ORIGINAL ARTICLE

Magnetized water induces changes in the antioxidant properties of some medicinal plants extracts

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Magnetized water or clustered water is an effective solvent and has the ability to dissolve the nutrients easier and faster than purified water. The objective was to explore the effect of magnet on the constituents of aqueous medicinal plants extracts. Aqueous extracts (infusion or overnight; 1% w/v) of *Cinnamomum verum* (cinnamon) bark, *Salvia officinalis* (sage) leaves, *Zingiber officinale Rosc* (ginger) tuberous and *Symphytum officinale* (comfrey) seeds were prepared and then divided into two parts, one part was exposed to magnetic disc (0.15 Tesla) for 1 hour. The UV-visible spectra of each extract were obtained and the total flavonoids, allantoin and the reducing power were determined. The UV-visible spectra showed changes in the magnitude of the absorbance peak, appearance of new peaks and shifted peaks in the magnetized aqueous extract compared with non-magnetized extracts. The changes in the total flavonoids, allantoin and the reducing power in the magnetized extract did not follow specific pattern. The magnet induces changes in the constituents of medicinal plants via its effect on the electrical properties of water.

Key words: Medicinal plants, magnet, antioxidants

INTRODUCTION

Water is almost universally the solvent used to extract medicinal plants activity. The aromatic or saturated organic compounds can be obtained initially through water besides solvents extraction.[1] Some methods are used to improve the extraction process such as microwave-assisted extraction, supercritical fluid extraction and accelerated solvent extraction or pressurized liquid extraction.[2,3] Magnetized water has a small molecule per water cluster (about 6 molecule) than regular water (has about 14–30 molecules). The properties of magnetized water include less surface tension, slightly alkaline, a lot of oxygen, easily passing through the cell membrane and more effective solvent.[4] The quantity of active ingredients as well as the total polyphenols extracted from the medicinal plants such as *Cinnamomum verum*,[5] *Symphytum officinale*,[6] *Zingiber officinale Rosc*[7] and *Salvia officinalis*[8] depended on the extracted solvent as well as the method of extraction. This study is aimed to explore the benefit of using magnetized water as a solvent in extraction total polyphenols and allantoin from some medicinal plants and to compare the yields with those extracted by non-magnetized water.

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MATERIALS AND METHODS

This study was conducted in Departments of Pharmacology and Physiology/Medical physics, College of Medicine, Al-Mustansiriya University in Baghdad, Iraq in cooperation with Department of Physiology/Medical Physics, College of Medicine, Diyala University in Diyala, Iraq. Four medicinal plants, *Cinnamomum verum* (cinnamon) bark, *Salvia officinalis* (sage) leaves, *Zingiber officinale Rosc* (ginger) tuberous and *Symphytum officinale* (comfrey) seeds, were investigated in this study. These medicinal plants were obtained from local sources, grinded mechanically and sieved prior to their extraction. A 1 g dried fine powder of each medicinal plant was extracted with 100 ml distilled water (1% w/v) for 24 hours in dark place at room temperature 25°C, then the extraction was followed by filtration. Another aqueous extract (1% w/v) of each medicinal plant was prepared by infusion. The boiling water was added to the powder of medicinal plant and left for 15 minutes, then followed by filtration. Each aqueous extract was divided into two parts; one of them was magnetized by ferrite magnet disc (0.15 Tesla) composed of ferrous trioxide (Fe_2O_3). The magnet disc was immersed in a glass container containing 25 ml of each extract of

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medicinal plant for 1 hour. The other part of each aqueous extract was not magnetized. The UV-visible spectra of each aqueous extract (magnetized and non-magnetized) were obtained by scanning the extract using UV-visible spectrophotometer (Aquarius, France, Cecil series with scanning ability). The biochemical analysis included determination of total flavonoids, allantoin and the reducing power of each aqueous extract.

