Equisetum Arvense (Horsetail): The Potential Effect of Natural Herb on Osteoporosis

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Abstract

This study aimed to; study the effect of Equisetum Arvense (horsetail) as natural herb on osteoporosis female rats. Thirty female albino rats (Sprague Dawley Strain) weighting an average of (150±5g) used in this study. The rats were divided into two main groups. The first main group (6 rats) was fed on basal diet, as a (control negative group). The second main group (24 rats) fed on basal diet and received oral prednisone acetate (4.5 ml/kg body weight/day twice a week) to establish osteoporotic models. The second main group was divided into four subgroups (6 rats each). The first subgroup fed on basal diet as a control positive group. The second, third and fourth subgroups fed on basal diet containing 2.5%, 0.5% and 7.5% horsetail.

Results indicated that treating osteoporosis groups with different levels of E. Arvense (horsetail) improved calcium and phosphorus on (serum and femur bone), bone mineral density (BMD), bone mineral concentration (BMC), kidney functions (uric acid, urea nitrogen and creatinine), liver enzymes (AST, ALT and ALP) Glucose and thyroid hormones (T₃, T₄ and TSH), particularly, the group which was treated with the high levels from horsetail 7.5%.
Equisentum arvense L. was able to produce significant osteoporosis changes when compared to the control group in most parameters.

**Introduction**

Osteoporosis results from reduced bone mass and disruption of the micro-architecture of bone, giving decreased bone strength and increased risk of fracture, particularly of the spine, hip, wrist, humerus and pelvis. The risk of fractures increases steeply with age and most of those affected are over 75 (Poole & Compston, 2006). Various factors resulting in bone loss are age; a chief single predator for osteoporosis, smoking, alcohol excess, calcium and vitamin D deficiency, low weight and muscle mass, anticonvulsants and corticosteroid. Bone loss can also be due to comorbid conditions such as rheumatoid arthritis (Javaid & Holt, 2008). Osteoporosis may also occur due to a number of diseases or treatments including alcoholism, anorexia, hyperthyroidism, surgical removal of the ovaries, and kidney disease (Poole and Compston, 2006).

Osteoporosis is a global problem in both men and women which is increasing in significance as the population of the world is growing in numbers and ageing. In old women, after menopause ageing results in deficiency of estrogen hormone, resulting in the elevation of bone resorption through osteoclastogenesis and is the most common cause of osteoporosis (Rodan & Martin, 2000).

Study by Abdollahi et al., (2005) reported that one of the factors significantly influencing bones mass is oxidative stress. Worldwide, lifetime risk for osteoporotic fractures in women is 30-50% and the same in men is 15-30% (Badole & Kotwal, 2014).
the other hand, thyroid hormones have direct catabolic effect on bone mineral homeostasis, leading to increased bone mineral resorption and calcium loss through kidneys (Dhanwal, 2011).

A significant numbers of patients die from complications during the first year following the fracture; half of those who survive will never be able to move around without the help of walking aids and wheelchairs (Brouns & Vermeer, 2000).

Several studies have support calcium supplementation in order to decrease the risk of vertebral fracture by approximately 35% and non-vertebral fractures by approximately 25%, daily supplementation of calcium (500–1200 mg) along with vitamin D is the regimen best supported by the evidence (Shea et al., 2002). Additionally, a 2013 review found that nutrition has an important and complex role in maintenance of good bone, a several micronutrients should be supplemented in addition to calcium and vitamin D as part of the management of osteoporosis, a lone calcium supplementation cannot reverse osteoporosis (Price et al., 2013).

The genus Equisetum consists of 30 species, Equisetum arvense L., commonly known as horsetail, is a bushy perennial herb. The name "horsetail" is often used for the entire group, because of its resemblance to a horse’s tail (Amit et al, 2013). The buds are eaten as a vegetable in Japan and Korea in spring time (Huh & Han, 2015). Study by Pereira et al., 2012 showed that hydro-methanolic extract of E. arvense promoted osteoblastic. The plant is reported to contain a number of flavonoids, alkaloids, minerals, phenolic petrosins, triterpenoids, saponins, phytosterols, which can be used medicinally (Sandhu et al., 2010).
E. arvense contains highest percentage of silica in the whole plant kingdom (Badole & Kotwal, 2014); it is an important mineral required for bone mineralization (Jugdaohsingh, 2007). Many studies have shown a positive correlation between silica and bone mineral density (BMD), silicon had increased BMD for men, premenopausal women, and postmenopausal women on hormone replacement therapy (Jugdaohsingh et al., 2004 & Macdonald et al., 2005). Rats deprived in silicon show decreased bone hydroxyproline and alkaline phosphatase activity (Seaborn & Nielsen 1994). In addition, European Food Safety Authority (2004) concluded that silicon had an effect on collagen to make the bone matrix more calcifiable.

