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Comparative Results Between Two Groups of Track-and-Field Athletes With or Without the Use of Master Amino Acid Pattern® as Protein Substitute

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ABSTRACT

Comparative results of this study have shown that athletes, by taking the Master Amino acid Pattern (MAP®) as a dietary protein substitute and performing physical activity, have had (1) increased body muscle mass, strength, and endurance; (2) decreased fat mass; (3) increased basal metabolism rate; (4) greater improvement in performance of the nonprevailing muscles compared to the prevailing ones; and (5) improved muscular and hematologic lactate clearance, which allows for better muscle performance and faster muscle recovery after physical activity. It was concluded that the use of MAP as a dietary protein substitute in conjunction with physical activity can provide a safe and unprecedented way to optimize the body's protein synthesis, thereby improving anthropometric characteristics and physical and physiologic performance.

Keywords: aerobic profile; amino acid formula; body composition; isokinetic evaluation; protein; protein substitute

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INTRODUCTION

The usefulness of the Master Amino acid Pattern (MAP® [SON Formula®, International Nutrition Research Center, Coral Gables, Fla, USA]), a dietary protein substitute, has been confirmed by results of a comparative, double-blind, triple-crossover net nitrogen utilization (NNU) clinical study.[1] Study results have shown that the participants, while taking MAP as a sole and total substitute of dietary protein, achieved a body NNU of 99%.[1] This means that 99% of MAP's constituent amino acids followed the anabolic pathway, thus acting as a precursor of the body's protein synthesis.[1] By comparison, dietary proteins only provide between 16% and 48% NNU; this demonstrates that MAP is more nutritious than dietary proteins. This has been confirmed by observing that each participant's nitrogen balance was maintained in equilibrium by taking MAP in a dosage of only 400 mg/kg per day, which provided less than 2 kcal per day (MAP 1 g=0.04 kcal).[1] Study results have also shown that 1% of MAP's constituent amino acids followed the catabolic pathway, thus releasing only 1% of nitrogen catabolites.[1] By comparison, dietary proteins release between 52% and 84% nitrogen catabolites, demonstrating that MAP is safer than dietary proteins. Because of MAP's unique characteristics, the investigators considered conducting a comparative study in 2 groups of athletes to evaluate some of their anthropometric, physiologic, and metabolic parameters with or without MAP as a dietary protein substitute. The physiologic parameters evaluated were correlated with the athletes' level of performance using typical physiologic techniques.[2,3]

STUDY POPULATION

The study population included 20 healthy participants, randomly chosen; 16 men and 4 women. They were randomly assigned to 2 matched groups. Group A (study group) included 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), and mean initial weight of 68.1 kg (SD 10.4, range 50–78.5 kg) (Table 1). Group B (control group) also included 8 men and 2 women whose mean age was 38.3 years (SD 9.5, range 22–49), with mean height of 173.2 cm (SD 7.3, range 160–181 cm) and mean initial weight of 69.3 kg (SD 12.1, range 46–81.5 kg) (Table 1).

All enrollees gave informed consent to participate in the study. All participants were well-trained and well-nourished amateur and professional athletes. As members of the Federazione Italiana di Atletica Leggera, they had been practicing track (400 m) and field running (800–1500 m) at least during the previous 3 years.

STUDY DESIGN AND METHODS

The study was conducted over 28 days. During this period, participants in group A took, as a dietary proteins substitute, 10 g (10 tablets) of MAP, once a day, during light training days (Tuesdays, Thursdays, and Saturdays). On heavy training days (Mondays, Wednesdays, Fridays, and Sundays), group A participants took MAP 10 g twice a day: at breakfast and 1 hour before training. Group B athletes did not take MAP; however, they were taking other nutritional supplements. All athletes' anthropometric, physiologic, and metabolic parameters were determined at the beginning of the study (T_0) and at study conclusion (T_1).

Table 1. Anthropometric Characteristics

Subject No.	Gender	Age, y	Height, cm	Weight, kg T_0	T_1	T_0–T_1
Group A						
1	F	24	168	50.0	51.0	2.0
2	M	48	168	55.0	55.5	0.9
3	M	54	179	76.0	77.0	1.3
4	M	32	178	71.0	71.0	0.0
5	M	42	174	78.5	78.0	–0.6
6	M	32	173	71.5	71.5	0.0
7	M	35	165	63.5	62.0	–2.4
8	M	54	183	81.0	83.0	2.5
9	F	50	163	60.0	60.0	0.0
10	M	44	180	74.0	77.0	4.0
Mean		41.5±10.3	173.1±6.9	66.5±9.5	68.6±10.8	0.8±1.8
Group B						
1	M	37	168	58.0	58.0	0.0
2	M	49	178	81.0	81.0	0.0
3	M	49	175	73.0	73.0	0.0
4	M	49	180	81.5	81.5	0.0
5	M	40	174	70.5	70.5	0.0
6	M	39	179	79.0	80.0	1.3
7	M	34	181	73.0	77.0	5.5
8	F	25	163	46.0	48.0	4.3
9	F	22	160	55.0	56.5	2.7
10	M	39	174	76.0	77.0	1.3
Mean		38.3±9.5	173.2±7.3	69.3±12.1	70.3±11.9	1.5±2.0