Quantification of Total Flavonoids

The method is based on the quantification of the yellow colour produced by the interaction of flavonoids with $AlCl_3$ reagent.[9] Aliquots of 1.5 ml (0.1% w/v)) of extracts were added to equal volumes of a solution of 2% $AlCl_3 \cdot 6H_2O$ (2 g in 100 ml methanol). The mixture was vigorously shaken, and absorbance at 367 nm was read after 10 minutes of incubation. The total flavonoids content was calibrated using the linear equation based on the calibration curve of rutin. The flavonoids content was expressed as microgram rutin equivalent per milligram dry weight.

Determination of Allantoin

This was carried out as described previously[10] using Ehrlich's reagent, which consists of 1 g ϱ-dimethylaminobenzaldehyde (ϱDMAB) in a mixture of 25 ml concentrated HCl and 75 ml methanol. One millilitre (0.05% w/v) of each extract was mixed with Elrich's reagent (1:2 v/v), incubated at room temperature and read the absorbance at 440 nm. The allantoin content was calibrated using the linear equation based on the standard allantoin calibration curve.

Determination of Reducing Power

One millilitre of each extract (0.05 w/v) was mixed with 2.5 ml of phosphate buffer (0.2 M, pH 6.6) and 2.5 ml potassium ferricyanide [$K_3Fe(CN)_6$] (1%); then the mixture was incubated at 50°C for 30 minutes. Afterwards, 2.5 ml of trichloracetic acid (10%) was added to the mixture, which was then centrifuged at 3000 rpm for 10 minutes. Finally 2.5 ml of the upper layer solution was mixed with 2.5 ml of distilled water and 0.5 ml of $FeCl_3$ (0.1%) and the absorbance was measured at 700 nm.[11] Increased absorbance of the reaction mixture indicated increased reducing power.

RESULTS

Table 1 shows that the absorbance of each principal peak that was detected in magnetized infusion extracts of comfrey, sage and ginger was less than counterpart peak of non-magnetized infusion extract, and the reverse finding was observed with cinnamon.

The absorbance peaks of overnight aqueous extracts of sage and ginger were higher while the extracts of comfrey and cinnamon were lesser when their solutions were magnetized [Table 1].

The yield of total flavonoids in terms of rutin in magnetized infusion aqueous extract of all tested medicinal plants were reduced compared with non-magnetized extract [Table 2]. On the other hand the total flavonoids of magnetized overnight extracts of sage and comfrey were higher than corresponding non-magnetized extracts.

The level of allantoin was reduced when the infusion aqueous extracts were magnetized [Table 3]. The cinnamon extract was less affected by magnet than other medicinal plants extracts. On the other hand the effect of magnet on the overnight aqueous extract was exactly opposite to that obtained with infusion aqueous extracts. The allantoin level was increased to reach the double in comfrey aqueous extract [Table 3].

The reducing power of magnetized infusion aqueous extracts of comfrey was increased while that of the other

Table 1: The effect of magnet on the medicinal plants extracts in reference to the absorbance peak (O.D.). Each prepared extract was diluted to 0.1% (w/v final concentration)

	Infusion aqueous extract				Overnight aqueous extract			
	Non-magnetic		Magnetic		Non-magnetic		Magnetic	
	Peak λ	O.D.	Peak Λ	O.D.	Peak Λ	O.D.	Peak λ	O.D.
Comfrey	355	0.082	355	0.062	-	-	-	-
Salvia	277.5	0.137	280	0.130	267.5	0.217	267.5	0.217
	325	0.106	355	0.057	330	0.164	330	0.164
			675	0.080				
Ginger	277.5	0.443	277.5	0.366	277.5	0.187	277.5	0.187
			355	0.106	355	0.051	355	0.051
					685	0.024	685	0.024
					747	0.176	747	0.176
					767.5	0.173	767.5	0.173
Cinnamon	282.5	2.215	282.5	2.298	282.5	2.765	282.5	2.765
	325	0.182						

OD - Optic density

Table 2: The effect of magnet on the total flavonoid of the aqueous extracts of medicinal plants

