitimate opinions.

Engaging Civil Society and Grassroots Movements. Civil society organizations and grassroots movements play a vital role in countering propaganda at the local level. These groups can act as a bridge between the government and the population, helping to disseminate accurate information and counter false narratives. Supporting initiatives that promote community resilience, such as local media projects, cultural exchanges, and educational programs, can help build trust and solidarity among different segments of society. For example, organizations like Detector Media have been effective in monitoring media bias and promoting ethical journalism, serving as a model for other civil society initiatives.

Countering Propaganda in Occupied Territories. In the occupied territories of Crimea and the Eastern Ukraine, countering Russian propaganda is particularly challenging due to the complete control of the information space by Russian authorities. However, Ukraine can still take steps to reach these populations. Broadcasting Ukrainian news and educational content via satellite and radio can provide an alternative source of information for those living under occupation. Additionally, supporting underground networks of activists and journalists who risk their lives to report the truth can help expose the realities of life under Russian control. International organizations can also play a role by providing humanitarian aid and supporting efforts to document human rights abuses in these regions.

Utilizing Strategic Communication. Strategic communication is a powerful tool in countering propaganda. Ukraine should develop a coherent and consistent narrative that highlights its democratic values, cultural heritage, and resilience in the face of aggression. This narrative should be communicated through various channels, including traditional media, social media, and international platforms. By presenting a positive and unified image of Ukraine, the country can counteract the negative stereotypes and false narratives propagated by Russian media. For example, campaigns that showcase Ukraine's contributions to global culture, science, and technology can help shift the international perception of the country.

Investing in Research and Development. Finally, investing in research and development is crucial for staying ahead of the evolving tactics of Russian propaganda. Ukraine should support academic and think tank research on disinformation, media manipulation and psychological operations. By understanding the mechanisms of propaganda, Ukraine can develop more effective countermeasures and anticipate future threats. Additionally, collaboration with international researchers and institutions can provide valuable insights and innovative solutions for countering disinformation.

In Conclusion countering Russian propaganda is a complex and ongoing challenge that requires a coordinated and sustained effort from all sectors of society. By strengthening media literacy, supporting independent journalism, enhancing cybersecurity, promoting transparent governance, fostering international cooperation, and engaging civil society, Ukraine can build a more resilient society capable of resisting disinformation. While the task is daunting, the stakes are high, and the success of these efforts will determine not only Ukraine's future but also the broader struggle for truth and democracy in the face of authoritarian aggression. The international community must stand with Ukraine in this fight, recognizing that the battle against disinformation is a global one, with implications for the future of democracy and freedom worldwide.

Conclusions.

Russia's information warfare against Ukraine represents a sophisticated and multifaceted strategy aimed at destabilizing Ukrainian society, undermining state institutions, and justifying its aggressive actions. Through the use of media manipulation, propaganda and disinformation, Russia has sought to create a distorted narrative that serves its geopolitical interests, while eroding trust in Ukraine's democratic processes and national identity. The consequences of this information warfare are profound, affecting not only Ukraine but also the broader international community, as the spread of false narratives, and the manipulation of public opinion have global implications.

One of the most significant challenges posed by Russian propaganda is its ability to exploit existing societal divisions. By disseminating fake news, manipulating historical narratives, and amplifying divisive content through social media, Russia has successfully

sowed discord within Ukrainian society. This polarization undermines social cohesion and weakens the collective resolve to resist external aggression. Furthermore, the psychological impact of propaganda, particularly in the form of fear-mongering and demoralization campaigns, has had a detrimental effect on both the civilian population and the armed forces, making it more difficult for Ukraine to maintain unity and resilience in the face of ongoing conflict.

The control of information in occupied territories, such as Crimea and parts of the Eastern Ukraine, has further entrenched Russian influence in these regions. By suppressing independent media and flooding the information space with pro-Russian narratives, Russia has effectively isolated these populations from the rest of Ukraine, making it challenging for the Ukrainian government to reassert its authority and reintegrate these territories. This strategy not only serves Russia's immediate military objectives but also poses a long-term threat to Ukraine's territorial integrity and national sovereignty.

To counter these threats, Ukraine must adopt a comprehensive and multi-pronged approach. Strengthening media literacy among the population is a critical first step. By educating citizens on how to identify and critically evaluate disinformation, Ukraine can build a more resilient society that is less susceptible to manipulation. Media literacy programs should be integrated into educational curricula and supported by public awareness campaigns that emphasize the importance of verifying information from reliable sources.

Supporting independent media is equally essential. Independent journalists and media outlets play a vital role in providing accurate and unbiased information, countering the narratives propagated by Russian state-controlled media. Financial and technical support for these outlets, as well as legal protections for journalists, can help ensure that the public has access to trustworthy news sources. Additionally, fostering a diverse and vibrant media landscape can help counteract the monopolization of information by pro-Russian actors.

Enhancing cybersecurity measures is another crucial component of Ukraine's strategy to combat Russian propaganda. Given the central role of social media in spreading disinformation, efforts to monitor and remove fake accounts, bots, and malicious content must be prioritized. Collaboration with international partners, particularly in the areas of cybersecurity and technology, can provide Ukraine with the tools and expertise needed to effectively counter online propaganda campaigns.

International cooperation is indispensable in the fight against Russian disinformation. Ukraine should work closely with its allies, including the European Union, NATO, and the United States, to expose Russian propaganda and coordinate efforts to counter its influence. Sharing intelligence, best practices, and technological tools can enhance Ukraine's ability to respond to information warfare. Moreover, international organizations such as the United Nations and the OSCE can play a role in holding Russia accountable for its actions and raising awareness of the dangers posed by state-sponsored disinformation.

Finally, strengthening legal frameworks to combat disinformation and propaganda is essential. Laws that hold individuals and organizations accountable for spreading fake news and inciting violence can help reduce the impact of propaganda and protect democratic values. At the same time, it is important to ensure that such measures do not infringe on freedom of speech or undermine press freedom. Striking the right balance between combating disinformation and upholding democratic principles is a complex but necessary task.

In conclusion, Russia's information warfare against Ukraine is a grave threat that requires a coordinated and sustained response. By strengthening media literacy, supporting independent media, enhancing cybersecurity, fostering international cooperation, and implementing robust legal measures, Ukraine can build a more resilient society capable of resisting Russian propaganda. The fight against disinformation is not only a battle for Ukraine's sovereignty but also a defense of democratic values and the principles of truth and transparency in the face of authoritarian aggression. The international community must stand with Ukraine in this struggle, recognizing that the outcome will have far-reaching implications for global security and the future of democracy.

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SOCIAL SCIENCES

ELECTORAL BEHAVIOR OF YOUTH IN THE STRUCTURE OF THE POLITICAL CULTURE OF SOCIETY

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ЭЛЕКТОРАЛЬНОЕ ПОВЕДЕНИЕ МОЛОДЕЖИ В СТРУКТУРЕ ПОЛИТИЧЕСКОЙ КУЛЬТУРЫ ОБЩЕСТВА

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Abstract
The scientific article is devoted to the study of the main factors and methods of forming the electoral culture of the youth of Kazakhstan as the most dynamic social group. The purpose of the study is to analyze the awareness of young people about the elections, their level of interest and participation in electoral events, as well as the means by which students learn about the upcoming elections. The electoral behavior of young people remains one of the little-studied areas. To achieve this goal, a sociological survey was conducted among students of the L.N. Gumilyov Eurasian National University.

Аннотация
Научная статья посвящена исследованию основных факторов и методов формирования электоральной культуры молодежи Казахстана как самой динамичной социальной группы. Цель исследования - анализ осведомленности молодежи о выборах, уровня их интереса и участия в избирательных мероприятиях, а также средств, с помощью которых студенты узнают о предстоящих выборах. Электоральное поведение молодёжи пока остается одной из малоизученных областей. Для достижения поставленной цели был проведен социологический опрос среди учащихся Евразийского национального университета имени Л.Н. Гумилева.

Keywords: electoral culture, youth, elections, social media, political activism.
Ключевые слова: электоральная культура, молодежь, выборы, социальные медиа, политическая активность.

Электоральная культура сегодня по праву является показателем демократических преобразований в любой стране мира. Выборы - это оптимальный способ обновления власти и легитимизации политического процесса. В Республике Казахстан традиционно большое внимание уделяется развитию электоральной культуры молодежи, которая всегда считалась авангардом нации, способным пересмотреть старые традиции, нормы, ценности, внести определенные новации в общественное развитие. Именно молодое поколение должно определять основные пути демократизации общества, в частности, через свое активное и сознательное участие в выборах. Феномен электоральной культуры является важной составляющей не только для стабильности демократических процессов, но и для формирования гражданской ответственности на долгосрочную перспективу, вовлекая в сферу политики каждого члена общества, достигшего определённого возраста. Эту тему в различных аспектах исследовали казахстанские и зарубежные ученые. Например, американские ученые Г. Алмонд, С. Верба и другие рассматривали в своих работах роль электорального поведения и социализации индивидов в рамках политической культуры [1]. Труды российских ученых Е.В. Филоненко, Д.Ю. Мартынкиной и других посвящены роли средств массовой информации в повышении электорально-правовой культуры молодёжи [2]. По мнению

профессора В.В.Комлевой в социологических исследованиях электоральной культуры можно выделить, как минимум, четыре подхода:

1) описательный – представляет электоральную культуру как совокупность ценностей, символов, традиций, из которых она складывается;

2) оценочный (аксиологический), при котором «культурность» электората определяется путем соотнесения оцениваемого избранным в качестве эталона;

3) поведенческий, когда электоральная культура изучается в контексте электорального поведения, активности/пассивности электората;

4) эмпирический – ориентированный на исследование отдельных элементов электоральной культуры с помощью социологических опросов [3, 112-113].