Recommended daily requirement for silica has not yet been established, but according to Jugdaohsingh, 2007 an intake of 10mg/day was associated with significantly increased bone mineral density in men and pre-menopausal women. Two main sources of silica are drinking water and plant fibers, the aboveground parts of horsetail - fresh or dried - are used for medicinal purposes, sterile stems are reported to contain silicic acid and silicates (5-8%), potassium (1.8%), calcium (1.3%), aluminium, sulphur, magnesium and manganese (Sandhu et al., 2010). Additionally, Labun et al. (2013) found that silicon content in plants ranged from 21.11 g·kg\(^{-1}\) to 32.80 g·kg\(^{-1}\), the location and the year in terms of silicon content were not statistically significant.

Osteoporosis is one among many diseases that horsetail extract benefits (Sandhu et al., 2010). Horsetail is known for its anti-inflammatory, antinociceptive (Do Monte et al., 2004) antioxidant and antiproliferative (Cetojević-Simin et al., 2010) antimicrobial (Garcia et al., 2011), hepatoprotective (Oh et al., 2004), anti-diabetic
(Safiyyeh et al., 2007) coagulant and astringent activity (Amit et al, 2013).

Similar to most dietary supplements, Horsetail is safe when taken short term and in moderation, Badole & Kotwal (2014) summarized some safety precautions while using E. arvense. Horsetail is not recommended for young children, Pregnant and breastfeeding women; because contains traces of nicotine. In addition, E. arvense along with other diuretics has been reported to cause hypokalemia. Chronic use of this herb causes deficiency of Vitamin B1 due to its thiaminase activity, thus daily supplement of vitamin B complex is advised.

In the present study, we examined the potential effect of E. arvense as a natural herb on osteoporosis in female albino rats.

**Materials And Methods**

**Materials:**

- Prednisone acetate, casein, vitamins, minerals, cellulose and choline chloride were purchased from El-Gomhoeya Company, Cairo Egypt.
- Thirty female albino rats (Sprague Dawley Strain) were obtained from Helwan farm.
- Horsetail herb was purchased from local market, Cairo - Egypt.
Methods:

Experimental design

Female rats (150 ± 5g) were kept in individual stainless steel cages under hygienic conditions and fed one week on basal diet for adaptation in adlibitum. The basal diet in the preliminary experiment consists of 14% casein (protein > 80%), corn oil 4%, cellulose 5%, vitamin mixture 1%, salt mixture 3.5%, choline chloride 0.25% and the remainder is corn starch (Reeves et al., 1993). Vitamin composition of the diets prepared according to (A.O.A.C. 1975).

After this period, the rats divided into two main groups, as a following: The first main group (6 rats) fed on basal diet, as a control negative group, the rats in basal control group were given oral normal saline (4.5 ml/kg body weight/ day). The second main group (24 rats) received oral prednisone acetate (4.5 ml/kg body weight/day twice a week) to establish osteoporotic models according to Liao et al., (2003). The second main group was divided into four subgroups (6 rats each). The first subgroup fed on basal diet as a control positive group. The second subgroups fed on basal diet containing 2.5% horsetail, the third subgroups fed on basal diet containing 0.5% horsetail. The fourth subgroup fed on basal diet containing 7.5% horsetail. During the experimental period (35 days), the diets consumed and body weights were recorded twice weekly.

Biochemical Studies

At the end of the experiment, the animals were fasted overnight, then the rats were anaesthetized and sacrificed, and blood samples were collected from the aorta. The blood samples were centrifuged and serum was separated to estimate some biochemical parameters, i.e. calcium according to (Baginski, 1973), phosphor (Yee, 1968), Femur bone calcium, and phosphor measured by using...
atomic absorption, uric acid (Fossati et al., 1980), urea nitrogen (Patton and Crouch 1977), creatinine (Bartels and Bohmer, 1971), serum glucose (Trinder, 1959) aspartate amino transferase (AST) and alanine amino transferase (ALT) (Reitman and Frankel, 1957), alkaline phosphatase (ALP) (Kind and King, 1954).

