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Influence *of Elaeagnus angustifolia* flour on the organoleptic and physicochemical characteristics of bread (LAVASH)

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Summary. In this study the influence of *Elaeagnus angustifolia* flour including all parts of the fruit (pulp, skin and core) added at different levels 2.5, 5, 7.5 and 10% on organoleptic and physicochemical characteristics of functional bread (LAVASH) were investigated. The moisture and protein content of treated bread decreased while ash, acidity, glucose, fructose, total sugar, fat content and water activity had been increased compared to control. This flour increased the sweetness of treated samples. Due to technological problems addition of E. angustifolia flour up to 7.5% was more acceptable. Organoleptic properties of treated types were approved by the evaluators.

Key words: bread, *Elaeagnus angustifolia*, functional

Introduction

Bread is the main bakery product consumed in Iran. Generally, five types of bread are baked in Iran: Sangak, Taftoon, Barbari, Lavash and village breads. Lavash is a soft, flat and thin bread is made of wheat flour, water, yeast and salt (1).Today, consumers are aware of the need for functional foods that present beyond the basic food ingredients and provide health benefits (2). It was uttered that *E. angustifolia* belongs to the family of Elaeagnaceae. It is native to western and central Asia, from southern Russia and Kazakhstan to Turkey and Iran. *E. angustifolia* as a nutrient or herb is mainly used for its medicinal properties. It is usually called a wild olive, silver berry, Russian olive or oleaster (3). In Iranian folk medicine it is mainly used for its anti-inflammatory, antinociceptive and analgesic effects. Decoction and infusion of its fruits are considered to be a good remedy for fever, jaundice, asthma, tetanus and rheumatoid arthritis (4). Generally, medulla powder of *E. angustifolia* had positive effects, especially in improving pain as well as stiffness and physical function in females with knee osteoarthritis (5). Phytochemical studies have shown that there are different groups of flavonoids in this plant (6-8). Investigations revealed that Elaeagnus angustifolia has a strong biochemical content like vitamins A, E, and C (9). *E. angustifolia* flour obtained from dried fruits because of its flour structure, specific taste and functional ingredients such as fiber, minerals and phenolic compounds content and demand for functional, healthy products to improve food and change in the composition of their food, leads to the use of flour as a functional component in the production of bakery products, yogurt, ice cream, baby food, chocolate and confectionery (10). It is apparent that the fruit is abundant in antioxidant lycopene Perceived health benefits of the fruit are removal of alcohol, pain reduction, and cancer prevention, antimicrobial and expectorant features etc. (11). Due to its health benefits and nutrients of *E. angustifolia*, our study aimed to investigate the results of addition of *E. angustifolia* flour in Lavash bread, namely on organoleptic and physicochemical characteristics.

Materials and Methods

Preparation of E. angustifolia Fruit Flour

E. angustifolia fruits were taken gradually from around gardens of Sufian, a city in East Azerbaijan from mid-September to October 15. After harvesting, sorting and screening (winnowing) operations were carried out for removing foreign substances and impurities. Then moisture of fruits was measured which was about 36%. Fruits were spread in cleanness site on fabric awnings for 10 days in front of the sun. After this period, moisture samples were measured again which had reached about 16%, this moisture created the stickiness in grinder devices (Hammer mill), so fruits were placed in Otto (Avon) 50˚C for 48 hours, after this period, fruits moisture was measured for the third time which was reduced to 7%. Then fruits were scrubbed on Lace sieves, fruits tail, external materials and petty leaves were removed by screening and aeration. They were placed some more time in the oven with 50˚C for 24 hours to fragmentize seeds rigid parts well. Then first stage of grinding was done by hammer mill. Since milled seeds still contained coarse fragments, after sifting, they were placed in Otto 50˚C for 48 hours. After the second milling stage was done, flour produced was sifted for the second time. It should be mentioned that the average moisture of final meal *E. angustifolia* fruit flour was 3.80% which made it possible to be easily mixed with wheat flour and other ingredients. Produced flour was stored in an air tight container at 4˚C until it was used in the production of bread.

