

EFFECT OF FEEDING SUGAR SYRUP ADDEND WITH POLLEN GRAINS AND SOME PLANT EXTRACTS ON BUILD-UP OF HONEY BEE COLONIES

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Abstract

The research aims to evaluate the garlic and lemon extracts individually or mixed together and added to the sugar syrup food to build bee colonies compared with pollen grains added to sugar syrup and plain sugar syrup. It was compared to five food factors on Carniolan hybrid bee colonies (Sugar syrup fortified with 10 grams of garlic plant extract or with 10 grams of lemon plant extract or with 5 gm garlic +5 g lemon or 10 gm pollen or plain sugar syrup / colony bee / week) during summer season of 2014 by counting the worker sealed brood and stored honey and pollen grains cells every 13 days before and after feeding and the relationship between them. The general mean of daily brood rates of colonies fed on sugar syrup fortified with pollen, Garlic+ Lemon together, lemon or Garlic extracts individually and plain sugar syrup (control) were 525.32, 493.15, 428.44, 379.99 and 307.21 brood cells / day, respectively. The percentages of increase in the mean daily brood rates were 127.7, 108.9, 80.4, 62.9, 34.7 %, respectively when compared to those before feeding. No significant difference in brood rearing rates was observed between feeding on sugar syrup fortified with pollen or garlic plus lemon extracts, with garlic plus lemon or individually lemon extracts, and with individually lemon or garlic extracts. Meanwhile plain sugar syrup significantly came the last in order. The feeding on sugar syrup fortified with pollen significantly surpassed all other treatments, in stored honey and pollen. It came the first in storing honey, third in storing pollen grains and caused an increase of stored honey and pollen by 73.9 and 128.7%, respectively when compared to that before feeding. It caused an increase in stored pollen grains by 149.1 and 136.5%, respectively when compared to those before feeding.

Key words: Feeding, honey bee colony, plant extracts, Garlic (*Allium sativum*), Lemon (*Citrus limon*), brood rearing, stored honey and pollen, sugar syrup.

INTRODUCTION

The brood rearing activity and nutritional state of the colony, the quantity and quality of incoming pollen grains, nectar and the food reserves in the hive will determine whether the bees need supplemental foods or no (Standifer *et al*,1977 and El-Sherif *et al*,1994). There are many studies regarding supplementary feeding of honey bee colonies with different formulae consisting of glucidic, proteic and vitaminic mixtures, but there are fewer studies made on the use of different plant infusions and extracts used in supplementary feeding of bee colonies, especially in different stages of their biological development (Marghitas *et al.*, 2010). Beekeepers often do not have much choice during periods of pollen dearth and feed their colonies any kind of pollen grains substitute or plain sugar aiming to produce highly rate of broods, stronger and healthy colonies (Atallah *etal*, 1979 and El-Banby and El-sherif,1987). Feeding colonies on either inadequate amount of natural pollen grains (Hussein,1981 and Lehnar,1983) or inferior pollen grains substitute (Wahl and Ulm,1983) were both cause losses in bee colonies. Feeding colonies on 10% pollen grains in sugar syrup significantly produced larger areas of sealed brood than the 5% or those fed only on sugar syrup (control) (Hussein, 1981). Those fed on fruit extracts increased the brood rearing rates (Watanable, 1993). Addition of one comb of pollen grains significantly increased bee population and stored honey (Wahl and Ulm,1983). Colonies fed on diets free from pollen grains did not rear brood to the sealed stage (Omar and Mateescu, 1985). Feeding colonies on extracts of certain medicinal plants have been mainly directed towards improving quality of the produced honey, as it had antimicrobial activity (Mishref *et al*,1989) and contained antioxidants (Rosenblat *et al*,1997). Less attention has been given to their effects on brood rearing rates and adult Longevity (Raj *et al*,1993 and watanable,1993). Honey was extracted from nectar gathered by bees from Tamarind trees during May – June (Ramanujan and Kalpana, 1992, Dewan, 1995 Chaudhay, 1997 and Lakshmi and Suryanarayana, 1997b). It also extracted from Carob which bears imperfect unisexual flowers on separate trees, and produce stichy nectar and pollen during November (Linskens and Scholten,1980 and EL – Hassania and Campi,1995). Feeding colonies with 20% of the four medicinal plant extracts (Carob, *Ceraionia silique* ;Tamarind, *Tamarindus indica*; Karkade, *Hibiscus sabdariffa* and Pepper-mint, *Mentha piperita*) mixed with sugar

