Effect of *Morinda officinalis* capsule on osteoporosis in ovariectomized rats

LI Ye¹, LÜ Shan-Shan², TANG Gui-Ying², HOU Min¹, TANG Qing¹, ZHANG Xiao-Na¹, CHEN Wei-Hai³, CHEN Gang⁴, XUE Qiang¹, ZHANG Cong-Cong¹, ZHANG Ji-Fen¹, CHEN Yi¹, XU Xiao-Yu¹*

¹ College of Pharmaceutical Sciences, Institute of Chinese Medicine, Pharmacology of Chinese Materia Medica-the key constructing discipline by the State Administrative Bureau of TCM, Southwest University, Chongqing 400715, China; ² Healn Pharmaceutical Co. Ltd., Chongqing 401520, China; ³ College of Psychology, Southwest University, Chongqing 400715, China; ⁴ Chongqing Key Laboratory of Nature Medicine Research, Chongqing Technology and Business University, Chongqing 400067, China

Available online 20 Mar. 2014

**Abstract**

**AIM:** To explore the therapeutic effects of *Morinda officinalis* capsules (MOP) on osteoporosis in ovariectomized rats.

**METHOD:** Six-month-old female Sprague–Dawley rats were induced for postmenopausal osteoporosis (PMOP) by bilateral ovariectomy and divided into seven groups as follows: sham-operated group, ovariectomized (OVX) control group, OVX treated with xianlinggubao (XLGB) (270 mg·kg⁻¹·d⁻¹), OVX treated with alendronate sodium (ALN) (3 mg·kg⁻¹·d⁻¹), and OVX treated with *Morinda officinalis* capsule (MOP) of graded doses (90, 270 and 810 mg·kg⁻¹·d⁻¹) groups. Oral treatments were administered daily on the 4th week after ovariectomy and lasted for 12 weeks. The bone mineral density was evaluated by dual-energy X-ray absorptiometry. The tartrate-resistant acid phosphatase (TRAP), alkaline phosphatase (AKP), and osteocalcin (OC) levels in the serum and plasma were determined by standard colorimetric and enzyme immunoassays methods. Bone biomechanical properties and morphological parameters were analyzed by three-point bending test and histomorphometry respectively.

**RESULTS:** *Morinda officinalis* capsules at all doses were able to significantly prevent the OVX-induced loss of bone mass due to diminishing serum AKP and TRAP levels while elevating OC level in the plasma. *Morinda officinalis* capsules also enhanced the bone strength and prevented the deterioration of trabecular microarchitecture.

**CONCLUSION:** *Morinda officinalis* capsules possess potent anti-osteoporotic activity in OVX rats which could be an effective treatment for postmenopausal osteoporosis.

**KEY WORDS** | *Morinda officinalis* capsule; Osteoporosis; Bone Metabolism; Bone Mineral Density; Biomechanics; Morphology

**CLC Number** | R965

**Article ID** | 2095-6975(2014)03-0204-09

**Introduction**

Osteoporosis (OP) is a systemic metabolic bone disease featuring low bone mass, damaged microstructure, highly fragile bone, and greater vulnerability to fracture [1]. It falls into two categories: primary and secondary, and post-menopausal osteoporosis (PMOP) is most common among the primary forms of osteoporosis. The causes of osteoporosis are very complicated, and the disease itself is closely related to aging, endocrine disorders, calcium malabsorption, and limb disuse, as well as immune, nutritional, and genetic factors. Drug and hormone replacement therapy are the main treatments presently available and are usually complemented with proper physical exercise and sensible diet. Therefore, it is important to carry out research on compound Chinese medicinal preparations containing multiple bioactive components in order to develop novel anti-osteoporosis drugs.
Pharmacological studies of traditional Chinese medicine have shown that traditional Chinese kidney-tonifying drugs are effective in treating osteoporosis because they can increase the bone mineral density in patients [2-3], improve the biomechanical properties of the bones [4-7], regulate and maintain the dynamic balance of hormones in the body, and thereby improve calcium-phosphorus metabolism and calcium salt deposition [8]. In addition, these drugs can also promote the proliferation and differentiation of bone cells [9-12], regulate the gene expression of Type-I collagen, LMP-1 CalBp-D9k, ER, and VDR [13-15], and regulate the concentrations of NO and SOD in the serum [16].