Bone mineral density (BMD) and bone mineral concentration (BMC) were measured in National Research Center, Osteoporosis Unit, by dual energy x-ray absorptiometry (DEXA) as classification of the World Health Organization, 1994. Liver and kidney were separated from each rat and weighted to calculate organs to body weight %.

The obtained data was analyzed statistically for standard deviation and one way ANOVA test (Steel and Torri, 1980).

Results

Minerals composition in horsetail (Equisetum Arvense).

In the present study, horsetail analyzed for its minerals content by Ministry of Education, Culture, Sports, and Science & Technology, 2015 and demonstrated in table (1). The percent content of sodium calcium, phosphorus, magnesium, potassium, Manganese, zinc and iron were 6.90, 57.53, 108.17, 37.97, 736.47, 0.253, 1.26 and 2.41 respectively.

Effect of some levels of horsetail (E. Arvense) on growth parameter and tissue weight of female rats suffering from osteoporosis.

The comparison between the values of feed intake of control negative group (-ve), control positive group (+ve) and the treated
groups with the three levels of horsetail (E. Arvense) is summarized in table (2). Value of feed intake in each of the negative control group fed on basal diet increased significantly p<0.05, as compared to the positive control group which fed on the same diet and treated with prednisone acetate (4.5 ml/kg body weight/day twice a week orally) (18.105± 1.603 vs. 12.803± 1.912 g/ day), respectively. The results in this table revealed that, all treated groups showed non-significant changes in food intake, as compared to the positive control group.

BWG% of osteoporosis female rats (PC) was significantly decreased (p<0.05) compared to healthy group (NC). Only osteoporosis group that treated with 2.5% horsetail showed a significant increase p<0.05 in BWG%, while the other treated groups (5% and 7.5% horsetail) showed non-significant changes, as compared to the positive control group.

Statistical analysis showed a significant decrease in Femur bone weight / body weight% for PC group compared with NC group at (p<0.05). Osteoporotic rats fed on basal diets containing different levels of horsetail (2.5%, 5% and 7.5%), showed a significant increase p<0.05 in femur bone weight/ body weight%, when compared with osteoporosis group (CP). Osteoporotic group of rats fed on basal diet containing 7.5% horsetail, recorded the best results for femur bone / body weight%.

The results in the same table (2) revealed that weight of liver and kidney as a percent of body weight were changed, results showed a significant increase p< 0.05 in liver and kidney weight / body weight % for PC group compared to NC group. Treating female rats which suffering from osteoporosis with the two levels of horsetail (5% and 7.5%) led to significant improvement in liver and kidney
weights/body weights %, while group of rats which treated with 2.5% horsetail showed non-significant changes in these organs, as compared to PC group.

**Effect of some levels of horsetail (E. Arvense) on Calcium and Phosphorus in serum and Femur bone, bone mineral density (BMD) and bone mineral concentration (BMC) of female rats suffering from osteoporosis.**

As presented in Table (3), serum Ca and serum P (mmol/L) for PC group showed a significant decrease p<0.05, compared to NC group. All groups which were fed on basal diet containing horsetail (E. Arvense) showed significant increase in the mean values of serum Ca and Serum P, compared with PC group. Feeding rats which were suffering from osteoporosis on diet containing 7.5% led to significant increase in serum Ca and serum P, as compared to other tested groups, this treatment increased serum Ca and serum P by about 34.5% & 33.7% than that of the positive control group, respectively.

Data observed that there were significant decreases p<0.05 in femur bone Ca and Femur bone P (g%) for PC group, as compared to NC group. Groups which were fed on basal diet containing 5% and 7.5% horsetail showed significant increase in the mean values of femur bone (Ca and P), as compared with PC. Feeding osteoporotic group on basal diet containing the lowest level of horsetail (2.5%) showed non-significant changes in the mean values of femur bone (Ca and P), as compared to PC. Ratios of increase femur bone Ca and P percent were about 21% & 44.2% respectively, when treated osteoporosis rats with 7.5% of horsetail, compared with PC group.
The most common, considered standard for osteoporosis screening is known as “dual energy X-ray absorptiometry” (DEXA). Results in the same table (3) showed that, there were a significant decreases at p<0.05 in values of bone mineral density (BMD) and bone mineral concentration (BMC) for PC group, compared to NC group. Addition of some levels of horsetail 2.5%, 5% and 7.5% to the diet resulted in significant increase p<0.05 in the mean values of bone mineral density (BMD) and bone mineral concentration (BMC), compared to PC group, especially with high levels 7.5% horsetail which recorded non- significant changes with the NC group. This treatment 7.5% horsetail improved BMD and BMC, by about 70.1% & 69.6% than that of the positive control group, respectively. This result confirms the results of Femur bone weight /body weight %.

