Effect of Feeding Peanut and Sesame Seeds on Bone of Rats Suffering from Osteoporosis

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ABSTRACT:

This study was carried out to determine the effect of two levels of peanut seeds (Arachis hypogaea) and sesame seeds (S. indicum) on rats suffering from osteoporosis. Forty eight female rats weighting an average of (200±10g) were used in this study. The rats were divided into two main groups. The first main group (6 rats) fed on basal diet as a (negative control group). The second main group (42 rats) received oral prednisone acetate (Glucocorticoid)(GC) daily for two weeks to induce osteoporosis, then the second main group divided into seven subgroups as follows: The first subgroup (6 rats) fed on basal diet as a (positive control group), the second and third subgroups fed on basal diet containing (5% and 10%) peanut seeds , respectively. The fourth and fifth subgroups fed on diet containing (5% and 10%) sesame seeds. The sixth and seventh subgroups fed on diet containing (5% and 10%) combination of Sesame and Peanut seeds. Sesame and peanut were added instead of corn starch. The results revealed that peanut seeds, sesame seeds, and combination especially 10% improved the nutritional status, the kidney functions (uric acid, urea nitrogen and creatinine), level of calcium and phosphorus; femur bone calcium and femur bone phosphorus and bone mineral density (BMD), Bone Mineral Concentration (BMC) compared to the positive group. The study recommends eating (peanut, sesame) seeds and food rich in calcium that help in accelerating bone growth and decrease bone fracture incidence.

Key words: *peanut seeds, sesame seeds, osteoporosis.*

INTRODUCTION:

Osteoporosis could be defined as a bone condition which characterized by low bone mass, increased fragility, decreased bone quality, and an increased fracture risk **(Vaytrisalova et al., 2007).** Osteoporosis is a major public health problem **(Riaz et al., 2008)** which affects millions of people around the world and its frequency increases by age **(Jalili et al., 2007).** The perception that osteoporosis is an older person's disease is an erroneous one. Osteoporosis does not discriminate by age; in fact, it is a geriatric disease with an adolescent onset. During childhood and adolescence, much more bone is deposited than withdrawn, so the skeleton grows in both size and density. Up to 90 percent of peak bone mass is acquired by age 18 in girls and by age 20 in boys, which makes youth the best time to "invest" in one's bone health **(Wahba et al., 2010).** Currently, Osteoporosis among the top five conditions causing disability and prolonged hospital stay for older people **(Chan 2006).** Constructed bone mineral density charts for Egyptian women showed that they have a lower bone mineral density compared to their western counterparts **(Sallam et al., 2006).** According to the recent International Osteoporosis Foundation (IOF) report, 28.4% of postmenopausal women in Egypt are estimated to have Osteoporosis **(International osteoporosis foundation 2010) and (Taha 2011).**

Peanuts are legumes and grow underground. Peanut is the fourth important oilseed crop of the world in production after soybean, cottonseed and rapeseed **(Awad et al., 2000),** (*Arachis hypogaea)* contained several active components including flavonoids, phenolic acids, phytosterols, alkaloids, and stilbenes **(Lopes et al., 2011)**. They are similar to tree nuts in form and fat content. Approximately 60% of the energy in nuts and peanuts is derived from fat, and greater than 75% of this fat is unsaturated **(USDA, 2009).** Much of the health benefit attributed to nuts stems from the lipid lowering effects**(Mukudden-Peterse et al.,2005)** of their high unsaturated fatty acid profile as well as actions of other constituents like fiber, vitamin E, and phytochemicals **(Maguire et al.,2004)**. Peanuts

are rich source of Mg, foliate, fiber, atocopherol, Cu, arginine and resveratrol **(Edrees et al., 2008).**

Sesame seed (*Sesamum indicum* L.), another widely consumed seed, is a good ω-6 source. This cropped in both tropical and subtropical countries. India and China are the major producers accounting for 70% of world production **(Arriel et al., 2005).** Sesame oil has advantages over other vegetable oils owing to its high nutritional and therapeutic value. Sesame seeds, which are used in traditional Indian and Chinese medicine, contain 57% highly stable oil **(Reshma et al.,2010).** Due to its high oxidative stability, sesame oil is added to margarines, salads, and frying oils **(Yen and Lay 1990).** Saturated fatty acid content in sesame oil is nearly 14%, comparable to soy and corn oil. Oleic and linoleic acid levels are approximately 45%, which is close to that found in corn, soy, and cottonseed oil **(Embrapa 2001).**

The present study was designed to evaluate the effects of two levels of peanuts seeds and sesame seeds on osteoporosis in female rats.

