# Potential Protective effects of Cauliflower on osteoporosis induced prednisolone acetate

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# Potential Protective effects of Cauliflower on osteoporosis induced prednisolone acetate

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## Abstract

Cauliflower (*Brassica oleracea* L.) was a nutrient – good source of phenolic compounds , minerals, vitamin K and C. The objective of the study was to investigate the effect cauliflower on induce osteoporosis in rats . Thirty female of albino rats (Sprague dawley) weighting 150±5g

Rats classified into five equal groups (6 rats each). The first group kept as negative control group which fed on standard diet only ,while the other four animals groups were administered methyl prednisolone acetate 0.2mg/kg/b.w.t. injected subcutaneously injection 3 times/ week to induce osteoporosis, one of them used as a positive control (+ve) and the other groups fed on standard diet containing 5%, 10% & 15% cauliflower, treatment groups". The study was assigned for seven weeks. The results revealed that all of the treated groups showed significant increase in BMD, BMC, estrogen ,alkaline phosphate, GSH Rd ,CAT, and osteocalcin in comparing to positive control group.

Also, nutritional values and lipid profile have been recorded. Our results demonstrate that cauliflower have beneficial effects on osteoporosis risk factors that extend beyond reduction of the symptoms of arthritis of the bones, called osteoarthritis.

**Keywords**: cauliflower, BMD, BMC, osteocalcin, bone.

## Introduction

The cauliflower *(Brassica oleracea* L.) is on several vegetables in the species *Brassica oleracea* in the genus Brassica, which is in *Brassicaceae* (or Mustard) family. It is an annual plant that reproduces by seed. Typically, only the head is eaten – the edible white flesh sometimes called "curd" (with a similar appearance to cheese crud) (**Vicent *et al.*, 2017**).

The cauliflower head is composed of a white in florescence meristem. Cauliflower heads resemble those in broccoli, which differs in having flower buds ad the edible portion. *Brassica oleracea* also includes broccoli, Brussels sprouts, cabbage, collard green, and Kale, collectively called "cole" crops, though they are of different cultivar groups (**kim ,2004** ) . The world "cauliflower" derives from the Italian cavolfiore, meaning" cabbage flower" **(weise, 1841**).

The ultimate origin of the name is from the Latin words caulis (cabbage) and flos (flower) (**Chiu *et al.*, 2005**) white cauliflower is the most common color of cauliflower, having a contrasting white head (also called "curd"). Surrounded by green leaves (**Vicent *et al.*, 2017**).

According to 2016 data, the world production of cauliflower and broccoli is around 25 million tonnes per year, corresponding to the European production about 10% (**Nakai, 2018**).

Cauliflower is one of the most popular Brassica vegetables and has abroad variety of uses as a dish or as an ingredient is soups or salads, cauliflower is an excellent source of vitamins( $B_1$, $B_2$, $B_3$, $B_5$, $B_6$, C,E , K ) and folic acid as well as dietary fiber, omega- 3 fatty acids, proteins, potassium, phosphours, magnesium manganese and iron (**Florkiewicz *et al.*, 2014).** Cauliflower is also rich in healthy plant metabolites, which include sulfur-containing glucosinolates, flavonoids **(Ahmed and Ali, 2013**).

The world "osteoporosis" is form the Greek terms for "Porous bones" (**king and Brucker, 2011**). Osteoporosis is defined as bone density of 2.5 standard deviation below of a young adult ,This is typically measured by dual – energy X-ray

absorptiometry (**Armas and Recker, 2012**). Bone loss increases after menopause due to lower levels of estrogen Osteoporosis may also occur due to anumber of disease of treatments, including alcoholism, anorexia, hyperthyroidism, kidney disease and surgical removal of ovaries ( **NIAMS, 2014**).

