

THE EFFECTS OF TARAXACUM OFFICINALE EXTRACTS (TOE) SUPPLEMENTATION ON PHYSICAL FATIGUE IN MICE

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Abstract

The study is to investigate the effect of *Taraxacum officinale* extracts (TOE) supplementation on physical fatigue based on the forced swimming capacity in mice. Forty Kunming male mice were randomly divided into 4 groups, i.e., normal control (NC) and three doses of TOE treated group (High-dose, Middle-dose and Low-dose). Three TOE treated groups were treated by oral TOE with 10, 30 and 100mg/kg b.w respectively for a period of 42 days. The normal control group was given a corresponding volume of sterile distilled water. After 6 weeks, the forced swimming capacity and blood biochemical parameters in mice were measured, and the result showed that TOE had an anti-physical fatigue effect. It enhanced the maximum swimming capacity of mice, effectively delayed the lowering of glucose in the blood, and prevented the increase in lactate and triglyceride concentrations.

Key Words: *Taraxacum officinale* extracts, forced swimming capacity, mice

Introduction

Fatigue is a common symptom both in sickness and in health (Abe et al., 1995; Babcock et al., 1995; Borer et al., 2009; Ream and Richardson, 1997). It can be subdivided into physical and mental fatigue. In China, Traditional Chinese Medicine (TCM) has a long history of use as 'tonics' to treat physical fatigue and are now being validated by scientific approach for their remarkable healing potential.

Taraxacum officinale (TO), a member of the Asteraceae family, is widespread throughout the warm-temperate zones of the Northern Hemisphere and have been used in many traditional and modern herbal medical systems, as have been documented particularly in Asia and Europe (Kim et al., 2000; Shen et al., 2004; Koo et al., 2004; Seo et al., 2005; Sigstedt et al., 2008; Zhang et al., 2008). In traditional Chinese medicine (TCM), it is also acclaimed as a nontoxic herb with exceptional values for its choleric, diuretic, anti-rheumatic, and anti-inflammatory properties (Lin and Zheng, 1998; Hu and Kitts, 2003; Jeon et al., 2008). Several flavonoids including caffeic acid, chlorogenic acid, ferulic acid, luteolin, and luteolin 7-glucoside have been isolated from the *Taraxacum officinale* (Williams et al., 1996; Shen et al., 2004; Schütz et al., 2005; Shen et al., 2006; Xu and Xu, 2008). However, relatively less has been studied about the effect of *Taraxacum officinale* on physical fatigue. The aim of the present study is to examine the effect of *Taraxacum officinale* on physical fatigue, based on the forced swimming capacity of mice administered *Taraxacum officinale* extracts (TOE).

Materials and Methods**Plant materials and preparation of extracts**

Plant materials of *Taraxacum officinale* were obtained from local herb stores in Huangshi City. Voucher specimen of the plant materials (voucher No. 07214) were deposited at the Herbarium at the Huangshi Institute of Technology. *Taraxacum officinale* extracts (TOE) were prepared by decocting the dried prescription of herbs with boiling distilled water. The decoction time was about 3 hr (Ling et al., 2005; Wu et al., 2005; Su et al., 2008).

Preparation of animal

Four-week-old Kunming male mice weighing 18-22 g were procured from Huangshi Laboratory Animal Center (Huangshi, China) and used for experiments after one week of acclimatization. Animals were housed in an air conditioned room (22 - 24 °C with a 12 hr light cycle) and maintained according to the Guide for the Care and Use of Laboratory Animals established by Huangshi Institute of Technology (Huangshi, China). The water and diet were provided *ad-libitum*.

Grouping of animals

For the measurement of the forced swimming capacity and analysis of blood biochemical parameters in mice, forty Kunming male mice were randomly divided into 4 groups(, i.e.,normal control (NC) and three doses of TOE treated group (Tables 1). The volume of administration was 1 mL and the treatments lasted for 42 days. Each mice was subjected to swimming exercise 15-mins period daily for the 6 weeks.