Morinda officinalis capsule (MOP) is made up of Morinda officinalis, Polygonum multiflorum, Eucommia, Cistanche, Dipsacus, Curculigo, Rosa laevigata Michx, Epimedium (leaves) and other herbs (16 kinds herbs in total). It can tonify the kidney and regulate menstruation, and is therefore effective for the syndrome of Kidney-Yang Deficiency, as manifested in the appearance of such symptoms as physical and mental fatigue, weak waist and knees, frequent urination at night, irregular menstruation, etc. Morinda officinalis F.C.How (Rubiaceae), the principal ingredient of the preparation, has been known to have effects of tonifying kidney, toning up bones and muscles, relieving rheumatism, and so on. Modern studies have shown that it can promote bone formation and inhibit bone resorption [17-18], and that the polysaccharides of M. officinalis can increase the bone mineral density and the level of trace elements in the serum in ovariectomized rats with OVX-induced osteoporosis. Besides, M. officinalis can inhibit IL26 and TNF2A expression [19] and increase the level of OPG expression [17, 20], thereby, promoting the proliferation of osteoblasts and the secretion of AKP (alkaline phosphatase) and OC (osteocalcin) [21-26], and allow TGF-β1mRNA [27] to be expressed so as to secrete, in a significant amount, type-I collagen to facilitate calcium deposition. Therefore, it is potentially an effective medication for osteoporosis and prevention of fracture. To demonstrate the curative effects of the MOP preparation on osteoporosis, an ovariectomized rat model of osteoporosis was developed, in which the changes in bone mineral density and in bone-metabolism-related biochemical markers before and after the preparation was administered, as well as biomechanical and morphological indexes, could be observed and measured. Finally, its effects on osteoporosis in rats, as well as its function of overall regulation were explored and verified. The study was intended to provide an experimental basis for the development of a highly effective, low-toxicity drug against osteoporosis.

Materials and Methods

Experimental animals

Six-month-old retired breeder female Sprague-Dawley (SD) specific-pathogen-free (SPF) rats were purchased from the Experimental Animal Center of Chongqing Chinese Herbal Medicine Research Institute (Chongqing, China) (average body weight (230 ± 10.0 g)), and acclimated to conditions for one week before the experiment, and housed in the Center of Animal Experiment, College of Pharmacy, Southwest University at constant temperature (22 ± 0.5°C) and humidity [(45–50)%] with a 12-h light and 12-h dark illumination cycle. During the experimental period, all the rats were allowed free access to distilled water and fed with standard rat chow. The experiment was undertaken in accordance with the guidelines for care and use of laboratory animals at Southwest University.

Materials

Morinda officinalis capsule (MOP) was provided by Chongqing Healn Pharmaceutical Co., Ltd. (Chongqing, China); Alendronate sodium (ALN) tablets was purchased from CSPC Europa Pharmaceutical Co., Ltd. (Hebei, China); Xianling gubao capsule (XLGB) was purchased from Tongjitang Pharmaceutical Co., Ltd. (Guizhou, China).

Reagents

Assay kits for determination of alkaline phosphatase (AKP) and tartrate-resistant acid phosphatase (TRAP) (all purchased from Jiancheng Bioengineering Institute, Nanjing, China); ELISA (enzyme-linked immunosorbent assay) kits for determination of osteocalcin (OC) (purchased from Biovalue Biomedical Engineering Co., Ltd., Shanghai, China).