Factors contributing to the increased risk of osteoporosis include physical inactivity, low BMI, Low fat mass, undernourishment (**Biskobing, 2002**). Osteoporosis can easily lead to fractures,

A patient suffering from osteoporosis should have calculated the anticipated fracture risk, or this risk is enhanced, a good nutritional program can prevent osteoporosis and regulate other nutrient deficiency problems and consequently prevent fractures, (**Cooper *et al.*, 2015**)

The diagnosis of osteoporosis can be made using conventional radiography and by measuring the bone mineral density (BMD). The most popular method of measuring BMD is dual – energy X-ray absorptiometry. In addition to the detection of abnormal BMD, the diagnosis of osteoporosis requires investigation into potentially modifiable underlying causes, this may be done with blood tests **(Frost and Thomas, 2012**). The

purpose of this study was to clarify the beneficial effect and nutritional value of cauliflower on osteoporosis in rats.

## Materials and Methods

**a- Materials:**

Cauliflower (*Brassica oleracea*): Cauliflower was purchased from a local market in Zagazig , Egypt.

**Biochemical kits:** All the kits for biochemical analysis of serum lipids total cholesterol (TC), triglycerides (TG), high density lipoprotein cholesterol (HDLc), low density lipoprotein cholesterol (LDLc) and very low density lipoprotein cholesterol (VLDLc). Sexual hormonal, follicle stimulating hormone (FSH), luteinizing hormone (LH), estradiol (E2), progesterone (P4) and testosterone from a Kamiya Biomedical Company, Cairo, Egypt.

**For medical induction of osteoporosis:** Methylprednisolone Acetate © (Depo Medrol 40 mg/ml Injection, Pfizer Co., USA).

**Rats:** Thirty female of albino rats (Sprague Dawley) weighting 150 ±5 g, obtained from of National Research Center, Cairo, Egypt.

## Methods:

**Sampling and sample preparation:** The cauliflower were allowed to ripen off the plant at room temperature within 3-4 days, to allow for optimum processing quality (**Verhiji,1996**), washed with tap water and dried at 60oc under vaccum for approximantely 6-7 hours then crushed to a fine powder and dried at 60oc under vaccum for approximantely 6-7 hours then crushed to a fine powder.

**Chemical analysis:** Fresh weight of homogenized cauliflower (5.0g) was placed in a 400ml tall-form pyrex beaker and 20ml of freshly prepared nutric acid-sulphuric acid-perchloric acid mixture (3:1:1.v/v/v) was added. In order to allow the initial reaction to subside, the beaker was covered with a watch glass and set aside for 1hr. the beaker and its contents were heated on a hot plate and boiling was continued until volume of acid digest was reduced to about 2ml. the beaker was allowed to cool and its contents were carefully filtered into a 50ml volumetric flask and made up to mark with deionized water (Food and Agriculture organization of the United Nations. The nutrient mineral and vitamin concentrations of the sample were determined by the method of atomic absorption spectrophotometry (AAS) using a buck atomic absorption/emission spectrophotometer (Model 210VGB) with air-acetylene flame, coupled to a recorder and using the appropriate hollow cathode lamp. The determination of sodium and potassium was by the flame photometric technique of (**Chapman and Pratt,1978**)

**Biological experiment:** Thirty female albino rats (Sprague Dowely) weighing 150±5 g at the beginning of the study were used. The animals were kept under normal laboratory conditions for five days before experiment and fed one week on standard diet for adaptation according to **(NRC,1995)** and water ad libitum.

**Experimental design:** The rats were fed on the basal diet for 7 days before starting the experiment for adaptation then the rats were classified into five equal groups (n= 6 rats). Negative control (-ve) group fed on the basal diet only while the other four animals groups were administered methylprednisolone acetate dose /rate of 0.2 mg/kg/b.wt. injected subcutaneously injection 3times/week according to (**Rajerdi Kashani, et al. 2009)**, then classified into 4 groups one of them positive control (+ve) "untreated rats" and the other groups, fed on diet containing 5, 10 & 15g/kg/diet cauliflower powder "treatment groups".

Daily feed intake and weekly body weight gain were calculated. Food efficiency ratio (FER) was determined according to the method of (**Chapman *et* al., 1959)**. For examination of bone metabolic markers, blood was taken by puncture of orbital sinus before and after performing the protocol under diethyl ether anesthesia. The blood samples immediately were centrifuged and serum samples were stored at 20ºC until assayed. All rats were killed by overdose chloroform at the end of 7 weeks.

