S. V. Svistunov et al /J. Pharm. Sci. & Res. Vol. 10(12), 2018, 3185-3188

ISSN:0975-1459
Journal of Pharmaceutical Sciences and Research
www.jpsr.pharmainfo.in

Selection of Bees of the Gray Mountain Caucasian Breed: *Apis mellifera caucasica* L. of the Krasnaya Polyana Type

S. V. Svistunov[1], A. G. Koshchaev[2], N. N. Bondarenko[2], O. V. Koshchaeva[2], A. M. Smirnov[3], Y. A. Yuldashbayev[4], O. G. Lorets[5]

[1]Federal Scientific Center of Beekeeping, Pchelovodov Str., 4, Sochi, 354393, Russia
[2]Kuban State Agrarian University named after I. T. Trubilin, Kalinina Str., 13, Krasnodar, 350044, Russia
[3]All-Russian Scientific Research Institute of Veterinary Sanitation, Hygiene and Ecology, Zvenigorodskoe highway, 5, Moscow, 123022, Russia
[4]Russian Timiryazev State Agrarian University, Timiryazevskaya Str., 49, Moscow, 127550, Russia
[5]Ural State Agricultural University, Karl Liebknecht St., 42, Ekaterinburg, 620075, Russia

Abstract

The article concerns research directed to improving the *A. mellifera caucasica* of the Krasnaya Polyana type. The basis of the study was the data of zootechnical accounting (for 60 families of bees in 2016 and in 2017) from apiaries. The study was a comparative assessment of the diversity and the degree of differentiation of the *A. m. caucasica* lines. It was based on morphometric analysis and microsatellites, which revealed the differences in the structure of the genealogical tree of the Gray Mountain Caucasian breed of bees of the Krasnaya Polyana type, and was built for 7 MS loci and 3 morphometric characteristics. Each year groups were formed from the bee families of medium strength (for each apiary). During the period of the experiment, the families of bees did not receive incentive feeding. The amount of the sealed brood was counted 3 times in 12 days, using a grid frame. The obtained data made it possible to determine the average daily egg production of the queen bees before the main honey collection and the number of bees that have been reared prior to the beginning of the main honey collection. After a comparative assessment of the productivity of the queen bees during the preparation of the bee colonies for the main honey collection in the conditions of the city of Sochi, we identified the population, the egg-laying productivity of which was on average by 17.02 - 20.77% higher than that of the Gray Mountain Caucasian bees of the Krasnaya Polyana type. These bees have the potential of becoming the progenitors of new lines of bees with higher productivity. In the Russian Federation, these studies are being conducted for the first time.

***Keywords**: Apis mellifera caucasica of the Krasnaya Polyana type, beekeeping, egg-laying productivity, honey bee, queen bees, productivity.*

INTRODUCTION

A. mellifera includes 30 recognized subspecies [1, 2]. Several different breeds of honey bees are bred in the territory under the jurisdiction of the Russian Federation including the Central Russian, the Carpathian, and the Gray Mountain Caucasian breeds. The Gray Mountain Caucasian breed is considered to be among the best breeds to raise for the purpose of harvesting honey because of their useful traits. They have the longest proboscis, the highest capacity for work and productivity, the ability to use a wide variety of melliferous plants, have an extremely low swarming tendency, are of a peaceful nature, etc. [3] The structure of the breed is heterogeneous and consists of populations that differ significantly in terms of biological and economic characteristics [4]. An exterior assessment is used to determine the pedigree of the bees, along with the study of physiological and ethological characteristics, as well as indicators of economic value [5-7]. Preservation of the genetic resources of domestic breeds of honey bees, their improvement through selection and rational use will allow for a 20% increase in the production of honey [8-11].

Despite the growing need for bees in the agricultural sector, the bee population has decreased in recent decades with an 18% reduction in numbers in comparison with 2006 (http://www.gks.ru) [12], and with a 30% reduction in numbers in comparison with 1990 [13]. As a result of the pollination by bees, the yield of agricultural entomophilous crops increases by 40-60%, and in the case of melons and sainfoins the yield increases by more than 100%. A vivid example of entomophilous plant species that need to be cross-pollinated to realize their full potential is the sunflower. Many different kinds of insects can collect nectar and pollen from sunflower, however, only the honey bee can provide full pollination of the sunflower and create a sufficient load of insect pollinators [14-16]. The mass application of chemical weed and pest killers in recent decades has led to the death of a huge number of insects, including natural pollinators, and thus has increased the importance of bees in modern agrobiocenoses**.**

The most important task in beekeeping and the condition of economic stability is to increase the productivity of bee colonies capable of pollinating entomophilous agricultural crops effectively and using the main honey collection. Beekeeping production is cost-effective when using highly productive bee families. It is important that a large number of bees from each family could work on honey collection. Bees that had been raised in strong families surpass individuals from weak colonies in size and body weight, the length of the proboscis, the level of muscle development, the volume of a honey sac, the flight distance, resistance to diseases, and life expectancy [17, 18].