syrup significantly increased the brood rearing rates and the longevity of emerged workers in both Carniolan and hybrid colonies together (El-Sherif,2002). Supplements Nettle (*Urtica dioica*), Protofil, Onion (*Allium cepa*), Garlic (*Allium sativum*), Thyme (*Satureja hortensis*), Ehinacea (*Echinaca sp*) were build out of artificially weakened bee colonies (Marghitas et al,2010). The aim of the present work is to study the effect of feeding colonies with sugar syrup fortified with certain plant extracts (Garlic and Lemon) or pollen grains on build-up of bee colonies for autumn division and good wintering by counting brood rearing rates, the amounts of stored honey and pollen grains during summer season of 2014.

MATERIALS AND METHODS

This work was done in the apiary of honeybee unit of plant protection department in the faculty of Agriculture, Ain Shams University during summer season of 2014. It aimed at studying the effect of feeding the bee colonies on sugar syrup fortified with pollen grains or certain plant extracts such as Garlic (*Allium sativum*), Lemon (*Citrus limon*), Garlic + Lemon), on brood rearing rates and amounts of stored honey and pollen grains. Twenty swarm boxes of honey bee colonies with relatively same strengths were used. Each contained 5 combs (2 combs of sealed and unsealed brood, 2 combs of stored honey and pollen grains, one empty comb), queen, and covered with bees. The bee swarms were divided into 5 groups of treatments. Each group composed of four bee swarms (replicates), which introduced into four Langstroth hives and received one of the following treatments:

Group (A): 400ml sugar syrup (1sugar:1water) + 10g Garlic extract /colony .

Group (B): 400ml sugar syrup (1sugar:1water) + 10g lemon extract /colony.

Group (C): 400ml sugar syrup (1sugar:1water) + 5g Garlic extract + 5g lemon extract /colony .

Group (D): 400ml sugar syrup (1sugar:1water) +10g pollen grains /colony .

Group (E): 400ml plain sugar syrup (1sugar:1water)/colony as control.

The honeybee swarms were received the food weekly during the period of the experiment starting from middle of June 2014 till the end of August 2014. Empty combs or frames provided with new wax were added when necessary. Areas of sealed brood cells, stored honey and pollen grains cells were measured in square inches at 13 day intervals before and after feeding till the end of the experiment. At every

inspection for each colony at 13 day intervals, the daily brood rearing rate was calculated by (area of brood in square inches \times 25/13), weight of stored honey was calculated by (area of honey cells in square inches \times 25 \times 0.35g honey/cell), weight of stored pollen was calculated by (area of stored pollen grains cells in square inches \times 25 \times 0.062g pollen grains /cell). Results were statistically analyzed and recorded in tables 1, 2, 3.

RESULTS AND DISCUSSION

1-Sealed brood rearing:

The data in table (1) significantly and clearly show that, the addition of pollen or plant extracts to sugar syrup caused more brood counts than plain sugar syrup during fall summer-season till the end of experiment on 21/8/2014. The general mean of daily brood rates of colonies fed on sugar syrup fortified with pollen grains or additive with Garlic + Lemon, lemon, or Garlic extracts and plain sugar syrup (control) were 525.32, 493.15, 428.44, 379.99 and 307.21 brood cells / day, respectively when compared to those before feeding. No significant difference in brood rearing rates was observed between feeding on sugar syrup fortified with pollen grains or additive with garlic + lemon extracts, with garlic + lemon or lemon extracts, with lemon and garlic extracts. Meanwhile plain sugar syrup significantly came the last in order. The percentages of increase in the mean daily brood rates were 127.7, 108.9, 80.4, 62.9, 34.7 % respectively. These results coincide with those of Hussein (1981) , Watanable (1993) and Marghitas *et al.*, (2010).

