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THE INFLUENCE OF ROSEHIP SEED FLOUR ON BREAD QUALITY

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Abstract

Effects of dried and ground rosehip seed flour (RSF) on bread quality and in particular on loaf volume, length, height, crumb and crust colour, texture and sensory properties were determined. RSF was added in levels of 0, 5, 7.5 and 10% to wheat flour sample. There was a considerable decrease detected at both loaf volume and loaf height whereas a sharp increase was measured at firmness and chewiness of breads as the concentration of RSF were increased. Brightness (L value) of crumb went down while redness (a value) went up as the ratio of RSF in bread formulation was increased. When 10% RSF was added total dietary fiber content of breads were doubled as compared to control. Sensory evaluation by a consumer panel resulted in a less rated scores at loaf volume, shape-symmetry, colour and structure of crust, crumb colour, grain structure, flavour, taste and aroma of RSF added breads than control. However all these parameters were affected significantly by the level of RSF. Beside general sensory attributes, acceptability and purchasing intent of 5% RSF containing breads were found as near as the control breads. According to the obtained results, RSF can be used up to 5% level without negatively affecting the technological and sensory quality of breads. Also it can be used above 10% to enhance the dietary fiber content of breads but in this case further studies should be needed to improve technological quality of breads.

Key words*: rosehip, bread, texture, sensory, acceptability, purchasing intent.*

INTRODUCTION

Rosehip fruits from the family of *Rosaceae* are an important source of proteins, carbohydrates, energy, sugars, particularly the reducing sugars, ascorbic acid, antioxidants, carotenoid pigments, minerals, organic and fatty acids (Demir and Özcan, 2001; Böhm, et al., 2003;Ercisli, 2007; Guimaraes,et al., 2010; Murathan et al., 2016). Rose hips are well known for their efficiency in strengthening the body's defence against infection, and particularly the common cold (Demir and Özcan, 2001).

During the last years, the use of rosehip fruits as raw materials for a lot of products such as jams, juices, etc. has started. During production of some rosehip products, seeds are discharged and they generally used as animal feed. Whereas seeds are also have high nutritional and bioactive compounds.

İlyasoğlu (2014) reported that the rosehip seed contains valuable phytochemicals such as phenolic compounds, carotenoids, ascorbic acid, polyunsaturated fatty acids, antioxidant activity. Beside rosehip seeds are important source of dietary fibers (Gül and Şen, 2017). High fiber intakes are associated with lower serum cholesterol concentrations, lower risk of coronary heart disease, reduced blood pressure, enhanced weight control, better glycemic control, reduced risk of certain forms of cancer, and improved gastrointestinal function (Anderson et al., 1994).

High fiber breads can be produced by incorporating nutritional and functional rosehip seeds.

Consumption may be increased by giving above mentioned information about the health benefits of these fibre enriched breads (Gül and Gül, 2011).

There is a great interest in utilising the valuable by products of food industry as functional food ingredients instead of discarding them. The present study was thus undertaken with an objective of utilizing rosehip seeds for human consumption as a source of functional ingredient in breads.

This paper reports the effectsof powdered rosehip seed on the physical, technological, textural and sensory properties of bread enriched with rosehip seed flour.

MATERIALS AND METHODS

Materials

Commercial bread wheat flour was supplied from Berberoğlu Milling Factory (Burdur, Turkey). Farinographic properties of the flour were 58.7% of water absorption, 7.9 min stability and 2.2 min of dough development time. The proximate compositions of wheat flour, analysed by the AACC (2001) methods, were 14.5±0 01% moisture, 0.61±0.03% ash, 10.47±0.03% protein, 29.9±0.12 % wet gluten, 96.2±0.20 % gluten index, sedimentation 31±1 ml and falling number 362±2 s. Salt and bread yeast were provided from the local market. Other chemicals were purchased from Merck (Darmstadt, Germany) and were of analytical grade.

Preparation of rosehip seed flour

Rosehip seeds were provided by manual separation of the seeds from pomace which was the by product of rosehip marmalade plant. They were dried in a cabinet drier at 55+2C before grinding the dried samples with a grinder mill and sieved to obtain a flour particle size of less than 300 μm.

