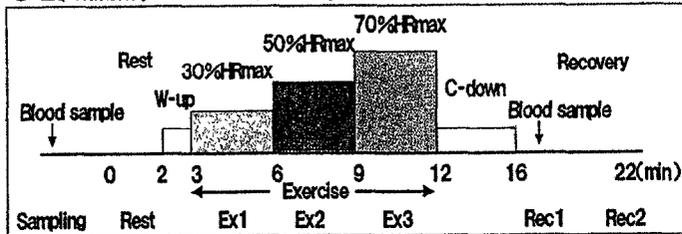


**Purpose**

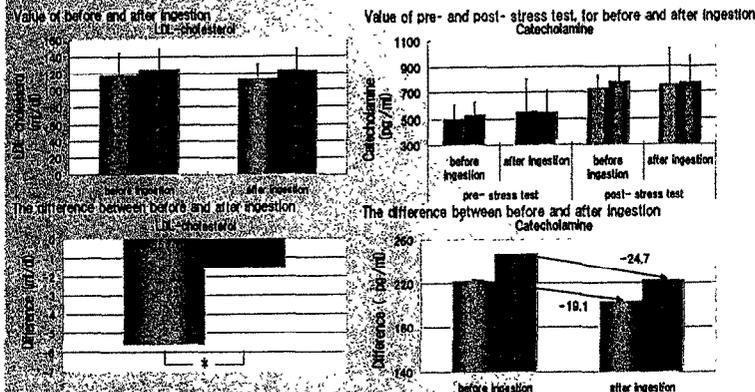
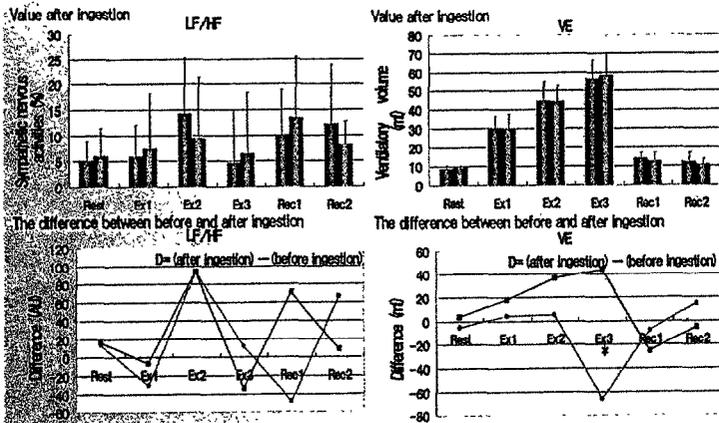
The purpose of this study was to evaluate the effects of astaxanthin (ACT) ingestion on the activities of the autonomic nervous system (ANS). In previous reports, ACT ingestion increasing data of an antioxidant activities and enhanced ability in the muscle contraction. In this experiment we planned to investigate the ANS and the respiratory metabolism during the prolonged exercises of three stepwise intensities. The design of this experiment was a double blind crossover study.

● Experiment protocol : Exercise (stress test)



Initial stress test I  
↓  
Ingestion of the test capsule (ACT or CON) for two weeks  
↓  
Wash out period (one month)  
↓  
Final stress test II  
↓  
Initial stress test III  
↓  
Ingestion of the test capsule (ACT or CON) for two weeks  
↓  
Final stress test IV

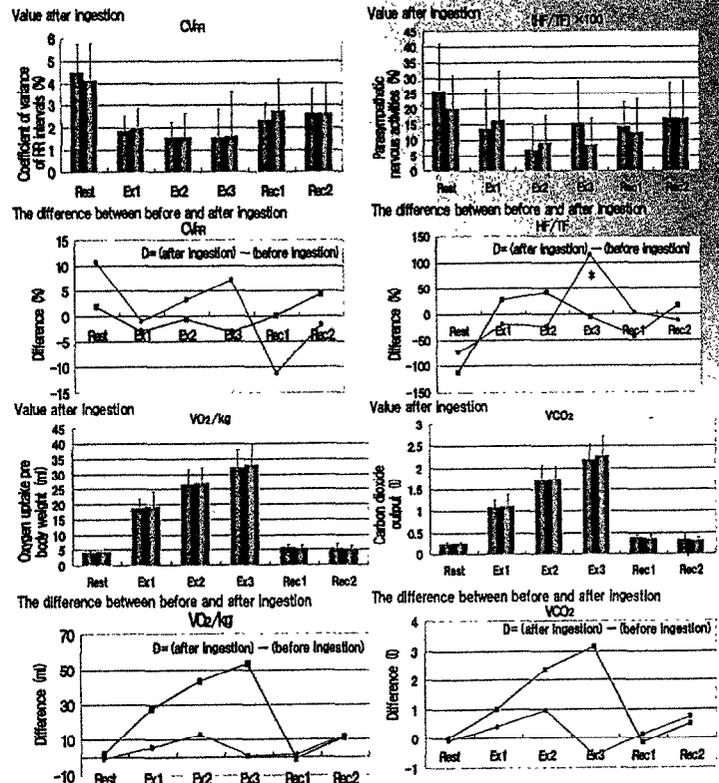
ACT: ACT: n=18 x 2  
CON: CON: p<0.05



**Method**

The experiments were designed to take orally ACT and placebo (CON) capsule daily for two weeks by volunteers. The exercise stress test were done before and after these ingestion.

- Subjects : 18 healthy male volunteers (35.8 ± 4.51 years old) who signed the informed consent
- Test capsule : ① Astaxanthin (5mg) : ACT  
② placebo : CON
- Measurement : ① CV<sub>RR</sub>, LF/HF, HF/TF of heart rate variability  
② VE, VO<sub>2</sub>/kg, VCO<sub>2</sub> of Expired Gases Analysis  
③ Cholesterol, Catecholamine of blood
- Analysis of HRV : MemCalc program  
Low frequency band : LF (0.03~0.15Hz)  
High frequency band : HF (0.15~0.4Hz)  
Total frequency band : TF (0.03~0.4Hz)  
CV<sub>RR</sub> : Coefficient of variance of RR interval  
LF/HF : Sympathetic nerve activities (SNA)  
(HF/TF) · 100 : Parasympathetic nerve activities (PNA)



**Results and Discussion**

During the exercise of the intensity of 70%HRmax, two parameters of CV<sub>RR</sub> and HF/TF · 100 significantly increased after ACT ingestion, more than those of CON ingestion (p<0.05). Additionally, VE and VO<sub>2</sub>/kg with ACT ingestion showed significant decrease during 70%HRmax exercise more than those with CON (p<0.05).

Those data are thought to be related to decrease of the sympathetic nerve activity (SNA) and to enhancement of the parasympathetic nerve activity (PNA) during these exercises. Upon ACT ingestion, LDL cholesterol decreased remarkably after exercise and ingestion for two weeks more than that of CON (p<0.05). Those decrease may be suggested that ACT ingestion can contribute to the to the combustion of the fat materials.

**Conclusion**

Effects of ACT ingestion for two weeks were summarized as follows.

- SNA were observed to be decreased, whereas PNA appeared to be enhanced during the exercise stress test by the measure of classification of HRV spectrum.
- Decrease of respiratory parameters may show augmentation of exercise efficacy of the energy metabolism with the same change of catecholamine.
- LDL cholesterol was decreased with ACT ingestion significantly.