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DIFFERENT SUPPLEMENTARY PROTEIN DIETS AND THEIR EFFECTS ON SEASONAL BIOLOGICAL ACTIVITIES LOCAL CARONIOLAN HYBRID BEE (*Apis mellifera* L.) STRAIN.

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ABSTRACT

This study is carried out in the village of Awlad Mousa, the center of the eastern Abu Kabir, Sharkia, Egypt on private apiaries 18 cells Carniolan hybrid bee strains. The results showed that feeding the honeybee colonies on dried brewer's yeast (Sccharomyces Sp.) at 25% concentration (Diet D) at 14 day intervals for two month of spring season (25/3 - 29/5/2015) produced more broods average 1168.64 ± 10.47 worker broods/day with a higher brood rearing rate than the other feeding regimes in the experiment.

The mean areas of pollen stored by Local Caroniolan hybrid bee strain colonies during the (summer period) period from Jun 1st, 2015 until Oct. 6th, 2015, measured at 14-day intervals. Carniolan hybrid colonies stored 1418 sq. inch. of pollen /colony during experiment period. Statistical analysis indicated that Artificial feed colonies stored significantly more pollen than by control colonies at all measuring date.

Summed data showed that the overall mean of sq. inches sealed honey stored by Diet (B) (401 sq. inch. /3 colonies) was significantly higher that stored by other colonies having other diets in descending order F, A, C, D and E they were 348, 337, 330, 302, 281 and sq. inch. /colony, respectively .

***Conclusively**, from these results it could be concluded that the best diet for stored honey bee by Diet B than the other feeding regimes in the experiment.*

Key words: Feeding, honey bee colony, *Apis mellifera,* protein supplement & substitute, sugar syrup, pollen cake, brood rearing, stored honey & pollen.

INTRODUCTION:

Experiments were conducted during the different seasons of one successive year started from January 2015 to end December 2015 investigate the effect of prepared diets as pollen substitutes on some

biological activities of honeybee colonies (brood rearing, honey and pollen storage) during studying season.

Honey and pollen are the natural food of the honey bees; from which they obtain carbohydrates, protein, minerals and vitamins essential for development and reproduction.

Great efforts have been devoted by many research workers (Taha *et al.* 2006, Ashour *et al.* 2008 and Abusabbah *et al.* 2012) in the field of honey bee nutrition to find out food materials which could be fed to honey bee colonies, in case of insufficiency or lack of natural nectar or pollen sources. Beekeepers can feed colonies of honey bees supplemental protein diets. These proteins are either fed as "pollen supplements" or "pollen substitutes". A pollen substitute is any material which, when fed to colonies of honey bees, replaces the pollen requirement of that colony for a short period of time. The same pollen substitute or any other proteins becomes a pollen supplement when pollen is added to the diet as an attractant or to increase its nutritive value (Graham 1992).

Engaging the honeybee colonies in pollen collection during flow period is expensive. That is why, development of a pollen substitute diet is most essential for feeding honey bee colonies during dearth period (Sharma and Gupta, 2006).

The development of a cheap and acceptable pollen substitute diet is the prime need of beekeepers especially in the developing countries where summer is very harsh and dry and there is also floral death combined with high temperature and incidence of several pests, predators and enemies of honeybees. (Sharma and Gupta, 2006).

The pollen substitute soya based diet was acceptable and palatable to the honeybees and could also sustain the honeybee colonies leading to some honey production (Sharma and Gupta, 2006 & Moja *et al.* 2015).

Therefore, the aim of the present is to study the rate of bee incineration, investigated the efficacy of supplementary feeding by use certain cheap carbohydrate and protein food materials which are available in the local market for feeding honey bee colonies on build-up of honeybee colonies for autumn and spring division and good wintering, amount of honey production, pollen storage area, brood rearing area.

MATERIALS AND METHODS

Experiments were conducted during the different seasons of one successive year started from January 2015 to end December 2015

investigate the effect of prepared diets as pollen substitutes on some biological activities of honeybee colonies (brood rearing, honey and pollen storage) during studying season.

18 bee colonies of the *Apis mellifera* L. for the first hybrid were selected with equal force and age. Communities were randomly allocated to six groups in each of three colonies. Each group was treated with one of the following tested diets.

Five diets were used as pollen substitutes (Fig.1) as follows:

Diet (A) Liquid yeast (*Candida tropicalis)* at 25% concentration. The diet was prepared as follows; 1000 gm sugar + 250 ml. liquid yeast + 750 ml. water.

