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Research Article

Investigating the Effects of Different Types of Fat on Some Sensory Properties of Chicken Sausage During Storage

Muamer Mandra[1], Ramzija Cvrk[2]*, Vladimir Tomović[3], Selma Čorbo[4] and Tijana Brčina[2]

[1]*Perutnina Ptuj BH, Breza, Bosnia and Herzegovina*

[2]*Department of Food Technology, University of Tuzla, Bosnia and Herzegovina*

[3]*Department of Food Technology, Universiyt of Novi Sad, Serbia*

[4]*Department of Food Technology, University of Sarajevo, Bosnia and Herzegovina*

***Corresponding Author:** Ramzija Cvrk, Department of Food Technology, University of Tuzla, Bosnia and Herzegovina.

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Abstract

The aim of this research was to investigate the effects of different fat formulations of the emulsion – type chicken sausage on the texture and some sensory properties, during 90 days storage period at 4°C and 8°C. Chicken sausages were processed under six different formulations with different combinations of added fat – chicken fat with chicken skin, chicken fat separated from the abdomen and hydrogenated fat. Emulsions for chicken sausages were produced with combinations of fats, as follows: F1 (13.67% chicken fat with skin), F2 (13.67% chicken abdominal fat), F3 (13.67% hydrogenated fat), F4 (6.84% chicken fat with skin + 6.84% chicken abdominal fat), F5 (6.84% chicken fat with skin + 6.84% hydrogenated fat, and F6 (6.84% chicken abdominal fat + 6.84% hydrogenated fat).

During 90 days of storage,the instrumental analyses were made periodically, every 15 days. Proximate analysis showed significant ($p<0.05$) differences in hardness, springiness, cohesiveness, chewiness, firmness, while for adhesiveness no significant differences between the formulations of any periods of storage were shown. Also, pH value of the product indicated a statistically significant difference between formulations and a storage period.

Keywords: Chicken Meat; Chicken Fat; Hydrogenated Fat; Emulsion-Type Chicken Sausages; Instrumental Sensory Analysis

Abbreviations

TPA: Texture Profile Analysis; WBT: Warner-Bratzler Test.

Introduction

Favorable nutritional characteristics put chicken meat among the most desirable foods for consumers, including chicken meat products [1]. Sensory and acceptability attributes are important factors that influence food choices and acceptance. The acceptability of sausage products by the consumers is strongly influenced by the sensory properties of products. It is known that fat content in sausages is one of the factors that influence the acceptability of products [1]. Also, in meat products, fat plays a central role in stabilizing meat emulsions, providing juiciness, hardness, and improving sensory quality of products [2]. Texture is an important aspect of meat products quality, sometimes even more important than color and flavor [3]. Most important textural characteristics are hardness, cohesiveness, chewiness, firmness, springiness, adhesiveness and juiciness. It is common knowledge that methods applied to evaluate texture can be divided into three groups: sensory methods, instrumental methods (also known as objective, physical or mechanical) and indirect methods (determination of collagen content in meat, amount of dry matter, etc.) [3]. Instrumental evaluation of texture is based on mechanical tests, which include the measurement of resistance the food presents to forces greater than gravity that are acting on it [3]. Warner-Bratzler Test (WBT), and Texture Profile Analysis (TPA) are the most common ways of evaluating meat and meat products texture [4]. Texture profile analysis (TPA) is one of the methods that simulates conditions that food is exposed to in the mouth [5]. Also, reason for research using chicken fat emulsion for preparation of chicken meat sausages is that after processing chicken carcasses, a large amount of chicken fat remainsin chicken meat industry. Incorporation of remaining chicken skin and abdomen fat significantly helps the management of these fats, because chicken fat sensory properties are not suitable for use in other food products. On the other hand, the use of chicken fat avoids hydrogenated fat, which potentially contains trans-fat acid, formed in the hydrogenation process. Therefore, this study was conducted to evaluate the effects of replacing hydrogenated fat with chicken fat, partially or completely.

