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Evaluation of the effects of commercial Moringa Oleifera supplement on physical fitness of young fit adults: A pilot study

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ABSTRACT

Background. The Moringa oleifera (Moringa) nutritional supplement is often used for medicinal purposes due to its acclaimed healing abilities. Indeed, research indicates that Moringa possesses antioxidant and anti-inflammatory properties, and has the potential of being an ergogenic substance by enhancing energy metabolism. Yet, despite numerous manufacturers producing Moringa-based supplements, little scientific research has been conducted on humans. Aims. The aim of this pilot study was to evaluate the effects of Moringa as an ergogenic aid in improving aerobic and anaerobic exercise performance in healthy young fit subjects. Methods. A randomized, double-blind controlled study was performed to evaluate Moringa supplement compared to placebo. The study included 16 healthy young male and female, age 26.6 ± 3.0 years physical education college students. Participants were evaluated before and after six weeks of intervention of Moringa (310 mg x 2) or placebo capsules. Participants were measured for body composition, resting blood pressure (BP), resting heart rate (HR), graded cardiopulmonary test on a treadmill until reaching maximal oxygen consumption (VO_2max) and maximal anaerobic Wingate bicycle test. Results. There were no differences in physiological or physical performances between the two groups before and after the intervention. Conclusions. Despite promising indications of positive effects of Moringa plant on physiological processes, there was no effect on physical activity performance. As such, the administering of Moringa for improving athletic performance should be taken with caution. Further studies should be conducted to examine the effects of the Moringa plant on human performance in other populations.
Keywords: Sport medicine, VO_2max, Wingate test, Aerobic capacity, Anaerobic capacity, Body composition.

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INTRODUCTION

Plant-derived nutritional supplements are often used for their contribution to people's health or improved physical and mental performance and capabilities (Alidadi et al., 2020; Calabrese, 2021; Hussain et al., 2019; Poulsen et al., 2020). Yet these supplements are largely unregulated and understudied. One such example is the Moringa oleifera Lam (Moringa), a small native tree of the Himalayan regions of North-West India, often referred to as the *miracle plant*, thanks to its ability to prevent and treat many diseases. For centuries, this herbal plant has been used for medicinal purposes, with acclaimed healing properties that can assist and heal various chronic diseases (Abdull Razis et al., 2014; Essa et al., 2014). Indeed, Moringa is rich in proteins, vitamin A, minerals, essential amino acids, antioxidants, flavonoids, and isothiocyanates (Kou et al., 2018).

The literature indicates that Moringa has antioxidant and anti-inflammatory capabilities (Adedapo et al., 2015; Gupta et al., 2010; Jaafaru et al., 2018), and may even possess anti-fatigue properties and the ability to improve people's tissue antioxidant capacity (Lamou et al., 2016b). In vitro studies indicate that Moringa improves skeletal muscle metabolism by increasing oxidative energy metabolism and possibly even mitochondrial biogenesis (Duranti et al., 2021). Importantly, various studies in animals indicate a high degree of safety, with no adverse effects having been reported in human studies (Stohs & Hartman, 2015).

When examining the effects of Moringa in animal models, findings suggest a range of physiological pathways. First, Moringa increases calcium ATPase pump activity in skeletal muscle, which is important trait for maintaining healthy muscle cell functionality (Olayinka & O., 2017) Moreover, increased calcium ATPase activity may expedite the recovery phase of contracting muscle cells when exercising. Moreover, Moringa attenuates the effects of exercise on cardiac hypertrophy via scavenging reactive oxygen species (ROS) (Jasaputra et al., 2022). This reduction in ROS has the potential to enhance muscle recovery and adaptations after exercise, as ROS serve as an important mediator in such processes (Thirupathi & Pinho, 2018). Finally, Moringa has been found to stimulate mitochondrial biogenesis in skeletal muscles in rats (Ray et al., 2020), which in turn may increase exercise performance.

In humans, extracts of the Moringa leaves has been found to enhance metabolism of glucose and lipids, and exhibit antioxidant activity (Stohs & Hartman, 2015). A daily dosage of 7 grams of a Moringa powder supplement in postmenopausal women, over a three-month period, was found to decrease fasting blood glucose levels (by 13.5%) while increasing hemoglobin (by 17.5%) (Kushwaha et al., 2014). Interestingly, Moringa has also been shown to potentially be an ergogenic aid, by enhancing energy metabolism in adult skeletal muscles. This is achieved by increasing metabolic markers, including those involved in glycolysis, oxidative phosphorylation, mitochondrial biogenesis, and angiogenesis (Dissertations & Eze, 2020).

In animal studies, aqueous extract of Moringa over a 28-day period was found to increase maximum swimming time ability, blood hemoglobin, blood glucose, and hepatic and muscle glycogen reserves in male rats (Lamou et al., 2016a). Moreover, Moringa has been found to improve muscle function and treadmill endurance results in rats (Barodia et al., 2022). Indeed, many manufactures market Moringa supplements for improving exercise performance, yet to the best of our knowledge, no scientific evidence exists on the effect of Moringa on muscle performance or exercise performance in humans. The aim of this pilot study, therefore was to evaluate the effects of Moringa as a novel ergogenic aid for improving aerobic and anaerobic exercise performances in humans. More specifically, this study strives to evaluate the outcome of six weeks of treatment using Moringa leaf extract on aerobic and anaerobic exercise performances.