Diet (B) Dried brewer's yeast (*Sacharomyces* Sp.) at 25% concentration and prepared as follows; 1000 gm sugar + 250 gm. dried brewer's yeast + 750 ml. water.

Diets A & B were introduced to the bee colonies in the liquid form using plastic feeders

Diet (C) was consisted from; 400 ml. liquid yeast (*Candida tropicalis*) + 200 gm. soya bean (lipid free) + 300 gm. bran + 100 gm. corn flour + 1000 gm. sugar.

Diet (D) was prepared from; 200 gm. dried brewer's yeast (*Sacharomyces* Sp.) at 25% concentration + 400 gm. soya bean (lipid free) + 400 gm. barley (apical + roots) +1000 gm. sugar.

Diet (E) colonies were fed on commercially available natural pollen pie so it can have pollen supplemented from fresh pollen that were available in bee market suppliers.

Diets C, D and E were introduced to the bee colonies in the paste , Whereas sugar syrup **(Diet F)** was used as control as follows - 1000 gm. sugar + 1000 ml. water.

Thousand ml. from each sugar syrup **(control, diet F)** and **diets A and B** were introduced to the tested colonies every 14 days' intervals during spring and summer seasons, while, 250 gm. from **diets C, D** and **diets E** were introduced to the tested colonies every 14 days' intervals during spring and summer seasons. The diets were placed between the top bars of the brood combs (brood nest). To prevent the dryness of these diets plastic cover with holes was used to cover these diets.

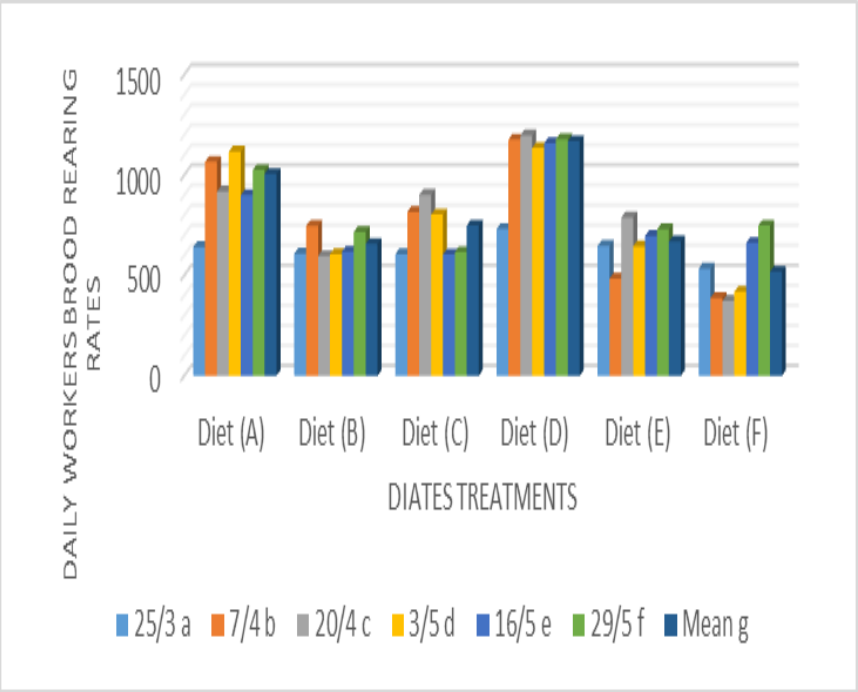

Fig. (1): Average daily worker brood rearing rates before and after feeding honeybee colonies on six different diets during spring season of 2015.

1. Measurement the incubation area (Brood rearing area) for each cultured area.

Calculation of the area of incubation of male and female workers by using a special scale, which is a transparent slide of the size of the frame divided into squares of 2.56 cm 3 (1.6 x 1.6 cm). Each box has 12 hexagonal eyes. The squares were numbered horizontally and vertically (El - Dakhakhni, 1995).

***2. Measurement the pollen storage area within the cultivar* (Fig.2):**

It was measured by a boxed square metal frame (It was a transparent slide of the size of the frame divided into squares of 2.56 cm 3 (1.6 x 1.6 cm). Each box has 12 hexagonal eyes) which the squares were numbered horizontally and vertically and the mean amounts of storage pollen every 14 day intervals (in^2.)/colony were recorded (El - Dakhakhni, 1995).

