JOURNAL OF AGRICULTURE AND PLANT SCIENCES, JAPS, Vol 17, No. 1, 2019

Manuscript received 01.05.2019
Accepted: 13.05.2019

In print: ISSN 2545-4447
On line: ISSN 2545-4455
UDC: 664.933.036.2
Original scientific paper

INFLUENCE OF THE STERILIZATION PROCESS ON THE PHYSICOCHEMICAL AND NUTRITIONAL PROPERTIES OF MEAT VEGETABLE PATE

Maria Momchilova[1], Dilyana Gradinarska[2*], Dinko Yordanov[2], Todorka Petrova[1], Ivan Bakalov[1], Nadezhda Petkova[3]

[1]Division of Food Technology, Institute of Food Preservation and Quality-Plovdiv, Agricultural Academy of Bulgaria.

[2]Department of Meat and Fish Technology, University of Food Technologies, Plovdiv, Bulgaria

[3]Department of Organic Chemistry and Inorganic Chemistry, University of Food Technologies, Plovdiv, Bulgaria

**Corresponding author: gradinarska_d@abv.bg*

Abstract

The aim of this research was to investigate the possibility of meat-vegetable sterilized pate production with reduced fat content and functional ingredient supplementation, as well as to evaluate the thermal effect on physicochemical and lipid content of the final products. In the study, ten experimental groups of poultry pate were produced with different level and type of fat substitution with inulin gel and lentils flour. The residual quantity of fructans was examined to evaluate the thermal effect on functional ingredients. Analysis upon changes in lipid fraction was performed in order to determine the appropriated thermal effect in different pate formula. The pate from sample 4 and 6 in which the amount of recipe fat was reduced and partially substituted with inulin gel or lentils flour had the most acceptable nutritional characteristics.

Keywords: *canned meat, inulin, lentils, fructans, thermal effect*

INTRODUCTION

The meat and meat products are highly evaluated and very preferred foods (Baltic & Boskovic, 2015), as well as concerning their sensory properties, and linking their nutritive and biological value (Pereira & Vicente, 2013; McNeill, 2014). By the other side the high level of unsaturated fatty acids and cholesterol, the high level of sodium chloride (NaCl) and nitrates contents in meat products are associated with a number of health problems as obesity, cardiovascular diseases, diabetes, cancer and etc. (Richi et al., 2015). Although these benefits and risks associated with processed meat, the consumption of meat products should not be necessarily questionable if they are consumed in moderate amounts manner as a part of balanced human daily diets (De Smet & Vossen, 2016).

Even more, the enrichment of meat products with natural functional ingredients contemporarily has widespread usage in the modern meat processing technologies with the aim to improve the health status of foods (Bhat & Bhat, 2011). The meat pâtés are widespread and they are consumed by many people. In fact, the meat pates have a fat contain about and over 30%, which has a negative effect on their health perception (Lorenzo et al., 2014; Latoch et al., 2016).

The inulin is a very promising functional additive (Roberfroid, 2004; Shoaib, 2016), which is involved in different food e.g. in meat salami as fat replacer, as a technological additive for improving water-holding and emulsifying ability, as an agent reducing product's energy value, or aiming to improve structural properties and viscosity of the product. By the other side the beans vegetables, and more especially the lentil, is accepted as good sources of proteins, slow-release carbohydrates, dietary fibres, mineral compound and vitamins (Iqbal et al., 2006). The lentil is successfully applied as a binding agent in the preparation of beef meatballs with low-fat content (Serdaroglu et al., 2005), but we have not enough information for its application in meat pate. At more long and severe thermal process as is sterilization, meat loses its colour, taste, its structure becomes too much crumbly, a formation of jelly increases that is not wanted. The use of binders and hydrocolloids is prospective to improve product consistency and to increase the jelly capacity in canned meat as well as the increasing density of a product and decreased diffusion of nutritive substances (Pasichinyi et al., 2017).

The inulin and lentil flour are interesting polyfunctional additives for the production of meat products in accordance with their structural and nutritive potential. However, there are no studies on their use as potential fat substitutes in sterilized canned foods. Therefore, the aim of the present study is to evaluate the changes in physicochemical, lipid and levels of oligofructoses in finished products, depending on the obtained sterilization effects in different samples of sterilized meat pâtés with reduced fat content and addition of inulin gel and flour of lentils.

MATERIAL AND METHODS

Materials

For the production of meat-vegetable pate it have been applied the following recipe for pate from poultry meat: turkey meat – 300 g/kg -1 as filling mass; poultry liver– 100 g kg-1; egg mélange – 150 g/kg-1; pork fat -250 g/kg-1; corn flour 20 g/kg -1; salt – 15 g/kg-1; sodium nitrite – 0,05 ; polyphosphate – 2 g/kg-1; black pepper -3 g/kg-1; nutmeg - 0,5 g/kg-1 ; coriander -1,5 g/kg-1 and drinking-water - 150 g/kg-1. Ten (10) samples with a different concentration of fat, inulin and lentil flour are developed according to Table 1.The added inulin Orafti®HPX was provided by the company „Artemis" Ltd - Sofia, representative of Beneo-Orafti Ltd., Belgium. The inulin was added on as gel, obtained by hydration in a ratio 1:4 (w/v) (Latochet al., 2016). Thus obtained suspension was heated to the 85ºC until complete dissolution and then cooled to 50°C. Both functional additives were added to the filler mass during cutting.

