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Honeybee Preferences for Pollen Substitute Diets: A Climatic Perspective

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Abstract

Honey bees (*Apis mellifera* L.) are the best known and most effective pollinating insects. Not enough information is available on the nutrition of these insects. Various products are used as protein sources for the diet of bees, and these products are usually given to the colony in the form of cake. There is little research on dry protein substitutes used for feeding bees outside the colony. In this study, the preference of bees for different dry protein substitutes was investigated in continental and subtropical climates. The results show that the seven different formulations are most preferred by the bees. In the subtropical climate, the bees showed no interest in these feeds, while in the continental climate they showed considerable interest. In addition, bees visited dark-colored baits more. In addition, baits close to the colonies were preferred more.

Key Words: *Apis, Dry, Feeding, Foraging, Substitute*

Introduction

Pollinators are an important species for the sustainability of flowering plants. Among these species, honeybees (*Apis mellifera* L.) are the most widespread and economically important species for humans (Güneşdoğdu et al., 2023). This species needs nutrients to survive and reproduce. These nutrients are carbohydrates, amino acids, lipids, vitamins, minerals, and water (Huang, 2012). Bees meet their carbohydrate requirements from nectar and honey. When these sources are scarce in nature, beekeepers add sugar syrup. Pollen provides the bees with amino acids, vitamins, minerals, and fats. When pollen is not available in nature, beekeepers use pollen diets or pollen substitutes. There are only a limited number of protein feeds for bees worldwide. These products are not yet sold in most countries (Güneşdoğdu et al., 2024).

The development of pollen substitutes for honeybees has long been of interest to the beekeeping industry. The development of such products makes it possible to feed the bees with protein feed and increase their productivity. Especially from fall to early spring, when there are no natural pollen sources in the environment, these substitutes induce the start of brood production in the colonies and the production of healthy offspring (Zahra and Talal, 2008). For honey production, it is important to start the nectar flow with strong colonies.

It is important to provide protein feed, promote the strengthening of bee colonies, maximize pollination, and protect them from pesticides, parasites, and diseases. Efficient forage production for animals, including insects, depends on palatability, health, and cost (Wilson et al., 2005). However, even a balanced diet that contains all nutrients is only important if it is consumed by the animal. It depends on whether it is consumed by the animals (Forbes, 1995). For bees, the fat and protein content in pollen is important for attractiveness (Ghosh et al., 2020).

Supplying powdered pollen substitutes to honey bee colonies is a simple method and requires minimal time and labor if weather conditions allow bees to leave the hives in search of food (Saffari et al., 2010).

Materials and Methods

Study Locations and Colony Information

This study was conducted in Muş/Turkey (38°46'19"N 41°25'47"E) and Tarsus/Mersin/Turkey (36°57'10"N 34°51'20"E) in the fall and in Kulp/Diyarbakır/Turkey (38°28'30"N 41°02'42"E) and Tarsus/Mersin/Turkey (36°57'10"N 34°51'20"E) in February and March (Figure 1). The elevation of these locations was 1290 mt, 110 mt, and 802 mt above sea level, respectively. There was a total of 105 honey bee colonies in the apiary. The colonies consisted of 3-8 bee covered frames.

Figure 1. Locations where the study was conducted in Turkey.

Raw materials and formulations

The raw materials listed in Table 1 were used to produce the dry pollen substitutes. The raw materials used are in powder or flour form. The quantities listed in Table 2 were used to produce the feeds. Many feed types were formulated, but the seven feed types that were most popular with the bees were indicated.

Table 1. Products used and their nutritional value (g/100g)

Raw Materials	Calories (kcal)	Protein	Carbohydrate	Fat
Ground Rice Flour	365.00	6.00	80.00	1.40
Corn Flour	167.00	5.50	73.00	3.50
Breadcrumbs Flour	395.00	13.50	72.00	5.30
Wheat Flour	200.00	10.50	76.00	1.00
Einkorn Wheat Flour	366.00	13.50	66.00	1.50
Soybean Flour	347.00	38.00	32.00	20.00
Corn Gluten Powder	385.00	60.00	13.00	2.00
Rye Flour	227.00	6.50	71.00	1.50
Chickpea Flour	387.00	23.00	63.00	5.00
Wheat Bran	60.00	14.80	17.50	4.00
Skim Milk Powder	500.00	35.5	100.00	1.00
Dry Yeast Powder	353.00	39.00	22.00	7.50
Cinnamon Powder	272.00	4.00	56.00	3.00
Turmeric Powder	354.00	8.00	65.00	10.00
Ginder Powder	79.00	1.80	18.00	1.00
Rock Salt	2.00	0.40	0.00	0.00
Wheat Starch	177.00	0.17	87.00	0.14