Особенности электоральной и политической культуры казахстанской молодежи проанализированы в трудах А.А. Камалдиновой и Г.К. Абдигалиевой [4]. Анализируя различные формы участия в политической жизни Республики Казахстан, авторы отмечают роль интернета и социальных сетей в формировании политической культуры молодежи. Значимость образования в формировании политической культуры общества подчеркивает профессор Евразийского национального университета имени Л.Н. Гумилёва (Астана) И.С. Рыстина, утверждая, что образованные молодые люди сохраняют высокий уровень политического доверия, тогда как не получившие образования становятся более скептичными, менее уверенными [5].

Покажем на примере данных Аналитического доклада об эволюции политики по повышению электоральной активности молодежи РК [6], этапы развития современного электорального процесса в Казахстане через призму участия молодежи.

Первый этап (1991-2015 гг.). Работа по вопросам формирования норм электорального поведения в документах по государственной молодежной политике не проводилась.

Второй этап (2015-2016 гг.). Работа в этом направлении осуществлялась неправительственными организациями, взаимодействующими с международными организациями, которые на протяжении ряда лет ведут системную работу среди молодежи по разъяснению им общественно политических прав с целью увеличения интереса молодежи к электоральной системе и повышения уровня её участия в выборах; организовано тестовое голосование в социальной сети, в частности «В Контакте». с помощью волонтеров распространяли в учебных заведениях информационные листы с указанием прав избирателей; проведены мини-лекции о выборном законодательстве и возможных нарушениях прав молодежи в день голосования.

Третий этап (2017-2021 гг.). Центральная избирательная комиссия, исходя из понимания значимости работы, осуществляла деятельность по направлениям: институциональное сотрудничество с организациями образования; электоральное обучение молодых и будущих избирателей; проведение организационно-познавательных мероприятий среди студентов. Принят ряд программных и законодательных документов, определяющих вектор развития молодежной политики.

Четвертый этап (с января 2022 г. по настоящее время). Выстраивается новая модель взаимодействия с участниками избирательного процесса посредством разноплановых форм работы с молодежью. В качестве консультативно-совещательного органа при Центризбиркоме создан Клуб молодых избирателей. Реализован большой пакет государственных мер по приоритетным направлениям развития молодежи: социального обеспечения, поддержки инициатив, образования и науки, содействия занятости и другое. Приняты и другие меры по повышению электоральной активности молодежи.

В то же время проведенный анализ по теме исследования позволяет констатировать, что, несмотря на имеющуюся теоретическую и эмпирическую базу по исследованию электорального поведения, на протяжении ряда лет в сфере молодежной политики вопросам электорального просвещения и культуры не уделялось должного внимания. На региональном уровне работа по электоральному просвещению молодежи проводится эпизодично или вовсе отсутствует. Пока недостаточно разработаны теоретико-методологические подходы к реализации механизмов воздействия на электоральное поведение молодого поколения. Так, изыскания руководителя Общественного фонда «Центр социальных и политических исследований «Стратегия» Г.Т. Илеуовой **[7]**, профессора И.А. Калиева [8] и др., свидетельствуют о слабой работе с молодыми избирателями, низком уровне их информированности о нововведениях, ограничиваясь лишь развитием правовой грамотности. По мнению политолога А. Шайкуловой, одна из причин отказа идти на выборы, заключается в том, что люди не верят в силу органов власти, и считают, что их участие или неучастие в выборах мало что изменит [9]. Кроме того, в отечественной научной литературе ощущается нехватка специальных научных работ по комплексному анализу современной электоральной культуры молодежи Казахстана.

Практика показала, что электоральную культуру и активность молодежи целесообразно выявлять посредством проведения исследования на местах. В этой связи с января по февраль 2025 года нами было проведено социологическое исследование студентов, и магистрантов ЕНУ им. Л.Н. Гумилева. В опросе приняли участие 414 респондентов в возрасте от 18 до 25 лет. При этом ответы были собраны через приложение Google Forms в онлайн формате с соблюдением принципов анонимности.

По данным исследования, среди обучающихся большинство опрошенных считают голосование своим гражданским долгом. Результаты опроса представлены в диаграмме 1.

Диаграмма 1. «Как Вы считаете, обязан ли гражданин участвовать в голосовании на выборах и референдумах?»

В диаграмме 2 представлен результат заинтересованности респондентов к подготовке к предстоящим выборам. Согласно данным, 43,7% респондентов проявляют активный интерес к выборам и референдумам. 42,8% опрошенных - «время от времени», что говорит о периодическом интересе, возможно, в зависимости от значимости конкретного события. Лишь 13,5% студентов не интересуются выборами.

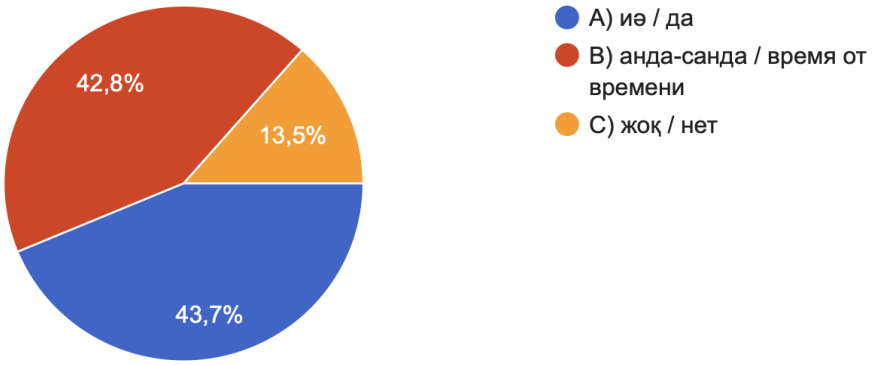

Диаграмма 2. «Когда идет подготовка к выборам или референдуму, интересуетесь ли Вы этим событием?»

Более 79,5% в качестве основных источников информации указали социальные сети и интернет, что делает соцсети ключевым инструментом политической коммуникации. Также преобладание в информировании интернета и соцсетей свидетельствует о развитии цифровизации казахстанского общества. Вместе с тем данные свидетельствуют о снижении влияния традиционных СМИ.

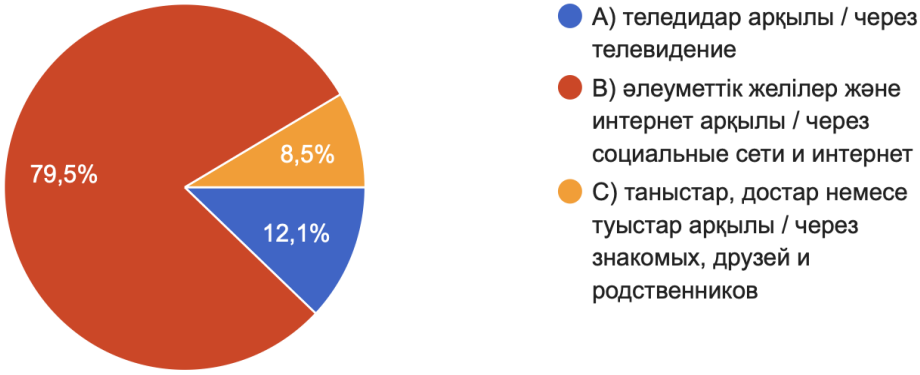

Диаграмма 3. «Каким образом Вы узнаете о проводимых выборах или референдумах?

Участники исследования также ответили на вопросы**,** касающиеся предпочтения способа голосования на выборах (Диаграмма 4). Большинство респондентов выбрали онлайн-голосование. Это может быть связано с удобством голосования из дома, особенно для молодых избирателей и тех, кто не может посетить участок лично. Важно отметить,

что доля участников предпочитающих традиционные методы голосования, остаются актуальными, особенно среди тех, кто ценит надежность и безопасность.

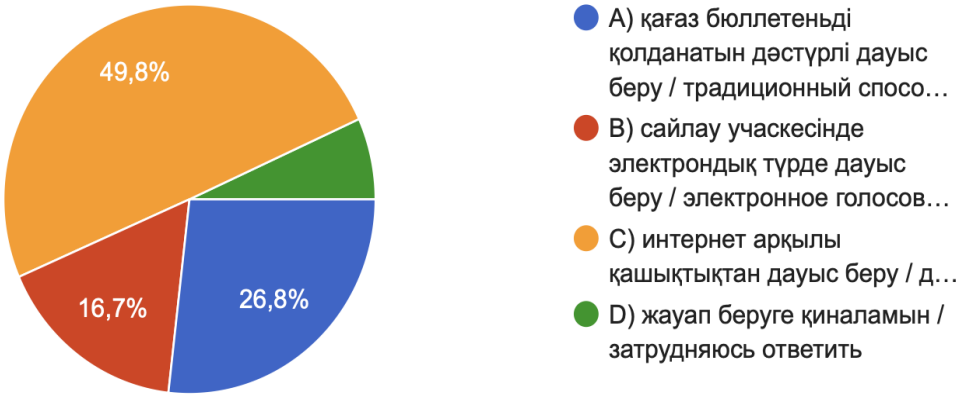

Диаграмма 4. «Какой способ голосования Вы лично предпочли бы на следующих выборах?»

На вопрос о возможных препятствиях для 39,9% респондентов признались, что не доверяют электронному голосованию, опасение мошеннических действий и манипуляций, 28,7% респондентов не доверяют технической надежности электронной системы, что подчеркивает необходимость большей прозрачности и мер безопасности для укрепления доверия к системам цифрового голосования.

На вопрос о правах граждан, признанных судом недееспособными, 44,4% респондентов дали ответ, что поддерживают избирательные права граждан, признанных недееспособными, что свидетельствует о прогрессивной позиции в отношении инклюзивности. Однако, к сожалению, зафиксирован, на наш взгляд, высокий процент респондентов, не определившихся с выбором - 34,3%.

Диаграмма 5. «Должны ли граждане, признанные судом недееспособными, иметь право голоса?»

В заключительный раздел анкеты был включен блок вопросов, посвящённых требованиям для кандидатов в Президенты РК. На вопрос «Поддерживаете ли Вы существующее требование по сроку проживания в Казахстане для кандидатов в Президенты - 15 лет?», - большинство опрошенных ответили утвердительно, что свидетельствует о предпочтении опрошенными кандидатов, имеющих долгие и глубокие связи со страной. Это отражает стремление к стабильности в политическом руководстве.

