

Is It Possible to Quench Thirst Using Licorice-Enriched Barley Bread during Islamic Fasting?

Mohammad Reza Amiryousefi^{1, 2}, Davoud Soleimani¹, Sara Movahed¹, Maryam Khosravi¹, Seyyed Mojtaba Mousavi Bazzaz³, Hassan Rakhshandeh⁴, Maryam Golzar¹, Naseh Pahlevani¹, Effat Saghi¹, Safieh Firouzi¹, Zahra Ghaemi⁵, Fatemeh Pourebrahim⁵, Mahsa Malek Ahmadi¹, Kazem Eslami¹, Reyhaneh Zadehahmad⁵, Mohsen Nematy^{6*}

1. Department of Nutrition, School of Medicine, Mashhad University of Medical Sciences (MUMS), Mashhad, Iran
2. Department of Food Science and Technology, Neyshabur University of Medical Sciences, Neyshabur, Iran
3. Department of Community Medicine, School of Medicine, Mashhad University of Medical Sciences (MUMS), Mashhad, Iran
4. Pharmacological Research Center of Medicinal Plants, Mashhad University of Medical Sciences, Mashhad, Iran
5. School of Medicine, Mashhad University of Medical Sciences (MUMS), Mashhad, Iran
6. Department of Nutrition, School of Medicine, Biochemistry and Nutrition, Endoscopic & Minimally Invasive Surgery, and Cancer Research Centers, Mashhad University of Medical Sciences (MUMS), Mashhad, Iran

ARTICLE INFO	ABSTRACT
<p><i>Article type:</i> Original article</p> <hr/> <p><i>Article History:</i> Received: 23 Dec 2017 Accepted: 05 Feb 2018 Published: 05 March 2018</p> <hr/> <p><i>Keywords:</i> Bread Enrichment Functional food Islamic fasting Licorice</p>	<p>Introduction: Thirst is one of the main complaints during Islamic fasting. As bread is the staple food among most Muslims, evaluating its impact on thirst is important. In this study, we investigated the effect of licorice-enriched barley bread compared to barley bread and white wheat bread.</p> <p>Methods: This clinical trial was performed on three consecutive days during <i>Itikaf</i> ceremony. Data were gathered by using a checklist including items on demographic data, weight, height, waist circumference, blood pressure, and pulse rate. Blood pressure and pulse rate measurements were repeated at the end of the study. The participants were divided into three groups receiving functional barley bread enriched with licorice, barley bread, and white wheat bread. The thirst sensation was assessed by Fan visual analogue scale. Also, 24-hour dietary recall was obtained on all the three days.</p> <p>Results: Overall, 273 people participated in this study. Thirst sensation in the functional barley bread was lower than that in the wheat bread and barley bread groups, but there were no significant differences between wheat and barley bread groups in this regard. During the fasting period, the greatest increase in thirst was observed during the first five hours of fasting in all the three groups, which was significantly lower in the functional barley bread group than the wheat and barley bread groups; however, there was no significant difference between wheat and barley bread groups in this respect. Finally, similar results were attained following fluid intake adjustment.</p> <p>Conclusion: This study showed that licorice enrichment of barley bread might alleviate thirst sensation among fasting individuals.</p>

► Please cite this paper as:

Amiryousefi MR, Soleimani D, Movahed S, Khosravi M, Mousavi Bazzaz SM, Rakhshandeh H, Golzar M, Pahlevani N, Saghi E, Firouzi S, Ghaemi Z, Pourebrahim F, Malek Ahmadi M, Eslami K, Zadehahmad R, Nematy M. Is It Possible to Quench Thirst Using Licorice-Enriched Barley Bread during Islamic Fasting? *J Fasting Health*. 2017; 5(4): 151-157. Doi: 10.22038/jfh.2018.28595.1108