2 – The stored honey:

The amounts of stored honey grams, at 13 day-intervals in the different groups of colonies before and after feeding on different diets are listed in table (2). The weight of stored honey at the end of the experiment were 3913.8, 2976.3, 2620, 2465.9 and 2440.8 grams/swarm when feeding the colonies on sugar syrup fortified with pollen grains, garlic + lemon, lemon, or garlic, or plain sugar syrup, respectively. The feeding on sugar syrup fortified with pollen grains significantly surpassed all other treatments. It came the first in order and caused an increase of stored honey by 73.9% when compared to that before feeding. It followed by those fed on sugar syrup additive with garlic plus lemon and caused an increase of stored honey by 32.5% when compared to that before feeding. The feeding with sugar syrup additive

with lemon or garlic or plain sugar syrup came the last in order with no significant differences between them and caused an increase of stored honey by 17.1, 9.2, and 10.1 %, respectively, when compared to those before feeding.

3 – The stored pollen grains:

The amounts of stored pollen grains grams, at 13 day-intervals in the different groups of colonies before and after feeding on different diets are listed in table (3). The weight of stored pollen grains at the end of the experiment were 149.8, 137.8, 128.0, 102.5, and 97.7 gram /swarm when feeding colonies on sugar syrup fortified with pollen grains, garlic plus lemon, lemon, or garlic or plain sugar syrup, respectively. The feeding on sugar syrup fortified with pollen or garlic plus lemon or lemon only significantly came the first in order in storing pollen with no significant differences between them. It caused an increase in stored pollen by 128.7, 149.1 and 136.5, respectively when compared to those before feeding. Feeding the swarms on sugar syrup additive with garlic or plain sugar syrup came the second in order without any significant difference between them and caused an increase in stored pollen by 70.1 and 61.5% , respectively. No significant difference was observed between weight of stored pollen grains in swarms fed on sugar syrup fortified with lemon or garlic, or plain sugar syrup.

Table 1. Average daily sealed brood rearing rates/inches before and after feeding honeybee colonies on five different diets during summer fall season of 2014.

Periods	Treatments (Diets)					F value	L.S.D.
	(A)	(B)	(C)	(D)	(E)		
Before feeding:							
17/6 a	233.25 ± 1.8	237.44 ± 3.4	236 ± 2.3	230.75 ± 4.2	228 ± 4.3	insign	----
After feeding:							
30/6 b	322.11 ±23.67 bc	278.85 ±24.81 cd	358.65 ±45.29 ab	423.08 ±48.27 a	216.35 ±30.02 d	9.5	77.82
13/7 c	346.3 ±28.07 b	362.98 ±35.84 b	464.10 ±29.72 a	495.67 ±40.99 a	265.87 ±22.53 c	15.33	72.96
26/7 d	377.31 ±55.21 bc	480.77 ±59.99 ab	506.41 ±13.5 ab	538.46 ±54.53 a	319.71 ±34.92 c	3.26	----
8/8 e	446.69 ±49.13 abc	509.62 ±71.61 abc	564.1 ±53.43 a	546.64 ±52.16 ab	362.5 ±25.57 c	1.97	----
21 /8 f	407.54 ±14.77 c	510 ±67.97 b	572.47 ±36.66 a	622.75 ±61.09 a	371.64 ±19.91 c	4.46	50.4
General Mean g	379.99 ±19.78 cd	428.44 ±45.45 bc	493.15 ±28.36 ab	525.32 ±23.92 a	307.21 ±18.62 d	8.8	90.22
% Increase or decrease:							
(b - a)/a	38.1	17.4	51.9	83.3	- 5.1		
(c - a)/a	48.5	52.9	96.7	114.8	16.6		
(d - a)/a	61.8	102.5	114.6	133.4	40.2		
(e - a)/a	91.5	114.6	139.03	136.9	58.9		
(f - a)/a	74.7	114.8	142.6	169.9	63		
(g - a)/a	62.9	80.4	108.9	127.7	34.7		

Where:

- A: 400ml sugar syrup (50% conc.) + 10g garlic / swarm
 B: 400ml sugar syrup (50% conc.) + 10 g lemon / swarm
 C: 400ml sugar syrup (50% conc.) + 5g garlic + 5g lemon / swarm
 D: 400ml sugar syrup (50% conc.) + 10g pollen / swarm
 E: 400ml plain sugar syrup (50% conc.) /swarm

Table 2. The weight of stored honey grams before and after feeding honeybee colonies on five different diets during summer fall season of 2014.