Blood Tests

Assessments of blood urea nitrogen, creatinine, iron, ferritin, red blood cells, white blood cells, hematocrit, and hemoglobin were performed by analyzing 15 mL of blood taken from a peripheral vein (Table 2).

Body Composition

Assessments of body fat (% BF), lean tissue (LBW, kg), basal metabolism rate (BMR, kcal/d), and amount of water in lean tissue (% BW) were performed using impedance methodology (Table 3).

Table 2. Hematologic Evaluation

Test	T_0	T_1	T_0–T_1, %
Group A			
Blood urea nitrogen, mg/dL	34.9±5.2	41.2±7.5	18.0±17.2
Creatinine, mg/dL	1.0±0.1	1.0±0.1	0.0±3.8
Iron, mg	96.6±17.0	93.4±33.6	3.3±79.8
Ferritin, ng/mL	97.6±61.0	97.5±59.7	0.0±15.6
Red blood cells, 10^6/mL	4.7±0.5	4.5±0.4	4.0±3.8
White blood cells, 10^3/mL	6.9±1.8	6.6±1.8	4.0±18.9
Hematocrit, %	41.7±3.6	40.2±2.6	3.5±4.2
Hemoglobin, g/dL	14.4±1.1	13.8±1.0	4.0±3.2
Group B			
Blood urea nitrogen, mg/dL	33.6±9.2	33.8±7.7	0.8±16.4
Creatinine, mg/dL	1.0±0.1	1.0±0.1	0.0±5.8
Iron, mg	100.0±15.9	98.7±25.8	1.0±13.3
Ferritin, ng/mL	77.0±67.3	92.4±93.7	20.0±35.8
Red blood cells, 10^6/mL	4.7±0.2	4.6±0.3	2.0±2.7
White blood cells, 10^3/mL	6.1±1.3	6.3±0.9	3.0±14.9
Hematocrit, %	42.1±3.0	40.8±3.4	3.0±2.4
Hemoglobin, g/dL	14.6±1.0	14.1±1.3	3.0±2.6

Table 3. Body Composition

	Body Fat, %	Lean Body Mass, kg	Basal Metabolic Rate, kg/m²	Body Water, %
Group A				
T_0	14.9±3.0	58.0±8.9	1764.0±270.0	72.2±2.3
T_1	14.5±4.3	58.9±9.5	1790.0±287.0	71.9±1.2
T_0–T_1, %	–2.7±16.5	1.4±2.4	1.5±2.4	–0.4±2.4
Group B				
T_0	14.1±6.1	59.3±9.7	1806.0±301.0	72.4±1.1
T_1	15.9±5.6	58.5±10.5	1777.0±319.0	71.9±1.2
T_0–T_1, %	12.7±33.1	–1.34±2.3	–1.6±2.3	–0.6±1.0

Isokinetic Tests

Isokinetic tests were used to evaluate both knee extensor muscles (Table 4). The tests included PT 60°/s to recruit all types of muscle fibers indiscriminately;

PT 300°/s to test only type II fibers; AP and TAE 180°/s, which measure effort during the first eighth of a second; TW 240°/s, used while performing up to 20 repetitions; A/G 60°/s, used to evaluate agonist vs antagonist (A/G) muscles; PT 300°/PT 60° ratio; and the difference between the PTs (ΔPT) and the difference between the TWs (ΔTW) of the right and left extensor muscles.[4-7] These tests were performed using a Cybex 340 (Lumex Inc, Ronkonkoma, NY, USA) isokinetic dynamometer.