Preparation of bread

Raw materials including water, *E. angustifolia* fruit flour, wheat flour (80% extract), salt and instant dry yeast used for preparation of the bread's dough. The common method was used for making dough of Lavash bread in Iran. Five samples of bread were produced with one of them as a control sample (without *E. angustifolia* flour) and others were the samples containing 2.5, 5, 7.5 and 10% *E. angustifolia* flour w/w wheat flour. First wheat and *E. angustifolia* flour were sifted to aeration and removal of foreign materials. Then the rest of materials were weighed. Next, all the materials were mixed for 15 minute in the mixer (10 minutes with low speed and 5 minutes with high speed) next the dough was formed, after a 15-20 minutes rest and fermentation, the dough was cut in the right dimensions and sent into the oven with indirect heat in 150-180˚C. After the baked bread cooled, it was packed by polyethylene bags and stored in a location with ambient temperature. The composite ingredients in mix formulations are presented in table 1.

Analytical methods

For comparing sensory properties among different groups combined with wheat flour and *E. angustifolia* flour, analysis of Kruskal-Wallis and ANOVA were used and tukey test was used for physicochemical properties. Physicochemical and organoleptic properties treated samples containing *E. angustifolia* flour and control sample without *E. angustifolia* flour examined after production in triplicate. Analysis were carried out with SPSS 22 software with the significance level set at 0.05.

Measurement methods of physicochemical properties

Bread moisture, protein and ash measurement were performed according to methods approved by the AACC (2000) to number 44-16 (ambient temperature of 25˚C and oven 105˚C), 46-16 and 08-01, respectively (12). The total sugar and reducing sugars (glucose and fructose) were determined according to Lyne eynon (Fehling) the method AOAC (2005) (13). Fat and acidity measurement was performed according to the method AOAC (1993) (14). Water activity was determined by using a measurement device of water activity manufactured Co. Novasina model NS1 (15).

Sensory evaluation methods

Based on Kruskal-Wallis test results between the groups, in terms of taste, texture, color and chewiness,

Table 1. The composite ingredients in mix formulations

Ingredients	Proportion (g)
Wheat flour	100
E. angustifolia flour	2.5, 5, 7.5, 10% w/w Wheat Flour
Salt	1.25
Instant dry yeast	0.375
Deionized water	Variable

a significant difference was observed (P≤ 0.05). Ten persons evaluated the bread samples. All sensory attributes were recorded on point scales with 5- very good, 4- good, 3- medium, 2- poor, 1- very poor. Warm water was also provided to the evaluators to clean their palates between testing samples. The questionnaires and the produced samples were coded and given to each person. Later they were asked to provide further comments. Final judgment was obtained by averaging the scores given by all evaluators.

Results and Discussion

Little or no experiment was carried out about use of *E. angustifolia* flour to bread. This was the main motive about starting the present research. Functional compounds of *E. angustifolia* fruit are shown in some researches: Ayaz et al. (1999) reported that phenolic compounds included 4-hydroxy benzoic acid, phenolic acid and caffeic acid, also glucose and fructose as the main sugar in it which along with phenolic compounds contribute to the flavor of the fruit (16). Goncharova and Goloshonova (1990) found that angustifolia fruit has fatty acids like palmitoleic, linoleic, oleic and linoleic acid. Its core has linoleic acid, phospholipid, glycolipid and beta-sitosterol (17). Functional properties of this fruit directly or indirectly affect the applications of processes, quality of food, final acceptance and its use in food formulations (18). Emulsification, solubility and water absorption capacity are functional properties (19). The researchers showed that moisture content, titrable acidity and ascorbic acid were 16.91 %, 4.99 %, 4.65 mg 100 g fresh weight^{-1}. Protein, K, Ca, P, Mg and N amount were 12.33, 1.10, 0.07, 0.06, 0.05 and 1.97 %, respectively (20). The rate of vitamin C for the different kinds of oleaster was determined to be 1.86-5.03 mg/100g (21).

