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CHEMICAL COMPOSITION OF HONEYBEE (*Apis mellifera* L.*)* BROOD

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ABSTRACT

Brood of honeybees (larvae & pupae), was periodically collected at 15 day intervals from the bee hives. The chemical components of these brood were determined and compared with the familiar protein sources. The results indicated that the fresh honeybee brood is rich in protein (16%), fat (3.7%), carbohydrate (4.1%), fiber (0.7%) and ash (0.9%). Several minerals were detected in brood of honeybees, i.e., K, Na, Fe, Cu, Zn and Mn, in considerable amounts., vitamins (A, B_1, B_2, B_6, B_{12} and C) were also detected in a pronouncing concentrations.

INTRODUCTION

Bee brood is probably the least recognized of all bee production in terms of its use by man as food or potential material of value. Yet, bee brood was probably the product of second greatest importance, after honey. (Kakeya, 1976). Honey and brood often comprise a considerable portion of the people's yearly calories and protein. (Hill, et al., 1984).

Bee brood has excellent nutrition properties. It is rich in protein and lower in fat than beef and it has no crunchy cuticle like most insects eaten for food. It has high quality food value and was exceedingly rich in vitamins A and D. (Hocking and Matsumura, 1960)

It contains reasonable amounts of protein and are non-toxic, where it could, therefore, serve as a direct food source once the beekeeper has no or more need for extra bees or brood, or when undesired colonies have to be removed. For several cultures, brood is said to form a considerable part of the diet such as shabbiness of Zaire, [(Parent et al., 1978 and Bailey, 1989). In China and Japan, drone larvae are canned for export or after being covered in chocolate to become a sweet treat. Bee brood is regularly sold alongside honey in markets in many parts of Asia. (Ryan *et al*., 1983 and Narumi, 2004).

Brood should be eaten or processed (boiled, fried or dried) immediately after harvesting without exposure to sunlight. After drying, they may be chopped or ground to a powder. The powder may be used to enrich other poor meals and can be mixed directly with any other flour products, (dough, bread), vegetable dish, or soup. In some Asian countries, worker or drone pupae (in their white stage) are also prepared for human consumption by pickling or boiling in canned form (Narumi, 2004). Besides, they are found in some European or American specialty stores and can be considered a value added product, even if there is not much demand or a broad market perspective in the West. (Schmidt & Buchmann, 1992)

MATERIALS AND METHODS

Collection of Honeybee Brood

Brood of honeybees, (Larvae and Pupae) was periodically collected at 15 day intervals from the bee hives. Ten honeybee colonies were necessary for continuous providing of brood was gathered or removing from brood combs according to the method that described by (Thoenes &Schmidt, 1990). The larvae were collected with water stream, while, for collecting the pupae of honeybees from their sealed brood cells, the cells were uncapped with a fine serrated and warmed knife and the pupae shaken out onto a sheet of aluminum foil, The collected brood was separated to pupae or larvae and preserve in a foil plates as shown in Fig.(1).

Chemical Composition of Honeybee Brood

Moisture, Protein, fat, fiber, total carbohydrate, and ash contents of the fresh honeybee brood (mixing of larvae and pupae) were determined according to the (AOAC, 2000).

(a) (b) (c)

Fig. 1 Collection methods of honeybee brood
(a)Floating by fine water stream, (b) picking by forceps, (c) scraping brood capping.

Vitamins A, B and C were determined according to the methods applied by (Kimura, 2007, Batifoulier, 2005 and Romeu-Nadel, 2006), respectively.

Total content of potassium, sodium, iron, manganese, zinc, copper, Lead and cadmium were determined by an Atomic absorption spectrophotometry , (Priken elemer 3600) described by (Chapman and Pratt, 1978).

RESULTS AND DISCUSSION

Chemical Composition of Honeybee Brood:

The chemical components of fresh honeybee brood were determined and compared with the familiar protein sources were determined in the literature as shown in Table (1).

