Effect of Tot'hema and Ferroglobin B_{12} Food Supplements on Changes of Blood Indices in Endurance-training Sportsmen

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Blood iron deficiency is a frequent problem among endurance-training sportsmen, which results in lower haemoglobin levels and impaired oxygen transport to the muscles. To escape these consequences, sportsmen use food supplements with increased iron content. In Lithuania, easily available are the preparations Tot'hema and Ferroglobin B_{12} intended for the treatment and prophylaxis of iron deficiency anaemia. However, we failed to find in the available literature data on the effect of these preparations on sportsmen's body.

Therefore the aim of the current work was to study the effect of the preparations Tot'hema and Ferroglobin B_{12} and their combinations with bee products on the body of aerobic endurance-training sportsmen. We found that administration of iron-saturated preparations and their combinations with bee products caused only insignificant changes in the energetic value of sportsmen's ration. However, the mineral composition of the ration changed considerably. The effect of the food supplements Tot'hema and Ferroglobin B_{12} and their combinations with bee products on blood morphogenesis and biochemical composition in endurance-training sportsmen was evident, as they statistically reliably increased haemoglobin level and erythrocyte count. These changes were most pronounced under the effect of Tot'hema combined with bee products: blood iron concentration became higher both in men and women, iron-saturated transferrin content increased, the mean volume of erythrocytes and the blood hematocrit decreased. These favourable changes were still present 2–3 weeks after interrupting blood supplementation with iron preparations.

Key words: food supplements, physical load, adaptation, bee products, blood, haemoglobin, transferrin, hematocrit, iron

INTRODUCTION

Sportsmen training in the aerobic endurance sport branches belong to a group exposed to a risk of developing iron deficiency, because under intensive and lasting physical loads iron content in blood decreases. This means that blood haemoglobin concentration also decreases and oxygen supply to the muscles becomes impeded (1–4). To compensate for iron deficiency in their organism, sportsmen use food supplements with a high content of iron (5, 6).

Iron belongs to a group of elements of vital importance and is a constituent part of haemoglobin, myoglobin, various enzymes that regulate the metabolism. Iron takes an active part in oxygen transport and deposition (7). Iron participates also in immune reaction of the body and is indispensable for growth and hemopoiesis (8).

Iron deficiency can exert a negative influence on the metabolic functions participating in energy production, therefore iron is of particular importance for sportsmen and especially for those representing endurance sports (9, 10). Iron deficiency in the body has been proven to reduce physical performance (2, 11, 12). Iron deficiency is accompanied by lowered haemoglobin, its reduced index b of colour, impaired cell functioning (13). Among subjects going in for sports, iron deficiency is more frequent in women, because they lose this element with blood during their menstruation cycle (11, 14, 15, 16).

Iron deficiency should be first of all compensated by adequate nutrition. Food ration should contain more products rich in iron (17).

The questioning of Lithuanian endurance-training sportsmen showed that they try to compensate iron

deficiency by using the preparations Tot'hema (INNOTERA, France) and Ferroglobin B_{12} (VITABIOTICS, Great Britain). According to the indications, these preparations are intended for the treatment and prophylaxis of anemia caused by iron deficiency. However, we failed to find in the literature data on the role of these food supplements on the organism of endurance-training sportsmen.

Presently sportsmen use various bee products as a means to improve their adaptation to physical loads (18, 19, 20), thus the question arises whether these products are compatible with food supplements containing high levels of iron.

Attention is given to the fact that nowadays widely advertised are various iron-containing food supplements in the absence of scientifically grounded information on their effect on sportsmen's body. The present study is supposed to contribute to a reasonable selection of best-suited food supplements without exposing the organism to a health hazard.

The aim of the current work was to elucidate the effect of the iron-containing food supplements Tot'hema and Ferroglobin B_{12} as well as their combination with bee products on the blood indices of endurance-training sportsmen.

METHODS

The object of the study was the effect of iron-containing food supplement on the blood indices of endurance-training sportsmen and the compatibility of these food supplements with bee products.

We examined 80 students aged 20–22 years, training in endurance sports. We assessed their physical development. The mean height of females was 168.0 ± 1.8 cm and body mass 61.0 ± 1.2 kg, these indices in males being 183.0 ± 2.1 cm and 78.0 ± ± 2.3 kg. The males where divided in to five groups 10 subjects each and the females into 3 groups 10 subjects each (Table 1).