Periods	Treatments (Diets)					F value	L.S.D.
	(A)	(B)	(C)	(D)	(E)		
Before feeding:							
17/6 a	2235 ±10.2	2237.75 ±7.9	2246 ±4.8	2250.5 ±6.3	2240 ±14.8	insign	----
After feeding:							
30/6 b	1784.4 ±98.4 b	2082.5 ±84.9 b	2107.5 ±127.2 b	3049.4 ±28.2 a	2278.8 ±80.1 c	28.5	273.4
13/7 c	1983.2 ±59.9 d	2125 ±92.4 bcd	2237.5 ±85.1 bc	3135 ±95.6 a	2287.2 ±79.4 b	30.9	249.7
26/7 d	1979.1 ±28.4 c	2283.1 ±27.1 b	2389.6 ±109.5 b	3316.5 ±107.7 a	2289.1 ±57.2 b	40.6	244.3
8/8 e	2133.2 ±22.1 c	2302.7 ±54.8 bc	2518.4 ±96.9 b	3644.6 ±160.9 a	2233.1 ±93.1 c	46.1	279.7
21/8 f	2440.8 ±41.6 c	2620 ±85.9 c	2976.3 ±62.5 b	3913.8 ±37.2 a	2465.9 ±139.3 c	49.7	267.3
% Increase or decrease:							
(b - a)/a	-20.2	-6.9	-6.2	35.5	1.7		
(c - a)/a	-11.3	-5.04	-0.4	39.3	2.1		
(d - a)/a	-11.4	2.03	6.4	47.4	2.2		
(e - a)/a	-4.6	2.9	12.1	61.9	-0.3		
(f - a)/a	9.2	17.1	32.5	73.9	10.1		

Where:

- A: 400ml sugar syrup (50% conc.) + 10g garlic / swarm
 B: 400ml sugar syrup (50% conc.) + 10 g lemon / swarm
 C: 400ml sugar syrup (50% conc.) + 5g garlic + 5g lemon / swarm
 D: 400ml sugar syrup (50% conc.) + 10g pollen / swarm
 E: 400ml plain sugar syrup (50% conc.) /swarm

Table 3. The weight of stored pollen gram before and after feeding honeybee colonies on five different diets during summer fall season of 2014.

Periods	Treatments (Diets)					F value	L.S.D.
	(A)	(B)	(C)	(D)	(E)		
Before feeding:							
17/6 a	60.25 ±2.8	54.13 ±3.1	55.31 ±6.3	65.5 ±5.4	60.5 ±8.7	insign	----
After feeding:							
30/6 b	47.29 ±6.5 b	62 ±12.3 b	85.8 ±8.9 a	91 ±9.9 a	50.5 ±5.7 b	11.12	18.48
13/7 c	58.3 ±1.5 c	69.9 ±16 bc	89.7 ±8.04 ab	103.8 ±7.2 a	62 ±10.2 bc	4.01	29.69
26/7 d	73.8 ±3.3 c	85.9 ±12.1 bc	100.8 ±4.3 ab	114.3 ±7.3 a	64.9 ±10.6 c	5.4	26.45
8/8 e	84.7 ±2.6 c	114.3 ±21.8 abc	135.1 ±15.9 ab	143.4 ±17.9 a	81.9 ±10.2 c	4.6	40.36
21/8 f	102.5 ±2.6 b	128 ±19.1 ab	137.8 ±7.8 a	149.8 ±12.6 a	97.7 ±7.9 b	4.4	32.78
% Increase or decrease:							
(b -a)/a	-21.5	14.5	55.1	38.9	-16.5		
(c -a)/a	-3.2	29.1	62.2	58.5	2.5		
(d -a)/a	22.5	58.7	82.2	74.5	7.3		
(e -a)/a	40.6	111.2	144.3	118.9	35.4		
(f - a)/a	70.1	136.5	149.1	128.7	61.5		

