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Effects of oral supplementation of mint extract on muscle pain and blood lactate

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Summary

Study aim: To determine the effects of mint extract on muscle pain and blood lactate levels after a 400-m run.
Material and methods: A group of 16 physical education students (mean age 21.81 ± 2.13 years) volunteered to participate in the study. The subjects were randomly assigned into 3 groups: mint, *placebo* or control. The mint group was given orally mint extract (5 ml/kg of body mass) and the *placebo* group was given unsweetened tea (5 ml/kg) in a double-blind fashion and cross-over design one hour before a 400-m running test. Subjects in the control group remained untreated. The effect of mint extract on muscle pain was recorded by an inquiry; blood lactate levels were measured after the running test.
Results: Oral administration of mint extract significantly ($p<0.01$) decreased blood lactate concentrations but muscle pain levels remained unchanged in all groups.
Conclusions: Oral administration of mint extract may have a beneficial effect on blood lactate clearance and therefore may increase athletic performance.

Key words: Mint – Blood lactate – Muscle pain – 400-m run

Introduction

Throughout history, various kinds of materials have been used and still are in use to improve sport performance and to attain athletic success. Ergogenic aids are dietary supplements or drugs intended to enhance the athletic performance, especially by eliminating fatigue symptoms [27]. Some of the more popular ergogenic aids include caffeine to increase fat metabolism, amino acids to increase protein synthesis, and various vitamins and minerals to accelerate energy metabolism [4,27].

Various kinds of mint (*mentha*), used in medical settings as an anaesthetic, have also been studied for their ergogenic properties in both animals [1] and humans [11, 19]. Mint is a plant very well known for its antispasmodic, choleretic and carminative effects. Moreover, it has various calming properties when combined with certain other plants [11,19] and small amounts of mint perfume have painkilling effects [1,2]. A significant analgesic effect with a reduction in sensitivity to headache was produced by a combination of peppermint oil and ethanol [10]. It was also found that the external application of peppermint extract raised the pain threshold in humans [15]. Furthermore, Davies *et al*. [5] reported a case of a 76-year-old woman whose pain had been resistant to standard therapies. The application of peppermint oil to her skin resulted in a significant pain reduction, the duration of analgesia lasting 4 – 6 hours post-application.

The effects of mint, such as anti-fatigue and relaxing, antibacterial and antifungal, and the effects on membrane permeability were also investigated [6,14,25]. Raudenbush *et al*. [21] found that peppermint odour administration significantly reduced the perceived physical workload, temporal workload, effort and frustration. Self-evaluated performance was also greater after administering peppermint and the participants rated their vigour higher and fatigue lower [22]. Peppermint odour also improved running speed, handgrip strength and push-up performance but had no effect on skill-related tasks, such as basketball free-throw shots [23]. The above findings have also been replicated when the odour of peppermint was added to drinking water during a workout [24].

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Although peppermint odour administration showed improvements in pain tolerance and athletic performance, the effects of these properties of mint on human performance have not been fully investigated. Thus, the aim of this study was to assess the effects of orally ingested mint extract on muscle pain and blood lactate levels following a 400-m run.

Material and Methods

Subjects: A group of 16 healthy, moderately active, physical education students aged 21.81 ± 2.13 years and weighing 68.56 ± 5.81 kg volunteered to participate in the study. The subjects were questionnaire-interviewed as to their physical activities and classified as moderately active. After having been informed about the experiment objective and protocol, the subjects submitted their written consents to participate and the study was approved by the local Ethics Committee. First, all subjects passed the control period (no treatment) and after that were randomly assigned into two groups: mint and *placebo* using a double-blind cross-over design. The mint group was given mint extract orally, the *placebo* group was given unsweetened tea. The three stages (control, *placebo*/mint, mint/*placebo*) took place at weekly intervals.

Methodology: Mint plants were picked in July and dried in the shadow. About 50 g of dry mint was infused in 1 l of water for 15 min [6], cooled under room temperature for 45 min and filtered [26]. Placebo drink was obtained by adding ½ glass of tea infusion without sugar into 1 l of water. The prepared extracts, cooled down to about 13ºC, were administered (5 ml/kg body mass [11]) orally about 1 h before the test. In order to avoid nausea, subjects were asked to take the extract in periodic sips.

The 400-m running test was conducted on a stadium in morning hours. The subjects checked in about 1 h before the test; they were not allowed to drink anything but water and were advised to consume their last meal at least 2 – 3 hours before the tests and not to partake in any strenuous physical activities for the preceding 48 h. The subjects ran 400 m distance at their maximum speed from the inner lane of the running track individually to prevent competition effects.

Measurements: Before the tests, the subjects were inquired about the level of muscle pain of lower legs, thighs and shoulders using a 6-point rating scale (never – too much) [3]. The same inquiry was also conducted 1 h post-test and on the following day. Blood (5 ml) for lactate assays was sampled from the antecubital vein 4 – 5 min post-run. Lactate was determined using a YSI Lactate analyser (Yellow Springs OH, USA).

Data analysis: Blood lactate values proved normally distributed by the Kolmogorov-Smirnov's test and were subjected to the robust test of equality of means after having applied the Levene's test, and then to one-way ANOVA followed by Tamhane's multi comparison test. Kruskal-Wallis' H test was applied to muscle pain data. The SPPS® software was used in data analysis, the level of <0.05 being considered significant.

Results

Muscle pain was low and ranged from 1 to 2 points throughout the study. Since no between-subject differences in muscle pain were observed within groups on given occasions, the data for the three muscle groups and two post-test periods (1h and 24 h post-test) were combined and presented in Table 1 together with the results of blood lactate.

