

## EVALUATION OF SOME NUTRITIONAL AND ANTIOXIDANT VALUES OF BEE BREAD (PERGA) FOR ATHLETES

<sup>1</sup>Mehmet Rüştü KARAMAN<sup>ABCDE</sup>

*A Çalışma Deseni (Study Design)*

*B Verilerin Toplanması (Data Collection)*

*C Veri Analizi (Statistical Analysis)*

*D Makalenin Hazırlanması (Manuscript Preparation)*

*E Maddi İmkanların Sağlanması (Funds Collection)*



**Abstract:** Bee bread named also as perga is fermented bee pollen, which is much more valuable and useful than the normal pollen due to its unique and high amount of beneficial components. Bee bread is known to have a high concentration of protein and other nutritional impacts making it more valuable to natural food nutritionists. Although there is no specific formula, the average makeup is said to contain simple sugars, proteins, minerals, vitamins, fatty acids, and diverse other components like fungi particles. In this sense, bee bread is even more health-giving than the more commonly available fresh bee pollen. Perga is not widely available on the market. The main reason for this is; it is very valuable and it is very troublesome to take the horn with the reason that it is buried in petit. Although a wide using area of perga in the health industry, especially it is a very special product that can be evaluated against metabolism problems, diet regulation and allergies. Bee bread on the other hand is a slightly different composition, as the bees add honey and bee secretions to the pollen to make a nutritional protein source for the hive. The main object of this study was to analyse some nutritional components together with physicochemical and antioxidant properties of bee bread. For this aim, some physicochemical and biological values together with antioxidant capacity of bee bread collected from different regions of Central Asia were investigated. The findings have revealed that bee bread have especially an abundance of fenolic substances and antioxidants, which are all important in achieving optimal health and performance. However, it has also been concluded that physicochemical and antioxidant properties of bee bread were varied depending on the varied geographical locations having different floral sources.

**Key Words:** Bee product, Perga, Bee bread, Antioxidant, Athletes

---

<sup>1</sup> Corresponding Author: Afyon Kocatepe University, Afyon

## 1. INTRODUCTION

Biologically active substances of natural origin always focus a great interest. This also applies to bee products because of their powerful healing properties. Bee products are multicomponent natural substances necessary for the proper course of basic life reactions (Bobis et al., 2010). These include the following: honey, pollen, and extracts derived from it, that is, bee bread, propolis, royal jelly, and bee venom. Bee products demonstrate a wide range of healing effects. They increase the level of ATP, thus neutralize an effect of many toxic agents, increase immunity of an organism, and improve the energy balance of tissues. They participate in many stages of protein metabolism. They are involved in the synthesis of nucleic acids and are essential to the proper functioning of the circulatory system of living organisms.

Bee bread is known under other different names such as perga or ambrosia. And it can be written in different ways: beebread, bee bread or bee-bread. Bee bread is not widely available on the market. The main reason for this is; it is very valuable and it is very troublesome to take the horn with the reason that it is buried in petit. Many beekeepers do not take the bee breads from their teeth to keep their bees strong and multiply. Although a wide using area of bee bread in the health industry, especially it is a very special product that can be evaluated against metabolism problems, diet regulation and allergies. Bee bread is made of pollen, which has been gathered by bees and mixed with its own digestive enzymes, carried back to the hive, packed into pellets and preserved with a tiny bit of honey and bee wax. This mixture undergoes different chemical processes by the action of different enzymes, micro-organism, moisture and temperature (35-36 °C), and bee bread is formed after two weeks (Nagi et al., 2004). Bee bread is rich in glucose, essential amino acids, fatty acid, multi vitamin and minerals (Nagai et al., 2005), and it has high anti-microbiyal activity (Abouda et al., 2011)

Bee bread on the other hand is a slightly different composition, as the bees add honey and bee secretions to the pollen to make a nutritional protein source for the hive. Bees tend to use this bee bread as a protein source especially for eggs and larva early on. There are even solitary bees that will pack a brood cell with a small ball of bee processed pollen and lay an egg on top (Thorp, 2016). Bee bread is known to have a high concentration of protein and other nutritional impacts making it more valuable to natural food nutritionists. Although there is no specific formula, the average makeup is said to contain simple sugars, proteins, minerals and vitamins, fatty acids, and diverse other components like fungi particles (Evans, 2015). In this sense, bee bread is even more health-giving than the more commonly available fresh bee pollen. The bees will use their head to pack in layers of pollen, sealed by honey until it is about  $\frac{3}{4}$  full. At this time, they'll seal it with another layer of honey, under which it ferments into bee bread (Evans, 2015). Bee bread is characterized by a higher nutritional value than pollen, better digestibility, and richer chemical composition.