Effect of some levels of horsetail (E. Arvense) on Liver enzymes and glucose of female rats suffering from osteoporosis.

Data in table (4) demonstrated that the mean values of serum AST, ALT and ALP (U/L) for PC group showed a significant increase at p<0.05, compared to NC group. Values of serum AST, ALT & ALP (μ/l) decreased gradually with increasing the level of horsetail, except, serum ALT in group of rats which treated with 2.5% horsetail, as compared to PC group.

The best results of liver enzymes were noticed in group of rats fed on basal diet containing a highest level of horsetail 7.5%. Concerning of Glucose (mg/dl), results observed that rats which suffer from osteoporosis in PC group had higher mean values than that of NC group. Glucose of all treated groups with 2.5%, 5% and 7.5% of horsetail recorded significant decrease p<0.05, as compared to PC group. Glucose in serum recorded high reduction 29.33% in group of rats fed on basal diet containing 7.5% of horsetail.
Effect of some levels of horsetail (E. Arvense) on kidney functions of female rats suffering from osteoporosis.

As observed in table (5), uric acid, urea nitrogen and creatinine (mg/dl) significantly increased p<0.05 for PC group in comparison with NC group. Treating osteoporotic female rats with basal diet containing 5% and 7.5% of horsetail had lower mean values in uric acid, urea nitrogen and creatinine than that of PC group. While diet containing low level of horsetail 2.5% showed non-significant difference in the mean values of uric acid, urea nitrogen and creatinine, as compared to PC group.

Effect of some levels of horsetail (E. Arvense) on thyroid hormones of female rats suffering from osteoporosis.

Results in Table (6) revealed that triiodothyronine T3 (ng/dl) and thyroxine T4 (µg/dl) from female rats suffering from osteoporosis increased significantly p<0.05 in the positive control group (PC), compared to the negative control group (NC). Feeding osteoporotic rats on basal diet containing some levels of horsetail 2.5%, 5% and 7.5%, showed significant decrease P<0.05 in serum triiodothyronine T3 & thyroxine T4, as compared to the PC group.

The obtained results in the same table (6) indicated that, thyroid–stimulating hormone TSH of osteoporosis female rats (PC) had non-significant changes compared to healthy group (NC). Treating osteoporosis groups with different ratios 2.5%, 5% and 7.5% of horsetail, showed non-significant changes in serum TSH, as compared to both PC & NC groups.
Osteoporosis is a silent epidemic of the 21st century, which presently in the UK results in over 200,000 fractures annually at a cost of over one billion pounds (Jugdaohsingh, 2007). Osteoporosis can be prevented, diagnosed and treated before fractures occur. Importantly; even after the first fracture has occurred, there are effective treatments to decrease the risk of further fractures. Prevention, detection and treatment of osteoporosis should be a mandate of primary care providers (Cosman et al., 2014).

World health organization (WHO) notes that 74% of the plant derived medicines are used in modern medicine, in a way that their modern application directly correlates with their traditional use as herbal medicines by native cultures (Kumar and Parmar, 2003). Huh and Han (2015) study that looked at the antioxidative and antiproliferative activity of horsetail extract found that horsetail exhibited significant free radical scavenging. Horsetail extracts inhibited cell growth, which prevents the proliferation of human tumour cells. Researchers concluded that horsetail extracts are potent sources of natural antioxidant, with other potential horsetail benefits as phytochemicals.

Revilla et al., (2002) demonstrated that the water extract of the aerial parts of horsetail shows a hypoglycemic effect in type 2 diabetic patients starting 90 min after its. Horsetail shows protective benefits on liver cells in a culture study; Hepatoprotective and free radical scavenging activities of phenolic petrosins and flavonoids isolated from E. Arvense (L) extract reported by Oh et al. (2004). Similar finding reported by Soleimani et al., (2007a) revealed that
the methanolic extract of Equisetum arvense was analysed for its antidiabetic activity in streptozotocin induced diabetic rats. The results showed methanolic extract of Equisetum arvense produced a significant Antidiabetic activity at doses 50 and 250 mg/kg -1/b.wt.

