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Extended Abstract

The Effect of Adding Flour Soy and Lentil to Doughnut on its Physicochemical Properties

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Abstract

Doughnut is a sweet fried golden-brown snack with energy value that is served as a convenient food. Quality of fried doughnut depends on its appearance (color, shape and brightness), aroma, flavor and nutrition value. In this research the effect of wheat flour partial replacement with soy flour and lentil flour (0, 15 and 30%) on physicochemical characteristics of doughnut including oil uptake, moisture loss, volume, texture, color and porosity were evaluated. Finally, sensory evaluation to determine the effects of soy and lentil on consumer acceptance of donuts was performed. The results were showed that addition of soy and lentil flour caused a decrease in moisture loss, fat content, volume, porosity and lightness of doughnut. During frying (a*) of doghnut shift to positive values and soy protein aggravate it. Crust color was darkened progressively with increasing frying time. The hardness of doughnuts decreased with increasing soy level but other rheological parameters did not change significantly. Increasing lentil flour, because of forming strong covalent bonds, increased this parameter. Sensory evaluation results showed that the sample contain 15% soy flour was the highest overall acceptability.

Keywords: Deep Fat Frying, Doughnut, Lentil Flour, Physicochemical Characteristics, Soy Flour

Introductıon

Donut characteristics are very important in many stages (molding, frying, among others) of the whole elaboration process for donuts, because they determine the good quality of the final product (Tan & Mittal, 2006). Fried foods have a particular attraction to human consumers, offering characteristics than increase their palatability. Fried foods also contain high amount of fat. Despite the consumer's demand for low-or reduced-fat food recently increased as excess fat consumption is considered to heighten blood cholesterol, high blood pressure and coronary heart disease (Dogan *et al*., 2005). Thus, research in reducing oil absorption during deep-fat frying has been intense in recent years, one of the methods which is used for decreasing fat absorption during frying process is replacing of wheat flour with some another type of flour is done for the purpose of improving the rheological properties and its effective

on moisture removal and fat absorption with an improvement of product nutrient due to amino acid combinations and different minerals. So, this study investigates the effect of adding soy and lentil flour in levels of 0, 15 and 30% on oil absorption, Disposal of moisture, physical and sensory properties of donuts.

Material and methods

Dough preparation

Fermented donuts were made according to sponge-anddough method. Dough pieces were fried in a domestic deep-fat fryer (Type 01, Black and Decker, Wilmington, CA). Frying operation was carried out at 150 °C for 2, 4, 6, 8 min. Moisture and fat content analysis was performed according to the procedure described respectively, in the AOAC (1980). Color and porosity of samples was measured using an image processing technique according to method Ghitaranpour *et al*. (2013). Texture of the samples was determined in terms of hardness, using a texture analyzer (QTS25 CNS Farnell, UK) interfaced to a personal computer. Volume and sensory evaluation of samples were done by the method Zolfaghari *et al*. (2010).

Results and discussion

Moisture loss was found to increase significantly (P<0.05) with frying time (Figure 1). This result was in agreement with results reported by Tan & Mittal (2006) and Vélez-Ruiz & Sosa-Morales (2003). the lowest moisture loss was in control sample and highest was in sample containing 30% soy flour, at all frying times. Donut moisture content is dependent on the water holding capacity of its compounds, and several studies indicate that water capacity of soy flour are higher than wheat flour (Singh and *et al*., 2008; Lee & Brennand, 2005). The oil uptake was strongly affected by frying time (P<0.05). As seen in Figure. 1, control donut had the maximum oil uptake and minimum value was devoted to 30 % soy flour. According to the Duncan's multiple range tests, effect of replacing flour on oil uptake was significant (P<0.05). Effectiveness of soy and lentil could be contributed on their film-forming properties and reduction of crust porosity of samples during frying time (Dogan *et al*., 2005).

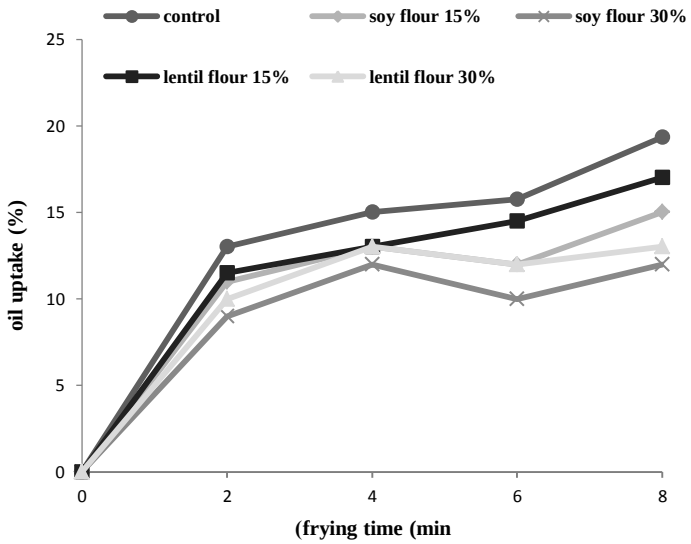

Figure 2. The Effect of Replacing Soy and Lentil Flour on oil uptake of Donut

As Table (1), changes volume and porosity of donuts during the frying process. At the first minutes of frying, volume increased and the highest volume was observed in the control sample and continued to decrease slightly, all samples showed similar trends. Replacement of soy and lentil flour in Donut formulation decreased significantly volume and porosity

(P<0.05). Wheat flour with unique characteristics, including the formation of a gluten-free network, has a gas storage capacity and increased volume (Zhang *et al.*, 2007).