**Bone mineral density (BMD and bone mineral concentration (BMC):** The bone mineral content of lumbar vertebrae was measured in all groups by Energy X-ray absorptiometry (DEXA) using the Norland, small subject, resolution 0.5 × 0.5 mm, speed 60 mm/s, Host scanner 3.2, 3.2 and 1.1. The bone mineral density was expressed as gram of mineral per unit area of bone (gr/cm2) in Department of Surgery, Anesthesiology and Radiology, Faculty of Veterinary Medicine University of Cairo.

**Determination bone calcium and phosphor:** The left femurs and tibias weredried at 80°C for 18 hours to evalute bone weight, and then ashed at 600°C for 24 hours. Ashed samples were dissolved in 4 ml of 0.1 NHCl, and then diluted apppropriately with distilled water for atomization. Bone calcium, phosurous and magnesium were analyzed using flame atomic absorption spectrophotometry (Model 5100 PC, Perkin-Elmer, Norwalk, CT) acorrding to ( **Fraser *et al.* 1986**).

**Biochemical assay:** Serum calcium, ionized calcium and phosphatase in serum were determined by spectrophotometer using commercially available test kit **(Furuichi *et al.*, 2000 and Fishman,1953).** Also, osteocalcin and estrogen and bone alkaline phosphatase (BAP), alkaline phosphatase (AP) and tartarte-resistant acid phosphatase (TRAP) in serum was

determined by enzyme immunoassay **(Owens and Ashby, 2002 and Shoji et al., 2003**).

Total cholesterol (TC), high-density lipoprotein cholesterol (HDL-c) and triglycerides (TG), while (LDL-c and VLDL-c) were calculated according to the equation of **(Richmod 1973, Lopes *et al.*, 1977, Fossati and principle 1982, and Foster and Dunn 1973).** Fatty acid profiles in serum total lipids were analyzed by the method of **(Lepage and Roy 1986).** Serum Reduced glutathione (GSH Rd ), catalase (CAT), and hydrogen peroxide (HP) according to **(Beutler *et al.*, 1963, Aebi 1983 and Aebi 1984)** respectively.

**Statistical analysis:** One-way analysis of variance (ANOVA), Duncan and Dunnett tests used to compare the means values between groups. Avalue of $P \leq 0.05$ was considered statistically significant **(Snedecor and Cochran 1967).**

## Results and Discussion

### Minerals and vitamins composition of cauliflower

From table (1) as regard the minerals composition of cauliflower, calcium, phosphor, potassium, iron and sodium were (22.00, 44.00, 303.00, 0.44 and 30. 0 mg). Also as regard the vitamins properties of cauliflower vit. C, E, K , and A were

(46.40, 0.08, 16.00 mcg and 13.0mg). These results are in agreement with the data obtained by **(FAOSTAT, 2016),** who found that calcium , phosphor and potassium in cauliflower were 24.0 ,47.0 and 320.0 mg respectively .(**Wang *et al* .,2015**) ,they found that calcium, iron , potassium , sodum , vit c , k and E in cauliflower were 22 .0 , 42.0 , 299 , 30 .0 , 48.2 , 15.5 and 0.08 mg respectively.

**Effect of levels cauliflower of body weight gain, feed intake and femur bone / body weight % in rats suffering from osteoporosis**

The results in table (2) revealed that positive control group showed significant decrease in weight gain, feed intake and femur bone in comparing to normal control group. While the other treated groups showed significant increase in weight gain, feed intake and femur bon in comparing to positive control group. The results revealed also, non-significant changes in all parameters between all treated groups.

The results were agreed with (**Kim and Milner, 2005**) they reported the I3C da glucosinolate derivation from cruciferous vegetables can affect adiposity, i.e., it decreased body weight, decreased the weight of epididymal fat mass, and modulated lipid metabolism-associated gene products in mice.

**Effect of levels cauliflower on the bone mineral density (BMD), bone mineral concentration (BMC), calcium, Ionized calcium and phosphorous in rats infected with osteoporosis.**

Data presented in table (3) showed treating osteoporotic rats by cauliflower on BMD. BMD, Ca, Ionized Ca and P in methylprednisolone acetate induced osteoporosis. Bone mineral density

( BMD) and bone mineral concentration( BMC )are normally referring to the amount of mineral matter per square centimeter of bones .Bone density on BMD is used in clinical medicine as an indirect indicator of osteoporosis and fracture risk (**American Academy of family physicians, 2012).**

The positive control group showed significant decrease in BMC, BMD, Ca, Ionized Ca and P in comparing to Normal control. While the other treated groups showed significant increase in in these parameters , as compared to the positive control group.

