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Effect of Some Supplemental Foods on the Bioactivity of Honey Bees

Research Project
Submitted to the department of (Plant protection) in partial fulfillment of the requirements for the degree of BSc. in (Agriculture Engineering Science)

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CERTIFICATE

This research project has been written under my supervision and has been submitted for the award of the degree of BSc in Agriculture Engineering Science – Plant Protection Department.

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Dedication

This research project is dedicated to

My Creator and my Master (Allah),

My great teacher and messenger, Mohammed (May Allah bless and grant him), who taught us the purpose of life,

My great parents, who never stop giving of themselves in countless ways,

My beloved brothers and sisters who stand by me when things look bleak,

All the people in my life who touch my heart.

Taha

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Contents

Abstract

A field study was carried out in the Apiary in Grdarasha Research Station-College of Agricultural Engineering Sciences-Erbil-Kurdistan region-Iraq, to study the effect of three types of Supplemental foods on the bioactivity of Honey Bees. The tested foods were Diet1, Diet2 and Diet3 (Control). The results showed the highest mean numbers was obtained by fed on Diet1 (150g powders of chickpea, 20ml orange juice and 10g bee honey + one liter of sugar syrup) which was mean numbers of eggs, broods, pollen grains and honey was 292.00, 1485.00, 70.66 and 156.33 inch² respectively. While the lowest mean number of eggs, broods pollen grain and honey was obtained when fed on sugar syrup (control) which was 89.66, 845.00, 40.00 and 94.33 inch² respectively.

Chapter1. Introduction:

Honey bees are one of the most important living organisms on the earth due to their importance in pollinating various crops and horticultures that are important to humans, in addition to produce honey, wax, propolis, royal jelly and venom these products are also important for human health (Hassona, 2023).
Nutrition has a significant effect on the health of honey bees, their resistance to various diseases, and their ability to survive for a long time. (Pudasaini *et al.*, 2020). Honey provides energy for honey bees while pollen provides protein and is required for larval and adult stage growth (DeGrandi-Hoffman *et al.*, 2018).The health, fertility and viability of the honey bees are completely dependent on the quantity and quality of food that is consumed. Honey bees obtain all their nutritional needs from pollen, nectar and water, which are collected by the honey bee workers foraging from the environment surrounding the colonies. The worker honey bees provide the colonies with the proteins, nutrients and carbohydrates they need to build the colony and feed the brood (Wright *et al.*, 2018).

Pollens are essential food for honey bee colonies and their shortage intermittent periods cause several problems for the colonies. Completely absence of protein sources in the hive can cause starvation for honey bees and consider among potential reasons for colony collapse disorder. Therefore providing colonies with protein source all over the year, especially during dearth periods of pollen is a critical matter (Seitz *et al.*, 2022). The quality of food provided to honey bees in addition to its quantity has the greatest impact on the health and longevity of honey bee individuals (DeGrandi-Hoffman *et al.*, 2016). Periods of nectar and pollen scarcity affect very negatively the activity of honey bee colonies, which leads to beekeepers resorting to feeding honey bee colonies on pollen alternatives because they believe that they suffer from nutritional deficiency (Pande *et al.*, 2015). Honeybee colonies need pollen and nectar to support forager bees, generate heat to thermo regulate their nest and to rear brood. Nectar is a carbohydrate source, while pollen supplies the bees with the protein, lipids, vitamins, and minerals needed to rear larvae (Mesbah *et al.*, 2017).The supplementary diet food was a very important for the honey bee colonies to supply them by the proteins and vitamins especially in the period of time there were not pollen and nectar (Ahmad *et al.*, 2021). The protein supplement foods used to feed honey bee colonies are not a complete substitute for natural pollen; However, using several additional products such as brewer's yeast, wheat, and soybean flours separately or mixed together improves the feeding of the colonies at a time of natural pollen scarcity. Also, to compensate for the absence of nectar and honey for bees (Paray *et al.*, 2021).

