CHAPTER III

RESULTS

In this study, the physical fitness tests and blood biochemistry were done between the 18th of March – 30th of June 2000. The results were divided into two parts. Part I showed data about general physical fitness tests and blood biochemistry between the exercise training and the exercise training plus vitamin E supplement group at the beginning of the experiment (week 0). Data obtained from part II include general physical fitness tests and blood biochemistry obtained 48 hours after exercise at the middle and the end of the experiments.

Part I: Comparison of general and physical fitness and blood biochemical data between the exercise training group (group A) and the exercise training plus vitamin E supplement (group B) at the beginning of the experiment (week 0).

1. Comparison of age and physical fitness data between group A and group B at the beginning of the experiment (week 0).

Age and Physical fitness in group A and group B at the beginning of the experiment (week 0) is shown in Table 2. The average age of group A and group B were not significantly different. Heart rate of subject in both groups found were in normal range and similar. Blood pressure and mean arterial pressure (MAP) of both groups were not significantly different. The body weight, body height and lean body mass of subject in both groups at week0 were not significant difference. There

were also no significant differences in the percent body fat and VO_2max of between the two groups.

2. Comparison of blood biochemistry data between group A and group B at the beginning of the experiment (week 0).

Table 2 shows blood biochemistry parameters including the level of serum total antioxidant capacity (TAC), lipid peroxidation product (serum malondialdehyde level, MDA), vitamin E and lipid profile between group A and group B at the beginning of the experiment (week 0).

All of subjects were in the same range of age, weight and height. Their general physical fitness parameters were relatively at the same levels (Table 2). TAC, lipid peroxidation product, vitamin E level and lipid profile were similar in both groups at the beginning of the experiment.

3. Comparison of dietary intake and plasma vitamin E levels between group A and group B in various time of the experiment.

3.1 Dietary intake

The records of daily dietary intake were obtained from each subject. There were not significant differences between the two groups and within each group throughout this experiment (Table 3).

3.2 Serum vitamin E level

Figure 10 shows the level of serum vitamin E in group A and group B at 48 hours after exercise of the beginning (week 0), the middle (week 6) and the end of the experiment (week 12). The level of serum vitamin E at resting in the group A and group B were not significantly different from each other. However, the level of serum vitamin E at week 6 and week 12 of the experiment in group B was significantly higher than group A in week 6 and week12 of the experiment, respectively. When compared within each group, serum vitamin E level at week 6 and week 12 of the experiment in group A were 0.74 ± 0.10 and 0.76 ± 0.05 mg/dl,

Table 2 Comparison of age and general data in exercise training group (gr.A) and exercise training plus vitamin E supplement group (gr.B) at the beginning (week 0) of the experiment

Parameter	group A (n = 16)	group B (n = 16)
Age (yr)	68.43±0.95	67.81±0.77
Heart rate (bpm)	71.43±1.63	72.93±1.96
Systolic blood pressure (mmHg)	130.00±3.74	122.75±3.81
Diastolic blood pressure (mmHg)	78.68±2.49	74.31±2.49
Mean arterial pressure (mmHg)	97.41±3.28	89.45±2.72
VO_2max ($ml.kg^{-1}.mim^{-1}$)	28.38±1.15	28.50±1.22
Body weight (kg)	57.31±2.00	60.81±2.30
Body height (cm)	174.32±0.98	175.0±1.14
Lean body mass (kg)	42.57±1.02	43.99±1.14
Body fat (%)	25.14±1.37	26.02±1.97
Cholesterol (mg/dl)	218.87±8.81	228.28±9.27
Triglyceride (mg/dl)	137.18±13.80	124.12±16.18
LDL-C (mg/dl)	143.31±7.67	151.18±9.56
HDL-C (mg/dl)	48.06±2.23	51.68±1.05
HDL-C/LDL-C	0.34±0.02	0.35±0.04
HDL-C/total cholesterol	0.22±0.01	0.22±0.01
TAC (mmol/L Trolox)	2.07±0.04	2.05±0.03
MDA (μmol/L)	35.0±1.72	36.66±1.74

Values are shown as means ± SEM

Table 3 Score of estimate dietary intake in exercise training group (gr.A) and exercise training plus vitamin E supplement group (gr.B) at various time of the experiment.

Time	Dietary intake (%)	
	group A (n = 16)	group B (n = 16)
Week 0	74.96±0.91	75.46±0.73
Week 1	75.16±0.96	75.26±0.99
Week 2	75.45±1.10	75.54±1.08
Week 3	76.34±1.19	77.20±1.18
Week 4	76.28±1.14	76.74±1.00
Week 5	77.24±0.95	77.19±1.03
Week 6	75.47±1.15	77.54±1.07
Week 7	75.84±1.19	76.66±1.12
Week 8	76.20±0.97	75.69±0.91
Week 9	76.50±0.82	77.04±1.04
Week 10	76.70±0.86	77.45±0.83
Week 11	77.61±1.07	75.85±0.52
Week 12	77.68±0.98	77.85±0.82

Values are shown as means ± SEM.