The current study demonstrated the efficacy of different levels of horsetail (Equisetum Arvense) on liver enzymes and glucose; they led to significant decrease p< 0.05 in serum (AST, ALT & ALP) and glucose. The high level of horsetail 7.5% recorded the best results.

Researchers from University of Balearic Islands Spain concluded that the beneficial effects caused by horsetail infusions on urolithiasis could be attributed to some disinfectant action, and tentatively to the presence of saponins from a study of Wistar rats. Specifically, some solvent action can be postulated with respect to uric stones or heterogeneous uric nucleus (Grases, 1994).

Administration of E. arvense to streptozitocin-induced diabetic rats for month lowers the level of serum glucose, urinary creatinine and microalbuminuria. Soleimani et al., (2007b). In this investigation, 7.5% of horsetail showed the higher reduction in kidney function, compared to other tested groups which suffering from osteoporosis.

Bone metabolism involves a complex balance between the deposition of matrix and mineralization and resorption. There is now good evidence that dietary components and herbal products can influence these processes, particularly by inhibiting bone resorption, thus having beneficial effects on the skeleton (Putnam et al., 2007).

It is well known that calcium and phosphorus are widely accepted as phenotype markers for bone formation (Evans et al., 1990). Price et al., (2013) demonstrated that dietary supplementation
with calcium and vitamin D decreases the risk of fractures and improves the effectiveness of pharmacological management. Study by Heaney (2000) firmly establishes that high calcium intakes promote bone health. Many essential nutrients behave synergistically, for example, vitamin D and vitamin K in the production and activation of osteocalcin. Vitamin D stimulates the production of osteocalcin, while vitamin K carboxylates osteocalcin for improved bone toughness (Dhanwal 2011 & Abdollahi et al., 2005).

A few European clinical studies have determined that fractured bones heal much more quickly when horsetail is taken. The incidence of osteoporosis is, likewise, more greatly reduced when some horsetail is added to the diet (Sandhu et al., 2010). Kervran (1998) reasoned that; horsetail is rich in nutrients, especially high in silicon. It is the richest plant source of this element, in the form of the compound monosilicic acid (10%) which the body can readily use. Silica, which has a valuable astringent, or binding, quality, facilitates the absorption of calcium by the body; calcium nourishes nails, hair, bones and connective tissues, helps prevent osteoporosis and can be used to treat bone fractures.

In studies on silica and bone formation; X-rays showed very rapid healing effects of horsetail on the broken bones just 10 and 17 days after the break, and the very slow rate of healing in control rats who received only calcium. In the rats receiving horsetail, after just 17 days the area where the bone was broken was completely healed and actually more solid than the rest of the bone, whereas, in those receiving calcium the healing was just beginning. General recommendations vary from 500 mg of horsetail per day for maintenance up to 1.5 to 6 grams for healing broken bones or damaged connective tissue such as torn ligaments (Kervran, 1998).
In the present study, parameters of both serum Ca & P and Femur bone ca & P were improved in the high level of horsetail 7.5%.

According to the WHO diagnostic classification, osteoporosis is defined by BMD at the hip or lumbar spine. The risk of fractures is highest in people with the lowest BMD; it is assessment by dual-energy x-ray absorptiometry (DXA) is the gold standard to diagnose osteoporosis (National Osteoporosis Foundation, 2013). Seaborn & Nielsen 1994 found that silica is necessary for proper skeleton development, silica deficiency is a precursor to calcium deficiency and thus it leads to loss of tissue elasticity, silica helps in the absorption and use of calcium by the body. Pereira et al., 2012 studied the effect of hydro-methanolic extract of E. arvense on behaviour of human bone marrow cells for osteoblastic modulation in vitro. The results showed that hydro-methanolic extract promoted osteoblastic response while preventing risk of infection at the biomaterial bone interface by local delivery system. More and more research evidence shows that through a transmutation process, silica is turned into calcium when it is needed (Kaufmann, 1995). As indication in that study, bone mineral density (BMD) and bone mineral concentration (BMC) enhanced and showed non-significant changes, as compared to healthy group (NC).