Results in the present study

The mean and standard deviation values for physicochemical properties of Lavash bread produced, including moisture, glucose, fructose, total sugar, protein, water activity, ash, acidity and fat in control group samples and enriched samples with *E. angustifolia* flour for 0, 2.5, 5, 7.5 and 10% are presented in table 2. Variance analysis for moisture, glucose, fructose, total sugar, water activity, protein and ash showed a significant difference at least in one of the groups ($p<0.05$). Results of tukey test showed a two by two difference among the groups. Based on variance analysis for acidity, a significant difference was observed at least in one of the groups ($p<0.05$). Tukey test results indicated no significant difference between 7.5 and 10% dosages regarding acidity, but a significant difference was observed among other groups. Based on variance analysis for fat, a significant difference was observed at least in one of the groups ($p<0.05$). Tukey test results indicated no significant difference between 5 and 7.5% dosages of fat, but a significant difference was observed among other groups. In this study moisture content in samples decreased by increasing *E. angustifolia* flour, the highest and the lowest moisture referring to the control bread and bread containing 10% *E. angustifolia* flour, and the water activity was on the rise by addition of percentage of *E. angustifolia* flour. Simona Man et al. (2012) showed that with addition of chestnut flour in bread the moisture decreased linearly (22). Water activity and moisture content will greatly determine the quality of its maintenance (23). Increasing of the *E. angustifolia* powder in bread (Burger buns) increased humidity (24). In our study the control bread and sample E had the highest and lowest protein content, respectively and protein content was decreased in samples. Yusnita Hamzah and Wong Fang Lian (2012) showed that increasing the percentage of mixing corn cob flour, significantly reduced protein content ($p<0/05$), however it had no significant effect on other chemical compounds such as moisture, ash, fat and carbohydrates (25). Fat plays an important role in shelf life food. High fat content can cause rancidity, development of unpleasant and bad smelling compounds (26). It was stated that a significant increase in ash may be attributed to an increase in the amount of minerals such as calcium, iron and higher levels of whole wheat flour substitution levels in the flour samples (27). In this study fat had increasing trend by adding the *E. angustifolia* flour and the amount of ash soared with addition of *E. angustifolia* flour. The highest and the lowest ash belonged to sample E and A, respectively. Also by addition of *E. angustifolia* flour, the content of reducing sugars (glucose and fructose) and total sugar raised in samples. Ayaz et al. (1999) reported that the concentrations of fructose and glucose as major sugar were 32.62-34.60% and 23.37-24.10% (w/w) (minimum-maximum), respectively (16). Yasemin

Table 2. Effect of the addition of E. angustifolia flour on physicochemical composition of samples

Sample	A		B		C		D		E		P-value ANOVA
	Mean(SD)	CI	Mean(SD)	CI	Mean(SD)	CI	Mean(SD)	CI	Mean(SD)	CI	
Moisture (g/100g)	11.36(0.05)	(11.33,11.40)	10.44(0.01)	(10.40,10.47)	9.48(0.005)	(9.45,9.52)	8.54(0.01)	(8.50,8.57)	7.58(0.005)	(7.54,7.61)	0.001
Glucose (g/100g)	2.67(0.009)	(2.67,2.68)	2.77(0.007)	(2.76,2.78)	3.39(0.005)	(3.38,3.40)	3.84(0.005)	(3.83,3.85)	4.59(0.005)	(4.58,4.60)	0.001
Fructose (g/100g)	0.17(0.006)	(0.16,0.18)	0.25(0.005)	(0.24,0.26)	0.67(0.006)	(0.66,0.68)	0.70(0.005)	(0.69,0.71)	1.84(0.01)	(1.83,1.84)	0.001
Total sugar (g/100g)	3.63(0.005)	(3.62,3.64)	3.80(0.01)	(3.79,3.80)	4.83(0.005)	(4.82,4.84)	5.30(0.005)	(5.29,5.31)	7.08(0.01)	(7.07,7.08)	0.001
Protein (g/100g)	10.49(0.0006)	(10.49,10.50)	10.30(0.006)	(10.30,10.31)	10.10(0.002)	(10.09,10.10)	9.78(0.0005)	(9.78,9.79)	9.48(0.001)	(9.47,9.48)	0.001
Acidity (g/100g)	3.95(0.03)	(3.88,4.01)	4.05(0.04)	(3.98,4.12)	4.27(0.07)	(4.20,4.33)	4.94(0.04)	(4.87,5.01)	5.20(0.06)	(5.13,5.27)	0.001
Water	0.37(0.001)	(0.36,0.37)	0.38(0.0005)	(0.38,0.39)	0.50(0.005)	(0.50,0.51)	0.47(0.0005)	(0.47,0.48)	0.58(0.005)	(0.57,0.58)	0.001
Ash (g/100g)	1.48(0.006)	(1.47,1.49)	1.57(0.001)	(1.55,1.58)	2.43(0.01)	(2.41,2.44)	2.91(0.005)	(2.90,2.92)	4.88(0.005)	(4.87,4.89)	0.001
Fat (g/100g)	0.50(0.005)	(0.49,0.51)	1.40(0.005)	(1.39,1.41)	1.47(0.005)	(1.46,1.48)	1.47(0.006)	(1.46,1.48)	1.60(0.005)	(1.59,1.61)	0.001

Data are mean (SD); Data are resulted from triplicate. A: Control without E. angustifolia flour, B: 2.5% (w/w) flour of E. angustifolia added, C: 5% (w/w) flour of E. angustifolia added, D: 7.5% (w/w) flour of E. angustifolia added, E: 10 %(w/w) flour of E. angustifolia added.