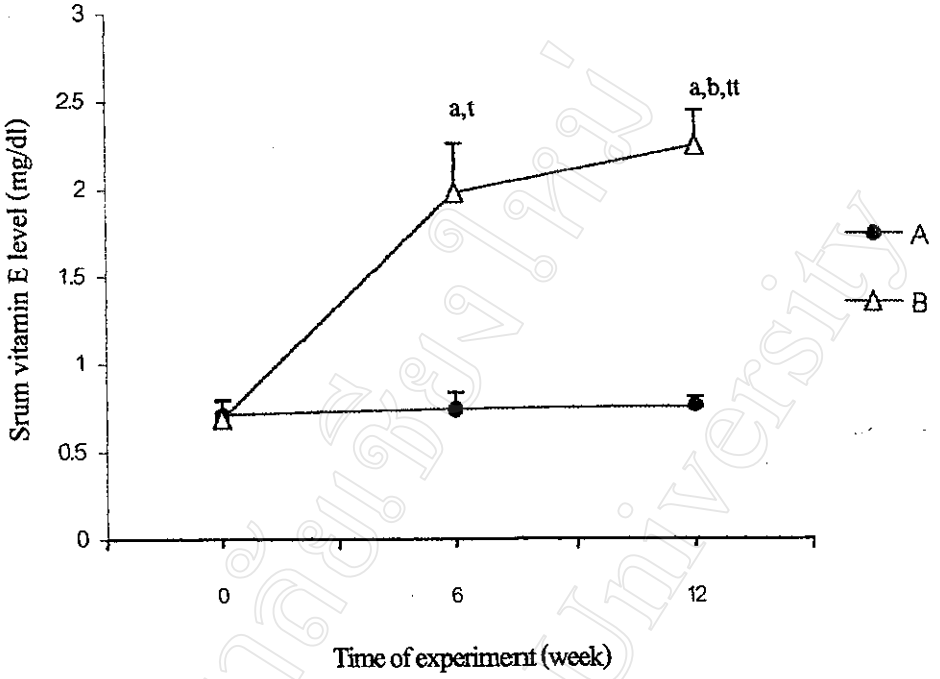

Figure 10 Comparison of serum vitamin E level between exercise training group (gr.A) and exercise training plus vitamin E supplement group (gr.B) 48 hours after exercise at various time of the experiment. Values are shown as means ± SEM.

[a] $p < 0.05$ Significant difference from that obtained at week 0 of the experiment from same group.

[b] $p < 0.05$ Significant difference from that obtained at week 6 of the experiment from same group.

[t] $p < 0.05$ Significant difference between the two groups at week 6.

[tt] $p < 0.05$ Significant difference between the two groups at week 12.

respectively. They were not significantly different from the resting value of 0.71± 0.08 mg/dl. However, the significant differences were shown in vitamin E level at week 6 and week 12 of the experiment in group B when compare with the corresponding values in group A. It was found in group B that serum vitamin E level significantly increased from 0.69±0.11 mg/al at week 0 to 1.98±0.28 mg/dl at week 6 and to 2.24±0.02 mg/dl at week 12 of the experiment.

Part II Effect of the exercise training group (group A) and the exercise training plus vitamin E supplement (group B) on physical fitness and blood biochemistry at 48 hours after exercise at week 0, at week 6 and at week 12.

1. Physical fitness data of group A and group B 48 hours after exercise obtained at week 0, at week 6 and at week 12.

Physical fitness data in the group A and group B at 48 hours after exercise of week 0, week 6 and week 12 are shown in Table 4 and Figures 11 - 15. There were no significant differences of all parameters between the two groups. However, there were significant differences in systolic blood pressure, mean arterial pressure, % body fat, lean body mass and VO_2max within each group.

1. 1 Heart rate

The heart rate in group A and group B were all in normal range at week 0, week 6 and week 12 of the experiment. There was no significant difference in heart rate between the two groups. In addition, there were no significant differences within group at week 0, week 6 and week 12 of the experiment in both groups.

Table 4 Effect of exercise training on Physical fitness in exercise training group (gr.A) and exercise training plus vitamin E supplement group (gr.B) 48 hours after exercise at various time of the experiment.

Parameter	group A			group B		
	wk0	wk6	wk12	wk0	wk6	wk12
Heart rate (bpm)	71.43 ± 1.63	70.50 ± 1.71	70.37 ± 1.47	72.93 ±1.96	74.18 ±1.50	72.12 ±1.54
VO_2max ($ml.kg^{-1}.min^{-1}$)	28.38 ±1.15	32.13 ±1.82[a]	35.09 ± 2.05[a,b]	28.50 ±1.22	34.24 ± 2.07[a]	35.83 ±2.09[a]
Blood pressure (mmHg)						
- Systolic	130.00 ± 3.74	126.37 ± 2.93	123.62 ± 2.47[a,b]	122.75 ± 3.81	118.81 ± 2.82	117.81 ± 2.49
- Diastolic	78.68 ± 2.49	77.50 ± 1.70	76.68 ± 1.67	74.31 ± 2.49	73.56 ± 2.43	72.62 ± 1.88
- MAP	97.41 ± 3.28	94.2 ± 2.05	92.70 ± 1.89[a,b]	89.45± 2.72	88.64± 2.38	87.70 ± 1.94
Body weight (kg)	57.31 ± 2.00	57.18 ± 1.96	57.43 ± 1.96	60.81 ±2.30	60.03 ± 2.34	60.12 ± 2.34
Body fat (%)	25.14 ± 1.37	23.30 ± 1.41[a]	22.58 ± 1.42[a,b]	26.02 ±1.97	24.92 ± 1.76[a]	24.09 ±1.50[a,b]
Lean body mass (kg)	42.57 ±1.02	43.52 ±1.02[a]	44.13 ±1.05[a,b]	43.99 ±1.14	44.59 ± 1.23	45.21 ± 1.25[a,b]

Values are shown as means ± SEM.

[a] $P < 0.05$ Significant difference from that obtained at week 0 of the experiment from the same group.

[b] $P < 0.05$ Significant difference from that obtained at week 6 of the experiment from the same group.

1.2 Maximal oxygen consumption (VO_2max)

Group A showed significant increas in VO_2max from 28.38±1.51 $ml.kg^{-1}.min^{-1}$ at week 0 to 32.13±1.82 $ml.kg^{-1}.min^{-1}$ at week 6 and to 35.09±2.05 $ml.kg^{-1}.min^{-1}$ at week 12 of the experiment. Group B also showed significant increas from 28.50±1.22 to 34.24±2.07 $ml.kg^{-1}.min^{-1}$ at week 6 and to 35.83±2.09 $ml.kg^{-1}.min^{-1}$ at the end of the experiment. However, there was no significantly difference of VO_2max between the two groups (Figure 13).

1.3 Blood pressure

Figure 11 and12 shows systolic blood pressure and mean arterial pressure in group A and group B at 48 hours after exercise of week 0, week 6 and week 12, respectively. There were still no significant differences in systolic blood pressure and mean arterial pressure between the two groups at week 0, week 6 and week 12 of the experiment. However, when compared with in the same group, systolic blood pressure at the end of training (123.62±2.47) was significantly lower than week 6 (126.37±2.93) and beginning (130.0±3.74) of the experiment in group A. Similarly, the mean arterial pressure were significantly reduced from 97.41±3.28 at week 0 to 94.2±2.05 at week 6 and to 92.70±1.89 at week 12 of the experiment. In group B, there were no significant differences in systolic blood pressure and mean arterial pressure at week 0, week 6 and week 12 of the experiment. Additionally, the diastolic blood pressure were not significant different at week 0, week 6 and week 12 of the experiment in both groups.