Tables 1: Grouping of animals

Group	Number	Administration of animals
Normal control (NC)	10	The mice were treated by oral sterile distilled water.
Low-dose (LD)	10	The mice were treated by oral TOE with 10 mg/ kg b.w
Middle-dose (MD)	10	The mice were treated by oral TOE with 30 mg/ kg b.w
High-dose (HD)	10	The mice were treated by oral TOE with 100mg/ kg b.w

Measurement of the forced swimming capacity

After 6 weeks, the forced swimming capacity in mice was measured with swimming tank (90 × 45 × 45 cm) filled with fresh water to a depth of 30 cm. Water temperature was maintained at 30±1 °C. A lead block (10% of body weight) was loaded on the tail root of the mice. Exhaustion was determined by observing loss of coordinated movements and failure to return to the surface within 5 s (Jung et al., 2004; Shin et al., 2006; Sugino et al., 2007; Nozawa et al., 2009). Swimming time was recorded as minute for each mice.

Analysis of blood biochemical parameters

Blood samples were taken by capillary glass tubes from the eye venous pool of mice after light anesthetized with ether, and the serum was separated for the measurement of triglyceride, glucose and lactate levels. Then blood triglyceride, glucose and lactate concentrations were determined according to the recommended procedures provided by the commercial diagnostic kit (Sigma Co., Shanghai, China).

Statistical analyses

All data were reported as means standard deviation (SD). Statistical analysis was performed by Kruskal Wallis Varyans Analysis followed by a post-hoc Mann-Whitney U test. The level of $p < 0.05$ was taken to indicate statistical significance. All statistical analyses were performed using computer software package (SPSS for Windows 13.0).

Results and Discussion

Effect of TOE on the body weight of mice

Figure 1 showed the body weight change of the mice during the experimental period. The body weight of all experimental animals was similar initially. However, all groups gained weight by the end of the experiment. At the 6th week, middle-dose (MD) group body weight increased the most by all the other groups while normal control group increased the least. However, there was no statistical difference between each TOE treated group and normal control (NC) group ($p > 0.05$). So the TOE had no significant effect on the body weight.

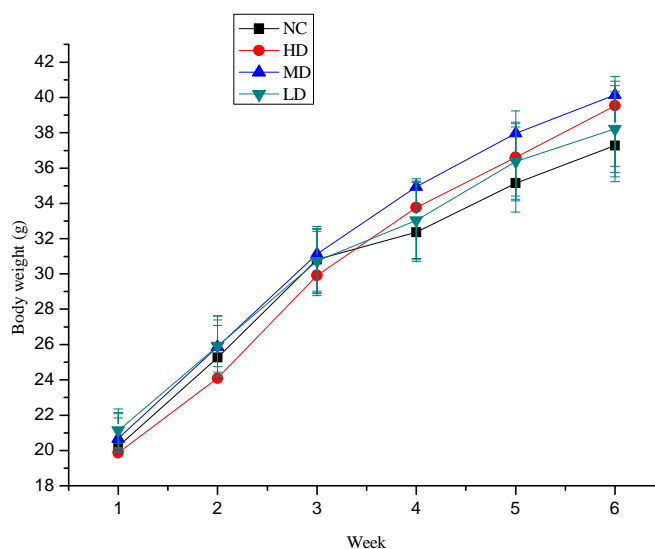


Figure 1: Effect of TOE on the body weight of mice. Each value represents mean \pm SD; $n = 10$.

Effect of TOE on the forced swimming capacity in mice

The forced swimming capacities are shown in Figure 2. There are significant differences in the swimming time to exhaustion between the normal control (NC) group and each TOE treated group ($p < 0.05$).

Swimming is frequently preferred as an exercise model for small laboratory animals, and it has several advantages over other types of exercise (Kramer et al., 1993; Yalcin et al., 2000). In this study, the forced swimming capacity test in mice was employed to evaluate the effect of medicinal plant extracts on exercise durability of mice. The data of the present study showed that the swimming time to exhaustion of the all TOE treated groups were significantly longer than that of the normal control (NC) group. The result indicated that TOE enhanced the swimming capacity by lessening of physical fatigue in mice.