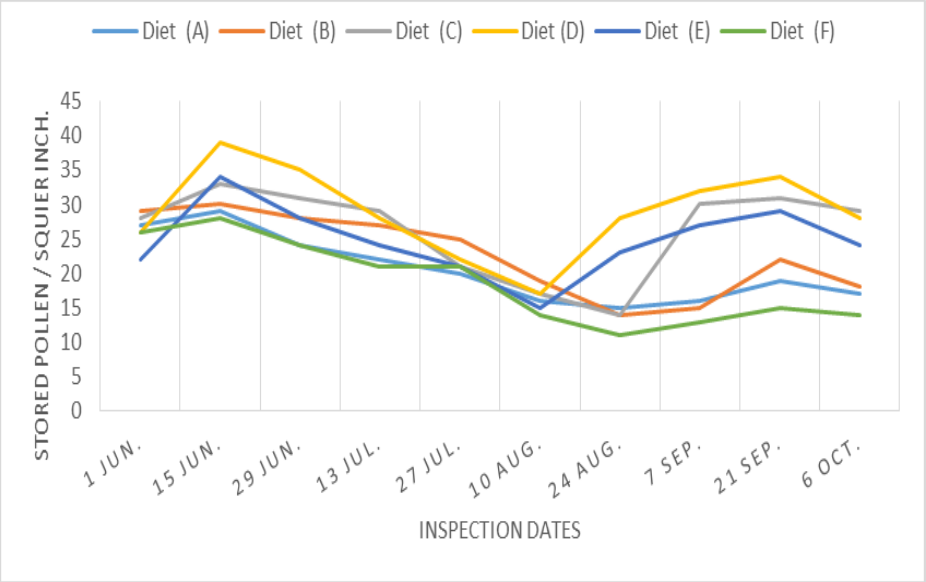

Fig. (2): The average measurement of stored pollen in inch^2 before and after feeding honeybee colonies on six different diets during summer season of 2015.

3. ***Measuring the storage honey area within the cultivar*.**

It was measured every 14 days by a boxed square box metal frame and the mean amounts of storage honey (in^2.)/colony and similarly calculated in measurement the pollen storage area **(El - Dakhakhni, 1995)**.

In the end of study, honey yield was weighed in Kg to determine the highest alternatives for honey production compared to control and natural alternatives.

***Statistical analysis*:**

Data were analyzed by the least square analysis of variance according to **Snedecor and Cochran (1982)** using the General Linear Model Procedure (**SAS, 2004**) at the 5% level of significance as the following model:

$$Y_{ijk} = \mu + N_i + Rj + e_{ijk}$$

Where: Y_{ij} = Any observation, μ = Overall mean, N_i = Effect of treatment diets (i = 1….6), Rj= Replicates(j1,2……..,10), e_{ijk} = Experimental random error.

All percentages, data were transferred to percentage angle using arcsine equation before subject to statistical analysis. Significant differences among means were tested using Duncan Multiple New Range Test (Duncan, 1955).

RESULTS AND DISCUSSION

1. Measurement the incubation area (Daily Brood Rearing Rate):

The results showed that feeding the honeybee colonies on dried brewer's yeast (*Sccharomyces* Sp.) at 25% concentration (Diet D) at 14 day intervals for two month of spring season (25/3 - 29/5/2015) produced more broods average 1168.64 ± 10.47 worker broods/day with a higher brood rearing rate than the other feeding regimes in the experiment as shown in Table 1. This may be due to that it contains barley (apical + roots), soya bean (lipid free), dried brewer's yeast (*Sccharomyces* Sp.) at 25% concentration and 1000 gm sugar more than the other diet regimes.

The data in Table 1 also show that the feeding of honeybee colonies on Liquid yeast (*Candida tropicalis*) at 25% concentration was the second in category, averaged 1004.88 ± 41.96 worker broods/day. The general means of brood rearing rates in colonies fed on 1000 gm. Sugar +1000 ml. water (as a control) on plain sugar came the last in order in brood rearing rate when compared to the average rate of brood rearing fed on diet D.

Table (1): Average daily worker brood rearing rates after feeding honeybee colonies on six different diets during spring season of 2015, and their relationships.