MATERIALS & METHODS

***Materials*:**

- Casein, vitamins, minerals, cellulose and choline chloride were obtained from El-Gomhorya Company, Cairo, Egypt.- Glucocorticoid (prednisone acetate) was obtained from pharmacy Cairo, Egypt.
- Normal female albino rats (Spraque- Dawely Strain) weighting 200±10g. Were purchased from Helwan
- The basal diet was prepared according to **(Reeves et al., 1993),**
- Experimental Animals station
- Peanut and sesame seeds were obtained from agriculture research center Cairo, Egypt.

Experimental design:

Forty eight female rats (Sprague Dawley Strain) weighting an average (200±10g) were housed in well aerated cages under hygienic condition and fed on basal control diet for one week for adaptation. After

this period, the rats were divided into two main groups, as follows: *The first main group* (6 rats) fed on basal diet, as a negative control group. *The second main group* (42rats) fed on basal diet and oral prednisone acetate (4.5 ml/kg body weight/day) for two weeks to induce osteoporosis according to **(Liao et al., 2003).** The second main group was divided into seven subgroups (6 rats each): *Subgroup (1):* fed on diet as a positive control group. *Subgroups (2 and 3)* fed on diets containing 5% and 10% peanut seeds, respectively. *Subgroups (4 and 5)* fed on diets containing 5% and 10% sesame seeds, respectively. *Subgroups (6 and 7) fed* on diets containing 5% and 10% combination of (peanut and sesame seeds), respectively. Peanut and sesame were replacement corn starch.

During the experimental period (4 weeks), the diets consumed and body weights were recorded twice weekly according to **(Chapman, et al., 1959).** At the end of the experiment, the animals were fasted overnight, then the rats were anaesthetized and sacrificed, and blood samples were collected. Blood samples were centrifuged and the serum was separated to estimate some biochemical parameters. Kidney function according to the methods described by **(Haisman and Muller 1977; Henry et al., 1974 and Larsen 1972)**,serum calcium according to **(Baginski 1973),** serum phosphorus by **(Quinlan and Desesa 1955)**. Bones were removed from each rats, cleaned and weighted, half amount of separated bones were kept in frozen till analysis at 20˚C, while the other bones were fixed with 10% neutral formalin and decalcified with 5% nitric acid solution for 1 day. The routine tissue processing for light microscopy was performed, and tissues were embedded in paraffin. Cross-sections of 5-µm intervals were taken and stained with hematoxylin and eosin for measurement of femur bone thickness and Masson Trichrom for collagen fiber evaluation. Diaphyseal femur bone

thickness was measured with ocular micrometer. Ten random areas were selected and average thickness was calculated for each femur **(Comelekoglu et al., 2007)**. Calcium and phosphorus in femur bone of rats were determined according to the method described by **(Muynck and Vanhaecke 2009).** Bone Mineral Density (BMD) Bone Mineral Concentration (BMC) measured by Dual Energy x-ray absorptiometry (DEXA) in National Research Center, Osteoporosis Unit. The data obtained was analyzed statistically for standard deviation and one-way ANOVA test **(Armitage and Berry 1987).**

RESULTS:

Data presented in table (1) showed the effect of two levels from peanut, sesame seeds and their combination on the mean value of feed intake of rats suffering from osteoporosis. Feed intake of healthy rats (negative control group) fed on basal diet increased than that of osteoporotic rats (positive control group) (16.412vs.12.577 g/day/rat). Treating groups of rats suffering from osteoporosis with levels of (5% and 10%) peanut seeds, sesame seeds and their combination increased the mean value of feed intake, than that of the positive control group.