Bread making with RSF substitution

Bread was prepared by AACC Method 10-10.03 (AACC, 2001) with some modifications. RSF was replaced the bread wheat flour at 0, %, 5%, 7.5% and 10% (w/w) levels. The other ingredients were yeast (3 g/100 g), salt (1.5 g/100 g) and water (variable depending on the farinograph absorption, it was determined in our previous research (Gül and Şen, 2017).

Dough was optimally mixed until dough development by a mixer (Günsa, Industrial Kitchen Equipment, İzmir, Turkey), rested for 30 min at 25±2C and 75±5% relative humidity.

After first fermentation dough was scaled into pieces according to 100 g flour weight basis, hand-rounded, molded and placed into baking pans for the second fermentation at 25±2C and 75±5% relative humidity for 90 min.

Baking was carried out at 275±2Cfor 15 min in a stone flour electrical oven (Enkomak, Antalya, Turkey). Breads were cooled at room temperature, and packed in plastic bags until further analysis.

Evaluation of bread quality

Volume of the bread was determined one hour after the end of baking process by the method of displacement of rapeseed (AACC, 2001). Width, length and height of breads from each batch were measured by digital calliper.

Crumb colour of breads

Colours of crumb were measured with a colorimeter (Minolta CR-300, Minolta Co Ltd., Tokyo, Japan). Minolta L indicates brightness, -a to +a indicates green to red, and -b to +b indicates blue to yellow. Each loaf of bread was cut in to slices, each of 2.00 cm in thickness. Five readings were taken from the middle of each crumb for colour measurement. Average of five measurements for L, a and b values were recorded.

Total dietary fiber content of breads

Total dietary fiber content of RSF and breads were measured by AACC Method 32-05.01 (AACC, 2001). Total dietary fiber assay kit was purchased from Megazyme Company (Wicklow, Ireland).

Textural profile analysis (TPA) of breads

The TPA test consists of compressing a 25 mm thickness bread slice two times in a reciprocating motion that imitates the action of jaw. After cooling for 4 h breads were cut in to slices of 25 mm thickness with a bread knife. The central two slices were used to perform textural analysis on a texture analyser (TA-XT2, Stable Micro Systems, Surrey, UK) equipped with a cylindrical probe of 36 mm in diameter. The bread slice was placed on the heavy duty platform and the pre test speed: 1 mm/s, test speed:1.7 mm/s, post test speed:10 mm/s and strain:40% were achieved. Based on the force deformation curves, parameters like hardness, adhesiveness, springiness, and cohesiveness and chewiness values were calculated.

Bread sensorial evaluation

For determining consumer acceptability of the breads, the loaves were evaluated for appearance characteristics (loaf volume, symmetry, crustcolour and crust structure), internal properties (colour of crumb, grain structure, texture), taste, flavour and overall quality characteristics. The 15 trained panellists were members of the Department of Food Engineering at Süleyman Demirel University in Turkey, ranging in age from 25 to 40, with 7 being female, non-smokers. Panellists were asked to evaluate the above attributes of the samples and to rate each attribute on a scale from 1 (dislike extremely) to 5 (like extremely) using five point hedonic scale (Meilgaard et al., 1999).

Statistical analysis

All measurements were carried out in three replicates. Analysis of variance (ANOVA) was conducted by using the SPSS 16.0 General Linear Model procedure. The calculated mean values were compared using Duncan's multiple range test with significance defined at P < 0.01.