Introduction

Fasting is one of the main practices in Islam (1); during Ramadan, healthy adult Muslims abstain from drinking, eating, and smoking from sunrise to sunset (2, 3). Based on the geographical location and season, Islamic

fasting lasts for 8 to 18 hours (3). During this period, there are changes in eating pattern, time and frequency of meals, and quality of food. Most Muslims usually eat two meals during 24 hours (3, 4), a meal before sunrise

* Corresponding author: Mohsen Nematy, Department of Nutrition, School of Medicine, Biochemistry and Nutrition, Endoscopic & Minimally Invasive Surgery, and Cancer Research Centers, Mashhad University of Medical Sciences (MUMS), Mashhad, Iran. Tel: +985138002361; Email: Nematym@mums.ac.ir

© 2017 mums.ac.ir All rights reserved.

This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/3.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

called Sahur and another meal after sunset called Iftar, which usually begins with consuming dates or sweetened beverages followed by a meal (5). Endurance of thirst and hunger is one of the most important issues during fasting.

According to Islam, *Itikaf* means seclusion for a certain period in a mosque for devotion, with the intention of meditation on Allah. *Itikaf* can be performed at any time, but the best time for it is the last ten days of Ramadan, and 13-15th of Rajab month. *Itikaf* incorporates three principles: (1) intention, (2) mosque, and (3) *Tahaarah* (purity). No other worship or special action has been set for this practice, and *mutakifs* (People who are in *Itikaf* ceremony) spend most of their time worshipping Allah. In Iran, since the early 1980s, the tendency towards *Itikaf* has expanded in the month of Rajab, and now, it is being held in most cities and mosques across this country on the 13th, 14th, and 15th of Rajab.

Barley is a fiber-rich grain that contains significant levels of both insoluble fiber and β -glucan, it is also classified as a grain with low glycemic index. Several food products are made of barley, including bread, pasta, tortillas, noodles, biscuits, and chips (6). Soluble fiber such as β -glucan, the type of starch, and the type and amount of fiber available in barley can elicit low postprandial glycemic response, hence improving glycemic control (6, 7).

The maintenance of fluid homeostasis in the body is crucial for survival. Sensation of thirst is a prime motivator of drinking water, and even short periods without water can lead to the thirst sensation and the desire to drink (8, 9). Thirst sensation is a warning, a signal from interoceptors indicating the need for rehydration. It plays a key role in maintaining fluid balance (8). The renin-angiotensin-aldosterone system (RAAS) is a principal water regulatory system, which acts on fluid balance and blood pressure both directly and indirectly via hormones, including arginine vasopressin (AVP) and aldosterone. AVP acts on the kidneys to enhance the reabsorption of water in the nephron, and aldosterone increases the reabsorption of sodium in the kidneys resulting in the retention of water (8). Also, a positive relationship between thirst sensation and brain activity was observed in

the posterior and anterior regions of the cingulate cortex (9).

Licorice is an herbal product used as a pharmacological agent from ancient times. Licorice is currently used for dietary and pharmacological purposes. Because of sweetness, licorice is used for masking bad taste of drugs. It is applied for several problems in the nervous system and alimentary canal such as peptic ulcer, dyspepsia, and liver toxicity, tuberculosis, sore throat, asthma, endocrine disorders such as Addison's disease, cardiovascular disorders, and rheumatoid arthritis. This herb is also used in respiratory laxatives and antitussives. It is also thought to be effective for thirst prevention. One of the principal components in the root of licorice plant is glycyrrhetic acid, the structure and activity of which were thought to be similar to those of adrenal steroid hormones such as aldosterone and cortisol, and licorice ingestion mimicked hyperaldosteronism (10, 11); therefore, it can be effective in quenching thirst sensation.

Since bread is the staple food among most Muslims, it has a major effect during Ramadan. Because licorice can act similar to aldosterone, our hypothesis was that licorice-enriched bread can affect thirst sensation. To our knowledge, no study has yet considered the effect of licorice bread, compared with other types of bread, on thirst sensation in fasting subjects. Herein, we sought to assess the effect of licorice bread on thirst during Islamic fasting.