Table 4. Isokinetic Evaluation

Test	Knee	T_0	T_1	T_0–T_1, %
Group A				
PT 60°/s	Right	296.0±36.0	309.0±45.0	4.0±7.0
	Left	301.0±43.0	300.0±43.0	0.0±5.0
PT 300°/s	Right	158.0±17.0	168.0±30.0	6.0±9.0
	Left	160.0±32.0	170.0±36.0	6.0±5.0
TAE 180°/s	Right	20.3±5.0	20.6±7.1	1.0±14.9
	Left	20.7±6.9	20.2±6.8	–2.0±6.5
AP 300°/s	Right	487.0±88.0	525.0±139.0	8.0±11.0
	Left	483.0±128.0	520.0±142.0	8.0±6.0
TW 240°/s	Right	2038.0±557.0	2254.0±698.0	10.0±10.0
	Left	2027.0±662.0	2100.0±741.0	3.0±8.0
A/G 60°/s	Right	58.6±12.9	59.7±12.8	2.0±8.6
	Left	60.4±9.7	61.1±7.4	1.0±9.2
PT 300°/PT 60°	Right	53.5±5.4	54.5±7.6	2.0±9.2
	Left	53.0±5.5	56.4±6.7	6.0±7.2
ΔPT		–2.3±7.4	0.3±4.6	
ΔTW		1.1±15.1	6.9±13.9	
Group B				
PT 60°/s	Right	323.0±51.0	327.0±55.0	1.0±8.0
	Left	321.0±47.0	317.0±40.0	1.0±6.0
PT 300°/s	Right	171.0±25.0	174.0±25.0	2.0±8.0
	Left	174.0±25.0	177.0±23.0	2.0±7.0
TAE 180°/s	Right	22.9±7.8	23.8±8.7	4.0±10.1
	Left	22.4±8.0	20.9±6.3	–7.0±16.5
AP 300°/s	Right	529.0±85.0	561.0±83.0	6.0±9.0
	Left	528.0±102.0	540.0±71.0	2.0±11.0
TW 240°/s	Right	2415.0±663.0	2570.0±754.0	6.0±8.0
	Left	2493.0±735.0	2504.0±780.0	0.0±6.0
A/G 60°/s	Right	59.1±10.7	56.0±11.2	–5.0±6.4
	Left	57.8±11.5	54.2±10.4	–6.0±13.6
PT 300°/PT 60°	Right	53.1±3.7	53.7±6.6	0.0±7.5
	Left	54.4±4.1	55.9±6.3	2.3±5.5
ΔPT		–1.1±8.6	0.3±9.6	
ΔTW		–2.6±10.0	2.8±11.4	

Measurements of Lactate Concentration (mmol/L)

These tests were performed with an Accusport analyzer (Boehringer, Mannheim, Germany) by analyzing a drop of capillary blood at 2 different times; first, after 4 minutes of running at a velocity target (VT) using a flat-surface treadmill. The VT corresponded to each athlete's best performance on the 3000 m. The VT was progressively reached through 2 steps of 2 minutes each. The first step started with an initial velocity of 4 km/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 2 minutes, reaching the VT. The time of second analysis was at the conclusion of the exhaustion test, namely at the final velocity (VF). The exhaustion test was performed on a flat-surface treadmill. It started 2 minutes after conclusion of the VT test, with an initial velocity equal to VT, which was progressively increased 1 km/h each minute.

Cardiorespiratory Tests

Cardiorespiratory assessments were performed in conjunction with measurements of lactate concentration by connecting each subject to the V_{max} 29 ergospirometric system (Sensor-Medics, Yorba Linda, Calif, USA) to evaluate, during each breathing cycle, the following metabolic parameters: oxygen consumption (VO_2), calculated in mL/kg per minute; lung ventilation (V_E), calculated in liters per minute; carbon dioxide production (VCO_2), calculated in mg/kg per minute; VO_2 and V_E at the anaerobic target (AT); and respiratory quotient. The heart rate was evaluated with a polar cardiofrequency meter.

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

RESULTS

Athletes' anthropometric characteristics are shown in Table 1; blood test results are shown in Table 2; body composition results are shown in Table 3; isokinetic test results are shown in Table 4. Measurements of lactate concentration related to the VT test and the exhaustion test are shown in Table 5; the respiratory parameters mean values are also shown in Table 5.

SAFETY AND TOLERANCE

None of the group A participants reported any side effects and none showed any adverse effects on blood parameters.

DISCUSSION AND CONCLUSIONS

Group A athletes showed a 1.4% mean increase in body lean tissue, equivalent to a 907 g gain. By comparison, group B subjects showed a 1.34% mean decrease in body lean tissue, equivalent to a 437 g loss. Group A showed a 2.7% mean decrease in body fat, equivalent to a 200 g loss. By comparison, group B showed a 12.7% mean increase in BF, equivalent to a 1279 g gain. Group A showed a 1.5% mean increase in BMR. By comparison, group B showed a 1.6% mean decrease in BMR. Group A showed a 100% greater mean increase in PT 60° values compared to that obtained in group B. Group A showed a 120% greater mean increase in PT 300° values compared

