Original paper

QUALITY OF HONEY BEE BREAD COLLECTED IN SPRING

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Abstract

Pollen is the only source of protein that honey bees collect from nature. It is very important for the development of brood, and consequently, for the development of the colony. Honey bee bread is the pollen which the bees collect from flowers and store in honeycomb cells. Honey bee bread has a modified structure due to the fermentation process under the influence of enzymes it passes through. For this study, ten honey bee colonies were selected. Honey bee bread was sampled from the combs. The quality of pollen and honey bee bread was determined by the chemical composition, using standard methods used in food analysis. Total nitrogen was determined by Kjeldahl method. Micro- and macroelements were determined by spectrophotometric method. The pollen collected from two sites had rich protein content (29.93 % and 27.63 % on average).

Key words: *chemical composition, honey bee bread, pollen*

Introduction

The development of strong and healthy colonies depends on the rearing of strong brood, which itself requires quality nutrients. Regarding honey bee diet, they require similar nutrients as humans. The need for carbohydrates is fully met by the consumption of honey, but other nutrients (primarily proteins, minerals, vitamins, etc.) are far less present in honey, and the need for these is met by the consumption of the pollen (Adekanmbi and Ogundipe, 2009).

Collecting of the pollen is done by forager honey bees, which take pollen from anthers, pack it together with saliva and nectar to their hind legs and bring it to the hive. In the hive, that pollen is, then, stored into the cells of honeycombs and such a stored pollen is called honey bee bread. Pollen is fine to coarse powder that is the microgametophytes of seed plants. Pollen grains have a hard membrane that protects the sperm cells during their movement between the stamens to the pistil of flowering plants or from the male cone to the female cone of coniferous plants. Various plants are pollinated by various ways (wind, insects, etc.). When pollen lands on a compatible pistil of flowering plants, it germinates and produces a pollen tube that transfers the sperm to the ovule of a receptive ovary (Taranov, 2006). Pollen is very rich in protein, which serves as material for tissue growth and tissue regeneration (Kulinčević, 2006).

Pollen and bee bread differ biochemically, due to changes bees afflict upon foraged pollen in the process. Pollen is mixed with saliva and honey and then stored. For example, bee bread contains more reducing sugars than pollen from the same plant species (Casteel, 1912). Also, bee bread contains vitamin K (Haydak and Vivino, 1950) and a milk-digesting enzyme (Hitchcock, 1956); pollen collected from the legs of foraging bees does not. Avetisian (1935) found that bee bread made from birch pollen contained six times as much lactic acid as hand-collected birch pollen. The conversion of pollen to bee bread and the accompanying biochemical changes have often been postulated to be the result of microbial action, principally a lactic acid fermentation caused by bacteria and yeasts (Foote 1957; Haydak, 1958).

The amount of protein in pollen ranges greatly, depending of the plant species. Considering chemical composition, besides protein, pollen also includes free amino-acids, lipids, carbohydrates (sugars, starch and cellulose), minerals (Ca, Mg, P, Fe, Na, K, Al, Mn, S, Cu, etc.), vitamins (pantothenic and ascorbic acid, vitamins of B complex, etc.), various enzymes and coenzymes, etc.

For the honey bees, it is the best if they have access to pollen derived from different plants, because balanced nutrition is of key significance for the development of honey bee colony (Kulinčević, 2006). Pollen, which is the main source of dietary protein and contains essential amino acids for their development (De Groot, 1953), can influence longevity, the development of hypopharyngeal glands (HPG) and ovaries (Pernal and Currie, 2000) and the susceptibility to pathogens (Rinderer and Elliott 1977); but to what extent pollen can affect IC is not known. Finally, honeybee populations have been declining over the last years and a current idea suggests that honeybee colonies may suffer from a compromised immune system, which could be related to poor nutrition commonly associated with colony losses (van Engelsdorp *et al*. 2008).

According to Hrassnigg and Crailsheim (2005), rearing one larva requires 25-37.5 mg of protein, equivalent to 125-187.5 mg pollen. Somerville, (2000), states that the protein levels vary from 6% to 40%. The minimum protein level required for honey bees is 20%. If the aim is rapid breeding and expansion of the hive population to work a heavy honey flow, crude protein levels of 25–30% are required (Somerville, 2000). The period of larval development lasts for about 8 to 9 days.

Material and methods

The aim of this paper was to determine the chemical composition of honey bee bread collected in spring. The experiment was conducted in the months of April and May.

Honey bee bread was sampled from the honey bee colonies of the Institute for Forage Crops Kruševac, directly from the honeycomb. Colonies were stationed at two sites, Makrešane and Vrbnica.

