

Research of the Royal Jelly Collection Technology and it's Quality Characteristics

Lazat Umiraliyeva, Svetlana Kolosova, Akniyet Ibraikhan and Timur Krupskii

Abstract—Royal jelly is the most valuable natural multivitamin-hormonal agent and biostimulant. The use of royal jelly as a biologically active substance in pediatrics, the treatment of the digestive system, mental disorders, dietetics, cosmetology, pharmacology, and other areas is constantly increasing. Royal jelly is successfully used in the world as a dietary and therapeutic product. It seems relevant to obtain royal jelly on an industrial scale and manufacture on its basis various medications and food additives, which opens up wide prospects both for beekeeping and for consumers - in the face of food, pharmaceutical, and cosmetic industries, as well as the use of colostrum with high food and biological value for functional products.

Keywords— royal jelly, bee family, nurse-families, nurse-families formation methods, fetal queen bee

I. INTRODUCTION

The development of all branches of agricultural production, including beekeeping, plays an important role in increasing the volume of agricultural production, which is one of the factors in increasing the well-being and cultural level of people in the Republic of Tajikistan. In modern beekeeping, among the products obtained from honey bees, a special place is occupied by royal jelly, which has been used for medicinal purposes since ancient times, and in the Middle Ages, it was considered a panacea for all diseases, calling it "royal jelly" [1]. At the same time, the maintenance of strong and high-quality bee colonies is an important reserve for increasing yields and improving the quality of royal jelly.

The object of the study is royal jelly collected in the conditions of the beekeeping farm which is located in the Almaty region of the Republic of Kazakhstan. Royal jelly has the highest biological activity for humans. The main biological principle of the action of royal jelly is to increase the immunity of the human

Lazat Umiraliyeva, Kazakh Research Institute of Processing and Food Industry LLP, 238 "G" Gagarin Ave, Almaty, 050060, Republic of Kazakhstan.

Svetlana Kolosova, NJSC "East Kazakhstan University named after Sarsen Amanzholov", st.Kazakhstan, 55, Ust-Kamenogorsk, 070004, The East Kazakhstan region, Republic of Kazakhstan

Akniyet Ibraikhan, Kazakh Research Institute of Processing and Food Industry LLP, 238 "G" Gagarin Ave, Almaty, 050060, Republic of Kazakhstan

Timur Krupskii, Kazakh Research Institute of Livestock and Forage Production, st.Zhandosova, 51, Almaty, 055552, Republic of Kazakhstan

body. Royal jelly has a very wide spectrum of action: it increases vitality, improves appetite, normalizes metabolism in tissues, improves vision, memory, concentration, hearing, regulates blood pressure, stimulates hematopoietic function (increases the content of hemoglobin, erythrocytes in the blood, reduces the content of leukocytes), lowers blood sugar levels, promotes the elimination of toxins, stimulates the activity of the nervous system and enhances the effect of drugs [2, 3].

II. MATERIALS AND METHODS

Natural royal jelly is white or slightly creamy color, with a slight burning sour taste, a specific smell, creamy consistency [4].

One of the main problems in the technology of royal jelly production is the choice of the most effective way of forming nurse families.

To receive royal jelly in July 2021, several options for forming nurse families were tested: complete orphanhood, partial orphanhood, and without orphanhood.

Method 1. When receiving royal jelly in this way, the bee colony lost its queen bee (complete orphanhood). The family still had a sufficient number of young and flying bees without unsealed and sealed brood.

Here, between the unsealed brood of different ages, a grafting frame was placed, having 15 cells in which 12-24-hour larvae were grafted. After 3 days, royal jelly was taken from the cells, after which the process was repeated up to 5 times to prevent the family from being spun off. During the entire period, when the grafting frames were removed from the hive, the entire nest of the nurse family was examined and the built emergency queen cells were removed promptly. After the last grafting and the completion of the work on obtaining royal jelly, it was revealed that the bee family begins to develop rapidly. This was facilitated by an abundant honey harvest (June).

Method 2. This method assumed "partial orphanhood" of the bee family and consisted in the fact that, unlike the methods described above, the queen bee was not completely isolated from the family [5]. To do this, the family was divided in half, the queen bee was placed behind the diaphragm, in which a block of Ganimanov grating with an area of 16 cells is mounted. The specified area and its location (at the bottom of the diaphragm) were selected experimentally and physiological conditions were created to simulate partial orphanhood. In the compartment with the queen bee, frames were formed, two feed conveyors were

placed on top-both for the nurse family's and the queen bee's compartments. With a good feed conveyor, both bee entrances were opened, and with a supporting feed conveyor, in the queen bee compartment bee entrance was closed. In the separated nurse family, grafting frames were consistently placed. At the same time, as the young bee came out, the sealed and unsealed brood was taken from the queen bee compartment, replenishing the nurse family during the entire period of receiving royal jelly. The strength of nurse families and the composition of bees of different ages were supported by systematically rearranging frames with sealed and unsealed brood in the nurse family.

