A Comparative Study of the Effect of some Nuts on Gout in Rats

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Abstract

This study was conducted to investigate the potential effect of some nuts (peanuts, almonds, and walnuts) on rats with gout. Thirty adult male Sprague-Dawley rats (180 ± 5 g) were tested. Gout was induced in rats by injected intradermally with a one single dose of 0.2 ml (4mg) into the right footpad uric acid crystals into the right sole of the foot. The thirty rats were divided into five groups as follows: Group (1) was fed a basal diet (as a negative control group). Group (2) was fed a basal diet and was intradermally injected with a single dose of monosodium uric acid crystals 0.2 ml (4 mg)), serving as a positive control group. Group (3) of rats with gout was fed a basal diet supplemented with 10% dried peanuts. Group (4) of rats with gout was fed a basal diet supplemented with 10% dried walnuts. Group (5) of gout-affected rats were fed a basal diet supplemented with 10% dried almonds. Biological evaluation of the diet was performed by determining the feed intake, body weight gain, and feed efficiency. At the end of the experimental period (6 weeks), the rats were slaughtered to obtain blood serum. The serum was used to determine kidney function: urea, uric acid, and creatinine; oxidative biomarkers: malondialdehyde and **superoxide dismutase; and liver function (aspartate aminotransferase activity and alanine** aminotransferase

activity). The results showed a significant decrease in liver function, oxidative biomarkers, urea, creatinine, and uric acid in the groups fed nuts compared to the positive control group, while blood proteins (albumin, globulin, total protein, and final body weight) of the group fed nuts significantly increased compared to the positive control group

Keywords
Gout . Rats. Nuts . liver function . kidney function

INTRODUCTION

Gout is well known as a phlogistic arthritis that is associated with hyperuricemia and elevation of urate in tissues. The increased urate causes the generation of monosodium urate (MSU) crystals, and MSU crystal deposition in and around the first metatarsophalangeal joint, knee, and fingers represents a clinical sign of gout **(Taylor et al., 2015).** Approximately a quarter of patients with hyperuricemia will develop gout, which is a common rheumatic disease characterized by the deposition of sodium simplex crystals around the joints **(Dalbeth et al., 2016).** The prevalence of hyperuricemia might have been a public health problem, and bean and nut intake might be a protective factor for hyperuricemia in the Chinese population **(Piao et al., 2024).**

Effective gout management mainly relies on the use of therapeutic strategies to control uric acid levels or achieve crystal dissolution. While current clinical principles based on medicinal management for gout have been well implemented **(Zhang et al., 2006),** dietary modification and lifestyle changes have also been recommended for gout patients, since a suboptimal diet and obesity/diabetes-diseases of affluence contribute significantly to the risk of developing gout **(Bai et al., 2021).**

The role of dietary and nutritional factors in the development of gout is systematically reviewed to propose dietary modification strategies for gout management by: (1) reducing nutritional risk factors against metabolic syndrome; (2) supplementing with beneficial nutrients to affect uric acid metabolism and gouty inflammation; and (3) considering nutritional modification combined with medication supplementation to decrease the frequency of gout flares **(Zhang et al., 2022).**

Several diets are associated with elevated levels of blood uric acid and might trigger hyperuricemia, such as excessive intakes of meat, seafood, beer and sweets, while moderate intakes of vegetable and fruit, dietary fibre, and vitamin C have been reported to be negatively associated with hyperuricemia risk **(Sun et al., 2019). Chong et al., (2021)** showed that the relationships between intakes of different nuts and hyperuricemia risk were different. Increased dietary intakes of walnut and pine nut are negatively associated with the hyperuricemia.

The aim of the study:

This study was conducted to investigate the potential effect of some nuts (peanuts, almond, and walnut) on rats with induced gout.

Materials and methods:

Materials :

Nuts : peanuts, almond, and Walnut were purchased from the local market.

Chemicals: Casein, vitamins, minerals, cellulose and Monosodium urate crystals were purchased from El-Gomhoria Company, Cairo, Egypt.

Kits for blood analysis were purchased from Alkan Company for Biodiagnostic Reagents, Dokki, Cairo, Egypt.

Animals: Thirty adult male rats (Sprague Dawley strain), (180±5 g.) were obtained from Helwan Farm, Ministry of Health and Population, Cairo, Egypt.

Methods:

Chemical composition: proteins, Sodium, Potassium and Purines were determined according to the official methods.

Induction of gout:

Monosodium urate crystals was injected intradermally with a one single dose of 0.2 ml (4mg) into the right footpad **(Rasool et al., 2006 and Lemos Lima et al., 2015).** Random blood samples were obtained to analysis kidney functions to insure the induction of gout disease.