Bone contains about 99% of body's calcium. Calcium plays a vital role in bone strength and is of redical nutritional importance in osteoporosis, being essential for bone health throughout life (**North American Menopause society, 2006**). The primary role of calcium in body is structural, providing the

rigidity necessary for the skeleton and teeth to perform their function.

Muscle contraction and nerve transmission are two of the many body functions the rely on calcium for activation, also calcium in involved in blood clotting (**Heaney *et al.*, 2005**).Vitamin C an important foundation supplement that is essential in the quest for younger bones. Sources of vitamin C are sometimes harder to come by in the fall and winter months, making cauliflower one of the few seasonal sources of this vital nutrient and plays a direct role in increasing bone density by stimulating osteoblasts and inhibiting osteoclasts,without vitamin C, your body can not produce collagen , the flexible protein matrix that accounts in large part for your bones ability to flex rather than break (**Gabbay, 2010**).

**Effect of Three levels from cauliflower on serum estrogen, osteocalic and alkaline phosphate in rats infected with osteoporosis.**

The results in table (4) revealed that , the positive control group showed significant decrease in estrogen , osteocalin and Alkaline phosphate compared to normal control group. while other treated groups showed significant increase in estrogen,

osteocalin and Alkaline phosphate compared to positive control group.

Treating osteoporotic rats with diet containing 15% cauliflower recorded the best results in all parameters , because this treatment showed non- significant changes in all parameters , as compared to the negative control group .

The vegetables richest in vitamin K are cauliflower, cabbage and spinach **(Plaza and Lamson, 2005**) low plasma vitamin K levels were associated with low bone mineral density at the femoral neck in men and the spine in women without using estrogen replacements (**Booth *et al*; 2004**).

Moreover, higher levels of vitamin K are associated with elevated levels of osteocalcin, therefore, vitamin K helps the body produce osteocalcin, aprotein that helps to improve bone density and reduce fracture risk (**Plaza and Lamson, 2005**)

Cauliflower contains about 40% of six – branched 1,3 – beta- glucan that can change gut microbita (**Ferrario, 2017).**

However, B-glucan is known to improve inflammation and to alleviate inflammatory bowel disease, cancer, atopic dermatitis and arthritis.Cauliflower may prevent the energy, glucose, lipid and bone metabolism disturbances that occur in estrogen-

deficient (**Seong et al., 2017**). In general, the best result was noticed in the group of rats fed on diet containing high level (15%couilflower) as compared to the group of rats fed on diet containing low level (5% cauliflower).

**Effect of levels cauliflower of lipids profile in rats infected with osteoporosis.**

Data presented in table (5) illustrate the effect of treating osteoporotic rats by cauliflower on lipids profile . The positive control group showed significant increase total cholesterol (TC),triglyceride(TG),low density lipoprotein cholesterol(LDL_c),very low density lipoprotein cholesterol (VLDL_c)and decrease in high density lipoprotein cholesterol(HDL_c) compared to normal control group. While other treated groups showed decrease in TC, TG, LDL, V-LDl and increasin HDL compared to positive control group, this results was agreed with (**Marius Lixandru, 2020**) who mentioned that the cauliflower is a great choice if you wish to regulate your blood pressure, reduce cholesterol and inflammation levels, reverse blood vessel calcification, pack up on antioxidants and prevent osteoporosis and bone fractures later on in life.

Our results were in line with (**Faten Fathy Mohammed, 2014**) who found that a number of experiments indicate that

cauliflower added to laboratory animals diet had positive effects on lipid profile. Antioxidants from cauliflower were shown to lower atherogenic cholesterol fraction (LDL + VLDL)concomitantly increasing HDL fraction, which is believed to be beneficial for the prevention of cardiovascular diseases **(Gorinstein *et al.*, 2006).** Also (**Mona and Sorial , 2003)** fond that dietary fiber in cabbage and cauliflower lowered the serum total lipid, total cholesterol, Triglycerides levels and LDL-C than in rats fed on the control diet.

