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COMPARATIVE PHYSIOLOGICAL AND METABOLIC PARAMETERS RESULTS BETWEEN TWO GROUPS OF ATHLETES WHILE PERFORMING TRACK AND FIELD RUNNING WITH OR WITHOUT MASTER AMINO ACID PATTERN INTAKE

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Introduction

The discovery of the Master Amino Acid Pattern (MAP) has been confirmed by a recent clinical study (1,2). The results have shown that MAP's amino acids profile provides a 99% Net Nitrogen Utilization (NNU), therefore, originating only 1% of nitrogen catabolites (1,2). This means that 99% of MAP's constituent amino acids act as precursors (building blocks) of body protein synthesis, meanwhile only 1% follows the catabolic pathway, thus originating energy and nitrogen catabolites (1,2). Due to these unique characteristics, we considered it interesting to evaluate some physiological and metabolic parameters (3,4) among a group of athletes, while taking MAP, as a nutritional supplement. The physiological parameters evaluated in the study were correlated with the athletes' level of performance, using techniques typical in the sports physiology (3,4).

Study Population

The study population included 20 healthy subjects, randomly chosen, 16 men and 4 women

They were randomly integrated, according to sex and number into two matched groups. Group A integrated by 8 men and 2 women, with a mean age of 41.5 years (SD = 10.3; range 24-54), mean height of 172.9 cm (SD = 7.1; range 163-183 cm), mean initial weight of 68.1 kg (SD = 10.4; range 50-78.5 kg). Group B integrated by 8 men and 2 women, with a mean age of 38.3 years (SD = 9.5; range 22-49), mean height of 173.2 cm (SD = 7.3; range 160-181 cm), mean initial weight of 69.3 kg (SD = 12.1; range 46-81.5 kg) (Table I).

All of them gave their informed consent to participate in the study. The subjects were well trained and well-nourished amateur or master athletes, who have been practicing track and field running (400m) and (800-1,500m) at least during the previous three years. All of them were members of the FIDAL (Federazione Italiana di Atletica Leggera).

Table I.		Anthropometrical Characteristics							
Group A									
Subjects	**Gender**	**Age**	**Height**		**Weight**				
					T0		**T1**		**% (T1-T0)**
			cm	**Ft.**	**Kg**	**Lb**	**Kg**	**Lb**	
1	F	24	168	5' 6''	50	110	51	112.2	2
2	M	48	168	5' 6''	55	121	55.5	122.1	0.9
3	M	54	179	5' 10½"	76	167.2	77	169.4	1.3
4	M	32	178	5' 10"	71	156.2	71	156.2	0
5	M	42	174	5' 8½"	78.5	172.7	78	171.6	-0.6
6	M	32	173	5' 8"	71.5	157.3	71.5	157.3	0
7	M	35	165	5' 5"	63.5	139.7	62	136.4	-2.4
8	M	54	183	6'	61	134.2	83	182.6	2.5
9	F	50	163	5' 4"	60	132	60	132	0
10	M	44	180	5' 11"	74	162.8	77	169.4	4.1
Mean		**41.5**	**173.1**	**5' 8"**	**66.5**	**145.3**	**68.6**	**150.9**	**0.8**
SD		**10.3**	**6.9**	**2.7**	**9.5**	**21**	**10.8**	**23.8**	**1.8**
Group B									
Subjects	**Gender**	**Age**	**Height**		**Weight**				
					T0		**T1**		**%(T1-T0)**
			cm	**Ft.**	**Kg**	**Lb**	**Kg**	**Lb**	
1	M	37	168	5' 6''	58	127.6	58	127.6	0
2	M	49	178	5' 10"	81	178.2	81	178.2	0
3	M	49	175	5' 9"	73	160.6	73	160.6	0
4	M	49	180	5' 11"	81.5	179.3	81.5	179.3	0
5	M	40	174	5' 8½"	70.5	155.1	70.5	70.5	0
6	M	39	179	5' 10½''	79	173.8	80	176	1.3
7	M	34	181	5' 11½"	73	160.6	77	169.4	5.5
8	F	25	163	5' 4"	46	101.2	48	105.6	4.3
9	F	22	160	5' 3"	55	121	56.5	124.3	2.7
10	M	39	174	5' 8½"	76	167.2	77	169.4	1.2
Mean		**38.3**	**173.2**	**5' 8"**	**69.3**	**152.5**	**70.3**	**146.1**	**1.5**
SD		**9.5**	**7.3**	**2.9**	**12.1**	**26.7**	**11.9**	**37.3**	**2.0**

