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Biological sciences

FLORA OF AZERBAIJAN

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Abstract

The flora of Azerbaijan includes examples of all areal types, i.e. ancient forest, boreal, steppe, xerophilous, desert, Caucasian and adventive plant types. Examples of ancient forest types are mostly distributed in Talysh, boreal type in the mountain zones of the Greater and Lesser Caucasus, and a small amount in the lower zones, while xerophyllous, Caucasian, steppe and desert types are spread in the plains, foothills and steppe summers of the republic, and the most in the Kura-Araz plain. The adventive areal type is a little less common in the Kura-Araz lowland, the Caspian coast, etc. rich and colorful vegetation has developed in the lakes, ponds, streams and swamps of the plains.

Key words: flora, territory, flowers, plant, zone.

Introduction

The territory of the Republic of Azerbaijan has a rich flora. More than 4,500 flowering plants of different varieties are spread here. According to the total number of species, the flora of Azerbaijan is much richer than other republics of the South Caucasus. The plant species found in the republic make up 66% of the total number of plant species growing in the Caucasus.

The Republic of Azerbaijan is also rich in relic breeds belonging to the third period, representatives of which are more common in all zones, especially in the territory of the Talish zone. Among them are ironwood, Lankaran acacia, chestnut-leaved oak, Caucasian hornbeam, bigavar, pumice stone, etc. can be shown. There are 240 endemic plant species in the republic.

Main parts

Reed jungles with a cosmopolitan composition are often found along the banks of rivers and drainage canals, in swampy areas, and locally in plain regions. In such swamps, tall foxtail, sedge, suluf, soft broom, calish, etc. there are many. Here, the savanna-type tall murchus also creates a crowd.

In the Kura-Araz plain, there is a relatively wide spread of sedum, licorice and liqvar jungle. In the Karabakh Plain, plant species such as camel's foot, horsetail, porug, aglarot, and iris both create obstacles and are found in the composition of other jungles.

In the port and rivers (especially in Agzibirchala port) most of the reeds, sea bream, sea bream, etc. there are jungles of plants. In swamps and warm places, gorse, salvinia, safflower, sufynida, hornbeam create a special jungle, and they find a large abode in the Kura-Araz plain. Gargi jungle is also typical for plain regions.

In the swamps of the Talysh plains, water lily, sagogot, iris, toadstool, yellow marsh iris, and marshes create special formations. For dried marshes, sedum, mint, sedum, quince, etc. such plants are typical.

Wetland plants are also found in lower, middle, upper and high mountain belts. Especially in the subalpine zones, wetland plants are spread over wide areas. There are more than 100 swamps, lakes and ponds in these zones.

The vast Kura-Araz plain, the Caspian coast and other plains are dominated by desert and semi-desert vegetation. Black salt marshes are widespread in deserts. Garashora's branches spread on the ground, forming mounds, are mostly spread around Lokbatan, Mugan, and East Shirvan. Saribash deserts with small hills are mostly found around the Caspian Sea, in the Kura-Araz plain.

Khasavdilik deserts are also widespread in the indicated zones. 5-6 types of ephemeral plants can be found in the Shahsevdilik desert, unlike the plants in the deserts mentioned above. Charan desert is formed in Eastern Shirvan and a little in the foothill regions. 3 types of shorange create very productive semi-deserts in large areas in Kura-Araz plain. In particular, in the mountain foothills, the mountain ash creates the ash-wort desert both alone and together with wormwood, and in slightly developed lands, it creates a semi-desert. The tree-like barberry is found in low salinity soils; the composition of the season is rich in dozens of different ephemeral and ephemeroid plants. Woody sorghum creates a special semi-

desert jungle, mostly with wormwood, wormwood, and licorice. In general, there are up to 22 species of the genus *Shoranga* in the republic, most of which create special formations. Shorange jungles, which look very fertile during fruiting, can be found in the low salinity soils of the Sheki plateau. Wormwood is one of the most common desert types; it is found in various soils, especially gray and weakly saline soils. Often, wormwood grows together with sorghum or perennial cereal grasses, creating mixed semi-desert formations. In all variants of wormwood, up to 30-35 and sometimes up to 50-55 ephemeral, ephemeroid plants grow. For example, bulbous sedge, Japanese togalot, solid gouramit, oriental cornflower, sedge, small alfalfa, blue alfalfa, etc. are considered permanent plants of wormwood. Bushes sometimes grow in wormwood. Another type of wormwood (sandwort or sea wormwood), sedum, Iranian ivy, Caspian khashanbul and hundreds of other ephemeral plant species can be found on the seashore and undersea sand dunes.

Although the very rich and rare plants in the sand areas of Absheron are short-lived, they activate their development in the spring and fade quickly. Among the abundant plants in the semi-steppes and steppes are sedge, sedge and various perennial grasses. Mountain xerophytic vegetation often merges with steppes, creating special formations.

In the dry and hot regions of the republic (Nakhchivan MR, Jabrayil, Zangilan), in the steppe plateau of the Greater Caucasus, xerophytic vegetation is found, i.e. freegana, siblak, thorny gorse, beech, sometimes and weak juniper, juniper-pistachio. Frinals create independent formations (jungles) at heights of 1000-1500 m in Nakhchivan MR. More than 300 plant species are found in these formations. Kekotu and its species form tumil-kekotu formations in arid regions. For Tumil fields, dirt, desert, caravan, etc. is very typical. In this type of fields, there are also plants such as milkweed, gorse, and thistle. In the Republic, you can find sables in local form, i.e. blackthorn, murdrachala, rabbitalma, almond, tobulgala, wild pear, bird pear; ash also creates special formations and directly participates in the formation of good mountain-xerophyte vegetation. Gum trees, juniper trees, mountain forests, and mountain forests are among the unique formations of the republic, and each of them forms a special vegetation on its own.

Along the Kura, Araz, Ganikhchay and Gabirrichay rivers, there is a tugay forest in a local ribbon-like form. The basis of these forests is formed by trees and shrubs such as poplar, willow, elm, mulberry, yulgun, and pomegranate.

Sometimes special mixed forests have been restored along mountain rivers or in river valleys. Here you can find tea tree, yida, willow, sumac, sorghum, yulin, mulberry, immortelle bush, pomegranate, rose hip, blackberry, etc. is spread. Chaytika is most common in the valleys of Shin, Kish, Demiraparag, Turyan, Goychay, Agsu, Valvala and Tartar rivers. Alder and alder often form a large forested forest on the banks of the Talish river. Another type of alder (*Alnus barbata*) is typical for the swamp forests of Talish. In the Talysh forests, the local endemic species of figs, sedummya, hedge ivy, gandalash, different types of cypress, heartwort, tussock, iris jungle, yellow marsh iris, toadstool, and marshes create special formations in the swamps.

In Guba-Khachmaz, Karabakh zones, as well as in the Alazan-Haftaran valley, lowland forests of local form are spread. The basis of these forests is long-stemmed oak, elm, hawthorn, alder, etc. constitutes. In addition to the above-mentioned species, in the forests of Alazan-Haftaran valley, tree species such as birch, linden, cypress, elm, and pear, and among ivy plants, white vine, stone ivy, and wild grape are very common. There are dozens of different forms of long-stemmed oak in lowland forests.

Ironwood and chestnut oak are among the typical tree species of Talish's lowland forests. In addition to these relict tree species, there are hirkan-type woodlands consisting of Caucasian vela, 2 types of free trees, elm, cherry poplar, and gilazhar. In the lower floors of these forests, there are also evergreen shrubs such as saffron and calendula. The Caucasus mountain range creates special forests on slightly humid slopes. Caspian devil tree dominates Talish. On the seaward slope of these forests, Lankaran acacia, linden and many others create special mixed forests. A little above sea level, another species of birch forms tall dense forests together with Oriental beech. In the lower floors of this type of forest, they create a special floor for blackthorn, pumice, and a small amount of calves.

In the mountainous zones of the Greater and Lesser Caucasus, broad-leaved forests are spread at heights of 600-1800 m above sea level. Among the genera that make up these forests are Georgian oak, Eastern beech, and Eastern oak in the upper mountain belts. Beech trees create highly productive, multi-composite mixed forests in this zone. In addition to beech and oak, linden, hemlock, 5-6 types of birch, especially Eastern oak, and trautfetter birch also grow in those forests. In a very dense beech forest there is no grass cover, but in a somewhat sparse beech forest, grass cover develops along with shrubs. Yellow rhododendron, blackberry, garmashov, gandalash, many species of sedge and dozens of different cereal grasses can be found under the forest. On the slopes of the mountains, Georgian oak, currant and

gooseberry are common. In high mountain zones (1800-2000 m) there are park-type forests. Park-type forests together with subalpine meadows and tall grasses form subalpine sparse forests.

Eldar candle - Baku

On the slopes of the high mountains, the eastern oak is typical, and on the northern slopes, the trees are bent as a result of avalanches, and for the high mountain slopes of the Greater Caucasus, traufetter birch and individual Caucasian gooseberry are typical. Coniferous forests are locally found in the Eldar plain (figure 1) (Eldar pine), in the mountain regions of the Greater and Lesser Caucasus (Koch pine), especially in the Bulannyk river basin of the Balakan region, in small forests around Goygol (at an altitude of 1600 m), and in the area of large rocks around Goygol together with Koch pine. creates a mixed forest.



Figure 1. *Pinus eldarica*.

Among conifers, many species of blackberry and juniper are widespread in mountain-forest zones. Caucasian rhododendron forests are located in small areas in the northwestern zone of the Greater Caucasus, especially in the subalpine zone of the Zagatala-Balakane regions.

At an altitude of 1800-3200 m above sea level, subalpine and alpine meadows of different composition, steppe and grass plants are dominant.

Results

The real subalpine meadow spreads in dozens of variants depending on the relief and character of the high mountains and creates different formations. In the subalpine zone, the high grassland also forms a special formation; the composition is quite diverse. Most of the upland and subalpine vegetation consists of plants that have emerged from the forest floor. Hundurotlug is rich in various representatives of the families of sedges, sedges, sedges, sedges, sedges, soft brooms, nettles, nettles, khashambul, and sedges. In the subalpine zone, there are meadows of various composition, low moisture and mesophilic meadows, dry xerophytes, and grassy meadows. The basis of the subalpine meadow is made up of many species of white birch, ala tongalotu, Caucasian sedge, purple barley, alpine sedge, lame and three-leaf clover, geranium, dewberry, yarrow, andiz; for this place, bulgary, bulagotu, gantaper, dilganadan, fodder, marigold, Novruz flower, scabiosa, plantain, cruciferous and dozens of other plants are characteristic. Up to 1000 plant species are spread in the subalpine meadow.

Although alpine meadows are widespread on the tops of high mountains, on steep slopes, and in saddle mountain passes, their diversity is less than that of subalpine meadows, but the types of small plants are very colorful and of great importance. Alpine rugs consist of two groups of formations: real alpine rugs (caraway, plantain, dewberry, dandelion) on small arable soils and alpine rugs (sibbaldia, bellflower, macrotomy) on stony areas.

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Economic sciences

THE IMPACT OF THE DEVELOPMENT OF TOURISM IN THE KARABAKH ECONOMIC REGION TO THE ECONOMY OF AZERBAIJAN

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QARABAĞ İQTİSADI RAYONUNDA TURİZMİN İNKİŞAFININ AZƏRBAYCAN İQTİSADİYYATINA TƏSİRİ

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Abstract

Tourism plays an important role as a leading economic factor in the international sphere. The word "Tourism" is a French word that means walking a for, travel.

Tourism is valued as a cultural phenomenon in the globalized world, not from an economic point of view like the non-oil sector. Because tourism is an aspect of the cultural process. As a result of the continuous and dynamic development of tourism, peoples of the world get to know each other's culture.

Tourism promotes economic development and adjusts the balance of trade. Tourism, which is one of the main areas of the non-oil sector that forms the state budget, expands economic and international relations. Tourism is the economic fundamental of the 21st century.

The development of tourism in the Republic of Azerbaijan, especially in the Karabakh economic region, is very necessary. Thus, as a result of the development of tourism in the Karabakh economic region, the economy of Azerbaijan is getting stronger. This effect mechanism is directly proportionality. The tourism resources of Karabakh economic region are quite rich. As a result of the region's tourism resources, Azerbaijan's economy occupies a unique place in the international tourism market.

In the article has been investigated the importance of tourism, its place in economic development, the development factors and potential of tourism in the Karabakh economic region, and the impact of this development on the economy of Azerbaijan.

Xülasə

Turizm beynəlxalq sferada aparıcı iqtisadi amil kimi mühüm rol oynayır. "Turizm" sözü fransız sözü olub, mənası gəzinti, səyahət deməkdir.

Turizm qeyri-neft sektoru kimi iqtisadi baxımdan deyil, qloballaşan dünyada artıq mədəniyyət fenomeni kimi dəyərləndirilir. Çünki turizm kulturoloji prosesin aspektini təşkil edir. Turizmin davamlı və dinamik inkişafı nəticəsində dünya xalqları biri-birinin mədəniyyəti ilə tanış olur.

Turizm iqtisadi inkişafa təkan verərək ticarət balansını tənzimləyir. Dövlət büdcəsini formalaşdıran qeyri-neft sektorunun əsas sahələrindən biri olan turizm iqtisadi və beynəlxalq əlaqələri genişləndirir. XXI əsrin iqtisadi əsasını turizm təşkil edir.

Azərbaycan Respublikasında, xüsusilə isə Qarabağ iqtisadi rayonunda turizmin inkişafı olduqca zəruridir. Belə ki, Qarabağ iqtisadi rayonunda turizmin inkişafı nəticəsində Azərbaycan iqtisadiyyatı daha da güclənir. Bu təsir mexanizmi düz mütənasiblik kəsb edir. Qarabağ iqtisadi rayonunun turizm resursları olduqca zəngindir. Regionun turizm resursları nəticəsində Azərbaycan iqtisadiyyatı beynəlxalq turizm bazarında özünəməxsus yer tutur.

Məqalədə turizmin əhəmiyyəti, onun iqtisadi inkişafda yeri və Qarabağ iqtisadi rayonunda turizmin inkişaf amilləri, potensialı və bu inkişafın Azərbaycan iqtisadiyyatına təsiri araşdırılmışdır.

Keywords: economy, development, Karabakh, tourism.

Açar sözlər: iqtisadiyyat, inkişaf, Qarabağ, turizm.

44 günə sığdırılan 30 illik həsrət bitdi! 44 gün davam edən müharibədə Müzəffər Azərbaycan Ordusu qələbə çaldı. Bununla da öz ərazini bütövlüyünü bərpa etmiş oldu. Beləliklə, Azərbaycanın Qarabağa Böyük və Məğrur Qayıdışı başlamış oldu...

Son dövrdə Azərbaycan xalqı diplomatik və hərbi sahədə ən böyük zəfərə nail oldu. Qələbənin əbədləşdirilməsi üçün öz doğma torpaqlarından köçkün düşən insanların vətənə qayıdışı təmin olunmalıdır. Bu Böyük Qayıdış vətəndaşlarımızın işğaldan azad edilmiş ərazilərdə dayanıqlı məskunlaşmasında və ölkənin iqtisadi fəaliyyətinə bu ərazilərin qoşulmasında bir körpü rolunu oynayacaqdır.

Qələbədən sonra Qarabağ iqtisadi rayonunda bərpa və yenidənqurma işlərinə başlanılmışdır. Qarabağ iqtisadi rayonunda bölgə iqtisadiyyatının inkişaf etdirilməsi prioritet məsələ kimi qarşıya qoyulmuşdur. Bu kontekstdə Qarabağ iqtisadi rayonunda kiçik və orta sahibkarlığın inkişafı da çox mühüm məsələdir. Bunun üçün regionda bu sahə ilə bağlı mövcud vəziyyət öyrənilməli, gələcək perspektivlər, güclü və zəif tərəflər araşdırılmalı, imkanlar və təhdidlər nəzərdən keçirilməlidir.

Qarabağ iqtisadi rayonunda turizmin inkişafının Azərbaycan iqtisadiyyatına təsiri də böyük olacaqdır. Bunun üçün də regionda sahibkarlıq fəaliyyətinin inkişafı üçün mövcud şərait dəyərləndirilməli və inkişafa təkan verilməlidir.

Qeyd etmək lazımdır ki, Qarabağ iqtisadi rayonu 2021-ci ildə təsis edilmişdir. İqtisadi rayona Ağcabədi, Ağdam, Bərdə, Füzuli, Şuşa, Tərtər, Xocalı və Xocavənd rayonları, həmçinin Xankəndi şəhəri daxildir.

Qarabağ iqtisadi rayonunun güclü tərəflərindən biri coğrafi müxtəlifliyidir. Bu da iqtisadi imkanların diversifikasiyasına imkan verir. Region həm düzən, həm də dağlıq ərazilərə malikdir. Buradan çoxlu çaylar axır. Kənd təsərrüfatı sahəsində bostan bitkiləri, pambıq, dənli və dənli-paxlalı bitkilər, günəbaxan, şəkər çuğunduru, tərəvəz, kartof, müxtəlif giləmeyvələr, üzüm istehsalı üçün böyük potensial mövcuddur. Burada strateji məhsul olan pambıq və taxıl xüsusi çəkisi ilə seçilir. Qarabağ iqtisadi regionunun anbar təsərrüfatı, təbii sərvətlərlə zənginliyi olduqca mühüm amildir. Belə ki, ərazidə faydalı qazıntılar, tikinti materialları olduqca çoxdur. Sənaye və tikinti sahələrinin inkişafı üçün də zəmin mövcuddur. Bütün bu qeyd edilənlər regionun turizm və iqtisadi inkişafının əhəmiyyətini göstərir.

Ümumiyyətlə, Qarabağ iqtisadi rayonunun böyük iqtisadi potensialı mövcuddur. Regionun qurulan infrastruktur, təbii şəraiti və s. amillər müxtəlif sahələrdə ixtisaslaşan biznes subyektləri üçün parlaq gələcək vəd edir. Lakin görülməli olan işlər də var. hansı ki, bu işlər böyük maddi vəsait tələb edir. Hərbi-siyasi təhlükələr, minatəmizləmə, xüsusi güzəştli şərtlərin tətbiqi, məcburi köçkünlərin qayıdışı, regionun social-iqtisadi inkişafı, ekoloji problemlər, regionda iqtisadi sabillik, yenidənqurma və bərpa prosesinin sürətləndirilməsi, əlverişli mühitin formalaşdırılması işləri həyata keçirilməli, həmçinin ümumölkə miqyasındakı bir sıra iqtisadi xarakterli problemlər həllini tapmalıdır.

Son dövrlərdə Azərbaycan Respublikasında əsas prioritet və strateji hədəf qeyri-neft sektorunun əsas sahəsini təşkil edən turizmin inkişafıdır. Turizm iqtisadiyyatın ən gəlirli sahələrindəndir. Bu baxımdan da turizm inkişafı iqtisadiyyatın inkişafına da təsir göstərir. Buna görə də Qarabağın işğaldan azad edilməsi ilə gecikmiş ədalət bərpa edilmiş və bununla da bu ərazinin ölkə iqtisadiyyatına qazandıracağı investisiya şübhəsizdir.

Azərbaycan Respublikasının Prezidenti İlham Əliyevin uğurlu siyasəti nəticəsində Qarabağ azad edilmiş və iqtisadi regionun turizm potensialı da dəyərləndirilmiş, turizm təsərrüfatının inkişafı üçün yeni imkanlar yaradılmışdır. Qarabağın mövcud turizm potensialının inkişaf etdirilməsi üçün mövcud potensial gücü ilə yaradılmış infrastruktur sistemi birləşdirilməlidir. Əlbəttə ki, bunun üçün hər cür imkan vardır. Turizmin inkişafı üçün birinci amil təbiətin füsunkarlığı, iqlim və estetik rekreasiya imkanlarının olmasıdır.

Turizm istirahətin fəal növü kimi çıxış edir [2, s.24]. Qarabağın iqtisadi potensialı və inkişaf perspektivləri zəngin olduğundan ərazinin növbəti 10-15 illiyində qurulucq, təmir-bərpa işləri başa çatdıqdan sonra "Böyük Qayıdış" baş tutduqdan sonra iqtisadi inkişaf sürətlənəcək, ölkəmizin həyatına çoxsaylı yeniliklər gətirəcəkdir.

Qarabağ regionu zəngin maddi mədəniyyət abidələri, qədim tarixi, ədəbiyyatı, incəsənəti və musiqi irsi, həmçinin adət-ənənələri ilə fərqlənir. Bütün bu qeyd edilənlər bədii təfəkkür və yaradıcılığa müsbət təsir göstərən ərazinin əsrarəngiz təbiətinin, təbii sərvətlərinin zənginliyinin nəticəsidir. Qarabağın mədəniyyət xəzinəsində bu elin insanların çoxəsrlik adət-ənənələri xüsusi önəm kəsb edir.

Erməni vandalizminin nəticəsində Qarabağ iqtisadi rayonunda yenidənqurma və bərpa işləri aparılır. Azərbaycanın qələbəsi nəticəsində regionda yaradılan yeni şərait ölkəmiz və bölgə üçün yaxşı

perspektivlərə yol açacaqdır. Azərbaycan Respublikasının Prezidenti İlham Əliyevin vurğuladığı kimi, biz tezliklə doğma Qarabağımızı cənnətə çevirəcəyik. İşğaldan azad edilmiş ərazilərdə görülən tədbirlər kompleksinin sürətlə aparılması bunu deməyə əsas verir [3,s.27].

Qarabağ iqtisadi regionu bir sıra efiryağlı, aromatik, bəzək, dərman və digər qeyri-ənənəvi bitkilərin də vətənidir. Xarı bülbül Şuşa şəhərində bitir və Qarabağın rəmzidir. Bu unikal bitki, həmçinin Vətən müharibəsi şəhidlərimizin ruhuna hörmət əlaməti olaraq anım gününün simvoludur.

Qarabağ böyük xammal bazasına malikdir. Regionun sənaye potensialına nəzər salsaq görürük ki, bu potensialı 4 əsas istiqamətdə qiymətləndirmək mümkündür [4,s.28]:

1. elektrik enerjisi;
2. zəngin faydalı qazıntıların email;
3. zəngin su təhizatı;
4. sənaye rekreasiya imkanları.

Qarabağ füsunkar təbiəti ilə yanaşı, zəngin iqtisadi potensiala, yeraltı və yerüstü sərvətlərə, geniş turizm imkanlarına malikdir. Bu rayonlarımız xammal bazası, aqrar üstünlüyü və emaledici sənaye istehsalı baxımından əlverişlidir. Belə ki, bu ərazilərin iqtisadi potensialının başlıca parametrləri Ermənistanın talançılığı, istismarı nəticəsində regionun infrastrukturunu yox səviyyəsinə gətirilib. İşğal nəticəsində minlərlə hektar əkinəyararlı ərazi hərbi tullantılarla çirkləndirilmiş, Azərbaycan iqtisadiyyatına və dünyanın genofonduna milyardlarla manat həcmində ziyan vurulmuşdur.

Statistik məlumatlara görə, işğal altında olan torpaqlarda 6 şəhər, 7 rayon mərkəzi, 830 kənd, 12 qəsəbə, 6 dövlət teatri, 700 xəstəxana və tibb müəssisəsi, 85 musiqi məktəbi, 368 klub, 600 kənd təsərrüfatı və sənaye müəssisələri dağıdılıb, talan olunub, 1 milyon hektardan çox kənd təsərrüfatı sahəsi, həmçinin, təxminən, 128 min suvarılan torpaq, 35 min hektara yaxın meyvə və üzüm bağları məhv edilərək dövrüyyədən çıxarılıb. İşğala qədər ölkə üzrə ÜDM istehsalının 24%-i, üzüm istehsalının 41%-i, ət istehsalının 18%-i, kartof istehsalının 46%-i, süd istehsalının 34%-i həmin rayonların payına düşüb. Vaxtilə işğalda olan torpaqlarda ümumi meşə sahələri 25%, yəni 280 min hektar ərazini təşkil etmişdir [4,s.28].

Hər bir ölkənin iqtisadiyyatının səmərəliliyinin yüksəldilməsində turizm zəruri rola malik olan amillərdən birini təşkil edir. Dövlətin iqtisadi siyasətinin nəticəsidir ki, qeyri-neft sektorunun bütün sahələri inkişafa doğru istiqamətlənmişdir. Uğurlu iqtisadi siyasət nəticəsində son 10 il ərzində Azərbaycanın sosial-iqtisadi həyatında baş verən irimiqyaslı kəmiyyət və keyfiyyət dəyişiklikləri ölkəmizin iqtisadiyyatının inkişafına və iqtisadi qüdrətinin daha da artmasına gətirib çıxarmışdır.

Qarabağ iqtisadi rayonunun iqtisadi potensialı çoxspektrli olub, kənd təsərrüfatının, sənayenin və turizmin müxtəlif sahələrini əhatə edir. Qarabağda trikotaj, metallurgiya, mədənçixarma, kənd təsərrüfatı, qida emalı, turizm, yaşıl energetika sahələrinin inkişafı üçün böyük potensial var. Region tütünçülük, üzümçülük, baramaçılıq, pambıqçılıq, bostançılıq, meyvə-tərəvəzçilik və heyvandarlığın inkişafı üçün böyük potensiala malikdir. Burada noxud, üzüm və qarğıdalı regionun xarakterik bitkilərindəndir. Qeyd edək ki, işğaldan əvvəlki dövrlərdə Ağdam və Füzuli rayonları taxıl, pambıq və üzüm istehsalına görə ölkədə aparıcı rayonlar sırasında olmuşlar [7].

4 yanvar 2021-ci il tarixində Azərbaycan Respublikasının Prezidenti İlham Əliyev Fərman imzalamışdır. Belə ki, işğaldan azad edilmiş ərazilərdə quruculuq-bərpa və abadlıq işlərinin aparılması, dayanıqlı məskunlaşma üçün müasir və layiqli həyatın təmin edilməsi, habelə təhlükəsiz yaşayışın, səmərəli fəaliyyətin və rifahın davamlı artmasının dəstəklənməsi məqsədilə "Qarabağ Dirçəliş Fondu" yaradılmışdır. Bu fond dayanıqlı iqtisadiyyata və yüksək rifaha malik regiona çevrilməsi yönündə aparılan tədbirlərə maliyyə dəstəyi göstərilməsini və sərmayələrin cəlb edilməsini, bu sahədə dövlət-özəl tərəfdaşlığının inkişafını təmin edən, həmçinin ölkə daxilində və xaricində zəruri təşviq işlərini həyata keçirən publik hüquqi şəxsdir.

Qarabağ iqtisadi rayonunda turizm sektorunun inkişafı ilə bağlı tədbirlər həyata keçirilir. Hazırda respublikamızda turizm infrastrukturunun lazımi səviyyədə olmaması problemi diqqəti cəlb edir. Ancaq buna baxmayaraq, milli və beynəlxalq miqyaslı şirkətlər tərəfindən Qarabağ iqtisadi regionunda turizmi bərpa etmək və inkişafını təmin etmək məqsədilə mehmanxana, kafe və restoranların, digər turizm əsaslı obyektlərin yaradılması planları artıq hazırlanmışdır.

Beynəlxalq investisiya maraqları Qarabağ iqtisadi rayonunda olduqca güclüdür. Qarabağın yenidən qurulmasına qeyri-dövlət və dövlət investisiyalarının cəlb olunması davamlı iqtisadi artımın əsasını təşkil edərək bazis rolunu oynayır. Qarabağ iqtisadi rayonuna yatırılmış dövlət investisiyaları katalizator rolunu oynayır. Bu da öz növbəsində, qeyri-dövlət investisiyalarına zəmin yaratmış olacaqdır.

Türkiyə, Böyük Britaniya, İtaliya, İsrail və Pakistandan Qarabağın bərpasına yönəlmiş sərmayə axınına başlanılmışdır.

Azərbaycan hökuməti Qarabağ iqtisadi rayonunun bərpası üçün "Böyük Qayıdış" adlı genişmiqyaslı işlərə başlamışdır. Bu ərazilərin bərpası və yenidən qurulması üçün 2022-ci ildə dövlət büdcəsindən 1,3 milyard dollar vəsait ayrılıb, Füzulidə yeni avtomobil yolu çəkilmiş və hava limanı tikilmişdir. Tərtər rayonunun Suqovuşan və Talış kəndlərində yeni yolların çəkilişinə başlanılmışdır.

Türkiyə şirkətləri Füzuli-Şuşa yeni avtomobil yolunu çəkirlər. Azərbaycan İnnovasiyalar Agentliyi ilə Türkiyənin aparıcı texnoparkı GOSB Qarabağ iqtisadi rayonunda yüksək texnologiyalar parkının yaradılmasına dair anlaşma memorandum imzalayıblar. Bundan əlavə, "Ziraat Bank" Türkiyənin dövlət bankıdır və Şuşa şəhərində bankın filialı açılacaqdır.