Materials and Methods

Processing and formulation of sausage

Chicken sausages were processed under six different formulations, in accordance with the legislation of Bosnia and Herzegovina for this type of product. Experimental batches were produced on industrial scale (PerutninaPtuj - BH, Breza, Bosnia and Herzegovina) in accordance with the Good Manufacturing Practice in food industry. Emulsions for chicken sausages were produced with combinations of fat (Table 1). The formulations were as follows: F1 (13.67% chicken fat with skin), F2 (13.67% chicken abdominal fat), F3 (13.67% hydrogenated fat), F4 (6.84% chicken fat with skin + 6.84% chicken abdominal fat),F5 (6.84% chicken fat with skin + 6.84% hydrogenated fat, and F6 (6.84% chicken abdominal fat + 6.84% hydrogenated fat. The basic formulations for the sausages were as follow: deboned chicken meat (74.46%), water (8.54%), potatoes fiber (0.98%), natural seasoning (0.88%) and nitrate salt (1.46%).

Formulation	Chicken fat with skin	Chicken abdominal fat	Hydrogenated fat
F1	13.67	-	-
F2	-	13.67	-
F3	-	-	13.67
F4	6.84	6.84	-
F5	6.84	-	6.84
F6	-	6.84	6.84

Table 1: Experimental design for emulsion-type chicken sausages (unit, %). c

Proximate analysis

Texture Profile Analysis (TPA) and Warner-Bratzler Test (WBT) were used to analyze hardness, adhesiveness, springiness, cohesiveness, chewiness, firmness and the standard method analysis was used to determine pH –value of emulsion-type chicken sausages.

Instrumental of texture profile analysis (TPA)

Instrumental of texture profile analysis (TPA) was conducted using a universal instrument for texture determination TA XP (Stable Micro System, Godalming, England). For texture analysis cylindrical samples were taken from the middle segment of sausages, with diameter of 2.54 cm, and height of 2.0 cm. Samples were tempered at room temperature, and there compressed to the 50% initial heights. Compression was performed using aluminum plates in diameter 75 mm (L/75) and load of 5 kg. Speed initiating contact proceeding before the test, during the test and after the test was 1 mm/s. From the curves of deformation of the sample, using the software hardness (g), adhesiveness (gx s), springiness, cohesiveness, and chewiness (g) of chicken sausagesis determined. The results are taken as the arithmetic mean of five measurements for each of the six formulations.

Warner-Bratzler test (WBT)

Warner-Bratzler test evaluated the shear strength (N) of sausages, also, using universal instrument for texture determination TA XP (Stable Micro System, Godalming, England), with contact extension by Warner-Bratzler. Conducting the shear strength analysis with the following working conditions: weight of load- 5 kg, speed startup extensions-1.5 mm/sand sample diameter: 1.27 cm. Results are expressed as arithmetic mean of 7 measurements for each formulation sausage. This method measures the force required to shear the sample [6].

pH value

The pH-value was determined using a portable pH meter (Consort C931, Turnhout, Belgium), equipped with a stab combined glass-electrode (Mettler Toledo, Greifensee, Switzerland) for direct determination of pH in the meat and meat products. Before and during pH analysis the meter is calibrated with a standard phosphate buffer (pH of calibration buffer was 7.02 i 4.00 at 20°C). Results of pH value are expressed as arithmetic mean of 3 measurements for each formulation sausage [7,8].

Statistical analysis

Results obtained it this research analyzed by different statistical analyses including T-test, standard deviation and analysis of variance (ANOVA) was carried out using SPSS software (version 22). Duncan's test was used rank the samples that were statistically different in all properties and acceptability (P<0,05).