Specially at high level (15% cauliflower) that revealed a marked improvement of these parameters. The best results for all lipoproteins were noticed in the group of rats fed on died containing high level (15%cauliflower) compared to the group of rats fed on diet containing low level (5% cauliflower).

**Effect of level s cauliflower on serum fatty acid levels in rats infected with osteoporosis.**

Data presented in table (6) revealed the effect of treating by cauliflower on serum fatty acid in osteoporotic rats . The positive control group showed decrease in oleic acid and palmitoleic acid compared to normal control group. All levels of cauliflower were able to improvement serum fatty acid significantly compared with untreated group especially at high level 15% cauliflower our

result were in line with **(Scalzo *et al.*, 2007**) who mentioned that the case of cauliflower cultivars, 12 fatty acids were found, the major ones being plamitic, linoleic and linolenic acid, accounting for more than 80% of total fatty acids content. In another study by ***(Kim et al., 2007)*** linolenic acid provides various health benefits

**Effect of levels cauliflower on serum reduced glutathione (GSH Rd), catalase (CAT) and hydrogen peroxide (HP) in rats infected with osteoporosis.**

The results in table (7) revealed that positive control group showed significant decrease in GSH Rd, CAT and HP in comparing to negative control group. While the other treated groups showed significant increase in GSH Rd, CAT and HP in comparing to positive control group.

Sulfur is important for producing glutathione, therefore make sure you're eating sulfur-rich proteins such as beef and fish as well as allium and cruciferous vegetables **(Kaitlyn Berkheiser, 2018).**

In General, the best result was noticed also in group treated with the high level 15% cauliflower.

# Conclusion

In the context of a healthy diet, consumption of cauliflower can fit into a full range of healthy eating plans. Based on the evidence available, the average cauliflower consumption provides for a nutrient and phytochemical dense food consisting of significant level of the following: mineral and vitamin (Calcium, phosphorus, potassium, iron, choline, folate, thiamin, niacin, vitamin C and Vitamin K cauliflower is also rich in healthy plant metabolites, which include sulfur, containing glucosinolates.Cauliflower can be used in many food products to increase nutritional value and also be considered functional foods to delay or protect the risk of osteoporosis because they have clear signs of improved health and bone in blood analysis.

Table (1): Mineral and vitamin composition of Cauliflower (mg/100gm fresh weight basis)

| **Element** | **Composition (mg/100gm)** |
|---|---|
| Ca | 22.00 |
| P | 44.00 |
| K | 303.00 |
| Fe | 0.44 |
| Na | 30.00 |
| Vit. C | 46.40 |
| Vit. E (α-tocopherol) | 0.08 |
| Vit. K | 16.00 µg |
| Vit. A (Retinol) | 13.0 µg |

**Mean under the same column with the different superscript letters means significant defference at p≤0.05**

Table (2): Effect of levels cauliflower of body weight gain, feed intake and femur bone/body weight %in rats infected with osteoporosis

| Groups / Variables | body weight gain % | Feed intake g/day | Femur bone/ body weight % |
|---|---|---|---|
| **Normal control** | 19.11 ± 1.34 [a] | 18.54 ±1.12 [a] | 2.041±0.074 a |
| **Positive control** | 10.69 ±1.32 [c] | 12.05 ±1.17 [b] | 0.615±0.118 c |
| **5% Cauliflower** | 13.02 ±1.61 [b] | 16.38±1.27 [a] | 1.689±0.114 b |
| **10% Cauliflower** | 13.80 ±1.17 [b] | 17.27±1.21 [a] | 1.809±0.079 b |
| **15% Cauliflower** | 14.02 ±1.17 [b] | 17.10±1.71 [a] | 1.926±0.075 b |