Türkiyənin aparıcı sahibkarlarını birləşdirən TUMKIAD dərnəyinin sədri işğaldan azad edilmiş torpaqlara 50 milyon dollar həcmində investisiya yatırmaq niyyətindədir. Milyonlarla dollarlıq investisiyalar üçün tekstil istehsalı başlıca sahə kimi müəyyənləşdirilmişdir. Böyük Britaniya da Qarabağ iqtisadi regionunun texnoloji inkişafına dəstək vermək öhdəliyinə sahibdir. Krallığın Azərbaycandakı səfiri Ceyms Şarp Azərbaycan hökumətinin nümayəndələri ilə Qarabağ iqtisadi regionunda "ağıllı şəhərlər" in yaradılmasını müzakirə etmişdir.

KİV-in verdiyi məlumatlara əsasən, Yaponiya, İran və İsrail şirkətləri də yenidənqurma və bərpa layihələrinə investisiya etməyə hazır olduqlarını bildiriblər. Azərbaycan Respublikası Energetika Nazirliyi ilə Aİ, BMT, BMT İnkişaf Proqramı, Dünya Bankı, ABŞ Beynəlxalq İnkişaf Agentliyi, Almaniya Beynəlxalq Əməkdaşlıq Cəmiyyəti, Beynəlxalq Maliyyə Korporasiyasının nümayəndələri ilə Qarabağ iqtisadi regionunda "yaşıl enerji zonası"nın yaradılması ilə bağlı məsələlər müzakirə edilmişdir.

Qarabağ iqtisadi rayonunun bərpası ilə bağlı işlər ölkə başçısının daim diqqət mərkəzindədir. Bunu imzaladığı fərman və sərəncamlarda, dövlət proqramlarının icrası üçün ayırdığı vəsaitlərdə əyani şəkildə görmək mümkündür. Qarabağ iqtisadi rayonunun bərpası ölkənin sosial-iqtisadi inkişafını təmin edəcəkdir. Bütün bununla yanaşı, kifayət qədər maliyyə tutumlu proqramların icrası özəl biznesdən milyardlarla dollar investisiya tələb edir. Təbii ki, hər bir investisiya gəlir gətirməlidir.

Çox qısa müddət əvvəl, beynəlxalq reyting agentliyi olan S&P Global Ratings ölkəmizin reytingini vermişdir. Azərbaycan Respublikası "BB+" səviyyəsində reytingə malikdir. Bu da o deməkdir ki, verilmiş proqnoz özünü doğrultmuşdur. Belə ki, erməni işğalı nəticəsində mənfidə olan iqtisadiyyat və ərazinin vəziyyəti işğaldan sonra isə stabilə doğru dəyişmişdir. Bu da böyük göstəricidir. Ümid edirik ki, bu inkişaf müsbət nəticələnəcək və növbəti reyting müsbət göstərici ilə özünü göstərəcəkdir.

Beləliklə, Qarabağ iqtisadi rayonunda həyata keçiriləcək yeni layihələr nəticəsində Azərbaycanda iqtisadi inkişaf o həddə çatmalıdır ki, 2020-ci ildə ÜDM-in kəskin azalmasından sonra növbəti ildə 2,1% artım proqnozlaşdırılır, daha sonra isə bu göstərici sabitləşməlidir. Məsələ isə ondadır ki, regionda ilkin infrastruktur bərpa olunan kimi çox yüksək və yaxşı rentabelli layihələrin, yəni – turizm, kənd təsərrüfatı, tikinti materiallarının istehsalı, mədənçixarma və həmçinin yükdaşımalarının həyata keçirilməsinə başlanılmalıdır [4,s.28].

Qarabağ iqtisadi rayonunda aqrar sahədəki layihələr, turizm marşrutlarının inkişafı, su elektrik stansiyalarının tikintisi, müasir suvarma sistemlərinin quraşdırılması başlıca prioritet məsələlərdəndir. Pandemiya dövründə bir çox ölkələrdəki kimi, o cümlədən Azərbaycanda da iqtisadi fəaliyyət çökmüş vəziyyətdə idi. Bundan sonra qeyri-neft sektorunun hər bir sahəsi, xüsusilə isə Qarabağ iqtisadi rayonunda turizmin inkişafı Azərbaycan iqtisadiyyatına təsir göstərəcəkdir.

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TOURISM DEVELOPMENT IN KAZAKHSTAN: CURRENT TRENDS, CHALLENGES, AND FUTURE PROSPECTS

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Introduction

Kazakhstan, the largest landlocked country and the ninth-largest in the world, is an emerging destination in global tourism. With its rich history, diverse landscapes, and strategic location at the crossroads of Europe and Asia, the country has significant potential to become a major tourist hub in Central Asia. However, despite these advantages, the tourism sector in Kazakhstan remains relatively underdeveloped compared to other destinations in the region. The purpose of this article is to explore the current state of tourism in Kazakhstan, highlighting its natural and cultural attractions, government initiatives, challenges, and future prospects. Understanding these factors is essential for policymakers, businesses, and stakeholders interested in the growth of tourism in the region.

Natural Attractions of Kazakhstan

Kazakhstan's vast geographical expanse offers a variety of natural attractions that cater to different types of tourists. The country is home to a diverse range of ecosystems, from snow-capped mountains and dense forests to arid deserts and steppe regions. This natural diversity makes Kazakhstan an ideal destination for eco-tourism, adventure tourism, and outdoor recreation.

One of the most famous natural attractions is the **Altai Mountains**, which are known for their pristine beauty and biodiversity. The mountains offer excellent opportunities for trekking, mountaineering, and wildlife observation. In the southern part of the country, the **Tien Shan Mountains** also attract tourists interested in winter sports such as skiing and snowboarding, particularly around Shymbulak, a popular ski resort near Almaty.

Kazakhstan is also home to several stunning lakes, including **Lake Alakol**, which is known for its therapeutic properties, and **Lake Balkhash**, one of the largest lakes in Asia. The **Kolsai Lakes National Park** offers breathtaking views of crystal-clear lakes surrounded by forested mountains, making it a popular destination for hikers and nature lovers. Another notable natural landmark is **Charyn Canyon**, often compared to the Grand Canyon in the United States. Its unique rock formations and dramatic landscapes attract thousands of tourists each year.

The vast steppes of Kazakhstan, while less visited, offer a unique experience for those interested in the nomadic lifestyle and traditional culture. The steppe regions are also home to rare wildlife species, such as the saiga antelope and steppe eagles, which appeal to wildlife enthusiasts and researchers alike.

Historical and Cultural Tourism

Kazakhstan's rich historical and cultural heritage is deeply rooted in its position along the ancient **Silk Road**, a major trade route that connected Europe and Asia for centuries. This historical connection has left the country with a wealth of archaeological sites, ancient cities, and monuments that reflect its diverse cultural influences, including Persian, Mongol, Russian, and Soviet legacies.

One of the most significant historical sites in Kazakhstan is the **Mausoleum of Khoja Ahmed Yasawi**, a UNESCO World Heritage Site located in the city of Turkestan. The mausoleum is a masterpiece of Timurid architecture and serves as an important pilgrimage site for Muslims. Turkestan itself is an ancient city that has long been a center of Islamic culture and learning in Central Asia.

In addition to religious monuments, Kazakhstan boasts a rich nomadic heritage that continues to shape its cultural identity. Tourists interested in nomadic culture can experience traditional Kazakh customs, including horse-riding, falconry, and staying in **yurts**, the traditional nomadic tents. Festivals such as **Nauryz**, the Kazakh New Year, offer visitors a glimpse into the country's folk traditions, music, and cuisine.

The cities of **Almaty** and **Nur-Sultan** (formerly Astana) serve as cultural and economic hubs, offering a mix of modern attractions and historical landmarks. Almaty, the former capital, is known for its vibrant arts scene, museums, and theaters. Nur-Sultan, the current capital, is a futuristic city with striking modern architecture, such as the **Bayterek Tower** and the **Khan Shatyr**, a giant tent-like structure that houses a shopping and entertainment center. These cities also serve as gateways for business tourism, with numerous international conferences and events being held there annually.

Infrastructure Development in Kazakhstan's Tourism Sector

Despite its natural and cultural wealth, Kazakhstan faces significant challenges in developing the infrastructure necessary to support a thriving tourism industry. The country's vast size and dispersed population make it difficult to create a cohesive and well-connected transportation network, especially in remote areas. However, recent government efforts have focused on improving both domestic and international accessibility to key tourist destinations.

The **Kazakhstan National Tourism Development Program 2025** is a comprehensive initiative aimed at modernizing the country's tourism infrastructure. This includes upgrading airports, improving road networks, and building new hotels and resorts that meet international standards. The government has also focused on expanding rail and air connectivity between major cities and tourist sites, which has been a key factor in attracting more domestic and international visitors.

One of the most significant infrastructure projects in recent years has been the modernization of **Almaty International Airport** and the construction of new terminals in **Nur-Sultan International Airport**. These upgrades have helped increase the capacity for handling international tourists and have made Kazakhstan more accessible to visitors from Europe, Asia, and the Middle East. Additionally, new highways, such as the **Western Europe-Western China International Transit Corridor**, have improved road travel within the country, making it easier for tourists to explore Kazakhstan's diverse regions.

Accommodation facilities are another critical area of infrastructure development. While luxury hotels and resorts are available in major cities like Almaty and Nur-Sultan, there is a growing demand for budget accommodations, eco-lodges, and traditional **yurt camps** in rural and remote areas. Developing these types of accommodations would not only cater to a wider range of tourists but also promote sustainable tourism practices that benefit local communities.

Government Policies and Initiatives for Tourism Promotion

Recognizing the potential of tourism as a key driver of economic diversification, the government of Kazakhstan has implemented a range of policies to promote the industry. One of the most important initiatives is the **National Tourism Development Program 2025**, which sets ambitious targets for increasing the number of domestic and international tourists.

A key component of this program is the **simplification of visa regulations**. Kazakhstan has introduced visa-free entry for citizens of many countries, including the European Union, the United States, Japan, and several others. This policy has significantly boosted the number of international arrivals in recent years and has positioned Kazakhstan as a more attractive destination for global travelers.

In addition to visa reforms, the government has been actively promoting Kazakhstan as a destination through international tourism fairs, digital marketing campaigns, and partnerships with foreign tour operators. The **Kazakh Tourism National Company** plays a central role in these efforts by organizing promotional events and developing marketing materials that highlight Kazakhstan's unique attractions.

Another important aspect of the government's strategy is the development of **tourism clusters**. These clusters are designed to concentrate tourism-related businesses and services in specific regions, making it easier for tourists to access multiple attractions within a single trip. For example, the **Almaty Region Cluster** focuses on eco-tourism and adventure tourism, while the **Mangystau Region Cluster** highlights historical and cultural tourism along the Caspian Sea.

Challenges Facing Kazakhstan's Tourism Industry

Despite the positive developments, Kazakhstan faces several challenges in growing its tourism sector. One of the most significant obstacles is the **lack of awareness** about Kazakhstan as a tourist destination. Many international travelers are unfamiliar with the country's attractions, and Kazakhstan often competes with more established destinations in Central Asia, such as Uzbekistan and Kyrgyzstan.

Another challenge is the **language barrier**. While English is becoming more widely spoken in major cities and tourist areas, many rural regions still rely primarily on Kazakh and Russian. This can make it difficult for foreign tourists to navigate and communicate effectively, especially in more remote locations.

In addition to these issues, Kazakhstan's **harsh climate** can deter tourists during certain times of the year. Winters in Kazakhstan are long and cold, which limits outdoor activities and reduces the appeal of certain natural attractions. However, the development of winter tourism, particularly in the ski resorts near Almaty, could help mitigate the impact of the climate on tourism numbers.

Future Prospects for Tourism in Kazakhstan

Looking ahead, the future of tourism in Kazakhstan is promising, provided that the country continues to invest in infrastructure, marketing, and sustainable practices. The government's

commitment to tourism development, combined with Kazakhstan's unique blend of natural beauty and cultural heritage, creates a strong foundation for growth.

One of the most exciting prospects for the future is the development of **eco-tourism** and **sustainable tourism**. Kazakhstan's vast, untouched landscapes make it an ideal destination for nature-based tourism that emphasizes conservation and environmental protection. By promoting responsible tourism practices, Kazakhstan can attract a growing segment of eco-conscious travelers while preserving its natural heritage for future generations.

Another area with significant potential is **business tourism**. As Kazakhstan continues to develop its economy and increase its integration into global markets, the demand for international conferences, exhibitions, and business events is likely to grow. Nur-Sultan, with its modern infrastructure and strategic location, is well-positioned to become a major hub for business tourism in the region.

Finally, Kazakhstan's role as a bridge between Europe and Asia presents an opportunity to attract tourists who are interested in exploring both regions. By marketing itself as a gateway to Central Asia, Kazakhstan can tap into the growing interest in multi-destination travel, where tourists visit multiple countries in a single trip.

Tourism in Kazakhstan is at a pivotal point in its development. The country has made significant strides in improving its infrastructure, promoting its natural and cultural attractions, and implementing policies to facilitate international tourism. However, challenges remain, particularly in raising global awareness, addressing infrastructure gaps in rural areas, and overcoming the language barrier.

With sustained government support and a focus on sustainable tourism practices, Kazakhstan has the potential to emerge as a leading destination in Central Asia. The country's unique combination of natural beauty, rich cultural heritage, and growing modern amenities can attract a wide range of tourists, from adventure seekers and eco-tourists to history enthusiasts and business travelers.

The ongoing development of tourism clusters, the promotion of Kazakhstan at international tourism fairs, and the simplification of visa policies are critical steps that will likely contribute to the continued growth of the tourism industry. Furthermore, the rise of digital marketing platforms provides an unprecedented opportunity for Kazakhstan to showcase its attractions to a global audience.

However, it is essential for policymakers to continue focusing on long-term sustainability. Protecting natural resources, promoting eco-friendly practices, and involving local communities in tourism development are key to ensuring that tourism in Kazakhstan benefits not only the economy but also the environment and local populations.

Recommendations for Future Development

To ensure the continued growth and sustainability of the tourism sector in Kazakhstan, several recommendations can be made:

1. **Expand Digital Marketing Efforts:** Kazakhstan should leverage digital platforms such as social media, travel blogs, and online influencers to raise global awareness of its unique attractions. Collaborations with international travel agencies and media outlets could further enhance visibility.

2. **Develop More Specialized Tourism Packages:** Creating tailored packages for specific types of tourists (e.g., adventure tourism, cultural tourism, luxury tourism) would help Kazakhstan cater to diverse traveler preferences. Packages that include experiences like traditional Kazakh ceremonies, wildlife safaris, and guided Silk Road tours could offer unique selling points.

3. **Improve Infrastructure in Remote Areas:** While urban centers like Almaty and Nur-Sultan have seen considerable infrastructure upgrades, rural areas that host natural and cultural landmarks still need better transportation, accommodation, and communication services. Investments in these regions could lead to significant growth in eco-tourism and adventure tourism.

4. **Enhance Language Accessibility:** To attract more international visitors, the government should invest in language training for tourism staff, tour guides, and local businesses. More signage and information in English at tourist sites, airports, and train stations would improve the overall visitor experience.

5. **Promote Year-Round Tourism:** Developing tourism products that cater to all seasons, such as winter sports, summer eco-tourism, and cultural festivals, would ensure a more consistent flow of visitors throughout the year. The promotion of winter sports in the mountainous regions and desert trekking in the steppes could attract niche markets.

6. **Foster Regional Cooperation:** Kazakhstan could collaborate with neighboring countries, such as Uzbekistan and Kyrgyzstan, to create multi-country tourism routes that attract visitors interested in Central Asian culture and history. Such cooperation would provide tourists with a richer and more diverse experience, increasing the appeal of the region as a whole.

Conclusion

Tourism in Kazakhstan is set for substantial growth in the coming years. The country's abundant natural resources, rich historical sites, and growing modern infrastructure offer numerous opportunities for tourism development. However, to fully capitalize on its potential, Kazakhstan must continue to improve accessibility, infrastructure, and marketing efforts, while also ensuring that sustainability remains at the forefront of its tourism strategy.

By addressing current challenges and focusing on long-term growth, Kazakhstan can establish itself as a premier travel destination in Central Asia, offering visitors a unique blend of adventure, culture, and natural beauty. With the right approach, tourism can become a key driver of economic diversification and cultural exchange in Kazakhstan, benefitting both the country and the broader international community.

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Geographical sciences

ELECTRONIC MAPPING OF TARTAR REGION BASED ON GEOGRAPHICAL INFORMATION SYSTEMS

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Abstract

In this work made an electronic map of Tartar region, was created based on a topographical map of 1:25000 scale and a high-resolution space image. Modern software - ArcView, Erdas Imagine software - was used to create the electronic map of Tartar region.

The work on the subject was carried out on a 1:25000 scale map and a high-resolution space image of the Tarter region.

Keywords: *electronic map, image, high-resolution, space, model.*

Introduction

Geographical Information System (GIS)- is a combination of a large array of geographical or topographical maps and various data described in digital form, connected to the corresponding point of the cartographic image and systematized. GIS performs two main functions: creating a digital map with a wide database of the territory, converting the digital map into an electronic map - visualization (with the possibility of interactive communication between the map and the user).

Main parts

The 1:25000 scale topographic map of Tarter region was used as the primary material. Maps were mapped to the Pulkovo 1942 coordinate system using Erdas Imagine software as required. A digital electronic map has been created. Many thematic layers are included in the created electronic map. In those layers, all the elements that are important for the complete reflection of the selected area - hydrography, soil and vegetation, settlements, road junctions, borders, industry, agriculture, socio-cultural, etc. we have tried to show the objects. Then, the created electronic map was combined with a high-resolution space image, and the changes that occurred were processed and updated based on the space image. In order to expand the database and ensure the accuracy of the data, our employees were sent to Tarter.

The preparation of the map in the traditional way involves taking pictures on the spot, collecting data and their adaptation, changing the scale, summarizing, choosing the means of representation, preparing the printing form and finally printing the map. It is a very long process and it takes years to develop a new map. The transition to digital electronic maps is fundamentally changing the entire mapping system.

A modern electronic map is an analogue of a conventional map that exists in the computer space and contains all the information necessary for the automatic creation of the map. According to their content, mathematical basis, accuracy, degree of generalization and other parameters, digital electronic maps correspond to paper maps of the same purpose and scale. Because they are mainly compiled on the basis of digital processing of topographic maps.

The content of the database is as varied as the themes of the maps. The topographic database provides information about the territory, its relief, hydrography, roads, settlements, borders, etc. - that is, it carries digital information about all objects on the topographic map. Creating a database completely changes the mapping process. For example, the need to divide maps into sheets is eliminated, it is possible to change the scale, change the projection, choose any combination of conventional signs, colors.

The data is conventionally provided in 2 ways: digital processing of the data on the area on topographical or space images and one-time input into the computer, and addition of changes and new data. The study and evaluation of the territory is carried out with the help of a computer. In this study, a

digital vector model of the graphic representation of the territory was developed on the 1:25000 (figure 1) scale maps of Tartar region. In general, maps are a mathematically determined, generalized representation of real three-dimensional terrain, expressed in conventional symbols.



Figure 1. Electronic map of Tartar region.

The fourth dimension of the dynamics of changes on the map is time. Thus, the main advantage of electronic maps is the ability to receive real-time information about the situation in the area. The fact that current changes can be immediately entered into the database expands the capabilities of digital electronic maps, making them spatio-temporal (multidimensional). We have updated our digital model by working on the space image using the capabilities of electronic maps and entering the changes in the area into the database.

We have tried to accurately and fully reflect the current state of the area, its characteristic features on the electronic map that we have developed according to the scale, and we have also succeeded in entering operational data and determining the coordinates of objects. Theoretically, a digital electronic map is a model of reality that has a spatial and mathematical basis and is expressed by generalized conventional signs.

Vector data is a collection of layers, each layer consisting of vector objects (points, lines, polygons). Although this approach is the same for all GIS, the creation of layers can be done in different ways. GIS vector software tools are generally divided into 2: topological and non-topological. In the first case, the relationship between objects (connection, etc.) is taken as a basis. In the second case, previously unrelated spatial objects are digitized, and the connection between these objects is established during the process. Topological systems are a more adequate tool for creating quality digital maps, because the main strength of traditional and digital maps is to record the spatial relationships between objects directly, rather than the objects themselves.

A modern electronic map is an analogue of a regular map, and includes the information necessary for the automation of the map. The digital form of the spatial coordinates of all elements of the map and their coded quantitative and qualitative characteristics form its basis.

The topographic database carries digital information about the territory, its relief, hydrography, roads, settlements, borders - that is, about all the objects on the topographic map.

In our work, the first element of the vector model - a list of layers - was compiled according to the map project of the Tartar region. These layers are different according to their importance, purpose, and themes. As the main layers, the raster image of the objects of the topographic base, vector and vector-

thematic layers were taken. The second element of the vector model is the objects of each layer, which are reflected in the layers.

Results

On the basis of digital data, it is possible to build not only an ordinary image, but also a volumetric model, for example, a three-dimensional map of a mountainous area, a map can be combined with space images, new statistical data and other data can be added. In addition, it is possible to display individual layers or a combination of layers of the cartographic image on the screen or print, for example, only terrain or only settlements and roads, etc. The task of updating maps becomes significantly easier. Any new information, changes in the area are immediately entered into the database, as a result of which the map is instantly updated.

Since topographic maps, which are graphical models of the earth's surface, no longer meet modern requirements, the main product of topography is digital topographic maps. A digital electronic map is a set of coded metric, semantic and logical information about any area of the earth's surface. The compactness of data storage, its quickness of updating and wide possibilities in solving various issues are important attributes of digital maps.

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Mathematical sciences

FROM THE EXPERIMENTALLY PROVED PRINCIPLE OF PHYSICAL REALITY OF IMAGINARY NUMBERS IN CORRECTED VERSION OF SRT IT FOLLOWS THAT MENTIONED IN ALL RELIGIONS THE INVISIBLE AFTERLIFE WORLD, WHERE GODS AND SOULS OF THE DEAD DWELL, ACTUALLY EXISTS¹

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Abstract

Rightly recognized as the outstanding scientific achievement of XX century physics, the special theory of relativity (SRT) has nevertheless proved to be incorrect, because at that time there was no experimental knowledge necessary for its creation, which had to be replaced by postulates. But not everything was guessed. And this is quite natural. All new theories are always subsequently refined and corrected. However, none of the many subsequent corrections and experimental refutations of SRT was not accounted for and still is not taken into account. As a result, SRT has remained uncorrected.

It is in this form that SRT is now studied in all physics textbooks, used in the educational process even in the most prestigious universities.

However, a corrected version of SRT has already been created, in which instead of the incorrect principle of non-exceeding the speed of light, the experimentally proven principle of physical reality of imaginary numbers, which refuted this postulate, is used. The corrected version of SRT has allowed to solve many unsolved in the noncorrected version of SRT problems. And from relativistic formulas of the corrected version of SRT follows the existence of numerous mutually invisible parallel universes. In the corrected version of SRT also it is explained that these invisible universes about which it is spoken in all religions, and are invisible afterlife world in which Gods and souls of dead dwell.

Keywords: imaginary numbers; complex numbers, hypercomplex numbers, WMAP, Planck, special theory of relativity, invisible parallel universes and antiuniverses, Multiverse, Hyperverse, portals. Gods, invisible afterlife world, souls of dead

1. Introduction

Created in the twentieth century by Joseph Larmor [1], Nobel Prize winner Hendrik Anton Lorenz [2], Jules Henri Poincaré [3], Nobel Prize winner Albert Einstein [4] and other outstanding scientists, the special theory of relativity (SRT) [5]-[7] because of its use of the principle of relativity is rightly considered a very great scientific achievement. However, in the XXI century it was proved that this theory is incorrect, because:

- the relativistic formulas obtained in it are not correct;
- they've been incorrectly explained using the wrong principle of light speed non-exceedance;
- from them were made incorrect conclusions about physical unreality of discovered 400 years before creation of SRT by Scipione Del Ferro, Niccolo Fontana Tartaglia, Gerolamo Cardano, Lodovico Ferrari and Rafael Bombelli¹ [8] imaginary numbers and the existence in nature of our only visible universe, in which all measurements are carried out only using real numbers.

As can be seen from the graphs (see Fig. 1a,b,c) of relativistic formulas of this version of SRT

$$m = m_0 / \sqrt{1 - (\frac{v}{c})^2} \quad (1)$$

¹ And perhaps even before them imaginary numbers were discovered by Paolo Valmes [9], who was burned alive at the stake by the Spanish Inquisitor Tomas de Torquemada.

$$\Delta t = \Delta t_0 \sqrt{1 - \left(\frac{v}{c}\right)^2} \quad (2)$$

$$l = l_0 \sqrt{1 - \left(\frac{v}{c}\right)^2} \quad (3)$$

where m_0 is the rest mass of the moving body;

m - relativistic mass of the moving body;

Δt_0 - rest time of a moving body;

Δt - relativistic time of a moving body;

l_0 - rest length of a moving body;

l - relativistic length of a moving body;

v - the velocity of the moving body;

c - speed of light;

in the range of pre-light speeds $v < c$ all these quantities take values measured by real numbers, in the range of superluminal speeds $v > c$ take values measured by imaginary numbers, and at the speed equal to the speed of light $v = c$, the function $m(v)$ has a gap. Therefore, in the pre-light speed $v < c$ range formulas (1)-(3) have been explained. And in the superluminal range of speeds $v > c$ the results of calculations in the form of imaginary numbers the creators of SRT could not explain. And in modern textbooks of physics they are not explained till now. After all, what is 5 meters, 6 grams and 7 seconds is clear to everyone, but what is 5i meters, 6i grams and 7i seconds, where $i = \sqrt{-1}$, and now no one can explain.

Moreover, as can be seen from the graphs of formulas (1)-(3), in the superluminal range of velocities $v > c$ (see Fig. 1a,b,c) these formulas correspond to physically unstable processes that cannot exist in nature at all.

Indeed, let us assume that the material body in the range $v > c$ for some reason began to move faster. Then its mass according to the function graph $m(v)$ in Fig. 1a will decrease. But because of this lighter body will move faster. This, according to the graph of the function, will lead to a further decrease in the mass $m(v)$ of the moving body. And this will again lead to an increase in the velocity v of the material body. And so on. Therefore, in the end this material body with zero mass and infinitely high speed flies to 'nowhere'.

And assuming that the material body on the graph of the function $m(v)$ in the range $v < c$ for some reason began to move slower and reasoning in a similar way, we will come to the conclusion that this material body moving slower and slower, will overcome the point of astrophysical singularity $v = c$ and, being in the range $v < c$ will, stop.

So, at any point in the range $v > c$ on the graph of the function $m(v)$ the ongoing process will indeed be unstable and therefore cannot exist. And so the fate of SRT hung in the balance. After all, no one would not need a theory that even its authors could not explain. But SRT was saved by the fact that in it introduced a postulate called the principle of non-exceeding the speed of light, the meaning of which is clear from its name. And from this postulate followed that the formulas (1)-(3) in the superluminal range of speeds $v > c$ do not need to be explained, since imaginary numbers allegedly do not describe any processes that do not exist in nature.

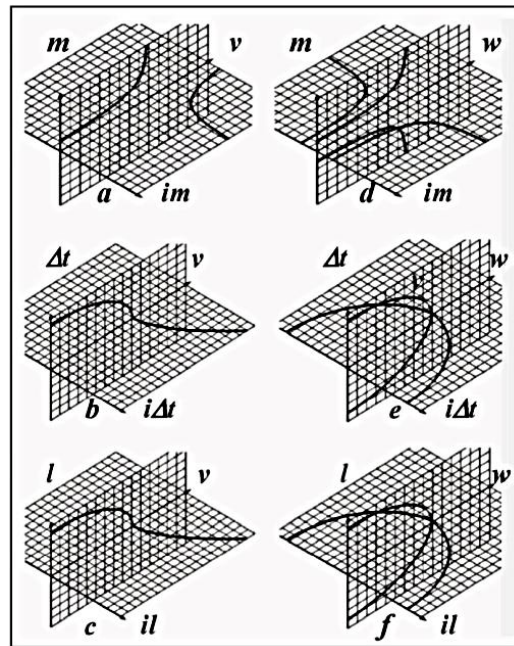


Fig. 1. Graphs of functions $m(v)$, $\Delta t(v)$ and $l(v)$ corresponding to the existing and the corrected versions of the STR in the subluminal $v < c$ and superluminal $v > c$ ranges

Indeed, let us assume that the material body in the range for some reason began to move faster. Then its mass according to the function graph in Fig. 1a will decrease. But because of this lighter body will move faster. This, according to the graph of the function, will lead to a further decrease in the mass of the moving body. And this will again lead to an increase in the velocity v of the material body. And so on. Therefore, in the end this material body with zero mass and infinitely high speed flies to 'nowhere'.

And assuming that the material body on the graph of the function in the range for some reason began to move slower and reasoning in a similar way, we will come to the conclusion that this material body moving slower and slower, will overcome the point of astrophysical singularity $v=c$ and, being in the range $v < c$ will, stop.

So, at any point in the range on the graph of the function the ongoing process will indeed be unstable and therefore cannot exist.