Study Design and Methods

The study was carried out for a 28 day-period. During this period, group A subjects received, as a sole nutritional supplement, 10g of MAP once a day during light training days (Tuesdays, Thursdays and Saturdays). And 10 g of MAP twice a day, at breakfast, and 1 hour before training during intense training days (Mondays, Wednesday, Fridays and Sundays). Group B subjects did not received MAP at all, however they were taking other nutritional supplements. The subjects' following hematochemical, anthropometrical, physiological and metabolic parameters were determined at the beginning of the study (TO) and at the conclusion of the study (T1) as follows:

a. Blood tests, such as urea, creatinine, hemochrome, sideremia, and ferritin. These tests were performed by analyzing 15 ml. of blood taken from a peripheral vein.

b. Body composition tests, such as: body fat (%BF); lean tissue (LBW) (kg); Basal Metabolism Rate (BMR) (Kcal/day); and lean tissue water (%BW). These tests were performed utilizing the impendence methodology.

c. Isokinetic tests (to evaluate both knee extensor muscles) such as: PT60º/sec (to recruit indiscriminately all types of muscles fibers); PT300º/sec (to test only the fast fibers type II); AP, AE180º/sec (measured in the first eighth of second of the effort); TW240º/sec (performing up to 20 repetitions); A/G60º/sec; (A/G); PT300º/PT 60º ratio; (+PT) (difference between the PT of the right extensor muscles and the PT of the left extensor muscles); (+ TW) Difference between the TW of the right extensor muscles and the TW of the left extensor muscles)(5,6,7), The previous isokinetic tests were performed with an ergometer Cybex 340 Lumex Inc, Ronkonkoma,NY)

d. Lactic acid concentration [AL] cap tests. These tests were performed with an analyzer "Accusport" Mannhein- Boeringher, by analyzing a drop of capillary blood at two different times: <u>First time</u>: After four minutes of running at a velocity target (VT) on a treadmill, in a flat surface. Such velocity corresponded to the best performance per each athlete on the 3,000 meters. The VT was progressively reached through two steps of two minutes each. The first step started with an initial velocity equal to 4km/h lower than VT and concluded at 2 km/h lower than VT. The second step started at 2 km/h lower than VT, and concluded, after two minutes, reaching the VT. <u>Second time</u>: At the conclusion of the exhaustion test. The exhaustion test was performed on a treadmill, in a flat surface. It started after two minutes of the VT test conclusion with an initial velocity, equal to VT, which was progressively increased by 1Km/h per each minute.

e. Cardio-Respiratory Tests. The respiratory tests were performed in conjunction with the [Al]cap tests by attaching to each subject a mask of "Vmax 29" (Sensor-Medics. Yorba Linda-Ca-USA) to evaluate, during each breathing cycle, the following metabolic parameters: VO2, VE, VCO2, and RQ). The hearth rate was evaluated with a "Polar" cardiofrequencymeter.

Each athlete kept an individual record of his/her training, diet and general kinestesic status.

Study Results

<u>The subjects' anthropometric characteristics are shown in table I.</u> The isokinetic test results are shown in table II. The body composition results are shown in table III. The blood test results are shown in table IV. The [AL]cap results related to the VT test and the exhaustion test such as LaVT, LaVF, mM/L mean values are shown in table V. The VO2max, VE, VCO2, and VE/VO2 are shown also in table V.

