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STUDYING THE EFFECT OF USING SUPER PROTEIN, VITAMIN C AND E AS A FOOD SUBSTITUTE IN HONEYBEE COLONY ACTIVITY

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ABSTRACT

The research was conducted in a native apiary in Baghdad Governorate- Al-Buaitha, to evaluate the effect of adding super protein, vitamin C and vitamin E to the diet of honeybee colonies, and to study their effect on the activity, growth, development and productivity of the colonies of honey.

The results of the research showed that super protein nutrition achieved the best percentages, and according to the results of the statistical analysis, it significantly outperformed the sugar solution feeding and control, in terms of measuring the honey area 2.631 cm^2, the brood area 1.622 cm^2 and the pollen area 0.378 cm^2.

The results of the use of vitamins also showed that the best treatments were using vitamin C nutrition, and according to the results of the statistical analysis, it significantly outperformed all other treatments in terms of measuring the honey area 3.820 cm^2 and the brood area 1.821 cm^2 and pollen area 0.608 cm^2. The results showed that vitamin E nutrition outperformed the sugar solution feeding and control, as the average area of honey, brood and pollen grains were (2.960 cm^2, 1.624 cm^2 and 0.473 cm^2) respectively.

Keywords: Apiary, Honeybees, Vitamins, Proteins.

* **The research is derived from the master's thesis of the first researcher.**

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دراسة تأثير استخدام السوبر بروتين، فيتامين C و E كبديل غذائي في نشاط طوائف نحل العسل

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الخلاصة

أجري البحث في منحل اهلي في محافظة بغداد - البوعيثة لتقييم تأثير إضافة السوبر بروتين وفيتاميني C و E الى غذاء طوائف نحل العسل، ودراسة تأثيرها على نشاط ونمو وتطور وانتاجية الطوائف للعسل. بينت نتائج البحث أن التغذية بالسوبر بروتين حققت افضل النسب وبحسب نتائج التحليل الاحصائي فقد تفوقت معنوياً على التغذية بالمحلول السكري والمقارنة من حيث قياس مساحة العسل 2.631 سم^2 ومساحة الحضنة 1.622 سم^2 ومساحة حبوب اللقاح 0.378 سم^2. كما بينت نتائج استخدام الفيتامينات أن افضل المعاملات كانت باستخدام التغذية بفيتامين C وبحسب نتائج التحليل الاحصائي فقد تفوقت معنوياً على جميع المعاملات الاخرى من حيث قياس مساحة العسل 3.820 سم^2 ومساحة الحضنة 1.821 سم^2 ومساحة حبوب اللقاح 0.608 سم^2. اظهرت النتائج ان التغذية بفيتامين E تفوقت على التغذية بالمحلول السكري و المقارنة اذ بلغ متوسط مساحة العسل والحضنة وحبوب اللقاح (2.960 سم2، 1.624 سم2 و 0.473 سم2) على التوالي.

الكلمات المفتاحية: المنحل، نحل العسل، الفيتامينات، البروتينات.

INTRODUCTION

honeybees *Apis mellifera* live in colonies, it is a social insect, The colony lives cooperatively, and the queen controls all members of the colony through her pheromone secretions. and the colony consists of several hundred males and thousands of workers, as its numbers depend on the surrounding environmental conditions of temperature, relative humidity, and vegetation cover **(Al-Sayegh & Mustafa, 2003; Ramal, 2005).**

There are also different types of bees in Iraq **(Augul, 2018)**. Bees and their products have many nutritional and medical benefits, as the royal jelly of honeybees is used to increase sperm activity in artificial insemination in field animals **(Hussin, 2015).**

Pollen grains are a source of vitamins, proteins, fats and minerals necessary to build body tissues, as the colony consumes some of the flowers it collects from pollen and nectar to sustain its various vital activities, and more than it needs it stores in the hexagonal eyes to benefit from it when needed **(White, 1993; Taha, 2015).**

Pollen alternatives mean any nutrient medium provided to bees and contains a protein source alternative to pollen, pollen supplements mean the nutrient medium for bees and contains a protein source added to it (5-25%) pollen **(Standifer, 1980).**

The importance of vitamins is evident during brood breeding, as the larva grows fully in the communities that fed their adults on industrial food containing vitamins, and the absence of vitamins leads to the death of the larva on the third or fourth day of its life, as well as the workers are able to raise the brood when fed on Inositol sugar in industrial food **(Nation & Robinson, 1968; Dadd, 1973).**The bee density of the colonies increases when fed with vitamins, proteins and sugar solution in November and December, which increases the amount of sealed and open honey, pollen area, eggs and larvae, as they pass the winter in good condition and give the highest weights **(Mansor *et al*., 2021).** Pollen substitutes and brood pheromone Super boost stimulate brood growth, honey space, and build wax foundations **(Shaher & Nasrallah, 2018).**

