J. Agric. Sci. Mansoura Univ., 32 (9): 7705 - 7711, 2007

COMPARATIVE STUDIES ON DIFFERENT HONEYBEE POLLEN TYPES AND THEIR EFFECT ON ROYAL JELLY PRODUCTION

El-Awady, S. M.* ; A. H. Helal*; A. El-Badawy and E.A Saleh****

*** Department Of Economic Entomology, Plant Protection Department. Faculty of Agriculture, Al-Azhar University. Nassr city ,Cairo.**

****Department Of Bee Research, Plant Protection Research Institute, Dokki, Egypt**

ABSTRACT

Three pollen types collected by honeybee were chosen (German ,Chinese and Egyptian pollen) to study their effects on royal jelly production of honeybee colonies (F1 Carniolan hybrid) and study the chemical composition of pollen types on royal jelly produced.

From the results the following aspects could be concluded:

1- Feeding with 200 g/ week German pollen gave the largest mean quantity of royal jelly g/ colony during the study period.

2-No significant appearance was found between the feeding with 100g / week and 200 g/ week German pollen.

3- Feeding with Chinese pollen gave the same results of German pollen.

Total lipid values of German, Chinese and Egyptian pollen were 12.0, 10.3 and 9.2 g/100g pollen, nitrogen content values of pollen were 5.0, 50 and 5.7 g /100g., crude protein were 31.25, 31.25 and 35.6 g/100g pollen ,respectively. Also the carbohydrates values were 48.0, 46.7 and 47.2 g/100g pollen ,respectively. The total lipid values of royal jelly were 8.3, 8.59 and 8.54 g/100g royal jelly, nitrogen content values of royal jelly were 1.6, 1.5 and 1.5g/100g, crude protein of royal jelly were 10.0,9.3 and 9.3 g/100g royal jelly, the carbohydrates values of royal jelly were 10.1, 9.3 and 11.5 g/100g royal jelly ,respectively , the pH of royal jelly were 3.81, 3.90 and 3.92 ,respectively. While, the moisture values of royal jelly production from German ,Chinese and Egyptian pollen fed honeybee colonies were 69.4, 66.5 and 68.5 % royal jelly ,respectively .

INTRODUCTION

Like animals, honeybees have to consume certain essential nutrients with their food. Pollen is their main source of proteins, minerals , fats and several other substances , while nectar provides the bulk of carbohydrates (Herbert, 1992). The adult bees of a colony obtain their dietary protein from the pollen the workers collect and bring back to the hive or from nitrogenous food-stuffs provided by the beekeeper. (Standifer *et al.*, 1977).

Different pollen types were found to vary considerably in their effectiveness, with some low quality pollen types having as little impact on physiological development as pure carbohydrate diet (Maurizio, 1950). Oilseed rape pollen contained a greater proportion of the most essential amino acids required by honey bees (valine, leucine, and isoleucine) than field bean, suggesting that oilseed rape pollen is of greater nutritional quality for honey bees than is field bean pollen. Honey bee foraging preferences appeared to reflect pollen quality. The hypothesis that pollen amino acid composition affects the foraging behavior of honey bees (Cook *et al.*, 2003).

for honey bees than is field bean pollen. Honey bee foraging preferences appeared to reflect pollen quality. The hypothesis that pollen amino acid composition affects the foraging behavior of honey bees (Cook *et al.*, 2003). Proteins of a precise quality and definite amino acid composition are required for optimum growth of young adult bees and for development of the brood food-producing hypopharyngeal glands of nurse worker bees. If nurse bees do not get pollen or some other appropriate protein source, their brood food gland secretions are not adequate for support of normal growth and development of the larvae and egg production of the queen.(Standifer *et al.*,1977). Lipid are important to honeybees primarily as a source of energy, with some components of lipids involved in the synthesis of reserve fat and glycogen, and membrane structure of cells (Graham 1992). Lipid components such as fatty acids , sterols etc. are importan in honeybee development , nutrition and reproduction. Singh *et al*,1999 suggested that pollen lipids play a considerable role in honey bee preference for pollen collection.

Three pollen types collected by honeybee were chosen, (Egyptian, German and Chinese pollen) to study their effects on royal jelly production and study the chemical composition of three pollen types and royal jelly produced.

