Effects of short-term bee bread supplementation on peak torque and average power of the lower limb in male athletes

Chee Ping Fadzel Wong#
Nutrition in Community Engagement (NICE) Living Lab, Faculty of Food Science and Nutrition, Universiti Malaysia Sabah, Jalan UMS, 88400, Kota Kinabalu, Sabah, MALAYSIA.
Corresponding author: Email: fadzel@ums.edu.my; Tel: +6088-320000; Fax: +6088-320259.

ABSTRACT Bee products are the common type of ergogenic aid to enhance exercise performance in athletes. Athletes consume bee products such as bee bread to make sure they have adequate nutrition and maximize their energy storage. To date, research on ergogenic effects of short-term bee bread supplementation on peak torque and average power of the lower limb in male athletes is still limited. Therefore, this study investigates the impact of short-term bee bread supplementation on peak torque and average power in the lower limbs of male athletes. Twelve athletes were selected and recruited in this randomized cross-over study. Subjects consumed either bee product or placebo for 8 weeks prior to the experimental trial. The Isokinetic dynamometer (Multi Joint System 3 Pro: Biodex Medical System, USA) was used to measure subjects' peak torque and average power of the isokinetic lower limb. Statistical analyses were performed using ANOVA with repeated measures. This present study found that isokinetic right knee extension and flexion of peak torque and average power at $180^{o}.s^{-1}$ was significantly higher in post-test compared to pre-test in the bee bread trial ($p<0.05$). The study discovered that bee bread supplementation had beneficial effects on the lower limb in male athletes.

KEYWORDS: Peak torque; Average power; Sport performance; Male athletes
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INTRODUCTION

Athletes take supplements to enhance their health, training, recovery and sports performance (Hills *et al*., 2019). Bee bread is a common daily supplement to improve sports. To date, several studies found that bee products have antioxidant properties (Nagai *et al*., 2001; Nagai *et al*., 2004; Nagai *et al*., 2005, Nakajima et *al*., 2009; Ilie *et al*., 2024; Wang *et al*., 2024; Wilczyriska and Zak, 2024), anti-inflammatory (Maruyama *et al*., 2010; Ranneh *et al*., 2021; Ilie *et al*., 2024), antitumor (Yang et al., 2007; Martiniakova *et al*.,2023), anti-allergic (Medeiros *et al*., 2008) and antimicrobial (Abouda *et al*., 2008). There also have been a few studies that discovered the ergogenic effect of bee product supplementation on exercise performance such as a study by Earnest *et al*. (2004) found that supplementation of honey at a dosage of 15 grams every 16 km during a simulated 64 km cycling time trial was significantly faster to complete cycling performance in comparison with the placebo trial. Rahim *et al*. (2011) also found that a combination of aerobic dance exercise and honey supplementation at a dosage of 20 grams for 8 weeks improved bone health and immune function compared to the aerobic dance exercise or honey supplementation alone. Another study by Shukri *et al*. (2011) discovered that supplementation of 500 mL of honey drink one hour before and 3 mL per body weight every 20 minutes during the running trial was as good as a sports drink to enhance endurance running performance.

Tavafzadeh *et al*. (2011) reported that a combination of jumping exercise and honey supplementation at 1 g per kg of body weight for 8 weeks may elicit beneficial effects on lower limbs in comparison with either jumping exercise or honey supplementation alone in female rats. It is speculated that the supplementation of bee bread will be beneficial and improve strength of the lower limb and sports performance. Aly *et al*. (2019) discovered that consumption of honey drink contains

50 grams of honey + 0.5 grams of royal jelly + 0.5 grams of bee pollen for 1 week before running an improved 1500-meter run in comparison with placebo. A recent study by Soleimani *et al*. (2021) found that supplementation of 450 mg propolis twice daily for 4-week had beneficial effects on oxidative stress and inflammation following intense exercise in healthy male subjects compared to the placebo. To date, there is scanty information on the possible beneficial effects of bee bread supplementation on peak torque and average power of lower limbs in male athletes. Therefore, the objective of this study was to investigate the short-term supplementation of bee bread on peak torque and average power of lower limbs in male athletes.