The brood contains a rate of protein with a mean value of 16%, mean moisture content was 74.6%, while, fat and carbohydrate contents were evaluated by 3.7% and 4.1% respectively. Ash and fibers were represented

by 0.9% and 0.7% respectively as shown in Fig. (2). Several minerals were detected in brood of honeybees such as K, Na, Fe, Cu, Zn and Mn, in considerable amounts, Table 1 and Fig. (3). Vitamins A, B_1, B_2, B_6, B_{12} and C were also detected in the fresh bee brood in considerable amounts as shown in Table (1) and Fig. (4). The results revealed that the fresh brood of honeybees rich in their chemical components, when compared with other animal food sources. (Bailey, 1989, and, Hill et al., 1984). The protein percentage in fresh bee brood is similar to that in beef or chicken meat, while it is 1.5 times than in hen eggs.

The percentage of fat in fresh brood was approximately equal from one third to half the percentages presented in meat, hen eggs and chicken in Fig. (2). Carbohydrate is completely absent in meat or chicken and present in a small percentage in hen eggs when compared with bee brood. Also, the percentage of ash in bee brood is similar to that found in the mentioned protein sources. As many honeybee products, (pollen, royal jelly and honey), bee brood had pronouncing quantities of the major and minor elements such as K, Na, Fe, Cu, Zn and Mn., (Bell *et al.*,1983, Schmidt & Schmidt,1984, and Herbert & Miller,1987). On the other hand, the brood of honeybees contained a great quantities of many vitamins as shown in Table (1). Beta carotene or vitamin A was presented in the fresh bee brood with about 3851.7 I.U. and increase about 4.2 time than those found in hen egg in general or more than that in egg yolk with 1.1 time as shown in Fig.(4). For thiamin, (vit.B_1), it was raised in bee brood with 13.9 times than those recorded for the highest familiar protein source, (hen egg). Similar results were obtained for riboflavin, (vit B_2), where it increased with 8.1 times than hen egg. The Pyrodoxine, (vit B_6) and Cobalamin, (vit. B_{12}), were completely absent from meat, chicken and hen egg while, they determined with 0.18 mg/100gm and 0.31 mg/100gm in fresh brood, respectively, Fig. (4). Ascorbic acid (vit. C) is also, found with about 566.1 mg/100gm in bee brood whereas it was very neglected or absent from other domestic protein sources, Table, (1) and Fig. (4). This rich in the nutritional components of bee brood may be attributed to the kind feeding within honeybee colonies. The bee larvae eating pollen and honey, where those materials are naturally collected from plant flowers. The chemical composition of pollen (the source of protein, fat, minerals and vitamins for bee brood) approved that pollen contained all the basic components for the natural development and growth for various kinds of animals, (kaller, et al., 2005, Schmidt & Buchmann, 1992 and El-Refai et al., 1986).

Table (1) General composition (%), Minerals content (in ppm) and Vitamins content (mg/100g) of fresh honeybee brood in comparison with some food protein sources

Component, (%)	Fresh Honeybee brood	meat[b]	Chicken[b]	Hen egg[b]
Moisture	74.6	67.4	71.6	75.2
Protein	16	19.6	19.6	12.6
Fat	3.7	11.9	7.8	10.8
Carbohydrate	4.1	0	0	0.3
Ash	0.9	1.1	1	1.1
Fibers	0.7	0	0	0
Undetermined	nd	nd	nd	nd
Minerals, (ppm)				
K	7150	375	340	174
Na	640	72	77	155
Fe	64.7	3.4	1.6	2.5
Zn	50.1	4.8	2	1.5
Cu	9.8	0.10	0.25	0.14
Mn	7.3	----	----	----
Vitamins, (mg/100gm)				
Vitamin A (Beta Carotene)	3851.7	12	22	918
Vitamin B_1 (Thiamin)	1.95	0.07	0.13	0.14
Vitamin B_2 (Riboflavin)	2.9	0.11	0.18	0.36
Vitamin B_6 (Pyridoxine)	0.18	----	----	----
Vitamin B_{12} (Cobalamin)	0.31	----	----	----
Vitamin C (Ascorbic Acid)	566.1	0	3	0

b =Data from Nutrition Institute, A.R.E, (1996)

