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EVALUATION OF ANTI-GOUT ACTIVITY OF SOME PLANT FOOD EXTRACTS

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Key words: anti-gout activity, functional food components, rats, urine, blood

The anti-gout activity of methanol and petroleum ether extracts of celery leaves, celery seeds, rosemary, cinnamon and turmeric as functional food components was studied in potassium oxonate treated rats (250 mg/kg body weight, intra-peritoneal). Blood samples were collected from all rats after an overnight fast and after 3 and 6 h from oxonate injection for determination of erythrocyte sedimentation rate (ESR), plasma uric acid, nitric oxide (NO) and malondialdehyde (MDA). Urine samples were collected for 6 h after injection for the determination of uric acid. Assessment of total phenolic contents, fatty acids and unsaponifiable matter (UNSAP) in the plants under study was carried out. Results showed that oxonate treatment produced a significant increase in all studied parameters compared to the healthy rats. Oral administration of different extracts (500 mg/kg body weight) showed a significant reduction in plasma and urine uric acid levels, petroleum ether extract of celery seeds was the most promising. The majority of administered extracts showed significant reduction in inflammatory (ESR and NO) and oxidative stress (MDA) markers with variable degrees. GLC investigation of plants UNSAP revealed the presence of different phytosterols. GLC analysis of the fatty acids methyl ester showed that celery seeds and leaves contained the highest contents of oleic and linoleic acid, respectively. Linolenic acid was only present in celery seeds and leaves. All the studied plants were rich in phenolics; rosemary was superior in this respect. In conclusion, the studied plant extracts showed significantly variable anti-gout activity associated with both antioxidant and anti-inflammatory effects, which may be due to the presence of phenolic compounds, unsaturated fatty acids, long chain fatty acids and phytosterols.

INTRODUCTION

The presence of biologically-active ingredients in food can provide us with new components of beneficial effects towards diseases. The present research is a trial for management of gout through functional food components. Gout is a metabolic disorder of purine metabolism characterized by hyperuricaemia and recurring attacks of arthritis, and in later stages chronic arthritis, tophi formation and a tendency to renal failure [Golding, 1989]. It is a chronic metabolic disease characterised by the deposition of monosodium urate crystals in joints and other tissues. These crystals cause an acute inflammatory response and can induce a permanent tissue damage which is characterised by the appearance of ulceration of the joint cartilage, marginal osteophytosis, geodic and erosive lesions and chronic inflammation of synovial membrane [Dalbeth & Haskard, 2005; Corrado *et al*., 2006]. Elevated oxidative stress has been reported in gouty patient [Urano *et al*., 2002]. Avoidance of purine-rich foods is important for gout management [Beneke, 2003]. The most important approach in the treatment of hyperuricemia is the development of xanthine oxidase inhibitors, which are effective in reducing plasma and urinary urate levels and reverses the development of tophaceous deposits [Nuki & Simkin, 2006]. So food components which inhibit xanthine oxidase activity can reduce the formation of uric acid and alleviate inflammation. This is because xanthine oxidase is a key enzyme playing a role in hyperuricemia, catalyzing the oxidation of hypoxanthine to xanthine and then to uric acid [Unno *et al*., 2004]. Also inhibition of renal urate reabsorption and oxidative stress has an important impact in gout management.

The aim of the present research is finding out functional food components of anti-gout activity. This is accomplished through testing different plant food extracts as uric acid lowering, antioxidant and anti-inflammatory in experimental gout model in rats. Specific phytochemical constituents of the studied plants have been assessed as well.

MATERIALS

Plant materials

Fresh celery leaves, celery seeds (*Apium graveolens*, Family Umbelliferae), dried fig fruits (*Ficus carica*, Family Moraceae), turmeric rhizomes (*Curcuma domestica* L., Family Zingiberaceae), cinnamon bark (*Cinnamomum zeylanicum*, Family Lauraceae) and rosemary leaves (*Rosmarinus officinalis* L., Family Labiatae) were purchased from local markets.

Animals

Male Sprague Dawely rats with average body weight of 150±6.049 g were used in the study. The animals were kept individually in metabolic stainless steel cages at room temperature.