89,9% респондентов выступают за проведение лингвистического теста на знание казахского языка для кандидатов в Президенты, подчеркивая необходимость свободного владения ими государственным языком и важность языка как символа национальной идентичности. Также утвердительный ответ получен от 74,2% респондентов на вопрос о предыдущем опыте работы кандидатов в Правительстве: «Как Вы считаете, должен ли кандидат в Президенты иметь стаж работы на государственной службе или на выборных государственных должностях.

Таким образом, в основном, для молодёжи характерна заинтересованность в участии в выборах. Тем не менее, определённая часть из них не обнаруживает интереса к политической жизни страны, к тем преобразованиям, которые в ней происходят, не видит реальных изменений, которые могли бы быть вызваны их голосом, проявляя относительную пассивность в вопросах участия в выборах, склонность к скептицизму по отношению к политическим институтам и партиям.

В процессе исследования также выявлено, что основными источниками информирования опро-

шенных являются интернет, социальные сети. Онлайн-активность молодежи в Казахстане представляет собой популярную форму для получения информации, для общения, обмена мнениями, вовлечения молодежи в избирательный процесс, формирования электоральной культуры. Положительное влияние на развитие электоральной культуры молодежи оказывают образовательные программы и деятельность молодежных организаций. Образование, как в школах, так и в вузах, может значительно повысить уровень политической грамотности и интереса к выборам. Молодежные организации, в свою очередь, должны способствовать развитию активного гражданского участия в жизни общества. Характерно, что современное поколение молодых интересует социальная справедливость, экологические вопросы и права человека, что должно быть учтено при разработке политических платформ и обещаний.

Формирование электоральной активности должно закладываться на ранних этапах, постепенно приводя молодых людей к мысли о том, что их выбор имеет значение. Выстраивание системной работы, как избирательных органов, так и институтов молодежной политики, безусловно, может способствовать расширению политического участия нового поколения на всех этапах электорального процесса в стране.

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TECHNICAL SCIENCES

APPLICATION OF NFC-BASED ATTENDANCE SYSTEMS, CHALLENGES AND SOLUTIONS

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Abstract
The application of NFC technology has become popular in many areas. Also, the optimal implementation of NFC-based attendance verification systems in the education system is a pressing issue. The article discusses the advantages of applying the NFC system for student attendance records, the collection of attendance data in the database, and the possibilities of integration into the university system.

Keywords: NFC technology, NFC mobile application, advantages of NFC technology, difficulties of NFC technology, NFC-based attendance system, NFC system architecture

Introduction. Near Field Communication (NFC) is a short-range wireless communication technology that enables secure data exchange between devices within a distance of less than 10 cm. NFC-enabled systems in the education system allow students to mark attendance by tapping their NFC-equipped student card or smartphone on a reader device, automating data collection and reducing errors caused by manual processes. The card reader captures unique identification data from the NFC tag and records attendance in a centralized database. The application of NFC technology has gained popularity in many areas. Additionally, methods for the optimal implementation of NFC-based attendance verification systems in the education system are reflected in this article. The article discusses the advantages of implementing the system, the collection of attendance data in the database, and the possibilities of integration into the university system.

Traditional attendance verification methods pose several challenges, which can be overcome and automated by integrating the NFC system into the university's student attendance system:

- **Time-consuming:** Manual attendance processes can consume significant teaching time.
- **Prone to errors:** Manually entered data may lead to inaccuracies in attendance records due to human errors.
- **Fraudulent practices:** Traditional methods are vulnerable to proxy attendance, where one student marks attendance on behalf of another.
- **Inefficient data management:** Paper-based systems make it difficult to store, retrieve, and analyze attendance data efficiently.

The main objectives of implementing NFC-based attendance systems include:

- **Enhancing efficiency:** Automating attendance processes reduces the time spent on manual methods and allows for more efficient operations.
- **Improving accuracy:** NFC technology minimizes human errors, ensuring accurate and reliable attendance records.
- **Preventing fraud:** NFC-based systems enhance security by reducing the potential for fraudulent attendance practices.
- **Real-time data transmission:** These systems provide immediate access to data, facilitating timely interventions and decision-making.
- **Integration capability:** NFC-based attendance systems can be integrated with existing university management software, improving overall operational efficiency.

From the above points, it is evident that implementing NFC-based attendance systems eliminates the shortcomings of traditional methods by offering a more efficient, accurate, and secure approach to attendance management. [1,2]

The implementation of an NFC-based student attendance tracking system requires several key components to ensure seamless operation, data accuracy, and integration with university servers. The key components include NFC readers, NFC tags (or student cards), and servers for data processing and storage:

1. **NFC Readers:** NFC readers serve as the primary interface for scanning student identification cards and capturing attendance data. These readers interact with NFC tags, retrieve student data, and send it to the system for processing. Installed in classrooms or lecture halls, the NFC reader connects to a computer running attendance tracking software. When a student taps their NFC-enabled card on the reader, the reader extracts a unique identifier and verifies their presence in real time.
2. **NFC Tags (Student Cards):** NFC tags act as digital identifiers assigned to each student. These tags contain unique identification numbers corresponding to student records stored in the database. If the system

supports NFC-based data reading via mobile phones, NFC-enabled smartphones can also serve as virtual tags, replacing physical cards.

3. **Servers:** The backend infrastructure of the system consists of university servers responsible for processing, storing, and managing attendance records.

- **Database Server:** Stores student data, attendance records, and class schedules.
- **Application Server:** Manages data processing, authentication, and integration with university systems.
- **Integration with the Electronic Education System:** Attendance data is transferred to the university's "Electronic Education System" for recording absences and participation. [3]

Proper structuring of data flow and processing mechanisms in NFC-based attendance systems is crucial for their effectiveness and reliability. This technology facilitates real-time user identification by offering low-latency and fast data exchange capabilities. The main stages of data transmission in NFC-based systems include:

1. Data Collection

At this stage, NFC reader devices collect data from cards or tags. One of the most important elements here is the **UID (Unique Identifier),** which is the unique identification code assigned to each NFC tag.

- **ISO/IEC 14443 and ISO/IEC 15693 protocols** define the data transmission standards for NFC cards and readers.
- **Difference between RFID and NFC:** NFC enables close-range (less than 10 cm) data transmission, increasing its security advantage.
- **Active and Passive NFC Tags:** While active tags have an internal power source, passive tags derive power from the electromagnetic waves generated by the NFC reader. When a user brings an NFC card close to the reader, the system retrieves the UID stored on the tag, initiating the identification process.

2. Data Processing

The UID and other user data retrieved by the NFC reader are sent to the **Data Processing Server.** These servers perform the following key functions:

- **Authentication & Authorization** – Verifies whether the user is registered in the system. If the UID exists in the database, the system records attendance.
- **AES (Advanced Encryption Standard) and RSA (Rivest-Shamir-Adleman) encryption** methods can be used to enhance data security during transmission.
- **API and Web Services Integration** – NFC-based systems can integrate with existing organizational databases, allowing them to work in sync with HRM (Human Resource Management) and ERP (Enterprise Resource Planning) systems.

3. Data Storage & Utilization

Collected and processed data is archived in servers or cloud systems for long-term storage.

- **SQL and NoSQL databases** are used for storing structured and unstructured data (e.g., MySQL, PostgreSQL, MongoDB).
- **Backup and Redundancy Systems** – To prevent data loss, automatic backup systems (Backup Servers) and RAID (Redundant Array of Independent Disks) technology can be employed.
- **GDPR (General Data Protection Regulation) and ISO/IEC 27001** – Compliance with international standards for data security and privacy is essential.

4. Real-time vs. Offline Processing

NFC-based attendance systems can process data using two main methods:

- **Real-time Processing:** Data is immediately transmitted to the server, and attendance records are updated instantly. This method is faster and more efficient but requires a continuous internet connection.
- **Offline Processing:** The NFC device temporarily stores data locally and transfers it to the server at a later time. This method is useful in areas with poor internet connectivity. [4,5,6]

Role of Mobile Applications. Mobile devices and applications play a crucial role in NFC-based attendance systems. These applications allow users to participate in the attendance process conveniently through their mobile devices without the need for physical cards or identification tools. The functionality of mobile applications not only enhances user convenience but also ensures the system operates more flexibly and efficiently.

The primary roles of mobile applications in NFC-based attendance systems should be evaluated based on the following aspects:

1. **Identification and Authentication** – Mobile applications should function as NFC readers. This enables users to be identified directly via their smartphones without requiring physical cards. Unique identifiers (UID) or cryptographic keys are used in this process to perform authentication.

2. **Real-time Data Transmission and Synchronization** – Mobile applications should establish real-time communication with the attendance system's server and automatically update user data. This prevents delays and maximizes data reliability. Additionally, through the user interface, employees or students can access real-time information about their attendance status.

3. **Cloud-based Data Management** – NFC-based attendance systems are often integrated with cloud technologies to ensure system continuity and accessibility. Mobile applications should transmit attendance data to cloud servers, ensuring secure storage and remote management. This facilitates organizations' and institutions' access to attendance records anytime and anywhere.

4. **Expanded Functionality and Notifications** – Mobile applications should offer more than just attendance registration. For example, if the system records delays or attendance issues, the mobile application should notify the user. Additionally, users should be able to access their attendance records, manage missed days, and submit leave requests through the application.

The use of mobile applications in NFC-based attendance systems increases technology's flexibility and convenience while reducing the need for physical infra-

structure. Such applications help organizations automate workflows and manage attendance more efficiently. [7]

Implementation Challenges. The implementation of NFC-based attendance systems inevitably encounters various challenges. These challenges manifest in technical, security, and user acceptance aspects. Below are the key technical challenges:

1. Device Incompatibility

- **Devices Without NFC Support:** Some older or lower-end mobile devices do not support NFC functionality, limiting users' access to the system.
- **Cross-platform Incompatibility:** The varying implementations of NFC functions across different operating systems (e.g., Android and iOS) complicate the integration process.

