

Research Article

Effect of Rosemary on Myocardium Free Radical Metabolism and Serum Enzyme after Exhaustive Exercise

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Abstract: By setting up the exhaustive swimming rats model, the activity of myocardium SOD, the quantity of MDA and the serum GOT are all valued. The results indicates that after the rats took rosemary, their physical ability improved remarkably; the activity of myocardium SOD appeared superior to the control group; the quantity of MDA turned lower than the control group, which shows that rosemary enjoys much stronger influence on the anti-oxidation and anti-free-radical. Besides, their ability of counteracting the free radical of myocardium jumped to a high level. Furthermore, rosemary can also be used to protect the integrality of myocardium cell membrane; to reduce the escape of enzyme from the cell.

Keywords: Exhaustive exercise, free radical, Glutamic-Oxalacetic Transaminase (GOT), Malondialdehyde (MDA), rosemary, Superoxide Dismutase (SOD)

INTRODUCTION

Rosemary, the Department of Labiatae herb, is native to the Mediterranean region. Rosemary extract is a natural antioxidant, containing a variety of active ingredients carnosic acid, rosemary acid, carnosol, rosmanol etc., with anti-aging, anti-corrosion, anti-bacterial, anti-oxidation effects (Thomas and Marshall, 1988). Also, rosemary extract is a natural non-toxic, whose antioxidant effect is much higher than the existing VC, VE, polyphenols and other natural antioxidants (Lang *et al.*, 1987), 2~4 times higher than synthetic antioxidants like BHA, BHT. Its structure is stable, not easily broken and is able to withstand a high temperature of 190~240°C. It prevents most natural antioxidants like polyphenols, VC from decomposition when confronted with high temperature. So the extract has a wide range of uses in food, health, medicine, cosmetics. This study aims to provide an experimental basis for its development and application in sport and health in terms of food or drink (Kanter *et al.*, 2005).

MATERIALS AND METHODS

Materials: Seventy male ICR mice, 5 weeks old, weighing 20-22 g, purchased from Xi'an Medicine Research Institute housed separately. Purchase of fodder as the basis for this experiment feed. Adaptive feeding experiments after a week.

Experimental methods: Mice were randomly divided into four groups: sedentary control group, quiet

medication group, the training group, the training medication group. Animal room temperature is 22-27°C and the lightning time changes naturally. Each group of mice will be fed with water and basic freedoms, while medication group were fed daily 0.6 mL concentration of 25 mg/kg of rosemary extract, purchased from Xian Shui Biotechnology Co., Ltd. products. The control group was given the same volume of water. Two training groups are given 6 w swimming sports, water temperature 30±2°C, depth 35 cm, 6 d/w training, weighed every Monday, Thursday. No-load swimming for 30 min every day during the first week, then plus 10 min every week, swimming for 80 min every day during the sixth week. Conduct the last exhaustive swimming and weigh before death. Exhausted judgment criteria: mouse is drowned under water 10s and cannot complete righting reflex on the plane (Ji, 1993). After exhaustive exercise training group was divided into after exercise immediate group and 24 h post-exercise recovery group (hereinafter referred to as the immediate group and the recovery group) Immediate group were sacrificed immediately after exhaustive exercise, recovery group were sacrificed after 24 h recovery after exhaustive exercise, draw retinal blood and separate serum to test the activity of GOT (Yang *et al.*, 2014). And remove the heart immediately, wash with physiological saline in an ice blood blotted, dry with filter paper, weigh, respectively cryogenic homogenize with phosphate buffer (pH = 7.12), centrifuge and take the supernatant to measure SOD activity and MDA content. Meanwhile sacrifice quiet group, draw materials as above.

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Determination of indicators and methods: SOD uses pyrogallol autoxidation; MD uses ATBA method; GOT uses Lai colorimetric assay.

Data processing: Process all the data in the computer's Excel, with $\bar{X} \pm S.D.$, use t-test for statistical analysis.

RESULTS AND DISCUSSION

Results: Table 1 shows that the exhaustive swimming time of the medication group is prolonged 37.82% than the training group, which is significantly higher than the control group ($p < 0.001$). In the myocardium, the SOD activity of instantly medication group was significantly higher than the control group immediately ($p < 0.05$), but it shows no significant difference in the other groups. Myocardial MDA in quiet medication group were significantly lower than the control group ($p < 0.001$). In terms of the GOT activity in serum, the instantly medication group was significantly lower than the control group immediately ($p < 0.001$), the recovery medication group was significantly lower than the control group recovery ($p < 0.001$), the immediate group was significantly higher than the sedentary group ($p < 0.001$). And the GOT activity of the quiet medication group showed no difference from the sedentary control group.

Discussion: SOD, whose substrate is oxygen radical, is the unique enzyme among the thousands of enzymes in aerobic organisms. Its role is to catalyze superoxide anion into generating H_2O_2 , effectively eliminating superoxide anion, thus reducing the generation of more toxic $\cdot OH$ and protecting cells. Free radicals are highly toxic to the body (Jenkins *et al.*, 1984). It can cause a large generation of lipid oxidation and damage the issue. MDA is a metabolite of lipid peroxidation, whose content can be seen as a reflection of the free radicals damage to the tissue. The result shows that the SOD activity of quiet medication group is higher than the sedentary group; MDA content of quiet medication group is significantly lower than the control group in mouse myocardium. It means that rosemary has the ability to enhance the SOD activity, eliminate free radicals, help the myocardial defense Lipid peroxides and reduce the content of MDA. Rosemary has a certain role in the recovery of SOD activity after exercise in

mice. It can also reduce the activity of GOT in serum, indicating that rosemary has protective effect on myocardial cells.