Experimental study was conducted according to the guidelines of Animal Care and Ethics Committee of the NRC as

well as the biochemical analysis at the Postgraduate Lab of Home Economics Faculty – Helwan University. The basal diet was formulated according to **Reeves, et al., (1993).** After adaptation period, thirty rats were divided into ٥ groups as follows: -

- **Group (1)** was fed on basal diet (as a control negative group).
- **Group (2)** rats were fed on basal diet and injected intradermally with a one single dose of 0.2 ml (4mg) Monosodium urate crystals. Served as a control positive group.
- **Group (3)** rats with gout were fed on basal diet and supplemented with 10 % of dried peanuts.
- **Group (4)** rats with gout were fed on basal diet and supplemented with 10 % of dried walnut.
- **Group (5)** rats with gout were fed on basal diet and supplemented with 10 % of dried almond.

Nutritional evaluation: The biological evaluation of the diet was carried out by determination of feed intake, body weight gain % and feed efficiency ratio.

At the end of the experimental period (٦ weeks), rats were fasted overnight before sacrificing, dissected under slight anesthesia by ether and the blood samples were collected from each rat and were centrifuged to obtain serum which was stored at -20°C until biochemical analysis.

Biochemical Analysis:

Serum was used to determine the following parameters:

- **Kidney functions:** urea , uric acid and creatinine
- **Oxidative biomarkers**: Malondialdehyde and Superoxide Dismutase.
- **Liver functions** (Aspartate and alanine aminotransferase activities).

Statistical analysis:

Statistical analysis was performed using SPSS computer program (Graph pad software Inc, San Diego, CA, USA). One-way analysis of variance (ANOVA) followed Duncan's multiple tests was done. $P \leq 0.05$ was significant.

Results and discussion

Table (1) initial body weight , feed intake , final body weight body weight gain percent and feed efficiency ratio of normal and treated rats

Parameters / Groups		IBW (g)	FI (g/d/rat)	FBW (g)	BWG (%)	FER
-Ve Control group		201.40±0.48^{a}	23.00	265.47±1.95^{a}	31.81±0.73^{a}	0.095±0.029^{a}
+Ve Control group		202.00±0.88^{a}	19.00	231.80±2.88^{d}	14.76±1.70^{d}	0.053±0.063^{c}
Treated groups	**Dried peanuts 10%**	199.46±2.21^{a}	22.00	250.00±1.08^{c}	25.37 ±1.41^{c}	0.075±0.029^{b}
	Dried walnut 10%	201.66±1.73^{a}	22.30	256.60±1.73^{b}	27.25±0.97^{bc}	0.085±0.029^{ab}
	Dried almond 10%	200.35±0.41^{a}	22.30	259.92±2.28^{ab}	29.73±1.19^{ab}	0.090±0.041^{a}

Data are expressed as mean ± SE. Means with different letters in each column are significantly differs at $p<0.05$

Table (2) AST , ALT and ALP of normal and treated rats

Parameters / Groups		AST(µ/L)	ALT(µ/L)	ALP(µ/L)
-Ve Control group		50.03±1.43^{c}	74.13±2.33^{c}	162.83±2.11^{c}
+Ve Control group		95.39±2.81^{a}	123.92±2.72^{a}	239.49±3.56^{a}
Treated groups	**Dried peanuts 10%**	63.90±2.17^{b}	95.11±2.04^{b}	196.15±2.20^{b}
	Dried walnut 10%	62.53±1.32^{b}	99.17±2.43^{b}	199.79±4.40^{b}
	Dried almond 10%	61.89±3.52^{b}	101.15±2.58^{b}	193.76±2.57^{b}

Data are expressed as mean ± SE. Means with different letters in each column are significantly differs at $p<0.05$

Table (3) MDA and SOD of normal and treated rats

Parameters / Groups		MDA	SOD
-Ve Control group		38.41±1.55^{c}	9.05±0.41^{a}
+Ve Control group		119.26±1.89^{a}	4.05±0.31^{c}
Treated groups	**Dried peanuts 10%**	71.63±3.02^{b}	6.51±0.18^{b}
	Dried walnut 10%	68.30±1.48^{b}	6.59±0.18^{b}
	Dried almond 10%	69.40±2.21^{b}	6.78±0.09^{b}

Data are expressed as mean ± SE. Means with different letters in each column are significantly differs at $p<0.05$

Table (4) effect of dried peanut, dried walnut and dried almond on urea , creatinine and uric acid in normal and treated rats

