THE EFFECT OF BEE POLLEN ON MACROSCOPIC STRUCTURE OF FEMORA IN ADULT FEMALE RATS AFTER AN EXPERIMENTAL ADDITION IN DIET

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ABSTRACT

Bee pollen is considered a super food because it contains proteins and is rich in vitamins, minerals and phytochemicals. According to these benefits is bee pollen often used as a dietary additive, but its role on growth characteristics and bone metabolism is still poorly understood. Therefore the objective of this study was to determine the effect of diet supplementation with bee pollen on selected growth characteristics (body weight, femoral weight and femoral length) in adult female rats. One-month-old female Wistar rats were randomly divided into four groups of 5 animals each. In the control group (1), rats were fed a commercial diet throughout the experiment (90 days). Rats of three other experimental groups received standard diets with a different content of bee pollen: group 2 – 0.2%, group 3 – 0.5% and group 4 – 0.75% of bee pollen for 90 days. The statistical analysis of obtained data showed a statistically significant decrease of femoral weight in rats from experimental group 4 as compared to control one (1) and also relevant differences were found between rats from the experimental groups 2 and 4 (P<0.05). The results produced by the current study allow better understanding of the role of bee pollen on growth and bone metabolism in rats.

Keywords: Bee pollen. Body weight. Femoral weight. Femoral length. Rats.

INTRODUCTION

Bee pollen is composed of flower pollen mixed with nectar and bee secretions (Silva et al., 2006). Bee pollen is one of the widely used natural supplements. It contains many essential nutritional elements important for growth and development of animals and humans (Bell et al., 1983; Orzaez Villanueva et al., 2002; Haščík et al., 2011; Capcárová et al., 2012; Petruška et al., 2012). Bees use pollen as their nutritional source of proteins (25-30%), carbohydrates (30-55%), lipids, including fatty acids and sterols (1-20%), vitamins and minerals. Futhermore, bee pollen is rich in carotenoids, flavonoids, phytosterols, polyphenols and other beneficial compounds (Baltrušaityté et al., 2007; Moreira et al., 2008). This natural product is recognized to be a valuable apitherapeutic product with potential for medical and nutritional applications (Almeida-Muradian et al., 2005). Bee pollen is promoted as a health food with a wide range of nutritional and therapeutic properties (Yamaguchi et al., 2006), triggering beneficial effects to human health and the prevention of prostate problems (Shoskes, 2002), allergy desensitization (Mizrahi and Lensky, 1997), arteriosclerosis (Wojcicki et al., 1986) and
tumors (Zhang et al., 1995). Its important physiological functions have already been widely praised. It has been reported that bee pollen accelerates mitotic rate, promotes tissue repair, enhances greater toxic elimination and reduces excessive cholesterol levels (Morais et al., 2011). Its radical scavenging activity has already been reported (Baltrušaitė et al., 2007). Moreover Yamaguchi et al. (2004) demonstrated that the water-solubilized extract of bee pollen (Cistus ladaniferus) has an anabolic effect on several bone components in rats. The extract of bee pollen has a stimulatory effect on bone formation and an inhibitory effect on bone resorption in vitro (Yamaguchi et al., 2004; Hamamoto et al., 2006) and also stimulates bone calcification (Yamaguchi et al., 2004).

Growth and development of animals and humans is affected by numerous factors, including nutritional regime, genetic factors, sex, age, management conditions and production system. Recent years have witnessed an increasing interest in the use of various feed additives and dietary supplements believed to improve growth characteristics of animals. Therefore the aim of this study was to determine the effect of bee pollen as alternative feed additive on selected growth characteristics (body weight, femoral weight and femoral length) in adult female rats.

MATERIAL AND METHODS

Our study was carried out on twenty one-month-old female Wistar rats. The animals were housed individually in plastic containers (Techniplast, Italy) under the same laboratory conditions of temperature (20-24°C) and relative humidity (55±10%) with access to food (feed mixture M3, Bonagro, Czech Republic) and drinking water ad libitum. All experiments were provided in accordance with accepted standards of animal care in accredited laboratory (SK PC 50004) of the Slovak University of Agriculture in Nitra.

At the age of four weeks the young rats were divided into 4 groups, of 5 animals each. The control group (1) was fed with feed mixture without bee pollen additive. Experimental group 2 was fed with the bee pollen addition in concentration of 0.2%, group 3 with addition of bee pollen in concentration of 0.5% and group 4 with addition of bee pollen in concentration of 0.75% for 90 days. All procedures were approved by the Animal Experimental Committee of the Slovak Republic.