Thyroid hormones regulate skeletal development, acquisition of peak bone mass and adult bone maintenance. Abnormal thyroid status during childhood disrupts bone maturation and linear growth, while in adulthood it results in altered bone remodeling and an increased risk of fracture (Wojcicka et al., 2013). Thyroid hormone directly stimulates bone resorption in organ culture; this action may be mediated by a nuclear triiodothyronine (T3) receptor which has been found in rat and human osteoblast cell lines and in osteoclasts.
derived from an osteoclastoma (Abu et al., 1997). Experimental studies in mice lacking either the TR-alpha or TR-beta receptor suggest bone loss is mediated by TR-alpha (Bassett et al., 2007). Thus, thyroid hormone may affect bone calcium metabolism either by a direct action on osteoclasts, or by acting on osteoblasts which in turn mediate osteoclastic bone resorption (Britto et al., 1994). Thyroid-stimulating hormone (TSH) may also appear to have a direct effect on bone formation and bone resorption, mediated via the TSH receptor on osteoblast and osteoclast precursors; however, bone loss appeared independent of TSH levels in the experiments with mice lacking specific TR isoforms (Abe et al., 2003).

Furthermore, population studies indicate that both thyroid hormone deficiency and excess are associated with an increased risk of fracture (Wojcicka et al., 2013). In that study, it is observed that levels of horsetail 2.5%, 5% and 7.5% displayed a decrease in serum triiodothyronine T₃ & thyroxine T₄, as compared to the PC group. The levels of thyroid–stimulating hormone (TSH) were stable in all treated groups compared to PC & NC groups; it means no problems affect the secretion of thyroid gland. That result confirms the improving in serum and Femur bone calcium.

**CONCLUSION**

Basically there are two strategies for osteoporosis prevention, at first; increase the peak bone mass in adolescents and adults. Second; reduce the rate of bone loss after the peak bone mass has been achieved at the age of about 30 years. On the other hand, data indicates that oral treatment with graded doses of Equisentum arvense L. was able to produce significant osteoporosis changes when compared to the control group in most parameters.
**Table (1):** Mineral composition in horsetail (mg/100g dry-weight basis).

<table>
<thead>
<tr>
<th>Minerals (mg/100 g) dry weight basis</th>
<th>Na</th>
<th>Ca</th>
<th>P</th>
<th>Mg</th>
<th>K</th>
<th>Mn</th>
<th>Zn</th>
<th>Fe</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>6.90</td>
<td>57.53</td>
<td>108.17</td>
<td>37.97</td>
<td>736.47</td>
<td>0.253</td>
<td>1.26</td>
<td>2.41</td>
</tr>
</tbody>
</table>

**Table (2):** Effect of some levels of horsetail (E.Arvense) on feed intake, body weight gain%, femur bone and organs weight / body weight % of female rats infected with osteoporosis.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Feed intake g/day/each rat</th>
<th>BWG%</th>
<th>Femur bone weight / body weight %</th>
<th>Organs weight / body weight%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>liver</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>kidney</td>
</tr>
<tr>
<td>Control (NC) (-ve)</td>
<td>18.105 ± 1.603</td>
<td>18.903 ± 1.291</td>
<td>1.581 ± 0.063</td>
<td>2.551 ± 0.127</td>
</tr>
<tr>
<td>Control (PC) (+ve)</td>
<td>12.803 ± 1.912</td>
<td>8.623 ± 1.825</td>
<td>1.129 ± 0.081</td>
<td>3.426 ± 0.106</td>
</tr>
<tr>
<td>2.5% horsetail</td>
<td>13.712 ± 1.257</td>
<td>11.335 ± 1.707</td>
<td>1.219 ± 0.074</td>
<td>3.317 ± 0.051</td>
</tr>
<tr>
<td>5% horsetail</td>
<td>14.226 ± 1.153</td>
<td>10.120 ± 1.308</td>
<td>1.305 ± 0.056</td>
<td>3.070 ± 0.055</td>
</tr>
<tr>
<td>7.5% horsetail</td>
<td>14.423 ± 1.167</td>
<td>7.575 ± 2.212</td>
<td>1.408 ± 0.048</td>
<td>2.796 ± 0.075</td>
</tr>
</tbody>
</table>

