OBTAINING FORTIFICATED PRODUCT BY ADDING FLAXSEED AND SOYA FLOUR TO HAZELNUT PASTE

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INTRODUCTION

Functional foods and natural health products encompass a wide range of food and ingredients, with a variety of bioactives responsible for their efficacy in health promotion and disease prevention (Shahidi, 2004). For this purpose, in order to benefit much more from these biactive compounds a new product was intented to develop which was formed by hazelnut, soybean and flaxseed. Thus, it was aimed to increase the consumption of these kind of foods in daily diet.

In this study, non-fat soya flour and milled flaxseed were added to hazelnut paste samples in ratios of 5 %, 10 % and 15 % and then the mixtures were stored at 21± 2ºC for a period of 3 months. By this study, the effects of the addition of soya and flaxseed to hazelnut paste on the sensory, textural properties and oxidative stability, were introduced.

MATERIAL AND METHODS

Hazelnut Paste Samples

The formulation of the paste samples as shown Table 1. The paste samples were stored at 21± 2ºC for a period of 3 months. The analyses were conducted at the begining and on the 45th day, 90th day of the storage period.

Oil Extraction from Paste Samples

Oil extraction from the paste samples were done according to the cold extraction method described by Sumainah et al. (2000). This extraction was repeated 45 th day and 90 th day and standard chemical analyses were performed at the oil samples obtained from paste samples.

Standard Chemical Parameters

The free fatty acidity and peroxide values were determined according to the AOCS Cd 3d-63 and AOCS Cd 8-53 methods, respectively.

Oxidative Stability Analysis

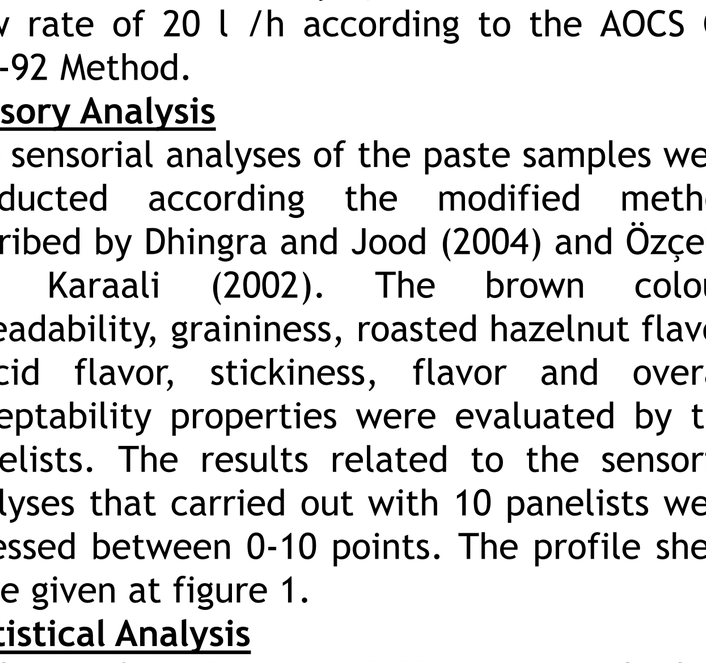
The oxidative stability analyses were conducted in the oil samples by using Rancimat 743 (Metrohm Herisau, İsviçre) at 120°C with the air flow rate of 20 l /h according to the AOCS Cd 21b-92 Method.

Sensory Analysis

The sensorial analyses of the paste samples were conducted according the modified method decribed by Dhingra and Jood (2004) and Özçelik and Karaali (2002). The brown colour, spreadability, graininess, roasted hazelnut flavor, rancid flavor, stickiness, flavor and overall acceptability properties were evaluated by the panelists. The results related to the sensorial analyses that carried out with 10 panelists were assessed between 0-10 points. The profile sheet were given at figure 1.

Statistical Analysis

Analysis of variance (ANOVA) was applied to indicate the differences among the samples using Fisher's least significant difference test at *P<0,05* significance level using SPSS 9.0 programme.



SENSORIAL ANALYSIS PROFILE SHEET

Name Surname: Date:

Evaluate the coded seven hazelnut paste samples that served you in terms of the properties given below. Specify the code of sample on the proper point of the scale for each property.