RESULTS AND DISCUSSIONS

Effect of RSF substitution on loaf volume, height, width and length values of the breads

Loaf volume, height, width and length values of bread samples are presented in Table 1. The loaf volume of the breads prepared from RSF showed lesser volume in comparison to the control (100% wheat flour bread). Compared to the 0 % RSF control, the replacement of 5, 7.5 and 10 % RSF resulted in 22, 25 and 28 % reduced volume, respectively. Similar results were obtained by Boubaker et al. (2016) and Wu and Shiau (2015) they revealed that the reduction of the bread volume as consequence addition of fiber concentrate from artichoke stem by-products and pine apple peel fiber, respectively. Gül et al. (2009) also was emphasized that addition of wheat bran or corn bran into wheat flour was led to progressive decrease of loaf volumes of fibre enriched breads. A possible reason is that probably due to the dilution of gluten and physicochemical reactions among fiber components, water and gluten (Kurek et al., 2016). There is a confirmed competition for water between gluten proteins and fiber polysaccharides that part of the water molecules interact with the fiber polysaccharides rather than protein molecules (Nawrocka et al., 2017).

Regarding height of breads, as in the bread volume, Table 1 was showed a significant decrease of this parameter as consequence of increasing levels of RSF addition. A slight decrease were found between RSF added breads and control breads. However, length was not significantly different (P<0.01) from control and enriched breads (Table 1).

Table 1. The effect of rosehip seed flour on the physical parameters and total dietary fiber content of the breads

Samples	Substitution level of RSF (%)	Loaf volume (cm3/100g)	Height (mm)	Width (mm)	Length (mm)	L	a	b	Total dietary fiber (%)
Control	0	561.7a*	66.6a	75.9a	131.4a	65.60a	-0.23a	7.53c	5.43c
RSF	5	434.2b	59.3b	72.9b	131.3a	56.07b	2.46c	7.75b	9.17b
	7.5	420.6c	57.7c	73.2b	131.0a	53.91bc	3.40b	8.53ab	9.40b
	10	404.4d	55.0d	73.1b	131.3a	51.68d	4.06a	8.84a	10.87c

Values in the same column with different superscripts are significantly different ($P < 0.01$). RSF: Rosehip seed flour.

Effect of RSF substitution on crumb colour of the breads

The effects of RSF addition on the bread colour are summarized in Table 1.The crumb colour of RSF-enriched breads were different from that of the control. Incorporation of RSF decreased the lightness (L) value and increased the a and b value of breads parallel to increasing levels of RSF as compared with the control breads. Darker colour of RSF enriched breads could be due to the original colour of rosehip seed fiber. However, as mentioned by Gomez et al. (2003) the crumb bread colour is usually similar to the colour of the ingredients because the crumb does not reach as high temperatures as the crust. Therefore, it is reasonable to perform measurements only for crumbs, the colour of which directly correlates with ingredients used in the dough production. Colour change of the breads with high content of dietary fiber is mainly associated to Maillard and caramelization reactions (Kurek et al., 2016). Wu and Shiau (2015) reported that baked bread with increasing (0–15%) pineapple peel fiber substitution had darker, redder and less yellow colour than control bread. Fakhfakh et al. (2017) verified that the addition of mallow powder produced breads with darker colour than the control bread, similar to what was found in the present study.

Effect of RSF substitution on total dietary fiber content of the breads

The total dietary fiber content (TDF) of the breads supplemented with different percentages of RSF is presented in Table 1. As expected, the incorporation of RSF to the formulation, gradually and significantly increased TDF content compared to the control sample. At the 10% RSF substitution level, TDF content of breads were increased to double (from 5.43% to 10.87%) of the content of control bread. Significant increase TDF content in wheat bread rolls with 0, 4, 8, 12, 16 and 20 % of flour replaced with oat fiber powder was also reported by Kurek et al. (2016). Roth et al. (2016) was stated that the 10 % of dried distiller's grains, by-product from ethanol production, can provide a valuable amount of dietary fiber to bakery products.

A claim that a food is a "source of fiber", and any claim likely to have the same meaning for the consumer, may only be made where the product contains at least 3 g of fiber per 100 g or a claim that a food is "high in fiber", and any claim likely to have the same meaning for the consumer, may only be made where the product contains at least 6 g of fiber per 100 g (Eur-lex, 2006). Therefore breads containing RSF at all substitution levels can be labelled "high in fiber".

