EFFECT OF FOOD OIL ADDITION OF POLLEN SUPPLEMENTS ON DIFFERENT HONEYBEE DEVELOPMENTAL STAGES

NAFEA E.A.[1], ASMAA M.FAWZY[1] AND AZZA T.ASHOUR[2]

1 Plant Protection Research Institute, ARC, Dokki, Giza
2 Department of Economic Entomology and Pesticides, Faculty of Agriculture, Cairo University, Giza

(Manuscript received 4 December 2007)

Abstract

Pollen supplements with addition of different lipid concentrations (3,5 and 7% lipid) were tested for honeybee colonies feeding preference.

The quantities of examined diets consumed by the treated colonies which fed with four pollen substitute diets: Yeast (control), dried medical yeast with 3% food oil (A), yeast with 5% food oil (B) and yeast with 7% food oil (C) were evaluated. The highest mean of food consumptio56.51 %diet obtained from (C) , followed by (A) (52.84%) and (B)(38.65 %) , while the lowest mean of food consumption (25.37%) was obtained from (Y) diet .The study showed significant differences among the mean quantity consumption obtained from all treatment and control diet.

The study discuss the mean values of total lipid in body of larvae, emergency nurses, forager worker and larvae and adult drones produced from treated colonies.

The experiments showed no significant differences were found among the mean lipid values obtained from all treatment and control of larvae and emergency honeybee workers. The highest total lipid values in body bees were obtained from those fed on (A) of nurse bees and larvae and adult drones, whereas (B) resulted was the highest total lipid values in body of forager bees. The study showed also significant differences among the mean lipid values obtained from all treatment and control diet of nurse and adult honeybee workers, also larvae and adult honeybee drones.

INTRODUCTION

All plant pollens contain lipids. The lipid concentration differs markedly in pollens as well as in its fatty acids composition. Lipids 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 structure of cells membrane. Lipid components such as fatty acids, sterols etc. are important for honeybee development, nutrition and reproduction. (Graham 1992)

Singh *et al*, (1999), stated that pollen lipids play a considerable role in honey bee preference for pollen collection. The unsaturated fatty-acid level varied from 18.6% to 55.9% of the total fatty-acid composition, that pollen is a good source of unsaturated

fatty acids to the diet (Bostos *et al*, 2004) .Generally, lipids are used for energy, synthesis of reserve fat and glycogen, and for the functioning of cellular membranes (Standifer *et al*, 1977). Honey bees satisfy their lipid requirement by consuming pollen. The free fatty acid content of the midgut was used to quantify fat digestion. (Loidl and Crailsheim 2001).

A number of pollens from particular species consistently showed high levels of lipids, which were observed to be highly favoured by foraging honey bees. The pollens noted to be particularly attractive to foraging honey bees included *Brassica napus* (mean 7.1%), *Sisymbrium officinale* (mean 5.8%), *Rapistrum rugosum* (mean 6%) and *Hypochoeris radicata* (mean 7.2%) (Somerville 2005). The aim of this work was to determine the importance of pollen lipids as a considerable role in honey bee preference for pollen collection and their importance for honeybees workers and drones development

MATERIALS AND METHODS

The present study was carried out in the apiary of the Beekeeping Research Department, Plant Protection Research Institute, A.R.C. Dokki Giza, during a spring season of 2007.

Materials

Bee colonies:

The first hybrid of Carniolan honeybee race *Apis mellifera* carnica was chosen to start the planned experiments.

Twelve honeybee colonies of about equal strength were chosen in the apiary at Dokki, Giza. The colonies were arranged in four groups each groups of three colonies, used as tested experimentally, while the fourth group was left as control.

Preparing the diets (Treatments):

Pollen supplement (yeast) with addition of different food oil concentration (3,5 and 7 g food oil /100g paste) were tested for honeybee colonies feeding preference.

Pollen supplements were used as follows:

-Dried medical yeast + sugar + water (3: 3: 1) (Macicka, 1987), then food oil as added at concentrations of 3g (A), 5g (B), 7g (C) to 100g paste .

