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ECOLOGICAL PROBLEMS OF HYDROLOGICAL MONUMENTS OF SHEKI-ZAGATALA REGION

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Abstract
The presented article examines hydrological monuments located in Sheki-Zagatala region. These monuments include rivers, lakes and waterfalls. In modern times, there are a number of environmental problems related to water resources. It is these environmental problems that greatly affect the ecotourism sector of the Sheki-Zagatala region.

Keywords: Azerbaijan Republic, Sheki-Zagatala region, hydrological monuments, ecology, ecotourism

Introduction
It is known that the basis of the world is water. Water is the basis of life. Like many countries around the world, the Republic of Azerbaijan is very rich in this regard. The presence of rivers, lakes and waterfalls indicates the abundance of water resources in the country. The Sheki-Zagatala region is very rich in this regard. The presence of every hydrological monument in the area has a positive impact on the development of the ecotourism sector in the region. However, these monuments have many ecological problems. The relevance of the article is to discuss the role of these hydrological monuments in the Sheki-Zagatala region in the ecotourism sector. The object of research is rivers, lakes and waterfalls in the region. The subject of the study is the ecological mechanisms of hydrological monuments of the Sheki-Zagatala region. The main purpose and task of the research is to provide information about these hydrological monuments located in the region and to study their ecological problems, as well as to show the usefulness of monuments for the ecological tourism sector.

Hydrological monuments in Sheki-Zagatala region
As we know, Sheki-Zagatala region is rich in natural resources. In each of the districts of the Sheki-Zagatala region, there are hydrological monuments, or more precisely, rivers, lakes and waterfalls. Thus, the hydrological monuments of the region can be divided as follows:

✓ Rivers – Turyanchay, Damiraparanchay, Tikanlichay, Bum, Vandam (Gabala), Khalkhal, Dashagil, Oghuz, Turyanchay, Galachay (Oghuz), Alijan, Kishchay, Shin (Shaki), Ganikh /Alazan, Kumruk, Ayrichay (Gakh), Talachay (Zagatala), Balakan, Mazim, Khatekh, Ganikh / Ayrichay (Balakan);

✓ Lakes – Nohurgol, Tufangol, Turfangol (Gabala) and Ajinohur (Gakh);

✓ Waterfalls – Ramrama, Lakit, Shahverdi, İlisu, Gochyataghi, Mamirli (Gakh), Yeddi Gozal, Mujugh (Gabala), Khatekhchay (Balakan) and etc.

Khatekhchay waterfall is considered to be the most famous and the most abundant waterfall in Azerbaijan and is included in the territory of Zagatala State Nature Reserve, its height is about 20 meters. Yeddi Gozal Waterfalls is located on the side of the Oguz-Gabala road. Ilisu waterfall in Gakh is located in the highest part of the region and its height is about 25 meters. Another waterfall in Gakh is Mamirli waterfall, located in the forest above the village of Lakit. The locals call this waterfall Damchi waterfall (Mammadov, 2012, pp.209, 223, 231, 239, 250, 258, 267, 279; Mammadov et al, 2015, pp. 658-659).
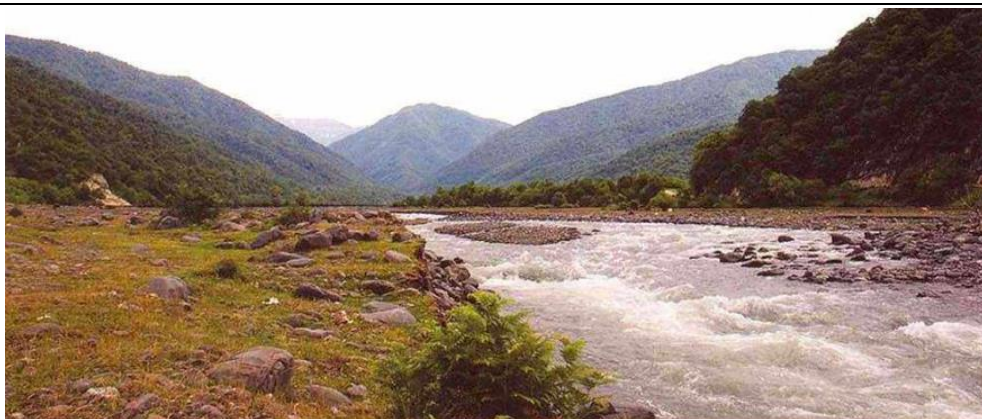
Figure 1. Khatekhchay (Mammadov, 2012, pp.206)

Problems of hydrological monuments of Sheki-Zagatala region in ecological environment

In addition to being rich in hydrological monuments, the Sheki-Zagatala region also has certain environmental problems. Observations in the region reveal the ecological environment and problems of water resources. In general, the disturbance of this ecological balance leads to the death and reduction of living things living inside hydrological monuments. This creates conditions for the extinction of wildlife. So, there are two main reasons for this problem:

1) Natural phenomena;
2) Anthropogenic influences.

It is a fact that man is a major figure in the pollution of nature, but also affects the hydrological regime. The influence of the human phenomenon is also observed in the Sheki-Zagatala region. So that, the Ganikh River is located on the border between Azerbaijan and Georgia. In 2015-2016, experts conducted seasonal surveys of the river, and as a result, it was determined that the river was polluted in Georgia. The main reason for this is industrial, agricultural and household waste. Because about 80% of the vineyards of the Republic of

Georgia are located in the Ganikh valley, and there are no sewage treatment plants in the area along this river. As a result, all domestic wastes and sewage from the washing of arable lands flow into the Ganikh river basin. On the border of the Republic of Azerbaijan, the Ganikh River is polluted by small tributaries that flow into the river. Turyanchay is considered to be one of the most silty rivers in the country. The ecological environment of the river is polluted by household waste, as well as fertilizers and medicines used in agriculture. As a result, it is one of the anthropogenic impacts on river pollution (https://azmbi.az/PDF/AMEA%20Mikrobiologiya%20%C4%B0nsti-tunun%20Elmi%20%C6%8Fs%C9%99rl%C9%99ri%202017_15_2.pdf)

Another issue is the turbidity of the rivers. It is formed under the influence of many natural factors in the formation of turbidity of rivers. According to experts, it is divided into seven zones due to the turbidity of rivers in the country. Zones IV, V and VII of them fall to the share of Sheki-Zagatala region. This is given in more detail in the following table:

Table 1.

Calculated and recovered values of turbidity in Sheki-Zagatala region

№	Zones	İnterval qr/m³	Riverpoint (Çay məntəqə)	$\rho_{natural}$ ($\rho_{təbii}$)	İnterval qr/m³	Riverpoint Çay məntəqə	$\rho_{natural}$ ($\rho_{təbii}$)
1.	Zone IV	200-5000	Khatekhchay-Gabizdere	372	200-500	Khatekhchay-Gabizdere	372
2.	Zone V	500-1000	Gabirri-Khasaman	565	500-1000	Gabirri-Khasaman	565
			Balakanchay-Balakan	860		Balakanchay-Balakan	867
3.	Zone VII	2000-5000	Talachay-Zagatala	3425	2000-5000	Alazan-Ayrichay	2053
			Ayrichay-Mansab	2571		Talachay-Zagatala	3425
			Alazan-Ayrichay	2053		Damarcig-Mansab	2015

(http://static.bsu.az/w8/Xeberler%20Jurnali/Tebiet%20%202013%20%202/209-216.pdf)

The whimsical influence of nature affects to some extent every part of the environment. Thus, natural disasters such as floods often occur in the water resources of the Sheki-Zagatala region. The rivers in the Sheki-Zagatala region, depending on the nature of the water regime, have a spring or spring-summer flow regime and belong to the summer-autumn or autumn flood regime. The hydrological phenomenon of floods in the

rivers of the region is very active. Such rivers in the Sheki-Zagatala region include Balakanchay, Khatekhchay, Talachay, Mukhakhchay (Garachay), Kurmukchay, Kishchay, Mazimchay, Alinjanchay (Khalkhalchay), Ayrichay, branches of Turyanchay - Bumchay, Tikanlichay, Damiraparanchay, Akhchachay (Galachay). In general, most floods were

observed in Damiraparanchay, Khatekhchay, Tikan-lichay. The consequences of the floods in the Sheki-Zagatala region are enormous. Here are some examples: An accident on the Damarchin (Kishchay) River on June 27, 1982, destroyed two 140-ton stone Marxal bridges and a road during a flood. During another flood on July 15, 1988, one of the two stones was carried under the bridge near the village of Kish and the other a short distance away; The flood in Ayrichay (Dashagil-chay) at the beginning of the 20th century caused great damage to the main Dashagil village, and there are 180 tons of stones brought by the flood in the Dashagilchay channel; The flood that passed through Demirparanchay on April 28-29, 1994 damaged 150 million m^2 roads in Gabala, and on August 13, 1999, the flood that passed through that river again covered the streets in Gabala with mud; As a result of the floods in Balakanchay, Mazimchay, Katekhchay on June 10-11, 1997, 2,500 hectares of grain crops became unusable, about 100 private houses were destroyed, and some administrative buildings were damaged; As a result of the floods in Demirparanchay and Tikanlichay in 16-17.1999, about 70 houses in Gabala were flooded, 18 cattle perished, and the fields were covered with mud; The flood in Kishchay on June 29, 2002 washed away the electric poles in the river basin in Sheki; As a result

of the flood in Shinchay on July 27, 2004, the drinking water supply was disrupted in Sheki, etc. According to Mammadov Magbet's research, the earliest floods in the Sheki-Zagatala region were in 1846 in Shinchay, and the last on August 17, 1999 in Damiraparanchay, a branch of the Turyanchay. However, floods still occur. On September 23, 2021, as a result of heavy rains, floods were observed in Balakanchay, Khatekhchay and Talachay (Mammadov, 2012, pp.101-127; Ma-harramova, 2008, pp.43-47; http://web2.anl.az:81/read/page.php?zoom=0&bibid= 346323&pno=12; https://az.trend.az/azerbaijan/soci-ety/3488294.html).

On the other hand, the lakes and waterfalls in the Sheki-Zagatala region are in danger of drying up. The main reason for this is climate change. The sharp change in climate as a result of global warming is creating these problems. Thus, in 2021, there was a drying of Lake Acinohurgol, a decrease in the water level of waterfalls such as Yeddi Gozel, Ilisu, Mujugh. So, the presence of rainwater can prevent this event (https://qafqazinfo.az/news/detail/acinohur-golu-niye-quruyur-321019; https://aqreqator.az/en/cemiyyet/1569614).