There is a complex set of external and internal factors that influence the development and productivity of bee colonies. Among these factors, the age of the queens and their quality (activity level, physiological state) are of a great importance [19, 20]. The process of egg-laying by the queen bee is determined by many factors, in particular the following ones: individual abilities and age, the number of bees in the family and their ability promote egg-laying by the queen, and the amount of nectar and pollen that are available in the nest and brought daily as feed. The process of egg-laying is also affected by the presence of suitable honeycombs and seasonal climatic phenomena [21].

In the process of ontogenesis in bees, certain relationships are established among the organs, tissues, and features ensuring their coordinated functioning and correlative development. Studies were conducted aimed at revealing correlations among individual features of bees in order to improve the efficiency of bee breeding. As a result of the studies conducted, a reliable and positive relationship was established between egg production of the queens and the total yield of honey in families of bees of the Gray Mountain Caucasian breed [22-24].

The work carried out at the Krasnaya Polyana experimental station of beekeeping aims at preservation and improvement of the *A. mellifera caucasica* of the Krasnaya Polyana type. The station provides an increase in the effectiveness of pollination of entomophilous cultures by providing raw materials for bee breeding and mass reproduction to the breeding regions. The main direction of the research is breeding work on the development of new lines of bees with increased productivity as this is one of the ways to preserve and improve the biodiversity of breeds and populations of the honey bee.

Selection began with the improvement of productive capacity and the breeding qualities of bee colonies of the Gray Mountain Caucasian breed at the background of phenotypic mass selection conducted in the 1960s. The initial material (500 bee colonies) was imported from Georgia, from which, according to the results of the two-year experiments, 50 of the most valuable purebred bee colonies were selected according to a complex of features. Later on, the selection was carried out by individual selection methods that involved checking the queens for the quality of the offsprings, followed by homogeneous selection and moderate inbreeding. As a result of 6 years of work, 6 lines of bees were selected to organize a massive reproduction of bee queens, and by 1984 the honey production of bee families had significantly increased [25, 26]. To carry out work to improve the productive and pedigree characters of bee colonies of the Gray Mountain Caucasian breed, line breeding and interline crossing were used.

As a result of the long-term selection of bees of the Gray Mountain Caucasian breed, in 2008 an improved breed type called Krasnaya Polyana was created by the Research Institute of Beekeeping. The bees of this breed type surpassed the initial bee population by all indices: honey production increased more than 1.5 times, egg production by the queens augmented by 20.5%, the intensity of spring and summer development of families improved by 30.5% and 25.9%. respectively, wax productivity increased by 35.5%, and the viability during winter period improved by 18.2% [25, 27].

Studies carried out in previous years aimed at a comparative assessment of the diversity and the degree of differentiation of the *A. mellifera caucasica* lines, based on the data of morphometric analysis and microsatellites, revealed the differences in the structure of the genealogical tree of bees of the Gray Mountain Caucasian breed of the Krasnaya Polyana type built for 7 MS loci and 3 morphometric characteristics, which may be a consequence of their geographical isolation [28, 29].

The purpose of this study is to compare the productivity of bee queens of *A. mellifera caucasica* of the Krasnaya Polyana type during the preparation of bee colonies to the main honey collection in the conditions of the city of Sochi.

Materials And Methods

The research was based on the materials obtained at the Krasnaya Polyana experimental station of beekeeping (Sochi, Krasnodar Region) for the period 2016-2017. For the study in 6 apiaries, groups of bee families of medium strength (for each apiary) were formed. During the period of the experiment, the families of bees did not receive incentive feeding. The number of the sealed brood was counted 3 times in 12 days, using a grid frame. The average daily egg production of the queen bees was calculated based on the data obtained. The number of bees that have been reared prior to the main honey collection was calculated by summing up the data of 3 records of the sealed brood [30]. The data of zootechnical accounting (for 60 families of bees in 2016 and in 2017) have been analyzed. The dynamics of the brood, the egg-laying production of queen bees, and the development of bee families before the main honey collection have been analyzed.