Result of feeding osteoporotic rats diets containing 5% and 10% (peanut and sesame) seeds and their combinations were presented in table (1). Using prednisone acetate to induce osteoporosis led to significant increase in BWG%, as compared to the negative control group. The best results of BWG% of all tested groups recorded for the group which treated with 10% combination of all seeds, followed by the groups treated with levels from seeds alone.

Effect of two levels from (peanut seeds, sesame seeds) and their combination on serum uric acid, urea nitrogen and creatinine (mg/dl) of rats suffering from osteoporosis in table(1) .The mean values of serum uric acid, urea nitrogen and creatinine of the positive control significantly increased than the negative control group .

The mean values of serum uric acid, urea nitrogen and creatinine decreased

gradually with increasing the levels of seeds. The best results of serum uric acid, urea nitrogen and creatinine recorded for osteoporotic group treated with 10% combination of peanut seeds and sesame seeds, this treatment decreased the mean values of serum utric acid, urea nitrogen and creatinine.

Table(2)showed that the mean values of serum calcium and phosphorus , femur bone calcium and phosphorus, BMD and BMC of osteoporotic group (+ control) decreased significantly $P<0.05$, as compared to healthy rats fed basal diet. On the other hand, serum calcium and phosphorus, femur bone calcium and phosphorus increased gradually with increasing the level of seeds. The highest increase in serum calcium and phosphorus of femur bone calcium and phosphorus, recorded for the group treated with high level from combination of all seeds, this group increased the mean values of serum calcium.

DISCUSSION:-

In this study, body weight of peanut treated group was significantly lower in comparison to that of positive control group. Some investigators observed similar type of findings **(Mattes, et al,.2008).** It has been suggested that, peanut intake provides the body with high level of vitamin A, vitamin E, folate, calcium, magnesium, zinc, iron, and dietary fiber, and decrease the level of saturated fat, cholesterol, triglycerides and thus causes reduction of body weight **(Alper and Mattes 2003).**

Peanuts significantly reduce renal oxidative damage and increase nitric oxide levels. Thus, suppress toxin mediated enhancement of serum urea and creatinine levels **(Wang,et al.,2011).** Again, some other researchers suggested that the peanut keeps the serum creatinine level close to normal due to the ability of some antioxidant in peanut to scavenge free radicals generated by irradiation, which would otherwise cause kidney damage **(Shimmi, et al, 2014 and Nath et al, 1994).**

It has been reported that many health benefits are associated with consumption of peanuts including weight gain control **(Alper, and Mattes**

2002) prevention against cardiovascular diseases **(Feldman, 1999),** protection against Alzheimer disease **(Arlingten, 2002),** and cancer inhibition. Benefits are mainly attributed to the fact that peanuts do not contain trans-fatty acids **(Sanders, 2001)** but they are rich in mono- and polyunsaturated fatty acids **(Kris-Etherton, et al, 1999) ,**micronutrients such as vitamin E, folate, minerals(potassium, magnesium, and zinc), fibers and health promoting phytochemicals, particularly resveratrol **(Sanders et al., 2000)** and other phenolic compounds.

Studies ***reported*** that, excess glucocorticoid causes muscular atrophy and a decreased rate of muscle protein synthesis and this lead to increase nitrogen compound that result from catabolism of muscle of protein. This compound may be heavy load on the kidney **(Wolthers et al. 1997)**.

Other studies reported that dietary sesame seeds and its lignan increase both ascorbic acid concentration in some tissues and urinary excretion by stimulating biosynthesis in rats. **Uchida et al, (2007)** reported that dietary sesame seeds decreases urinary excretion of alpha and gamma tocopherol metabolites in rats.

Researches recommended to meals for osteoporosis. Milk and milk products are the representative sources of calcium supply and their absorbency is excellent and small fish that can be eaten whole, sesame seeds, and legumes in daily life **(Titchenal and Dobbs, (2007)**.

