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Comparing the Antioxidant Capacity of Low Fat Prebiotic Yoghurt with/without Red Sumac Powder

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ABSTRACT

Background

Yoghurt is one of the popular food diet ingredients with refreshing taste and health benefits. The purpose of this study was to identify antioxidant capacity of low fat yoghurt with/without red sumac powder.

Methods

The antioxidant effects of sumac (Rhus coriaria L.) powder (0%, 1%, 1.5%and 5%) in prebiotic (Resistant starch type 2) low fat yoghurt, was investigated by to the DPPH method. The data were expressed as mean ± SD and were tested by one-way ANOVA at $\alpha=0.05$.

Results

The antioxidant activity and overall acceptability of yoghurt samples were significantly increased with the increasing of sumac powder from 0 to 5% ($p<0.05$).

Conclusion

Addition of 5% sumac increased the sensory attributes in prebiotic low fat yoghurt. Also the addition of sumac powder in prebiotic low fat yoghurt formulation improved the antioxidant capacity.

Keywords: *Antioxidant; red sumac powder, Low fat yoghurt.*

INTRODUCTION

Yoghurt is the most popular fermented milk product all over the world because of its high nutritive, therapeutic values and sensory properties (Srivastava et al., 2015). This properties are due to the presence of lactic acid bacteria, which ferment lactose to lactic acid, and improve the nutritional values of yoghurt (Adolfsson et al., 2004, Mirghafourvand et al., 2016). This product is made with different fat percentages, but nowadays it is preferred to use low-fat and non-fat dairy foods, especially those with high blood lipids and cardiovascular disease (AGHAZADEH et al., 2010, Khalili et al., 2019).

The amount of total solids in the milk will greatly affect the physical properties and the texture of the manufactured yoghurt. Reducing the fat content will decrease the total solids in the produced yoghurt. Studies have been carried out to improve rheological and the physico-chemical properties of low-fat and non-fat yoghurts using various additives. Therefore, to create such properties in low-fat products, appropriate additives such as resistant starches type 2 should be used for texture improvement. Rs is a prebiotic ingredient (Heshmati et al., 2016). Prebiotics are nonviable food ingredients that exert a benefit on the health of the host, linked with modulation of the intestinal micro biota (Cruz et al., 2010, Rad et al., 2012, Ejtahed et al., 2011).

Oxidative stress is caused by an imbalance between the production of free radicals within the body and the mechanisms of defense of biochemical antioxidants. In living organisms, peroxidation of lipids in the wall of living cells is one of the main objectives of free radicals. In

this situation, cell wall structure and its function are affected. Therefore, the high presence of free radicals, especially peroxides, plays a key role in the pathogenesis of a number of diseases, such as aging, cancer, cardiovascular disease, various degenerative diseases of the lungs, and also plays an important role in the pathogenesis and progression of diabetes (Ejtahed et al., 2012, Thanonkaew et al., 2008). On the other hand use of antioxidants is important to increase the shelf-life and safety of foods (McCarthy et al., 2001, Sadighara and Barin, 2010). According to previous studies, some of the synthetic antioxidants used in the food industry as preservatives have side effects. Therefore, the addition of natural antioxidants in order to confidence the quality and safety improvements of the food has gained move attention (Sadighara and Barin, 2010). Recently, the use of various natural flavoring ingredients in yoghurt manufacturing has been gained more attention. Spices are the new source of functional flavoring agents. There is now more scientific evidence of health benefits of plant, including antibacterial, antifungal, antioxidant, as well as anti-carcinogenic properties (Azhdarzadeh and Hojjati, 2016). Sumac (*Rhus coriaria L.*) is used in the Mediterranean region and Middle East as a spice. The fruits have been reported to possess antimicrobial and antioxidant properties (Kossah et al., 2009). Literature review implies that sumac powder was not used for improvement of antioxidant activity in yoghurt so far. The aim of this research was to manufacture functionally prebiotic low fat yoghurt containing sumac powder with increased antioxidant activity.

Materials and Methods

Preparation of Sumac Powder

Aerial parts of *Rhus coriaria L.* were planted in full flowering state of East Azarbaijan in summer (Arasbaran, Iran) and confirmed by the Herbarium of the Faculty of Pharmacy of Tabriz University scientifically (Tabriz, Iran). Separate parts of the plant were cleaned and dried at room temperature for one week. The dried plant was then turned into powder well using the mill. In order to prepare the sumac powder, the dried parts of the sumac were completely milled and separated using a mesh No 335 nm. They were stored in dark glass containers and refrigerated until to evaluation.

Preparation of Yoghurt Containing Sumac Powder

In order to produce low-fat yoghurt containing sumac powder, fresh cow milk is used inordance with Fig (1). Then the yoghurt containing different percentages of sumac powder was dried by freeze drying.