Where:

A: 400ml sugar syrup (50% conc.) + 10g garlic / swarm

B: 400ml sugar syrup (50% conc.) + 10 g lemon / swarm

C: 400ml sugar syrup (50% conc.) + 5g garlic + 5g lemon / swarm

D: 400ml sugar syrup (50% conc.) + 10g pollen / swarm

E: 400ml plain sugar syrup (50% conc.) /swarm

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تأثير التغذية بالمحلول السكرى المضاف إليه حبوب اللقاح و بعض المستخلصات النباتية على بناء طوائف نحل العسل

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أجري هذا العمل في منحل كلية الزراعة، جامعة عين شمس لدراسة تأثير التغذية بالمحلول السكرى المقوى بحبوب اللقاح و بعض المستخلصات النباتية (الثوم (*Allium sativum*)، الليمون (*Citrus limon*) ، والثوم + الليمون، على بناء طوائف نحل العسل لإنتاج طرود النحل فى الخريف . حيث تم مقارنة خمسة معاملات غذائية لطوائف النحل الهجين الكرنبولى (محلول سكرى + 10 جم من مستخلص الثوم أو + 10 جم من مستخلص الليمون أو + 5 جم ثوم + 5 جم ليمون أو + 10 جم حبوب لقاح أو محلول سكرى فقط/ طائفة / أسبوع) خلال الفتره من منتصف يونية وحتى نهاية أغسطس ٢٠١٤ ، وذلك بحساب حضنة الشغالات المقللة والعسل المخزن وحبوب اللقاح المخزنة كل ١٣ يوم، قبل وبعد التغذية و علاقته بينهما.

وقد أظهرت النتائج أن إضافة حبوب اللقاح أو المستخلصات النباتية إلى المحلول السكرى أعطى معنوية لزيادة أعداد العيون السادسة للحضنة مقارنة بالمحلول السكر فقط (المقارنة) خلال موسم نضب الرحيق فى الصيف . وكانت المتوسطات العامة للمعدلات اليومية لحضنة الطوائف المغذاة على المحلول السكرى المضاف إليه حبوب اللقاح، أو بالثوم + الليمون مجتمعين أو الليمون والثوم منفردان أو المحلول السكر (معاملة المقارنة) هى 525.32 ، 493.15 ، 428.44 ، 379.99 ، و 307.21 خلية حضنة / يوم، على التوالي. وكانت النسبة المئوية للزيادة فى متوسط معدلات الحضنة اليومية هى 127.7 ، 108.9 ، 80.4 ، 62.9 ، 34.7% ، على التوالي بالمقارنة مع ما قبل التغذية . لم يلاحظ أي اختلاف كبير فى معدلات تربية الحضنة عند التغذية على المحلول السكر المزود بحبوب اللقاح أو الثوم مع الليمون مجتمعان، أو الليمون منفردا أو الثوم منفردا . وفى الوقت نفسه جاء المحلول السكرى فى الترتيب الأخير. بينما التغذية بالمحلول السكرى المزود بحبوب اللقاح كان الأفضل من كل المعاملات الأخرى، فى كميات العسل وحبوب اللقاح المخزنة، وجاء ترتيبها الأول فى تخزين العسل والثالث فى تخزين حبوب اللقاح وتسببت فى زيادة كمية العسل وحبوب اللقاح المخزنة بنسبة 73.9 و 128.7% على التوالي بالمقارنة مع ما قبل التغذية . إن التغذية على المحلول السكرى المزود بمستخلصات الثوم مع الليمون مجتمعان أو الليمون مفردا جاءتا بشكل ملحوظ الأولى من نوعها فى الترتيب فى تخزين حبوب اللقاح فقط مع عدم وجود فروق كبيرة بينهما وتسببتا فى زيادة كميات حبوب اللقاح المخزنة بنسبة 149.1 و 136.5 %، على التوالي بالمقارنة مع ما قبل التغذية. وعموما فإن إضافة حبوب اللقاح أو مستخلصات الثوم والليمون للمحلول السكرى فى أوقات ندرة الرحيق وحبوب اللقاح الطبيعية يسبب زيادة فى قوة طوائف نحل العسل.