1.4 Body weight, percent body fat and lean body mass

There were no statistically difference in body weight, % body fat and lean body mass between the two groups after 12 weeks. When compared within each

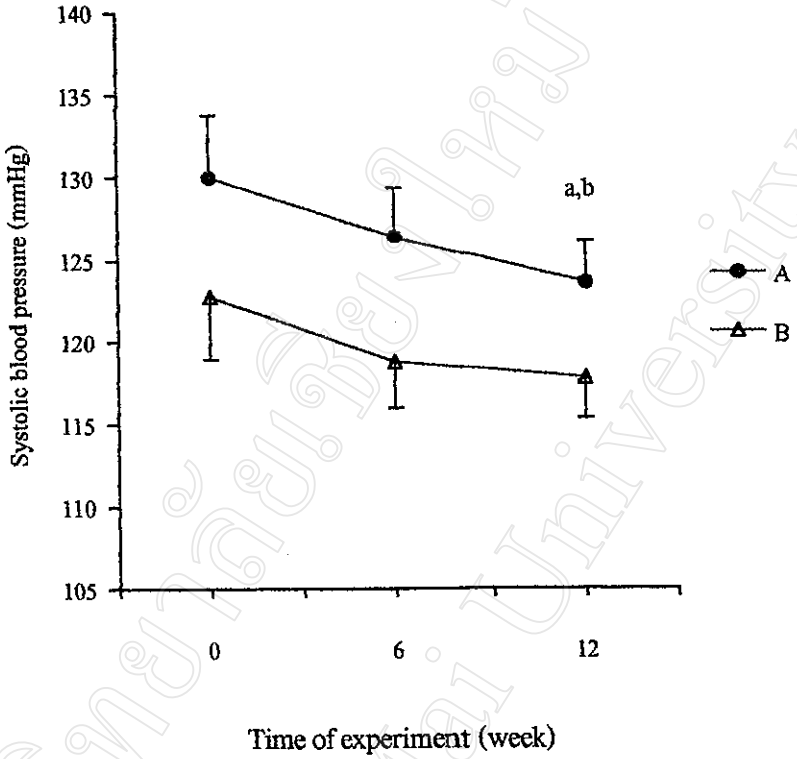

Figure 11 Comparison of systolic blood pressure between exercise training group (gr.A) and exercise training plus vitamin E supplement group (gr.B) 48 hours after exercise at various time of the experiment. Values are shown as means ± SEM.

[a] $p < 0.05$ Significant difference from that obtained at the week 0 of the experiment from the same group.

[b] $p < 0.05$ Significant difference from that obtained at the week 6 of the experiment from the same group.

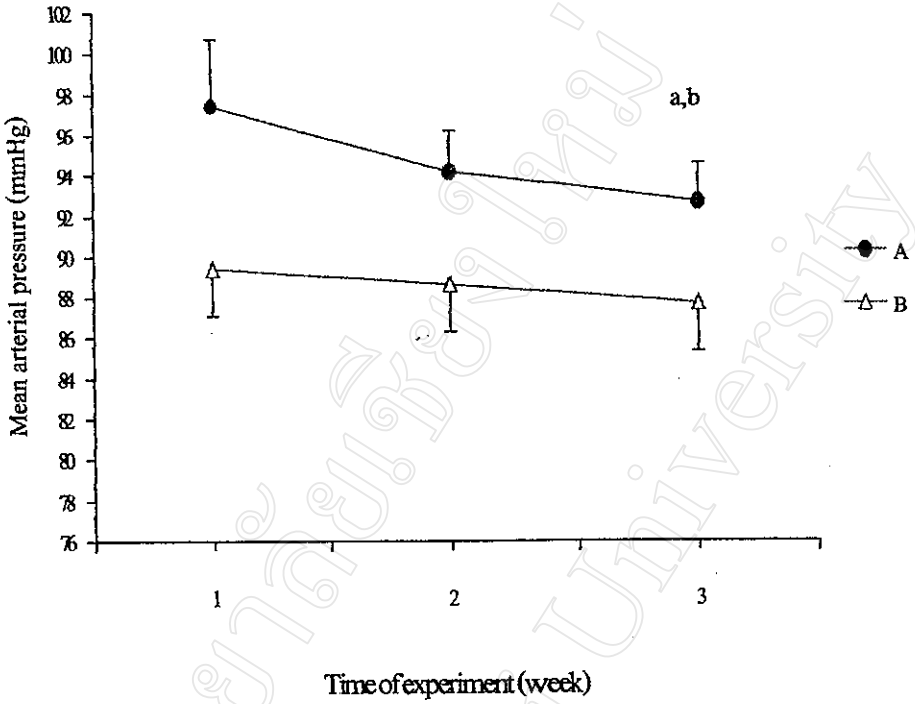

Figure 12 Comparison of mean arterial pressure between exercise training group (gr.A) and exercise training plus vitamin E supplement group (gr.B) 48 hours after exercise at various time of the experiment. Values are shown as means ± SEM.

[a] $p < 0.05$ Significant difference from that obtained at week 0 of the experiment from the same group.

[b] $p < 0.05$ Significant difference from that obtained at week 6 of the experiment from the same group.

