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Review Article

Honey Bees And Their Brood: A Potentially Valuable Resource Of Food, Worthy Of Greater Appreciation And Scientific Attention.

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Abstract

Although bee brood is consumed in many parts of the world, especially in tropical regions, the practice has gotten relatively little attention. We have examined every piece of information that is currently available regarding the nutritional makeup and functional characteristics of the various developmental phases of honey bee workers from various species and subspecies. Given the competent nutritional makeup of honey bee brood, pupae, and prepupae in particular, we propose that they may one day be used as both animal feed and human food.Additionally, drone brood is a perfect candidate to be used as a food or ingredient. However, further research is still needed to examine the functional characteristics of various honey bee species..

Keywords : *Entomophagy, Protein, Amino acid, Minerals, Functional properties, Apiary, Bee products.*

INTRODUCTION

Human civilizations have had a close relationship with honey bees since the beginning of time. Humans have been using honey bees and their products for at least 9,000 years, according to archaeological evidence discovered in Neolithic sites in northern Africa and Europe (Roffet-Salque et al. 2015). As previously mentioned in the ancient texts of the Bible, Talmud, Ayurveda, and others, humans collected honey to use as sustenance and medicine. According to d'Errico et al. (2012), the significance of honey bees was not limited to their use as food and medicine; beeswax also had uses and a place in ancient cultures.

The honey bee was gradually domesticated by humans, and in addition to honey and beeswax, the number of beneficial hive products was enhanced and increased to include bee pollen, royal jelly, propolis, and bee venom. All of these products are valued for their functional qualities (Ghosh et al. 2021a). In addition, honey bees are regarded as the primary pollinators in the insect kingdom, contributing 35% of the world's food production along with other pollinators (Klein et al. 2007).

But even though eating bee brood is common around the world, especially in tropical regions, this type of diet has gotten very little attention as a food item for humans. For instance, the Hazda people of Tanzania do not remove bee larvae from the combs they eat (Murray et al. 2001); the Australian Aboriginal people eat honey along with native bee specimens (Cherry 1991); and in Thailand, "bee hunters" gather over 10,000 colonies of Apis florea each year, where they consume the honey, larvae, and pupae together (Wongsiri et al., 1997). Additionally, Mexico (Ramos-Elorduy et al. 1997) and Bali (TorreBueno 1944, cf.) employ honey bee brood as nourishment.

DIVERSITY OF HONEY BEE

There are only a few species in the Apini, and the four major ones are Apis mellifera, A. cerana, A. dorsata, and A. florea. The most widely utilized species in commercial beekeeping practices globally is the European (or Western) honey bee, A. mellifera. With a few exceptions of cultivated A. cerana, the other three social bee species continue to exist as wild bees. However, the research currently in publication indicates that there is no such species-biased selection with relation to

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entomophagy, or the eating of bees and their developmental phases, particularly when it comes to the bee brood. Consequently, it was necessary to look into the nutrient makeup of this resource using all four primary species.

Four stages make up the life cycle of honey bees, which are holometabolous insects: egg, larva, pupa, and adult. Additionally, because they are social insects, they can be divided into three distinct castes: workers, drones, and queens. If one wants to offer them as a dietary item for humans, it is crucial to determine and choose the most appropriate developmental stage or phases. Since hymenopteran larvae do not empty their gut contents until two to three days before to pupation, pupae or prepupae (commonly referred to as "pharates") can be the best choices among the many developmental stages (DeFoliart 1995). due to the honey bee's crucial role in crop pollination and the fact that worker bees are the only ones engaged in the process.

Literature review of published works on the nutritional composition of honey bees and their brood

Although the use of honey bee brood as human food has been documented, information regarding the nutritional makeup of the bees and their broods, as well as the useful chemicals present, is still lacking. But in the past, determining the nutritional makeup of various developmental stages has not entirely been unexplored. To the best of our knowledge, Strauss (1911) seems to have been the first to show that worker and drone honey bees of different developmental stages differed in their chemical composition (see Hocking and Matsumura, 1960).

Hocking (1957) experimented with freezing techniques, conducted a few cooking experiments (such as deep-frying in vegetable fat and shallow-frying with butter), and tackled the issue of prospective consumers' acceptance of honey bee larvae and pupae as food.The nutritional content of honey bee brood was reported by Hocking and Matsumura (1960) based on wet weight. Mature larvae and pupae were found to have respective protein values of 15.4% and 18.2% on a wet weight basis, and fat contents of 3.71 and 2.39% (Hocking and Matsumura 1960).

NUTRIENT POTENTIAL OF HONEY BEE

Protein and amino acid composition

When evaluating a food's quality, protein is typically regarded as the most significant nutrient and a trustworthy indicator (Ghosh et al. Journal of Ecology and Environment (2021) 45:31 Page 2 of 12). On dry matter basis, respective protein content of larval, pupal, and adult A. mellifera workers was reported to be 35.3, 45.9, and 51% (Ghosh et al. 2016).These figures concur with earlier findings (Strauss 1911; De Groot 1950). Ozimek et al. (1985) observed a somewhat higher protein value for adult workers (56.8%). According to Bamidele et al. (2021), A. mellifera adansonii's protein content ranged from 7.4 to 8.7% on a fresh weight basis. Finke (2005) assessed the protein content of 94 g per kg of bee brood to be roughly 40.5% on the dry matter basis, which is in agreement with the reportspublished by Hu and Li (2001) and Ghosh et al. (2016). Higher protein levels were found in adult larvae (15.4% wet weight basis) and pupae (18.2% wet weight basis), according to Hocking and Matsumura (1960). However, Kim et al. (2018) observed that the protein content of A. mellifera drone pupae was 11.1% on a wet weight basis, or 42.9% on a dry weight basis. This number is consistent with the drone pupae's total amino acid content (Ghosh et al. 2020c).