MATERIALS AND METHODS

The present study was carried out in Shubramint, Giza, Egypt on twenty one F1 Carniolan hybrid colonies during the seasons 2001 & 2002.

I- Preparing of the experimented colonies

In this respect, virgin queens (F1Carniolan hybrid) were reared through the Jenter device. A newly mated queens were divided into three groups as follows with 3 colony each :

Group (1) was left for plants cultivated in the area (control) under the environmental condition (clover was the main plant) .

Group (2) was fed on bee pollen imported from German (50,100 and 200g./week).

Group (3) was fed on bee pollen imported from China (50,100 and 200g./week).

Production of Royal Jelly Material :

The Jenter device was processed to produce the royal jelly material . 10 queen cell cups with newly hatched larvae were provided to each deprived colony of the experiment. Collection of royal jelly material was achieved in deprived colonies after 3 days of transfer the cell cups. Collected royal jelly was kept in plastic capsule after being weighed and were put in deep freeze running at –18 C° till the chemical analysis would be processed .

Chemical analysis of pollen and royal jelly :-

A total lipid concentration in the pollen and royal jelly samples was determined according to the A.O.A.C. (1995) .

The total protein content was determined material in terms of organic nitrogen content by semi– microKjeldahl method according to Loiseleur (1963) in pollen and royal jelly .

Table 1: Effect of feeding with 50, 100 and 200 g / week German pollen (multiflora), on royal jelly production in Giza governorate (March –November) 2002 .

Months	Wight of royal jelly g / colony			
	feeding with 50 g (Gp)	feeding with 100 g (Gp)	Feeding with 200 g (Gp)	Control (Ep)
March	20.236	25.245	29.478	12.103
April	26.121	30.918	35.824	17.110
May	28.125	29.824	34.734	22.122
June	21. 329	25. 458	28. 925	16.192
July	17.194	20.357	29.158	16.107
August	14.254	17.589	20.528	10.119
September	13.521	16.627	19.725	09.111
October	09.897	15.348	17.258	07.102
November	09.354	12.758	14.824	03.135
Total	160.03	194.12	230.45	109.97
Mean	17.78	21.56	25.60	12.21
L.S.D. 5%	4.85	3.58	3.97	4.78

Determination of carbohydrate contents in pollen and royal jelly was carried out according to the method of Dubois *et al.* (1956).

Determination of pH Value approximately (1g) of royal jelly was dissolved in 5 ml of deionized water and the pH was then measured by a pH meter (A.O.A.C. , 1980).

Determination of the moisture content of royal jelly was carried out according to the standard method of the Association of Official Analytical Chemist (A.O.A.C. , 1980).

Chemical studies were achieved in the laboratory of Bee Research , Plant protection Institute , Agriculture Research Centre.

RESULTS AND DISCUSSIONS

The mean weight of royal jelly produced from different colonies treatments as in (Table 1).

Feeding with German pollen (50 g/week): Results of the statistical analysis showed that there was significant t - Reject the Hypothesis Confidence limits for the difference of the means (for alpha=0.05) t value : 6.368 and feeding with 100 g/ week showed that there was significant t - Reject the Hypothesis Confidence limits for the difference of the means (for alpha=0.05) t value : 9.137, While feeding with 200 g/week German pollen showed that there was significant t - Reject the Hypothesis Confidence limits for the difference of the means (for alpha=0.05) t value : 12.390

These data showed also that there was positive correlation between the weight of feeding pollen and royal jelly production.

From the previous results the following aspects could be concluded:

1- Feeding with 200 g / week German pollen gave the largest mean quantity of royal jelly g / colony during the study period.

Table 2: Effect of feeding with 50, 100 and 200 g/week Chinese pollen on royal jelly production in Giza governorate (March – November) 2002.

Months	Wight of royal jelly g / colony			
	feeding with 50 g(Cp)	feeding with 100 g (Cp)	feeding with 200 g(Cp)	Control (Ep)
March	40 358	44.514	49.428	12.103
April	35.758	38.298	44.785	17.110
May	33.624	35.429	39.952	22.122
June	29. 429	33. 583	35. 624	16.192
July	26.528	29.624	33.825	16.107
August	12.645	15.758	16.579	10.119
September	11.398	12.693	15.741	09.111
October	9.291	11.392	13.624	07.102
November	4.614	6.541	8.524	03.135
Total	203.65	227.83	258.08	113.10
Mean	22.63	25.31	28.68	12.57
L.S.D. 5%	3.51	2.97	3.41	3.57

2-No significant appearance was found between the feeding with 100 g/ week and 200 g / week German pollen.

