



The Protective Effect of Gum Arabic on the Electrolyte Balance and Parathyroid Hormone among Osteoporotic Rats

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ABSTRACT:

The present study investigated how gum Arabic affected osteoporotic rats. Thirty-five male albino rats averaging (150±170g) were used. Two major groups were; the first major group (n=5) was kept as a negative control group, while the second major group (n=30) was given oral injection of prednisolone (5 mg) to cause osteoporosis for two weeks every day, then divided into six subgroups, positive control group, treated group that take the dose of medical therapy (bonapex) only, and other four subgroups were given basal diet plus 10% or 15% of gum Arabic, and 10% or 15% of gum Arabic plus medical dose for 28 days. The results indicated that dietary intervention with gum Arabic could improve urea and creatinine concentration, which decreased gradually by increasing the dose of gum Arabic. Gum Arabic (15%) plus bonapex had the best serum electrolytes phosphorus, calcium, and magnesium values after dietary intervention among osteoporotic groups but differed significantly when compared with the control negative group. The effect of gum Arabic at a higher dose on vitamin D and Parathyroid hormone (PTH) in gum Arabic was 15%, and it did not differ significantly from the medicine in the treated group with bonapex. In conclusion, gum Arabic had a protective effect on osteoporotic rats.

Keywords: Gum Arabic, Vitamin D, Calcium, Bone, Rats, Antioxidant Activity

1. INTRODUCTION

Osteoporosis is a skeletal-metabolic disease marked by decreased bone mineral density (BMD) and bone microarchitecture (1) and (2). Around 200 million people worldwide have osteoporosis, with 34% of women over the age of 50 affected (3). Osteocytes produce molecules that regulate the location and rate of bone remodeling.

Mechanical loading and circulating hormones, such as parathyroid (PTH), regulate osteocyte function. Another naturally occurring polysaccharide is gum Arabic (GA), which comes from the acacia tree and is non-toxic, biocompatible, and renewable. The US Food and Drug Administration (USFDA) has classified it as "Generally Recognized as Safe (GRAS)" (4). Osteoporosis is a disease that affects

millions of people around the world; it is a health condition that weakens bones, making them fragile and more likely to break. It takes years to manifest and is sometimes discovered only when a fall or other traumatic event breaks one (fracture) (5). Osteoporosis is a "silent disease," meaning that symptoms do not appear until a fracture occurs, which is problematic. Among those who have osteoporosis, fractured wrists and hips are the most frequent injuries (6) and (7). According to (8), gum Arabic solutions have especially high Ca²⁺ concentrations. Calcium (Ca) has many chemical and functional similarities to bone tissue (9). According to (10), GA's high Calcium content aids in osteoporosis prevention, treatment, and remineralization. Bacteria also produce short-chain fatty acids, which reduce PTH and improve mineral absorption through solubilization (11). The main mechanisms are increasing minerals through short-chain fatty acid production (12), decreasing intestinal inflammation, which leads to increased bone mass density (13), and Lactobacillus and Bifidobacteria hydrolyzing glycoside bond food in the intestines (14). These mechanisms enhance mineral bioavailability. Furthermore, (15) established that GA possesses biological antioxidant properties. The present investigation aimed to see how nutritional intervention with gum Arabic affected the electrolyte balance of osteoporotic rats. In the last twenty years, the effective biological function of GA has been

confirmed, including a reduction in plasma cholesterol concentration in animals and humans, an anticarcinogenic effect, and an antioxidant effect (16) and (17) and (18) and (19), with a protective role against hepatic and cardiac toxicities.

2. MATERIALS AND METHODS

2.1. MATERIALS

2.1.1 Gum Arabic:

Gum Arabic were purchased from El-Nobi Co., Shebin El-Kom, Menoufia, Egypt. Chemicals will be obtained from Morgan Co. Cairo, Egypt.

2.1.2 Rats

Adult male Sprague Dawley Albino rats were obtained from the Laboratory Animal House, National Research Center, Cairo, Egypt.

