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Effect of Manuka honey administration on malondialdehyde, in intense exercise

Efectul administrării de miere de Manuka asupra malondialdehidei, în efort fizic intens

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Abstract

Background. Honey is known for its many beneficial effects on health, including its antioxidant benefits.

Aims. The objective of the study was to evaluate the effect of Manuka honey (MKH) on malondialdehyde (MDA) in intense exercise.

Methods. 32 healthy volunteer men were randomly assigned to four groups: control (C), who did not receive therapy; and the therapy groups who received MKH before exercise, for: one week (1E=8), two weeks (2E=8), and three weeks (3E=8). For all groups the protocol was the same: short-term intense exercise on a Monark Ergomedic 839E cycle ergometer. MDA was analyzed: 10 min before (T1) and 30 min (T2) and 4h (T3) after the exercise. Statistical evaluation was done using the Student test.

Results. MDA was significantly increased at T2 compared to T1, the most in C and the least in 3E. MDA was significantly reduced in 3E compared to 2E and 1E, at T2 and T3. The biggest difference was between C and 3E, both at T2 and T3.

Conclusions. 1) MKH administration had the same type of effects on MDA, regardless of the administration period. 2) The effects of MKH administered for 3W, 2W and 1W on MDA differed in their intensity at T2 and T3. 3) The MKH action on MDA was most important at T2. 4) Because 3E administration had the most intense and persistent effect on MDA, we recommend it as a modulator of oxidative stress in short-term intense exercise, in sedentary subjects.

Keywords: Manuka honey, malondialdehyde, intense exercise.

Rezumat

Premize. Mierea este cunoscută pentru numeroasele sale efecte benefice asupra sănătății, inclusiv pentru cele antioxidante.

Obiective. Obiectivul studiului a fost de a evalua efectul mierei Manuka (MKH) asupra malondialdehidei (MDA) în efort fizic intens.

Metodă. 32 de voluntari sănătoși au fost repartizați aleatoriu în patru grupuri: control (C), care nu au primit terapie; și grupurile de terapie care au primit MKH înainte de efortul fizic, timp de: o săptămână (1E=8), două săptămâni (2E=8) și trei săptămâni (3E=8). Pentru toate grupurile, protocolul a fost același: efort fizic intens și de scurtă durată, efectuat pe bicicleta Monark Ergomedic 839E. MDA a fost analizată: cu 10 minute înainte de efort (T1); la 30 min (T2) și 4h (T3) după efortul fizic. Evaluarea statistică a fost efectuată utilizând testul Student.

Rezultate. MDA a fost semnificativ crescută la T2 în comparație cu T1, cel mai mult la C și cel mai puțin la 3E. MDA a fost redusă semnificativ la 3E comparativ cu 2E și 1E, la T2 și T3. Cea mai mare diferență a fost între C și 3E, atât la T2, cât și la T3.

Concluzii. 1) Administrarea MKH a avut același efect asupra MDA, indiferent de perioada de administrare. 2) Efectele MKH administrate timp de 3S, 2S și 1S asupra MDA au diferit ca intensitate la T2 și T3. 3) Acțiunea MKH asupra MDA a fost cea mai importantă la T2. 4) Deoarece administrarea 3E a avut cel mai intens și persistent efect asupra MDA, o recomandăm ca un modulator al stresului oxidativ în efortul fizic intens și de scurtă durată, la subiecții sedentari.

Cuvinte cheie: miere de manuka, malondialdehidă, efort fizic intens.

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Introduction

Among various supplements, honey and honey-derived products have been more recently used, being demonstrated to have immunomodulatory, antiinflammatory, antibacterial, antiviral and antioxidant properties (Tartibian & Maleki, 2012). Honey contains a number of components known to act as antioxidants; these include vitamin C, vitamin E, enzymes such as catalase, peroxidase, and, phenolic compounds (Aljadi & Kamaruddin, 2004). Phenolic antioxidants from processed honey are bioavailable, and they increase plasma antioxidant activity, so they may augment defenses against oxidative stress and might be able to protect humans from oxidative stress (Schramm et al., 2003).

Many studies indicate that the antioxidant activity of honey varies widely, depending on the floral source (Bertoncelj et al., 2007). It has been shown that Manuka honey (MKH) has the highest content of polyphenols, (899.09 mg gallic acid/kg), whereas lavender honey has the lowest polyphenol content (111.42 mg gallic acid/kg) (Alzahrani et al., 2012).

