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INFLUENCE OF STIMULATIVE FEEDING OF NURSE BEES ON ROYAL JELLY PRODUCTION

Eremia Nicolae, Jereghi Vitalie¹

¹Technical University of Moldova, Faculty of Agricultural, Forestry and Environmental Sciences, Department of Animal Resources and Food Safety, Chişinău, Republic of Moldova

Abstract: The study evaluated the influence of stimulative feeding of nurse bees on royal jelly production in the absence of a maintenance nectar flow. Four groups of queenless rearing colonies were formed and administered 50% sugar syrup supplemented with the biostimulant MF-SIB-49 at doses of 1.0, 2.0 and 3.2 mL/L, while the control group received pure sugar syrup. Frames with 45, 90 and 135 grafted larvae were introduced over three production cycles, and larval acceptance, queen-cell diameter and length, queen-cell mass with larva and royal jelly, and royal jelly yield per queen cell and per colony were assessed. The best overall results were obtained in the group fed with 2.0 mL/L biostimulant, where the total amount of royal jelly reached 66.144 g over three cycles, representing 45.4% more than in the control group. The results show that stimulative feeding can improve larval acceptance, queen-cell development and royal jelly yield, especially when administered at an optimal dose during the larval rearing period.

• Introduction

Royal jelly is a substance secreted by the hypopharyngeal and mandibular glands of young worker bees (also called nurse bees), aged between 3 and 12 days. It is used to feed larvae during the first three days of life, larvae destined to become queens throughout their entire larval development period, as well as adult queens [1, 2]. In royal jelly production, the Nicot system is used with several components, including the cell-cup holder fixing cap, cell-cup holder and cell cup, which are used for obtaining royal jelly [5]. The authors reported an acceptance rate of 71.86% and production indicators of 213.15 mg/queen cell and 6.88 g/colony per application, with a total of 34.40 g/colony in their production scheme [7]. The central role belongs to nurse bees, because their hypopharyngeal and mandibular glands secrete royal jelly, and the functioning of these glands depends on bee age, protein and sugar intake, as well as on the physiological condition of the whole bee colony. It has been demonstrated that pollen diet influences both hypopharyngeal gland development and the expression of genes involved in royal jelly biosynthesis. Thus, *Brassica napus* pollen led to better development of these glands and increased expression of the *mrj1* gene. At the same time, pollen consumption increased the expression of the *cyp450 6AS8* gene, associated with 10-HDA biosynthesis. Under the controlled experimental system, a positive correlation was found between the number of worker bees and the total amount of royal jelly produced [10]. It has been highlighted that harvesting time significantly influences both the quantity and mineral composition of royal jelly. Thus, the highest amount of royal jelly was obtained at 72 hours, with 318.5 mg per queen cell, compared with only 70.4 mg/queen cell at 24 hours [12]. Feeding, larval age and queenlessness are important technological factors for royal jelly production [15], while the role of colony condition and larval origin on acceptance has also been emphasized [16]. A comparative study on bee races showed that the Italian honey bee had a maximum acceptance of 75.53% and 13.10 g royal jelly/colony, compared with 58.20% and 9.66 g in the Carniolan race; in addition, cups primed with royal jelly increased acceptance up to 81.16% and production up to 245.52 mg/queen cell in the Italian bee, compared with 26.00% in the dry control [17]. Stimulative feeding represents a particularly important technological component during periods without a maintenance nectar flow. Research has shown that feeding with honey, sugar syrups or nutritional supplements can modify larval acceptance and yield, as well as the carbohydrate, mineral and biochemical profile of royal jelly [9, 18, 19]. Studying ways to diversify biologically active substances that stimulate royal jelly production is of scientific and practical interest. The aim of the research is to evaluate the influence of stimulative feeding of nurse bees on increasing larval acceptance for rearing, the dimensions of queen cells (diameter, length, mass of the queen cell with royal jelly and larva), as well as the amount of royal jelly obtained from one queen cell, in one production cycle and in total over three production cycles.