Figure 2. Ajinohurgol (Mammadov, 2012, pp. 239)

The policy of the Republic of Azerbaijan in the protection of the hydrological environment of the Sheki-Zagatala region

One of the main priorities of the successful state policy pursued by the President of the Republic of Azerbaijan Ilham Aliyev is the development of the country's regions. So that, the Order of the President of the Republic of Azerbaijan "On additional measures to accelerate the socio-economic development of Sheki, Balakan, Gakh and Zagatala districts of the Republic of Azerbaijan" contains a number of laws, the implementation of which is entrusted to Melioration and Water Management OJSC:

1) Cleaning of the bed of the Gurjana and Deyirmanarkhi rivers flowing along the center of Sheki and major restoration of the coastal walls;

2) Shore protection works on Kishchay, Dashagilchay and Shinchay rivers;

3) Shore protection works on Mazimchay, Khatekhchay and Balakanchay rivers;

4) Carrying out shore protection works to protect the "Sumug Qala" monument and the surrounding area in Ilisu State Historical-Cultural Reserve from floods;

5) Shore protection works on Kurmukchay, Zarna and Ganikh rivers;

6) 1548.6 pm shore protection works on the Mukhakh, Tala and Khatekh rivers at the expense of the Asian Development Bank loan.

The Law on Approval of the "State Program of Socio-Economic Development of the Regions of the Republic of Azerbaijan in 2019-2023" dated January 29, 2019 by the President of the Republic of Azerbaijan Ilham Aliyev adopted strategic laws for socio-economic development of the country's regions. One of these measures is an important part of the strategy in the regions. Also, the main priority here is to protect the population from floods and floods to ensure the safety of the population. In the state program of socio-economic development of the regions of the Republic of Azerbaijan for 2019-2023, the regions of the Sheki-Zagatala region are also included in the list of these

measures. Implementation of the planned works has been entrusted to the Ministry of Emergency Situations, "Azerbaijan Amelioration and Water Management" OJSC, local executive power. The decree envisages the continuation of measures for the development of tourism in the Sheki-Zagatala region, as well as in other regions of Azerbaijan, and this State Tourism Agency has been assigned to the local executive power. Taking into account such measures in our country is one of the main steps for the development of ecotourism in the region.

However, various pilot projects have been proposed in our country to address this issue: "Pilot River Basin Management Plan for Alazan / Ganikh River Basin" developed by Jesper Ansbaek, Anatoly Pichugin, Peter Roncak, Vafadar Ismayilov, Farda Imanov and Rafig Verdiyev and funded by the European Union in October 2011; "Consultations and workshop on assessment of impact on the National Strategy for the Use of Alternative and Renewable Energy Sources in the Republic of Azerbaijan in 2015-2020 and defining the scope of analysis at the base level" held on May 12, 2015 in Baku "; A seminar on MSD on the National Water Strategy of the Republic of Azerbaijan SEIIE held on June 7-8, 2012 within the framework of EU SI, etc.

In addition, many river protection and restoration projects have been implemented around the world: projects such as Central Europe – REURIS, UK – River Restoration Center (RRC), Berlin (Germany) – Panke River Restoration, Munich (Germany) – Isar River Restoration, Olomous (Czech Republic) – Morava River Rehabilitation, Teplise (Czech Republic) – Black River Rehabilitation, Durham County (UK) – Skerne River Rehabilitation, Havant (UK) – Hermitage River Rehabilitation, National River Protection Authority in Israel, development of a special program in this field in Russia, etc. (https://e-qanun.az/framework/12260; https://e-qanun.az/framework/41320; Mammadov et al, 2015, pp.659; İmanov et al, pp.24-32; https://meteo.az/index.php?ln=az&pg=110; https://unece.org/filead-min/DAM/env/eia/meetings/2015/May_SEA_workshop_scoping_Baku/12_may.pdf; https://unece.org/filead-min/DAM/env/water/npd/Water_Strategy_Rafig_Verdiyev.pdf)

Determining the importance of hydrological monuments of Sheki-Zagatala region in the ecotourism system

The presence of hydrological monuments in the Sheki-Zagatala region is one of the main factors contributing to the development of the ecotourism sector in the region. It is known that the field of ecotourism presents the pearls of nature to people. It is the pleasant fresh air of the region, as well as the flora and fauna, as well as the presence of hydrological monuments that make the area useful for the tourism sector. Thus, local and foreign guests visit the water resources monuments here.

Figure 3. Mamirli waterfall (Mammadov, 2015, pp. 658)

Thus, one of the charming hydrological monuments of the region is Mamirli waterfall located in Gakh region. This waterfall is located in a forested area above the village and the water flows through the mossy rocks. Many tourists flock here to see this beautiful view. Thus, the village municipality has cleared the roads leading to the waterfall from large stones to ensure their comfort. Also, the area around the waterfall is monitored, and assistance is provided by guides for visitors. Prohibit the special needs of people in this area, as well as bathing or car washing. İn addition, drinking water was pumped to the village from here through a pipeline. Mamirli waterfall of Gakh region was renamed as "Natural Monument" by the decision of the Cabinet of Ministers of the Republic of Azerbaijan dated August 5, 2006 and is protected by the state.

Another mysterious waterfall of Gakh is Ilisu. This waterfall is located on the highest peak of the region, so it is not easy for him to climb there. To get here, the tourist must walk at least half an hour. However, for those who can not climb to this height, vehicles are organized (Mammadov et al, 2015, pp. 658-659). There are also many visitors to other hydrological monuments in the region. Even those parts have become places that will be suitable for the tourism sector. However, the improper use of these areas by people who migrate to them leads to the destruction of their natural environment. Therefore, the main issue is not to damage the landscape of these hydrological monuments and to protect them seriously in order to attract more tourists to the region. This in itself is of great importance for

Sheki-Zagatala, as well as for the tourism sector of the Republic of Azerbaijan (Nazarova, 2022, pp. 8-9).

Conclusion and suggestions

Finally, let's list the results we received from the article:

o Ecological problems of hydrological monuments in Sheki-Zagatala region are still on the agenda;

o Certain natural and anthropogenic factors damage hydrological monuments in the area;

o Natural disasters damage the agriculture and individual habitats of the regions, as well as the local population, just as hydrological monuments are damaged;

o The force of anthropogenic impacts on the hydrological monuments of the regions is very large. Chemicals, agricultural waste, industrial waste, etc. these include.

o The state policy of the Republic of Azerbaijan on the protection of water resources and the solution of problems in the region, as well as a number of organized projects and programs are of great importance;

o There are environmental problems of hydrological monuments in most countries of the world and international measures are taken on this;

o Damage to the ecological environment of rivers, lakes and waterfalls in the region leads to the destruction of living things within them;

o The availability of river, lake and waterfall type water resources in the region is very important for the ecotourism sector of the region;

o Hydrological monuments in Sheki-Zagatala region are very important for the Azerbaijani ecotourism system;

o Nowadays, these hydrological monuments are used for the tourism sector and are open to local and foreign tourists.

Thus, we consider it expedient to note the following proposals on the protection of Sheki-Zagatala hydrological monuments:

• Study of natural phenomena in the region – Taking into account the natural effects on the Sheki-Zagatala hydrological monuments, it is expedient to continue work on the study of natural disasters and to establish geographical plans for their prevention;

• Carry out awareness-raising activities on the protection of hydrological monuments in the Sheki-Zagatala region – In this process, it is possible to involve the local population, including pupils and students. In this regard, it is possible to hold various educational events;

• Provide tourists with information on the non-pollution of recreation areas – Local and foreign visitors can be informed about the protection of hydrological monuments that have now become recreation centers;

• Strengthening control over hydrological monuments – It is more appropriate to increase special control to prevent pollution in these hydrological monuments, which are also used as recreation areas in modern times;

• Strengthening measures to ensure human safety – It is known that the hydrological monuments of the Sheki-Zagatala region are well-known and dangerous areas. One of the main issues for this is to ensure the safety of foreign citizens, including locals. Therefore, it is appropriate to intensify the work in this direction;

• Increasing the role of monuments in the region in the ecotourism sector – determining the compliance of these monuments with international standards can increase the importance of the Sheki-Zagatala region in the field of ecotourism. For this reason, it would be good to identify tourist activities used in hydrological monuments around the world and to clarify their compatibility with hydrological monuments in the Sheki-Zagatala region.

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ECONOMIC SCIENCES

ASPECTS OF THE IMPACT OF INTERNATIONAL TOURIST FLOW ON EMPLOYMENT

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Abstract
The article examines the influence of seasonality of international tourist flows on their distribution by regions of the world and the definition of aspects of the impact of tourism and travel on the level of employment in the country based on a comparative analysis of different countries. The direct and indirect contributions of tourism to the economy are revealed, the main tourist markets that form international tourist flows are highlighted. The sphere of tourism and travel is of great importance in providing employment for the population. This makes it possible to identify favorable tourist resources and new products for the development of tourism in various regions of the world, as well as to develop a tourism development strategy at the level of international standards.
The significance of the study lies in the fact that the data and results obtained make it possible to realize the significance of the issue under study and the need to study it.

Keywords: international tourism, regions, distribution, population, employment, provision

I. INTRODUCTİON

Tourism today has become a rapidly developing industry in many countries, being an industry of the socio-economic complex. Currently, every 7th workplace in the world is accounted for by organizations engaged in the tourism business. According to WTO forecasts, by 2025 the number of international tourist trips will amount to about 1.7 billion people. Estimates show that the daily expenses of tourists, with the exception of air transportation, will increase to $5 billion per day [21].

Currently, there are two trends in tourism:
- impact of external economic and political factors;
- the ability of tourism volumes to recover quickly under unfavorable conditions [Kazybaykyzy, 2015: 265-269].

Stability in the global financial markets has led to some changes in the habits of vacationing tourists: the number of bookings for this period and beyond has increased, and tourist spending on holidays has decreased. From the above, it can be concluded that tourism became a deeply rooted part of culture at the end of the twentieth century.

Tourism in Azerbaijan is a developing complex. Therefore, the market is constantly looking for new forms of work, ways to solve problems arising in this industry. Despite the rapid pace of development of the tourism sector in recent years, with the exception of the pandemic period, currently the share of this sector in the country's GDP (5.5-6.9%) in those years did not have very high quantitative indicators [26].

The economy of the country as a whole is associated with obtaining the optimal effect through the use of limited resources. As a rule, limited economic factors or resources, including tourism, are designed to meet the psychological and physical needs of a person.