**Mean under the same column with the different superscript letters means significant defference at p≤0.05**

Table (3): Effect of levels Cauliflower on BMD, BMC, serum calcium, Ionized Ca and P in rats infected with osteoporosis

| Groups / Variables | BMD | BMC | Ca | Ionized Ca | P |
|---|---|---|---|---|---|
| | (g/cm$^{2)}$ | | (mg/dl) | | |
| **Normal control** | 0.163± 0.006 [a] | 0.297± 0.023 [a] | 7.52± 2.83 [a] | 4.22± 0.31 [a] | 5.06± 1.57 [a] |
| **Positive control** | 0.0087± 0.018 [c] | 0.153± 0.031 [d] | 4.39± 0.22 [c] | 1.64± 0.59 [c] | 2.98± 0.64 [c] |
| **5% Cauliflower** | 0.155± 0.018 [b] | 0.286 ± 0.0045 [b] | 6.18± 0.55 [b] | 2.65± 0.67 [b] | 4.33± 0.35 [b] |
| **10% Cauliflower** | 0,159± 0.014 [ab] | 0.293± 0.0041 [a] | 6.69± 0.45 [a] | 3.64± 0.83 [a] | 4.52± 0.67 [b] |
| **15% Cauliflower** | 0.160± 0.017 [a] | 0.295± 0.0053 [a] | 7.31± 0.46 [a] | 3.94± 0.75 [a] | 4.92± 0.63 [b] |

**Mean under the same column with the different superscript letters means significant defference at p≤0.05**

BMD:Bone Mineral Density. BMC: Bone Mineral Concentration.

Table (4): Effect of levels Cauliflower on serum estrogen, osteocalcin and alkaline phosphatase in rats infected with osteoporosis

| Groups / Variables | Estrogen (mg/dl) | Osteocalin | Alkaline Phosphate (U/L) |
|---|---|---|---|
| **Normal control** | 17.84± 4.11 [a] | 2.98± 0.48 [a] | 93.21± 7.31 [a] |
| **Positive control** | 10.19± 2.45 [c] | 1.58± 1.82 [c] | 33.64± 5.49 [d] |
| **5% Cauliflower** | 16.46± 4.15 [b] | 2.49± 4.12 [b] | 76.65± 6.11 [c] |
| **10% Cauliflower** | 16.99± 4.05 [b] | 2.62± 5.01 [ab] | 87.64± 7.13 [b] |
| **15% Cauliflower** | 17.11± 4.11 [a] | 2.82± 5.13 [a] | 92.44± 7.15 [a] |

**Mean under the same column with the different superscript letters means significant defference at p≤0.05**

Table (5): Effect of levels Cauliflower of lipids profile in rats infected with osteoporosis

| Groups / Variables | TC | TG | HDL-C | LDL-C | VLDL-C |
|---|---|---|---|---|---|
| | mg/dl | | | | |
| **Normal control** | 119.22± 9.26 [e] | 126.74± 11.15 [d] | 35.45± 3.11 [a] | 50.78± 5.16 [e] | 25.17± 3.12 [c] |
| **Positive control** | 187.88± 25.98 [a] | 162.31± 18.19 [a] | 24.39± ±3.01[c] | 154.01 ±6.21 [a] | 32.76 ±4.72 [a] |
| **5% Cauliflower** | 129.89± 13.21 [b] | 135.26± 14.16 [b] | 32.21± 3.11 [b] | 86.15± 7.24 [b] | 27.09± 4.05 [b] |
| **10% Cauliflower** | 125.79± 16.11 [bc] | 132.38± 15.22 [c] | 33.66± ±4.01 [b] | 63.71± 6.71 [c] | 26.60± 4.07 [b] |
| **15% Cauliflower** | 121.18± 14.29 [c] | 129.72± 13.22 [d] | 34.71± 4.33 [a] | 54.27± 6.22 [d] | 26.40± 3.01 [b] |

Means under the same column with the different superscript letters means significant defference at p≤0.05

TC: total cholesterol TG: total triglyceride HDL-c: High density lipoprotein cholesterol