So the fate of the SRT hung in the balance. After all, no one would not need a theory that even its authors could not explain. But SRT was saved by the fact that it introduced a postulate called the principle of non-exceeding the speed of light, the meaning of which is clear from its name. And from this postulate followed that formulas (1)-(3) in the superluminal range of speeds could not be explained, as imaginary numbers no existing in nature processes are allegedly not described. Here in such a form the uncorrected SRT is studied in all textbooks of physics up to now.

Nevertheless, at the initial stage of creation of SRT such variant of its statement was acceptable, though it obviously contained, as well as all new theories, some misconceptions. However, at present, when it has been found out the fallacy of some assumptions used by its authors a hundred years ago, which are further explained, ignoring these circumstances was already unnecessary.

All the more that now such a corrected interpretation of SRT already hinders the development of the whole science.

2. Physical reality of imaginary numbers

But there are other sciences besides physics. Including electrical engineering and radio engineering created before SRT. And in these sciences the theory of linear electric circuits of alternating current is used, in which the fundamental is the Ohm's law discovered in 1893 in the interpretation of Steinmetz [10]. And a simpler version of this law for DC electric circuits [11], [12], studied now in school physics textbooks, was discovered by Ohm himself in 1826, when no electrical measuring device existed yet. About the physics of that time, the professor of the Imperial Moscow University, Alexander Grigorievich Stoletov wrote: "...physics especially seduced natural philosophers. What a grateful theme for the most unbridled fantasies were electrical phenomena... Beautiful and vague deductions were in the foreground: painstaking work of the experimenter, precise mathematical analysis were not in honor; they seemed

superfluous and harmful in the study of nature...". Therefore, in 1828 Ohm was dismissed from his job by the Minister of Education for publishing about the law he had discovered. The high-ranking official believed that the use of mathematics and experimental research in natural philosophy was inadmissible.

And Ohm's law as interpreted by Steinmetz is now used daily in practice by millions of electrical and radio engineers all over the world. Thereby, of course, confirming that it is true.

But in SRT the existence of this law is ignored, because from the postulate about the non unexceeded speed of light the conclusion about physical unreality of imaginary numbers is made, which is obligatory not only for physics but also for all other sciences. Including electrical and radio engineering. After all, mathematics is the common language of all exact sciences. Therefore, mathematics cannot be one in physics and another in electrical and radio engineering. And in SRT it is stated (although it is not written anywhere) that Ohm's law as interpreted by Steinmetz is wrong, because it follows from this law that electrical resistances of capacitors and inductors (also called inductance coils) are measured by imaginary numbers, and only resistances of resistors are measured by real numbers. Due to this circumstance imaginary resistances of capacitors and inductors SRT proposes to consider actually imaginary, i.e. physically non-existent.

Note - the formulation of Ohm's law in Steinmetz's interpretation states that imaginary resistances are measurable. And in fact, any electrical and radio laboratory has been using commercially available devices for measuring imaginary resistances and other imaginary electrical quantities for many decades (Fig. 2)

But everything that can be measured always exists. This is the fundamental position of any science. If people in their activities did not use instruments, and relied on knowledge obtained only from their sensations, then science would not exist. And physicists can't help but know this. And

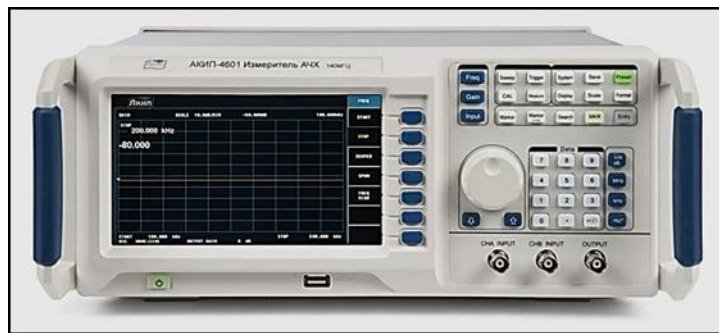


Fig. 2. In any radio-technical laboratory there are devices called frequency response meters, which prove the physical reality of imaginary and complex numbers by their mere existence

since in electrical and radio engineering the resistances of capacitors and inductors, which someone unsuccessfully called imaginary, are in fact measured by existing devices, then they are not imaginary at all, but the most real physically existing ones.

Nevertheless, in SRT, in accordance with the principle of non-exceeding the speed of light, it is actually asserted that imaginary resistances of capacitors and inductors, since they are called imaginary, should not really exist. Therefore, electrical and radio engineering also should not exist [13]-[32].

In fact they existed even before the creation of SRT by publications of Einstein and Poincaré in 1905. But physicists of that time probably did not know and/or did not understand these sciences. They don't want to understand them now, since the theory of linear AC electric circuits is not taught to physics students.

Nevertheless, since in electrical and radio engineering the used imaginary quantities - resistances, transfer functions, etc. - correspond to real physical entities (since they are measured), it proves in the most indisputable way that the named imaginary numbers contrary to the postulate of SRT about non-exceeding the speed of light not only in electrical and radio engineering, but always and everywhere in all sciences are physically real. And it is time to realize that mathematics cannot be one for Einstein, another for Steinmetz, another for someone else. So imaginary numbers are physically real in all sciences. Textbooks on different sciences (for example, physics textbooks and radio engineering textbooks) should not contradict each other. And it is unethical to teach schoolchildren and students using such textbooks.

There are other experimental proofs of the general scientific principle of the physical reality of imaginary numbers [33]-[44]. And no experiments are never refuted by postulates. And since the

following from the postulate about not exceeding the speed of light SRT statement about physical unreality of imaginary numbers turned out to be incorrect, this postulate itself is incorrect. Therefore the generally accepted version of the SRT itself also turned out to be incorrect. There are also other proofs of the incorrectness of the version of SRT [45]-[65] still studied in all physics textbooks.

3. Corrected version of SRT

Since the principle of the physical reality of imaginary numbers has been experimentally proven in the most indisputable way, the relativistic formulas must now be explained for the super-luminal speed range [66]-[73]. But for these relativistic formulas to be explainable, they must first be corrected. To their graphs in the superluminal speed range $\mathbf{v} > \mathbf{c}$ (Fig. 1a, b, c) were similar to the graphs of the same quantities in the sublight speed range $\mathbf{v} < \mathbf{c}$, as shown in Fig. 1d,e,f. And for this, it is necessary to introduce the factor i^q into formulas (1)-(3). After which they will take the form

$$m(q) = m_0 i_1^q / \sqrt{1 - (\frac{v}{c} - q)^2} \quad (4)$$

$$\Delta t(q) = \Delta t_0 i_1^q \sqrt{1 - (\frac{v}{c} - q)^2} \quad (5)$$

$$l(q) = l_0 i_1^q \sqrt{1 - (\frac{v}{c} - q)^2} \quad (6)$$

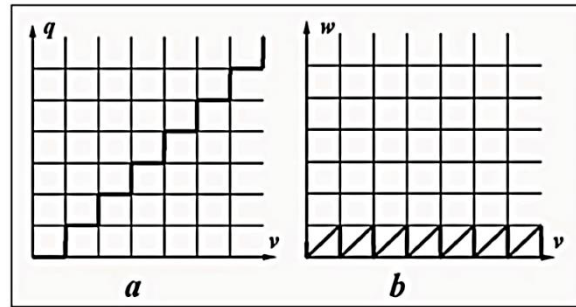


Fig. 3. Graphs of functions $q(v)$ and $w(v)$, illustrating the meaning of the "floor" function of discrete mathematics

where $q(v) = \lfloor v/c \rfloor$ is the "floor" function of discrete mathematics of the argument v/c (its graph is shown in Fig. 3a), which is the fourth spatial dimension;
 $w(v) = v - qc$ is the local velocity for each universe (its graph is shown in Fig. 3b).

Therefore, the function i^q for successive values of $q(v)$ equal to 0, 1, 2, 3, 4, 5, ... takes the values $+1, +i, -1, -i, +1, +i, \dots$. And the value $q(v)=0$ in formulas (1)-(3) for the speed range $\mathbf{v} < \mathbf{c}$ corresponds to our visible universe, which for definiteness we will call the tardyon universe. The value $q(v)=1$ in the speed range $\mathbf{v} > \mathbf{c}$ corresponds to the invisible universe, since it is beyond the event horizon. For definiteness, we will call it tachyon. The value $q(v)=2$ will then correspond to an invisible tardyon antiuniverse, the value $q(v)=3$ will correspond to an invisible tachyon antiuniverse, the value $q(v)=4$ will correspond to another (and therefore also invisible) tardion universe, the value $q(v)=5$ will correspond to another tachyon universe. Etc.

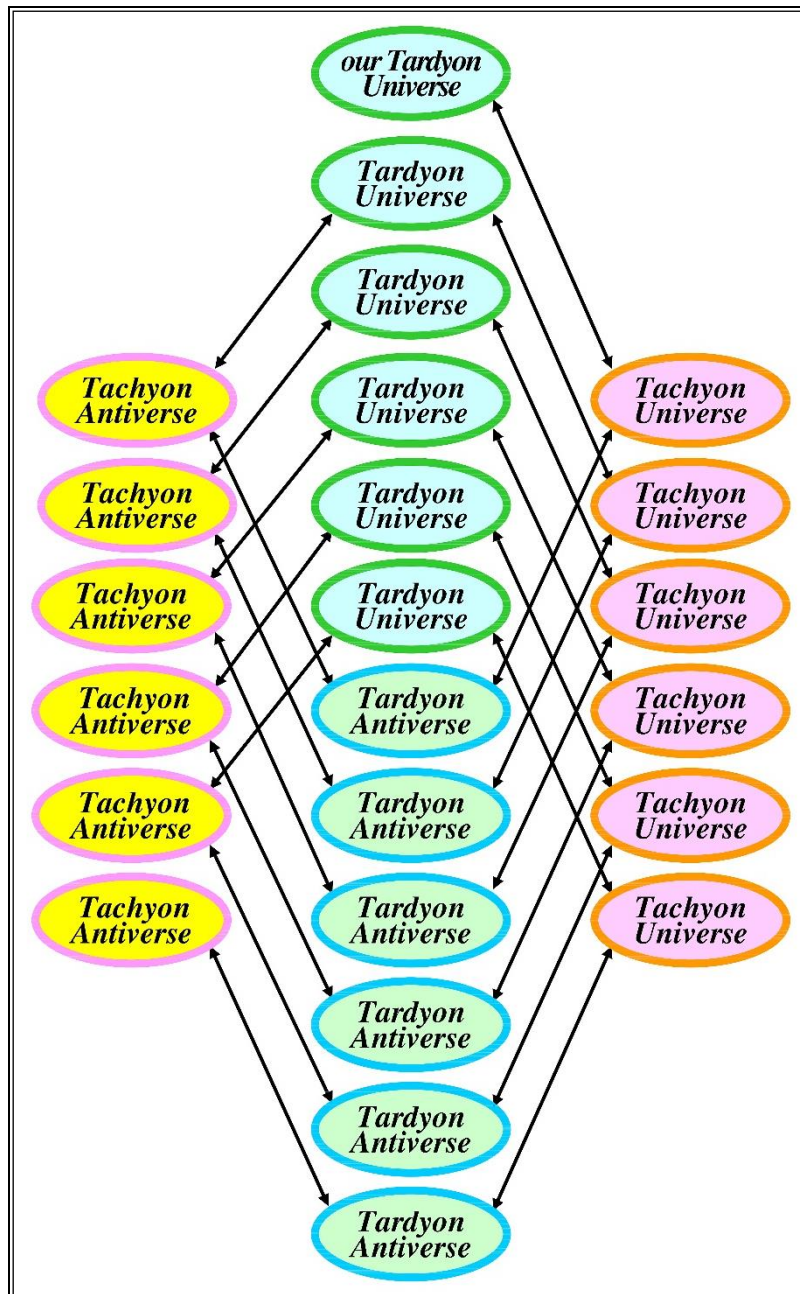


Fig. 4. Structure of the hidden Multiverse corresponding to the principle of physical reality of complex numbers

Thus, from the corrected relativistic formulas (4)-(6) it follows that in reality in nature there exists a Multiverse, which contains, in addition to our visible universe, also many other mutually invisible parallel (since they do not intersect) universes², since relative to each other they are all located beyond the event horizon. And such a Multiverse, which we will therefore call hidden, has an opened screw structure (as, for example, in Fig. 4).

And in this structure of the hidden Multiverse the distribution of material contents in each three-dimensional parallel universe will be determined by its function $f_q(x)$. and by the magnitude the coordinates of these universes. I.e. the structure of the hidden Multiverse will be described by the formula формулой $f_q(x) + iq$.

² In other dimensions, therefore on Earth invisible

4. How to calculate the function i^q for non-integer argument values?

But the function i^q which was very convenient and understandable in the presentation of the previous section, is not currently used in the theory of functions of a complex variable. Therefore, it is useful to clarify this situation. The i^q function is not used because it is now known how to calculate it only for integer values of the argument - you just need to multiply by i the original value, equal to one, q times. But in the case of non-integer values of q , this algorithm does not work. That's all.

Nevertheless, this situation is completely solvable. After all, the values $+1, +i, -1, -i$, etc. are the same as the function i^q for integer argument values $0, 1, 2, 3$, etc. function $e^{iq\pi/2}$ also accepts in Euler's formula $e^{iq\pi/2} = \cos(q\pi/2) + i\sin(q\pi/2)$, which allows you to calculate its values for non-integer values of the argument. Therefore, it is acceptable to assume that these two functions i^q and $e^{iq\pi/2}$ are identically equal to each other. And then we get the formula

$$i^q = \cos(q\pi/2) + i\sin(q\pi/2)$$

(7)

by which for the function i^q one can find its values for both integer and non-integer values of the argument q .

Thus, the last mathematical operation from algebra, which until now was not feasible in the theory of functions of a complex (and hyper complex) variable, has now also become feasible.

5. Analysis of experimental data obtained by the WMAP and Planck spacecraft

In order to obtain more information about the possible structure of the hidden Multiverse and to verify that it is correct, we will analyze the data obtained by the WMAP [74] spacecraft, launched in 2001 by the National Aeronautics and Space Administration (NASA), which operated until 2010, and Planck [75], launched by the European Space Agency (ESA) in 2009, which operated until 2013.

According to the data obtained by the WMAP spacecraft, the entire universe (in fact, the entire hidden Multiverse) consists of 4.6% baryonic matter, 22.4% dark matter, and 73.0% dark energy. And according to more recent data obtained by the Planck spacecraft, the entire universe (again, in fact, the entire hidden Multiverse) consists of 4.9% baryonic matter, 26.8% dark matter, and 68.3% dark energy. As you can see, these results differ little from each other, which proves their truth. But what dark matter and dark energy themselves are has never been explained.

It is for this incomprehensibility that these physical entities were called dark. Therefore, Stephen William Hawking wrote: "The missing link in cosmology is the nature of dark matter and dark energy."

And since it was proven above in the most indisputable way that in nature there is not a monoverse, but a hidden Multiverse, then dark matter and dark energy must somehow be present in it [76]-[80]. Consequently, the structure of the hidden Multiverse discussed above, shown in Fig. 4, must be accordingly corrected.

But how? To do this, we will abandon the assertion of the version of STR presented in textbooks that explanations for the phenomena of dark matter and dark energy must certainly be sought in our visible Universe. And we will look for them in the hidden Multiverse, since its existence has been proven. Let us assume that these phenomena are somehow generated by the very structure of the hidden Multiverse and are caused by the mutual influence of invisible parallel universes on each other. And then it's possible it is quite clear and convincing to explain the hitherto inexplicable main features of these phenomena - their invisibility and undetectability of corpuscular contents:

- dark matter and dark energy are actually not some kind of material physical entities, but just phenomena (presumably a gravitational shadow) generated by the existence, in addition to our visible tardion universe, of other invisible ones parallel universes of the hidden Multiverse;

- moreover, dark matter is a phenomenon generated by the existence of invisible parallel universes of the hidden Multiverse adjacent to our visible universe;

- and dark energy is a phenomenon generated by the existence of the rest, in addition to our visible universe and the invisible universes adjacent to it, the remaining invisible parallel universes of the hidden Multiverse;

- and precisely because dark matter and dark energy are just phenomena, they have no material content, as a result of which they themselves are invisible.

Then it becomes obvious that some unusual material content in dark matter and in dark energy in nature probably does not actually exist. Just as there is no material content in our shadow on a sunny day. Therefore, attempts to detect some subatomic particles of dark matter and dark energy by the ongoing research at the Large Hadron Collider are probably not very promising.

This explanation of these phenomena also makes it possible to clarify the structure of the hidden Multiverse. Indeed, assuming the mass of different invisible parallel universes in the hidden Multiverse with a high degree of accuracy due to the presence between them of a large number of portals that have existed for billions of years is almost identical³, it is possible to determine:

- how many parallel universes form the hidden Multiverse. And in accordance with the above data obtained by the WMAP spacecraft, their number is $100\% / 4.6\% = 21.74$. And in accordance with the data obtained by the Planck spacecraft, their number is $100\% / 4.9\% = 20.41$. Consequently, their real number is equal to 20...22 universes. Those in addition to our visible universe, there are also 19...21 invisible universes.

- how many parallel universes are neighboring our universe and give rise to the phenomenon of dark matter. According to data obtained by the WMAP spacecraft, their number is $22.4\% / 4.6\% = 4.87$. And in accordance with the data, received by the Planck spacecraft, their number is $26.8\% / 4.9\% = 5.47$. Therefore, their real number is most likely equal to 5...6 parallel universes.

- how many parallel universes give rise to the phenomenon of dark energy. And in accordance with the data obtained by the WMAP spacecraft, their number is $73.0\% / 4.6\% = 15.87$. And according to data obtained by the Planck spacecraft, their number is $68.3\% / 4.9\% = 13.94$. Consequently, their real number is presumably equal to 14...16 parallel universes.

6. Corrected version of SRT (continued)

As can be seen, the experimental data obtained by the WMAP and Planck spacecraft did not confirm the above conclusions about the structure of the hidden Multiverse, since our visible universe in this structure should have not two neighboring invisible universes - more precisely, one tachyon universe and one tachyon antiuniverse - but five or six.

Therefore, it is logical to assume that there was some error in the previous reasoning. And this error is that earlier, for the sake of simplicity, we assumed in the hidden Multiverse⁴ the existence of only one additional dimension q and, consequently, its correspondence to physically real complex numbers containing only one imaginary unit. And in order for our universe to be neighbors of six other parallel universes⁵ - three tachyon universes and three tachyon antiuniverses - it is necessary to have three additional dimensions q, r, s , which will determine their position in space. Consequently, the space of such a hidden Multiverse will be six-dimensional (see Fig. 5). And its structure will correspond to quaternions $\sigma + i_1\omega_1 + i_2\omega_2 + i_3\omega_3$, i.e. hypercomplex numbers [81], containing three imaginary units i_1, i_2, i_3 , which are related to each other by the relations

$$i_1^2 = i_2^2 = i_3^2 = -1 \quad (8)$$

$$i_1 i_2 i_3 = i_2 i_3 i_1 = i_3 i_1 i_2 = -1 \quad (9)$$

$$i_1 i_3 i_2 = i_2 i_1 i_3 = i_3 i_2 i_1 = 1 \quad (10)$$

In such a quaternion structure of the hidden Multiverse [82], [83] the distribution of material content in each three-dimensional parallel universe will be determined by some the function $f_{q,r,s}(x, y, z)$ and the quantities $i_1 q, i_2 r, i_3 s$ and are the coordinates of these universes. Those. the structure of the hidden Multiverse is described by the formula $f_{q,r,s}(x, y, z) + i_1 q + i_2 r + i_3 s$. This

³ according to the law of communicating vessels

⁴ Just like in the single visible universe in the generally accepted version of STR

⁵ Or less. Then some parallel universes of our hidden Multiverse may be absent and replaced by universes of neighboring Multiverses.

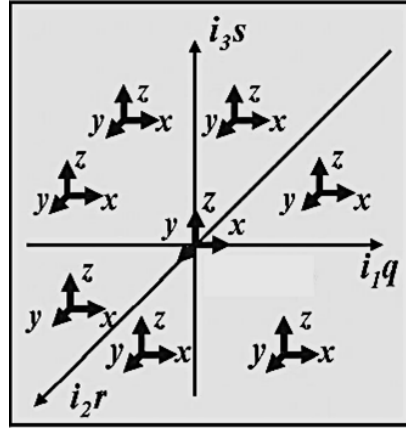


Fig. 5. Six-dimensional space of the hidden Multiverse, where q, r, s are the coordinates of invisible parallel universes, and x, y, z are the coordinates of the matter content in each parallel universe

is exactly what Lisa Randall predicted: “We could be living in a three-dimensional slit of higher dimensional space.”

And therefore the relativistic formulas (4)-(6) must be corrected once again as follows

$$m(q, r, s) = \frac{m_0 i_1^q i_2^r i_3^s}{\sqrt{1 - [v/c - (q + r + s)]^2}} \quad (11)$$

$$\Delta t(q, r, s) = \Delta t_0 i_1^q i_2^r i_3^s \sqrt{1 - [v/c - (q + r + s)]^2} \quad (12)$$

$$l(q, r, s) = l_0 i_1^q i_2^r i_3^s \sqrt{1 - [v/c - (q + r + s)]^2} \quad (13)$$

Information about the helical structure of such a hidden Multiverse is contained in formulas (11)-(13). It follows from them that it is possible to move from a tardion universe to a tardion antiuniverse and from a tardion antiuniverse to a tardion universe in different ways, but not in an arbitrary way, but only in such a way (see Fig. 6) that the quantity $i_1^q i_2^r i_3^s$ will successively take on the values $+1, +i_1 \oplus i_2 \oplus i_3, -1, -i_1 \oplus i_2 \oplus i_3, +1, \dots$ etc., where $\oplus$ is the symbol of the logical operation of discrete mathematics ‘exclusive OR’. In this case, different trajectories of movement from one universe (or antiuniverse) to another can differ only due to the replacement of some tachyon universes $i_1^q i_2^r i_3^s$ with others and some tachyon antiuniverses $i_1^q i_2^r i_3^s$ with others. Consequently, the tachyon universes $i_1^q i_2^r i_3^s$ in the hidden Multiverse are located parallel to each other. The tachyon antiuniverses $i_1^q i_2^r i_3^s$ for the same reasons are also located parallel to each other. And therefore, in the hidden Multiverse, when moving from any tardyon universe to a tardyon antiuniverse and then to another tardyon universe, parallel universes and anti-universes must alternate in the following sequence – ‘tardyon universe’, ‘one of the tachyon universes’, ‘tardyon anti-universe’, ‘one of the tachyon anti-universes’, ‘tardyon universe’, ‘one of the tachyon universes’, etc.

The simplest such quaternion structure of the hidden Multiverse to explain is shown in Fig. 6. However, it is possible that more complex structures exist in nature, formed by the interweaving of many (perhaps even infinitely many) sequences of tardion and tachyon universes and antiuniverses

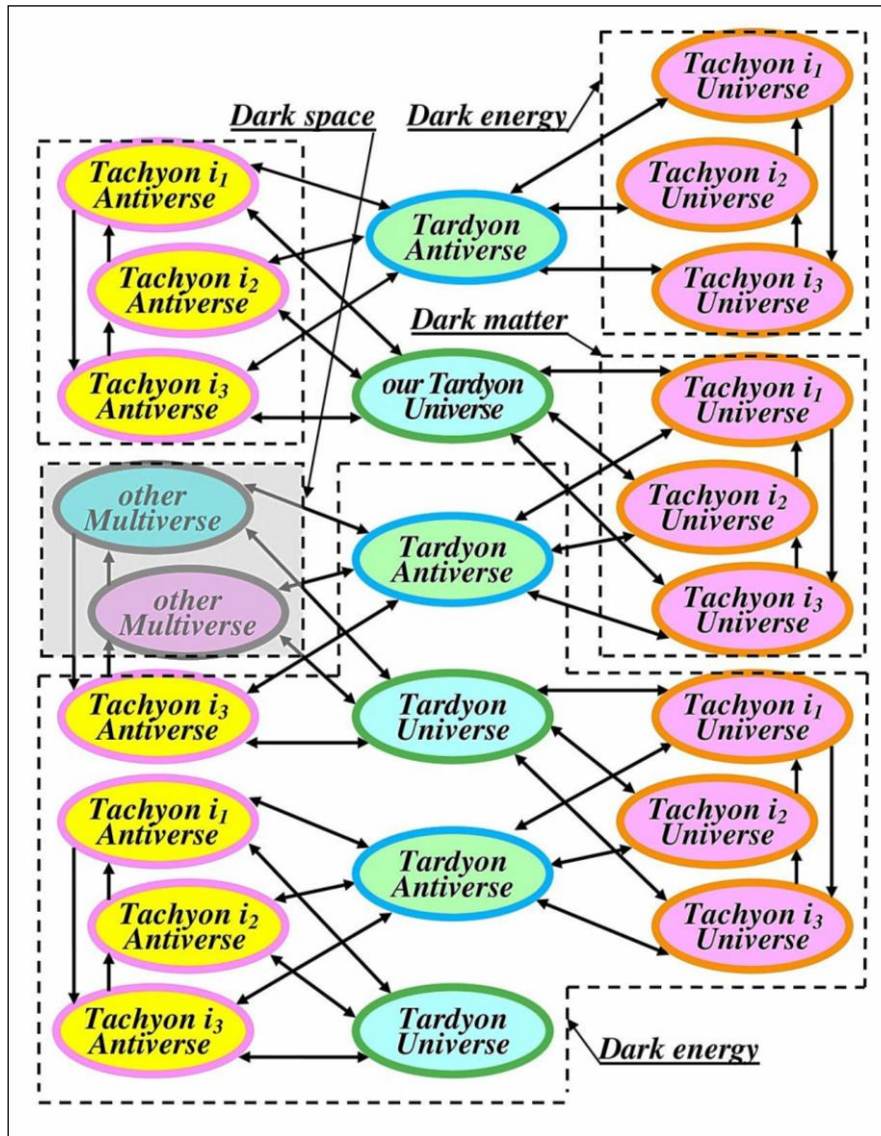


Fig. 6. Possible quaternion structure of the hidden Multiverse containing twenty-two parallel universes, including six invisible universes adjacent to our visible universe

in the hidden Multiverse and located beyond it in the Hyperverses. But we will not consider them, since we do not have any experimentally obtained knowledge for this, and one can assume a great many such hypothetically possible structures.

The difference between the structure shown in Fig. 6 structure from the structure shown in Fig. 4 is the presence in it of several different tachyon universes and antiuniverses corresponding to three imaginary units i_1^q , i_2^r , i_3^s . Another difference is the presence in such a structure of the Multiverse of not only bidirectional portals corresponding to formula (8) and designated by double-sided arrows, but also unidirectional portals⁶, corresponding to formulas (9), (10) and designated by single-sided arrows.

Moreover, naturally, the movement from our tardyon universe to the tardyon antiuniverse through some tachyon universe – for example i_1 – does not necessarily have to proceed further through the tachyon antiuniverse i_1 . It can proceed further through the tachyon antiuniverses i_2 and i_3 . The same reservation applies to the situation if the movement from the tardyon universe to the tardyon antiuniverse begins through the tachyon universes i_2 or i_3 .

⁶ Due to what circumstances in such portals movement is possible only in one direction - from entrance to exit - it is difficult for us, living in a space in which movement in nature is possible in any direction, even to imagine. And the processes that make such movement possible in nature are yet to be understood. But they are more dangerous for visitors who have fallen into such unidirectional portals than bidirectional portals, because it is impossible to return to one's own universe from them. And while there is one-way travel on escalators in the subway, the subway is not nature,

In Fig. 6 all these transitions are shown. Moreover, since the data obtained by the WMAP and Planck spacecraft correspond to the open spring-like structures of our hidden Multiverse, united through the corresponding portals with other Multiverses, then all together they form the Hyperverse.

And there may be many other similar structures. And to clarify which of them really exists in our hidden Multiverse, additional experimental research is naturally necessary.

7. Physical reality of invisible universes

But this is not the main thing for us now.

The main thing is to prove experimentally, in an indisputable way, that there is a Multiverse in nature, and not the only visible universe in nature, as it is asserted not only in the generally recognized version of SRT, but also in string theory and in quantum physics.

And for this purpose, without wasting time on analyzing complex theories, it is necessary to prove experimentally that invisible universes corresponding to the corrected version of SRT, actually exist in nature. And it is possible to do it, if to see on a starry sky corresponding to them other constellations [84]-[89]. But that can only be done where no one has ever seen them before. And these other constellations⁷ (invisible outside the portals) can be seen in the starry sky in the portals, i.e. in the transitions between our visible universe and neighboring invisible universes. Similarly, as it is possible to see neighboring with our visible room, in which we are now, neighboring invisible room (or at least its edge to be convinced of its existence), only if you go into the corridor between the rooms. Portal are such corridor between universes.

