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Empirical Analysis of Assessing the Factors Affecting Grape Supply in Armenia

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ABSTRACT

Grape is one of the strategic commodities for Armenia as it plays an important role in economy. Wine and brandy production volumes display increasing tendencies and it is of high interest what factors influence grape supply and which is the main input for those industries. To achieve this goal an empirical model of grape supply was developed. The analysis revealed that lagged log of average real price of grape, lagged log of average planted area of grape and technology positively affect log of average quantity of the grape supplied in Armenia. The highest positive influence on the regressand had lagged log of average planted area of grapes, as betta coefficient associated with it had the highest value.

Introduction

The relevance of the research is conditioned by the importance of estimation of grape supply and revelation of the factors affecting it, since grape is the main input in winemaking and brandy making industries which are considered to be vitally important branches in the economy of Armenia, estimation of grape and the revelation of the factors affecting grape supply. The research aims to estimate grape supply in Armenia and find out whether theoretical supply factors have significant influence on grape supply in Armenia and to measure their influence. In order to estimate the influence of traditional supply determinants on grape supply regression model was developed. Selection of variables has been based on similar fruit estimation models developed for China and Armenia. Consultation with local field expert has been conducted for in-depth understanding of sector peculiarities. The outcomes of this research can help to identify problems in the supply and make appropriate adjustments in the policy, help grape producers to increase efficiency of their production planning and help insurance companies providing grape insurance to highlight the main factors affecting the grape yield.

Materials and methods

Based on a research done in China to estimate factors affecting grape supply it becomes clear that the supply of grapes has significant connections with its production volume in the previous production cycle, the price of substitute crops, the volume of imports. It was observed that increase of grape supply does not necessarily lead to a fall in price. (WEISONG, et al., 2007)

L. Mamikonyan and G. Sahakyan (2017) in their article of "Implementation of surplus purchase program for grapes in the Republic of Armenia" estimated a simultaneous-equation model for demand and supply for grapes. The estimation results showed that the lagged average real sale price of grapes, the lagged average planted area of grapes and trend variables had positive influence on the average per capita quantity supplied. The lagged average real price of apple, the average real price of nitrogen had adverse impact on the average per capita quantity supply of grapes (Sahakyan, et al., 2017).

Oczkowski investigated premium wine grapes' demand and supply determinants in the warm inland regions of Australia.

Estimation results showed that current own prices, quantity partial adjustment process, time trend and lagged relative prices with regard to non-premium and other premium varieties are important supply determinants. (Oczkowski, 2014).

In order to provide higher precision and take into account local market specifications an interview with a field expert was conducted (Mkrchyan, 2018. - March 13. Grape production in Armenia [Interview]).

Industry overview

Historical evidence indicates that Armenia is one of the oldest countries engaged in wine production and grape cultivation. Currently, there are about 70 grape species with approximately 600 varieties that become the main input in wine production process. The main grape varieties grown in Armenia are Voskehat, Haghtanak, Karmrahyut, etc (IPGRI, 2016). The mountainous Armenia has favorable climate conditions for grape cultivation. Vineyards constitute almost the 17% of total orchard area in Armenia. Most of vineyards are small-scale orchards with less than a hectare planting area. The main grape production regions are Ararat and Armavir provinces with a margin of 88% of total grape production and 73% of total vineyards in Armenia. The total vineyard area and total grape harvest during the 2006-2017 periods were as follows (Statistical Committee of RA, 2017).

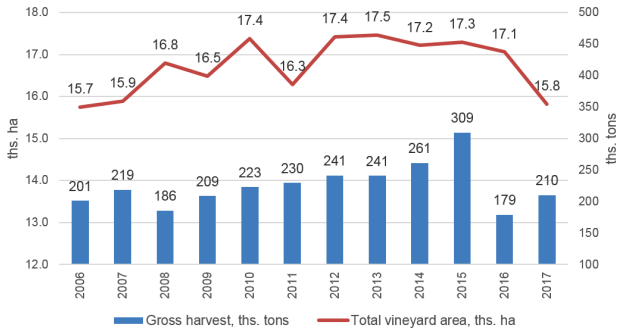

Figure 1. Gross Harvest and Total Vineyard Area

The average productivity of vineyards was on average 13.3 tons per ha in 2017. The regions that had the highest productivity indicators were Ararat and Armavir provinces with correspondingly 20.9 and 14.4 tons of average yield per hectare (Statistical Committee of RA, 2017).

Since grape is the main input for wine and brandy production, most of the harvested grape is obtained and used by the processing companies. Currently, the total number of large and medium companies engaged in wine and brandy production is approximately 90 (Ministry of Agriculture of RA, 2018).

On absolute terms, the total amount of grape used by the processing companies had an increasing trend. However, it is important to notice that from 2015 to 2017 the less portion of harvested grape had been used by the processing companies. This could be due to the increase in the fresh grape export volume or increase in domestic grape consumption by households. The exports and imports of fresh grape during 2013-2017 were shown in Figure 3. Almost 98% of exported grape goes to Russian Federation each year for recent years. (UN Comtrade, 2018).

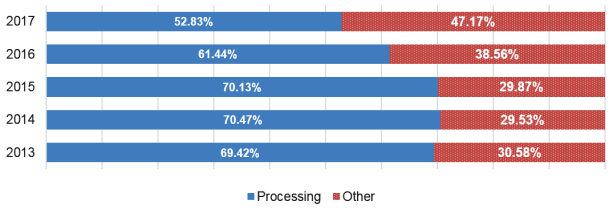

Figure 2. Sales of grape based on the use purpose

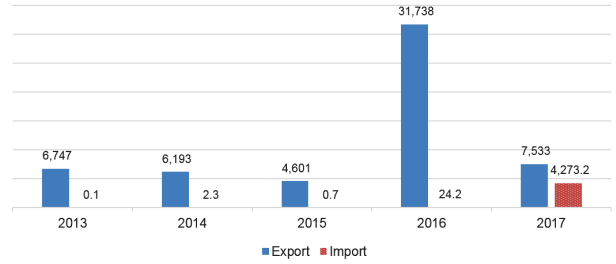

Figure 3. Fresh grape imports and exports, tons

Data Description

Annual time-series data for the period of 2000-2017 were used in this analysis. The dataset consists of the logged average quantity of produced grapes, log of average planted area of grapes, log of average real sale price of grapes, log of real average sale price of apple, log of real average sale price of nitrogen, log of average grape import, artificially created trend variable, which is a proxy for technological developments. The data sources are National Statistical Service (NSS) and the International Monetary Fund (International Monetary Fund, 2018). Prices were adjusted for inflation using producer price index (PPI); the benchmark year in calculation is 2010.

Table 1. Summary Statistics

Variable	Obs.	Unit	Mean	Sd. Dev.	Min	Max
ln_QG_t	18	ths. tons	199.22	64.34	81.6	318.8
ln_A_{t-1}	17	hectares	15,925.35	1,450.64	12,997	17,465
$ln\_rl\_PG_{t-1}$	17	AMD	180.05	44.91	120.05	273.95
$ln\_rl\_PA_{t-1}$	17	AMD	191.88	46.16	117.36	290
$ln\_rl\_PN_{t-1}$	17	AMD	117.47	27.25	73.89	193.65
ln_Import_{t-1}	17	ths. tons	2.606	1.286	0.9	4.6
Technology	18	-	9.5	5.34	1	18

So, we can make the following conclusions:

- The quantity of grapes supplied for the period of 2003 through 2015 displays increasing trend with certain fluctuations. The quantity of grapes supplied sharply decreased in 2016. Mean value of grape supply is 199 thousand tons with sd. deviation of 64.34 thousand tons.
- The planted area of grapes has increasing trend from 2002 to 2011. The area has displayed decreasing trend during the recent 4-5 year. The mean value of this variable is 15,925.35 ha with sd. deviation of 1,450.64 ha.
- Average real sale price of grapes was calculated based on PPI obtained from IMF database. The mean value of the real average grape price is 180.05 AMD/kg with sd. deviation of 44.91.
- Average real sale price of apple was calculated based on PPI. Average real sale price of apple displays decreasing trend during recent 7 year. Mean value of this variable is 191.88 AMD/kg with sd. deviation of 46.16.
- Average real sale price of nitrogen was calculated based on PPI. Mean value of this variable is 117.47 AMD/kg with sd. deviation of 27.25.
- The grape import displays increasing trend over the studied period. Mean value of grape import is 2,606 tons with standard deviation of 1,286 tons.

Empirical Model

Based on MWD test, log linear model was developed to estimate grape supply in Armenia. The logged average quantity of grape supply was observed as the variable dependent on lagged log of average planted area of grapes, lagged log of average real sale price of grapes, lagged log of average real sale price of apple (as the price of a substitute commodity), lagged log of average real price of nitrogen (production input), lagged log of average grape import and artificially created technology variable which is a proxy for technological developments.

$$ln\_QGt = \beta_0 + \beta_1 * ln\_A_{t-1} + \beta_2 * ln\_rl\_PG_{t-1} + \beta_3 * ln\_rl\_PA_{t-1} + \beta_4 * ln\_rl\_PN_{t-1} + \beta_5 * ln\_Import_{t-1} + \beta_6 * Technologyt + u_t$$

Where

- ln_QG_t - the logged average quantity of grape supply in thousand tons in t time period
- ln_A_{t-1} - log of average planted area of grapes in ha in t-1 time period
- $ln\_rl\_PG_{t-1}$ - log of average real sale price of grape in AMD/kg in t-1time period
- $ln\_rl\_PA_{t-1}$ - log of real average sale price of apple in AMD/kg in t-1 time period
- $ln\_rl\_PN_{t-1}$ - log of real average sale price of nitrogen in AMD/kg in t-1 time period
- ln_Import_{t-1} - log of annual import in ths. tons in t-1 time period
- $Technology_t$ - artificially created trend variable which is a proxy for technological developments
- u_t - random error term
- t - time index (2000–2017)

Economic theory suggests that grape supply is Cobweb type of function. Taking this into consideration Akaike values were calculated to understand the lag length to be employed in the model. Calculated Akaike values confirmed the results obtained from the literature review that regressors should be included in the model with 1 lagged value.

The presence of multicollinearity was checked using several tests. Partial correlations between independent variables were calculated. According to this test high partial correlation between lagged log of planted area of grapes and Technology variables gave place to suspect for moderate multicollinearity, which was confirmed by pair-wise correlation results. The VIF values of all regressors are less than 10 and the tolerance values are not close to zero. Therefore, according to rule of thumb we may consider that multicollinearity is not a troublesome problem for this model.

Table 2. Variance Inflation Factor (VIF)

Variable	VIF	1/VIF
ln_A_{t-1}	5.09	0.1965
$ln\_rl\_PG_{t-1}$	4.95	0.2020
$ln\_rl\_PA_{t-1}$	4.45	0.2245
$ln\_rl\_PN_{t-1}$	3.97	0.2516
ln_Import_{t-1}	3.21	0.3116
$Technology_t$	1.85	0.5394
Mean VIF	3.92	

The problem of heteroscedasticity in the error term is mainly observed in cross-sectional data. However, Breusch-Pagan and White tests were conducted to test the error term for the existence of heteroscedasticity. In both cases, we failed to reject H_0: homoscedasticity.

Reset test was conducted to find out if there are omitted variables in the model. there is not enough evidence to state that there are omitted variables in the model.

The results of the autocorrelation tests (graphical, Run's test, Durbin Watson and Breusch Godfrey LM tests) did not provide definite answer. After certain considerations, based on graphical tests it was decided to re-estimate the model with Cochrane-Orcutt iterative procedure.

Results and discussions

Table 3 presents the parameter estimates, standard errors, t statistics, p values, corresponding 95% confidence intervals, R^2 value and F statistic for the supply function. The selected level of significance for this analysis was 10%. The probability of obtaining F statistic greater than 11.46 from the F table was 0.0001. Therefore, we can reject H_0 that all parameter estimates are zero and conclude that parameter estimates are jointly statistically significant at 10% significance level. R squared was 0.873, which means 87.3% of variations in the dependent variable is explained by the model. The model was re-estimated using

Cochrane-Orcutt AR(1) procedure. Coefficient of autocovariance was equal to -0.4.

$$\widehat{ln\_QGt} = -16.104 + 1.917*ln\_A_{t-1} + 0.723*ln\_rl\_PG_{t-1} - 0.188*ln\_rl\_PA_{t-1} - 0.063*ln\_rl\_PN_{t-1} + 0.234*ln\_Import_{t-1} + 0.019*Technology_t$$

Parameter estimates associated with lagged log of average real price of nitrogen and lagged log of grape import were not statistically significant at 10% significance level, however they are left in the model because of right sign. Parameter estimate associated with lagged log of average real price of grape was 0.723 (own price elasticity of supply) and it was statistically significant, meaning that as the lagged average real sale price of grape increases by 1%, on average, grape supply increases by 0.723%, ceteris paribus. The supply of grapes is inelastic. The lagged log of real price of apple is negatively correlated with the dependent variable, meaning that when the lagged real price of apple increases by 1%, on average the grape supply decreases by 0.188%, everything else holds constant. Parameter estimate associated with lagged average planted area of grapes was 1.917 and it was statistically significant. When the lagged planted area of grapes increases by 1%, on average, quantity supplied of grapes increases by 1.917%, ceteris paribus. Parameter estimate associated with proxy variable Technology was 0.019 and it was statistically significant. Technological improvements in each year, on average, contribute 0.019% increase to average quantity of grapes supplied.

Table 3. Estimation results

	Coefficient	Sd. Error	t	P>|t|	Confidence Interval 90%	
Dependent variable is log of average quantity of grapes supplied						
ln_A$_{t-1}$	1.917	0.865	-1.952	***0.079***	0.349	3.485
ln_rl_PG$_{t-1}$	0.723	0.379	2.216	***0.051***	0.036	1.410
ln_rl_PA$_{t-1}$	-0.188	0.380	1.906	***0.086***	-0.877	0.501
ln_rl_PN$_{t-1}$	-0.063	0.255	-0.494	0.632	-0.525	0.398
ln_Import$_{t-1}$	0.234	0.122	-0.249	0.808	0.014	0.454
Technology$_t$	0.019	0.017	1.925	***0.083***	-0.012	0.050
Constant	-16.104	8.249	1.088	0.302	-31.055	-1.153
R^2 = 0.873		R^2 adj = 0.797		F (6, 10) = 11.46 (p-value - 0.0001)		

Conclusion

The aim of this research was to find out how economic supply determinants influence on grape supply in Armenia. Log-log linear equation model was used to estimate the supply function. The parameters of this model were estimated by the OLS method and re-estimated with Cochrane-Orcutt iterative procedure using STATA statistical software. The analysis showed that lagged log of average real price of grape, lagged log of average planted area of grape and technology had positive influence on the grape supply in Armenia. The highest positive influence on the dependent variable had lagged log of average planted area of grapes, as betta coefficient associated with it had the highest value.

Historically winemaking is one of the most important economic sectors of Armenia. As a rule, the government of Armenia pays special attention to the sphere by developing specific policy. The results of the econometric analysis could suggest that government subsidies for fertilizers might neutralize the impact of the latter on grape supply. However, grape prices have the highest impact on the average grape supply. Subsidizing the grape purchase price for grape processors would require significant financing and it hardly could be efficient. Tax advantages granted to grape processing organizations intended to increase their capacities would allow them to produce higher valued products, which would enable processors to pay more for high quality inputs including grapes.

Agricultural market imperfections and data collection methods applied by NSS could cause this outcome. In case of availability of additional micro data, it is recommended to do further research to reveal the influence of certain supply factors such as the number of grape processing firms, investment capacity, related supply taxes and government subsidies suggested by the economic theory on local grape supply.

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Environmental, Nutritional and Other Socio-Economic Factors of Life Expectancy: Cluster Analysis of EAEU Countries

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ABSTRACT

The article considers life expectancy as one of the main indicators determining the socio-economic development of countries, analyzes the impact of the main environmental, nutritional and other socio-economic indicators on life expectancy based on the structure of the regression model. Also, based on the data, a cluster analysis of the EAEU countries was performed.

Introduction

One of the indicators for determining the socio-economic status of countries, their level of development, is the life expectancy. Life expectancy is the hypothetical number of years to be lived for this generation of births, provided that throughout their lives, the death rate in each age group will be the same as it was in the year of calculation. This indicator is recommended by the World Health Organization (WHO) as the most important medical and demographic characteristics and health status of the population, as well as it is one of the three components of the human development index, which the UN uses to compare and evaluate the socio-economic development of different countries (Bubis, Gilyazetdinova, Dyukina, 2014).

In addition, life expectancy of the population of the country and its individual regions characterizes the level and quality of people's life. Changes in life expectancy can be a consequence of economic, political, social reforms, as well as a change in the ideology of society. In recent years, the concept of "quality of life" has taken a strong position in public opinion and scientific circulation. The growing interest in the problem of quality of life indicates that human society is currently concerned not so much with the problem of self-preservation but with the issues of sustainable socio-economic development.

Scientific and practical interest in the category of "quality of life" is due to the ongoing process of globalization, which dictates the need for modern states to create decent living conditions.

The quality of life of the population affects all aspects of life and, above all, reproduction, health and life expectancy of the population. The standard of living is not only measurable, but also comparable. For a better understanding and possibility of estimating the standard of living in terms of "low" - "high", it is necessary to compare the values of indicators selected for its characteristics in time or space aspects, for example, in different periods of time, between regions, between different population groups.

Living standards research also includes inequality analysis as a part of it. This inequality of living standards especially exists between the rural and urban populations, as well as between different racial groups and regions of the country. The "urban-rural gap" in living standards is a major source of inequality. It can be vivid in three measuring aspects that contrast welfare levels in rural and urban areas: (1) agricultural and non-agricultural productivity, (2) poverty levels in rural and urban areas, and (3) levels of infrastructure and public services deprivation in rural and urban areas. The productivity gap can be illustrated by comparing the productivity of labor employed in agriculture (value-added per worker per year) with the productivity of labor employed in other sectors (services and industry). The productivity gap between agriculture and industry and services is the core issue underlying the content of an urban-rural gap. With such a gap in productivity, it should come as no surprise that poverty is concentrated in rural areas. Agriculture and agriculture-related industry and services dominate rural areas, and unproductive and low-wage agriculture is unable to provide the dynamic, demand-led growth for the non-

farm rural sector to prosper. The result is high poverty in rural areas, sometimes two to three times more than in urban areas.

The third aspect of the rural-urban gap is the significantly lower level of infrastructure (especially health and education) and rural services in rural areas, as compared to urban areas.

Differences between rural and urban areas are particularly high for low income countries. But there is no significant correlation between the sizes of the urban-rural gap in living standards and urbanization or GDP per capita. While the gaps between mean urban and rural living standards are dramatic, the average levels of consumption discrepancies or inequality within urban and rural areas are almost equal.

Materials and methods

In this article we have decided to determine the impact of environmental, nutritional and other socio-economic factors on life expectancy, quantify their impact, as well as the implementation of cluster analysis within the EAEU countries on the basis of identified factors.

The study of the dynamics of human longevity has always interested scientists. Such studies are relevant in modern society. Back in the 1980s, researcher Wilkins was one of the first to note the fact that life expectancy at birth is a broad social indicator that involves the influence of various factors of social well-being (Pandey, Nathwani, 1997).

The Human Development Index (HDI), developed in the early 1990s, is used by the UN to measure the level of human development in countries. The life expectancy included in the index is considered to be an integral index of public health.

Life expectancy and other similar indicators of longevity (for example, the probability of "living" up to a certain age) are actively used by the UN in other integral indicators of development:

- in the Gender-Related Development Index (GDI),
- in the Human Poverty Index (HPI).

Scientists Pandey and Nathwani offer the Life Quality Index, which includes real GDP per capita and life expectancy at birth.

If we talk about the genesis of the very concept of "quality of life of the population," then in 1978, I.V. Bestuzhev-Lada believed that, in the understanding of this category, emphasis should be put on the comprehensive development of the personality in the form of a continuous process of forming a truly human community (Bestuzhev-Lada, 1978). English scientists L. Levy and L. Andersen (Levi, 1979) held a rather similar point of view, considering the quality of population' life as a set of conditions of physical, mental, socio-economic well-being from the standpoint of different individuals, social groups, society as a whole, including the definition of such states like needs satisfaction, pleasure, happiness.

Currently, life expectancy is recognized as a comprehensive indicator of development. Complexity is due to the fact that it itself is an important characteristic of the life quality and the fact that it is closely related to the level of socio-economic development. Life expectancy is formed under the influence of both natural and social factors:

- environment
- economic development,
- social well-being,
- education,
- health care, etc. (Teplikh, 2013)

Our health is an inseparable component of our environment, and therefore it cannot be regarded as something independent. The environment is commonly understood as an integral system of interconnected natural and man-made objects and phenomena, in which work, life and recreation of people flow. Changes of the environment will lead to changes in human health. In this context, the environmental factor is defined as any physical, chemical or biological component of the external environment, or within it, which can have an impact on human health and well-being.

The following environmental factors affect human health:

- geophysical, primarily climatic: atmospheric pressure, determined by the height of the terrain, dry air and high natural dustiness,
- geochemical,
- biotic: the action of allergens, poisons of plant and animal origin.

All people are exposed to environmental factors, for example, through the air we breathe, the water we drink, contact with various substances and preparations, etc. However, the degree of this impact varies and depends on the environment in which we are located and our behavior. The reason for this difference may be, for example, the location of the house and daily activities (city or rural area, special environment).

Thermal power stations, automobile transport, enterprises producing zinc, lead, and mercury have a great influence on human health. All this contributes to the accumulation of harmful substances in the body, increase in the incidence of cancer, worsening of the respiratory tract, and the breakdown of the nervous system. All of these symptoms lead to poor health and reduced life expectancy. Natural-catastrophic processes and phenomena also affect human longevity: earthquakes, landslides, floods, droughts.

Nowadays, a lot of attention is paid to food. Nutrition is one of the external factors affecting human health and longevity. The better food we eat, the better our health is. Food can be divided into 2 categories - foods that prolong life and reduce it. Life-prolonging food includes seafood and red wine. The list of life-reducing products includes sugar, salt, yeast-containing products. Food quality is one of the most important factors affecting our life expectancy.

As for socio-economic factors, they are discussed in detail below. Here it can be said that there is a positive relationship between the economic development of the country and the life expectancy of the population. The reverse effect of life expectancy on the GDP per capita of countries in the long- term perspective is also considered.

Results and discussions

As we have already mentioned, there are many factors affecting life expectancy, but within the context of this article, we are most interested in socio-economic factors. Therefore, we have adopted GDP per capita, the Gini coefficient characterizing inequalities in income distribution and unemployment as the main socio-economic factors affecting life expectancy. Let's justify the choice of factors.

GDP per capita is an indicator that shows how much income a resident of a certain country has on average, and, consequently, depending on the size of this income, the conditions and quality of life of a person and, consequently, life expectancy change.

GDP per capita is an average and aggregate indicator that shows only the absolute value of income. However, this indicator does not reflect the actual distribution of income received by individual residents of a given country (or their individual segments). If a country has a good indicator of income, but a very unequal distribution, it means that the smallest part of the country accounts for the largest part of income. That is why the life expectancy in the country will decrease due to the insecurity of the rest of the population. And the Gini coefficient was adopted as an indicator characterizing the inequality of income distribution.

The main and important source of income of the population is salary. If the country's unemployment rate is high, we can assume that a certain part of the population is deprived of the main source of income, which means a low level of quality and living conditions. As a result, life expectancy in this country will decrease.

In order to assess the impact of the adopted indicators on the life expectancy, we carried out a sampling (Table 1). The sample consists of 23 countries. It includes the best and the worst five countries regarding this indicator; the G7 countries, Armenia and countries with similar development levels in the region.

Table 1. Indicators of 23 countries. (World Bank database, 2017)

№	Country	Life expectancy (year)	GDP per capita ($)	Gini coefficient (%)	Unemployment rate (%)
1	Japan	83.7	38428	24.9	2.83
2	Sweden	83.4	53442	33.7	6.72
3	Germany	83.1	44470	28.3	3.75
4	Austria	82.8	49290	29.1	5.5
5	Spain	82.8	28290	34.7	17.2
6	Armenia	74.8	3936	33.8	18.23
7	Georgia	74.4	4057	40.4	11.6
8	Azerbaijan	72.7	4132	36.5	5.03
9	Turkey	75.8	10546	43.6	11.26
10	USA	79.3	59531	40.8	4.36
11	Russia	70.5	10743	39.9	5.2
12	UK	81.2	39720	36	4.33
13	France	82.4	38477	32.7	9.4
14	Italy	82.7	31952	36	11.21
15	Canada	82.2	45032	32.6	6.34
16	Belarus	72.3	5727	29.7	0.48
17	Kazakhstan	70.2	9030	33.9	4.9
18	Kyrgyzstan	71.1	1220	30.3	7.28
19	Cote d'Ivoire	53.3	1537	44.6	2.6
20	Chad	53.1	662	36	5.89
21	CAR	52.5	418	61.3	5.95
22	Angola	52.4	4100	60	8.17
23	Sierra Leone	50.1	499	62.9	4.47

Based on sample data, a regression analysis was carried out, particularly a regression model was constructed in which the life expectancy was taken as the dependent variable, and the GDP per capita, the Gini coefficient and the unemployment rate were taken as regressors.

$$L = c_1 + c_2 \times GDP + c_3 \times G + c_4 \times U + \varepsilon \quad (1)$$

The results of the embedded model are as follows:

$$L = 82.99 + 0.345 \times GDP - 0.62 \times G + 0.52 \times U \quad (2)$$

The indicators characterizing the level of significance of the model are shown in Tables 2 and 3.

Table 2. The indicators characterizing the level of significance of the model.

R^2	0.844
$R^2_{adj.}$	0.819
$F_{stat.}$	34.395
Prob. $F_{crit.}$	0.00001
Darbin-Watson stat.	2.023

Table 3. The indicators characterizing the level of significance of each factor.

Regressor	t-stat.	Prob.
Permanent	14.032	0.0000
GDP per capita	5.314	0.0000
Gini coefficient	-5.170	0.0001
Unemployment rate	-3.069	0.0063

The results show that if GDP per capita increases by one, life expectancy will increase by 0.345. If the Gini coefficient increases by one, the life expectancy will decrease by 0.62. If the unemployment rate increases by one, life expectancy will decrease by 0.52.

The coefficient of the model determination is 0.844: this means that the selected regressors determine the dependent variable by 84.4%. The adjusted coefficient of determination also indicates a high level of significance of the model.

Cluster analysis of the EAEU countries.

Now let's conduct a cluster analysis of the EAEU countries. The purpose of the analysis is to find out whether the aforementioned countries have the same level of development, that is, to identify integration possibilities in the EAEU countries. As a result of this cluster analysis, we can make relevant judgments, since the most significant socio-economic factors have been selected.

Below is the initial cluster analysis matrix (Table 4).

Table 4. Matrix of cluster analysis of the EAEU countries (World Bank Database, 2017)

Indicator	Armenia	Belarus	Kazakhstan	Kyrgyzstan	Russia
Life expectancy (year)	74.8	72.3	70.2	71.1	70.5
GDP per capita ($)	8710	18845	25045	3447	23703
Gini coefficient (%)	33.8	29.7	33.9	30.3	39.9
Unemployment rate (%)	17.3	0.5	6.1	8.2	5.2

Based on the obtained data, cluster analysis was performed using the "Nearest Neighbor" method, the final matrix of which is as follows (Table 5).

Table 5. The final cluster analysis matrix*

	[1,4]	[2,3,5]
[1,4]	0	9635
[2,3,5]	9635	0

*** Calculation made by the author**

The final table shows that Armenia and Kyrgyzstan are at the same level of development and the weakest within the five countries, while Kazakhstan, Russia and Belarus have an incomparably high level of socio-economic development.

Conclusion

As it has been already mentioned above, one of the main indicators determining the socio-economic development of countries is life expectancy. The life expectancy of a country's population characterizes the level and quality of people's life. And as it has been shown, there is a positive relationship between the socio-economic development of the country and the life expectancy of the population.

In this article, we analyzed the impact of the main socio-economic indicators (GDP per capita, Gini coefficient characterizing inequality of income distribution and unemployment) on life expectancy. To this end, we have introduced a sample, which consists of 23 countries. Based on sample data, a regression model has been constructed.

According to the results of the built-in model, the Gini coefficient (-0.62 per unit) and the unemployment rate (-0.52 per unit) have the greatest impact (negative) on life expectancy, and the GDP per capita (0.345 per unit) also has a significant effect (positive).