Effect of RSF substitution on texture profile of the breads

The effect of RSF on bread texture was shown at Table 2. It can be seen that the addition of RSF resulted in significant($p<0.01$) increased hardnessas compared to control bread. The hardness value of the breads were gradually increased from 2190 g to 3998.8 g when RSF was elevated from 0 to 10%. Chewiness of breads also increased significantly with RSF addition, but there was no difference between chewiness of 7.5% and 10% RSF containing breads. Our results coincides with the findings of Frutos et al. (2008) and Boz (2015) they observed increase in bread hardness and chewiness with substitution of artichoke fiber and whole barley flour , respectively.

The aggregation of the gluten proteins, observed as a result of the fiber supplementation, is probably connected with partial dehydration of the gluten network. After fiber addition competition for water starts among gluten proteins and fiber polysaccharides. Thus part of the the water molecules interact with the fiber polysaccharides rather than protein molecules. The rest of the water molecules form strong hydrogen bonds with the gluten proteins which resulted in more firm and stiff dough (as shown in our previous research) and breads with lower volume and higher firmness (Nawrocka, 2017).

Adhesiveness is a measure of the tendency to adhere to contacting surfaces (especially the palate, teeth, tongue) during mastication (Chen, 2007). It is worthwhile to note here that adhesiveness was significantly influenced both by the addition of RSF and its increasing percentage. The adhesiveness was decreased with increase in RSF level, and the extent of decrease was greater for bread containing higher amount of RSF. Addition of fiber increased the stiffness of the dough and bread thus adhesiveness value gradually decreased from -5.14 g.sec to -26.87 g. sec on addition of increasing amounts (0–10%) of RSF.

No statistically significant differences were noted in the springiness of the control and RSF breads. An addition of 5% RSF in the bread formulations was not lead to any significant changes in the crumb cohesiveness and gumminess (Table 2). There was, however, a slight decrease in crumb cohesiveness between bread made with 7.5 and 10% RSF and the control. On the other hand gumminess of breads were significantly increased over 5% of RSF. The highest gumminess value (2201.6) was obtained at levels of 10% RSF. The results for the 5% of RSF added were coincident with those of Frutoset al. (2008) that did not found significant differences for the cohesiveness in breads supplemented with a 3%, 6% and 9% artichoke fiber.

Table 2. The effect of rosehip seed flour on the texture profile parameters of the breads*

Samples	Substationl level of RSF (%)	Hardness (g)	Adhesiveness (g.sec)	Springiness	Cohesiveness	Gumminess	Chewiness
Control	0	2190.9d	-5.14d	0.97a	0.65a	1533.5b	1386.3c
RSF	5	2495.4c	-8.9c	0.98a	0.61a	1541.2b	1596.5b
	7.5	3645.7b	-16.91b	0.89a	0.55b	2195.9a	1894.4a
	10	3998.8a	-26.87a	0.96a	0.53b	2201.6a	1860.8a

Values in the same column with different superscripts are significantly different ($P < 0.01$). RSF: Rosehip seed flour

Effect of RSF substitution on sensory parameters

Taste panel tests and consumers' questionnaire are the most commonly used for consumers' preference of a bakery products. Sensory analysis was carried out by checking loaf volume, crust colour, crust appearance, crumb colour, chewiness, taste and aroma of fresh prepared breads. The current study highlighted significant effect ($p < 0.01$) of RSF supplementation on different sensory attributes (Figure 1). There was a relationship between sensory and instrumental measurements. Loaf volume values,given by the panel to the control and RSF substituted breads were correlated with the values found for the instrumental volume measurements (Table 1), with decreesing values for loaf volume, as the proportion of PSF was increased in the formulation.

The colour of bread crust is an important parameter to determine its acceptability. Supplementation of wheat bread with RSF decreased both crust colour and crust appearance scores. Crust colour and crust appearance of 5% RSF added breads was found slightly lesser than the control, whereas their scores were decreased significantly ($p < 0.01$) over 5% replacement level of RSF.