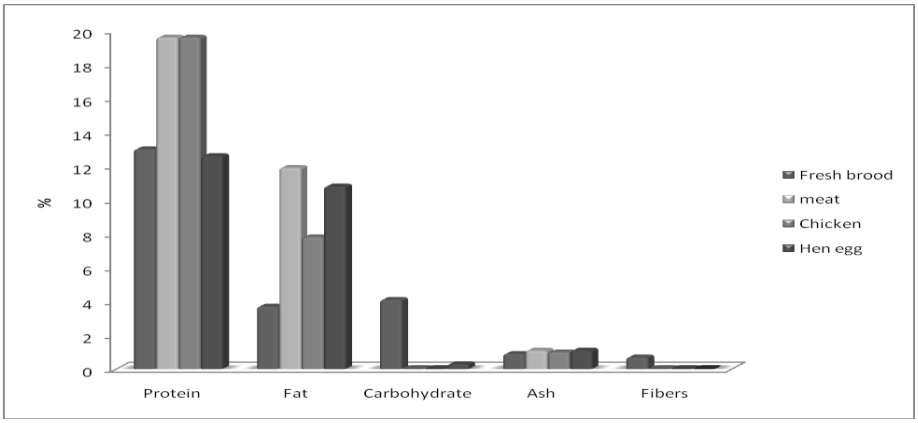
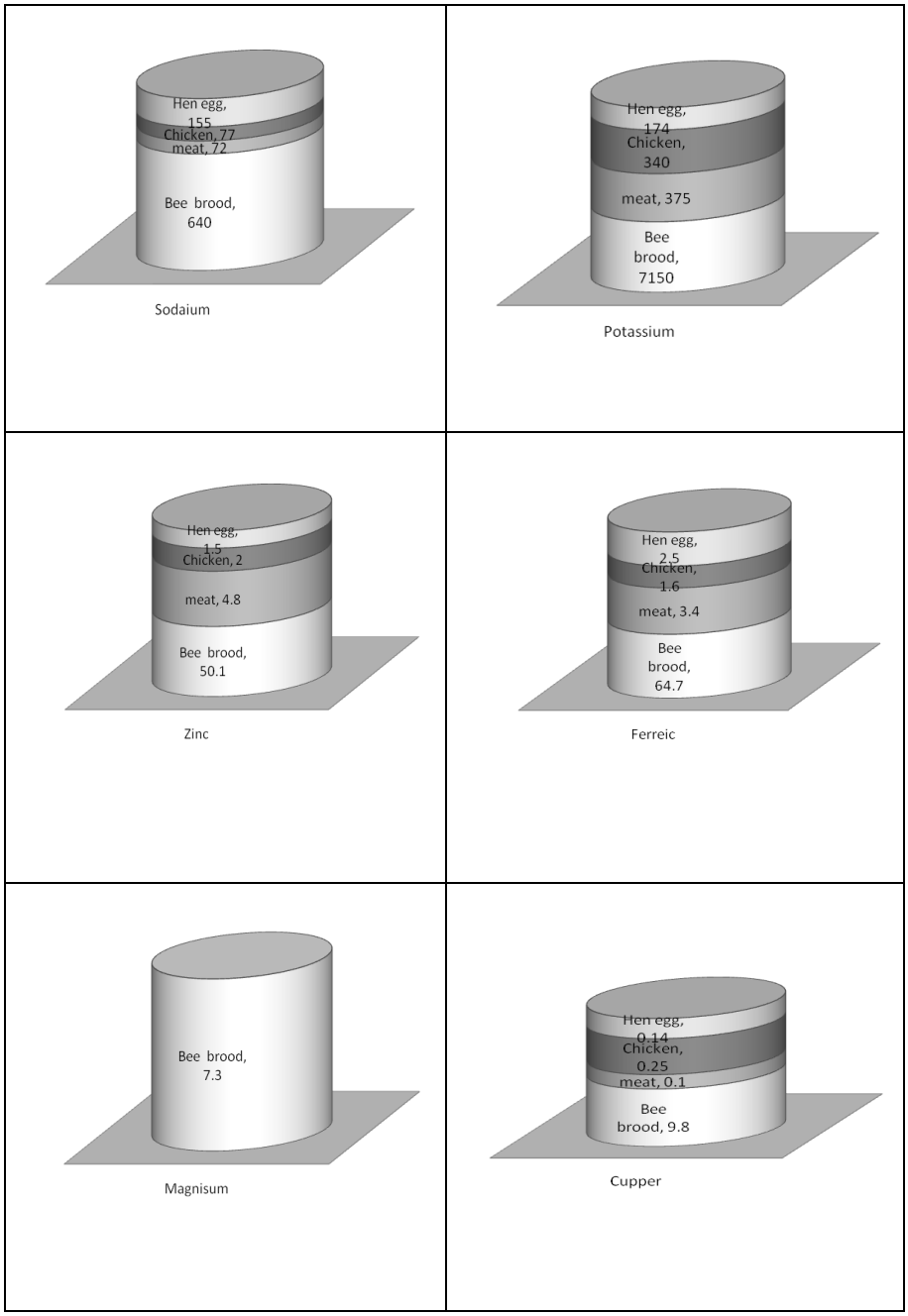


Fig. (2) General composition (%) of fresh honeybee brood in comparison with some food protein source.