Instruments

An ELX800 microplate reader (Gene Co., Ltd., USA) and a U-3010 UV-Vis spectro-photometer (Hitachi High-Tech Company, Japan) were used for the assay of serum and plasma chemistry; a bone mineral analyzer (DPX dual-energy X-ray absorptiometry) (GE Co., Ltd., USA) was used for measurement of bone mineral density (BMD). Olympus DP72 microscope and Image-pro plus 6.0 image analysis system (Media Cybernetics Inc., USA) were used for histomorphometric analysis; Instron1101 universal material testing machine (Biomechanics Laboratory, School of Biomedical Engineering, Chongqing University, Chongqing, China) was used for the biomechanical testing.

Ovariectomized rat model and experimental protocol

The acclimatized rats underwent either bilateral laparotomy (Sham, n = 10) or bilateral ovariectomy (OVX, n = 60). Four weeks after recovering from surgery, the sixty ovariectomized (OVX) rats were then randomly divided into six groups as follows: OVX with vehicle (OVX, n = 10); OVX with Xianlinggubao (XLGB) (n = 10, 270 mg·kg⁻¹·d⁻¹); OVX with alendronate sodium (ALN) (n = 10, 3 mg·kg⁻¹·d⁻¹) and three groups of OVX with MOP of graded doses (MOP90, n = 10, 90 mg·kg⁻¹·d⁻¹, MOP270, n = 10, 270 mg·kg⁻¹·d⁻¹, and MOP810, n = 10, 810 mg·kg⁻¹·d⁻¹). According to the Human and Rat Equivalent Dose Conversion Principle, the experimental dose for MOP, Xianlinggubao and alendronate sodium in the present study was equivalent to the corresponding clinical prescription dose for a 60 kg human subject. Vehicle, MOP, Xianlinggubao and alendronate sodium were all administered orally for 12 weeks through
oral gavage, which started on the 4th week after OVX. The sham-operated group was orally treated with vehicle.

The body weight of each animal was measured once a week during the experimental period until the final day of administration. After laparotomy using anesthetized with chloral hydrate, blood sample was collected through femoral artery puncture, serum and plasma were then prepared by centrifugation and anticoagulation with EDTA of the collected blood respectively (2 000 r·min⁻¹ for 20 min). Serum and plasma samples were then stored at −20°C for biochemical determinations. Uterine, liver, spleen, kidney, thymus, and adrenal were removed from each rat and immediately weighed. The femurs, tibiae, and lumbar vertebrae were dissected, and then the adherent soft tissues were removed and filled in physiological saline and stored at −20°C for measurement of bone mineral density (BMD) by dual-energy X-ray absorptiometry (DEXA).

**Assay for serum and plasma chemistry**

Alkaline phosphatase (AKP) and tartrate resistant acid phosphatase (TRAP) concentrations were measured by standard colorimetric methods using commercial kits (Jiancheng Bioengineering Institute, Nanjing, China) in a spectrophotometric analyzer (Japan). Plasma osteocalcin (OC) were determined by enzyme immunoassays using a commercial kit (Biovalue Biomedical Engineering Co. Ltd., Shanghai, China) according to the manufacturer’s instructions.

**Measurement of bone mineral density (BMD)**

Two-dimensional total bone mineral density (t-BMD) of the left femur and lumbar vertebrae were measured by dual-energy X-ray absorptiometry (DEXA) (GE Healthcare, USA) equipped with appropriate software for bone density assessment in small laboratory animals. BMD was calculated by BMC of the measured area.

**Biomechanical testing**

The isolated right femurs were assessed with three-point bending test by using the Instron 1101 universal material testing machine. Prior to mechanical testing, the right femurs were slowly thawed and held at room temperature on the day of test, the length of the femurs (distance from intermalleolar to intercondylar region) was measured with a micrometer, and the middle of the diaphysis was determined. The intact femur was then placed in the material testing machine on two supports separated by a distance of 20 mm and load was applied to the middle of the diaphysis, thus creating a three-point bending test. The biomechanical quality of the right femoral diaphysis were determined using Instron 1101 universal material testing machine at a speed of 2 mm·min⁻¹. The central loading point was displaced, and the load was recorded until the specimen was broken. From the load-displacement curve, maximum load (ultimate strength) was obtained.