Honeybees are exposed to many insect and disease pests, such as *Nosemia serana*, which is the most common pest and most influential on members of the colony **(Abdulhay &**

Yonius, 2020). Fructose-loving lactic acid bacteria are a mechanism of protection or vital enhancers against diseases **(Saleh, 2020)**. Lactic acid bacteria are found in the stomach of honeybees **(Khaled & Ward Shaher, 2021).**

The greater wax worm is one of the important insect pests that infect beehives, as a study was conducted in which the alcoholic extract of the leaves of the dodonia plant was used against this pest due to its availability in the Iraqi environment and ease of extraction **(Mohammed & Nawar, 2020)**. There is a type of bacteria used to protect the waxy frames of honeybee hives from infection with the greater wax worm **(Al-Jassani & Dawi, 2013)**.

The eastern hornet is one of the pests to which bees are exposed, causing their death or the migration of members of the beehive's colony **(Glaiim, 2009).** Several studies have been conducted to determine the type of varroa that infects beehives in Iraq **(Awwad & Shaher, 2023).** Environmental pollution is one of the most important factors that have an impact on honeybee populations directly and indirectly **(Ward & Manjy, 2020).**

In view of the importance of nutrition in the life of honeybee colonies, the study aimed to use the super protein food alternative and add vitamins (E and C) to the diet of the bee colonies, with the aim of increasing the efficiency of queen bees in laying eggs, worker activity and increasing production, and studying its effect on the area of honey, brood and pollen.

MATERIALS AND METHODS

Prepare honeybee colonies

The study was conducted in the province of Baghdad - Al-Buaitha in a special apiary, as (15) homogeneous cells were selected in terms of the activity of the colony (the number of frames on which the bees work) product, the study was conducted on two seasons, the autumn season for the period from 1/9/2022 - 1/12/2022 and the spring season for the period from 1/1/2023 - 1/4/2023 by three replicates (cells) for each treatment (Super Protein, vitamin C, vitamin E, control treatment and sugar solution).

Preparing bee food

Use the super protein supplement from the Lebanese company Eiffel at the rate of (1 ml/ liter of water), vitamin C and vitamin E, using (vitamin E 1 ml/ liter of water) for each treatment, (vitamin C 10 g / liter of water) for each treatment, where feeding was done twice a week for all cells, and then measurements were taken for honey area, brood area and pollen area every 14 days.

Statistical design and analysis:

The experiments were designed according to the randomized complete block design (RCBD), and the results were analyzed statistically according to the analysis of variance (ANOVA) method, Analysis Of Variance, and the significant differences between the means were compared by the Least Significant Difference (LSD) test at the level of 0.05 **(Al-Sahoki & Wahib, 1990).**

RESULTS AND DISCUSSION

Effect of treatments on honey area.

The results of Table (1) showed that feeding the colonies with super protein and vitamins had an effect on increasing the area of honey, with the treatment of vitamin C superior to the rest of the treatments with significant differences between the treatments according to the statistical analysis, as the average area of honey was 2.631 cm^2, 3.820 cm^2, 2.960 cm^2, 2.529 cm^2 and 1.997 cm^2 for the treatment of super protein, vitamin C, vitamin E, sugar solution and control respectively. The best feeding period was during the months (November and January) with an average of 3.628 cm^2 and 4.069 cm^2 respectively.

Feeding honeybee populations with protein supplements increased honey area compared to sugar solution feeding **(Mattila & Seeley, 2010; Nabors, 2000).** Use a food substitute (super protein) The results of the study showed a good improvement in the performance of members of the honeybee colonies, as a positive effect was observed in terms of honey area and brood, and the colonies produced more honey than the control treatment, so it is recommended to use it to improve their strength **(Nabors, 2000).** This is consistent with the results of the research.

It was found in a study that the addition of sugar solution when feeding honeybee colonies in a ratio of 1:1 during the spring season and a ratio of 1:2 during the winter season has an effect on the growth and activity of bees **(Abou-Shaara *et al*, 2017).** Feeding dates should also coincide with the colony's need for food to obtain positive results **(Noordyke *et al*., 2021)**.

Table (1): Effect of adding super protein and vitamin C and E on honey area.