The main purpose of the article is to study the influence of seasonality of international tourist flows on their distribution by regions of the world and to find out the impact of tourism and travel on the level of employment in the country based on a comparative analysis of different countries.

The theoretical and practical significance of the study lies in the fact that the data and results obtained as a result of the study make it possible to realize the significance of the issue under study and the need to study it.

Seasonality is an interdisciplinary concept that includes a change in the number of people visiting a certain tourist place. Seasonality also affects the marketing policy of the tourist market, the labor market and financial flows. Today, the influence of seasonality on all spheres of the economy is undeniable. Thus, tourism is a commercial destination, and any business is subject to seasonal changes. One of the important factors that needs to be studied in order to get the most out of the tourist market is seasonality [Konstantinova, 2019: 1-8]. The dictionary of business terms contains information about the change of the season of the year, about the period of performance of certain works, as well as about traditions, holidays, etc. the economic processes associated with it are considered seasonal.

In some studies, tourism is defined as the seasonality of tourist activity, recurring from year to year, which is characteristic of the place (territory) under study and is associated with changes in recreational conditions [Sharafanova, 2015: 30-40].

II. MATERİALS AND METHODS

From the point of view of the activity and development of the tourism sector in Azerbaijan, there are comprehensive opportunities. In this regard, unlike a number of countries where the tourism sector is developed, in order to support the development of this sphere at the required level, the state conducts a special policy, which also reflects the strategy of tourism development and its phased solution [18]. Compared with foreign countries, Azerbaijan has truly unique natural, cultural,

and architectural monuments, including about 38 architectural monuments of world significance: Ateshgah, Icheri Sheher, Muhammad Mosque, Maiden Tower, Shirvanshah Palace, Seyid Yahya and Shirvanshah mausoleums, etc. are available [23]. It should also be noted that Azerbaijan receives only 0.02-0.03% of the international tourist flow around the world, while our country, according to approximate estimates, has the ability to receive up to 10 million tourists a year. It should be noted that the development of tourism in Azerbaijan was also negatively affected by the state of emergency that occurred in the world (the COVID-19 pandemic), which is 3.15 times higher than the number of tourists received in the year preceding the pandemic (2019) [19, pp. 21-25].

Tourism experienced the most serious crisis in the history of observations in 2020 after an unprecedented emergency in the field of health, social and economic situation amid the outbreak of the COVID-19 pandemic. This crisis led to a reduction in the number of international tourists (overnight guests) in 2020 by 74% compared to the previous 2019, which had a negative impact on the travel of international tourists, and the tourism industry worldwide faced a loss of export revenues worth 1.3 trillion US dollars. It should be noted that during this emergency, the tourism sector suffered 11 times more total losses than during the global economic crisis of 2009.

According to the annual report of the World Economic Forum in the field of tourism and travel for 2021, Azerbaijan ranked (72nd) among 194 countries of the world in terms of attractiveness for foreign tourists, being above the average by 20 countries. The tourist flow is understood as the movement of tourists from a certain place, place of residence (supplier market) to other places (the core of attraction) that have some resources and tourist offer (receiving the market). The change of tourist destinations and its conjunctural changes may be due to motivational (fatigue from overloaded and noisy centers), economic (inflation, exchange rate), social and other reasons.

The main tourist markets generating the flow of tourists at the international level are:

- In Europe: markets of Central Europe and Northern Europe (Germany, Benelux countries, Great Britain, France, Scandinavian Peninsula countries);

- In America: Canada and the USA;

- In Asia: Japan.

The main international markets that receive tourists include:

- In Europe: countries of the Mediterranean countries of Europe, Asia and Africa; especially between the countries of the European Union, intra-European exchange plays an important role;

-In Asia: Middle East (Israel, Egypt, Turkey, Jordan, Syria); Hindustan Peninsula: India, Nepal; Southeast Asian countries: Thailand, Philippines, Indonesia, etc.;

- In America: USA, Mexico, Caribbean countries, Peru and Brazil;

- In Africa: Maghreb countries, Egypt, Kenya, Indian Ocean islands (Seychelles, Maldives and Mauritius).

III. RESULTS AND DİSCUSSİON
3.1. CONTRİBUTİON OF TOURİSM TO THE ECONOMY

In order to identify the structural features of tourism organizations based on the methodology of the World Tourism Organization, the World Council for Tourism and Travel, the contribution of the tourism sector to the economy is systematized according to the characteristics: direct, indirect and individual impact (Table 1).

Table 1

Characteristics of the impact of the contribution of tourism to the country's economy

Brief description of the contribution of tourism to the economy		
Straight	Indirect	Individual
Hotel tourism services: accommodation, meals, transport, religious-cultural-historical-ecological attractions, entertainment. **Areas of direct impact:** mass accommodation facilities (hotel, otel, motel, etc.), transport, travel agencies, tour operators, retail, culture, sports, recreation. **Sources of income to the country's budget from tourism:** residents' expenses on tourism and travel, non-residents' expenses (export of tourist services), residents' expenses on business trips, individual government expenses	**Investments** aimed at the tourism sector **Government spending** on tourism in general Domestic **supplies and purchases**	**Material and technical support** of specialized tourism enterprises Goods and services **that ensure the livelihoods of workers in this field:** food, beverages, clothing, housing services and agriculture

Note: based on [Kapustin, 2014: 35-43] compiled by the author

The direct contribution of tourism to the economy is recorded directly in the service sector, which is related to the quantitative and qualitative indicators of the services provided to tourists. The indirect impact of tourism on the country's economy directly covers a wide range of types of tourism and related enterprises that support the activities of specialized tourism enterprises and their service personnel. It should be noted that the tourism industry directly contributes to the formation of added value in the country's GDP and in the service sector. And taking into account additional enterprises and related enterprises, this increases the indirect and induction incomes of the entire complex of the "tourist economy".

For a broader explanation of the contribution of the tourism sector to the country's economy, consider its share in world GDP (Fig.1).
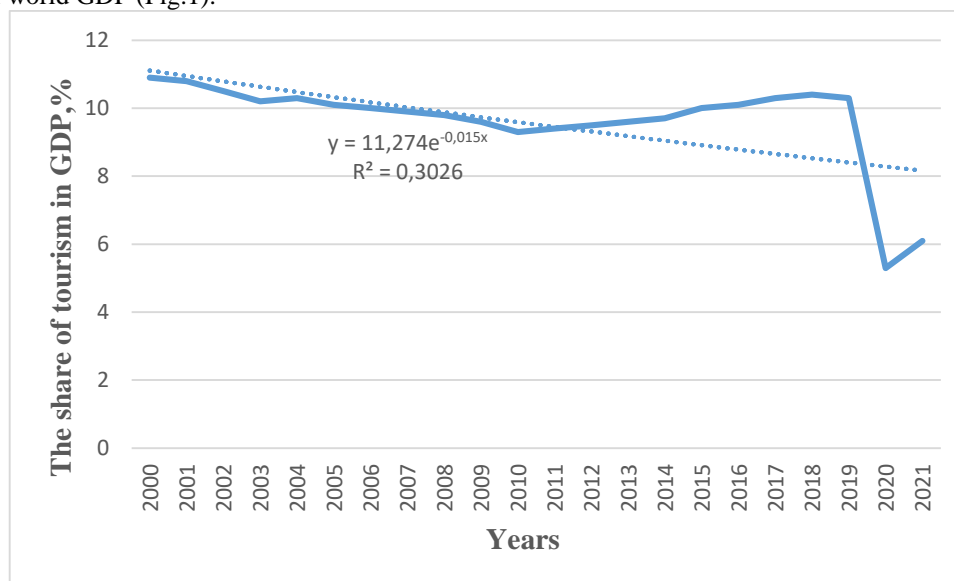
The presence of competition between economic entities leads to the fact that enterprises with large economic activities are increasingly being displaced by small enterprises operating in the market, these enterprises occupy a dominant position in the market, while enterprises with a high market share occupy a dominant position in economic power and concentrate the market in their hands [Burak, 2016: 58-63]. Thus, the concentration of production occurs very unevenly at individual enterprises, in different industries and countries. Unlike the sphere of material production, where large enterprises dominated in the XIX-XX centuries, this process in tourism began relatively recently, that is, in the 1970s. But the concentration of production in tourism very quickly began to cover all its aspects, covering all sectors of the tourism industry.

$$y = 11{,}274e^{-0{,}015x}$$
$$R^2 = 0{,}3026$$

Figure 1. The share of tourism and travel in GDP
Source: based on [26] compiled by the author

A number of studies have concluded that tourism and the hotel business create various business opportunities in such sectors as housing, catering and beverage companies, transport services, travel agencies, travel companies, natural and cultural tourism [Syntaexn et al.: 2016, 7-9].

So, in the sphere of accommodation (accommodation) and catering (catering) of tourists, respectively, giant chains of hotels and restaurants have been formed. For example, the number of real estate objects included in the largest hotels and resorts in the world is shown in Table 2.

The analysis shows that the top five leading hotel companies in the world include Wyndham Hotels &

Resorts (8941 properties), International Marriott (7662 properties), World Hotels (7111 properties), Hilton (6619 properties) and ICN Hotels & Resorts (5959 properties). Among these 15 leading hotel companies, Westmont Hospitality Group, which is in the last five (11th - 15th places), has -736 properties, Red Roff -668 properties, Extended Stey Mnenka -653 properties, Highdate -366 properties and Apple Hospitality RPT - 232 properties. It should also be noted that the number of Apple Hospitality RPT properties, which are in last place among the leading hotel companies, is 38.5 times, or 8,709 units less than that of Wyndham Hotels and Resorts.

The number of real estate properties of the world's leading hotel companies as of September 2021, units.

n/a	The world's largest hotel and restaurant chains with accommodation facilities and catering facilities	The number of real estate objects in the largest hotels and resorts
1	Wyndham Hotels and Resorts	8941
2	International Marriott	7662
3	Hotels of the World	7111
4	Hilton	6619
5	ICH hotels and Resorts	5959
6	The best hotels and resorts on the West Coast	4039
7	Radisson Group Hotel	1615
8	C6 Hospitality	1393
9	Cambridge Hospital	1380
10	Hyatt Hotels Corporation	1020
11	Westmont Hospitality Group	736
12	Red Roff	668
13	Mnenca Extended Steak	653
14	Hidhdates	366
15	Apple Hospital RPT	232

Source: based on data [21] compiled by the author

3.2. TOURISM COMPETITIVENESS INDEX AND INTERNATIONAL TOURIST RECEPTION IN THE REGIONS

The World Economic Forum annually determines the ranking of the countries of the world (by 195 countries) according to the travel and tourism competitiveness index. When determining the ranking of countries, a set of data from common sources, information from international information organizations, experts in the field of travel and tourism is used. These data provide favorable conditions for making the right decisions by States seeking to improve the travel and tourism sector. In the process of analysis, the article used methods of comparison (benchmarking) and interstate regression analysis with the most advanced countries.