MATERIALS AND METHODS

The study has been approved by the institutional research ethics committee before experiment was started and that has been conducted in accordance with the principles set forth in the Helsinki Declaration (0197-18-WOMC).

Participants

This pilot study included 16 physical education college students. The students (seven men and nine women) were studying to become physical education teachers. Their average age was 26.6 ± 3.0 years, they were in good health (based on their self-reporting), and had not been administered any medication. Participants signed an informed consent approved by Helsinki board committee.

Procedures

For this randomized double blind control study, the participants were invited to our research lab a total of four times: *Time 1: Pre-Intervention Baseline session*, divided into two sessions, and *Time 2: Post-intervention session* six weeks later, also divided into two sessions. The participants were instructed to maintain their regular diet and exercise habits throughout the six-week intervention period. During the baseline session, the participants signed an informed written consent form after receiving a short explanation about the study. Next, they were measured for height, body composition (weight, body fat, BMR) resting blood pressure (BP), resting heart rate (HRrest), and VO_2max. Finally, the participants were asked to perform a graded cardiopulmonary test on a treadmill (explained in detail below). The participants were then asked to return to lab two-three days later to perform a Wingate bicycle Test (explained in detail below) – to prevent influence from the VO_2max. Six weeks later, the participant returned to the lab to perform the same tests.

Intervention

The participants were randomly divided into two groups, seven on the Moringa group and nine on the placebo group. The research group was administered two Moringa capsules a day (Moringa Arava, Israel). The control group was administered two placebo capsules a day. The Moringa and placebo capsules looked identical so that the participants could not tell them apart. Both groups were instructed to take one capsule at the morning and one at the evening after eating. Each Moringa capsule contained 310 mg of Moringa powder, consisting of 127 mg carbohydrates, 30 mg moisture, 91 mg protein, and 16 mg fat. This dosage was in line with the manufacturer's recommendations. The placebo capsule contained Dextrin.

Measures

Body composition [(weight, body fat and body mass index (BMI)] was measured using the Tanita MC 780-MAP Body Composition Analyzer (Japan); *resting BP* was measured using the Connex® ProBP™ 3400 Digital Blood Pressure Device (Welch Allyn®, USA); *HRrest* was measured using the *Polar Heart Rate Monitor* (USA). *Basal metabolic rate (BMR)* and *VO_2max* were measured based on a maximal graded exercise test that was performed on a treadmill (PPS MED; Woodway, Weil am Rhein, Germany) (Vehrs et al., 2007). Briefly, the starting velocity, which was 6 kph, was increased by 1 kph every minute. The slope was 1% throughout the test. Prior to each increase, *oxygen consumption (VO_2)*, *HR*, and *subjective sense of effort* (via the Rating of Perceived Exertion [RPE]) were measured. At the end of the test, when participants reached exhaustion, they were instructed to walk for an additional three minutest at 4 kph for active recovery. HR was measured at 1 minute after exercise termination (recovery-1).

The Wingate anaerobic test was performed on an ergometric bicycle (Monark, Ergomedic 894 Ea). The test started with a 3-minute warm up, pedaling with no load. Participants were asked to pedal as fast they could; when their maximum pedaling velocity was reached, a load was applied (pre-calculated as 8% of the participants' body mass). The participants were encouraged to maintain a 30-second maximal effort, after which they were instructed to continue pedaling with no load for an additional 3-minute active recovery period. Using the 30-sec all-out test, the following parameters were calculated: peak power (PP): the highest power obtained during first 5 s, mean power (MP): the average power exerted through the 30 s and fatigue index (FI): the percentage decrement between highest and lowest power output (Inbar et al., 1996).

Analysis

This study employed a quantitative methodology. To analyze the input received from the tests at the different time points of the study, two-way repeated-measures (group × before/after) analysis of variance was used. Data were analyzed with SPSS version 24, with significant set at $p < .05$.

RESULTS

Based on our findings, no differences were seen between the two groups at the baseline with regards to weight, body fat, BMI, BMR, resting HR, resting blood pressure, VO_2max, and the Wingate test. In addition, comparison were made between submaximal aerobic effort after 5 minutes in the VO_2max tests: (VO_2, RPE, HR minute 5). Moreover, for all variables measured, no differences were seen between the baseline and the post-intervention results, nor were any differences between the two groups (Table 1).

Table 1. The effects of Moringa vs placebo measured before and after intervention. Variables presented as means (SD).