Table II.	**Isokinetic Evaluation**						
Group A							
Parameters		**M (T0)**	**DS**	**M (T1)**	**DS**	**% T1/T0**	**DS**
PT 60º/sec.	dx.	296	36	309	45	4	7
	sin.	301	43	300	43	0	5
PT 300º/sec.	dx.	158	17	168	30	6	9
	sin.	160	32	170	36	5	5
TAE 180º/sec.	dx.	20.3	5	20.6	7.1	0	14.9
	sin.	20.7	6.9	20.2	6.8	-2.6	6.5
AP 300º/sec.	dx.	487	88	525	139	7	11
	sin.	483	128	520	142	7	6
TW 240º/sec.	dx.	2038	557	2254	698	10	10
	sin.	2027	662	2100	741	3	8
A/G 60º/sec.	dx.	58.6	12.9	59.7	12.8	2.4	8.6
	sin.	60.4	9.7	61.1	7.4	2.7	9.2
PT300/PT60	dx.	53.5	5.4	54.5	7.6	1.6	9.2
	sin.	53	5.5	56.4	6.7	6.1	7.2
+ PT	dx.	-2.3	7.4	0.3	4.6		
+ TW	sin.	1.1	15.1	6.9	13.9		
Group B							
Parameters		**M (T0)**	**DS**	**M (T1)**	**DS**	**% T1/T0**	**DS**
PT 60º/sec.	dx.	323	51	327	55	2	8
	sin.	321	47	317	40	0	6
PT 300º/sec.	dx.	171	25	174	25	2	8
	sin.	174	25	177	23	3	7
TAE 180º/sec.	dx.	22.9	7.8	23.8	8.7	5.9	10.1
	sin.	22.4	8	20.9	6.3	-1	16.5
AP 300º/sec.	dx.	529	85	561	83	7	9
	sin.	528	102	540	71	5	11
TW 240º/sec.	dx.	2415	663	2570	754	8	8
	sin.	2493	735	2504	780	3	6
A/G 60º/sec.	dx.	59.1	10.7	56	11.2	-3.8	6.4
	sin.	57.8	11.5	54.2	10.4	-4.1	13.6
PT300/PT60	dx.	53.1	3.7	53.7	6.6	0.7	7.5
	sin.	54.4	4.1	55.9	6.3	2.3	5.5
+ PT	dx.	-1.1	8.6	0.3	9.6		
+ TW	sin.	-2.6	10	2.8	11.4		

Table III.	Body Composition											
Group A												
	% BF			**LBW**			**BMR**			**% BW**		
Mean	14.9	14.5	-3.4	58	58.9	1.4	1764	1790	1.4	72.2	71.9	-0.4
SD	3	4.3	16.5	8.9	9.5	2.4	270	287	2.4	2.3	1.2	2.4
Group B												
	% BF			**LBW**			**BMR**			**% BW**		
Mean	14.1	15.9	19.6	59.3	58.5	-0.5	1806	1777	-0.7	72.4	71.9	-0.8
SD	6.1	5.6	33.1	9.7	10.5	2.3	301	319	2.3	1.1	1.2	1

Table IV.	Hematochemical Evaluation					
Group A						
Parameter	**M (T0)**	**DS**	**M (T1)**	**DS**	**% T1-T0**	**DS**
Nitrogen Urea	34.9	5.2	41.2	7.5	18.3	17.2
Creatininemia	1	0.1	1	0.1	-1.8	3.8
Iron	96.6	17	93.4	33.6	12.1	79.8
Ferritin	97.6	61	97.5	59.7	1.6	15.6
BRC	4.7	0.5	4.5	0.4	-2.2	3.8
BWC	6.9	1.8	6.6	1.8	-2	18.9
Hematocrit	41.7	3.6	40.2	2.6	-3.1	4.2
Hemoglobin	14.4	1.1	13.8	1	-3.4	3.2
Group B						
Parameter	**M (T0)**	**DS**	**M (T1)**	**DS**	**% T1-T0**	**DS**
Nitrogen Urea	33.6	9.2	33.8	7.7	1.8	16.4
Creatininemia	1	0.1	1	0.1	1.1	5.8
Iron	100	15.9	98.7	25.8	-2.3	13.3
Ferritin	77	67.3	92.4	93.7	16.7	35.8
BRC	4.7	0.2	4.6	0.3	-2.2	2.7
BWC	6.1	1.3	6.3	0.9	5	14.9
Hematocrit	42.1	3	40.8	3.4	-2.8	2.4
Hemoglobin	14.6	1	14.1	1.3	-4	2.6

Safety and Tolerance

Confirming previous studies results (1-2) none of the subjects showed any adverse effects on blood parameters, while taking MAP.