The results of the analysis show that Spain, France, Germany, Japan, BB, USA, Australia, Switzerland, Italy and Canada (within 5.43-4.97 points) entered the top ten leading countries in terms of the average index of competition in the tourism sector [28]. In the last ten countries are Burundi, Chad, Yemen, Mauritania, Congo, Sierra Leone, Mali, Nigeria, Lesotho and Cameroon (border 2.88-2.44 points). Among the countries of the former Soviet Union, Estonia, Russia, Latvia, Lithuania, Azerbaijan, Georgia, Kazakhstan, Armenia, Ukraine, Kyrgyzstan are in the top ten (the limit is 4.23-5.31 points). According to the travel and tourism competitiveness index, Azerbaijan ranked 73rd among 195 countries.

It should be noted that according to the assessment based on 14 components reflecting the competitiveness of tourism by country, it is possible to compile an exhaustive map of the best tourism destinations in the world. One of the evaluation indicators is the development of tourism infrastructure in the country, which determines how well the country copes with the reception and accommodation of tourists, takes into account the number of hotel beds per 1000 people, the number of tourist infrastructure, as well as the number of ATMs for every 1000 elderly people [Roudy and etc, 2019:1280-1300].

A comparative analysis of the international reception of tourists in the regions of the world in 2018-2020 shows that compared to 2018 in the European region in 2019, this figure increased by 30.3 million, or 4.2%, and in 2020-by 480.9 million, or 67.2%. This figure increased by 13.9 million or 4% in the Asia-Pacific region in 2019 and decreased by 289.4 million or 83.5% in 2020, respectively. In addition, the reception of international tourists in the American region increased by 3.3 million in 2019 and by 146.3 million in 2020. In the African region, this figure increased by 1.4 million in 2019 and decreased by 50.5 million in 2020. At the same time, this figure in the Middle East region increased by 5 million in 2019, and decreased by 47.3 million in 2020. According to this indicator, an increase of 0.053 million was observed worldwide in 2019, and a decrease of 47.3 million in 2020.

In 2020, the number of international trips in the Asia-Pacific region decreased by 83.5%, which is almost 303.3 million less than last year. The number of arrivals in the Middle East and Africa decreased by 51.8 million, or 74%. The number of arrivals to Europe decreased and amounted to 235.1 million. This is 67.2% less than the number of international tourists in 2018. In general, in North and South America, the decrease in the number of foreign tourists in 2018 compared to 2020 was 67.7%. Compared to 2018, the number of international tourists worldwide in 2020 decreased by 1015 million, or 71.8% (Figure 2).
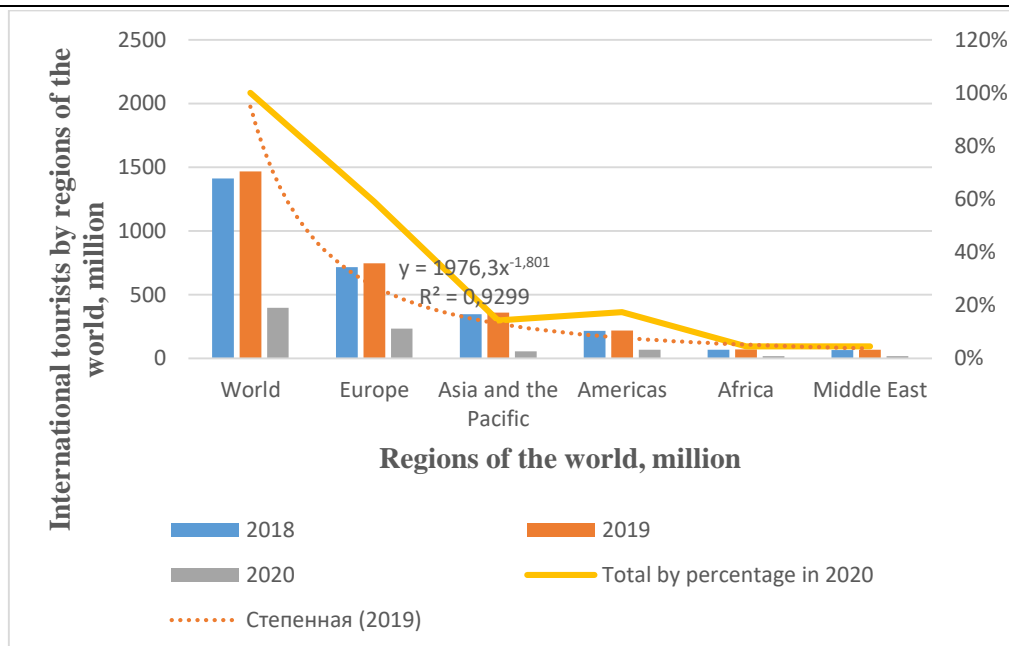
Figure 2. Arrival of international tourists in the regions of the world
Source: based on data [21] compiled by the author

When mitigating the problem of unemployment (the influx of citizens abroad reduces the intensity of unemployment in the country, reduces the supply of labor), along with the positive consequences, it is necessary to take into account the negative consequences that may arise due to the influx of tourists from certain regions. So, if there is not enough labor in the region, then this may affect the emergence of certain stagnations in the tourism industry, as well as in agriculture. The migration of the population from rural to urban areas will increase the burden on non-productive areas such as health and education. Also, the investment resources spent on additional investments in the tourism sector will not be able to be directed to those areas that they need.

For example, the advantage of our tourists traveling abroad compared to the entry of foreign tourists to Azerbaijan leads to the actual transfer of the country's currency funds to the economy of other countries. Statistics show that the number of local tourists traveling abroad is very large, and the ratio of these two indicators in Azerbaijan is within 1:2.04 in 2015 and 1:1.46 in 2020 [19, p.20]. It should also be noted that the tourism sector is considered vulnerable in the development of the economy of this country, when the number of tourists leaving and coming to the leading developed countries is 1:5.

The main factor hindering the faster development of outbound tourism in Azerbaijan is the low purchasing power of monetary incomes of the majority of the population. Because the crisis of recent years in the world, the military conflict between Russia and Ukraine and the latest waves of the pandemic have inevitably affected the purchasing power of monetary incomes of the population. For example, in 2021, the average monthly salary of the population amounted to $ 416.3 (707.7 manats), and its purchasing power for goods decreased by 35-45% compared to 2019. In our opinion, if in the coming years it is possible to reverse this negative trend and stimulate income growth, this process will have a positive impact on the organization of tourist trips of the local population in our country and will contribute to the rapid development of tourism.

Thus, the most important organizational and economic problems of the entry of foreign tourists to Azerbaijan can be attributed to two main issues. On the one hand, with an increase in the standard of living and well-being of the population living in Azerbaijan, the volume of mobile tourism will increase, which will undoubtedly increase the demand for services by the consumer of the country. At the same time, it is necessary to regulate both the standard of service and the level of prices for tourist services. On the other hand, inbound tourism to the country is an important source of foreign exchange earnings. The decrease in the volume of inbound tourism requires domestic firms hosting tourists to analyze the reasons for the lack of interest in our country among tourists from abroad. In this regard, tourism, in our opinion, has an impact on the country's economy in almost all aspects of the fundamental definition of this sphere of society.

3.3. ASPECTS OF THE IMPACT OF TOURISM ON EMPLOYMENT

International tourism has become an important source of foreign exchange earnings for many developed and developing countries [Ismayilov, 2017: 562-569]. The growing importance of tourism in the economic development of an increasing number of countries confirms the assumption that international tourism revenues will gradually increase. According to the World Tourism and Travel Council, in 2021, the share of people employed in world tourism accounts for 9.9% of those employed in all sectors of the economy. Forecasts show that in 2022 the number of people employed in tourism will amount to 10.2% of the world's employed population.

An analysis of the number of people employed in the areas characteristic of tourism in the countries of the

world and Azerbaijan, which entered the top ten in 2018-2019, shows that only in Angola there is an increase in the number of people employed in this direction by 363 thousand people. But despite this growth, the rating of this country in 2018 decreased by one notch compared to the previous year and took 11th place. It should be noted that among the compared countries, the smallest decrease in the number of people employed in tourism-specific areas occurred in Belarus (1,000 people), Chile (4,000 people) and Azerbaijan (6,000 people).

The largest decrease in this indicator occurred in the Philippines, which are in the second place of the rating -349 thousand people, in Spain-69 thousand people, Greece-27 thousand people, Turkey-21 thousand

people, Morocco-17 thousand people and Algeria-12 thousand people. Also among the compared countries, the percentage of decrease in the number of admissions compared to 2018 was in Greece-7.8%; in the Philippines-6.1%; in Algeria-3.8%; in Morocco-3% and Spain-2.6%. Among the compared countries, the lowest percentage of decline was in Belarus-0%; Chile-0.9% and Turkey-1.9%. The largest was in Azerbaijan, which dropped from 26th to 46th place in 2018, and dropped from 20th to 20th place in 2019. At that time, the drop in the rating in Belarus was 14 row.

In our opinion, the decrease in the number of people employed in tourism-specific areas in 2019 compared to 2018 can be illustrated by the pandemic situation that has already begun in these countries (Table 3).

Table 3

The number of people employed in industries specific to tourism, thousand people

Countries	Years				Increase (+) or decrease (-) in 2019 compared to 2018
	2018	Country rating		Country rating	
Philippines	5714	1	5365	2	-6,1%
Spain	2674	2	2605	4	-2,6%
Turkey	1600	3	1569	7	-1,9%
Morocco	565	4	548	13	-3,0%
Chile	442	5	438	15	-0,9%
Indonesia	409	6	400	17	-2,2%
Greece	347	7	320	20	-7,8%
Algeria	320	8	308	21	-3,8%
Belarusian	243	9	242	23	-0,4%
Angola	216	10	579	11	+1,68 times
...	…		…		…
Azerbaijan	59	20	53	46	-10,1%

Source: based on [Employment in Tourism Industries: 2018-2019] compiled by the author

Based on a comparative analysis of the number of people employed in the spheres characteristic of tourism in Azerbaijan, it can be noted that in 2016, compared with 2015, there was a decrease of 12.1%; in 2017 - by 5.3% and in 2020 - by 0.9%, only in 2018 - by 7.6% and in 2019 year-by 19.2%. In our opinion, the presence of such an increase in the number of people employed in tourism-specific destinations in 2018-2019 compared to 2015 may be due to an increase in the number of international tourists traveling to the country in those years and an increase in their service personnel.

