

# Abstract

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## Thiamine tetrahydrofurfuryl disulfide improves energy metabolism and physical performance during physical-fatigue loading in rats.

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**BACKGROUND:** Impaired energy metabolism is considered a possible cause of fatigue. The thiamine derivative, thiamine tetrahydrofurfuryl disulfide (TTFD), is prescribed and is also an over-the-counter drug for the attenuation of fatigue. It is readily absorbed from the intestinal tract and converted into thiamine pyrophosphate (TPP), which plays an important role as a cofactor for enzymes of metabolic pathways involved in the production of adenosine triphosphate (ATP).

**OBJECTIVE:** We postulated that TTFD has an anti-fatigue effect by improving energy metabolism during physical-fatigue loading.

**METHODS:** Here, we initially used the forced swimming test to determine whether daily TTFD or thiamine for 5 days has anti-fatigue effects on weight-loaded rats.

**RESULTS:** The swimming duration of TTFD-, but not of thiamine-treated rats, was significantly longer than that of control rats ( $P < .05$ ). Based on these findings, we examined changes in the levels of thiamine and its phosphate esters in various organs and the effect of TTFD on ATP levels in skeletal muscle after forced swimming, to determine the cellular mechanisms of the anti-fatigue effect of TTFD. Daily TTFD resulted in a characteristic distribution of thiamine and its phosphate esters in rat skeletal muscle, liver, kidney, heart, brain, and plasma. Furthermore, daily TTFD attenuated the decrease in ATP content in the skeletal muscle caused by forced swimming with a weight load for a defined period (150 s).

**CONCLUSIONS:** These results indicate that TTFD exerts anti-fatigue effects by improving energy metabolism during physical fatigue.

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