Pollen supplementary feeding plays a vital role in the life of the honeybee colony. Honeybees require protein (amino acids), carbohydrates (sugars), lipids (fatty acids, sterols), vitamins, minerals (salts) and water to survive. These nutrients must be in the diet in a definite qualitative and quantitative ratio for optimum nutrition (Kim *et al.*, 2022). A protein supplemental diet is very important in the spring, as colonies fed by diet are more active than colonies not provided with diet supplementation. When colonies were supplemented with a protein diet in early spring, they were more active before the queen's mating season and healthier than others not supplemented. Supplemented food consumption was an important predictor of its quality (Hoover *et al.*, 2022). Several studies mentioned more attention to formulate supplementary diets or substitutes to compensate the lack of the natural protein source (Negri *et al.*, 2017); (Gamal Eldin *et al.*, 2018); (Younis, 2019). Moreover, different pollen types from different plant origin differently effects on the physiological conditions of worker honey bee (Amro *et al.*, 2016). Testing and utilization of different materials as pollen supplements have been mainly directed toward producing brood, and less attention has been given to the pollen gathering and honey production during the spring and summer seasons of the year. Protein supplementation is a key management tool to maintain the strength of bee colonies during the period of pollen shortage (Moja *et al.*, 2015).

The aims of this study were to:

1- Make a suitable pollen supplement made from some materials of high protein content and low cost.

2- Find the effect of supplemental food on the bioactivity of bees.

3- Evaluation the complementary diets of honey bees which have important roles in the development of honey bees.

Chapter2. Literatures Review

2.1. Importance of Honey Bees:

As it is known, not all insects are harmful to agriculture and its products, but many insects play an important role in increasing and protecting agricultural products some species of insects become parasites and predator on other harmful insects and others perform pollination between plants, this playing an important role in increasing and improving agricultural production(Khalifa *et al.*, 2021). Fikadu (2019) Indicated that the honey bees provide pollination services that are essential for reproduction and improving the quality and quantity of many agricultural crops. From the significant 53 crops cultivated (62.2%) of them are dependent on biological pollinators. Besides this, honey bees play a vital economic role and their contribution to pollination service in agriculture crops.

Kumar *et al.* (2018) Said that the one third of world agricultural production depends upon pollinators especially honey bees, nevertheless their significance, these pollinators die with alarming speed. Different factors including disease, parasites, climatic factors and flora are responsible for decline in honey bee population. Sometime bee keepers himself cause honey bees poisoning by use of honey bees protecting agents. It is also revealed that excess use of pesticides is key factor in deterioration of honeybee population. Hung *et al.* (2018) Stated that honey bees are the most frequent floral visitor in natural habitats worldwide, averaging 13% of floral visits across all networks (range 0–85%), with 5% of plant species recorded as being exclusively visited by honey bees. Champetier *et al.* (2015) Mentioned that the pollen and nectar collected by forager bees on crops are limiting resources for both bee growth and honey production. Torné-Noguera *et al.* (2016) Founded floral resource consumption in rosemary (*Rosmarinus officinalis*) and thyme (*Thymus vulgaris*) related these measures to visitation rates of honey bees, bumblebees (*Bombus terrestris*) that honey bees are the main contributors to pollen/nectar consumption of the two main flowering plants**.** Meo *et al.* (2017) Indicated the use of honey has a very long history. Honey has been used since ancient time due to its nutritional and therapeutic values. There had been varied ways of consumption honey including its use as a sweetener and flavoring agent. Honey is produced all over the world. The most important nutriment of honey is carbohydrates present in the form of monosaccharaides, fructose and glucose. Honey plays an important role as an antioxidant, anti-inflammatory, anti-bacterial agent and augments the adherence of skin grafts and wound healing process.

Ajibola (2015) Mentioned the honey is a sweet, flavourful liquid substance with several beneficial constituents. Extensive research has shown the therapeutic promise of the use of honey in enhancing health values and improving body systems. Honey is also evaluated for its wide acceptability as a complementary and alternative medicine for most ailments. All types of honey exhibit different biochemical activities and show greater variability in their potency as apitherapeutic agents than conventional medicines. The use of apitherapy in synergy with chemotherapy to manage microbial and cancer ailments is also helpful in reducing drug-induced cytotoxicity. The mechanistic insights into the overall protective, preventive, and therapeutic effects of honey portend the presence of a unique factor, a 'synergistic multiple ingredients factor', designated. Purbafrani *et al.* (2014) Showed that the honey contains a wide variety of vitamins, minerals, amino acids and antioxidants. The vitamins found in honey include niacin, riboflavin and pantothenic acid; minerals present include calcium, copper, iron, magnesium, manganese, phosphorus, potassium and zinc. In addition honey contains a variety of flavonoids and phenolic acids which act as antioxidants, scavenging and eliminating free radicals. Honey has had a long history in human consumption, and is used in various foods and beverages as a sweetener and flavoring. It also has a role in religion and symbolism. Medicinal importance of honey has been documented in the world's oldest medical literatures, and since the ancient times, it has been known to possess antimicrobial property as well as wound-healing activity. More than 1,400 years ago, honey is described as a source of healing in the Quran and it is also mentioned as one of the foods of Paradise.