An analysis of the number of jobs created in tourism and travel around the world in 2019-2021 shows that in subsequent years, due to the consequences of the extraordinary pandemic conditions that began at the end of 2019, the number of jobs in this area decreased

by 62 million or 18.6% in 2020; and by 44 million or 13.2% in 2021 (Figure 1) [29].

The equation of approximation of the trend of job cuts in tourism and travel around the world is written as (1):

$$Y=-45.37 \ln (x)+324.76 \qquad (1)$$

Equation (1) allows us to investigate the quantitative and qualitative characteristics of jobs created in the field of tourism and travel, directs the question under study to the study of simpler or more convenient objects. This equation shows that the theoretical prices for the number of jobs created by tourism and travel around the world are relatively close to experimental prices. This also reflects the adequacy of this model. In addition, the results of the study suggest a long-term asymmetric relationship between the impact of tourism and travel on employment.
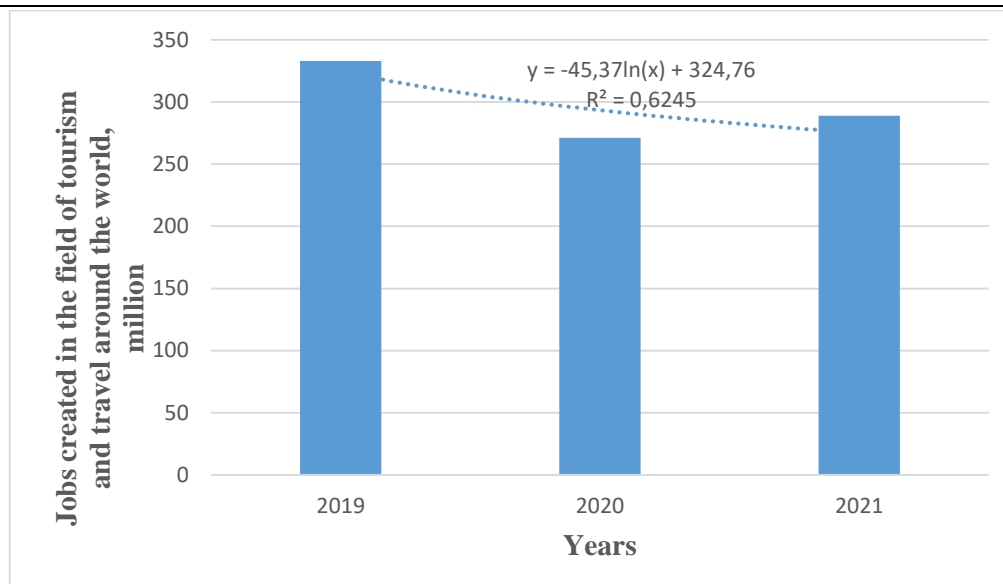
$y = -45{,}37\ln(x) + 324{,}76$
$R^2 = 0{,}6245$

Chart 1. Number of jobs in tourism and travel around the world
Source: based on data from [Syntaexn atc, 2016:12] compiled by the author

IV.CONCLUSIONS

International tourism, becoming an important source of foreign exchange earnings for countries, increasingly increases its importance in the economic development of countries and confirms the assumption that revenues from international tourism will increase. The crisis of recent years, as well as the military conflict between Russia and Ukraine and the recent waves of the pandemic have inevitably had a negative impact on the purchasing power of monetary incomes of the population. If in the coming years it is possible to reverse this negative trend and stimulate income growth, then rapid development of tourism will be achieved in the country, which will have a positive impact on the organization of tourist trips of the local population in their territories. In our opinion, the decline in 2019-2021 in the number of people employed in tourism-specific areas compared to 2018 can be illustrated by the pandemic conditions that have already begun in these countries and are currently continuing in various waves.

The sphere of tourism and travel is of great importance in providing employment for the population. This makes it possible to identify favorable tourist resources and new products for the development of tourism in various regions of the world and accurately identify tourist resources, as well as correctly formulate a strategy for their development in this direction.

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MATHEMATICAL SCIENCES

PULSATING FLOW OF INCOMPRESSIBLE VISCOELASTIC FLUID IN A TUBE

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ПУЛЬСИРУЮЩЕЕ ТЕЧЕНИЕ НЕСЖИМАЮЩЕЙ ВЯЗКО-УПРУГОЙ ЖИДКОСТИ В ТРУБКЕ

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Abstract
The impulsive stream of the non-press able liquid in the half-infinite viscous-elastic pipe with variable profile is investigated. The solution of the problem is reduced to the solution of the singular boundary Shturm-Luivill problem. In one simple case the influence of the rheology of the liquid on the wave characteristics are investigated.

Аннотация
Исследуется пульсирующее течение вязкоупругой несжимаемой жидкости в полубесконечной вязко-упругой трубке переменного кругового сечения. Решение задачи сводится к решению сингулярной кривой задачи Штурма-Лиувилля. В простейшем случае выявлено влияние реологии жидкости на волновые характеристики.

Keywords: viscoelastic fluid, pulsating flow.
Ключевые слова: пульсирующее течение, вязко-упругая жидкость.

В настоящее время большое внимание привлекают задачи математической физики, связанные с описанием волновых движений жидкостей различной физической природы. Этот интерес обусловлен не только большой прикладной значимостью указанных задач, но и их новым теоретическим и математическим содержанием, часто не имеющим аналогов в классической математической физике. При решении такого рода задач необходимо привлекать к рассмотрению уравнения движения трубки с учетом влияния движущейся в ее полости жидкости на динамику трубки. Специфика таких исследований, корни которых заложены в работах Л.Эйлера, И.Громека, Е.Жуковского, подробно отражены в работах [1,2,3,4]. Однако учет ряда весьма важных факторов, таких как вязко-упругие свойства жидкости и материала трубки в купе с ее сужением изучены недостаточно. В работе [5], на основе одномерных линейных уравнений, построено аналитическое решение задачи о пульсирующем течении вязко-упругой жидкости в упругой трубке с учетом эффекта сужения.

В предлагаемой статье рассматривается волновое течение жидкости, заключенной в деформируемую трубку. Математическая модель используемой системы описывается уравнением движения несжимаемой вязко-упругой жидкости совместно с уравнением неразрывности и уравнением динамики для изотропной линейно вязко-упругой трубки переменного кругового сечения. Поставленная задача приводит к решению сингулярной краевой задачи Штурма-Лиувилля.

1. **Формулировка уравнений гидроупругости.**

Сначала положим, что дана полубесконечная трубка переменного кругового сечения радиуса $R = R(x)$ и толщиной h, где $R(x)$ монотонна убывающая функция $\forall x \in [0, \infty]$, а x-продольная координата. Система одномерных уравнений гидроупругости состоит из уравнение неразрывности

$$\frac{\partial}{\partial x}(S u) + L \frac{\partial w}{\partial t} = 0, \qquad (1.1)$$

уравнение импульсов

$$\rho \frac{\partial u}{\partial t} = \frac{\partial}{\partial x}(-p + \sigma), \qquad (1.2)$$

уравнения движения трубки, которое для линейной вязко-упругости имеет вид [6]:

$$p = \frac{h}{R^2(x)} E^v w = \rho_* h \frac{\partial^2 w}{\partial t^2}. \tag{1.3}$$

При написании уравнения (1.3) полагалось, что трубка тонкостенная и она жестко прикреплена к окружающей среде, вследствие чего трубка не может совершать движение вдоль оси [6]. Классические представления гидродинамики идеальной и вязкой ньютоновой жидкости неприемлемы при описании течения сплошных сред, содержащих длинные «высокомолекулярные» соединения. Этот факт имеет первостепенное значение для многих технологических процессов, в которых приходится встречаться с движением коллоидных растворов, суспензий, эмульсий и т.д. с этой целью, для замыкания установленных выше уравнений, запишем реологическое соотношение для жидкости и примем его в форме линейной вязкоупругости [7].

$$\prod_{j=1}^{r}\left(1 + \lambda_j \frac{\partial}{\partial t}\right)\sigma = 2\eta \prod_{j=1}^{s}\left(1 + \theta_j \frac{\partial}{\partial t}\right)e \tag{1.4}$$

В уравнениях (1.1)-(1.4) $u(x,t)$ - скорость течения жидкости, $w(x,t)$ - радиальное смещение стенки трубки, $p(x,t)$ - гидродинамическое давление, $\sigma(x,t)$ - «вязко-упругое» напряжение, ρ и ρ_* - соответственно плотности, жидкости и материала трубки, $e(x,t)$ - скорость деформации, $S = \pi R^2(x)$ - площадь поперечного сечения, $L = 2\pi R(x)$ - длина окружности трубки, η - динамический коэффициент вязкости жидкости, а величины λ_j и θ_j образуют спектры релаксации и ретардации соответственно. В (1.3) E^v - оператор наследственного [6]

$$E^v = E(1 - \Gamma^*),$$

в котором E - модуль упругости, Γ^* - оператор релаксации

$$\Gamma^* w(x,t) = \int_{-\infty}^{+\infty} \Gamma(t-\tau) w(x,\tau) d\tau,$$

а $\Gamma(t-\tau)$ - разностное ядро релаксации. Таким образом соотношение (1.3) в развернутом виде записывается как

$$p = \frac{h}{R^2(x)} E\left\{ w(x,t) - \int_{-\infty}^{t} \Gamma(t-\tau) w(x,\tau) d\tau \right\}. \tag{1.5}$$

Учитывая в (1.4) равенство $e = \frac{\partial u}{\partial x}$, уравнение (1.4) перепишем в виде:

$$\prod_{j=1}^{r}\left(1 + \lambda_j \frac{\partial}{\partial t}\right)\sigma = 2\eta \prod_{j=1}^{s}\left(1 + \theta_j \frac{\partial}{\partial t}\right)\frac{\partial u}{\partial x}. \tag{1.6}$$

Известно [8], что существуют два класса линейных вариантов модели (1.6). к первому классу относятся среды, обладающие мгновенной упругость, для которых $r = s+1$. Ко второму классу отнесены модели, обнаруживающие при мгновенном нагружении вязкое поведение. Для них $r = s$.