Taking into account the fact that the factors chosen by us have a significant impact on life expectancy and are the main indicators of the country's socio-economic development, these indicators have been used for cluster analysis of the EAEU countries.

The results of the study show that Armenia and Kyrgyzstan are at the same low level of development, and Kazakhstan, Russia and Belarus have an incomparably high level of socio-economic development. This means that the EAEU countries have different levels of socio-economic development, that is, one of the most important prerequisites for economic integration is violated.

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The Infrastructural Provision of Entrepreneurial Activities

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ABSTRACT

Infrastructures are characterized as the main resources and systems that serve a region, country or province ensuring the full and effective functioning of the economy. The business infrastructure includes services available in a geographic area, as well as the means that meet the needs and development of entrepreneurship. As part of our study, we used the following indicators to evaluate the provision rate of business infrastructure: access to financial resources, legislative regulation, tax system, customs system, business infrastructure, judicial system, level of corruption.

Introduction

The study of the infrastructure as an economic concept has always been relevant since the 50s and 60s of the 20th century, when it was scientifically proved that economic development should be beyond the boundaries of countries' colonial dependence (Lewis, 1955, Nurkse, 1963, Hirshman, 1958), where the problem of infrastructural provision was set in conditions of market economic relations.

When studying the works of Cunningham S.W., Kwakkel J.H., Hew D., Nee L., we have found out that the concept of infrastructural provision is not fundamentally described, thus there is a great need to define it thoroughly.

The next objective of this article is to introduce the main indicators for evaluating infrastructural provision of entrepreneurial activities based on the results of the survey. The aim of the survey is to identify the indicators affecting the entrepreneurial activities most and to make recommendations for the growth of infrastructural provision rate throughout entrepreneurial activities.

Materials and methods

The main materials for this article are the studies of various authors, who have made vast studies on infrastructural provision of entrepreneurial activities (Cunningham, Kwakkel, 2009, Hew&Nee, 2004). As for the scientific study, observation methods and collection of facts, analysis and synthesis, historical and logical methods have been used.

The survey method used helped to disclose the feeblest indicators. Based on the results of the survey, some recommendations have been made for the growth of infrastructural provision rate of entrepreneurial activities. In the current study 10% of "micro"-sized companies with 1-9 employees, 30% of "small" companies with 10-49 employees and 60% "medium" companies with 50-250 employees have been investigated. The representation of the sectors was also ensured: the sample included 40% importing companies, 30% trading companies, 20% exporters and 20% producers based on the survey sample size of the SurveyMonkey portal.

Results and discussions

According to L. A. Winters, formation of the economic category of "infrastructure" is associated with the development of human economic activity, scientific and technical progress, and globalization of the economy (Winters, 2014). In the world economic science, the concept of infrastructure is divided into three stages (Vining&Richards, 2001).

Theoretical approaches to the analysis of the problem of creating "general conditions of production" are formed in the first stage. The second stage can be defined as "the phase of "infrastructure" as an economic category. In the third stage, the infrastructure is interpreted as a means of promoting national economic systems and increasing competitiveness (from the 80s up to now).

In the professional literature, the infrastructure is defined as the "capitalized structure" for the whole economy, the operation of which is normally secured by the state (highways, bridges, urban transport systems, water treatment facilities, local water supply systems, airports).

As an infrastructure, the concept of entrepreneurial infrastructure needs a special study. Jochimsen defines infrastructure as the sum of material, institutional and personal facilities and data which are available to the economic agents and which contribute to realizing the equalization of the remuneration of comparable inputs in the case of suitable allocation of resources, that is, complete integration and maximum level of economic activities (Jochimsen, 1966).

One of the prerequisites for the progressive development of each country is the availability of a favorable business environment and, in this context, the formation of market infrastructures is considered as the most important precondition for healthy economic relations. In our opinion, the effectiveness of economic reforms is largely dependent on the level of development of infrastructure of individual markets and its types that provide adequate conditions for reproduction, on the basis of which we have singled out industrial and non- industrial infrastructures (figure 1), out of which we have identified infrastructures of industry, agriculture, construction, transport and communication, and non- industrial infrastructure: information technologies, tourism and banking system.

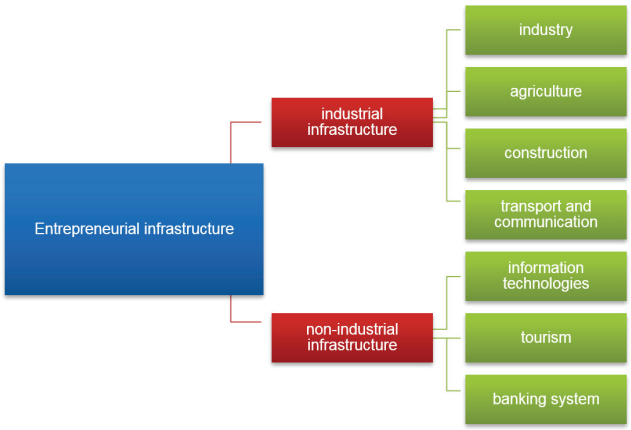

Figure 1: Entrepreneurial infrastructure

Considering the fact that infrastructure is a multifaceted concept, it is necessary to emphasize that the management of enterprise infrastructure development is an essential part of modern business activities, including the optimal storage of production resources and their successful interoperability. Effective management of infrastructural development depends on the overall success of the organization, the share of infrastructure costs in total production costs, the combination of engineering systems and equipment, the cost of all these activities, and the availability of resources to improve the infrastructure.

Having made a transition to the concept of "infrastructural provision of entrepreneurial activities", it should be noted that it is versatile and there is pluralism in its interpretation and interpretation of its contents in the economic literature. First of all, it can be defined as a complete system of industrial and non-industrial sectors, which is a link between the market vendor (service provider, employee) and the user.

Entrepreneurial infrastructure involves the services available in the given geographical area and the means that meet needs, advancement and development of the entrepreneurship (Hew&Nee , 2004).

In general, entrepreneurial infrastructure is divided into three main components: providing, supporting and supervising (Tan&TAN&Young, 2000). Under the concept of infrastructure provision we mean roads, banks, credit organizations, and various communication channels. The supporting infrastructure is represented by support funds, associations, and business incubators. The supervising infrastructure includes tax inspectorates, trade surveillance, state registration institutions, etc (Tan&TAN&Young, 2000).

In a market economy, infrastructure is an interconnected unique sub-system whose target function is to create common conditions for the economic activity of different markets, which allow to consider it as a production, financial-credit, institutional, commercial, social, and information infrastructure system. The authors consider that as a result of accurate infrastructural provision of entrepreneurial activities we will have the following outcomes:

- accelerated and regulated trade;
- specialization of market participants: producer, broker, buyer;
- the function of state regulation of entrepreneurship carried out; (Minniti, 2008)
- legal control over financial flow (Simon, 1997).

Under the concept of "infrastructural provision of entrepreneurial activities", some authors refer to the relationships of factors that are manifested in the form of a complex system in public relations, structures and objects, and create conditions for the effective functioning of entrepreneurship (Cunningham, Kwakkel, 2009).

To reveal the main problems of the infrastructural provision of entrepreneurial activities in Armenia, we have conducted a survey. The survey included 644 companies, based on the veracity of the survey sample size of the SurveyMonkey portal (https://www.surveymonkey.com/mp/sample-size/).

To ensure the integrity of the study we used the following indicators for measuring infrastructural provision rate of entrepreneurial activities:

- *access to financial resources,*
- *legislative regulation,*
- *tax system,*
- *customs system,*
- *judicial and legal system*

Nearly 68% of micro, small and medium-sized entrepreneurs have mentioned that for the development of business they need trade financing and more flexible requirements (figure 2). High value of loans and borrowings and strict requirements for collateral are assessed as the most serious obstacles: these are considered as an

important issue for their business expansion by 54% and 67% of the companies, respectively.

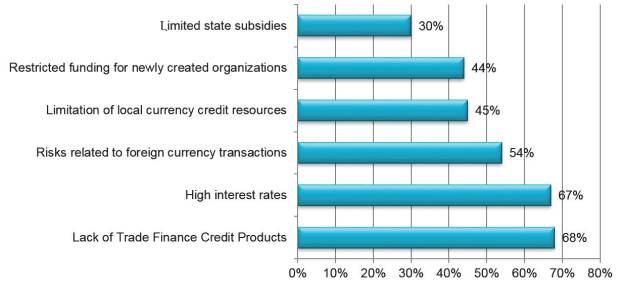

Figure 2: Financial Affiliation Issues

There are many banks and credit organizations in Armenia. Financial resources are actually available, but interest rates are often too high and there is lack of funding in AMD. Additionally, companies need a wider range of trading finance products.

According to the majority of participants, the judicial system in Armenia is not independent. Local and foreign investors don't consider the judicial system credible and believe that working with local courts is extremely difficult. Companies don't trust the Armenian judicial system and don't feel protected (see figure 3).

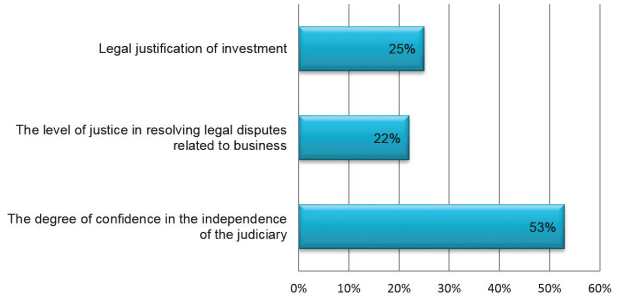

Figure 3: Attitudes towards the legal framework

Survey participants believe that laws and regulations are applied in unequal conditions. All market participants need equal conditions. These are raising business-related costs in Armenia and hinder access to the global market.

Corruption is a serious problem for business development in Armenia. Over the past four years, the Armenian Government has undertaken a number of reforms, including the simplification of the licensing process, the reform of social services, the new Criminal Code, anti-corruption laws and regulations and the creation of an anti-corruption council that aims to coordinate anti-corruption activities and improve anti-corruption policies. However, corruption remains a problem in law enforcement.

The next and the larger group of issues is related to tax barriers (see figure 4).

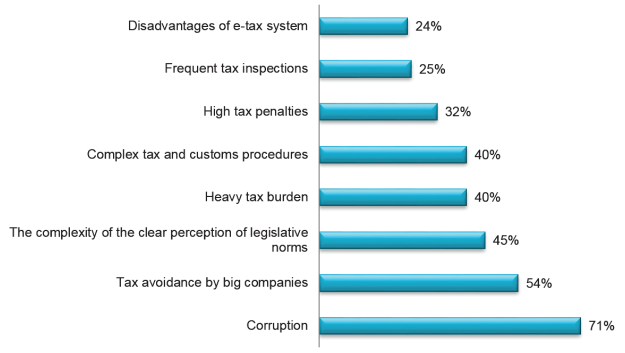

Figure 4. Main obstacles for exporting / importing companies in Armenia

The main ways to increase the level of infrastructural provision of entrepreneurial activities should be suggested in relation to the above-mentioned indicators.

Access to financial resources

In order to increase access to financial resources for entrepreneurs we recommend to introduce Basel IV monitoring system in banks and lending institutions, particularly the highest leverage ratio (currently 3% minimum threshold for Basel III, 4% in IV), definition of universal standards of capital, exclusion of internal models of rating and creditworthiness assessment by banks and application of standardized models.

Legislative regulation

We propose to improve the tax-GDP ratio by improving the tax administration and ensuring economic growth, as there is a great potential for that. Since Armenia is one of those countries that set a higher rate of profit tax, we think there is a need to apply differentiated rates for separate geographical zones, economic activities and export-oriented industries in Armenia, which is the key to balanced development and a basis for modernization of priority sectors of the economy.

Conclusion

Thus, considering the historical development of the term "infrastructure" and the comments by different authors, we conclude that the necessity of its study as a separate element of the economic system is due to the deepening of the public division in labor on the one hand and the impossibility of developing infrastructures only through market mechanisms on the other. This made it possible to establish two fundamental approaches to the problem of infrastructure development. The first approach involves analyzing the infrastructure in terms of expanding the division of labor, and the second one in terms of the need to strengthen the role of state regulation of economic mechanisms in infrastructure development.

As a result of our surveys, first, we propose to minimize the frequency of changes and amendments in laws and regulations. Further we propose to create tax registers through the adoption of appropriate legislative and subordinate acts, which will carry out

tax audits in accordance with individual infrastructures.

Tax system

We propose to incorporate a tax planning system into organizations that require compulsory enforcement, which implies the development and implementation of an appropriate tax accounting procedure, the implementation of which will be supervised by the internal control body of the relevant entity.

Customs system

We recommend to minimize the use of pre-customs preparation, customs inspections and customs clearance procedures.

Judicial and legal system

In order to increase the level of confidence in the judiciary, we propose to increase the level of independence and impartiality of judges through the implementation of effective steps by the Judicial Council of Armenia, particularly, to introduce an electronic system for judicial proceedings, which will minimize the involvement of litigation participants outside the court, which in its turn will raise the level of transparency of the judicial proceedings.

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Regulations of Underground Water Usage in Armavir Region

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ABSTRACT

In this article justifications of using underground water for irrigation purposes of lands in the landscape of Armavir region are introduced: water intake has been implemented from low pressurized aquifer by repairing existing boreholes and by drilling new ones. Research on hydrogeological conditions of the selected area, its analysis and schematization has been performed. Hydrogeological calculations of boreholes with actual discharges are presented as an example, taking into account the permissible drop rate of piezometric level. As a result, the groundwater level drawdown of an aquifer has been obtained under possible discharges, considering the hydraulic connections between the aquifers.

The obtained results will enable to regulate working regimes of both new drilled and already operating boreholes in the region, as well as those under construction.

Introduction

The development and implementation of complex water engineering measures (land melioration) in the field of water management and agriculture in Ararat Valley are associated with the use of large amounts of underground water (mostly low pressurized). However, the use of underground water for irrigation and water supply purposes requires justification in engineering and scientific approaches.

Justification of engineering approaches is based on hydrogeological sections of the area, lithological composition of the rocks, borehole parameters in consistent with filtration characteristics, type of filters and correct location of the deep pump.

Justification of scientific approaches is based on the forecast of water level fluctuations of aquifers when boreholes are operated and determination of the permissible maximum water level drawdown excluding water resource consumption.

The basis for hydrodynamic calculations is the actual baseline data of existing boreholes in the abovementioned area operating in low pressurized horizons with a depth of 60-250*m*.

It should be noted, that underground water's hydrodynamic indices are classified as confined and unconfined types in Armavir region. Moreover, the confined aquifer is presented as low- (I) and high-pressurized (II). Currently, there is a tight hydraulic connection between the aquifers. The water from boreholes for irrigation purposes in the Ararat Valley is mainly taken from the low pressurized aquifer by using deep pumps. Consequently, when presenting parameters of a new drilled borehole, the hydrodynamic indicator of a filtering environment should be primarily taken into account, particularly, in order to maintain the piezometric level in boreholes when water is taken, that is, to exclude water resource consumption (Mkrtchyan, 1974).

Materials and methods

In order to efficiently use underground water resources for irrigation purposes in the Armavir region, the research of hydrogeological conditions of the area has been carried out and the filtering environment has been prepared in cases when water is taken from perfect and imperfect boreholes, which is as follows (pic. 1).

In consistent to the schemes a hydrodynamic calculation has been carried out.

Considering hydraulic connection between aquifers (water inflow from bottom and top aquifers to the observed one) and taking into account the condition of unlimited expansion of an aquifer, underground water flow to the vertical perfect borehole in a pressurized aquifer can be determined by the following equation (Khachatryan, 1993, Klimentov, 1985).

$$S_0'' = \frac{Q}{2\pi (km)_1} \ln \frac{1.12B}{r_0} \quad (1)$$

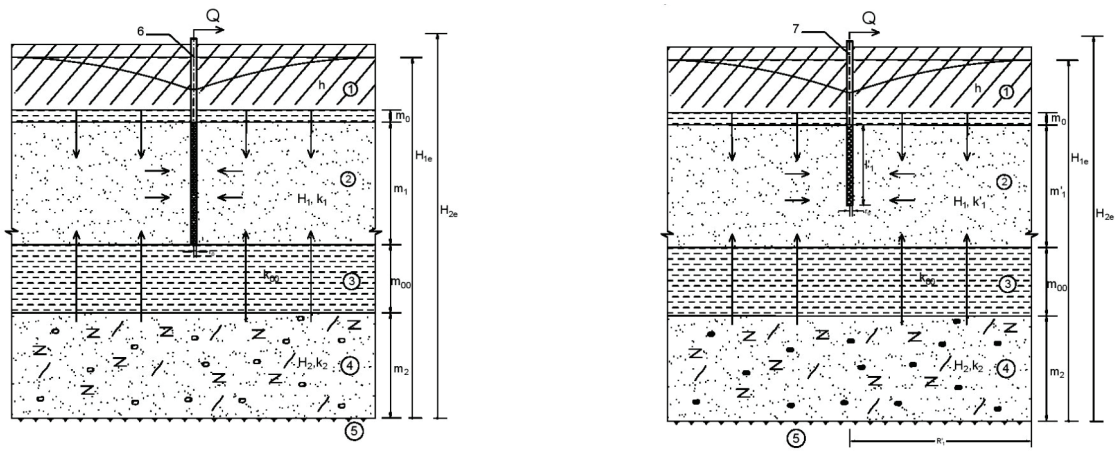
where r_o is a diameter of a borehole, Q is a discharge from the borehole, $(km)_1$ is a coefficient of water conductivity of a low pressurized aquifer, B is the water inflow parameter of an observed aquifer, the size of which depends on the filtering properties of the low permeable and effective horizon and can be determined as follows (Klimentov, 1985).

$$B = \sqrt{\frac{(km)_1 m_0 m_{00}}{k_0 m_{00} + m_0 k_{00}}} \quad (2)$$

Where k_0, k_{00} are filtration coefficients of low permeable horizons, m_o, m_{00} are their thicknesses.

a) Borehole N1, village Margara,

b) Borehole N1, village Vardanashen



Pic.1. Hydrogeological calculation scheme
1- unconfined aquifer, 2, 4- low and high-pressurized aquifers, 3- low permeable layer, 5- impermeable rocks, 6- perfect borehole, 7- imperfect borehole

In cases, when water is taken from the imperfect borehole, (1) equation can be presented as follows (Klimentov, 1985, Maksimova, 1979):

$$S_1' = \frac{Q}{2\pi (km)_1} \left[\ln \frac{R_1'}{r_0} + \zeta_1' \right] \quad (3)$$

Where R_1' is the radius of the borehole impact, ζ_1' is the additional resistance, which depends on $\frac{l_1'}{m_1'}, \frac{m_1'}{r_0}$ parameters. Here l_1' is the length of the water intake part of the borehole, m_1' is the thickness of an aquifer. The value of ζ_1' parameter is presented in the table 1 (Verigin et al., 1977).

Table 1 The value of addition resistance based on $\frac{l_1'}{m_1'}, \frac{m_1'}{r_0}$ parameters

$\frac{l_1'}{m_1'}$	$\frac{m_1'}{r_0}$									
	0.5	1	3	10	30	100	200	500	1000	2000
0.1	0.04	0.122	2.04	10.4	24.3	42.8	53.8	69.5	79.6	90.9
0.3	0.03	0.09	1.29	4.79	9.2	14.5	17.7	21.8	24.9	28.3
0.5	0.016	0.05	0.66	2.26	4.21	6.5	7.86	9.64	11.0	12.4
0.7	0.0005	0.017	0.24	0.88	1.69	2.67	3.24	4.01	4.58	5.3
0.9	0.00004	0.0015	0.02	0.13	0.3	0.53	0.66	0.85	0.98	1.12

According to the abovementioned schemes, calculations of piezometric levels' drawdown in aquifers have been performed with (1) and (3) equations, which are based on the following actual baseline characteristics (borehole N1, village Margara and borehole N1, village Vardanashen): $r_0 = 0.16m$, $k_1 = 10.3$ m/day, $m_1 = 68m$. The characteristics of an upper low permeable layer are as follows: $k_0 = 0.1m/day$, $m_0 = 4m$. The characteristics of a low permeable layer below are as follows: $k_{00} = 0.01m/day$, $m_{00} = 15m$, $k'_1 = 13.6m/day$, $m'_1 = 80m$, $l'_1 = 47m$, $R'_1 = 600m$. The drawdowns of levels have been determined for $Q = 40, 60, 80$ l/s borehole discharges. According to the table 1 from $\frac{l'_1}{m'_1} = \frac{47}{80} = 0.6$ and $\frac{m'_1}{r_0} = \frac{80}{0.16} = 500$, ζ'_1 = 6.825 is derived. The calculation results are summarized in Table 2.

Table 2 The drawdown of piezometric levels in Armavir region when water is taken from perfect and imperfect boreholes

r, m	Q, l/s	$\frac{Q}{2\pi(km)}$	$\frac{Q}{2\pi(km)'_1}$	$\ln\frac{R'_1}{r_0}+\zeta'_1$	B	$\ln\frac{1.12B}{r_0}$	S^n_o, m	S'_1, m
0.16	40	0.79	0.51	15.05	165	7.05	5.5	7.6
	60	1.18	0.76				8.3	11.4
	80	1.57	1.01				11.1	15.2

The maximum permissible drawdown of piezometric levels for vertical perfect borehole can be determined by the following equation: (Maksimova, 1979, Bochever, 1976)

$$S_{mad} = H_{le} - (0.4m_1 + \Delta H_p + \Delta H_f): \quad (4)$$

Where H_{le} is the initial size of the pressure, ΔH_p is the maximum depth of the bottom of the pump in the well, ΔH_f is the loss of pressure at the borehole entrance. In our situation the abovementioned parameters are as follows: $H_{le} = 80.2m$, $m_1 = 68m$, $\Delta H_p = 5m$, $\Delta H_f = 6m$. By placing these parameters in the equation (4), the maximum acceptable drawdown will be $S_{mad} = 42m$.

In cases when there is an imperfect borehole, (4) equation can be written as follows (Maksimova, 1979).

$$S'_{1mad} = (0.5 \ldots 0.7)(M_1 + H_1) \quad (5)$$

Where H_1 is the initial size of the pressure, M_1 is the thickness of the observed aquifer. In this situation these two parameters are as follows: $H_1 = 28m$, $M_1 = 47m$. By placing these parameters in the equation (5), the maximum acceptable drawdown will be $S'_{1mad} = 37.5m$.

Results and discussions

The calculation results show that in Armavir region the maximum drawdown in boreholes takes place when water is taken from the imperfect borehole with the possible maximum discharge ($Q = 80l/s$) and it is $15.2m$ (table 2), which is less than the maximum acceptable drawdown: $S'_{1mad} = 37.5m$.

Conclusion

Hydrodynamic calculations show that the irrigation of a part of landscapes in Armavir region can be done by using underground water resources without disrupting the maximum acceptable piezometric level drawdown in boreholes. Similar calculations have been performed for 20 new and 14 operating boreholes in Armavir region, which show that in appropriate discharge conditions the piezometric level drawdowns in boreholes are 7-22m, which is always less than maximum acceptable drawdown.

The calculations enable to irrigate the existing land areas and to expand their sizes.

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Reliability Assessment of the Brake System in Gazelle Minibus Through Resource Indicators of the Limiting Machine Parts

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ARTICLE INFO

Keywords:
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gamma-percentile resource,
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critical in reliability

ABSTRACT

The resource indicators of the machine parts limiting the brake system reliability in the minibuses of GAZelle series are introduced in the current article. Based on these indices the critical machine parts from the perspective of reliability have been identified. The experimental researches refer to the 3 m 600 thousand km of total run for 20 units of minibuses as a result of which the durability indices have been developed.

Introduction

In order to study the reliability of the brake system in the minibus of GAZelle series, scientific experimental researches have been carried out upon the example of the minibuses of GAZelle series exploited in the seven intra-urban passenger routes in Yerevan. In the transportation company the controlled technical exploitation of the minibuses' brake system is moderated in consistent with the statutes approved by the RA government in 2007.

Materials and methods

The total run of the 20 minibuses under control has made over 3 m 600 thousand km throughout 3 years. In conditions of such running rate, activities of technical service number 2 (TS-2) 307 and technical service number 1 (TS-1) for the minibuses have been carried out 1228 times. Current repair (CR) works have been implemented to eliminate the malfunctions of the brake system 603 times, out of which in 336 cases the works have coincided with those carried out at TS-2 and for the rest 267 cases work performance requests have been submitted. The expense on the spare parts during the Current Repair works was mainly for the change of the shoe-beams of the working brake mechanism in the front axle with 316 kits and 87 kits for the change of the shoe-beams of the drum brake mechanism in the rear axle. It should be mentioned that the shoe-beams of the brake mechanisms in the front axle are replaced with the new ones but the rear axle shoes mainly stay the same; for each minibus they are renewed through merely nailing the beams onto the shoes. The mentioned repairing technology is accepted by the companies exploiting GAZelle minibuses both in the RA and abroad. In the table introduced below the number of the machine parts used during the TS and CR works for the brake system of 20 unit of minibuses of GAZelle series under control is introduced. The machine parts limit the exploitation reliability (GOST 27002-89, 2002) of the minibus brake system.

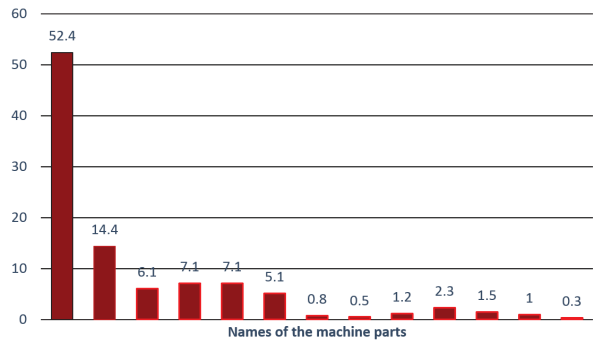
It should be mentioned that for the rest machine parts of the minibus brake system of GAZelle series, such as pipelines, chamber adapters, brake pedal spring, axis, pedal, etc., hardly any repairing work has been implemented or if so, it has been carried out once or twice, which has been ignored due to the goal of the issue. Meanwhile, it should be mentioned that in the company where the investigations are being carried out, the current repairing works of the vacuum booster in the brake system are being implemented through the aggregate-link changing method and the mentioned link is changed in a collective way but not through replacing the machine parts.

Results and discussions

For the visual comparative evaluation of the repairing works of the machine parts in the brake system of GAZelle series the specific weight of the machine parts according to the name list of the table is introduced in the figure. The aim of the figure is to show the name list of the machine parts which limit the exploitation reliability and resource indicators (Lukomsky, 1961) of the brake system in minibus brake system.

Table Machine parts expenses during the TS and CR

N	Name of the machine part	The cost amount of the machine parts	The machine part replaced upon the CR claim	The machine part replaced during the TS-2	The average run of the machine part, thousand/km
1	Front axle brake shoe 3105-3501216	316 sets	137	179	12.3
2	Rear axle brake shoe 3302-3501090	87 sets	41	46	40.0
3	Support guide pin 3105-3501214	37 sets	14	23	97.84
4	Front axle hydro-cylinder piston 3105-3501186	43 sets	32	11	87.3
5	Front axle hydro-cylinder collar 3105-3501194	43 sets	32	11	83.3
6	Front axle brake mechanism disk	31 sets	-	31	110.0
7	Clamp	5	-	5	Selection volume is not sufficient
8	Support	3	-	3	-"-
9	Hydro-cylinder	7	-	7	-"-
10	Brake fluid rubber pipe/tube	14	2	12	-"-
11	Rear axle hydro-cylinder collar	9	7	2	-"-
12	Rear axle hydro-cylinder piston	6	-	6	-"-
13	Vacuum booster	2	2	-	-"-
		603	267	336	



Fg. The specific amount of the Current Repair machine parts (names according to the table) for the minibus of GAZelle series

As it is shown in the introduced diagram figure the names of the machine parts in the brake system needed to be repaired is divided into three main groups:

a) with high specific weight-14.4÷52.4%,
b) average specific weight-5.1÷7.1% and
c) low specific weight- 0.2÷2.3%.

Conclusion

Thus, in exploitation conditions of minibuses of GAZelle series in the intra-urban route of Yerevan, the shoe-beams of the front axle disk-type brake mechanism and partially the beams of rear axle brake drum-like mechanism can be assessed as critical from the perspective of the brake system reliability. This means that the conducted research experiments will enable to find the real resources of those machine parts, as non-renewable machine parts, to find out the resource distribution regularity, to estimate the gamma percentile resource and to develop the possibility of uninterrupted work.