Method 3. The nurse family was formed "without orphanhood". With this method, a long hive was used.

The long hive was blocked by partitions into 3 compartments, separated by diaphragms, in which a block of separation grid with an area of 16 cells is mounted. In the right and left parts of it, there were bee colonies with fetal queen bees. In the middle part, which has its bee entrance, a nurse family is formed without a queen bee with an unsealed and sealed brood.

The collection of royal jelly in all nurse families (in three variants) took 18 days and during the entire period, it was necessary to review bee colonies twice for emergency queen

cells. For each of the methods of collecting royal jelly, the basis is the training of nurse families. In the case of partial and complete orphanhood, it is necessary to find a queen bee, make a temporary layer on the fetal queen bee for the period of collecting royal jelly, and thus, we turn off the queen bee from the general work. Stress experienced by the bee family is an undesirable factor for productive work. A nurse family formed by the third method (without orphanhood) is a gentle method for collecting royal jelly. The turnover of frames with a brood that you have to do in a long hive is a cyclical process that can be suggested as a recommendation for commercial apiaries. To obtain royal jelly, young nurse bees are used, bred in the middle compartment of the long hive. The presence in the hive of two fetal queens allows the middle part to contain 7-9 frames of different-aged brood and also one with 15 queen cells on the frame.

Table 1 shows the data obtained during the experiment.

TABLE I. RESULTS ON OBTAINING ROYAL JELLY IN NURSE FAMILIES FORMED IN DIFFERENT WAYS

Method of nurse family's formation	Number of grafted larvae for upbringing	Number of accepted larvae for upbringing	Average weight of a queen cell with royal jelly, g
Formation of nurse family with complete orphanhood	75	35	0,74
Formation of nurse family with partial orphanhood	75	48	0,93
Formation of nurse family without orphanhood	75	62	1,1

For the preparation of queen-cell cup, a method of casting queen-cell cup into silicone molds was used. This innovative method allows you to get a large number of larval transfer queen-cell cups in a large volume and at the right time [6].

In our experiment, the queen-cell cup itself and later the queen-bee cell is used as a container and the royal jelly is frozen in it. In this case, we do not get royal jelly from the queen-bee cell, and this has a positive effect on the quality of royal jelly, there is no oxidation factor. For the introduction of industrial methods for obtaining royal jelly in industrial apiaries, it is necessary to take into account the specifics of nomadic beekeeping, since the main commercial apiaries receive products in the field.

We also modified the frame of the bar, where the queen cells were fixed in the grooves without sticking with wax. This is also an innovative approach that allows you to quickly prepare the bar for laying queen cells in the field.

From the quantity and quality of the obtained queen cells in different variants, it can be concluded that in a bee family without orphanhood, royal jelly collection can be carried out

cyclically, while not distracting the queen bees from work.

So, during the entire period of collecting royal jelly in the middle part of the long hive, the queen bees located in the hive on the right and left sides continued to work fully. Frames that were released from the brood, the bee nurse family poured honey.

When collecting queen cells, the weight of royal jelly obtained in a family without orphanhood was significantly higher. This method requires additional testing in nomadic apiaries, as it may well become the basis for obtaining royal jelly on an industrial scale.

Thus, the developed technology for the production of bee's royal jelly in the formation of a nurse family without orphanhood can be used in the field for use in industrial production.

To determine the storage methods of royal jelly, 2 options were tested: freezing and adsorption.

After being removed from the nurse family, some of the queen-bee cells were sent to the laboratory for analysis. The royal jelly moisture content (60-63% for all samples) and pH (3.9% for all samples) were determined.

Another part of the queen-bee cells is placed in a freezer with a temperature of -20°C for storage. Every 5 months (GOST 28888-2017 Interstate Standard for bee's royal jelly), analyses will be carried out to determine the quality of royal jelly and, accordingly, the shelf life to use the freezing method.

The second method of storing royal jelly is adsorption [7]. Royal jelly was adsorbed in two ways.

The first method is traditional with the use of a mixture of lactose and glucose in the ratio (royal jelly: with a mixture of lactose and glucose) 1:4 [7, 8]. After adsorption, a dry powder of white color with a yellow tint, slightly burning taste, and a residual moisture content of 5% was obtained. The powder is placed in sterile glass vials for storage at room temperature.