Treatments	Honey area / cm^2				Average Treatments
	27/10/2022	10/11/2022	24/01/2023	07/02/2023	
Super protein	2.148	3.233	3.834	1.308	2.631
V.C.	3.370	4.840	5.274	1.797	3.820
V.E.	1.744	3.840	4.273	1.982	2.960
sugar solution	1.667	3.393	3.537	1.517	2.529
control	1.500	2.833	3.429	0.225	1.997
Lsd0.05	0.238**				0.119**
Average Date	2.086	3.628	4.069	1.366	
Lsd0.05	0.107**				

Effect of treatments on brood area

The results of Table (2) showed outperformed of the treatment of super protein, vitamin C and vitamin E over the two treatments of sugar solution and control when measuring the brood area, and the statistical analysis showed significant differences between the treatments, as the average brood area was 1.622 cm^2, 1.821 cm^2, 1.624 cm^2, 0.987 cm^2 and 0.766 cm^2 for the treatment of super protein, vitamin C, vitamin E, sugar solution and control respectively.

The best feeding period was recorded during the months (November and February) with an average brood area of 1.339 cm^2 and 2.042 cm^2 respectively.

When supplemental alternative food is the only food available, it leads to increased brood area and adult population **(Degrandi-Hoffman *et al*., 2008).** Feeding with pollen substitutes motivated queens to lay more eggs, and encouraged workers to raise more broods, the increase in brood breeding has positive results on the number of colonies, pollen area and honey area (**Ghazala *et al*., 2006; Nabors *et al*., 2018).**

Herbert & Shimanuki (1978) showed that feeding honey beehives with vitamin C gave the highest average brood area, as bees raised more brood. Also, adding vitamins to the diet of bees led to a significant improvement in the amount of brood and thus increased its area **(Beck & Strand, 2007)**. Eggs raised by bees fed with vitamin C are heavier than those that have not been fed, and these results are consistent with those of other research **(Herbert *et al*., 1976).**

Table (2): Effect of adding super protein and vitamin C and E on brood area.

Treatments	Brood area / cm^2				Average Treatments
	27/10/2022	10/11/2022	24/01/2023	07/02/2023	
Super protein	1.140	1.577	1.589	2.183	1.622
V.C.	1.388	1.700	1.442	2.755	1.821
V.E.	0.512	1.642	1.488	2.855	1.624
sugar solution	0.700	0.943	0.955	1.350	0.987
control	0.467	0.833	0.696	1.067	0.766
Lsd0.05	0.259**				0.130**
Average Date	0.841	1.339	1.234	2.042	
Lsd0.05	0.116**				

Effect of treatments on pollen area

The results of Table (3) and according to the statistical analysis showed that there are significant differences between the treatments, as the super protein treatment gave the least area for pollen and the average area was 0.378 cm^2. While the sugar solution treatment and control outperformed the super protein treatment, the average pollen area was 0.453 cm^2 and 0.458 cm^2 for the two treatments, respectively. The reason for this is that pollen is mainly a source of protein, so the hives need for protein is low. The statistical analysis showed that feeding the colonies with vitamin C and vitamin E outweighs the nutrition with vitamin C over all other treatments when measuring the area of pollen, The average pollen area was 0.608 cm^2, while the pollen area for vitamin E treatment was 0.473 cm^2, outperforming the treatment with sugar solution and control.

Through our results, we notice that there is a positive relationship between food consumption and brood breeding and storing honey and pollen during the winter, compared to the control treatment and this is consistent with the results mentioned by the researchers **(Nabors, 2000; Mattila & Seeley, 2010)**. The importance of protein increases only at the time of scarcity, and the consumption of the supplement decreases when natural food is available **(Nabors, 2000).**

Mansor *et al*. (2021) found that feeding bee colonies with proteins, vitamins and sugar solution in November and December outperformed the control treatment in terms of bee density, sealed and open honey area, pollen area and egg and larval area, as it passed the winter in good condition and gave the highest weights.

Table (3): Effect of adding super protein and vitamin C and E on pollen area.

Treatments	Pollen area / cm^2				Average Treatments
	27/10/2022	10/11/2022	24/01/2023	07/02/2023	
Super protein	0.733	0.478	0.000	0.300	0.378
V.C.	0.563	0.185	1.442	0.242	0.608
V.E.	0.695	0.535	0.275	0.386	0.473
sugar solution	0.417	0.715	0.295	0.383	0.453
control	0.333	0.167	0.696	0.637	0.458
0.05Lsd	0.182**				0.091**
Average Date	0.548	0.416	0.542	0.390	
0.05Lsd	0.081**				

CONCLUSIONS

It is preferable to add super protein, vitamin C and E in feeding honeybee colonies because of its importance in increasing production.

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