Potassium oxonate

Potassium oxonate was obtained from Sigma, USA, for induction of gout in rats.

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METHODS

Preparation of plant materials

All plant materials understudy were dried in an air-circulated oven at 40°C till complete dryness, and then reduced to powder form.

Preparation of plant extracts

The dried powder of different plants was separately placed in a continuous extraction apparatus and subjected to successive extraction using petroleum ether (40-60°C), then methyl alcohol. Complete extraction has been verified for each solvent when no residue was obtained when small aliquot of colorless extract was evaporated to dryness in small glass watch; the solvent of each extract was removed by evaporation under reduced pressure. All extracts were kept in vacuum desiccators over anhydrous calcium chloride.

Preparation of dosage form

Methanol and petroleum ether extracts of different plants were dispersed separately in water using the same amount of gum acacia. For the control, the vehicle was prepared through dissolving the same amount of gum acacia in water.

Determination of total phenolics content of different plants under study

Total phenolics were determined colorimetrically in the powder of different plants materials using the Folin-Ciocalteu reagent [Singleton & Rossi, 1965]. Absorbance was measured at 765 nm using a UVPC spectrophotometer. The total phenolics content was expressed as gallic acid equivalents (GAE) in milligrams per 100 gram of dry material.

Assessment of fatty acids, hydrocarbons and sterols contents in different studied plants

The petroleum ether extracts of different plant materials except figs were prepared according to A.O.A.C [2000] to be subjected to GLC analysis of fatty acids, hydrocarbons and sterols.

The unsaponifiable fraction was analyzed by GLC adopting the following conditions: column: 10% OV-101 packed column; stationary phase: Chromosorb W-HP; detector temperature: 290°C; injector temperature: 28°C; carrier gas N_2; flow-rate: 30 mL/min; air flow-rate: 300 mL/min; H_2 flow-rate: 30 mL/min; detector: FID; chart speed: 0.5 cm/min; oven program: initial temperature of 70°C; final temperature of 270°C; programmed 4°C/min, for 35 min at 270°C, total time, 85 min. Identification of hydrocarbons and sterols contents of the unsaponifiable matter was carried out by comparison of their retention times with co-injected authentic reference compounds. Quantization was based on peak area integration.

Analysis by GLC of the fatty acids methyl ester was carried out according to the following conditions: stationary phase: 10% diethylene glycosuccinate (DEGS) packed column; oven temperature: 170°C; detector temperature: 300°C; injector temperature: 250°C; carrier gas: N_2; flow-rate: 30 mL/min; air flow-rate: 350 mL/min; H_2 flow-rate: 350 mL/min; detector: FID; chart speed: 2 cm/min. Identification of the fatty acid methyl ester was carried out by direct comparison of retention times of each of the separated compounds with authentic samples of the fatty acid methyl esters analysed under the same conditions. Quantization was based on peak area integration.

Design of experimental study for anti-gout activity

The anti-gout activity of different plant extracts was evaluated in rats. Seventy-eight male Sprague-Dawely rats maintained on laboratory stock diet were fasted for 16 h before starting the experiment and divided into thirteen groups, each comprised 6 rats. Two groups served as control (one healthy control and the other was gouty control), where rats received no extracts. The other eleven groups were the test groups. At the start of experiment, all rats except healthy control group were injected intraperitoneally with potassium oxonate (250 mg/kg body weight) for induction of gout [Yonetani *et al*., 1987]. An hour later, rats of different test groups were given one oral dose (500 mg/kg rat body weight) through an esophagus tube of either methanol or petroleum ether extracts of celery leaves, celery seeds, cinnamon, rosemary or turmeric. Rats of the residual test group were given one oral dose (500 mg/kg rat body weight) of a methanol extract of fig fruits. Rats of the control groups were given only the vehicle. After 3 and 6 h from injection, blood samples were withdrawn from eye vein orbital and divided into two parts: one mixed with sodium citrate (109 mmol/L) for determination of erythrocyte sedimentation rate (ESR) [Westergren, 1921] and the second part mixed with heparin for the separation of plasma for the determination of uric acid [Watts, 1974], nitric oxide [Montgomery & Dymock, 1961] and malondialdehyde (MDA) as an indicator for lipid per-oxidation [Satoh, 1978]. Urine was collected for 6 h after injection for the determination of uric acid [Watts, 1974].