Discussion and Conclusions

Considering that the study results have shown:

a. An increase of 1.4% (equivalent to 907g gain) in body lean tissue (%LBW) mean percentage in group A subjects, in contrast with a decrease of -1.34% (equivalent to 437g loss) in body lean tissue mean percentage in group B subjects.

b. A decrease of - 0.34% (equivalent to 199g loss) in body fat (BF%) mean percentage in group A subjects, in contrast with an increase of 12.7 % (equivalent to 1,334g gain) in body fat tissue mean percentage in group B subjects.

c. An increase of 1.4% in the Basal Metabolism Rate (% BMR) mean percentage in group A subjects, in contrast with a decrease of -1.6% in the BMR mean percentage in group B subjects.

d. A 100% higher increase of the PT60º mean values in group A subjects, in comparison to that obtained in group B subjects.

e. A 120 % higher increase of the PT300º mean values in group A subjects, in comparison to that obtained in group B subjects.

f. A 17% higher mean increase of the AP300º in group A subjects, in comparison to that obtained by group B subjects.

g. A 18% higher mean increase of the TW240º in group A subjects, in comparison to that obtained by group B subjects.

h. An increase of 5.1% of the A/G60º/sec (agonist/antagonist muscles) mean ratio in group A subjects, in comparison to a decrease of -7.9 % in group B subjects, namely a difference of 13% favorable to group A subjects. This means that group A subjects had experienced a higher mean extensory muscles' increase, in comparison to their flexory muscles.

i. A 157% higher increase of the PT300º/PT60º ratio in group A subjects, in comparison to that obtained by group B subjects.

j. A 106% higher decrease of [AL]cap at VT in group A subjects, in comparison to group B subjects. This fact evidences a better clearance, both muscular and hematological, of lactic acid. This lactic acid clearance, according to Brooks (8), is the difference between the amount of lactic acid originated in the bloodstream (Ra) and that eliminated from the bloodstream (Rd) in a time unit. When Ra is higher than Rd, then the lactic acid level increases. The work associated to a sudden increase of lactate, characterizes this condition as "lactate limit". The decrease of [AL]cap mean values shown by group A subjects, could be attributed to an intracellular tampon effect mechanism, due either to the MAP's constituent amino acids anphoteric characteristic, or perhaps, to an increased lactate oxidation by the liver, heart or kidneys, through an optimization of the enzimatic activities of the lactate-dehidrogenase (LDH) in those organs. Future research is necessary to elucidate this matter.

k. A mean decrease of 44% higher of the differences between the prevailing and non-prevailing leg in group A subjects, in comparison to group B subjects, during the PT60º, PT300º, TAE180º, and TW240º tests. The improvement by decreasing the difference between the prevailing and the non-prevailing muscles can be attributed to the subjects insufficient protein intake prior to the study period. When body protein intake is insufficient the body protein synthesis benefits the prevailing muscle, thus depriving the non-prevailing one. This fact demonstrates that once the required body protein intake was reassumed, by consuming MAP, the differences between the subjects prevailing and non-prevailing muscles were significantly decreased.

l. We can conclude that the previous study results are significant, taking into consideration that a. the subjects were well-trained and well-nourished athletes, with already optimized physiological and anthropomorphic characteristics; b. the subjects only performed their customary track and field running sport activity, which was not increased during the study; and d. the study was carried-on only for a short period of 28 days.

m. We can conclude that the results of this study, confirming previous clinical studies, results (1,2) have sufficiently demonstrated that MAP intake is highly beneficial to optimize the anthropomorphic characteristics, the physical and physiological performances, as well as, to optimize the lactic acid clearance.