2.2. METHODS

2.2.1 Gum Arabic preparation

gum Arabic is a soluble dietary fiber obtained naturally from the stems and branches of Acacia trees (family: legume). It was purchased as crystals (commercial grade) and ground to a fine powder (20 and 21).

2.2.2 Dose of Gum Arabic

An aqueous solution of Gum Arabic (10%, w/v) was prepared freshly every day and introduced to the rats in potable water (1 ml/100 g BW) (22).

2.2.3 Induction of osteoporosis

For inducing osteoporosis, rats will be injected subcutaneously with

methylprednisolone (5 mg/kg per day) for 2 weeks (23).

2.2.4 Dose of clinical therapy of osteoporosis

The human dose was extrapolated to animal by the normalization method based mainly on body surface area (BSA) as mentioned in the study of (24).

The animal dose of risedronate sodium drug for adult male Sprague Dawley rats that used in the experiment was 21.5 mg/ 100 g per week.

2.2.5 Experimental design

The strategy for this experiment was approved by the Research Ethics Committee of the Faculty of Science, Menoufia University , Egypt (Approval No: MUFHE / S / NFS / 1 / 24). Rats were housed individually in wire cages under the normal laboratory conditions in Biological Laboratory , Faculty of Home Economics, Menoufia University . The study will be conducted on twelve-week-old male Sprague Dawley rats (150 ± 20 g). Only male rats will be used due to the hormonal fluctuation of female rats during the menstruation cycle, which may have influenced our experiment and results. The rats will be housed individually in ventilated cages and maintained in a 12 h light/12 h darkness cycle at 23-25°C, with free access to food and deionized water.

All rats were fed on basal diet (casein diet) prepared according to American Institute of Nutrition for 7 consecutive days.

After this adaptation period, five rats were considered as negative control group (5

rats); and the remained rats will be induced as osteoporotic model and divided into the following groups:

Positive control group (5 rats): These rats will be fed on the standard diet along the study period and treated with osteoporotic drug at dose 21.5 mg/ 100 g per week.

The remained of the osteoporotic rats (n=20) was administered varying gum Arabic dosages for 28 days. Rats was divided into four subgroups, five for each, as follow:

- Osteoporotic gum group 1 (GG10%) was fed on standard diet and administered gum Arabic at dose 10% (W/V) in potable water.
- Osteoporotic gum group 2 (GG15%) was fed on standard diet and administered gum Arabic at dose 15% (W/V) in potable water.
- Osteoporotic risedronate gum group 3 (GBG10%) was fed on standard diet and administered gum Arabic at dose 10% (W/V) in potable water addition to osteoporotic drug at dose 21.5 mg/ 100 g per week.
- Osteoporotic risedronate gum group 4 (GBG15%) was fed on standard diet and administered gum Arabic at dose 15% (W/V) in potable water addition to osteoporotic drug at dose 21.5 mg/ 100 g per week.
- Osteoporotic risedronate gum group 5 (BG) was fed on standard diet addition to osteoporotic drug at dose 21.5 mg/100 g per week in potable water.

2.2.6 Diets preparations

Basal diet (Standard diet) was prepared according to (25).

2.2.7 Biochemical Analysis:

Serum urea and Concentrations of creatinine were determined using the modified kinetic methods of (26) and (27), respectively. Determination of serum alkaline phosphatase (ALP) was carried out based on the procedure of (28). Calcium (Ca), phosphorus (P) and magnesium (Mg) values were assessed based on the procedure of (29).

1,25-(OH)₂-Vitamin D₃ was quantitatively measured in plasma using an ELISA kit based on the procedure of (30).

Parathyroid Hormone (PTH) was established utilizing an ELISA kit based on the procedure of (31).