Statistical analysis

The results obtained were expressed as the mean±SE. Rats of the control gouty group were compared with healthy rats. Test groups were compared with control gouty group. The significance of values was analysed by Student's t-test.

RESULTS AND DISCUSSION

The different edible plants used in the present study have been chosen from literature to possess antioxidant and anti-inflammatory activity to be tested in a gout model in rat.

Total phenolics content of different plants food under study

Table 1 showed the contents of total phenolic as mg gallic acid equivalent/100 g dry weight of different studied plants. Rosemary showed the highest content of total phenolic

TABLE 1. Total phenolic contents of plants under investigation.

Plants	Total phenolic (mg gallic acid equivalent/100g)
Celery seeds	2486
Celery leaves	3160
Turmeric	3656
Rosemary	8643
Cinnamon	5844
Fig	920

compounds (8643 mg/100 g sample) followed by cinnamon (5844), turmeric (3656), celery leaves (3160) and celery seeds (2486). Fig was of the lowest content of phenolic compounds (920 mg/100 g sample).

Phenolic compounds are composed of several classes including flavonoids, anthocyanins, phenolic acids and catechins that are characterised by cyclic rings with hydroxyl substitutions at various positions [Duthie *et al*. 2000] which react readily with free radicals, thereby preventing cell damage. Phenolic compounds have been reported to have multiple biological effects, including antioxidant and anti-inflammatory activity [Löliger, 1991].

Previously rosemary has been shown to contain different phenolic compounds such as carnosol, rosmarinic acid and carnosic acid in addition of their terpene metabolites, and flavones [Lee *et al*., 2006; Almela *et al*., 2006]. Carnosol has been reported to possess antioxidant and anti-inflammatory activity [Lo *et al*., 2002; Lee *et al*., 2006] and inhibit nitric oxide production [Chan *et al*., 1995]. Rosmarinic acid and carnosic acid have been shown to have very high antioxidant activity [Almela *et al*., 2006].

Curcumin, a polyphenol isolated from turmeric, has been reported to have antioxidant and anti-inflammatory activity [Chen *et al*., 2006; Rahman *et al*., 2006] through inhibiting the generation of reactive oxygen species and nitrite radical [Joe & Lokesh, 1994] and down regulation of cyclooxygenase 2 and nitric oxide synthetase [Surh *et al*., 2001]. The antirheumatic activity of curcumin has also been proved in clinical study [Deodhar *et al*., 1980].

Phenolic compounds in cinnamon have been reported to have a marked antioxidant potential and to suppress lipid peroxidation [Lee *et al*., 2003; Ranjbar *et al*., 2006].

Celery leaves extracts are scavengers of $OH^{\bullet}$ and $DPHH^{\bullet}$ radicals and reduce liposomal peroxidation, which may be due to the presence of flavonoids [Popovic *et al*., 2006]. Celery seeds also showed antioxidant and cyclooxygenase inhibitory activity reflecting the anti-inflammatory effect due to the presence of phenolic compounds; sedanolide and senkyunolide-N [Momin & Nair, 2002].

Fig fruits have been previously shown to have antioxidant activity, which correlated with total polyphenols, flavonoids and anthocyanins contents; cyanidin-3-O-rhamnoglucoside is the main anthocyanin in fig fruits [Solomon *et al*., 2006].