2. Interface and Protocol Incompatibility

- **Diversity of Standards:** The presence of different protocols and standards in NFC technology can lead to compatibility issues between devices.
- **Software Incompatibility:** The use of different firmware versions across various manufacturers' devices can create integration difficulties.

3. Infrastructure Limitations

- **Challenges in Integration with Existing Systems:** Integrating NFC-based attendance systems with existing databases and management systems may be complex.
- **Network Connectivity Constraints:** Real-time data transmission requires a stable and high-speed network connection, which may not always be available in certain locations.

4. Energy Consumption and Battery Life

- **High Energy Demand:** Continuous use of NFC functionality may reduce mobile device battery life, potentially affecting user satisfaction.
- **Energy Efficiency Issues:** Devices with low energy efficiency may face problems during prolonged usage. [6,7]

NFC-based attendance systems process personal and sensitive data, making them vulnerable to various cybersecurity risks. To protect data, security measures must be implemented at both software and hardware levels:

1. **Unauthorized Data Interception (Eavesdropping)**

Since NFC technology operates over short distances, third parties can intercept data transmissions. Attackers can steal user data by listening to electromagnetic waves. To prevent this:

- **AES-128 or AES-256 encryption methods** should be applied.
- **Secure communication methods** such as Diffie-Hellman key exchange should be used.

2. **Replay Attacks**

Attackers can capture signals transmitted during NFC communication and later resend the same signal to the system. To prevent this:

- **One-Time Passwords (OTP)**
- **Timestamp validation**
- **Cryptographic nonces (random number generators)** should be used.

3. **Man-in-the-Middle (MITM) Attacks**

During data transmission between NFC devices, third parties may intercept and alter the communication. To mitigate this:

- **Mutual authentication** should be implemented.
- **TLS (Transport Layer Security) and SSL (Secure Sockets Layer) encryption protocols** should be used.

4. **Privacy Violations and Personal Data Protection**

NFC-based attendance systems collect students' or employees' personal data. To comply with GDPR (General Data Protection Regulation) and other data security regulations:

- **Data minimization** should be applied (only essential data should be stored).
- **Pseudonymization and anonymization techniques** should be used.
- **Data retention periods** should be limited, and an automatic data deletion policy should be implemented. [8,9]

Solutions and Recommendations:

1. **Standardization and Compatibility Testing.** To ensure interoperability between different NFC devices, compliance with international standards such as **ISO/IEC 14443, ISO/IEC 18092, and ISO/IEC 21481** must be ensured.

2. Standardization should also be supported by **NFC Forum's tag and device compatibility tests.** For example:

- Devices supporting **NFC-A, NFC-B, and NFC-F** protocols should be tested.
- **Verification tests** should be conducted to confirm the accuracy of identification data (UID).

3. **Implementation of Security Protocols.** The following protocols should be applied to enhance data security:

- **TLS 1.3 or TLS 1.2 Protocols**

NFC-based attendance systems should use TLS 1.3 or TLS 1.2 when transmitting data to servers to prevent data interception by third parties.

- **HMAC (Hashed Message Authentication Code) and SHA-256 Hashing**

To prevent data tampering, **HMAC-SHA256** authentication methods should be applied to every communication process.

- **Elliptic Curve Cryptography (ECC) and RSA 4096**

Using **ECC-256 or ECC-384** cryptography for NFC devices enhances both speed and security.

- **Near Field Communication Secure Element (NFC-SE)**

Implementing a **Secure Element (SE)** within NFC chips ensures secure data storage within the device. **Embedded Secure Element (eSE)** or **SIM-based Secure Element** options can be used.

User Training and Awareness Campaigns

1. **Security Training for Users**

Users should be educated on best security practices when using NFC-based attendance systems.

2. **Raising Awareness of Potential Risks**

Informing users about security threats such as data interception, unauthorized access, and phishing attacks is essential.

3. **Integration of Security-Enhancing Hardware and Software**

Organizations should implement additional security measures, such as **biometric authentication, multi-factor authentication (MFA), and intrusion detection systems.** [5,6,8]

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MODERN METHODS OF MARKET RESEARCH AND DIGITAL OPTIMIZATION OF PRODUCT QUALITY MANAGEMENT

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Abstract
The main idea of the systematic approach to analysis is to consider the market as a complex system where different elements interact with each other and influence the quality of products that meet international standards. This allows businesses to better understand market conditions and adapt their quality management strategy to ensure competitiveness and customer satisfaction.

Keywords: optimization research methods, information technology, quality, market

Humanity has always strived to ensure high quality, especially when it comes to ensuring the safety of products, preserving human health and the environment, etc. The saturation of the market with a variety of products has given consumers a choice. This has led to the fact that ensuring high quality products has become an important area of socio-economic development in most countries.

In a globalised marketplace, the issue of quality is relevant for all countries and organisations, as only high quality products can be competitive. This problem is multifaceted and has political, social, economic, scientific, technical and organisational aspects.

All of this is extremely relevant for Ukraine. Our country's desire to integrate into European and global economic structures requires us to work according to the rules of the market economy. In today's environment of sophisticated military and space technology, nuclear power plants, environmental degradation, and growing human security concerns, the topic of quality is extremely relevant.

The Centre for Innovation Development, the Business Development and Support Office, the Ministry of Economy, the Ministry of Finance, the State Regulatory Service of Ukraine, the Ukrainian Chamber of Commerce and Industry, and the United Nations Development Programme in Ukraine, with the assistance of the United Nations Recovery and Peacebuilding Programme, funded by the European Union, conducted the eleventh wave of business surveys in Ukraine. Survey period: 24.03 – 04.04.2023. A total of 999 owners and CEOs of SMEs were interviewed. The key results of the survey, which reflect the state of the business environment in Ukraine, are shown in the graph in Figure 1.

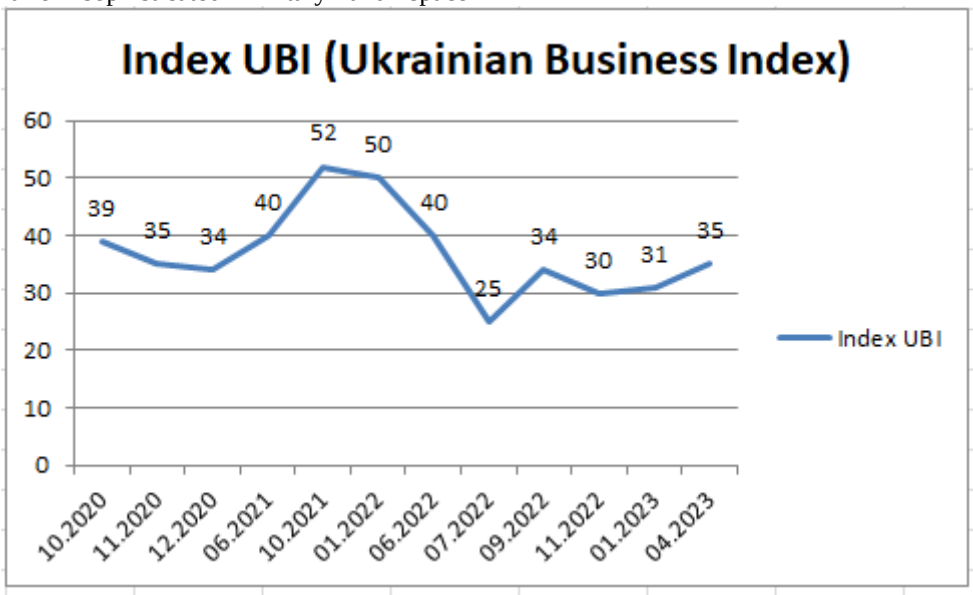

Figure 1 Business activity index – Ukrainian Business Index (UBI).

At the beginning of 2023, the Ukrainian Business Index (UBI) stood at 34.03 (out of 100). The UBI shows business activity, its ability to increase turnover and create jobs. If the index is below 50, this indicates negative business expectations of further developments. The index has increased compared to February 2023 (30.76) and the local maximum in September (33.9). This increase in the index reflects business fatigue from uncertainty and a desire to intensify rather than an improvement in the economic situation: the number of orders from customers remains unchanged, but output and inventories are growing.

The quality of products is the backbone of today's business economy. Firms from different countries and continents, producing a wide range of products, are actively working to improve their quality. Expenditures on product quality improvement have a significant and growing share. Improving quality is a labour-intensive activity for an enterprise, as it touches almost all areas of activity and ultimately results in such a macroeconomic indicator as the quality of life.

Many years of experience of leading companies in the developed world show that market success can be achieved by improving the quality management system. That is why today, when we talk about quality, we mean not so much the quality of the product itself as the quality of the functioning of enterprises and organisations, the perfection of their quality management systems aimed at continuous self-improvement and, most importantly, meeting the existing market demand.

It is generally accepted that if a company has received a certificate of compliance of its quality management system with international standards ISO 9000, it is able to consistently produce quality products that can be competitive. Most companies in the world use ISO 9000 international standards for this purpose [4].

Compliance with ISO 9001 demonstrates an organisation's ability to provide products and services that meet customer requirements and relevant regulatory requirements. It also demonstrates an organisation's ability to continuously improve its processes and quality management system.

ISO 9001 is one of the best known and most widely used international standards in the field of quality management. It sets out the requirements for a quality management system in organisations, regardless of their size, type of activity or industry.

Thus, the level of effectiveness of the quality management system is directly proportional to the level of competitiveness of the product and the enterprise.

The concept of market relations in the automated product quality management system focuses on understanding and meeting customer needs through effective interaction with the market environment. The main idea is to consider the market as a complex system where various elements interact with each other and influence the quality of products that meet international standards.

This approach involves researching various aspects of the market environment, such as customer needs and requirements, the competitive situation, market trends, economic and technological factors, etc. Based on the data obtained, an understanding is developed of which aspects of the market can affect product quality and which quality management strategies can be used to achieve the desired result.