- Values are expressed as mean ± SD
- Significant at p<0.05 using one way ANOVA test.
- Values which have different letters in each column differ significantly, while those with have similar or partially are not significant.
**Table (3):** Effect of some levels of horsetail (E.Arvense) on Serum Ca & P, Femur bone Ca & P, BMD and BMC of female rats infected with osteoporosis.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Serum Ca</th>
<th>Serum P</th>
<th>Femur bone Ca</th>
<th>Femur bone P</th>
<th>BMD</th>
<th>BMC</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>mmol/L</td>
<td>g%</td>
<td>g/cm²</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Groups</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control (-ve) (NC)</td>
<td>3.299 a ± 0.067</td>
<td>2.417 a ± 0.078</td>
<td>93.149 a ± 2.975</td>
<td>51.483 a ± 2.908</td>
<td>0.161 a ± 0.006</td>
<td>0.287 a ± 0.023</td>
</tr>
<tr>
<td>Control (+ve) (PC)</td>
<td>2.327 e ± 0.084</td>
<td>1.695 e ± 0.079</td>
<td>58.928 d ± 2.309</td>
<td>31.553 d ± 2.322</td>
<td>0.097 c ± 0.018</td>
<td>0.158 d ± 0.031</td>
</tr>
<tr>
<td>2.5% horsetail</td>
<td>2.570 d ± 0.072</td>
<td>1.877 d ± 0.063</td>
<td>60.691 d ± 2.391</td>
<td>33.699 d ± 3.082</td>
<td>0.136 b ± 0.016</td>
<td>0.232 c ± 0.014</td>
</tr>
<tr>
<td>5% horsetail</td>
<td>2.841 c ± 0.079</td>
<td>2.094 c ± 0.116</td>
<td>66.198 c ± 2.742</td>
<td>39.909 c ± 2.961</td>
<td>0.155 a b ± 0.017</td>
<td>0.247 b c ± 0.012</td>
</tr>
<tr>
<td>7.5% horsetail</td>
<td>3.130 b ± 0.100</td>
<td>2.266 b ± 0.074</td>
<td>71.083 b ± 4.212</td>
<td>45.484 b ± 1.926</td>
<td>0.165 a ± 0.014</td>
<td>0.268 a b ± 0.015</td>
</tr>
</tbody>
</table>

- BMD: bone mineral density
- BMC: bone mineral concentration
- Values are expressed as mean ± SD
- Significant at p<0.05 using one way ANOVA test.
- Values which have different letters in each column differ significantly, while those with have similar or partially are not significant.
**Table (4):** Effect of some levels of horsetail (E.Arvense) on serum glucose and liver enzymes of female rats infected with osteoporosis.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>AST U/L</th>
<th>ALT U/L</th>
<th>ALP U/L</th>
<th>Glucose mg/dl</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control (-ve) (NC)</td>
<td>69.925 ± 3.611</td>
<td>28.039 ± 2.454</td>
<td>82.459 ± 2.677</td>
<td>74.993 ± 4.070</td>
</tr>
<tr>
<td>Control (+ve) (PC)</td>
<td>139.854 ± 4.172</td>
<td>62.115 ± 6.336</td>
<td>185.413 ± 4.682</td>
<td>148.537 ± 3.397</td>
</tr>
<tr>
<td>2.5% horsetail</td>
<td>133.948 ± 3.537</td>
<td>57.411 ± 4.353</td>
<td>178.195 ± 4.477</td>
<td>134.890 ± 3.406</td>
</tr>
<tr>
<td>5% horsetail</td>
<td>119.207 ± 4.348</td>
<td>48.535 ± 3.249</td>
<td>165.180 ± 5.050</td>
<td>119.346 ± 8.245</td>
</tr>
<tr>
<td>7.5% horsetail</td>
<td>107.899 ± 3.211</td>
<td>40.320 ± 2.752</td>
<td>152.145 ± 2.269</td>
<td>104.967 ± 4.416</td>
</tr>
</tbody>
</table>