	Moringa (N = 7)		Placebo (N = 9)	
	Pre-Intervention	**Post-Intervention**	**Pre-Intervention**	**Post-Intervention**
Weight (Kg)	62.8 (10.7)	63.0 (10.1)	65.5 (10.9)	65.5 (10.9)
BMI	23.3 (1.9)	23.3 (1.9)	23.4 (3.5)	23.3 (3.5)
Fat (%)	19.8 (6.8)	20.8 (6.0)	20.9 (8.9)	22.3 (9.2)
BMR (kcal)	1509.0 (294.7)	1497.1 (278.5)	1543.1 (246.4)	1379.5 (565.7)
SBP (mmHg)	111.3 (10.8)	113.6 (8.4)	119.2 (8.4)	115.8 (6.8)
DBP (mmHg)	65.7 (8.6)	65.3 (8.1)	66.7 (5.1)	65.2 (7.1)
HR rest (bpm)	61.0 (9.1)	68.7 (12.2)	69.0 (11.4)	68.7 (12.2)
RPE Minute 5	11.8 (4.9)	11.8 (4.8)	12.5 (2.2)	10.1 (3.7)
HR Minute 5	153.7 (19.3)	155.7 (18.8)	162.0 (19.2)	159.0 (18.5)
VO_2 Minute 5	32.6 (1.4)	33.5 (1.6)	32.5 (2.2)	33.0 (2.1)
VO_2max	44.7 (8.2)	41.6 (7.1)	41.0 (6.7)	41.0 (6.8)
RPE max	17.0 (3.9)	16.7 (3.7)	17.7 (1.5)	15.7 (3.7)
HR max	181.6 (9.6)	179.4 (7.5)	185.2 (9.9)	186.1 (8.9)
HR recovery 1 minute	176.1 (12.6)	172.6 (11.2)	181 (11.0)	181.0 (8.2)
VO_2 recovery 1 minute	40.6 (6.0)	38.1 (8.4)	37.7 (5.4)	36.6 (8.1)
Wingate MP (w/k)	7.1 (1.5)	6.3 (1.6)	7.1 (1.6)	6.6 (8.5)
Wingate PP (w/k)	10.0 (3.4)	8.5 (2.8)	9.7 (2.7)	9.1 (1.5)
Wingate FI (w/k)	52.2 (11.5)	47.7 (7.1)	50/6 (12.9)	53.2 (4.6)

DISCUSSION

The aim of this pilot study was to evaluate the influence of the Moringa nutritional supplement on physiological responses in aerobic and anaerobic exercise performances, following a six-week intervention program in healthy young active physical education college students. The Moringa treatment did not improve VO_2max

test results or anaerobic Wingate test results. These findings different from Gopi (2017), who found a beneficial effect of a sport nutrient supplement that contained Moringa on aerobic performance (Gopi et al., 2017). This difference in findings could stem from differences in the nutritional supplement used in the two studies, especially as the supplement used in the comparative study included a number of ingredients. Moreover, the exercise test modality (time to exhaustion versus VO_2max) differed in the two studies, which may have also influenced the findings.

A recent literature review presents data supporting the positive effect of Moringa on body weight (Ali Redha et al., 2021) – a finding that was not seen in the current study. It is possible that six weeks of treatment were insufficient for achieving weight loss in young, fit physical education students. Moreover, the effect of Moringa on body weight could be related to its effect on blood glucose levels, as a recent review indicates that Moringa lowers blood glucose levels in diabetic humans (Owens et al., 2020). These effects of Moringa on blood glucose in healthy populations should therefore be further investigated.

Finally, the Moringa dosage used in this study, i.e., 620 mg per day, is the recommended dose stated by the manufacture. It is possible, however, that this dose in insufficient for having a meaningful effect on young healthy physically active participants. Indeed, different studies on humans apply different dosages of Moringa, as well as supplements that have been produce in different manners (leaf powder, extraction, cooked, etc.). Although studies using leaf powder such as in our study use higher dosages of Moringa (from 1-2 g and up to 8 g per day), limited effects can be seen (Monera-Penduka et al., 2017; Sissoko et al., 2020; Taweerutchana et al., 2017), except for aqueous leaf extracts of 2, 4, and 6 g yielded an effect on blood pressures in young healthy participants (George et al., 2018).

CONCLUSION

While some studies indicate a positive effect of the Moringa plant on physiological and pathological processes in animals, its effect on humans is unclear and should be further examined. In this study, no effects were seen of the powder extracted from the Moringa leaf on aerobic and anaerobic maximal capacity in young active healthy participants compared to a placebo.

AUTHOR CONTRIBUTIONS

S.T. responsible for the supervision and writing the first draft; S.T. and M.A. responsible for conceptualization; S.T., M.A. and A.E. responsible for methodology; T.O. responsible for performing the experiments, and data collection. All authors discussed the results and contributed to the final manuscript.

SUPPORTING AGENCIES

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DISCLOSURE STATEMENT

Availability of data and material

The datasets generated during the current study are available from the corresponding author on reasonable request.

Conflict of interest

The authors report there are no competing interests to declare and report no involvement in the research by the company that could have influenced the outcome of this work.

Ethical approval

Approval was obtained from the ethics committee of Wolfson medical centre. The procedures used in this study adhere to the tenets of the Declaration of Helsinki.

Consent to participate

Informed consent was obtained from all individual participants included in the study.

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