A systematic approach allows us to consider market conditions and factors in conjunction with each other and to analyse their impact on product quality in a comprehensive manner. This allows businesses to better understand market conditions and adapt their quality management strategy to ensure competitiveness and customer satisfaction [1].

The main aspects of this concept include:

1. Satisfaction of consumer needs. A central element of the marketplace concept is the recognition and understanding of customer needs and expectations. An automated quality management system should be designed in such a way as to ensure that products are manufactured that meet these needs and requirements.

2. Analysis of the market environment. The automated quality management system should include mechanisms for continuous monitoring and analysis of market trends, competitive situation, changes in customer requirements, etc. This allows the company to adapt to changes in the market and respond to them in a timely manner.

3. Increasing competitiveness. By continuously improving product quality and responding to market demands, the company seeks to increase its competitiveness. An automated quality management system helps to identify and resolve problems that may arise in the production process, which helps to improve quality and reduce costs.

4. Collaboration with partners and suppliers. An automated quality management system may include modules for monitoring and controlling the quality of incoming materials and components supplied by partners and suppliers. This allows you to ensure quality at every stage of the production process.

Market analysis is the process of collecting, evaluating and interpreting information about a market in order to understand its potential, dynamics and characteristics in order to make informed business decisions. Market analysis is an iterative process that may require constant updating and adjustments based on new information or changes in market conditions.

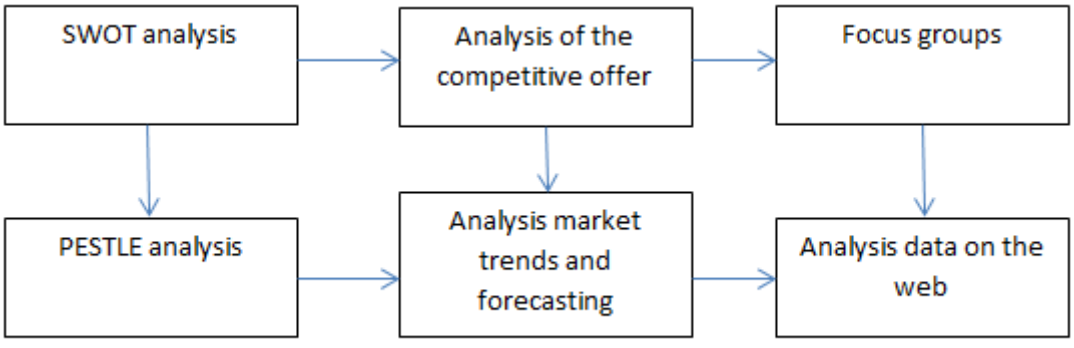

Figure 2 Market research methodology.

The first stage of market analysis involves gathering various information about the sector, products or services, competitors, potential customers, etc. This may include statistical data, market research, interviews with experts, consumer surveys, trend analysis.

An important step is to analyse competitors in the market. This includes studying their products or services, pricing strategies, marketing techniques, strengths, weaknesses, opportunities and threats.

The system of collecting external current marketing information is a set of sources and methodological measures that help the company's management to obtain regular information about events taking place in the commercial environment. The organisation of the information gathering and processing by the management team can be different.

First, it is the use of data on the state of the macro environment, which newspapers, specialised magazines, and newsletters; secondly, a lot of information about the product can be provided by sellers who are in daily contact with customers; thirdly, specialised firms that provide external current information have the necessary information; fourthly, any employee of the marketing service can be entrusted with collecting and presenting information in the appropriate form for the manager.

Sources of external information about competitors may include: purchased goods; visits to open days and specialised exhibitions; reading company reports; attending shareholder meetings; talking to company employees who are sales agents; collecting and analysing advertising; reading documents of professional associations; data from specialised firms and other sources.

From a marketing perspective, the market is not homogeneous but consists of parts and segments. The market can be divided into different segments based on various criteria, such as age, geographic location, income, interests, etc. Segmentation helps to better understand the diversity of the audience and identify strategies to engage each segment.

The main segmentation criteria are as follows:

1. Quantitative parameters of the segment: segment capacity, i.e. how many products and for what total amount can be sold; number of potential consumers. Based on these parameters, an enterprise should determine which production capacities should be targeted at a particular segment and what the selling price should be.

2. Accessibility of the segment for the enterprise. The company must determine whether it has sufficient sales channels for its products, what is the capacity of these channels, and whether the system of bringing products to consumers is reliable.

3. Materiality of the segment. It is necessary to determine whether this market segment is stable, growing or declining.

4. Profitability, i.e. how profitable is the work in the selected market segment.

5. Comparability of the segment with the market of the main competitor. It is necessary to determine to what extent the main competitors are ready to give up the chosen market segment, to what extent their interests will be affected.

6. Protection of the selected segment from competitors, the enterprise needs to determine its capabilities in the competition in the selected market segment.

The main actor in the consumer market is a specific personality with a unique set of specific traits and qualities that are constantly influenced by external factors. Studying the target audience helps to understand their needs, requirements, wishes, consumer habits, as well as their willingness to buy and other aspects that influence their purchase decision.

Several groups of factors influence the consumer's way of thinking: cultural, social, personal, and psychological factors. Getting into the ‘black box’ of the buyer's mind, these factors, taking into account his or her characteristic features, adjust the decision-making process regarding the choice of product, brand, dealer, time and volume of purchase accordingly.

Customer behaviour research is an important part of market analysis, as it helps to understand how consumers make decisions about buying products or services. Here are some of the aspects that can be included in customer behaviour research in market analysis:

1. Motivation to buy. The study of what motivates customers to purchase a particular product or service. These can be functional needs, emotional motives, social factors.

2. The decision-making process. Understanding the stages that a customer goes through from realising a need to making a purchase. This includes searching for information, comparing options, evaluating alternatives, and making a decision.

3. Influencing factors. Determining what factors influence buyers' decisions. These can be personal characteristics of the buyer (age, gender, income), marketing influences (advertising, promotions), social environment (friends' opinions, family influence).

4. Market segmentation. The division of the market into different segments depending on certain characteristics of customers. This allows you to better understand the diversity of the consumer base and develop convenient strategies for attracting each segment.

5. The impact of information technology. Study of how the use of information technology affects customer behaviour, including visiting online stores, reading reviews, using mobile applications.

These aspects of research help businesses to better understand their target audience, their needs and preferences, which in turn allows them to tailor products and marketing strategies more effectively to meet market needs [4].

Continuous systematic updating of the product range and high quality of products enable the company to ensure: stability and expansion of the sales market, increase in profits, reduction of dependence on the sales of a particular type or product group, efficient use of the existing goods movement system, and creation or maintenance of the company's reputation.

The new product planning process includes the following key stages: idea generation, idea selection, concept development, concept validation, economic analysis, product development, trial marketing, and commercialisation.

The main characteristics of a new product are: attractiveness to consumer markets; potential attractiveness of the product life cycle; resistance to seasonal factors; ability to produce at specific prices; general characteristics; potential profit; existing competition; level of investment; possibility of patenting; degree of risk; marketing characteristics; production characteristics; ease of production; time to commercialisation; availability of labour and material resources.

Let's take a closer look at how consumer reaction to new products is studied in the process of planning new products.

The first stage is the generation of ideas. This is a kind of search for opportunities to create a product with market novelty. Ideas for creating new products arise in research laboratories and design bureaus, and are based on reports and suggestions from sales agents, research into the advantages and disadvantages of their products, analysis of trends in the development of new products by competitors.

The second stage is the selection of ideas. Whereas the aim of the previous stage was to generate as many ideas as possible, the second stage reduces the number of ideas by using comprehensive characteristics (general product analysis, potential profit, competition, market size, investment level, patentability.). Each of the characteristics is assigned a score (from 1 to 10), and, if necessary, a weighting factor is also set.

The third stage is the development of the marketing concept. The development of this concept for entering the market with a new product can consist of three parts.

The first part describes the size, structure and behaviour of the target market, the intended product positioning, sales, market share and profit figures for the next few years. The second part provides general information about the estimated price of the product, the general approach to its distribution and the estimated marketing costs for the first year. The third part defines long-term goals in terms of sales and profits, and creates a marketing mix.

The fourth stage is concept validation. It is about presenting the intended product to the consumer and thereby changing their attitude to the product, making them want to buy it at this early stage of development.

The fifth stage is the economic analysis of the accepted ideas. The analysis is based on the study of forecasts of demand, costs, competition, required investments, and profits.

The sixth stage is the product development process. The process involves making decisions on the design of the product, its packaging, trade mark, determining the condition of the product, checking the attitude to the product and its use by the consumer. Functional cost analysis and other methods are widely used in the process of developing new products.

The seventh stage is trial marketing. It is carried out in order to evaluate products and test marketing activities in real conditions in advance before the start of full-scale sales.

The eighth stage is commercialisation. This stage corresponds to the product life cycle stage, includes the implementation of a marketing plan and full-scale production, requires significant costs, and quick management decision-making.

For a product to be easily sold on the market, it must meet two requirements: it must have consumer properties and it must be competitive. The competitiveness of a product is a set of quality and cost characteristics that ensure that specific needs are met. It can be determined by the ratio of the beneficial effect to the total costs, including the costs associated with both the acquisition and operation of goods. Competitiveness is the compliance of a product with market requirements. The level of competitiveness of a product can be assessed using a system of individual, group (aggregate) and integral indicators.

Today, it is important not only to develop and manufacture products that meet international quality standards, but also to sell them. In order for a manufactured product to meet consumer requirements, it must be delivered from the manufacturer to the consumer with certain properties, in a certain quantity and to a certain place.

Sales of goods guarantee coverage of all costs of production, delivery, and customer satisfaction. It is in the area of sales that the effectiveness of all the company's activities is determined. That is why a well-thought-out action plan for the company's sales team is important.

By accurately forecasting sales, a firm is able to: identify growth areas, study competitors, develop a marketing budget, allocate marketing resources, analyse sales performance, monitor the external environment, modify marketing plans, and measure success [3].