**Histomorphometric analysis**

The bilateral tibial and lumbar vertebrae for morphology were excised, fixed with 4% paraformaldehyde in 0.1 mol·L⁻¹ phosphate buffer system (PBS, pH 7.2) for three days at room temperature, and decalcified with 6% HNO₃ in 0.1 mol·L⁻¹ PBS at room temperature for one week. The tissue samples were then dehydrated in a vacuum desiccator through a graded ethanol series, then defatted in xylene, embedded in paraffin, and sectioned in 5 µm-thicknesses slides. The slides were processed for H-E staining. The specimens were subjected to histomorphometric analysis followed the protocols recommended by the software instructions.

**Statistical analysis**

All data were statistically analyzed using SPSS18.0 software. The measurement data is expressed as the mean ± SD. The groups were compared by one-way analysis of variance LSD with P < 0.05 as the criterion for significance determination.

**Results**

**Serum and plasma chemistry**

The metabolic measurements made at the end of the experimental period are summarized in Fig. 1. Compared with the sham-operated group, a highly significant decrease (P < 0.01) in serum OC and a highly significant increase (P < 0.01) in serum AKP and TRAP, were observed in the model group, indicating that it was a reliable model. Compared with the model group, a significant increase in plasma OC (P < 0.05), and a highly significant decrease (P < 0.01) in serum TRAP and AKP, were observed in all MOP groups (810, 270, and 90 mg·kg⁻¹). These results showed that MOP increased bone density by inhibiting bone resorption and by promoting bone formation.

**Bone mineral density analysis**

Dual-energy X-ray absorptiometry (DEXA) was used to evaluate the BMD of rats. Compared with sham-operated group, a highly significant decrease (P < 0.01) in femoral and vertebral BMD was observed in the model group. Compared with the model group, a highly significant increase (P < 0.01) in vertebral BMD was observed in all of MOP groups (810, 270, and 90 mg·kg⁻¹), and a highly significant increase (P < 0.01) in femoral BMD in the high-dose group (810 mg·kg⁻¹) was also found, which showed that MOP, to some extent, improved BMD of femur and vertebrae, and decreased bone loss induced by ovariectomy (Fig. 2).

**Femur biomechanical measurement**

The actual effect of treatment on biomechanical competence can only be fully evaluated if the structural biomechanical parameters (maximum load) are corrected for changes in the geometric properties of the femur mid-shaft. Compared with the sham-operated group, a highly significant decrease in the maximum load of femur was observed in the

Fig. 1  Biochemistry index levels of OVX rats. Data are expressed as the mean ± SD (n = 10). Asterisks and number signs indicate comparison with the OVX group (*P < 0.05 and **P < 0.01) and the sham group (#P < 0.05 and ##P < 0.01), respectively. The abbreviations are the following: Sham, sham-operated and normal diet group; OVX, ovariectomized and normal diet group; ALN, ovariectomized and 3 mg·kg⁻¹·d⁻¹ alendronate group; XLGB, ovariectomized and 270 mg·kg⁻¹·d⁻¹ xianlinggubao power group; MOP, ovariectomized and 810, 270 and 90 mg·kg⁻¹·d⁻¹ Morinda officinalis fluid extract group, respectively.

Fig. 2  Bone mineral density of OVX rats. Data are expressed as the mean ± SD (n = 10). Asterisks and number signs indicate comparison with the OVX group (*P < 0.05 and **P < 0.01) and the sham group (#P < 0.05 and ##P < 0.01) respectively. The abbreviations that appear here are the following: Sham, sham-operated and normal diet group; OVX, ovariectomized and normal diet group; ALN, ovariectomized and 3 mg·kg⁻¹·d⁻¹ alendronate group; XLGB, ovariectomized and 270 mg·kg⁻¹·d⁻¹ xianlinggubao power group; MOP, ovariectomized and 810, 270 and 90 mg·kg⁻¹·d⁻¹ Morinda officinalis fluid extract group, respectively.