BROWN COLOUR — LIGHT — DARK

SPREADABİLİTY — HARD SPREADABLE — EASY SPREADABLE

ROASTED HAZELNUT FLAVOR — LITTLE — MUCH

RANCID FLAVOR — NONE — MUCH

GRAININESS — LITTLE GRAININESS — MUCH GRAININESS

STICKINESS — LITTLE STICKINESS — MUCH STICKINESS

FLAVOR — DISLIKE — LIKE

OVERALL ACCEPTABILITY — DISLIKE — LIKE

Figure 1. Sensory Analysis Profile Sheet

Table 1. Formulation of Hazelnut Paste

İngredient % by weight	Addition Level						
	Control	Soybean %5	Soybean % 10	Soybean %15	Flaxseed %5	Flaxseed %10	Flaxseed %15
Hazelnut paste	79	74	69	64	74	69	64
Non-fat soybean flour	-	5	10	15	-	-	-
Milled flaxseed	-	-	-	-	5	10	15
Powdered sugar	20	20	20	20	20	20	20
Monoglyseride	1	1	1	1	1	1	1

Table 2.Quality Criteria of Hazelnut Samples

Quality Criteria	Days	Hazelnut Samples						
		Control	Soybean %5	Soybean %10	Soybean %15	Flaxseed %5	Flaxseed %10	Flaxseed %15
Peroxide Value (meqO2/kg)	1	2.16 x^{a}	2.17 x^{a}	2.87 x^{a}	2.05 x^{a}	2.42 x^{a}	2.40 x^{a}	2.81 x^{a}
	45	2.22 x^{a}	2.49 x^{a}	2.94 x^{a}	2.48 x^{a}	2.52 x^{a}	2.67 x^{a}	2.95 x^{a}
	90	4.31 y^{b}	3.62 x^{a}	4.27 y^{b}	4.28 y^{b}	4.20 y^{b}	4.84 y^{c}	4.88 y^{c}
Free Fatty Acidity (oleic acid %)	1	0.92 x^{a}	0.94 x^{a}	0.91 x^{a}	1.14 x^{bc}	1.09 y^{b}	1.22 x^{cd}	1.28 x^{d}
	45	1.05 y^{b}	1.08 y^{bc}	1.07 y^{bc}	1.12 x^{cd}	0.95 x^{a}	1.16 x^{d}	1.30 x^{e}
	90	1.12 z^{b}	1.05 y^{a}	1.12 z^{b}	1.22 y^{c}	1.21 z^{c}	1.33 y^{d}	1.41 x^{e}

x, y, z: The values in the same column indicated with different letters are varied from each other with the level of $p<0.05$

$^{a, b, c}$: The values in the same row indicated with different exponential letters are varied from each other with the level of $p<0.05$