Unsaponifiable matter and fatty acids methyl ester

Tables 2 and 3 showed the fatty acids and the contents of unsaponifiable matter respectively in the plants under investigation. The results of total fatty acids analysis revealed that celery seeds contained the highest amount of oleic acid (51.9%), followed by cinnamon (45.4%) then celery leaves (29.7%). Turmeric and rosemary do not contain oleic acid. Celery leaves are the richest source of linoleic acid (26.2%) followed by turmeric (19.6%), rosemary (16.2%) and celery seeds (2.6%). Cinnamon does not contain linoleic acid. Linolenic acid was only present in celery seeds and leaves as 1.3% and 3.2%, respectively. Total identified unsaturated fatty acids ranged from 16.2% in rosemary to 84% in celery leaves. Total unsaturated fatty acids were determined to be 55.8%, 49.7% and 19.6% in celery seeds, cinnamon and tumeric, respectively. Total saturated fatty acids percentage from total fatty acids were found to be 14.5, 14.8, 28.8, 33.2 and 43.1 in celery leaves, celery seeds, cinnamon, rosemary and turmeric, respectively. GLC investigation of the unsaponifiable matter revealed the presence of β-sitosterol in all plants; its highest percentage was reported in rosemary (6.4%), followed by cinnamon (5%) and celery leaves (4.4%). Turmeric and celery seeds contain only very little percentage of β-sitosterol. β-Amyrine occurred in trace amounts only in celery seeds (0.067%). Rosemary was the richest plant under investigation in stigmasterol (8.5%), while turmeric and celery seeds contained 1.2% of that compounds, in turn its least percentage (0.469%) was noticed in celery leaves. Cinnamon is the only plant under study that does not contain stigmasterol. Only very little amounts of campesterol were present in rosemary (1.7), cinnamon (1.1), celery seeds (0.271) and turmeric (0.266). Squalene was present in very low percentage in turmeric, rosemary and celery seeds. The results showed that total sterols as percentage of unsaponifiable matter have been detected to be 2.8, 4.9, 6.1, 2.6 and 18.2% in turmeric, celery leaves, cinnamon, celery seeds and rosemary, respectively. The identified hydrocarbons (C10-C30) seen in Table 3 showed that the total hydrocarbon as percentage of unsaponifiable matter were 5.7, 7.1, 22.0, 52.2 and 75.9% in rosemary, celery seeds, cinnamon, celery leaves and turmeric, respectively. The highest percentage of hydrocarbon was attributed to C12 (29.4%) in turmeric.

TABLE 2. Fatty acids contents of the different plants (% of total fatty acids).

Fatty acids	Celery seeds	Celery leaves	Turmeric	Rosemary	Cinnamon
C10	-	-	2.2	13.9	3.1
C11	0.784	-	23.5	3.3	-
C12	2.8	-	14.0	-	2.7
C14 (0)	11.2	4.7	12.4	-	1.4
C14 (1)	-	7.2	-	-	2.0
C16 (0)	-	9.8	3.4	16.0	21.6
C16 (1)	-	14.8	-	-	-
C18 (1)	51.9	29.7	-	-	45.4
C18(2)	2.6	26.2	19.6	16.2	-
C18 (3)	1.3	3.2	-	-	-
C22 (1)	-	2.9	-	-	2.3
Total identified saturated fatty acids	14.8	14.5	43.1	33.2	28.8
Total identified unsaturated fatty acids	55.8	84	19.6	16.2	49.7

Long chain fatty acids such as palmitic, stearic, linoleic, α-linolenic, *etc*., have been reported to have antidenaturant activity, which might have beneficial effects in rheumatic diseases [Saso *et al*., 1999] such as gout.

Plant sterols are important structural components of plant membranes and they play a key role in plant cell membrane function [Dillard & German, 2000]. β-Sitosterol, its glycoside and stigmasterol have been reported to have anti-inflammatory and immune-modulating activity [Gomez *et al*.,

TABLE 3. GLC analysis of unsaponifiable matter of the different plants (as percentage of total unsaponifiable matter).