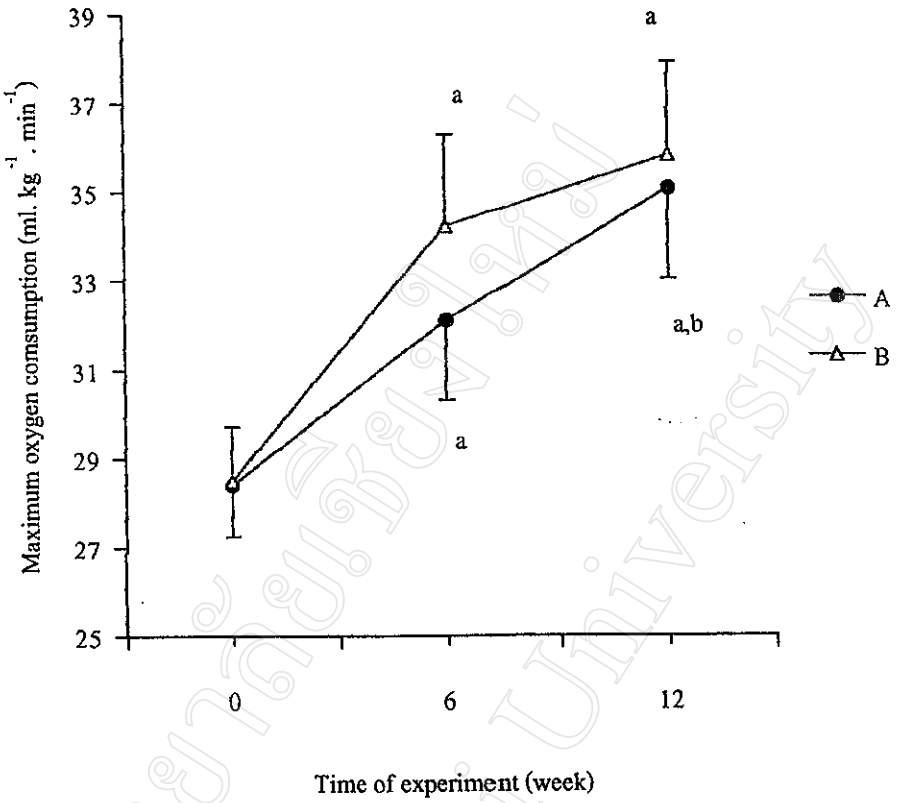

Figure 13 Comparison of maximum oxygen consumption between exercise training group (gr.A) and exercise training plus vitamin E supplement group (gr.B) 48 hours after exercise at various time of the experiment. Values are shown as means ± SEM.

[a] $p < 0.05$ Significant difference from that obtained at week 0 of the experiment from the same group.

[b] $p < 0.05$ Significant difference from that obtained at week 6 of the experiment from the same group.

group, the body weight did not changed while percent body fat were significantly reduced in group A from 25.14±1.37 to 23.30±1.41 and 22.58±1.42% at week 0, week 6 and week 12 of the experiment, respectively (Figure 14).

In addition, after 12 weeks, percent body fat in group B were significantly lower than that at week 6 (24.92±1.76) and week 0 (24.09±1.50) of the experiment.

Lean body mass, shown in Figure 14, were significantly increased from 42.57±1.02 kg at the beginning to 43.52±1.02 kg at week 6 and to 44.13±1.05 kg at the end of the experiment in group A. In group B, it was found that lean body mass at the end of training (45.21±1.25) was significantly higher than those obtained at week 6 (44.59±1.23) and at the beginning (43.99±1.14) of the experiment.

2. Blood biochemistry of group A and group B at 48 hours after exercise at week 0, at week 6 and at week 12.

The level of serum total antioxidant capacity (TAC), lipid peroxidation product (serum MDA level), vitamin E and lipid profile in group A and group B at 48 hours after exercise at week 0, week 6 and week 12 of the experiment are shown in Table 5 and Figure 16-21.

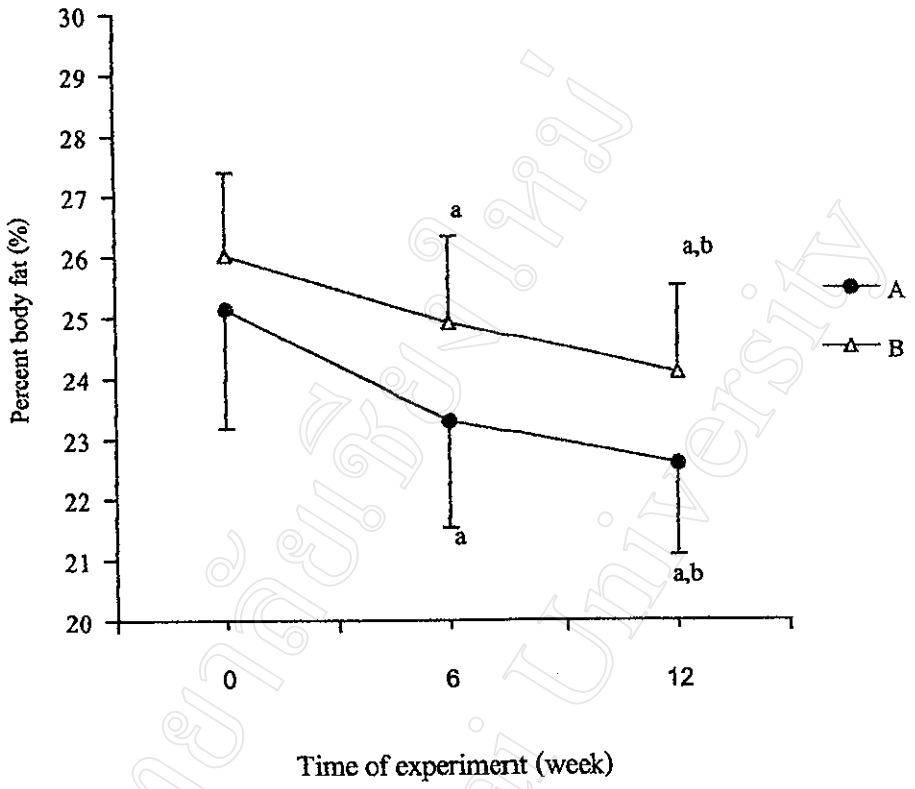

Figure 14 Comparison of percent body fat between exercise training group (gr.A) and exercise training plus vitamin E supplement group (gr.B) 48 hours after exercise at various time of the experiment. Values are shown as means ± SEM.

[a] $p < 0.05$ Significant difference from that obtained at week 0 of the experiment from the same group.

[b] $p < 0.05$ Significant difference from that obtained at week 6 of the experiment from the same group.