• Material and method

For the experiments, four groups of rearing bee colonies were formed at the apiary in Cojuşna village, Străşeni district, Republic of Moldova, using the complete queenlessness method by removing the queen and 2–3 combs with unsealed brood, thus depriving the colonies of the possibility of rearing their own queens. In the absence of a maintenance nectar flow, which was confirmed in the current year by the lack of nectar flow from black locust and linden, the rearing bee colonies were administered one liter of a mixture of 50% sugar syrup and the biostimulant (MF-SIB-49): group I – 1.0 mL/L, group II – 2.0 mL/L, group III – 3.2 mL/L, group IV (control) – pure sugar syrup. In the first production cycle, one standard frame (435 × 300 mm) with three bars was introduced into the rearing colonies; Nicot elements (queen cells) were fixed on the bars, 45 in total, into which 8–12-hour-old larvae were grafted. In the second production cycle, two frames with 90 grafted larvae were provided, and in the third production cycle, three frames with 135 grafted larvae were provided. Nurse bees received daily one liter of a mixture of sugar syrup and biostimulant, starting from the introduction of frames with grafted larvae and for three consecutive days, until the day when the frames with queen cells were removed for royal jelly harvesting. This procedure was applied during the second and third production cycles. During the experiments on royal jelly collection, the following indicators were studied: percentage of larval acceptance for rearing, diameter, length and mass of queen cells with royal jelly and larva, amount of royal jelly obtained from one queen cell and from one nurse colony per production cycle, as well as the total amount obtained over three production cycles. The obtained data were processed using a computer program, applying the method of variation statistics.

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• Results and discussions

In total, over three production cycles, the introduction into rearing colonies of frames with 45, 90 and 135 grafted larvae, 270 pcs. It was found that, in total over three production cycles, the queen-cell dimensions were as follows: diameter averaged 10.59–10.93 mm in the experimental groups, or 0.47–3.7% more than in the control group; length was 24.75–26.63 mm, or 1.31–9.01%, respectively; and the mass of the queen cell with larva and royal jelly was 1.224 g, or 12.6%. The highest mean amount of royal jelly obtained from one queen cell was recorded in group II, reaching 0.444 g, which represents an increase of 23.3% compared with the control group.

Diameter, length, mass of queen cell with larva and royal jelly, and amount of royal jelly obtained from one queen cell, on average over 3 production cycles (13–16; 16–19 and 19–22.06.2025).

Group	Queen-cell diameter		Length of queen cells		Mass of queen cell with larva and royal jelly		Total amount of royal jelly obtained from one queen cell	
	mm	%	mm	%	g	%	g	%
I-Sugar syrup + biostimulant, 1.0 mL/L	10.59	+0.47	24.75	+1.31	1.087	0	0.351	97.5
II-Sugar syrup + biostimulant, 2.0 mL/L	10.93	+3.7	26.63	+9.01	1.224	+12.6	0.444	123.3
III-Sugar syrup + biostimulant, 3.2 mL/L	10.61	+0.66	24.22	-0.86	1.091	0	0.381	105.8
IV-Pure sugar syrup (control)	10.54	0	24.43	0	1.087	0	0.360	100.0

It was found that, over three production cycles, the total amount of royal jelly obtained from the rearing colonies in the experimental groups ranged between 60.023 g and 66.144 g, representing an increase of 32.0–45.4% compared with the control group. It was also found that the highest amount of royal jelly (66.144 g) over the three production cycles was collected from the bee colonies in group II.

Number of grafted larvae and amount of royal jelly obtained over three production cycles (13–16; 16–19 and 19–22.06.2025)

Group	Number of larvae grafted per production cycle/accepted			Total number of larvae provided/accepted/%	Number of larvae grafted per production cycle / amount of royal jelly obtained, g/%			Total amount of royal jelly obtained, g	Difference compared with the control group	
	45	90	135		45	90	135		g	%
I-Sugar syrup + biostimulant, 1.0 mL/L	32	51	107	270/190/70.4	13.024/126.5	20.145/118.5	26.857/147.7	60.026	+14.547	132.0
II-Sugar syrup + biostimulant, 2.0 mL/L	31	50	69	270/150/55.6	14.074/136.7	22.400/131.7	29.670/163.2	66.144	+20.665	145.4
III-Sugar syrup + biostimulant, 3.2 mL/L	20	37	59	270/116/43.0	8.660/84.1	13.320/83	20.591/113.3	42.571	2.900	93.6
IV-Pure sugar syrup (control)	24	49	60	270/133/49.3	10.296/100.0	17.003/100.0	18.180/100.0	45.479	-	100.00

It was evaluated that the optimal dose of biostimulant used in nurse-bee nutrition is 2.0 mL/L of sugar syrup. It is administered daily for three days, starting from the introduction of frames with grafted larvae until the removal of frames with queen cells for royal jelly collection. Subsequently, the procedure is repeated in three production cycles.

• Conclusions

Following the evaluation, it was found that, in the absence of a maintenance nectar flow, feeding nurse bees with a mixture of sugar syrup and biostimulant stimulates royal jelly secretion, which is necessary for the development of grafted larvae. This leads to an increase in the number of grafted larvae accepted for rearing, improvement of queen-cell development parameters (length, diameter, mass of the queen cell together with royal jelly and larva), as well as an increase in the amount of royal jelly obtained from a single queen cell, both per production cycle and in total over three production cycles. The total amount of royal jelly obtained from one bee colony over the three production cycles was 66.0 g, or 32.0–45.4% more than in the control group.