Material and methods

Study setting

This clinical trial was performed in the grand mosque of Ferdowsi University of Mashhad, Iran, during the *Itikaf* period because all the participants had the same kind of meal. Also, as it is only three days, the long-term effects of fasting such as hormone modifications, as the confounding factor, would not affect the results. This research project was approved by the Ethics Committee of Mashhad University of Medical Sciences (code: IR.MUMS.fm.REC.1396.458).

Participants

The participants were students and staff who

decided to participate in *Itikaf* ceremony during three days, in this period, they fast and stay inside the mosque. We enrolled individuals whose body mass index (BMI) was within the range of 18.5-29.9 kg/m² and did not report any history of diseases such as chronic heart failure, chronic renal failure, hypertension, or cirrhosis.

All the participants filled out the consent form, and then a checklist was completed that included items on demographic data, weight, height, waist circumference, blood pressure, and pulse rate. The measurement of blood pressure and pulse rate was repeated at the end of study. The participants were randomly assigned into three groups.

Dietary plan

Fasting duration was 15 hours a day during this study, and the prepared meals for the participants were homogeneous. However, the participants were permitted to bring some snacks, which were mentioned in 24-hour diet recall was filled by the participants.

The first group received functional barley bread enriched with licorice, the second had barley bread, and the third group was given white wheat bread. One loaf of bread was served in *Sahur*, as rice was the staple, and three loaves of bread were served in *Iftar* during three consecutive days. Each loaf of bread weighed approximately 60 grams (two portions).

Bread preparation

For licorice dosage, as the maximum dosage of licorice is 17.5 g/day for short-term usage (12), and four breads were served for every person that weighed 240 g, the approximate allowed amount of licorice to barley flour was 7%. As licorice might cause problems in hypertensive patients, hypertensive participants were excluded from the study.

After organoleptic tests and technical evaluation of the possibility for bread preparation using different ratios of barley flour and white flour (without bran) and different percentages of licorice, 70% of barley flour and 30% of wheat flour were selected for the preparation of both barley bread and licorice-enriched barley bread. In addition, 4% licorice was used to prepare functional barley

bread.

Thirst assessment

Thirst sensation was assessed eight times a day including immediately before and after *Iftar* and *Sahur*, 5 and 10 hours after *Sahur*, and 2 and 4 hours after *Iftar*. Thirst was assessed by a 100-mm self-rating visual analog scales (VAS) with zero indicating *I am not thirsty at all* and 100 *I am extremely thirsty* (13).

Statistical analysis

All the data were collected and analyzed in SPSS, version 16. The prevalence rates were calculated using descriptive statistics. To examine the correlation between the variables, ANOVA test was run. P-value less than 0.05 was considered statistically significant.

Results

Overall, 273 individuals participated in this study. The demographic characteristics and baseline clinical data of the participants such as age, gender, marital status, smoking, heart rate, systolic and diastolic blood pressure, as well as anthropometric indices (e.g., weight, height, body mass index, and waist circumference) were not significantly different among the groups ($P > 0.05$; Table 1).

Figure 1 illustrates the rate of thirst sensation adjusted based on fluid intake during the fasting period. During the study, the rate of thirst sensation in functional barley bread group was lower than those in the wheat bread and barley bread groups ($P < 0.001$), but there were no significant differences between wheat and barley bread groups ($P = 0.56$). During the fasting period, the highest increase in thirst was observed during the first five hours of fasting in all the three groups ($P < 0.001$), which was significantly lower in the functional barley bread group than the wheat and barley bread groups. However, there was no significant difference between wheat and barley bread groups in this regard ($P = 0.9$). Increased thirst in the first five hours in all the three groups was significantly reduced over time.

In this study, dietary intake of energy, macronutrients, fluids, and caffeine was not significantly different between the barley bread and wheat bread groups ($P > 0.05$; Table 2).