Results and Discussion

Cohesiveness and chewiness of chicken meat sausage

The result of the proximate analysis of cohesiveness and chewiness of emulsion – type chicken meat sausage shown in Table 2. Significant differences among sausage samples were observed for Cohesiveness ($p<0.05$) during all storage time, at temperature of 4°C and temperature of 8°C. Significant differences in the results for cohesiveness are shown between the formulations, temperatures and storage period. Chewiness (Table 2.) shows significant differences ($p<0.05$) only later in the storage period, at 75 days and 90 days of storage.Also, significant difference in the results for chewiness is shown between the formulations, temperatures and storage for the periodsof 75 days and 90 days (Table 2).

Table 3 shows the rsults for firmnes and pH – value of emulsion –type chicken sausage with different fat emulsion. Result obtained for firmness shows significant differences ($p<0.05$) at 15 days, 30 days and 45 days of storage. After 45 days of storage, there was no change in firmness. Also, pH-value shows significant differences

Storage duration in days (d)	Formulation	Cohesiveness		Chewiness	
		4°C	8°C	4°C	8°C
0	F1	0.69 ± 0.00	-	2388.62 ± 92.24	-
	F2	0.67 ± 0.00	-	2885.32 ± 188.35	-
	F3	0.65 ± 0.00	-	2591.66 ± 230.29	-
	F4	0.71 ± 0.06	-	2607.05 ± 439.89	-
	F5	0.67 ± 0.00	-	2979.84 ± 201.80	-
	F6	0.66 ± 0.00	-	2783.21 ± 144.43	-
15	F1	0.69 ± 0.00^{e}	0.69 ± 0.01^{e}	2569.41 ± 102.67	2490.97 ± 321.40
	F2	0.67 ± 0.01^{bcd}	0.67 ± 0.01^{bcd}	2637.27 ± 39.07	2433.48 ± 238.68
	F3	0.65 ± 0.00^{a}	0.66 ± 0.01^{ab}	2268.33 ± 32.77	2285.25 ± 326.79
	F4	0.68 ± 0.01^{cde}	0.67 ± 0.00^{bcd}	2439.16 ± 50.43	2508.93 ± 500.24
	F5	0.67 ± 0.00^{bcd}	0.66 ± 0.00^{ab}	2505.65 ± 70.05	2470.79 ± 140.06
	F6	0.67 ± 0.00^{abc}	0.66 ± 0.00^{ab}	2464.30 ± 268.49	2438.15 ± 122.85
30	F1	0.69 ± 0.00^{de}	0.69 ± 0.00^{e}	2506.24 ± 293.62	181.28 ± 104.66
	F2	0.66 ± 0.00^{b}	0.67 ± 0.00^{bc}	2957.42 ± 176.29	271.13 ± 156.54
	F3	0.65 ± 0.00^{a}	0.66 ± 0.00^{b}	2741.46 ± 236.16	135.89 ± 78.46