Далее, не умоляя общности, функцию $R(x)$ запишем посредством равенства $R(x) = R_\infty g(x)$ и примем, что функция $g(x)$ дважды дифференцируема. Будем также полагать, что на бесконечности трубка имеет постоянное поперечное сечение R_∞. Отсюда имеем:

$$\lim_{x \to \infty} g(x) = 1. \tag{1.7}$$

Одновременно считаем, что

$$\lim_{x \to \infty} g'(x) = 0, \quad \lim_{x \to \infty} g''(x) = 0, \tag{1.8}$$

где штрихи здесь и далее означают дифференцирование по координате x. Примером такой функции является, например функция

$$g(x) = 1 + e^{-\alpha x} \quad (\alpha > 0), \tag{1.9}$$

которая характеризует конусообразное сужение трубки по ее длине. Тогда, учитывая (1.5) и (1.6) приходим к следующей замкнутой системе уравнений:

$$\frac{\partial u}{\partial x} + 2\frac{g'(x)}{g(x)}u + \frac{2}{R_\infty g(x)}\frac{\partial w}{\partial t} = 0, \tag{1.10}$$

$$\rho\frac{\partial u}{\partial t} = -\frac{\partial p}{\partial x} + \frac{\partial \sigma}{\partial x}, \tag{1.11}$$

$$p = \frac{h}{R_\infty^2 g'(x)}E\left\{w(x,t) - \int_{-\infty}^{t}\Gamma(t-\tau)w(x,\tau)d\tau\right\}, \tag{1.12}$$

$$\prod_{j=1}^{r}\left(\sigma + \lambda_j\frac{\partial\sigma}{\partial t}\right) = 2\eta\prod_{j=1}^{s}\left(\frac{\partial u}{\partial x} + \theta_j\frac{\partial^2 u}{\partial x\partial t}\right). \tag{1.13}$$

Отметим, что для волновых процессов линеаризация уравнений гидроупругости справедлива пока выполняется неравенство $\left|\dfrac{u}{c}\right| \square\ 1$, где c -комплексная скорость распространения волны, во все моменты времени. Отсюда следует также линеаризация уравнений теории вязко-упругости, что непосредственно следует из кинематического условия непроницаемости.

2. Введение задачи к решению сингулярной краевой задачи Штрума-Лиувилля.

Перейдем к построению решения уравнения . Для этого воспользуемся заменой Лиувилля

$$y(x) = u_1(x)\exp\left(\frac{1}{2}\int\frac{G_2(x)}{G_1(x)}d x\right) = u_1(x)\chi(x), \tag{2.1}$$

где

$$\chi(x) = \exp\left(\frac{1}{2}\int\frac{G_2(x)}{G_1(x)}d x\right),$$

которая приведет к вид (приведенная форма волнового уравнения)

$$y'' + I(x)y = 0. \tag{2.2}$$

При этом инвариант $I(x)$ определяется посредством формулы

$$I(x) = \frac{G_3}{G_1} - \frac{1}{4}\left(\frac{G_2}{G_1}\right)^2 - \frac{1}{2}\left(\frac{G_2}{G_1}\right)'. \tag{2.3}$$

Для последующих рассуждений в силу (1.7) и (1.8), устоновим следующее предельное равенство

$$\lim_{x\to\infty}k(x) = h\left\{\frac{E}{R_\infty^2}(1-\alpha) - \rho_*\omega^2\right\}.$$

Отсюда очевидно, что

$$\lim_{x\to\infty}G_1(x) = 2\eta\frac{b}{a} - i\frac{R_\infty h}{2\omega}\left\{\frac{E}{R_\infty^2}(1-\alpha) - \rho_*\omega^2\right\},$$

$$\lim_{x\to\infty}G_2(x) = 0, \ \lim_{x\to\infty}G_3(x) = -i\omega\rho.$$

Таким образом, можно записать

$$\lim_{x\to\infty}I(x) = -\frac{i\omega\rho}{2\eta\dfrac{b}{a} - i\dfrac{R_\infty h}{2\omega}\left\{\dfrac{E}{R_\infty^2}(1-\alpha) - \rho_*\omega^2\right\}}. \tag{2.4}$$

Расчленяя дисперсионное уравнение (2.4) на действительную и мнимую части, получим:

$$\delta^2 = \mu_0 - i\mu_1. \tag{2.5}$$

В приведенной записи (2.5) введены обозначения

$$\mu_0 = \frac{\omega\rho m_3}{4\eta^2 m_1^2 + m_3^2}, \ \mu_1 = 2\eta\frac{\omega\rho m_1}{4\eta^2 m_1^2 + m_3^2}$$

в которых

$$m_1 = \operatorname{Re}\frac{b}{a}, \ m_2 = \operatorname{Im}\frac{b}{a},$$

а

$$m_3 = -2\eta\, m_2 + \frac{R_\infty\, h}{2\omega}\left\{\frac{E}{R_\infty^2}(1-\alpha) - \rho_*\,\omega^2\right\}.$$

По правилу извлечения квадратного корня из комплексного числа, следуя (2.5) легко определить величину δ, определяемую соотношением

$$\delta = \pm\left\{\sqrt{\frac{\psi + \mu_0}{2}} - i\sqrt{\frac{\psi - \mu_0}{2}}\right\},$$

где

$$\psi = \sqrt{\mu_0^2 + \mu_1^2}\,.$$

В дальнейших рассуждениях будем использовать корень, для которого $\operatorname{Im}\delta < 0$. Из этого непосредственно следует

$$\delta = \delta_0 - i\,\delta_1.$$

Здесь δ_0 и δ_1 записываются как

$$\delta_0 = \sqrt{\frac{\psi + \mu_0}{2}}\,,\quad \delta_1 = \sqrt{\frac{\psi - \mu_0}{2}}\,.$$

Теперь, полагая следующую замену

$$q(x) = 1 - \frac{I(x)}{\delta^2}\,, \tag{2.6}$$

в качестве дифференциального уравнения задачи из (3.2) получаем

$$y'' + \delta^2\, y = \delta^2\, q(x)\, y. \tag{2.7}$$

На комплекснозначный потенциал $q(x)$ наложим условие интегрируемости

$$\int_0^\infty \left|q(x)\right| d\,x < +\infty\,. \tag{2.8}$$

Нетрудно показать, что построенная по формуле (3.6) функция $q(x)$ при (1.9) удовлетворяет условию (2.8). для последующего построения решения, уравнение (2.6) необходимо дополнить следующими граничными условиями

$$y(0) = y_0\,, \tag{2.9}$$

$$\lim_{x\to\infty} y(x) = 0\,. \tag{2.10}$$

Ход вычисления величины y_0 зависит от режима функционирования системы (разные краевые условия на торце трубки) и будет изложен ниже. Условие (2.9) обеспечивает ограниченность искомого решения. Таким образом, сформулированную задачу гидроупругости удалось свести к решению сингулярной краевой задачи Штрума-Лиувилля (2.7), (2.9) и (2.10).

3. **Вывод эквивалентного интегрального уравнения и его решение.** Представляется целесообразным решение краевой задачи Штрума-Лиувилля свести к решению интегрального уравнения. Для этого заметим, что однородное уравнение

$$y'' + \delta^2\, y = 0 \tag{3.1}$$

имеет фундаментальную систему решений вида

$$y_1 = e^{-i\delta x}\,,\quad y_2 = e^{i\delta x}\,.$$

Рассматривая (2.1) как неоднородное уравнение с известной правой частью $\delta^2 q(x)\, y$ и применяя метод вариации произвольных постоянных, решение задачи (2.7), (2.9) и (2.10) сведем к эквивалентному интегральному уравнению

$$y(x, -\delta) = C\, e^{-i\delta x} + \delta \int_x^\infty \sin\delta(\eta - x)\, q(\eta)\, y(\eta, -\delta)\, d\eta\,. \tag{2.2}$$

которые описывает волну, бегущую в положительном направлении оси x. Здесь C подлежащая определению постоянная интегрирования. Покажем, что уравнение (4.2) имеет единственное решение, которое обозначим через $y(x, -\delta)$ и которое будет также решением уравнение (2.7), удовлетворяющее граничному условию на бесконечности

$$\lim_{x\to\infty} y(x, -\delta) = 0\,. \tag{3.3}$$

Уравнение (3.2) является интегральным уравнением типа Вольтера и его можно решить методом последовательных приближений. Отсюда, по определению имеем

$$y_0(x, -\delta) = C \exp(-i\delta x) \tag{3.4}$$

$$y_{n+1}(x, -\delta) = C e^{-i\delta x} + \delta \int_x^\infty \sin\delta(\eta - x) q(\eta) y(\eta, -\delta) d\eta.$$

Так как $\operatorname{Im}\delta < 0$, то

$$\left|y_0(x, -\delta)\right| \le |C| \exp(\operatorname{Im}\delta) x.$$

Методом индукции докажем оценку

$$\left|y_n(x, -\delta) - y_{n-1}(x, -\delta)\right| \le |C| e^{(\operatorname{Im}\delta)x} \frac{B_\delta''(x)}{n!} \tag{3.5}$$

В которой принято следующее обозначение

$$B_\delta(x) = |\delta| \int_x^\infty |q(\eta)| d\eta$$

тогда, в соответствии с очевидным неравенством

$$B_\delta(x) = |\delta| \int_x^\infty |q(\eta)| d\eta \le |\delta| \int_0^\infty |q(x)| dx = B_\delta(0) < +\infty.$$

получим

$$\left|y_n(x, -\delta) - y_{n-1}(x, -\delta)\right| \le |C'| e^{(\operatorname{Im}\delta)x} \frac{B_\delta''(0)}{n!}.$$

Теперь начатые выше рассуждения доведем до конца. Для этого, привлекая оценку

$$\left|\sin\delta(\eta - x)\right| \le \exp\left|-\operatorname{Im}\delta(\tau - x)\right| \quad (\tau \ge x)$$

и ограничившись далее лишь самыми существенными выкладками при $n=1$ запишем

$$\left|y_1(x, -\delta) - y_0(x, -\delta)\right| \le |C||\delta| \int_x^\infty e^{-\operatorname{Im}\delta(\eta - x)} |q(\eta)| e^{(\operatorname{Im}\delta)\eta} d\eta =$$

$$= |C||\delta| e^{(\operatorname{Im}\delta)x} \int_x^\infty |q(\eta)| d\eta = |C| e^{(\operatorname{Im}\delta)x} B_\delta(x)$$