Why radicals are produced during exercise:

- Movements will lead to an increase in intracellular ATP lysis, increasing ADP and AMP and then AMP will turn into hypoxanthine, hypoxanthine will be turned into uric acid under catalytic hypoxanthine oxidase, generating superoxide anion.
- Different kinds of causes increased the content of free iron ions in plasma and tissues. Iron ions can result in an increased production of oxygen free radicals in tissue and an increased content of lipid peroxides.
- Exercise will cause to an increasing of oxygen utilization pathways in muscle mitochondria and increased production of free radicals.
- The auto-oxidation of catecholamines, myoglobin and other chemicals will produce superoxide anion (Jenkins *et al.*, 1984).
- The burst of leukocyte respiratory will produce oxygen free radicals (Lang *et al.*, 1987).

It is generally believed that exercise intensity will affect the generation of free radicals, but exercise training can improve the body's ability of radical oxidation. The effect of long-term endurance exercise on activity of cardiac anti-oxidant enzyme is inconsistent and so does the one-time exhaustive exercise (Kanter *et al.*, 2005). Some people think that, after eight weeks of increasing endurance training, the activity of myocardial antioxidant enzyme did not produce adaptability because the enzyme activity itself is high in myocardial (Ti *et al.*, 2013). After six weeks of endurance training, we compare the condition of immediate group and recovery group after exhaustive exercise and find that the SOD activity of the recovery group was significantly higher than the immediate group ($p < 0.101$). And SOD activity in these two groups were significantly higher than sedentary control group ($p < 0.1001$); MDA in the recovery group was significantly lower than the immediate group ($p < 0.1001$). And the MDA in these two groups were significantly higher than the immediate group and the recovery group after 6 weeks of endurance training and exhaustive exercise. SOD activity of the control

Table 1: Effects of rosemary on free radical metabolism and serum enzyme in rats myocardium

Index	Quiet group		Group after training		After training recovery group	
	Control group (a)	Medicine group (b)	Control group (c)	Medicine group (d)	Control group (c)	Medicine group (d)
SOD (NU/mg)	20.94±1.12	22.04±1.18	22.39±0.99	25.82±1.01 ^{cp}	21.01±0.98	21.09±1.62
MDA (nmol/mL)	9.79±0.58	6.98±0.53 ^{ab}	17.02±1.03	15.08±2.56	10.57±0.56	11.02±1.18
GOT (U/L)	39.81±7.98	36.78±7.09	65.88±5.12 ^{a*}	50.13±4.65 ^{cpa*}	60.03±7.85	40.78±5.99 ^{a*}

^{a*}: Said tag group with significant difference compared with group a; ^{b*}: Said tag group with significant difference compared with group b; And so on

group was found to be significantly higher than the immediate group ($p < 0.01$). This indicates that after exhaustive exercise, the body produces large amounts of oxygen free radicals and lipid peroxides and cannot achieve full recovery within 24 h. The SOD activity of myocardial achieved the peak immediately after exercise and the SOD activity of the control group and sedentary control group had no significant difference; MDA content achieved the peak immediately after exercise and the MDA activity of recovery control group and the sedentary control group showed no significant difference, indicating that the myocardial can thoroughly clear the free radicals produced in motion and become fully restored 24 h after the exercise, which is related to sufficient myocardial blood supply and strong aerobic capacity.

The SOD activity of the immediate medication group were significantly higher than the immediate control group; the SOD activity of the recovery medication group was significantly higher than the restored control group in myocardial, but showed no significant change ($p > 0.05$); the MDA content of the immediate medication group in mice myocardial were significantly lower than that of the immediate control group in the counterpart tissues; the DMA content of the recovery medication group was lower than that of the recovery control group in mice myocardial. The results show that the complemented rosemary can increase SOD activity, antioxidant capacity, thereby enhancing the capacity of endurance exercise.

Sports, especially endurance exercise, can significantly increase serum enzyme activity, which is a common result of many researchers (Bull *et al.*, 1987). The main theories explaining the motion of serum activity changes are:

- Anoxia or hypoxia during exercise will damage the muscle, especially muscle fiber damage or purely mechanical-stretch-caused muscle tissue damage, so a lot of muscle enzymes will leak into the blood and enhance serum enzyme activity.
- Exercise will increase membrane permeability, leading to increased enzyme release.

Scholars sharing this opinion believe that increase release of cellular enzyme is mainly related to cell hypoxia caused by exercise, energy substances depletion, the accumulation of acidic metabolites and increase of hormone secretion of catecholamines. Because stimulate given by these factors will increase permeability of cell membranes. Aspartate Transaminase mainly distributed in the cytoplasm and the mitochondrial, especially in cardiac muscle, skeletal muscle, kidney. Apart from the clinical diagnosis of myocardial infarction, myocarditis and infectious mononucleosis syndrome, the serum GOT vitality can still be applied in the diagnosis of other diseases like renal artery obstruction and polio. This experiment showed that: The GOT activity of the immediate

medication in mice serum was significantly lower than the immediate control group ($p < 0.0001$), The GOT activity of medication group were significantly lower than the recovery control group in serum ($p < 0.0001$), they GOT activity of immediate control in mice serum was significantly higher than the sedentary control group ($p < 0.0001$). It is the same with the change of GOT activity in serum. It can be concluded from the result that exhaustive exercise significantly increased GOT activity in mice serum, indicating that other parts of myocardium in mice was damaged. Medication group were less injured than the control group and the recover process is apparently faster than the control group. The mechanism is that rosemary are combined with a large number of free radicals produced in the exhaustive exercise and excreted from the body, so that the function of cell membranes will be protected to a certain extent. So the rosemary sugar can play a role in myocardial protection in endurance exercise.

CONCLUSION

This study showed that supplemented rosemary can prolong exercise time; rosemary can improve the ability of anti-free radical oxidation in mice myocardial.

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