Results And Discussion

Using the results of morphometric and genetic studies which have been previously conducted in collaboration with scientists from Ernst Federal Science Center *for* Animal Husbandry, 6 apiaries belonging to the Center were selected during the period between 2016-2017. In May experimental groups of bee families were formed to take into account the development of bee families before the main honey collection provided by a sweet chestnut (*Castanea sativa Mill*.) flowering from June 10-15 to July 5 -10 and linden blooming from July 20-25 to August 1-5. During the study period, nectar and pollen were provided by blooming of the black locust, cherry laurel, rhododendron, blueberry, raspberry, blueweed, etc. Tables 1 and 2 show data on brood dynamics in bee families during this period. The decrease in the value of this indicator is due to a decrease in the temperature of the ambient air, prolonged rainfall and the lack of incentive feeding during the period when nectar and pollen stop entering the hive in the periods under study.

Despite unfavorable weather conditions, in 2016 egg-laying production of queens in 4 groups before the main honey collection (Table 3) was as follows: the apiary No. 19 – 1,649 ± 53.9; the apiary No. 24 – 1,721 ± 129,9; the apiary No. 27 – 1,595 ± 85,1; the apiary No. 28 – 1,773 ± 75.2. In 2017, in two groups, the egg-laying production of queens before the main honey collection (Table 4) was as follows: the apiary No. 19 – 1,547 ± 82.6; the apiary No. 27 – 1,767 ± 55.1.

Data received in 2016-2017 and characterizing the egg-laying production of queens before the main honey collection were by 17.02-20.77% higher than the previously published data on the egg production of queens of the Gray Mountain Caucasian breed of the Krasnaya Polyana type (depending on the year: 2004 -1,475 ± 36.8, 2005 -1,510 ± 29.4, 2006-1,496 ± 48.3, 2009-1,449.53 ± 29.27) [31, 32].

Table 1. Brood dynamics in bee families in 2016, n=10

The number of an apiary	The first record			The second record			The third record		
	lim	M±m	Cv, %	lim	M±m	Cv, %	lim	M±m	Cv, %
9	44-205	107.70±48.50	18.25	37-137	81.80±8.96	34.65	77-226	159.30±13.87	27.53
13	61-159	114.80±10.83	29.83	11-96	61.00±8.23	42.69	114-238	175.20±9.86	17.79
19	143-243	189.50±9.52	15.89	18-112	69.80±10.25	46.46	158-227	197.90±6.46	10.33
24	85-184	128.00±9.99	24.68	16-226	88.50±20.36	72.76	88-238	206.50±15.59	23.87
27	135-207	170.60±7.10	13.17	90-222	159.50±14.89	29.52	139-241	191.40±6.46	16.88
28	100-240	154.50±11.84	24.23	117-273	183.60±13.29	22.89	150-247	212.80±9.02	13.41

Table 2. Brood dynamics in bee families in 2017, n=10

The number of an apiary	The first record			The second record			The third record		
	lim	M±m	Cv, %	lim	M±m	Cv, %	lim	M±m	Cv, %
9	38-64	48.3±3.02	19.76	61-184	129.90±13.48	32.82	82-188	120.20±9.93	26.13
13	103-131	116.4±2.75	7.46	124-203	159.70±7.13	14.13	84-187	131.30±9.31	22.43
19	89-122	98.3±3.00	9.66	93-224	163.40±11.15	21.58	153-234	185.60±9.91	16.88
24	71-98	82.7±3.00	11.47	139-194	163.10±5.48	10.63	53-150	117.80±9.12	24.49
27	174-197	185.50±2.65	4.52	128-230	167.50±10.10	19.06	186-244	212.00±6.14	9.15
28	83-113	100.4±2.97	9.36	56-171	130.20±11.79	28.64	51-154	103.40±12.84	39.28

Table 3. Indicators in families before the main honey collection in 2016, n=10

The number of an apiary	The queen bees' egg-laying productivity, eggs/day			Bees raised prior to the main honey collection, kg		
	lim	M±m	Cv, %	lim	M±m	Cv, %
9	642-1,883	1,328±115.6	27.53	2.41-4.78	3.5±0.3	23.61
13	950-1,983	1,460±82.1	17.79	2.64-4.43	3.5±0.2	17.46
19	1,317-1,892	1,649±53.9	10.33	3.54-5.46	4.6±0.7	13.07
24	733-2,267	1,721±129.9	23.87	2.30-5.67	4.2±0.3	26.00
27	1,158-2,008	1,595±85.1	16.88	3.93-6.26	5.2±0.3	15.57
28	1,250-2,058	1,773±75.2	13.41	3.95-7.33	5.5±0.3	16.67