FAT AND FATTY ACID COMPOSITION

Generally speaking, the densest dietary source of energy is fat and fatty acids. In addition, they play crucial roles in cell membrane structure, hormone regulation and signaling (including steroid functions), absorption, and the bioavailability of many nutrients. According to dry matter, the fat contents of A. mellifera larvae, pupae, and adults were 14.5, 16.0%, and 6.9%, respectively (Ghosh et al. 2016). According to Ozimek et al. (1985), 7.5% of the fat content of entire dried worker honey bees was detected. According to Finke (2005), there was 47 g of fat per kilogram of bee brood, or roughly 20.3% of the dry weight. Nonetheless, certain dietary fats—particularly saturated fats—have the potential to be substantial risk factors for obesity and other associated problems degenerative illnesses. Fatty acids are divided into three types according to their level of saturation: saturated (SFA), monounsaturated (MUFA), and polyunsaturated (PUFA). Due to their association with obesity and associated diseases, a high intake of SFAs is undesirable. Conversely, MUFA and PUFA are thought to be advantageous and health-promoting, having cardio-protective properties, reducing atherosclerotic issues, and treating other disabilities. Therefore, it was essential to look at the fatty acid profiles of honey bee lipids in order to look into their possible involvement. The fatty acid contents of worker honey bees and drones at various developmental stages.

CARBOHYDRATE CONTENT

Another class of macronutrients is carbohydrates. Chitin, a naturally occurring polymer made up of repeating β (1,4)-N-acetylglucosamine units that form cuticle and make up 5–20% of body weight, is found in insects, particularly adults and crustaceans. The same is true of honey bees. Although the precise makeup of the carbohydrates present has not been investigated, Ghosh et al. (2016) calculated that the carbohydrate content of honey bees ranged from 30.6%

to 46.1%, depending on the developmental stage. Nemtsev et al. (2001) calculated that the amount of chitin in dead and dried bees might reach 10-12%. He subsequently separated the chitin and chitosan from honey bees and described the material (Nemtsev et al. 2004). Draczynski obtained chitin from the bodies of honey bees.

MINERALS CONTENT

Minerals are vital micronutrients that perform a number of vital physiological roles, such as supplying structural integrity and catalytic activity. They are typically acquired through nutrition. "Micronutrient deficiency" emerged as a significant food policy concern in the 1990s, particularly in the context of developing nations (Kimura 2013). Iron is a serious issue, particularly in developing nations. According to Haddad (1999), "the green revolution" caused the iron content of the Asian diet to decline, and foods like beans, peas, and grains have taken its place. Women, particularly those who are nursing and of reproductive age, are the most susceptible group in the population when it comes to iron deficiency or anemia.

VITAMIN CONTENT

A chemically diverse class of substances, vitamins are vital micronutrients that serve a number of purposes, such as coenzymes, antioxidants, cell differentiation, and colors for the eyes. The vitamin content of honey bees is shown in Table 7. The vitamin A (larva, 89-119; pupa, 49.3-53.3 IU per g wet weight) and D (larva, 6130-7430; pupa, 5070-5260 IU per g wet weight) concentrations of honey bee worker adult larvae and pupae were estimated by Hocking and Matsumura (1960). According to Finke (2005), honey bee brood contains every nutrient.

PHARMACOLOGICAL FUNCTIONS

In addition to being a wholesome food source, honey bees have a number of medicinal uses. Hu and Li (2001) showed that worker larvae, pupae, and queen larvae have anti-tumor and anti-aging properties.

HONEY BEE AS A POTENTIAL ANIMAL FEED

The European Union (EU) recently approved the use of insect protein in pig and poultry feed under regulation EU 2021/1372, which essentially opens the door for the use of honey bees as animal feed. By administering apilarnil (drone bee larvae) to broiler chickens, Yucel et al. (2011) exhibited improved feed conversion and androgenic effects, including wattle width and comb length. Another study by Muraviev and Kalatzinskaja (2014) showed that chickens given drone homogenate produced more eggs of greater quality (cf. Sawczuk et al. 2019). Male pigs aged two to four months who were given an ethanolic extract of drone brood homogenate shown notable increases in reproductive traits, such as an increase in the volume of the epididymis and the weight of the seminal glands.

CONCLUSION

The acceptance of honey bees as a possible source of animal feed and human nutrition may be facilitated by paying attention to the competent nutritional composition of their brood, pupae, and prepupae in particular. Specifically, drone broth is a great option for usage as a dish or ingredient. However, just like with other insects, ecological and environmental factors, such as the amount and quality of the bees' food, can affect the honey bee's chemical makeup, body weight, and overall health (MeyerRochow et al., 2021). It will be necessary to conduct additional research on these issues. It is still mainly unknown and a job for the future to estimate vitamins and provide a full description of carbohydrates in relation to the various developmental phases of honey bees. To guarantee the product's safety, a system that maintains hygiene and sanitation is required, as is routine monitoring of the effects of pesticides and antibiotics. Furthermore, in order to identify the most effective and practical bioactive compounds in bee brood, an examination of the specific functional characteristics that the consumed meal has on the consumer is necessary.

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