LDL-c: Low density lipoprotein cholesterol

VLDL-c: very low density lipoprotein cholesterol

Table (6): Effect of levels Cauliflower on serum fatty acid levels in rats infected with osteoporosis

| Groups / Variables | Oleic acid | Linoleic acid | Stearic acid | Palmitic acid | Palmitoleic acid |
|---|---|---|---|---|---|
| | mol/100 mol fatty acids | | | | |
| **Normal control** | 1.77 ± 0.27 c | 13.38± 1.22 b | 3.14± 0.23 e | 2.05± 3.11 c | 1.05 ± 0.08 c |
| **Positive control** | 0.49 ± 0.03e | 5.44 ± 1.87 c | 1.41± 0.35 f | 0.98 ± 0.54 e | 0.31 ± 0.02 e |
| **5% Cauliflower** | 5.83 ± 0.15 b | 44.42 ± 3.04 ab | 39.65± 3.01 c | 3.16 ± 0.46 b | 2.75± 0.05 b |
| **10% Cauliflower** | 6.09± 0.09 a | 47.42 ± 3.14 a | 43.29± 3.11 b | 4.26± ±0.11 ab | 2.89 ± 0.05 b |
| **15% Cauliflower** | 6.88± 0.04 a | 49.42 ± 3.18 a | 45.68± 3.12 a | 4.38± 0.13 a | 3. 32 ± 0.06 a |

Means under the same column with the different superscript letters means significant defference at p≤0.05

Table (7): Effect of levels Cauliflower on serum reduced glutathione (GSH Rd), catalase (CAT) and hydrogen peroxide (HP)in rats infected with osteoporosis

| Groups / Variables | GSH Rd (mg/g) | CAT (U/g) | HP (mm/g) |
|---|---|---|---|
| **Normal control** | 1.45± 0.06 [a] | 57.08± 4.48 [a] | 1.21± 0.06 [a] |
| **Positive control** | 0.49± 0.01 [c] | 22.72± 2.32 [c] | 0.34± 0.04 [c] |
| **5% Cauliflower** | 1.26± 0.05 [b] | 49.58± 3.07 [b] | 0.99± 0.04 [b] |
| **10% Cauliflower** | 1.30± 0.05 [b] | 51.92± 4.01 [ab] | 1.09± 0.03 [b] |
| **15% Cauliflower** | 1.41± 4.11 [a] | 54.85± 4.12 [a] | 1.15± 0.05 [a] |

Means under the same column with the different superscript letters means significant defference at $p \leq 0.05$

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# التأثيرات الوقائية المحتملة لنبات القنبيط ضد هشاشه العظام المستحدثه بواسطه خلات البريدنيزولون

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الملخص العربي

يعتبر القرنبيط مصدر جيد وغني بالمواد الغذائية لأحتوائة علي المركبات الفينولية والمعادن وفيتامين K,C وكان الهدف من هذه الدراسة هو معرفة تأثير القرنبيط علي الفئران المصابة بهشاشة العظام .اجريت هذه الدراسة علي ثلاثين من أناث الفئران البيضاء (سبراج داولي) وزنها 150 ± 5 جرام تم تقسيمها إلي خمس مجموعات (6 فئران) المجموعة الأولي (الضابطة السالبة) والتي تغذت علي الوجبة القياسية فقط، بينما المجموعات الاربعة الاخري فتم حقنها بخلات البريدنيزولون(2، ملجم /كجم من وزن الفأر، 3 مرات / أسبوع) للاصابة بهشاشة العظام. وتركت المجموعة الثانية (مجموعة ضابطة) غير معالجة. بينما المجموعات الاخري عولجت بمسحوق بالقرنبيط بنسبة 5% ، 10%، 15% لمدة 7 اسابيع. اوضحت النتائج ان كل من المجموعات المعالجة اظهرت ارتفاع معنوي في مستوي كثافة المعادن في العظام (BMD) ، ومستوي تركيز المعادن بالعظام (BMC) ، وكذلك الكالسيوم والاسيتوكالسين مقارنة بالمجموعة الموجبة، بينما سجلت القيم الغذائية ومستوي الدهون

في الدم ارتفاع معنوي ملحوظ مقارنة بالمجموعة الضابطة الموجبة. ومن خلال هذه النتائج يؤكد ان القرنبيط له اثار مفيدة علي هشاشة العظام والتهاب المفاصل.

الكلمات المفتاحية: كثافة المعادن في العظام ، مستوى تركيز المعادن في العظام ،الاوستيوكالسين ،العظام.