Compared with the model group with P < 0.01. Compared with the model group, a significant increase (P < 0.05) in the maximum load of the femur was observed in the MOP high- and medium-dose groups (810 mg·kg⁻¹ and 270 mg·kg⁻¹) (Fig. 3 and Fig. 4).

Histomorphometric change of cancellous bone in lumbar vertebra (Fig. 5)

Histomorphometric change of tibial cortical bone (Fig. 6)

Static parameters of tibial cortical bone

Compared with the sham-operated group, a highly significant decrease (P < 0.01) in tibial cortical bone area percentage (%Ct.Ar), as well as a highly significant increase (P < 0.01) in % Ma.Ar was observed in the model group.

Compared with the model group, the high dose group showed a significant increase in %Ct.Ar and a decrease in marrow cavity area percentage (% Ma.Ar) in all of the MOP groups (810, 270, and 90 mg·kg⁻¹) with P < 0.01 (Fig. 6 and Fig. 7).

Discussion

Morinda officinalis capsule can reduce the loss of bone mass, increase femoral and vertebral BMD, and improve bone metabolism and the level of bone mineralization in ovariectomized rats without any inhibition on OVX-or growth-induced increase in body weight. The ovariectomized rats in each MOP group showed a significant increase in %Ct.Ar
Fig. 3 Load-Displacement Curve (A) and Stress-Strain Curve (B) of femur and vertebrae for biomechanical properties

Fig. 4 Bone biomechanical properties of OVX rats. Data are expressed as the mean ± SD (n = 10). Asterisks and number signs indicate comparison with the OVX group (*P < 0.05 and **P < 0.01) and the sham group (#P < 0.05 and ##P < 0.01), respectively. The abbreviations that appear here are the following: Sham, sham-operated and normal diet group; OVX, ovariectomized and normal diet group; ALN, ovariectomized and 3 mg·kg⁻¹·d⁻¹ alendronate group; XLGB, ovariectomized and 270 mg·kg⁻¹·d⁻¹ xianlinggubao power group; MOP, ovariectomized and 810, 270, and 90 mg·kg⁻¹·d⁻¹ Morinda officinalis fluid extract group, respectively.

and decrease in %Ma.Ar, as well as somewhat improved microstructure of bone tissue. In this experiment, an increase in the maximum load after administration of MOP preparation, suggesting that the preparation can improve bone mechanical properties, and increase the resistance of the femur to bending.

The process of bone metabolism and bone turnover is a process of laying down new bone by osteoblasts and resorbing old bone by osteoclasts. Bone construction and bone reconstruction are the two basic regulatory mechanisms of the functional unit of the bone so as to regulate bone growth at the tissue level. Therefore, primary osteoporosis (OP) is a direct result of a disorder balance between bone formation and its resorption in the bone reconstruction unit [28]. The much higher incidence of osteoporosis among post-menopausal women is closely related to their decreased level of estrogen and atrophied gland (ovary). The ovariectomized rat model of osteoporosis is similar to post-menopausal women that resulted in bone loss, and is therefore a classic animal model for the study of post-menopausal osteoporosis [29]. The ovariectomized (both ovaries) rats showed a decreased femoral and vertebral BMD and OC concentrations, and increased TRAP and AKP.

Fig. 5 H-E staining pathological section of decalcified bone tissue from lumbar vertebra. Trabecular in red stain. (original magnification × 100). A: Sham-Operated Group. B: Model Group: There is a significant trabecular bone loss in the OVX group compared to sham control. C: ALN Group. D: XLGB Group. E: MOP High-Dose Group (810 mg·kg⁻¹). F: MOP Medium-Dose Group (270 mg·kg⁻¹). G: MOP Low-Dose Group (90 mg·kg⁻¹) significantly prevented bone loss from OVX-induced osteopenia.
Fig. 6  H-E staining pathological section of decalcified bone tissue from tibia. Cortical bone in red stain (original magnification × 40). A: Sham-Operated Group; B: Model Group: There is a significant cortical bone loss in the OVX group compared to sham control; C: Alendronate Group; D: XLGB Group; E: MOP High-Dose Group (810 mg·kg⁻¹); F: MOP Medium-Dose Group (270 mg·kg⁻¹); G: MOP Low-Dose Group (90 mg·kg⁻¹) significantly prevented bone loss from OVX-induced osteopenia.