Table 5. Respiratory Parameters and Blood Concentrations of Lactate

Subjects	$V_{max}O_2$		VO_2AT		VCO_2AT		V_EAT		V_E/VO_2		LaVT		LaVF	
	T_0	T_1	T_0	T_1	T_0	T_1	T_0	T_1	T_0	T_1	T_0	T_1	T_0	T_1
Group A														
1	49.8	48.3	41.6	41.0	1943	1950	59.2	47.6	28	23	9.5	7.0	11.1	10.4
2	50.3	52.0	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	50.0	43.0	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	12.0	11.4
8	55.3	54.2	44.5	45.3	3631	3561	114.6	109.3	31	29	6.4	6.1	8.0	10.4
9	33.0	37.8	28.8	35.7	1753	2061	54.0	57.4	31	27	6.3	4.7	7.4	8.2
10	53.2	65.9	49.1	47.3	3469	2863	107.0	77.6	29	21	3.7	3.2	7.2	9.0
Mean ± SD	53.7 ± 8.6	54.8 ± 7.9	45.0 ± 7.8	44.5 ± 4.5	2948 ± 714.7	2815 ± 597.1	89.2 ± 23.1	80.3 ± 19.4	28.9 ± 3	26.1 ± 2.5	7.5 ± 2	6.3 ± 1.6	10.1 ± 1.9	10.6 ± 1.3
Group B														
1	63.8	65.0	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	44.0	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	60.0	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	89.0	108.3	28	27	9.1	5.7	9.4	9.3
8	59.0	61.1	42.9	46.8	1718	2184	53.6	58.8	27	26	3.0	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 ± SD	58.7 ± 4.6	59.5 ± 9.6	43.3 ± 6.1	47.2 ± 7.3	2721 ± 658	3039 ± 767	88.1 ± 29.6	89.2 ± 24.5	29.0 ± 5.9	26.7 ± 1.9	6.5 ± 2	6.4 ± 2.1	9.3 ± 1.6	10.5 ± 1.9

to that obtained in group B. Group A showed a 100% greater mean increase in AP 300° values compared to that obtained in group B. Group A showed a 50% greater mean increase in TW 240° values compared to that obtained in group B. Group A showed a 1.5% mean increase in the A/G 60°/s (agonist/antagonist muscle) ratio. By comparison, group B athletes showed a 5.5% mean decrease in the A/G 60°/s ratio. Group A subjects showed a 116% greater mean increase in the PT 300°/PT 60° ratio compared to that obtained in group B.

Group A athletes showed a 1500% greater mean decrease in lactate concentration at VT compared to that obtained in group B. This shows that group A athletes had better muscular and hematologic lactate clearance. Lactate clearance, according to Brooks,[7] is the difference between the amount of lactate originating in the bloodstream (Ra) and that eliminated from the bloodstream (Rd) in time. When Ra is greater than Rd, the lactate level increases. The work associated with a sudden

increase in lactate characterizes this condition as "lactate limit." The decrease of lactate mean values shown by group A could be attributed to an intracellular tampon effect mechanism, due to the amphoteric characteristics of MAP's constituent amino acids, and/or increased lactate oxidation by the liver, heart, or kidneys through optimization of the enzymatic activities of lactate dehydrogenase in these organs.

Group A athletes showed a mean increase in the performance of the nonprevailing muscles, 225% greater during the PT 60°, 233% greater during the PT 300°, and 40% greater during the TW 240°, compared to that obtained in group B. This confirms that group A experienced enhanced body protein synthesis by taking MAP, compared to that in group B. As is well known, when the body's protein synthesis is not optimal, there are benefits to the prevailing muscle, thus depleting the nonprevailing muscle.

Blood parameters of group A athletes did not show any adverse effects, which confirmed previous clinical findings.[1] In addition, group A did not report any side effects, which also validated previous clinical findings.[1]

Bearing in mind that the participants were well-trained and well-nourished athletes, a further optimization of their anthropometric characteristics and physical and physiologic performance would be the exception and not the rule. Their customary track-and-field running activity was not increased during the study; study results were obtained in only 28 days.

It was concluded that the group A athletes, by taking MAP as a dietary protein substitute and performing physical activity, have experienced (1) increased muscle mass, strength, and endurance; (2) decreased fat mass; (3) increased basal metabolism rate; (4) greater improvement in performance of nonprevailing muscles compared to the prevailing ones; and (5) improved muscular and hematologic lactate clearance, which allows for better muscle performance and faster muscle recovery after physical activity.

It was also concluded that use of MAP as a dietary protein substitute, in conjunction with physical activity, can provide safe and unprecedented optimization of the body's protein synthesis, thus improving the body's anthropometric characteristics and physical and physiologic performance.

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