Examination was carried out before the use of the food supplements (Study I), 14 days following their use (Study II) and two weeks following interruption of food supplement administration (Study III). The C_m and C_f groups were studied simultaneously with Studies I and II or the groups that used food supplements.

For every study group blood erythrocyte count, mean erythrocyte volume, hemoglobin concentration, blood hematocrit were determined (Sysmex K-3000 analyzer, Japan). Blood for morphological and biochemical tests was taken from finger and vein. The whole picture of peripheral blood was studied. Iron concentration in blood plasma was found to be 14.3–25.9 μmol/l in men and 10.7–21.5 μmol/l in women. Plasma concentration of the β_1-globulin fraction protein transfer was determined by the same method as used for Fe, sedimenting iron ions with magnesium salts.

The obtained data were analysed by methods of mathematical statistics. The significance of the differences of the mean values was evaluated according to the Fisher (F) ANOVA criterion. The mean values (M) for the groups, standard errors (SE) and standard deviations from the mean values (SD) were calculated. Parametrical statistics hypotheses were verified according to Student's t criterion.

Table 1. **Scheme of the study**

Groups	Food supplements	Dosage/day	Duration, days
	Male groups		
F	Ferroglobin B_{12}*	15 g	14
F+b	Ferroglobin B_{12}* + bee pollen and honey mixture (1:1)	15 g + 20 g	14
T	Tot'hema**	10 g	14
T+b	Tot'hema** + bee pollen and honey mixture (1:1)	10 g + 20 g	14
C_m	None	–	–
	Female groups		
T_f	Tot'hema**	10 g	14
T_f+b	Tot'hema** + bee pollen and honey mixture (1:1)	10 g + 20 g	14
C_f	None	–	–

Notes. * VITABIOTICS laboratories (Great Britain). The supplement contains 21 mg iron, 12 mg thiamine, 3 mg riboflavin, 6 mg vitamin B_6, 15 mg vitamin B_{12}, 30 mg vitamin C, 15 mg zinc.
** INNOTERA laboratory (France). The supplement contains 50 mg iron, 133 mg manganese, 0.7 mg copper and 20 mg sodium benzoate.

RESULTS AND DISCUSSION

Our investigation showed that administration of the food supplement Tot'hema did not induce statistically significant changes in blood iron content and in the

males this index even showed a decreasing tendency (Fig. 1). The food supplement Feoglobin B_{12} and its combination with bee products had no influence on this index either, while under administration of Tot'hema in combination with bee products blood iron levels in females increased by 10.51 µmol/l ($p < 0.01$) and in males by 7.7 µmol/l ($p < 0.05$). The difference between groups in Study II was statistically significance: in females $p < 0.001$, in males $p < 0.001$.

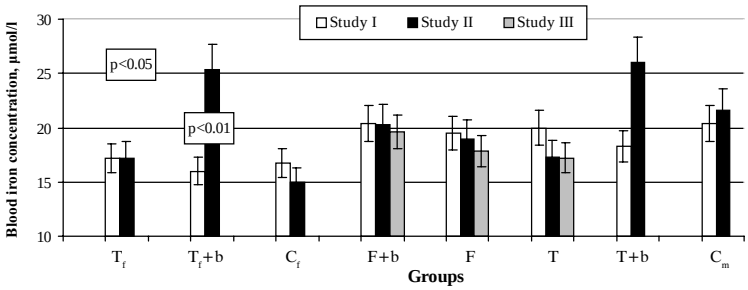

Fig. 1. Blood iron concenration dynamics

Transferrin is the initial reserve or iron in the body. It reflects iron stocks in the hemopoietic organs. Haemoglobin production highly depends on its content, iron-saturated transferrin in particular. Iron-saturated transferrin content in the course of two weeks of Tot'hema administration in female bodies showed no changes and in males decreased by 8% ($p < 0.05$). Upon administration of this food supplement in combination with bee products the blood transferin content in females increased by 27.5% ($p < 0.01$) and was higher than in the other female groups, while in males it increased by 12% ($p < 0.05$) and was also higher that in the other groups of males ($p < 0.05$). In males, upon administration of Ferroglobin B_{12} and its combination with bee products, this index decreased by 1 ($p < 0.05$) and 12% ($p < 0.05$). In control groups the blood content of iron-saturated transferrin during the study period showed no changes (Fig. 2).