Fig. 7  Static parameters of tibial cortical bone of OVX rats. Data are expressed as the mean ± SD (n = 10). Asterisks and number signs indicate comparison with the OVX group (*P < 0.05 and **P < 0.01) and the sham group (#P < 0.05 and ##P < 0.01) respectively. The abbreviations that appear here are the following: Sham, sham-operated and normal diet group; OVX, ovariectomized and normal diet group; ALN, ovariectomized and 3 mg·kg⁻¹·d⁻¹ alendronate group; XLGB, ovariectomized and 270 mg·kg⁻¹·d⁻¹ xianlinggubao power group; MOP, ovariectomized and 810, 270 and 90 mg·kg⁻¹·d⁻¹ Morinda officinalis fluid extract group, respectively.

concentrations in their blood. The ovariectomized rats used in this research all showed an increase in body weight and %Ma.Ar of tibial cortical bone, a decrease in uterine weight, femoral and vertebral BMD, and maximum load of femur, as well as %Cl.Ar of tibial cortical bone, which indicated that the model was successful.

The changes in biochemical markers indicated if the balance of bone metabolism has changed or disorder, and therefore can be used to assess the bone turnover rate in order to reflect bone resorption and formation [30]. These changes can be used to evaluate bone status and condition. Biochemical specificity markers of the serum AKP and TRAP indicated bone formation and resorption. The model group showed a significant increase in s-AKP and s-TRAP suggesting that ovariectomy can promote bone formation by osteoblasts and increase the bone resorption by osteoclasts at the same time, resulting in osteoporosis of high turnover. There are a variety of hormones and cytokines that can regulate the functions of both osteoclasts and osteoblasts which are closely related to the occurrence of osteoporosis [31]. OC is a non-collagen protein synthesized and secreted by osteoblasts as a regulatory factor of bone metabolism and bone turnover [32]. The results showed an increased level of OC in the blood in all groups, suggesting that MOP can inhibit bone resorption and promote bone formation. It is thereby reasonable to presume that the curative effect of MOP on osteoporosis is probably achieved by inhibition activities of osteoclasts or promotion proliferation of osteoblasts.

Bone biomechanics, which is based on the engineering mechanics, refers to the study of the mechanical properties of bone tissue under external action, as well as the biological effects of bone under a force or stress. It is a reliable way to assess the quality of bones. One of the main purposes of osteoporosis prevention and treatment is to prevent bone breaking. Naturally, the biomechanical indexes of the bone are very important in evaluating the efficacy of a drug [33]. In this experiment, the rats first showed a decrease in the maximum load of femur after the ovariectomy, then an increase in the same index after administration of the MOP preparation.
suggested that the material can improve a bone's mechanical properties and increase the femur's resistance to bending.

The histomorphometric changes of bone tissue are another important index for the objective evaluation of the state and condition of osteoporosis. The application of histomorphometric technology can ensure an objective evaluation of bone tissue in both qualitative (bone structure) and quantitative (bone mass) sense. The static histomorphometric indexes of bone tissue that were observed in this experiment could reflect, in almost all aspects, the effects of MOP on the bones of the rats. Specifically, the rats in sham-operated group had neatly-arranged cancellous trabeculae in much greater number, and in a smaller trabecular space. The rats in the model group, on the contrary, had much thinner and sparsely-arranged trabeculae in smaller number and with a wider trabecular space, broken trabeculae in some parts and damaged microstructure. The rats in the MOP groups showed an increase in both number and thickness of trabecular, as well as an increase in the number of trabecular connections. It was found that the ovariectomized rats all showed an increase in %Ma.Ar and a decrease in %Ct.Ar through the image quantitative analysis. The ovariectomized rats in each MOP group, on the contrary, showed a significant increase in %Ct.Ar, and a significant decrease in %Ma.Ar, as well as somewhat improved microstructure of bone tissue.