Then it will be possible to find the distribution principles: mathematical expectation value - X, mean-squared departure/ deviation - σ, dispersion - D, dispersion ranges or the variation correlation - V.

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Image Recovery with the Help of Dirichlet Problem for Laplace's Equation

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image recovery,
Dirichlet problem

ABSTRACT

Images often contain noises or unwanted parts that need to be removed. Various techniques are used to reduce the noise level or to remove the abovementioned parts. This objective is reviewed as the task of recovering the lost part of the image. Anisotropic diffusion model served as a motivation for constructing a mathematical model used for solving the reconstruction problem. In this paper, the Dirichlet problem is used for Laplace's equation. The Dirichlet boundary condition gives the opportunity to restore the value of each pixel based on the color intensity of adjacent pixels.

Introduction

One of the most promising areas for the use of drones is farming. Drones can be effectively used for planning and controlling the stages of agricultural production, as well as for chemical processing of crops and other plants. They are mainly used for aerial photography. UAVs allow creating a cartographic base with the exact coordinates of all objects, which will make visual analysis of objects with a resolution of up to several cm per pixel possible. Often in such images there are noises or objects that affect the accuracy of research. This paper considers a method for solving such problems.

Materials and methods

The numerical method used for Laplace's equation discretization helps to replace the damaged pixels in the image matrix. The image will be shown in the form of a matrix the elements of which are vectors (r,g,b)The image will be presented in the form of 3 channels: Red, Green and Blue. The restoration will be performed on each of these channels, after which they will be merged into one image. Thus, each channel itself represents a matrix, the elements of which are the number - intensity of the corresponding color. Such strategy gives good results when the area to be filled does not have a certain structure, or the area is small in comparison with the image as a whole. This method is more suitable for working with smaller and non-textured areas. There are different methods for texture synthesizing (Heeger&Bergen, 1995).

Laplace's equations are differential equations with second-order partial differential equations and fall under the category of ecliptic partial differential equations. Harmonic functions are the solutions of Laplace's equations. Harmonic functions quite accurately characterize the nature of multiple potentials of liquids, electricity, springs, etc.

When applying Laplace operator (discretized) to a certain image, a new image can be obtained, which represents the outlines of objects in the original image from itself. All parts of the original image that undergo linear or non-linear changes are displayed in 0.

In this recovery method, partial differential equation with Dirichlet boundary conditions is used. There are initial values of pixels on the border of the restored part and from these values it is necessary to obtain the values of all pixels in the entire area under consideration. Heat equation meets all these requirements. It is also known as diffusion equation, since in addition to modeling the temperature dynamics, this equation can also be used as a model for describing the dynamics of density in the material undergoing the diffusion process. Taking into account the given

differential equation, as well as the law of thermal conductivity of materials when taking into account the initial zero temperature, it is possible to calculate the temperature of two-dimensional material at any time and at any stage with the help of equation:

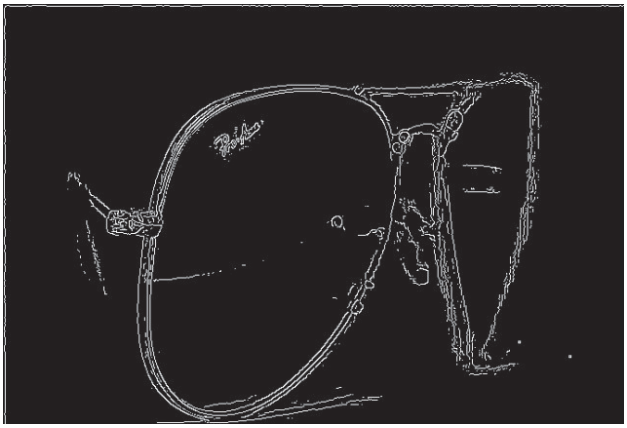
$$u_1 = c^2(u_{xx} + u_{yy}).$$

In the equation introduced above, time is involved as a parameter, which is not necessary for our task. On the contrary, in image restoration, time should not affect the result at all. Based on the physical properties of the problem $t \to \infty$ when striving to solve the heat equation, we obtain a function that is the solution to the Laplace's equation. The idea is that, if the time is not fixed we can obtain more uniform temperature distribution or a more homogeneous material after diffusion. Thus, this problem can be better modeled using the Stationary heat equation, or Laplace's equation, regardless of time. The Laplace's equation looks as follows:

$$\Delta u = u_{xx} + u_{yy} = 0.$$

The intensity of each color in a RGB image or the intensity of white in black can be interpreted as the temperature to be diffused or the substance subjected to diffusion. Thus, the intensity of the color of the area surrounding the missing part and the part to be recovered may fill this missing part with the help of diffusion. Therefore, the pixels surrounding this part will act in the role of boundary values.

Pic. 1.a. Original image



Pic. 1.b. Image obtained after the application of Laplace operator (with some modifications).

Two methods for solving the problem can be used- analytical and numerical. In case of the first method analytical function must be obtained from matrix of pixels, for example with the help of interpolation. In the current research the second option is used. Further, the finite-difference method will be used (Smith, 1985).

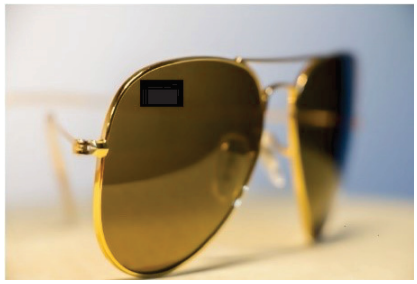
Color intensity matrix in pixels represents grid function from itself and we have the intensity of the color of the pixels on the border of the area that needs to be restored. The values of these pixels appear in the role of Dirichlet boundary conditions.

The derivative of the second order will be approximated as follows:

$$\frac{\partial^2 U}{\partial x^2}_{i,j} = \frac{U(x-\Delta x, y) - 2U(x,y) + U(x+\Delta x, y)}{\Delta x^2}$$

$$\frac{\partial^2 U}{\partial y^2}_{i,j} = \frac{U(x, y-\Delta y) - 2U(x,y) + U(x, y+\Delta y)}{\Delta y^2}$$

Pic 2.a. Original image



Pic 2.b. Trying to remove the inscription

Pic 2.c. Inscription is successfully removed

Pic 3.a Original image

Pic 3.b. Image to be recovered

Pic3.c. Recovered image

Pic 4.a Original image

Pic. 4.b. Image to be recovered

Pic. 4.c. Recovery failed

After substituting the abovementioned approximations in equation, we get:

$$\frac{U_{i-1,j}-2U_{i,j}+U_{i+1,j}}{(\Delta x)^2}+\frac{U_{i,j-1}-2U_{i,j}+U_{i,j+1}}{(\Delta y)^2}=0,$$

for the pixel in i-line and j-column

The remaining calculations are not introduced in this research.

Results and discussions

This method fills the missing part evenly. Due to the lack of information about the values of the function in the area, zero function was taken on the right side of equation, which is the reason for non-ideal recovery. Thus, harmonic function becomes the solution to the equation mentioned above. Consequently, this function cannot have “jumps”. Jump is the non-linear behavior of a function. That is, abrupt color changes cannot be present in the restored part. Here you can see a few recovered images.

In the first two examples the method worked. In the third example the recovery failed. The reason is “jumps".

Let's denote $L = U$. (U - one ot the channels R, G, B)

On the image 5.b. black pixels correspond to the points in which the function L takes values close to 0. That is, along the white curves, U varies nonlinearly. But since in the parts lost there is no information about the curves and L values on those curves, the “jumps" of U function can't be recovered.

Pic. 5.a. Original image

Pic. 5.b. Image obtained after the use of Laplace operator (with some modifications)

Conclusions

Further researches devoted to the recovery of images similar to the image 5.a will be presented.

Track U is one of the channels R,G,B. Ω- an area, where the values of the pixels must be recovered. For the beginning Laplace operator must be applied on the image U.

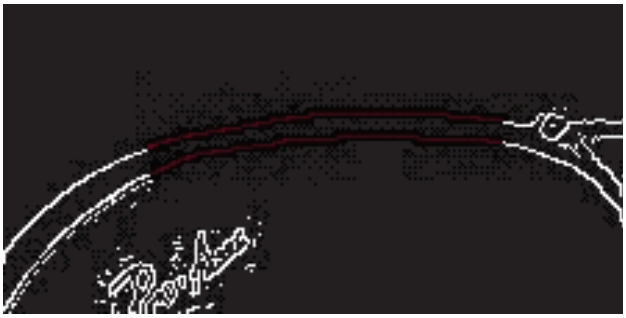
$$S := \{(i,j) \mid \Delta U(i,j) \text{ enough bigger } 0\}$$

S - the set of all points that belong to the curves, which are the boundaries of objects in the original image.

From the set of non-intersecting curves the folloving must be separated.

$$C := \{F(x,y) = 0 \mid (x,y) \in S\}$$

From C only those curves must be taken, which intersect with the area Ω. Further from all those curves pairs of sequels must be created. That is, each curve needs to be associated with a curve that mostly suits as a continuation of the first curve before entering Ω and leaving it. Later, for all those pairs, curves must be merged (using interpolation or extrapolation). On Image 6 the reconstructed continuation of the image is marked red. After which on the intersected part of the curves the value of the function must be obtained.



Pic. 6 (Example of recovering curves)

Thus, not all the values in the lost part will be equal to 0. Now, on the right side of Laplace equation we will not get the 0 function, but the function obtained as a result of the abovementioned steps.

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Development Dynamics of the Apple Scab in Pre-Mountainous Conditions of the Artsakh Republic /NKR/

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Keywords:
apple scab,
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climatic conditions

ABSTRACT

Apple scab is a widespread disease in the Republic of Artsakh. In order to efficiently struggle against this disease it is necessary to study the virus development related to the climatic conditions. Upon the studies carried out in 2011 -2014 it has been disclosed that in conditions of pre-mountainous zone of the Artsakh Republic the critical period for the apple scab development is May-June, that is the end of the apple tree blossoming and the start of fructification period and it is necessary to suppress the virus development through the fungicidal preparations to be applied for that period.

Introduction

Apple scab is a widespread disease in the Republic of Artsakh (Arakelyan&Avagyan, 2014). The hibernating infection stock, the sufficient amount of mature spore sacs, climatic conditions observed in winter season, as well as in the first half of summer and spring, also the sort resistance rate (Bystraya, 2013, Litvinova, 1969) are stimulating factors for the scab virus (*Venturia inaequalis* (Cooke) G. Wint.) development. In order to organize an efficient struggle against this disease it is necessary to study the development process of the mentioned virus related to the climatic conditions.

Materials and methods

To accomplish this objective, after disclosing the infection in the apple sort "Idared", on the natural infestation background in conditions of Ukhtadzor and Berqadzor communities, at pre-mountainous zone of NKR, we conducted investigations on the scab development dynamics with 10 days' intervals throughout 2011-2014. 10 trees (Litvinova, 1969, Dementieva, 1962) in the orchard of up to 1 hectare territory were examined.

The disease intensity for the apple scab was evaluated with 5-point scale (fg. 1):

0 point - lack of plant infestation,
1 point - infestation up to the 10 % of the plant (leaf, fetus) surface,
2 points - infestation up to the 11%-25 % of the plant (leaf, fetus) surface,
3 points - infestation up to the 26%-50 % of the plant (leaf, fetus) surface,
4 points - infestation of more than 51 % (Dementieva, 1985) of the plant (leaf, fetus) surface.

Fg. 1. Leaves infested with apple scab (0-3-point intensity)

The disease development or its rate, which indicates the average infestation intensity (for an individual plant (sort) in a specific

plot) has been determined through the following formula expressed in percents:

$$R = \frac{\sum(a \cdot b)}{N \cdot K} \cdot 100\% \qquad \text{(Arakelyan\&Avagyan, 2014)}$$

where
R - is the disease development or its rate (%),
∑(a·b) - is the product sum of the respective points of infested leaves, fruits amount and infestation rate,
N - is the calculated feti (leaves) number,
K - is the maximum point (4) of the calculation scale.

No caring or treatment measures have been implemented in the orchards.

The yield data have been subjected to the statistical development through the method of dispersion analysis (Khachatryan, 2002).

Results and discussions

The precipitations in pre-mountainous zone of the Artsakh Republic /NKR/ mostly fall in March, April, May and June which coincides with the outbreak of the mature spore sacs of the scab virus and with the plants initial and secondary infestation period (Arakelyan&Avagyan,2016). In April, May and June of 2011 and 2013 the amount of atmospheric precipitations made 248mm and 195 mm respectively and in 2012 and 2014 it made 170mm and 116.5 mm (Data of Stepanakert Meteorological Center, 2011-2015). The humid climatic conditions in the Spring and Autumn seasons of 2011 and 2013, including the continuous drizzles, relatively high air humidity and the favorable temperature for the virus development promoted the early outburst and development of the scab (diagrams 1, 3). While the relatively dry climatic conditions of the early spring period in 2012 and 2014 delayed the scab development, due to which the symptoms of the disease appeared in the first 10 days of June and it was developed with relatively lower intensity (diagrams 2, 4).

So, in the pre-mountainous zone of NKR, the more humid the first half of Summer and the second half of spring are with more intensity the scab on the leaves and feti will develop.

As we can see from the diagram 1, the first signs on the leaves in Ukhtadzor community were observed in the first 10 days of May, 2011 and on the feti they were observed in the third 10 days, when the air temperature fluctuated within +15^{0}C -+17,6^{0}C (Data of Stepanakert Meteorological Center, 2011-2015). In conditions of the favorable temperature and humidity for the virus development it rapidly grew up in May-June. The calculation results carried out on June 24 have shown that the scab development rate on the apple tree leaves made 41,3 % and on the fruit it was 26,4 %. Related to the high air temperature (+27,2^{0}C -+30,4^{0}C) and the relatively low air humidity in July the rate of virus development slowed down. In the calculation outcomes of July 24, the scab development rate on the apple tree leaves made 43,2 % and on the fruit it was 31,2 %. Upon the calculation results implemented by September 12, the development rate of the disease was 46,1 % on the leaves and 40,3 % on the fruit.

In 2012 the first scab signs on the apple tree leaves were observed in the first 10 days of June and on the fruit they appeared in the second 10 days of June (diagram 2). It rapidly developed until the second 10 days of July. Due to the calculation results of July 15, the scab development rate made 24,6 % on the apple tree leaves and 18,6 % on the fruit. Anyhow, because of the high air temperature (+26,3^{0}C +27,6^{0}C) and scarce atmospheric precipitations (Data of Stepanakert Meteorological Center, 2011-2015) the scab development intensity had a slow course up to the third 10 days of August. By the end of vegetation the scab development rate had made 29,8 % on the leaves and 24,4 % on the fruit (feti).

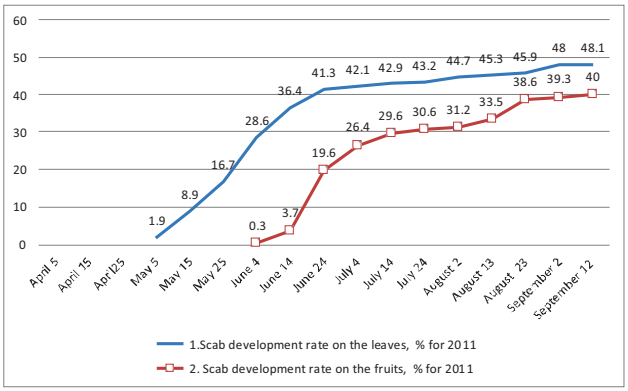

Diagram 1. Development dynamics of the apple scab in conditions of Ukhtadzor community in "Idared" sort, 2011

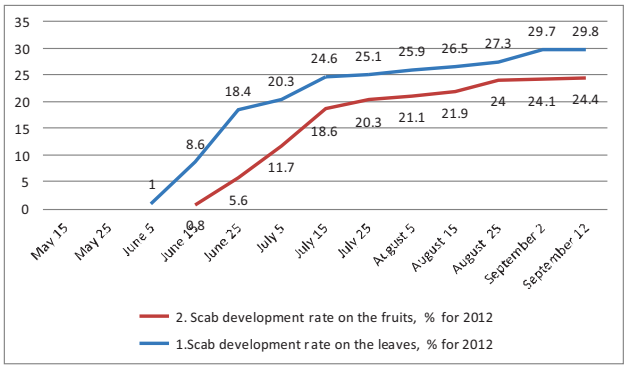

Diagram 2. Development dynamics of the apple scab in conditions of Ukhtadzor community in "Idared" sort, 2012

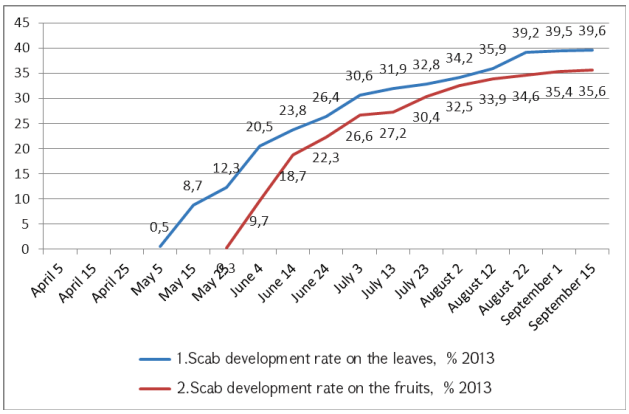

Diagram 3. Development dynamics of the apple scab in conditions of Ukhtadzor community in "Idared" sort, 2013

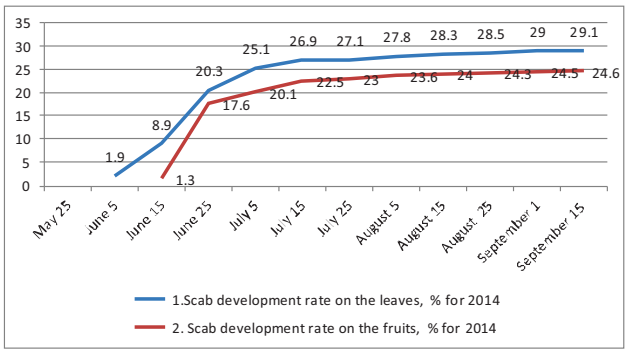

Diagram 4. Development dynamics of the apple scab in conditions of Ukhtadzor community in "Idared" sort, 2014

In 2013 the scab development on the leaves started in the first and on the fruit in the third ten days of May, when the air temperature fluctuated within +18^{0}C -+18,1^{0}C (Data of Stepanakert Meteorological Center, 2011-2015). Due to the calculation results implemented by May 25, the scab development rate on the leaves of the apple tree made 12,3 % and on the fruit-0,3 %. Its development was intensive up to the first ten days of July. By June 14, the scab development rate on the apple tree leaves made 23,8 % and on the fruit – 18,7 %, while on July 23, it was 32,8 % and 30,4 % respectively. After the first ten days of July the precipitation amount decreased and it influenced the further development intensity of the scab. By the end of vegetation the scab development rate on the leaves had made 39,6 % and on the fruit -35,6 %.

In 2014 the first signs of scab appeared in the first and on the fruit in the second ten days of June (diagram 4). It developed intensively until the first ten days of July. By June 25 the scab development rate on the apple tree leaves had made 20,3 %, on the fruit it was 17,6 %, while by July 5 it was 25,1 % and 20,1 % respectively. Starting from the second ten days of July up to the first ten days of September the air temperature was +25,2^{0}C-27,9^{0}C (Data of Stepanakert Meteorological Center, 2011-2015) and no precipitation was observed, thus the scab development had a low intensity by the end of vegetation. By the end of vegetation the scab development rate on the apple tree leaves had made 29,1 % and on the fruit it was 24,6 %.

In the pre-mountainous zone of Berqadzor community at NKR (Republic of Artsakh) the development process of the apple tree scab had the same dynamics (Arakelyan&Avagyan, 2014).

Conclusion

The studies have indicated that the weather conditions in 2011 and 2013 at the pre-mountainous zone of the Artsakh Republic were more favorable for the scab development than those in 2012 and 2014. Besides, the disease was fixed in the first and second ten days of May in 2011 and 2013 and developed until the beginning of July. During the mentioned period both thermal and moisture factors were favorable for the scab development. In conditions of high temperature and relatively low humidity in July the disease development slowed down. In 2012 and 2014 the scab was fixed in the first ten days of June and further the disease developed with lower intensity. At the end of vegetation, despite the favorable climatic conditions for the disease development, the apple tree scab didn't develop rapidly due to the ontogenesis specialization (contaminates mostly young tissues) of the virus.

So, in conditions of pre-mountainous zone of the Artsakh Republic, May-June months are considered to be critical period for the development of the apple tree scab, which coincides with the end of the apple tree blossoming and with the start of its fruiting phase: during this period it is necessary to suppress the virus development by means of various fungicides.

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Biohumus Effect on Detoxification Rate of Some Pesticides in Tomato and Cucumber

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ARTICLE INFO

Keywords:
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ABSTRACT

The dynamics of detoxification of a number of pesticides in cucumber and tomato was studied. The preparations were mixed in the water solution of biohumus. In the control variant ordinary water served as the experimental fluid. Studies have shown that when the water solution of biohumus serves as a working fluid, the process of detoxification of cypermethrin and topaz is accelerated in tomato, and that of actellic in cucumber.

Introduction

In Armenia tomato and cucumber are among the most important vegetable components of the diet which are consumed raw, cooked or processed. Nevertheless, tomato and cucumber plants are susceptible to several pests and diseases that have been controlled through the application of pesticides. But the pesticides are highly toxic compounds, and they can have undesirable effects on human health if their amounts are exceeding the maximum residual level (MRL) (Carvalho, 2006; Ecobichon, et al, 1990; Jouany , 1993; Lozowicka, et al, 2015; Yaser, 2010).

Timely fruit harvesting is very important. Harvesting in protected ground is carried out if not every day, but at most every 2-3 days.

Our long- year research has shown that not always do the crops become safer 3 days after preparation introduction. Depending on the environmental conditions (temperature, humidity, ventilation, etc.) pesticide residues can be stored longer in some cases even exceeding the maximum residual level (Atshemyan, et al, 2017; Edvards, 1975; Edvards, 1994; Kah, Beulke, & Brown, 2007).

The goal of this work is to develop measures to accelerate the process of pesticide detoxification in protected crops.

In our opinion, plant stimulants can produce such effect. The priority was given to the biohumus water solution which is the cheapest and the most available among the stimulants.

Materials and methods

Studies have been conducted in conditions of protected ground (tomato), as well as in field conditions (cucumber) in the farms of Merdzavan village in Armavir marz of RA. In protected ground tomato plants were sprayed with combined solution of 0.05% cypermethrin and 0.07% topaz. Cucumber plants were sprayed with 0.2 % solution of actellic. Preparations were developed in the biohumus water solution. In the control variant ordinary water was used. Samples of tomato fruits were taken 1, 3 and 5 days after spraying. Sampling of cucumber was done 1, 3 and 8 days after the spraying.

The residual amounts of cypermethrin, topaz and actellic were determined by thin-layer chromatography (MUK N 2085-79, MUK N 2473-81). To determine the amount of pesticides inside the fruit, the tomato surface was carefully washed with wet cotton several times.

Preparation of biohumus water solution: 2 cups of biohumus were added to 10 liters of boiled and cooled-to- room- temperature water, well stirred and left for 24 hours. The brown liquid formed on the solvent surface was used as a working solution.

Results and discussions

The results are represented in curves and columns.

It is clear that in case of combined application of cypermethrin and topaz (Fg.1.) the most significant content of pesticides is decomposed during the first 3 days after spraying: cypermethrin –

61.1%-77.6 %, topaz – 62.8%-72.0%. Later on (five days after spraying), the rate of detoxification of preparations diminishes and their residues are still detected in all variants: cypermethrin – 0.08 mg/kg, topaz – 0.1 mg/kg -0.2 mg/kg.

Studies also reveal that cypermethrin and topaz have been detoxified faster in the fruits of biohumus (the lower curve) variant.

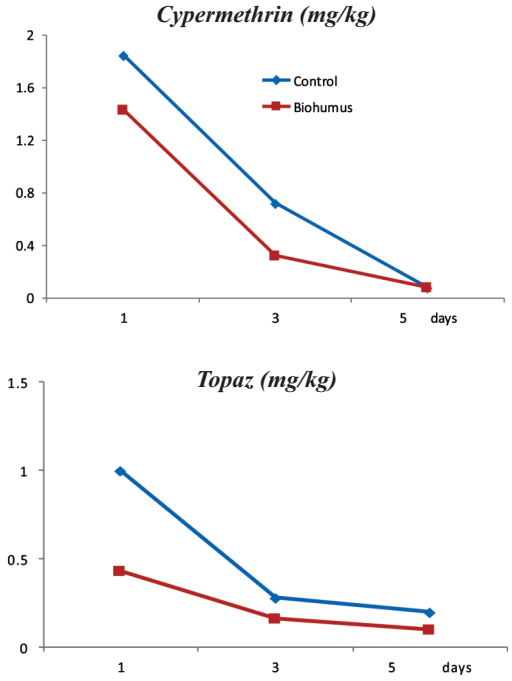

Figure 1: Dynamics of detoxification of cypermethrin and topaz in tomato fruit when using biohumus solution

Figure 2 depicts the residual amounts of cypermethrin on the surface of tomatoes and inside the fruit 1, 3 and 5 days after spraying.

It is clear that one day after the treatment, the level of insecticide in the tomato fruit of the biohumus variant is lower as compared to the control one: 0.95 mg/kg and 0.7 mg/kg respectively. Studies also reveal that the detoxification process inside the fruit is much faster in case of preparing the solution with biohumus. Thus, the amount of cypermethrin within 3 days after the application decreases by 80% inside the fruit of biohumus variant and only by 64.2% in case of water. 5 days after spraying, the residues of cypermethrin are still found only on the surface of the fruits both in the control (ordinary water) and biohumus variants.

As to topaz, a significant decline in the residual amount of the preparation on the tomato surface is observed when using biohumus, where the removal of toxicity is much more intensive in comparison with control (water solution) variant. Meanwhile, the amount of preparation decreases more intensively inside the tomato fruit. Thus, if 1 day after the application the residual amount of the topaz inside the fruits of the biohumus variant is just 8% less against the control one, it decreases by 33.3% within 3 days, and by 50% within 5 days.

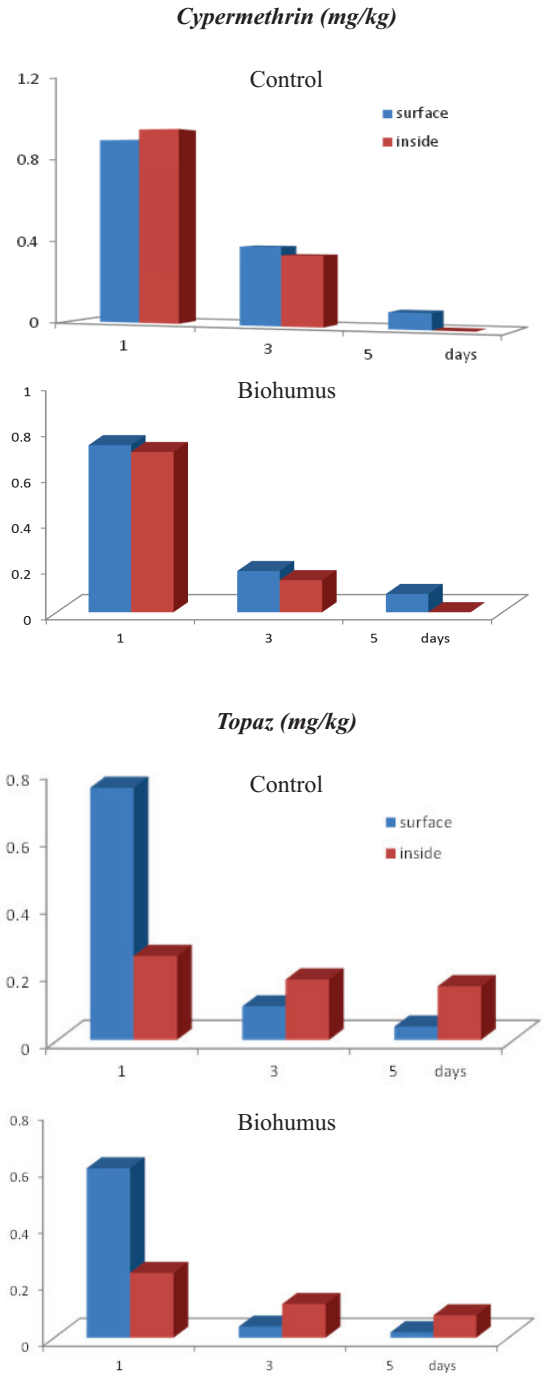

Figure 2: Residues of cypermethrin and topaz on surface and inside the fruit of tomato when using biohumus solution

However 5 days after the treatment, residual amount of topaz is still detected both on the surface and inside the fruit.