Another study concluded that the Ca from sesame seeds and spinach does not cause an acute response in Ca metabolism. Also, that cheese could be a better dietary source of Ca than milk when the metabolic effects of the foods are considered **(Karkkainen et al, 1997).**

Sesame is also a source of helpful biologically active components found in plant foods, such as phytochemicals and it is a functional food. Bioactive compounds and nutraceuticals in sesame could be used in the prevention, controlling and even the management of illnesses **(Kanu**

et al., 2007)&(Sacco **et al ,2007).**

CONCLUSION:

In summary, it appears that consumption of diets rich in peanut and sesame seeds improve kidney function and increase calcium and phosphorus thus reducing the incidences of osteoporosis in rats. Nutrition education program should be encouraged to inform the public about the protective effect of peanut and sesame seeds from osteoporosis.

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Table (1):-Effect of peanut seeds and sesame seeds on feed intake, Body weight gain% and kidney functions of rats suffering from osteoporosis.

Groups / Parameter		(-ve) Control	(+ve) Control	5% peanut seeds (PS).	10% peanut seeds (PS).	5% sesame seeds (SS).	10% sesame seeds (SS).	5% combination of (PP, SS).	10% combination of (PP, SS).
Feed intake (g/day/rat)		16.412± 0.773[a]	12.577± 0.836[e]	13.773± 0.599[b]	14.439± 1.0731[b c]	13.509± 0.958[e]	14.085± 0.312[a]	13.956± 0.037[d e]	14.543± 0.254[a]
Body weight gain %		32.078 ± 2.273[a]	33.118 ± 5.585[e]	27.465 ± 5.117[d e]	18.49± 6.251[b c]	29.824± 3.124[e]	21.407± 8.085[c d]	21.701± 8.913[c d]	16.325± 4.958[b]
mg / dl	Uric acid	1.510± 0.026[g]	2.475± 0.061[a]	2.081± 0.042[c]	1.717± 0.0324[d e]	2.140± 0.051[b]	1.832± 0.031[d]	1.934± 0.043[d e]	1.602± 0.027[f]
	Urea nitrogen	32.909± 1.306[g]	57.987± 3.412[a]	48.779± 2.015[b]	37.738± 1.486[e]	51.001± 2.671[b]	39.029± 1.663[d e]	42.776± 2.370[d]	34.078± 1.854[g f]
	Creatinine	0.607± 0.018[g]	1.234± 0.049[a]	0.983± 0.048[c]	0.891± 0.056[d e]	1.036± 0.074[b]	0.886± 0.021[d e]	0.812± 0.052[d]	0.765± 0.047[f]

- ***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 letters are not significant***

Table (2): Effect of peanut seeds and sesame seeds on calcium, phosphorus, femur bone calcium, Femur bone phosphorus, BMD and BMC of rats suffering from osteoporosis.

Groups / Parameters		Control (-ve)	Control (+ve)	5% peanut seeds (pS).	10% peanut seeds (pS).	5% sesame seeds (SS)	10% sesame seeds (SS)	5% combination of ,PS and SS.	10% combination of ,PS and SS.
mmol/l	Calcium	4.476± 0.121 ^{a}	2.921± 0.063 ^{i}	2.969± 0.085 ^{g}	3.987± 0.086 ^{de}	2.964± 0.096 ^{h}	3.891± 0.072 ^{f}	3.048± 0.069 ^{cd}	4.247± 0.058 ^{b}
	Phosphorus	3.572± 0.049 ^{a}	1.828± 0.068 ^{e}	2.076± 0.105 ^{cd}	2.877± 0.115 ^{c}	2.159± 0.088 ^{d}	3.117± 0.113 ^{c}	2.996± 0.083 ^{b}	3.388± 0.075 ^{b}
mg/kg	Femur bone Calcium	46.566± 1.738 ^{a}	27.332± 2.379 ^{g}	33.772± 1.753 ^{d}	39.995± 0.485 ^{c}	32.585± 0.465 ^{c}	38.559± 0.476 $^{d e}$	38.996± 0.881 ^{c}	43.213± 0.883 ^{b}
	Femur bone phosphorus	93.715 ±2.230 ^{a}	57.404± 2.378 ^{i}	67.842± 0.824 ^{e}	74.463± 0.615 ^{c}	63.178± 0.743 ^{h}	73.283± 0.175 ^{f}	73.101± 0.702 ^{d}	82.834± 1.127 ^{b}
g/cm2	BMD	0.169± 0.0041 ^{a}	0.068± 0.0037 ^{g}	0.108± 0.0037 ^{e}	0.138± 0.0035 c	0.099± 0.0049 ^{f}	0.130± 0.0025 ^{e}	0.121± 0.0026 ^{d}	0.149± 0.0061 ^{b}
	BMC	0.099± 0.0023 ^{a}	0.036± 0.0037 ^{g}	0.059± 0.0026 ^{e}	0.076± 0.022 ^{b}	0.058± 0.0015 ^{f}	0.069± 0.0017 ^{d}	0.071± 0.017 $^{b c}$	0.087± 0.004 ^{a}