Table 3. Sensory Evaluation of the Hazelnut Paste Samples

Sensorial Properties	Days	Hazelnut Samples						
		Control	Soybean %5	Soybean %10	Soybean %15	Flaxseed %5	Flaxseed %10	Flaxseed %15
Brown colour	1	3.68x^{c}	3.23x^{b}	2.62xy^{b}	1.5x^{a}	5.04x^{c}	6.16x^{e}	6.94x^{f}
	45	4.2y^{d}	3.14x^{c}	2.47x^{b}	1.86x^{a}	5.42xy^{e}	6.48x^{f}	7.08xy^{g}
	90	4.04xy^{c}	3.36x^{b}	3.07y^{b}	1.73x^{a}	5.99y^{d}	6.79x^{e}	7.77y^{f}
Spreadability	1	7.68x^{e}	4.91y^{d}	2.38y^{b}	1.01x^{a}	7.03x^{e}	4.91xy^{d}	3.3y^{c}
	45	7.56x^{g}	3.98x^{d}	1.88x^{b}	0.89x^{a}	6.82x^{f}	4.83x^{e}	2.84x^{c}
	90	7.76x^{g}	4.66y^{d}	2.17xy^{b}	0.95x^{a}	6.93x^{f}	5.29y^{e}	3.19y^{c}
Roasted Hazelnut Flavor	1	5.34x^{cd}	4.75x^{bc}	4.70x^{b}	3.29x^{a}	5.69y^{d}	5.24y^{cd}	4.42x^{ab}
	45	5.72x^{c}	5.45x^{c}	5.12x^{bc}	4.04x^{ab}	4.17xy^{bc}	3.69xy^{abc}	2.90x^{a}
	90	6.02x^{c}	5.64x^{c}	5.56x^{bc}	3.37x^{abc}	3.96x^{ab}	3.76x^{a}	3.63x^{a}
Rancid Flavor	1	0.17x^{a}	0.21x^{a}	0.29x^{a}	0.37x^{a}	0.45x^{a}	0.53x^{a}	0.48x^{a}
	45	0.29x^{a}	0.49x^{a}	0.64x^{ab}	0.79x^{ab}	1.20y^{cd}	1.42x^{bc}	1.97y^{d}
	90	1.01y^{a}	1.36y^{abc}	1.92x^{ab}	2.66y^{bcd}	2.69z^{cd}	3.52y^{de}	4.34z^{e}
Graininess	1	1.22x^{a}	2.11x^{b}	3.75x^{c}	5.72x^{d}	2.93xy^{bc}	5.03x^{d}	7.01x^{e}
	45	1.03x^{a}	1.83x^{b}	3.33x^{c}	5.84x^{d}	2.57x^{b}	4.60x^{d}	6.63x^{e}
	90	1.33x^{a}	2.29x^{b}	4.27x^{d}	6.04x^{f}	3.29y^{c}	5.21x^{e}	7.07x^{g}
Stickiness	1	1.57x^{a}	3.63x^{b}	5.88x^{d}	8.17x^{f}	2.93x^{b}	5.22x^{c}	7.02x^{e}
	45	1.28x^{a}	3.29x^{c}	5.38x^{e}	7.70x^{g}	2.26x^{b}	4.38x^{d}	6.63x^{f}
	90	1.31x^{a}	3.18x^{b}	5.52x^{c}	7.58x^{d}	2.18x^{b}	4.43x^{c}	6.63x^{d}
Flavor	1	5.72x^{b}	5.23x^{b}	4.12x^{a}	3.33x^{a}	6.27x^{c}	3.60x^{a}	3.86x^{a}
	45	6.67x^{b}	5.00x^{b}	5.53y^{b}	3.95x^{a}	5.02x^{b}	3.37x^{a}	2.24x^{a}
	90	5.32x^{c}	5.92x^{c}	4.91y^{cd}	4.93x^{bc}	5.84x^{c}	3.5x^{ab}	3.83x^{a}

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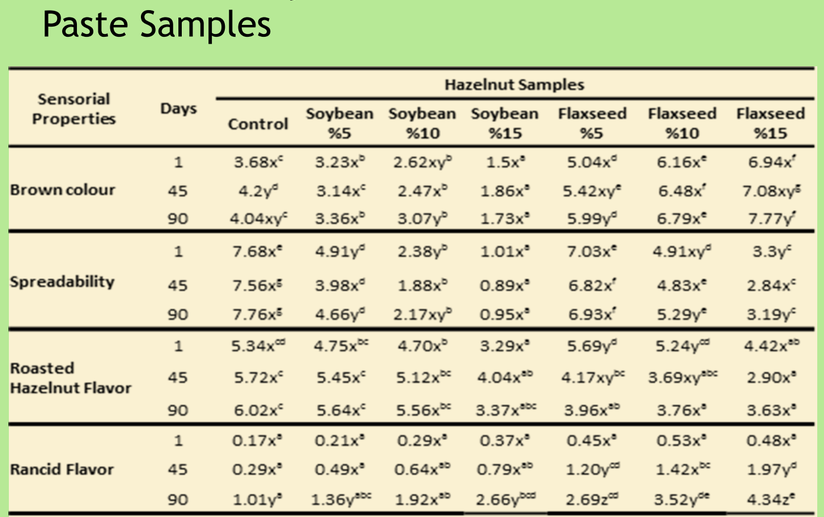

Figure 2. The induction time of the samples with the addition of soybean and flaxseed in the accelerated oxygen conditions

RESULTS AND DISCUSSION

The quality criteria of the hazelnut paste samples were given in table 2. During storage period, the free fatty acid content and the peroxide values of the hazelnut samples progressively increased. At the end of three months these criteria reached the maxmimum levels in the samples with flaxseed contents. It was probably due to the higher polyunsaturated fatty acid content of flaxseed (Flaxseed contains approximately 40% oil, of which 52% is α-linolenic acid as a polyunsaturated fatty acid)compared to hazelnut and soybean. Nattress et all.,(2003) also reported that the high content of polyunsaturated oil results in high susceptibility to fatty acid oxidation.