	F4	0.68 ± 0.01^{cd}	0.68 ± 0.00^{cd}	2786.77 ± 7.56	337.17 ± 194.66
	F5	0.67 ± 0.00^{bc}	0.68 ± 0.00^{de}	2718.65 ± 276.24	105.75 ± 61.05
	F6	0.66 ± 0.00^{b}	0.69 ± 0.00^{de}	2541.15 ± 288.49	338.55 ± 195.46
45	F1	0.67 ± 0.01^{d}	0.7033 ± 0.00^{ab}	2434.38 ± 291.72	1809.99 ± 51.31
	F2	0.67 ± 0.01^{cd}	0.6700 ± 0.01^{bcd}	2369.30 ± 156.43	2190.25 ± 345.16
	F3	0.62 ± 0.01^{d}	0.6800 ± 0.00^{ab}	2430.32 ± 274.14	1775.87 ± 132.15
	F4	0.70 ± 0.00^{a}	0.6867 ± 0.01^{abc}	1737.92 ± 132.92	1978.43 ± 156.00
	F5	0.74 ± 0.11^{d}	0.6633 ± 0.00^{bcd}	2459.63 ± 242.48	2170.65 ± 175.27
	F6	0.66 ± 0.00^{abcd}	0.6833 ± 0.02^{a}	2045.52 ± 245.32	1713.43 ± 253.50
60	F1	0.70 ± 0.01^{d}	0.69 ± 0.01^{cd}	2876.95 ± 196.91	2780.56 ± 258.21
	F2	0.69 ± 0.00^{cd}	0.67 ± 0.00^{abc}	3001.30 ± 145.16	3223.12 ± 450.39
	F3	0.67 ± 0.00^{ab}	0.67 ± 0.00^{ab}	2484.83 ± 232.65	2565.04 ± 52.04
	F4	0.69 ± 0.00^{d}	0.68 ± 0.00^{bcd}	3055.30 ± 76.22	2824.94 ± 235.02
	F5	0.67 ± 0.00^{abc}	0.67 ± 0.^{0ab1}	2689.98 ± 108.58	2818.85 ± 57.83
	F6	0.67 ± 0.01^{ab}	0.66 ± 0.01^{a}	2692.58 ± 352.03	2769.60 ± 421.74
75	F1	0.69 ± 0.01^{de}	0.69 ± 0.00^{e}	2860.07 ± 281.04^{bcde}	3120.51 ± 199.88^{def}
	F2	0.68 ± 0.00^{cde}	0.67 ± 0.00^{bcd}	2751.31 ± 38.23^{bc}	3281.49 ± 73.93^{f}
	F3	0.66 ± 0.01^{ab}	0.64 ± 0.02^{a}	2564.13 ± 203.40^{ab}	2417.46 ± 236.92^{a}
	F4	0.66 ± 0.00^{bc}	0.68 ± 0.00^{cde}	2821.40 ± 140.88^{bcd}	3175.96 ± 185.39^{ef}
	F5	0.67 ± 0.00^{bc}	0.65 ± 0.00^{ab}	2830.33 ± 151.19^{bcd}	2972.03 ± 49.07^{cdef}
	F6	0.67 ± 0.00^{bcd}	0.64 ± 0.00^{a}	2985.08 ± 142.44^{cdef}	2988.59 ± 228.52^{cdef}
90	F1	0.69 ± 0.01^{f}	0.70 ± 0.01^{g}	3176.5733 ± 201.92^{d}	2832.05 ± 207.61^{abc}
	F2	0.66 ± 0.00^{cd}	0.68 ± 0.00^{ef}	3027.78 ± 248.22^{bcd}	3164.84 ± 238.90^{cd}
	F3	0.64 ± 0.00^{ab}	0.64 ± 0.00^{a}	2636.57 ± 84.92^{a}	3029.57 ± 29.24^{bcd}
	F4	0.68 ± 0.00^{f}	0.68 ± 0.00^{f}	2658.00 ± 208.73^{a}	2759.27 ± 87.68^{ab}
	F5	0.67 ± 0.01^{cde}	0.67 ± 0.00	2762.84 ± 111.31^{ab}	2815.89 ± 123.76^{ab}
	F6	0.65 ± 0.00^{abc}	0.66 ± 0.01^{bc}	3061.38 ± 194.86^{bcd}	2917.20 ± 239.55^{abcd}