Effect of TOE on the blood biochemical parameters

Blood biochemical parameters were shown in Table 1. Muscular work, performed aerobically in the post-absorptive state, depends mainly on the utilization of fat. Free fatty acids and triglyceride fatty acids can provide energy

for muscular contraction (Jones and Havel, 1967; Jung et al., 2004; Fueger et al., 2007). In this study, blood triglyceride concentrations were lower in all TOE treated groups than in the normal control (NC) group ($p < 0.05$). The result suggested that TOE could increase fat utilization of mice during exercise, delaying the onset of fatigue.

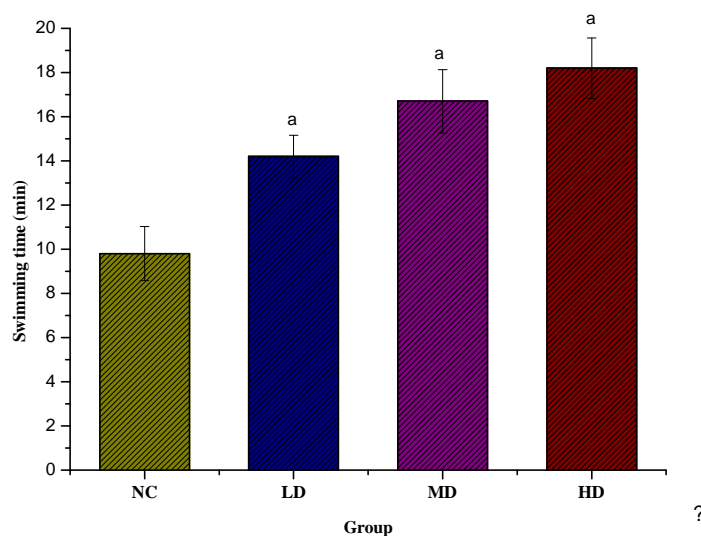


Figure 2: Effect of TOE on the forced swimming capacity in mice

Each value represents mean \pm SD; $n = 10$. ^a $p < 0.05$, compared with normal control group.

It was known that hypoglycemia could suppress the active functioning of the brain during exercise, and this often led to the inability of continuing exercise (Wang et al., 2006; Borer et al., 2009). On the other hand, the homeostasis of blood glucose played an important role in prolonging endurance exercise (Van der Vusse and Saris, 1991; Zinker et al., 1993; Abe et al., 1995). In this study, blood glucose concentrations were significantly higher in all TOE treated groups than in the normal control (NC) group ($p < 0.05$). The result indicated that the supply of glucose could be used smoothly and /or that glucose utilization might decrease by the use of TOE as an energy source during exercise.

Blood lactate is the glycolysis product of carbohydrate under an anaerobic condition and glycolysis is the main energy source for fierce exercise in a short time. It represents the degree of fatigue after exercise and the condition of recovery (Babcock et al., 1995; Wang et al., 2006; Yu et al., 2008; Cao et al., 2009). In this study, blood lactate concentrations were significantly lower in all TOE treated groups than in the normal control (NC) group ($p < 0.05$). Therefore, it can thus be considered that TOE could effectively retard and lower the blood lactate produced after exercise, postpone the appearance of physical fatigue and accelerate the recovering from physical fatigue.

Table 1: Effect of TOE on the blood biochemical parameters

Group	Triglyceride (mg/dL)	Glucose (mg/dL)	Lactate (mg/dL)
Normal control (NC)	168.23 \pm 14.84	56.24 \pm 14.48	70.28 \pm 3.76
Low-dose (LD)	121.35 \pm 18.78 ^a	94.26 \pm 17.97 ^a	54.27 \pm 6.43 ^a
Middle-dose (MD)	114.72 \pm 11.42 ^a	87.29 \pm 21.37 ^a	52.61 \pm 4.75 ^a
High-dose (HD)	106.89 \pm 19.36 ^a	81.27 \pm 19.65 ^a	47.23 \pm 5.77 ^a

Each value represents mean \pm SD; $n = 10$. ^a $p < 0.05$, compared with normal control group

Conclusion

The present results suggested that TOE showed an anti- physical fatigue effect. It enhanced the maximum swimming capacity of mice, effectively delayed the lowering of glucose in the blood, and prevented the increase in lactate and triglyceride concentrations.

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