Induction time is one of the significant parameters to determine the resistance against the oxidation of fats and oils. As can be seen in figure 2, induction times of the samples ranged from 8.6 h to 5.63 h. In the samples enriched with soya, the increase in ratio of addition of soya was caused a small decrease in the induction time, on the other hand, compared to others a distinct decrease has been especially determined in the induction period for samples with 10 and 15 % flaxseed addition. The slight decrease in the induction time for soybean added samples may attibuted to the low oil content (non-fat soybean flour with the 1% oil content) wheras the distinct decrease for flaxseed added samples may stem from higher polyunsaturated oil content.

To evaluate the effect of storage time on the sensory attributes of the paste samples, reference samples were provided at the beginning of each session. All the hazelnut samples with different addition levels were prepared as reference samples at the beginning of storage period and were stored in -18°C. Spreadability was scored highest in control sample and decreased as the level of soybean and flaxseed addition increased. This may be because of different oil content and particulate size as reported by some authors (Özçelik and Karaali,2002).

Three sensory texture attributes -spreadability, stickiness and graininess- were not influenced by time, whereas the flaxseed and soybean additon caused statistically significant difference ($P<0.05$) between samples.

The changes in sensorial properties like spreadability, roasted hazelnut flavor, graininess, stickiness, taste and overall acceptability except for rancid flavor values were not perceived by the panelists during the period of storage. In the beginning period of storage time, while the rancid flavor values of the samples didn't reveal statistically significant differences ($P>0.05$), by the end of 3 months the samples indicated statistically significant difference between samples ($P<0.05$). The flaxseed added samples got higher scores for rancid flavor than the soybean added samples. This finding correlated well with the induction time as can be seen in figure 2.

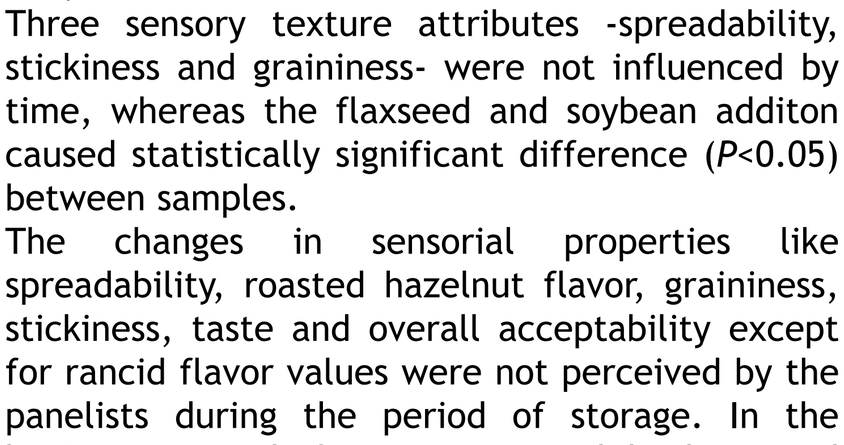

Figure 3. The overall acceptability attribute results of the hazelnut samples

CONCLUSION

As a conclusion the addition of 10% and 15% soybean and flaxseed has unfavourable effects on hazelnut paste. On the contrary, the hazelnut paste samples enriched with 5% soybean and 5% flaxseed were the highest scoring samples in terms of flavour and overall acceptability in sensory analysis. Additionally these samples revealed similar results with control sample as being more resistance to the oxidation according to the results obtained for quality criteria and induction time. At the beginning of storage period the paste samples which were the most favorite in flavor and overall acceptability were the ones containing 5 % soybean and 5 % flaxseed and the control sample, at the end of 3 months the same samples were still the most favorite for these attributes.. This study has revealed that soybean and flaxseed can be added to breakfast products like hazelnut paste for enrichment.

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