Table 1. Characteristics of study participants

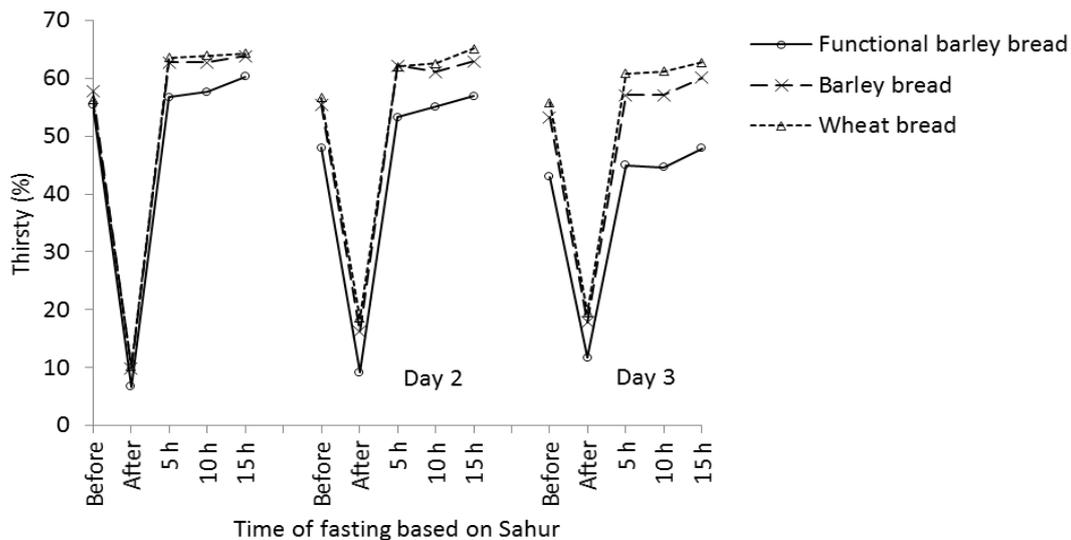
Characteristics	All (n=273)	Functional bread (n=89)	Barley bread (n=102)	Wheat bread (n=82)	P-value
Age, (years)					
Male	24.8±6.7	24.3±7.2	24±4.8	26.2±7.8	0.38
Female	23.8±6.2	23.5±5.5	24.1±7.5	23.8±4.9	0.87
Sex, n (%)					0.5
Male	105(38.5)	35(39.3)	35(34.3)	35(42.7)	
Female	168(61.5)	54(60.7)	67(65.7)	47(57.3)	
Married, n (%)	57(20.9)	15(16.9)	22(21.6)	20(24.4)	0.42
Smoking, n (%)					0.41
Yes	4(1.5)	2(2.24)	2(1.96)	0(0)	
No	268(98.5)	87(97.76)	100(98.04)	82(100)	
Weight (kg)	65.4±15.6	64.6±13.9	65.5±18.1	66.1±14.3	0.82
Height (cm)	166.7±14.7	168.1±9.3	164.3±20.8	168.3±8.6	0.11
BMI* (kg/m ²)	23.5±7.3	22.8±3.9	24.4±10.7	23.2±4.1	0.31
WC** (cm)	81.1±11.7	80.6±11.3	80.6±11.9	82.1±11.9	0.66
SB*** (mmHg)	113.8±13.5	112.1±13	114±14	115.5±13.1	0.25
DB**** (mmHg)	72.3±10.1	70.4±9.7	72.2±11	74.5±9	0.26
Heart rate	79.8±12.6	78.7±10.9	80.3±12.3	80.3±14.7	0.61

* Body mass index

** Waist circumference

*** Systolic blood pressure

**** Diastolic blood pressure

**Figure 1.** The rate of thirst sense adjusted based on fluids intake during the fasting period

During the study, the feeling of thirst was lower in the licorice-enriched barley group than the barley bread and wheat bread groups ($P < 0.001$).