As shown in Table (2) the mean weight of Royal Jelly g/ colony when feeding with 50, 100 and 200 g / week Chinese pollen for royal jelly production at Giza governorate (season 2002) :

Feeding with Chinese pollen (50 g/week) showed that there was significant t - Reject the Hypothesis Confidence limits for the difference of the means (for alpha=0.05) t value : 3.288, and feeding with 100 g / week showed that there was significant t - Reject the Hypothesis Confidence limits for the difference of the means (for alpha=0.05) t value: 3.895. While feeding with 200 g/ week showed that there was significant t - Reject the Hypothesis Confidence limits for the difference of the means (for alpha=0.05) t value : 4.343.

These data showed also that there was positive correlation between the weight of pollen feeding and royal jelly production.

From the previous results the following aspects could be concluded:

1- Feeding with 200 g / week Chinese pollen gave the largest mean quantity of Royal Jelly g / colony during the study period .

2-No significant appearance was found between the Feeding with 100 g / week and 200 g / week Chinese pollen.

Chemical Composition of Pollen types:

Honey bees require proteins (amino acids), carbohydrates (sugars), lipids (fatty acids, sterols), vitamins, minerals (salts), and water, and these nutrients must be in the diet in a definite qualitative and quantitative ratio for optimum nutrition (Standifer *et al.*, 1977).

Table (3) shows that the total lipid values of German ,Chinese and Egyptian pollen fed honeybee colonies were 12.0, 10.3 and 9.2 g/100g pollen respectively. Data in table (3) shows that the crude protein of German, Chinese and Egyptian pollen fed honeybee colonies were 31.25, 31.25 and 35.6 g/100g pollen ,respectively. Also nitrogen content values of pollen were 5.0, 50 and 5.7 g /100g for the same respect. Data in table (3) shows that the carbohydrates of German ,Chinese and Egyptian pollen fed honeybee colonies were 48.0, 46.7 and 47.2 g / 100 g, respectively.

Chemical Composition of Royal Jelly

Royal jelly is a thick milky food which is a glandular secretion from hypopharyngeal glands of the young nursing worker bees to feed young larvae and the adult queen. The principal constituents of royal jelly are water, protein, sugars, lipids and mineral salts. Although they occur with notable variations the composition of royal jelly remains relatively constant when comparing different colonies, bee races and time (Krell, 1996).

The chemical constituents of royal jelly determined were, total lipid, nitrogen, crude protein, in addition carbohydrates, pH and moisture content .

Data in table (4) shows that the total lipid values of royal jelly production from German ,Chinese and Egyptian pollen fed honeybee colonies were 8.3, 8.59 and 8.54 g/100g royal jelly. These results are agreement with authors , lipids constitute 3.5 – 19.0 % of royal jelly of dry weight (Palma 1992 , Echigo *et al.*, 1986 and Abd El Samie ,1994). Nafea (2004) showed that the total lipid of different royal jelly types were 10.2 and 10.4 g/100g. Nitrogen content values of royal jelly were 1.6, 1.5 and 1.5g/100g. The average content of protein of royal jelly is 9.9 % (17 – 45 % of dry weight). Of the nitrogenous substances, proteins consist of 73.9 % nitrogen (Otani *et al.* ,1985 ; Takenaka, 1987 and Takenaka, 1984). Data in table (4) shows that the crude protein of royal jelly production from German ,Chinese and Egyptian pollen fed honeybee colonies were 10.0,9.3 and 9.3 g/100g royal jelly ,respectively. Nafea (2004) found that crude protein of different types of royal jelly ranged from 11.1-13.4 g/100g.