Analysis of PH and Titratable Acidity

The pH of homogenized yoghurt was determined using a digital pH meter. Titratable acidity (TA) was determined by titration with 0.1N NaOH. Yoghurt sample (3 mL) was transferred into an Erlenmeyer flask containing 27 mL of dH2O. Three to five drops of 0.1% phenolphthalein as pH indicator were added. The yoghurt mixture was then titrated with 0.1N NaOH with continuous stirring until a stable pink color was achieved. The amount of acid produced during fermentation was calculated as follows:

TA (% Lactic acid) = Dilution factor × V NaOH×0.1N×0.009×100%

Where, V NaOH was the volume of NaOH required to neutralize the acid. A dilution factor of 10 was used.

Statistical Analysis

The data were analyzed and expressed as mean ± SD and parameters were compared among groups by one way analysis of variance (ANOVA) followed by Tukey post hoc test. All statistical analyses were performed using the SPSS version 25 and Minitab 18. (P<0.05)was considered statistically significant.

Results And Discussions

Changes in Ph and Titratable Acidity

The pH and TTA of yoghurt prepared with (0%, 1%, 1.5%, 5%) sumac powder are shown in Fig. 2A and B, respectively. Yoghurt with 5% sumac powder showed a slightly lower pH than yoghurt with 0% sumac powder (Fig. 2A). These results were in agreement with that obtained by mahmoudi et al. (2013), who reported that the TA increased and pH decreased gradually during cold storage period of yoghurt treated with different concentration of the T. polium EO(Mahmoudi et al., 2014).

Finally, it was reported that the concentration of sumac powder, fermentation temperature, storage duration and contamination. could influence the overall level of acidity and pH of stored yoghurt samples(Singh et al., 2011).

The constantly higher TTA in yoghurt enriched with (0%, 1%, 1.5%, and 5%) sumac powder (Fig. 2B) could be attributed to higher acid production due to the addition of sumac powder to the yoghurt. Yoghurt added with 5% sumac showed TTA contents in the range of 3.68. TTA is generally high depending on the decrease of

PH. However, the addition of sumac powder showed a different tendency with some unknown reason.

The Antioxidant Activity during the Storage of Yoghurt

Free radicals contribute to more than one hundred disorders in humans including atherosclerosis, arthritis, and ischemia and reperfusion injury of many tissues, central nervous system injury, gastritis, cancer and AIDS. These free radicals are the major points in lipid peroxidation. The antioxidants may mediate their effect by directly reacting with Reactive oxygen species(ROS), quenching them and/or chelating the catalytic metal ions. Several synthetic antioxidants, e.g., butylated hydroxyanisole (BHA) and butylated hydroxytoluene (BHT) are commercially available but are quite unsafe and their toxicity is a problem of concern (Rashid et al., 2012). Natural antioxidants, especially phenolics and flavonoids, are safe and also bioactive which are capable of absorb and neutralize free radicals, quenching singlet and triplet oxygen or decomposing peroxides. Recently focus has been concentrated on identification of plants components with antioxidant ability that may be used for human diet (Rashid et al., 2012).

The antioxidant effect of sumac in (0%, 1%, 1.5% and 5%) during 1, 7, 14, 21 and 28 days was evaluated. According to the results, there is a significant difference between the different concentrations of sumac powder ($P<0.05$). Analysis of variance was shown in Table (2).

The level of antioxidant activity in yoghurt samples containing different percentages of sumac powder was significantly higher than that of control samples ($P<0.05$). The sample containing 5% of the sumac powder had the higher antioxidant activity. At 1% concentration, it showed the lowest antioxidant activity in all storage times (Fig 4).

Sensory Evaluation

The sensory properties of the yoghurt prepared with sumac powder at concentrations of 0-5% were evaluated by 8 trained no smoking panelists of aged 24 and 30 years, and the results are summarized in Table 3.The flavor score of yoghurt containing sumac powder ranged from 2.475to 3.675. The color value of yoghurt containing sumac powder ranged from 3.625to 4.275.The texture value of yoghurt containing sumac powder ranged from 3.750 to 3.625. The mean acceptance scores ranged from 2.750 to 3.650 (Table3).

The overall acceptability increased with increasing amounts of added sumac powder. High scores was received by yoghurt with 5% sumac powder (Fig 5). Therefore, the addition of sumac powder in yoghurt improved the functional properties such as antioxidant activity as well as the sensory characteristics of yoghurt. These results indicate that the addition of sumac powder at a concentration of 5% would be appropriate for the production of acceptable color and functionally enriched yoghurt with antioxidant, anti-obesity, and anti-inflammatory properties. In conclusion, the addition of sumac powder to yoghurt resulted in increased titratable acidity and water activity (a_w). In sensory evaluation, yoghurt samples containing 5% sumac powder received higher scores for, flavor, color and overall acceptability.