The baseline systolic blood pressure, diastolic blood pressure, and heart rate among the functional bread, barley bread, and wheat bread groups were not significantly different ($P > 0.05$).

The rate of thirst sensation adjusted based on fluids intake before *Iftar* is shown in Figure 2.

The results showed that the feeling of thirst before *Iftar* was significantly lower in the functional barley bread group than the wheat and barley bread groups ($P < 0.001$), while there was no significant difference between the wheat and barley bread groups in this respect ($P = 0.2$). On the other hand, trend analysis over time revealed that the rate of thirst before *Iftar* significantly decreased in the functional barley bread and barley bread groups ($P < 0.05$).

Table 2. Comparison of dietary intake among the groups

Variables	Functional bread (n=89)	Barely bread (n=102)	Wheat bread (n=82)	P-value
Energy (kcal/day)	1990±685	1860±620	1854±551	0.30
Protein (g/day)	96.2±31	83.6±32	87.1±36	0.23
Carbohydrates (g/day)	219±77	213±64	221±76	0.32
Fat (g/day)	76.4±30.8	74.8±31.3	75.4±30.2	0.93
TDF* (g/day)	11.7±5.1	11.5±5.6	10.1±4.2	0.12
Fluid (ml/day)	1210±501	1102±434	1143±397	0.29
Caffeine (mg/day)	71.7±17	54.3±11	58.2±13	0.09

* Total dietary fiber

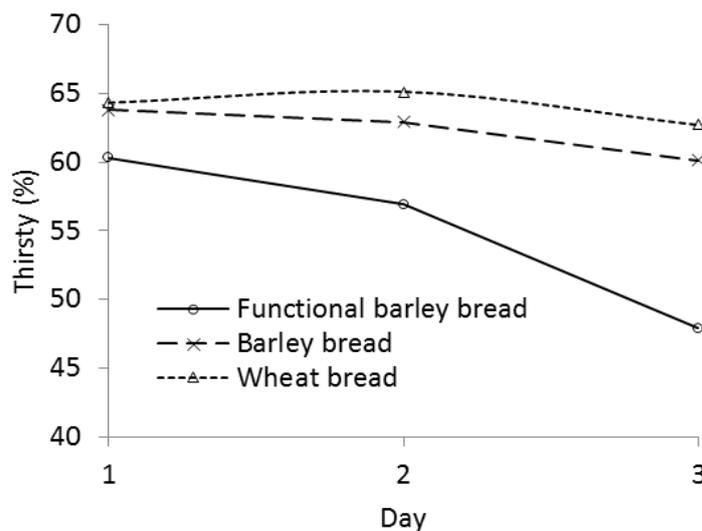


Figure 2. The rate of thirst sensation adjusted based on fluid intake before *Iftar*

Table 3. Comparison of blood pressure among the groups

Variables		Functional Bread (n=89)	Barley Bread (n=102)	Wheat Bread (n=82)	P-value
SBP (mmHg)	Before fasting	112±13	114±14	115.4±13.1	0.25
	After fasting	111.4±13	111.3±15.3	109±15.4	0.66
	Change	-2.4±13.5	-5.2±14.1	-7.5±13.1	0.18
DBP (mmHg)	Before fasting	70.3±9.7	72.2±11	74.5±8.9	0.26
	After fasting	72.7±8.5	72.1±11.1	74.2±12.1	0.61
	Change	1.3±8.6	-1.8±10.6	-1.9±10.2	0.19
Heart rate	Before fasting	78.7±10.8	80.3±12.3	80.3±14.6	0.61
	After fasting	78.1±12.2	77.2±9.9	76.3±15	0.79
	Change	-2.8±12.6	-2.4±12.8	-3.4±21	0.95

However, no significant reduction was noted in the wheat bread group (P=0.97).