The paste was spread on a plastic sheet and was left for 24 hours to be little pit dried. The paste was divided into small pieces (100g). Experimental colonies were provided with one piece of prepared paste each at 7 day interval (four weeks) all over the experimental period. These pastes were placed directly over the brood combs covered with plastic sheets to avoid drying. Sucrose syrup (2 sugar:1 water) was continuously provided to every colony under investigation.

These diets were compared to determine the total lipids in the different stages of honeybee workers and drones.

Estimation of pollen substitutes consumption:

Each group of colonies received weekly 100 g of each the tested diets during the experimental period. The unconsumed diets were collected and weighted to determine the rate of consumption of each one. The selected colonies including the control were fed weekly with 500 ml sucrose solution.

Preparation of honeybee worker and drone samples for lipid determination:

Total lipid was determined in each of worker larvae, nurse bees (1-6 days), newly worker, forager bees, and larval and adult drones, after homogenizing them.

The exuded homogenous from the stages of worker and drones were sucking into a 10 ml capillary tube. The pooled homogenous was centrifuged using an Eppendorf microcenterifuge at 10.000 r.p.m for 5 min. at room temperature. The supernatant was transferred to a new Eppendorf tube and kept frozen at (-20°c) till required.

Determination of total lipid in the worker and drone stages :

One gram of the substance was accurately weighted, and the lipid content was extracted by 100 ml. of methanol-chloroform mixture (2:1) in a soxhlet apparatus for 8 hours, according to the procedure described by Folch *et al.* (1957). The solvent was distilled off under vacuum at room temperature, and the weight of lipid was then measured.

Statistical analysis:

Data were analyzed by one-way analysis of variance (ANOVA), followed by Duncan (1955) multiple test and the L.S.D. at 0.05 values were calculated for the variance according to the method of Sendecor and Cochran 1980.

RESULTS AND DISCUSSION

Data in Table (1) show the mean quantities of examined diets consumed by the treated colonies which fed with four diets accept control fed on yeast only , Yeast (control)(y), yeast with 3% food oil (A), yeast with 5% food oil (B) and yeast with 7% food oil (C) . The highest mean of consumption was record in the case of C treatment (56.51 %) followed by (B) diet (38.65%), and (A) diet (52.84%), while the lowest mean of consumption was obtained from (Y) diet (25.375%) .Statistical analysis showed significant differences among the mean quantity consumption obtained from all treatment and control diet.

Table 1. Consumption of different pollen supplements by treated honeybee colonies (%)

	Control	Treatments (%)		
Food oil %	(Y)0.0%	(A)3.0% food oil	(B)5.0 % food oil	(C)7.0 % food oil
No.coloneis	3	3	3	3
Mean of pollen supplementary consumption	25.37 % (c)	52.84 % (ab)	38.65 % (bc)	56.51 % (a)

F-ratio =1.28

LSD =22.03

-Data followed by different litters have significant difference.

-Data followed by the same litter have no significant difference.

Data in Table (2) showed the mean values of total lipid in body of larvae, emergency ,nurses, forager of worker and (larvae & adult) drones ,produced from treated colonies.

Statistical analysis showed no significant differences were found among the mean lipid values obtained from all treatment and control diet of larvae and emergency workers .

The highest total lipid values in bee bodies were obtained from those fed on (A) of worker larvae and drones larvae, whereas (B) diet was the highest total lipid values in body of forager bees and drone larvae.

Statistical analysis showed significant differences were found among the mean lipid values obtained from all treatment and control diet of nurse and adult workers , also larvae and adult drones.

Table 2. Total lipid percentages in different workers and drones honeybee developmental stages

	Workers				Drones	
Treatment yeast + food oil	Worker larvae	Emergency bees	Nurse bees	Forager bees	Drone larvae	Drone adults
3% (A)	19.59 (a)	2.13 (a)	8.98 (a)	6.18 (b)	42.71(a)	4.47 (a)
5% (B)	20.1 (a)	3.94 (a)	4.75 (b)	6.24 (b)	21.24 (c)	6.94 (a)
7% (C)	21.6 (a)	3.97 (a)	6.53 (ab)	8.33 (a)	23.03 (c)	7.13 (a)
Control	22.49 (a)	3.57 (a)	5.59 (b)	5.4 (b)	29.86 (b)	4.62 (b)
F-ratio	0.312	0.97	4.24	9.05	39.11	34.74
LSD	7.81	2.86	2.89 *	1.36 **	5.08 ***	0.8 ***

-Data followed by different litters have significant difference

-Data followed by the same litter have no significant difference.