Athletes are exposed to oxidative stress during physical activity, physical injury, or emotional stress (Bloomer et al., 2005). An increase in exercise intensity is one of the many ways in which oxidative stress and free radical production have been shown to increase inside cells (Kerksick, Willoughby, 2005). MDA increased immediately after aerobic exercise (treadmill running) in subjects working at high percentages of VO_{2max} (Alessio et al., 1997).

Hypothesis

The influence of polyphenols, including those of honey, on the oxidative process has been a growing concern in recent years. The use of polyphenols in exercise is also a point of interest in research. The comparative influence of different amounts of honey consumed on stress-induced acute short-term exercise has been less explored.

Objective

The objective of the study was to evaluate the effect of MKH on malondialdehyde (MDA) in short-term intense exercise.

Material and methods

Research protocol

a) Period and place of the research

The study was approved by the Ethics Committee of the College of Physicians. An informed consent was obtained from each participant, according to the Declaration of Helsinki. The measurements were carried out in May 2017, in the Family Medical Practice 122 in Cluj-Napoca.

b) Subjects and groups

Participation of all subjects in the study was voluntary. The selected subjects were sedentary. Persons with mental disorders, any type of cortisone therapy and toxic addiction - alcohol, tobacco, drugs, coffee - were excluded from the study. Four groups were explored: the control group (C), which received no therapy, and the experimental groups (E), which were administered MKH for 1 week (1E), 2 weeks (2E), and 3 weeks (3E). All four groups were subjected to the same type of physical exercise.

The number and the gender of the subjects in all groups were the same (8, male). The mean age for each group was: 28.2 ± 3 (C), 30.3 ± 4 (1E), 24.9 ± 1 (2E), 24.4 ± 3 (3E). Participants were asked not to consume alcohol, coffee, not to smoke and not to use any medication or antioxidant during the study.

c) Tests applied

- *Study design*

For stress caused by physical exercise, short-term heavy exercise on the cycle ergometer was chosen as a model. Before physical testing, the participants performed a 4-min muscle warm-up on the ergonomic bike adjusted to 40 watts. After an 8-min break, the testing proper followed, which was carried out on a MONARK ERGOMEDIC 839E cycle ergometer. The exercise test was performed at a pedaling rate of 60 rotations/min, starting with a power of 30 watts for three minutes, followed by a gradual increase of power until fatigue was felt by each subject.

The selected apitherapy product was Manuka honey MGO™ 100+ (MKH), marketed by Apiland (1,2). It was administered to 1E, 2E and 3E daily, for one, two and three weeks, respectively, at a dose of 1g/kg body weight. In all E groups, MKH was administered before physical exercise on the cycle ergometer.

- *Determination of indicators*

It was the same for C and E groups, performed at the end of the MKH administration period, as follows: time 1 = first determination, basal (T1), 10 min before exercise; time 2 = second determination (T2), and time 3 = third determination (T3), 30 min and 4 hours, respectively, after exercise.

- ***Explorations***

The examinations consisted of measuring venous blood malondialdehyde (MDA) levels at the Synevo laboratory in Cluj-Napoca, using the high-pressure liquid chromatography method (HPLC) with fluorescence detection (3).

d) Statistical processing

- The results obtained were analyzed using the SPSS 13.0. statistical package.
- For continuous data examination, Student's t test was used.
- The differences were considered significant at a $p< 0.05$.

Results

Note that the *reference values* were those of C and the *reference time* was considered to be T2.

A. Intra-group analysis (Tables I, II, III, IV)

The dynamics of MDA values were similar for all groups (Fig. 1).

MDA values significantly increased from T1 to T2 for: C ($p < 0.00001$), 1E ($p < 0.00001$), 2E ($p < 0.00001$) and 3E ($p < 0.00001$). MDA values decreased from T2 to T3: insignificantly for C and 1E and significantly for 2E ($p = 0.042$) and 3E ($p = 0.031$).

