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THE EFFECTS OF FAT TYPE IN MEAT EMULSION ON COLOUR, TEXTURE AND CONSUMER ACCEPTABILITY OF CHICKEN MEAT SAUSAGES

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ABSTRACT

The aim of this research was to investigate the effects of the types of fat in fat emulsions for the production of chicken meat sausages on colour, texture and consumer acceptability. For the purpose of this research, six formulations were produced, in industrial conditions, with different percentage of chicken fat from different carcass parts that were used as total or partial replacement for hydrogenated fat.

Emulsions for chicken sausages were produced with fat combinations 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 skin, and F6 (6,84% chicken abdominal fat + 6,84% hydrogenated fat). These products were stored for 90 days at the temperatures of 4 ºC and 8 ºC. The anlyses of colour, texture and consumer acceptance were conducted every 15 days during 90-day storage.

KEYWORDS: chicken sausages , fat emulsions, colour, texture, consumer acceptability .

1. INTRODUCTION

Due to different nutritional strategies, consumers often favour chicken meat and it means that the production and processing of chicken meat are constantly increasing. Consumers also often consume certain parts of chicken carcass (drumsticks, thighs, breasts) which leads to a large amount of by-products in chicken meat industry, mostly chicken skin, subcutaneous and abdominal fat. With the increase of this production, there is also an increase of by-products, mostly fat parts of chicken carcass that are separated during processing since producers do not prefer fat. For that reason, during the process of slaughtering and processing chicken carcass, abdominal and subcutaneous fat remain as by-products which are mostly discarded as waste matter which can further cause some environmental issues. Taking care of these carcass parts requires additional resources and costs and due to that new possibilities for the use of these by-products are opening, mostly by developing new formulations for chicken meat sausages, partial replacement of hydrogenated fat with chicken fat (with or without skin) [1].

This paper explores the possibility of using chicken fat that remains as byproduct during chicken carcass processing for preparing meat emulsions used during the prodution of emulsion-based chicken meat sausages. Chicken fat is used as total or partial replacement for hydrogenated fat. Colour, texture and sensory acceptability of the products is evaluated considering the fact that sensory quality is one of the most important factors in food consumption [1,2,3].

2. MATERIALS AND METHODS

Formulations and the production of sausages

Fat-emulsion-based chicken sausages were produced in six different formulations according to the legislation for emulsion type sausages in Bosnia and Herzegovina and according to Good Manufacturing Practice. The experiment was conducted in industrial conditions (Perutnina Ptuj Industry for Chicken Meat Processing–BH,

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Breza, Bosnia and Herzegovina. Basic formulation for the production of chicken sausages was: deboned chicken meat (74,46 %), water (8,54 %), potato fiber (0,98 %), natural spices (0,88 %) and nitrite salt (1,46 %), and the type and amount of fat for the preparation of fat emulsions in six different combinations are presented in Table 1.

Table 1. Experimental formulations for emulsion type chicken sausages

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

Determination of pH value of sausages

pH value was determined ba portable pH meter (Consort C931, Turnhout, Belgium) with a combined reinforced glass probe electrode (MettlerToledo, Greifensee, Switzerland) for direct determination of pH value of meat products. Prior and during the determination process, pH meter was calibrated with standard phosphate buffers (pH of the buffer for calibration was 7.02 and 4.00 at 20°C) and set for measured temperature of sausages. The arithmetic mean of pH value determined in three sausages from every tested sausage type was taken as a result according to the standard ISO 2917, 2004 method.