The company's sales manager is advised to develop a forecasting plan that includes a number of elements:

1. Define the tasks of forecasting (examination of company materials, analysis of potential sources of information, collection of information directly in the sales territory).
2. Evaluation, analysis and extrapolation of data, measurement of changes, objective and subjective forecasting methods; combined method.
3. Applying the forecast to sales centres, sales territories, markets for production goods, markets for consumer goods, sales channels.
4. Control of forecasts and the forecasting process, audit of the forecast, audit of the ‘mechanics’ of forecasting.

After analysing the desires and characteristics of consumers, the company is ready to select a target market, which it will focus on and develop an appropriate strategy for.

There are three alternative methods that companies can use to reach their target market:

1. Mass marketing. Targets the consumer market using a single basic plan. The company believes that consumers have similar desires for the characteristics of goods or services. The main goal is to maximise sales.
2. Market segmentation. Aimed at a narrow group of consumers - a market segment. This method is used by small or specialised businesses. A company

can succeed with limited resources and capabilities by specialising.

3. Multiple segmentation. The enterprise focuses on two or more market segments with different plans for each of them. This strategy requires a detailed analysis, as the resources and capabilities of the enterprise must be sufficient to produce and market goods of two or more brands.

The methodology for studying the market as a component of an automated product quality management system, which is presented in the article, allows to: determine the needs for products, market demand for them and areas of their sale, identify specific customer requirements or analyse general ones, and coordinate all relevant functions of the organisation related to meeting customer requirements.

The enterprise quality management system can become a tool for winning the competition, given that the competitiveness of an enterprise is the level of its competence relative to other competitors in the accumulation and use of production potential of a certain orientation, which is reflected in such indicators as product quality, production volumes, profits.

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ADAPTIVE MULTI-KERNEL BACKGROUND SUBTRACTION USING FUZZY LOGIC FOR ROBUST OBJECT DETECTION IN COMPLEX SCENES

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Abstract
This research introduces an adaptive background subtraction method utilizing Fuzzy Logic. The approach dynamically adjusts to factors such as illumination variations, scene complexity, and motion dynamics, ensuring the optimal model selection. By leveraging Fuzzy rules, various background subtraction models are managed in real-time, and parameters are updated adaptively. The proposed method enhances stability and accuracy in object detection systems. Experimental results demonstrate that the Fuzzy Logic-based background subtraction technique exhibits greater flexibility and efficiency compared to conventional and deep learning-based methods.

Keywords: Fuzzy Logic, Adaptive Background Subtraction, Object Detection, Multi-Kernel Approach

Introduction

Real-time object detection is a crucial domain in computer vision, encompassing a broad spectrum of applications, including video surveillance systems, autonomous vehicles, human-computer interaction, and industrial automation [1, 2, 3]. A fundamental phase in object detection is background subtraction.

Conventional background subtraction techniques, such as the Gaussian Mixture Model (GMM), Median Filtering, and Optical Flow, perform well under specific conditions; however, they encounter notable difficulties in complex and dynamic environments [4, 5]. In such cases, these methods tend to produce a high rate of false positives (FP) and false negatives (FN) [6].

The primary challenges faced by modern object detection systems include:

- Varying conditions between day and night, artificial lighting changes, shadows, and reflections can cause detection errors.
- Elements such as fluctuating water, wind-driven objects, reflections from vehicle lights, and other dynamic factors complicate background stability.
- Rapid object motion and size variations due to perspective pose challenges for traditional methods in accurate object recognition.
- Many object detection techniques demand substantial computational power, leading to performance constraints in real-time applications.

To overcome these obstacles, adaptive background subtraction methods leveraging Fuzzy Logic can be introduced. Fuzzy Logic provides an effective framework for modeling object and background variability in real-world conditions, thereby improving object detection accuracy.

In this paper, a Fuzzy Logic-based adaptive background subtraction method is introduced as a novel approach to overcoming existing challenges in real-time object detection. Traditional background subtraction techniques depend on static rules, limiting their effectiveness in handling varying illumination, complex scenes, and dynamic backgrounds. The proposed method addresses these constraints by implementing an adaptive system that considers multiple parameters.

The key contributions of this paper are as follows:

Fuzzy Logic-Based Background Subtraction – Unlike conventional methods, the proposed approach selects the background model dynamically based on illumination levels, motion dynamics, and scene complexity.

Multi-Kernel Background Models – Assesses the suitability of various background subtraction techniques such as MOG2, KNN, and GMM for different scenes and automatically selects the most optimal model.

Adaptive Handling of Illumination and Scene Complexity – Adjusts the background model in real time based on lighting variations and object movement characteristics within the scene.

Optimized Real-Time Object Detection Approach – Reduces computational overhead, ensuring more efficient utilization of GPU and CPU resources.

The primary objective of this research is to develop a Fuzzy Logic-based adaptive background subtraction technique and assess its performance in real-world applications. The aim is to improve the accuracy and speed of object detection by addressing the following challenges:

- Designing a background model resilient to illumination changes.
- Enhancing accuracy in distinguishing objects from the background in dynamic environments.
- Developing a fast and optimized method suitable for real-time processing.

The proposed method can be applied across various domains, including industrial automation, video surveillance systems, autonomous vehicles, and artificial intelligence-based object recognition systems. The effectiveness of the approach has been evaluated and validated.

Application of Fuzzy Logic in Background Subtraction

Fuzzy Logic is employed to adapt to uncertain and dynamic environments, in contrast to traditional methods that depend on rigid rules. Instead of binary classification, a pixel's probability of belonging to the background or an object is assigned a value between 0 and 1 [7, 9, 11]. Methods such as the Gaussian Membership Function, Triangular Membership Function, and Trapezoidal Membership Function are utilized. Fuzzy logic-based systems determine the

background model by taking into account scene complexity, illumination levels, and object motion [5].

Advantages:

- Adapts effectively to dynamic illumination changes.
- Better manages transition regions between background and objects [4].
- Provides an improved framework for adaptive background subtraction.

A potential drawback is that integrating Fuzzy Logic with deep learning methods may increase computational load.

We have briefly outlined the working principles, advantages, and disadvantages of traditional methods, deep learning approaches, and fuzzy logic-based models in the domain of background subtraction and object detection. In this paper, our objective is to develop an adaptive background subtraction method by leveraging the strengths of these approaches.

Traditional and deep learning-based methods in background subtraction and object detection have various limitations. In dynamic environments, factors such as illumination changes, scene complexity, and object variability reduce the effectiveness of existing techniques. To address these challenges, we propose a method that integrates a multi-kernel approach with fuzzy logic-based background subtraction.

Application of the Multi-Kernel Approach

Traditional background subtraction techniques rely on a single model for object detection. However, in real-world scenarios, their effectiveness diminishes due to scene variability. For instance, the Gaussian Mixture Model (GMM) may misclassify shadows as objects in complex environments, whereas the K-Nearest Neighbors (KNN) method has a high likelihood of producing false positives in regions with significant motion [8, 9].

To overcome these limitations, we introduce a multi-kernel background subtraction approach. This method runs multiple background subtraction techniques in parallel and dynamically selects the most optimal background model based on scene characteristics. By leveraging multiple statistical and machine learning-based models, the multi-kernel approach enhances accuracy and reliability [3, 6].

Key Principles of the Multi-Kernel Approach:

- Multiple background subtraction methods (e.g., MOG2, KNN, GMM) are executed simultaneously.
- The most suitable model is dynamically selected based on scene complexity and illumination conditions.
- The background model is continuously updated in real-time to adapt to environmental changes. This results in improved accuracy and robustness compared to single-model approaches.

Advantages of the Multi-Kernel Approach:

- Effectiveness in Dynamic Scenes – If one model struggles with illumination changes, other models compensate.
- High Accuracy with Combined Models – The most appropriate model is chosen based on diverse scene characteristics.
- Real-World Adaptation – The optimal background model is determined for various objects and scene conditions, enhancing overall detection reliability.

Adaptive Background Subtraction using Fuzzy Logic and Multi-Kernel Integration

Traditional background subtraction methods employ a strict classification approach, categorizing pixels as either background (0) or object (1). However, in real-world scenarios, this rigid classification often results in inaccuracies. In contrast, Fuzzy Logic-based background subtraction determines the probability of a pixel belonging to the background or an object by using smooth transitions with values ranging between 0 and 1 [9].

Fuzzy Logic-based systems incorporate multiple variables to facilitate adaptive decision-making in dynamic environments. These variables include:

- Lighting Conditions – Different background models are applied depending on whether the scene is dark or overly bright. Lighting is assessed using histogram analysis and brightness statistics.
- Scene Complexity – The number of objects and edge details in the scene are considered. Complexity is evaluated using Canny Edge Detection and ORB/SIFT Feature Extraction methods.
- Motion Complexity – The intensity of object movement in the scene is measured using Optical Flow and Frame Differencing techniques.

Stages of Fuzzy Logic-Based Systems

Fuzzy Membership Function – The probability of background and object classification is determined using the Gaussian Membership Function:

$$\mu(x) = e^{-\frac{(x-c)^2}{2\sigma^2}}$$

Here, c represents the mean value, and σ denotes the standard deviation.

Model Selection Based on Fuzzy Rules:

If the lighting is stable and the scene is simple → GMM is used.

If the lighting varies and the scene is complex → KNN is applied.

If there is high motion in the scene → MOG2 is selected.

Fuzzy Output and Adaptive Updating:

As each new frame is processed, Fuzzy membership functions are updated, and the optimal background model is dynamically selected.

Advantages of Fuzzy Logic:

- The background model is selected based on scene conditions.
- Ensures reliable performance in both bright and dark environments.
- Evaluates the probability of each pixel belonging to the background or an object, reducing abrupt misclassifications.

The multi-kernel approach further enhances object detection accuracy by integrating multiple background models. Fuzzy Logic ensures that the most suitable background model is selected by taking into account illumination variations, scene complexity, and motion dynamics.

Fuzzy Logic-based background subtraction methods improve object detection accuracy by making adaptive decisions based on varying scene conditions. A key advantage of this approach is its ability to select the most suitable model and dynamically update parameters using Fuzzy rules.