Moreover, it is better absorbed by the human body than pollen since the components of bee bread are partially fermented and are more easily assimilated in an organism (Barene et al., 2015; Kielizsek et al., 2017). Because of the presence of all the essential amino acids, bee bread is characterized by better composition than many valuable products obtained based on animal proteins. Bee bread also has good properties that help eliminate various toxins from organism (Habryka et al., 2016).

Bee bread or perga, is a naturally fermented, enzymatically-activated food made by bees inside the hive, with around 25% honey or nectar, 70% pollen, and 5% mixture of bee wax and enzymes. In the process of fermentation, microorganisms conserve the pollen and convert it into bee bread. Considered far superior to flower pollen, protein bioavailability is significantly enhanced. The fermentation process not only helps preserve the pollen's shelf life, but also amplifies the bioavailability of its nutrients, which makes it much more important as a food supplement than the pollen. Bee bread is about 20% proteins, 24-35% carbohydrates and 1,6 % of lipids. Bee bread has a large variety of minerals and has high quantities of iron, cobalt, phosphorus, calcium. It is one of the richest natural foods containing selenium . Bee bread is also an excellent source of potassium and B-group vitamins. Amino acids, which are predigested for easy assimilation in the ratio that the human body needs, constitute about 15% of the dry substance in beebread. It is a natural nourishing supplement rich in phytohormones, flavonoids, amino acids, minerals and other active biological compounds, with bioavailability at least three times more than regular bee pollen. This complex of vital substances determines the immune stimulating nature of bee bread. Bee bread vitamins: A, B1, B2, B3, B6, B12, C, PP, E, D, K and H .Bee bread minerals: P, S, Cl, K, Ca, Na, Mg, Fe, Cu, Zn, Co, Mo, Se, Cr, Ni and Si. Bee bread amino acids: phenylalanine, leucine, valine, isoleucine, arginine, histidine, lysine, methionine, threonine and tryptophan.

Due to the rich nature of its minerals, vitamins, lipids, amino acids, enzymes, fatty acids, bioflavonoids and carotenoids, bee bread acts as an: antioxidant, antifungal agent, antibacterial agent, antiviral agent, allergy alleviator, stimulates the immune system, reduces inflammation, detoxifying agent, agent promoting healthy digestion, cholesterol lowering agent and and much more. It has been also revealed that bee bread can be applied as a suitable dietary supplement due to a high content of omega-3 linolenic acid and a beneficial ratio of  $\omega$ -3 /  $\omega$ -6 fatty acids and unsaturated-to-saturated fatty acids (Ceksteryte and Jansen, 2012). However, there is limited information on the ergogenic effects of bee products on antioxidant status and sports performance, particularly on the effectiveness of bee bread supplementation on endurance running performance. Though there are very few studies of this bee product, lately research focused on finding more about it.

*Antioxidant activity:* Bee bread was found to have a high antioxidant activity (Nagai et al., 2004; Baltrusaityte et al., 2007b). Stanciu et al. (2009) reported that bee bread has antioxidant components such as phenolic acids and flavonoids. High

antioxidant activity also reported (Zuluaga et al., 2015), which evaluated polyfloral Colombian bee bread with ABTS method; values from their study range from 46.1 to 76.3  $\mu\text{mol Trolox/g}$ . On the basis of the above findings, bee bread seems to be attractive as an important source of antioxidants for the food and pharmaceutical industries.

*Anaemia:* Bee bread (as only medicine) was administered to 20 patients suffering from anaemia. The study conclusion was that bee bread is suitable for the treatment of anemia. The same conclusion is supported by a Bulgarian report as well (Georgijewa et al 1993).

*Antimicrobial activity:* Bee bread samples showed a potential activity against the growth of both gram positive and gram negative bacteria which was resistant to antibiotics. This would be a very interesting approach to control more dangerous species of micro-organism in medical sciences (Baltrušaitytė et al. 2007; Ivanisova et al., 2015).