Khan *et al.* (2018) Said honey use as a therapeutic agent is as old as human civilization itself. Prior to the appearance of present day drugs, honey was conventionally used for treating many diseases. At this instant, the modern research has proven the medicinal importance of honey. It has broad spectrum anti-biotic, anti-viral and anti-fungal activities. Honey prevents and kills microbes through different mechanism such as elevated pH and enzyme activities. Till now, no synthetic compound that works as anti-bacterial, anti-viral and anti-fungal drugs has been reported in honey yet it works against bacteria, viruses and fungi while no anti-protozoal activity has been reported. Nong *et al.* (2023) Indecated the beeswax is a naturally occurring product secreted from worker bees that has varied uses in modern day. In skincare, its function ranges from its role as an occlusive, helping to create a semi-occlusive skin barrier that minimizes transepidermal water loss; as a humectant, locking in hydration; and an emollient to soften and soothe the skin. As a natural substance, its use has been shown to help alleviate symptoms associated with common cutaneous conditions like dermatitis, psoriasis, and overgrowth of normal skin flora.

Basa *et al.* (2016) Said honey bees are the "Golden insects" that produce honey and other vital honeybee products. However, the best known primary products of honey bees are honey and bee wax, but pollen, propolis, royal jelly, bee venom, queen bees and their larvae are also marketable primary bee products. Worldwide the usage of such primary products as propolis, royal jelly and bee venom have increased mostly due to inclusion in cosmetics preparation. Medicinal use will increase once better and more detailed studies are completed, which however may not yet be in the very near future. Honey has medicinal uses like antiseptics and wound healing properties while propolis is used to treat diabetes patients. Additionally, pollen has antioxidant property and anticoagulant and anti-inflammatory properties of bee venom serve to treat arthritis and other inflammatory conditions. Pasupuleti *et al.* (2017*)* Mentioned the several health benefits that honeybee products such as honey, propolis, and royal jelly claim toward various types of diseases in addition to being food.

Collazo *et al.* (2021) Discovered the royal jelly is formed by different substances, mainly carbohydrates, proteins, and lipids, but also vitamins, minerals, and phenolic or volatile compounds in lower proportion. Major royal jelly proteins (MRJP) are, together with 10-hydroxy-2-decenoic acid (10-HDA), key substances of RJ due to their different biological properties. In particular, 10-HDA is a unique substance in this product. Royal jelly has been historically employed as health enhancer and is still very relevant in the world due to the traditional medicine and the apitherapy. Nowadays, it is mainly consumed as a functional food or is found in supplements and other formulations for its health-beneficial properties. Within these properites, anti-lipidemic, antioxidant, antiproliferative, antimicrobial, neuroprotective, anti-inflammatory, immunomodulatory, antiaging, and estrogenic activities have been reported for royal jelly or its specific components. This manuscript is aimed at reviewing the current knowledge on royal jelly components, their assessment in terms of authenticity, their biological activities, and related health applications.

2.2. Nutrition roles on honey bee development:

Adequate nutrition supports the development of healthy honey bee colonies. Larvae are especially dependent on protein and brood production is strongly affected by shortages of this nutrient. The number of larvae reared may be reduced to maintain the quality of remaining offspring. The quality of developing workers also suffers under conditions of larval starvation, leading to slightly affected workers. Larval starvation, alone or in combination with other stressors, can weaken honey bee colonies (Brodschneider and Crailsheim, 2010). Vaudo *et al.* (2020) Observed pollen and nectar are very important for bees and are the main source of foods for larvae and collect by forager bees in the agricultural fields from flowers and honey bees obtain their protein and lipid nutrient intake from pollen, which is essential for larval growth and development as well as adult health and reproduction. Nicolson (2011) Reported

that the honey bees consuming nectar and pollen throughout their life cycles. Nectar is primarily an energy source, but in addition to sugars contains various minor constituents that may, directly or indirectly, have nutritional significance. Pollen provides bees with the protein, lipids, vitamins and minerals that are essential for larval rearing. ULUTAŞ and ÖZKIRIM (2018) Mentioned the quality and the nutritious components of the food help bees to be healthy. Honey bee colonies health cannot be measured by the fact that they are purified from diseases. Colonial health status is also measured by the presence of well - nurtured individuals who can nurture new offspring in a healthy manner, and their ability to resist stress sources such as periodic starvation, infections, insecticides and parasites.

