

Pueraria mirifica Replacement Improves Skeletal Muscle Performance Associated with Increasing Parvalbumin Levels in Ovariectomized Rat

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Abstract : Sarcopenia is a loss of muscle mass, and strength frequently found in menopause. Estrogen replacement has been shown to improve such a loss of muscle functions. However, there is an increased risk of cancer that has to be considered because of the estrogen replacement therapy. Thus, phytoestrogen supplementation has been suggested as an alternative therapy. Pueraria mirifica (PM) is a plant in the family Leguminosae, that is known to be phytoestrogen-rich and has been traditionally used for the treatment of menopausal symptoms. It contains isoflavones and other compounds such as miroestrol and its derivatives. Parvalbumin (PV) is a calcium binding protein and functions as a relaxing factor in fast twitch muscle fibers. A decrease of the PV level results in a reduction of the speed of the twitch relaxation. Therefore, this study aimed to investigate the effect of an ethanolic extract from Pueraria mirifica on the estrogen levels, skeletal muscle functions and PV levels in the extensor digitorum longus (EDL) and gastrocnemius of ovariectomized rats. Twelve-week old female Wistar rats (200-250 g) were divided into 6 groups: SHAM (un-ovariectomized rats, that received double distilled water), PM-0 (ovariectomized rats, OVX, receiving double distilled water), E (OVX, receiving an estradiol benzoate dose of 0.04 mg/kg), PM-50 (OVX receiving PM 50 mg/kg), PM-500 (OVX receiving PM 500 mg/kg), PM-1000 (OVX receiving PM 1000 mg/kg) all for 90 days. The PM-0 group had estrogen levels, uterus weights, muscle mass, myofiber cross-section areas, peak tension, fatigue resistance, speed of relaxation and parvalbumin levels of both EDL and gastrocnemius that were significantly reduced compared to those of the SHAM group ($p < 0.05$). Also the α and β estrogen receptor immunoreactivities and the parvalbumin immunoreactivities of both EDL and gastrocnemius were decreased in the PM-0 group. In contrast the E, PM-50, PM-500 and PM-1000 group had estrogen levels, uterus weights, muscle mass, myofiber cross-section areas, peak tension, fatigue resistance, speed of relaxation of both EDL and gastrocnemius that were significantly increased compared with PM-0 group ($p < 0.05$). In addition, the α and β estrogen receptor immunoreactivities and parvalbumin immunoreactivity of both the EDL and gastrocnemius were increased in the E, PM-50, PM-500 and PM-1000 group. In addition the extract of Pueraria mirifica replacement group at 50 and 500 mg/kg had significantly increased parvalbumin levels in the EDL muscle but in the gastrocnemius, only the dose of 500 mg/kg increased the parvalbumin levels ($p < 0.05$). These results have demonstrated that the use of the Pueraria mirifica extract as a replacement therapy for estrogen produced estrogenic activity that was similar to that produced by the estradiol benzoate replacement. It seems that the phytoestrogens could bind with the estrogen receptors and stimulate the transcriptional activity to synthesise muscle protein that caused an increase in muscle mass and parvalbumin levels. Thus, muscle synthesis may restore parvalbumin levels resulting in an enhanced relaxation efficiency that would lead to a shortened latent period before the next contraction.

Keywords : Pueraria mirifica, Parvalbumin, estrogen, ovariectomized rats

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