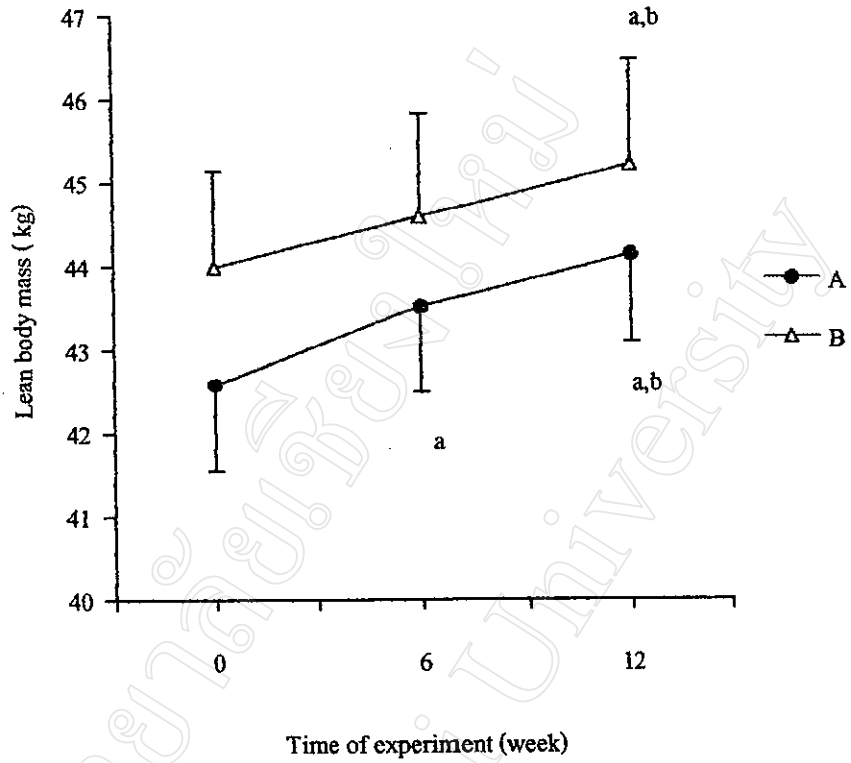

Figure 15 Comparison of lean body mass between exercise training group (gr.A) and exercise training plus vitamin E supplement group (gr.B) 48 hours after exercise at various time of the experiment. Values are shown as means ± SEM.

[a] $p < 0.05$ Significant difference from that obtained at week 0 of the experiment from the same group.

[b] $p < 0.05$ Significant difference from that obtained at week 6 of the experiment from the same group.

Table 5 Effect of exercise training on total serum antioxidant capacity (TAC), malondialdehyde (MDA), vitamin E and lipid profile in exercise training group (gr.A) and exercise training plus vitamin E supplement group (gr.B) 48 hours after exercise at various time of the experiment.

Parameter	group A			group B		
	wk0	wk6	wk12	wk0	wk6	wk12
Lipid profile (mg/dl)						
- Cholesterol	218.87 ± 8.81	205.81 ± 5.16[a]	204.93 ± 6.14[a]	228.28 ± 9.27	220.18 ± 7.89	213.81 ± 6.14[a]
- Triglyceride	137.18 ± 13.80	122.68 ± 9.47	122.50 ± 9.52	124.12 ±16.18	118.18 ±10.48	116.25 ± 9.70
- LDL-C	143.31 ± 7.67	130.37 ± 5.73[a]	130.00 ± 4.55[a]	151.18 ± 9.56	147.07 ± 7.55	138.93 ± 6.76
- HDL-C	48.06 ± 2.23	51.62 ± 1.71	52.12 ± 1.18	51.68 ± 1.05	52.12 ± 2.16	53.75 ± 1.16
- HDL-C/LDL-C	0.34 ± 0.02	0.40 ±0.03	0.41 ± 0.05[a]	0.35 ± 0.04	0.36 ± 0.02	0.39 ± 0.05
- TC/HDL-C	4.54±0.08	4.16±0.12[a]	4.00±0.07[a]	4.50±0.18	4.24±0.25[a]	4.10±0.28[a]
- TAC (mmol/L Trolox)	2.07 ± 0.04	2.12 ± 0.03	2.24 ± 0.04[a,b]	2.05 ± 0.03	2.08 ± 0.03	2.24 ± 0.03[a,b]
MDA (μmol/L TEP)	35.0 ±1.72	33.37 ±1.68	26.31±1.55[a,b]	36.66 ± 1.74	35.75 ± 2.25	26.18 ±1.22[a,b]
Vitamin E (mg/dl)	0.71± 0.08	0.74 ± 0.10	0.76 ± 0.05	0.69 ± 0.11	1.98 ± 0.28[a,t]	2.24 ± 0.20[a,b,tt]

Values are shown as means ± SME.

[a] $P < 0.05$ Significant difference from that obtained at week 0 of the experiment from the same group.

[b] $P < 0.05$ Significant difference from that obtained at week 6 of the experiment from the same group.

[t] $P < 0.05$ Significant difference between the two groups at week 6.

[tt] $P < 0.05$ Significant difference between the two groups at week 12.

2.1 Lipid profile level

The levels of total cholesterol in both groups are shown in Figure 16. There was no significant difference in total cholesterol level between the two groups. However, the total cholesterol level in the group A were significant reduced from 218.8±78.81 mg/dl at week 0 to 205.81±5.16 mg/dl at week 6 and to 204.93±6.14 mg/dl at week 12 of the experiment. Group B, there were significant reduced from 228.28±9.27 mg/dl at week 0 to 213.81±6.14 mg/dl at week 12 of the experiment. However, there were no significant differences of cholesterol between week 6 and week 12 of the experiments in both groups.

The serum triglyceride level at week 0, week 6 and week 12 of the experiment in group A and group B were not significantly different. When compare the serum triglyceride level within each group at week 0, week 6 and week 12 of the experiment, it was not significantly different.

Figure 17 shows the level of low density lipoprotein- cholesterol (LDL-C) a 48 hours after exercise of both groups. The LDL-C level in group A and group B was not significantly different from each other. When compared within each group, LDL-C levels were reduced from 143.31±7.67 mg/dl at week 0 to 130.37±5.73 mg/dl at week 6 and to 130.00±4.55 mg/dl at week 12 of the experiment in group A. However, no significant difference in LDL-C were found in group B.