Bogdanov *et al.* (2008) Reported the variation of botanical origin honey differs in appearance, sensory perception and composition. The main nutritional and health relevant components are carbohydrates, mainly fructose and glucose but also about 25 different oligosaccharides. Although honey is a high carbohydrate food, its glycemic index varies within a wide range from 32 to 85, depending on the botanical source. Bryś *et al.* (2021) Stated the diet is an important factor in the proper development of the individual and the entire colony. A pollen diet affects honey bees in a number of ways. It can stimulate the number and type of hemocytes, the total number of proteins, carbohydrates and lipids, affect the histology of the middle intestine, and ensure the correct ontogenesis of the larvae. Huang (2012) Indicated that the poor pollen nutrition led to a reduction of worker bees' resistance to the microsporidian, Nosema apis, an increase of bee's sensitivity to pesticides, and an increased titer of bee virus. On the other hand, poly floral pollen made bees more resistant to stresses by enhancing their immune related enzyme activities. At the colony level, good pollen nutrition increased honey bee's resistance to Nosema ceranae or the ectoparasitic mite, Varroa destructor. The effects of both transportation and habitat changes on honey bees seem most likely mediated via decreased diversity, or amount, of pollen to the colonies. Pollen nutrition, therefore, might work together with other factors in reducing the bees' resistance and exacerbate the effects of viruses, pesticides, or parasites, eventually resulting in Colony Collapse Disorder.

2.3. Supplemental Food:

Suitable supplement of these nutrients play significant role in growth and development in honeybees and also development of immunity in honeybees (Pudasaini et al., 2020). Souza et al. (2023) Stated the food supplementation of honeybee colonies is, together with management and genetic breeding, one of the bases for high productivity in beekeeping. However, the proper balance of nutrients that make up the diet is essential for supplementation to have productive benefits for colonies and, consequently, for the beekeeper's profits. Nutrients play a key role in a variety of physiological functions of individuals and the colony, including reproduction, growth, development, production and overwinter survival. Food is obtained through the collection of floral resources in nature, but the beekeeper can

assist the colony by providing food supplementation during periods of scarcity or during productive activities with a high demand for energy and protein, such as the raising of the queen and the production of royal jelly.

Ullah *et al.* (2021) Discovered that soybean flour enriched artificial diet was maximally consumed (74.34 g) by honey bees per week. Minimum consumption was observed for grinded groundnut enriched diet (64.62 g) which was relatively lesser than the other tested artificial diets. Results of area of worker brood disclosed that soybean flour fortified diet (1489.27 cm^2 /colony) statistically noteworthy than the other artificial diets whereas control (463.51 cm^2/colony) was least effective. Highest bee strength (10.00 bee frames/colony) was noted in the bee colonies fed with soybean flour fortified diet, date paste (8.0 bee frames/colony) was the next effective one, among the tested pollen replacement diets whereas relatively least (5 bee frames/colony) was noticed in case of grinded groundnut. Highest body weight (12.41 g) of neonate bees was noted in case of soybean enriched diet while lowermost (5.31 g) was noted in control bees. Results of wax cell built up and foraging efficiency were also superior in artificial diets than respective control bees.

(Islam *et al.*, 2020) Recorded the highest consumption rate (71.90 g per colony), maximum sealed worker brood area (1562.0 cm^2 per colony), mean highest maximum (12 frames covered with bees per colony), and higher (9.2 kg honey per colony) when fed on (soybean flour + brewer's yeast + powdered sugar + Fenugreek and Turmeric powders + honey + orange juice + A, D and E vitamins + sugar syrup), as compared with control. (Younis, 2019) Recorded that the (chickpea flour + wheat germ + dried brewer's yeast) produced the highest average of biological activities, which were 105.54 g, 363.75 inch², 134.83 inch² and 404.08 inch²/colony for diet consumption, sealed workers brood area, stored pollen area and stored honey area, respectively. On the contrary, but the colonies fed on (pea flour + defatted soybean flour + dried brewer's yeast) produced the lowest average of biological activities, which were 77.0 g., 235.1 inch², 75.43 inch² and 258.39 inch²/colony for diet consumption, sealed workers brood area, stored pollen area and stored honey area, respectively. Amin and Ameen (2019) Showed that the highest numbers of workers prefer fed on dry yeast was 529.000 workers inside the hives and 252.333 workers outside the hives. The highest average age of longevity was 31.5 days when fed on dry yeast and the lowest average was 26.0 days fed on bean. The highest percentage of protein content in workers body was 48.922% fed with dry yeast and the lowest was 40.915% fed with bean. The workers fed on dry yeast gave the higher resistant to cooling at 15°C for 14 days, at 12°C for 11days at 8°C for 8 days and at 4°C 6 days for both dry yeast and broad bean. The workers fed with bean and sugar solution gave the lower resistant to cooling at 15°C for 11 days, at 12°C for 10 days, at 8°C for 6 days, at 4°C for 5 days. The highest average of body weights of mature larvae fed on dry yeast was 106.20 mg but the lowest was 79.45 mg fed on bean in spring season. The highest body weight of ten day old workers was 121.15 mg fed on broad bean and the lowest was 102.95 fed on bean in spring season.