Periods	Diets						F value	L.S.D.
	(A)	(B)	(C)	(D)	(E)	(F)		
25/3 a	641.83	608.65	605.77	730.77	646.64	533.65	In sign.	
7/4 b	1065.87	746.64	815.87	1175.96	484.14	387.5	4.05	465.39
20/4 c	917.31	596.15	900.96	1196.63	788.46	372.59	3.53	457.05
3/5 d	1116.35	605.77	802.88	1134.62	644.71	418.27	5.53	370.65
16/5 e	900	617.83	604.29	1158.08	696.77	662.5	12.75	182.97
29/5 f	1024.90	715.87	615.31	1177.89	729.24	747.36	17.45	156.39
General	1004.88	656.45	747.86	1168.64	668.66	517.64	9.42	239.69

2. Measurement the pollen storage area within the cultivar:

The mean areas of pollen stored by Local Caroniolan hybrid bee strain colonies during the (summer period) period from Jun 1st, 2015 until Oct. 6th, 2015, measured at 14-day intervals (Table 2). Carniolan hybrid colonies stored 1418 sq. inch. of pollen /colony during experiment period. Statistical analysis indicated that Artificial feed colonies stored significantly more pollen than by control colonies at all measuring date. Also, summed data showed that the overall mean of pollen stored by Carniolan hybrid colonies have type Diet (D) was the significantly higher (289 sq. inch. /colony) than the different types of Diets and it were 263, 247, 227, 205 and 187 sq. inch. /colony, respectively. The changes in amounts of pollen stored in hives were found to follow the pattern of brood rearing activity. Colonies adjust their pollen foraging effort in Accordance with the pollen needs.

Table (2): The average measurement of stored pollen in inch^2 after feeding honeybee colonies on six different diets during summer season of 2015.

Periods	Diet (A)	Diet (B)	Diet (C)	Diet (D)	Diet (E)	Diet (F)	Total squi. Inch. Stored pollen
1 Jun.	27	29	28	26	22	26	
15 Jun.	29	30	33	39	34	28	
29 Jun.	24	28	31	35	28	24	
13 Jul.	22	27	29	28	24	21	
27 Jul.	20	25	21	22	21	19	
10 Aug.	16	19	17	17	15	14	
24 Aug.	15	14	25	28	23	11	
7 Sep.	16	15	30	32	27	13	
21 Sep.	19	22	31	34	29	15	
6 Oct.	17	18	29	28	24	14	
Sum.	205	227	263	289	247	187	**1418**
Average %	**14.5**	**16**	**18.5**	**20.4**	**17.4**	**13.2**	

3. Measuring the storage honey area within the cultivar.

Mean amounts of sealed honey stored by Carniolan hybrid colonies, measured at 14-day intervals. Colonies stored 33326.63 gm of sealed honey/18 colonies /colony during experiment period stored by Carniolan hybrid colonies (Table 3). Statistical analysis revealed that Carniolan hybrid colonies stored significantly more sealed honey when fed on the Diet (B) compared with Diet F as control.

Table (3): The average measurements in square inches of stored honey before and after feeding honeybee colonies on six different diets during summer season of 2015.

Periods	Diet (A)	Diet (B)	Diet (C)	Diet (D)	Diet (E)	Diet (F) Control	Total gm. Weights / 18 colonies in the end of experiment
1/6	38	54	36	34	29	43	
15/6	44	59	39	36	32	45	
29/6	38	48	37	32	28	32	
14/7	32	37	32	31	25	23	
28/7	29	26	28	27	21	28	
11/8	24	24	25	25	19	32	
25/8	23	30	29	27	30	41	
8/9	24	31	35	30	32	44	
22/9	46	54	39	32	38	31	
6/10	39	38	30	28	27	29	
Total gm. / 3 colonies *	7110.34	8627.99	4666.82	4369.39	3447.75	5104.34	**33326.63**
Average %	21.35	25.86	14.00	13.10	10.35	15.34	100

*Total gram weighted in the end of experiment / 3 colonies

Thus, summed data showed that the overall mean of sq. inches sealed honey stored by Diet (B) (401 sq. inch. /3 colonies) was significantly higher that stored by other colonies having other diets in descending order F, A, C, D and E they were 348, 337, 330, 302, 281 and sq. inch. /colony, respectively (Figure 3).

The pattern of fluctuations in honey storage activity was not similar to that observed in pollen storage activity. But, the higher colony type in pollen storage activity were in the lower two in honey storage activity at most dates. If the pollen storage activity increases, it is possible that this will result in lower availability of field worker bees for nectar gathering, hence in decreased honey storage activity. In addition, the greater quantity of pollen stored in the hives may stimulate extensive brood rearing. These hives would turn out more populous after one cycle of brood rearing. As a result, more stored honey would be consumed.