The levels of the high density lipoprotein (HDL-C) 48 hours after exercise were 48.06±2.23, 51.62±1.71 and 52.12±1.18 mg/dl at week 0,week 6 and week 12 of the experiment in group A. In group B the levels were 51.68±1.05, 52.12± 2.16 and 53.75±1.16 mg/dl at week 0, week 6 and week 12, respectively. There were no significant difference HDL-C levels between the two groups. When compare within each group at week 0, week 6 and week 12 of the experiment, there were not significant differences.

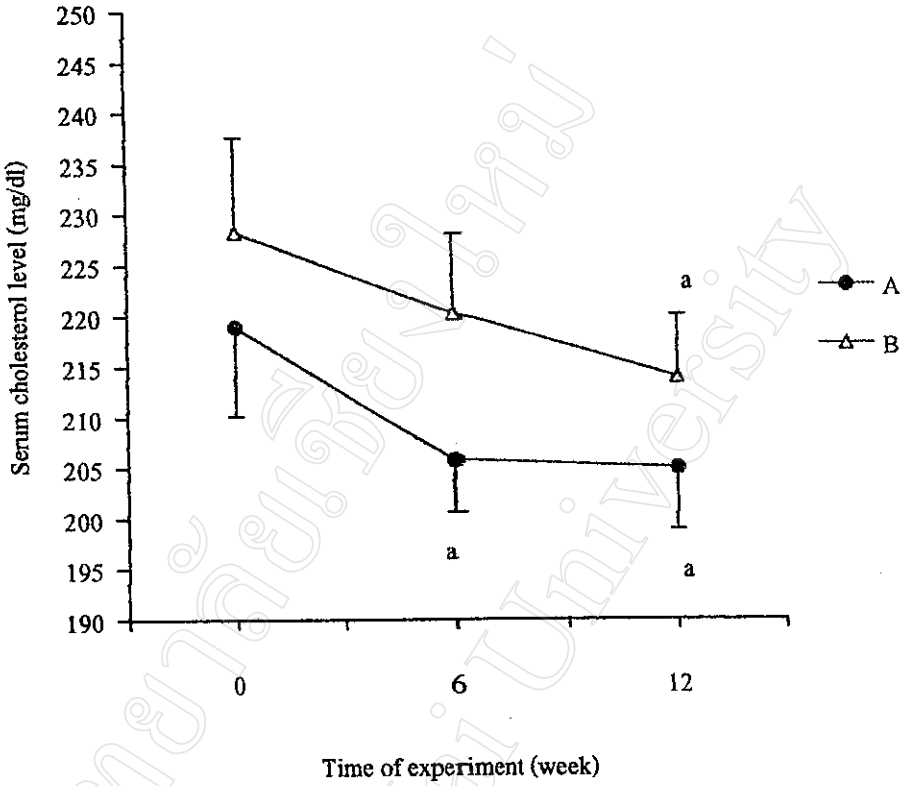

Figure 16 Comparison of serum cholesterol level between exercise training group (gr.A) and exercise training plus vitamin E supplement group (gr.B) 48 hours after exercise at various time of the experiment. Values are shown as means ± SEM.

[a] $p < 0.05$ Significant difference from that obtained at week 0 of the experiment from the same group.

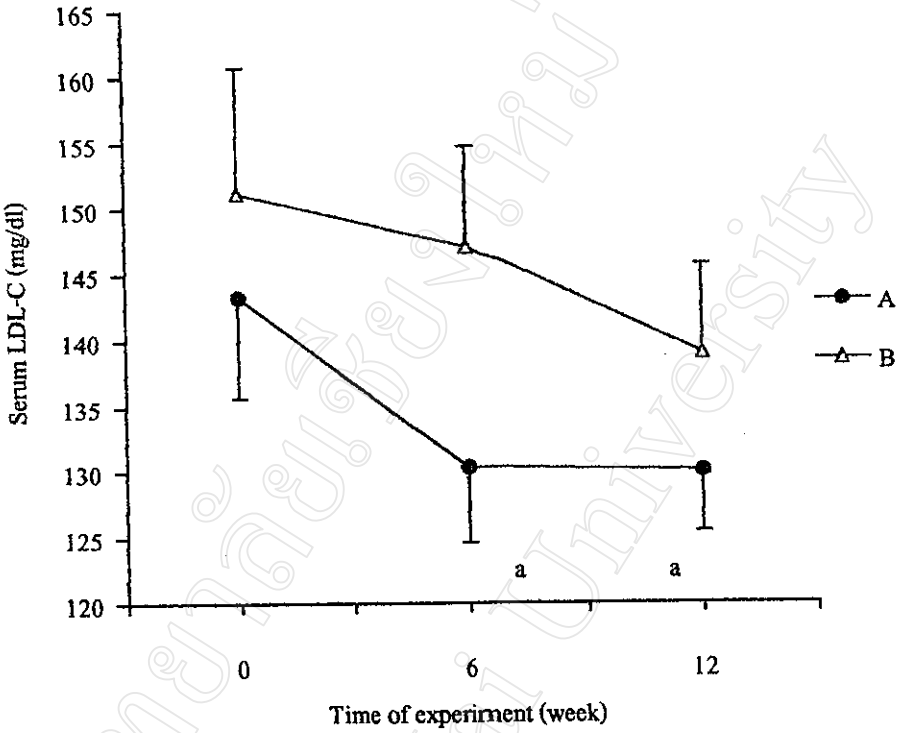

Figure 17 Comparison of serum LDL-C level between exercise training group (gr.A) and exercise training plus vitamin E supplement group (gr.B) 48 hours after exercise at various time of the experiment. Values are shown as means $\pm$ SEM.

[a] $p < 0.05$ Significant difference from that obtained at week 0 of the experiment from the same group.

Figure 18 shows the HDL-C/LDL-C ratio 48 hours after exercise of both groups. The HDL-C/DLD-C ratio in group A and group B was not significantly different from each other. When compared within each group, the ratio were increased from 0.32±0.02 at week 0 to 0.40±0.03 at week 6 and to 0.41±0.05 at week 12 of the experiment in group A. However, no significant difference in HDL-C/LDL-C ratio were found in group B.