Пусть оценка (3.5) верна при $n = m$. Докажем ее справедливость при $n = m+1$. Имеем

$$\left|y_{m+1}(x, -\delta) - y_n(x, -\delta)\right| \le |\delta| \int_x^\infty \sin\delta(\tau - x) |y_m(\eta, -\delta) - y_{m-1}(\eta, -\delta)| |q(\eta)| d\eta \le$$

$$\le \frac{|C|}{m!} e^{(\operatorname{Im}\delta)x} \int_x^\infty B_\delta^m(\eta) |\delta| |q(\eta)| d\eta = -\frac{|C|}{m!} e^{(\operatorname{Im}\delta)x} \int_x^\infty B_\delta^m(\eta) d B_\delta(\eta) = |C| e^{(\operatorname{Im}\delta)x} \frac{B_\delta^{m+1}(x)}{(m+1)!}$$

Зная, что

$$\left|y_0(x, -\delta)\right| \le |C| \exp(\operatorname{Im}\delta) x \le |C|$$

в силу неравенства (3.5) заключаем, что ряд

$$y_0(x, -\delta) + \sum_{n=1}^\infty \left\{y_n(x, -\delta) - y_{n-1}(x, -\delta)\right\}. \tag{3.6}$$

Мажорируется в промежутке $[0, +\infty)$ сходящимся положительным числовым рядом

$$|C| \sum_{n=0}^\infty \frac{B_\delta''(0)}{n!}.$$

Тем самим по признаку Вейерштрасса, он сходится равномерно по $x \in [0, +\infty)$. Из этого следует, что его сумма, которую обозначим через $y(x, -\delta)$ является решением уравнения (3.2). На самом деле, так как для частичной суммы $S_n(x)$ ряда (4.6) имеем:

$$S_n(x) = y_0(x, -\delta) + \sum_{k=1}^n \left\{y_k(x, -\delta) - y_{k-1}(x, -\delta)\right\} = y_n(x, -\delta),$$

то

$$y(x, -\delta) = \lim_{n \to \infty} S_n(x) = \lim_{n \to \infty} y_n(x, -\delta).$$

Переходя к пределу в (3.4) при $n \to \infty$, получим

$$y(x,-\delta)=C\,e^{-i\delta x}+\delta\int_x^\infty \sin\delta(\eta-x)q(\eta)\,y(\eta,-\delta)\,d\eta \qquad\qquad .(3.7)$$

Таким образом, нами установлены, что функция $y(x,-\delta)$ является решением уравнения (3.2). отметим, что переход к пределу при $n\to\infty$ под знаком интеграла в (4.4) справедлив в силу равномерной сходимости $y_n(x,-\delta)$. Кроме того, исходя из неравенства

$$\left|y(x,-\delta)\right|\le\left|y_0(x,-\delta)\right|+\sum_{n=1}^\infty\left|y_n(x,-\delta)-y_{n-1}(x,-\delta)\right|\le$$

$$\le\left|C\right|\exp(\operatorname{Im}\delta)x+\left|C\right|\exp(\operatorname{Im}\delta)x\sum_{n=1}^\infty\frac{B_\delta''(x)}{n!}\le$$

$$\le\left|C\right|\exp(\operatorname{Im}\delta)x+\left|C\right|\exp(\operatorname{Im}\delta)x\sum_{n=1}^\infty\frac{B_\delta''(0)}{n!}=$$

$$=\left|C\right|\left\{\exp(\operatorname{Im}\delta)x+\exp\left[(\operatorname{Im}\delta)x+B_\delta(0)\right]\right\}$$

следует

$$\lim_{n\to\infty}y(x,-\delta)=0\,.$$

Непосредственной проверкой можно установить, что $y(x,-\delta)$ удовлетворяет уравнению (2.7). На самом деле, учитывая, что интеграл в (3.7) сходится равномерно, дифференцирование под знаком интеграла правомерно. Отсюда следует

$$y'(x,-\delta)=-i\,\delta\,C\,e^{-i\delta x}-\delta^2\int_x^\infty\cos\delta(\eta-x)q(\eta)\,y(\eta,-\delta)\,d\eta\,. \qquad (3.8)$$

Здесь аналогично, в силу равномерной сходимости интеграла в (3.8) можно установить законность дифференцирования (3.8). Вследствие этого запишем

$$y''(x,-\delta)=-\delta^2\,C\,e^{-i\delta x}-\delta^3\int_x^\infty \sin\delta(\eta-x)q(\eta)\,y(\eta,-\delta)\,d\eta+\delta^2 q(x)\,y(x,-\delta)\,.$$

Отсюда, учитывая (3.7), следует

$$y''(x,-\delta)=\delta^2 q(x)\,y(x,-\delta)-\delta^2\left\{C\,e^{-i\delta x}+\delta\int_x^\infty \sin\delta(\eta-x)q(\eta)\,y(\eta,-\delta)\,d\eta\right\}=$$

$$=\delta^2 q(x)\,y(x,-\delta)-\delta^2\,y(x,-\delta)$$

или

$$y''(x,-\delta)+\delta^2\,y(x,-\delta)=\delta^2 q(x)\,y(x,-\delta)$$

то есть функция $y(x,-\delta)$ является решением уравнения (2.7). остается определить постоянную C. Ее нужно выбрать таким образом, чтобы удовлетворялось граничное условие (2.9). Для этого сопоставим уравнению (3.2) следующее интегральное уравнение

$$f(x,-\delta)=e^{-i\delta x}+\delta\int_x^\infty \sin\delta(\eta-x)q(\eta)\,y(\eta,-\delta)\,d\eta \quad (3.9)$$

и его решение обозначим через $f(x,-\delta)$. Теперь постоянную C определим следующим образом:

$$C=\frac{y_0}{f(0,-\delta)}\,. \qquad\qquad (3.10)$$

Легко убедиться, что функция

$$y(x,-\delta)=y_0\,\frac{f(x,-\delta)}{f(0,-\delta)}$$

является решением краевой задачи Штрума-Лиувилля (2.7), (2.9), (2.10).

На основании сопоставления полученных численных данных можно сделать следующие выводы:

-для первого класса модели коэффициент затухания на два порядка меньше, чем для второго класса;

-амплитуда «вязкого напряжения» при втором режиме возрастает, в зависимости от ξ;

-амплитуда «вязкого напряжение» при первом режиме уменьшается в зависимости от λ;

-неньютоновые свойства жидкости наиболее существенно проявляются при использовании второго класса моделей.

В заключении отметим, что достоверность и точность полученных результатов обеспечиваются корректностью постановки задачи, применением строгих и обоснованных математических методов и физически обоснованными выводами.

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SOCIAL SCIENCES

REALIZATION OF THE PRINCIPLE OF JUSTICE DURING THE PANDEMIC OF COVID-19 IN SRI LANKA

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Abstract
The COVID-19 pandemic is not merely a public health emergency, it goes far beyond that: it encompasses economic crisis, social crisis, and a human crisis that is rapidly turning into a human rights crisis. The WMA Declaration of Lisbon on the Rights of the Patient reads that the interests of everyone should be taken into consideration and ensures that no one should be left behind. Human rights-based action can help beat the pandemic by putting everyone's health at the forefront. This is written in the official document, the life experience shows the opposite situation: COVID-positive patients are a priority, whilst other patients are deprived of the right to undergo routine medical check-ups that results in severe complications and irreversible consequences leading to deaths.

Keywords: COVID, pandemic, patients, diseases, justice.

COVID-19 has been a brutal reminder of the importance of ensuring lasting progress with respect to social right's enjoyment, particularly through the development of the universal public health care services and the adherence of the people to it.

The pandemic sows in practical terms the indivisibility of human rights – giving rise to the major ethical challenges and difficult decisions made in counteracting them, one of which is the highly debated criticism of the principle of justice!

As we all know and have studied, the principles of justice denoting equality, fairness and access are one of the first virtues of social institutions as truth is of systems of thought. But, the question is- Were these virtues realized as said in theory in the practical aspects of the pandemic? Let me take you in a journey of pros and cons to actually visualize and idealize the above set question.

Firstly, the COVID-19 pandemic has resulted in serious lockdowns causing restriction of liberties; refuse to medical treatment, inability of access to the minimum of the daily essentials a citizen requires for one's survival and many other changes to everyday patterns of behavior in persons.

Lockdowns cut off most of what people yearned for in the height of the pandemic, even if they did get access to their needs, it was not easy and had many obstacles to overcome

The justice issue it raises are diverse and profound and are not confined to just one aspect of the health care sector or even to the health care sector only, but disseminates vastly among other institutions as well and this will demand our attention for a very long time.

Out of many questions one of the most questioned or rather considered as a central issue is the newly introduced "COVID-19 triage " in hospitals and its utilization of ICU's, hospital beds, medicine, supplies and so on and so forth

The current situation has led to new systems that are required given the circumstances but was it necessary that we disregard the old measures or as they claim "not important as of now", this brought on more chaos as patients criticized and argued with the officials.

Patients complained of how they were treated even if they were not on the brink of death as surviving and were made to wait in queues that lasted hours and maybe even days, gotten their appointments cancelled or postponed with no further notices raising questions and judgments- Are all patients treated fairly? As equals? Aren't patient's unrelated to COVID patients too? Do all patients receive the same access as those infected ones?

This lead to conflicts amongst patients, those who came with minimum symptoms worsened over time due to lack of access or proper consultation and led eventually to unavoidable deaths which could have been prevented if they had been noticed earlier.

Dire situations were not only the cases in hospitals but also in other related facilities such as detention centers, psychiatric hospitals, social care homes, newly established quarantine facilities or zones. These places required patients to move freely about, distress have consultations with specialized doctors or even meet their loved ones for the sake of their physical and mental stability and well-being but, COVID deprived them of such liberties.

Resulting from such issues there was an unfortunate incident in Sri Lanka where a disabled boy of just 25 years committed suicide as his mother was forcibly taken into treatment leaving the child helpless and depressed/ it is devastating yet true and reality as the new realities required new norms which weren't available, leaving officials burdened and speechless as to how to provide care and treatment to the special needs groups.

Therefore, at this point it is necessary to stress that even the lives saved seemed to be in tension with equity! All the hard work seemed to turn into dust due to harsh criticism from all around.