METHODOLOGY

Selection and Preparation of Subjects

Twelve male athletes were selected for this study based on inclusion criteria: active athletes who exercise 3-5 times per week and are healthy with no chronic diseases. Subjects consumed either bee bread or a placebo at a dosage of 20 grams for 8 weeks. One day before the trial, subjects were asked to refrain from exercise for 24 hours to ensure that they had adequate rest. Subjects' food and physical activity diary for the last 72 hours were collected and analyzed. Subjects recorded their 3-day food diary before the first trial. They repeated the same diet over 3-day before the days of consecutive test to minimize the differences in muscle glycogen between the trials.

Procedure of Isokinetic Dynamometer

An isokinetic dynamometer (Multi Joint System 3 Pro: Biodex Medical System, USA) was used to measure subjects' peak torque and average power of the lower limbs (Zapparoli & Riberto, 2017). Testing angular velocities were set at $180^{o}.s^{-1}$ to measure peak torque and average power of knee extension and flexion at pre and post 8-week of experimental period. Subjects performed quadriceps and hamstring stretching exercises as a warm-up. Subject familiarized with the isokinetic dynamometer protocol before the actual testing to measure peak torque and average power of the lower limb. To begin the test, subjects were seated while leaning against a backrest tilted 85^{o} from the horizontal position. The chair and dynamometer were adjusted to a 90^{o} angle. Knee attachment was secured to the dynamometer. The subject's knee axis of rotation was aligned with the dynamometer shaft. The seat was raised or lowered, or the subject was moved towards or away from the dynamometer to fine adjust the testing position. Knee attachment was adjusted so that it was proximal to the medial malleoli. The subject's knee, shoulder, waist and thigh were strapped to minimize body movement and gave stabilization position during the test. Shoulder straps were applied diagonally across the chest to prevent excessive upper body movement. The lateral femoral epicondyle was palpated and used as a bony landmark for matching the axis rotation of the knee joint and the axis rotation of the dynamometer shaft. All subjects were fully informed about the procedures to determine the isokinetic muscular strength and power test before performing these tests. They were asked to do 5 repetitions for the $180^{o}.s^{-1}$ angular velocity for each lower limb. The subjects were given 60 seconds to rest between each set of angular velocity test.

Statistical Analysis

All the statistical analyses were computed by using the Statistical Programme for the Social Sciences (SPSS) version 29.0 (SPSS Incorp, United States). The level of significance for all analysis was set at $p<0.05$. All the collected data were expressed in mean and standard deviation (mean ± SD). ANOVA with repeated measures was used to determine the differences of the measured isokinetic knee extension and flexion parameters over time and between trials. Bonferroni adjustment for

multiple comparisons was used to locate the differences when repeated measures analysis of variance revealed a significant main effect of time.

RESULTS AND DICUSSION

Mean body mass index (BMI) of the subjects was categorized as healthy (Table 1). The mean maximum oxygen consumption (VO_{2max}) reflected that the subjects had good cardio-respiratory fitness and ability in endurance sports performance.

Table 1. Physical characteristics of subjects.

Physical characteristics of subjects	Mean ± SD
Age (years)	24.0 ± 1.8
VO_{2max} ($ml.kg^{-1}.min^{-1}$)	52.0 ± 2.8
Height (cm)	173.7 ± 6.1
Body mass (kg)	67.4 ± 6.2
Body mass index ($kg.m^{-2}$)	22.3 ± 1.3

Figure 1 shows the mean values of isokinetic right and left knee extension peak torque and average power at $180^{o}.s^{1}$. There was a significant main effect of time on isokinetic right knee extension peak torque and average power at $180^{o}.s^{-1}$ in the bee bread trial ($p<0.05$). Isokinetic right knee extension peak torque and average power at $180^{o}.s^{-1}$ was significantly higher at post-test compared to pre-test in the bee bread trial ($p<0.05$).