*** very high significant

** high significant

* low significant.

The results obtained were in agreement with that of Yoshida *et al.* (1984) who studied the effects of feeding on artificial diet with a lipid content of 3%, 7%, 11% and 15%. The diet with 3% lipid content gave the greatest larval body weight soon after defecation (> 300 mg.), the best rate of emergence (80%) and the best queen differentiation (63%), but the larval period was 7-8 days compared with 5-6 days under natural conditions. Robinson and Nation (1970) found that the fatty acids of the body of adult worker bees was (6%) and larvae was (40%). Young (1967), also showed that these fatty acids were dominant in adult worker and drone honeybees. The importance of lipids in the diet of honeybees was demonstrated by Herbert *et al* (1980) , they showed that colonies fed 2%, 4%, 6% or 8% lipid in pollen substitute feed reared more brood to the sealed stage than colonies fed only the substitute without the lipid. Colonies fed 2% or 4% lipid reared as much brood as colonies fed pollen. (Konopacka *et al.* (1987) found that mean amounts of lipid in highly preferred pollens such as Brassica campestris var. toria, *Cosmos bipinnatus* and *Raphanus sativum* were 20.3%, 19.4% and 17.8%, respectively, and in least preferred pollens such as sunflowers (*Helianthus annuus)* and *Petunia hybrida* were 11.9% and 11.6%, respectively.

Both the total amount of pollen and the amount of free fatty acids in the endoperitrophic region and in the intestinal wall depend on the bee's age. The amounts increase within the 1st 3 days of a honey bee's life, reaching maximum around the age of 8 days and then decrease continuously to the lowest values, measured in forager bees (Loidl and Crailsheim 2001). Mohammad (2002) . He recorded that the highest lipid content appeared in autumn bees (9.2%), followed by spring (6.68%) and summer (5.54%).

In conclusion we can suggested that addition of lipids to pollen substitute play a considerable role in honey bee preference for little food oil and then pollen collection.

REFERENCES

1. Bastos, D.H.M., O.M. Barth, C.I. Rocha, P.de O. Cunha- Carvalho, E-A-S Torres,-, ,-M Michelan. 2004. Fatty acid composition and palynological analysis of bee (Apis) pollen loads in the states of Sao Paulo and Minas Gerais, Brazil. Journal-of-Apicultural-Research. 43(2): 35-39.
2. Duncan, D.B. 1955. Multiple rang and multiple F- test . Biometrics, 11(1):1-24.
3. Folch, J., M less,. and G.H.S Stanfey. 1957. Simple method for isolation and purification of twxotal lipid from animal tissues. J. Biol. Chem, 226:497.
4. Graham,JM(ed). 1992. the hive and the honry bee Dadant & Sons Hamiltone, lilinois, USA , 1324pp (rvised edition).