Fig(3) Minerals content (in ppm) of fresh honeybee brood in comparison with some food protein sources.

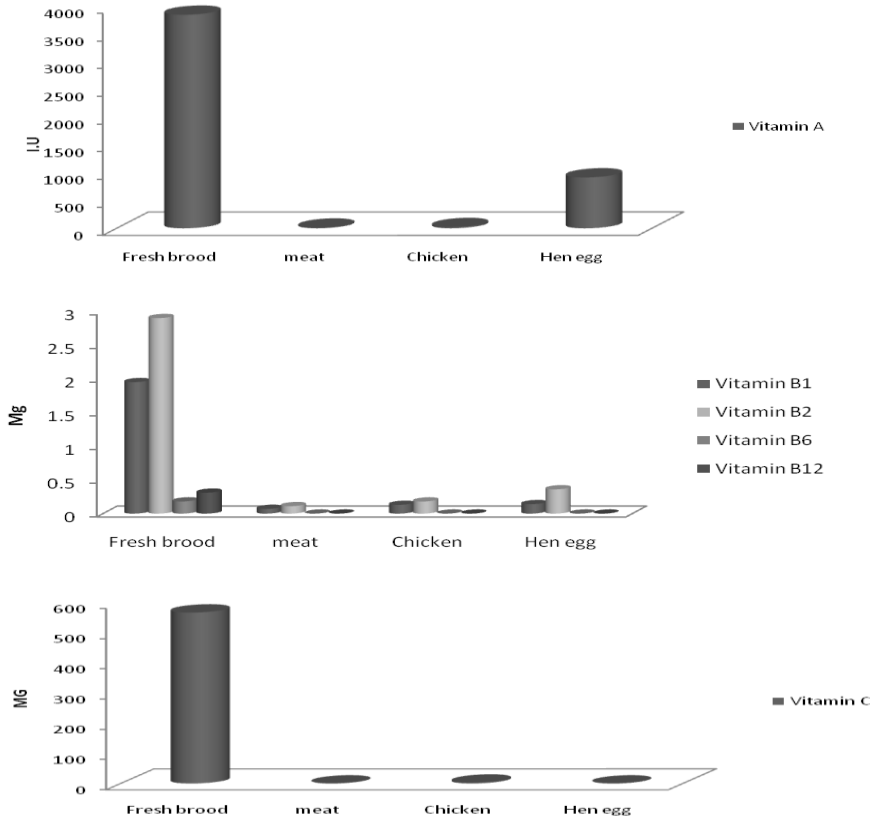


Fig (4) Vitamin A(in IU) and vitamin B & C (in mg) of fresh honeybee brood in comparison with some food protein sources

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التركيب الكيماوي لحضنة نحل العسل

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**** قسم هندسة التصنيع وتعبئة وتغليف الأغذية ـــ معهد بحوث تكنولوجيا الأغذية ـــ مركز البحوث الزراعية ـ الجيزة**

تم تقدير المكونات الكيماوية لحضنة نحل العسل (اليرقات و العذارى) التى تم تجميعها من طوائف النحل دوريا كل ١٥ يوم، بمقارنة التركيب الكيماوى لهذه الحضنة بغيره من مصادر الغذاء الشائعة أوضحت الدراسة إحتواء الحضنة على النسب التالية ١٦ % بروتين ، ٣,٧ % دهون ، ٤,١ % كربوهيدرات، ٠,٩ % رماد، ٠,٧ % الياف، هذا بالإضافة الى وجود عناصر البوتاسيوم، الصوديوم، الحديد، النحاس، الزنك و المنجنيز بكميات كبيرة. كما إحتوت الحضنة على نسب جيدة من فيتامينات A, B_1,B_2, B_6, B_{12} و كذلك فيتامين C. و هذا التركيب يفتح المجال لإختبار هذه الحضنة كمدعم غذائى فى الوجبات الفقيرة .