Table I
Comparison of MDA values for C

C	T1	T2	T3
Mean	0.51625	3.88625	3.734
SD	0.46816	1.3656	0.40673
p	T2-T1 = 0.00001 T3-T1 = 0.00001		T2-T3 = Ns

Table II
Comparison of MDA values for 1E

1E	T1	T2	T3
Mean	0.40125	3.44	3.20875
SD	0.1715	0.34496	0.34382
p	T2-T1 = 0.00001 T3-T1 = 0.00001		T2-T3 = Ns

Table III
Comparison of MDA values for 2E

2E	T1	T2	T3
Mean	0.42625	3.025	2.7425
SD	0.16151	0.303926	0.30165
p	T2-T1 = 0.00001 T3-T1 = 0.00001		T2-T3 = 0.042

Table IV
Comparison of MDA values for 3E

3E	T1	T2	T3
Mean	0.43625	2.43125	2.13375
SD	0.18547	0.30012	0.28908
p	T2-T1 = 0.00001 T3-T1 = 0.00001		T2-T3 = 0.031

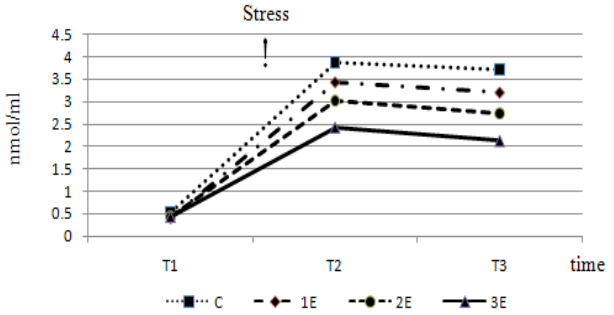

Fig. 1 – Changes in MDA under the influence of MKH, in intense exercise «Stress» = the time of acute short-term exercise.

B. Inter-group analysis (Tables V, VI)

Compared with C, MDA values decreased in all MKH-treated groups at: a) T2 - 1E (p = 0.017), 2E (p = 0.00015) and E3 (p = 0.00001); and b) T3 - 1E (p = 0.0071), 2E (p = 0.00004) and E3 (p = 0.00001).

Table V
Comparison of MDA inter-group values versus C

Moments	MDA	C	1E	2E	3E
T2	Mean	3.88625	3.44	3.025	2.43125
	p		0.017	0.00015	0.00001
T3	Mean	3.734	3.20875	2.7425	2.13375
	p		0.0071	0.00004	0.00001

Table VI
Comparison of MDA inter-group values versus 3E

Moments	MDA	1E	2E	3E
T2	Mean	3.44	3.025	2.43125
	p	0.00001	0.0007	
T3	Mean	3.20875	2.7425	2.13375
	p	0.00001	0.0005	

C. Analysis of the MDA value ratio by moments and between groups (Figs. 2, 3)

The greatest difference between the groups was between C and 3E, both at T2 (1.6) and T3 (1.7).

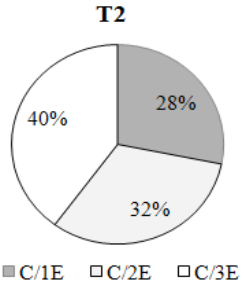

Fig. 2 - Inter-group MDA value ratio at T2.

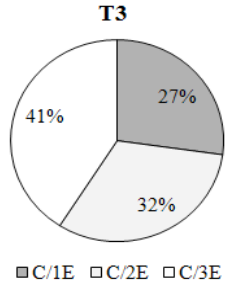

Fig. 3 - Inter-group MDA value ratio at T3.

Discussion

This article is a continuation of previous research of the authors regarding the relationship between sport and stress (Jurcău et al., 2012), sport and polyphenols (Jurcău, 2012), and sport and oxidative stress (Jurcău & Jurcău, 2013).

a) Manuka honey

In the present study, a comparative analysis of the impact of different MKH administration periods on MDA in sedentary persons subjected to short-term intense exercise was carried out.

Chronological Pubmed evidence

MKH (Leptospermum scoparium) in New Zealand contains a high amount of phenolic compounds such as flavonoids, methyl syringate and a methoxylated benzoic acid, a structural isomer of syringic acid (Stephens et al., 2010). Methyl syringate in MKH was identified as a potent superoxide scavenger that could be expected to reduce free radical activity (Jubri et al., 2013). MKH was positively correlated with the unique manuka factor (UMF) value, which is expressed as phenol equivalents of its bactericidal activity (Kato et al., 2012). MKH reduces oxidative damage in young and middle-aged rats, and this effect could be mediated through the modulation of its antioxidant enzyme

activities and its high total phenolic content, so it can be used as an alternative supplement from an early age, in order to improve oxidative status (Jubri et al., 2013). MKH proved to be superior in its phenolic content (899.09 mg gallic acid/kg) to acacia honey of Germany and wild carrot honey, and to have significantly higher levels of polyphenols and antioxidant activity than portobello honey (made in Edinburgh, UK) (Patel & Cichello, 2013). Thus, oral administration of MKH, interfering with the oxidative process, reduces the free radical level (MDA) (Almasaudi et al., 2017).