It should be noted that the waiting period is 3 days for protected tomato. The Codex MRL value for tomato is 0.1 mg/kg for cypermethrin and 0.2 mg/kg for topaz.

In none of the samples the cypermethrin residues are below the detection limit 3 days after application. However, it is only 0.22 mg/kg higher in biohumus variant, while it is more by 0.62 mg/kg

in case of water (Control).

As for topaz, the residual amount of fungicide found within the waiting period (3 days) is lower than the stated one (0.2 mg/kg) only in the biohumus variant.

Similar studies have been also carried out in the open ground. The detoxification rate of actellic offered for pest management of cucumber (greenhouse whiteflies, mites, aphids, thrips, etc.) has been studied.

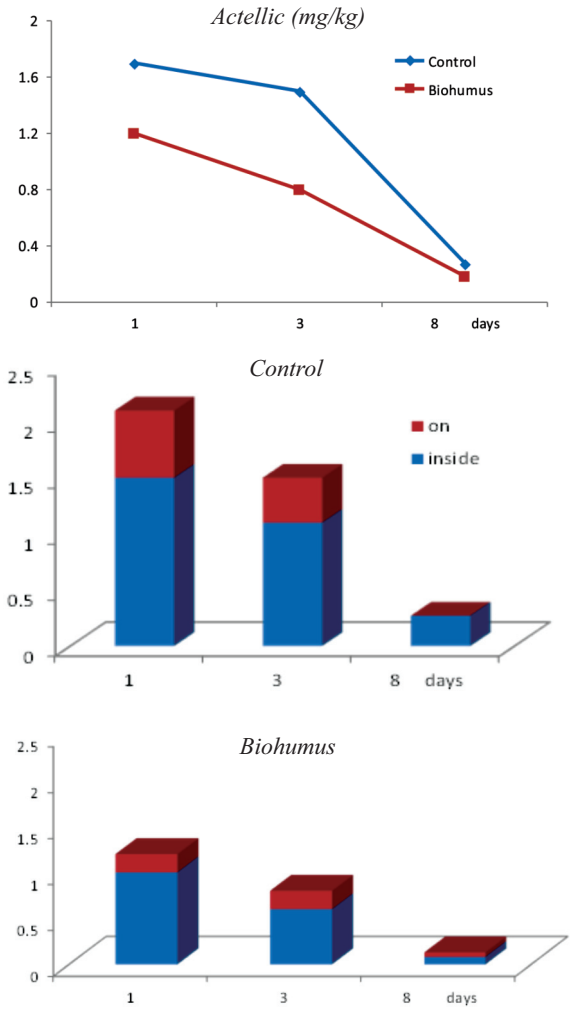

Figure 3: Dynamics of detoxification of actellic in cucumber fruit under the impact of biohumus solution

In the open ground the phenomenon of accelerated detoxification of pesticide under the impact of biohumus solution is more obvious (both inside the fruit and on the surface) (Fig. 3).

It should be noted that for the cucumber cultivated in the open ground there is a "waiting period" for actellic which makes 20 days. MRL value for cucumber is 0.2 mg/kg.

The remarkable thing here is that already 8 days after spraying the total amount of actellic detected in cucumber fruit of the biohumus variant is less by 0.02 mg/kg against the limit.

Conclusion

Thus, the results of our experiments can be summarized as follows:

1. When biohumus solution serves as an applied fluid, the detoxification process of cypermethrin and topaz is accelerated in tomatoes, and that of actellic in cucumber.
2. The "waiting period" for cucumber cultivated under the open ground is reduced by half as much when dilution of the preparation is carried out through biohumus water solution.

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Prohibited and Obsolete Pesticides in the Vorotan and Voghji Rivers in Armenia

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ARTICLE INFO

Keywords:
prohibited pesticides, surface waters, heptachlor, DDT, food safety strategy

ABSTRACT

In the current work the existence of chloral-organic pesticides - heptachlor and DDT - in waters of the rivers Vorotan and Voghji was disclosed through Gas Chromatographic method. It was identified that their concentration was higher than the accepted standards. Prohibited and obsolete pesticides remain beyond control in "burials" that is common in many regions of Armenia. Surveys show that some of these pesticides are also common among population. It is recommended to collect these quantities and keep them under control until the storage facility is completed.

Introduction

The problem of prohibited and obsolete pesticides remains unresolved in the Transcaucasian region and in Armenia (Avagyan, 2016). As persistent organic pollutants (POP) these chemicals aren't decomposed or get slowly decomposed under natural conditions. Being easily volatile and resistant to photolysis, to biological and chemical destruction, their trace amounts easily spread over long distances and are continuously in a wide circulation polluting the air, water, soil, feed and agricultural products.

They are accumulated in biological tissues, appear in the food chain and cause damage to the environment and human health (Guideline P2.1.10.1920-04, 2004, Vashenko, 2005, Rostami et al., 2011). As a result of pesticides' impact on humanity oncological diseases, allergies and hypersensitivity, damage to the central and peripheral nervous systems, reproductive disorders and destruction of the immune system of several human generations, as well as irregularities in the growth and formation of children occur.

The 2001 Stockholm Convention on Persistent Organic Pollutants aims to protect public health and the environment from exposure to POPs. The following 12 POPs were originally targeted: pesticides: aldrin, dieldrin, chlordane, heptachlor, DDT, endrin, hexachlorobenzene (HCB), mirex, toxaphene; industrial chemicals: polychlorinated biphenyls (PCBs); by-products: dioxins and furans. After 1970, the production and use of DDT, hexachlorocyclohexane and other organochlorine pesticides was banned in a number of countries, including Armenia (Sargsyan, et al. 2006).

In 1982 in the landslide zone near the Yerevan deep fault and the Jrvezh active fault, a cemetery with 110 m length and 10m–15 m width was built without the necessary preparation of the cemetery base and without a surface water drainage system (formed during precipitation and snowmelt). About 600 tons of pesticides in 60 items were buried here. As a result of landslide processes and the leaching of pesticides and their derivatives with surface waters, as well as unattended treatment and plundering by the local population, currently there are about 150 tons of toxic chemicals and derivatives resulted from their decomposition.

Nowadays, there are abandoned repositories of expired pesticides in different parts of the republic (Dvorská, et al., 2012). An informal survey among the population from different areas revealed that there are certain stocks of banned and expired Soviet-made pesticides in different localities. Literary data testify about the presence of pesticides both in surface waters and in the soils of traditional agricultural regions of Armenia (Beglaryan et al., 2016).

Pesticides penetrate into the surface waters mainly as a result of their leaching from the soil and their application in agriculture, and some of them appear as a result of chemical decomposition of the pesticides introduced into the soil. Such situation is dangerous, and the risks of environmental pollution and damage to human health are high.

The issue of recording and controlling the use and storage of pesticides in the territory of Armenia still remains particularly important; there is lack of information on the type and amount of pesticides actually used in the republic and in the literature there are only stale and brief data. The probability that prohibited and expired toxic chemicals may be used in agriculture is large. The state government does not conduct systematic research and monitoring on their presence in the air, soil, water, nor has it worked out a food safety strategy related to contamination with prohibited and expired pesticides for both imported goods and agricultural products produced in the country.

Materials and methods

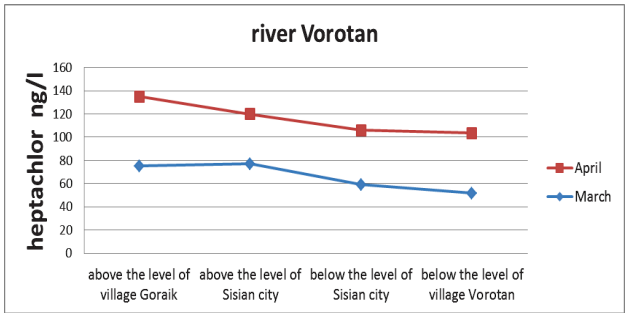
The objective of this work was to identify and quantify organochlorine pesticides- heptachlor and DDT- in the waters of Vorotan and Voghji rivers in 2017.

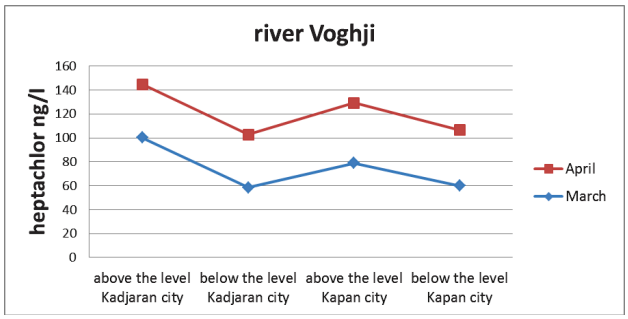
Sampling, preservation, extraction and concentration of organochlorine pesticides were carried out according to standard methods (Cesceri et al., 1998). Identification and quantification was performed using gas-liquid chromatography on a Varian CP-3800, capillary column VF-5ms, l = 30m, d = 0.25 mm, electron capture detector (Cesceri, 1998, Drugov, et al., 2006).

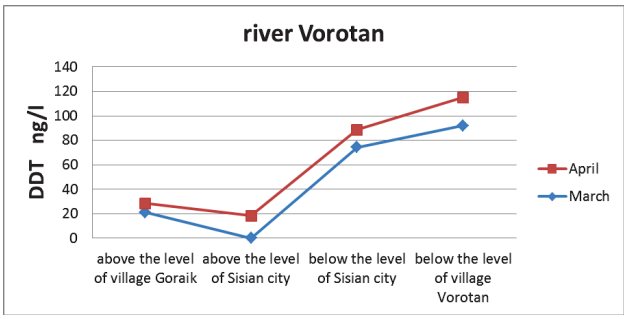
The MPC of pesticides in surface waters is 10 ng /l.

Results and discussions

Figures below show the data on the availability of heptachlor and DDT in Vorotan and Voghji rivers for 2017.







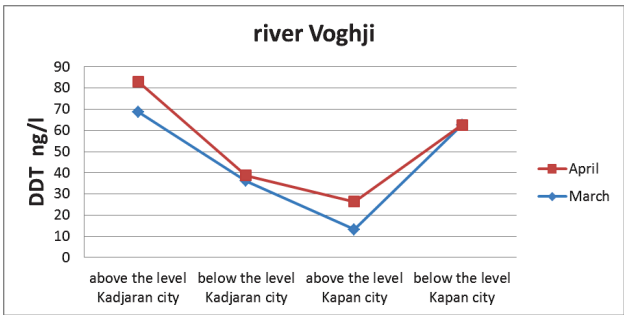


Fig. Organochlorine pesticides in the waters of Vorotan and Voghji rivers (water sampling points are given on the abscissa. Maximum permissible concentrations of pesticides in surface waters are 10 ng / l) in 2017.

Based on the data obtained in the waters of Vorotan and Voghji rivers, we can state that the concentrations of heptachlor and DDT exceed the MPCs during the snow and long rain season. It can be assumed that this is the result of leaching of pesticides from the soil.

Conclusion

Previous studies testified on the presence of a number of organochlorine pesticides in the waters of Hrazdan and Kasakh-Sevdzhur rivers, the level of heptachlor in Hrazdan and Kasakh-Sevdzhur rivers was higher even 40-60 times than the MPCs, (Avagyan, 2010).

Our data on the availability of pesticides heptachlor and DDT in the waters of Vorotan and Voghji rivers indicate that organochlorine pesticides are widely spread in the surface waters of Armenia with quantities exceeding MPC. Similar problems have also been identified in the territory of CIS (Mamontov et al., 1998, Gravel, 2003).

The current situation requires implementation of a number of activities, the priority of which is obvious. Here are some identified ones:

- To prevent further ingress of pesticides into the soil and into surface water from abandoned storage facilities, and in order to avoid their use in the farm, it is necessary to urgently collect stocks of pesticides from both the population and from abandoned storage facilities.
- To design and arrange temporary storage of collected pesticides before the storage for expired chemicals is finally constructed.

- To apply emergency strategy to eliminate the consequences of pesticides from abandoned cemeteries throughout all regions in Armenia.
- The state is obliged to immediately organize and conduct systematic research, objective and reliable monitoring on the presence of organochlorine pesticides, as persistent organic pollutants in the air, soil and water.
- To create a system of accounting and control over the importation, use and storage of pesticides in Armenia.

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Chemical Evaluation of Fruit Pulp in the Introduced Varieties and Palynological Studies of Malus Domestica Borkh in the Republic of Armenia

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ARTICLE INFO

Keywords:
apple,
variety,
chemistry,
analysis,
palynology

ABSTRACT

The results of chemical analysis of the seven foreign varieties of Malus domestica against those of two standard ones have indicated that Idared and then Melrose, Goldspur, Maxspur and Starkrimson varieties are relevant for regionalization in the Republic of Armenia.

The data of palynological investigations of Malus domestica varieties will serve as a good basis for further research, in particular, for determination of the origin of domestic apple and the participation of various wild varieties of the genus Malus Mill. in the establishment of this genesis.

Introduction

New apple varieties were imported into the Armenian Soviet Socialist Republic in 1976-1979 from Yugoslavia, and then they were planted in the villages of Karpi, Ohanavan, Mayakovsky and some other farms of the Aragatsotn marz and adapted afterwards. However, their distinct and detailed scientific assessment, including quarantine, has never been carried out. Some experiments on their sorting were carried out by the workers (Harutyunyan A. S., Arakelyan A.O., Apoyan L.A., Snapyan G.G., Oganesyan G.G., Vardanyan Z.B., Harutyunyan A. C.) of the Viticulture, Wine-making and Fruit-growing Scientific Research Institute.

Materials and methods

Three-year (2015-2017) chemical evaluation of the pulp of seven foreign perspective spur and dwarf varieties/cultivars (Agulyan et al.,1983, Brown, 1981, Chandler, 1960, Decourtis et al., 1971, Polikarpov et al., 1983, Stepanyan et al., 2002), was implemented against the background of the two standard varieties selected as control ones: Renette Simirenko (Ukraine) and Golden Delicious (USA) varieties of M. domestica Borkh species (Fedorov, 1958) (also known as orchard apple, or table apple) (Table 1). The yield was collected during the crops industrial maturity in the individual farms of the village Merdzavan at Armavir marz, RA. The experiments were carried out using standard biochemistry techniques (Ermakov, 1987) and mathematical analysis (Dospekhov, 1985). For comparison, data from similar experiments from literature sources are introduced (Galasheva et al., 2007, Pavel, 2007).

The study of pollen morphology of the species Malus domestica was also carried out through light (PZO, Warszawa) and scanning electron microscope (Jeol, JSM-6390). The description of pollen grains (on the level of light microscope) is based on acetylated material (Avetisyan, 1950), and also on grains stained with basic fuschsine (Smolyaninova et al, 1950). For scanning electron microscope (SEM), dry non-acetylated pollen grains were placed in a drop of alcohol, then sputter-coated with gold.

Long-term practice shows that the uncontrolled weather affects the availability of the crop and as a result of the decrease in the overall air temperature during the autumn-winter-spring period the yield is sometimes destroyed altogether. But the control on irrigation, fertilization, pruning, pests and diseases can be completely regulated. Besides, long-term experiments have revealed the following characteristics:

1) High content of dry substances, total sugar, sucrose and sugar acid index, as well as low acidity improves the taste of fruits in different breeds of fruit crops
2) The value of the acidity index is not related to the acidic taste of the fruit, since it directly depends on the number of free hydrogen ions - pH (Chandler, 1960).

Results and discussions

Some literature data on the spur and some other famous varieties are presented for comparison, and also their general characteristics are introduced in Table 1.

Table 1: General data on the varieties from literature sources

Variety	Country	Date	Fruit (weight, color)	Harvest	Expiration date	Tree size	Other
Renette	Ukraine	1880	185g, green	20.09-15.10 300 kg/tree	until May	medium tall	infected with scab
Golden Delicious	USA	1914	150g, yellow	20.09.-10.10, -	-“-	-“-	infected with powdery mildew
Starkrimson	-“-	1952	165g, dark red	01-30.10, 75 kg/tree	until March	short growing	-
Idared	-“-	1942	150g, green-yellow-red	01-30.09, 60 kg/tree	until April	medium tall	infected with powdery mildew, non- frost-resistant
Gloster	Germany	1969	160g, bright crimson	20-30.09, 55 kg/tree	until March	tall	infected with scab
Melrose	USA	1944	190g, red-yellow	20.09-10.10, 82 kg/tree	-“-	-“-	-
Goldspur	-“-	1950-1960	115g, green, (rounded-conical)	01-30.11, 145 kg/tree	until April	short growing	infected with scab
Yellowspur	-“-	-“-	171g, green-yellow-red	20.09-10.10, 22,1 kg/tree	until May	medium tall	Non- frost-resistant
Maxspur	-“-	-“-	170g, (pitcher-like)	01-30.09, -	-“-	-	-
Morspur	-“-	-“-	100g, green-yellow	-	-	-	fruits are shallow
Starspur	-“-	-“-	-	-	-	-	-
Wellspur	-“-	-“-	-	-	-	-	-
Melba	Canada	1898	120g, yellow-red	20.07-10.08, 100,0 kg/tree	until November	medium tall	infected with scab
Papirovka	Latvia	1880	90g, yellow-white, (elliptical)	01-20.08, 75 kg/tree	-	medium tall	-

Table 2 involves the main data we have obtained along with three-year data on seven standard chemical parameters. We have also introduced average total data for the three-year period. The date of the analysis practically coincided with the date of the industrial harvest, (namely 3-5 days before the biological ripening of the fruit), which affects the quality of the fruits when they are collected, packaged, sorted, transported and stored.

Table 2: Results of the chemical analysis of fruit pulp of introduced apple varieties for three years (2015-2017 (K-control)

N	Foreign apple varieties	Date of analysis	Dry substances	Sugars			Titrate acids	Sugar-acid index
				common	invert	sucrose		
			(%)					
1-1		25.10.15	14.9	10.58	7.81	2.77	0.52	20.3
2-2	1. Simirenko-K1 (Ukraine)	28.10.16	14.0	9.91	8.03	1.88	0.56	17.5
3-3		24.10.17	14.5	10.90	8.30	2.60	0.50	21.8
4-4	On average over 3 years	26.10	14.5	10.46	8.05	2.42	0.53	19.9
5-1		19.10.15	15.9	12.68	9.80	2.88	0.33	36.7
6-2	2.Golden Delicious – K2 (USA)	20.10.16	16.4	12.78	9.91	2.87	0.38	33.6
7-3		12.10.17	17.1	12.88	10.02	2.86	0.37	34.8
8-4	On average over 3 years	17.10	16.5	12.78	9.91	2.87	0.36	35.0
9-1		08.10.15	15.0	11.12	9.23	1.87	0.58	19.2
10-2	3.Goldspur (USA)	06.10.16	15.8	11.33	9.38	1.95	0.56	20.2
11-3		28.09.17	16.6	12.43	9.69	2.74	0.52	23.9
12-4	On average over 3 years	04.10	15.8	11.63	9.43	2.19	0.53	21.1
13-1		19.10.15	13.5	9.30	7.28	2.02	0.37	25.1
14-2	4.Yellowspur (USA)	15.10.16	14.3	9.48	7.29	2.20	0.39	23.7
15-3		05.10.17	15.2	9.70	7.48	2.22	0.40	24.2
16-4	On average over 3 years	13.10	14.3	9.49	7.35	2.15	0.38	24.3
17-1		25.10.15	14.2	10.02	7.59	2.43	0.45	22.3
18-2	5.Maxspur (USA)	26.10.16	12.6	9.69	7.28	2.40	0.44	21.5
19-3		24.10.17	13.9	9.91	7.48	2.41	0.42	23.5
20-4	On average over 3 years	25.10	13.6	9.87	7.45	2.41	0.44	22.4
21-1		08.10.15	14.1	10.48	9.30	1.18	0.20	52.4
22-2	6.Starkrimson (USA)	06.10.16	15.0	10.90	9.58	1.32	0.26	41.9
23-3		28.09.17	16.1	11.51	9.91	1.59	0.29	39.6
24-4	On average over 3 years	04.10	15.1	10.96	9.60	1.36	0.25	44.6
25-1		13.10.15	15.4	11.49	8.38	3.12	0.91	11.7
26-2	7. Idared (USA)	15.10.16	15.7	11.23	8.13	3.09	0.88	12.7
27-3		05.10.17	16.3	11.58	8.48	3.11	0.85	13.6
28-4	On average over 3 years	11.10	15.8	11.43	8.33	3.11	0.88	12.7
29-1		19.10.15	16.1	11.50	9.30	2.20	0.58	19.8
30-2	8.Gloster (Germany)	20.10.16	17.0	12.79	9.69	3.10	0.55	23.2
31-3		12.10.17	18.4	12.99	9.80	3.19	0.53	24.5
32-4	On average over 3 years	17.10	17.2	12.43	9.60	2.83	0.55	22.5
33-1		13.10.15	14.7	11.20	7.81	3.39	0.56	20.0
34-2	9.Melrose (USA)	06.10.16	14.9	11.04	7.92	3.08	0.53	20.7
35-3		05.10.17	15.5	11.23	8.03	3.20	0.48	23.3
36-4	On average over 3 years	08.10	15.0	11.16	7.92	3.22	0.52	21.3
37	On average for 7 varieties (3-9)	11.10	15.3	11.00	8.53	2.47	0.51	24.1
38	On average for 9 grades (1-9)	16.10	15.4	11.14	8.83	2.51	0.47	26.3

According to the data of Table 2 the index of dry substances in Gloster makes 18.4%, which exceeds the maximum index (17.1%) of the standard Golden Delicious throughout the same year. According to the index of total sugar content (12.99%) Gloster again exceeds the Golden Delicious (12.88%) which is hardly surprising since the variety Gloster has an extremely sweet fruit pulp not pleasant to everyone, while at the same time fruit pulp of Golden Delicious and other varieties have a specific pleasant and sour flavor.

Sucrose sugar content (3.39%) of the Melrose variety in 2015 exceeded that of the Golden Delicious (2.88%) for the same year.

It should be noted that the Melrose variety slightly differs from the standard apple varieties by general taste qualities and the complex of pulp chemical indices as well as by maintaining the quality and external fruit parameters thus it can be widely used throughout Armenia.

As to the titrated acids Idared had an index of 0.91% for 2015 which exceeded the standard Renette (0.56%) in 2016. and this also gives us the right to recommend it for wide regionalization from the perspective of a number of advantages.

Table 3: Results of chemical analyzes of a number of apple varieties according to literature data (Galasheva et al., 2007, Pavel, 2007)

N	Varieties	Dry substances	Soluble dry substances	Titrate acids	Sugar sum	Sugar-Acid	Ascorbic acid (vitamin C)	Vitamin P- substances	
								cate-china	leuco-antociana
		%					мg/100g		
1	Renette	-	-	0.4- 0.7	7.5-12.0	10.0-16.0	7.0-9.0	97	110
2	Starkrimson	14.8	-	0.22	9.0-11.2	-	4.0-6.1	145	-
3	Papirovka	13.7	11.7	0.74	10.4	14.1	10.6	100.6	171.2
4	Melba	13.8	10.4	0.72	8.8	12.2	6.0	-	-
5	Melba (Pavel)	14.2	10.7	0.64	9.08	14.2	7.8	439.7-	13.9
6	Yellow spur	16.6	-	-	12.8	-	6.6	100.0	0.13
7	Gloster	oils-0.4g	albumens-0.4g	calorie content - 47kkal	9.8g	tast-4.45points	Sum of active air temperature. 2650°	-	-

The data of Table 1 (Agulyan et al., 1983, Stepanyan et al., 2002) and table 3 (Galasheva et al., 2007, Pavel, 2007) have supplementary significance and help to understand the high regionalization and expansion opportunities of the mentioned varieties throughout the farms of the Republic of Armenia. Unfortunately, existing scientific data are non-identical, since no single and generally accepted scheme for presenting chemical and all other data on varieties has been developed yet.

The above mentioned numerical data were subjected to mathematical processing by the method of variance analysis. The calculations were carried out according to the following content parameters in the flesh pulp: dry substances, sucrose, invert sugars and total sugars. We also studied the differences between the main average parameters and their difference from the respective indices of the two control varieties.

Pollen Morphology

Pollen of the Malus domestica Borkh species is zonocolp-porate, oblate-spheroidal or almost spheroidal in shape, in polar view the outline is rounded-3(4)-angular; polar axis is 22.3 μm -25.0 μm, equatorial diameter is 26.5 μm -29.0 μm. The colpi are of medium length, with rounded ends, colpus membrane is plicate; apocolpium diameter is 5.7μm -7.2 μm, mesocolpium width-21.1 μm -23.0 μm. Pores are circular, submerged, 6.3 μm -7.2 μm in diameter. Exine thickness is 1.2μm -1.3 μm, slightly raised to the pores, columellae are straight, thin. Exine ornamentation is granulate-finely striate (LM); exine ornamentation is perforate-finely plicate or perforate-finely striate, perforations vary in size; on the surface of the pollen grains irregular granules and small verrucae are also noted (SEM).

Conclusions

Based on the obtained results of the mathematical analysis, it can be concluded that the index of dry substances of the Golden Delicious, Goldspur, Idared and Gloster varieties exceed that of the variety of Simirenko (group 1) . As to the other indicators, the difference was not significant (group 2), (S_{x0}% = 2.1% / LSD_{05} = 0.95).

The total sugar contents of the varieties Maxspur, Starkrimson and Simirenko were very close to each other, and the differences were insignificant (group 2). At the same time, the indicators of the Yellow spur variety were significantly inferior to those of the standard varieties (group 3) ($S_{X0}\% = 1.9\% / LSD_{05} = 0.63$).

If the Golden Delicious variety is accepted as a control one, it is mostly a precursor, and the calculated differences are much lower than LSD_{05} or insignificant (groups 3 and 2).

The above noted statement is also applicable to calculations of parameters of invert sugars ($S_{X0}\% = 0.93\% / LSD_{05} = 0.24$) and sucrose ($S_{X0}\% = 6.7\% / LSD_{05} = 0.50$).

The results of chemical analysis showed that among the seven foreign varieties of Malus domestica growing in Armenia, first of all, Idared and then Melrose, Goldspur, Maxspur and Starkrimson are relevant for regionalization.

The comprehensive palynological studies of these varieties will serve as a good basis for further investigations and, in particular, for those aimed at the determination of the origin of the Malus domestica and the participation rate of various wild apple species in this process.

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Aftereffect of Fertilizers and Ameliorants on the Reclamation of Some Agro-Physical and Agro-Chemical Indicators in Soil

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ABSTRACT

The forest brown soils of the Artsakh Republic are often distinguished by the less favorable agro-physical and agro-chemical properties, including low fertility. It is possible to reclaim these soils by means of appropriate fertilizers.

According to our observations the processed dacite tuff (PDT) is among these fertilizers, which is fabricated out of the potassium-rich dacite tuffs through thermo-chemical method.

According to the experimental data, in case of applying PDT or "MM" bio-fertilizer in $N_{90}P_{90}K_{90}$fertilization system the soil water absorption capacity has increased by 5.7%-15.5 %, water permeability by 16.2%-20.6 % and the absorption capacity for NH_4^+- ion by 14.9%-16.3 % as compared to the same properties of $N_{90}P_{90}K_{90}$(KCI) variant.

In case of applying processed dacite tuff or "MM" bio-fertilizer on its background, the content of mobile nitrogen has increased by 65.4%-96.1 % against the control variant and by 38.7%-64.5 % against the $N_{90}P_{90}K_{90}$(KCI) variant. This difference for the mobile phosphorus has made 126.9%-161.5% and 90.3%-119.3 %, for the potassium-49.5%-62.8 %. The use of gypsum hasn't influenced the abovementioned indicators.

Due to the aftereffect in the fertilization variants of $N_{90}P_{90}K_{90}$(PDT) and $N_{90}P_{90}K_{90}$(PDT)+MM the yield surplus has made 37.4%-43.6 % against the control variant and 17.1%-24.3 % against the $N_{90}P_{90}K_{90}$(KCI) variant. The use of gypsum hasn't provided any yield surplus.