Hydrocarbons and sterols	Celery seeds	Celery leaves	Turmeric	Rosemary	Cinnamon
Hydrocarbons					
C10	-	1.6	-	-	-
C11	0.592	0.332	6.6	-	-
C12	0.912	1.2	29.4	-	-
C13	-	-	17.3	-	-
C14	-	0.917	1.9	-	-
C15	-	1.1	3.0	-	1.7
C16	-	1.5	16.4	-	0.636
C17	1.1	-	-	0.528	0.925
C18	-	-	-	-	-
C19	-	-	0.151	-	1.4
C20	0.221	-	0.159	0.325	-
C21	2.9	-	0.235	0.457	-
C23	0.404	-	-	0.324	2.1
C24	0.156	0.804	-	1.1	5.5
C25	0.824	13.0	0.735	3.0	1.8
C26	-	2.8	-	-	3.4
C27	-	11.4	-	-	2.6
C28	-	15.0	-	-	1.0
C29	-	2.5	-	-	0.947
C30	-	-	-	-	-
Sterols					
Squalene	0.089	-	0.744	0.606	-
Campesterol	0.271	-	0.266	1.7	1.1
Spinosterol	0.765	-	0.399	0.952	-
Stigmasterol	1.2	0.469	1.2	8.5	-
β-Sitosterol	0.167	4.4	0.181	6.4	5.0
β-Amyrin	0.067	-	-	-	-
Total identified hydrocarbons	7.1	52.2	75.9	5.7	22.0
Total identified sterols	2.6	4.9	2.8	18.2	6.1

1999; Bouic & Lamprecht, 1999]. Plant sterols display their anti-inflammatory activity through inhibition of the secretion of interleukin-6 and tumor necrosis factor-α [Bouic, 2001]. Phytosterols have been shown to possess antioxidant activity [Mohamed *et al*., 2005].

Evaluation of anti-gout activity of different plants

Mean uric acid levels in urine of different experimental groups are illustrated in Table 4. The intra-peritoneal injection of potassium oxonate in rats elevated uric acid levels significantly in urine ($p<0.001$, 134%) compared with normal healthy rats. Potassium oxonate injection increased the synthesis of uric acid through stimulation of xanthine oxidase. Administration of different plant extracts significantly reduced the elevation of uric acid in urine with variables degrees. Oral administration of the petroleum ether extract of celery seeds

TABLE 4. Uric acid levels in urine of different experimental groups.

Groups	Uric acid (μmol/L) (mean ± SE)
Normal control	866 ± 17.014
Gouty control % Change	2024• ± 58.834 + 134
Petroleum ether extract of celery seeds % Change	882* ± 12.731 - 56
Methanol extract of celery seeds % Change	920* ± 20.761 - 55
Petroleum ether extract of celery leaves % Change	924* ± 9.280 -54
Methanol extract of celery leaves % Change	1173* ± 13.385 - 42
Petroleum ether extract of cinnamon % Change	1071* ± 11.124 - 47
Methanol extract of cinnamon % Change	1054* ± 12.433 - 48
Petroleum ether extract of turmeric % Change	1294* ± 12.255 - 36
Methanol extract of turmeric % Change	1109* ± 9.780 - 45
Petroleum ether extract of rosemary % Change	1006* ± 13.266 - 50
Methanol extract of rosemary % Change	1013* ± 6.008 - 50
Methanol extract of fig fruits % Change	924* ± 13.266 - 54

Values significantly differ from normal control: •$p<0.001$; values significantly differ from gouty control:*$p<0.001$.

produced the highest reduction (56%) in uric acid level in urine, while petroleum ether extract of turmeric showed the lowest reduction (36%). Percentage inhibitions of urine uric acid were more or less similar on administration of the methanol extract of celery seeds (55%), petroleum ether extract of celery leave (54%) and methanol extract of fig (54%).

Tables 5 and 6 showed the different determined biochemical parameters in blood after 3 and 6 h from oxonate injection, respectively. Injection of oxonate in rats stimulates xanthine oxidase to produce excess uric acid, so elevates their level in plasma and urine. The elevation of uric acid level in plasma is an indicator of its elevation in joints and other tissues which causes an acute inflammatory response and can induce permanent tissue damage [Corrado *et al*., 2006]. In the present study gouty rats showed a significant increase in erythrocyte sedimentation rate (ESR), nitric oxide (NO) and malondialdehye (MDA) levels compared with normal rats. These results indicate inflammatory condition and elevated oxidative stress as described previously [Urano *et al*., 2002] in gouty patients and experimental animals. The oral administration of different plant extracts produced significant reduction in plasma uric acid levels and reduced inflammatory (ESR and NO) and oxidative stress (MDA) markers with variable degrees. The oral administration of petroleum ether extract of celery seeds produced the highest reduction of plasma uric acid levels after 3 and 6 h from oxonate injection (41 and 44%, respectively). The same extract showed significant reduction in ESR, plasma NO and MDA levels after 3 and 6 h from oxonate injection. Previously, Wood *et al*. [2001] suggested that

TABLE 5. Biochemical parameters of different experimental groups after 3 h of oxonate injection.

