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INVESTIGATION OF SOME PHYSICOCHEMICAL AND ANTIOXIDANT PROPERTIES OF BEE POLLEN FOR ATHLETES

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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 products include honey, pollen, propolis, royal jelly and bee bread consists mainly of carbohydrates (CHO), minerals, and vitamins which are properties that are believed able to improve performance and general human health. Especially, bee pollen can be an effective nutrient source for human body to increase immune functions and antioxidant activity, which is essential for a wide variety of metabolic and physiologic processes. Thus, it is believed that bee pollen can be the best supplement for human nutrition and health, but there is limited information on the ergogenic effects of bee pollen on body performance. The main target of this study was to analyse some energy components together with physicochemical and antioxidant properties of bee pollen to determine its potential as a performance-enhancing energy source for humans. For this aim, some physicochemical and biological values together with antioxidant capacity of bee pollen collected from different regions of Central Asia were investigated. The findings have revealed that bee pollens have 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 pollen samples were varied depending on the varied geographical locations having different floral sources.

Key Words: Bee pollen, Nutrient, Antioxidant, Total fenolics

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1. INTRODUCTION

Minerals and nutrients are essential for a wide variety of metabolic and physiologic processes in the human body. Some of the physiologic roles of minerals are their involvement in: muscle contraction, normal hearth rhythm, nerve impulse conduction, oxygen transport, oxidative phosphorylation, enzyme activation, immune functions, antioxidant activity, bone health, and acid-base balance of the blood (Speich et at., 2001; Melvin, 2005). Especially, carbohydrates are the most essential nutrient in an athlete's diet because they are the only fuel that can sustain intense exercise for extended durations. The energy requirements of training vary according to the type and duration of sessions which in turn change across training cycles.

Bee products include honey, propolis, royal jelly, bee pollen and bee bread consists mainly of carbohydrates (CHO), minerals, and vitamins which are properties that are believed able to improve exercise performance and general health. It is believed that bee products such as pollen are the best supplements for human nutrition and health. Compared to the vitamin-richest corns, fruits and vegetables, pollen has 20 times more vitamine A and significantly more panthothenic and folic acids and biotin. Values are in mg per 100 g pollen. Vitamin C (Ascorbic acid): 7 – 56, Vitamin E (Tocopherol): 4 – 32, Vitamin B3 (Niacin): 4 – 14.4, Vitamin B6 (Pyridoxin): 0.2 – 0.7, Vitamin B1 (Thiamin): 0.6 – 1.3, Vitamin B2 (Riboflavin): 0.6 – 2.6, Vitamin B5 (Pantothenic acid): 0.5 – 2, Vitamin B9 (Folic acid): 0.3 – 1, Vitamin B7 (Biotin): 0.05 – 0.07. However, there is limited information on the ergogenic effects of bee products on sports performance. Pollen consists mainly of carbohydrates (CHO), minerals, and vitamins which are properties that are believed able to improve exercise performance and general health. The consumption of energy giving substances before, during and after any form of physical exercise improves the individual's performance and increases the rejuvenation of muscles. This is also associated with dietary supplementation with NH, which provides up to 17 g of carbohydrates for every tablespoon consumed and gives the much needed energy, thus serving as an inexpensive substitute to commercially available sporting activities enhancers (Ajibola et al., 2012). The data obtained from the Sports Nutrition and Exercise Laboratory of one University show that honey can be used effectively instead of glucose for energy replenishment during physical exercise (Kreider et al., 2002). A very recent review of the hypoglycaemic effect of honey by some workers also conclude that, the synergistic effect of fructose and glucose constituents of honey might contribute to the low glycaemic response after a honey meal (Erejuwa et al., 2012).

