

## A Review of Honey Supplementation on Endurance Performance in Athletes

Chee Ping Wong

Faculty of Food Science and Nutrition, Universiti Malaysia Sabah, Kota Kinabalu, Sabah, Malaysia

### ABSTRACT

Nutritional ergogenic aids are substances which can enhance athletic performance by influencing physiological processes. Sportspeople usually take supplements before, during and after a sports competition to make sure they have adequate nutrition, maximize their energy storage and enhance their physical sports performance. Endurance athletes such as marathon runners, triathlons and cyclist are known to use supplements to enhance their physical performance. Supplements may enhance endurance performance by increasing the available blood glucose during exercise, increasing body glycogen storage in muscle and liver, and increasing antioxidant status. The increasing availability of adenosine triphosphate (ATP) in the working muscles will augment physical sports performance. It is believed that honey is an ergogenic aid supplement but it is lacking in solid scientific evidences to prove its efficacy. Thus, it has received scientists' attention to conduct scientific research to test this supposition. This article discusses the effects of honey supplementation on endurance performance in athletes.

### \*Corresponding author

Dr Chee Ping Wong, Nutrition Program, Faculty of Food Science and Nutrition, Universiti Malaysia Sabah, Jalan UMS, 88400, Kota Kinabalu, Sabah, Malaysia. E-mail: fadzel@ums.edu.my

**Received:** November 02, 2020; **Accepted:** November 05, 2020; **Published:** November 07, 2020

### Honey

Honey has been used thousands of years ago as a supplement and in traditional medicine. Honey is a natural substance from flowers nectar by bees and used as a nutritious food. The color of honey is related to the plant pigment and the darker color of honey has reported contain higher level of antioxidant properties [1,2]. Honey contains antioxidant components such as phenolic compounds, flavonoid, and water soluble vitamins [3-5]. Nutrient composition of honey is influenced by the types of bee, botanical origin and environmental conditions [6]. Honey contains glucose, fructose, amino acids, bio-enzymes multi-vitamins and multi-minerals [7]. It is reported that honey has antioxidant, anti-inflammatory, antimicrobial and anti-tumor properties [4,5,8-22].

Antioxidant is a substance that helps to reduce the severity of oxidative stress. Free radicals and oxidative stress increased during exercise due to the oxygen flux increased to the exercising skeletal muscle [23]. Exercise increases the oxygen uptake 10 to 20 fold and promotes generation of reactive oxygen species [24]. Exercise is postulated to generate free radicals and oxidative stress by production of lactic acid that can convert a weakly damaging free radical (superoxide) into a strongly damaging free radical (hydroxyl), and also due to inflammatory responses to muscle damage [25,26]. This oxidative stress may limit the sports performance because the free radicals can cause cell damage and promote muscular fatigue. Honey possesses remarkable antioxidant and free radical scavenging abilities and beneficial to the endurance performance [4,5,8-11].

Honey primary contain monosaccharaides carbohydrate such as glucose and fructose. Previous studies indicated that consuming carbohydrate can enhance physical exercise performance [27-29].

Ingestion carbohydrate may enhance endurance performance via sparing endogenous blood glucose concentration and glycogen storage [29]. Previous studies reported that just a simple swilled glucose around the mouth before exercise was able to enhance physical sports performance due to the stimulation of central nervous system via communication between the mouth and the brain [30]. It is assumed that honey contains antioxidant properties, glucose and multi-nutrients can enhance the physical sports performance [4,5,8-11,19].

### Effects of Honey Supplementation on Endurance Performance

There is limited information of scientific research on effectiveness of honey supplementation on physical sports performance in human. To date, there are only a few related studies on effect of honey supplementation on endurance performance in athletes [31-36]. Earnest et al.[31] investigated the effect of low and high glycemic (GI) carbohydrate feedings during a simulated 64-km cycling time trial. Nine subjects ingested 15 g of low GI (honey) or high GI (dextrose) or placebo every 16 km during cycling time trial. This study reported that time to complete 64 km cycling time trial for honey trial was 128 minutes, 42 seconds  $\pm$  3.6 minutes; dextrose trial was 128 minutes, 18 seconds  $\pm$  3.8 minutes; and placebo trial was 131 minutes, 18 seconds  $\pm$  3.9 minutes. This finding indicated that supplementation of low GI (honey) at a dosage of 15 g every 16 km during a simulated 64-km cycling time trial (TT) significantly reduced the time to complete 64 km cycling time trial performance in comparison with placebo trial.