Groups	Parameters			
	Plasma			Whole blood
	Uric acid (μmol/L)	Nitric oxide (umol/L)	MDA (nmol/L)	ESR (mm/h)
Normal control	65 ± 0.357	9.8 ± 0.387	9.8 ± 0.145	2.5 ± 0.115
Gouty Control	190▪ ± 0.535	14.7▪ ± 0.382	16.8▪ ± 0.235	10.3▪ ± 0.251
% Change	+191	+50	+71	+ 312
Petroleum ether extract of celery seeds	113** ± 0.297	11.9** ± 0.785	10.6** ± 0.321	6.2** ± 0.315
% Change	-41	-19	-37	-40
Methanol extract of celery seeds	119** ± 4.164	12.6** ± 0.359	12.8** ± 0.435	8.4** ± 0.131
% Change	-38	-13	-24	-18
Petroleum ether extract of celery leaves	125** ± 0.476	12.8** ± 0.292	11.5** ± 0.382	7.9** ± 0.245
% Change	-34	-13	-32	-23
Methanol extract of celery leaves	143** ± 0.119	13.7 ± 0.541	13.6** ± 0.41	9.0** ± 0.125
% Change	-25	-7	-19	-13
Petroleum ether extract of cinnamon	131** ± 0.238	13.00* ± 0.140	14.2** ± 0.272	8.1** ± 0.251
% Change	-31	-12	-15	-21
Methanol extract of cinnamon	149** ± 0.357	13.8 ± 0.235	15.3** ± 0.181	8.5** ± 0.365
% Change	-22	-6	-9	-17
Petroleum ether extract of turmeric	137** ± 0.59	12.9* ± 0.142	14.8** ± 0.295	9.1** ± 0.206
% Change	-28	-12	-12	-12
Methanol extract of turmeric	155** ± 0.357	13.4 ± 0.495	15.2** ± 0.35	8.8** ± 0.285
% Change	-19	-9	-10	-15
Petroleum ether extract of rosemary	146** ± 0.238	12.9* ± 0.333	14.6 ± 0.385	8.6** ± 0.155
% Change	-23	-12	-13	-17
Methanol extract of rosemary	137** ± 0.595	13.3* ± 0.252	15.1 ± 0.211	9.1** ± 0.105
% Change	-28	-10	-10	-12
Methanol extract of dry fig fruits	143** ± 0.476	12.8** ± 0.175	11.9 ± 0.593	7.8** ± 0.213
% Change	-25	-13	-29	-24

Values significantly differ from normal control: ▪$p<0.001$; values significantly differ from gouty control: *$p<0.005$, **$p< 0.001$.

celery seed oil is a significant source of sedanolide, which can be used to treat inflammation in gout and rheumatic diseases. Recently, petroleum ether and methanol extracts of celery leaves and seeds showed inhibition of xanthine oxidase activity *in vitro* [Mohamed & Al-Okbi, in press]. It was reported previously that the methanol extract of cinnamon produced significant inhibition of xanthine oxidase activity [Kong *et al*., 2000]. The petroleum ether, alcohol and water extracts of *Curcuma longa* have been shown to have anti-inflammatory effects [Yegnanrayan *et al*., 1976].