The performance of a background subtraction system is highly dependent on illumination conditions, scene complexity, and motion intensity. Since a single background model may not always yield optimal results across different environments [10], our approach focuses on achieving the best possible performance by dynamically selecting the most appropriate background subtraction method based on Fuzzy Logic.

Experimental Evaluation and Performance Analysis

For a comparative analysis of object detection and background subtraction methods, both widely used international datasets and a custom-created dataset were utilized.

Used Datasets:

CDNet 2014 (Change Detection Dataset) - A dataset comprising real-world scenes with various background changes. Evaluation of object detection efficiency in both static and dynamic background conditions.

VisDrone (Vision Meets Drone Dataset) - A dataset containing videos captured by drones. Assessment of the method's robustness in scenarios involving a moving camera and highly dynamic backgrounds.

Custom Video Dataset (Our Own Dataset) - A collection of videos featuring diverse real-world scenes, including outdoor environments, low-light conditions, and crowded areas. Examination of the proposed fuzzy logic-based system's adaptive performance across different environmental conditions.

The results demonstrate that the Fuzzy Adaptive Multi-Kernel background subtraction method achieves high accuracy and speed, surpassing traditional approaches. This method recorded the highest values in Precision (0.92), Recall (0.84), and IoU (0.80), indicating its superior performance.

Additionally, the computational load of the proposed method is lower compared to MOG2 and GMM, while still ensuring better accuracy and adaptability. Due to its high FPS performance, the method is well-suited for real-time object detection.

A key advantage of the Fuzzy Logic-based approach is its adaptive nature - unlike other methods, it automatically analyzes illumination conditions and background complexity and adjusts dynamically. The system utilizes Fuzzy Membership functions to handle illumination variations, ensuring stable detection.

Key Findings from Tests:

Illumination Variations: Traditional methods often misclassify objects under shadows and lighting changes, whereas the Fuzzy Logic-based system maintains more consistent results.

Dynamic Background Handling: In real-world scenarios, backgrounds are often not static (e.g., moving tree leaves, rippling water, crowded areas). The Fuzzy Logic-based method successfully analyzes dynamic background changes and provides stable results.

Test Results

Static Lighting Conditions: All methods produce stable results.

Sudden Lighting Changes (e.g., day-night transitions, vehicle headlights): The Fuzzy Adaptive Multi-Kernel method maintains over 90% object detection accuracy.

Shadows and Light Reflections: MOG2 and KNN misclassify objects as background, whereas the Fuzzy Logic-based method effectively distinguishes shadows.

Static Background Conditions: All methods achieve 85%+ accuracy.

Dynamic Background Conditions (e.g., tree leaves moving in the wind):

MOG2, KNN, and GMM misclassify parts of objects as background, leading to a decrease in Recall.

Fuzzy Adaptive Multi-Kernel evaluates motion intensity, extracts the background more accurately, and maintains Recall > 0.84.

Fuzzy Adaptive Multi-Kernel Background Subtraction outperforms traditional background subtraction methods in terms of accuracy, speed, and stability.

Key Advantages:

- Higher Accuracy (Precision = 0.92, IoU = 0.80)
- Adaptive Response to lighting variations and background complexity
- Optimized Computational Load (FPS = 55, RAM usage = 1.5 GB)
- Robust Performance in challenging scenes and real-world environments

Conclusion

The Fuzzy Adaptive Multi-Kernel Background Subtraction method demonstrates exceptional performance in dynamic and complex environments, ensuring high accuracy while optimizing computational efficiency. Unlike traditional background subtraction techniques that rely on static models, this approach dynamically adapts to changing illumination conditions, scene complexity, and motion dynamics. By incorporating Fuzzy Logic, the method continuously selects the most suitable background model based on real-time environmental conditions, significantly improving object detection accuracy. This adaptability allows the system to effectively handle challenges such as shadows, reflections, and sudden lighting changes, which often degrade performance in conventional methods.

In addition to its robust detection capabilities, the method also mitigates background motion challenges. By leveraging a multi-kernel approach, it ensures that multiple background models work in parallel to achieve higher precision and recall rates. Furthermore, the optimized computational framework reduces processing load, allowing the system to maintain high FPS performance while consuming minimal resources. These advantages make the Fuzzy Adaptive Multi-Kernel approach particularly well-suited for real-time applications.

Comparison of Different Background Subtraction Methods:

Method	Precision ↑	Recall ↑	F1-score ↑	IoU ↑	FPS ↑	Computational Load ↓
MOG2	0.85	0.72	0.78	0.68	**50 FPS**	**Medium**
KNN	0.87	0.74	0.80	0.70	35 FPS	High
GMM	0.82	0.76	0.79	0.69	40 FPS	Medium
Fuzzy-GMM	**0.90**	**0.81**	**0.85**	**0.78**	45 FPS	Medium
Fuzzy Adaptive Multi-Kernel	**0.92**	**0.84**	**0.88**	**0.80**	**55 FPS**	**Low**

Challenging Cases and Advantages of the Fuzzy Logic-Based Method:

Challenging Scene	Limitations of Traditional Methods	Advantages of Fuzzy Adaptive Multi-Kernel
Fog or low-visibility objects	Objects are not fully detected (Recall < 0.7)	Accuracy is improved using Fuzzy membership functions (Recall > 0.82)
Light reflections and mirrors	Objects are misclassified (FP increases)	Lighting is adjusted using Fuzzy membership functions
Overlapping multiple objects	Object contours are not fully identified	Multi-kernel approach effectively separates objects
Moving background (crowds, rippling water, etc.)	Objects blend with the background (IoU < 0.7)	Fuzzy rules enhance object recognition (IoU > 0.78)

Real-Time Test Results (Computational Load vs. Performance):

Method	CPU Load ↓	GPU Load ↓	RAM Usage ↓	FPS ↑
MOG2	Medium	Low	1.2 GB	50 FPS
KNN	High	Medium	2.5 GB	35 FPS
GMM	Medium	Medium	2.0 GB	40 FPS
Fuzzy-GMM	Medium	Medium	2.0 GB	45 FPS
Fuzzy Adaptive Multi-Kernel	Low	Medium	1.5 GB	55 FPS

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VETERINARY SCIENCES

THEORETİCAL FOUNDATİONS OF THE USE OF BİOLOGİCALLY ACTİVE SUBSTANCES İN POULTRY FARMİNG

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QUŞÇULUQDA BİOLOJI AKTİV MADDƏLƏTİN İSTİFADƏSİNİN NƏZƏRİ ƏSASLARI

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Abstract

Poultry meat and its processed products are one of the most important components of rational human nutrition. These products are a source of high-quality protein, vitamins, unsaturated fatty acids and other substances necessary for the normal development of the human body. Along with the implementation of programs to increase the productivity of poultry and increase production, it is also necessary to improve its quality. The solution of this problem is of great importance in the implementation of the concept of state policy in the field of healthy nutrition, aimed at eliminating the deficiency of animal protein.

Annotasiya

Quş əti və onun emal məhsulları insanların rasional qidalanmasının ən mühüm komponentlərindən biridir. Bu məhsullar insan orqanizminin normal inkişafı üçün lazım olan yüksək keyfiyyətli zülal, vitamin, doymamış yağ turşuları və digər maddələrin mənbəyidir. Quşların məhsuldarlığının artırılması və istehsalın artırılması proqramlarının həyata keçirilməsi ilə yanaşı, onun keyfiyyətinin yüksəldilməsi də zəruridir. Bu problemin həlli heyvan zülalının çatışmazlığının aradan qaldırılmasına yönəlmiş sağlam qidalanma sahəsində dövlət siyasətinin konsepsiyasının həyata keçirilməsində mühüm əhəmiyyət kəsb edir.

Keywords: poultry, biologically active substances, antibiotics, probiotics.
Açar sözlər: quş əti, bioloji aktiv maddələr, antibiotiklər, probiotiklər.

Cavan quşların yetişdirilməsi zamanı antibiotiklərlə yanaşı, probiotik preparatlarıda istifadə olunur. Probiotik preparatları - quş orqanizminə münasibətdə antibiotiklərin müsbət keyfiyyətlərinə malik olan, lakin mənfi yan təsirləri olmayan simbiont bakteriyaların canlı kulturalarından ibarət olan və muasir dövrdə getdikcə daha çox istifadə olunan preparalardır. (O.Y.Şiryayeva və b. ., 2006; A.B.,Ivanova2006). Probiyotiklər cavan kənd təsərrüfatı heyvanlarında və quşlarda yoluxucu xarakterli mədə-bağırsaq xəstəliklərinin profilaktika və müalicəsində, qeyri-spesifik immunitetin stimullaşdırılmasında, həzm proseslərinin yaxşılaşdırılmasında, heyvanların yüksək enerjili yem paylarına və qeyri protein azotlu maddələrə tez bir zamanda uyğunlaşmasında geniş istifadə edilir. Bunlar yemlərin istifadəsinin səmərəliliyi və heyvan məhsuldarlığının artırılması məqsədilə hərtərəfli geniş öyrənilərək istehsalata tətbiq edilir P. Delpech, J. L.Lepieffes, 1989 F. Brzoska, et al 1999.

Probiyotiklər necə mədə-bağırsaq traktının mikroflorasına, eləcədə heyvan orqanizminin metabolik funksiyalarına çoxşaxəli təsir göstərir. Müxtəlif bakteriyaların probiotik təsiri isə onların xüsusi fəaliyyətlərinin cəmi ilə müəyyən edilir. Məsələn işgənbə bakteriyalarının növləri digər bakteriyaların çoxalması üçün lazım olan bioloji aktiv maddələr istehsal edir. Maddələr mübadiləsinin zərərli metabolik məhsullarını zərərləşdirərək həzm sistemində ekoloji tarazlığı qoruyur. (K. N. Wilson, B. Tackisch, H. Teroch, 1990)

Probiotik preparatların quş orqanizminə müsbət təsiri və onlardan istifadənin effektivliyi bir sıra tədqiqatçıların əldə etdiyi nəticələrldə də sübut olunmuşdur. (Н.Ф. Белова, 2008).