Table 1. Mean values (±SD) of 400-m running velocity and post-run blood lactate and muscle pain

Group	Running speed (m/s)	Blood lactate (mmol/l)	Muscle pain (point score)
Control	6.55 ± 0.08	20.6 ± 1.8**	1.8 ± 0.5 #
Placebo	6.54 ± 0.10	19.1 ± 1.6*	1.3 ± 0.5
Mint	6.53 ± 0.07	17.0 ± 3.1	1.2 ± 0.5

Significantly higher than in the mint group: * $p<0.05$; ** $p<0.01$;
Significantly ($p<0.05$) higher than in both other groups

The ANOVA of blood lactate data revealed no significant effects other than treatments. The overall residual variance (residual, subjects, periods and carryover), based on 45 degrees of freedom, amounted to 5.22. In effect, blood lactate proved significantly lower following mint treatment compared with either placebo ($p<0.05$) or control ($p<0.01$). The perceived combined muscle pain after the run was significantly higher in the control period than in the two other ones. No between-treatment differences were found in running velocity; the latter was not correlated significantly with the post-run blood lactate concentrations (r = -0.146).

Discussion

The main finding of this study was the specific effect of mint extract ingestion on reducing blood lactate concentrations following a 400-m run. That finding seems valid in view of the fact that running velocities on all occasions were nearly identical and were not correlated significantly with lactate levels. This shows that the decreases in lactate concentrations post-exercise were not due to the workload but could be attributed to the effects of mint oils.

Mint was used by doctors in the middle ages to cure many illnesses and to recover from various pains. Dedeçay [6] reported that mint produced stimulating effects on the heart and nervous system. In other studies investigating the pain killing properties of mint, different results were obtained and it was found that various kinds of mints were effective in reducing muscle pains [7,8]. The results of the present study concerning muscle pain are not clear in view of the fact that a significant, albeit small, decrease was noted in both mint and *placebo* situations vs. control.

Forster *et al*. [8] and Dukiç *et al*. [7] stated that various *Mentha* species had antispasmodic properties and for that reason were widely used in medicine. In a study on animals [1] it was found that rotundifolone, the main component of perfume oil obtained from the leaves of M*entha x villosa* had a pain-killing effect. The authors stated that pains caused by acetic acid were relieved almost completely by injecting rotundifolone (250 mg/kg) into the peritoneal space. In another study, Raya *et al*. [19] investigated the effects of *Mentha rotundifolia* and *Mentha longifolia* on the central nervous system of mice and rats and found that *Mentha* species, like e.g. *Mentha piperita*, had spasmolytic and pain alleviating effects; besides, stomach pain-relieving effects were reported [11].

In Dedeçay's study [6], the infusion containing 6 pinches of mint and 2 pinches of rosemary in one litre of water given to French cyclists improved muscle relaxation and fatigue reduction. These two herbs used in a hot water bath helped to relax tired muscles [9]. Further, peppermint administration significantly reduced the perceived physical workload, temporal workload, effort, and frustration [20-22], brought about increases in running speed, handgrip strength and push-up performance but had no effect on skill-related tasks, e.g. basketball free-throw shots [23]. Similar effects were also observed when the odour of peppermint was added to drinking water during a workout [24]. In that study, the athletes performed a 15-min treadmill test and were given 50 ml of beverage (peppermint water, unflavoured water or Gatorade® sport drink) at 3-min intervals. Both the peppermint and sport drinks led to greater ratings of personal performance and increased mood.

Short, intense exertions lasting about one minute, induce increases in blood lactate which result in increased acidity in muscles and blood and, thus, in muscle fatigue [18]. The results of this study showed that mint extract ingested before such an exercise brought about significant decreases in blood lactate concentrations. Mint supplementation may therefore help athletes recover faster and may relax fatigued muscles even though the mechanism of that effect remains unclear.

A study of Madalane *et al*. [13], however, produced a different finding. An ointment containing 18.3% methyl salicylate and 16% menthol was applied to the site of muscle pain in a 62 year-old man. When the ointment was absorbed by the skin, complications such as muscle and skin diseases, and chronic kidney inflammation developed. Kidney function tests revealed that serum glutamyl aminotransferase activity increased to as much as 480 U/ml and alkaline phosphatase activity increased slightly. In addition, the subject was found to suffer from metabolic acidosis. That latter finding, however, could have been the result of different method of administering mint extract.

In another study [17], it was found that inhaling peppermint odour during an acute, intense exercise had no significant effect on pulmonary indices and physical performance. The authors suggested that the result could be due to the intensity and duration of training. Also McKenzie *et al*. [12] investigated the effects of peppermint odour inhalation, claimed an ergogenic aid, on running performance under different conditions. Eighteen fit, young female subjects performed 3 × ¼-mile runs under 3 randomly assigned treatments: wearing a peppermint-scented mask, unscented mask or no mask. Each subject was also given either a positive, negative, or neutral expectancy message regarding peppermint's influence on the performance. The results showed that neither peppermint inhalation nor expectancy information had any significant effect on running time. However, expectancy information increased running times of high positive affect subjects. Subjects receiving negative information showed significantly lower heart rates during the running task.

In another study [16], peppermint was found to enhance memory whereas ylang-ylang impaired it, and lengthened the processing speed. In terms of subjective mood, peppermint increased alertness while ylang-ylang decreased it, calmness being significantly increased. These results provide support for the contention that the aromas of essential oils can produce significant, idiopathic effects on both subjective and objective assessments of aspects of human behaviour.

In conclusion, future research is needed to demonstrate that oral supplementation of mint extract improves the exercise (and athletic) performance and post-exercise recovery; another objective would be to clarify the mechanism of that effect.

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