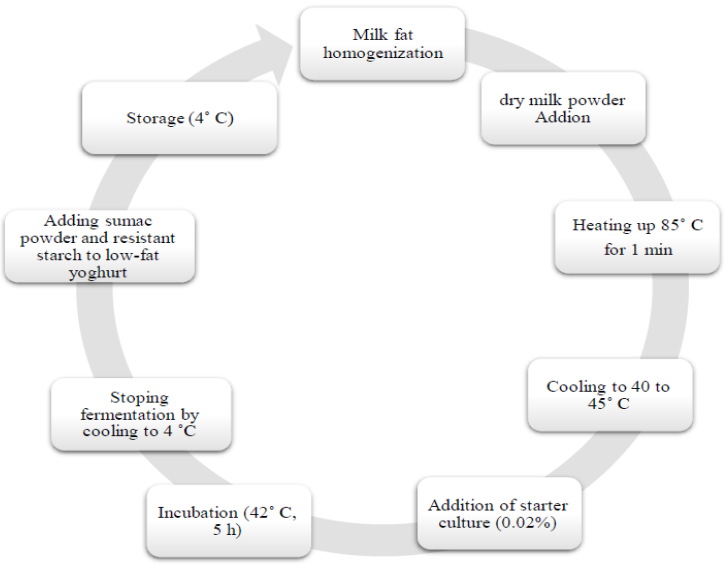

Figure1. *Procedure for the manufacture of low fat yoghurt enriched with sumac powder*