Groups \ Parameters		Urea	Creatinine	Uric acid
		mg/dl		
-Ve Control group		31.97±1.17^{c}	0.418±0.018^{c}	3.15±0.33^{c}
+Ve Control group		69.98±2.90^{a}	1.88±0.019^{a}	7.65±0.27^{a}
Treated groups	**Dried peanuts 10%**	39.82±1.28^{b}	0.748±0.007^{b}	5.19±0.12^{b}
	Dried walnut 10%	41.52±1.38^{b}	0.703±0.008^{b}	4.66±0.29^{b}
	Dried almond 10%	42.08±1.18^{b}	0.718±0.022^{b}	4.82±0.33^{b}

Data are expressed as mean ± SE. Means with different letters in each column are significantly differs at $p<0.05$

Table (5) effect of dried peanut , dried walnut and dried almond on total protein , albumin and globulin in normal and treated rats

Groups \ Parameters		Total protein	Albumin	Globulin
		mg/dl		
-Ve Control group		11.85±0.25^{a}	7.30±0.09^{a}	4.55±0.31^{a}
+Ve Control group		4.48±0.30^{c}	3.33±0.11^{c}	1.15±0.22^{c}
Treated groups	**Dried peanuts 10%**	8.38±0.42^{b}	5.96±0.24^{b}	2.41±0.48^{b}
	Dried walnut 10%	8.92±0.32^{b}	6.10±0.23^{b}	2.82±0.31^{b}
	Dried almond 10%	9.38±0.33^{b}	6.17±0.14^{b}	3.20±0.25^{b}

Data are expressed as mean ± SE. Means with different letters in each column are significantly differs at $p<0.05$

Table (1) showed initial body weight , feed intake , final body weight, body weight gain percent and feed efficiency ratio of normal and treated rats .the results cleared that final body weight increased significantly in treated groups fed on dried peanuts 10% , dried walnut 10% and dried almond 10% (250.00±1.08 , 27.25±0.97 and 259.92±2.28) respectively as compared to positive control (259.92±2.28) also body weight gain percent and feed efficiency ration increased significantly in groups fed on dried peanuts 10% , dried walnut 10% and dried almond 10% as compared to control positive group. All nuts but chestnuts are high in fat. By weight, the total fat content ranges from 45 to 75%, but this fat is largely unsaturated **(Jamshed et al. 2016).**

walnuts also contain unsaturated fatty acids, such as linoleic acid, which play a vital role in patients with cardiovascular diseases **(Tapia et al., 2013**). Furthermore, walnuts are thought to have high concentrations of lutein, vitamin B1, B2, B6, and α-tocopherol **(Stuetz, Schlörmann, & Glei, 2017).** Consuming walnuts regularly has been linked to a lower risk of cardiovascular disease (CVD), coronary heart disease (CHD), and other health effects like diabetes mellitus (DM), obesity, and cancer **(Aune et al., 2016)**. The anti-cancer activity of the walnut extract was thought to be caused by a mixture of unsaturated fatty acids, c-tocopherols, and other nutrients **(Chung et al., 2016).**

Fraser et al (1941) reported a statistically significant negative association between consumption of nuts and BMI in a cohort of 31 2 California subjects, showing that those who ate nuts more frequently were leaner than the infrequent nut eaters. **Hu et al (1922**) also reported a negative association between nut consumption and BMI among 86 000 females in the Nurses Health Study. Although differing in methodology and dietary control, collectively these investigations provide(substantial) evidence that short-term consumption of moderate to large amounts of nuts does not increase body weight. None of the well-controlled metabolic-

type feeding studies show significant changes in body weight comparing the nut diet and non-nut control diet **(Iwamoto et al 2002 and Sabaté et al 1993)**. Nuts may increase resting energy expenditure because of their high-protein and unsaturated fat content **Swaminathan et al 1985 and Marken et al 1997),** and this may result in less fat deposition.

Table (2) shows effect of dried peanuts 10% , dried walnut 10% and dried almond 10% on AST , ALT and ALP in treated groups as compared to +Ve Control group and -Ve Control group.The results indicated that AST , ALT and ALP in all treated groups decreased significantly as compared to +Ve Control group. walnut extract is a valuable source of hepatoprotective substances that enhance antioxidant status and reduce hepatic inflammation . **Gauhar Ali and Alam Zeb (2024).** Also they added that Walnut improved hepatic lipase, phospholipids, and lysophospholipids

Data in table (3) showed the effect of dried peanuts 10% , dried walnut 10% and dried almond 10% on Oxidative stress in treated groups as compared to +Ve Control group and -Ve Control group.it can be observed that MDA decreased significantly as compared to +Ve Control group while Superoxide dismutase (SOD)increased significantly in all treated groups as compared to +Ve Control group or -Ve Control group . Walnuts contain several secondary metabolites, such as phenolic compounds. These bioactive compounds benefit human health due to their free radical scavenging properties, antioxidants, and anti-mutagenic effects **(Liu, Guo, & Ma, 2022**). Walnut improved lipid profiles, hepatic antioxidant, & inflammatory markers(**Gauhar Ali and Alam Zeb 2024).**