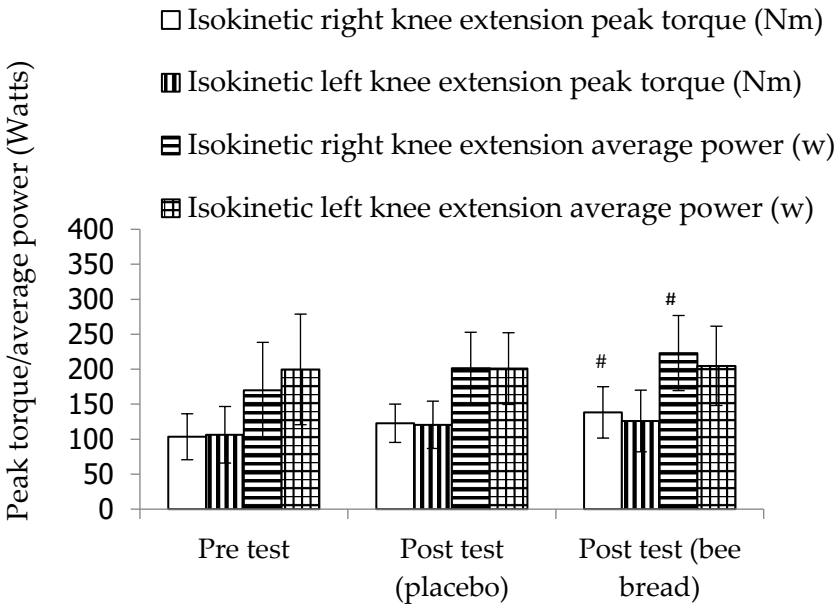

Figure 1. Right and left knee extension peak torque and average power at $180^{o}.s^{1}$ in the placebo and bee bread trials. Data are presented as mean ± SD.
#denotes significant difference from respective pre-test values at $p<0.05$.

Figure 2 shows mean values of isokinetic right and left knee flexion peak torque and average power at $180^{o}.s^{1}$. There was a significant main effect of time on isokinetic right knee flexion peak torque and average power at $180^{o}.s^{-1}$ in the bee bread trial ($p<0.05$). Isokinetic right knee flexion peak torque and average power at $180^{o}.s^{-1}$ was significantly higher at post-test compared to pre-test in the bee bread trial ($p<0.05$).

TRANSACTIONS ON SCIENCE AND TECHNOLOGY

Isokinetic assessment is used to measure the extension and flexion of lower limb muscles, such as the quadriceps and hamstrings, to determine peak torque and average power. This present study found that there were significant increases in isokinetic right knee extension peak torque at 180°.sec^{-1}, right knee extension average power at 180°.sec^{-1}, right knee flexion peak torque at 180°.sec^{1} and right knee flexion average power at 180°.sec $^{-1}$ between pre and post-test after 8-week supplementation in the bee product trial. This is the first study exploring the effect of bee bread supplementation on muscular strength and power. This finding was similar with a previous study found aerobic dance exercise and honey supplementation for 8-week elicited more beneficial effects on muscular strength and power compared to the aerobic dance exercise or honey supplementation alone (Rahim *et al.*, 2011).