Increased bone mineral density is another important marker in the evaluation of curative effect on osteoporosis. The results of the experiment showed a decrease after ovariectomy, and an increase after administration of the preparation in femoral and vertebra BMD among the ovariectomized rats. What underlies the Chinese theory of “kidney governing bones” is that the kidney, bones, marrow, blood, and brain are acting as one, with the kidney being the congenital origin storing all the spirit from which the marrow is produced and resides in the bones to nourish the bones [34]. Traditional Chinese Medicine puts the post-menopausal osteoporosis into the category of bone atrophy, osteoarthritis, and low back pain. It holds that the kidney is the congenital origin from which marrow is produced and bones are nourished, and that the lack of kidney energy will cause the deficiency in marrow production and consequently undernourished and weak bones. From TCM’s point of view, this is the underlying cause and pathogenesis of osteoporosis, as accompanied by such symptoms as being stiff, weakness of waist and knees, painful hip and so on [35]. Modern medical studies have demonstrated that patients with “kidney deficiency” always are accompanied with dysfunction of hypothalamic-pituitary-gonadal axis, disorder of hormone secretion and weakened osteogenesis, ultimately leading to osteoporosis [36]. *Morinda officinalis* capsule can significantly promote the decreased bone mineral density in ovariectomized rats, and can be used in the treatment of osteoporosis, which is closely associated with the function of “tonifying the kidney”.

In these experiments, it was observed that the rats in the MOP groups all showed an increase in the uterus index in rats, which suggested that MOP can, to some degree, increase the bone mass, slow down the reduction in the level of estrogen, and inhibit high bone turnover. It was also observed in these experiments that MOP increased the femoral and vertebral BMD in the ovariectomized rats resembling patients suffering from kidney deficiency, and suggesting that the capsule is curative for osteoporosis. The capsule's curative effects on osteoporosis are manifested in its positive effects on the skeletal system, and on a variety of links and targets in many facets. The immune system and skeletal system are closely related. Studies [37] have shown that *M. officinalis* increases the rate of lymphocyte proliferation and improves the killing function of NK cells. The mechanism of action through which the immune system is improved may be a result of its stimulation of cytokines. The traditional Chinese kidney-tonifying medicine contains sex hormone-like ingredients, which will combine with estrogen receptor or increase the sensitivity of the estrogen receptor to the extent that the hormone balance in the body can be restored and osteoporosis can be cured or relieved [38-42]. MOP compound has been demonstrated to be effective in treating rats in an osteoporosis model. Its mechanism of action is probably through improving the body's intrinsic regulatory mechanism so as to mobilize, activate, and restore the body's intrinsic functions and overall regulation, thereby, to relieve or cure osteoporosis, as suggested by the theory of Traditional Chinese Medicine.

The experiments have shown that *Morinda officinalis* capsule plays a role in therapy on rats with osteoporosis (ovariectomized for 12 weeks) which qualifies it for the development of new anti-osteoporosis drug. Its pharmacological mechanism on osteoporosis requires further study.

**Acknowledgements**

We thank the Healn (Chongqing) Pharmaceutical Co., Ltd. for providing MOP fluid extracts, the Third Affiliated Hospital of Third Military Medical University for providing the bone mineral density testing, the College of Resources and Environment, Southwest University for providing bone mineral content testing using atomic absorption spectrophotometer, the Biomechanics Laboratory, School of Biomedical Engineering, Chongqing University for providing biomechanics properties testing, the Third Military Medical University and Google Biotechnology Co., Ltd. for providing paraffin section preparation and bone image analysis.

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Cite this article: LI Ye, LÜ Shan-Shan, TANG Gui-Ying, HOU Min, TANG Qing, ZHANG Xiao-Na, CHEN Wei-Hai,
CHEN Gang, XUE Qiang, ZHANG Cong-Cong, ZHANG Ji-Fen, CHEN Yi, XU Xiao-Yu. Effect of Morinda officinalis