Table 2: Mean values (± standard deviation) of Cohesiveness and Chewiness of chicken meat sausage with different fats abcdef– (different superscript letters within the same column indicate significant difference (p<0,05)

Storage duration in days (d)	Formulation	Firmness		pH	
		4°C	8°C	4°C	8°C
0	F1	3.84 ± 0.53	-	6.46 ± 0.01	-
	F2	4.72 ± 0.40	-	6.44 ± 0.02	-
	F3	3.67 ± 0.33	-	6.49 ± 0.00	-
	F4	3.93 ± 0.44	-	6.47 ± 0.00	-
	F5	4.12 ± 0.45	-	6.48 ± 0.05	-
	F6	3.94 ± 0.32	-	6.49 ± 0.00	-
15	F1	3.99 ± 0.37^{bc}	4.12 ± 0.57^{bcd}	6.46 ± 0.00^{bc}	6.47 ± 0,00^{bc}
	F2	3.81 ± 0.25^{abc}	4.49 ± 4.49^{cd}	6.39 ± 0.08^{a}	6.45 ± 0,00^{b}
	F3	3.56 ± 0.38^{ab}	3.27 ± 3.27^{a}	6.51 ± 0.00^{c}	6.51 ± 0,00^{c}
	F4	4.14 ± 0.36^{bcd}	4.70 ± 0.70^{d}	6.48 ± 0.01^{bc}	6.48 ± 0,00^{bc}
	F5	3.88 ± 0.33^{abc}	4.01 ± 0.01^{bc}	6.50 ± 0.00^{c}	6.48 ± 0,01^{bc}
	F6	3.51 ± 0.47^{ab}	3.78 ± 0.78^{ab}	6.48 ± 0.01^{bc}	6.48 ± 0,00^{bc}
30	F1	3.88 ± 0.73^{abcde}	4.29 ± 0.58^{de}	6.56 ± 0.01^{de}	6.51 ± 0.01^{b}
	F2	4.04 ± 0.42^{bcde}	4.54 ± 0.25^{e}	6.54 ± 0.02^{bcde}	6.47 ± 0.00^{a}
	F3	4.14 ± 0.72^{bcde}	3.06 ± 0.19^{a}	6.59 ± 0.02^{f}	6.56 ± 0.00^{de}
	F4	4.00 ± 0.29	4.20 ± 0.44^{cde}	6.55 ± 0.01^{cde}	6.51 ± 0.01^{b}
	F5	3.71 ± 0.32^{abcde}	3.58 ± 0.22^{abcd}	6.57 ± 0.02^{ef}	6.52 ± 0.01^{bc}
	F6	3.35 ± 0.09^{ab}	3.41 ± 0.39^{abc}	6.55 ± 0.01^{cde}	6.53 ± 0.02^{bcd}
45	F1	4.77 ± 0.91^{bc}	5.31 ± 0.67^{c}	6.55 ± 0.01^{d}	6.48 ± 0.01^{a}