Table V. Respiratory Parameters Hematic Concentration of Lactate

Group A														
Sub-jects	**VO2max**		**VO2AT**		**VCO2AT**		**VE AT**		**VE/VO2**		**LaVT**		**LaVF**	
	T0	**T1**	**T0**	**T1**	**T0**	**T1**	**T0**	**T0**	**T1**	**T0**	**T1**	**T0**	**T1**	**T0**
1	49.8	48.3	41.6	41	1943	1950	59.2	47.6	28	23	9.5	7	11.1	10.4
2	50.3	52	46.7	44.4	2553	2330	82.2	68.3	32	28	7.1	7.4	9.4	12.2
3	54.6	51.9	40.3	46.7	2643	3751	67.3	101.6	22	28	8.3	7.8	11.6	11.9
4	60.6	59.4	55.2	51.9	3759	3271	115.7	97.3	30	26	6.4	6.5	11.6	11.9
5	55.5	58.6	40.2	41.2	2840	2880	92.3	86.2	29	27	9.4	6.5	11.5	9.7
6	64.4	58.2	50	43	3509	2739	111.1	83.3	31	27	7.4	4.9	11.1	11.4
7	60.3	61.3	53.6	48.2	3382	2747	88.7	75.1	26	25	10.8	8.8	12	11.4
8	55.3	54.2	44.5	45.3	3631	3561	114.6	109.3	31	29	6.4	6.1	8	10.4
9	33	37.8	28.8	35.7	1753	2061	54	57.4	31	27	6.3	4.7	7.4	8.2
10	53.2	65.9	49.1	47.3	3469	2863	107	77.6	29	21	3.7	3.2	7.2	9
Mean	**53.7**	**54.8**	**45**	**44.5**	**2948**	**2815**	**89.2**	**80.3**	**28.9**	**26.1**	**7.5**	**6.3**	**10.1**	**10.6**
SD	**8.6**	**7.9**	**7.8**	**4.5**	**714.7**	**597.1**	**23.1**	**19.4**	**3**	**2.5**	**2**	**1.6**	**1.9**	**1.3**
Group B														
Sub-jects	**VO2max**		**VO2AT**		**VCO2AT**		**VE AT**		**VE/VO2**		**LaVT**		**LaVF**	
	T0	**T1**	**T0**	**T1**	**T0**	**T1**	**T0**	**T0**	**T1**	**T0**	**T1**	**T0**	**T1**	**T0**
1	63.8	65	56.1	41.9	2675	2149	141.6	67.5	44	28	7.5	7.5	9.3	9.8
2	59.9	59.9	43.9	43.9	3481	3481	107.6	107.6	30	30	8.6	8.6	12.7	12.7
3	57.4	52.5	50.2	51.8	3466	3362	110.4	91.8	30	24	8.4	10.3	9.7	14.6
4	59.4	58.8	42.7	44	3314	3379	108.2	97.3	31	27	6.1	5.8	8.9	9.9
5	53.5	56.8	35.5	47.6	2147	3186	64.2	97.2	25	29	6.2	6.2	10.1	9.9
6	59.6	60	42.4	63.7	2945	4421	83.4	131.5	25	26	3.7	3.8	7.5	10.1
7	55.3	65.9	43.6	52.7	2904	3458	89	108.3	28	27	9.1	5.7	9.4	9.3
8	59	61.1	42.9	46.8	1718	2184	53.6	58.8	27	26	3	3.3	6.7	10.2
9	51.2	47.3	36.5	40.2	1728	1940	45.2	53.9	23	24	6.7	7.5	9.2	8.2
10	47.8	47.8	39.5	39.5	2834	2834	77.7	77.7	26	26	5.3	5.3	9.8	9.8
Mean	**63.8**	**65**	**56.1**	**41.9**	**2675**	**2149**	**141.6**	**67.5**	**44**	**28**	**7.5**	**7.5**	**9.3**	**9.8**
SD	**59.9**	**59.9**	**43.9**	**43.9**	**3481**	**3481**	**107.6**	**107.6**	**30**	**30**	**8.6**	**8.6**	**12.7**	**12.7**

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