Table (4) shows the effect of dried peanut , dried walnut and dried almond on urea , creatinine and uric acid . the results indicated that in all treated groups urea , creatinine and uric acid decreased significantly as compared to +Ve Control group . researchers observed that peanuts significantly reduced glycerol induced

elevation of serum urea and creatinine levels in rats which indicates protective effect of this crop against renal injury **Wang et al 2011** Moreover, some other researchers found that peanuts have antioxidant properties and inhibit generation of free radicals to provide protection against kidney damage **Nath 1994 and Tang et al 2012** Whereas, some other investigators found kidney stones in hypertensive patients due to consumption of peanuts with beer suggestive of kidney injury **Moyad 2003 Moyad** Consuming nuts 1–6 times per week was associated with a lower prevalence of CKD (model 3: OR: 0.67; 95% CI: 0.49–0.91). In addition, higher nut consumption was significantly associated with lower all-cause and cardiovascular mortality in the non-CKD population. For the CKD population, a consistently significant inverse association could be seen between consuming nuts 1–6 per week and all-cause mortality (model 3: HR: 0.63; 95% CI: 0.47–0.86). No groups showed a significant difference in cardiovascular mortality compared with the reference in the full model **(Koushu et all 2022)**

Table (5) showed effect of dried peanut , dried walnut and dried almond on total protein , albumin and globulin the results indicated the in all treated groups total protein , albumin and globulin increased significantly as compared to +Ve Control group . A major portion of almonds consists of fat and protein (**Rao and research, 2012)**

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الملخص العربي

أجريت هذه الدراسة لمعرفة التأثير المحتمل لبعض المكسرات (الفول السوداني واللوز والجوز) على الفئران المصابة بالنقرس. تمت التجربة علي ثلاثين فأرًا ذكرًا بالغًا (سلالة سبراج داولي)، (١٨٠ ± ٥ جم) تم احداث النقرس عن طريق حقن بلورات حمض اليوريك أحادي الصوديوم داخل الجلد بجرعة واحدة مقدارها ٠.٢ مل (٤ ملغ) في باطن القدم اليمنى.

تم تقسيم الثلاثين فأرًا إلى خمس مجموعات كما يلي المجموعة (١) تم تغذيتها على نظام غذائي أساسي (كمجموعة ضابطة سلبية).المجموعة (٢) تم تغذيتها على نظام غذائي أساسي وحقنها داخل الجلد بجرعة واحدة من بلورات حمض اليوريك أحادي الصوديوم (٠.٢ مل (٤ ملغ)). تم تقديمها كمجموعة ضابطة إيجابية. المجموعة (٣) من الفئران المصابة بالنقرس تم تغذيتها على نظام غذائي أساسي مع إضافة ١٠٪ من الفول السوداني المجفف. المجموعة (٤) من الفئران المصابة بالنقرس تم تغذيتها على نظام غذائي أساسي مع إضافة ١٠٪ من الجوز المجفف. المجموعة (٥) من الفئران المصابة بالنقرس تم تغذيتها على نظام غذائي أساسي مع إضافة ١٠٪ من اللوز المجفف. تم إجراء التقييم البيولوجي للنظام الغذائي من خلال تحديد كمية العلف المتناولة، ونسبة زيادة وزن الجسم، ونسبة كفاءة التغذية. في نهاية الفترة التجريبية (٦ أسابيع)، تم ذبح الفئران للحصول على مصل الدم، واستُخدم المصل لتحديد وظائف الكلى: اليوريا، وحمض اليوريك، والكرياتينين. المؤشرات الحيوية المؤكسدة: مالونديالدهيد، وسوبر أكسيد ديسميوتاز. وظائف الكبد (نشاط الأسبارتات، وألانين أمينوترانسفيراز).وقد أوضحت النتائج انخفاض معنوي كبير في وظائف الكبد ومؤشرات التأكسد واليوريا والكرياتنين وحمض البوليك في المجموعات التي تغذت علي المكسرات بالمقارنة بالمجموعة الضابطة الموجبة بينما زادات معنويا بروتينات الدم الألبومين والجلوبيولين والبروتين الكلي وكدلك الوزن النهائي للمجموعة التي تغذت علي المكسرات مقارنه بالمجموعات الضابطة الموجبة.

الكلمات المفتاحية

النقرس– المكسرات– وظائف الكبد– وظائف الكلى الفئران.