Figure 19 shows the total cholesterol/ HDL-C ratio 48 hours after exercise of both groups. The ratio in group A and group B was not significantly different from each other. When compared within each group, the ratio were significantly reduced from 4.54±0.08 at week 0 to 4.61±0.12 at week 6 and to 4.00±0.07 at week 12 of the experiment in group A. total cholesterol/ HDL-C ratio were significantly reduced from 4.50±0.18 at week 0 to 4.24 ± 0.25 at week 6 and to 4.10±0.28 at week 12 in group B.

2.2 antioxidant capacity (TAC)

There was no significantly difference in TAC between the two groups. When compare within each group at beginning, the middle and the end of the experiment, TAC were increased from 2.07±0.04 to 2.12±0.03 and 2.24±0.04 mmol/L as Trolox, respectively in group A. It was increased from 2.05±0.03 to 2.08±0.03 at week 6 and 2.24±0.03 mmol/L as Trolox at week 12 in group B. However, serum TAC were significantly increased only at the end of the experiment in both groups (Figure 20)

2.3 Lipid peroxidation product (serum MDA level)

Lipid peroxidation in this study was determined by using serum MDA as indicator. The effects of exercise in group A and group B on this indicator are shown in Figure 21. There were not significantly different from each other. When compared within each group at week 0, week 6 and week 12 of the experiment,

MDA significantly reduced from 35.0±1.72 to 26.31±1.55 μmol/L TEP at week 12 in group A. It significantly reduced from 36.66±1.74 to 26.18±1.22 μmol/L TEP at the end of the experiment in group B. However, MDA of week 6 of the experiment was not significant different from the beginning of the experiment in both groups.

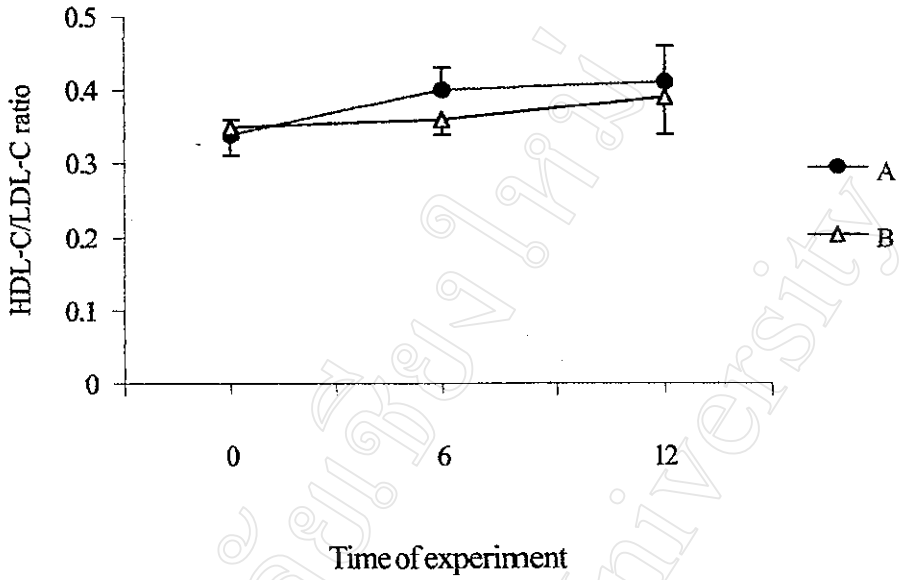

Figure 18 Comparison of HDL-C/LDL-C ratio between exercise training group (gr.A) and exercise training plus vitamin E supplement group (gr.B) 48 hours after exercise at various time of the experiment. Values are shown as means ± SEM.

[a] $p < 0.05$ Significant difference from that obtained at week 0 of the experiment from the same group.

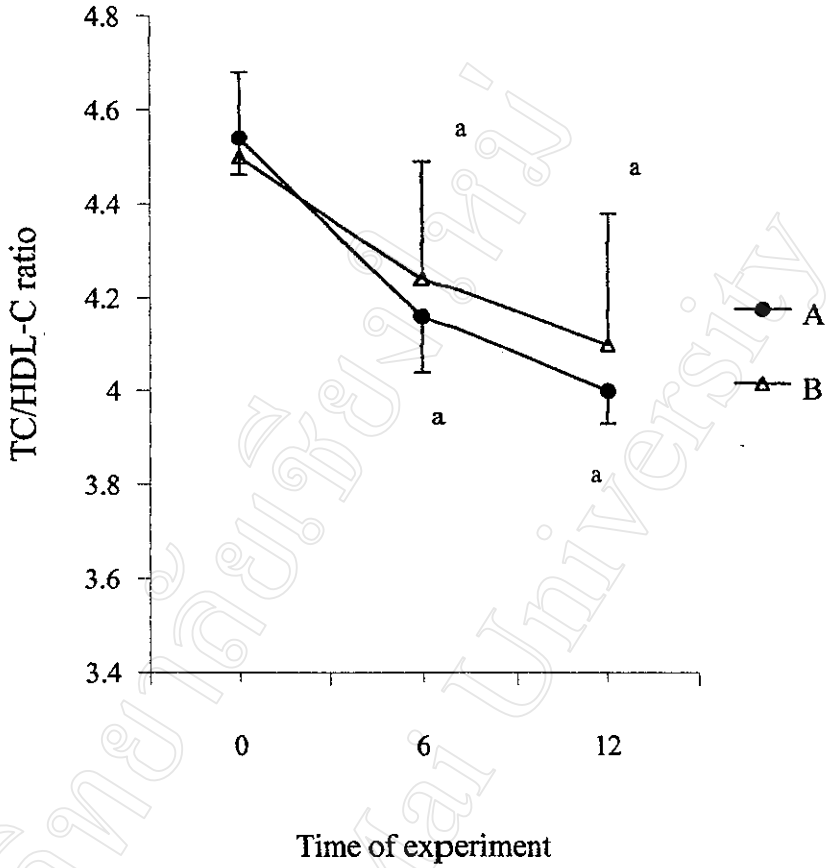

Figure 19 Comparison of Total cholesterol /HDL-C ratio between exercise training group (gr.A) and exercise training plus vitamin E supplement group (gr.B) 48 hours after exercise at various time of the experiment. Values are shown as means $\pm$ SEM

[a] $p < 0.05$ Significant difference from that obtained at week 0 of the experiment from the same group.