The proximate composition of the bee bread was determined by using standard methods of food analysis (Roma R. B. et al, 1983). According to these authors, ash content was measured in samples that were heated in a muffle furnace at 600°C until a uniform gray-white ash remained. The samples were then used for the subsequent determination of macro- and microelements by using atomic absorption spectrophotometry (AAS-Perkin Elmer 1100 B USA) and total nitrogen in the samples was determined by micro-Kjeldahl method.

Results and discussion

The chemical composition of honey bee bread collected from two sites was somewhat similar when compared (tables 1 and 2). This is due to similar vegetation composition found on these two sites. The analysis of phytocenological composition of plants on two sites showed that the most common plants were dandelion and deadnettle.

When a colony is actively breeding, or during periods of heavy wax production (such as during a heavy honey flow), the demand for pollen is high. Wax glands use a lot of protein and a lack of pollen or pollen with low nutritional values will have significant management implications (Somerville, 2000). During the periods of high bee activity and lower pollen influx (autumn and early spring), honey bees must rely on their store of honey bee bread.

Table 1. *Chemical composition of honey bee bread from Makrešane*

Parameters	Average	SD	CV
Crude ash (%)	3.05	0.2329	7.64
Crude protein (%)	29.93	8.5807	28.67
Crude cellulose (%)	2.64	0.8701	32.95
Crude fat (%)	4.92	0.6975	14.18
NEM (%)	65.26	3.0353	4.65
Ca (%)	0.65	0.1774	27.29
P (%)	0.65	0.0332	5.11
K (%)	0.74	0.0492	6.65
Mg (%)	0.27	0.0250	9.26
Fe (mg/kg)	121.99	31.8625	26.12
Zn (mg/kg)	44.09	3.8639	8.77
Mn (mg/kg)	29.92	0.6006	2.01

Table 2. *Chemical composition of honey bee bread from Vrbnica*

Parameters	Average	SD	CV (%)
Crude ash (%)	2.67	0.2421	9.07
Crude protein (%)	27.63	9.1542	33.13
Crude cellulose (%)	3.23	0.7831	24.24
Crude fat (%)	4.51	0.5873	13.02
NEM (%)	68.28	3.0502	4.47
Ca (%)	0.55	0.0984	17.89
P (%)	0.72	0.0367	5.09
K (%)	0.77	0.0531	6.89
Mg (%)	0.21	0.1012	48.19
Fe (mg/kg)	115.76	29.8394	25.78
Zn (mg/kg)	32.15	2.6571	8.26
Mn (mg/kg)	33.05	0.5975	1.80

In the samples collected in Makrešane, average amount of protein was 0.015 mg for 50g of bee bread sample, while in samples from Vrbnica average was 0.014 mg for 50g of bee bread.

No complete study has been conducted into the role that fats, vitamins and minerals play in honey bee nutrition. Deficiencies or imbalances may well exist (Somerville, 2000).

Honey bees obtain lipids exclusively from pollen, and the lipid content of pollen from various species ranges between 0.8% and 18.9% (Roulston and Cane, 2000). Considering that honey bee bread is derived from pollen, it contains considerable amount of fat.

Honey bees obtain inorganic elements mainly from pollen, and according to Imdorf et al. (1998), bees can obtain minerals from other important sources of minerals like nectar and water or the existence of endogenous mineral pools in adults. During the shortage of fresh pollen, bees will use their stores of honey bee bread to replenish required nutrients.

The authors recommended a diet containing 1000 mg/kg potassium, 500 mg/kg calcium, 300 mg/kg magnesium and 50 mg/kg each of zinc, manganese and iron. Considering data obtained in samples from Vrbnica and Makrešane, honey bee bread do contain relatively large amounts of these elements, and depending on the state of colony (colony strength, brood rearing), this honey bee bread can be used as additional nutrition if there is a shortage of fresh pollen.

The highest variation in samples from Makrešane was determined for the amount of crude cellulose, while in samples from Vrbnica it was for the content of Fe. The variation in the amount of protein was somewhat similar in both sites (tables 1 and 2).

However, the availability of pollen, and subsequently honey bee bread, must be taken into account, and further researches have to be done. Considering obtained results, honey bee bread collected from these sites can be taken from colonies, stored and then used as additional feed for periods of either shortage of natural pollen or in cases of rapid colony development, such is in spring.

Conclusion

Considering that the proteins are among the most vital nutrients required for the development of honey bees, it is important to study the quality of sources of proteins. There were no significant researches considering honey bee bread.

Honey bee bread collected from sites Vrbnica and Makrešane can be considered of good quality, and can be used directly by bees which made it or it can be taken from colonies and used as additional nutrient in spring during the highest activity of brood rearing in colonies. Samples from both sites had relatively high amount of protein (29.93 % and 27.63 % on average), which is the most important nutrient for honey bees. There were no significant researches in the role of other nutrients, so their importance is yet to be determined through future studies.

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