Sahan et al. (2015) showed that the main fatty acids of *E. angustifolia* were palmitic acid, oleic acid and lignoceric acid, respectively. All samples contained larger amounts of saturated fatty acids as compared to mono unsaturated fatty acids and polyunsaturated fatty acids (28). Simona Man et al. (2012) reported there was border line between acidity and addition of chestnut flour, and that only 2% of the total acidity variable can be attributed to chestnut flour (22). In the present study by addition of *E. angustifolia* flour, acidity (based on oleic acid percentage) content of all bread samples was close and almost increased. Joel Ndife et al. (2011) showed that by increasing soy flour, the approximate value of variables such as moisture, ash, fat, crude fiber and protein increased except carbohydrate and energy. Flavones of Soy are effective in the prevention of cancer and osteoporosis (29), which might be the case for *E. angustifolia*, since it contains flavonoids compounds, too. Ash in ice cream samples slightly increased by adding *E. angustifolia* flour and crust. This was the same in the present study. Addition of *E. angustifolia* flour and crust reduced the proportion of protein and fat in control ice cream sample relatively (30), but in our study fat content of samples increased and protein amount of bread samples decreased by adding of *E. angustifolia* flour.

Results of sensory evaluation

Comments showed that by addition of *E. angustifolia* flour, popularity of fortified bread increased. Our study indicated addition of this flour up to 7.5% in dough bread formulation did not create problems technologically but more than this amount, the dough ruptured a little when flattened and shaped. Generally, the sample containing 7.5% *E. angustifolia* flour was preferred in terms of technological and sensory evaluation. By addition of this flour, color of bread turned to brown. Texture of bread was integrated and it had a sweet taste with good odor. Sensorial properties of bread samples are shown in Radar plot (Figure 1). This diagram shows that by increasing *E. angustifolia* flour the taste variable presented the same acceptability score for all samples. Also increasing this flour in all samples, except the sample with 5% *E. angustifolia* flour, had the same score based on the texture. Color acceptability presented no problem in treatment samples and the samples containing 2.5% *E. angustifolia* had lower scores. Chewing acceptability in all samples had a high score and no sig-

Figure 1. Radar plot; Sensorial properties of bread samples (A: Control; without flour of E. angustifolia added, B: 2.5% (w/w) flour of E. angustifolia added, C: 5% (w/w) flour of E. angustifolia added, D: 7.5% (w/w) flour of E. angustifolia added, E: 10% (w/w) flour of E. angustifolia added).

nificant problem was observed in this case. Generally, adding *E. angustifolia* flour brought about no problem for evaluators and they were really eager to consume bread containing *E. angustifolia* flour, since they all enjoyed the taste. It incited that by usage of this flour in burger bread, it gained darker appearance in comparison to the control sample (24). Adding oleaster flour to cookies made them to have darker appearance than those in control samples and increased stiffness of cookies (10). In present study by adding *E. angustifolia* flour the color of bread changed to darkness brown. Taste of sweet in bread samples increased because the glucose, fructose and total sugar was on rise.

Conclusions

The overall conclusion of this study shows that addition of *E. angustifolia* flour increases the content of ash, acidity, glucose, fructose, total sugar, fat and water activity, and decreases content of moisture and protein. Results of sensory evaluation revealed that addition of *E. angustifolia* flour in the formulation of raw materials, increased darkness and sweetness of bread. Chewiness of samples had no problem, but it was possible to add *E. angustifolia* flour, technologically up to 7.5%. Previous studies indicate that *E. angustifolia* contains functional materials such as dietary fiber and K, B, A vitamins, phenolic compounds, Ascorbic Acid, minerals especially Ca, K and that *E. angustifolia* flour has flour or powder structure i.e. it is easy to use.

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