G. W. Tannok (1988) bildirir ki, probiotiklərin faydalı təsirləri mikroorqanizmlərin spesifik qruplarına qarşı birbaşa antaqonist fəaliyyətlə: antibakterial maddələrin əmələ gəlməsi, qida maddələri yapışma yerləri uğrunda rəqabət, mikrob metabolizmasında dəyişikliklər (fermentativ məsuliyyətin artması və ya azalması), immun sisteminin stimullaşdırılması, xərçəng əlehi və xolesterolanemik əlehi təsirləri əldə edilə bilər.

R.Fuller (1989) probiotik anlayışını "heyvan sahibinin bağırsaq mikrob balansını yaxşılaşdırmaqla ona faydalı təsir göstərən canlı mikrob yem əlavəsi" kimi formalaşdırmışdır. Probiyotiklərin bu tərifi elmi ədəbiyyatda möhkəm şəkildə təsbit edilmişdir və bu günə qədər dəyişdirilməmişdir. G.R. Gibson, X. Wang (1994) öz tədqiqatları nəticəsində belə qənaətə gəliblər ki, broyler cücələrinə maye probiotik ACTD-PAK4-WAY (1 q/l) su ilə və quru probiotik Lakto-SACC (1 kq/t) yem ilə tətbiqi onlarda diri çəkinin etibarlı artmasına, xərclərin və ölümün azalmasına səbəb olmuşdur.

A.Tixomirova və başqaları (1993) öz təcrübələrində müəyyən etmişlər ki, fizioloji aktiv bifidobakteriya hüceyrələrinin cücələrə ağızdan verilməsi nəticəsində quşarın baş sayının, diri kütləsinin saxlanması, və cücələrin yumurtadan çıxma qabiliyyəti 5- 6%.artmışdır. Həzm sistemində faydalı bakteriyaların spesifik keyfiyyətlərinin saxlanması heyvanın həyatı üçün ideal bir vəziyyətdir. Bunun üçün onların yetişdirilməsi zamanı heyvan orqanizminin mikrob balansını saxlayan şərait təmin edilməlidir. Bunu təbii şəraitdə saxlamaq çətindir. Məs buna görədə heyvan davamlı olaraq yem və ya su ilə öz mikrob balansının aktivləşməsinə kömək edən mikroorqanizmlərdən və substratlardan müəyyən edilmiş onun mikrob populyasiyasını fəallaşdıran əlavə almalıdır. (De Simone C. et al, 1993).

Cücələrdə kolibasillozun qarşısının alınması üçün probiotik bifidumbakterin və immunomodulyator timalinin istifadəsi ilə bağlı tədqiqat aparan Z.F Dzhanova müəyyən etmişdir ki, bu preparatların birgə istifadəsi bifidobakteriyaların sayının bir necə dəfə artmasına səbəb olaraq əlavə effekt verir.

Bu gün deyə bilərik ki istifadə olunan probiotiklərin istifadəsi üsulları və dozaları ilə bağlı elədə çox tədqiqatlar aparılmamışdır (Endo T., Nakano M., 1999). Probiotiklərin heyvan orqanizminə təsirini öyrənən mütəxəssislər. Крюков, О А.Г. Кошаев и др. (2006); Н.Ф. Белова (2008); Anand, S. K. (1985). Brzoska və.b (1999); Lan, Y., (2005) müəyyən etmişlər ki bu dərman preparatları biostimuledici və müxtəlif yönümlü farmakoloji təsirlərə malikdirlər. Bunların müsbət təsiri orqanizmdə həzmetmə və maddələr mübadiləsi proseslərində iştirakı, zülalın və bir çox aktiv maddələrin biosintezi və mənimsənilməsi bununlada orqanizmin rezistentliyinin təmin edilməsi ilə bağlıdır. Orqanizmdə probiyotiklərin təsiri aşağıdakı ardıcıllıqla: südturşulu bakteriyaları tərəfindən patogen bakteriaların çoxalmasının qarşısının alınması, orqanizmin patogen floranın çoxalmasına səbəb olan karbohidrat yüklənməsindən qorunması, rəqabət aparan fermentlərin köməyi ilə karbohidratların mənimsənilməsi və patogen bakteriyaların toksinlərinin sorulması baş verir. Quşçuluqda probiotiklərin istifadəsi bağırsaq biosenozunun hormonal və enzimatik sistemlərlə korreksiyası, immun sisteminin stimullaşdırılması, disbakteriozun qarşısının alınması və müalicəsi ilə bağlı problemlərin həlli üçün çox perspektivli bir istiqamətdir. B.V. Tarakanov (2000) hesab edir ki, probiotik preparatın əlavə edilməsi yem lifinin hidrolizini aktivləşdirir və heyvanların mədə önlüklərində sirkə turşusunun əmələ gəlməsini intensivləşdirərək karbohidratların fermentasiyasını gücləndirir. Тедтова, В. və digərləri (2005) hesab edirlər ki, bioloji aktiv maddələrin əlavələrinin istifadəsi quşların həzm sisteminin bufer xüsusiyyətlərinin aktivləşməsinə və bununla da məhsullarda zəhərli elementlərin miqdarının azalmasına səbəb olurlar. Cücələrə həyatlarının birinci beş(5) günlərində diyetik vasitə kimi mədə və bağırsağın ifrazat fəaliyyətini artırmaq üçün kombikorm kimi probiotik bifidumbakterin 5 doz 200 başa verilməsi onların saxlanmasını 4-6% artırmışdı. A.N. Panin (2002) hesab edir ki, probiotik preparatların perspektivliyi onların heyvan orqanizminə təsir spektrinin geniş olması ilə bağlıdır. Onların tərkibinə daxil olan canlı diri kulturalar fermentativ, immun, vitamin əmələ gətirən və antaqonist kimi mühüm funksiyaları yerinə yetirirlər.

N.V. Soboleva (2002) öz tədqiqatında müəyyən etmişdir ki, quşlara laktatlarla zənginləşdirilmiş fermentativ- hidrolizləşdirilmiş zərdabın icməli maye

şəklində 2 q/kq diri çəkiyə dozada istifadəsi , yüksək keyfiyyətli inkubasiya yumurtaların əldə edilməsinə və damazlıq məhsulların istehsalının maya dəyərini azalmasına səbəb olur.

Son zamanlar bir çox tədqiqatçılar quşçuluqda baytarlıq immunobioloji preparatların - probiotiklərin getdikcə daha çox istifadə olunmağa başladığını qeyd edirlər.İ.Eqorov, F.Myaqkix (2003). Onlar normobiosenozun formalaşması və quş orqanizminin əlverişsiz amillərin infeksiyalar, zəif qidalanma, yemin toksikliyi və mikrob çirklənməsi, əlverişsiz yaşayış şəraiti, peyvənddən sonrakı reaksiyalar və bir çox başqalarının təsirinə ümumi müqavimətini artırmaq üçün lazımdır. Bir çox tədqiqatçılar hesab edirlər ki muasir quşçuluqda probiotiklərin 60 gün müddətində,zəif qida dəyəri olan kombikormlarla birqə verilməsi böyük əhəmiyyət kəsb edir, məqsədə uyğundur və böyük perspektivləri var.

Quşların mədə-bağırsaq xəstəlikləri viruslardan sonra ikinci yeri tutur və cavan quşların ölümünün əsas səbəbidir. Quşların bağırsaqlarında mikroekoloji pozuntular lakto- və bifidobakteriyaların eyni vaxtda aradan qaldırılması ilə fürsətçi mikrofloranın nümayəndələrinin sayının artması ilə ifadə edilir. Sübut edilmişdir ki, antibiotiklərin istifadəsi quşlarda disbakteriozun inkişafına və digər arzuolunmaz nəticələrə gətirib çıxarır. Bu problemin mümkün həlli yolu normal mikrofloranın inkişafı üçün bağırsaqlarda optimal şərait saxlaya bilən və patogen mikrofloranı dəf edə bilən turşulaşdırıcıların istifadəsi ola bilər.

Əvəzedici terapiya kimi canlı faydalı bakteriyaların mədə-bağırsaq traktına su və ya qida ilə daxil edilməsi çox effektivdir. Probiyotiklər bağırsaq mikroflorasının funksional fəaliyyətini aktivləşdirir, həzm sistemini lazımi fermentlər və vitaminlərlə əhəmiyyətli dərəcədə stimullaşdırır və zənginləşdirir, bu da yemin daha yaxşı mənimsənilməsinə kömək edir. Beləliklə, yuxarıda göstərilən ədəbiyyat məlumatlarından belə çıxır ki, bioloji aktiv əlavələrin yemlə cücələrə verilməsi perspektivli olsada onların quş orqanizminə təsiri, yetərincə öyrənilməmişdir. Fikrimizcə, bu cür perspektivli dərmanların qida maddələrinin həzminə və istifadəsinə, ətin, yumurtanın məhsuldarlığına quşların reproduktiv qabiliyyətinə təsiri haqqında kifayət qədər məlumat yoxdur. Quş yemində probiotiklərin və mineral-vitamin preparatlarının kompleks istifadəsi hal-hazırda problemli olaraq qalır.

Bu gün bir çox tədqiqatçıların maraq dairəsində olan probiotik Бифидум-СХЖ, və vitamin-mineral premiksi olan Untivitin, quşçuluqda istifadəsi yolları bizi çox maraqlandırdı. Əlimizdə olan ədəbiyyatda ümumiyyətlə bu barədə heç bir məlumat əldə edə bilmədiyimiz üçün, bir sıra tədqiqatların aparılmasına qərar verdik.

Aparılması nəzərdə tutulan tədqiqatların əsas məqsədi **probiotik Bifidum-СХЖ**, və vitamin-mineral premiksi olan **Untivitin**, ayrı-ayrılıqda və ya birlikdə qarışıq halda yemlə quşlara 1-60 günlərində verilməsi və onların quş orqanizminə təsirinin öyrənilməsi olmuşdur.

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