	F2	4.39 ± 0.17^{abc}	4.77 ± 0.16^{bc}	6.52 ± 0.00^{bc}	6.50 ± 0.01^{ab}
	F3	4.26 ± 0.60^{ab}	3.62 ± 0.31^{a}	6.54 ± 0.01^{cd}	6.52 ± 0.01^{bc}
	F4	4.43 ± 0.59^{abc}	4.68 ± 0.23^{bc}	6.52 ± 0.01^{bc}	6.51 ± 0.01^{b}
	F5	4.29 ± 0.10^{ab}	4.66 ± 0.25^{bc}	6.53 ± 0.00^{cd}	6.55 ± 0.00^{d}
	F6	4.11 ± 0.72^{ab}	4.00 ± 0.54^{ab}	6.55 ± 0.00^{d}	6.52 ± 0.01^{bc}
60	F1	4.45 ± 0.07	4.43 ± 0.58	6.52 ± 0.00^{de}	6.41 ± 0.00^{a}
	F2	4.05 ± 0.57	5.09 ± 0.58	6.50 ± 0.03^{cd}	6.42 ± 0.01^{a}
	F3	3.40 ± 0.37	4.15 ± 0.33	6.52 ± 0.02^{de}	6.47 ± 0.00^{bc}
	F4	4.03 ± 1.06	4.87 ± 0.14	6.53 ± 0.00^{de}	6.50 ± 0.04^{cd}
	F5	4.27 ± 0.78	4.59 ± 0.38	6.54 ± 0.01^{e}	6.46 ± 0.00^{b}
	F6	4.04 ± 0.48	4.57 ± 0.78	6.52 ± 0.00^{de}	6.46 ± 00.02^{b}
75	F1	4.08 ± 0.97	4.25 ± 0.76	6.52 ± 0.02	6.48 ± 0.00
	F2	3.84 ± 0.37	4.18 0.27	6.48 ± 0.01	6.46 ± 0.00
	F3	3.25 ± 0.36	3.55 ± 0.85	6.50 ± 0.05	6.49 ± 0.32
	F4	3.91 ± 0.45	4.44 ± 0.37	6.52 ± 0.00	6.48 ± 0.10
	F5	3.80 ± 0.30	4.46 ± 0.74	6.46 ± 0.07	6.49 ± 0.05
	F6	4.02 ± 0.36	3.69 ± 0.17	6.48 ± 0.04	6.49 ± 0.20
90	F1	3.95 ± 0.46	4.31 ± 0.41	6.49 ± 0.02^{bc}	6.34 ± 0.13^{a}
	F2	4.86 ± 0.26	4.49 ± 0.49	6.42 ± 0.08^{b}	6.49 ± 0.00^{bc}
	F3	3.77 ± 0.79	4.16 ± 0.25	6.51 ± 0.02^{bc}	6.51 ± 0.00^{bc}
	F4	4.35 ± 0.43	4.39 ± 0.53	6.48 ± 0.00^{bc}	6.49 ± 0.00^{bc}
	F5	3.63 ± 0.29	3.72 ± 0.73	6.53 ±0.00^{c}	6.51 ± 0.25^{bc}
	F6	3.59 ± 0.30	4.44 ± 0.77	6.51 ± 0.01^{bc}	6.51 ± 0.15^{bc}