The rate of thirst sensation adjusted based on fluids intake before Sahur is presented in Figure 3. The results showed that the feeling of thirst before Sahur in the functional barley bread group was significantly lower than that in

the wheat and barley bread groups (P<0.001), but no significant difference was observed between the wheat and barley bread groups (P=0.5). On the other hand, the decreasing trend in the level of thirst before Sahur over time did not differ significantly among the three groups (Figure 3).

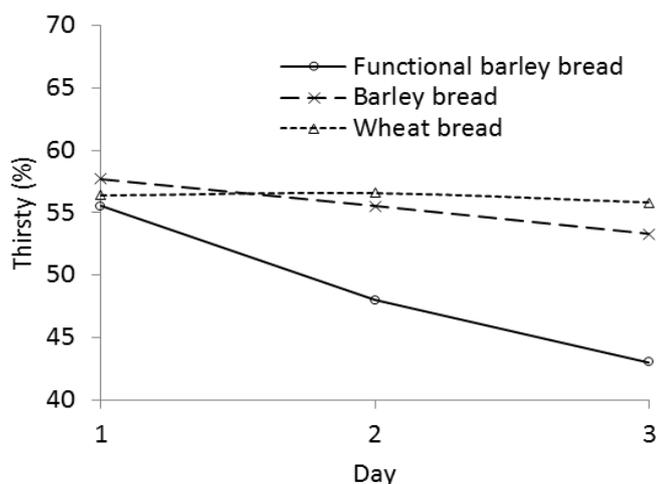


Figure 3. The rate of thirst sensation adjusted based on fluid intake before *Sahur*

Discussion

The main finding of the current study was the significant decline in thirst sensation by adding licorice to barley bread during Islamic fasting. In the present study, thirst sensation adjusted to fluids intake significantly diminished only in the licorice-barley bread group. It seems that this effect may be attributed to mineralocorticoid properties of licorice and its active ingredient, glycyrrhizic acid. Licorice ingestion stimulates the reabsorption of sodium and water in the kidneys and suppresses the renin-angiotensin-aldosterone system and renin level (14). Therefore, licorice can assuage thirst sensation by suppressing renin level.

Another key finding was the lack of any significant alterations in blood pressure and heart rate in the licorice-enriched barley bread group. Our finding is in contrast with those of other studies on the impact of licorice on blood pressure. In a clinical study, Leskinen et al. reported that the consumption of licorice for two weeks elevated systolic and diastolic blood pressure in normotensive subjects (15). Licorice and glycyrrhizic acid elevate blood pressure by increasing cortisol level and intravascular volume (14). In our study, we added licorice to barley. In a clinical study, Maki et al. showed the beneficial effects of foods containing β -glucan from oats on blood pressure (16). Moreover, it has been reported that Ramadan fasting declines blood pressure. As mentioned above, our observation may be

due to the interaction between fasting and β -glucan of barley with licorice on blood pressure and the short time of licorice consumption.

To the best of our knowledge, this study is the first clinical trial investigating the effect of food fortifying on thirst sensation during Islamic fasting. We should consider several points as the strengths of the current study such as adequate sample size, the presence of a control group, as well as homogeneous food and drink distribution among the groups. Finally, the limited duration and population of the study, not taking blood samples, and not considering the body composition of the participants were among the limitations of this study.

Conclusion

This study indicated that adding licorice to barley bread can diminish thirst sensation without any alteration in blood pressure during Ramadan fasting. To improve the generalizability of our findings, further studies performed with stronger designs and during more extended periods are recommended.

Acknowledgments

Hereby, we extend our gratitude to the National Elites Foundation. We also sincerely thank Nahad Rahbari of Ferdowsi university for cooperating with this study.

Conflict of interest

None declared.