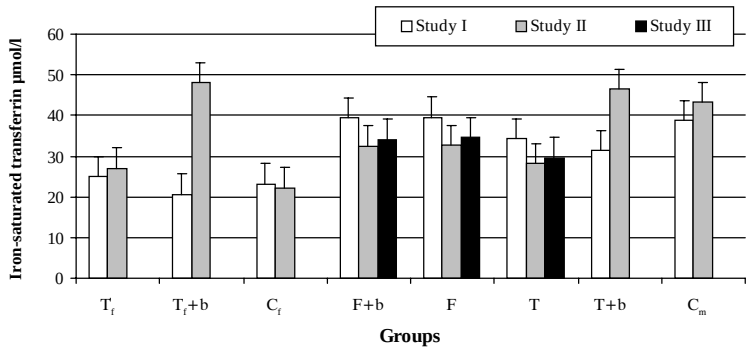

Fig. 2. Dynamics of iron-saturated transferrin concenration in sportsmen's blood

The food supplements Tot'hema and Ferroglobin B_{12} as well as their combination with bee products had no effect on general blood picture. The combination of Tot'hema with bee products induced higher erythrocyte counts: in females from 4.23×10^{12} to 4.59×10^{12} ($p < 0.05$) and in males from $4.70 \times$

Table 2. **Blood erythrocyte count dynamics (M ± SE)**

Groups	Erythocyte counts, $\times 10^{12}$/l					
	Study I	Study II	Study III	Difference reliability among the indices		
				p_{I-II}	p_{II-III}	p_{I-III}
			Female			
T_f	4.32 ± 0.12	4.58 ± 0.11	4.48 ± 0.10	>0.05	>0.05	>0.05
T_f+b	4.23 ± 0.11	4.59 ± 0.12	4.43 ± 0.11	<0.05	>0.05	>0.05
C_f	4.28 ± 0.17	4.32 ± 0.23		>0.05		
Difference reliability among groups	F = 0.71, p > 0.05	F = 0.86 p > 0.05	F = 0.94 p > 0.05			
			Male			
F	5.08 ± 0.12	5.08 ± 0.13	4.88 ± 0.12	>0.05	>0.05	>0.05
F+b	4.85 ± 0.08	4.91 ± 0.07	4.99 ± 0.09	>0.05	>0.05	>0.05
T	4.91 ± 0.11	4.90 ± 0.11	4.92 ± 0.09	>0.05	>0.05	>0.05
T+b	4.70 ± 0.08	5.03 ± 0.04	4.92 ± 0.09	<0.05	>0.05	<.0.05
C_m	4.90 ± 0.08	4.93 ± 0.08		>0.05	>0.05	
Difference reliability among groups	F = 1.56, p > 0.05	F = 2.74 p > 0.05	F = 2.10 p > 0.05			

$\times 10^{12}$ to 5.03×10^{12} ($p < 0.05$) (Table 2), while the mean erythrocyte volume decreased in both gender groups by 7.00 μ^3 ($p < 0.01$)). This status survived upon interruption of the food supplements.

The mean blood erythrocyte corpuscle volume (MCV) was found to exhibit most positive changes in the group of men and women administered the preparation Tot'hema in combination with bee products. MCV during the first stage of the study decreased significantly both in men and women (on the average 7 μ^3, $p < 0.01$ and $p < 0.05$), whereas Study II showed that in the groups administered Tot'hema with bee products the MCV was lower than in the group that received Ferroglobin B_{12} (Table 3).

Administration of Tot'hema with bee products increased blood hemoglobin concentration as soon as after two weeks: in females on average by 8.3 g/l ($p < 0.05$) and in males 6.4 g/l ($p < 0.05$) (Fig. 3). In the group of men administered Tot'hema and bee products, blood haemoglobin concentration changed more frequently than in the other groups. During the first stage of the study this index increased on the average by 6.4 g/l ($p < 0.05$) and in Study II a tendency to a lower blood haemoglobin concentration was observed (on the average by 2.1 g/l, $p > 0.05$), however, if compared to the baseline and Study III results, this index tended to increase (on the average by 4.8 g/l, $p > 0.05$). In the group of women administered Tot'hema with bee products, blood haemoglobin concentration in Study I increased on the average from 129.0 ± 1.63 to 137.3 ± ± 1.98 g/l. In Study II this index almost did not change and reached 136.0 ± 2.26 g/l, being higher