Table 3: Mean values (± standard deviation) of Firmness and pH - value of chicken meat sausage with different fats.

abcdef– (different superscript letters within the same column indicate significant difference (p<0,05)

($p<0.05$) between the formulations and the storage period, excluding the period of 75 days of storage.

Results for hardness, adhesiveness and springiness are shown in Table 4. Significant differences ($p<0.05$) among sausage samples were observed for springiness between the formulation and the storage period, excluding the period of 30 days of storage. Also, for springiness no significant difference was observed ($p<0.05$) between the formulation at 4°C in 60 days storage period. Significant difference ($p<0.05$) for hardness is shown in Table 4. Differences for hardness between the formulation and temperatures at 4°C and 8°C are observed at 30, 45, 75 and 90 days storage period. The results in Table 4. indicate important information for adhesiveness. For adhesiveness no significant difference were shown neither between the formulation nor storage period.

Storage duration in days (d)	Formulation	Hardness		Adhesiveness		Springiness	
		4˚C	8˚C	4˚C	8˚C	4˚C	8˚C
0	F1	3820. 67 ± 188.37	-	- 57. 01 ± 40.55	-	0.90 ± 0.01	-
	F2	4877.94 ± 334.37	-	- 109.79 ± 41. 33	-	0.88 ± 0.01	-
	F3	4525.05 ± 453.59	-	- 138.78 ± 32.86	-	0.88 ± 0.01	-
	F4	4105.68 ± 462.64	-	- 77.91 ± 37.87	-	0.89 ± 0.02	-
	F5	5064.46 ± 329.35	-	- 123.18 ± 35.03	-	0.88 ± 0.01	-
	F6	4849.93 ± 249.88	-	- 117.54 ± 35.10	-	0.87 ± 0.01	-
15	F1	4198.09 ± 166.81	3975.85 ± 621.96	-127.06 ± 1.83	-74.14 ± 58.20	0.88 ± 0.01^{bcd}	0.90 ± 0.01^{e}
	F2	4359.20 ± 68.41	4077.07 ± 372.33	-73.52 ± 27.50	-133.83 ± 4.43	0.89 ± 0.01	0.80 ± 0.05^{ce}
	F3	3966.06 ± 58.11	4033.73 ± 567.70	-142.46 ± 57.35	-144.96 ± 46.10	$0.87 \pm 0.01^{a,b}$	0.86 ± 0.01^{a}
	F4	4117.72 ± 91.82	4201.48 ± 784.51	-129.30 ± 3.24	-68.46 ± 54.79	$0.86 \pm 0.01^{a,b}$	0.88 ± 0.00^{bcd}
	F5	4214.0 ± 179.87	4294.04 ± 249.45	-120.52 ± 38.71	-123.57 ± 34.75	0.88 ± 0.01^{bcd}	$0.86 \pm 0.00^{a,b}$
	F6	4205.94 ± 455.80	4183.16 ± 266.48	-101.88 ± 49.47	-133.75 ± 34.56	$0.87 \pm 0.01^{a,b,c}$	0.87 ± 0.01^{abcd}
30	F1	4099.40 ± 420.74^{ab}	4177.07 ± 272.10^{ab}	-127.22 ± 10.98	-103.67 ± 48.33	0.88 ± 0.02	0.89 ± 0.01
	F2	5100.82 ± 274.28^{c}	4345.89 ± 379.96^{ab}	-126.44 ± 39.36	-67.40 ± 1.23	0.87 ± 0.01	0.90 ± 0.00
	F3	4735.41 ± 274.73^{bc}	3994.39 ± 139.63^{a}	-126.89 ± 33.64	- 82.25 ± 12.20	0.89 ±0.02	0.88 ± 0.01
	F4	4618.53 ± 149.16^{abc}	4508.81 ± 540.40^{abc}	-93.25 ± 37.05	-79.69 ± 69.00	0.88 ± 0.03	0.88 ± 0.01
	F5	4570.14 ± 462.40^{abc}	4040.51 ± 157.02^{ab}	-151.04 ± 1.61	- 88.61 ± 41.58	0.88 ± 0.00	0.88 ± 0.01
	F6	4390.79 ± 525.21^{ab}	4110.89 ± 499.41^{ab}	-128.79 ± 42.43	-144.95 ± 15.65	0.86 ± 0.01	0.86 ± 0.02
45	F1	4252.59 ± 487.32^{cd}	3527.66 ± 26.98^{ab}	-107.93 ± 60.75	-95.53 ± 76.33	0.85 ± 0.02^{e}	0.73 ± 0.03^{ab}
	F2	4501.49 ± 118.71^{cd}	4259.72 ± 480.23^{cd}	-97.46 ± 77.84	-116.50 ± 69.17	0.78 ± 0.04bcd	0.76 ± 0.05^{abc}
	F3	4623.19 ± 371.72^{d}	3573.03 ± 240.15^{ab}	-181.00 ± 72.25	-119.73 ± 53.68	0.84 ± 0.02^{dc}	0.73 ± 0.01^{ab}
	F4	3438.92 ± 101.78^{a}	3859.90 ± 205.13^{abc}	-68.46 ± 59.29	-96.00 ± 57.49	0.71 ± 0.04^{a}	0.74 ± 0.04^{abc}
	F5	4159.88 ± 335.88^{bcd}	4265.93 ± 384.48^{cd}	-184.91 ± 4.45	-143.20 ± 59.92	0.80 ± 0.01^{cde}	0.76 ± 0.01^{abc}
	F6	3937.20 ± 332.35^{abc}	3446.74 ± 586.92^{a}	-152.71 ± 37.35	-124.38 ± 68.86	0.78 ± 0.04^{bcd}	0.73 ± 0.01^{ab}