2.2.8 Statistical analysis

The data were statistically analyzed using SPSS Version 22.0 software. The differences in mean values among all groups was evaluated by one-way analysis of variance (ANOVA), with post hoc test to compare differences in values and determine the significance level ($p < 0.05$). The results were presented as mean \pm standard deviation (SD).

3. RESULTS AND DISCUSSION

The results in table (1) indicated that dietary intervention with gum Arabic could improve urea concentrate across all groups. GBG 15% (22.75 \pm 0.12 mg/dl) has the lowest mean value that showed the best result when compared with BG (28.89 \pm 0.07 mg/dl). GG 15% and BG showed no discernible change at ($p \leq 0.05$), being (29.76 \pm 1.59 mg/dl) (28.89 \pm 0.07 mg/dl), respectively. While,

GBG 15% had the best alleviation that didn't show any significant difference compared to control (-ve), being (22.88 \pm 1.08 mg/dl) (22.75 \pm 0.12 mg/dl), respectively. Gum Arabic may have acted by increasing urea disposal in the large intestine (the site where it is degraded) and thus reducing the amount of urea nitrogen excreted in urine (32). According to (33), gum Arabic can reduce urea nitrogen excretion, urea production, and urea cycling in rats.

Table (1). Effect of Dietary intervention with gum Arabic on serum urea of osteoporotic rats

Groups	Urea (mg/dl)	
	Pre	Post
Control (-ve)	22.91 \pm 0.98 b	22.88 \pm 1.08 e
Control (+ve)	38.54 \pm 1.34 a	40.61 \pm 2.75 a
GG10%	39.05 \pm 1.20 a	35.75 \pm 3.33 b
GG 15%	38.81 \pm 1.55a	29.76 \pm 1.59 c
BG	39.07 \pm 1.65 a	28.89 \pm 0.07 c
GBG 10%	38.43 \pm 0.86a	26.30 \pm 0.86 d
GBG 15%	39.30 \pm 0.13 a	22.75 \pm 0.12 e
LSD	1.87	3.45

Values are expressed as mean \pm SD, means in the same columns with different letter are significantly ($P \leq 0.05$), LSD: Least significant of difference, GG10%: group supplemented with gum Arabic 10%; GG15%: group supplemented with gum Arabic 15%; BG: group supplemented with bonapex; GBG10%: group supplemented with bonapex addition to gum Arabic 10%; GBG15%: group supplemented with bonapex addition to gum Arabic 15%.

As shown in table (2) the mean value of creatinine was decreased gradually by increasing dose of gum Arabic of experimental groups GG10%, GG15%, BG, GBG10% and GBG15% at significant value ($p \leq 0.05$) as compared to control (+ve), being (1.77 \pm 0.09, 1.63 \pm 0.11, 1.52 \pm 0.08, 1.35 \pm 0.06, 1.19 \pm 0.004 and 2.01 \pm 0.10 mg/dl) respectively. On the

other hand, the study found that dietary intervention with gum Arabic at dose 15% (GG15%) did not differ significantly than treated group with medical therapy in BG, being $(1.63\pm 0.11$ and 1.52 ± 0.08 mg/dl) respectively. These results were consistent with those of (34), who discovered that giving gum Arabic orally to those suffering from long-term renal failure helped reduce urea and creatinine plasma concentrations.

Table (2) Effect of Dietary intervention with gum Arabic on serum creatinine of osteoporotic rats

Groups	Creatinine (mg/dl)	
	Pre	Post
Control (-ve)	0.87 ± 0.04 c	0.88 ± 0.12 f
Control (+ve)	1.99 ± 0.02 a	2.01 ± 0.10 a
GG 10%	1.96 ± 0.003 a	1.77 ± 0.09 b
GG 15%	1.96 ± 0.05 a	1.63 ± 0.11 c
BG	1.92 ± 0.002 b	1.52 ± 0.08 c
GBG 10%	1.93 ± 0.03 a	1.35 ± 0.06 d
GBG 15%	1.91 ± 0.01 b	1.19 ± 0.004 e
LSD	0.06	0.13

Results are expressed as mean \pm SD, means in the same columns with different letter are significantly ($P\leq 0.05$), LSD: Least significant of difference, GG10%: group supplemented with gum Arabic 10%; GG15%: group supplemented with gum Arabic 15%; BG: group supplemented with bonapex; GBG10%: group supplemented with bonapex addition to gum Arabic 10%; GBG15%: group supplemented with bonapex addition to gum Arabic 15%.