References

1. Abolaban H, Al-Moujahed A. Muslim patients in Ramadan: a review for primary care physicians. *Avicenna J Med.* 2017; 7(3):81-7.
2. Nematy M, Alinezhad-Namaghi M, Rashed MM, Mozhdehifard M, Sajjadi SS, Akhlaghi S, et al. Effects of Ramadan fasting on cardiovascular risk factors: a prospective observational study. *Nutr J.* 2012; 11(1):69.
3. Soleimani D, Nematy M, Hashemi M, Khayyat-zadeh SS. Effects of Ramadan fasting on cardiovascular risk factors: a narrative review. *J Fasting Health.* 2016; 4(4):140-4.
4. Nematy M, Alinezhad-Namaghi M, Rashed MM, Mozhdehifard M, Sajjadi SS, Akhlaghi S, et al. Effects of Ramadan fasting on cardiovascular risk factors: a prospective observational study. *Nutr J.* 2012; 11(1):69.
5. Vasan SK, Karol R, Mahendri NV, Arulappan N, Jacob JJ, Thomas N. A prospective assessment of dietary patterns in Muslim subjects with type 2 diabetes who undertake fasting during Ramadan. *Indian J Endocrinol Metab.* 2012; 16(4):552-7.
6. Ames N, Blewett H, Storsley J, Thandapilly SJ, Zahradka P, Taylor C. A double-blind randomised controlled trial testing the effect of a barley product containing varying amounts and types of fibre on the postprandial glucose response of healthy volunteers. *Br J Nutr.* 2015; 113(9): 1373-83.
7. Canadian Diabetes Association Clinical Practice Guidelines Expert Committee, Cheng A. Canadian Diabetes Association 2013 clinical practice guidelines for the prevention and management of diabetes in Canada. Introduction. *Can J Diabetes.* 2013; 37(Suppl 1):S1-3.
8. Peyrot des Gachons C, Avriillier J, Gleason M, Algarra L, Zhang S, Mura E, et al. Oral cooling and carbonation increase the perception of drinking and thirst quenching in thirsty adults. *PloS One.* 2016; 11(9):e0162261.
9. Becker CA, Flaisch T, Renner B, Schupp HT. From thirst to satiety: the anterior mid-cingulate cortex and right posterior insula indicate dynamic changes in incentive value. *Front Hum Neurosci.* 2017; 11:234.
10. Davis EA, Morris DJ. Medicinal uses of licorice through the millennia: the good and plenty of it. *Mol Cell Endocrinol.* 1991; 78(1-2):1-6.
11. Isbrucker RA, Burdock GA. Risk and safety assessment on the consumption of Licorice root (*Glycyrrhiza* sp.), its extract and powder as a food ingredient, with emphasis on the pharmacology and toxicology of glycyrrhizin. *Regul Toxicol Pharmacol.* 2006; 46(3):167-92.
12. Aghili Alavi Khorasani SM. Repertory of spices (Makhzan Al Advieh in Persian). Tehran, Iran: Islamic Revolution; 1992. P. 529-31.
13. Fan WF, Zhang Q, Luo LH, Niu JY, Gu Y. Study on the clinical significance and related factors of thirst and xerostomia in maintenance hemodialysis patients. *Kidney Blood Press Res.* 2013; 37(4-5):464-74.
14. Farese RV Jr, Biglieri EG, Shackleton CH, Irony I, Gomez-Fontes R. Licorice-induced hypermineralo-corticoidism. *New Engl J Med.* 1991; 325(17): 1223-7.
15. Leskinen MH, Hautaniemi EJ, Tahvanainen AM, Koskela JK, Päällysaho M, Tikkakoski AJ, et al. Daily liquorice consumption for two weeks increases augmentation index and central systolic and diastolic blood pressure. *PloS One.* 2014; 9(8):e105607.
16. Maki KC, Galant R, Samuel P, Tesser J, Witchger MS, Ribaya-Mercado JD, et al. Effects of consuming foods containing oat β -glucan on blood pressure, carbohydrate metabolism and biomarkers of oxidative stress in men and women with elevated blood pressure. *Eur J Clin Nutr.* 2006; 61(6): 786-95.