	Infusion aqueous extract		Overnight aqueous extract	
	Non-magnetic	Magnetic	Non-magnetic	Magnetic
Comfrey	12.5	11.4 (91.2)	13.7	13.3 (97.1)
Salvia	25.8	16.0 (62.0)	18.6	30.4 (163.4)
Ginger	55.5	29.3 (52.8)	13.3	23.2 (174.4)
Cinnamon	142.5	41.0 (28.8)	31.2	30.8 (98.7)

Figures in parenthesis indicate percentage. The results are expressed as µg rutin/mg dry weight plant and the percent of non-magnetized value

Table 3: The effect of magnet on the allantoin of the aqueous extracts of medicinal plants

	Infusion aqueous extract		Overnight aqueous extract	
	Non-magnetic	Magnetic	Non-magnetic	Magnetic
Comfrey	1.312	0.543 (41.4)	0.731	1.481 (202.6)
Salvia	2.187	0.543 (24.8)	0.793	1.418 (178.8)
Ginger	2.3356	1.168 (49.6)	0.731	1.231 (168.4)
Cinnamon	3.668	3.356 (91.5)	1.168	2.168 (185.6)

Figures in parenthesis indicate percentage. The results are expressed as µg/mg dry weight plant and the percent of non-magnetized value

medicinal plants' extracts was reduced [Table 4]. On the other hand the reducing power of magnetized overnight aqueous extracts of ginger was decreased to less than 10% of the non-magnetized extract while the reducing power of other medicinal plants' extracts was increased [Table 4].

Table 4: The effect of magnet on the reducing power of the aqueous extracts of medicinal plants

	Infusion aqueous extract		Overnight aqueous extract	
	Non-magnetic	Magnetic	Non-magnetic	Magnetic
Comfrey	1.312	0.543 (41.4)	0.731	1.481 (202.6)
Salvia	2.187	0.543 (24.8)	0.793	1.418 (178.8)
Ginger	2.3356	1.168 (49.6)	0.731	1.231 (168.4)
Cinnamon	3.668	3.356 (91.5)	1.168	2.168 (185.6)

Figures in parenthesis indicate percentage. The results are expressed as the optic density of the absorbance at λ700 nm and the percent of non-magnetized value

DISCUSSION

The results of this study show that the constituents of aqueous extracts of different medicinal plants are altered when the solutions are magnetized and the alterations are related to the plant source (leaves, barks, tuberous or seeds) and to the method of extraction. The alterations in the UV-visible spectra observed in this study are in agreement with other studies. Pang and Deng[12] studied the property of water and its changes under the actions of magnetic fields by infrared, Raman, UV-visible and X-ray lights and found great changes in the properties of magnetic water relative to those of pure water; their strength of peaks were all increased, there was a shift of some peaks and some new peaks appeared. The changes in the constituents of medicinal plants' aqueous extracts in terms of total flavonoids and allantoin as well as their reducing power may be attributed to the reduction of the electrical resistivity and thermal stability of purified water that triggered with magnet.[13,14] In the solid materials, the frequency spectrum of magnetized water exerts changes in the electrical properties of chemical that are closely related to the di-electric performance of magnetized water.[15] Moreover, magnetic water posses an antioxidant activity via generating oxygen anion molecule ($OH^- + OH^- \rightarrow H_2O + O^-$) which can stop the free radical cycle and this may explain the changes in the reducing power which observed in this study. It was reported that the crystallization mode of water's mineral content changed from dendritic substrate-bound solidification habit to separate disc-shaped crystals after the water had moved through a number of magnetic fields.[16]

In vivo the seedling growth is magnetically sensitive as a result of photo-induced radical-pair reactions in cryptochrome photoreceptors[17] and the response manifested in terms of the constituents of growing plants. Gu and Zhou found that the effect of magnetizing soil on the seedling included an increase of water soluble sugars, certain enzymes, root vitality and total biomass of plant.[18] In conclusion, the antioxidant properties of medicinal plants are affected by magnet possibly due to the direct effect of magnet on the chemical constituents of plants and indirect effect on the electrical properties of water.