Table (3) illustrate the mean value of ALP. All osteoporotic rats given treatment with different dose of gum Arabic revealed substantial reductions in mean value as compared to control (+ve); being $(72.83\pm 5.93$, 60.78 ± 4.71 , 55.75 ± 3.82 , 50.80 ± 4.76 , 41.62 ± 2.06 and 83.98 ± 4.05 U/L) respectively. It is interesting that the result of the medicine in (BG) was similar to the effect that found in (GG15%), being

$(55.75\pm 3.82$ and $60.78\pm 4.71)$. (35) discovered that taking gum Arabic for 45 days in a row reduced ALP.

Table (3) Effect of dietary intervention with gum Arabic on serum ALP of osteoporotic rats

Groups	ALP (mg/dl)	
	Pre	Post
Control (-ve)	36.06 ± 0.06 d	35.3 ± 1.56 g
Control (+ve)	80.78 ± 0.56 c	83.98 ± 4.05 a
GG10%	82.6 ± 0.06 b	72.83 ± 5.93 b
GG15%	82.3 ± 0.22 b	60.78 ± 4.71 c
BG	83.9 ± 0.66 a	55.75 ± 3.82 c
GBG10%	83.46 ± 0.26 a	50.80 ± 4.76 d
GBG15%	83.74 ± 0.87 a	41.62 ± 2.06 f
LSD	1.22	7.87

Values are expressed as mean \pm SD, means in the same columns with different letter are significantly ($P\leq 0.05$), LSD: Least significant of difference, ALP: Alkaline phosphatase, GG10%: group supplemented with gum group 10%; GG15%: group supplemented with gum group 15%; BG: group supplemented with bonapex; GBG10%: group supplemented with bonapex addition to gum Arabic 10%; GBG15%: group supplemented with bonapex addition to gum Arabic 15%.

Table (4) illustrate the mean value of P for normal and osteoporotic rats. It was observed that levels of P in GG150% had no discernible change compared with BG, being $(3.27\pm 0.54$ and 3.25 ± 0.54 mg/dl), respectively. Also, non-significant difference was observed between GBG10% and GBG15%, being $(2.32\pm 0.54$ and 2.01 ± 0.54 mg/dl). The outcomes demonstrated that GBG15% had the highest value among osteoporotic groups, but it differed significantly from the control value ($4.980.54$ mg/dl). Previous findings confirmed that gum Arabic treatment reduced urinary phosphate excretion significantly, as (36) concluded.

Table (4). Effect of dietary intervention with gum Arabic on serum P on osteoporotic rats.

Groups	P (mg/dl)	
	Pre	Post
Control (-ve)	2.99±0.21a	2.98±0.54a
Control (+ve)	4.09±0.09b	4.04±0.54b
GG10%	3.04±0.03c	3.74±0.54c
GG15%	2.55±0.17c	3.27±0.54d
BG	4.31±0.11b	3.25±0.54d
GBG10%	3.04±0.20c	2.32±0.54e
GBG15%	3.22±0.04b	2.01±0.54e
LSD	0.22	0.45

Values are expressed as mean±SD, means in the same columns with different letter are significantly ($P\leq 0.05$), LSD: Least significant of difference, P: Phosphore, GG10%: group supplemented with gum group 10%; GG15%: group supplemented with gum group 15%; BG :group supplemented with bonapex; GBG10%: group supplemented with bonapex addition to gum Arabic 10%; GBG15%: group supplemented with bonapex addition to gum Arabic 15%.