5. Herbert, EW, H Shimanuki,and ,BS Shasha. 1980. Brood rearing and food consumption by honey bee colonies fed pollen substitutes supplemented with starch –encapsulated pollen extract . J.of Apicultural Research 19:115-118.
6. Konopacka, Z., J. Muszynska, and A., Hartwig. 1987. Effect of brood rearing intensity and of physical condition of worker honeybees on their susceptibility to Nosema apis infection. Pszczelnicze-Zeszyty-Naukowe. 31: 263-277.
7. Loidl, A., K. Crailsheim. 2001. Free fatty acids digested from pollen and triolein in the honeybee (*Apis mellifera carnica* Pollmann) midgut. Journal-of-Comparative-Physiology-B, -Biochemical, -Systemic, -and- Environmental-Physiology. 2001, 171(4): 313-319
8. Macicka, M. 1987. Effect of pollen and its substitutes on hypopharyngeal glands, fatty tissue, length of life and content of nitrogen compounds in the fat of bee bodies. Vedecke-Prace-Vyzkumneho-Ustavu-Vcelarskeho-v-Dole. 9: 137-148.
9. Mohammad, R.E. H. 2002. Studies on rearing and production of honeybee queens, *Apis mellifera l.* Ph. D. Thesis, Fac. Agric., Zagazig Univ.
10. Robinson,FA and JL Nation. 1970. long-chain fatty acids in honeybees in relation to sex, caste, and food during development . J. of Apicultural Research 9:121-127.
11. Singh S., Kavita-Saini and K.J. Jain. 1999. Quantitative comparison of lipids in some pollens and their phagostimulatory effects in honey bees.Journal-of-Apicultural-Research.1999, 38(1/2): 87-92
12. Somerville, D.C. 2005. Lipid content of honey bee-collected pollen from south-east Australia. Australian-Journal-of Experimental-Agriculture. 45(12): 1659-1661
13. Standifer, L. N., F. E. Moeller, N. M. Kauffeld, E. W. Jr. Herbert and H. Shimanuki. 1977. Supplemental Feeding of Honey Bee Colonies. United States Department of Agriculture Agriculture Information Bulletin No. 413, 8 pages, illus.
14. Sendecor, G.w and W.g. Cochran. 1980. Statistical Methods. The Iowa state Univ., Press Amer., USA, 7th ed.
15. Yoshida, T., M. Sasaki and T. Ohnishi. 1984. Effect of lipid content in royal jelly on the queen differentiation of the honeybee, *Apis mellifera*. Bulletin-of the Faculty of Agriculture, Tamagawa University. No. 24, 43-52.
16. Young,R.G. 1967. Fatty acids of some arthropods. Memoirs. Comell University Agricultural Experimental Station No.401.

اضافة الدهون لبدائل حبوب اللقاح وتأثيرهاعلى مراحل نمو نحل العسل

عماد الدين أحمد عبد الحميد[1] ، أسماء محمد فوزى[1] ، عزه توفيق عاشور[2]

١. معهد بحوث وقاية النباتات – مركز البحوث الزراعيه – الدقى – جيزة
٢. قسم الحشرات الاقتصادية والمبيدات– كلية الزراعه – جامعة القاهرة

أجرى هذا البحث بمعهد بحوث وقاية النباتات ،قسم بحوث النحل حيث اختبر أحد بدائل حبوب اللقاح (خميره طبيه جافه) المضافة الى طوائف نحل العسل حيث تم اختيار اضافة الزيوت النباتية بنسب مختلفة ٣% (أ) ،٥%(ب) و ٧%(ج) بالاضافة الى المقارنه (د) . وكانت نسبة الاستهلاك كالاتى :

حيث سجلت اعلى نسبة استهلاك (٦٥,٥١ %) بالنسبة لبدائل حبوباللقاح المضاف اليها ٧% (ح) زيت ،يليها المعاملة (ا) ٥٢,٤٨% والمعاملة (ب) ٣٨,٦٥ ، ثم اخيرا طوائف المقارنه اقل نسبة استهلاك (٢٥,٣٧ %).

وقد وجد انه لاتوجد فروق معنوية لنسب الدهون الكلية بين جميع المعاملات والمقارنه فى اليرقات والشغالات حديثه الفقس وكانت اعلى نسبة الدهون الكلية متواجدة فى تلك الطوائف التى غذيت على الخميره المضاف اليها الزيت بنسبة ٣% وذلك فى النحل الحاضن للشغالات ويرقات والذكور الكاملة بينما المعاملة (ب) كانت اعلى نسبة دهون كانت فى جسم الشغالات السارحه .

واظهرت الدراسة ايضا انه توجد فروق معنوية بين نسب الدهون الكلية فى جميع الطوائف المعامله عن الطوائف غير المعاملة فى كل من فى الشغالات حديثة الفقس والحاضنة وكذلك فى اليرقات والحشرة الكامله للذكور.يستنتج من البحث انه باضافة قليل من الزيوت النباتيه الى بدائل حبوب اللقاح تشجع طوائف نحل العسل على استهلاكها أكثر من غيرها من الطوائف المقارنه لما لها من اهمية فى غذاء وتطور الاطوار المختلفه لشغالات وذكور نحل العسل .