Table 3: Chemical composition of different pollen types (g/100g)

Pollen types	lipid	nitrogen	protein	carbohydrate
Germany	12.0	5.0	31.25	48.0
Chinese	10.3	5.0	31.25	46.7
Egyptian	9.2	5.7	35.6	47.2

Table 4: Chemical composition of royal jelly

Pollen types	Lipid g/100g	Nitrogen g/100g	Protein g/100g	Carbohydrate g/100g	pH	Moisture %
Germany	8.3	1.6	10.0	10.1	3.81	69.4
Chinese	8.59	1.5	9.3	9.3	3.90	66.5
Egyptian	8.54	1.5	9.3	11.5	3.92	68.68.5

Data in table (4) shows that the carbohydrates of royal jelly production from German ,Chinese and Egyptian pollen fed honeybee colonies were 10.1, 9.3 and 11.5 g/100g royal jelly ,respectively. The sugars consist 18 – 52 % of dry weight of royal jelly, mostly of fructose and glucose in relatively constant proportions similar to those in honey. In many cases fructose and glucose together account for 90% of the total sugars. (Takenaka ,1984 , Palma ,1992 and Echigo *et al.*,1986) . Nafea (2004) found that carbohydrates of different types of royal jelly ranged from 10.10-11.3 g/100g.

As shown in table (4) the pH of royal jelly production from German ,Chinese and Egyptian pollen fed honeybee colonies were 3.81, 3.90 and 3.92 ,respectively. Nafea (2004) found that pH of different types of royal jelly ranged from3.4-4.7. Data in table (4) shows that the moisture values of royal jelly production from German ,Chinese and Egyptian pollen fed honeybee colonies were 69.4, 66.5 and 68.5 g/100g royal jelly respectively.Water makes up about two thirds of fresh royal jelly (60.0- 70.0 %) (Palma ,1992 , Echigo *et al.*, 1986, Abd El Samie , 1994).

Acknowledgment

The authors thanks all membranes of chemical analysis lab. of honey bee products (Dr. Emad Nafea) in the Beekeeping Res. Plant Protec. Res. For helping In Chemical analysis.

REFERENCES

Abd EL Samie M. (1994) Factor affecting royal jelly production. Thesis, Msc. Ain Shams university.

A.O.A.C.(1980) Official methods of analysis . 15-th Ed. , Arington, index of method number

AOAC.(1995) Method of analysis .Association of Official Agriculture Chemists. 16th ed , Washington D.C.USA.

Cook,-S-M; Awmack,-C-S; Murray,-D-A; Williams,-I-H (2003)Are honey bees' foraging preferences affected by pollen amino acid composition? Ecological-Entomology. 2003; 28(5): 622-627

Dubois, M.; Smith, F.; Gilles, K. A.; Hamilton, J. K. and Rebers, P.A. (1956).Calorimetric method for determination of sugars and related substances. Anal. Chem., 28 (3): 350-356.

Echigo-T; Takenaka-T and Yatsunami-I (1986) comparative studies on chemical composition of honey, royal jelly and pollen loads. Bulletin of the faculty of Agriculture, Tamagswa University. No- 36-1-8.

Graham,JM(ed) (1992) the hive and the honry bee Dadant & Sons Hamiltone, lilinois, USA ; 1324pp (rvised edition).

Herbert,E W (1992) honeybee nutrition.In Graham, J E (ed) The hive and the honey bee. Dadant& Sons Inc. ; Hamilton , Il, USA ; pp.197-233

Krell, R (1996).Value-added products from beekeeping. FAO-Agricultural-Services-Bulletin. No. 124, 409 pp.

Loiseleur, J. (1963) : Techniques de laboratories " Tome I, Fasiccule 2 – 3ed. , Enterement Remaniee " Masson et cie Editeurs, Paris , Baulevard Saint Germain, p.980

Maurizio, A., (1950). The influence of pollen feeding and brood rearing on the length of life and physiological condition of the honeybee. Bee Wld., 31: 9-12.

Nafea E.A. (2004) The biological effect of honeybee products as environmentally safe substances against some pathological microorganisms . Ph.D Dep.Agric. Sci. of Inst. of Eniv. St. Res. Ain Shams Univ.

Otani, H.; Oyama, M. and Tokita, F (1985). Polyacrylamide gel electrophoretic and immunochemical properties of proteins in royal jelly.J., Dairy – and – Food – Science – 34 A21 - A25 .