It could be noticed that the mean value of Ca was increased by increasing the dose of gum Arabic. The outcomes demonstrated that the great significant effect of Ca was recorded in GBG15% by mean value 16.13±0.39 mg/dl. While, there was non-significant difference between GG15% and BG by mean values (11.05±0.39 and 12.91±0.39 mg/dl), respectively. (37) previously reported that gum Arabic solutions have particularly high Ca²⁺ concentrations. Calcium (Ca) is biocompatible and bioactive, with chemical and functional properties that are very comparable to those of bone tissue. The high Ca content of GA helps to protect against osteoporosis and contributes to its treatment. Furthermore, as mentioned by (38), its high Ca content aids in increasing tooth remineralization.

Because natural bone is composed of carbonate-substituted hydroxyapatite (nHA) nanocrystals, combining nHA fillers with natural polymers is the most promising and widely used method for producing bone tissue scaffolds. Furthermore, the gelation properties and mechanisms of GA provide a source of calcium and phosphate ions, which are required for cell survival while being osteoconductive and bioactive (39).

Table (5). Effect of dietary intervention with gum Arabic on serum Ca on osteoporotic rats.

Groups	Ca (mg/dl)	
	Pre	Post
Control (-ve)	18.68±0.07c	19.99±0.39f
Control (+ve)	8.5±0.54 a	8.60±0.39 a
GG10%	18.62±0.81a	9.66±0.39 b
GG15%	18.57±0.39 a	11.05±0.39 c
BG	17.79±0.17 a	12.91±0.39 c
GBG10%	18.08±0.66 a	13.08±0.39 d
GBG15%	17.74±0.29 b	16.13±0.39 e
LSD	0.92	1.46

Values are expressed as mean±SD, means in the same columns with different letter are significantly ($P\leq 0.05$), LSD: Least significant of difference, Ca: Calcium, GG10%: group supplemented with gum group 10%; GG15%: group supplemented with gum group 15%; BG : group supplemented with bonapex; GBG10% : group supplemented with bonapex addition to gum Arabic 10%; GBG15% : group supplemented with bonapex addition to gum Arabic 15%.

The results in table (6) showed that the correspondence effect was revealed between BG and GBG15% without any significant difference at mean values (1.59±0.23 mg/dl) and (1.55±0.23), respectively. The most effective improvement was found in a group GBG15%, being 2.16±0.17 mg/dl. Gum Arabic is a natural multifunctional

branched-chain hydrocolloid with a highly neutral or slightly acidic arabinogalactan-protein complex containing magnesium. (40) discovered Arabic gum (AG) as sticky exudates from the stems and branches of Acacia trees. Gum Arabic is a naturally occurring multifunctional hydrocolloid with branching chains that has an arabinogalactan-protein complex that is very neutral or slightly acidic and contains magnesium (41).

(42) also synthesized magnesium oxide nanoparticles using AG by the solgel method as a flashy and friendly approach to nature. The magnesium source was magnesium nitrate. FTIR, PXRD, and UV-Vis spectroscopy were used to characterize the synthesized samples. As a result, the studies confirmed that GA is an excellent source of Ca^{2+} , K^{+} , and Mg^{2+} .

Table (6). Effect of dietary intervention with gum Arabic on serum Mg on osteoporotic rats.

Groups	Mg (mg/dl)	
	Pre	Post
Control (-ve)	2.65±0.003a	2.69±0.11a
Control (+ve)	0.92±0.002b	0.90±0.20f
GG10%	0.91±0.008b	1.19±0.07e
GG15%	0.94±0.06b	1.55±0.23d
BG	0.95±0.05b	1.59±0.23d
GBG10%	0.96±0.009b	1.85±0.005c
GBG15%	0.91±0.001b	2.16±0.17b
LSD	0.07	0.25

Values are expressed as mean±SD, means in the same columns with different letter are significantly ($P \leq 0.05$), LSD: Least significant of difference, Mg: Magnesium, GG10%: group supplemented with gum group 10%; GG15%: group supplemented with gum group 15%; BG: group supplemented with bonapex; GBG10%: group supplemented with bonapex addition to gum Arabic 10%; GBG15%: group supplemented with bonapex addition to gum Arabic 15%.