*Antitumoral effect:* Bee bread showed moderate antitumor activity. The samples were screened, using in vitro assays, against different human tumor cell lines, MCF-7 (breast adenocarcinoma), NCI-H460 (non-small cell lung cancer), HeLa (cervical carcinoma) and HepG2 (hepatocellular carcinoma), and also against non-tumor liver cells (porcine liver cells, PLP2) (Sobral et al., 2017). In the 6 tested samples there have been identified 32 flavonol glycoside derivatives, such as quercetin, kaempferol, myricetin, isorhamnetin and herbacetin derivatives. Very important also is that none of the bee bread samples showed toxicity for normal cells (Anonymous, 2018).

*Effect of immune system:* Bee bread strengthens the immune system of an organism and also supports the treatment with pharmaceuticals. It also improves concentration and memory. It can be used during an increased mental effort. Bee bread also demonstrates an effect regulating the digestive system functioning (Kieliszek et al., 2018).

## 2. MATERIALS AND METHODS

The main target of this study was to analyse some energy components, minerals, vitamins etc. of bee bread to determine their potential as a performance-enhancing energy sources for healthy life. For this aim, a total of 20 bee bread samples were collected directly from honey beekeepers in different geographic regions of Kyrgyzstan and Turkey. Total of 20 bee bread samples were also collected directly from honey beekeepers in different geographic regions of Kyrgyzstan and Turkey. The botanical origin of unifloral and multifloral bee bread samples were presented in Table 1.

**Table 1.** Botanical origin of bee bread samples.

Bee Bread Origine	Number of Samples	Province
-------------------	-------------------	----------

Multifloral	20	Turkey
Multifloral	20	Kyrgyzstan

Energy values (kcal per 100g<sup>-1</sup>) together with some physicochemical and biological properties such as protein (%), oil (%), carbohydrates (%), total sugar (%), sucrose (%), glucose + fructose (%), total phenolics (mg 100g<sup>-1</sup>), antioxidants (mg 100g<sup>-1</sup>), moisture (%) of bee bread samples were analysed according to the routine methods (Anonymous, 2005). All bee products were prepared for analysis in the laboratory of Ankara University Technopark Region. For all quality analysis were made by using routine methods. The values obtained from analysis were compared to the limit values reported by Agricultural Ministry.

### 3. RESULTS AND DISCUSSION

Some quality properties of bee bread samples collected from Turkey and Kyrgyzstan were presented in Table 2. The average moisture contents of the samples were varied 5.13 and 11.69 % depending on region. The free acidity levels of the samples are ranged from 1.84 to 5.42 meq kg<sup>-1</sup>, respectively. In this study, average carbohydrate capacity of bee bread collected from Turkey was 34.62 % having 370 kcal 100g<sup>-1</sup>, whereas it was 41.91 % having 439 kcal 100g<sup>-1</sup> for bee bread samples collected from Kyrgyzstan. The findings have revealed that bee bread had an abundance of carbohydrates, which are also all important in achieving optimal health and performance. Whereas, average protein capacity of bee bread collected from Turkey was 23.19%, whereas it was 23.48% for bee bread samples collected from Kyrgyzstan. Mutsaers et al. (2015) have also pointed that bee bread contains fewer proteins than the original pollen, but they are easier to absorb.

On the other hand, total phenolic contents were found between 12.53 and 35.67 mg 100g<sup>-1</sup> for Turkey, 23.82 mg 100g<sup>-1</sup> and 39.01 mg 100g<sup>-1</sup> for Kyrgyzstan. Average antioxidant capacity of bee bread collected from Turkey was 79.27 mg 100g<sup>-1</sup>, whereas it was 83.84 mg 100g<sup>-1</sup> for the samples collected from Kyrgyzstan. The findings have revealed that bee bread have an abundance of fenolic substances and antioxidants, which are all important in achieving optimal health and performance. Bee bread has high antioxidant and scavenging abilities against free radicals and reactive oxygen species such as superoxide anion and hydroxyl radical. Stanciu et al. (2009) reported that bee bread has antioxidant components such as phenolic acids and flavonoids. Phenolic compounds are considered as possible protective agents in reducing damage in human body from free radicals and retard the progress of lipid peroxidation (Fadzel et al., 2018). It has also been concluded that total flavonoid and total phenolic contents varied between the samples depending on the geographical location of the different floral sources (Table 2).