Chapter3. Materials and Methods:

3.1. Study design and sampling:

The present research was conducted in the apiary of the Grdarasha station-Erbil starting from 20 February to 30 Marche 2024, to study the effect of some supplemental foods on the honey bees activities and production of (Eggs Broods, Pollen and Honey) under field condition as shown in figure (1). At the beginning of the research nine colonies of *Apis mellifera* were selected from apiary. These colonies were divided at random into three groups, each group included three replicates (colonies), and each colony nearly equalized in terms of brood, each colony included five frames to be homogenous and uniform in activity (Younis, 2019).

3.2. Tested Diets:

Three diets were selected to make to test them as supplemental foods (Table1). The seeds of (chickpea and maize) were grinded by electrical grinder until flour. The prepared diets were mixed in one liter of the sugar syrup by hand mixer until the powder was mixed completely in the sugar solution to provide the honey bee colonies.

Table (1) Tested diets

No.	Diet ingredients
1	150g powders of chickpea, 20ml orange juice and 10g bee honey + one liter of sugar syrup.
2	150g powders of maize, 20ml orange juice and 10g bee honey + one liter of sugar syrup.
3	One liter of sugar syrup (Control).

3.3. Treatment of Honeybee Colonies:

Every honeybee colony was received 150g. of the diet + one liter of sugar syrup (1:1) weekly during the experimental period. While, control colonies were received just one liter of sugar syrup (1:1) weekly for each one as shown in figure (2).

3.4. Sampling:

Areas of egg cells, workers brood cells, pollen grains cells and honey cells were measured in square inches by using a typical Langstroth wireframe divided into square inches before the beginning of the study and after feeding at 10 days intervals till the end of the experiment as shown in figure (3) (Younis, 2019).

3.5. Experiment design:

The study was performed by using R.C.B.D.; with three replications for testing three types of supplemental foods the tested diets included 150g powders of chickpea, 20ml orange juice and 10g bee honey + one liter of sugar syrup, 150g powders of maize, 20ml orange juice and 10g bee honey + one liter of sugar syrup and Sugar syrup.

3.6. Statistical Analysis:

The obtained data from the study were subjected to Excel program and the means were compared with each other using SPSS Program version 26 (Spss, 2018).

Figure (1) Apiary site station Grdarasha –Erbil City

Figure (2) Received food to the honey bee

Figure (3) Sampling method by typical Langstroth wire frame

Chapter4. Results and Discussions:

4.1. Effect of diets on honey bee bioactivity

4.1.1. Eggs area (inch²)

Table (2) provied data information about effect of three type dites on honey bee bioactivites in Grdarasha Apiary, Erbil city 2024.

According to the table number (2), the highest number of eggs affected byDiet1 (150g powders of chickpea, 20ml orange juice and 10g bee honey + one liter of sugar syrup) in 20/3/ was 292.00 inch² , while in the same day the lowest number was 89.66 inch² when fed on sugur syrup. Based on the statistical analysis and Duncan test of 0.5 significant levels, there are significant differences between Diet1and sugur syrup control.

Table (2): Mean areas (inch²) of eggs in honeybee colonies fed on three types of diets during 20 February to 30 March 2024

days of Sampling	Mean area of eggs Name of diets			Average
	Dite1	Diet2	Sugar syrup (Control)	
20/2/2024	43.66 a	26.33 b	10.33 c	26.77
1/3/2024	64.00 a	40.66 b	18.33 c	41.00
10/3/2024	90.33 a	80.66 a	94.66 a	88.55
20/3/2024	292.00 a	115.00 b	89.66 b	165.55
30/3/2024	188.33 a	110.33 a	95.00 b	131.22

Means with different letters in a row significantly different based on Duncan test, 0.5 significant level.

