

THE EFFECTS OF USING HAZELNUT OIL IN WATER EMULSION AND HAZELNUT POWDER ON EMULSION PROPERTIES OF REDUCED FAT SAUSAGES

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Abstract – In this study, the effects of substitution of beef fat with hazelnut oil in water emulsion (0%, 10%, 20%) and the addition of hazelnut powder (0%, 3%, 6%) on emulsion characteristics of reduced fat sausages. Using hazelnut oil and hazelnut powder in sausage formulations significantly increased fat content, energy values, emulsion stability, water holding capacity. Cooking loss was decreased significantly by the addition of hazelnut oil and hazelnut powder in sausage formulations.

Key Words – Sausages, Hazelnut oil, Hazelnut powder

I. INTRODUCTION

Sausage is an emulsion type meat product that is widely consumed. It usually contains fat as high as 30%. Use of animal fat in meat products gives a certain taste and flavor and improves the textural properties of the product [1,2]. In recent years, there has been decrease in popularity of meat products because of high cholesterol and saturated fatty acid content [2,3].

Health organizations all over the world have promoted lowering the intake of total dietary fat, saturated fatty acids and cholesterol as a means of preventing cardiovascular heart disease. Vegetable oils are free of cholesterol and have a higher ratio of unsaturated to saturated fatty acids than animal fats [4]. Thus the incorporation of vegetable oil in meat products may have a positive effect on consumer health.

Turkey produces about 550,000 t of hazelnut annually, which is approximately 80% of the World's hazelnut production [5]. Hazelnut oil is rich in both monounsaturated and polyunsaturated fatty acids, as well as

tocopherols [6,7]. Hazelnut oil contains 74.2–83.1% oleic acid and linoleic acid. Thus the incorporation of hazelnut oil in meat products may have positive effects on consumer health.

The addition of dietary fiber in meat products is desirable for nutritional properties but also for their technological improvement and functional properties related with the benefits for human health. Hazelnut contains dietary fiber, proteins, minerals and vitamin B components, and has been frequently used in prepared foods as a potential dietary fiber source, as well as fat substitute in reduced-fat meat products.

The objective of this study was to investigate the effect of replacing animal fat with hazelnut oil and adding hazelnut powder on emulsion properties of reduced-fat sausages.

II. MATERIALS AND METHODS

Fresh lean beef (moisture 72.74%, fat 3.99%, protein 20.13% and ash 1.23%) and back fat were purchased from local processor and was ground through a 3-mm plate. Hazelnuts were ground in a mill to obtained hazelnut powder and stored in plastic flasks at 4±2°C until used.

Hazelnut oil in water (O/W) emulsions were prepared by adding 51.6% hazelnut oil into aqueous phase containing 1% salt, 5.26% sodium caseinate. Sausage formulations are seen in Table 1. Ground meat, curing ingredients (2% salt, 0.5% sodium phosphate, 0.5% sodium ascorbate, 0.015 sodium nitrite) and half the ice (10%) were homogenized and in a cutter for 2 min, then emulsified fat (20%), spice mix (1.5%) binders and extenders and other half the ice (10%) were added and homogenized for an

additional 6 min. Batters were stuffed into synthetic casings using a hydraulic sausage filling machine (Alpina-SG-Schweiz) and smoked at 45°C for 105 min in smoking cabinet AFOS MINI KLN. The sausages were heat processed in steam jacket vessel at 80°C until reached 73°C internal temperature, afterward cooled in iced water for 15 min before being stored at 4°C overnight. After that the sausage samples were vacuum packaged.

Moisture, protein and ash content of each cooked emulsion were measured using the appropriate AOAC (1990) procedures [8]. Lipid content was determined using the chloroform–methanol extraction method according to Flynn & Bramblett (1975) [9]. Emulsion stability, water holding capacity and cooking yield analyses were performed based on weight losses [10]. Statistical analyses was determined by SPSS[®] version 16 program, One-Way ANOVA and Duncan multiple comparison methods and interpolation was determined by Univariate General Linear Modelling [11].

Table 1. Formulation of reduced fat sausages (%)

Sample	Meat	Fat Emulsions	W/O Emulsion	Ice	Hazelnut Powder
KF0	60	20	0	20	0
KF3	57	20	0	20	3
KF6	54	20	0	20	6
YF0	60	10	10	20	0
YF3	57	10	10	20	3
YF6	54	10	10	20	6
FF0	60	0	20	20	0
FF3	57	0	20	20	3
FF6	54	0	20	20	6

III. RESULTS AND DISCUSSION

Chemical composition of sausage samples formulated with back fat and hazelnut oil emulsion and hazelnut powder are shown in Table 2. The differences in moisture, protein, fat, and ash contents of sausage formulations were statistically significant ($p < 0.05$). The lowest moisture content and the highest fat content were found in samples formulated with hazelnut oil and 6% hazelnut powder (FF6). The protein content was lower in sausages formulated with hazelnut oil and hazelnut powder than the other

samples. The ash content was higher in KF6 due to the added hazelnut powder.