The reduction in uric acid levels, inflammatory markers and oxidative stress in gouty rats after oral administration of different plants extracts may be ascribed to the presence of phytochemical constituents such as phenolic compounds, plant sterols, long chain fatty acids and to a lesser extent unsaturated fatty acids as noticed from the present results. Phenolic compounds play an important role in the protection of human from damage by free radicals through its antioxidant activity [Löliger, 1991]. Phenolic compounds have also been reported to possess anti-inflammatory activity. Phytochemical constituents previously showed to have anti-gout activity are phthalide, phenolic compounds and tannins [Owen & Johns, 1999; Wood *et al*., 2001]. Caffeic acid has been reported to be an inhibitor of xanthine oxidase [Chiang *et al*., 1994]. The current results revealed that phenolic compounds are present in all plants under investigation with different percentages. Also the reported results showed the presence of β–sitosterol and stigmasterol in the unsaponifiable fraction of the majority of the studied plants. These compounds have been reported previously to possess antioxidant and anti-inflammatory activities [Wang *et al*., 2002; Mohamed *et al*., 2005]. It was cited previously that long chain fatty acids, as those present in the studied plants, possess significant anti-inflammatory activity [Saso *et al.*, 1999]. In the present study the reduction of uric acid levels in both plasma and urine on administration of the different extracts may reflect xanthine oxidase inhibition and/or inhibition of renal urate reabsorption. Some natural compounds, such as vitamin C, have been reported to produce reduction in plasma uric acid with simultaneous increase in urinary uric acid [Stein *et al*., 1976]. This effect is called uricosuric which may result in deposition of urate in kidney tissue with possible formation of stones. This is not the case in our administered extracts.

TABLE 6. Biochemical parameters of different experimental groups after 6 h of oxonate injection.

Groups	Parameters			
	Plasma			Whole blood
	Uric acid (μmol/L)	Nitric oxide (umol/L)	MDA (nmol/L)	ESR (mm/h)
Normal control	68 ± 0.595	10.2 ± 0.202	10.2 ± 0.231	2.8 ± 0.211
Gouty Control	268▪ ± 8.566	18.8▪ ± 0.232	18.4▪ ± 0.163	12.1▪ ± 0.132
% Change	+ 291	+ 84	+ 80	+ 332
Petroleum ether extract of celery seeds	149** ± 11.243	13.3** ± 0.244	12.7** ± 0.232	7.8** ± 0.209
% Change	-44	-29	-31	-36
Methanol extract of celery seeds	184** ± 9.816	14.5** ± 0.341	13.8** ± 0.181	8.9** ± 0.135
% Change	-31	-23	-25	-26
Petroleum ether extract of celery leaves	196** ± 10.232	14.8** ± 0.321	15.8** ± 0.101	9.3** ± 0.181
% Change	-27	-21	-14	-23
Methanol extract of celery leaves	208** ± 11.600	15.6** ± 0.332	16.2** ± 0.153	9.9** ± 0.138
% Change	-22	-17	-12	-18
Petroleum ether extract of cinnamon	226** ± 11.898	14.9** ± 0.359	16.0** ± 0.185	10.4** ± 0.131
% Change	-16	-21	-13	-14
Methanol extract of cinnamon	220** ± 7.615	15.8** ± 0.325	16.8** ± 0.238	10.8** ± 0.099
% Change	-27	-16	-9	-11
Petroleum ether extract of turmeric	202** ± 12.790	15.7** ± 0.308	17.4** ± 0.111	11.3** ± 0.152
% Change	-24	-16	-5	-7
Methanol extract of turmeric	214** ± 13.325	16.6** ± 0.256	17.8 ± 0.252	11.7 ± 0.144
% Change	-20	-12	-3	-3
Petroleum ether extract of rosemary	190** ± 8.031	15.3** ± 0.185	16.1** ± 0.115	10.2** ± 0.150
% Change	-29	-19	-13	-16
Methanol extract of rosemary	202** ± 15.348	15.5** ± 0.299	16.6** ± 0.204	10.6** ± 0.192
% Change	-24	-18	-10	-12
Methanol extract of dry fig fruits	179** ± 6.068	13.8** ± 0.249	13.3** ± 0.231	9.3** ± 0.185
% Change	-33	-27	-28	-23

Values significantly differ from normal control: ▪$p<0.001$; values significantly differ from gouty control: *$p<0.005$, **$p<0.001$.

CONCLUSION

The studied plant extracts produced significant reduction in uric acid levels in both plasma and urine associated with both antioxidant and anti-inflammatory effects which may be due to the presence of phenolic compounds, unsaturated fatty acids, long chain fatty acids and phytosterols.

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