Table (7) showed the mean value of PTH for normal and osteoporosis rats. The results noted that dietary intervention at 10% dose of gum in GG10% was comparable to control positive group. However, the impact of gum Arabic at higher dose in GG15% did not differ significantly than medicine in BG, being (53.08 ± 0.13 and 52.27 ± 3.55 Pg/ml). It was observed that GBG15% had more efficient hormone regulation at mean value 43.47 ± 2.01 Pg/ml.

Likewise, in the investigation of (43), sodium and calcium levels were gradually increased from 111.56 mmol/L and 6.89 mg/dL to 129.86 mmol/L and 10.16 mg/dl, respectively. GA's high calcium content resulted in significantly elevated calcium levels (44). A reduction in plasma phosphate ratio leads to a rise in plasma ionized calcium ratio, which eliminates hyperparathyroidism, the major pathophysiological factor in advanced kidney disease (45). Intake of calcium-containing it has been demonstrated that GA lower blood pressure by activating calcium receptors and inhibiting sodium, potassium, and chloride transport to the outer layer (46).

(47), on the other hand, randomly assigned 36 chronic kidney disease (CKD) patients to receive 10, 20, or 40 grams of GA daily for four weeks and studied the systemic effects of this intervention, finding that the addition of GA had no effect on parathyroid hormone.

Table (7). Effect of dietary intervention with Gum Arabic on serum PTH on osteoporotic rats.

Groups	PTH pg/mL	
	Pre	Post
Control (-ve)	34.91±0.23 a	34.99±2.93 e
Control (+ve)	60.96±0.47 a	60.97±1.04 a
GG10%	59.29±0.03 b	57.37±2.32 a
GG15%	59.73±0.25 a	53.08±0.13 b
BG	58.15±0.03 b	52.27±3.55 b
GBG10%	58.94±0.08 b	48.23±1.84 c
GBG15%	59.76±0.28 a	43.47±2.01 d
LSD	1.32	4.22

Values are expressed as mean±SD, means in the same columns with different letter are significantly ($P\leq 0.05$), LSD: Least significant of difference, PTH: Parathyroid hormone, GG10%: group supplemented with gum group 10%; GG15%: group supplemented with gum group 15%; BG : group supplemented with bonapex; GBG10% : group supplemented with bonapex addition to gum Arabic 10%; GBG15% : group supplemented with bonapex addition to gum Arabic 15%.

The same table represent the mean values of vitamin D for normal and osteoporotic rats. The results demonstrated that the higher value of dietary intervention of gum Arabic was administered, the higher values of vitamin D gradually was set. and showed that the great value recorded in GBG15% (25.55±1.73) that is very close to control (-ve) at mean value (29.61±1.77). GG15% revealed the same improving effect of medical treatment only in BG without notable distinction between them, being (19.93±1.29 and 20.39±0.05 nmol/L) respectively. For several years, vitamin D deficiency in many people's diets has been revealed; this vitamin deficiency may result in critical diseases such as rickets, osteomalacia, and osteoporosis. Vitamin D maintains bone and tooth health; improves immune, brain, and

nervous system health; and improves lung function and cardiovascular health, so experts believe that fortification of food products with this micronutrient is the best solution to removing the problem (48), as suggested by (49).

Lamsen et al., (50) investigated gum Arabic (GA) as a VD3 transporter for encasing VD3, and it was discovered that bio-accessibility of VD3 was substantially more in capsules (95.76%) than in nonencapsulated VD3 (68.98%). An in vivo pharmacokinetic research in Sprague-Dawley rats following a single-dose of 300 g VD3 revealed that the area-under-curve of serum 25 (OHD) level in 48 hours of the encapsulation treatment was 4.32-fold greater than the nonencapsulated VD3 and more than twice higher than the VD3 -GA physical combination. The study's findings demonstrated that adding vitamin D3 to gum Arabic enhanced absorption and dispersion stability. Additionally, the enhanced VD3 absorption after encapsulation highlights the nutritional advantages of the studied encapsulation method.