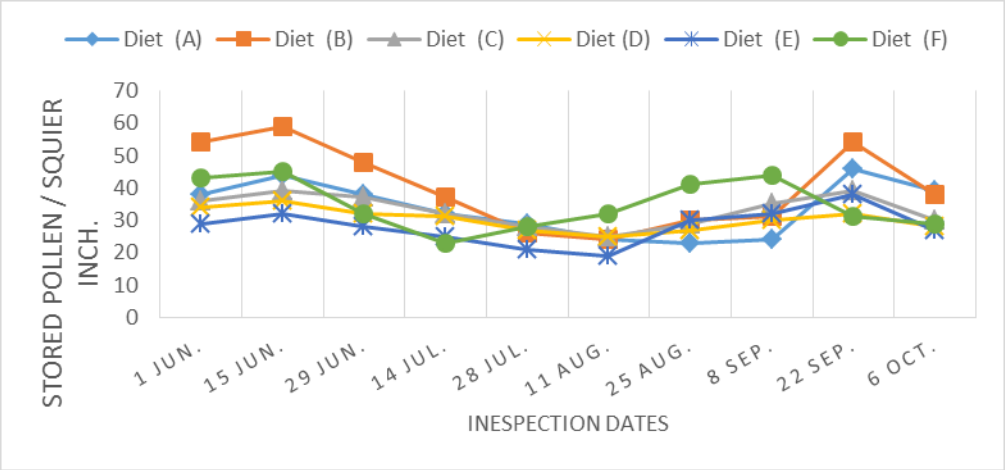

Fig. (3): The average measurements in square inches of stored honey before and after feeding honeybee colonies on six different diets during summer season of 2015.

Conclusively, from these results it could be concluded that the best diet for stored honey bee by Diet B *than the other feeding regimes in the experiment.*

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تاثير نظم غذائية مختلفة من البروتينات على الأنشطة البيولوجية الموسمية لطوائف نحل الهجين المحلية(*Apis mellifera* L.)

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أجريت هذه الدراسة في قرية أولاد موسى ، مركز أبو كبير ، محافظة الشرقية ، مصر ، على مناحل خاصة بعدد ١٨ خلية من سلالات نحل كرنولي هجين.

أظهرت النتائج أن تغذية طوائف نحل العسل على خميرة البيرة المجففة (*Saccharomyces* Sp.) بتركيز ٢٥٪ (Diet D) على فترات ١٤ يومًا بالتتابع لمدة شهرين من موسم الربيع ، أنتجت المزيد من متوسط عدد عيون الحضنة ١١٦٨.٦٤ ± ١٠.٤٧ حاضنة / طائفة حيث ان معدل تربية الحضنة أعلى من أنظمة التغذية الأخرى في التجربة.

كما كانت المناطق الوسطى من حبوب اللقاح المخزنة من قبل طوائف النحل الهجين المحلية Caroniolan خلال الفترة الصيفية ، تقاس على فترات ١٤ يوما تخزين طوائف حبوب اللقاح هجين كارنيولا ١٤١٨ / بوصة مربعة من حبوب اللقاح خلال فترة التجربة.

أوضح التحليل الإحصائي إلى أن طوائف التى غذيت على العلائق الصناعية تخزَّن حبوب اللقاح أكثر بكثير من الطوائف الاخرى طوال مدة الدراسة .

أوضحت البيانات المجمعة بأن المتوسط العام للعسل فى البوصة المربعة بالعسل المخزن من قبل العليقة (B) (طوائف ٤٠١ بوصة / ٣ طائفة) كان أعلى بشكل ملحوظ من قبل الطوائف الأخرى التي غذيت علائق أخرى بالترتيب التنازلي F، A، C، D و E كانوا ٣٤٨ و ٣٣٧ و ٣٣٠ و ٣٠٢ و ٢٨١ بوصة / طائفة ، على التوالي.

التوصية: من هذه النتائج يمكن أن نستنتج أن أفضل غذاء لنحل العسل المخزن من قبل Diet B عن أنظمة التغذية الأخرى في التجربة.

الكلمات المفتاحية: تغذية ، طوائف نحل العسل ،*Apis mellifera* L ، مكمل غذائي للبروتين ، شراب السكر ، كعكة اللقاح ، تربية الحضنة ، العسل المخزن وحبوب اللقاح.