60	F1	4605.51 ± 236.46	4560.77 ± 385.49	-103.22 ± 90.85	-135.53 ± 58.07	0.89 ± 0.01^{c}	0.88 ± 0.88^{bc}
	F2	4933.35 ± 365.28	5333.12 ± 764.48	-109.30 ± 40.78	-304.63 ± 100.18	0.88 ± 0.02^{bc}	0.89 ± 0.89^{c}
	F3	4224.59 ± 280.70	4564.39 ± 101.00	-116.60 ± 67.87	-118.43 ± 35.19	0.88 ± 0.01^{bc}	0.83 ± 0.83^{a}
	F4	4987.86 ± 124.99	4577.45 ± 450.77	-124.79 ± 6.79	-41.01 ± 12.55	0.88 ± 0.00^{bc}	0.89 ± 0.89^{c}
	F5	4565.31 ± 150.68	4823.10 ± 33.58	-76.32 ± 10.49	-238.79 ± 228.75	0.87 ± 0.01^{bc}	0.86 ± 0.86^{bc}
	F6	4548.02 ± 545.64	4882.58 ± 854.44	-105.54 ± 57.16	-128.58 ± 66.50	0.88 ± 0.00^{bc}	0.85 ± 0.85^{ab}
75	F1	4737.51 ± 585.79^{abcd}	5177.48 ± 300.50^{cde}	-95.47 ± 43.66	-99.42 40.98	0.88 ± 0.02^{cde}	0.87 ± 0.01^{abcde}
	F2	4594.76 ± 110.36^{abc}	5623.48 ± 110.90^{e}	-107.83 ± 37.04	-117.55 ± 40.210	0.88 ± 0.01^{cde}	0.86 ± 0.01^{abcde}
	F3	4432.59 ± 362.69^{ab}	4412.03 ± 642.49^{a}	-102.95 ± 56.20	-522.38 ± 680.52	0.87 ± 0.01^{bcde}	0.85 ± 0.01^{abc}
	F4	4761.47 ± 255.50^{abcd}	5405.48 ± 325.04^{e}	-82.90 ± 37.42	-141.71 ± 1.86	0.88 ± 0.00^{de}	0.86 ± 0.01^{abcd}
	F5	4741.50 ± 272.69^{abcd}	5315.85 ± 125.10^{de}	-92.90 ± 39.54	-154.28 ± 3.76	0.89 ± 0.01^{e}	0.85 ± 0.01^{ab}
	F6	5067.20 ± 203.10^{bcde}	5483.80 ± 228.43^{e}	-107.49 ± 34.26	-147.66 ± 55.14	0.87 ± 0.01^{bcde}	0.84 ± 0.02^{a}
90	F1	5120.97 ± 411.82^{bcdef}	4672.40 ± 255.17^{abc}	-69.67 ± 58.82	-119.45 ± 7.56	0.90 ± 0.01^{e}	0.85 ± 0.01^{bc}
	F2	5057.52 ± 451.91^{bcdef}	5331.40 ± 485.03^{def}	-84.06 ± 34.90	-132.74 ± 12.41	0.89 ± 0.01^{e}	0.86 ± 0.00^{bcd}
	F3	4950.50 ± 102.45^{bcdef}	5529.44 ± 107.47^{f}	-149.89 ± 7.88	-150.61 ± 45.57	0.82 ± 0.01^{a}	0.85 ± 0.00^{b}
	F4	4357.16 ± 404.24^{a}	4533.97 ± 58.89^{ab}	-117.04 ± 7.53	-94.39 ± 36.52	0.88 ± 0.00^{de}	0.88 ± 0.02^{cde}
	F5	4753.18 ± 163.14^{abcd}	4844.59 ± 155.73^{abcde}	-105.20 ± 46.88	-138.60 ± 9.33	0.86 ± 0.00^{bcd}	0.86 ± 0.01^{bcd}
	F6	5377.52 ± 391.61^{ef}	5187.81 ± 327.61^{cdef}	-105.53 ± 33.26	-152.09 ± 21.57	0.86 ± 0.00^{bcd}	0.85 ± 0.02^{b}

Table 4: Mean values (± standard deviation) of hardness, adhesiveness, springiness of chicken meat sausage with different fats. abcdef– (different superscript letters within the same column indicate significant difference (p<0,05)

Conclusion

Results of this study show that significant changes occur between the formulations, in certain storage time. In periods of storage, when significant changes occurred, these changes were observed between all the formulations and between both storage temperatures. This fact suggests that the addition of chicken fat during the preparation of emulsion for chicken sausage does not have significant effect on the researched parameters. The important fact is that the adhesiveness was not changed during the entire period of storage, regardless of the formulation.

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Conflict of Interest

We have no conflicts of interest to disclose.

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