Currently for Indian population calcium supplementation is recommended in all regardless of BMD (51) and (52) reported that calcium supplementation (alone or in combination with vitamin D) is effective in preventing osteoporotic fracture in elderly women and men.

Table (8). Effect of dietary intervention with Gum Arabic on serum V.D on osteoporotic rats.

Groups	V.D nmol/L	
	Pre	Post
Control (-ve)	29.49±0.08 a	29.61±1.77 a
Control (+ve)	12.67±0.11b	12.69±0.12f
GG10%	12.97±0.34 b	17.31±0.36 e
GG15%	12.28±0.40 c	19.93±1.29 d
BG	12.65±0.39b	20.39±0.05 d
GBG10%	12.06±0.25 c	22.63±2.01 c
GBG15%	12.28±0.07 c	25.55±1.73 b
LSD	0.45	2.09

Values are expressed as mean±SD, means in the same columns with different letter are significantly ($P\leq 0.05$), LSD: Least significant of difference, V.D: Vitamin D, GG10%: group supplemented with gum group 10%; GG15%: group supplemented with gum group 15%; BG : group supplemented with bonapex; GBG10% : group supplemented with bonapex addition to gum Arabic 10%; GBG15% : group supplemented with bonapex addition to gum Arabic 15%.

Data in Table (9) was demonstrated how gum Arabic affected the osteoporotic rats' bone mass density (BMD). These findings showed that administering methylprednisolone to rats resulted in a notable reduction ($p\leq 0.05$) in BMD by mean value 0.251 ± 0.02 g comparing to 1.02 ± 0.04 g in control negative group. Additionally, at least 10% gum concentration did not significantly differ between the positive control group (GG10%; 0.289 ± 0.003) and the other group. Similarly, there was no statistically significant difference between the 10% low concentration of gum Arabic and the BG medication dosage, which were 0.457 ± 0.03 and 0.499 ± 0.052 , respectively. But the GBG15% showed the greatest relieving impact of BMD, with a mean value of 0.668 ± 0.002 . resulted in a ratio of 283.68% greater

blood glucose concentration ($p\leq 0.01$) as compared to normal controls. After feeding rats GLE (200, 400, 600, and 800 mg/kg bw) for 28 days, the rats' blood glucose levels decreased considerably ($p\leq 0.05$), recording 256.07, 223.82, 158.94, and 141.13% lower than the normal controls, respectively. The insulin level showed the opposite trend. When rats were treated with STZ, their blood insulin concentration was significantly ($p\leq 0.01$) lower than that of normal controls by a ratio of -49.75%. After feeding rats GLE at doses of 200, 400, 600, and 800 mg/kg bw over 28 days, the rats' blood insulin levels increased considerably ($p\leq 0.05$), recording -44.38, -41.09, -32.43, and 30.64% higher than those of the normal controls, respectively. The most important aspect in determining the process of developing osteoporosis is still up for debate: is bone loss or peak bone mass achieved? (53). Rats have a 5-week skeletal development surge, which is followed by a lethargic period that ends around 11.5–13 weeks, when they reach skeletal maturity. Rats receiving ASF therapy for three to sixteen weeks during both the skeletal growth and maturity periods showed longer and higher growth plates on their long bones than the control group. Chondrocytes in the growth plate undergo cell division in the proliferating zone and cell differentiation in the hypertrophic zone (54).

Table (9). Effect of gum arabic on the bone mass density (BMD) of osteoporotic rats.