Palma, M. S. (1992). Composition of freshly harvested Brazilan royal jelly: identification of carbohydrates from the sugar fraction. Brazil J., Apic., Res. ; 31 : 42-44.

Singh-MP; Verma-LR; Mattu-VK (1999). Pollen spectrum of some honeys of the north-east Himalayas as determinant of honey bee forage. Indian-Bee-Journal. 1994, 56: 1-2, 37-52.

Standifer, L. N., Moeller, F. E., Kauffeld, N. M., Herbert, E. W., Jr., and Shimanuki, H.1977. Supplemental Feeding of Honey Bee Colonies. United States Department of Agriculture Agriculture Information Bulletin No. 413, 8 pages, illus.

Takenaka, T. (1984) . Studies on proteins and carboxylic acid in royal jelly. Bulletin-of-the-Fac., Agric.,Tamagawa-Univ. No. 24, 101-149.

Takenaka, T. (1987) . Protein synthesis by the hypopharyngeal glands of worker honeybees. Honeybee-Science. 9: 13-18.

دراسات مقارنه لانواع حبوب اللقاح المختلفه التى يجمعها نحل العسل وتأثيرهـا على انتاج الغذاء الملكى

شلبى محمد العوضى[1] – هلال أحمد هلال[1] – أحمد البدوى عبد المنعم[2] و عماد عبده صالح[2]

١ – قسم وقاية النبات – كلية الزراعة – جامعة الأزهر – مدينة نصر – القاهرة

٢ – قسم بحوث النحل – معهد بحوث وقاية النباتات – مركز البحوث الزراعية

دراسة مقارنة على بعض انواع حبوب اللقاح (الالمانى، الصينى والمصرى) وتاثيرها على انتـاج الغـذاء الملكى تم اختيار حبوب لقاح كل من الالمانى والصينى والمصرى على عدد ٢١ طائفة نحل هجين اول كرينيـولى فـى منطقة شبرامنت بمحافظة الجيزة وقد تم استخدام لوزان من حبوب اللقاح بواقع ٥٠ و١٠٠و٢٠٠جرام لكل طائفـة فـى مكررات لكل الانواع الموضحة سابقا أسبوعيا. وقد وجد أن التغذية بـ ٢٠٠جرام حبوب لقاح المانى اعطت اعلى كمية من الغذاء الملكى فى الطائفة ولا توجد اى فروق معنوية بين التى غذيت ٢٠٠ جرام و١٠٠جرام وايضا وجد ان التغذية بحبوب لقاح صينى اعطت نفس النتائج. اما بالنسبة للتحليل الكيميائى فقد وجد ان الدهون الكلية فى حبوب اللقاح الالمانى والصينى والمصرى ٩,٢، ١٠,٣ و١٢%. تحليل البروتين فى حبوب اللقاح الالمانى والصينى والمصرى ٣٥,٦، ٣١,٢٥ و٢٥,٣١ جم/١٠٠جم حبوب لقاح. النيتروجين فى حبـوب اللقـاح الالمـانى والـصينى والمـصرى ٥,٢، ٥,٠ و٥,٠ جم/١٠٠جم حبوب لقاح والكربوهيدرات فى حبـوب اللقـاح الالمـانى والـصينى والمـصرى ٤٨,٥، ٤٦,٧ و٤٧,٢ جم/١٠٠جم حبوب لقاح اما بالنسبة للتحليل الكيميائى للغذاء الملكى الناتج من تغذية الطوائف على حبوب اللقاح المختلفة فكانت: الدهون الكلية ٨,٥٤، ٨,٥٩ و٨,٣ جم/١٠٠جم غـذاء ملكـى علـى التـوالى والنيتـروجين ١,٥، ١,٥ و١,٦ جم/١٠٠جم غذاء ملكى.

البروتين ١٠,٠، ٩,٣و ٩,٣ جم /١٠٠جم غذاء ملكى والسكريات الكلية فكانـت ١١,٥، ٩,٣ و١٠,١ جـم /١٠٠جم غذاء اما درجة pH فكانت ٣,٨١، ٣,٩ و٣,٩٢ اما الرطوبة فكانت ٦٩,٤، ٦٦,٥ و٦٨,٥ % غذاء ملكى.