Introduction

Application of fertilizers is an indispensable measure (Gulyan, Adamyan, Melkumyan, 2011, Mineev, 2004) for the increase of soil fertility and crops yield capacity. It is related not only to the lack of the plants available nutrients in the soil but also to the reclamation need for some soil agro-physical and agro-chemical properties (Hakobyan, 2010, Atlas of soils of the RA, 1990, Vadyunina, Korchagina, 1986). Some fertilizers are also endowed with considerably high aftereffect, which is particularly characteristic to the organic fertilizers, since their organic substances promote the reclamation of soil properties. Moreover, their effect lasts more than 3-4 years. Thus, such fertilizers can be used in one and the same place once in 3-4 years (Mineev, 2004, Myazin, Lutsenko, 2002).

The forest brown soils of the Artsakh Republic are often distinguished by the less favorable agro-physical and agro-chemical properties, including insufficient water permeability, low water absorption and retention capacities, the property of solidification and encrustation when dried out, as well as by low fertility rate. In such soil conditions the plants suffer from water and nutrients shortage during the vegetation period (Gulyan, Adamyan, Melkumyan, 2011, Hakobyan, 2010, Vadyunina, Korchagina, 1986).

It is very vital that due to the fertilizer's aftereffect its nutrients become available gradually. In this respect the processed dacite tuff (PDT) stands apart, which is endowed with the above mentioned properties, due to which it becomes possible to reduce the application of phosphorus and potassium containing

fertilizers. Possessing a positive side effect PDT partially increases the plants drought-hardiness and mitigates the nitrogen loss (Yeritsyan, Farsiyan, 2016, Loboda, 2009).

Materials and methods

The aim of this work is to study the effect and aftereffect of the fertilizers on the soil properties, as well as on the growth and yield capacity of potato and winter wheat, since it is known that the use of these fertilizers and ameliorants is very important for the improvement of the above mentioned properties.

The field studies and fertilization experiments have been carried out in the arable forest brown soils of the Askeran district at NKR.

Based on the soil map of the republic, land areas were selected on the basis of field surveys, 6 soil segments were dug out, described, then soil samples were taken from the genetic horizons and their agro-physical and agro-chemical properties were examined (Atlas of soils of the RA, Yerevan, 1990, Vadyunina, Korchagina, 1986) .

Results and discussions

The results of the soil samples' analyses testify that the land areas significantly differ from each other by their agro-physical and agro-chemical properties. There is also a difference between the various depths (table 1,2) of the same segment. The soil specific and volumetric (dimensional) weights are relatively lower in segment 1 and then in those of 3 and 5. Besides, this regularity is also observed in the top soil and partially in sub-soil layers. We think that this is related to the high humus content in the soil and its mechanical composition. While in the 2nd, 4th and 6th segments of the soil its specific and volumetric weights are relatively higher, which is more vivid in the sub-soil layers. According to our observations this is accounted for the relatively lower humus content in the soil, mechanical composition and the same plowing depth for many years as a result of which a solid layer appears in the sub-soil layer.

Based on the "marginal numbers" stated for the soils specific and volumetric weights the 2nd, 4th and 6th segments of the soil are considered to be strongly solidified, thus less favorable for the plants growth and yield capacity, so they need to be reclaimed (Vadyunina, Korchagina, 1986).

The data on the soils porosity and water permeability show that the porosity in the segments 1, 2, 3 and 5 is equal or exceeds 50 %, thus they are favorable for the plants growth. The data of the same table testify that the water permeability in the segments 1 and 3 is assessed as "good", while those of the segments 2, 4, 5 and 6- as "satisfactory". Thus, the property of water permeability in those soil segments needs to be reclaimed, which is possible to implement through the use of organic fertilizers and ameliorants. As to the soils water retention capacity (moisture capacity), it turns out that there is a slight difference between the individual soil samples.

Table 1 The agro-physical properties of the experimental plots

The soil segment and the experimental number	Sample taking depth, cm	Specific weight, g/cm^3	Volumetric weight, g/cm^3	Porosity %	Water permeability mm/hour	Water retention capacity, %	Hygroscopic moisture, %
Segment №1 Experiment № 1	0-19	2.31	1.05	54.6	75	32.6	7.7
	19-44	2.46	1.27	48.4	58	26.8,	7.1
Segment №2 Experiment № 2	0-22	2.42	1.21	50.0	66	31.0	7.2
	22-49	2.48	1.35	45.6	58	27.8	7.5
Segment №3	0-17	2.29	1.08	52.8	80	31.9	6.3
	17-38	2,41	1,20	50,4	62	31,2	5,1
Segment №4	0-24	2.38	1.29	45.8	63	31.3	4.8
	24-37	2.37	1.51	36.3	57	29.0	4.0
Segment №5	0-29	2.31	1.03	55.4	69	35.4	7.9
	29-49	2.35	1.09	53.6	69	34.7	7.1
Segment №6	0-21	2.51	1.28	49.0	61	30.3	5.4
	21-49	2.72	1.51	44.5	45	23.5	6.3

The data on the agro-chemical characteristics (table 2) of the experimental plots testify that the selected land areas considerably differ from each other by the mentioned indicators, which is particularly true for the content of mobile nutrients. This is, probably, related to the terms of soil formation and to the human agricultural activities. In this regard it should be mentioned that as a result of ongoing cultivation (irrigation, fertilization, crop rotation) of the RA semi-desert brown soils, they have been turned into irrigated meadow brown soils, which are endowed with much higher fertility and yield capacity (Atlas of soils of the RA, 1990).

Table 2 The agro-chemical properties of the experimental plots (at the start of the experiment)

Sample taking place, experiment	Sample taking depth, cm	Humus, %	pH in the water extract	Water – soluble salts content,%	Carbonates, ($CaCO_3$), %	The absorbed $Ca^{2+}+Mg^{2+}$ mg/eq in100g soil	Physical clay, %	Available nutrients mg in 100g soil		
								N	P_2O_5	K_2O
Experiment № 1	0-19	4.29	7.1	0.116	3.60	34.8	58.9	4.5	3.80	55.10
Segment № 1	19-44	3.71	7.3	0.091	4.70	31.6	56.6	3.6	3.10	48.60
Experiment №2	0-22	3.18	6.86	0.108	0.12	29.6	61.2	4.57	0.78	45.55
Segment 2	22-49	2.06	6.95	0.081	1.21	27.1	60.4	2.81	0.49	39.50
Segment №3	0-17	4.18	7.0	0.078	2.14	38.9	49.39	2.91	2.70	48.61
	17-38	3.19	7.1	0.047	4.07	31.6	47.24	1.75	1.65	35.62
Segment №4	0-24	3.12	7.3	0.055	4.06	31.5	59.66	2.13	0.92	38.25
	24-37	0.78	7.4	0.036	5.95	27.4	65.22	1.36	0.43	35.41
Segment №5	0-29	5.12	6.9	0.094	1.52	40.8	49.88	4.18	4.36	62.15
	29-46	3.44	7.2	0.042	1.68	38.5	44.99	4.03	3.29	47.83
Segment №6	0-21	3.06	7.1	0.041	4.84	28.4	73.07	2.15	0.81	34.17
	21-49	1.46	7.4	0.037	6.93	23.6	67.85	1.37	0.39	33.58

The land areas are poorly provided with the available nitrogen content everywhere. The 2nd, 3rd, 4th and 6th segments of the soil areas are poorly provided with phosphorus and only the 1st and 5th soil segments are averagely provided with it (table 2). The plants available potassium content is compatible with the standard one except for the 6th segment soil which is averagely provided with potassium.

Taking into account the vitality of the effect and aftereffect of the fertilizers and ameliorants' application on the reclamation of the soil agro-physical and agro-chemical properties we have studies their impact on the changes of the mentioned properties (table 3). The data of the table show that the use of the gypsum or bentonite on the background of the main mineral fertilizers (NPK) has had an insignificant aftereffect on the soil agro-physical or agro-chemical properties, while it is remarkable, when in the fertilization system PDT or "MM" bio-fertilizer has been used. "MM" bio-fertilizer was produced in the RA institute of bio-chemistry upon the supervision of H. Sargsyan. It contains strains of 8-10 microorganisms. There are about 9-10 billion bacteria in 1 g fertilizer. It is used by soaking the seeds before their sowing watering the soil through top/foliar nutrition.

So, in the potato fertilization variants-($N_{90}P_{90}K_{90}$(KCI), $N_{90}P_{90}K_{90}$(KCI))+bentonite, $N_{90}P_{90}K_{90}$(KCI)+gypsum) - the pH fluctuated within the range of 7.10%-7.20 %, the content of soluble salts was 0.076%-0.101 %, water absorption capacity was 31.7%-35.7%, water permeability was 68-71 mm/hour, the absorption capacity due to the NH_4 was 28.9 mg/eq - 30.0 mg/eq in 100 grams soil. The data of those indicators are rather close to those of the variant without fertilization. Nevertheless, when the potassium chloride was displaced by PDT in the $N_{90}P_{90}K_{90}$ system, or the "MM" bio-fertilizer was applied the above mentioned indicators grew up, evidencing the reclamation of some soil properties.

The aftereffect of the fertilizers' application is more vivid upon the content of the available nutrients in the soil. So, the available amounts of nitrogen, phosphorus and potassium are lower in the control (non-fertilized) variants which are followed by the 2nd control variant, as well as by the 4th and 5th variants. While when the potassium chloride was displaced by PDT or the "MM" bio-fertilizer was introduced, out of the mobile nutrients the nitrogen content increased by 65.4%-96.1 % against the control variant and by 38.7%-64.5% against the variant of $N_{90}P_{90}K_{90}$(KCI). The mentioned difference for the phosphorus makes 126.9%-161.5% and 90.3-119.3%, for the potassium it is 49.5%-62.8% and 31.6%-43.3 % respectively. We think that the increase of the available phosphorus and potassium amounts in the soil is particularly related to the positive side effect of PDT, which promotes the gradual increase of the mentioned elements in the soil, which is also proved for other silicon containing fertilizers (Ammosova, et al, 1990, Baranov, 2006, Gladkova, 1982, Yeleshev, et al, 1990).

As to the changes of the soil properties in the industrial sowings (segment 3, 4, 5, 6), it turns out that the content of their available nutrients has decreased throughout time, which is probably related to the unifold /single/ fertilization (only nitrogen) system (tables 2, 3).

The aftereffect of the fertilizers is vivid on the growth and yield capacity of the winter wheat (table 4). According to the table data the size of the aftereffect depends on the fertilization system. It has lower indices in the fertilization system where as a potash fertilizer potassium chloride and then on this background bentonite or gypsum has been used. In the mentioned variants the plants height,

grain yield, weight of thousand grains, as well as the content of NPK are lower. Anyhow, the highest yield has been received when the processed dacite tuff (PDT) or "MM" bio-humus on its background or $N_{90}P_{90}K_{90}$(KCI) with manure has been used. In the mentioned variants the plant growth has improved as well: the weight of 1000 grains and the content of nitrogen, phosphorus and potassium have increased.

Table 3 The aftereffect of fertilizers and ameliorants on some indicators of the soil agro-physical and agro-chemical properties in the layers of 0cm-20 cm depth

Variants		pH	Soluble salts, %	Water absorption capacity, %	Water permeability, mm/hour	(NH4) absorption capacity, mg/eq in100 gram soil	Available nutrients, mg, in 100 gram soil		
							N	P_2O_5	K_2O
Before fertilization of the main crop		6.91	0.101	31.2	66	29.3	3.8	0.51	43.4
1.	Without fertilization (control 1)	6.97	0.078	31.0	65	29.5	2.6	0.26	38.4
2.	N_{90} P_{90} K_{90} (KCl) (control 2)	7.14	0.081	31.7	68	28.9	3.1	0.31	43.6
3.	N_{90} P_{90} K_{90} (PDT) 600 kg/ha	7.18	0.121	33.5	79	33.6	4.3	0.59	57.4
4.	$N_{90}P_{90}K_{90}$(KCl) + bentonite 300kg/ha	7.20	0.101	35.1	71	30.0	3.6	0.47	43.0
5.	$N_{90}P_{90}K_{90}$(KCl) + gypsum 300 kg/ha	7.10	0.076	31.9	71	27.8	3.5	0.40	43.2
6.	$N_{90}P_{90}K_{90}$ (PDT) 600kg/ha +MM	7.01	0.119	36.6	82	33.2	5.1	0.68	62.5
Segment №3		7.0	0.056	34.6	75.	25.4	1.81	2.06	44.32
		7.2	0.038	28.5	61	21.6	1.13	0.79	33.64
Segment №4		7.2	0.041	29.3	55	28.3	0.86	0.42	37.13
		7.4	0.029	21.6	49	29.5	0.28	0.35	31.15
Segment №5		7.0	0.096	34.4	72	25.7	4.52	4.48	65.71
		7.2	0.057	34.2	70	21.2	4.50	3.08	62.24
Segment №6		7.0	0.035	27.6	51	30.4	0.98	0.36	34.08
		7.5	0.031	24.1	40	24.3	0.43	0.17	30.39

Table 4 The aftereffect of fertilizers and ameliorants on the growth and yield capacity of the winter wheat (average data for 3 years)

№	Variants	Plants height, cm	Grain yield, c/ha	Yield surplus, c/ha	Grain weight, g	Content in a grain, %		
						N	P_2O_5	K_2O
1.	Without fertilization (control-1)	72	25.9	-	43.3	1.78	0.69	0.53
2.	$N_{90}P_{90}K_{90}$ (control-2)	78	30.4	4.5	43.7	1.80	0.81	0.65
3.	$N_{90}P_{90}K_{90}$ (PDT) 600 kg/ha	81	35.6	9.7	44.3	1.90	0.93	0.77
4.	$N_{90}P_{90}K_{90}$(KCI) + bentonite 300kg/ha	78	32.8	6.9	43.7	1.96	0.78	0.61
5.	$N_{90}P_{90}K_{90}$(KCI)+ gypsum 300kg/ha	76	30.6	4.7	43.6	1.79	0.68	0.45
6.	$N_{90}P_{90}K_{90}$(KCI) + manure 30t/ha	87	37.2	11.3	44.8	2.08	0.97	0.73
7.	$N_{90}P_{90}K_{90}$ (PDT) 600 kg/ha+ "MM"	86	37.8	11.9	44.8	2.15	0.93	0.85

Notification: In the experiments Sx%=1.3 % and $LSD_{0.5}$=1.2 c/ha has been calculated through the dispersion analysis method accepted in the RA.

Conclusion

Thus, it can be concluded that the forest brown soils of Askeran district at NKR are often distinguished by less favorable agro-physical and agro-chemical properties: insufficient water permeability, low water absorption and retention capacity, solidification and encrustation properties when dried out, as well as by low fertility.

The investigated land areas are poorly provided with available nitrogen in 100 %, poorly provided with phosphorus in 80 %, whereas no land areas with poorly provided potassium have been observed.

In case of using processed dacite tuff or the "MM" fertilizer on this background in the fertilization system, the content of the mobile nitrogen has increased by 65.4%-96.1 % against the control variant and by 38.7%-64.5 % against the $N_{90}P_{90}K_{90}$(KCI). For the mobile phosphorus this difference is between 126.9%-161.5% and 90.3%-119.3 % and for the potassium it has made 49.5%-62.8 %. The use of gypsum hasn't influenced the mentioned indices.

Due to the aftereffect in the fertilization variants of $N_{90}P_{90}K_{90}$(PDT) and $N_{90}P_{90}K_{90}$(PDT)+MM the surplus of the winter wheat yield has made 37.4%-43.6 % as compared to that of the control variant and 17.1%-24.3 % against the $N_{90}P_{90}K_{90}$(KCI) variant. The application of gypsum hasn't provided any yield surplus.

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The Impact of Application Times and Various Dosages of Organomix and Bio-Liquid on the Potato Growth And Development

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ABSTRACT

The results of the field experiments concerning the impact of organomix organic fertilizer and bio-liquid growth stimulator on the growth, development, intensity of tuber accumulation, yield capacity and marketability of the potato cultivated in the irrigated brown semi-desert soils of the Masis province at Ararat region, RA, are introduced in the article.

Upon the two-year (2017-2018) investigations it has been disclosed that the fractional application (with sowing and through nutrition) of the same organomix dosage (10 t/ha) has had a more favorable effect on the yield amount (12.9%) of potato and its structural elements than the simultaneous (with sowing) application or through the combination of mineral fertilizers ($N_{90}P_{90}K_{90}+N_{60}$). Meanwhile, by applying the growth stimulating bio-liquid with the dosage of 14 l/ha (by means of moistening the planting material) before the potato planting the potato yield amount and the tubers' marketability have considerably increased (20.5 %) during the vegetation period in comparison to those in case of the top/foliar nutrition introduced with the same dosage.

Introduction

Coming forth as the second bread for humanity, potato has become widespread throughout Armenia; it is cultivated from the lowland areas up to 2025 m heights above the sea level. Great amount of research works are currently implemented aimed at the selection, seed-breeding and improvement of agro-techniques concerning that valuable crop.

The main pre-requisite for the increase of potato yield, its qualitative indicators, as well as the decrease of its cost price is the provision of maximum yield per unit area. To handle these issues together with numerous factors (introduction of new high-yielding sorts, application of efficient methods to combat pests and diseases, improvement of product sales methods) the application of scientifically justified mineral and organic fertilizers, as well as the use of the growth regulators have become particularly important, which provide high results with low costs in terms of both yield capacity increase and cost price reduction (Galstyan, 2007, Galstyan, et. al, 2009, Onayini, et. al, 2003).

At the same time in conditions of agricultural intensification the production of ecologically safe food has become an urgent issue which is intrinsically related to the provision of environment quality. Energetic materials, agro-chemicals and chemical methods of plant protection should be gradually denied, being substituted with organic fertilizers and composts, particularly when they are produced from the organic wastes appeared in the result of household and agricultural activities or with herbal tinctures and growth stimulators, which enhance the soil biological activity and promote the humification acceleration.

Considering the urgency of the above mentioned issues solution we have set up an objective to study and disclose the impacts of various dosages and application times of bio-liquid and organomix organic fertilizer produced from the household and agricultural wastes through bio-technological innovative methods by the Armenian-Norwegian joint venture "ORWACO" established in Abovyan town, on the growth, development, tuber accumulation and yield amount indicators of mid-early potato variety of "Ausonia" in conditions of Geghanist community of Masis province at Ararat region and to compare them with the results of the mineral fertilizers' impact applied in the region. The aim of such studies is to introduce a tangible recommendation to the agricultural industry on the gradual development of agriculture and on the production of ecologically safe food product.

Materials and methods

The studies were carried out in 2017-2018, in conditions of Geghanist community of Masis region (the land area belongs to the farmer Hrahat Hoveyan). The field experiments were implemented with three repetitions and in each repetition the size of the experimental bed made 20 m^2. The soils of the experimental plot are irrigated, brown meadow soils of semi-desert type where the humus content makes all in all 1.4 %; they have average environmental reaction (pH 6.9-7.1) close to the neutral one and are easily hydrolyzed. The nitrogen content is 2.49 mg in 100 gram soil, the mobile P_2O_5 is 7.8 mg, and the exchangeable potassium content makes 40.0 mg/100g soil (table 1). As we can see from the table data the soils of the experimental plot are poor in humus, weakly provided with the available nitrogen and well provided with mobile phosphorus and potassium (Arinuskina, 1970).

Table 1 Agro-chemical indicators of the experimental plot soils

Soil type and the year of experiment	Soil sample taking depth, cm	Humus, %	pH in the water extract	Absorbed cations, mg eq. in 100g soil			Content of mobile nutrients mg in 100 g soil,		
				CaI^{2+}	MgI^{2+}	The sum	N	P_2O_5	K_2O
Irrigated brown meadow 2017	0-25	1.4	6.9	23.3	5.2	28.5	2.49	7.8	41.0
Irrigated meadow 2018	0-25	1.4	7.1	24.2	5.0	29.2	2.59	7.4	39.0

The aim of the investigations is to study the impact of different dosages and simultaneous and fractional application times of organomix organic fertilizer and the bio-liquid growth stimulator on the growth, development, yield amount and commodity rate of the "Ausonia" potato variety.

The field experiments have been implemented for 8 variants:

1. Control(without fertilization)
2. Organomix 8 t/ha
3. Organomix 10 t/ha
4. Organomix 12 t/ha
5. Organomix 6 t/ha (with sowing) + Organomix 4t/ha(through nutrition)
6. Organomix 6 t/ha (with sowing)+ Organomix 4t/ha +bio-liquid 14l/ha (through nutrition)
7. Bio-liquid(wetting up the seeds) 14 l/ha+ organomix 6t/ha (with sowing) + organomix 4t/ha (through nutrition)
8. $N_{90}P_{90}K_{90} + N_{60}$.

In the 2nd, 3rd and 4th variants the organomix was introduced simultaneously together with sowing in spring and in the 5th, 6th and 7th variants it was done in fractions: 60% was introduced with sowing and 40 % through nutrition at the start of budding stage, besides, in one case the bio-liquid was introduced with the amount of 14 l/ha in the 6th and 7th variants (in the 6th variant) through spraying at the blossoming stage and in another case the potato tubes were moistened with the bio-liquid 3 days before planting and out of the mineral substances $N_{90}P_{90}K_{90}$ was introduced with sowing, while N_{60} at the budding stage through nutrition.

The data on yield capacity have been subjected to mathematical analyses upon the determination of the error (Ex,%) of the experiment and the least significant difference (LSD 0,95 g) through the method of dispersion analyses (Galstyan, 2015).

Results and discussions

In the result of the field experimental activities it has been found out that the different dosages and application times of organomix and bio-liquid have had a certain influence on the germination, growth and development process of potato. In comparison with both control variant (without fertilization) and that of fertilized with mineral fertilizers the germination of the potato planting material has averagely accelerated by 3-5 days throughout the studies in case of both simultaneous and fractional uses of organomix and bio-liquid. If the potato tubes (planting material) germinated 29-30 days after planting in the variant without fertilization or in the variant of $N_{90}P_{90}K_{90} + N_{60}$ after 31-32 days, then in the variants where organomix fertilizer and bio-liquid were introduced both simultaneously and fractionally the potato tubes germinated 25-27 days after planting.

The influence of organomix and bio-liquid was more clearly observed in the transitional phenological phases of potato. If the mentioned impact was less vivid in the initial phases, then in the last phases (blossoming, then the natural dieback of the tops) the impact of organomix and bio-liquid is more obvious in comparison with the variant of complete combination of mineral fertilizers and the duration of the plants' vegetation has been reduced by 5-6 days (table 2).

This circumstance is vital from the perspective that in the farm households there will be an opportunity to harvest the potato yield earlier, to better provide the population needs and which is of particular importance there will be an opportunity to accomplish the summer sowing (other crops) activities successfully in the region.

At the same time the investigations indicate that in comparison with the organomix and mineral fertilizers the bio-liquid has had a certain influence on the acceleration of the potato germination, as well as on the balanced growth and development of the plants surface and subsurface mass. In the 7th variant of the experiments, where the potato planting material has been treated with bio-liquid, it sprouted 6 days earlier than that of the variant without fertilization and 3 days earlier than that of fertilized only with organo-mix and 6 days earlier than that of the variants fertilized with mineral fertilizers. It is worth mentioning that in the variant where the planting material has been treated with bio-liquid the potato plants have grown up more opulently, the stalks and leaves are much more exuberant than in other variants and the surface mass of a plant has developed averagely, that is the stalk mass and the leaves have shown greater indices than those of the other variants by 20-38 g and 9-26 g respectively (Table 2).

Table 2 The impact of different dosages and application times of organomix, bio-liquid and mineral fertilizers on the phenological transition phases, surface mass and stolons of potato

Variants	average data for 2017-2018								The number of stolons, n
	germi-nation	From germination to the mentioned periods			Plants height, cm	The number of stalks, n	Weight, g/plant		
		budding	blossoming	maturation			stalks	leaves	
Without fertilization (control)	31.03	32	43	78	52.0	5.2	495.0	245.0	11.6
Organomix 8 t/ha with sowing	28.03	34	44	75	57.0	6.2	527.0	255.0	13,8
Organomix 10 t/ha -//-	27.03	34	44	75	59.0	6.5	530.0	256.0	15.6
Organomix 12 t/ha -//-	27.03	34	44	75	60.0	6.5	532.0	258.0	15,7
Organomix 6 t/ha with sowing+ 4t/ha nutrition	27.03	34	44	75	57.0	6.6	553.0	269.0	16.4
Organomix 6 t/ha with sowing + Organomix 4 t/ha nutrition + bio-liquid 14 l/ha nutrition	27.03	34	43	76	61.0	6.6	560.0	272.0	17,8
Bio-liquid 14 l/ha+ organomix 6 t/ha with sowing + organomix 4t/ha nutrition	25.03	32	43	74	62.0	7.2	565.0	281.0	17.8
$N_{90}P_{90}K_{90}$ with sowing + N_{60} nutrition	02.04	33	45	76	62.0	6.3	530.0	257.0	16.0

Upon the bio-liquid impact the number of the plants stalks has increased as well. If in the non-fertilized variant the number of stalks per plant made 5.2, in the variant of simultaneous and fractional application of organomix its number made 6.2 and 6.6 respectively, in the variant fertilized with mineral fertilizers it made 6.3, then in the variant fertilized with the same dosage of organomix, where the planting material was treated with bio-liquid the average stalk number per plant made 7.2 pieces.

The table data show that if in case of fractional application of bio-liquid+organomix 10t/ha the number of stolons per plant made 17.8 pieces, then in the variants where the same dosage of organo-mix was applied both simultaneously and fractionally the number of stolons made 15.6-16.4 pieces respectively, while in the non-fertilized variant the mentioned index made 11.6 and in NPK variant it amounted to 16.0 pieces.

The mentioned circumstance is accounted for the fact that in this case the bio-liquid comes forth as a growth stimulator, under the impact of which the apical (of the base) dominance of the planting material stays behind (Avagyan, 2004, Galstyan, 2007, Galstyan, 2013, Hayrapetyan& Shirinian, 2002, Galstyan, et al, 2015).

As it is known the apical dominance is related to the vast accumulation of physiologically active substances (auxins, vitamins, hiberelines) in the upper part of apical layer. Thus, the buds of the mid part of the tubes develop poorly/badly/ and those of the lower part don't develop at all. In case of influencing with the solution of stimulators (in the given case with bio-liquid) the active substances of the source /mother/ tube are re-distributed and the tube sprouts into great number of buds as a result of which both the surface and subsurface parts of the potato plant increase, which in their turn ensure the balanced growth and development of

the plants promoting the tubers accumulation, as well as the improvement of the yield quantitative and qualitative indices (Avagyan, 2004, Galstyan, 2007, Hayrapetyan, et.al, 2009).

The full ratio of simultaneous and fractional application of organomix and mineral fertilizers had a specific effect on the tuber accumulation of potato as well. If in the control variant during the vegetation period the daily average tuber accumulation rate made 8.05 g, then in the variants where organomix and mineral fertilizers were applied it made 10.9 g-13.9 g (table 3).

Besides, the highest intensity /13.9 g/ of the tuber accumulation was observed in the variant, where with the organomix of 10 t/ha dosage (fractional application) the bio-liquid had been introduced beforehand.

So, if in the variant where the 10 t/ha organomix was applied simultaneously and the same amount has been introduced fractionally the daily tuber accumulation made averagely 12.2 g and 13.0 g, then in the variant where the planting material treated with bio-liquid and organomix with 10 t/ha dosage have been used fractionally, it has amounted to 13.9 g or only upon the bio-liquid impact during the vegetation the tuber accumulation rate has increased by 1.7 g in a day.

Table 3 The impact of different dosages and application times of organo-mix, bio-liquid and mineral fertilizers on the tuber accumulation rate of potato according to its pheno-phases (the average data within the period of 2017-2018)

Variants	Tubers' weight according to the development phases , g			From budding to maturation	
	Budding	Blossoming	Maturation	Day	The daily average tuber accumulation, g
Without fertilization (control)	54.0	265.0	390.0	42	8.0
Organomix 8 t/ha with sowing	60.0	310.8	539.6	44	10.9
Organomix 10 t/ha -//-	62.4	341.0	623.6	46	12.2
Organomix 12 t/ha -//-	63.0	50.0	633.4	46	12.4
Organomix 6 t/ha with sowing+ 4t/ha nutrition	63.3	360.0	677.7	48	12.8
Organomix 6 t/ha with sowing +organomix 4 t/ha nutrition +bio-liquid 14 l/ha nutrition	63.9	351.0	726.9	51	13.0
Bio-liquid 14l/ha + organomix 6 t/ha with sowing+ organomix 4 t/ha nutrition	65.0	371.5	773.9	51	13.9
$N_{90}P_{90}K_{90}$ with sowing + N_{60} nutrition	62.0	342.0	684.2	51	12.2

The organic and mineral fertilizers have had a considerable impact on the increase of potato yield amount. The average data of three repetitive field experiments carried out within two years have shown that both the simultaneous and fractional application of organomix and organomix, bio-liquid and mineral fertilizers have increased the potato yield by 97.0 c/ha-198.0 c/ha or by 56.7%-115.8% against the variant without fertilization. It is noteworthy that the fractional application of organomix with the same dosage has had more efficient impact on the potato yield capacity, than the equivalent dosage (10 t/ha) of its simultaneous application. If in the variant of organomix 6 t/ha (with sowing) + organomix 4t/ha (through nutrition) the surplus of the potato yield has made 153.0 c/ha or 89.5 % against the control variant, then in the variant where the organomix has been applied simultaneously (with sowing) with the dosage of 10 t/ha the yield surplus has made 131.0 c/ha or 76.6% (table 4).