- ***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 letters are not significant***

Histopathological study of Bone:

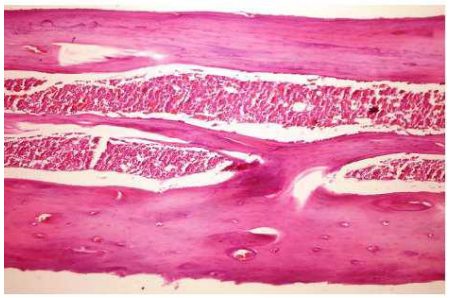

Photo (1): Bone of rat from group (-) control showing no histopathological changes. (H and E X100).

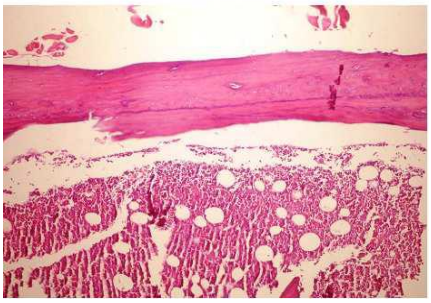

Photo (2): Bone of rats (+ control) showing reduced bone mass. The cortical bone is reduced in thickness. (H and E X100)

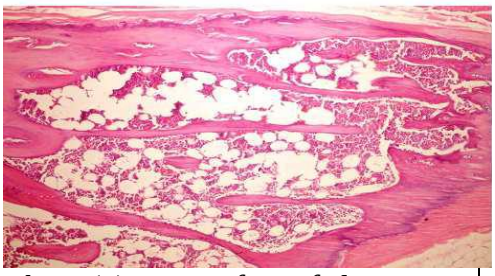

Photo (3): Bone of rats fed on dietary supplemented 5% peanut seeds showing thin bone trabeculae. (H and E X100).

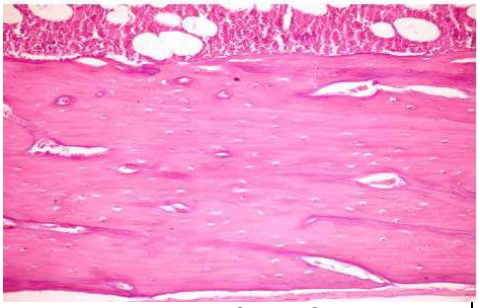

Photo (4): Bone of rats fed on dietary supplemented 10% peanut seeds showing apparent normal bone structure. (H and E X100).

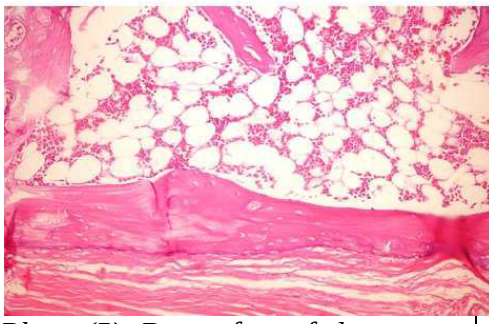

Photo (5): Bone of rats fed on dietary supplemented 5% sesame seeds showing thin cortical bone, few bone trabecullae and enlarged medullar cavity. (H and E X100).