Analysis of consumer acceptability of samples

Colours, texture and consumer acceptability of sausages were tested by ranking method – ranking in sequence, according to standardISO 4121, 2003., ISO 8587, 2006 methods and authors(Lawless and Heymann, 2010). The methodology of sensory ranking of sausages is described hereafter.Evaluation sheets for the ranking of sensory properties by consumers included: evaluation date, evaluation series, evaluator data (name, signature). The evaluators were young 19-to-23-year old students. During the sensory evaluation, they were given 6 coded samples (each sample had a six figure code). They evaluated each sample in the order indicated and ranked them according to the increase of the intensity of sensory colour property (lightest to darkest), for sensory texture property (softest to hardest) and for overall acceptability (intensly dislike tolike it very much). The evaluation codes were written in the boxes provided.In case that the evaluators could not feel the difference between products, „no difference“ option was not provided. The same sensory ranking method was used for every period of sensory ranking form 0 to 90 days.

Statistical analysis

Results obtained in 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 to rank the samples that were statistically different in all properties and acceptability ($P<0,05$).

3. RESULTS AND DISCUSSION

Analysing sausage colour during storage

When anlysing the results of consumer acceptability of sausages, it is important to bear in mind that the fat added in sausages is a source of essential fatty acids, fat-soluble vitamins and energy [4]. Likewise, the type of fat added in sausage formulations has a considerable effect on sensory properties (colour, texture and consumer acceptability). In this research, when we observed the colour properties of newly produced sausage samples (Table 2), there was no difference between F1 and F2 samples which is explained by the fact that during the production of these formulations only chicken fat was added (F1- added chicken fat with skin; F2 – added chicken abdominal fat). The results and discussion may be combined into a common section or obtainable separately. They may also be broken into subsets with short, revealing captions.

Also, the Table 1. Indicates no significant differences for newly produced F3, F4, F5 and F6 sausage formulations, and that can be related to the fact that these formulations were produced with the combination of

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chicken fat and hydrogenated fat (F3 – hydrogenated fat; F4- chicken fat with skin and chicken abdominal fat: F4; F5 – chicken fat with skin and hydrogenated fat, F6- chicken abdominal fat and hydrogenated fat).

Analysing the results of the consumer acceptability of colour during 15 - day storage, it is evident that there were acceptability differences at the temperature of 4ºC betweenF1, F2 and F3 formulations. There was no considerable difference in colour between F4, F5 and F6 formulations. At the storage temperature of 8˚C F4, F5 and F6 samples indicated no difference in colour, unlike other samples (Table 2).The difference in colour property of all anylised samples was evident during the storage period od 15 to 90 days at the temperatures of 4˚C and 8˚C (Table 2).

During the storage period of 30 days at 4˚C, there was no difference (p< 0, 05) between F3(hydrogenated fat) and F6 (chicken abdominal fat and hydrogenated fat). There was also no difference between F4 (chicken fat with skin and chicken abdominal fat) and F5 (chicken abdominal fat and hydrogenated fat). There was a difference between other samples. During the storage period of 30 days at 8˚C, there was no obvious difference (0< 0,05) between the samples F1 (chicken fat with skin) and F2(chicken abdominal fat), and there was also no significant difference between F5 (chicken fat with skin and hydrogenated fat) and F6 (chicken abdominal fat and hydrogenated fat). There was a statistically significant difference (p<0,05) between F3 (chicken abdominal fat) and F4 (chicken fat with skin) samples during the storage period of 30 days in both temperature conditions (4˚C and 8˚C).
During the storage period of 45 days at 4˚C there was a significant difference (p< 0,05) between F1(chicken fat with skin) and F2 (chicken abdominal fat)samples, while there were no significant differences betweenF3(hydrogenated fat) and F6 (chicken abdominal fat and hydrogenated fat) samples and betweenF4 (chicken fat with skin and chicken abdominal fat) and F5 (chicken fat with skin and hydrogenated fat) samples.

During the storage period of 45 d ays at the temperature of 8˚C**,** there was no difference between F1(chicken fat with skin), F2 (chicken abdominal fat) andF4 (chicken fat with skin and chicken abdominal fat) samples. There was a statistically significant difference (p< 0, 05) between other samples.