Table 4. Indicators in families before the main honey collection in 2017, n=10

The number of an apiary	The queen bees' egg-laying productivity, eggs/day			Bees raised prior to the main honey collection, kg		
	lim	M±m	Cv, %	lim	M±m	Cv, %
9	683-1,567	1,002±82.8	26.13	2.07-4.11	2.98±0.2	22.3
13	700-1,558	1,094±77.6	22.43	3.47-4.84	4.07±0.1	10.75
19	1,275-1,950	1,547±82.6	16.88	3.42-5.03	4.47±0.1	10.24
24	442-1,250	982±76.0	24.49	2.77-4.10	3.64±0.1	9.86
27	1,550-2,033	1,767±55.1	9.15	4.31-6.04	5.65±0.1	6.11
28	425-1,283	892±107.0	39.28	2.63-4.15	3.34±0.2	17.22

Previously conducted studies aimed at revealing correlations among the economic characters of the Gray Mountain Caucasian bees have demonstrated a close positive correlation between the egg-laying production of the queens and the gross honey production of the bee colonies of the Gray Mountain Caucasian breed [28, 33]. Therefore, to predict the gross honey production of bee families, the data on brood dynamics can be used, since the sum of 3 records of the sealed brood, which have been conducted in 12 days, characterizes the total number of bees in the bee family on the 12th day after the last record.

The data presented in Tables 3 and 4 characterize the honey productivity of bees of the Gray Mountain Caucasian breed of the Krasnaya Polyana type in the natural honey-bearing conditions of the city of Sochi. More than 5 kg of bees had been raised by the main honey collection in the apiaries No. 27, 28 in 2016, and in the apiary No. 27 in 2017.

Not receiving incentive feeding during the preparation for the main honey collection, bee families depended on the weather conditions during this period. This confirms that bees of the Gray Mountain Caucasian breed of the Krasnaya Polyana type are extremely efficient even in unfavorable climatic conditions, which is mainly due to their pedigree features: the behavioral flexibility of bees when finding sources of food, the rapid switching from the worst sources of nectar and pollen to the best ones, the high mobilization activity, which manifests itself in the limitation of the queen bee in the egg-laying production in the periods of honey collection of medium and high intensity allowing more bees to participate in the collection and processing of nectar and pollen. The stable development of bee families without sharp fluctuations in the periods under study contributed to the achievement of the best results in the apiary No. 27 (Tables 1 and 2).

CONCLUSION

According to the data obtained, apiary No. 27 has been selected. At this apiary, queens whose offsprings steadily pass on inherited useful traits will be identified. These queens can potentially serve as the progenitors of new lines of bees with increased productivity.