In another honey supplementation study, Shukri et al. investigated the effects of honey supplementation pre and during exercise on physiological responses and running time trial performance in the hot environment [32]. Ten subjects were requested to run

at 60%  $VO_{2max}$  for 60 minutes and immediately followed by 20 minutes time trial performance in a hot environment (31 °C) and 70% relative humidity. Subjects ingested 500 ml of honey drink one hour before trial and 3ml per kg of body weight of cool honey every 20 minutes during the running trial. This study found that distance covered in the honey trial was  $3.34 \pm 0.3$  km and sports drink was  $3.25 \pm 0.4$ . There was no significant difference in distance covered in the 20 minutes time trial performance between the two trials. There was also no significant difference in blood glucose between the two trials. The authors concluded that honey drink was as good as commercial sports drink in improving running time trial performance and have similar effects on blood glucose in a hot environment.

Ahmad et al. investigated the effects of honey drink supplementation during rehydration post exercise on physiological changes and subsequent running performance in a hot and humid environment [33]. Ten subjects were required to run on a treadmill for 65%  $VO_{2max}$  for 60 minutes. After that, subjects were required to rest for two hours and they were given either plain water or honey drink with equivalent to 150% of body weight lost at 0 min, 30 min and 60 min. Then subjects were required to perform 20 minutes time trial performance. This study reported that running distance covered by the subjects in the 20 minutes time trial performance was  $3.42 \pm 0.35$  km in honey trial and  $3.12 \pm 0.34$  km in plain water trials. The distance covered in 20 minutes time trial performance for honey trial elicited +9.6 % in comparison with plain water respectively. There were significant differences in blood glucose and insulin in honey trial during rehydration and time trial performance compared to the plain water trial. This study indicated that honey elicited more beneficial effects than plain water and can be recommended as an ergogenic aid for rehydration in a hot and humid environment.

Aly et al. investigated effects of honey on 1500 meters run. Fifty subjects were recruited to perform two study groups; one with intervention with the honey drink for one week before and after running and the second group was running without using the honey drink (control group) [34]. The experimental group was given 50g of honey + 0.5g of royal jelly + 0.5g bee-pollen 30 minutes before running. The present study reported time to complete 1500 m run in the honey group was  $5.01 \pm 0.24$  minutes and placebo group was  $5.16 \pm 0.11$  minutes. Honey group was 0.15 minutes faster than placebo group to complete the 1500meter run but with no significant difference. The blood glucose was higher in the honey trial in comparison with placebo trial. There was no statistical difference in the blood pressure and creatine kinase-muscle/brain (CK-MB) between the two trials. The authors conclude that despite insignificant time to complete 1500 meter but it seems that honey group was shorter time to complete the 1500 meter run and beneficial in enhancing running performance.

Abbey and Rankin [35] investigated the effect of a honey-sweetened beverage, commercial sports drink and placebo on exercise performance. Ten subjects consumed beverage before and during halftime for a total of 1.0 g per kg of body weight of weight of carbohydrate for honey trial and sports drink trial. Performance measures included 5 sets of a high-intensity run, agility and ball-shooting tests followed by a final progressive shuttle-run test to exhaustion. This study reported that no significant effect of the interventions was observed for any performance measures. This study indicated that acute ingestion of honey drink before and during a soccer-simulation test did not significantly improve results of progressive shuttle-run test to exhaustion in comparison with placebo trial.

Hajizadeh et al. [36] investigated the effects of 16-week supplementation of honey or placebo on cycling performance. Twenty four subjects were randomly equally divided into experiment group and control group. Subjects consumed 70 g honey or placebo before 90 min each training session for 16 weeks. Time taken to complete 5 km and 40 km tests cycling ergometer test, and peak power was measured at pre (baseline data) and post-test (week 16). There was no significant difference time take to complete 5 km and 40 km cycling ergometer test, and peak power between the two trials. This study reported that supplementation of honey did not significantly increase cycling performance compared to placebo among road cyclist.

As a conclusion, the evidence from the above mentioned previous studies indicating the ergogenic aids of honey, it is postulated that honey supplementation will improve the endurance performance due to its natural nutritious' content and antioxidant properties [31-34]. However, two studies reported that honey supplementation did not significant beneficial on endurance performance [35,36]. The equivocal findings are due to different types of exercises (intensity and duration of exercise), honey supplementation (timing, dosage and duration of supplementation), research subject (individual responsiveness and fitness level of the individual), experimental design and environment condition. Further studies are warranted to investigate effects of honey supplementation on different types of sports. To date, there is still scanty information on effects of honey supplementation on resistance and anaerobic sports performance. Thus, scientific studies were warranted to investigate the potential ergogenic effects of honey supplementation on this aspects of sports performance. The findings will be beneficial for an athlete who prepares for a sports tournament, undertaking two or more sessions each day and training for prolonged periods. Honey can then be recommended to the athlete for enhancing their sports performance.

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