Analysing the produced samples of sausages stored for **60** days at 4˚C no significant difference (p < 0,05) was reported for F4 (chicken fat with skin and chicken abdominal fat) and F6 (chicken abdominal fat and hydrogenated fat) samples. There was a statistically significant difference between all other samples. Likewise, during the storage time of 60 days the temperature of 8˚C,there was no statistically significant difference between F3 (hydrogenated fat) and F6 (chicken abdominal fat) samples. There was a statistical difference (p < 0,05) between other samples.

During the storage period of 75 days at 4˚C there was no significant difference (p< 0,05)in colour between the F3 (hydrogenated fat) and F6 (chicken abdominal fat and hydrogenated fat) samples and there was also no difference between F4 (chicken fat with skin and chicken abdominal fat) and F5(chicken fat with skin and hydrogenated fat) samples. During the storage period of 75 days at 8˚C, there was no significant difference between F1(chicken fat with skin) and F2 (chicken abdominal fat) samples, but a significant difference was reported between F1 and F2 samples compared to all the other samples stored at 8˚C during the period of 75 days. There was no difference (p < 0, 05) between other samples (F3, F4, F5, F6).

During the storage period of **90 days** at the temperature of 4˚C and 8˚C, there were statistically significant differences between all samples analysed.

Analysing the texture of sausages during storage

The results for the acceptability of the texture of (Table 2) stored for **15 days** at the temperature of 4˚C indicated no significant difference in texture between F1, F2, F3 and F4 samples, while at the temperature of 8˚C significant difference (p< 0,05)was noted between F2 and F4 samples, compared to other samples. During the period of 15 days at the temperature of 8˚C there was no significant difference regarding sausage texture between F2 (chicken abdominal fat), F4 (chicken fat with skin and chicken abdominal fat), F3 (hydrogenated fat) and F6 (abdominal chicken fat and hydrogenated fat). There was a significant difference between other samples.

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During the storage period of 30 days at the temperature of 4˚C,F1 and F5 samples indicated no significant differences in texture while other samples indicated significant differences. Likewise, during the storage period of 30 days at 8˚Cthere was no difference (p< 0, 05) in texture between all samples analysed.

During the storage period of 45 days at the temperature of 4˚C, F1 and F2 samples indicated no significant difference in texture, while all other samples indicate (p< 0,05) indicate a significant difference. Likewise, during the storage period of 45 days at 8˚C, it was noted that F2, F3 and F5 samples indicated no significant difference, while there was a difference between other samples analysed.

Analysing the changes in sausage texture during the storage period of 60 days at 4˚C changes in texture (p< 0,05) were noticed between all samples observed. During the storage period of 60 days at 8˚C, there was no significant difference between F1, F2 and F3 samples while there was a significant difference (p< 0,05) between all other samples.F1, F3 and F4 samples stored for 75 days at4˚C indicated no significant difference (p< 0,05), unlike other samples (Table 2).

During the storage period of 75 days at 8˚C, there was no difference between F2 and F4 samples; between all other samples there were significant differences (p< 0, 05). During the storage period of 90 days at 4˚C, all samples indicated significant differences in texture (p< 0, 05). Also, all samples indicated significant differences in texture (p< 0, 05) during the storage period of 90 days at 8˚C.

Analysing consumer acceptability of sausages

Observing consumer acceptability of sampled sausages (Table 2) for the storage period of15 days at the temperature of 4˚C, it was evident that F1, F6, F2 and F3samples indicated no significant differences while the other samples indicated some significant differences in terms of consumer acceptability.

During the same storage period onlyat the temperature of 8˚C, there was no significant difference in consumer acceptability between F4 and F5 samples, while there were significant differences (p< 0,05) between the other samples in terms of consumer acceptability

During the storage period of30 days, F2, F4 and F5 samples indicated no significant differences (p< 0,05) in consumer overall acceptability, while all other samples indicated significant difference in consumer acceptability. Likewise, for the storage period of 30 days at the temperature of 8˚C all the samples indicated significant differences in consumer overall acceptability.