And for this purpose, without wasting time on the analysis of these complex theories, let us try to prove experimentally that invisible universes corresponding to the corrected version of SRT, actually exist in nature. Then theoretical considerations on this subject will become unnecessary. And it can be done, if to see on a starry sky corresponding to other universes other constellations. But this can only be done where no one has ever seen them before. And these other constellations (invisible outside the portals) can be seen in the starry sky in the portals, i.e. in the transitions between our visible universe and neighboring invisible universes. Similarly, as it is possible to see neighboring to our visible room, in which we are now, the neighboring invisible room (or at least its edge to make sure of its existence), only if you go into the corridor between these rooms. Such corridors between universes are portals [90]-[92]. And the entrances to the portals are the so-called anomalous zones, of which there are many on our planet - more than a hundred thousand [93]-[96]. And in some of these anomalous zones even already placed observatories. As, for example, the Main Astronomical Observatory of the National Academy of Sciences of Ukraine, which is located in the Goloseevsky forest just 12 km. from the center of the capital of Ukraine, Kiev.

But people avoid going into portals. And rightly so, because portals are invisible labyrinths. That's why it's almost impossible to get out of them after accidentally entering them. But it is possible to create equipment for orientation in portals. It is also possible to use unmanned remote-controlled robotic means to explore portals. You just need to want to do all this.

It is even possible not to go far into the portals, but to limit ourselves to the use of anomalous zones (e.g., the above-mentioned Main Astronomical Observatory of the National Academy of

⁷ During the transition from one universe to another, the map of the starry sky in the portal, continuously changing all the time, smoothly transforms from the map of one universe into the map of the neighboring universe. But at the same time it will naturally differ from the map of the starry sky on the Earth outside the portal at any place in the portal

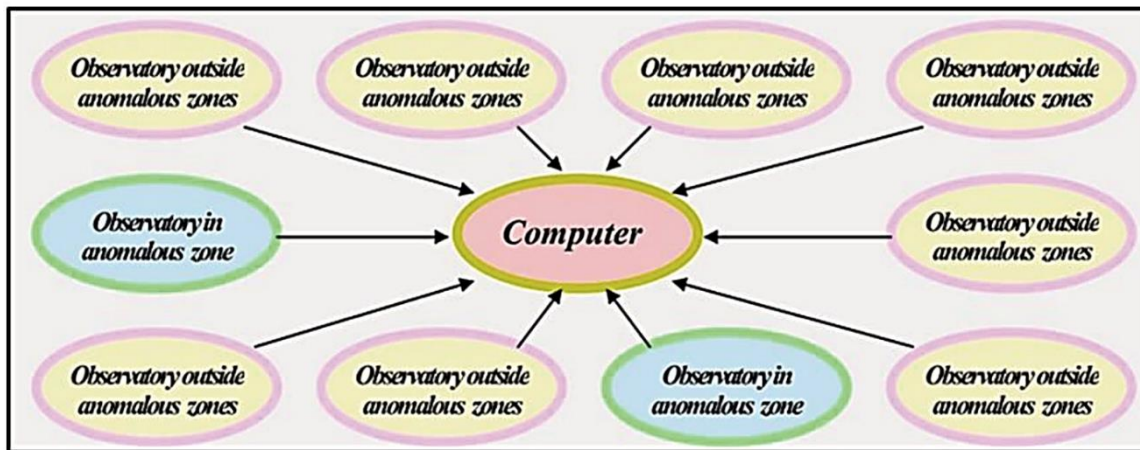


Fig. 7. Scheme of an astronomical experiment to detect invisible universes

Sciences of Ukraine). Although in anomalous zones, i.e., at the very edge of the portals, the change in the appearance of familiar constellations is very small, they can still be detected with modern equipment, comparing on the computer (Fig. 6) observations of the same areas of the starry sky by different observatories located both in the anomalous zones and outside the anomalous zones in the same region.

After all, the English astrophysicist Sir Arthur Stanley Eddington [97] was able to his famous experiment, similar to the one described above in Fig. 7, back in 1919 to confirm the predicted by the general theory of relativity deviation of light rays in the gravitational field of the Sun. That's what it means to actually want to.

8. Why hasn't this experiment been done yet?

So why hasn't this simple and very low-cost experiment has not yet been done? Even though in case of a positive result one could hope for a Nobel Prize for the discovery of invisible universes neighboring our visible universe. And in the case of a negative result, one could hope to get a very authoritative proof that Einstein and his theory were right. That is, any result of such an experiment is very important for science.

And because astronomers don't need the first result at all, so as not to complicate their relations with relativistic physicists. It is more important for them than even the Nobel Prize. And the second result, as they themselves realize, is very unlikely. But after realization of such experiment all scientific disputes about whether the version of SRT studied in physics textbooks is correct or incorrect, and also any references to string theory, to quantum physics and to nothing else will not be taken into account any more, as on this question will be received indisputably correct answer. And this answer is most likely to prove unambiguously the infidelity of the generally recognized version of SRT.

Even physicists themselves are sure of it. After all, if physicists hoped that this experiment would confirm the truth of the existing version of SRT, it would have been done long ago.

9. Civilizations and supercivilizations

But even if there were only our visible universe, then, despite the big bang theory, when exploring the cosmos it is impossible not to take into account that different stars with their planets arose in our visible universe at different times. And they still continue to arise. According to modern estimates, the number of galaxies in our visible universe alone is about $2E11$. And each galaxy contains about $1E8$ stars. Of these, at least $8E9$ contain Earth-like planets on which life is possible. And the ages of the stars are very different. For example, the star HE1523-0901 is $13.2E9$ years old, the Sun is $4.6E9$ years old, Sirius is $2.3E8$, and the recently discovered star Swift J1818.0-1607 is only about 240 years old. For comparison, recall that the age of our visible universe is about $13.8E9$ years. In the invisible universes of the hidden Multiverse and Gi-universe this diversity is surely even greater. And even the invisible universes themselves, contrary to the Big Bang theory, probably did not appear in nature at the same time. Consequently, at least on some planets, the age of the super-civilizations existing there exceeds the age of our earthly human civilization by billions of years. And comparing our civilization of the XXI century

with the human civilization, for example, of the IXX century, i.e. existing only 200 years ago⁸, it is not difficult to understand how much our civilization is surpassed by super-civilizations.

Therefore, the inhabitants of supercivilizations are real all-powerful Gods for us. And some information about these supercivilizations is contained (though in a in allegorical form to be somehow understandable to people) in the church books of all world religions.

But other civilizations also exist on Earth. These are numerous communities of living be-ings - mammals, birds, dolphins, even ants and bees - which form hierarchical structures united by common vital interests and coordinate their activities for the benefit of the whole community as a result of exchange by information between these living beings. Only these civilizations, unlike human civilization, are not machine civilizations.

And these non-machine civilizations are also of great interest for people, because due to the fact that other living beings have sensory organs different from those of humans, they possess knowledge about nature unknown to humans. For example, cats feel geopathogenic zones, which are not registered by any existing equipment. Consequently, there are some other physical fields unknown to people in the nature, besides electromagnetic and gravitational fields known to people. Cats can also cure people in some unknown way. But people don't know how they do it. And how to learn it from them.

10. Fermi paradox, which proves the existence of supercivilizations in other spatial dimensions.

The Fermi paradox is a statement of a seemingly paradoxical situation in which, on the one hand, it is known that there are many star systems suitable for life in the cosmos, and on the other hand, despite all the efforts of scientists, no signs of life have been found in this cosmos. And it would seem very strange [98]-[100].

But in fact there is nothing strange about this. After all, what are we looking for? What signs of life do we expect to see? The same as on Earth now? So that the same radio stations as on Earth would work, which, when transmitting signals, would spend most of their energy on transmitting signals to nowhere due to the use of a non-optimal directional diagram? So that, in addition, these radio stations would also spend a considerable part of their energy on out-of-band radiation? So that aliens would detonate atomic and hydrogen bombs? And so on.

But first of all, these are all defects of our imperfect civilization, which supercivilizations have long ago got rid of. And that's why they're invisible. And secondly, why not assume that we do not see their ships in space also because they have different logistics as a result of using their super knowledge. Even on Earth, people on their way to work in big cities often use the subway. And then their movement underground cannot be detected from space. But then it is necessary to recognize the existence of invisible parallel universes, portals between them and admit that the generally accepted version of SRT is wrong.

Besides, they certainly know stealth technology or some other super stealth technology. So the cost of all the searches for signs of life in space is money wasted.

And finally, why do we assume that as soon as people want to establish contacts with the inhabitants of supercivilizations, for example, on the Moon or on Mars, their inhabitants will immediately want to contact us? Always and everywhere to be or not to be contacts are decided by the masters of the situation. To be sure of it try to meet your director or minister at least. That is why in this situation the inhabitants of supercivilizations make decisions, not us. After all, we also do not seek contact neither with wild animals, nor with insects, nor with snakes that try to get into our dwellings. For example, rats are very smart and even in some situations, out of gratitude for the fact that the miners fed them, they sometimes saved their lives. Nevertheless, no one keeps rats as pets. And we lock our houses even from people we don't need.

And the inhabitants of supercivilizations are perfectly capable of protecting themselves to protect themselves from unnecessary human contact, even on Earth. For example, presumably in Shambhala. Or Antarctica. Or at the bottom of the oceans.

And another thing. Why do we seek contact with supercivilizations? We won't understand anything. After all, they have been sending us messages in the form of crop circles for centuries. But we don't have enough intelligence to read them. So we should not try to solve problems that are beyond human intellect. We need to increase our intelligence. And first we have to read the crop circles in the margins. And what to do next will be clear late

⁸ When russian writers A. S. Pushkin and M. Yu. Lermontov lived and wrote, there were no computers, no Internet, no cars, no rail transport, no aviation, and many other things that have become familiar to us in the 21st century.

11. The phenomenon of déjà vu, which proves the existence of super civilizations in other time dimensions

This is an extremely interesting phenomenon [101]. Déjà vu from French translates as "already seen". There have even been 84 films made on this topic at different times and in different countries.. The essence of the phenomenon is that practically every person (more precisely, about 97% of people) sooner or later, at least once in his life, found himself in a situation in which he had already been once before. Or so it seems to him. Psychologists have offered many medical explanations for this phenomenon. But all of them are not very convincing, since science does not know of any disease, much less a mental one, with which 97% of the world's population could have been infected (and how?).

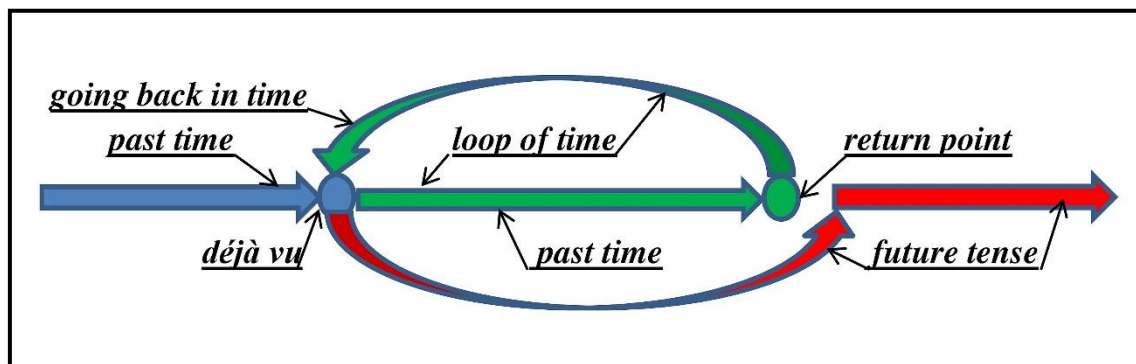


Fig. 8. Explanation of the phenomenon of déjà vu occurring as a result of intersection of timelines "going back in time" and "past time" with the formation of a "loop of time"

So let's offer another explanation, but this time a physical one. It is also quite unusual. Let's assume that this phenomenon is explained by interference in our life by our descendants from the distant future, who have unusually perfect computers capable of calculating our behavior down to the smallest detail, as well as time machines, with the help of which our descendants can move.

both to the past and future time. Which is plausible. And then these descendants of ours, in order to correct their existence in their future, go by time machines (and for them it is easier and cheaper than other variants of obtaining the same result) to our past and correct this past by algorithms created by supercomputers of the future (for example, Hitler's mother is married to another man). Then the inhabitants of the future, naturally, get to another future, which they like better. And in order not to lose any of their relatives, who have many other relatives and friends, etc., they have to interfere in the lives of all the people currently living on Earth. That is why the above-mentioned figure of 97% appeared.

And people of our time on Earth because of this interference in our lives of aliens from the future make a journey through a time loop (see Fig. 8). Which they then forget. Or our descendants from the distant future erase it from our memory. But because of the existence of the time loop, they have to actually visit the 'déjà vu' point twice. And this is not erasable from their memory.

12. The invisible afterlife world, where the Gods and souls of the dead dwell, really exists

But religions, unlike many modern scientific hypotheses that have not been confirmed experimentally, which for some reason in the twentieth century unreasonably began to be called theories, do not try to deceive people. At least because all world religions, without collusion, actually tell people about the same thing.

That there are Gods⁹. Well, it's true. It was explained above that the Gods are all-powerful inhabitants of super-civilizations in star systems that appeared billions of years before our solar system. And who help humans to become more civilized and advanced. Gods also through Religions somehow allegorically (and otherwise people would not understand anything and this information was not preserved to the next generations) explain to us the structure of the world in which they and we actually

⁹ The most prominent thinkers, both churchmen and scientists, have argued about who God is and whether God really exists for many millennia. And they are still arguing today. For example, in 2008, Polish mathematician Michael Heller received the Templeton Foundation Prize for his proof of God's existence. At the same time, they all understand God as a non-material omnipotent and omniscient entity that is the creator of our material and spiritual world, in particular, of all living beings and the universe. But all their proofs and refutations of these proofs are unsubstantiated, never supported by references neither to any physical facts and experiments, nor to mathematical calculations. That is, their arguments are not direct physical arguments, but merely indirect logical ones. And therefore for opponents they are mutually unconvincing. However in this publication physico-mathematical most indisputably proves that Gods are quite material omnipotent and super intellectual inhabitants of super civilizations existing in invisible universes and antiverse of the Hyperuniverse, which are older than our visible universe by billions of years.

live. Church books are therefore invaluable teaching aids for us to learn the science of the distant future. They also try to instill in us a more humane morality of these super-civilizations (e.g., in the form of Christ's commandments), in contrast to the far from perfect morality that people live by today. And largely due to the efforts of Religions, people are becoming more and more humane.

But Gods and the souls of the dead also have to be somewhere. The invisible world in which they dwell in religions is called beyond the grave. And as it is shown above in the hidden Multiverse and Giperuniverse there are many (perhaps even infinitely many) mutually invisible parallel universes in which there are inevitably super-civilizations. Which therefore may be this invisible afterlife world.

Religions also tell us that people have an immortal soul that passes into this afterlife world after death. There are many testimonies of this from people who have been in a state of clinical death. And the author believes that this is also true. Therefore, the author is happy that after his death he will be able to reunite with his beloved parents, his wife and his wife's parents.

But in the version of STR, studied in physics textbooks, the existence of an invisible afterlife is denied for quite understandable reasons. It and its inhabitants - Gods, souls of the dead and others - simply have no place in this, the only one existing in nature according to the generally accepted version of STR, our visible Universe.

13. Conclusion

Thus, in the article it is experimentally proved and theoretically explained that up to now studied in all textbooks of physics the version of SRT, created in the XX century, is incorrect, because:

- the relativistic formulas obtained in it are incorrect;
- these formulas are incorrectly explained using the incorrect postulate called the principle of non-exceeding of the speed of light;
- from these formulas wrong conclusions about physical unreality of imaginary numbers and about existence in the nature of our only visible universe in which everything is measured only by real numbers are made.

But in the XXI century, a corrected version of the STR was created, in which, instead of the incorrect postulate about not exceeding the speed of light, an experimentally proven principle of the physical reality of imaginary numbers is used. And the physical reality of such numbers is proven by the existence of not only electrical engineering, radio engineering and computer technology (which was written about above), but also by the existence of the natural phenomenon of tsunamis and even swings swinging on playgrounds, as well as music created by pianos and other musical instruments. What more convincing refutations are needed? After all, these refutations have not been refuted by anyone.

Thus, naturally, the postulate of the generally accepted version of STR about not exceeding the speed of light, from which this conclusion about the physical unreality of imaginary numbers was made, is also experimentally refuted. For the same reasons, the conclusion about the existence in nature of our only visible universe is also refuted. And instead, it is asserted that in fact, in addition to our visible universe, there are many other mutually invisible parallel universes. The corrected version of STR also explains that the existence of these invisible universes can be experimentally proven by astronomical observations in the starry sky in the portals of constellations that are invisible outside the portals.

But the significance for science of the principle of physical reality of imaginary numbers is not limited to the possibility of correcting the generally recognized version of SRT. From this principle follows the necessity of corresponding correction in exact sciences of all theories and hypotheses in which imaginary numbers are used.

It also follows from this principle that around us there exists not only the visible world known and clear to us, but also a much larger and not yet completely cognized by us invisible world [102]-[111]. Including the invisible afterlife world [112]-[123], where Gods, souls of the dead and numerous other inhabitants of supercivilizations dwell.

The author hopes that the realization of all this will encourage Science and Religion to cooperate mutually beneficially in their activities for the benefit of people.

Acknowledgments

The author sincerely thanks his wife Olga Ilyinichna Antonova for her participation in the discussion, understanding and valuable advice, with whose support he also wrote the book "A Corrected Version of the Special Theory of Relativity". And for its publication he is now looking for a sponsor and publisher.

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Medical sciences

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ONCOLOGICAL SCREENING IN KAZAKHSTAN: STATISTICAL ASPECTS, METHODOLOGY AND NEWEST RESULTS

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Abstract

In this scientific and analytical work, the indicators of incidence and mortality from cervical cancer, breast cancer and colorectal cancer in the regions of our country are considered. The screening methods currently used and the results of this preventive survey of the population are described in detail. Detailed step-by-step algorithms are presented, and the principles of organization and diagnostic capabilities of the screening program for the active detection of these nosological forms of malignant neoplasms in clinically asymptomatic individuals are reflected.

Keywords: *cervical cancer, breast cancer, colorectal cancer, epidemiology, incidence, mortality, screening, Pap test, smear for oncocytology, mammography, hemocult test, fecal occult blood test - FOBT, total colonoscopy.*

Today, one of the most important postulates of the oncology service continues to be the early diagnosis of malignant tumors. The purpose of screening is to identify asymptomatic (preclinical) cancer or precancerous conditions in an otherwise healthy target population. In this case, screening plays a leading role in secondary cancer prevention. The key concept of cancer screening is to identify pathology at a stage of development when the effectiveness of treatment is maximum and the prognosis is most favorable. When precancerous diseases are detected during screening, secondary prevention methods allow to prevent the transition of the initial pathological state to cancer. In this case, the main conditions for screening are the presence of trained personnel and a standard approach to identifying the trait being studied and evaluating the results. The methods used must be sufficiently simple, reliable and reproducible, as well as have sufficient sensitivity and high specificity [1-3].

Screening plays an important role in improving early diagnosis and treatment outcomes. According to the Guide to Cancer Early Diagnosis by Ilbawi A. et al. [4], screening aims to detect unrecognized cancer or its prior lesions in a typically healthy, asymptomatic population through tests or other procedures that can be applied quickly and are widely available to the target population. In screening, the target

population is assessed for unrecognized cancer or precancer, and most people tested will not be diagnosed with the disease. Screening should be seen as a process and not as the performance of a specific test, examination, or procedure. The screening process includes a system of informing and inviting the target population to participate; administering the screening test; following-up with test results and referral for further testing among those with abnormal test results; ensuring timely pathologic diagnosis, staging and access to effective treatment with routine evaluation to improve the process. A screening program encompasses the process from invitation to treatment and requires planning, coordination and monitoring and evaluation.

To date, the republican oncological screening program includes three nosological forms of malignant neoplasms - cervical cancer (CC), breast cancer (BC), colorectal cancer (CRC). Let's consider the current epidemiological indicators, methodology and results of cancer screening in our country.

CC in the structure of all malignant tumors of both sexes of the population in 2022 took 6th place with a share of 5.51% (2021 - 4th place, 5.54%), in women - stable 2nd place - 9.7% (9.7%) [5].

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

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

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

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

Below the national average, mortality was recorded in Abay region, cities Astana, Shymkent - 2.9 per 100 thousand population, Mangistau - 2.8 (3.0), Turkestan - 2.3 (2.2), Aktobe - 2.2 (3.0), North - Kazakhstan - 2.0 (2.6), Kyzylorda regions - 1.7 (3.5) - the best result [5].

In 12 regions, a 100% level of morphological verification of the diagnosis was ensured, the lowest or worst indicator for the third year was in the Kyzylorda region - 94.3%, below the national average indicators in Akmola - 98.8%, Atyrau - 98.9%, Kostanay - 98, 9%, Mangistau - 97.6%, Pavlodar - 96.6%, regions and Almaty city - 98.5%;

In a number of regions, the frequency of diagnosis of stage I-II CC was below the national average (88.1%) - in Akmola - 76.2% (2021 - 73.6%) - the worst result in the country, in Karaganda - 77, 2%, Zhetysu - 82.9%, Abay - 83.8%, Kostanay - 84.3%, Aktobe - 85.5%, West Kazakhstan - 85.7%, Pavlodar - 81.3%, while that in the Atyrau region - 100.0% result.

The proportion of stage IV CC is higher than the national average (2.7%) in the following regions: the worst result is in Zhetysu (6.1%), above the national average in Karaganda - 5.1% (2021 - 5.6%), Akmola - 4.8% (2.3%), Kostanay - 4.5% (4.4%), North Kazakhstan - 3.9% (7.4%), Almaty - 3.7 % (5.1%), Zhambyl - 2.9% (0.0) regions, cities Almaty - 3.6% (1.8%) and Shymkent - 3.8% (5.9%). The lowest neglect is in the East Kazakhstan region - 1.0% (0.7%).

Late diagnosis rates (III-IV stages) for CC are above the national average - 11.9% (15.4% in 2021) were noted in Akmola - 23.8% (2021 - 26.4%) - worst result, Karaganda - 22.8% (35.2%), Pavlodar - 18.8% (20.8%), Zhetysu - 17.1% (24.2%), Abay - 16.2% (12.8%), Kostanay - 14.6% (15.6%), Aktobe - 14.5% (9.6%), West Kazakhstan - 14.3% (32.4%) regions. The lowest neglect is in the Mangistau region - 6.0% (20.8%).

Across the country, the five-year survival rate of patients with CC registered in 2018 was 59.9% in 2022, with a decrease from the level of 2021 (67.5% for those registered in 2017), and with a significant range in by region, from the maximum - 72.9% (2021 - 70.7%) in the North Kazakhstan region, to the minimum - 34.9% (64.4%) in the Atyrau region [5].

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

Type of screening - population. The purpose of screening is to identify pre-invasive diseases of the cervix with subsequent recovery. The screening method is a cytological examination of a smear for oncocytology from the cervix (traditional and liquid cytology). Coloring according to the "Papanicolaou

test" (Pap test). Interval - 1 time in 4 years. Target group: women aged 30-70 years who are not registered in the dispensary for CC. The expected results are a decrease in incidence and mortality from CC.

Screening steps:

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

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

3) The final one is obtaining the results of cytology, informing the woman and developing further management tactics, fill out accounting and reporting statistical documentation. Responsible for the final stage of screening is the obstetrician-gynecologist of primary health care [6].

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

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

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

There are certain features when taking material for oncocytology: firstly, the examined woman should be informed about the exclusion of sexual intercourse, vaginal manipulations, including douching, baths, tampons, etc. 2 days prior to sampling. Taking material for cytological examination is carried out by the midwife of the examination room of the department of medical examinations of the primary health care organization: the traditional method (2 glasses - with obligatory fixation in 96% alcohol, it is preferable to use glass slides with a polished edge, which are easily marked) or the liquid cytology method (one container with stabilizing liquid); the code or surname of the patient, identical to the code and surname in the form for sending material for cytological examination, should be clearly marked on the glasses or container [6].

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

A cytological study is carried out in centralized cytological laboratories at oncological institutions, where an archive of cytological preparations of patients involved in the screening examination is formed,

regardless of the result, for a period of at least 10 years with the formation of a computer database.

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

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

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

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

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

High detection of CC during screening is ensured in Aktobe, Almaty, Atyrau, East Kazakhstan, Kyzylorda, Pavlodar, North Kazakhstan, Turkestan regions and Shymkent city. The detection rate in these regions ranges from 0.55 to 1.59 per 1000 women examined. The best indicator is in Atyrau region - 1.59. Compared to 2021, there is an increase in detection in 10 regions, with the exception of Akmola, Aktobe, Zhambyl, Kostanay, Mangistau, North Kazakhstan regions and Shymkent city. The worst result in Astana is 0.15 per 1000 women examined [5].

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

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

Localized processes (stages I-II) were identified in 99.2% of all cases of detected cancer (96.5%). In the Akmola and Karaganda regions, cases of CC were identified not only in localized, but also in widespread stages of the process. A total of 3 cases of CC in stage III and no cases in stage IV were identified (11 and 0, respectively) [5].

BC ranks first in the structure of the frequency of malignant tumors of both sexes in the population with a share of 14.7% (2021 - 15.4%). This situation has been stable since 2004; in addition, BC ranks first and remains consistently in this position in the structure of female oncopathology. The incidence of BC in 2022 in the country as a whole increased to 26.5 per 100 thousand (2021 – 26.3). In the structure of cases, BC occupies the 1st ranking place in the vast majority of regions and cities of the country, except for three: Akmola, Kyzylorda and North Kazakhstan regions, where lung cancer takes the 1st ranking place [4].

Above the national average - 26.5 per 100 thousand of us. – incidence of BC in 10 regions of the country: Abay – 33.3, Akmola – 32.7 (2021 – 29.8), East Kazakhstan – 44.7 (39.9) – the highest level, West Kazakhstan – 31.2 (28.4), Karaganda – 40.2 (40.1), Kostanay – 37.5 (35.8), Pavlodar – 43.2 (47.4), North Kazakhstan – 34.7 (38.2) regions and Almaty city – 35.4 (34.5), Astana city – 31.5 (28.4). Below average indicators per 100 thousand of us. in Aktobe - 21.6 (24.3), Almaty - 21.9 (17.7), Atyrau - 22.8 (15.7), Zhambyl - 14.2 (15.1), Zhetysu - 22.8, Kyzylorda - 14.6 (14.4), Mangistau - 14.7 (17.3), Turkestan - 11.3 (11.7) regions and Shymkent city - 14.9 (21.9) [5].

BC ranks third in the structure of causes of death from malignant tumors in the population of both sexes for the thirteenth year in a row, amounting to 8.1% in 2022 (2021 – 8.7%). In the republic as a whole, mortality from BC decreased by 13.0%, from 6.2 to 5.4 per 100 thousand people.

The regions where mortality from BC is higher than the national average include: Abay - 10.1 per 100 thousand people (maximum level), East Kazakhstan - 8.0 (2021 - 8.5), Pavlodar - 7.1 (10.0), North Kazakhstan - 7.0 (11.4), Kostanay - 6.9 (7.5), Akmola - 6.5 (8.2), West Kazakhstan - 5.7 (6.9), Zhambyl - 5.5 (4.8) and Astana city – 6.3 (6.6), Almaty city – 6.6 (9.5). The indicators are significantly lower in Aktobe - 4.5 (3.5), Almaty - 4.5 (5.8), Zhetysu - 4.0, Atyrau - 3.7 (3.0), Kyzylorda - 4.4 (4.1), Turkestan - 3.6 (3.6), Mangystau regions - 2.7 (3.6) - the lowest level [5].

Mass screening to identify BC patients should mainly involve healthy women without any signs of the disease or symptoms. Screening not only helps to detect hidden forms of cancer that can be treated,

but also has psychological value for women. As a result of screening, women are convinced that they do not have BC, and this is the most important potential success of such programs. While the ultimate goal of screening is to reduce BC mortality, its immediate goal is to detect cancer before clinical manifestation. However, BC is a heterogeneous disease, which can significantly affect the effectiveness of screening. Screening models for BC are usually based on the fact that the majority of detected tumors are invasive cancers in the early stage of progression. In addition, it must be taken into account that the detection of cancer (or its precursors) before clinical manifestation increases the risk of false positive diagnosis [7,8].

Mammography has a sensitivity of 95% and a specificity of 97%. These indicators decrease when examining women with denser mammary glands (young age, use of hormone therapy), with low quality mammography, and also with insufficient qualifications of the radiologist. Detection of high-grade invasive cancer by screening, when the tumor is not yet detected by clinical examination (palpation), means the possibility of reducing mortality from BC [9].

Preventive screening for early detection of BC in the Republic of Kazakhstan includes [10]:

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

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

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

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

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

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

◆ The radiologist of the mammography room of the Cancer Center: evaluates the quality of the provided images and the correctness of the styling. Viewing digital x-ray images transferred to the server or on digital media (CD, DVD) is carried out on a monitor for interpreting digital x-ray images with a resolution of at least 5 megapixels, which has a certified grayscale transmission in accordance with the DICOM standard; conducts a double (second) reading of mammograms with the interpretation of the results according to the BI-RADS classification, using, if necessary, archival images. Organizes the third reading according to indications. With double reading, an independent interpretation of the images is

carried out (blinding method - the second radiologist does not know the results of the first reading); in the M0m category (technical errors in mammography), recommends repeat mammography; in the M0d category (uncertain or suspicious radiographic changes requiring additional examination), the study protocol indicates the predominant pathology: education; asymmetry, violation of architectonics, microcalcifications; recommends that the outpatient care organization, according to indications, invite the patient for in-depth diagnostics (targeted mammography, ultrasound of the mammary glands, trephine biopsy, including under ultrasound or stereotaxic control, followed by histological examination of the material); collects and archives all mammograms (films and electronic media) made as part of the examination. The shelf life of mammograms is at least 3 years after leaving the age subject to a screening study; the results of the double (second) reading are transferred to the outpatient care organizations through information exchange.