The highest chewiness scores were observed in control and then they decreased when the incorporation of PSF increased. Likewise, the taste and aroma results also showed that there was a decreasing trend of the averages of scores when the incorporation of PSF increased (Figure 1). These results are in agreement with the findings of Peighambardoust and Aghamirzaei (2014). Chewiness was correlated with the values found for the instrumental texture determinations (Table 2), with increasing values for hardness, chewiness, and gumminess decreasing for cohesiveness and adhesiveness, as the level of PSF was increased in the breads.

Breads prepared from blends with 5% RSF were judged better than those prepared from other blends in respect of all tested sensory parameters. Reduced acceptability of breads prepared from blends in comparison to control can be attributed to the familiarity of panellists with the former. The scores obtained for the sensory parameters were similar to those obtained by Feili et al. (2013) in breads formulated with jackfruit rind flour which added to bread formula at 5%, 10% and 15% levels.

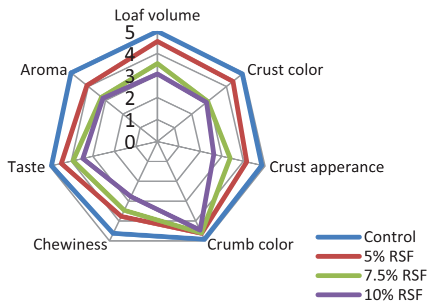

Figure. 1. Sensory evaluation of breads prepared with wheat flour fortified with 5, 7.5 and 10% RSF. The control represented the product without enrichment

Effect of RSF substitution on overall acceptability and purchasing intent

Overall acceptability and purchasing intent scores of the control and RSF enriched breads were presented in Figure 2. The results revealed that the scores for both of these two parameters were decreased significantly as the replacement level increased from 0 to 10%. At the higher levels, the acceptability and purchasing intent decline mainly due to the lower loaf volume, harder texture and lesser chewiness of the breads. The addition of a 5% of RSF to bread did not affect the acceptability of the bread in a great extent. However, in case of purchasing intent, the decrease was significant by the addition of RSF but there was no great difference between the purchasing intent of 5% and 7.5% RSF containing breads.

Results showed that increasing RSF in the bread samples decreased the overall acceptability and purchasing intent scores especially at addition levels of 7.5% and 10% (Figure 2). Therefore, we suggest that the fiber-enriched bread can be prepared with 5% RSF in order to increase functional properties of bread and maintain the sensory acceptability for the consumers. A survey of the literature showed that bread enrichment up to 5% jackfruit rind flour (Feili et al., 2013), 3% lemon fiber (Chang et al.,2015) and 3% of mallow powder (Fakhfakh et al., 2017), gave satisfactory consumer acceptability.

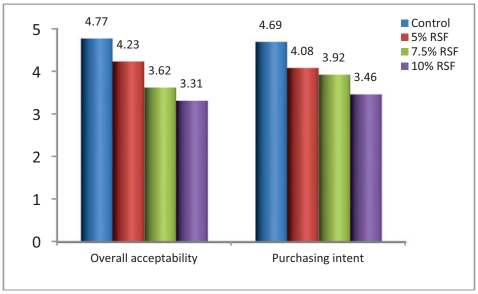

Figure. 2. Overall acceptability and purchasing intent of breads prepared with wheat flour fortified with 5, 7.5 and 10% RSF. The control represented the product without enrichment.

CONCLUSIONS

We have shown that bread parameters such as loaf volume, loaf height, hardness, colour and chewiness were affected by the incorporation of rosehip seed flour, especially over 5% addition, whereas the dietary fiber content was increased. A high dietary fiber content in bread is a very important characteristic for consumer who demand bread with high functional properties and high nutritional content.

The sensory quality, overall acceptability and purchasing intent of bread with 5% PSF was almost similar to that of the control bread. These results are important technologically to improve new bread formulations. Therefore, rosehip seeds (a valuable by product of the rosehip processing industries) may be used as a nutritional, healthy, functional, economical and novel ingredient in high fiber bread formulations to produce a bread of acceptable baking properties. Beside these due to very low price of rosehip seeds those findings can be considered significant from industrial and economic points of view.

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