Bee pollen contains all of the eight essential amino acids in amounts that vary between five to seven times the level found in equal weights of traditional high

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protein foods. It also contains vitamins A, D, E, K, C and bioflavonoids, as well as the complete Bcomplex; especially pantothenic acid (B5) and niacin. The high levels of vitamin B5 are particularly beneficial for the adrenal glands which are adversely affected during stress. Bee pollen has been used traditionally as an anti-aging food, and an energy food. On the other hand, as a functional food one of the main health enhancing properties is the strong antioxidant activity of pollen. As a matter of fact, it has been used by a number of Olympic athletes to improve their performance (Bruno, 2005). Bee pollen have been used commonly all over the world as traditional and ethnopharma-cological nutrients since ancient times. It has a lot of active ingredients which are known to be effective for several medical conditions.

The effectiveness of bee pollen on physical fitness and some other parameters were investigated after adding it to the food as a supplementation in rats (Haro et al., 2000). Improved regeneration efficiency of hemoglobin, increased calcium and phosphorus absorption, improved utilization of iron, and increased weight gain were notified in the rats fed with pollen. Thus, it is regarded as an excellent food for energy requirement, maintaining the physiological equilibrium and body chemistry, strengthening immune system, treating influenza-like diseases, maintaining regular functioning of the kidney and liver, maintaining healthy blood low density lipoprotein (LDL) and high density lipoprotein (HDL) cholesterol levels (Karabağ et al., 2010). Regular exercise programs may result in decreases in some of the blood parameters while causing increase in some others. This kind of a difference can be seen in athletes who have high levels of blood parameters in the beginning of training (Zorba et al., 2000). Hence, reviewing of the scientific reports on bee products could help us to reach two main conclusions in terms of nutritional properties and the usage of these mixtures in sport performance. Still there is a tremendous need for advanced good quality experimental and clinical studies. On the other hand; there is obviously an urgent need to find out the best reliable and standardized mixture, which have been approved for health and sport-beneficial effects.

2. MATERIALS AND METHODS

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

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Table 1. Botanical origin of honey and bee pollen samples.

Bee Products	Number of Samples	Province
Honey Type		
Multifloral	20	Kyrgyzstan
Multifloral	20	Turkey
Pollen Type		
Multifloral	20	Kyrgyzstan
Multifloral	20	Turkey

Energy values (kcal per 100g^{-1}) together with some physicochemical and biological properties such as protein (%), fat (%), carbohydrates (%), total sugar (%), sucrose (%), glucose + fructose (%), total phenolics (mg 100g^{-1}), antioxidants (mg 100g^{-1}), moisture (%) of the bee pollen samples were analysed according to the routine methods (Anonymous, 2005). All bee products and mixtures 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 compaired to the limit values reported by Agricultural Ministry.

3. RESULTS AND DISCUSSION

Some quality properties of bee pollen samples collected from Turkey and Kyrgyzstan were presented in Table 2. The average mositure contents of pollen samples were varied 6.54 and 8.35 % depending on region. The free acdity levels of the samples are ranged from 8.37 to 12.66 meq kg^{-1}, respectively.

Table 2. Some quality properties of pollen samples

Parameters	Minimum	Maximum	Mean ± SD
Turkey			
Moisture, %	6.54	8.35	7.85 ±
Free Acidity, meq kg^{-1}	8.37	12.66	10.31 ±
EC, mS cm^{-1}	0.63	0.87	0.72 ±
Total Sugar, %	30.46	38.75	34.97 ±
Sucrose, %	3.38	5.00	4.12 ±
Antioxidant, mg 100g^{-1}	72.51	86.39	79.48 ±
Total Phenolics, mg 100g^{-1}	8.64	12.15	10.56 ±
Energy, kcal 100g^{-1}	381	402	392 ±
Fat, %	10.27	16.09	13.14 ±
Protein, %	25.26	32.64	28.95 ±
Carbohydrate, %	44.92	55.29	49.38 ±
Kyrgyzstan			
Moisture, %	6.17	8.23	7.55 ±
Free Acidity, meq kg^{-1}	8.52	12.86	10.49 ±
EC, mS cm^{-1}	0.70	0.94	0.86 ±