REFERENCES

1. Serdyuchenko, I.V., Koshchaev, A.G., Guguchvili, N.N., Zholobova, I.S., Donnik, I.M., Smirnov, A.M., Usha, B.V., Microbiocenosis of the intestinal tract of honey bees and its correction, *OnLine Journal of Biological Sciences* 2018, *18(1)*, pp. 74-83.
2. Ruttner, F., *Biogeography and taxonomy of honey bees*, Springer Verlag, Berlin 1988.
3. Bilash, G.D., Krivtsov, N.I., Selektsiya serykh gornykh kavkazskikh pchel [Selection of the Gray Mountain Caucasian bees], *Pchelovodstvo* [Beekeeping] 1984, *2*, 12-13.
4. Alpatov, V.V., *Porody medonosnoy pchely* [Honey bee breeds], Izdatel'stvo moskovskogo obshchestva ispytateley prirody [The Printing House of the Moscow Society of Naturalists], 1948.
5. Starostina, N.G., Koshchaev, A.G., Ratner, E.N., Tsiomenko, A.B., Assessment of cell-surface hydrophobicity in methanotrophic bacteria by their adherence to hydrocarbons, *Microbiology* 1997, *66(2)*, 151-156.
6. Starostina, N.G., Koshchaev, A.G., Ratner, E.N., Tsiomenko, A.B., Cell surface hydrophobicity in methanotrophic bacteria by their adherence to hydrocarbons, *Mikrobiologiya* 1997, *66(2)*, 185-191.
7. Ruttner, F., Tassencourt, L., Louveaux, J., Biometrical-statistical analysis of the geographic variability of Apismellifera L., *Apidologie* 1978, *9*, 363-381.
8. Krivtsov, N.I., Perspektivy ispol'zovaniya geneticheskogo potentsiala pchel i aktual'nyye problemy ikh selektsii [Prospects of using genetic potential of bees and actual problems of their selection], in *Sbornik nauchno-issledovatel'skikh rabot po pchelovodstvu* [Collection of scientific research works on beekeeping], Rybnoye 2016, pp. 31-35.
9. Zverzhanovskiy, M.I., Zabashta, S.N., Kataeva, T.S., Koshchaev, A.G., Nazarov, M.V., Epizootic trichinellosis situation and consortive links in jackals (Canis aureus L.) in North-western Region of Russia, *Indian Veterinary Journal* 2017, *94(10)*, 29-32.
10. Koshchaev, A.G., Shchukina, I.V., Garkovenko, A.V., Ilnitskaya, E.V., Radchenko, V.V., Bakharev, A.A., Khrabrova, L.A., Allelic variation of marker genes of hereditary diseases and economically important traits in dairy breeding cattle population, *Journal of Pharmaceutical Sciences and Research* 2018, *10(6)*,1566-1572.
11. Garkovenko, A.V., Radchenko, V.V., Ilnitskaya, E.V., Koshchaev, A.G., Shchukina, I.V., Bakharev, A.A., Sukhanova, S.F.P, olymorphism of cattle microsatellite complexes, *Journal of Pharmaceutical Sciences and Research* 2018, *10(6)*, 1545-1551.
12. Russian Federal State Statistics Service, *Vserossiyskaya sel'skokhozyaystvennaya perepis' 2016 goda* [All-Russian Agricultural Census of 2016], Vol. 2, 2016.
13. Lebedev, V.I., Dokukin, Yu.V., Prokof'yeva, L.V., Pchelovodstvo Rossii [Beekeeping in Russia], in *Sbornik nauchno-issledovatel'skikh rabot po pchelovodstvu* [Collection of scientific research works on beekeeping], FGBNU "NII pchelovodstva" [The Scientific Research Institute of Beekeeping], Rybnoye 2016, pp. 3-9.
14. Shcherbatov, V.I., Sidorenko, L.I., Koshchaev, A.G., Vorokov, V.K., Skvortsova, L.N., Chicken hatching syncronization for artificial incubation, *Journal of Pharmaceutical Sciences and Research* 2018, *10(1)*, 148-151.
15. Koba, I.S., Lysenko, A.A., Koshchaev, A.G., Rodin, I.A., Shantyz, A.U., Effective treatment of chronic endometritis in cows by florinazol preparation, *Indian Veterinary Journal* 2017, *94(10)*, 15-18.

