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Dietary supplementation with astaxanthin-rich algal meal improves strength endurance.

A double blind placebo controlled study on male students.

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Abstract

Forty healthy paramedic students were recruited to investigate the effect of dietary supplementation with astaxanthin on their physical performance in a double blind placebo controlled study. All subjects were given identically looking capsules, one a day for six months. Twenty of the subjects received capsules filled with algal meal (AstaCarox™) to provide 4 mg astaxanthin per capsule, whereas the other twenty received placebo capsules. The physical parameters monitored were fitness, strength/endurance and strength/explosivity by standardised exercises. Before starting the dietary supplementation base values for each of the subjects were obtained. At the end of the six month period of dietary supplementation, the average number of knee bendings (squats) increased by 27.05 (from 49.32 to 76.37) for subjects having received astaxanthin and by 9.0 (from 46.06 to 55.06) for the placebo subjects. Hence, the increase in the astaxanthin supplemented group was 3 times higher than that of the placebo group ($P=0.047$). None of the other parameters monitored differed significantly between the groups at the end of the study period.

METHODS

The subjects were young healthy male students not subjected to any medication. The students ($n=40$) were randomly divided into two groups of equal size. Before

starting the dietary supplementation each individual carried out the standardised test exercises to obtain starting point values.

The dietary supplementation comprised the intake of one capsule daily in conjunction with a meal. Individuals of the experimental group received capsules containing algal meal with a high concentration of astaxanthin (*Haematococcus pluvialis*, manufactured by AstaCarotene AB, Gustavsberg, Sweden), whereas the placebo group received identical looking placebo capsules. Information regarding the contents of the capsules were not given to the individuals or to the supervisor of the experiment until after the end of the experiment.

The students were encouraged to exercise normally and to lead a normal life during the experimental period. No further control of the training conditions were performed.

Standardised exercise tests were carried out before starting the dietary supplementation, and after three and six months of dietary supplementation with the capsules. At each of these occasions blood serum Hb was measured and a health control was carried out.

During the experimental period three individuals were discarded - one due to illness, one due to major ortopedic surgery and one due to moving abroad (2 of the placebo and 1 of the experimental group).

Fitness, strength/endurance and strength/explosivity were the physiological test parameters monitored.

Fitness was determined through submaximum load until steady state pulse (the Åstrand method) was achieved. The test was carried out by a step-up exercise with a bench of 32 cm height at a pace of 25 step-ups per minute using a metronome. Each individual carried a gas tube set (Interspiro 324) weighing 17 kg used for smoke diving. Steady state pulse was achieved when during one minute deviation in heart rate compared to the previous minute was less than 3. Steady state pulse was achieved by all individuals within 6-9 minutes.

Fitness/endurance was determined as the maximum number of knee-bendings by each individual in a so-called "Smith machine" in standardised conditions. Warming up before the fitness exercise was carried out by biking on an ergometer bike according to a standard protocol (load 125 W for 3 minutes).

The knee-bending (squatting) was performed by bending knees to a 90° angle controlled by an adjustable stool. During the exercise the individuals carried a barbell weighing 42.5 kg.

Strength/explosivity was estimated in standardised conditions using a Wingate machine with individually adjusted load and registration of maximum effect during 30 seconds. The standardised warm-up before this exercise was biking on an ergometer bike (5 minutes at 150 W followed by 3 minutes at 200 W and idling for 5 minutes at 50 W). The Wingate exercise comprised biking with a load calculated individually on the basis of the body weight (75 g/kg body weight). The test included maximum effort for 5 seconds - rest/slow biking for 60 seconds - maximum effort for 30 seconds. The effect was measured during these 30 seconds, which were followed by biking at own speed.

During the entire experimental period, each individual made an assessment of his well being on a scale from 1 to 10 (1=awful, 5=normal and 10=excellent). The assessments were handed in to the test supervisor once every month.

RESULTS

There was no difference in the Hb (haemoglobin) values between the two experimental groups. Both groups gained weight during the experiment (placebo on average +2.1 kg and the astaxanthin group on average +1.0 kg). The difference was not statistically significant.

Likewise, there was no difference between the experimental groups in terms of steady state pulse, which decreased by on average 1.31/min. in the placebo group and by on average 1.75/min. in the test group.

In the Wingate test, there was a non-significant reduction in the total effect per kg body mass (W/kg) in both groups. The reduction in the placebo group was on average 5.81 and in the test group 4.13.

There was a significant difference in strength/endurance between the two experimental groups. The number of knee-bends increased in both groups (placebo on average by 9 or 19.5 per cent and test on average 27.05 or 54.8 percent). According to least square means analysis of the data with an alpha=0.05, the confidence range of the placebo group was 14.6374 - 39.4679 and for the test

group -3.7554 - 21.7554. According to difference of least square means analysis P=0.047.

There was no difference in the subjective assessment of the well being between the experimental groups. Neither was there a significant difference in terms of absence from school between the groups.

DISCUSSION

The subjects taking part in this investigation were young males (the majority aged 17-19 years) at the paramedical school of Värmdö. Most of these young men were completing their last semester at the school, and so a change in the training and living habits during these last months may have occurred. Consequently, the results of this experiment may have been influenced by external factors.

The general increase in body weight observed during the experiment would seem logical considering the age of the individuals.

Since many of the individuals exercise by running and playing ball games, the reduction in strength/explosivity can be explained by the poor training conditions out-doors during the experimental period.

The marked improvement in strength/endurance would seem very interesting, since it cannot be explained by an improved fitness (step-up test) or improved lactic acid tolerance (Wingate test). Furthermore, since there was no significant increase in body weight, an increased muscle mass cannot be used to explain this positive effect. The positive effects of astaxanthin observed in athletes elsewhere and results obtained in animals warrant a different physiological or biochemical explanation.

Further studies need to be designed to find explanations to the mechanisms involved.