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Effects of Feeding Gamma Irradiated Pollen on the Functional Traits of Honey Bee Colony

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Introduction

The quality of bee diet protein strongly affects the growth and development of the hypopharyngeal gland, ovaries, lifespan, pollen digestion and consumption, and hemolymph index. The quality of pollen protein depends on its source (type of flower). Some pollen sources, such as canola, have lower quality pollen. Irradiation plays an important role in increasing protein digestibility and making protein available for the active sites of protein-digesting digestive enzymes by modifying protein and bringing hydrophobic groups to the surface. The aim of the present study was to study the effects of feeding irradiated pollen on bee colony performance.

Material and Methods

32 bee hives were grouped for 4 treatments and 8 repetitions. The experimental treatments were 1- control diet (without using pollen), 2- diet containing raw pollen, 3- diet containing gamma irradiated pollen, 4- diet containing microfeed protein supplement. Functional characteristics of the colony include the extent of queen spawning, the number of population frames, the weight and body composition of nurse bees, the level of malondialdehyde and the antioxidant capacity of the body, hygienic behavior, the level of Nosema parasite contamination, The microbial population of the digestive tract, the growth of acini glands, gene expression. Vitellogenin was determined. The digestibility of raw and processed pollen was performed in cage conditions and in an incubator at 30 degrees Celsius for 3 days. The data were analyzed in the form of a completely randomized design with SAS software.

Result and Discussion

There was a significant difference between the treatments ($P<0.05$) in the size of the queen's egg laying and the number of frames inside the hive. The greatest extent of queen egg laying was related to the treatment

of raw and ultra-processed pollen ($P<0.05$). The extent of queen egg laying in the microfeed treatment was more than the control treatment and less than the pollen treatment ($P<0.05$). The number of frames of the population in the raw and radio-processed pollen treatments was higher than the control and microfeed treatments ($P<0.05$). There was a significant difference between the microfeed treatment and the control, and the microfeed treatment had more population frames ($P<0.05$). The use of irradiated pollen increased the egg laying area of the queen by 4.2 % and the number of frames inside the hive by 6.5 % compared to raw pollen. In terms of palatability, diets containing raw pollen and microfeed did not differ ($P>0.05$), but it was more than the control diet. Irradiated pollen had the highest palatability and was 12 % and 2 % more acceptable than the control diet and the raw pollen diet, respectively. The chemical composition of the body of nurse bees was affected by the type of protein source in the diet. The body weight of nurse bees was the highest in the irradiated pollen treatment and increased by 14 % compared to the raw pollen treatment. The dry matter percentage of the nurse bees was also the highest in the irradiated pollen treatment (36.42 %) and increased by 7 % compared to the raw pollen treatment (33.88 %). The use of irradiated pollen increased the body fat and protein reserves of nurse bees ($P<0.05$). The increase of fat and protein reserves of the nurse bee in the treatment of irradiated pollen compared to raw pollen was 2.7 % and 2.4 %, respectively. There was no significant difference between the fat and protein reserves of the nurse bee in the treatment of raw pollen and microfeed ($P>0.05$). The use of different protein sources caused a significant decrease in the level of malondialdehyde in the body of nurse bees compared to the control group ($P<0.05$). There was no significant difference in the amount of malondialdehyde in the body of nurse bees in the treatments receiving protein sources ($P>0.05$). The antioxidant capacity of the nurse bees in the pollen treatment was higher than in the control and microfeed treatments ($P<0.05$). No significant difference was observed between the treatment of raw pollen and irradiated pollen ($P>0.05$). In terms of removal of dead pupae in the first 12 hours of counting, there was a significant difference between the treatments ($P<0.05$).

Comparing the average treatments during this period showed that the hives receiving protein sources had a higher percentage of dead pupa removal than the control. Among the treatments of protein sources, the highest percentage of dead pupa removal was related to the pollen treatment. According to the results of microscopic observations and count of nosema spores in the intestine for each bee in control treatment and raw pollen, nosema spores were more ($P<0.05$). Nosema spores were reduced in the hives that had received processed pollen and microfeed. Diet digestibility, hypopharyngeal gland surface and acini diameter were significantly different in different treatments ($P<0.05$). According to the results, the diet containing irradiated pollen was more digestible than raw pollen ($P<0.05$). Irradiation increased the digestibility of the diet containing pollen by 4.8 %. The surface and acini diameter of hypopharyngeal glands of nurse bees were the highest in irradiated pollen and microfeed treatments ($P<0.05$). The acini level of nurse bees fed with irradiated pollen increased by 20 %. The relative expression of vitellogenin gene in different treatments showed that the use of different protein sources caused a significant increase in the expression of the studied gene compared to the control group. Vitellogenin gene expression was higher in the two groups receiving raw and protein-processed pollen than the control group and the microfeed receiving group.

Conclusions

The use of irradiated bee pollen by increasing its digestibility and removing parasitic contaminations can improve the functional characteristics of the colony and increase the colony's performance, increase the antioxidant capacity of the body, the health of the digestive system, increase the expression of the Vitellogenin gene and increase the body weight of nurse bees.

Keywords: Gamma irradiation, Microfeed, Nosema, Vitellogenin

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