During the storage period of 45 days at the temperature of 4˚C the F3 and F5 samples indicated no significant difference in consumer overall acceptance, while other samples did indicate statistically important differences (p< 0, 05). During the storage period of 45 days at the temperature of 8˚C there was no difference between F4 and F5 samples, while there were significant differences between all other samples.

After the storage period of 60 days at the temperature of 4˚C, the analysed samples indicated no statistically significant differences between them in terms of consumer overall acceptability, while all other samples indicated some differences. Likewise, during the storage period of60 days at the temperature of 8˚C, F1 and F2 samples indicated no significant difference consumer acceptability, while all other samples indicated differences.

After 75 days of storage at 4˚C, there were differences between all samples; at 8˚C F1 and F3 samples had same values, while there were differences between all other samples.

After 90 days of storage, it could be observed that F2, F4, F5 and F6 samples stored at 4˚C indicated no statistical difference, while all other samples did. Likewise, during the storage period of90 days at 8˚C, there was a significant difference in consumer acceptability between F2, F3 and F4 samples; there was no significant difference between other samples.

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Table 2. Consumers acceptability during 90-day storage at4˚C and 8˚C

abc d– P < 0.05 (different superscritpt letters within the same column indicate significant difference (p<0,05)

Storage duration in days (d)	Formulation	Color		Texture		Consumer acceptability		pH-value	
		4˚C	8˚C	4˚C	8˚C	4˚C	8˚C	4˚C	8˚C
0	F1	18^{b}	-	48^{bc}	-	62^{ab}	-	6.46 ± 0.01	-
	F2	28^{b}	-	40^{c}	-	42^{c}	-	6.44 ± 0.02	-
	F3	58^{a}	-	18^{d}	-	48^{bc}	-	6.49 ± 0.00	-
	F4	56^{a}	-	74^{a}	-	76^{a}	-	6.47 ± 0.00	-
	F5	70^{a}	-	54^{bc}	-	32^{c}	-	6.48 ± 0.05	-
	F6	64^{a}	-	60^{ab}	-	34^{c}	-	6.49 ± 0.00	-
15	F1	18^{c}	20^{c}	70^{a}	64^{ab}	44^{b}	28^{c}	6.46 ± 0.00^{bc}	6.47 ± 0,00^{bc}
	F2	48^{b}	38^{b}	68^{a}	74^{a}	68^{a}	66^{ab}	6.39 ± 0.08^{a}	6.45 ± 0,00^{b}
	F3	74^{a}	76^{a}	64^{a}	34^{c}	66^{a}	46^{bc}	6.51 ± 0.00^{c}	6.51 ± 0,00^{c}
	F4	68^{ab}	52^{b}	82^{a}	80^{a}	52^{ab}	68^{a}	6.48 ± 0.01^{bc}	6.48 ± 0,00^{bc}
	F5	68^{ab}	72^{a}	28^{b}	52^{b}	62^{ab}	74^{a}	6.50 ± 0.00^{c}	6.48 ± 0,01^{bc}