At the end of the experiment, all animals were killed, weighed and their femora were used for macroscopic analysis. Femora were weighed by analytical scales and their length was measured by a sliding instrument. Values for macroscopic analysis were expressed as mean ± standard deviation. Comparisons between experimental and control groups were assessed by the one-way analysis of variance (ANOVA) and Post Hoc Tukey’s test. The significance level was accepted at p<0.05.

RESULTS AND DISCUSSION

Our results demonstrate no significant effect of bee pollen application on body weight and femoral length in adult female rats. Statistically significant differences were found only for femoral weight in rats from experimental group 4 in comparison with those from the control one (1) and also relevant differences were observed between rats from the experimental groups 2 and 4 (Table 1).

In general, bee pollen contains a wide spectrum of amino acids, vitamins, hormones, and minerals, as well as enzymes and co-enzymes necessary for good digestion and growth. Our study revealed a non-significant effect of bee pollen administration (in concentrations of 0.2%, 0.5% and 0.75%) on body weight in adult female rats. In the contrary Haro et al. (2000) reported that male rats fed with multifloral bee pollen (10g.kg⁻¹ of diet for 10 days) had increased body weight. Significantly increased body weight was also observed in chicken fed...
with a basic diet supplemented with 1.5% of bee pollen over a period of 6 weeks (Wang et al., 2007) and also in male rabbits received bee pollen as water suspension at 100, 200 and 300 mg.kg⁻¹ of body weight for 10 weeks (Attia et al., 2011). These differences, however, could be caused by different concentrations of bee pollen used in the mentioned studies. In addition, it is known that differences of bee pollen application on growing characteristics depend on animal species and also sex. The data observed by Kolesárová et al. (2011, 212) indicate a significant decrease in the secretion of insulin like growth factor I (IGF-I) and subsequent stimulation of reproductive female hormones after unifloral rape seed bee pollen addition in dose 5g.kg⁻¹of diet for 90 days. In accordance with results obtained by Haščík et al. (2012) we suppose that some energy are therefore channelled to the reproductive system and don’t affect growing of female rats supplemented by bee pollen.

Weights of femora were significantly decreased in female rats from experimental group 4 as compared to control group and also between rats from the experimental groups 2 and 4. In general, steroid hormones play the important role in bone cell development and in the maintenance of normal bone architecture. We assume, that changes in progesteron and estradiol production in female rats after bee pollen addition reported by Kolesárová et al. (2011, 2012), could have an impact on activity of osteoblasts and bone mineralisation resulting in decreased femoral weight.

The femoral lengths did not differ between rats from all groups. The results by Kleczek et al. (2012) revealed that bee pollen (0.5% concentration) in the diet did not cause significant changes in the weight and length of tibial bones in broilers. However, the addition of bee pollen (Cistus ladaniferus) water-solubilized extract in the diet has shown to increase bone formation and decrease bone resorption (Hamamoto et al., 2006; Yamaguchi et al., 2006), and had a preventive effect on the decrease of mineral content and mineral density in the femora of ovariectomized rats (Yamaguchi et al., 2007). We suppose that a positive impact of bee pollen on bone metabolism could have concentration-dependent manner and further research is needed to determine the optimal dosage of bee pollen in the diet of rats with a stimulative effect on bones.

CONCLUSION
Our results revealed a significant effect of bee pollen administration on femoral weight in adult female rats. Statistically significant differences were found between rats receiving 0.75% of bee pollen in their diet and those from the control group. Also, relevant differences were observed in rats with 0.2% addition of bee pollen in the diet as compared to those with 0.75% of bee pollen supplementation. On the other hand, body weight and femoral length were non-significantly affected by the administration of different concentrations of bee pollen in female rats.

<table>
<thead>
<tr>
<th>Rat’s group</th>
<th>N</th>
<th>Body weight (g)</th>
<th>Femoral weight (g)</th>
<th>Femoral length (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control (1)</td>
<td>5</td>
<td>246±15.57</td>
<td>0.8185±0.05</td>
<td>3.3840±0.11</td>
</tr>
<tr>
<td>0.2% of bee pollen (2)</td>
<td>5</td>
<td>241±12.92</td>
<td>0.7780±0.04</td>
<td>3.4180±0.03</td>
</tr>
<tr>
<td>0.5% of bee pollen (3)</td>
<td>5</td>
<td>237±18.24</td>
<td>0.7535±0.09</td>
<td>3.4120±0.09</td>
</tr>
<tr>
<td>0.75% of bee pollen (4)</td>
<td>5</td>
<td>245±20.00</td>
<td>0.5832±0.05</td>
<td>3.4360±0.08</td>
</tr>
<tr>
<td>Tukey’s test</td>
<td>NS</td>
<td>1:4; 2:4†</td>
<td>NS</td>
<td></td>
</tr>
</tbody>
</table>

N: number of rats, NS: non-significant changes, P < 0.05 (+)
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REFERENCES