Moreover a central point to this discussion and research is the utilization of ICUs. it was declared by the health ministries that the ICU importance is for COVID-19 patients, leaving staff of other departments and its patients requiring this essential service for survival helpless, speechless, hopeless questioning how much weight is given for the equality of access. This deprived of youth with a more survival rate lose their dreams of the future into the darkness while cor-morbid senior posterities were given the chance to see another day of light.

Not only were the general everyday patients in conflict, the COVID-19 patients had their own issues to deal with amidst all the attitude and stigma the society had classified them into – it was known in my country that it was a curse or bad karma that acted upon such people and wished that they'd perish not accounting that they were as innocent as all the others are.

Also, most of the infected patients were sent and contained in clusters to the quarantine centers and their cure seemed far off until recently with the introduction of the vaccines.

And when it comes for organ transplantation the COVID positive patients were not offered a position in the list as the disease was novel and was not proven that a transplant could increase their survival or even rather save them.

Another potential issue that aroused after the light of the vaccines was the immunity passports, immense resentment arose among those who did not hold such credibility; this caused a loss of social cohesion.

While all these opposing factors existed all nations worldwide came together with services extending from the WHO to the regional health care sectors of each country.

In Sri Lanka guidelines were developed as one vision "DReam" on the social distancing guidelines and provision of essential healthcare, medicine were delivered via post even while clinics remained closed.

The Tele-Health program was introduced, promoted and regulated where patients could access their doctors by just the click of a button, home visits were expanded, volunteer groups initiated social campaigns and carried out odd-jobs to raise awareness and help with the division of labour.

Primary medical care units, OPD, emergency and accident care units, maternity clinics operated 24 hours following the new social distancing regulations. Such services were distributed among both the national and private medical facilities giving rise to more access and more resources to patients.

Right now Sri Lanka is continuing the vaccination programs to offer hope to better future and a new method of infection control.

Finally it can be concluded that amidst all challenges – the scope of equity was somewhat achieved to encompass remediable differences among social, economic, demographic or geographic groups during the COVID-19 allowing people to look beyond differences in lives of the pandemic, because "United we stand, divided we fall".

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VETERINARY SCIENCES

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DETERMINATION OF THE OPTIMUM DOSE OF INACTIVATED VACCINE AGAINST NECROBACTERIOSIS FOR CATTLE

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ОПРЕДЕЛЕНИЕ ОПТИМАЛЬНОЙ ДОЗЫ ВВЕДЕНИЯ ИНАКТИВИРОВАННОЙ ВАКЦИНЫ ПРОТИВ НЕКРОБАКТЕРИОЗА ДЛЯ КРУПНОГО РОГАТОГО СКОТА

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Abstract
The article presents data obtained by determining the intensity of immunity in cattle immunized with a vaccine against necrobateriosis in various doses.
Аннотация
В статье представлены данные, полученные при определении напряженности иммунитета у крупного рогатого скота, иммунизированного вакциной против некробатериоза в различных дозах.

Keywords: necrobacteriosis, vaccine, administration dose, antibodies.
Ключевые слова: некробактериоз, вакцина, доза введения, антитела

Казахстан является аграрной республикой с развитым сектором животноводства и овцеводства. В последние годы в различные регионы республики завезены тысячи голов высокопродуктивных коров молочного направления. При этом, почти во всех данных хозяйствах с импортным скотом, в настоящее время отмечается болезни конечностей, и в том числе некробактериозная инфекция.

При этом, заболеваемость конечностей, преимущественно некробактеризом, у ввозимого скота занимает одно из лидирующих мест среди остальных патологий. К числу болезней имеющих в последние годы возрастающее значение и представля-ющих важную в практическом отношении проблему для животноводства в первую очередь следует отнести некробактериоз. Так, среди группы болезней инфекционной патологии по заболеваемости и падежу он занимает 2-3 место, что дает полное основание считать данную болезнь одним из факторов сдерживающих повышение рентабельности сельскохозяйственной отрасли [1].

Как правило, все мероприятия для ликвидации некробактериоза направлены на комплекс терапевтических и профилактических мероприятий. При этом, вакцинация животных является одним из основных методов специфической профилактики.

Несмотря на противоречивые точки зрения об иммунитете при некробактериозе и иммуногенности существующих вакцин, результаты производственных испытаний многих авторов свидетельствуют: вакцинация КРС – важное звено в профилактике этого заболевания [2; 3]

Профилактические меры с использованием вакцины против некробактериоза приобретают особое значение при ввозе импортного поголовья крупного рогатого скота [4; 5].

Сотрудниками ТОО «КазНИВИ» в процессе работы отработан технологический процесс изготовления инактивированной вакцины против некробактериоза животных.

Для определения наиболее оптимальной дозы введения препарата для крупного рогатого скота было испытано несколько объемов введения вакцины, а именно: 3,0 см^3-5,0 см^3-7,0 см^3 и 10,0 см^3

Вакцину вводили подкожно в среднюю треть шеи. Контроль опыта составляли аналогичные животные (10 голов), которым вакцинный препарат не вводился, содержащиеся в таких же условиях, что и опытные.

Наблюдение за вакцинированными и контрольными животными вели в течение 9 месяцев.

Для контроля иммуногенной активности вакцин от опытных животных отбирали кровь, получали сыворотку, которую исследовали, до проведения вакцинации, и далее через различные периоды времени, на наличие поствакцинальных антител, а именно: 30 суток, 60 суток, 180 суток и 270 суток.

Серологические исследования проводили с использованием реакции агглютинации (РА). Реакцию ставили в серологических плашках в объеме 0,4 см^3 по общепринятой методике. В качестве антигена использовали музейную анимализированную культуру Fus. necrophorum H – 134 с концентрацией 10 млрд. м.т. в см^3. Титры антител рассчитывали в log2.

Статистическую обработку результатов исследований проводили используя программу Microsoft Excel.

Результаты исследований

В Агрохолдинге ТОО «Байсерке-Агро» на отделении «Кербулак» Кербулакского района Алматинской области для проведения опыта было сформировано 4 опытные группы животных, по 10 голов в каждой. Для эксперимента были отобраны телочки 1,5 годовалого возраста породы ангус, одного возраста и одинаковой массы тела.

Перед введением вакцины у животных выборочно взяли кровь на определения возможного наличия антител к *Fus. necrophorum.* При этом антитела обнаружены не были

Исследование сывороток крови крупного и мелкого рогатого скота, иммунизированных различными вариантами вакцин, показали, что при их введении через 30 суток отмечается выработка антител у всех опытных животных, которые сохраняются в течение 9 месяцев после иммунизации.

Таблица 1

Результаты исследований сывороток крови у вакцинированного крупного рогатого скота различными дозами

Титры поствакцинальных антител	Дозы введения вакцины, см^3, по 10 голов в каждой группе				Контроль
	3,0	5,0	7,0	10,0	
30 суток после вакцинации					
Не обнаружено	-	-	-	-	10
1:2-1:4	-	-	-	-	-
1:4-1:8	2	1	-	-	-
1:8-1:16	2	1	2	2	-
1:16-1:32	3	3	3	3	-
1:32-1:64	3	4	4	4	-
1:64-1:128	-	1	1	1	-
Средние титры антител log2	1,29± 0,18	1,47± 0,24	1,53 ± 0,26	1,53 ± 0,26	-
60 суток после вакцинации					
Не обнаружено	-	-	-	-	10
1:2-1:4	-	-	-	-	-
1:4-1:8	1	-	-	-	-
1:8-1:16	2	1	1	-	-
1:16-1:32	3	4	3	4	-
1:32-1:64	3	3	4	4	-
1:64-1:128	1	2	2	2	-
Средние титры антител log2	1,41± 0,20	1,56 ± 0,22	15,9 ± 0,24	16,2± 0,23	-
180 суток после вакцинации					
Не обнаружено	-	-	-	-	10
1:2-1:4	-	-	-	-	-
1:4-1:8	2	-	-	-	-

1:8-1:16	2	1	1	-	-
1:16-1:32	3	4	4	5	-
1:32-1:64	2	4	4	4	-
1:64-1:128	1	1	1	1	-
Средние титры антител log2	1,32 ± 0,18	1,53 ± 0,22	1,53 ± 0,22	1,56 ± 0,24	-
270 суток *после вакцинации*					
Не обнаружено	-	-	-	-	10
1:2-1:4	3	-	-	-	-
1:4-1:8	3	3	3	2	-
1:8-1:16	2	4	3	3	-
1:16-1:32	2	3	4	5	-
1:32-1:64	-	-	-	-	-
1:64-1:128	-	-	-	-	-
Средние титры антител log2	0,87± 0,16	1,08± 0,14	1,11± 0,16	1,17± 0,15	-

Исследование сывороток крови крупного рогатого скота, иммунизированного, вакциной против некробактериоза показало, что при введении различных объемов препарата уже через 30 суток отмечается наличие антител у всех опытных животных. При этом, пик антителообразования отмечен на 60 сутки после введения вакцины, далее наблюдали плавное снижение титров антител.

В течение всего периода наблюдения наиболее высокие титры после введения вакцины отмечены при использовании объема 10,0 см^3, средние титры антител составляли от 1,53 ± 0,26 до 1,17± 0,15.

Как и ожидалось, самый низкий показатель антителообразования отмечен при введении вакцины в дозе 3,0 см^3, а именно от 1,29± 0,18 до 0,87± 0,16.

Следует отметить, что при использовании вакцины в объемах 5,0 см^3 и 7,0 см^3 были получены относительно аналогичные результаты. Так, через 30 суток они составляли 1,47 ± 0,24 и 1,53 ± 0,26, через 60 суток 1,56 ± 0,22 и 15,9 ± 0,24, через 180 суток в обоих случаях 1,53 ± 0,22, а через 270 суток (9 месяцев) 1,08± 0,14 и 1,11± 0,16, соответственно.

В процессе клинического наблюдения за животными в течение 9 месяцев после вакцинации установлено, что заболевания некробактериозом у опытных животных не отмечено. При этом в контрольных группах регистрировали случаи заболевания у 2 животных, т.е. заболеваемость составила 20%.

Учитывая опыт изготовления и применения анаэробных вакцин, иммунную нагрузку на организм животного и высокие результаты иммунного ответа при введении всех опытных доз препарата, считаем, что для иммунизации крупного рогатого скота целесообразно использовать дозу введения 5,0 см^3.

Заключение Данные исследования, подтверждают наличие стойкого иммунитета у крупного и мелкого рогатого скота, принадлежащего Агрохолдингу ТОО «Байсерке-Агро», иммунизированных инактивированной вакциной против некробактериоза животных; наиболее оптимальной является доза введения равная 5,0 см^3.

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