Many authors have also studied phenolic and flavonoid contents of bee bread to determine their beneficial effect in human health and whether a correlation exists with floral origins (Macdermid and Stannard, 2006; Dubtsova et al., 2007; Yakusheva, 2010; Ping et al., 2018). Furthermore, bee bread can be an effective carbohydrate source and a better substitute to glucose for exercise and athletic performance, due to its constituent of various classes of sugars (Markiewicz-Żukowska, et al., 2013). In a similar study at Sains Malaysia University, Fadzil et al. (2018) have found that bee bread support could improve athletic performance. The researchers examined the effects of bee bread supplementation on athletes' running performance and antioxidant status. They gathered 12 male athletes to participate in the study. In the first experimental trials, they gave athletes 20 g of bee bread or placebo daily for eight weeks. During the trials, participants ran 60 percent of VO<sub>2</sub>max for 90 minutes. Blood samples were also collected to measure total antioxidant status. The results showed that participants receiving bee bread supplements lasted longer than those receiving placebo. In addition, antioxidant status and plasma were significantly higher than the placebo group within 24 hours post-exercise, post-exercise, and post-exercise. The results of the study showed that daily bee bread supplementation may improve antioxidant status in jogging performance and recreation athletes. Hence, supplementation of bee bread will elicit an ergogenic effect on running time trial performance in recreational athletes due to their rich capacities of many nutrients, minerals, and enzymes.

**Table 2.** Some quality properties of bee bread samples

Parameters	Minimum	Maximum	Mean ± SD
Turkey			
Moisture, %	7.92	11.69	9.81 ±
Free Acidity, meq kg <sup>-1</sup>	2.54	5.42	3.98 ±
EC, mS cm <sup>-1</sup>	0.57	0.78	0.68 ±
Total Sugar, %	22.83	35.03	28.93 ±
Sucrose, %	2.64	4.50	3.57 ±
Antioxidant, mg 100g <sup>-1</sup>	70.11	88.42	79.27 ±
Total Phenolics, mg 100g <sup>-1</sup>	12.53	35.67	24.10 ±
Energy, kcal 100g <sup>-1</sup>	342	398	370 ±
Fat, %	5.02	7.73	6.38 ±
Protein, %	19.65	25.48	23.19 ±
Carbohydrate, %	31.94	37.30	34.62 ±
Kyrgyzstan			
Moisture, %	5.13	9.38	7.26 ±
Free Acidity, meq kg <sup>-1</sup>	1.84	4.93	3.39 ±
EC, mS cm <sup>-1</sup>	0.73	0.95	0.84 ±
Total Sugar, %	14.10	28.65	21.38 ±
Sucrose, %	1.99	3.42	2.71 ±
Antioxidant, mg 100g <sup>-1</sup>	77.59	90.08	83.84 ±

Total Phenolics, mg 100g <sup>-1</sup>	23.82	39.01	34.42 ±
Energy, kcal/kJ 100g <sup>-1</sup>	398	479	439 ±
Fat, %	8.25	12.49	10.37 ±
Protein, %	19.79	26.83	23.48 ±
Carbohydrate, %	25.17	33.48	41.91 ±

#### 4. CONCLUSION

Recently, there has been an increasing demand for natural products, particularly the bee products. Bee products have been used thousands of years ago as a supplement and as a form of traditional medicine. Bee products are multicomponent natural substances necessary for the proper course of basic life reactions (Bobis et al., 2010). In this article, we want to show that some health effects of bee bread as an important natural bee product. An increasing number of people appreciate the therapeutic effect not only of honey, but also of other products with wide application in apitherapy. Bee bread (ambrosia) is a unique product, which is very important not only for humans, but also for the bees. Bee bread, due to their nutritional and medicinal properties, are used for apitherapeutic purposes. It has been emphasized that from biological point of view the most effective pollen forms are bee bread and fresh frozen pollen (Bogdanov, 2014). Due to the rich nature of its minerals, vitamins, lipids, amino acids, enzymes, fatty acids, bioflavonoids and carotenoids, bee bread acts as an: antioxidant, antifungal agent, antibacterial agent, antiviral agent, allergy alleviator, stimulates the immune system, reduces inflammation, detoxifying agent, agent promoting healthy digestion, cholesterol lowering agent and and much more. Thus, they allow in supplementing nutritional deficiencies, as well as better adaptation of an organism to adverse environmental conditions, improving the physical and mental state.

However, the potential application of beebread as a food and as a nutraceutical supplement depends in a greater extent on its chemical composition which varies directly with the flora of the region and the time of collection by the bees (Markiewicz-Żukowska *et al.*, 2013). Ceksteryt et al. (2016) have also pointed that the potential application of bee bread as a food supplement and as a nutraceutical greatly depends on its biochemical richness, which varies upon the flora diversity of the region and the of the pollen collection. As a result; bee bread is highly recommended to people suffering from illnesses of digestive and hepatic systems. It helps liver to function well and detoxifies the body. It lowers the level of cholesterol and it is recommended for atherosclerosis. It is also very efficient in urinary disorders and prostate issues. While allergy to bee pollen is frequent, allergy to bee bread is very rare. In conclusion, it can be stated that bee products are characterized by many beneficial biological properties that can be successfully used in food technology and medicine.