Table 1. The Effect of Replacing Soy and Lentil Flour on porosity and volume of Donut

	Frying time	Lentil flour 30%	Lentil flour 15%	Soy flour 30%	Soy flour 15%	control
Volum (cm^3)	0	134±34^{i}	128±73^{j}	145±54^{gh}	132±26^{ij}	150±32^{f}
	2	163±18^{d}	154±12^{e}	165±18^{c}	160±42^{d}	175±13^{a}
	4	154±19^{e}	147±26^{g}	163±21^{cd}	157±43^{ed}	169±43^{b}
	6	150±54^{f}	145±29^{gh}	162±81^{cd}	155±25de	164±21^{c}
	8	148±32^{f}	141±45^{h}	155±33de	153±72^{e}	162±51^{cd}
Porodity (%)	0	13.43±8.4^{ef}	12.89±9.3^{f}	14.55±3.5^{ef}	13.24±5.2^{f}	15.21±4.3^{e}
	2	18.36±9.6^{cd}	17.47±6.4^{d}	18.56±8.3^{cd}	18.08±11.4^{d}	19.50±3.6^{c}
	4	19.84±11.3^{c}	20.11±7.6^{c}	21.51±11.2^{b}	21.34±12.3^{b}	23.20±2.9^{a}
	6	15.96±12.3^{d}	16.53±2.6^{d}	18.27±6.4^{cd}	19.51±7.4^{c}	21.41±13.1^{b}
	8	15.42±9.8^{e}	15.72±12.1^{de}	18.35±7.4^{cd}	17.72±8.4^{cd}	19.93±8.8^{c}

Table data reported in mean±standard deviation
Means followed by different letters within a column are significantly different (P≤0.05).

By replacing soy and lentil flour into donut formulation, b* and a* was increased and L* was decreased. As shown in Figure (2), the addition of soy and lentil flour has a significant effect on the ΔE in donut. Most color changes after 8 minutes of frying in a sample containing 30% lentil flour. The lowest was observed for the control sample.

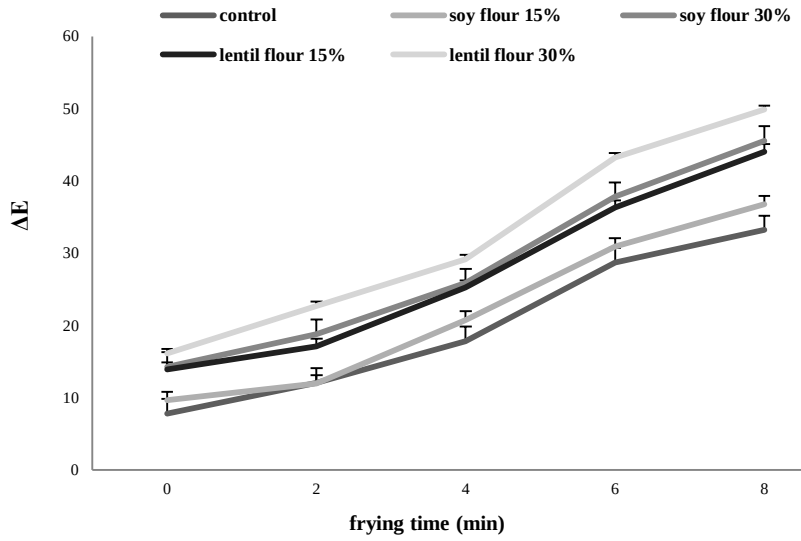

Figure 2. The Effect of Replacing Soy and Lentil Flour on ΔE of Donut

According to the mean scores of sensory tests, replacing soy and lentil flour in donut formulation, the amount of color and texture increased, volume and taste decreased compared to the control sample (Table 2). Appearance and color are important and effective features in customer selection. By increasing the soy and lentil flour, the sensory sensors were darker in color and less acceptance, which could be attributed to the Millard reaction as a result of adding more protein.

Table 2. The Effect of Replacing Soy and Lentil Flour on Sensory properties of Donut

formulation	color	flavor	texture	volume	General acceptance
Control	6.03[b]	3.51[c]	3.86[d]	6.12[a]	5.62[b]
Soy flour 15%	6.45[a]	6.78[a]	4.34[c]	5.84[b]	6.75[a]
Soy flour 30%	5.44[c]	4.43[b]	4.55[c]	4.34[c]	5.78[b]
Lentil flour 15%	4.23[d]	3.25[c]	5.04[b]	4.23[c]	5.23[bc]
Lentil flour 30%	4.13[d]	2.16[d]	5.56[a]	4.12[c]	4.49[c]

Table data reported in mean±standard deviation
Means followed by different letters within a column are significantly different ($P \leq 0.05$).

Conclusion

In this research, (0, 15 and 30%) soy flour and lentil flour was replaced part of wheat flour used to prepare donuts and its effect on the quality parameters of donut was investigated. Replacing soy and lentil flour reduced moisture loss and oil absorption. By increasing the percentage of soy flour, color variations have increased but the volume and porosity was decreased. Soy and lentil flour, reduced the absorption of oil, which is very desirable, and on the other hand, qualitative factors such as texture, color and taste have been reduced which is suggested for solving this problem simultaneously with wheat in products made from wheat flour.

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