b) The relationship of oxidative stress and MDA with exercise

Short-term intense physical exercise may result in oxidative phenomena, which can be evidenced by changes in MDA, a known marker of oxidative stress. This idea is supported, in this study, by MDA dynamics in C, the post-exercise values of this paramater being highly significantly increased at T2 and significantly increased at T3.

Chronological Pubmed evidence

Exhaustive maximal exercise induces free radical generation, while short periods of submaximal exercise (i.e. less than 70% VO2max) may inhibit it and lipid peroxidation; the tendency to an increase in MDA with exercise intensity was obvious (Lovlin et al., 1987). Physical exercise in healthy individuals induced transient lipid peroxidation, which could be reversed by some products during recovery (Leaf et al., 1997). For example, following a downhill run for 45 min at 75% VO2max, young and older men experienced similar increases in serum MDA, and vitamin E administration influenced, even if only modestly, oxidative stress induced by this intense exercise (Sacheck et al., 2003). Thus, athletes are at risk of constant exposure to oxidative stress, which is why the consumption of antioxidant-rich food may be necessary in order to meet their dietary antioxidant requirements (Ahmad et al., 2017).

c) The antioxidant effect of honey and the relationship of honey with exercise

Intra-group analysis showed that T2-T1 differences of MDA values were highly significant for all groups, while T2-T3 differences were significant only for 2E and 3E. This proves that MKH administration for a longer time period resulted in a higher anti-oxidative stress protection.

Inter-group analysis showed that for all the groups receiving MKH, there was a significant reduction in MDA values in the post-exercise period compared to the control group. Of the three variants, the 3-week treatment had the most intense effect.

The analysis of the ratio between groups showed that the greatest difference was between C and 3E groups, both at T2 and T3, which demonstrates, once again, that the longer administration of MKH achieved a more effective protection against oxidative stress induced by short-term intense exercise.

The antioxidant effect of honey - chronological Pubmed evidence

Honey has great potential to be used as a natural source of antioxidants to reduce the negative effects of fruit and vegetable processing (Chen et al., 2000) and its use in some foods, instead of traditional sweeteners, could result in an enhanced antioxidant defense system in healthy adults (Schramm et al., 2003). Processing, handling and storage affect honey antioxidant activity only to a minor degree, while the botanical origin of honey has the greatest influence on its antioxidant activity (Bertoncelj et al., 2007). Although honey has gained interest as a source of antioxidants, the exact dose of honey that is optimal for protection against oxidative damage is still debatable and more studies are required (Ahmad et al., 2017).

The relationship of honey with exercise - chronological Pubmed evidence

The influence of honey consumption on exercise has been studied in various stress models. Thus, after consumption of 1.5 g/kg body weight of buckwheat honey by healthy human adults, plasma total phenolic and antioxidant content increased (Schramm et al., 2003). Consumption of 70 g/day of unprocessed honey by male cyclists, after 8 weeks of cycling, determined suppression of MDA in seminal plasma and increased antioxidant activity (Tartibian & Maleki, 2012). Honey was also recommended to be consumed by athletes before exercise, as a carbohydrate source for energy (Ahmad et al., 2017).

The results obtained by MDA testing under the action of the MKH used are consistent with data from recent studies related to changes in this parameter, under the action of honey. This study also confirms the antioxidant effect of MKH. The difference from the cited studies is that our study shows that the longer the administration of MKH (three weeks), the more intense and persistent is the modulation of oxidative stress induced by short-term intense exercise in sedentary subjects.

Conclusions

1. MKH administration had the same type of effects on MDA, regardless of the administration period.
2. The effects of MKH on MDA in 3E, 2E and 1E were different in intensity at T2 and T3.
3. The MKH action on MDA was most important at T2.
4. Because 3E administration had the most intense and persistent effect on MDA, we recommend it as a modulator of oxidative stress in short-term intense physical exercise.

Conflicts of interest

Nothing to declare.

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