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

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

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

◆ Physician or responsible person of the outpatient care organization:

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

- in case of M0t (technical errors in mammography) - sends the patient for a second X-ray examination to the mammography room of the city, district polyclinic (mobile medical complex);

- with M0d (undefined or suspicious X-ray changes requiring additional examination) - sends the patient for in-depth diagnostics to the mammography room of the Cancer Center;

- with M1 (no changes detected) - recommends that the patient undergo a follow-up mammography examination after 2 years. With radiological density of the mammary glands, C and D are sent for ultrasound of the mammary glands to exclude a false-negative result of mammography;

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

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

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

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

- benign education - refers the patient to an oncologist (mammologist) of the clinical diagnostic department for dynamic monitoring, followed by a screening mammography examination after 2 years;

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

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

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

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

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

Let's analyze the results of BC screening. Mammography screening identified 1,570 cases of BC in 2022 (1,402 in 2021). The cancer detection rate increased from 1.78 to 1.94 per 1000 examined. The best result is in the Karaganda region – 2.63 per 1000 women examined. Low detection rate per 1000 examined, compared to the republican average, in Atyrau (1.72), Zhambyl (0.58), Kyzylorda (1.68), Mangistau (0.42 - worst result), Turkestan (1.22) regions and cities Astana (1.5) and Shymkent (1.58). Compared to 2021, there was an increase in the detection of BC in 9 regions, with the exception of Aktobe (decrease from 2.87 to 2.19 per 1000 women examined), Karaganda (from 2.73 to 2.63), Mangistau (from 1.10 to 0.42), North Kazakhstan (from 3.27 to 2.31), Turkestan (from 1.36 to 1.22) regions and cities Astana (from 1.54 to 1.50), Almaty (from 2.24 to 2.18) and Shymkent (from 2.35 to 1.58) [5].

In 2022, the proportion of patients identified during screening studies with early stages of BC (stage 0-I) was 50.2% during screening (in 2021 - 47.9%). A high proportion of stages 0-I BC (over 50%) was recorded in 8 regions (in 8 in 2021): Akmola, West Kazakhstan, Karaganda (70.8% - best result), Pavlodar, North Kazakhstan, Turkestan regions, cities Astana and Shymkent. Low levels of early detection of BC (below 40%) were noted in Aktobe (19.3% - worst result), Zhambyl (34.8%), Kostanay (39.5%), Mangistau (27.3%) regions and Almaty city (37.3%). Localized cancer (0-I and II stages) amounted to 96.2% (2021 - 95.5%), while not a single case was detected in stages III-IV in Atyrau, West Kazakhstan, Zhambyl, Kyzylorda, Mangistau, Pavlodar regions, cities Astana and Shymkent. A total of 46 cases of breast cancer in stage III and 14 in stage IV were identified (52 and 11, respectively) [5].

Epidemiological indicators of CRC in the form of colon cancer and colorectal cancer are considered separately for objective reasons.

Colon cancer with a specific gravity of 5.53% (2021 - 5.2%) in the structure of oncopathology of both sexes of the population has risen to 5th place, in men it remains in 6th place - 5.8% (5.5 %), for women - in the 5th - 5.3% (4.91%) The incidence rate of cancer of this localization in the country in the reporting year increased from 8.8 to 9.95 per 100 thousand population.

The incidence of colon cancer in 10 regions is higher than the national average - 9.95 per 100 thousand population: Kostanay - 20.7 (2021 - 15.9), Pavlodar - 18.8 (15.3), North Kazakhstan - 18, 0 (12.7), East Kazakhstan - 16.9 (13.4), Karaganda - 15.4 (15.0), Akmola - 14.6 (10.2), West Kazakhstan - 11.0 (10.1), Abay - 10.0 (9.0) regions and cities Almaty – 12.8 (12.1) and Astana – 10.5 (9.0). As in 2021, colon cancer was detected much less frequently in Turkestan - 3.1 per 100 thousand population (2.7), Kyzylorda - 4.1 (4.6), Zhambyl - 5.5 (5.8), Almaty - 6.3 (4.7), Zhetysu - 6.4, Mangistau - 6.8 (4.9) regions and Shymkent city - 5.0 (4.0) [5].

Rectal cancer in the structure of malignant neoplasms of both sexes retains 7th place in rank with a specific gravity of 4.9% (2021 - 4.92%), but in men it dropped from 4th to 5th place - 6.1%, for women – from 9th to 10th – 4.0%. The incidence rate per 100 thousand population increased from 8.4 to 8.8.

A high incidence rate was recorded in Kostanay - 17.8 per 100 thousand population (2021 - 16.2), East Kazakhstan - 17.7 (13.9), North Kazakhstan - 15.6 (15.1), Pavlodar – 14.9 (18.1), Karaganda – 13.3 (11.7), Abay – 12.9, West Kazakhstan – 12.9 (9.8), Akmola – 10.3 (13.1) regions and Astana city – 10.3 (9.0). Traditionally, a low incidence of rectal cancer is observed in Mangistau - 3.1 (2.8), Turkestan - 3.3 per 100 thousand population (2.7), Zhambyl - 3.7 (5.1), Kyzylorda - 4, 1 (5.3), Almaty – 5.3 (5.6) regions and in Shymkent city – 5.5 (5.0) [5].

Rectal cancer in the structure of causes of death from malignant neoplasms of the population of both sexes in 2022 remained in 5th place with a share of 5.41% (2021 – 5.41%). In the republic as a whole, the mortality rate from this form of cancer was 3.6 per 100 thousand population (3.87).

The mortality rate per 100 thousand population was higher than the national average in East Kazakhstan - 7.8 (2021 - 8.6) - the maximum level, Pavlodar - 7.5 (7.6), Abay - 5.9, North Kazakhstan - 5.8 (4.3), Kostanay - 4.9 (4.9), West Kazakhstan - 4.8 (4.2), Karaganda - 3.8 (5.2) regions. Below the national average - 3.8 per 100 thousand population, mortality in Aktobe - 3.2 (4.1), Almaty - 2.6 (2.6), Atyrau - 2.5 (3.4), Zhetysu - 2, 6, Zhambyl - 3.3 (2.7), Turkestan - 2.1 (1.6), Mangistau - 1.9 (1.2), Kyzylorda regions - 1.8 (2.1) - the lowest figure, and cities Almaty – 3.7 (4.3), Shymkent – 2.6 (2.1).

Colon cancer in the structure of causes of death from malignant neoplasms of the population of both sexes in 2022, as in 2021, ranks 6th, with a share of 5.2% (2021 – 5.0%). At the same time, the mortality rate in the country decreased by 5.6%, from 3.6 to 3.4 per 100 thousand population.

Mortality rates in 10 regions are higher than the national average: East Kazakhstan - 7.1 per 100 thousand population (2021 - 5.1) - maximum level, Pavlodar - 5.6 (6.0), Kostanay - 5.3 (5.6), Akmola – 5.2 (3.8), Abay – 5.1, Karaganda – 5.1 (5.6), West Kazakhstan – 4.8 (4.4), North Kazakhstan – 4.8 (5.0) regions and cities Astana – 3.6 (2.7), Almaty – 4.5 (5.3). Low mortality rates from colon cancer were

noted in Kyzylorda - 1.2 per 100 thousand population (2.7) - the best result, Turkestan - 1.3 (1.7), Mangystau - 1.6 (2.6), Aktobe - 2.0 (2.5), Zhetysu - 2.4, Zhambyl - 2.5 (3.7), Atyrau - 2.5 (1.8), Almaty - 2.6 (1.8) regions and cities Astana - (2.7), Shymkent - (2.4).

For colon cancer (94.0%) - 100% verification level was achieved in 3 regions (Abay, Almaty and Turkestan regions), high rates in the Astana city (98.5%), Shymkent city (98.0%), Zhambyl (98.4%), Atyrau (98.2%) regions, low - in Akmola region (86.7%), Almaty city (84.3%), in the Kyzylorda region (61.8%) - the worst result since 2017.

For rectal cancer (97.4%) - in 6 regions there is a 100% verification level, the worst level is still in the Kyzylorda region - 85.3%, lower than the republican average in the Akmola region - 92.6%, Aktobe region - 96.8%, Mangystau region - 87.0%, Pavlodar region - 95.3%, Almaty city - 93.2% [5].

The frequency of diagnosis of stage I-II rectal cancer, as a visually accessible localization (68.9% - national average) in the regions, was: in Akmola - 34.6% - the worst result, as in 2021, in the country (2021 - 44.1%), Mangystau - 47.8%, Abay - 53.9%, West Kazakhstan - 59.1%, Almaty - 66.2%, Zhetysu - 68.6%, Karaganda - 65.7% regions and Shymkent city - 62.9%.

For colon cancer (52.4%), early diagnosis rates are higher in Pavlodar (65.9% - best result), Abay, Aktobe, Atyrau, East Kazakhstan, Zhambyl, Zhetysu, Karaganda, Kostanay, Pavlodar, North Kazakhstan, Turkestan regions and Shymkent. The lowest figure (23.5%) is in the Kyzylorda region.

For colon cancer (17.3%), the rates of neglect at stage IV are higher - in Akmola - 31.0% - the worst result (2021 - 20.3%), Zhetysu - 27.3%, Abay - 23.1%, Turkestan - 22.2% (29.1%), Karaganda - 28.1% (28.6%), West Kazakhstan - 18.8% (8.2%), Mangystau - 17.6% (19.4%) regions and cities Astana - 18.0% (22.9%), Shymkent - 20.0% (22.7%). The lowest level of neglect is 2.9% in the Kyzylorda region (7.9%).

The proportion of stage IV in rectal cancer (13.1%) is higher in Akmola - 29.6% - the worst result (2021 - 19.4%), Abay - 19.7%, Kyzylorda - 17.6% (9.1%), Karaganda - 16.9% (28.4%), Almaty - 15.6% (17.0%), Kostanay - 14.8% (11.1%), Zhambyl - 13.3% (13.6%) regions and Shymkent city - 14.5% (12.5%). The lowest level of neglect - 6.0% - is in the Atyrau region (12.5%).

Late diagnosis of rectal cancer as a visually accessible localization (stages III-IV) in 2022 amounted to 31.1% (in 2021 - 33.5%).

For rectal cancer, the level of neglect is higher than the national average - 31.1%, the indicators in Akmola - 65.4% (2021 - 55.9%) - the worst result in the country, Mangystau - 52.2% (38.1%), Abay - 46.1% (30.6%), West Kazakhstan - 40.9% (25.4%), Karaganda - 34.3% (46.5%), Almaty - 33.8% (35.7%), Zhetysu - 31.4% (34.1%) regions and Shymkent city - 37.1% (42.9%). The lowest neglect is in the Atyrau region - 12.0% (17.5%).

In the country as a whole in 2022, the five-year survival rate of patients with CRC registered in 2018 decreased to 40.4% (2021 - 52.9% for those registered in 2017); there is a significant dispersion of indicators by region, from maximum - 56.1% (47.5%) in the Kyzylorda region, to minimum - 24.3% (51.5%) in the Aktobe region [5].

Screening of CRC screening is the systematic use of screening studies in an asymptomatic population. The purpose of screening is to identify people with abnormalities suggestive of CRC. These persons in the future need additional examination to clarify the diagnosis. Opportunistic screening is the non-systematic use of screening tests in routine medical practice. A screening program is much more challenging than an early detection program. At the same time, the success of the screening program is largely determined by the awareness of the population and medical workers about the possibilities of early diagnosis of CRC. The feasibility of a screening program is determined by several factors that relate to the disease being screened, the screening test, the characteristics of the population, and the characteristics of the healthcare system.

The first factor is that the disease must be well understood, common enough in the target population to justify screening, have a recognizable early stage; treatment of the disease at an early stage should be more effective than at a later stage.

The second is that the test should be characterized by sufficient sensitivity, i.e. the ability to detect cancer among people with the disease; sufficient specificity - the probability that among people who do not have a disease, the test result will be negative; have a high positive predictive value (positive predictive value) or, in other words, the likelihood that people with a positive test result have the disease; have a high predictive value of a negative result (negative predictive value), i.e. the likelihood that people with a negative test result do not have the disease; security; low cost; and acceptability - the likelihood that people for whom this test is intended will agree to the examination (which to some extent depends on the awareness of the population about the possibilities and importance of early diagnosis).

The third factor is that the healthcare system should be ready for maximum screening test

coverage of the target group, have the resources to confirm the diagnosis, appropriate treatment and follow-up of people with positive test results, and regularly conduct screening tests at regular intervals. At the same time, the benefits of screening must outweigh the potential physical and psychological harm and justify the financial costs of its implementation [11].

The factors most significant for the development of CRC are:

- the presence of chronic inflammatory bowel diseases, adenomatous polyps, cancer of other localization, etc.;

- family history (presence of one or two first-degree relatives with CRC or familial diffuse intestinal polyposis);

- the age of men and women over 50 years old, taking into account the fact that more than 90% of patients with colorectal cancer are people of this age (medium risk).

Age, regardless of gender, is an important risk factor for CRC. After the age of 50, the incidence of CRC increases from 8 to 160 per 100,000 population. Thus, people who have reached the age of 50, even in the absence of symptoms, constitute a moderate risk group for CRC.

The second category of increased risk of CRC (20%) is made up of persons with a genetic and family predisposition, suffering from chronic inflammatory bowel diseases, diffuse familial polyposis.

The high-risk CRC group is determined by the so-called Amsterdam criteria (the presence of malignant tumors in two generations, the presence of cancer in a first-line relative under the age of 50 years), in this case, CRC screening should be carried out after the age of 30 years [12].

The degree of individual risk of developing CRC is determined before screening to select the scope of studies and the frequency of their conduct.

The interval for oncological colorectal screening is 1 time in 2 years, target group: men and women aged 50-70 years, with the exception of persons registered at the dispensary for CRC and colon polyposis. At the same time, when forming the target group, one should take into account the absence of severe concomitant diseases, such as the presence of a common malignant neoplasm, cerebrovascular diseases in the stage of decompensation, chronic obstructive pulmonary disease with respiratory failure, cirrhosis of the liver, myocardial infarction with congestive heart failure, diabetes mellitus with vascular complications. and others, which are highly likely to lead to death in the next 10 years.

The first step in screening for CRC is the fecal occult blood test (FOBT). Traditionally, such methods include a benzidine test for occult blood in the feces. This is a biochemical method based on the assessment of pseudoperoxidase activity of hemoglobin. There is ample evidence that invitation to guaiac FOBT screening (gFOBT) reduces CRC mortality by approximately 15% in age-matched average-risk populations.

To ensure the effectiveness of screening with gFOBT, the interval for screening under the national screening program should not exceed two years. To date, there is an immunochemical FOBT method - iFOBT, which is superior in efficiency to gFOBT in terms of the probability of detecting adenoma and cancer. iFOBT has improved analysis performance compared to gFOBT.

Immunochemical (immunochromatographic) examination of feces for occult blood - iFOBT or hemocult test is carried out for all men and women of the target group using an express method, which allows you to get a result within 3-5 minutes, without the participation of a medical worker. However, the evaluation of the test is carried out only by a medical worker in the PHC preventive department.

With a positive analysis of feces for occult blood, the second stage of colorectal screening is performed, which consists in endoscopic examination of the colon - total colonoscopy [6]. At the same time, in this case, this medical manipulation is of a therapeutic and diagnostic nature, since it allows one-stage removal of adenomatous polyps, which, according to various authors, occur in every third subject after 50 years of age. At the same time, women have 20% fewer polyps than men, but they have more right-sided lesions, which are more difficult to detect using fecal blood tests, because they are less traumatic [13, 14].

What results were obtained from screening for CRC? In 2022, 937,859 men and women of the target group aged 50 to 70 years were examined during colorectal screening (in 2021 - 920,640) [5].

Colorectal screening revealed 325 cases of colorectal cancer in the reporting year, which is 114 cases more than in the previous year (211 cases). The detection rate increased from 0.23 to 0.35 per 1000 patients examined. Low detection of colorectal cancer was noted in Zhambyl, Karaganda, Kostanay, Kyzylorda, Mangistau, Turkestan - the worst result, East Kazakhstan regions, Astana city - from 0.07 to 0.30 per 1000 examined. The best result is in the North Kazakhstan region – 0.81 per 1000 examined. Compared to 2021, there was a decrease in the detection of colorectal cancer per 1000 people examined during screening in Karaganda (from 0.22 to 0.21), Kostanay (from 0.29 to 0.28), Mangistau

(from 0.20 to 0.12) regions and Astana city (from 0.20 to 0.19).

Colon precancer (adenoma detection rate) was detected in 27.5% of patients who underwent colonoscopy (2021 – 22.8%). The detection rate of precancer in Akmola, Aktobe, Almaty (8.5% is the worst result), West Kazakhstan, Zhambyl, Kostanay, Kyzylorda, Mangistau, Pavlodar, North Kazakhstan, Turkestan regions and cities is lower than the national average Astana and Shymkent. The best result is 36.2% in Almaty city. It should be noted that the planned indicator for the detection of precancer of the colon and rectum in the country for 2022, according to the Comprehensive Plan, was 23.0% and was achieved.

In 2022, the proportion of patients identified during screening studies with early stages of malignant neoplasms (stages 0-I) was 26.2% during colorectal screening (in 2021 - 27.5%).

High early detection of colorectal cancer (above 30%) was noted in Akmola, West Kazakhstan, Karaganda, Kostanay, Kyzylorda, Turkestan regions and Astana city (57.1% - the best result). Not a single case of early cancer has been identified in the Mangistau region. Cases of cancer in stages III-IV detected during screening were registered in Akmola, Aktobe, Almaty, West Kazakhstan, Zhambyl, Karaganda, Kostanay, Mangistau regions and Almaty city. A total of 21 cases of colorectal cancer in stage III and 3 in stage IV were identified (in 2021 - 18 and 5, respectively) [5].

The complex analysis carried out allows us to conclude that satisfactory results of cancer screening can be achieved only with its proper organization, high quality of implementation, active participation in population screening, the use of highly sensitive tests and instrumental methods of preventive examination, as well as subsequent accurate diagnosis of identified tumors and timely treatment. High-quality screening leads to early diagnosis of pedological diseases and malignant pathology in the early stages, which, in turn, increases the effectiveness of treatment and improves the prognosis of the disease. Target groups that, for one reason or another, do not participate in screening should be informed that there are no other methods other than screening that would reduce mortality from malignant neoplasms. Incidence and mortality rates from cervical cancer, breast cancer and colorectal cancer clearly reflect the epidemiological situation with this pathology in the regions of our country.

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FLAVONOIDS OF PLANT ORIGIN IN CHRONIC RESPIRATORY PATHOLOGY AND MECHANISMS OF THEIR ACTION

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ФЛАВОНОИДЫ РАСТИТЕЛЬНОГО ПРОИСХОЖДЕНИЯ ПРИ ХРОНИЧЕСКОЙ ПАТОЛОГИИ ДЫХАТЕЛЬНЫХ ПУТЕЙ И МЕХАНИЗМЫ ИХ ДЕЙСТВИЯ

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Abstract

It is known that acute respiratory diseases occupy the first place among acute infectious pathologies of the respiratory tract in both children and adults. Respiratory viruses can cause exacerbations of chronic diseases of the respiratory system, in particular bronchial asthma and chronic obstructive pulmonary disease. It has been proven that damage to the bronchial mucosa by viruses leads to an increase in its permeability to allergens and pollutants, increased production of biologically active substances, which leads to an exacerbation of the disease. Currently, herbal remedies are actively used to treat acute inflammatory diseases of the respiratory tract. The group of flavonoids (plant pigments) consists of 75% curcumin. Curcumin is a component of the spice turmeric, which is obtained from the rhizome of the perennial tropical plant *Curcuma longa* L. Currently, a large amount of experimental data has been accumulated that confirm that the main component "curcumin" has high biological activity and a wide spectrum of action. It seems possible to formulate the main pharmacological properties and therapeutic potential of curcumin: antibacterial, antiviral, antifungal, antiparasitic action. Bactericidal and bacteriostatic activity of curcumin against some bacteria has been discovered. From the analyzed literature data it follows that flavonoids are promising natural polyphenolic compounds with broad biological activity, which determines their value for more in-depth pharmacological studies and the development of new advanced drugs on their basis. The flavonoids can be recommended for chemical modification

in order to obtain highly active compounds with antioxidant, antiallergic, anti-inflammatory, cardioprotective and antitumor activity.

Аннотация

Известно, что острые респираторные заболевания) занимают первое место среди острой инфекционной патологии дыхательных путей как у детей, так и у взрослых. Респираторные вирусы могут вызывать обострения хронических заболеваний дыхательной системы, в частности хронической обструктивной болезни легких. В настоящее время фитопрепараты активно используются для лечения острых воспалительных заболеваний дыхательных путей.

Группа флавоноидов (растительных пигментов), состоит на 75% из куркумина. Куркумин является компонентом пряности куркума, которую получают из корневища многолетнего тропического растения Куркума длинная (*Curcuma longa* L.). В настоящее время накоплено большое количество экспериментальных данных, которые подтверждают, что основной компонент «куркумин» обладает высокой биологической активностью и широким спектром действия. Представляется возможным сформулировать основные фармакологические свойства и терапевтический потенциал куркумина: антибактериальное, противовирусное, противогрибковое, противопаразитарное действие. Обнаружена бактерицидная и бактериостатическая активность куркумина в отношении некоторых бактерий. Из проанализированных данных литературы следует, что флавоноиды являются перспективными природными полифенольными соединениями с широкой биологической активностью, что обуславливает их ценность для более углубленных фармакологических исследований и разработки на их основе новых передовых лекарственных препаратов. Флавоноиды можно рекомендовать для химической модификации с целью получения высокоактивных соединений с антиоксидантной, противоаллергической, противовоспалительной, кардиопротекторной и противоопухолевой активностью.

Введение

Известно, что острые респираторные заболевания (ОРЗ) занимают первое место среди острой инфекционной патологии дыхательных путей (ДП) как у детей, так и у взрослых. ОРЗ – группа полиэтиологических заболеваний, возникающих в результате воздействия на ДП различных вирусных и бактериальных агентов, тропных к дыхательному эпителию. Среди вирусов преобладают респираторно-синцитиальный вирус, вирусы гриппа и парагриппа, аденовирусы. Респираторные вирусы могут вызывать обострения хронических заболеваний дыхательной системы, в частности бронхиальной астмы и хронической обструктивной болезни легких. Доказано, что повреждение вирусами слизистой оболочки бронхов приводит к повышению ее проницаемости для аллергенов и поллютантов, повышенной продукции биологически активных веществ, что и приводит к обострению болезни. Большинство возбудителей бактериальных ОРЗ входит в состав условно-патогенной бактериальной микрофлоры, постоянно пребывающей в ДП человека. Поэтому в механизме развития этих заболеваний пусковым и решающим фактором является резкое снижение факторов местной и общей защиты в результате воздействия вирусов. Данная клиническая ситуация наблюдается при формировании вирусно-бактериальных ассоциаций [1].

Вместе с тем ДП представляют собой сложную многофункциональную систему. Слизистая оболочка ДП подвергается непрерывному воздействию разнообразных потенциально патогенных веществ, которые человек вдыхает с воздухом. Существует множество защитных механизмов, определяющих согревание, увлажнение и очищение ДП от чужеродных частиц. В настоящее время выделяют три основных очищающих механизма для удаления ингалированных и депонированных в ДП продуктов: мукоцилиарный клиренс (МЦК); кашель – при недостаточной эффективности МЦК; альвеолярный клиренс – удаление нерастворимых частиц, депонированных на респираторной поверхности легких.

Мукоцилиарный клиренс – процесс очищения путем перемещения слизи ресничками. МЦК состоит из двух составных частей: реснитчатого аппарата мерцательного эпителия и секреторной системы ДП, к которой относятся секреторные клетки, белково-слизистые железы подслизистого слоя и секретируемый ими слой слизи, покрывающий эпителий ДП. Жидкость, выстилающая ДП изнутри, состоит из двух слоев: слизистого слоя или

перициллиарной жидкости (золя), покрывающего реснички, и муцинового слоя (геля), располагающегося поверх золя. Перициллиарная жидкость – золь-слой – представляет собой раствор с низкой вязкостью, что позволяет ресничкам колебаться с большой частотой и защищает поверхность эпителиальных клеток от вышележащего муцина. Муциновый слой (гель-слой) представлен мукопротеинами – гликопротеинами с высокой молекулярной массой, вырабатываемыми бокаловидными клетками. Структура секретируемых муцинов и химическая природа их поверхностных групп определяют вязкость и эластичность бронхиального секрета. Химический состав гель-слоя определяет его антимикробную и противовирусную активность за счет входящих в его состав секреторных иммуноглобулинов (IgA), лизоцима, лактоферрина и других биологически активных веществ. Нарушение работы МЦК происходит при любом дефекте реснитчатого или секреторного компонентов, что приводит к снижению физической, химической и биологической защиты ДП. При неэффективности МКЦ возникает кашель, обеспечивая очищение ДП [2].

Вместе с тем следует учитывать, что кашель является симптомом многих заболеваний. Кашлевой рефлекс инициируется при стимуляции чувствительных нервных окончаний ротовой полости, придаточных пазух носа, гортани, голосовых связок, глотки, наружного слухового прохода, евстахиевой трубы, трахеи и ее бифуркации, мест деления бронхов, плевры, перикарда, диафрагмы, дистальной части пищевода и желудка [3].

По длительности выделяют острый кашель продолжительностью до 3 недель, хронический – более 8 недель и затяжной – от 3 до 8 недель.

Вместе с тем следует отметить, что наиболее частой причиной кашля являются как острые, так и многие хронические заболевания дыхательной системы.

Воспалительный ответ слизистой оболочки ДП на воздействие вирусной и бактериальной флоры приводит к перестройке эпителиального слоя слизистой оболочки. Значительно возрастает число бокаловидных клеток, изменяется физико-химический состав слизи, повышается ее вязкость, что приводит к нарушению бронхиальной проходимости. В связи с неэффективностью МКЦ кашель становится основным механизмом очищения ДП.

Нарушение дренажной функции бронхов, скопление вязкого бронхиального секрета в ДП приводят к раздражению кашлевых рецепторов трахеи и бронхов, что и определяет развитие кашля – сложного нервно-рефлекторного механизма защиты ДП. Скопление трахеобронхиальной слизи вызывает вентиляционные нарушения, снижается местная иммунологическая защита ДП за счет уменьшения концентрации IgA, лизоцима, лактоферрина и интерферона. Повышенная вязкость слизи при ослаблении функции реснитчатого эпителия замедляет ее движение по ДП, что способствует повышенной адгезии патогенных микроорганизмов и микробной колонизации. Этим формируется высокий риск затяжного течения воспалительного процесса.

К перспективной группе полифенольных биологически активных соединений (БАС) с разнообразным спектром фармакологического действия относят флавоноиды, которые широко распространены в растениях в качестве вторичных продуктов их метаболизма. С химической точки зрения они представляют собой производные хромана (бензо-γ-пирана) или хромона (бензо-γ-пирана), содержащие в положениях 2, 3 и/или 4 арильный радикал, в основе строения которых лежит фенилпропановый скелет, состоящий из C6-C3-C6 углеродных единиц. Их структурное разнообразие и фармакологическая ценность обуславливает значимый интерес для разработки на их основе новых растительных лекарственных средств с низкой токсичностью [4]. В последние годы наблюдается увеличение количества фармакопейных растений, содержащих в качестве ведущей группы БАС флавоноиды и другие полифенольные соединения [5], что актуализирует фитохимические исследования и поиск новых растительных объектов с выраженными фармакологическими эффектами для терапии различных заболеваний.

Цель обзора: изучить литературные данные использования флавоноидов растительного происхождения при хронической патологии дыхательных путей.

Методы исследования – анализ научных источников информации и научно-методической литературы, посвященной изучению фармакологических свойств лекарственных растений и эффективности их применения при хронической патологии дыхательных путей.

Воспалительный процесс, развивающийся в ДП при воздействии респираторных вирусов и бактерий, приводит к выраженному нарушению МКЦ, повышению вязкости мокроты, развитию отека слизистой оболочки и появлению феномена гиперреактивности бронхов, что определяет нарушение откашливания мокроты. В связи с этим использование мукоактивных препаратов

приоритетно в лечении кашля при ОРЗ. Их применение основано на способности влиять на толщину гель-золя бронхиального секрета, изменять его вязкость и уменьшать адгезивность за счет повышения активности реснитчатого эпителия. В соответствии с преобладающим механизмом действия мукоактивные лекарственные средства (ЛС) подразделяются на отхаркивающие (экспекторанты), мукорегуляторы, муколитики и мукокинетики [6]. В некоторой степени деление мукоактивных препаратов на группы условно, определяющее прежде всего преимущественный механизм действия ЛС для правильного их назначения в конкретной клинической ситуации.