- Values are expressed as mean ± SD
- Significant at p<0.05 using one way ANOVA test.
- Values which have different letters in each column differ significantly, while those with have similar or partially are not significant.
**Table (5):** Effect of some levels of horsetail (E.Arvense) on serum kidney function of female rats infected with osteoporosis.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Uric acid</th>
<th>Urea nitrogen</th>
<th>Creatinine</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>mg/dl</td>
<td>mg/dl</td>
<td>mg/dl</td>
</tr>
<tr>
<td>Control (-ve) (NC)</td>
<td>1.481&lt;sup&gt;d&lt;/sup&gt; ± 0.057</td>
<td>30.410&lt;sup&gt;d&lt;/sup&gt; ± 1.621</td>
<td>0.518&lt;sup&gt;d&lt;/sup&gt; ± 0.043</td>
</tr>
<tr>
<td>Control (+ve) (PC)</td>
<td>2.475&lt;sup&gt;a&lt;/sup&gt; ± 0.184</td>
<td>60.370&lt;sup&gt;a&lt;/sup&gt; ± 5.113</td>
<td>1.516&lt;sup&gt;a&lt;/sup&gt; ± 0.080</td>
</tr>
<tr>
<td>2.5% horsetail</td>
<td>2.297&lt;sup&gt;a&lt;/sup&gt; ± 0.203</td>
<td>57.044&lt;sup&gt;a&lt;/sup&gt; ± 4.662</td>
<td>1.462&lt;sup&gt;a&lt;/sup&gt; ± 0.057</td>
</tr>
<tr>
<td>5% horsetail</td>
<td>2.026&lt;sup&gt;b&lt;/sup&gt; ± 0.161</td>
<td>50.838&lt;sup&gt;b&lt;/sup&gt; ± 4.332</td>
<td>1.184&lt;sup&gt;b&lt;/sup&gt; ± 0.020</td>
</tr>
<tr>
<td>7.5% horsetail</td>
<td>1.794&lt;sup&gt;c&lt;/sup&gt; ± 0.074</td>
<td>43.868&lt;sup&gt;c&lt;/sup&gt; ± 3.369</td>
<td>0.883&lt;sup&gt;c&lt;/sup&gt; ± 0.042</td>
</tr>
</tbody>
</table>

- Values are expressed as mean ± SD
- Significant at p<0.05 using one way ANOVA test.
- Values which have different letters in each column differ significantly, while those with have similar or partially are not significant.
Table (6): Effect of some levels of horsetail (E.Arvense) on Serum T₃, T₄ and TSH of female rats infected with osteoporosis.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Groups</th>
<th>T₃ ng/dl</th>
<th>T₄ µg/dl</th>
<th>TSH µ IU/ml</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Control (-ve) (NC)</td>
<td>70.342 ± 3.538</td>
<td>2.274 ± 0.121</td>
<td>0.764 ± 0.092</td>
</tr>
<tr>
<td></td>
<td>Control (+ve) (PC)</td>
<td>95.688 ± 4.016</td>
<td>3.102 ± 0.085</td>
<td>0.835 ± 0.077</td>
</tr>
<tr>
<td></td>
<td>2.5% horsetail</td>
<td>89.201 ± 4.146</td>
<td>2.922 ± 0.861</td>
<td>0.809 ± 0.105</td>
</tr>
<tr>
<td></td>
<td>5% horsetail</td>
<td>84.683 ± 3.965</td>
<td>2.766 ± 0.119</td>
<td>0.790 ± 0.091</td>
</tr>
<tr>
<td></td>
<td>7.5% horsetail</td>
<td>80.305 ± 3.291</td>
<td>2.484 ± 0.127</td>
<td>0.774 ± 0.091</td>
</tr>
</tbody>
</table>

- T₃: triiodothyronine,
- T₄: thyroxine,
- TSH: thyroid–stimulating hormone
- Values are expressed as mean ± SD
- Significant at p<0.05 using one way ANOVA test.
- Values which have different letters in each column differ significantly, while those with similar or partially are not significant.
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دليل الحصان: التأثير المحتمل للاعشاب الطبيعية علي هشاشة العظام

رشا محمود عرفه

قسم الاقتصاد المنزلي - كلية التربية النوعية - جامعة دمياط

الملخص العربي

استهدفت الدراسة التعرف علي تأثير عشب ديل الحصان كأعشاب طبيعيه علي اناث الفئران المصابة بهشاشة العظام. استخدم في هذه الدراسة 30 فأر (5±0.5 جم) من نوع الألبينو، تم تقسيمها إلى مجموعتين رئيستين: المجموعة الرئيسية الأولى: (6 فئران) اصحاء تم تغذيتها على الغذاء الأساسي (مجموعة ضابطة سالبة)، المجموعة الرئيسية الثانية: (24 فأر) تم تغذيتها على غذاء اساسي وحقنها عن طريق الفم بمادة إستيتيت بريدنزن (0.5مل/كم من الوزن يوميا). مرتين اسبوعيا لإحداث لاصابة بهشاشة العظام; بعد الحقن تم تقسيمها الي 4 مجموعات فرعية كالتالي: المجموعة (1) تم تغذيتها علي غذاء اساسي (مجموعة ضابطة موجبة)، المجموعات (2، 3، 4) اضيف لغذائهم الأساسي نسبة 2.5، 5، 7.5% من مسحوق عشب ديل الحصان.