Table 2. Chemical composition of sausage samples (values are means $\pm$ SD)

Sample	Moisture	Fat	Protein	Ash
KF0	67.46 $\pm$ 2.8 ^a	16.25 $\pm$ 0.3 ^a	10.95 $\pm$ 1.9 ^c	2.56 $\pm$ 0.2 ^b _c
KF3	65.91 $\pm$ 2.7 ^{ab}	15.38 $\pm$ 0.3 ^{ab} _c	11.84 $\pm$ 0.9 ^{de}	2.72 $\pm$ 0.3 ^b _c
KF6	62.49 $\pm$ 2.9 ^c	14.85 $\pm$ 0.4 ^{bc}	15.87 $\pm$ 3.9 ^{abc}	3.09 $\pm$ 0.1 ^a
YF0	66.67 $\pm$ 0.8 ^{ab}	15.93 $\pm$ 0.5 ^{ab}	12.88 $\pm$ 0.7 ^{cde}	2.65 $\pm$ 0.1 ^b _c
YF3	65.50 $\pm$ 0.8 ^{ab}	15.05 $\pm$ 1.3 ^{bc}	13.35 $\pm$ 1.4 ^{bcd} _e	2.60 $\pm$ 0.1 ^b _c
YF6	63.32 $\pm$ 0.7 ^{bc}	14.90 $\pm$ 0.3 ^{bc}	16.70 $\pm$ 3.3 ^{ab}	2.70 $\pm$ 0.2 ^b _c
FF0	66.85 $\pm$ 0.4 ^a	15.09 $\pm$ 0.3 ^{bc}	11.96 $\pm$ 1.9 ^{de}	2.57 $\pm$ 0.2 ^b _c
FF3	64.71 $\pm$ 0.01 _{abc}	14.98 $\pm$ 0.5 ^{bc}	15.02 $\pm$ 0.9 ^{bcd}	2.44 $\pm$ 0.1 ^c
FF6	59.67 $\pm$ 2.85 _d	14.92 $\pm$ 0.9 ^c	19.34 $\pm$ 2.9 ^a	2.83 $\pm$ 0.1 ^a _b

a–e: Any two means in the same column having the same letters in the same section are not significantly different at $p > 0.05$, SD: standard deviation.

The differences in emulsion stability of meat emulsions formulated with hazelnut oil and hazelnut powder were significant (Table 3). The meat emulsion prepared with fat and no added hazelnut powder resulted in the highest total expressible fluid and fat released, thus decreasing the stability of the emulsion. Among all the treatments, hazelnut oil and hazelnut powder treatment had contained the lowest total expressible fluid and fat released. These results agree with those reported by Choi et al. [12], in which vegetable oils and rice bran fiber increased emulsion stability in reduced fat meat emulsion systems.

Cooking loss of sausages formulated with hazelnut oil and hazelnut powder are given in Table 4. Cooking loss was lower in sausages formulated with hazelnut oil and hazelnut powder than in control samples, and sausages with added hazelnut oil had the lowest cooking loss.

Table 3. Effects of hazelnut oil and hazelnut powder on emulsion stability of sausages (values are means $\pm$ SD)

Sample	TEF %	FR %
FD		
K	2.07±0.66 ^a	1.61±0.34 ^a
Y	1.25±0.10 ^b	0.91±0.17 ^b
F	1.01±0.21 ^c	0.76±0.09 ^c
Significance	0.000	0.000
HP		
F0	1.85±0.79 ^a	1.35±0.51 ^a
F3	1.34±0.39 ^b	1.03±0.40 ^b
F6	1.12±0.28 ^c	0.91±0.25 ^c
Significance	0.000	0.000
FD*HP	0.000	0.000

a–c: Any two means in the same column having the same letters in the same section are not significantly different at $p > 0.05$, SD: standard deviation. FD: Fat Difference, HP: Hazelnut powder.

Reducing the animal fat content in frankfurters reduced the cooking loss, which was also dependent on the fat type [13]. Also, cooking loss was affected by dietary fiber, as was fat concentration, both of which decreased as the amount of dietary fiber increased [14].

Table 4. Effects of hazelnut oil and hazelnut powder on cooking loss and water holding capacity of sausages (values are means ±SD).

Sample	Cooking loss	Water Holding Capacity
FD		
K	11.77±3.65 ^a	77.62±2.20 ^c
Y	9.45±0.71 ^b	81.33±0.80 ^b
F	8.41±0.82 ^c	83.11±2.10 ^a
Significance	0.000	0.000
HP		
F0	11.82±3.60 ^a	78.62±2.87 ^c
F3	9.37±0.90 ^b	80.99±1.96 ^b
F6	8.44±0.71 ^c	82.45±2.59 ^a
Significance	0.000	0.000
FD*HP	0.000	0.000

a–c: Any two means in the same column having the same letters in the same section are not significantly different at $p > 0.05$, SD: standard deviation. FD: Fat Difference, HP: Hazelnut powder.

The effects of hazelnut powder and the replacement of back fat with hazelnut oil on water holding capacity are given in Table 4. The water holding capacity of sausages were higher in sausages formulated with hazelnut oil and hazelnut powder than the other treatments. Vural et al. [15] indicated that the addition of

sugarbeet fiber increased the water holding capacity value of frankfurters.

IV. CONCLUSION

The results of this study indicate that the replacement of back fat emulsion with hazelnut oil in water emulsion and addition of hazelnut powder in sausage formulations significantly affects composition and emulsion properties of sausages. Emulsion properties were significantly improved by the addition of hazelnut oil and hazelnut powder. The incorporation of hazelnut oil and hazelnut powder in the formulation successfully reducing animal fat in sausage formulation.

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