Groups	BMD g
Control (-ve)	1.02±0.04 a
Control (+ve)	0.251±0.02 e
GG 10%	0.289±0.003 e
GG 15%	0.329±0.01 d
BG	0.499±0.052 c
GBG 10%	0.457±0.03 c
GBG 15%	0.668±0.002 b
LSD	0.121

Values are expressed as mean±SD, means in the same columns with different letter are significantly ($P \leq 0.05$), LSD: Least significant of difference, BMD: Bone mass density, GG10%: group supplemented with gum group 10%; GG15%: group supplemented with gum group 15%; BG: group supplemented with bonapex; GBG10%: group supplemented with bonapex addition to gum Arabic 10%; GBG15%: group supplemented with bonapex addition to gum Arabic 15%.

CONCLUSION

The results of this investigation indicate that Gum Arabic protects osteoporotic rats receiving therapy. The dietary intervention with Arabic gum aids in maintaining calcium, phosphorus, and magnesium levels. The magnitudes of vitamin D and parathyroid hormone were also increased.

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التغذية وعلوم الاطعمة

التأثير الوقائي للصبغ العربي على توازن الإلكتروليتات وهرمون الغدة الدرقية لدى الفئران المصابة بهشاشة العظام

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<p>الملخص العربي: تمت هذه الدراسة لفحص المزيد حول كيفية تأثير الصمغ العربي على الفئران التي تعاني من هشاشة العظام. تم استخدام خمسة وثلاثون من الفئران البيضاء الذكور بمتوسط (150 + 170 جرام). تم تعيين مجموعتين رئيسيتين؛ تم الاحتفاظ بالمجموعة الرئيسية الأولى (ن = 5) كمجموعة ضابطة سالبة، في حين تم إعطاء المجموعة الرئيسية الثانية (ن = 30) حقنة بريدنيزولون عن طريق الفم (5 ملجم) لتسبب هشاشة العظام لمدة أسبوعين يومياً، ثم تم تقسيمها إلى ست مجموعات فرعية، المجموعة الضابطة الموجبة، المجموعة المعالجة التي تأخذ جرعة العلاج الطبي فقط، وأربع مجموعات فرعية أخرى أعطيت نظام غذائي أساسي بالإضافة إلى 10% أو 15% من الصمغ العربي، و10% أو 15% من الصمغ العربي بالإضافة إلى جرعة طبية لمدة 28 يوماً. أشارت النتائج إلى أن التدخل الغذائي مع الصمغ العربي يمكن أن يحسن تركيز اليوريا والكرياتينين الذي ينخفض تدريجياً بزيادة جرعة الصمغ العربي. حيث أن مجموعة GBG15% كان لديه أفضل قيم إلكتروليتات مصل الفوسفور والكالسيوم والماغنسيوم بعد التدخل الغذائي بين مجموعات هشاشة العظام ولكن تختلف بشكل كبير بالمقارنة بالمجموعة الضابطة السالبة. تأثير الصمغ العربي بجرعة أعلى على فيتامين د وPTH في 15% GG لم يختلف بشكل ملحوظ عن العلاج في BG. وفي الختام، كان للصبغ العربي تأثير وقائي من هشاشة العظام لدى الفئران.</p>	<p>نوع المقالة بحوث أصلية</p> <p>المؤلف المسئول مي غريب mai.ghareb@hec.menofia.edu.eg الجوال +2 01098023098</p> <p>DOI:10.21608/MKAS.2024.259658.1272</p> <p>الاستشهاد الي: Shahin et al., 2024, The Protective Effect of Gum Arabic on the Electrolyte Balance and Parathyroid Hormone among Osteoporotic Rats. JHE, 34 (3), 19-33</p> <p>تاريخ الاستلام: 2 يناير 2024 تاريخ القبول: 20 مارس 2024 تاريخ النشر: 1 يوليو 2024</p>
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الكلمات الكاشفة: الصمغ العربي، فيتامين د، الكالسيوم، العظام، الفئران، النشاط المضاد للأوكسدة