16. Montilla, F., Gomez-Arnau, J., Duhigg, P., Bee-attractiveness and self-compartibility of some inbred lines and their hybrids, in *Proc. of 12th Intern. Sunfl. Conf.*, Novi Sad 1988, pp. 421-428.
17. Krivtsov, N.I., Lebedev, V.I., Tunikov, G.M., *Pchelovodstvo* [Beekeeping], Kolos, Moscow 1999.
18. Koshchaev, A.G., Shchukina, I.V., Semenenko, M.P., Vasilevich, K.V., Amino acid profile of meat of specialized beef breeds, *Research Journal of Pharmaceutical, Biological and Chemical Sciences* 2016, *7(5)*, 670-676.
19. Radchenko, V.V., Ilnitskaya, E.V., Rodionova, A.S., Shuvaeva, T.M., Lysenko, Y.A., Plutakhin, G.A., Manolov, A.I., Donnik, I.M., Koshchaev, A.G., Identification of autochthonous strains as a basis for the development of the therapeutic and profylactic probiotics, *Russian Journal of Biopharmaceuticals* 2016, *8(1)*, 3-12.
20. Nelson, D.L., The effect of queen related problems on honey production, *Am. Bee J.* 1982, *9*, 636-637.
21. Vasiliadi, G.K., *Razvitiye pchelinykh matok i faktory, vliyayushchiye na ikh kachestvo* [Development of queen bees and factors affecting their quality], Rossagropromizdat, Moscow 1991.
22. Lyubimov, Ye.M., Sokol'skiy, S.S., Savushkina, L.N., Borodachov, A.V., *Selektsiya pchol seroy gornoy kavkazskoy porody i proizvodstvo produktsii v pchelorazvedencheskom khozyaystve* [Selection of bees of the Gray Mountain Caucasian breed and production in the bee-breeding farm], Ryazan' 2013.
23. Sobol, I.V., Donchenko, L.V., Rodionova, L.Y., Koshchaev, A.G., Stepovoy, A.V., Peculiarities of analytical characteristics of pectins extracted from sunflower hearts, *Asian Journal of Pharmaceutics* 2017, *11(1)*, S97-S100.
24. Zykova, S.S., Danchuk, M.S., Talismanov, V.S., Tokareva, N.G., Igidov, N.M., Rodin, I.A., Koshchaev, A.G., Gugushvili, N.N., Karmanova, O.G., Predictive and experimental determination of antioxidant activity in the series of substituted 4-(2,2-dimethylpropanoyl)-3-hydroxy-1,5-diphenyl-1,5-dihydro-2h-pyrrol-2-ones, *Journal of Pharmaceutical Sciences and Research* 2018, *10(1)*, 164-166.
25. Fornara, M.S., Kramarenko, A.S., Svistunov, S.V., Lyubimov, Ye.M., Sokol'skiy, S.S., Zinov'yeva, N.A., Morfometricheskaya i molekulyarno-geneticheskaya differentsiatsiya liniy i semey medonosnoy pchely *Apis mellifera caucasica* L., razvodimykh v rayone Bol'shogo Sochi (Morphometric and molecular genetic differentiation of *Apis mellifera caucasica* L. lines and families reared in the city of Sochi), *Sel'skokhozyaystvennaya biologiya* [Agricultural Biology] 2015, *50(6)*, 776-784.
26. Plutakhin, G.A., Koshchaev, A.G., Donnik, I.M., Quality assessment of chicken meat by analysis-of-variance method, *Research Journal of Pharmaceutical, Biological and Chemical Sciences* 2016, *7(3)*, 2293-2299.
27. Donnik, I.M., Krivonogova, A.S., Isaeva, A.G., Koshchaev, A.G., Neverova, O.P., Bykova, O.A., Productivity and health markers for large cattle, *International Journal of Green Pharmacy* 2017, *11(3)*, S620-S625.
28. Subbotin, Yu.A., Korrelyatsionnyye svyazi mezhdu otdel'nymi priznakami u pchel raznogo proiskhozhdeniya [Correlation between individual traits in bees of different origin], in *XXIII Mezhdunarodnyy kongress po pchelovodstvu* [XXIII International Congress on Beekeeping], Izdatel'stvo Apimondii, Bukharest 1972, pp. 447-449.
29. Chasovshchikova, M.A., Sheveleva, O.M., Svjazhenina, M.A., Tatarkina, N.I., Satkeeva, A.B., Bakharev, A.A., Ponomareva, E.A., Koshchaev, A.G., Relationship between the genetic variants of kappa-casein and prolactin and the productive-biological characteristics of cows of the black-motley breed, *Journal of Pharmaceutical Sciences and Research* 2017, *9(7)*, 1038-1044.
30. Krivtsov, N.I., Sokol'skiy, S.S., Lyubimov, Ye.M., *Seryye gornyye kavkazskiye pcholy* [The Gray Mountain Caucasian bees], Poligraf-Yug, Sochi 2009.
31. Shagun, Ya.L. (ed.), *Metodicheskiye ukazaniya k postanovke eksperimentov v pchelovodstve* [Methodical instructions for conducting experiments in beekeeping], RASKHN, Moscow 2010.
32. Koshchaev, A.G., Lysenko, Y.A., Lysenko, A.A., Luneva, A.V., Saleeva, I.P., Fisinin, V.I., Screening of microorganism symbiont strains as a base of probiotics for poultry industry, *Journal of Pharmaceutical Sciences and Research* 2017, *9(8)*, 1373-1379.
33. Onischuk, P.D., Semenenko, M.P., Kuzminova, E.V., Koshchaev, A.G., Selective mechanisms of antiviral effect of triazole derivatives in a transplantable virus-producing cell culture of hamadryas baboon, *Research Journal of Pharmaceutical, Biological and Chemical Sciences* 2016, *7(6)*, 1778-1782.