

Noni leaf, black tea and Black cohosh encouraged bone growth in post-menopausal mammals

High intake of black tea and certain types of flavonoids were associated with lower risk of fracture-related hospitalizations in elderly women at high risk of fracture. Black tea consumption increased serum estradiol and prevented bone loss in post-menopausal rat model. Bone strength and integrity rely on sustaining a subtle balance between bone resorption by osteoclasts and bone formation by osteoblasts. With age, diseases or sedentary life style this balance tends to favor bone resorption rather than bone formation, making bones brittle and increases fracture risk. Osteoporosis is when the bone mineral density (BMD) is significantly below the mean for normal young woman.

Osteoporosis causes over 9 million fractures annually, and affect over 200 million women worldwide (approximately 10% aged 60, 20% aged 70, 40% aged 80 and 70% aged 90).

Osteoporosis increases fracture risks and physically debilitating injuries occurrences. Physical activity and healthy diet (that includes calcium and vitamins) help ameliorate osteoporosis.

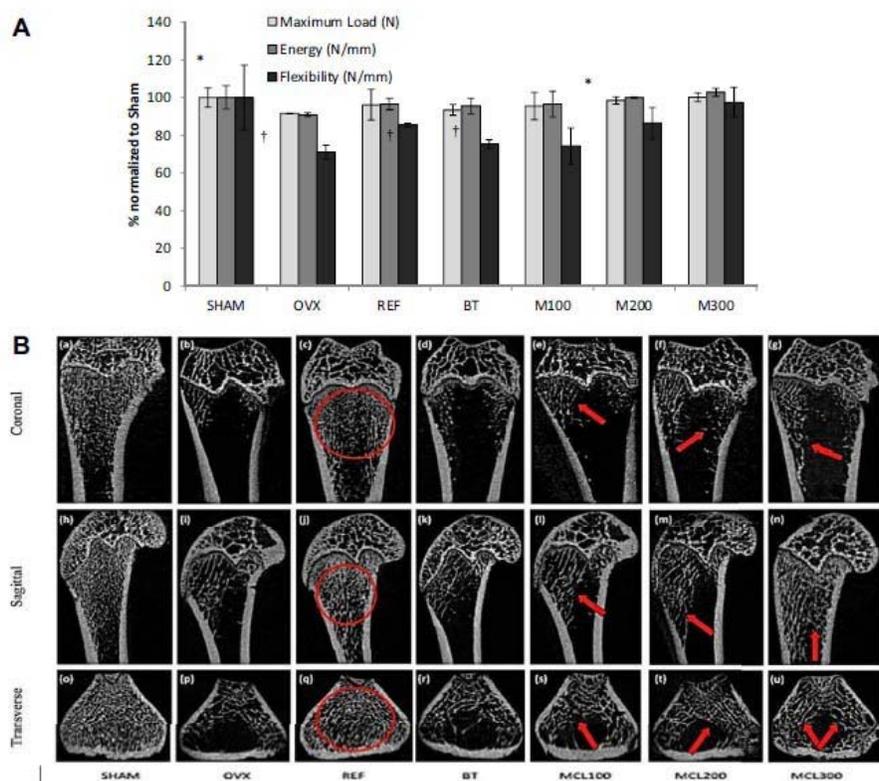


Fig. 1. Effects of 4 months consumption of Noni leaf extract, Black cohosh (Remifemin) or black-tea on ovariectomized (post-menopausal) rats: (A) Femur bone mechanical properties ; (B) Bone Cross-sectional (micro-CT) images of femur.

Images were obtained from healthy control (a,h,o), ovariectomised OVX (b,i,p), OVX treated with remifemin (c,j,q); black tea (d,k,r); 100mg/kg MCL (e,l,s), 200mg/kg MCL (f,m,t); and 300mg/kg MCL (g,n,u). 100 (e,l,s), 200 (f,m,t) and 300 (g,n,u) mg/kg bw MCL showed dose-dependent restoration of bone (red arrows).

Food that help bone formation help prevent bone loss. We compared the efficacy and mechanisms by which Noni (*Morinda citrifolia*) leaf, black tea and Black cohosh (Remifemin) water extracts enhanced bone growth in estrogen-deficient osteoporosis rat model. We found Noni leaf and black tea extracts encouraged bone growth in ovariectomized (ovary removed) rats. The four months' study showed dose-dependent increase in bone growth. The catechins-rich extracts showed bone regeneration evidently through increasing (i) bone size and structure, (ii) bone mechanical properties (strength and flexibility), and (iii) bone mineralization and density. Their detail mechanisms were then studied. The extracts favoured bone growth and suppressed bone loss by (i) enhancing osteoblast generation and survival, (ii) inhibiting osteoclast growth and activities, (iii) suppressing inflammation, (iv) improving bone collagen synthesis and (v) upregulating ESR1 (Estrogen receptor 1) expression to augment phytoestrogenic effects. Estrogen deficiency often increased body weights and fat deposits, together with the bone mass decrease. The Noni leaf extract dose-dependently ameliorated the estrogen deficiency induced body weight gain. The enhanced femur BMD by Noni leaf extract and Black tea to beyond that of the control healthy (Sham) rats indicated active bone regeneration. These results indicated potential benefits of consuming Noni leaf and black tea for the aged and menopausal women.

Noni (*Morinda citrifolia* L.) is traditionally used as a poultice for broken bones and sprains, deep cuts, bruises, sores and wounds. Noni fruit extract reportedly increased osteoblast activity, enhanced matrix mineralization and restrained osteoclast activity. However excessive intake of Noni fruit extract may cause liver toxicity. The water extract of Noni leaf (a vegetable) promoted osteogenic differentiation and matrix mineralization in human periodontal ligament cells. Additionally, Noni leaf were shown to be safe with therapeutic and nutritional benefits such as anticancer, antiviral, anti-bacterial, anti-tubercular, anti-inflammatory, analgesic, hypotensive, and immune enhancing effects.

Estrogen-deficiency significantly decreased femur elasticity (compared to the control healthy group). Treatment with Noni leaf extract dose-dependently increased the femur flexibility. Estrogen-deficiency also decreased the maximum fracture load and energy, and the Noni leaf extract dose-dependently increased both parameters to the sham level (Fig. 1). Bone strength, fracture energy and flexibility represent the bone integrity. Bone strength is the maximum load that fractures the bone, bone flexibility is the bone deformation extent, and the fracture energy is the *energy* required to open a unit area of crack. Here, Noni leaf extract dose-dependently increased all three parameters, validating its good effects on the bone mechanical properties.

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