REFERENCES

1. Lewis WH, Elvin-Lewis MP. Medicinal plants as sources of new therapeutics. Ann Mo Bot Gard 1995;82:16-24.
2. Moerman DE. An analysis of the food plants and drug plants of native North America. J Ethnopharmacol 1996;52:1-22.
3. Wen Z, Liu B, Zheng ZK, You XK, Pu YT, Dang Z. Harmful elements removal from *Polygonum multiflorum* by supercritical CO2 extraction. Zhong Yao Cai 2008;31:1567-71.
4. Vangra W. Property and benefit of magnetized water. Available from: http://ezinearticles.com/?Property-and-Benefit-of-Magnetized-Waterandid=1038528.
5. Mathew S, Abraham TE. *In vitro* antioxidant activity and scavenging effects of *Cinnamomum verum* leaf extract assayed by different methodologies. Food Chem Toxicol 2006;44:198-206.
6. Benedek B, Ziegler A, Ottersbach P. Absence of mutagenic effects of a particular *Symphytum officinale* L. liquid extract in the bacterial reverse mutation assay. Phytother Res 2010;24:466-8.
7. Wang Z, Wang L, Li T, Zhou X, Ding L, Yu Y, *et al*. Rapid analysis of the essential oils from dried *Illicium verum* Hook. f. and *Zingiber officinale Rosc*. by improved solvent-free microwave extraction with three types of microwave-absorption medium. Anal Bioanal Chem 2006;386:1863-8.
8. Koşar M, Dorman HJ, Başer KH, Hiltunen R. *Salvia officinalis L.*: Composition and antioxidant-related activities of a crude extract

and selected sub-fractions. Nat Prod Commun 2010;5:1453-6.
9. Lamaison JL, Carnet A. Levels of major flavonoids in flowers and Crataegeus monogyna Jacq Crataegeus laevigata (Poiret D. C) depending on the vegetation. Pharmaceutica Acta Helvetiae 1990;65:315-20.
10. Vrbaski M, Injac GB, Gajic A. A new method for allantoin determination and its application in *Agrostemma githago* L. seed. Anal Biochem 1978;91:304-8.
11. Yen GH, Chen HY. Antioxidant activity of various tea extracts in relation to their various tea extracts. J Agric Food Chem 1995;43:27-32.
12. Pang X, Deng B. Investigation of magnetic field effects on water. Chengdu, China: Applied Superconductivity and Electromagnetic Devices International conference; 2009. p. 278-83.
13. Mohri K, Fukushima M, Matsumoto M. Gradual decrease of electrical resistivity in water triggered with milli-gauss low frequency pulsed magnetic field. INERMAG Europe: Magnetics Conference; 2002. P. FU8.
14. Mohri K, Fukushima M. Gradual decreasing characteristics and temperature stability of electric resistivity in water triggered with milligauss AC field. IEEE Tranactions 2002;38:3353-5.
15. Li J, Zhai D, Zhang Y. Dielectric characterization of magnetized water and its effect on electrical performance on ZnO varisotor. Properties and Applications of Dielectic materials. Bali: 8th International Conference; 2006. p. 797-800.
16. Kronenberg K. Experimental evidence for effects of fields on moving water. Mgnetics. IEEE Transactions 1985;21:2059-61.
17. Harris SR, Henbest KB, Maeda K, Pannell JR, Timmel CR, Hore PJ, *et al*. Effect of magnetic fields on cryptochrome-dependent responses in *Arabidopsis thaliana*. J R Soc Interface 2009;6:1193-205.
18. Gu J, Zhou Q. Effects of magnetized soil on physiological and biochemical indexes of *Brassica napus* seedlings. Ying Yong Sheng Tai Xue Bao 2003;14:794-6.

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