At the same time in case of fractional use of organo-mix, when the same bio-liquid dosage (14l/ha) was introduced before the planting of potato tubers (3 days before), a higher yield was provided than in the cases when the bio-liquid dosage was applied in the blossoming stage in the form of nutrition (through sprinkling). As a result in the variant where the potato tubers had been soaked with bio-liquid before planting the surplus of potato yield made 45,0 c/ha as compared to that of fractional use of organo-mix, while when the bio-liquid dosage had been given in the form of nutrition in the same fractional application, the yield surplus made 10,0 c/ha, which is almost within the range of LSD.

Upon the impact of simultaneous and fractional use of organo-mix, as well as upon that of bio-liquid and mineral fertilizers used in the potato sowings of the region the marketability of potato tubers and the average weight of commercial tubers have also grown up.

Thus, if in the control variant the marketability of potato tubers has made 65.6% in the yield fraction, the average weight of commercial tubers-68.0g, then in the variants of organomix 8-12 t/ha(simultaneous) the mentioned indices have fluctuated respectively within 74.4%-86.2% and 80.5g-85g, and in the variant where organomix with the dosage of 10t/ha has been used fractionally or in those where the bio-liquid dosage has been used at different timeframes the marketability of potato tubers has fluctuated within 86.0%-90%, the weight of commercial tubers-

Table 4 The impact of different dosages and application times of organomix, bio-liquid and mineral fertilizers on the potato yield amount and its structure (the average data within the period of 2017-2018)

Variants	The yield according to repetitions, c/ha			The average yield of tubers, c/ha	Yield surplus		The tubers according to fractions			The commodity of the tubers , %	The average weight of the trade tubers, g
	I	II	III		c/ha	%	100g	50-100g	Up to 50g		
Without fertilization (control)	165.0	173.0	175.0	171.0	-	-	33.6	32.0	34.4	65.6	68.0
Organomix 8 t/ha with sowing	270.0	267.0	267.0	268.0	97.0	56.7	43.0	31.4	25.6	74.4	80.5
Organomix 10t/ha with sowing	297.6	302.0	306.4	302.0	131.0	76.6	46.0	39.0	15.0	85.0	84.0
Organomix 12t/ha with sowing	310.0	303.6	310.4	308.0	137.0	80.1	45.6	40.6	13.8	86.2	85.0
Organomix 6t/ha with sowing+4t/ha nutrition	320.8	325.0	326.2	324.0	153.0	89.5	46.0	40.0	14.0	86.0	86.0
Organomix 6t/ha with sowing + organomix 4t/ha nutrition + bio-liquid 14l/ha nutrition	329.0	338.0	335.0	334.0	163.0	95.3	45.0	43.4	11.6	88.4	85.2
Bio-liquid 14l/ha+ organomix 6t/ha with sowing + organomix 4t/ha nutrition	371.0	366.0	370.0	369.0	198.0	115.8	46.5	43.5	10.0	90.0	88.0
$N_{90}P_{90}K_{90}$ with sowing + N_{60} nutrition	294.0	296.0	300.0	296.0	125.0	73.1	44.4	39.6	16.0	84.0	83.5
Ex, %	**1.8**										
LSD 0,95, c	**7.9**										

within 85.2g-88.0g, while in the variant of $N_{90}P_{90}K_{90}$ + N_{60} the marketability of potato tubers has made 84.0%, and the average weight of commercial tubers has made 83.5 g.

Conclusion

Based on the study results we have come to the following conclusions:

1. The increase of the dosages of organomix organic fertilizer produced by the "ORWAKO" Armenian-Norwegian joint venture has promoted the potato growth, development, tuber accumulation intensity, as well as the increase of the yield amount and its marketability.
2. In case of applying the the same dosage of organo-mix through the fractional method (with sowing and through nutrition) it has had a more efficient impact on the potato growth, development, yield amount and structural elements, than in case of applying it simultaneously (with sowing) or in the variant of combined mineral fertilizers $N_{90}P_{90}K_{90}$+N_{60}.
3. The bio-liquid, coming forth as a stimulant, has promoted the rapid germination of potato planting material, the disappearance of apical (base) dominance, the regular plants growth and development significantly increasing the yield amount and the tubers' marketability.
4. When implementing fertilization activities in mid-early and early potato sowings it is necessary to moisten the potato tubers with bio-liquid before planting, to fertilize them with 10 t/ha dosage of organomix, out of which 60% (6 t/ha) should be applied with sowing and 40% at the budding stage in nutritional form.

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Different Reactions of Iranian Wheat Genotypes in Conditions of Water Shortage

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ABSTRACT

Drought is one of the most serious problems for agriculture. The aim of this study is to explore tolerant wheat genotypes under drought conditions. One of the practical methods for identification of tolerant wheat genotype is the use of Poly Ethylene Glycol (PEG 6000) .In this research four genotypes (D92, C80,AIOI5,F46) are introduced and four water stress treatments (0 MPa,-0.5MPa,-0.75 MPa, and -1.0 MPa.) have been carried out for creating drought conditions. Results have indicated that genotypes' drought stress levels and their interactions have enormous effects on seed germination, shoot length, root percentage and their fresh and dry weight. Out of the tested genotypes F46 and AIOI5 proved to be drought stress tolerant. However, D92 was sensitive to water stress at germination stage while C80 demonstrated average indices.

Introduction

The planet earth is composed of 70% water. Water is a source of life both for humanity, animals, marine life and plants. Although there are many seas and oceans in the earth they are not easily available for use, and water scarcity can play a vital role in planting and growing periods of the plants. Therefore, sufficient water absorption is an important precondition for seed germination under optimum conditions. Establishment of appropriate seedlings largely depends on uniform, timely, and rapid germination of seeds (Bano et al., 2012). The ability of seeds to absorb water decreases with reduced osmotic and matric potentials which disrupts seed germination. Seeds that experienced higher water stress tolerance in the germination and seedling stages exhibited this ability at later stages. Application of physiological properties of wheat seeds in the germination and emergence stages cannot be a suitable criterion in assessing drought stress tolerance of genotypes. For this purpose, experiments have been carried out to study the impacts of drought stress during which genotypes of the desired seeds are exposed to drought stress, while the tolerant and better genotypes are employed in breeding programs (Bartels and Sunkar, 2005).

Solid substances with high molecular weights that are absorbed by plants but do not participate in tissue nutrition are usually used to create artificial environments for controlling water potential. Polyethylene glycol (PEG), one of the substances with high molecular weight, is most widely used in research on plants drought tolerance because it produces a solution with conditions similar to those of the natural ones. PEG is a non-toxic tissue substance that can infiltrate plant tissues (Rauf et al., 2006). However, unlike such materials as sodium chloride, mannitol, and sucrose it does not damage plants. In recent years, Iranian research institutes, which have got an objective to improve wheat cultivars, have tried to produce cultivars and genotypes that do not suffer significant yield losses upon irrigation cessation during the vegetation period and also possess higher yield capacity. Regions with a Mediterranean-like climate, such as Iran, naturally face drought and heat stress in the final phases of the growing season. Water stress during the seed filling stage may have negative effects on seed vigor and germination properties for the following crop year (Lagerwerff et al., 1961).

Materials and methods

In the current study, seeds of the four wheat genotypes (F 46, AIOI 5, D 92 and C 80) at the "Arman Naghsh-Sabz Aras Co." greenhouse site of Aras free zone were exposed to distilled water treatment at different potentials (0, -0.5, -0.75, and -1.0 MPa) in 2018. PEG 6000 was used to establish the desired water potentials employing the Mitchell and Kaufmann method (Michel and Kaufman,1973). Ten intact and pure wheat seeds were randomly selected from the seed mass, disinfected for two minutes in 10%

sodium hypochlorite, washed with distilled water, and placed in 10 cm diameter petri dishes that had been autoclaved for two hours at 120˚C to be sterilized (Shafeeq et al., 2006). Whatman filter paper was put on the bottom of every petri dish and 10 ml of the solution prepared for each treatment and 100 seeds of the same size were added. The seeds were covered with filter paper, and the petri dishes were placed in a germinator with the accuracy of ±1˚C (Desai 2004). The number of germinated seeds was recorded daily. On the last germination day, the fresh weight of each seedling and its radicle and plumes lengths were measured. The samples were then separately put in an oven at 70˚C for 24 hours and then weighed using a balance with the accuracy of 0.001g to determine their dry weights.

The germination experiment lasted for two weeks, but treatments that achieved 95% germination earlier were considered to have reached their last day of germination and were weighed (Hegarty,1977).

Results and discussions

Results indicated that the effects of genotype and drought stress and their mutual effects on germination percentage were significant. The F46 and D92 genotypes had the highest and lowest germination percentages respectively. When water potential was reduced from zero to -1.0 MPa, germination percentage declined from 99% to 45%. Water stress applied by PEG reduced germination rate , most likely because it decreased the contact area between the seeds and water, lowered the hydraulic conductance around the seeds, reduced oxygen absorption through limiting the amount of oxygen dissolved in the culture medium, and decreased diffusion of water through the seed coat at lower osmotic potentials. The significance of the mutual effects showed the different reactions of the genotypes to changes in water potential.

Although there were no significant differences between the treatments in germination percentages, yet germination percentages of the genotypes differed at more negative water potentials and the decrease in germination percentages of the tolerant genotypes were far less as compared to the sensitive ones. Under the control level, maximum seed germination was recorded in C80 and AIOI5 (100 %) while the minimum seed germination was recorded in F46 (98%). Similarly under higher osmotic stress level (-1.0MPa) the maximum seed germination was recorded in F46 (78%) whereas the minimum seed germination under high osmotic stress was recorded in the genotype D92 which was 50%. (fig.1). This indicated about the differences between the genotypes in drought tolerance.

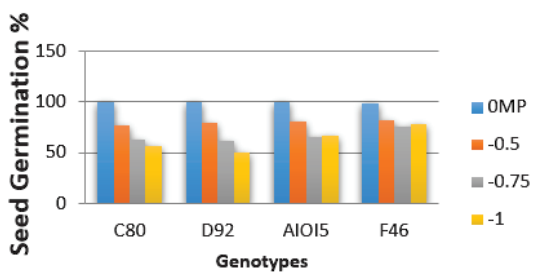

Fig.1. Effect of PEG-6000 on wheat seed germination (%)

The effects of water potential showed significant decrease in shoot and root length. Maximum shoot length was recorded in f46 (6.2 cm) and minimum one in C80 (3.5 cm) under higher water potential (fig.2) and concerning the root length the maximum value was in F46 (7.1cm) and minimum was in C80 (4.9 cm) (Fig.3).

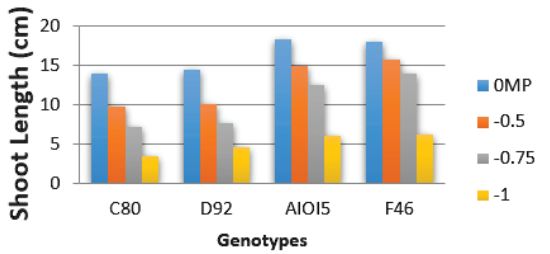

Fig.2.Effect of PEG-6000 on wheat shoot length (cm)

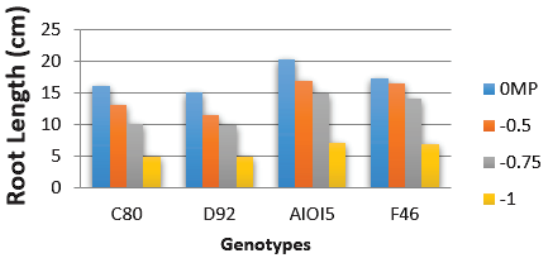

Fig.3.Effect of PEG-6000 on whaet root length (cm)

Also the shoot and root fresh weight values decreased with increasing water stress in all wheat genotypes (fig. 4 and fig. 5). Maximum root and shoot fresh weight was observed in AIOI5 and F46, whereas the minimum values were observed in C80 and D92.

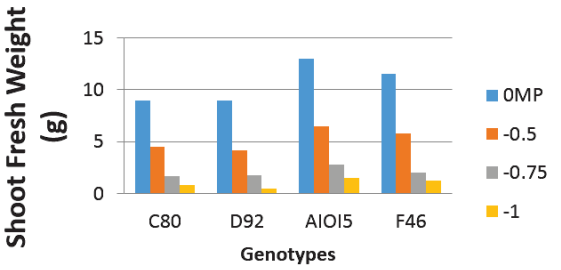

Fig.4. Effect of PEG-6000 on wheat shoot fresh weight (g)

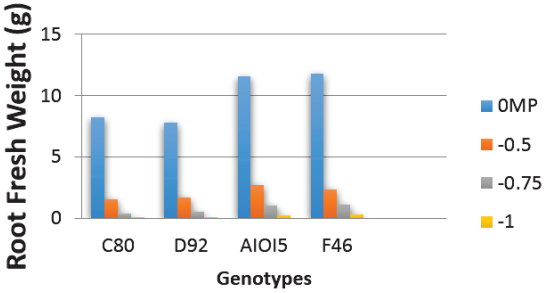

Fig.5. Effect of PEG-6000 on wheat root fresh weight (g)

The results of shoot and root dry weights are introduced in the fig. 6 and fig. 7. Results showed significant decrease in the above mentioned indices with increasing water stress. In case of higher osmotic stress level (-1.0 MPa) there was comparatively higher reduction in plant biomass with increasing water stress of the growing media. Genotypes AIOI5 and F4 showed maximum shoot/root dry weight, while minimum dry weight was observed in C80 and D92.

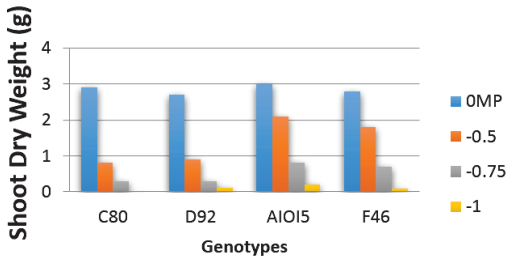

Fig.6.Effect of PEG-6000 on wheat shoot dry weight (g)

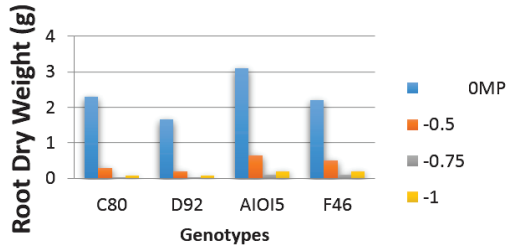

Fig.7. Effect of PEG-6000 on wheat root dry weight (g)

In a greenhouse research study it was found out that drought resistant wheat cultivars enjoyed higher root growth in the early stages and produced more initial roots (Condon, et al, 2004).

Dakheel et al(1993) stated that water stress during seed development was one of the most important environmental factors influencing reduction in seed vigor. The reason was that the transfer of absorbed materials from leaves to seeds declined due to water shortage and as drought stress during this period coincided with warm weather, seeds shriveled.

In addition, irrigation increases the percentage of absorbed mineral materials (except for nitrogen) and improves seed quality. Therefore, though germination ability is dependent on genetic properties of genotypes, yet this ability is influenced by environmental conditions. It seems that genotypes of seeds from plants exposed to water stress at seed filling stage exhibit a lower emergence rate and vigor at the beginning of the growing season if moisture conditions in the field are unsuitable at planting time.

Larsen et al. (2007) stated that various samples allocated greater quantities of the nutrients to the roots in order to better adapt themselves to water stress, thus creating a greater surface area for water absorption.

Plumes length was very sensitive to changes in drought potential and plumes, as radicles could be a very useful parameter in assessing drought tolerance (Hardegree, 2006).

Growth rates were very sensitive to water deficit and cell growth rate declined even with slight changes in water availability. This is due to the turgor, which provides the necessary force for increases in cell length, not being sufficient (Hsiao and Acededo ,1974).

Minimum amount of water for wheat seed germination varied from 35% to 45% of seed dry weight, and seeds were not able to germinate if this amount of moisture was not provided (Heyne,1987).

Gill *et al.* (2002) noticed that percentages of soluble sugars, (especially fructose), increased in seed embryo and endosperm when roots of different sorghum seeds were exposed to mannitol-induced drought in normal moisture conditions. However, the percentage increase was much higher under conditions of drought stress and eventually increased plume and radicle weights in tolerant cultivars four times more than those of the sensitive ones. Moreover, the germination rate of tolerant cultivars was significantly higher than that of the sensitive ones. These researchers stated that osmotic potential was directly related to the number of molecules dissolved inside cells.

In order to withstand water deficient environments, plants have developed biochemical and physiological mechanisms.

Conclusion

The current studies indicate that osmotic stress greatly reduces the seed germination, shoot/root length, fresh and dry weight. In the drought conditions, AIOI5 and F46 genotypes tested proved to be more tolerant and were most likely to perform better in hostile environments- in this case drought conditions. When this was compared with D92's tolerance, the latter was mediocre under water stress conditions (the same condition). Besides, the genotype C80 was sensitive. It is highly advisable that in future breeding programs, the tested genotypes should certainly be included for the development of drought tolerant cultivars.

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Peculiarities of Making Fruit Alcoholic Dry Beverages from Armenian Apricot Varieties of "Yerevani (Shalakh)" and "Aghdjanabad"

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ABSTRACT

The potential of making low alcoholic beverages (wine type) from the less common stone fruits as a raw material have been investigated during the experiments. In particular, Armenian apricot varieties "Yerevani (Shalakh)" and "Aghdjanabad" were used. In order to regulate the low content of carbohydrates in the fruit raw material, the inverted syrup was used. Moreover, to ensure fast and complete breakdown of pectin compounds, the pectolytic enzyme was added to the fruit juice. In terms of quality and organoleptic characteristics, the samples of fruit alcoholic beverages (wine type) were prepared according to the proposed technology in consistent to the general technical requirements for fruit alcoholic beverages (wine type).

Introduction

The production of alcoholic beverages has its unique place in overall food industry. There is a very strong competition in this area worldwide. Searching for the new markets for export of alcoholic beverages, as well as replenishing existing markets with the new types of drinks is one of the most crucial issues for any alcohol-exporting country. Armenia also participates in this competition thanks to the unique taste and variety of its wines, brandies (cognac) and sparkling wines.

Armenian winemaking is mainly based on wine production from different grape varieties. In addition, various types of fruits and berries are also used for the production of fruit low-alcoholic beverages (wine). Those fruits contain sufficient amount of carbohydrates, which enable to utilize them as a basic raw material for the above mentioned productions (Kazumov, 2013).

One of the peculiarities of fruit-based winemaking is the diversity of cultivated and wild fruit and berry varietals. This allows expanding the range of alcoholic and non-alcoholic products by ensuring the release of competitive products (Kishkovsky, 1984).

Fruit-based winemaking is a young branch of winemaking industry in Armenia. Production of fruit low-alcoholic beverages (wine) in Armenia started at the beginning of the previous century (Kazumov, 2013).

Taking into account the role of fruit and berry wines with their taste and high health values, we find it relevant to develop new technical and technological solutions that will improve the well-known production processes.

Materials and methods

The aim of the given research was to dedicate our trials to the issue of making fruit low-alcoholic dry beverage (wine type) from apricot fruit. Particularly, Armenian varieties of apricot "Yerevani (Shalakh)" and "Aghdjanabad" grown in Ararat region were used as raw materials for the trials. It should be noted that the same technological processes were applied to both varieties.

The chain of technological processes of apricot low-alcoholic dry beverage production is described as follows: received raw material was subjected to sorting, washing and sterilization. Afterwards, the basic physical and chemical parameters of the apricots (table 1) were determined.

Table 1.The analytical analysis of apricot varieties used in the trials.

Indicators name	Unit	Name of the fruit	
		Yerevani (Shalakh)	Aghdjanabad
Weight of one fresh fruit Inner stone weight	g	62,5 2,3	32,35 2,09
Total acidity	g/l	4,68	5,04
Volatile acidity	g/l	0,06	0,05
pH	-	4,10	3,80
Sugars	g/l	140	161
Total phenolic content	mg/l	270	192,8

Subsequently, the fruits were moved for further processing. Initially, the apricot fruits were destoned by special destoner equipment. The machine made a complete separation of the pulp from the inner stone of apricot and at the same time exerted a crushing of the fruit, by releasing a fruit mash suitable for further processing. Additionally, the juice was pressed out from the fruit mash. During the process the output of the juice was 61-63 % (depending on apricot variety) of the total mass. After the pressing the juice (must) was filed into the stainless steel tank. Due to the high amount of pectin compounds in the juice the pectolytic enzyme was added (10-40 ml/1000 l) into the mass, which ensured fast and complete breakdown of pectin (Ribereau-Gayon, 2006).

Moreover, gelatine (20-30 g/100 l) was added for juice clarification and potassium metabisulfite (MBSK) was used against oxidation processes. Clarification continued for 16-18 hours at the temperature of 15-17^{0}C. The clarified juice was raked from the sediment.

In general, fruit and berries are characterized by the low content of nitrogen compounds, which can essentially affect the normal functioning of the yeast (Ribereau-Gayon, 2006). For this purpose, the nutritional supplement “Vitamin Combi” (diammonium phosphate, thiamine, vitamin B1) of German "Erbslöh" company (30-50 g / 100 l dose) was added to the juice. The addition of ammonium sulphate, in combination with thiamine and biotin, has a positive effect on the dynamics of the fermentation process. In addition, in order to regulate the low content of carbohydrates in the fruit raw material and then to obtain the required amount of ethyl alcohol (11-12 %), prior to the fermentation inverted syrup was added to the mass.

In order to start the fermentation process active dry yeasts “Oenoferm Belle Arome” (Erbslöh) were added to the mass in dosage of 30-40 g / 100 l. The fermentation was carried out at 18-20^0 C temperature. The fermentation continued till dryness with 4 g/l and less residual sugar content. After the fermentation the wine was raked from the lees. Then, the young wine was sent for storage and maturation. During the period provided by the technological directive the wine was stabilized, filtered and in order to maintain the amount of free SO_2 in the range of 18-22 mg / l, potassium metabisulphite ($K_2S_2O_5$) was added regularly.

Results and discussions.

Organoleptic characteristics as well as physical and chemical parameters of the young fruit low-alcoholic beverages (wine type) obtained as a result of the trials are presented accordingly in Table 2 and 3.

Table 2. Organoleptic characteristics of apricot low-alcoholic beverage

Indicator name	Characteristics
Appearance of beverage	Clear, transparent, without sediment
Color	Light straw-color to rich golden
Taste and bouquet	Dry, harmonious, with expressed apricot aromas

It should be mentioned, that samples without addition of inverted syrup and nutritional supplement for yeasts “Vitamin Combi” were used as control samples during the trials. Due to the absence of those technological procedures the stuck fermentation of control samples was noted. Later on, this will cause the spoilage of wines. Therefore, in fruit based winemaking addition of inverted syrup and nutritional supplement for yeasts is desirable and advantageous.

Table 3. Chemical and physical analysis of apricot low-alcoholic beverages

Indicators name	Unit	Name of the beverage			
		"Yerevani (Shalakh)" wine	Control "Yerevani (Shalakh)" wine	"Aghdjanabad" wine	Control "Aghdjanabad" wine
Alcohol	% vol.	11.3	5.4	12.1	6.1
Total acidity	g/l	4.01	4.35	4.78	4.90
Volatile acidity	g/l	0.61	0.81	0.7	0.9
pH	-	4.15	4.15	4.00	3.90
Sugars	g/l	<4	49.28	<5	58.52
Free SO_2	mg/l	7.44	-	5.95	-
Total SO_2	mg/l	101.2	-	82.58	-
Total phenolic content	mg/l	251	-	176	-

Conclusion

The obtained results prove that selected apricot varieties have shown promising results as a raw material for production of fruit based low-alcoholic beverages. The beverages obtained from "Yerevani (Shalakh)" and "Aghdjanabad" varieties and made by recommended technology fully correspond to the standards (GOST 33806-2016) of general technical parameters of fruit-berry based wines.

The abovementioned technology can be considered as a new direction of processing of apricots, which will provide new opportunities and economic profit for apricot growers and processors. The technology discussed in the article with some modifications can be applied to preparation of low-alcoholic beverages from other types of stone fruits.

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Technical and Technological Solutions for the Processing of Stone Fruits in the Production of Alcoholic Beverages

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cleaning,
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pulp smashing

ABSTRACT

The article deals with the development and selection activities of technical equipment for all technological phases necessary for preprocessing of stone fruits, such as apricot and plum, in order to produce fruit alcoholic beverages. In particular, the technical scheme and operation mode of preprocessing plant was designed, including the following technological steps and equipment: antimicrobial cleaning, fruit washing and the appropriate equipment. Besides, the selection of destoning, crushing, pulp smashing and juice squeezing equipment was justified.

Introduction

The fermentation of fruit to produce wines, as well as the brewing of beer, is recorded in ancient Egyptian and Greek writings. Although production was based largely on the fermentation of grape juice, there is no doubt that fermentation of fruits other than grape had been practiced widely (Taylor, 1996). Fermentation of fruit juice resulting in the alcohol content was one of the earliest forms of food preservation by the human species. With rapid changes taking place in most technologies during the past century, the manufacture of fruit juice has progressed from the farm industry into the efficient technology of modern food processing (Ashurst, 1995).

Methods of extracting fruit juices are dependent upon the structure and edible portion of the fruit. The stone fruits are characterized by a fleshy mesocarp (pulp) surrounding a wood-like endocarp or stone, referred to in agricultural and processing circles as the 'pit'. The epicarp or skin is thin and smooth, except in case of the peach and apricot, which possess fine hair-like coatings (Taylor, 1996).

The best fruit juice is produced only by pressing good fruit. As many impurities as possible need to be removed prior to milling and pressing, particularly rotted or damaged fruit. It is difficult to remove damaged or rotted fruit automatically; therefore the most common method is to spread the fruit out on a conveyor where labor can be used.

Juice extraction requires equipment for handling and cleaning fruit, for reducing it to pulp (mash) and for pressing the pulp to expel the juice. The initial processing of stone fruit involves various technological steps, such as fundamental washing, antibacterial cleaning, destoning, pulp smashing and then mash pressing. These technological processes eventually contribute to the process of fruit juice production, which create the possibility to get a carbohydrate-containing environment for alcoholic fermentation (Litovchenko, 2004).

Nowadays, there are many fruit washing machines that operate in different ways with water. For instance, the washing plant equipped with brushes and water jet units are introduced in fruit processing industry. The equipment represents a combination of consecutive units, first of all with dry thereafter with wet cleaning devices (Samsonova, 1990). Moreover, root and tuber crops cleaning machine is also introduced. It is composed of the funnel for reception of the crops, dry cleaning, water cleaning sites and drainage system separated from each other. The sections are installed in the form of a single cylindrical cavity. There are pores at the bottom of the water cleaning site. In the center of the cylinder an axis is located with shovels, fastened towards the longitudinal axis at the sharp angle. At the top of the cylindrical cavity, along the length of the water purification section, three nozzles are located parallel to each other. The wastewater discharge hub in the form of a half-tube is located at the bottom of the water cleaning section (Nirmal, 2012). The aforementioned technical approaches do not provide completeness and high quality cleaning of stone fruits.

Materials and methods

The aim of the given article was to provide the engine solutions and to design the technical scheme of a plant for preprocessing the stone fruits in order to produce fruit alcoholic beverages. Stone fruit such as plums and apricots may need to be processed without damage to the stone as this often contains substances which would affect the juice taste and/or storage stability. Grape primary processing machines, widely used in winemaking don't correspond to the mentioned criteria and are not applicable for stone fruit processing. Based on the above mentioned, the evaluation and selection of the tools for the production of fruit alcohol beverages was implemented considering their high applicability in fruit juice productions. The choice of equipment was based on their technical characteristics, productivity, which guarantees processing of 20-25 tons/day of fruits during the season, and raw material specificities.