Total Sugar, %	32.19	41.05	35.74 ±
Sucrose, %	3.67	4.51	3.99 ±
Antioxidant, mg $100g^{-1}$	77.63	85.19	82.50 ±
Total Phenolics, mg $100g^{-1}$	9.58	15.73	12.37 ±
Energy, kcal/kJ $100g^{-1}$	392	433	419 ±
Fat, %	8.16	17.42	13.32 ±
Protein, %	29.28	34.25	31.77 ±
Carbohydrate, %	48.57	56.94	52.33 ±

Total phenolic contents were found between 8.64 and 12.15 mg $100g^{-1}$ for Turkey, 9.58 mg $100g^{-1}$ and 15.73 mg $100g^{-1}$ for Kyrgyzstan. Average antioxidant capacity of bee pollens collected from Turkey was 79.48 mg $100g^{-1}$, whereas it was 82.50 mg $100g^{-1}$ for pollen samples collected from Kyrgyzstan. The findings have revealed that bee products have an abundance of fenolic substances and antioxidants, which are all important in achieving optimal health and performance (Carpes et al., 2007). It has also been concluded that total flavonoid and total phenolic contents varied between different bee samples depending on the geographical location of the different floral sources. De Melo Pereira and Almeida-Muradian (2010) have also revealed that stability of antioxidant vitamins in bee pollen samples. Many authors have studied phenolic and flavonoid contents of bee products 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, pollen can be an effective carbohydrate source and a better substitute to glucose for exercise and athletic performance (Markiewicz-Żukowska, et al., 2013). In this study, average carbohydrate capacity of bee pollens collected from Turkey was 49.38 % having 392 kcal $100g^{-1}$, whereas it was 52.33 % having 419 kcal $100g^{-1}$ for pollen samples collected from Kyrgyzstan. The findings have revealed that bee pollens had an abundance of carbohydrates, which are also all important in achieving optimal health and performance. Especially, carbohydrates are the most essential nutrient in an athlete's diet because they are the only fuel that can sustain intense exercise for extended durations. On the other hand, many studies have also revealed long term ingestion of pollen and special pollen preparations could improve the physical performance and fitness of sportsmen and elderly people.

The data obtained from the Sports Nutrition and Exercise Laboratory of one University showed that honey could also be used effectively instead of glucose for energy replenishment during physical exercise (Macdermid and Stannard, 2006). Supplementation of bee pollen will elicite an ergogenic effect on running time trial performance in recreational athletes due to their rich capacities of many nutrients, minerals, and enzymes. However, the analysed values of samples were varied depending on variety of bee products or their mixtures (Bobis et al., 2010). In other

study, the effects of a six-week course of pollen extract administration were investigated on a variety of physiological parameters in a group (N = 20) of adolescent swimmers. The number of training days missed due to upper respiratory tract infections was less in the pollen treatment group (4 days) than in the placebo group (27 days) (Maughan & Evans, 1982).

4. CONCLUSION

As a result, bee products such as bee pollen have been used thousands of years ago as a natural supplement and as a form of traditional medicine. Bee pollen contains all of the eight essential amino acids in amounts that vary between five to seven times the level found in equal weights of traditional high protein foods. It has a lot of active ingredients which are known to be effective for several medical conditions. The effectiveness of bee pollen on physical fitness and some other parameters were investigated after adding it to the food as a supplementation in rats. However, many authors have studied phenolic and flavonoid contents of bee pollen to determine their beneficial effect in human health and whether a correlation exists with floral origins. Thus, there are many bee-products on the market, many of which are very poor quality with very suspect ingredients that is also contaminated with antibiotics, heavy metals and other impurities. Standardisation of quality properties of the bee products will be valuable for their optimal performance effects for athlets. On the other hand, our stdy have revealed that long term ingestion of pollen and special pollen preparations could improve the physical performance and fitness of sportsmen and elderly people.

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