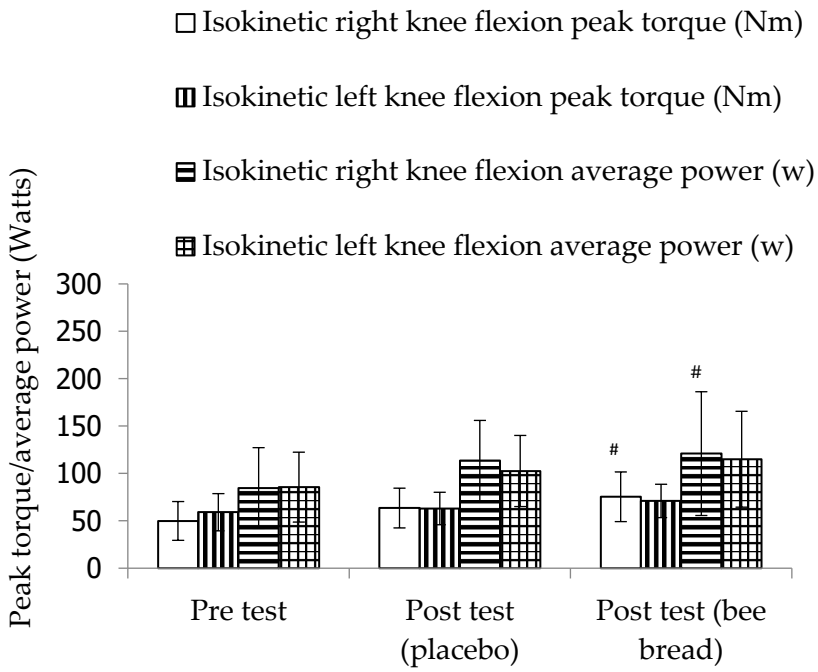

Figure 2. Right and left knee flexion peak torque and average power at 180o.s-1 in the placebo and bee bread trials. Data are presented as mean ± SD. #denotes significant difference from respective pre-test values at $p<0.05$.

Bee bread contains high protein, i.e., essential amino acid and non-essential amino acid (Nagai *et al.*, 2001; Nagai *et al.*, 2004) and it is speculated that protein contained in this supplement enhanced the muscular strength and power compared to placebo in this present study. It is well documented that athletes use protein supplementation to increase muscular strength and power (Schenk & Costley, 2002). Skeletal muscle is undergoing constant remodeling through the continuous and stimulation process of muscle protein synthesis and muscle protein breakdown (Power & Howley, 2014). Hence, it is speculated that bee bread supplementation was able to increase new or repair damaged muscle fibers through a cellular process where it fuses muscle fibers to form new muscle myofibrils compared to the placebo in the present study. Skeletal muscle is composed of thread-like myofibrils and sarcomeres that form a muscle fiber and are the basic units of contraction. These new synthesis or repaired myofibrils increase in size of a muscle and number of myofibrils to create muscle become hyperplasia and hypertrophy (Power & Howley, 2014) and lead to increased muscular strength and power with bee bread supplementation.

Many previous studies have reported that protein supplementation plays a key role in repairing and remodeling the process of skeletal muscle fibers to increase muscular strength and power (Tarnopolsky *et al*., 1992; Ratames *et al*., 2003). Rozenek *et al.* (2002) found that protein has important implications for improving both muscle size and strength. Burke *et al*. (2001) found that supplementation of whey protein at a dosage of 1.2 g/kg/day for 6 weeks significantly increased the peak torque compared to the placebo group. Based on these previous study findings, it seems that bee bread supplementation in this study was more advantageous compared to the placebo in terms of enhancing muscular strength and power.

This present finding was similar with the previous study finding by Rahim *et al*. (2011) who also found that 20 g of honey supplementation alone for 8 weeks only improved a few measured parameters of muscular and strength. Bee bread contains glucose, acid amino and multivitamin-mineral which act as ergogenic aid. Based on this previous finding, it is demonstrated that specific training of aerobic dance exercise with honey supplementation was crucial to increase muscular strength and power compared to the aerobic dance exercise or honey supplementation alone. This previous study suggested that combination of aerobic dance exercise and honey supplementation may elicit effects on reducing the increment in bone resorption, and more beneficial effects on lower limb muscular strength compared to aerobic dance exercise or honey supplementation alone. It is speculated that bee bread supplementation alone without any specific training program in this present study was not sufficient to increase all the measured parameters of muscular and strength power.

CONCLUSION

This study found that isokinetic right knee extension and flexion peak torque and average power at $180^{o}.s^{-1}$ were significantly higher at post-test compared to pre-test in the bee bread trial ($p<0.05$). The study showed that bee product supplementation had beneficial effects on peak torque and average power of the lower limb in male athletes.

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