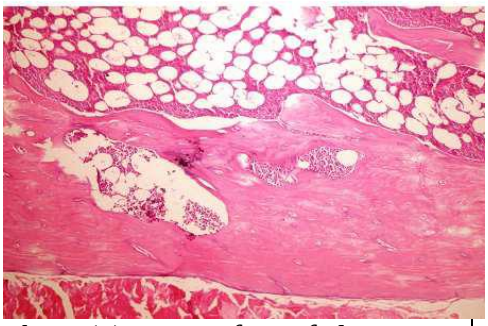

Photo (6): Bone of rats fed on dietary supplemented 10% sesame seeds showing apparent normal histological structure. (H and E X100).

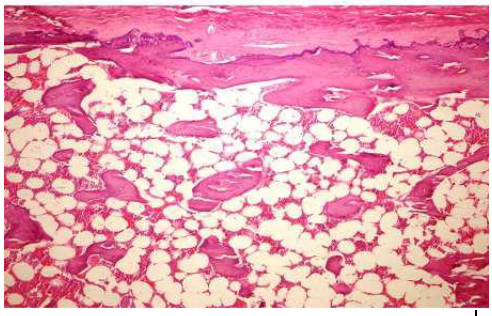

Photo (6): Bone of rats fed on dietary supplemented 5% combination of peanut seeds and sesame seeds showing thin cortical bone, thin and few bone trabecullae as well as enlarged medullar cavity.(H and E X100).

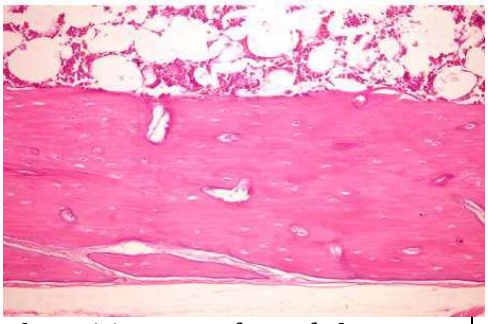

Photo (7): Bone of rats fed on dietary supplemented 10%combination of peanut seeds and sesame seeds showing no histological changes.(H and E X100).

تاثير تناول بذورالفول السودانى و السمسم على الجرذان المصابه بهشاشه العظام

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الملخص العربى

اجريت هذه الدراسه لمعرفة تاثير بذور الفول السودانى و السمسم على الجرذان المصابه بهشاشه العظام. و فيها استخدم (٤٨) جرذ انثى بأوزان ٢٠٠±١٠ جم حيث قسمت هذه الجرذان الى مجموعتين رئيسيتين.المجموعه الرئيسيه الاولى(٦) جرذ تم تغذيتهم على الوجبه الرئيسيه (كمجموعه ضابطه سالبه) و المجموعه الرئيسيه الثانيه (٤٢) جرذ تم اعطائهم ماده استات البريدينزيون يوميا لمده اسبوعين لاصابتهم بهشاشه العظام. ثم قسمت هذه المجموعه الى (٧) مجموعات فرعيه.المجموعه الاولى (٦ جرذ) تم تغذيتها على الوجبه الاساسيه (كمجموعه ضابطه موجبه) المجموعه الثانيه و الثالثه تم تغذيتهم على الوجبه الاساسيه مضاف لها نسب (٥،١٠%) من بذور الفول السودانى. المجموعه الرابعه و الخامسه تم تغذيتها على الوجبه الاساسيه مضاف اليها نسب(٥،١٠%) من بذور السمسم . المجموعه السادسه و السابعه تم تغذيتهم على مستويات مختلفة من خليط بذور السودانى و السمسم بنسب (٥،١٠%) . اظهرت النتائج ان بذور الفول السودانى و السمسم و الخليط منهم خاصه (١٠%) حسنت الحاله الغذائيه و وظائف الكلى و المستويات المختلفه من الكالسيوم و الفسفور فى العظام و حسنت من كثافه المعادن فى العظام ومحتوى المعادن فى العظام و محتوى عظام الفخد من الكالسيوم و الفسفور مقارنه بالمجموعه الضابطه الموجبه.لذا من خلال الدراسه ننصح بتناول الفول السودانى و السمسم و الاطعمه ذات المحتوى العالى من الكالسيوم ليساعد على زياده معدل نمو العظام و يقلل من معدل ترقق العظام .

الكلمات المفتاحيه: بذور الفول السودانى، بذور السمسم، هشاشه العظام .