В настоящее время существует масса мукоактивных ЛС, улучшающих откашливание мокроты. Некоторые из них известны уже не одно столетие, относятся к фитопрепаратам, другие – синтезированы и применяются с середины XX столетия. Созданы и успешно применяются комбинированные мукоактивные ЛС, что позволяет достигать желаемого терапевтического эффекта при уменьшении числа и кратности приема.

Имеются определенные группы пациентов (дети, беременные, кормящие и пожилые), имеющие противопоказания к назначению синтезированных ЛС. В терапии этой категории пациентов назначение препаратов растительного происхождения предпочтительно. Вместе с тем очевиден тот факт, что растительные ЛС не используются в лечении неотложных состояний. Они рекомендованы при острых и обострении хронических заболеваний дыхательной системы легкой и средней степеней тяжести, а также в комбинации с другими химиотерапевтическими средствами. В пульмонологии успешно используются отхаркивающие, противовоспалительные и бактерицидные свойства лекарственных растений.

Применение лекарственных растений при заболеваниях ДП имеет многовековую историю. Авиценна в Каноне о врачебной науке, написанном в 1012–1024 гг., подробно описывает различные лекарственные растения для лечения многих заболеваний. Так, при легочных болезнях Авиценна рекомендовал использовать экстракт семян подорожника, отвара тимьяна, настои ромашки, фенхеля, масло эвкалипта и многих других лекарственных растений. В XVII в. известный английский фармацевт Николас Калпнер в наиболее известной и до сих пор цитируемой своей книге «Полный травник» описал лечебное действие тимьяна, применение отвара которого способствовало эвакуации мокроты и облегчению дыхания [7].

В настоящее время фитопрепараты для лечения острых воспалительных заболеваний ДП активно используются как в России, так и за рубежом. Так, в 2014 г. представлены результаты исследования Y. Ди и соавт., осуществивших интервьюирование 17 650 детей (и их родителей) и подростков Германии, которые подтвердили высокую частоту применения лекарственных препаратов растительного происхождения в лечении ОРЗ [8].

Растительные препараты, в состав которых входят термопсис, душица, тимьян, багульник, подорожник, алтей, мать-и-мачеха, относят к отхаркивающим лекарственным препаратам рефлекторного действия. При использовании внутрь они вызывают раздражение рецепторов желудка, при этом рефлекторно увеличивается секреция бронхиальных желез, повышается активность мерцательного эпителия, усиливаются сокращения мышц бронхов. Мокрота становится менее вязкой и более обильной, и отделение ее с кашлем облегчается [Харкевич Д.А., Фармакология (12-е изд.), М., 2017.].

Одним из используемых растительных препаратов в лечении кашля при ОРЗ является Эвкабал сироп и Эвкабал бальзам («ЭспармаГмбХ», Германия). В составе препарата Эвкабал сироп содержатся активные действующие вещества – жидкие экстракты подорожника остролистного и тимьяна (чабреца).

Подорожник и тимьян имеют разные фармакологические свойства, которые в комбинации действуют синергично, обеспечивая отхаркивающий, секретолитический, противовоспалительный, умеренный бронхоспазмолитический эффекты, обуславливая высокую эффективность Эвкабала сироп при остром бронхите с продуктивным кашлем.

Растительные муцины, содержащиеся в экстракте подорожника, уменьшают раздражение слизистой оболочки трахеи и бронхов, что понижает интенсивность сухого кашля. Фитонциды и фенолы подорожника разжижают бронхиальный секрет, улучшают мукоцилиарный транспорт. Было установлено, что экстракт подорожника содержит гликозиды (аукубин) и флаваноиды, что также определяет его противомикробный, в особенности в отношении *Staphylococcus aureus*, противовоспалительный и отхаркивающий эффекты [9]. Интересны данные, полученные в исследованиях R. Gomez-Flores и соавт., где было показано иммуномодулирующее действие веществ, содержащихся в экстракте листьев

подорожника, в виде снижения выделения провоспалительных цитокинов, в частности фактора некроза опухоли α [10].

Экстракт тимьяна также в течение многих лет используется для лечения воспалительных заболеваний ДП как в виде монотерапии, так и в комбинации с другими лекарственными растениями. Трава тимьяна содержит около 2,5% эфирного масла, основными активными компонентами которого являются монотерпеноидные фенолы тимол (30–45%) и карвакрол (3–15%). До настоящего времени продолжаются исследования и анализ биологических свойств и механизма действия различных эфирных масел. Вместе с тем доказано антимикробное действие эфирного масла тимьяна. Как эфирное масло тимьяна, так и экстрагированный тимол оказывают антибактериальное действие в отношении ряда микроорганизмов, в т.ч. *S. aureus*, *Escherichia coli*, *Klebsiella pneumoniae* и др. Кроме того, фенолы проявляют активность в отношении антибиотикорезистентной микрофлоры, в т.ч. L-форм и грибов [11]. Отхаркивающее и секретолитическое действия эфирного масла и флавоноидов тимьяна обусловлены ферментированием густого вязкого секрета и повышением подвижной активности мерцательного эпителия. Большей частью эффект зависит от свойства поверхностно-активного вещества эфирного масла изменять коллоидное состояние мокроты. Спазмолитический эффект флавоноидов обеспечивает умеренную бронходилатацию, облегчение дыхания [12].

Наибольший опыт применения растительных лекарственных препаратов при ОРЗ, накоплен в педиатрической практике [13]. У всех пациентов отмечено уменьшение болезненности кашля. Облегчение откашливания сопровождалось уменьшением адгезивных свойств мокроты. Побочных эффектов при применении данного лекарственного препарата не отмечено [14]. Вместе с тем применение растительных ЛС оправданно также и для взрослых пациентов при остром бронхите, трахеите, трахеобронхите, а также в составе комплексной терапии при обострении хронического бронхита, сопровождающегося кашлем с трудноотделяемой мокротой [15].

В настоящее время обсуждается возможность использования растительных препаратов в лечении т.н. постинфекционного кашля [16]. Постинфекционный кашель характеризуется затяжным течением длительностью от 3 до 8 недель, возникает после перенесенных острых респираторных инфекций. Для определения кашля как постинфекционного необходимо тщательное обследование больного для исключения осложнений перенесенной острой респираторной вирусной инфекции (ОРВИ) с присоединением бактериальной флоры и развитием пневмонии, обострения хронических воспалительных заболеваний дыхательной системы (хронический бронхит, бронхиальная астма, хроническая обструктивная болезнь легких и др.).

Возникновение постинфекционного кашля связывают, прежде всего, с сохраняющимся нарушением целостности реснитчатого эпителия и персистирующей в результате этого гиперреактивностью ДП [17]. Лечение постинфекционного кашля с применением экстрактов растительных средств оправданно с учетом широкого терапевтического профиля компонентов, входящих в их состав: экстракт подорожника и тимьяна, обладающих способностью к воздействию на МЦК, эфирных масел (разрежение бронхиального секрета, усиление его эвакуации мерцательным эпителием, уменьшение выраженности катаральных явлений в респираторных путях, а также противомикробное действие) и др. [18].

Группа флавоноидов (растительных пигментов), состоит на 75% из куркумина [19, 20]. Куркумин является компонентом пряности куркума, которую получают из корневища многолетнего тропического растения Куркума длинная (*Curcuma longa* L.). Порошок корневища куркумы имеет многокомпонентный состав и содержит 69,4 % углеводов, 6,3 % белка, 5,1 % эфирных масел, 3,5 % минеральных компонентов, витамины группы В (В₁, В₂, В₃, В₆, В₉) и витамины С, К, Е. Порошок корневищ куркумы использовался издавна не только как пряная приправа, натуральный желтый краситель для пищевых продуктов, косметических препаратов и продукции текстильной промышленности, но и как универсальное лекарственное сырье. Известно, что порошок куркумы активно применялся в традиционной медицине Китая, Индии, Ирана для профилактики функциональных расстройств организма и лечения различных заболеваний. Так, например, в Аюрведе описаны рецепты мазей и отваров, изготовленных из корневища куркумы, которые применялись для лечения конъюнктивитов, укусов, ожогов, незаживающих язв, гнойных ран, экземы, псориаза, расстройств пищеварения, язвы желудка и двенадцатиперстной кишки. Порошок куркумы применялся также для лечения бронхиальной астмы, хронического насморка, кашля и синуситов, расстройств функций печени, анорексии,

ревматизма, диабетических язв [21]. Основной группой биологически активных соединений, которые обуславливают яркий оранжевый цвет и определяют многочисленные фармакологические свойства препаратов куркумы, являются куркуминоиды.

В настоящее время накоплено большое количество экспериментальных данных, которые подтверждают, что основной компонент куркумы – куркумин обладает высокой биологической активностью и широким спектром действия. На основании многочисленных обзоров клинических исследований представляется возможным сформулировать основные фармакологические свойства и терапевтический потенциал куркумина: антибактериальное, противовирусное, противогрибковое, противопаразитарное действие. Обнаружена бактерицидная и бактериостатическая активность куркумина в отношении некоторых бактерий: *Staphylococcus aureus*, *Klebsiella pneumoniae*, *Salmonella paratyphi*, *Mycobacterium tuberculosis*, *Escherichia coli*. Препараты куркумина усиливают фагоцитоз макрофагами возбудителей малярии (*Plasmodium falciparum*), сонной болезни (*Trypanosoma brucei*) и лейшманиозов (*Leishmania species*). Экстракт куркумы проявляет противогрибковое действие в отношении *Rhizoctonia solani*, *Phytophthora infestans*, *Erysiphe graminis*, *Puccinia recondita*, *Botrytis cinerea* [22].

У куркумина идентифицированы антипролиферативные, ангиогенные и антиметастатические свойства, а также способность повышать апоптоз опухолевых клеток и подавлять активацию генов онкологических заболеваний. Успешное применение куркумина в программе комплексного лечения онкологических заболеваний с целью подавления роста опухоли при многих видах рака подтверждено результатами многочисленных клинических исследований [23, 24].

Куркумин обладает способностью модулировать воспалительный ответ через подавление активности ряда ферментов и продукции провоспалительных цитокинов, тем самым снижает выраженность воспалительного процесса [25, 26]. Терапевтическая эффективность куркумина как активного противовоспалительного средства подтверждена при лечении острых неинфекционных заболеваний дыхательной системы [27], опорно-двигательного аппарата [28] и скелетной мускулатуры [29].

В обзоре D. Lelli et al. представлены результаты более 200 клинических исследований, проведенных для изучения противовоспалительной активности куркумина и плейотропных эффектов куркумина в программе комплексного лечения пациентов с легочной патологией. Клиницистами многократно подтверждены эффективность и безопасность применения препаратов куркумы при терапии легочных заболеваний, которые характеризуются аномальными воспалительными реакциями (астма или хроническая обструктивная болезнь легких, синдром острой дыхательной недостаточности, фиброз легких и острая травма легких) [30].

Антиоксидантное действие основано на способности куркумина участвовать в механизме подавления воспалительного ответа, связывать активные кислородные радикалы и предотвращать окислительное повреждение клеток [31].

Иммуностимулирующий эффект куркумина обусловлен способностью активизировать иммунный ответ, путем воздействия на иммунокомпетентные (Т- и В-лимфоциты) и вспомогательные клетки организма (клетки моноцитарно-макрофагального ряда, нейтрофилы, дендритные клетки) [32].

Кверцетин относится к одним из наиболее распространенных флавоноидов в растительных объектах и проявляет широкий спектр биологической активности, что обуславливает перспективность разработки на его основе лекарственных препаратов и синтеза новых фармакологически активных молекул. Наиболее распространенными формами кверцетина являются кверцетин глюкуронид, кверцетин сульфат и метилированный кверцетин [33]. Стоит отметить, что чаще всего данный флавоноид встречается в растениях в виде соединений, которые, как правило, содержат в своей структуре сахара. Например, рутин представляет собой гликозид, состоящий из кверцетина и дисахарида рутинозы. В случае замена гликона на галактозу формируется широко известное фенольное соединение — гиперозид. Такой гликозид кверцетина, как кверцитрин, содержит в своей структуре дезоксисахар рамнозу. Таким образом, ядро кверцетина встречается в составе таких хорошо известных полифенольных соединений, как рутин и гиперозид, которые обладают разнообразными видами биологической активности [34]. Введение сахаров в структуру кверцетина, помимо влияния на его всасывание и фармакологический эффект, также изменяет

его растворимость. Сам же кверцетин нерастворим в холодной воде, немного лучше растворяется в горячей воде и растворим в спиртах и липидах [35]. Считается, что на кверцетин и его гликозилированные формы приходится около 60–75% потребления флавоноидов с пищей человека [36].

Кверцетин может влиять на разнообразные биологические пути функционирования иммунных клеток при аллергическом иммунном ответе, а также оказывает комплексное противовоспалительное действие. Так, данный флавоноид ингибирует высвобождение гистамина и активацию ядерного фактора NF-κB. Он снижает выработку противовоспалительных цитокинов и лейкотриенов. Предполагают, что снижение выработки гистамина происходит за счет стабилизации клеточных мембран тучных клеток. Полифенольное соединение выражено активирует выработку интерферонов клетками крови. Проводились исследования по сравнению силы ингибирования дегрануляции тучных клеток кверцетином и кромолином, который позиционируется на фармацевтическом рынке как стабилизатор мембран тучных клеток. Доказано, что эти два соединения эффективно ингибируют секрецию гистамина, простагландина D и лейкотриенов из первичных культивируемых тучных клеток, полученных из пуповинной крови человека, стимулированных IgE/анти-IgE. При этом кверцетин лучше снижает выделение интерлейкина-6 и фактора некроза опухолей из тучных клеток, стимулируемых таким неиммунным триггером, как субстанция P, что делает флавоноид многообещающим соединением для эффективного ингибирования тучных клеток при аллергических и воспалительных заболеваниях [37, 38, 39, 40].

Кверцетин, помимо влияния на выброс гистамина, лейкотриенов, простагландина D, также может дозозависимо ингибировать высвобождение гранулоцитарно-макрофагального колониестимулирующего фактора из культивируемых тучных клеток человека. Реализацию биологически активного действия полифенольного соединения связывают со снижением внутриклеточной концентрации катиона кальция в клетках, высвобождающих медиаторы воспаления и клеточного ответа. Также показано, что он выражено ингибирует транслокацию протеинкиназы C, которая участвует в передаче внутриклеточных сигналов. Таким образом, противовоспалительное действие кверцетина обусловлено ингибированием многих ферментов, например, липоксидазы и снижением продукции медиаторов воспаления. Также полифенольное соединение влияет на многие внутриклеточные сигнальные киназы и фосфатазы, ферменты и мембранные белки, которые играют решающую роль в развитии воспаления. Флавоноид проявил способность снижать выработку воспалительных цитокинов на мышинной модели астмы, вызванной *Blomia tropicalis* [41, 42, 43].

Кемпферол оказывает противовоспалительный эффект за счет комплексного действия на патологические звенья воспалительных процессов. Флавоноид обладает способностью ингибировать синтез оксида азота, а также гиалуронидазы, коллагеназы, 15-липоксигеназы и циклооксигеназы первого и второго типа. Противовоспалительные эффекты флавоноида, вероятно, обусловлены блокадой активации NF-κB и, как следствие, усилением регуляции провоспалительных генов. К тому же García-Mediavilla и соавт. установили, что при применении кемпферола в клетках печени Chang происходит снижение синтеза C-реактивного белка, циклооксигеназы 2-го типа и оксида азота. Стоит отметить, что оксид азота снижает активность многих ферментов, в частности каталазы, что приводит к накоплению в клетках пероксида азота. Также оксид азота взаимодействует с супероксидным анионом, который продуцирует пероксинитрит, повреждающий ДНК и ингибирующий митохондриальное дыхание. В ходе фитохимических исследований плодов *Moringa citrifolia* был выделен кемпферол, который ингибировал 5- и 15-липоксигеназу. Данные ферменты играют важную роль в дериватизации лейкотриенов, принимающих участие в патогенезе различных воспалительных заболеваний, например, ревматоидного артрита, астмы и воспалительных заболеваний кишечника. Имеются данные литературы, согласно которым кемпферол значительно ингибирует индуцируемую липополисахаридами продукцию хемокина моноцитарного происхождения, интерферон-гамма-индуцируемого белка 10 и интерлейкина-8 в клеточной линии моноцитарных клеток человека THP-1. Установлено, что полифенольное соединение способно подавлять индуцируемые липополисахаридами пути митоген-активируемой протеинкиназы, Т-хелперы 1, Т-хелперы 2 и продукцию хемокинов, связанных с нейтрофилами, в моноцитах, возможно, через пути митоген-активируемой протеинкиназы. По результатам оценки противовоспалительного потенциала кемпферол был предложен в качестве нового терапевтического средства для лечения ревматоидного артрита. Флавоноид ингибировал

пролиферацию стимулированных интерлейкином-1 β синовиальных фибробластов, а также выработку металлопротеиназ, циклооксигеназу второго типа и простагландина E2, участвующих в воспалении и разрушении суставов при ревматоидном артрите. Изучение активности кемпферола в отношении тучных клеток, культивируемых из пуповинной крови человека, позволило выявить, что флавоноид ингибирует высвобождение из них провоспалительных цитокинов и ферментов: интерлейкина-6, интерлейкина-8, фактора некроза опухоли, гистамина и триптазы. Флавоноид подавляет повышение уровня внутриклеточного иона кальция и ингибирует фосфорилирование нечувствительной к кальцию протеинкиназы C, что обуславливает IgE-опосредованное высвобождение провоспалительных медиаторов из тучных клеток [44, 45, 46].

Полифенольное соединение снижало уровни зотаксина-1 и CCR3 рецептора зотаксина в тканях дыхательных путей. Тем самым кемпферол ослаблял воспаление дыхательных путей посредством модуляции передачи сигналов Tук2-STAT1/3, реагирующих на интерлейкин-8, в эпителии дыхательных путей, подверженном воздействию эндотоксина, у мышей с астмой. Пероральное введение кемпферола ослабляло повышенную экспрессию зотаксина-1 и основного белка эозинофилов в эпителии BEAS-2B дыхательных путей человека путем блокады трансактивации NF- κ B, тем самым уменьшая накопление эозинофилов в дыхательных путях и легочной ткани. Флавоноид ослаблял TNF- α -индуцированную экспрессию эпителиальной внутриклеточной молекулы клеточной адгезии 1 и интегрина- β 2 эозинофилов, затрудняя, таким образом, взаимодействие эозинофилов с эпителием дыхательных путей. Также он замедлял воспаление дыхательных путей, вызванное TNF- α , путем ослабления транскрипции моноцитарного хемоаттрактантного белка-1, возможно, из-за нарушения передачи сигналов NF- κ B. Это позволяет рассматривать данный флавоноид как терапевтическое средство при лечении аллергических и воспалительных заболеваний дыхательных путей. Кемпферол может снижать возрастное увеличение активности NF- κ B и зависящей от NF- κ B активности провоспалительных генов за счет ингибирования возрастной никотинамидадениндинуклеотидфосфатоксидазы. Постишемическая терапия кемпферол-3-О-рутинозидом и кемпферол-3-О-глюкозидом предотвращает ишемическое повреждение головного мозга и нейровоспаление путем ингибирования активации STAT3 и NF- κ B и обладает терапевтическим потенциалом при заболеваниях, связанных с нейровоспалением. Lee и соавт. пришли к выводу, что кемпферол может быть полезен для лечения воспалительных заболеваний, в патогенезе которых принимает участие TNF- α , так как он блокирует активацию промотора интерлейкина-8, индуцированного TNF- α , и экспрессию генов в клетках HEK 293. Также флавоноид снижал выработку активных форм кислорода в ответ на воздействие TNF- α [47, 48, 49]. Таким образом, кемпферол воздействует на разнообразные каскады провоспалительных и воспалительных процессов, что позволяет рассматривать его в качестве перспективного соединения для комплексной терапии воспалительных процессов, в том числе и при аллергических проявлениях у человека.

Заключение

Многовековой опыт использования лекарственных растений позволяет рекомендовать их в терапии острых и хронических заболеваний дыхательных путей. Накопленный опыт использования растительных лекарственных растений, обладающих комплексным противовоспалительным, муколитическим, отхаркивающим, противомикробным, иммуномодулирующим действиями, при высоком уровне безопасности, позволяет использовать их в комплексной терапии заболеваний дыхательной системы взрослых и детей. Из проанализированных данных литературы следует, что флавоноиды являются перспективными природными полифенольными соединениями с широкой биологической активностью, что обуславливает их ценность для более углубленных фармакологических исследований и разработки на их основе новых передовых лекарственных препаратов. Ядра данных флавоноидов можно рекомендовать для химической модификации с целью получения высокоактивных соединений с антиоксидантной, противоаллергической, противовоспалительной, кардиопротекторной и противоопухолевой активностью.

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Pedagogical sciences

PROSPECTS FOR IMPLEMENTING MICRO-LEARNING IN THE EDUCATIONAL PROCESS AS A COMPONENT OF COMBINED LEARNING IN THE MODERN REALITIES OF EDUCATION IN UKRAINE

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ПЕРСПЕКТИВИ ВПРОВАДЖЕННЯ МІКРОНАВЧАННЯ В ОСВІТНІЙ ПРОЦЕС ЯК СКЛАДОВОЇ ЛАНКИ КОМБІНОВАНОГО НАВЧАННЯ В СУЧАСНИХ РЕАЛІЯХ ОСВІТИ В УКРАЇНІ

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Abstract

Modern education is undergoing a period of radical changes associated with the development of technology and globalization. One of the most important trends is the shift to blended learning, which combines traditional methods with online technologies. In the context of these changes, microlearning has become particularly relevant—a method that involves delivering educational material in small, easily digestible portions. This article is dedicated to researching the effectiveness of microlearning within the context of Ukrainian education. The authors analyze the theoretical foundations of microlearning, examine its advantages and disadvantages, and explore the practice of implementing this method in Ukrainian educational institutions. The main objective of the research is to determine the potential of microlearning to enhance the quality of the educational process, develop individual learning pathways, and adapt to the needs of modern learners. The article presents a positive attitude toward microlearning among both students and educators. It has been established that microlearning contributes to increased motivation for learning, improved material retention, and the development of students' independence. A number of problems related to the implementation of microlearning in the Ukrainian context are outlined, such as insufficient technical resources in educational institutions, the lack of appropriate methodological developments, and the need for additional training for instructors. Based on the studied material, the authors formulate recommendations for the implementation of microlearning in Ukrainian education.

Анотація

Сучасна освіта переживає період кардинальних змін, пов'язаних з розвитком технологій та глобалізацією. Однією з найважливіших тенденцій є перехід до комбінованого навчання, яке поєднує традиційні методи з онлайн-технологіями. В контексті цих змін особливої актуальності набуває мікронавчання – метод, що передбачає подачу навчального матеріалу невеликими, легко засвоюваними порціями. Стаття присвячена дослідженню ефективності мікронавчання в контексті української освіти. Автори аналізують теоретичні основи мікронавчання, розглядають його переваги та недоліки, а також досліджують практику впровадження цього методу в українських закладах освіти. Основною метою дослідження є визначення потенціалу мікронавчання для підвищення якості освітнього процесу, розробки індивідуальних траєкторій навчання та адаптації до потреб сучасних здобувачів. У статті представлено позитивне ставлення до мікронавчання як серед здобувачів освіти, так і серед педагогів. Було встановлено, що мікронавчання сприяє підвищенню мотивації здобувачів до навчання, поліпшенню засвоєння матеріалу та розвитку самостійності студентів. Окреслено ряд проблем, пов'язаних з впровадженням мікронавчання в українських реаліях, таких як недостатня технічна оснащеність закладів освіти, відсутність відповідних методичних розробок та необхідність додаткової підготовки викладачів. На основі вивченого матеріалу автори формують рекомендації щодо впровадження мікронавчання в українську освіту.

Keywords: *microlearning, combined learning, online learning, educational process, pedagogical technologies.*

Ключові слова: мікронавчання, комбіноване навчання, онлайн-навчання, освітній процес, педагогічні технології.

Сучасна освіта переживає період кардинальних змін, пов'язаних з широким спектром глобальних чинників, які суттєво видозмінюють сучасний освітній процес. Розвиток технологій, глобалізація, світові пандемії та локальні війни – суттєво вплинули на освіту в цілому і Україна не стала винятком. Одним з найважливіших трендів є перехід до змішаного навчання, яке поєднує традиційні методи навчання з онлайн-технологіями. Важливу роль у цьому процесі відіграє мікронавчання – метод, який передбачає подачу навчального матеріалу невеликими, легко засвоюваними порціями. Саме мікро навчання набуває широкого використання в усьому світі і потребує більш глибокого вивчення для успішного впровадження в освітній процес в Україні.

Роль педагогічного працівника у процесі трансформації освіти є ключовою і вимагає від нього відповідного рівня ІК-компетентності та умінь орієнтуватися в сучасних інформаційних технологіях. З огляду на те, що цифрова компетентність педагога має підтримуватися на належному рівні і постійно підвищуватися, виникає потреба в започаткуванні нових форм навчання практикуючих педагогів у рамках неформальної освіти, а саме мікронавчання [3].

Мікронавчання – це інноваційний підхід до навчання, який полягає в розбитті великих обсягів інформації на короткі, інтенсивні модулі. Кожен модуль фокусується на конкретній темі або навичку, що дозволяє здобувачам освіти легко засвоювати новий матеріал та ефективно повторювати пройдене. Модулі зазвичай тривають від кількох хвилин до півгодини. Основною метою мікронавчання є забезпечення ефективного засвоєння знань шляхом подачі інформації в маленьких, легко засвоюваних частинах. Цей підхід відповідає сучасним вимогам швидкоплинного інформаційного середовища, де учасники освітнього процесу часто стикаються з обмеженим часом та увагою.

У сучасних публікаціях (як зарубіжних, так і вітчизняних) мікронавчання може позначатися різними термінами, маркерами або метафорами, наприклад: навчання в мікродозах, мікромодульне навчання, «гранульоване» або «мікрогранульоване» навчання, порційне навчання (*bite-sized learning* капсульне навчання, що навчає «крупинками» (*learning nugget*) та ін [5].

Основні характеристики мікронавчання включають:

Короткочасність: навчальні модулі зосереджені на конкретних темах або навичках, що призводить до швидкого засвоєння нової інформації.

Адаптивність: мікронавчання легко інтегрується в різні формати навчання, забезпечуючи персоналізацію підходу відповідно до потреб здобувачів освіти.

Доступність: матеріали розміщені на різних онлайн-платформах, дозволяють здобувачам освіти опрацьовувати матеріал у зручні для них час і місце.

Активне залучення: мікронавчання часто включає інтерактивні елементи, такі як вікторини, ігри чи відео, що підвищує рівень залученості здобувачів освіти, особливо при всебільшому зростанню людей, які мають «кліпове мислення».

Комбіноване навчання (combined learning) є освітньою моделлю, що поєднує традиційні методи навчання з онлайн-форматами, забезпечуючи інтерактивність та гнучкість в освітньому процесі. Цей підхід ефективно використовує переваги обох форм навчання: особистих занять в аудиторії та можливостей, які надають цифрові технології. Комбіноване навчання передбачає використання різноманітних технологій, включаючи онлайн-курси, відеолекції, форуми для обговорення та інтерактивні платформи, що дозволяють здобувачам освіти отримувати доступ до навчальних матеріалів у зручний для них час. Дає можливість педагогам адаптувати курси під індивідуальні потреби здобувачів освіти, що сприяє більш глибокому засвоєнню знань. В Україні комбіноване навчання почало набувати популярності в останні роки, особливо в умовах пандемії COVID-19 та після початку повномасштабної війни з Російською Федерацією, коли освітні заклади були змушені швидко адаптуватися до нових реалій. Цей досвід продемонстрував переваги змішаного формату навчання, зокрема: гнучкість, доступність, інноваційність. В умовах сучасного українського освітнього простору, комбіноване навчання розглядається як важливий інструмент для вдосконалення освітніх процесів, що сприяє формуванню активних, самостійних здобувачів освіти, готових до викликів сучасного світу. Поступове впровадження мікронавчання в цю модель може стати наступним кроком у розвитку освітньої системи України.

Актуальність впровадження мікронавчання в освітній процес обумовлена кількома ключовими викликами, з якими стикається сучасна освіта в Україні. По-перше, швидкий розвиток технологій і доступність інформації призвели до необхідності постійного оновлення знань і навичок. Здобувачі освіти сьогодні мають справу з великими обсягами інформації, і мікронавчання дозволяє їм ефективно засвоювати новий матеріал у зручних форматах. По-друге, саме з приходом пандемії COVID-19, значно змінились освітні процеси, примусивши заклади освіти адаптуватися до дистанційного навчання. Це підкреслило потребу в гнучких та інтерактивних методах навчання, які могли б підтримати освітній процес в умовах нестабільності. Крім того, традиційні методи навчання часто не відповідають потребам сучасних здобувачів освіти, які вимагають більше активного залучення в процес. Мікронавчання пропонує можливість інтеграції різних форм навчання, що відповідає індивідуальним стилям навчання та потребам. Нарешті, мікронавчання сприяє розвитку критичного мислення та самостійності здобувачів освіти, що є важливими навичками для успішної адаптації в динамічному світі. У світлі цих викликів, впровадження мікронавчання в рамках змішаного навчання стає не лише доцільним, але й необхідним для формування конкурентоспроможних фахівців в Україні та відповідності освітнього процесу сучасним вимогам.