## 5. REFERENCES

- Anonymous. (2018). <https://Healthywithhoney.Com/What-Are-Health-Benefits-of-Bee-Bread/2018>.
- Baltrusaityte, V., Venskutonis, P. R. & Ceksteryte, V. (2007). Antibacterial activity of honey and beebread of different origin against S-aureus and S-epidermidis. *Food Tech. and Biotechnology* 45(2), 201-208.
- Bobis, O., Marghitas, L. A., Dezmirean, D., Morar, O., Bonta, V. & Chirila, F. (2010). Quality parameters and nutritional value of different commercial bee products. *Bulletin of University of agricultural sciences and veterinary medicine Cluj-Napoca, Animal science-biotechnologies*, 67.
- Ceksteryte, V., Kurtinaitiene, B., Venskutonis, P. R., Pukalskas, A., Kazernaviciute, R. & Balžekas, J. (2016). Evaluation of antioxidant activity and flavonoid composition in differently preserved bee products. *Czech. J. Food Sci*, 34, 133-142.
- Dubtsova, E., Komisarenko, I. & Kassyanenko, V. (2007). Bee pollen and bee bread: Biological action and use in aged people. *C. Gerontol*, 13, 50-52.
- Detroy, B. F. (2016). *Pollen traps – Trapping pollen from honey bee colonies*. Beesource.com. Production Research Report No. 163, Retrieved August 2019.
- Evans, J. (2015). Bee bread, *Nordicfoodlab.org*. Retrieved August 2019.
- Georgijewa, E. & Wassileff, W. (1993). *Pollen against anemia*. 29 Apimondia Kongress in Budapest.
- Habryka, C., Kruczek, M. & Drygas, B. (2016). Bee products used in apitherapy. *World Scientific News*, 48, 254-258.
- Kassyanenko, V., Komisarenko, I. & Dubtsova, E. (2010). Influence of honey, pollen and bee bread on serum cholesterol of patients with pathological lipid metabolism (Russian). *Beekeeping, Apitherapy and Life Quality, Int. Industrial Academy, Moscow*, 81-82.
- Kielizsek, M. et al. (2018). Pollen and bee bread as new health-oriented products: A review. *Trends in Food Science & Technology*, 71, 170-180.
- Markiewicz-Żukowska, R., Naliwajko, S. K., Bartosiuk, E., Moskwa, J., Isidorov, V., Soroczyńska, J. & Borawska, M.H. (2013). Chemical composition and antioxidant activity of beebread, and its influence on the glioblastoma cell line (U87MG). *Journal of Apicultural Sci.*, 57(2), 147-157.
- Mutsaers, M., Blitterswijk L., Leven, L.V. & Waerdt, J.W. (2005). Bee products: Properties, processing and marketing. *Agromisa*, 90.
- Lifterovr, F. W., Shishkina, L., Agafonova, W., Soldatov, E. G., Marhovskaya, I. & Pushkareva, S. (2009). Experience with the use of bee bread for the treatment of dislipidemia of patients with high or intermediate risk for heart disease having arterial hypertension, *Apitherapy Today (In Russian)*, Ribnoe, 54-55.
- Stanciu, O., Marghitas, L. & Dezmirean D. (2009). Macro-and oligo-mineral elements from honeybee-collected pollen and beebread harvested from Transylvania (Romania). *J. Anim Sci Biotechnol*. 66, 1-6.
- Thorp, R.W. (2016). *Vernal pool flowers and their specialist bee pollinators*. Vernalpools.org. Retrieved August 2019.

Yakusheva, E. (2010). *Pollen and bee bread: Physico-chemical properties. Biological and pharmacological effects. Use in medical practice.* In Rakita, D., Krivtsov, N., Uzbekova, D.G. (Eds.). *Theoretical and Practical Basics of Apitherapy* (Russian), Roszdrav: Ryazan.

Zuluaga, C. M., Serrato, J. M. & Quicazan, M. C. (2015). Chemical, nutritional and bioactive characterization of Colombian bee-bread. *Chemical Engineering Transactions*, 43, 175-180.