Results and Discussion

Numerous diet compositions were tested. Table 2 shows seven diet compositions that were of great interest to the bees. The results are from three different locations. In Mersin, the bees showed no interest in any forage composition. This could be due to the year-round agricultural activity and natural pollen sources in this region. At the other two sites, the bees were interested in a range of forage compositions (Figure 2). This is thought to be due to the continental climate in these regions and the lack of natural pollen sources at the beginning of the fall season. When bees are offered such diets, it is not known which ones they will choose. Saffari et al. (2010) reported that among three different commercial dry pollen substitutes (Feedbee®, Bee-Pro®, and TLS Bee Feed), Feedbee® was the most attractive. The protein, fat and carbohydrate contents of this product were 36.4%, 3.9%, and 51.8%, respectively. Gregory (2006) and De Jong et al. (2009) reported that these diets increased the protein level in the hemolymph. Furthermore, Gregory (2006) reported that pollen was the most effective in terms of lifespan and colony strength, followed by Feedbee®, Bee-Pro® products.

Recommendations for the use of dry diets;

- The feeding sites should be in the immediate vicinity of the colonies,
- It should be in a shady place without direct sunlight,
- It must be protected from the wind,
- Yellow and darker colored flours should be preferred,
- White flour is rarely preferred,
- It should have good moisture and oil content,
- Pollen sources must be scarce in nature,
- The bees need time to get used to it, there should be no rush.

Table 2. Diets and their proportions (g/100g)

Raw Materials	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5	Diet 6	Diet 7
Ground Rice Flour	20	-	-	-	-	-	15
Corn Flour	20	-	-	-	-	10	-
Breadcrumbs Flour	20	-	-	-	-	10	-
Wheat Flour	-	20	-	-	-	-	15
Einkorn Wheat Flour	-	20	-	-	-	-	15
Soybean Flour	-	20	-	60	-	10	-
Corn Gluten Powder	-	-	20	-	60	10	-
Rye Flour	-	-	20	-	-	10	-
Chickpea Flour	-	-	20	-	-	10	-
Wheat Bran	15	15	15	15	15	10	-
Skim Milk Powder	10	10	10	10	10	-	15
Dry Yeast Powder	3	3	3	3	3	-	15
Cinnamon Powder	2	2	2	2	2	-	15
Turmeric Powder	2	2	2	2	2	10	-
Ginder Powder	2	2	2	2	2	10	-
Rock Salt	1	1	1	1	1		-
Wheat Starch	5	5	5	5	5	10	10
Total	100	100	100	100	100	100	100

Figure 2. Different diets and forager bees' density

Conclusion

Honey bees have an important place in people's lives, even if many people are not aware of this. Measures must be taken to reduce the negative impact on these insects. We need to control pests and ensure the quality of food for bees. There is very little research on substitutes for dry pollen. There is a need for numerous studies like our study.

References

De Jong, D., da Silva, E. J., Kevan, P. G., & Atkinson, J. L. (2009). Pollen substitutes increase honey bee hemolymph protein levels as much as or more than does pollen. Journal of Apicultural Research, 48, 34–37.

Forbes, J. M. (1995). *Voluntary Feed Intake and Diet Selection in Farm Animals* (1st ed.). CAB International, Wallingford, U.K.

Ghosh, S., Jeon, H., & Jung, C. (2020). Foraging behavior and preference of pollen sources by honey bee (*Apis mellifera*) relative to protein contents. Journal of Ecology and Environment, 44, 4.

Güneşdoğdu, M., Bayram, A., Işıkber, A. A., Şekeroğlu, A., & Bozkurt, H. (2023). Insecticidal effect of a natural Turkish diatomaceous earth formulation on greater wax moth. Turkish Journal of Agriculture - Food Science and Technology, 11(12), 2372–2376. https://doi.org/10.24925/turjaf.v11i12.2372-2376.6436

Güneşdoğdu, M., Sarıoğlu-Bozkurt, A., Şekeroğlu, A., & Abacı, S. H. (2024). Changes in Vitellogenin, Abdominal Lipid Content, and Hypopharyngeal Gland Development in Honey Bees Fed Diets with Different Protein Sources. Insects, 15, 215. https://doi.org/10.3390/insects15040215

Gregory, P. G. (2006). Protein diets and their effects on worker weight, longevity, consumption and hemolymph protein levels of *Apis mellifera*. Proceedings of the American Bee Research Conference. http://www.feedbee.com/publications/downloads/ABRC.pdf

Huang, Z. (2012). Pollen nutrition affects honey bee stress resistance. Terrestrial Arthropod Reviews, 5(2), 175–189.

Saffari, A., Kevan, P. G., & Atkinson, J. (2010). Consumption of tree dry pollen substitutes in commercial apiaries. Journal of Apiculture Science, 54, 5–12.

Wilson, G. P., Church, D. C., Pound, K. R., & Schoknecht, P. A. (2005). *Basic Animal Nutrition and Feeding* (5th ed.). John Wiley & Sons, Hoboken, NJ, USA.

Zahra, A., & Talal, M. (2008). Impact of pollen supplements and vitamins on the development of hypopharyngeal glands and brood area in honey bees. Journal of Apiculture Science, 52(2), 5–12.