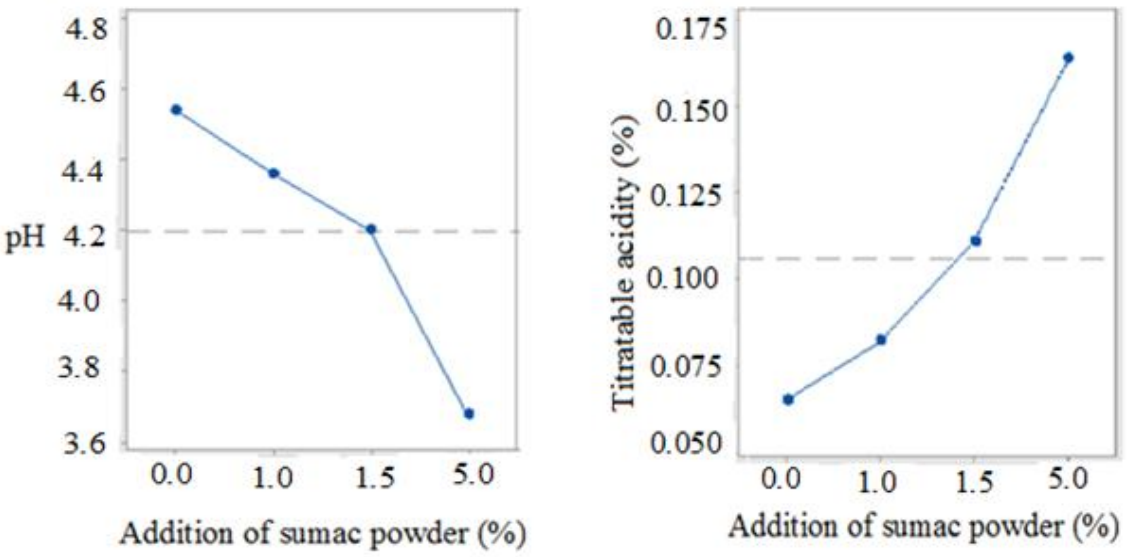

Figure2. *Changes in pH and titratable acidity*

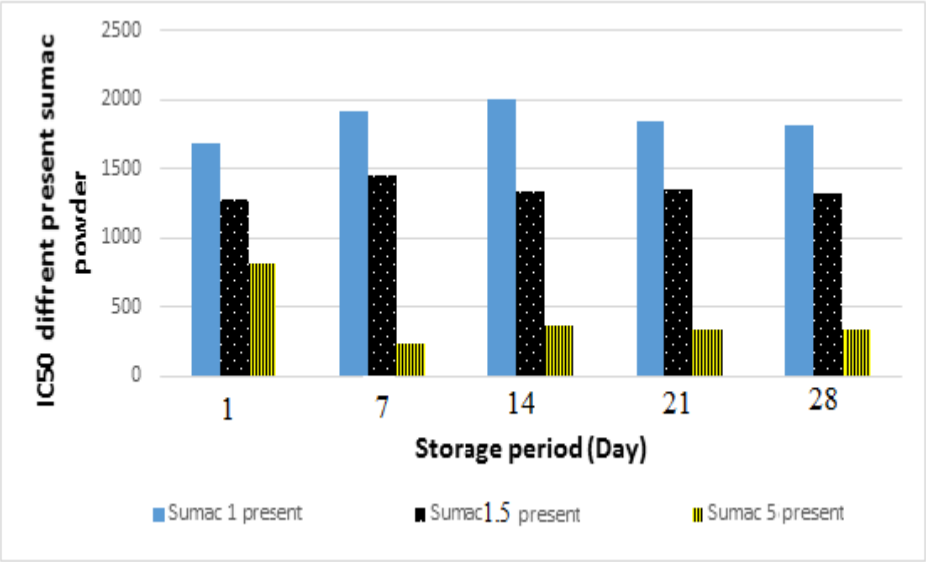

Figure3. *Antioxidant activity of different concentration of sumac powder*

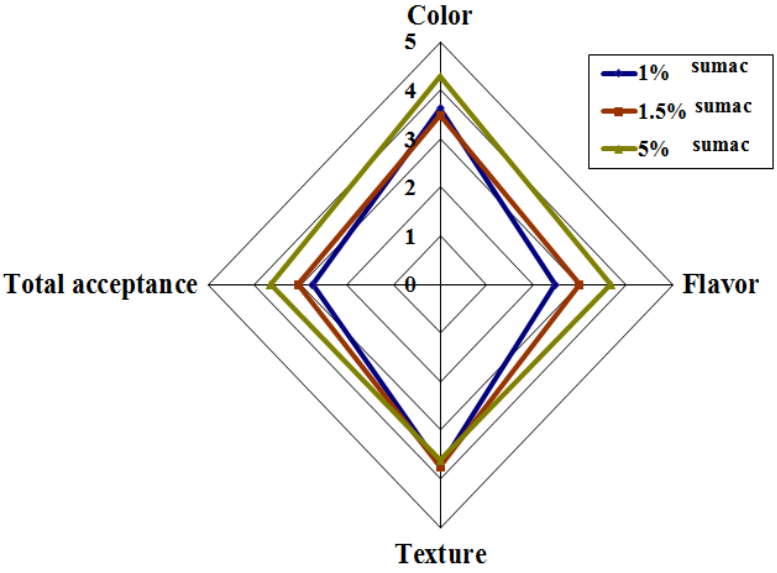

Figure4. *Spider chart representing sensory properties of yoghurt enriched with sumac powder.*

Table1. *Variation in antioxidant activity during 28 days of refrigerated storage period*

Day	0%	1%	1.5%	5%	P-Value
1	18.31±0.14 [e]	27.38±0.23 [f]	36.78±0.29 [d]	46.25±0.28 [c]	0.000
7	16.04±0.11 [e]	24.07±0.02 [f]	32.5±0.250 [e]	73.96±0.01 [a]	0.000
14	11.27±0.24 [e]	24.14±0.03 [f]	34.96±0.27 [de]	66.56±0.2 [b]	0.000
21	12.17±0.53 [a]	23.70±0.28 [de]	34.31±0.28 [de]	71.66±0.22 [a]	0.000
28	15.02±0.01 [e]	25.14±0.22 [f]	35.45±0.28 [j]	70.33 ±0.20 [ab]	0.000

Different letters are significantly different (P <0.05).

Table2. *Sensory properties of yoghurt enriched with sumac powder*

Attributes	Addition of sumac powder%			
	1	1.5	5	P-Value
color	3.625±0.806	3.475±0.678	4.275±0.784	0.01
Flavor	2.475±1.280	3±1.339	3.675±1.071	0.04
Texture	3.750±1.103	3.750±0.980	3.625±0.952	0.06
Overall acceptability	2.750±0.980	3.050±0.845	3.650±1.001	0.03

Data was presented as means ± SD.

CONCLUSIONS

The results of the present study indicated that the addition of different percentage of red sumac *(Rhus coriaria L.)* powder (0%, 1%, 1.5%and 5%) in prebiotic low fat yoghurt may minimize the lipid and protein oxidation. So, it is suggested that sumac powder, as a natural additive, could be used to increase the shelf life of industrial yoghurts, providing the consumer with a product containing natural additives, which might be more healthful in this research. In this study functional prebiotic low fat yoghurt containing sumac powder was manufactured and antioxidant activity was indicated by incrusting the red sumac concentrated. However, more studies are needed to evaluate the clinical health effect of yoghurt containing red sumac on metabolic and food born disease.

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