Bone mass density estimation: archimede`s principle versus automatic x-ray histogram and edge detection technique in ovariectomized rats treated with germinated brown rice bioactives

ABSTRACT

Background: Bone mass density is an important parameter used in the estimation of the severity and depth of lesions in osteoporosis. Estimation of bone density using existing methods in experimental models has its advantages as well as drawbacks. Materials and methods: In this study, the X-ray histogram edge detection technique was used to estimate the bone mass density in ovariectomized rats treated orally with germinated brown rice (GBR) bioactives, and the results were compared with estimated results obtained using Archimede's principle. New bone cell proliferation was assessed by histology and immunohistochemical reaction using polyclonal nuclear antigen. Additionally, serum alkaline phosphatase activity, serum and bone calcium and zinc concentrations were detected using a chemistry analyzer and atomic absorption spectroscopy. Rats were divided into groups of six as follows: sham (nonovariectomized, nontreated); ovariectomized, nontreated; and ovariectomized and treated with estrogen, or Remifemin®, GBR-phenolics, acylated steryl glucosides, gamma oryzanol, and gamma amino-butyric acid extracted from GBR at different doses. Results: Our results indicate a significant increase in alkaline phosphatase activity, serum and bone calcium, and zinc and ash content in the treated groups compared with the ovariectomized nontreated group ($P < 0.05$). Bone density increased significantly ($P < 0.05$) in groups treated with estrogen, GBR, Remifemin®, and gamma oryzanol compared to the ovariectomized nontreated group. Histological sections revealed more osteoblasts in the treated groups when compared with the untreated groups. A polyclonal nuclear antigen reaction showing proliferating new cells was observed in groups treated with estrogen, Remifemin®, GBR, acylated steryl glucosides, and gamma oryzanol. There was a good correlation between bone mass densities estimated using Archimede's principle and the edge detection technique between the treated groups ($r2 = 0.737$, $P = 0.004$). Conclusion: Our study shows that GBR bioactives increase bone density, which might be via the activation of zinc formation and increased calcium content, and that X-ray edge detection technique is effective in the measurement of bone density and can be employed effectively in this respect.