З психологічної точки зору, мікронавчання базується на принципах когнітивної науки, зокрема теоріях, що стосуються обробки інформації. Здобувачі освіти краще запам'ятовують інформацію, коли вона подається у коротких, фрагментованих частинах. Це пов'язано з обмеженнями робочої пам'яті, яка здатна утримувати лише обмежену кількість інформації одночасно. Крім того, мікронавчання підтримує принцип "сприйняття та повторення", де короткі сесії навчання з можливістю повторення інформації підвищують її закріплення в пам'яті. Взаємодія з освітнім контентом через різноманітні формати навчання, також підвищує рівень залучення здобувачів освіти, що сприяє глибшому розумінню та засвоєнню матеріалу.

Ефективність мікронавчання залежить від низки чинників: логіка розподілу освітнього контенту, наявність динамічного і формувального оцінювання, чіткість дидактичної мети, покрокова інструкція, чек-лист з визначенням часу, обов'язкова результативність через зворотний зв'язок.

Умовами ефективного мікронавчання є:

- логічна послідовність інструкцій чи кроків,
- відкритість, простота, чіткість, зрозумілість, однозначність усіх засобів освітнього контенту,
- доступність в будь-який час, за запитом, вчасність надання інформації,
- інтерактивність,
- вбудованість в повсякденне життя,

- адаптивність до швидкозмінюваних умов [6].

Процес впровадження мікронавчання має ряд викликів, які має подолати освітнє середовище для ефективного використання мікронавчання для підвищення рівня освіти в Україні. Одним з основних викликів впровадження мікронавчання в Україні ми вбачаємо в технічних бар'єрах, пов'язаних із доступом до сучасних технологій та інтернету. У віддалених і сільських районах, де інфраструктура не завжди є достатньо розвинутою, багато здобувачів освіти та педагогів стикаються з проблемами доступу до високошвидкісного інтернету та необхідних пристроїв. Це обмежує можливості для впровадження онлайн-форм навчання і знижує ефективність мікронавчання. Крім того, не всі заклади освіти мають ресурси для закупівлі новітнього програмного забезпечення або технологій, необхідних для створення якісного контенту. Ще одним важливим викликом є методичні питання, зокрема підготовка педагогів до роботи з мікронавчанням. Багато з них не мають достатнього досвіду в створенні інтерактивних та адаптивних навчальних модулів. Це потребує нових навичок у дизайні освітнього контенту та володіння цифровими технологіями. Важливо також забезпечити освітні програми, що сприятимуть розвитку цих навичок. Створення якісного контенту, який відповідає потребам здобувачів освіти, є ще одним завданням, яке вимагає зусиль і часу.

Співвідношення мікронавчання з традиційними формами навчання також може викликати труднощі. Впровадження мікронавчання в існуючі освітні програми потребує переосмислення підходів до оцінювання, структурування курсів та інтеграції нових методів навчання. Часто виникає питання, як балансувати між короткими модулями і глибоким вивченням тем, що може призвести до конфлікту між традиційними та новими формами навчання. Педагоги повинні знайти способи, як максимально ефективно інтегрувати мікронавчання у звичайний освітній процес, що вимагає креативності і адаптивності. Таким чином, виклики впровадження мікронавчання є багатограними і потребують комплексного підходу для їх подолання.

За кордоном, заклади освіти все більше використовують мікронавчання у своїх комбінованих курсах, пропонуючи здобувачам освіти доступ до коротких відеолекцій та інтерактивних вправ. Ці практики сприяють підвищенню залученості студентів і покращенню їхніх результатів навчання. Так за даними опитування (рис 1.), проведеним серед здобувачів освіти Університету Павла Йозефа Шафарика в Кошиці (Univerzita Pavla Jozefa Šafárika v Košiciach), 74.05% опитаних застосування мікронавчання оцінюють позитивно [4].

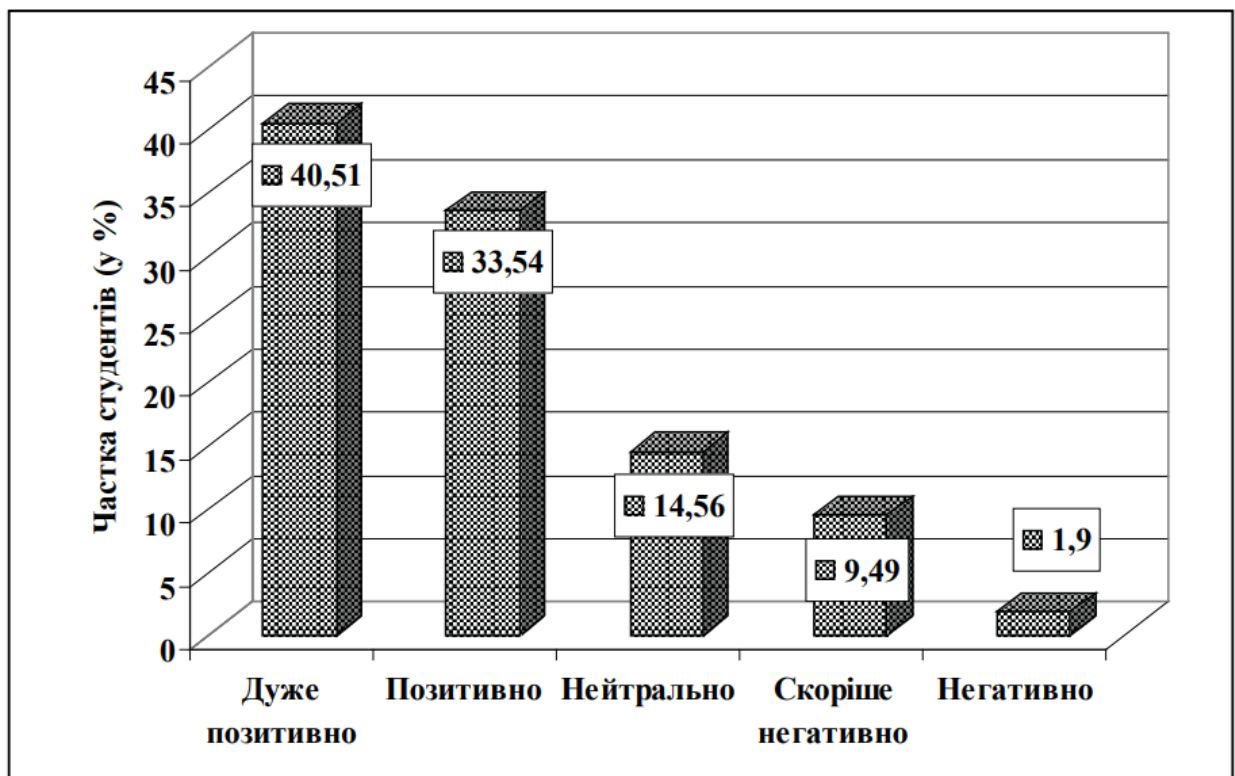


Рис 1. Результати відповідей студентів на питання анкети: «Як Ви оцінюєте семінари із загальної дидактики з використанням мікронавчання?» [4].

Відповідно мікронавчання відіграє важливу роль у формуванні активного освітнього середовища, де здобувачі освіти стають більш залученими в освітній процес. Короткі модулі заохочують здобувачів до самоосвіти і надають можливість навчатися в будь-який час і в будь-якому місці, що підвищує їхню мотивацію та автономію. В інтерактивному середовищі, що поєднує мікронавчання та традиційні методи, здобувачі освіти отримують змогу брати участь у групових обговореннях, проєктах та інтерактивних завданнях, що сприяє розвитку критичного мислення і співпраці. Таким чином, мікронавчання не лише збагачує комбіноване навчання, але й стимулює формування активних, самостійних учасників освітнього процесу, готових до викликів сучасного світу.

Впровадження мікронавчання в українських навчальних закладах має значні перспективи, оскільки цей підхід відповідає сучасним вимогам освітнього процесу. Завдяки своїй гнучкості та адаптивності, мікронавчання суттєво підвищить ефективність навчання, забезпечить доступ до якісних освітніх ресурсів та відповідає потребам різних категорій здобувачів освіти. З огляду на швидкі зміни в технологічному середовищі та вимоги ринку праці, мікронавчання стає невід'ємним інструментом для підготовки конкурентоспроможних фахівців.

Висновок. Для успішного впровадження мікронавчання, освітнім установам варто розвивати інфраструктуру для забезпечення доступу до необхідних технологій та інтернет ресурсів всіх категорій здобувачів освіти, проводити навчання для педагогів, організовуючи тренінги та семінари щодо створення та використання мікронавчальних модулів. Також варто створювати якісний контент, інвестуючи в розробку інтерактивних та адаптивних освітніх матеріалів, які відповідатимуть сучасним потребам здобувачів освіти. Важливою є й інтеграція мікронавчання в існуючі програми, проводячи експерименти з поєднання мікронавчання з традиційними формами навчання, оцінюючи їхню ефективність.

Оскільки мікронавчання є новою та динамічною областю, важливо продовжувати дослідження з метою виявлення найкращих практик та методів впровадження. Закликаємо дослідників, учасників освітнього процесу та освітні установи активно співпрацювати для обміну досвідом, розробки нових концепцій та адаптації мікронавчання до специфіки українського освітнього середовища. Тільки спільними зусиллями ми зможемо створити інноваційні та ефективні освітні системи, які відповідатимуть вимогам сучасності.

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LINGUISTIC AND DIDACTIC POSSIBILITIES OF THE QUIZLET ELECTRONIC APPLICATION FOR TEACHING FOREIGN LANGUAGE VOCABULARY

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Abstract

The article discusses the linguistic and didactic possibilities of using the Quizlet electronic application in the process of teaching foreign language vocabulary. The main functions of the application are analyzed, such as creating flash cards, conducting tests, interactive games and repetitions, which contribute to the active assimilation of new lexical material. The advantages of using Quizlet for various categories of students are described, including improved memorization, development of motivation for learning and the possibility of independent work. The methods of integrating the application into the learning process, as well as its role in the formation of long-term memory, are also discussed. The author identifies three groups of components of knowledge of a foreign language word: (1) knowledge of the form (oral and written for reception and production); (2) knowledge of the semantic structure (lexical meaning, semantic relations of the word and grammatical meaning); (3) knowledge of the peculiarities of the use of the word (knowledge of collocations and potential syntactic functions of the word). The effective use of the Quizlet service for the purpose of mastering foreign language vocabulary is possible with a clear definition of the role and place of this tool in an integrated system of lexical skills formation.

Keywords: *Quizlet, vocabulary learning, electronic applications, linguodidactics, foreign language learning, digital technologies, flash cards, memorization, motivation, interactive methods.*

Introduction

Modern foreign language teaching requires the use of innovative technologies that make it possible to increase the efficiency of vocabulary acquisition. One of the most popular tools is the Quizlet electronic application, which provides interactive opportunities for memorizing and practicing new words. The application aims to optimize the learning process through the use of flash cards, games, tests and repetitions, which makes it attractive for both students and teachers.

The purpose of this article is to study the linguistic and didactic possibilities of the quiz in teaching foreign language vocabulary. We will look at how the application can be integrated into the learning process, as well as its impact on motivation, memorization and active use of vocabulary.

Theoretical foundations of vocabulary teaching

Vocabulary is the most important component of any language. Without a sufficient vocabulary, it is difficult to perceive and transmit information, as well as full-fledged interaction in a foreign language. The importance of vocabulary in the learning process can hardly be overestimated, since the possession of vocabulary determines the success of communication and understanding.

Traditional vocabulary teaching methods, such as memorizing words from lists and using paper cards, do not always prove effective for all categories of students. These methods can be monotonous and do not provide deep understanding and memorization. In addition, the insufficient use of words in context leads to problems in their practical application in communication.

Features of the Quizlet electronic application

The Quizlet app offers a wide range of vocabulary learning tools. The main function is to create flash cards, which can include both text and images or sound files. This allows the material to be adapted to different levels of student training and types of educational content.

In addition to flash cards, the app offers test functions where students can test their knowledge through multiple choice questions, term matching, and translations. An important feature of Quizlet is

the repetition system, which automatically adjusts to the student's progress, providing more frequent repetition of those words that were mastered worse. [1].

To analyze the linguistic and didactic capabilities of this electronic application, it is necessary to show the place and role of acquiring knowledge of lexical units in the general system of formation and development of lexical skills. In linguodidactics, when working with vocabulary, three stages are usually distinguished. N.D. Galskova and N.I. Gez name the following as the main stages of work on lexical material: familiarization with new vocabulary (including semantics), primary consolidation and the stage of using vocabulary in various forms of oral and written communication (preparatory and speech exercises) [2].

The authors emphasize that the initial consolidation stage follows directly after the familiarization stage and even merges with it. The examples of exercises recommended by the authors show that the assimilation of meanings, forms and use of words occurs at the stage of primary fixation during the performance of mainly language exercises by students [2].

Despite the different names of the stages, all of the above algorithms for vocabulary assimilation are similar in content: at the first stage, familiarization with new lexical units takes place, followed by work on forming their image in the memory of students, and at the third stage, the primary fixed lexical units are included in speech. Unlike the authors of these three-stage algorithms for the formation of lexical skills, E.I. Passov believes that the stages of familiarization with new vocabulary and its training at the level of individual units do not meet the requirements of a communicative approach. Familiarization and primary training should take place in situationally related, motivated statements: "The mastery of meaning is carried out through a function; the disclosure of the meanings of words is only a component accompanying the process of assimilation, as if dissolving in this process" [3].

One of the key linguistic and didactic advantages of Quizlet is the ability to personalize the learning process. The teacher can create sets of flashcards that correspond to a specific topic, textbook or course, as well as provide access to students for self-study.

The application uses the principles of interval repetition, which helps to improve long-term vocabulary memorization. The system monitors how the student answers questions, and depending on success, suggests repeating those words more often that are remembered worse. This approach has proven to be effective in terms of the psychology of learning and memory enhancement.

Quizlet can be effectively integrated into the learning process at different stages. For example, the application can be used to prepare for lessons, when students independently study new lexical material before discussing it in class. In the classroom, Quizlet can serve as a tool for testing knowledge, conducting tests or active games.

In addition, the application is useful for students to work independently outside the classroom. They can use it for regular repetitions, homework, or exam preparation.

Motivation plays an important role in learning, and the use of interactive tools such as Quizlet helps to increase student engagement in the learning process. The various game mechanics built into the app create a competitive atmosphere and increase students' motivation to study.

Students who actively use Quizlet often show a higher level of engagement and interest in learning vocabulary, which in turn has a positive effect on their academic performance.

The Quizlet service can be very effective if it is thoughtfully integrated into the general methodological system of working with lexical material. The assimilation of a multidimensional image of a word does not happen at once, at the first meeting with a new word, but is distributed over time and may even take several years. As Norbert Schmitt notes, various components of word knowledge can be acquired at different times, for example, it is quite possible to use a word in oral speech, but not be able to write it [4].

Advantages and disadvantages of Quizlet in teaching vocabulary

- Accessibility: Quizlet is available for free and is supported on various platforms (mobile devices, computers), which makes it convenient to use both in the classroom and at home.

- Flexibility: The ability to create your own sets of cards allows you to adapt the material to the specific needs of students and curricula.

- Interactivity: Interactive games and tests contribute to better learning of the material compared to traditional methods.

Disadvantages

- Limited context: Despite the wide functionality, Quizlet does not always provide the opportunity to study words in complex contexts, which may limit the development of vocabulary skills in real situations.

- Internet addiction: Full use of Quizlet requires constant internet access, which can be an obstacle in some educational environments. [4].

Conclusion

The Quizlet electronic application is an effective tool for teaching foreign language vocabulary. Its capabilities for creating flash cards, tests and interactive games can significantly improve the process of memorizing vocabulary, as well as maintain a high level of motivation for students. However, to achieve maximum effect, the application should be used in conjunction with other learning methods that provide the opportunity to study words in a deeper and contextual format.

Prospects for further research may include studying the impact of Quizlet on the development of other aspects of language competence, such as grammar and listening, as well as its application in a mixed learning environment.

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Physical sciences

STUDY OF METHODS OF ACQUIRING HIGH-DEFINITION IMAGES THROUGH LASER OPTICAL DEVICES

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Abstract

State-of-the-art optical cameras mimic human vision in the sense that they record the visible spectrum. However, much of the information that allows us to study objects more precisely lies outside the visible spectrum. Back in 1972, Landsat-1, the first large civilian Earth observation satellite, observed the near-infrared portion of the spectrum, which is particularly useful for monitoring vegetation. Conventional multispectral sensors, which usually only cover the visible and near-infrared spectrum, record small amounts of Earth-reflected radiation in broad spectral bands. These sensors provide reliable information for quality reports on topics such as land cover and vegetation type. However, quantitative information, such as providing nutrients to crops, water quality of lakes, or determining mineralogy in rocks and soil, requires higher spectral resolution data than that provided by conventional multispectral sensors. In contrast, hyperspectral sensors observe sunlight reflected from the Earth at many wavelengths over a wide range [1]. High-precision measurement of spectral distribution reveals properties of objects based on their chemical composition. This allows the spectral signatures of individual materials to be determined based on molecular absorption and scattering.

Keywords: optical, cameras, human, vision , spectrum.

Introduction

In recent decades, the demand for higher resolution data has increased. Depending on the application, it may be useful to increase the resolution in space, obtaining more accurate data of the visible or infrared spectrum. Consequently, researchers want to have higher pixel density, which is increasingly needed in various applications. There is a huge and rapidly growing demand for such geoinformation on a large scale worldwide, and hence the need for improved (airborne and spaceborne) remote sensing.

The demands of new applications are constantly increasing, and the current resolutions may not be able to meet future demands. Although solutions for very high-resolution hyperspectral imaging are currently available, they are not available for large-scale coverage due to high cost.

On the other hand, expensive high-precision optical and image sensors are a significant concern in many applications. Technological advances in optics and sensors are approaching physical limits in some respects, and we have reached a level where further improvements degrade the spectral resolution [2].

For image sensors, there is actually a trade-off between spatial, spectral and resolutions. For a given, small spectral region, the pixel size cannot be drastically reduced (for better spatial resolution) because the light reaching the sensor is reduced and the signal-to-noise ratio is reduced. The observed increased obstructions significantly degrade the image. The effect is amplified for wavelengths that are more affected by atmospheric absorption of the signal. On the other hand, for wider spectral bands, the amount of incoming light is greater, so the pixel size can be reduced, but at lower spectral resolutions. The observed weak signal can be removed by longer integration, but this requires a static camera, which is not realistic for moving antenna and speaker sensors. Hence, it is difficult to overcome this physical limitation.

In addition, satellites with different spatial resolutions have additional limitations for some multispectral sensors. The main reason for the different spatial resolutions is to reduce the amount of

data that needs to be transmitted to Earth: "the rates and volume of data produced by payloads continue to increase."

Main parts

The aforementioned limitations end up creating very similar problems. Therefore, a new approach is required to overcome these shortcomings arising from sensors and optics manufacturing technology and thus increase the spatial and spectral resolution.

For this purpose, it is necessary to combine spatial and high spectral resolution images and analyze them in an integrated manner using the complementary features of both data sources. Finding a way to combine high spatial and high spectral resolution is a major goal of remote sensing research. The key question is how best to combine both data sources into an integrated product with the spectral detail of modern imaging spectroscopy and the geometric resolution of the latest mapping cameras.

Taking into account the already mentioned limitations, improving the quality of spectral and spatial characteristics of remote sensing images using software techniques and methodological solutions is investigated from various aspects:

- The goal of the project is to combine high spatial and high spectral resolution images and analyze them in an integrated manner using the complementary features of the two data sources. Finding a way to combine high spatial and high spectral resolution is the main goal in this research.

Hyperspectral images can separate the spectral reflectance into hundreds of spectral bands versus a few multispectral bands. However, the drawback is the lack of global coverage, as there are currently not enough satellites/sensors to meet the given requirements. The main importance of hyperspectral imaging is to obtain geochemical, biochemical and biophysical parameters, which can then provide information on the state and evolution of various terrestrial and aquatic ecosystems.

- discussed improvements in higher resolution of hyperspectral data can provide results in post-processing, especially where advanced data classification tools are available. The presence of multiple spectral bands, complex soil ecosystems, land assets, and land use can be precisely classified using defined molecular absorption and scattering properties. More precisely, it is possible to obtain accurate information depending on the more detailed classification of forestry and agricultural species, the state of vegetation and the dynamics of development.

- Additional applications include contributions to mining and geology for mineral exploration with more accurate remote sensing. Assessment of plant productivity, better forecasting, conservation mapping and monitoring of roof deterioration in buildings are possible.

- Hyperspectral data can also be used to provide information on pollution damage to plants and soil.

Thus, without any physical contact with objects on the Earth's surface, information can be extracted based on their brightness. Optical space and airborne sensors capture Earth's radiance (reflected sunlight) in different regions of the electromagnetic (EM) spectrum (Figure 1). The EM spectrum can be divided into several spectral regions. Panchromatic (PAN) imaging usually refers to "all colors" (from the Greek), meaning the visible spectrum. The shortwave infrared (SWIR) part of the spectrum covers the range of about 1.4 to 2.5 μm . This is followed as the wavelength increases (up to 15 μm) by the thermal infrared (TIR) spectrum (also called Long Wave Infrared), where the observed energy is no longer reflected but emitted from the ground. When multiple spectra of this type are acquired simultaneously from the same sensor, images at different wavelengths are formed, superimposed and called bands.

Some widely used satellites have instruments (in some cases multiple sensors or detectors) with multiple spectral bands but with different spatial resolutions (usually two or three groups of different spatial resolutions). In this case, a very positive aspect is that such spectral the bands image the same area at the same time, which means that very similar lighting and atmospheric conditions are created and other multitemporal change problems are avoided. It also means that the viewing directions of the bands are usually very similar, while the spectral bands of each sensor share a common geometry. Examples of such multispectral sensors with variable spatial resolution are: MODIS, VIIRS, ASTER, WorldView-3, and Sentinel-2.

A comparison of spectral bands obtained between Landsat-8 and Sentinel-2 is presented in figure 2. Due to the good features and novelty of Sentinel-2, special attention is paid to the high resolution of Sentinel-2 images [3].

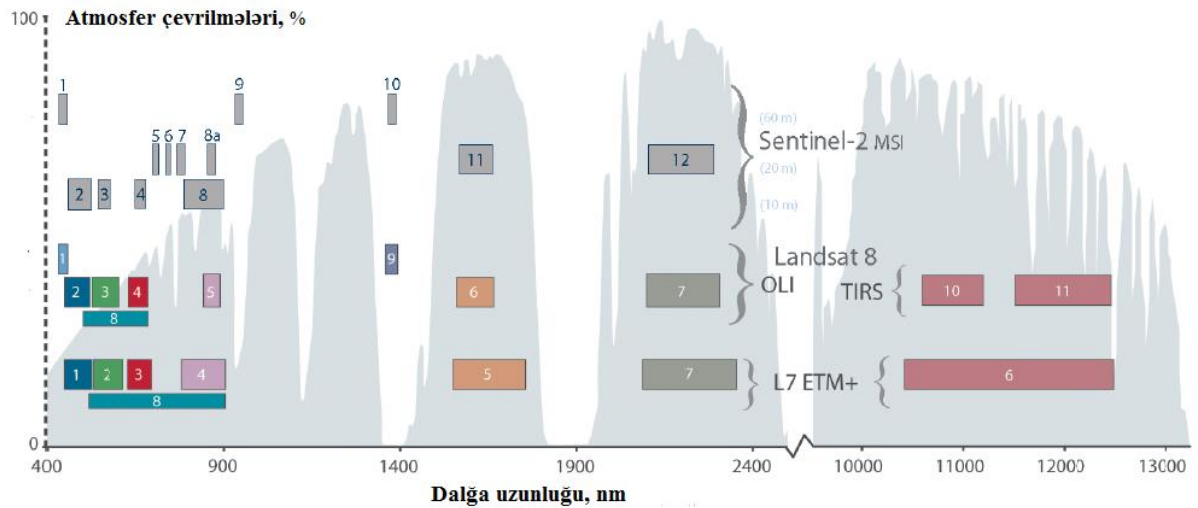


Figure 2. Comparison of spectral bands obtained by Landsat-7/8 and Sentinel-2 satellites. The gray curves show the atmospheric transmission and absorption of the EM spectrum.

There are many studies on single-image high resolution, but it is limited by spatial domain expansion. For a typical terrestrial application, the goal is to generate 30 spectral bands from 3 input bands per pixel. The difference in airborne and satellite remote sensing (MZ) is extreme, as typical low spectral resolution sensors only have up to 10 spectral bands, while hyperspectral sensors have many more bands covering the same range.

High-frequency spatial information and spatial context allow distinguishing spectral signatures of different objects and materials with similar colors [4].

The main disadvantages of this process are the limited initial data compared to single-image high resolution, as hyperspectral images are not available everywhere. Another drawback is that after simulating the training samples, the system is "tuned" to the specific spectral response of the simulated camera.

Different sensors suitable for research purposes will be considered, as well as several different methods of high-resolution image enhancement. Finally, a brief overview of neural networks and, in addition, some high-performance network architectures will be considered.

Combining a low-resolution hyperspectral image with a higher-resolution multispectral image can be viewed as hyperspectral high-resolution, as the process increases the spatial resolution of the hyperspectral image by using auxiliary data. Supporting information is considered an additional source of information. The way to increase multi-sensor high resolution is shown schematically in figure 3.

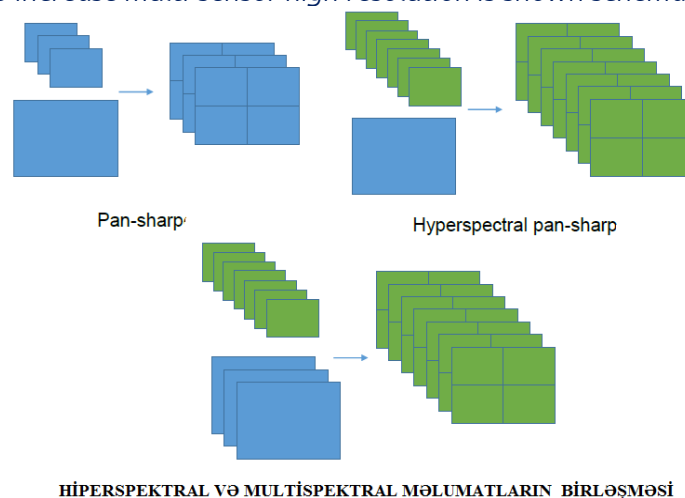


Figure 3. Schematic illustration of three different types of multi-sensor high resolution. Blue was used for panchromatic/multispectral images and green for hyperspectral images.

Results

A joint unmixing process was used to combine the hyperspectral and multispectral images. Spectral unmixing helped to apply sparsity to the representation coefficients. In addition, it is possible to increase the sparsity according to the linear mixing model. From the data itself, it was possible to estimate the relative responses of the sensors. Due to the different spectral and spatial information, the problem of perfect matching of two images is quite difficult. For this, it is necessary to remove the spatial blurring of the hyperspectral image. Thus, after pre-processing the images, it is still possible to remove the remaining errors. Finally, applying the method to real images validates the proposed approach (Figure 4).

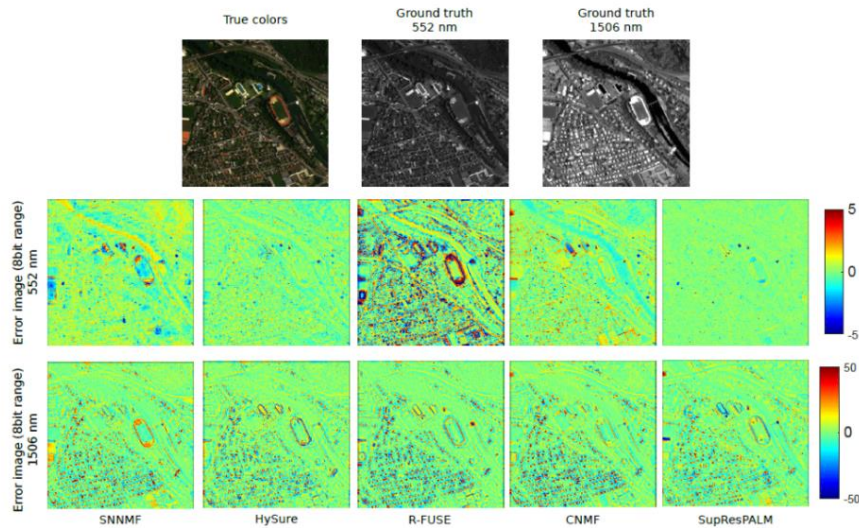


Figure 4. Top row: True color image and terrestrial true spectral images for wavelengths 552 and 1506 nm. Second and third rows: reconstruction images for each method at the indicated wavelengths (color differences between the two rows are clearly visible).