	F6	60^{ab}	78^{a}	24^{b}	32^{c}	44^{b}	54^{ab}	6.48 ± 0.01^{bc}	6.48 ± 0,00^{bc}
30	F1	18^{c}	22^{c}	40^{b}	48^{bc}	36^{b}	66^{a}	6.56 ± 0.01^{de}	6.51 ± 0.01^{b}
	F2	36^{bc}	20^{c}	74^{a}	28^{d}	74^{a}	44^{b}	6.54 ± 0.02^{bcde}	6.47 ± 0.00^{a}
	F3	72^{a}	62^{ab}	18^{c}	66^{ab}	14^{c}	48^{ab}	6.59 ± 0.02^{f}	6.56 ± 0.00^{de}
	F4	42^{b}	46^{b}	76^{a}	74^{a}	72^{a}	50^{ab}	6.55 ± 0.01^{cde}	6.51 ± 0.01^{b}
	F5	44^{b}	66^{a}	52^{b}	48^{bc}	60^{a}	62^{ab}	6.57 ± 0.02^{ef}	6.52 ± 0.01^{bc}
	F6	82^{a}	78^{a}	34^{bc}	30^{cd}	38^{b}	24^{c}	6.55 ± 0.01^{cde}	6.53 ± 0.02^{bcd}
45	F1	18^{c}	22^{c}	44^{b}	50^{ab}	56^{a}	42^{bc}	6.55 ± 0.01^{d}	6.48 ± 0.01^{a}
	F2	36^{bc}	20^{c}	50^{b}	58^{a}	62^{a}	58^{ab}	6.52 ± 0.00^{bc}	6.50 ± 0.01^{ab}
	F3	72^{a}	62^{ab}	52^{ab}	52^{a}	64^{a}	74^{a}	6.54 ± 0.01^{cd}	6.52 ± 0.01 ^{bc}
	F4	42^{b}	46^{b}	70^{a}	32^{b}	48^{a}	44^{bc}	6.52 ± 0.01^{bc}	6.51 ± 0.01^{b}
	F5	44^{b}	66^{a}	60^{ab}	52^{a}	50^{a}	44^{bc}	6.53 ± 0.00^{cd}	6.55 ± 0.00^{d}
	F6	82^{a}	78^{a}	18^{c}	50^{ab}	14^{b}	32^{c}	6.55 ± 0.00^{d}	6.52 ± 0.01^{bc}
60	F1	12^{c}	14^{d}	48^{ab}	54^{ab}	54^{a}	44^{ns}	6.52 ± 0.00^{de}	6.41 ± 0.00^{a}
	F2	34^{b}	32^{c}	44^{b}	42^{ab}	36^{b}	46^{ns}	6.50 ± 0.03^{cd}	6.42 ± 0.01^{a}
	F3	50^{ab}	60^{a}	22^{c}	42^{ab}	14^{c}	44^{ns}	6.52 ± 0.02^{de}	6.47 ± 0.00^{bc}
	F4	56^{a}	50^{ab}	38^{bc}	40^{b}	46^{ab}	40^{ns}	6.53 ± 0.00^{de}	6.50 ± 0.04^{cd}
	F5	42^{ab}	34^{bc}	62^{a}	58^{a}	58^{a}	46^{ns}	6.54 ± 0.01^{e}	6.46 ± 0.00^{b}
	F6	58^{a}	62^{a}	38^{bc}	16^{c}	44^{ab}	32^{ns}	6.52 ± 0.00^{de}	6.46 ± 00.02^{b}
75	F1	14^{c}	14^{b}	34^{c}	44^{ab}	32^{c}	40^{b}	6.52 ± 0.02	6.48 ± 0.00
	F2	22^{c}	22^{b}	70^{a}	60^{a}	66^{a}	40^{b}	6.48 ± 0.01	6.46 ± 0.00
	F3	68^{a}	44^{a}	28^{c}	36^{bc}	34^{bc}	42^{b}	6.50 ± 0.05	6.49 ± 0.32
	F4	44^{b}	52^{a}	32^{c}	56^{a}	32^{c}	62^{a}	6.52 ± 0.00	6.48 ± 0.10
	F5	42^{b}	60^{a}	52^{b}	32^{bc}	50^{ab}	50^{ab}	6.46 ± 0.07	6.49 ± 0.05
	F6	62^{a}	60^{a}	36^{bc}	24^{c}	38^{bc}	18^{c}	6.48 ± 0.04	6.49 ± 0.20
90	F1	16^{e}	16^{c}	34^{cd}	26^{cd}	26^{b}	26^{c}	6.49 ± 0.02^{bc}	6.34 ± 0.13^{a}
	F2	30^{de}	24^{c}	38^{bc}	60^{a}	48^{a}	38^{bc}	6.42 ± 0.08^{b}	6.49 ± 0.00^{bc}
	F3	68^{a}	50^{b}	18^{d}	48^{ab}	24^{b}	40^{bc}	6.51 ± 0.02^{bc}	6.51 ± 0.00^{bc}
	F4	34^{cd}	42^{b}	58^{a}	64^{a}	56^{a}	72^{a}	6.48 ± 0.00^{bc}	6.49 ± 0.00^{bc}
	F5	50^{bc}	50^{b}	50^{abc}	42^{bc}	46^{a}	48^{b}	6.53 ±0.00^{c}	6.51 ± 0.25^{bc}
	F6	54^{ab}	70^{a}	54^{ab}	12^{d}	52^{a}	28^{c}	6.51 ± 0.01^{bc}	6.51 ± 0.15^{bc}