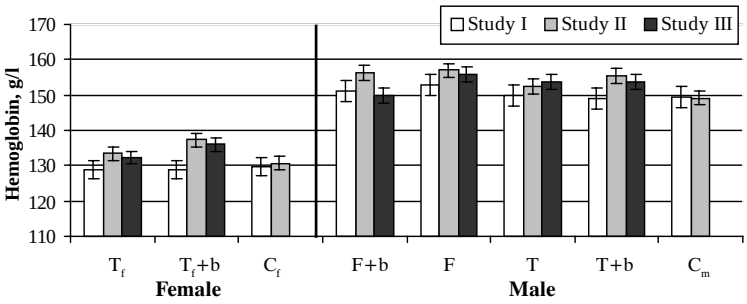

Fig. 3. Blood haemoglobin concentration in the groups

Table 3. **Erythrocyte mean corpulscule volume (MCV) dynamics (M ± SE)**

Groups		MCV, μ^3					
		Study I	Study II	Study III	Reliability among studies		
					$t_{I–II}$	$t_{II–III}$	$t_{I–III}$
			Female				
T_f	M ± SE	95.1 ± 2.16	97.2 ± 2.12	102.1 ± 1.31	0.88	2.04	2.91*
	SD	4.31	4.01	2.01			
T_f + b	M ± SE	98.4 ± 0.98	91.4 ± 1.6	96.2 ± 1.2	3.72**	2.4*	1.42
	SD	1.94	3.1	2.3			
C_f	M ± SE	100.1 ± 0.48	102.1 ± 2.46		0.4		
	SD	0.91	4.40				
Reliability among groups		F = 1.01	$F_{Tf+b-Tm}$ =3.20* $F_{Tf+b-Km}$ = 3.70*	$F_{Tf+b-Tm}$ = 3.20*			
			Male				
F + b	M ± SE	103.5 ± 2.6	101.6 ± 3.3	97.5 ± 1.8	0.45	1.09	1.88
	SD	6.7	10.1	3.7			
F	M ± SE	99.6 ± 2.8	99.6 ± 2.7	102.0 ± 3.9	0	0.48	0.41
	SD	5.2	5.8	10.3			
T	M ± SE	103.0 ± 3.9	99.2 ± 3.4	100.5 ± 3.8	1.54	0.25	0.46
	SD	11.8	10.2	8.2			
T + b	M ± SE	102.0 ± 2.1	95.0 ± 2.7	92.0 ± 3.1	2.24*	0.73	2.7*
	SD	4.5	5.1	9.8			
C_m	M ± SE	100.0 ± 2.3	103.0 ± 2.7		0.86		
	SD	7.4	7.5				
Reliability among groups		F = 1.56	F_{T+b-K} = 4.51*	F_{T+b-F} = 4.16*			

Note: * $p < 0.05$.

than in the female group administered Tot'hema alone (3.75 g/l, $p < 0.05$).

Another blood index important for sportsmen is hematocrit. While comparing blood henatocrit in T_f and T_f + b groups and in similar male groups, we found that in Study I the differences among the mean values for the group were statistically not significant (Table 4), while in Study II subjects administered Tot'hema and bee products it was lower on the average by 4.7% in women and 4.76–5.8% in men. Study III revealed no significant differences in the blood hematocrit index among the groups.

Table 4. **Blood hematocrit dynamics**

Groups	Hematocrit, per cent		
	Study I	Study II	Study III
		Female	
T_f	45.0 ± 1.16	44.8 ± 1.12	45.5 ± 1.11
T_f + b	43.2 ± 0.98	40.1 ± 0.90*	41.5 ± 1.2
C_f	43.3 ± 0.48	43.8 ± 1.46	
Difference reliability among groups	F = 0.58, p > 0.05	$F_{Tf+b-Tf}$ = 7.54, p < 0.05	F = 8.32, p < 0.05
		Male	
F	50.1 ± 1.22	50.9 ± 1.62	49.8 ± 1.35
F+b	50.2 ± 0.97	49.86 ± 0.83	48.6 ± 1.03
T	50.7 ± 1.17	48.6 ± 0.94	48.9 ± 1.08
T+b	49.0 ± 1.00	45.1 ± 0.94*	47.2 ± 0.69
C	49.4 ± 1.22	50.6 ± 1.10	49.8 ± 1.35
Difference reliability among groups	F = 2.06, p > 0.05	F_{T+b-K} = 14.1, p < 0.01 F_{T+b-F} = 9.40, p < 0.01 $F_{T+b-F+b}$ = 16.4, p < 0.01	F = 2.86 p > 0.05

Note. * $p_{I-II} < 0.05$.