Results and discussions

According to the assessment of technological approaches and technical solutions available in fruit juice production we have developed preprocessing plant for stone fruits. Particularly, the antimicrobial cleaning unit of fruits as well as modified temperature application during the initial steps of processing was suggested.

Plum and apricot juice browns rapidly because of enzymatic action once the fruit is broken. To prevent enzymatic action, the whole fruit is heated to a temperature (60 C and more) that will inactivate the enzymes before it is crushed. However, heated raw material denaturated, aroma compounds were evaporated resulting in lower quality of finished product. This technological approach doesn't correspond to the requirements of alcoholic beverage production. On the other hand, the juice derived from fruit and subsequently the processes for producing alcoholic beverages are not subjected to heat treatment. In the absence of this technological process the bacterial contamination cannot be eliminated. Taking into consideration those facts we developed antimicrobial cleaning unit which will provide technological solution without rising the temperature and at the same time will prevent activity of microorganism as well as enzymatic action. Aqueous solution of sulfur dioxide was applied as an antimicrobial agent.

The developed technical scheme of stone fruit preprocessing plant is presented in figure 1.

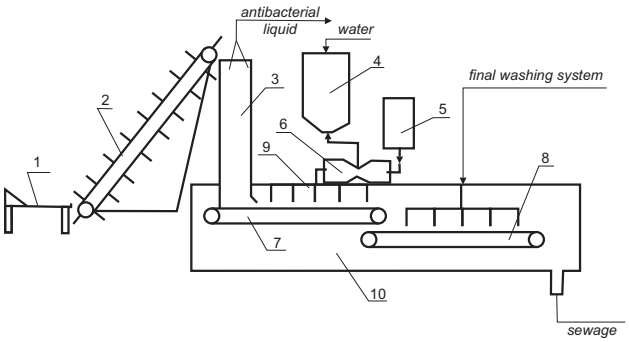

Figure 1. The technical scheme of a plant for antibacterial cleaning, purification and final washing of stone fruits

Recommended processing plant for stone fruits consists of the following parts: reception table (1), belt conveyor for fruits transportation (2), device for covering the fruits with antibacterial liquid (3), reservoir for water storage (4), compressor for air production required for fruits cleaning (5), injector for mixing the cleaning water and the compressed air (6), transportation conveyor (7), transportation conveyor for final cleaning (8), nozzle setting (9), wastewater collection capacity and drainage system (10).

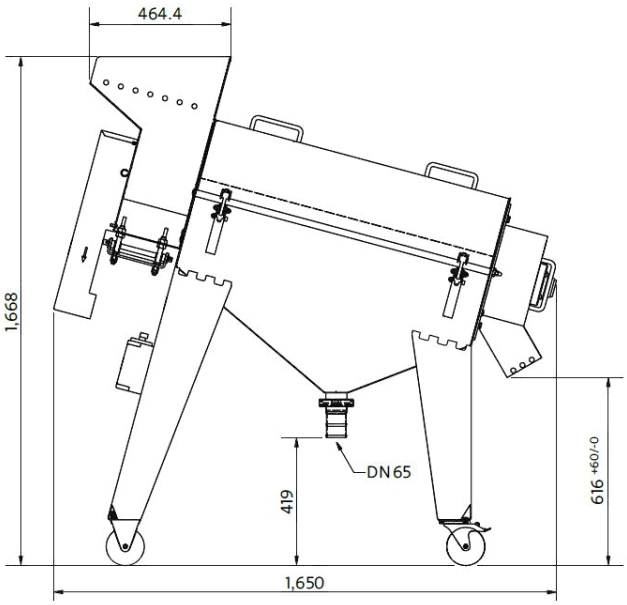

Figure 2: Technical scheme of destoning equipment for stone fruits

The installation runs as follows: the fruits are emptied out from the boxes onto the receiving table (1) which provides fruits transportation into belt conveyor (2) where the fruits are placed by the rows per each cell of the belt. Afterwards the fruits are transferred to the (3) device with the continuous flow of the antibacterial liquid where they are splashed by the liquid. Subsequently the fruits pass to the transportation conveyor (7) where the mixture of cleaning water and compressed air is generated from injector device (6) and splashed through the nozzle setting (9). Sterilized and partially purified fruits are passed on to the final cleaning transporter (8) where they are cleaned with the help of nozzles connected to the high pressure water system. All wastewater is removed though the sewage system (10).

Plums, peaches, apricots and cherries are the stone fruits most commonly processed into pulps and juices. With these fruits, the normal crushing operation does not give a reasonable yield because of the structure of the fruit flesh.

The destoning equipment "EP1000" of Austrian "Voran Machinery" company for stone fruits has been selected according to its productivity and technical indicators (productivity: 2 t/h, electric power: 4 kW, dimensions: 1.65m x0.85m x1.67m) (fig.2). In case of using this equipment hard rubber lobed wheels rotate

together forcing the fruit down and stripping most of the flesh but not affecting the stone. The machine makes a complete separation of the pulp from the inner stone of the fruits and at the same time exerts crushing of the fruit, by releasing a mash suitable for further processing.

In addition, the belt press “EBP650” (productivity: 1.5 t/h, dimensions: 2.5m x1.47m x1.46m) has been selected for further fruit mash pressing and juice extraction. Using two belts and squeezing sludge between them has long been used as a 'de-watering' system for removing liquids from a solid mass.

The equipment chosen in the course of the assessment and the right sequence of their usage has ensured the removal of stones without damaging them, which provides acquisition of a high quality mash. Another advantage is the complete separation of the pulp from the stone leaving fewer residues on it.

Moreover, treating the fruits through the initial processing plant of recommended design (fig.1) has given an opportunity to obtain a mash free of microorganisms which prevents its further bacterial contamination.

Conclusion

Hereby, in order to produce alcoholic beverages the development and selection of all technical equipment needed for the abovementioned technological steps for preliminary fruit processing has been justified. The issues concerning the process of antibacterial cleaning, purifying and washing of the fruits have been solved through the plant development.

The technological chain discussed in the article can be applied with some modifications to other types of stone fruits in order to obtain alcoholic beverages.

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Construction of Cold Accumulator with Condensing Heat Utilization

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Energy efficient,
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EER

ABSTRACT

The article considers a new cold accumulator system upon which all disadvantages of the existing similar devices and the advantages of the recommended one are taken into account. The released heat amount in the condenser is used in different production processes like hot water supply, heating, etc. The proposed system can be applied in cases when there is simultaneous demand for both heat and cold. The corresponding calculations show that by applying the recommended system it is possible to economize up to 27% energy as compared to the existing cold accumulators, besides, the system has a rather high performance coefficient equal to 5.5.

Introduction

In different buildings and production processes the cold amount needed per day is distributed disproportionally; that is to say, the peak power needed in a day can exceed the average daily demand in about 4 times. Besides, in addition to the cold demand in many cases there is also a demand for heat.

The cold supplying systems, when designed for the maximum power, cause a number of problems: increase in capital investments, underloading of the cooling system, increase of power use, high exploitation costs. In other words, we'll have an inefficient system.

To liquidate these deficiencies it is very convenient to apply the cold accumulation systems. The mentioned systems meet the maximum daily cold demand with small base power devices.

The accumulation systems work with their daily maximum power which can be only 30% of the peak power, compensating the required power of the cooling device when cooling demand is high (Melikyan, 2012). The specificity of the accumulation systems is in the utilization of the hidden heat conditioned by phase transition. The used liquid is usually water, because it has high specific capacity (4.2 kJ/kg^0), high hidden heat amount 333.7 kJ/kg^0) (Kuhling, 1982) in the heat-ice phase transition and low cost.

Together with the mentioned advantages the existing cold accumulators also have certain disadvantages, for instance, when the formed ice layer gets thicker the efficiency of the system operation decreases. Ice has low heat conducting coefficient (2.22 Wt/m^0 at 0^{0}C) and it forms heat resistance on the surface of the evaporation, which leads to the decrease of the evaporation temperature in refrigerant (Ochsner, 2008). This phenomenon leads to a decrease in the Energy Efficiency Ratio (EER) of the cooling device. Another disadvantage of cold accumulators is the small area of heat transfer in the ice formed in the tank-accumulator, which causes problems in meeting peak power demand.

Materials and methods

To solve the mentioned problems, as well as for effective use of the condensed heat, application of a new type of cold accumulator is recommended, which makes ice production process more efficient. Below in Fig. the main scheme of the recommended cold accumulator is introduced. In the presented system the ice layer thickness can be regulated by variable geometry through evaporator.

The compressor squeezes the refrigerant and increases its pressure to the respective value and sends it to the oil switch. The oil mixed with the refrigerant is separated there and sent back through the oil returning tube. The refrigerant passes to the condenser through the reverse valve, where the phase transition – condensing – takes place. The pressure of the refrigerant is tuned by the reverse valve, carrying out changes of its geometrical sizes, which results in separation of the ice from the surface of the evaporator. After condensation the refrigerant is pressed into the throttle unit from where it passes into evaporator in a two-phase state. The refrigerant takes the needed heat amount from the tank water and is evaporated; then it passes through the liquid separator where the remaining liquid drops are separated from the vapor, and then it passes into the compressor.

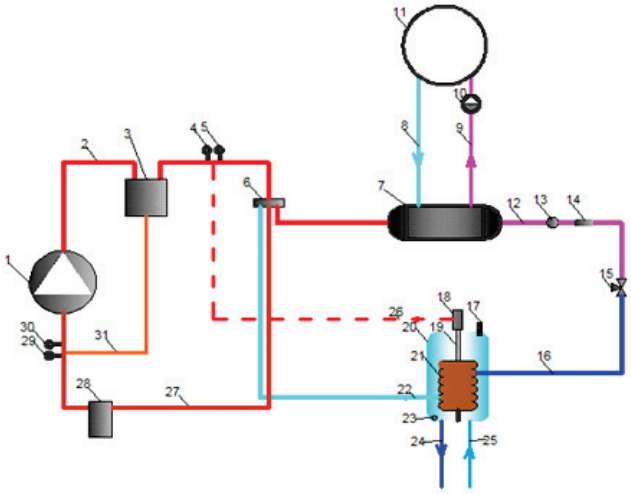

Fig. The scheme of suggested milk pasteurization and cooling system
1.Compressor, 2.discharge pipe, 3.oil separator, 4.high pressure switch, 5.high pressure relay, 6. reverse valve, 7. condensator, 8. hot water return pipe, 9 hot water supply pipe, 10. circulation pump, 11. hot water tank, 12.liquid line, 13.peephole, 14. filter-dryer, 15. electric thermo regulating valve, 16. pipe of two phase refrigerant, 17. level switch, 18. pneumatic cylinder, 19. roller of the cylinder, 20. tank of cool water, 21. evaporation with variable geometry. 22. vapor line. 23. thermometer, 24. cool water supply pipe, 25. cool water return pipe, 26 pressure pipe of cylinder, 27. suction pipe, 28. liquid separator, 29. low pressure switch, 30. low pressure relay, 31. pipe for oil return

It is very important to implement accurate choice in condensing and evaporating temperatures, consequently a correct choice in pressures for providing energy efficient operation of the system. In the cold accumulators in which it is impossible to regulate the ice layer thickness, the boiling point of the refrigerant decreases to -10^0C in case of 1 cm ice thickness (Brodski, 2011). In the recommended device we can keep an ice layer thickness up to 2-3 mm, which will provide larger surface of heat conduction and the temperature of the refrigerant will be -5^0C.

In case of such temperatures the values of *EER* at 45^0C condensation temperature are respectively 1.77 and 2.25 (http://www.tecumseh.com/en/eu/products/recip/AJE4511YGZ?pdf=performance). Comparing the values of EER we can see that the efficiency of the proposed cold accumulator makes 27% against the existing ones.

The condenser in the recommended system is a tube shell heat exchanger (water-refrigerant) in which the heat amount obtained from condensing of the refrigerant is transferred to water, increasing its temperature up to 40^0C. Then the water is additionally heated and utilized for milk pasteurization or used for other purposes.

Results and discussions

Let us discuss the energy-technical indices of the proposed cold accumulator. The coefficient of performance (*COP*) (http://www.xiron.ru/content/view/31274/28/) in the cold accumulator is defined by the following formula:

$$COP = \frac{EER * W + W * (EER + 1)}{W},$$

Where EER is the energy efficiency ratio and W is the needed power of the compressor.

At the temperature of evaporation, $t_{ev} = -5^0C$ and that of condensation, $t_{cond} = 45^0C$ and for the *EER* value- 2.25, we have:

$$COP=5.5.$$

For the case $t_{ev} = -5^0C$, $t_{cond} = 50^0C$ and $EER = 1.97$ we have:

$$COP=4.94.$$

Let us count the heat amount which comes from the operation of cold accumulator with the power of 10 kW.

$$Q=M*(Q_{ht}+W)$$

M is the weight of ice, Q_{ht} is the hidden heat amount and W is the needed power of compressor

$$Q=115687\ kJ$$

This heat quantity can be generated by burning 3.3 m^3 natural gas.

Conclusion

Taking into account the abovementioned calculations, it can be stated that application of the recommended system gives an opportunity to economize up to 27% energy as compared to the existing cold accumulators. Due to utilization of condensation heat amount the system has a high performance; using 1 unit of electric energy it produces 5.5 units heat energy. Besides, upon the cold accumulator operation with 10 kW power we can save about 3.3 m^3 natural gas.

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Investigation of Antioxidant Activity of Armenian Honey

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ABSTRACT

During the past decades, a lot of research has been conducted on measuring the antioxidant capacity of honey produced in different countries. Nevertheless, there are no data on the antioxidant capacity of Armenian honey. So, this study aims to evaluate total antioxidant capacity of Armenian honey. In total, 14 multi-floral honey samples were investigated using the 1,1-diphenyl-2-picrylhydrazyl (DPPH) method and the ferric reducing antioxidant power (FRAP) assay. The results of the current study have indicated that all honey samples have high antioxidant potential.

Introduction

Nowadays, there is a growing demand for bio-organic and natural products in the human diet (Dobre et al., 2010). Antioxidants, introduced by diet and presenting high bioactivity, can act on different cell targets, protecting consumers' health (Di Marco et al., 2018). In general, antioxidants are nutritive and non-nutritive agents that can retard biologically negative chemical reactions in foods and live organisms. These compounds are thought to protect humans from disease, in part, through their ability to scavenge oxidants and free radicals absorbing molecular damage that might otherwise compromise the function of essential lipids, proteins, and nucleic acids (Schramm et al., 2003). Among natural products with similar health-promoting effects, the bee products have generated considerable interest (Balkanska et al., 2017). Honey is one of the popular bee products, which has different biological properties, including antioxidant effects (Boulanouar et al., 2017).

Honey serves as a source of natural antioxidants, which are useful in reducing the risk of heart disease, cancer, immune system decline, the autism disease, gastrointestinal disorders, asthma, infected and chronic wounds, skin ulcers, cataracts, etc. Since some of these diseases are the consequence of oxidative damage, it seems that part of the therapeutic properties of honey is due to its antioxidant capacity (Ferreira et al., 2009, Moniruzzaman et al., 2012, Pontis et al., 2014).

Many studies have shown that antioxidant activity of honey can be attributed to the wide range of compounds such as phenolic acids, flavonoids, glucose oxidase, catalase, ascorbic acid, enzymes and carotenoids. Moreover, the antioxidant activity of honey can vary due to the botanical and geographical origin, climatic conditions and handling procedures (Boulanouar et al., 2017, Wilczynska, 2010).

During the past decades, there has been a lot of research on measuring the antioxidant activity of honey produced in different countries (Balkanska et al., 2017, Di Marco et al., 2018, Ferreira et al., 2009, Pontis et al., 2014). Nevertheless, there are no data on the antioxidant capacity of Armenian honey.

The excellent climatic conditions for beekeeping can promote high-quality honey production in Armenia (Mkrtchyan et al., 2015). Therefore, this study aims to evaluate the total antioxidant capacity of Armenian honey, which will provide an understanding of its functional properties.

Materials and methods

Totally 14 multi-floral honey samples were obtained directly from beekeepers in 4 regions of Nagorno-Karabakh Republic (Shushi, Askeran, Hadrut, Martakert) and Kotayq region of Armenia (Abovyan city) (Table 1).

Determination of the antioxidant activity of honey samples was carried out in the analytical laboratory of the Center for Ecological-Noosphere Studies of NAS, RA.

The antioxidant activity of each honey sample was determined based on the scavenging activity against the free radical 2,2-

diphenyl-1-picryl-hydrazyl (DPPH radical scavenging assay) (Molyneux, 2004, Saric et al., 2013). Stable DPPH radical reached the absorbance maximum at 517 nm, and its color was purple. The change of this color into yellow was the result of the pairing of an unpaired electron of a DPPH radical with the hydrogen of the antioxidant, thus generating reduced DPPH-H. Increase in the antioxidant resulted in the absorbance decrease, which was proportional to the concentration and antioxidant activity of the compound. The absorbance was measured in a spectrophotometer at 517 nm. Besides, the absorbance of the blank and control samples was measured. Results were shown as EC50 values, i.e. the concentration of an antioxidant that causes 50% inhibition of DPPH (Saric et al., 2013).

Table 1: Study sites and codes of investigated honey samples

Honey production regions		Sample code
Shushi region	Village Khalifali	AH-1
	Village Hinshen	AH-6
	Village Eghtsahogh	AH-8
	Village Qirsavan	AH-13
Askeran region	Village Jivani	AH-3
	Village Karmir	AH-4
	Village Qrasni	AH-5
	Village Patara	AH-15(19)
Hadrut region	Village Drakhtik	AH-22(25)
Martakert region	Village Varankatagh	AH-18
	Village Zardakhach	AH-21
	Village Vaghuhas	AH-26
	Village Chapar	AH-28(13)
Kotayq Region	Abovyan city	KH-1

Since there is no official method for honey's antioxidant activity determination, additionally FRAP (ferric reducing/antioxidant power) method was used for assessing the antioxidant activity of honey produced in Kotayq region of the Republic of Armenia (KH-1). The FRAP assay was carried out in the Laboratory of Cellular and Molecular Nutrition of Tuscia University (Italy).

The FRAP assay was adapted for 96-well plates and an automatic reader (Infinite F200, Tecan, Salzburg, Austria). The method is based on the reduction of the Fe3+-2,4,6-tripyridyl- s-triazine (TPTZ) complex to its ferrous form at a low pH. Briefly, 160 lL of FRAP assay solution (consisting of 20 mM ferric chloride solution, 10 mM TPTZ solution, and 0.3 M acetate buffer at pH 3.6) was prepared daily, mixed with 10 lL of the sample, standard or blank, and dispensed into each well of the 96-well plate. The absorbance was measured at 595 nm at 37ºC after 30 minutes of incubation. The final results were expressed as mmol Fe^{2+} equivalents/ g of dry weight (DW) (Costantini et al., 2014).

Generally, the FRAP method is used for the quantitative determination of antioxidants, whereas the DPPH method determines the qualitative presence of antioxidants.

Each antioxidant activity assay was done twice from the same extract to determine their reproducibility. Statistical analyses of all assay results were done using the Microsoft Excel program.

Results and discussion

The DPPH method with the stable organic radical 1,1-diphenyl-2-picrylhydrazyl is used for determination of free radical scavenging activity, usually expressed as EC50, the amount of antioxidant necessary to decrease the initial concentration of DPPH by 50%. The lower is the EC50 value for honey the higher is its antioxidant activity (Molyneux, 2004). The results obtained for the scavenging ability of honey (EC50) were in the range of 5,4 - 22,2 mg/ml (Fig.).

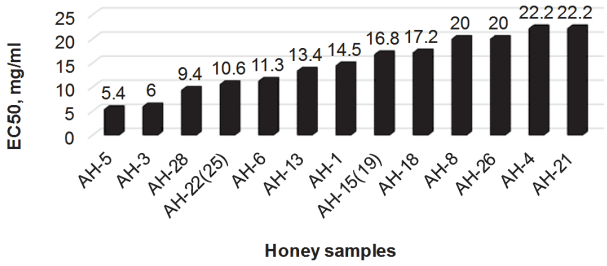

Fig. Antioxidant activity of honey samples

The detected antioxidant activity in studied samples showed a decreasing order of AH-21, AH-4 > AH-26, AH-8 > AH-18 > AH-15(19) > AH-1 > AH-13 > AH-6 > AH-22(25) > AH-28 > AH-3 > AH-5. So, the antioxidant activity was the lowest in the AH-21 and AH-4 honey samples, produced in village Zardakhach (Martakert region) and village Karmir (Askeran region), respectively. According to DPPH assay, the highest antioxidant capacity was observed in AH-5 honey, produced in Village Qrasni (Askeran region). Relatively high antioxidant capacity was obtained for AH-3 honey from village Zardakhach (Martakert region). Overall, the DPPH assay results emphasized the high antioxidant capacity of Armenian honey.

For determination of the antioxidant capacity of KH-1 honey sample, not only the DPPH method but also the FRAP assay was used. The results of two methods are introduced in Table 2.

Table 2: Antioxidant activity of honey produced in Kotayq region

Honey sample	Antioxidant activity	
	DPPH assay (EC50)	FRAP assay (mmol Fe^{2+}/g)
KH-1	12.5	3.31

Comparison of the results of both DPPH and FRAP assays allows to conclude that the KH-1 honey sample showed high antioxidant capacity.

Conclusion

It is the first study on evaluating the antioxidant capacity of Armenian honey. The results of the present study indicated that all honey samples showed high antioxidant potential. Nevertheless, for the overall evaluation of the antioxidant activity, future studies are needed to identify and quantify individual flavonoids and phenolic acids in honey.

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Risk Assessment of Tetracycline Residues in Ishkhan Fish Meat Cultured in Armenia

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ABSTRACT

The aim of this study was to conduct dietary exposure assessment of tetracycline residues through consumption of cultured Ishkan fish meat in Armenia. Tetracycline concentrations were detected by enzyme linked immunosorbent assay method (ELISA). The results indicated that the contents of tetracycline residues exceed the maximum allowable concentration (MAC) value in more than half of the samples. However, due to relatively low consumption of Ishkhan fish, the Hazard Quotient (HQ) is less than 1, indicating a low health risk.

Introduction

Aquaculture is the fastest growing animal food producing sector that provides approximately 46% of total food fish supply for meeting the increasing protein needs. One of the most urgent problems of aquaculture, which can bring significant economic loss, is the fish mortality caused by infectious diseases that are often addressed with antibiotics (Agriculture Organization of the United Nations. Fisheries Department, 2000). Antibiotics are natural or semi-synthetic drugs, widely used among humans and animals for treating and preventing various diseases through their ability to kill or inhibit the growth of microorganisms (Bacanli, et al., 2019). To date, antibiotics, particularly tetracyclines are commonly used and often detected in high concentrations in aquatic production (Liu, et al., 2017). The presence of antibiotic residue in food products is a great concern according to international scientific authorities such as World Health Organization (WHO) and American Public Health Association, etc. (Graham et al., 2007). Antibiotic residues can cause various toxic effects including allergies, cancer, alterations in the intestinal flora, and can become a public health issue by contributing to the development of bacterial resistance (Mensah et al., 2014).

In Armenia, where fish farming is regulated by the EAEC Technical Regulation (Ministry of Foreign Affairs of the Republic of Armenia, 2015), aquaculture is a developing field and the export of fish has a growing potential (Customs Service of the Republic of Armenia, 2017). As there are limited studies regarding tetracycline use in aquaculture, the present study aims to assess occurrence and dietary exposure of tetracycline residues and related human health risk through consumption of cultured Ishkhan fish meat in Armenia.

Materials and methods

The sampling and analysis was performed in the framework of State Monitoring Program (Decision N 1142-N). In 2017, a total of 21 cultured Ishkhan fish samples were collected from different regions of Armenia and were analyzed for detecting the contents of tetracycline residues. The sampling was carried out during September-November, 2017 and the contents of tetracyclines were quantified via enzyme linked immunosorbent assay method (ELISA).

Afterwards Estimated Daily Intake (EDI) was calculated according to the following equation:

$$EDI = \frac{C_{antibiotic} \times C_{fish}}{BW}, \quad (1)$$

where $C_{antibiotic}$ is the concentration of tetracyclines in μg/kg, C_{fish} is the average daily consumption of Ishkhan fish, which is 2.94 g/day

for Armenia according to Statistical committee of the Republic of Armenia (List of Individual Consumption of Goods and Services, 2016). BW is the average body weight for the adult and is 70 kg. For those samples, where the concentration of tetracyclines residues was under the limit of detection (10 µg/kg), EDI values were not calculated.

For carrying out risk assessment the Hazard Quotients (HQ) were calculated as ratios between EDIs and the Acceptable Daily Intake (ADI, 0-3 µg/kg bw/day), recommended by WHO (JECFA, 1998):

$$HQ = \frac{EDI}{ADI} . \quad (2)$$

HQ≥1 is considered to indicate a high risk of an adverse health effect, while HQ<1 indicates a low risk.

Results and discussions

Concentrations of tetracyclines in Ishkhan fish samples are summarized in the Figure below. These concentrations were compared with a maximum allowable concentration (MAC= 10 µg/kg) established by the Eurasian Economic Commission (EAEC 021/2011).

Contents of tetracyclines exceeded the MAC value in 12 samples (F2, F3, F5, F6, F9, F10, F11, F12, F13, F14, F20 and F21) out of 21 (51,7%) and ranged between 11-28 µg/kg. It should be noted, that in other 9 investigated samples the contents of tetracyclines were below the limit of detection. The highest concentration levels were observed in the samples F5, F6 and F9 being 2.4 to 2.8 times higher than the corresponding MAC value. Likewise, in the recent study conducted in neighboring Iran, 63.1% of farmed rainbow trout samples contained the residues of tetracyclines, concentrations of which in positive samples ranged from 1.43 to 101.4 µg/kg. Nevertheless, these concentrations did not exceed the maximum residue level (200 µg/kg) recommended by the Institute of Standards and Industrial Research (Barani et al., 2015).

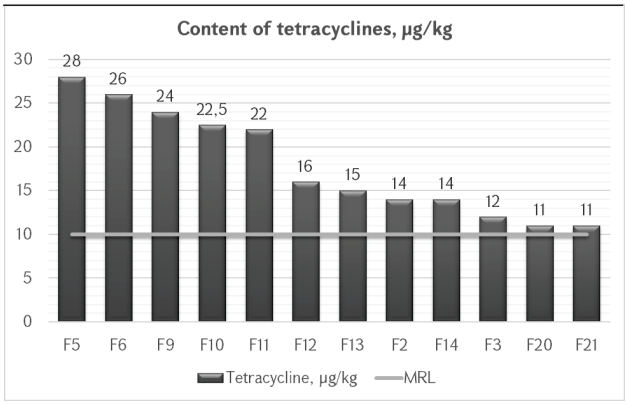

Figure . Concentrations of tetracyclines in Ishkhan fish samples.

Obtained EDI and HQ values are presented in the table below. The EDI's ranged from 4.62E-04 to 1.18E-03 µg/kg bw/day. However, the HQ for tetracyclines is much smaller than 1, which indicates no direct adverse effects from ingestion of these antibiotic-contaminated Ishkhan fish (Table).

Table. Concentrations, EDI and HQ values for tetracyclines in Ishkhan fish

Sample	Concentration, µg/kg	EDI, ng/kg bw/day	HQ
F1	n/d	-	-
F2	**14**	0.588	0.020
F3	**12**	0.504	0.017
F4	n/d	-	-
F5	**28**	1.176	0.039
F6	**26**	1.092	0.036
F7	n/d	-	-
F8	n/d	-	-
F9	**24**	1.008	0.034
F10	**22.5**	0.945	0.032
F11	**22**	0.924	0.031
F12	**16**	0.672	0.022
F13	**15**	0.630	0.021
F14	**14**	0.588	0.020
F15	n/d	-	-
F16	n/d	-	-
F17	n/d	-	-
F18	n/d	-	-
F19	n/d	-	-
F20	**11**	0.462	0.015
F21	**11**	0.462	0.015

***Note**: values below the limit of detection (10 µg/kg) are indicated as "not detected" (n/d), values that exceeded MRL are bolded. For samples where the content of tetracycline is below the limit of detection, EDI and HQ are not calculated.*

In the comparative study, which included risk assessment of tetracyclines in 14 cultured fish species from a coastal city in the northern China (Liu et al., 2018), consumption of cultured fish from mentioned region was not associated with significant human health risks as well, whereas concentration of tetracycline residues exceeded the MRL (100 µg/kg) in two samples of fish spieces.