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Analysing pH values

During the analysis of pH value, it was evident that there was a significant difference between pH value of the produced formulations (P< 0, 05) during all periods of storage. These results are consistent with the results of Abdelmageed M.E.I. at alt.[6] in terms of analysing chicken gizzard fat. Also, significant differences in pH values between temperatures 4˚C and 8˚C , were observed during the whole storage period (Figure 1).

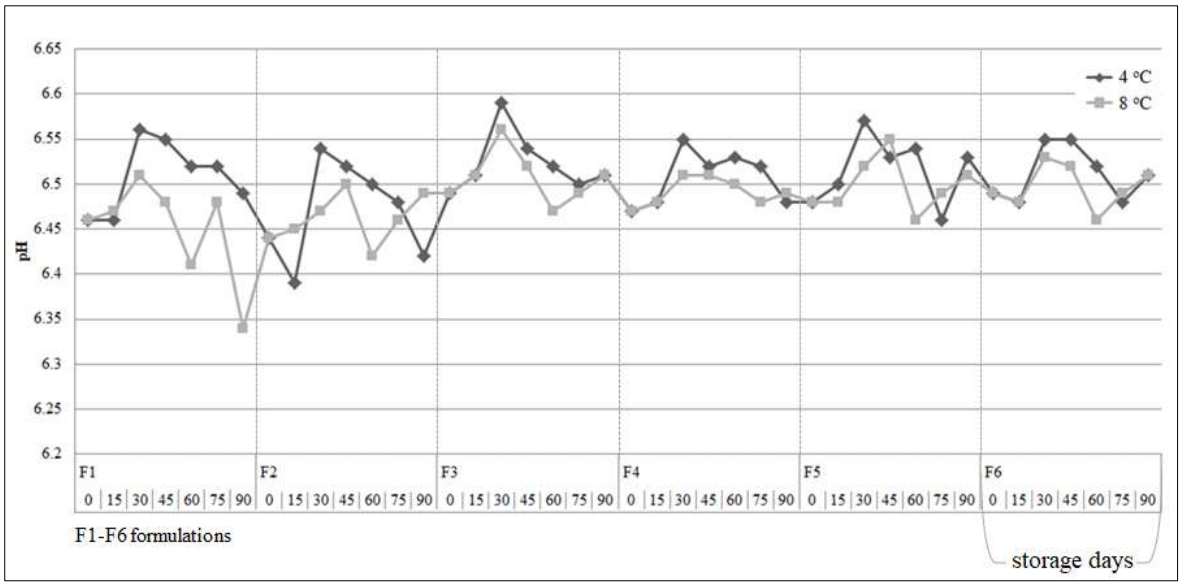

Figure 1. komparacija pH veijednosti tokom vremena čuvanja na temperraturama 4˚C i 8˚C

4. CONCLUSION

Analysing the results of the research, it can generally be concluded that for all examined properties – colour, texture and consumer overall acceptability – there were significant differences between samples stored at 4˚C and those stored at 8˚C. Mainly, no significant difference was observed between the samples produced with combined chicken fat and combined hydrogenated fatand chicken fat. Based on this fact, it can be concluded that samples were better ranked at 4˚C. It can also be concluded that during the storage at 4˚C the examined propertieschange later than the properties during the storage at 8˚C,which indicates that the analysed products should be stored at temperatuer lower than 8˚C.

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