CONCLUSIONS

1. The food supplements Tot'hema and Ferroglobin B_{12} alone had no effect on sportsmen's haemoglobin and hematocrit. However, a combination of Tot'hema supplement and bee products increased haemoglobin concentration (in women by 8.3 g/l, $p < 0.05$, and in men 6.4 g/l ($p < 0.05$), and decreased blood hematocrit in sportsmen's blood (in women by 3.14%, $p < 0.05$, and in men 3.9%, $p < 0.05$).

2. General blood picture and iron content and the iron-saturated transferrin did not change when the food supplements Tot'hema and Ferroglobin B_{12} were administered. Neither did the changes occur when Ferroglobin B_{12} with bee products was administered. However, under the effect of a combination of Tot'hema with bee products increased the following indices: erythrocyte count (in women by 0.36×10^{12}, $p < 0.05$, and in men by 0.33×10^{12}, $p < 0.01$), iron level (in women 10.4 μmol/l, $p < 0.01$, and in men 7.7 μmol/l, $p < 0.05$), iron-saturated transferrin level (27.5%, $p < 0.001$, and 12.0%, $p < 0.05$, respectively), whereas decreased the average erythrocyte mean corpuscle volume in men and women (7 μ^3, $p < 0.01$).

3. The food supplement Tot'hema in combination with bee products is most advisable for endurance-training sportsmen, because it exerts the best effect on sportsmen's general blood picture and blood biochemical indices.

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MAISTO PAPILDŲ TOT'HEMA IR FEROGLOBIN B_{12} VARTOJIMO EFEKTAS IŠTVERMĘ LAVINANČIŲ SPORTININKŲ KRAUJO POKYČIAMS

S a n t r a u k a

Ištvermę lavinančių sportininkų organizme dažnai trūksta geležies. Dėl to gali sumažėti hemoglobino koncentracija kraujyje, pablogėti raumenų aprūpinimas deguonimi. Sportininkai, norėdami kompensuoti geležies trūkumą, vartoja maisto papildus su padidintu geležies kiekiu. Lietuvoje sportininkai daugiausia vartoja „Tot'hema" ir „Feroglobin B_{12}", kurie skirti geležies deficito sukeltai anemijai gydyti ir jos profilaktikai. Deja, mums prieinamoje literatūroje nepavyko rasti duomenų apie šių preparatų reikšmę sportininkų organizmui.

Darbo tikslas buvo ištirti maisto papildų su padidintu geležies kiekiu „Tot'hema" ir „Feroglobin B_{12}" bei jų derinių su bičių produktais vartojimo įtaką ištvermę lavinančių sportininkų organizmui.

Nustatyta, kad šiuos preparatus derinant su bičių produktais sportininkų maisto raciono sudėtis mažai tepakinta, tačiau mineralinėje raciono dalyje pastebėti nemaži poslinkiai.

Akivaizdus maisto papildų „Tot'hema" ir „Feroglobin B_{12}" ir jų derinių su bičių produktais poveikis sportininkų kraujo morfologinei ir biocheminei sudėčiai. Raciono papildymas minėtais preparatais padidina hemoglobino koncentraciją sportininkų kraujyje. Šie pokyčiai labiausiai išryškėja vartojant „Tot'hema" ir bičių produktų derinį: tiek vyrų, tiek ir moterų kraujyje padidėja geležies koncentracija, geležies prisotinto transferino kiekis, sumažėja eritrocitų vidutinis tūris, kraujo hematokritas. Minėti poslinkiai išsilaiko 2–3 savaites pabaigus vartoti geležimi praturtintus maisto papildus.

Raktažodžiai: maisto papildai, fizinis krūvis, bičių produktai, kraujas, hemoglobinas, transferinas, hematokritas, adaptacija, geležis