In the second method, lactose and glucose were replaced with dry honey also in a ratio of 1:4. Dry honey has all the useful properties of liquid honey but is a powder obtained by special technology. The analyses were carried out according to GOST 31767-2012 Royal jelly bee adsorbed.

As a result, in the first case, a loose powder of white color with a yellow tint was obtained. In the second version, the mixture

turned out to be slightly viscous with a brown tint, which indicates that it requires refinement in terms of testing different ratios of royal jelly:with honey.

In the course of research work, after 3 months of storage of frozen mother liquors at $t -18^{\circ}\text{C}$, the vitamin and amino acid composition of the obtained royal jelly was studied. As a result, the following B vitamins - B2, B3, B5, B6, B9 were found, which play an important role in strengthening the body's defenses, taking an active part in muscle growth, the work of all cells, obtaining energy, normalizing the functioning of the nervous and cardiovascular systems, helping to reduce the level of depression and improve mood. Vitamins E and C were also found.

In addition, out of 20 commonly determined standard amino acids in the studied samples of royal jelly, 18 were found, including the most important for the human body 8 essential amino acids that are not synthesized in the human body. These are valine, isoleucine, leucine, methionine, threonine, tryptophan, phenylalanine, lysine, which proves the high biological value of this product (table 2).

TABLE II. VITAMIN AND AMINO ACID COMPOSITION OF ROYAL JELLY

Name of indicators, units of measurement	Actually received
Vitamins per 100 g:	mg / 100 g.
Vitamin A, mg	0.73 ± 0.04
Vitamin D3, mg	0.086 ± 0.004
Vitamin E, μg	63.7 ± 3.2
Vitamin B1, mg	0.86 ± 0.04
Vitamin B2, mg	1.43 ± 0.07
Vitamin B3 (PP), mg	6.34 ± 0.32
Vitamin B5, mg	8.72 ± 0.44
Vitamin B6, mg	3.34 ± 0.17
Vitamin B9, μg	46.0 ± 2.3
Vitamin C, mg	1.213 ± 0.061
Amino acid composition	mg / g
Serine	10.55 ± 105.52
Histidine	4.9 ± 48.99
Glycine	7.91 ± 79.14
Arginine	5.15 ± 51.5
Alanin	5.4 ± 54.02
Tyrosine	4.9 ± 48.99
Cysteine	1.63 ± 16.33
Valine	10.04 ± 100.50
Isoleucine	4.01 ± 40.20
Leucine	12.18 ± 121.85
Methionine	3.01 ± 30.15
Threonine	5.90 ± 59.04
Tryptophan	1.63 ± 16.33
Phenylalanine	2.76 ± 27.64
Lysine	6.28 ± 62.81
Aspartic acid	9.42 ± 94.22
Glutamic acid	4.89 ± 49.99

According to the results of a study by Russian and foreign scientists, leucine is one of the most important essential amino acids [8]. Its average value should be 9.0-10.6 mg/g. In our sample, this figure was 12.18 mg/g. This indicates that after three months of storage of frozen mother liquors at t -18 °C, royal jelly has not lost its valuable biological qualities.

III. CONCLUSION

When breeding queen bees, great importance is attached to the methods of forming nurse-families. At the same time, the reception of larvae for queen bee education depends on the correct choice of the formation method and type of orphanhood, the usefulness of nurse-families. Based on our research, we have established that the most suitable way of forming and using nurse-families is "without orphanhood", which allows you to reliably receive more royal jelly from the family for the entire period of their use. With this method, nurse-families are used during the entire optimal period of brood rearing by bees (up to 60 days). In addition, the presence of the queen in the nurse-family during the entire period of obtaining royal jelly allows you to get from the bee colonies significantly more marketable honey (by 22.4%) and increase the production of other products than in the case of "complete orphanhood". This is due to the fact that the temporary absence of the queen in the bee colony significantly reduces the number of bees in the collection of nectar and its processing.

When considering the advantages of a particular method of forming nurse-families in industrial apiaries, it is necessary to evaluate all the components of beekeeping technology, taking into account that the production of royal jelly should not reduce or worsen the production of other beekeeping products.

Financing. The materials were prepared as part of the project "Development of technology for the production and processing of royal jelly for the food industry" in the framework of the scientific and technical program BR10764970 "Development of science-intensive technologies for deep processing of agricultural raw materials to expand the range and yield of finished products from a unit of raw materials, as well as reducing the share of waste in production" of the budget program 267 "Increasing the availability of knowledge and scientific research" subprogram 101 "Program-targeted financing of scientific research and activities" of the Ministry of Agriculture of the Republic of Kazakhstan for 2021-2023.

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