4.1.2. Broods area (inch²)

Table (3) provied data information about effect of three type dites on honey bee bioactivites in Grdarasha Apiary, Erbil city 2024.

According to the table number (3), the highest number of broods affected by Diet1(150g powders of chickpea, 20ml orange juice and 10g bee honey + one liter of sugar syrup) in 30/3/ was 1485.00 inch² , while in the same day the lowest number was 845.00 inch² when fed on sugar syrup. Based on the statistical analysis and Duncan test of 0.5 significant levels, there are significant differences between Diet1and sugar syrup (control).The findings of this study are in agreement with those

reported by (Younis, 2019) Recorded that the (chickpea flour + wheat germ + dried brewer's yeast) produced the highest average of biological activities, which were 105.54 g, 363.75 inch², 134.83 inch² and 404.08 inch²/colony for diet consumption, sealed workers brood area, stored pollen area and stored honey area, respectively.

Table (3): Mean areas (inch²) of workers brood in honeybee colonies fed on three types of diets during 20 February to 30 March 2024

days of Sampling	Mean area of broods			Average
	Name of diets			
	Dite1	Diet2	Control	
20/2/2024	130.00 a	71.33 b	52.33 b	84.55
1/3/2024	250.66 a	173.66 b	136.33 b	186.88
10/3/2024	392.00 a	211.66 b	197.66 b	267.11
20/3/2024	1135.33 a	818.66 b	798.33 b	917.44
30/3/2024	1485.00 a	1144.33 b	845.00 c	1158.11

Means with different letters in a row significantly different based on Duncan test, 0.5 significant level.

4.1.3. Pollen grains area (inch²)

Table (4) provied data information about effect of three type dites on honey bee bioactivites in Grdarasha Apiary, Erbil city 2024.

According to the table number (4), the highest number of broods affected by Diet1 (150g powders of chickpea, 20ml orange juice and 10g bee honey + one liter of sugar syrup) in 30/3/ was 70.66 inch² , while in the same day the lowest number was 40.00 inch² when fed on sugar syrup. Based on the statistical analysis and Duncan test of 0.5 significant levels, there are significant differences between Diet1and sugar syrup (control).

Table (4): Mean areas (inch²) of pollen grain in honeybee colonies fed on three types of diets during 20 February to 30 March 2024

days of Sampling	Mean area of pollen grain			Average
	Name of diets			
	Dite1	Diet2	Control	
20/2/2024	7.00 a	4.00 a	2.33 b	4.44
1/3/2024	10.33 a	8.66 b	3.33 c	7.44
10/3/2024	48.00 a	25.66 b	49.33 a	41.00
20/3/2024	64.00 a	36.33 b	48.00 a	49.44
30/3/2024	70.66 a	47.33 b	40.66 b	52.88

Means with different letters in a row significantly different based on Duncan test, 0.5 significant level.

4.1.4. Honey area (inch²)

Table (5) provied data information about effect of three type dites on honey bee bioactivites in Grdarasha Apiary, Erbil city 2024.

According to the table number (5), the highest number of broods affected by Diet1 (150g powders of chickpea, 20ml orange juice and 10g bee honey + one liter of sugar syrup) in 30/3/ was 156.33 inch² , while in the same day the lowest number was 94.33 inch² when fed on sugar syrup. Based on the statistical analysis and Duncan test of 0.5 significant levels, there are significant differences between Diet1and sugar syrup (control).

Table (5): Mean areas (inch²) of honey in honeybee colonies fed on three types of diets during 20 February to 30 March 2024

days of Sampling	Mean area of honey			Average
	Name of diets			
	Dite1	Diet2	Control	
20/2/2024	26.66 a	11.66 a	11.66 a	16.66
1/3/2024	53.00 a	40.00 a	6.33 b	33.11
10/3/2024	84.33 a	149.66 a	90.00 a	108.00
20/3/2024	121.00 a	145.00 a	100.33 a	122.11
30/3/2024	156.33 a	94.66 b	94.33 b	115.11

Means with different letters in a row significantly different based on Duncan test, 0.5 significant level.

Conclusion:

Depending on the results of the present study, it can be concluded that the diet1(150g powders of chickpea, 20ml orange juice and 10g bee honey + one liter of sugar syrup) had a highest effect on the honey bee bioactivity from production of eggs, brood, honey and stored pollen grain.

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