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Technical sciences

UNMANNED AERIAL VEHICLE

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Abstract

Unmanned aviation received its main development with the advent of microcontrollers and microprocessors. Microelectronics replaced bulky autopilots, and it became possible to create small-sized aircraft. If in the 20th century drones were mainly military, at the beginning of the 21st century, civilian drones appeared. Even now, drones are used to deliver cargo, collect various information over large areas, and take aerial and photographic photographs. The capabilities of drones are still being studied, and the devices are being improved

Keywords: devices, unmanned, aviation, development, microcontrollers.

Introduction

The first unmanned aerial vehicles were aerostats (Figure 1.1). They were intended to be used for bombing, but they did not produce significant results on the battlefield. This is considered the first documented use of UAVs. For a long time, unmanned aerial vehicles were used only for military purposes. The first unmanned aerial vehicle was a modified airplane and could be controlled from a sea vessel at a distance of up to 5 km. It was used as an aerial target. In the early 1930s, the first autopilots appeared, and radio-controlled aircraft received a new round of development.

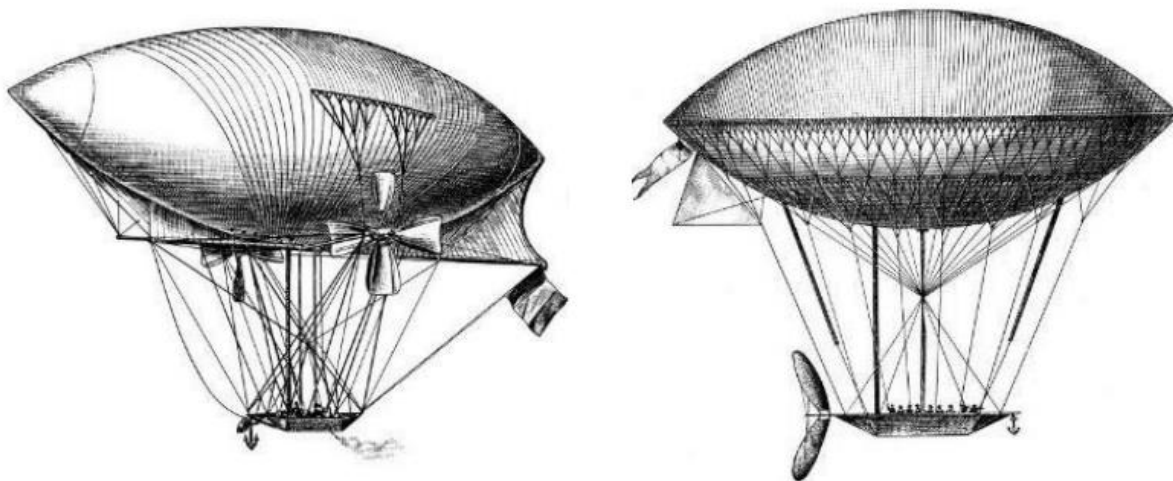


Figure 1. Examples of balloons.

The famous Soviet orbital ship Buran can also be called a drone. It flew in automatic mode without a crew on board.

Main parts

A UAV with four motors is called a quadcopter, with six - a hexacopter, with eight - an octocopter.

A distinctive feature of a helicopter-type drone is its ability to hover over an object and rotate around its axis.

Multicopters are used for photo and video shooting, in agriculture and for cargo delivery. It is also worth noting that drones have different types of configurations. Let's consider each of them in more detail.

A tricopter is a model of a multicopter that has 3 propellers. In such a drone, two front propellers move forward and have the opposite direction of rotation, and the third is a tail rotor. A quadcopter is the most popular design scheme for multicopters.

There are two movement schemes:

1. the "+" scheme, when one of the rotors is front, the opposite one is rear, and two rotors are lateral;

2. the "x" scheme, when two rotors are simultaneously front, the other two are rear, and lateral displacements are also realized simultaneously by a pair of corresponding rotors.

There are also hexacopters, they have 6 motors, and octocopters, which have 8 motors. Both types are used when it is necessary to lift a heavy load. They are also able to maintain stability during flight, so multicopters of this configuration are used for video filming. At present, the First

Person View (FPV) direction of drones, which implement the virtual presence of the operator, is actively developing.

The pilot, controlling the drone via the remote control, sees a picture in real time through the camera on the UAV by displaying it on a monitor, TV, video glasses or a video helmet.

Almost any flying machine can be converted for FPV. But do not forget about the important feature of the FPV carrier - the need for an on-board transmitter.

The minimum kit consists of a camera connected to a video signal transmitter, mounted on a regular radio-controlled model with a control signal receiver and several controls.

Nowadays, the direction of unmanned aviation for civil purposes is actively developing. One of the most popular areas of using drones is logistics. Several main areas prevail here: courier, air taxi and warehouse drones that can read barcodes from packages and conduct technological inventory.

In production, drones are used for inventory in warehouses.

By reading QR codes, barcodes and RFID, drones take stock of goods at various heights intelligently and autonomously, which

significantly helps to speed up the inventory process.

The construction industry is no exception, drones are actively used in it. With their help, it is possible to monitor without

disrupting technological processes on the site, and easily

conduct inspections in hard-to-reach places.

Photos obtained from a UAV can be used

to determine the boundaries of land plots, create photo materials for clients and employees, mapping, as well as to monitor the quality and progress of work performed at a construction site. Currently, there is a problem in agriculture of crop control. After all, during the long process of growing land, unforeseen circumstances may occur, about which the farmer will not be warned at an early stage of the problem.

First, let's look at the main parts of an FPV UAV.

List of components:

1. Frame

2. Electric motors

3. Propellers

4. Speed controller

5. Flight controller

6. Batteries

7. Radio control equipment

1. Frame

The frame is the main and supporting element of the quadcopter design, to which all other components are attached. The frame consists of two parts: the fuselage and the beams. An example is shown in Figure 1.2



Figure 1.2. Frame.

The fuselage usually houses the electronics and payload, and the arms house the motors and regulators. The quadcopter frame must be strong enough not to break after the first fall or collision with an obstacle.

When talking about the size of a drone, they usually mention the frame size, which is the distance between the diagonally located motors.

If the drone is smaller than 150 mm, it is a micro drone, and from 150 to 300 mm, it is already a mini drone.

Frames are made of plastic, wood, fiberglass, textolite, aluminum, and so on. The most popular material for frames is carbon. It is very light and durable. A carbon frame will last much longer than a frame made of another material.

But despite this, carbon has a small disadvantage: it conducts electricity very well, and if bare wires touch the frame, a short circuit may occur.

2. Motors

There are two types of electric motors: brushless and collector. Brushless motors are reliable and powerful, so they are used in both mini-drones and larger devices. But collector motors are used in small-sized drones with a frame diagonal of up to three inches, that is, micro- and mini-drones.

When choosing a motor, you need to pay attention to the "KV rating" characteristic. The KV rating is the maximum number of revolutions that the motor can develop without losing power at a given voltage.

If we need a drone for stable flight, then it is necessary to purchase a motor with a low KV value (for example, from 500 to 1000). For acrobatic flight, the KV should be between 1000 and 1500.

Also, manufacturers of brushless motors indicate in the specification information about the maximum possible thrust that the motor creates in combination with the recommended rotor. Thrust is usually measured in kilograms (Kg), pounds (Lbs) or Newtons (N).

Let's say you are assembling a quadcopter and the thrust of one motor

is 0.5 kg, then 4 motors can lift up to 2 kg of cargo. That is, if your device is slightly less than two kilograms, then it will be able to take off only at the maximum number of revolutions, so in this case it is better to choose a more powerful "motor + rotor" combination, which will provide greater thrust, or reduce the overall weight of the drone.

Results

Thus, it turns out that with a maximum thrust of the power plant of two kilograms, the ideal weight of the drone should be no more than half of this value, that is, 1 kg. To analyze the situation and identify problems, an expert group goes to the fields, which is extremely ineffective.

Drones in agriculture help to obtain information about the area, relief, soil and condition of plants.

Drones in the power industry are used to analyze and control the strength and reliability of energy infrastructure. With the help of drones, traditional ground maintenance of utility networks will be much faster, better and safer.

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HIGH TECHNOLOGIES AND ARTIFICIAL INTELLECT**Dargahgulyev Rasim Ahmad**

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Abstract

The main aim of this research is to explore high technologies and artificial intellect. Thus since the first computing machines, including ECMs (Electronic computing machines), and then the first personal computers were made individually, in incompatible copies, it was not possible to get the necessary results in solving the problems of humanity, and soon the need to connect individual computers into a network he stood before the experts of this field with his sharpness. First, local networks on the scale of individual countries, and then global networks, and then the international computer society - the global information network - the Internet, were created.

Artificial intelligence began to develop with the appearance of the first computers. There is no single universally accepted definition of artificial intelligence, proposed by John McCarthy at a Dartmouth College summer seminar in 1956. In this article, artificial intelligence is considered to be the branch of computer science that deals with the creation of systems with "human-like intellectual functions" (learning, problem solving, understanding natural language, etc.). Although artificial intelligence methods are still far behind the human brain, they have some remarkable successes - for example, they beat humans in chess, go and poker, they show near-human results in image and speech recognition, and they can synthesize images, paintings and music of a certain quality. they can do.

Keywords: high technology, artificial intellect, internet, computer, innovation

Introduction

In our opinion, since the main mission of Man is to create a thinking tool and to achieve the understanding of the Universe as a whole, the multifaceted scientific researches conducted to date in the field of artificial intelligence, intelligent systems and technologies are the first steps of a long road that reaches almost infinity. Artificial intelligence, as a scientific direction, is a clear example of the integration of various fields of science. Artificial intelligence is a field of free scientific research formed as a result of the achievements in the field of mathematics and logic and based on the knowledge accumulated by mankind about living and non-living nature. Although artificial intelligence as an established field of scientific knowledge was formed in the middle of the 20th century, it is known that the first attempts in this field were made both in antiquity and in the Middle Ages. Practically, scientists who have been dealing with this new field of knowledge since the beginning considered it appropriate to address specific issues for the constructive determination and modeling of thinking and to use the concept of "artificial intelligence" as a mechanism for solving these issues. Thus, in the modern sense, artificial intelligence is a set of methods and instruments developed using principles and approaches similar to human thought or processes in living and non-living nature to solve various complex applied problems. However, there is currently no universally accepted definition of artificial intelligence. There is nothing unusual here. Because there is no universal definition of natural intelligence - human thinking. The creation of mechanical, electromechanical and electronic computing machines, including modern computers, which strengthen the mental work of a person, expand the brain's ability to think, but cannot completely replace the brain, is a special direction in the development of "information amplifiers". Electronic-calculating machines or computers are "active information amplifiers", and before transmitting the information from the source directly to us, they carry out the necessary calculation and logical actions on it and put it into a suitable form. Computers are universal information processors. What makes them universal is the presence of multiple "digitizing" input devices, which are used to convert information of various nature into 2-bit code and enter it into the computer. Then, the central processor performs any arithmetic operations on those 2 codes. The processing results are transferred to the output devices. The output devices are for converting the 2 codes into a form suitable for later use. For example, you can enter the sound into the computer and get its graph. Thus, the number 2 acts as a general equivalent in the computer.

Since the first computing machines, including EHMs, and then the first personal computers were made individually, in incompatible copies, it was not possible to get the necessary results in solving the problems of humanity, and soon the need to connect individual computers into a network he stood before the experts of this field with his sharpness. First, local networks on the scale of individual countries, and then global networks, and then the international computer society - the global information network - the Internet, were created. However, it is wrong to understand the Internet simply as a planetary computer network. Because it essentially has a wider meaning. Thus, the Internet is the first step in the creation of world-wide artificial consciousness, which allows us to abandon the method of information exchange between individuals or their limited groups. The next steps on this path should be the miniaturization of the means of communication, which should ultimately lead to the creation of the integration of miniature computers.

In the theory of artificial intelligence, the presentation of knowledge is important. What does knowledge represent and how is it different from data? Knowledge refers to the set of information that includes information about the environment (a specific subject area, an object or a group of objects), information about the properties of objects, the regularities of events and processes, and the rules of using information for decision-making. The first computing machines were focused on data processing. This was due to the level of development of technical and software solutions, as well as the specifics of the issues being resolved. The complexity of the issues solved in the later stages of development, their intellectualization, the development of computing technology, made it necessary to create a machine that processes knowledge. The biggest difference between knowledge and data is undoubtedly that knowledge is interpretive. It is important to have a program to explain (interpret) data, and data itself does not carry complete information, but knowledge always carries complete information.

The transition to the innovation environment has created new opportunities for the Republic of Azerbaijan, as in all countries. Special attention is paid to the development of Information and Communication Technologies (ICT) in order to expand all sectors in our country. In recent years, artificial intelligence (AI) technology, which has deeply penetrated all fields in the country, has great prospects in the direction of intensification of the sector in Azerbaijan and the formation of a highly competitive market mechanism.

The reconstruction and development of the liberated territories is also carried out on the basis of the newest approaches based on high technologies. These once again confirm how the development vectors of the Azerbaijan state were determined decades ago. One of these vectors is the construction of the country's entire infrastructure based on the most advanced digital technologies and comprehensive, inclusive development of human resources. Artificial intelligence technologies and solutions act as the main driving force in this mission [2].

Artificial intelligence began to develop with the appearance of the first computers. There is no single universally accepted definition of artificial intelligence, proposed by John McCarthy at a Dartmouth College summer seminar in 1956. In this article, artificial intelligence is considered to be the branch of computer science that deals with the creation of systems with "human-like intellectual functions" (learning, problem solving, understanding natural language, etc.). Although artificial intelligence methods are still far behind the human brain, they have some remarkable successes - for example, they beat humans in chess, go and poker, they show near-human results in image and speech recognition, and they can synthesize images, paintings and music of a certain quality.

The main research directions of artificial intelligence

The main areas of research in the field of artificial intelligence include modeling of judgments (proving theorems, decision-making), natural language processing, knowledge engineering (expert systems, machine learning), modeling of biological systems (neural networks, bio-"influenced" algorithms), image recognition, intelligent robots, machine creation, etc. is attributed. One of the main goals of artificial intelligence is for computers to understand natural language. Let's just note that work is being done on artificial consciousness - computerized systems that feel alive and can experience real emotions.

Currently, artificial intelligence has become a complex of technological and software solutions and allows to achieve results that exceed human intellectual activity in many fields.

Automation and intellectualization are rapidly giving way to smart technologies. There is a significant difference between intellectual and smart. Intelligent - works on the basis of a given algorithm, and smart systems improve that algorithm based on the data collected as it works.

Although artificial intelligence has not yet met great expectations, it is moving from "infancy" to a new stage in its development, has been able to fully prove its potential power in a number of applications,

and has become an arena of competition between countries (it also has great applications in the military field). Azərbaycanca süni intellekt sahəsində tədqiqatlar

Süni intellektin praktikada geniş tətbiq tapmış sahələrindən biri əsası dahi həmyerlimiz Lütfi Zadə tərəfindən qoyulmuş qeyri-səlis məntiqdir. Azərbaycan alimləri tərəfindən qeyri-səlis məntiq və idarəetmə, süni neyron şəbəkələri, evolyusiya metodları, qərar qəbulunu dəstəkləyən intellektual sistemlər, ekspert sistemləri kimi süni intellekt mövzuları geniş tədqiq olunub və bir sıra praktiki həllər təklif edilib. Son onillikdə verilənlərin intellektual analizi, maşın öyrənməsi sahəsində də fundamental və tətbiqi tədqiqatlar aparılıb, bir sıra diqqətəlayiq nəticələr əldə edilib. Eyni zamanda, hazırda e-hökumətin inkişafı və rəqəmsallaşdırma strategiyası çərçivəsində bir sıra süni intellekt əsaslı tətbiqlərin işlənməsi həyata keçirilir.

The "spring" and "winter" of artificial intelligence

Usually, AI projects have very big goals. This is due to the great enthusiasm of the researchers and their inability to correctly assess the complexity of the problems of artificial intelligence. For example, as early as the 1960s, researchers were confident that machine translation systems would be created, but the idea collapsed in 1966. The consequences of the failure to fulfill the social order are expressed in English-language popular literature by words such as "Artificial Intelligence Spring" and "Artificial Intelligence Winter".

The winter of artificial intelligence - huge goals promised to society in the field of artificial intelligence are not realized, and funding allocated to scientific and practical projects is sharply reduced. Two major winters are known: 1974-1980 and 1987-1993. In 1982, a multi-year project aimed at creating 5th generation computers was underway in Japan, but now few people remember it and its results.

Deep neural networks

Currently, artificial intelligence is experiencing its next spring, and this is related to the development of deep neural networks. Since 2006, deep learning has been at the forefront of machine learning research. "Deep Learning" is a type of machine learning based on deep neural networks (i.e. with more than 2 layers). Although deep neural networks have been studied for a short time, they have been successfully applied in natural language processing, speech recognition, and computer vision. In some areas, the application of deep neural networks and machine learning methods in general is still not widespread. The point is that machine learning needs to collect large amounts of data and analyze it properly. Deep neural network methods, on the other hand, require larger amounts of data. Therefore, deep neural networks cannot always help, sometimes it is necessary to apply simpler, classical methods.

Learning strategies in artificial intelligence

Machine learning methods are a leading component in today's applications of artificial intelligence. Machine learning studies algorithms that improve their performance by learning from past experience (i.e. data). Machine learning, which uses hundreds of methods to detect hidden patterns in data, allows optimizing complex processes by taking full advantage of data.

The following learning strategies are mainly used in machine learning methods:

Learning with a teacher - requires data with class icons for learning. It's typical problems are classification (image recognition) and prediction (regression analysis) and it is widely used in practice.

Teacherless learning - does not require class badges for learning; typical issues are clustering (data grouping) and finding associative rules.

Stimulation learning - learns from experience gained in interaction with the environment (plays, wins, draws, loses - learns from the result - learns). It is widely used in intelligent agents and robots.

"Sputnik Moment"

In the globalized world, a paradigm shift is currently taking place in the field of practical application of artificial intelligence. As a result of its development and convergence with the Internet of Things, cloud computing, mobile technologies, robotics, "Big data" analytics, and social media over the last decade, artificial intelligence has reached a critical point where it will strengthen and expand every technology-based service and application.

Artificial intelligence is radically changing all fields of activity - industry, agriculture, transport and logistics, energy, telecommunications, financial sector, health, trade, education, science, public administration, public and national security, and the judicial system.

The nations of the world are trying to use this potential of artificial intelligence to achieve a competitive advantage. The "Sputnik moment" of artificial intelligence was the adoption of A Next Generation Artificial Intelligence Development Plan in China in July 2017. was also a strong impetus to the development of science and technology). After that, other countries also urgently began to develop

their respective strategies to ensure their technological sovereignty in the field of artificial intelligence and allocate large funds for its implementation. At present, more than 40 countries have started implementing such strategies. It seems that artificial intelligence in its modern form has become the next "rapid arms race in space".

Priority directions for the country in the field of artificial intelligence

The analysis of the national strategies of a number of advanced countries in the field of artificial intelligence allows us to distinguish the following five directions as priorities for our country.

- *Conducting fundamental applied research in the field of artificial intelligence - creating new artificial intelligence algorithms using mathematical methods;*

- *Development of artificial intelligence engineering - application of algorithms obtained as a result of fundamental applied research to solving various practical problems, development of new software and technological solutions;*

- *Data - data collection, storage, processing and optimization (for training algorithms);*

- *Personnel training - preparation of highly qualified scientific personnel and specialists in the field of artificial intelligence, creation of new educational programs;*

- *Legislative framework - development and implementation of laws, standards and ethical rules that support the development of artificial intelligence technologies.*

Essentially, fundamental applied research in the field of artificial intelligence does not require a large investment: mainly, an Internet connection and in some cases high computing power (for example, for training deep neural networks). Our country has highly qualified scientific personnel and great experience in this field, their support and stimulation is extremely important for the entire artificial intelligence ecosystem.

In order to determine the priority areas of artificial intelligence engineering in our country, it is necessary to pay attention to a number of factors. Artificial intelligence technologies are applied to free people from monotonous work, support decision-making, automate dangerous workplaces, support communication between people, strengthen social influence and social integration, and ensure internal and external security of the country. Artificial intelligence technologies are becoming a tool for economic development, and can provide an opportunity to gain a decisive advantage in the military field. Artificial intelligence engineering should focus on technological solutions that overcome the weak points in these multidisciplinary fields and overcome the boundaries. In this regard, one of the important tasks is to promote the application of artificial intelligence solutions in various fields, support technological entrepreneurship and stimulate the export of artificial intelligence-based products.

Data serves as the "fuel" for AI models. Training a model on a specific problem requires real data, and the more and better the data, the better it will be able to train the models. Therefore, ensuring the collection, storage and availability of data is of great importance. In this regard, it is one of the priority issues to ensure the collection, digitization and availability of data generated in the country, to implement a well-coordinated single policy, and to create the necessary infrastructure for this process.

In general, the lack of highly qualified personnel in the field of information technology and brain drain problems are no secret to anyone. There is a serious need for new educational programs, resources, and new forms of education to provide the labor market with highly qualified personnel in artificial intelligence technologies. At the same time, it is important to raise the level of public awareness of possible areas of use of artificial intelligence technologies. Special attention should also be paid to supporting the self-organization of the community of Azerbaijani-speaking scientists and specialists in the relevant field.

As a result of the wide application of artificial intelligence, new social relations are formed in society, and management and regulation in this field must be in line with rapidly changing requirements. In our opinion, the time has come to establish the principles and standards of responsible use of artificial intelligence technologies, ensuring confidentiality, security and ethics in accordance with national legislation and values.

Result. *Artificial intelligence is one of the newest technologies of the 21st century and one of the main driving forces of the Fourth Industrial Revolution. Already, artificial intelligence technologies are beginning to be widely used in practice, and it can be expected that they will soon completely change the way people live.*

The Republic of Azerbaijan, which has successfully implemented the course of digital transformation in all areas of social life, is showing its will in this area as well. Our country, which has restored its territorial integrity, has the goal of standing in the leading positions in the world, not on the periphery, in the field of high technologies. For the successful implementation of this difficult task, the

government, science, education and industry sectors have a special mission, and it can be said with certainty that thanks to effective cooperation and purposeful work between them, our country will enter the group of leaders in the field of artificial intelligence and become one of the main centers of innovation in this field.

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RESEARCH OF VEHICLE MOVEMENT IN TRAFFIC ACCIDENT ANALYSIS

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ДОСЛІДЖЕННЯ РУХУ ТРАНСПОРТНИХ ЗАСОБІВ ПРИ АНАЛІЗІ ДТП

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ВСТУП

Дорожньо-транспортні пригоди (ДТП) є серйозною проблемою, яка щороку призводить до численних травм та смертей по всьому світу. Аналіз руху транспортних засобів при ДТП є важливим інструментом для розуміння причин аварій та розробки ефективних заходів для їх запобігання. Ця стаття розгляне методи дослідження руху транспортних засобів, використання сучасних технологій та програмного забезпечення, а також важливість цих досліджень для покращення безпеки дорожнього руху та експертного аналізу механізму ДТП.

1. Методи дослідження руху транспортних засобів

1.1. Традиційні методи

Традиційні методи дослідження ДТП включають огляд місця події, збирання свідчень очевидців, та аналіз фізичних доказів. Серед них можна виділити:

- **Огляд місця події:** Включає фотографування та вимірювання слідів шин, пошкоджень на транспортних засобах та дорозі, а також фіксацію розташування уламків.
- **Аналіз свідчень:** Опитування свідків та учасників ДТП для отримання інформації про обставини події.
- **Фізичний аналіз:** Оцінка пошкоджень транспортних засобів та їх кореляція з можливими сценаріями аварії.

1.2. Сучасні технології

З розвитком технологій з'явилися нові методи дослідження руху транспортних засобів, які дозволяють більш точно і швидко аналізувати ДТП:

- **Телематика:** Використання даних з датчиків, встановлених у транспортних засобах, для аналізу їх руху перед ДТП.
- **Комп'ютерне моделювання:** Використання програмного забезпечення для відтворення аварій на основі зібраних даних.
- **Аналіз відеозаписів:** Використання відеокамер спостереження для вивчення поведінки транспортних засобів перед аварією [1].

2. Телематика та її роль в аналізі ДТП

2.1. Принцип роботи телематики

Телематика передбачає використання різноманітних датчиків та GPS-трекерів, встановлених у транспортних засобах, для збору даних про їх рух. Ці дані можуть включати інформацію про швидкість, прискорення, напрямок руху, гальмування та інші параметри.

2.2. Застосування телематики при аналізі ДТП

Телематичні дані дозволяють аналітикам більш точно відтворити події, що передували аварії. Це може включати:

- **Аналіз швидкості та гальмування:** Визначення, чи перевищував транспортний засіб швидкісний режим і як швидко водій почав гальмувати перед зіткненням.
- **Аналіз руху:** Визначення траєкторії руху транспортних засобів, їх маневрів та змін смуги руху.
- **Реакція водія:** Оцінка того, як водій реагував на обставини, що передували аварії, наприклад, на перешкоди або інші транспортні засоби.

3. Комп'ютерне моделювання

3.1. Види програмного забезпечення для моделювання

Існує декілька видів програмного забезпечення, яке використовується для моделювання ДТП:

- **Динамічні симулятори:** Програми, які моделюють динаміку транспортних засобів на основі фізичних законів.
- **Аналіз відеозаписів:** Інструменти, які дозволяють аналізувати відеозаписи з місця ДТП для визначення траєкторій руху транспортних засобів.
- **Програмне забезпечення для візуалізації:** Програми, які створюють тривимірні моделі місця події та дозволяють відтворити події з різних кутів огляду.

3.2. Переваги комп'ютерного моделювання

Використання комп'ютерного моделювання має кілька переваг:

- **Точність:** Моделі базуються на точних математичних розрахунках та фізичних законах, що дозволяє отримати достовірні результати.
- **Швидкість:** Аналіз за допомогою програмного забезпечення можна виконати значно швидше, ніж традиційні методи.
- **Візуалізація:** Тривимірні моделі дозволяють краще зрозуміти обставини ДТП та показати їх учасникам розслідування або суду.

4. Аналіз відеозаписів

4.1. Джерела відеозаписів

Для аналізу ДТП можуть використовуватися відеозаписи з різних джерел:

- **Камери спостереження:** Вуличні камери або камери на будівлях, які фіксують події на дорогах.
- **Відеореєстратори:** Пристрої, встановлені в автомобілях, які записують відео під час руху.
- **Мобільні пристрої:** Відео, зняте очевидцями на смартфони.

4.2. Технології аналізу відеозаписів

Існують спеціальні програмні інструменти, які використовуються для аналізу відеозаписів:

- **Аналіз руху:** Визначення швидкості та траєкторії руху транспортних засобів на основі відеозаписів.
- **Розпізнавання об'єктів:** Використання алгоритмів машинного навчання для ідентифікації транспортних засобів, пішоходів та інших об'єктів на відео.
- **Відтворення подій:** Створення хронології подій на основі відеозаписів для точного відтворення ДТП.

5. Важливість дослідження руху транспортних засобів

5.1. Підвищення безпеки дорожнього руху

Дослідження руху транспортних засобів при аналізі ДТП має вирішальне значення для підвищення безпеки на дорогах. Отримані дані дозволяють:

- **Ідентифікувати причини аварій:** Аналіз дозволяє виявити основні фактори, що призводять до ДТП, такі як перевищення швидкості, порушення правил дорожнього руху, або технічні несправності.
- **Розробка заходів безпеки:** На основі отриманих даних можуть бути розроблені рекомендації щодо покращення інфраструктури, зміни правил дорожнього руху, або введення нових технологій безпеки.
- **Освіта водіїв:** Поширення інформації про типові причини ДТП та способи їх уникнення сприяє підвищенню культури водіння та зниженню кількості аварій.

5.2. Юридичні аспекти

Аналіз руху транспортних засобів має важливе значення у правовій сфері:

- **Встановлення винуватості:** Точний аналіз подій дозволяє визначити, хто є винуватцем аварії, що є важливим для розгляду справ у суді.
- **Оцінка компенсацій:** На основі аналізу визначається обсяг пошкоджень та витрат, необхідних для відшкодування збитків постраждалим сторонам.
- **Профілактика шахрайства:** Детальний аналіз допомагає виявити випадки шахрайства, коли учасники ДТП намагаються отримати неправомірну вигоду [2].

Висновок

Дослідження руху транспортних засобів при аналізі ДТП є надзвичайно важливим для підвищення безпеки дорожнього руху та забезпечення справедливості у правових питаннях. Використання сучасних технологій, таких як телематика, комп'ютерне моделювання та аналіз відеозаписів, дозволяє отримувати точні та достовірні дані, що сприяє більш ефективному розслідуванню ДТП. Подальший розвиток цих технологій та їх впровадження у експертну практику під час розслідування ДТП, може значно знизити час досудового розслідування.

Перелік використаних джерел

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