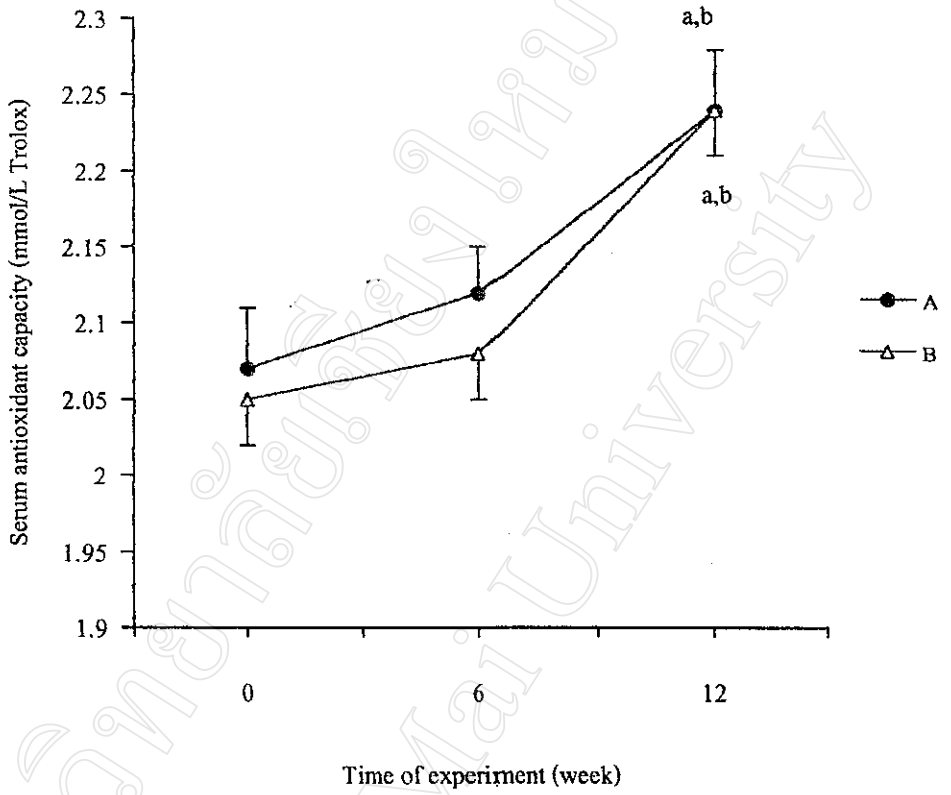

Figure 20 Comparison of serum total antioxidant capacity between exercise training group (gr.A) and exercise training plus vitamin E supplement group (gr.B) 48 hours after exercise at various time of the experiment. Values are shown as means ± SEM.

[a] $p < 0.05$ Significant difference from that obtained at week 0 of the experiment from the same group.

[b] $p < 0.05$ Significant difference from that obtained at week 6 of the experiment from the same group.

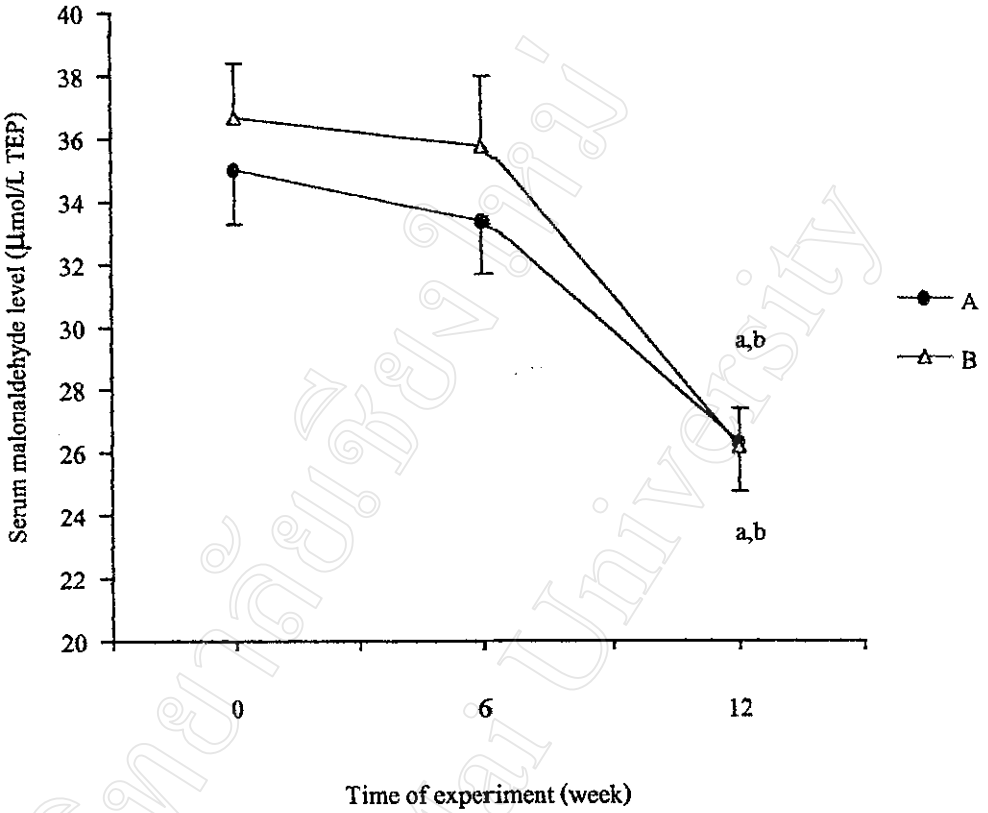

Figure 21 Comparison of serum malondialdehyde level between exercise training group (gr.A) and exercise training plus vitamin E supplement group (gr.B) 48 hours after exercise at various time of the experiment. Values are shown as means ± SEM.

[a] $p < 0.05$ Significant difference from that obtained at week 0 of the experiment from the same group.

[b] $p < 0.05$ Significant difference from that obtained at week 6 of the experiment from the same group.