Conclusion

Despite the fact, that in the majority of samples the concentrations of tetracycline residues exceeded the MAC value, they pose a low health risk as a result of relatively low consumption of Ishkhan fish. The obtained HQ values indicated that Ishkhan fish consumption does not have significant contribution in tetracycline exposure, so it is important to assess shares of its exposure due to consumption of other food items (i. g. meat and dairy products). Therefore, human health risk assessment of tetracyclines should be further investigated. Moreover, in this study concentrations of other antibiotics that might occur in cultured fish were not considered, which should be addressed in future studies.

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Epizootiological and Pathological Features in Case of Respiratory Mycoplasmosis of Poultry in Jrashen Community

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ABSTRACT

Poultry farmstead provides citizens with fresh eggs and meat, as well as funds family budget at the expense of income from the sale of poultry products. However, violation of veterinary and sanitary rules and unsatisfactory maintenance and feeding conditions contribute to the emergence of infectious mycoplasmosis, leading to a decrease in productivity, and often, to the birds diseases. The aim of our work is to conduct complex epizootiological, clinical, pathological and bacteriological studies in private poultry farms of the community Jrashen at Yerevan city. To prevent further development of respiratory mycoplasmosis by farmers, we have proposed a comprehensive plan for veterinary and sanitary measures.

Introduction

Poultry farmstead not only provides citizens with fresh eggs and meat, but also funds family budget at the expense of income from the sale of poultry products (Mukhin, 1989). The prevalence of respiratory mycoplasmosis of poultry is due to asymptomatic bacteria-carrier, the contagiousness of the disease, the uncontrolled movement of breeding poultry and hatching eggs and the lack of routine for preventive measures in private poultry farms (Barisovich, 1987). Violation of veterinary and sanitary rules and unsatisfactory feeding and caretaking conditions contribute to the emergence of a number of infections and invasions, leading to a decrease in productivity, and, often, to the death of diseased birds (Barisovich, 1987). It is also known that the causative agent of respiratory mycoplasmosis is capable of staying in the organism demonstrating long-term asymptomatic persistence in the body of birds, namely on the mucous membranes of the respiratory tract, and under the influence of stressors (shortage or abrupt change of feed, late drinking, immunization with live vaccines) the disease is manifested upon the development of an infectious process leading to a decrease in productivity, depletion and also promotes growth decline of infected birds (Bakulov, 1987). According to the literature, the pathogen often enters the poultry farms when the uncontrolled import of poultry takes place, especially import of chickens-carriers and the infected eggs for incubation. Once detected, the disease remains in the farm forever and can be eradicated only by complete replacement of poultry stock to the pre-disinfected poultry houses and yards (Bakulov, 1987).

Materials and methods

The aim of our work is to carry out complex epizootiological, clinical, pathoanatomical and bacteriological studies in one of the private poultry farms of Jrashen community in Yerevan. The research lasted from April to May 2018, the epizootiological and clinical examination was carried out in the farm, while pathological changes and microscopic data of bacteriological smears were studied in the laboratory of the Chair of Epizootiology and Parasitology at the National Agrarian University of Armenia. The investigated farm specializes in the maintenance of agricultural poultry from the order of chicken: turkeys, pheasants, peacocks and chickens of Indian, Malaysian, Chinese breeds. The total number of birds in the farm at the time of the study reached 250 items from the chicken order at the age of one to five years. From the anamnestic data it became known that in previous year the number of clinically ill birds with signs of respiratory system damage (rhinitis, conjunctivitis, cough) was 150 at the age of 6 months, 80 of which died out. In 2018 clinical disease was manifested only sporadically, because of the lack of young animals

up to the age of six months, the decrease in the intensity of the epizootic process, which transformed into postepizootic stage of development, weakening of the virulence of the pathogen on the background of antibiotic therapy and the transition of acute form of the disease into sluggishly flowing chronic.

Result and discussions

In the course of clinical and epizootiological studies, it was revealed that the farm does not observe the basic veterinary and sanitary rules in poultry keeping. The way of livestock acquisition is the uncontrollable import of the poultry purchased on various poultry farms located in different regions of the country; the farm does not have any system of quarantine for imported poultry; poultry is kept on a deep irreplaceable litter consisting of urea-soaked straw; in the poultry house there is no system of supply and exhaust ventilation, that is why there is a sharp smell of ammonia; the diet of birds consists only of a grain mixture (oats, millet, sunflower), which surely does not contribute to the formation of a resistant immune system to infectious agents.

Among 20 clinically ill birds the following symptoms were observed: mucous discharge from the nostrils, swelling of the eyelids and narrowing of the eye slit, tracheal wheezing and coughing, sneezing and head shaking. In turkeys and pheasants there was a change in the head shape due to edema of the infra-orbital sinuses (Fig. 1).

Figure 1. Edema of the infra-orbital sinuses

As a measure to combat infection in the farm all poultry have been periodically treated with chemotherapy drug "Tilan" since last year, which includes antibiotics erythromycin and oxytetracycline. The drug was given with water/1 ml/; the preparation was diluted in 1 liter of water and the birds were treated with it for 10 days. In total, 3 treatment courses are held annually with a weekly interval. Also the drug Iodinol /1 ml/ was used, which was dissolved in 5 liters of water and the resulted solution fed birds for 5 days (Chervyakov, 1977, Mejlumyan, 1986). The treatment helped to reduce the intensity of the epizootic process, but did not eliminate the disease as a whole. The most exhausted chickens-"crackers" /five items/ were selected for pathological and bacteriological research. As a result of pathoanatomical autopsy the following changes have been identified in the 5 slaughtered birds with a pronounced symptom of respiratory Mycoplasmosis: catarrhal inflammation of the mucous membranes in the nasal cavity, sinuses infra-orbital, larynx and trachea with accumulation of serous-mucous fluid; the walls of pneumatic sacs are thickened and coated with yellowish-white mucous layer on the inner side, and the cavity of sacs contains muddy viscous liquid; the lungs have motley appearance due to diffuse hyperemic and compacted areas, and on the surface of the liver and heart pale-yellowish fibrin flakes are visible (Fig. 2,3).

Figure 2. Larynx and trachea with accumulation of serous-mucous fluid

Figure 3. Larynx and trachea with accumulation of serous-mucous fluid

As a result of microscopic investigations on smears prepared from scrapings of the mucous membranes of the trachea, content of pneumatic sacs, exudates of infra-orbital sinuses stained through Romanovsky-Giemsa method small coccobacilli were found. The

same bacteria were found by microscopy of smears prepared from 10 percent suspension of the affected tissues treated with penicillin (500 thousand units per 1 ml. of suspension). The availability of epidemiological, clinical, pathoanatomical data characteristic of Mycoplasmosis and detection of micrococci gives us grounds for suspicion in respiratory mycoplasmosis of birds, which in the investigated sector is characterized by the stationarity, chronic course, respiratory form of the disease and low intensity of the epizootic process (Fig. 4).

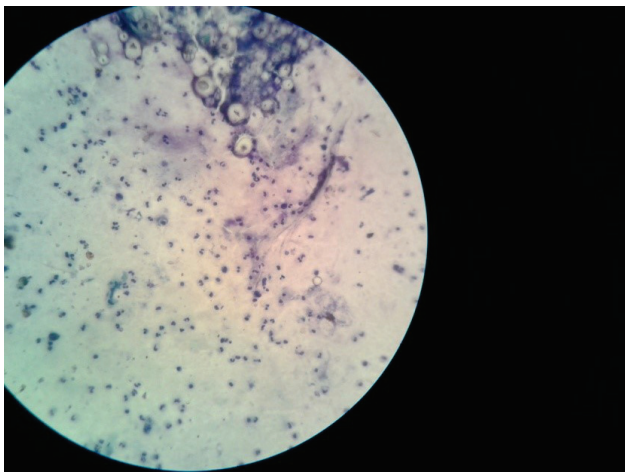

Figure 4. Agent of Mycoplasmosis

Conclusion

In conclusion it should be stated that at this stage of the disease, when there is a low intensity of the epizootic process, the treatment of birds with chemotherapy drugs and even the improvement of zoohygenic conditions and parameters of the microclimate are not able to eliminate the mycoplasmosis. As the only effective method, forced slaughter of all birds in the farm, mechanical cleaning and sanitation of premises, followed by the introduction of a new batch of birds (Korovin, 1990) can be proposed. To prevent undesirable consequences of respiratory mycoplasmosis by poultry farmers, we have proposed the following plan of veterinary and sanitary measures:

1. To fill up farms with poultry and hatching eggs from regions safe from infectious diseases, to place the imported batch of birds in the quarantine building for a month before replacing them to the poultry house;
2. To use eggs from chickens of the second year use for incubation, providing more resistance towards mycoplasmosis offspring;
3. Vaccination with live vaccines should be carried out only in special cases and with great caution considering their immunosuppressive effect on the body of birds;
4. To balance the diets of birds on vitamins, macro and microelements, taking into account the fact that the presence of herbal cutting or flour with the amount of 10% and above in the feed contributes to the increase of natural resistance of the birds' body to infectious agents;
5. To improve the keeping conditions of poultry: to carry out regular mechanical cleaning and disinfection of premises, to provide ventilation and optimal microclimate parameters in poultry houses;
6. To give preference to the maintenance of local or crossbreeds of poultry throughout the selection in homestead farms taking into account that egg producing breeds are more sensitive to respiratory infections.

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Impact of Low Dose Electron Beam Irradiation on Putative Probiotic Strain *Lactobacillus Rhamnosus* Vahe

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ABSTRACT

The impact of 50 - 150 Gray electron beam irradiation on the viability of the commercial strain *Lactobacillus acidophilus* from the symbiotic formula Lacto-G (GM Pharmaceuticals, Georgia) and the putative probiotic strain *L. rhamnosus* Vahe was investigated during this study. The strain- specific effects of EBI on the bacterial viabilities were revealed.

Introduction

The human intestinal microbiota is considered to be an "essential organ", which contains about 150 times more genes than those found in the entire human genome, and plays an important role in host homeostasis (Bouskra et al., 2008; Liu et al., 2004; Sartor, 2008; Sekirov et al., 2010; Ursell et al., 2014: Rooks and Garret, 2016). One of the methods that promote the restoration of the integrity and functionality of the intestinal microbiota during its disturbances is the use of probiotics (Neish, 2009; Williams et al., 2010; Underwood, 2016). Lactic acid bacteria, mainly representatives of the genera Lactobacillus, Bifidobacterium and Enterococcus, are the most common components of various probiotic preparations (Gomes and Malcata, 1999).

The high antagonistic potential against pathogenic strains of Acitenobacter baumannii, Staphylococcus aureus, Klebsiella pneumoniae and Enterobacter gergoviae isolated from various patients in the hospitals of Yerevan and the radioprotective effect of novel probiotic strain Lactobacillus rhamnosus Vahe were revealed in our previous investigations (Pepoyan et al., 2018).

The purpose of this study was to assess the effect of electron beam irradiation (EBI) on the viability of the probiotic strain L. rhamnosus Vahe taking into account the widespread use of radiation in health care and food industry.

Materials and methods

Probiotic strain L. rhamnosus Vahe isolated from feces of the healthy infant and a control strain Lactobacillus acidophilus isolated from Lacto-G (GM Pharmaceuticals, Georgia) were used in this study.

Lactobacillus strains were cultured according to the manufacturer's recommendations in DeMan-Rogosa-Sharpe (MRS broth) (Fisher Scientific, Pittsburg, Pennsylvania, USA). The selective media and conventional biochemical testing for bacteria isolation, as well as enumeration was used (Holt et al., 1994). Phenotypically described Lactobacillus isolates were checked using VITEK® 2 compact (BioMerieux, France). Endo and MRS agars were used for the cultivation of multi-resistant clinical isolate K. pneumoniae from the culture collection of the Department of Food Safety and Biotechnology at Armenian National Agrarian University. A 2 ml of bacterial suspension ($1,5x10^8$ CFU/ml) was prepared in phosphate buffered saline immediately prior to the irradiation.

The EBI of bacterial cells was performed by AREAL electron accelerator. Bacterial suspensions have been irradiated with 50GY, 100GY and 150GY (Table, Figures 1-4).

Table. AREAL beam parameters and radiation conditions

RF System	Beam parameters		
RF High Voltage	[kV]	117	
RF High Voltage (Peak Power)	[dBm]	-4.4	Power meter on Gun
RF Phase	[deg]	-82	
Pulse Repetition Rate	[Hz]	12	
Magnets			
Solenoid Current	[A / V]	9.7/47	
Dipole Current	[A / V]	4/9	Numbers on Power Supply
Corrector Magnet (X | Y)	[A / V]	2.5/7.3	Y
Beam Parameters			
Beam Charge (FC-IN/FC-OUT)	[pC]	440/55	8(with sample)
Beam Energy @ spectrometer	[MeV]	3.6	
Beam transverse profile (x / y)	[mm]	-	Diameter
Laser System			
Laser Energy (Room / Tunnel)	[μ J]		
Laser pulse duration	[ps]	0.42	
Beam Profile @ YAG 1 (straight screen)	Beam profile @ spectrometer E=3.6 MeV		
Mass of the samples	3.2g		
Doze (Gy)	150	100	50
Time (hh/mm/ss)	6m35s	4m23s	3m7s

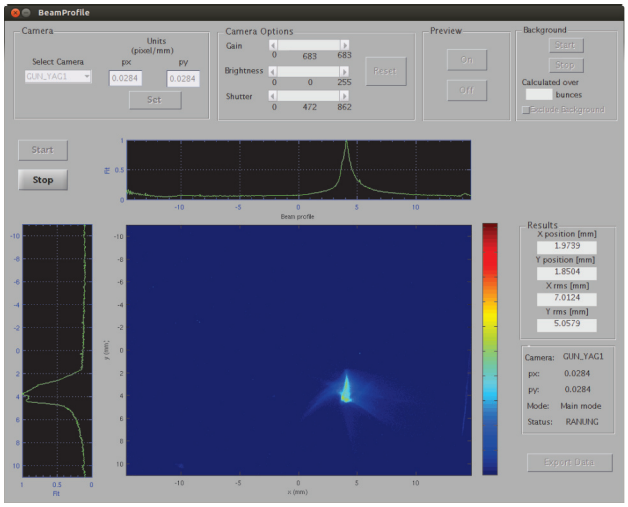

Fig. 1: Beam Profile @ YAG 1 (straight screen).

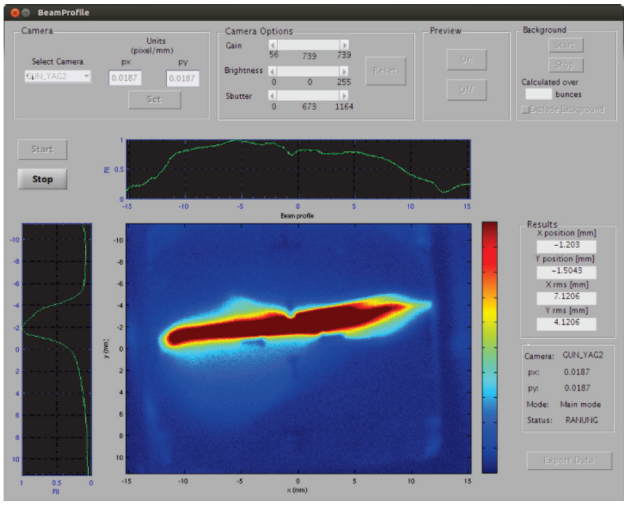

Fig. 2: Beam profile @ spectrometer E=3.6 MeV.

Cell-free supernatants have been isolated from the irradiated strains by filter method (Millex-GV). The effect of 0.1 ml supernatants on the growth of *K. pneumonia* were studied . The growth of cells was assessed by measuring OD under 600 nm.

Statistical processing of data was performed using Mann-Whitney's and Student's t-test. The probability $P<0.001$ was considered statistically significant.

Fig. 3: Scope Charge measurement Q =300 pC FC in.

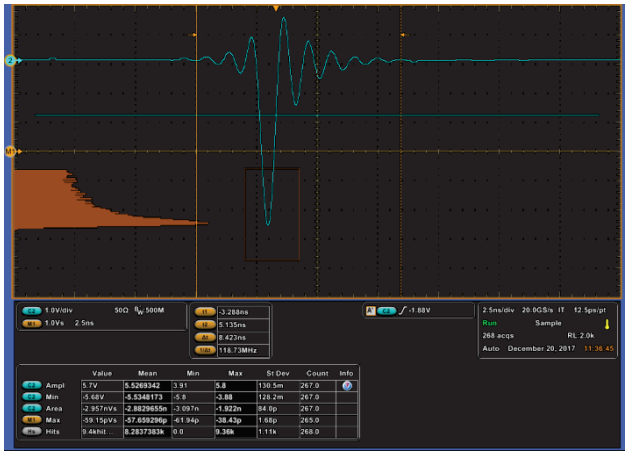

Fig. 4. Scope Charge measurement Q =33 pC FC out.

Results and discussions

Since its discovery it has been known that ionizing radiation has a fatal effect on microorganisms. Microorganisms, however, vary greatly in their resistance to ionizing radiation (Delia et al., 2007; Seal et al., 2007). In general, gram-negative bacteria, including most common food spoilage organisms (e.g., pseudomonads), are more sensitive to radiation than gram-positive organisms (e.g., lactic acid bacteria and micrococci).

The results have shown that putative probiotic *L. rhamnosus* Vahe is more resistant to low-dose EBI than *L. acidophilus* from Lacto-G (Diagram 1).

The viability of *L. rhamnosus* Vahe dropped by 57 % after 50 GY and 100 GY, and more than 15% of cells remained viable after 150 GY. On the other hand, the viability of *L. acidophilus* from Lacto-G did not exceed 5%.

The preliminary investigations on antagonistic activities of irradiated lactobacilli strains against *K. pneumoniae* revealed high antagonistic potential of *L. rhamnosus* Vahe against *K. pneumoniae* (Diagram 2). The optical density (OD) of the pathogen's suspensions after incubation with 50 GY irradiated probiotics' supernatants was 0.224 for *L. rhamnosus* Vahe and 0.745 for *L. acidophilus* from Lacto-G (Diagram 2).

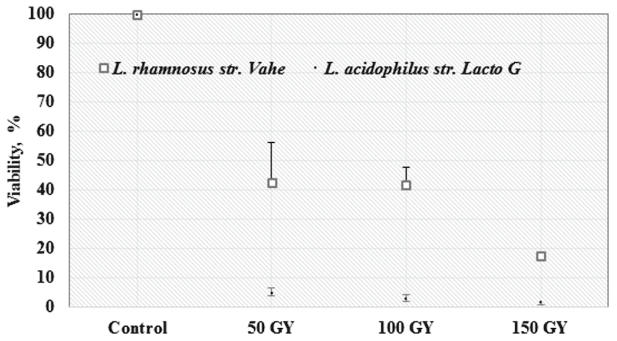

Diagram 1. Dose-response relationship for lactobacilli (50 – 150 GY electron beam irradiation)

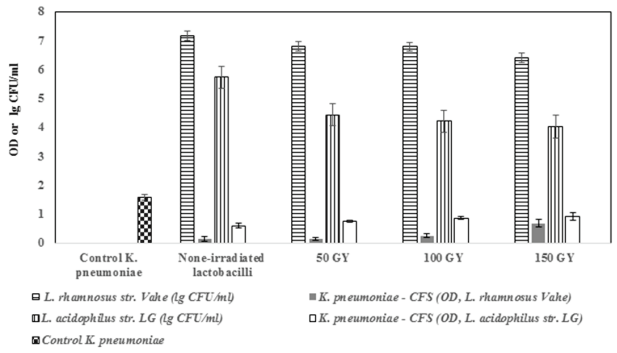

Diagram 2. Antimicrobial effects of cell-free supernatants from the irradiated and non - irradiated lactobacilli on *K. pneumoniae* cells' growth after 24 h incubation, where OD is optical density, CFS is cell free supernatant, and, CFU is colony-forming unit.

The antagonistic effects of probiotics were much lower after irradiation with higher doses (150 Gy), which can be explained by a decrease in the viability of the bacterial cells as indicated in Diagram 1. In comparison with *L. rhamnosus* Vahe, the effects of supernatants of *L. acidophilus* from Lacto-G were lower both for intact and irradiated cells. This could be accounted for the weak growth of intact and irradiated *L. acidophilus* from Lacto-G and its susceptibility to the e-Beam radiation.

Conclusion

This study showed that 50-100 Gy of EBI reduces the viability of new putative probiotic *L. rhamnosus* Vahe and *L. acidophilus* from Lacto-G cell strains, but it probably does not strictly affect the antagonistic activity of bacteria.

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Monotoring of Sausage Product Adulteration in Armenia

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ABSTRACT

Taking into consideration the fact that very often producers decrease the cost of products through adulterations, particularly through the replacement of animal protein with plant ingredients, a study has been carried out, which is aimed at the detection and evaluation of adulterations observed in the market of sausage products. In all samples of sausage products studied in 2017, and in the majority of sausage products studied in 2018 soy protein allergen was determined, however, the relevant labeling was missing. The latter is not only a legislative, but also a public health issue.

Introduction

In recent years, sausage products have often been targets for fraud due to their high market value. Although different types of food frauds (adulteration, counterfeiting, substitution and deliberate mislabeling of products) occur for a variety of reasons, most often they are connected with financial profit achieved through adulteration (Abbas et al., 2018). One of the adulteration forms for economic gain is the addition of cheaper proteins in sausage products as undeclared ingredients. Vegetable protein, such as the cheap and readily available soy, is one of the most commonly used proteins for fraudulent substitution of animal protein (Ballin, 2010). This adulteration often occurs to cause unfair competition and is a potential health hazard for individuals (Asensio et al., 2008, Sentandreu et al., 2014).

In order to protect consumers' interests and public health, in addition to combating the growing problems of sausage adulteration, product's specificities have to be identified in an evidence-based manner. From this perspective, the authenticity and safety of sausage products are of primary importance to avoid unfair competition and assure consumer protection against fraudulent practices (Asensio et al., 2008, Iammario et al., 2017). This involves procedures capable of verifying that the product matches the label statements and that it conforms to the provisions of applicable laws and regulations (Abbas et al., 2018). Currently, Armenia is a member of Eurasian Customs Union and according to Technical Regulations (TR TS 022/2011, TR TS 034/2013), ingredients (including soy protein), the consumption of which may entail allergic reactions or are contraindicated in case of certain diseases, should be indicated in the food ingredient list irrespective of their quantity. Nevertheless, the previous investigations of 2017 showed that 18 types of sausages produced by 11 meat producing companies have contained allergen soy protein, without any declaration on the package of the product (Pipoyan et al., 2018). Therefore, this study aims to carry out the monitoring of adulteration of sausage products manufactured in Armenia.

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Materials and methods

Sampling of the sausages was done from Yerevan's markets in 2017 and 2018 according to GOST standard 9792-73 (GOST 9792-73). In total, 39 (with *E1/17-E18/17, N1/17-N14/17 and S1/17-S7/17* codes) and 36 (with *E1/18-E4/18, E6/18-E11/18, E14/18, E15/18, E17/18-E21/18, N1/18-N3/18, N6/18, N7/18, N10/18, N11/18, N15/18-N20/18, S1/18* and *S7/18-S10/18* codes) types of sausage products were investigated during 2017 and 2018, respectively. Sampled and investigated sausage products were produced by the "Bari Samaratsi" LLC, "Atenk" LLC, "Luma" LLC, "Bacon Product" LLC, "Natali Farm" LLC, "Elit Prod" LLC, "A. Bilian" LLC, "AR Delikates" LLC, "Ararat" P/C, Tsaritsino" LLC, "Marila" LLC, "Natfood" CJSC and "Bayazet 1" LLC.

Qualitative and quantitative measurements of soy protein in the sausage product samples were done by enzyme-linked

immunosorbent assay (ELISA) method and by using the R-biopharm RIDASCREEN®FAST Soya (Art. No. R7102) kit with 5 standard solutions containing 0-20 mg/kg soya protein. Quality assurance and quality control (QA/QC) on the analysis was implemented in accordance to Quality Assurance Certificate provided with the kit (Pipoyan et al., 2018).

Results and discussions

The 2017-2018 monitoring results for sausage products are summarized in Table.

Table. Soy protein in analyzed samples of sausage products

Code of the samples		Declared				Determined soy protein, mg/kg	
		Generally - plant protein		Soy protein			
		2017	2018	2017	2018	2017	2018
1	2	3	4	5	6	7	8
Sausage	E1	-	+	-	-	>20	>20
	E2	+	+	-	-	>20	>20
	E3	+	+	-	-	>20	>20
	E4	-	+	-	-	>20	>20
	E5	-	*	-	*	>20	*
	E6	-	-	-	-	>20	>20
	E7	-	-	-	-	>20	*9,98*
	E8	-	-	-	-	*17,42*	>20
	E9	-	-	-	-	>20	>20
	E10	-	-	-	-	*4,91*	***not detected***
	E11	-	-	-	-	>20	>20
	E12	-	*	-	*	>20	>20
	E13	-	-	-	-	*8,21*	>20
	E14	+	-	-	-	>20	>20
	E15	-*	+	-	-	>20	>20
	E16	-	*	-	*	>20	*
	E17	-	-*	-	-	>20	>20
	E18	-	+	-	-	>20	>20
	E19	*	+	*	-	*	>20
	E20	*	-	*	-	*	***not detected***
	E21	*	+	*	-	*	>20
Paris sausages	N1	+	+	-	-	>20	>20
	N2	-	+	-	-	>20	>20
	N3	+	+	-	-	>20	>20
	N4	-	*	-	*	>20	*
	N5	-	*	-	*	>20	*
	N6	+	+	-	-	>20	>20
	N7	+	+	-	-	>20	>20
	N8	-	*	-	*	12,4	*
	N9	+	*	-	*	>20	*
	N10	+	+	-	-	>20	
	N11	-	-	-	-	15,72	***not detected***
	N12	-	*	-	*	>20	*
	N13	+	*	-	*	>20	*
	N14	-	*	-	*	>20	*
	N15	*	-	*	-	*	***not detected***
	N16	*	-*	*	-	*	>20
	N17	*	-	*	-	*	>20
	N18	*	-	*	-	*	>20
	N19	*	-	*	-	*	>20
	N20	*	-	*	-	*	>20

Table Cont'd

1	2	3	4	5	6	7	8
Paris sausages	S1	+	+	-	-	>20	>20
	S2	-*	*	-	*	>20	*
	S3	-*	*	-	*	>20	*
	S4	-*	*	-	*	>20	*
	S5	-	*	-	*	>20	*
	S6	+	*	-	*	>20	*
	S7	+	+	-	-	>20	>20
	S8	*	+	*	-	*	>20
	S9	*	-	*	-	*	***not detected***
	S10	*	-	*	-	*	>20

Note: "-"- not declared, "+" - declared, "-*" - product label is missing, ">20" - the quantity higher than the equipment sensitivity, "*" - not studied in that year.

The obtained data for 2017 showed that a soy protein was detected in all 39 investigated samples. In contrast to this, the results obtained in 2018 showed, that only in 5 samples the soy protein was not detected. It should be stressed that for the majority of investigated samples soy protein was not declared. Instead, 20 samples with declared composition by the producer, were labeled only with general data (plant protein), without specifying the origin of the plant protein (Table).

Conclusion

The obtained data allows us to conclude that in all samples (100%) of sausage products studied in 2017, and in the majority of sausage products (86 %) studied in 2018, the soy protein was determined, however the relevant labeling was missing (Figure). The latter is not only a legislative, but also a public health issue.

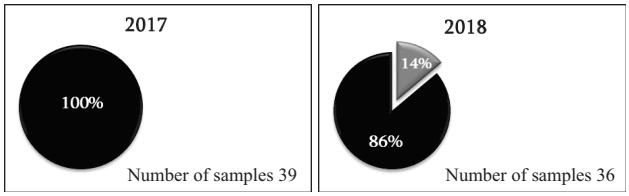

Figure. The percentage (%) of soy protein containing sausage products in 2017and 2018

Thus, it should be concluded that it is urgent for the authorities to control the adequacy of labeling and extend the scope of official monitoring plans, focused on overall assessment of the quality and safety of sausage products.

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1. Հոդվածներն ընդունվում են հայերեն, ռուսերեն և անգլերեն լեզուներով:
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