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# The effects of *Panax notoginseng* on delayed onset muscle soreness and muscle damage in well-trained males: A double blind randomised controlled trial

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**KEYWORDS**
*Panax notoginseng*;
Exercise;
Muscle damage;
DOMS;
Recovery;
Acute phase response

**Summary**
*Objectives:* The aim of the study was to determine if *Panax notoginseng* is effective in reducing pain, indicators of inflammation and muscle damage, and in turn improve performance in well trained males who underwent a bout of eccentric exercise designed to induce delayed onset muscle soreness (DOMS).
*Design:* A double blind randomised placebo controlled trial.
*Setting:* Twenty well trained male volunteers, matched by maximum aerobic capacity were randomly assigned to consume a regime of 4000 mg of *P. notoginseng* capsules or an indistinguishable placebo before and after a downhill treadmill running episode designed to induce DOMS.
*Main outcome measures:* Performance measures (Kin—Com, counter movement and squat jump), pain assessments (visual analogue scale (VAS), algometer) and blood analyses (interleukin-1, interleukin-6 (IL-6), tumour necrosis factor-alpha (TNF-$\alpha$), C-reactive protein, myoglobin, creatine kinase) were assessed at 7 time points over 5 days (pre, post, 4, 24, 48, 72 and 96 h after the downhill run).
*Results:* The placebo group demonstrated a significant decrease in squat jump performance immediately post the downhill run, with a mean change $\pm$ 95% confidence interval (CI) of 0.8 cm (−3.53 to 1.93). The placebo group also experienced increased pain in the quadriceps 96 h after the downhill run, with a mean VAS change $\pm$ 95% CI of −0.32 cm (−0.34 to 0.98).The serum concentration of IL-6 and TNF-$\alpha$ were significantly lower in the placebo group 24 h after the downhill run. Mean IL-6 change $\pm$ 95% CI of 0.50 pg/mL (−1.59 to 0.59), and mean TNF-$\alpha$ change $\pm$ 95% CI was 0.98 pg/mL (−2.04 to 0.09). No other significant differences were identified between the groups for any other outcome measure.

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*Conclusion:* Considering all data from this study, *P. notoginseng* did not convincingly have an effect on performance, muscular pain or assessed blood markers in well-trained males after an intense bout of eccentric exercise that induced DOMS.


## Introduction

The term ginseng refers to products prepared from the *Panax* species. Korean and Chinese ginseng are prepared from the dried root of *Panax ginseng* C.A. Meyer, and American, Sanchi (Sanqi, Tienchi, or Tienqi), Japanese and Vietnamese ginsengs are prepared from *Panax quinquefolius* L., *Panax notoginseng* (Burkill) F.H. Chen, *Panax japonicas* C.A. Meyer, and *Panax vietnamensis* Ha et Grushv respectively.[1] *P. notoginseng* is predominantly grown in the Southern Provinces Yunnan and Guangxi in China.[2,3] It is one of China's most commonly used and prestigious traditional medicines and boasts a history of greater than 2000 years of safe use.[4] *P. notoginseng* is generally used as a remedy to combat stress and promote blood circulation.[2,4]

*P. notoginseng* has been credited with the ability to enhance stamina, decrease blood pressure, aid in recuperation from physical stress, and if used topically as an ointment, improve microcirculation in muscles, dissipate bruises, act as an anti-inflammatory agent and have a positive effect on coronary heart disease and angina pectoris.[5,6] *P. notoginseng* has also been used for reducing pain and swelling.[7]

The active components of *Panax* include saponins (ginsenosides) of which there are over 20 different varieties.[3] Saponins isolated from *P. notoginseng* have demonstrated the potential to block calcium influx into vascular smooth muscle through activating $Na^+$-$K^+$-ATPase, leading to decreased $Na^+/Ca^{2+}$ exchange, a lowered intracellular $Ca^{2+}$ level and reduced heart rate.[8,9] Among a number of theories proposed to explain delayed onset muscle soreness (DOMS), including lactic acid accumulation, muscle spasm, connective tissue damage, muscle damage, inflammation and enzyme efflux,[10] calcium accumulation has been purported as one potential explanation.[11–13] If *P. notoginseng* can block calcium influx into muscle, it may prevent or reduce the effects of DOMS.

*P. notoginseng* in Australia is currently marketed to: ''provide powerful support to soft tissue recovery by promoting the healing of microtrauma to muscles, tendons and ligaments following strenuous exercise; quickly relieve the symptoms of inflammation, pain, swelling, bleeding and bruising associated with soft tissue injury including DOMS, sprains and strains''.[14] Though one of the approved therapeutics claims listed with the Australian Therapeutics Goods Administration is for the treatment of DOMS, there is yet to be a rigorous scientific trial providing convincing results that *P. notoginseng* is effective for any of the above mentioned musculoskeletal conditions. The majority of evidence for this product is based on association, anecdote or traditional Chinese use. There have been numerous studies on *P. ginseng* and exercise, however few relating specifically to DOMS and muscle damage.

The only human study to assess *P. notoginseng* in relation to exercise concluded that *P. notoginseng* supplementation enhances physical performance during endurance exercise.[15] A confounding factor in this study was that subjects were only asked to avoid strenuous physical exertion the day before physiological measurements. There were no statements regarding the activities carried out during the 30 days between trials. The reported increase in aerobic capacity may have been due to increased physical activity within the study period or the ginseng or both.

The purpose of this study was to determine the effect of *P. notoginseng* on indicators of muscle damage and inflammation, pain, and performance in well-trained males after a bout of eccentric exercise.

## Materials and methods

### Participants

Twenty male volunteers with a mean (SD) age of 28.5 (6.4) years, weight 76.35 (9.58) kg and height 179.9 (6.0) cm commenced and completed the study. All of the subjects were well trained males from a variety of sports (Australian football, swimming, middle and long distance running and cricket), with a mean predicted $VO_{2max}$ of 49.92 (7.27) mL $kg^{-1}$ $min^{-1}$.

Male athletes were the target group for this study as the effects of hormones associated with the menstrual cycle on markers of muscle damage and inflammatory ions are unclear. To prevent any confounding results males were deemed the most appropriate participants for this study. For this study, 20 participants were expected to provide a clinically significant outcome based on the matching of subjects and other studies conducted in this field.[16–18]

Subjects who participated in the study did not report injuries or conditions associated with inflammation, consumed any anti-inflammatory medications for the month prior to and during the week of testing nor completed any eccentric exercise six weeks prior to testing or during the week of testing. Subjects abstained or completed only light training during the week of physiological testing. All subjects gave their written informed consent. The Human Ethics Committees of the Australian Institute of Sport (AIS) and University of Western Sydney (UWS) approved the study.

### Procedures

The procedures have been described in detail in Pumpa et al.[19] Briefly, subject recruitment and registration was completed by the principal researcher through advertising at local universities and sporting teams. All subjects completed a 20 m shuttle run test to predict $VO_{2max}$, they were then matched based on this parameter. One subject from each matched pair was allocated to either the active or placebo group by a computer generated randomisation chart compiled by an independent researcher. The independent