Table 1. Samples of poultry meat pate with inulin and lentil flour.

Sample	Pork fat, $g{\cdot}kg^{-1}$	Inulin gel, $g{\cdot}kg^{-1}$	Lentil flour, $g{\cdot}kg^{-1}$
1	0,25	0	0
2	0	0,25	0
3	0	0	0,25
4	0,125	0,125	0
5	0,125	0	0,125
6	0	0,125	0,125
7	0,0835	0,0835	0,0835
8	0,167	0,042	0,042
9	0,042	0,167	0,042
10	0,042	0,042	0,167

The samples were prepared in the meat cutter machine (model Fimar CL/5), adding the water during the cutting in quantity until 15% concerning the weight of meat mass.

The prepared filling mass was manually filled in the cans of 200 g and then sterilized in the following regime: $\frac{10-45-20}{121°C}, 2x10^5\,Pa$ at the laboratory autoclave (Hydroplast, Khaskovo). To determine the sterilization regimes of the cans, the F-value was determined by using the company's Ellab (Denmark) report device. The thermograms of the regime were set and the actual sterilization effects ($F^{10}_{121°C}$) were determined.

Methods

Prepared meat-vegetable pates were analysed for the following physicochemical parameters: pH value, TBA, fatty acid composition and residual fructan (inulin) [%].

The pH value of the pate mass was recorded immediately after preparation, as well as after sterilization of the meat-vegetable pates. The determination was carried out using a pH meter of MS 2004 (Microsyst, Bulgaria) on a pre-prepared aqueous extract of the sample at a sample/water ratio of 1: 9 (w/v). Prior to the measurement, the extract was filtered through filter paper. The remaining analyses were carried out after sterilization of the preserves, on the 4-th day of their storage. For the determination of TBA, the method described by Sörensen and Jörgensen (1996) was used. The fatty acid composition of the extracted lipids from the sample pates (Bligh & Dyer, 1959) was obtained by gas chromatography after pre-esterification of the higher fatty acids with methanol in order to obtain more readily volatizing methyl esters of fatty acids (ISO 5508). For determination of residual fructans (inulin) in the samples, a spectrophotometric method based on the qualitative reaction of Selivanov to prove ketoses was used (Petkova et al., 2014).

The Statistical Data Analysis was performed by the software program Statgraphics 16. The trials were performed in triplicate, the data in the tables and graphs being arithmetic mean ± standard deviation (SD). Statistically significant differences between the mean values were found with a probability of less than 0.05.

RESULTS AND DISCUSSION

Determination of the actual sterilization effects of meat-vegetable pates

Table 2 sets out the determined actual sterilization effects (F_{121}^{10}) of the different samples in the selected sterilization regime of the meat-vegetable pate and the sterilization effect required for the test microorganism Cl. sporogenes - 25, according to the pH value and volume of the package.

The obtained results show that in all meat-vegetable pate samples, achieved sterilization value is higher than the required sterilization effect, which ensures the production of practically sterile and safe for human health cans. The actual sterilization effects obtained (Tab. 2) are higher in samples with a higher addition of inulin, which is a direct result of the consistency of the pate mass. In these samples, the heating process under the same sterilization regime was much faster than that observed at lentils samples.

Table 2. Actual sterilization effects of meat-vegetable pates.

Sample	3	4	5	6	8	9	10
(F_{121}^{10})	24,83min	51,43min	31,88min	26,91min	31,07min	26,46min	33,35min
Necessary lethality for sterilization of cans with the volume of the package 200 cm^3 and pH 6,1 – 6,4						F_0 = 17,4 min	
Necessary lethality for sterilization of cans with the volume of the package 200 cm^3 and pH above 6,4						F_0 = 20,3 min	

In Figure 1 are shown curves of heat treatment (thermograms) during the sterilization of seven selected meat-vegetable pate samples at the selected sterilization mode. The intensity of heat treatment has not only a decisive impact on the inactivation of bacteria, but also on physicochemical properties and subsequently on organoleptic quality of the final product. In some of the samples has been seen a considerable deteriorate in colour and consistency after heat treatment (data not shown). However proper prevention measurement must be taken to avoid undesirable protein denaturation or fat oxidation and fat and jelly release due to emulsion destabilization from excessive heat application.

Changes in physicochemical characteristics of meat-vegetable cans

One of the most important factors on which the process of sterilization depends is the active acidity of the food products (Gavin et al., 1995). By comparing the samples, it was found that the used inulin and lentil flour had an effect on the hydrogen ion concentration of the raw pate mass and on the sterilized meat-vegetable pate (Tab. 3). There was a trend for increase of pH of the sample's raw meat masses in which the degree of fat replacement with inulin had been increased. The established difference between meat-vegetable pate samples can be explained by the different amount of inulin addition and its pH. According to the technical specification, the inulin has a pH value of 6.40, which leads to an increase in the pH value of the inulin added samples. An increase in pH value due to the addition of inulin was also found by Méndez-Zamora et al. (2015) in the production of frankfurter sausages. Contrary to what has been stated for inulin, higher concentrations of the lentils flour result in a decrease in the pH of the pate masses.

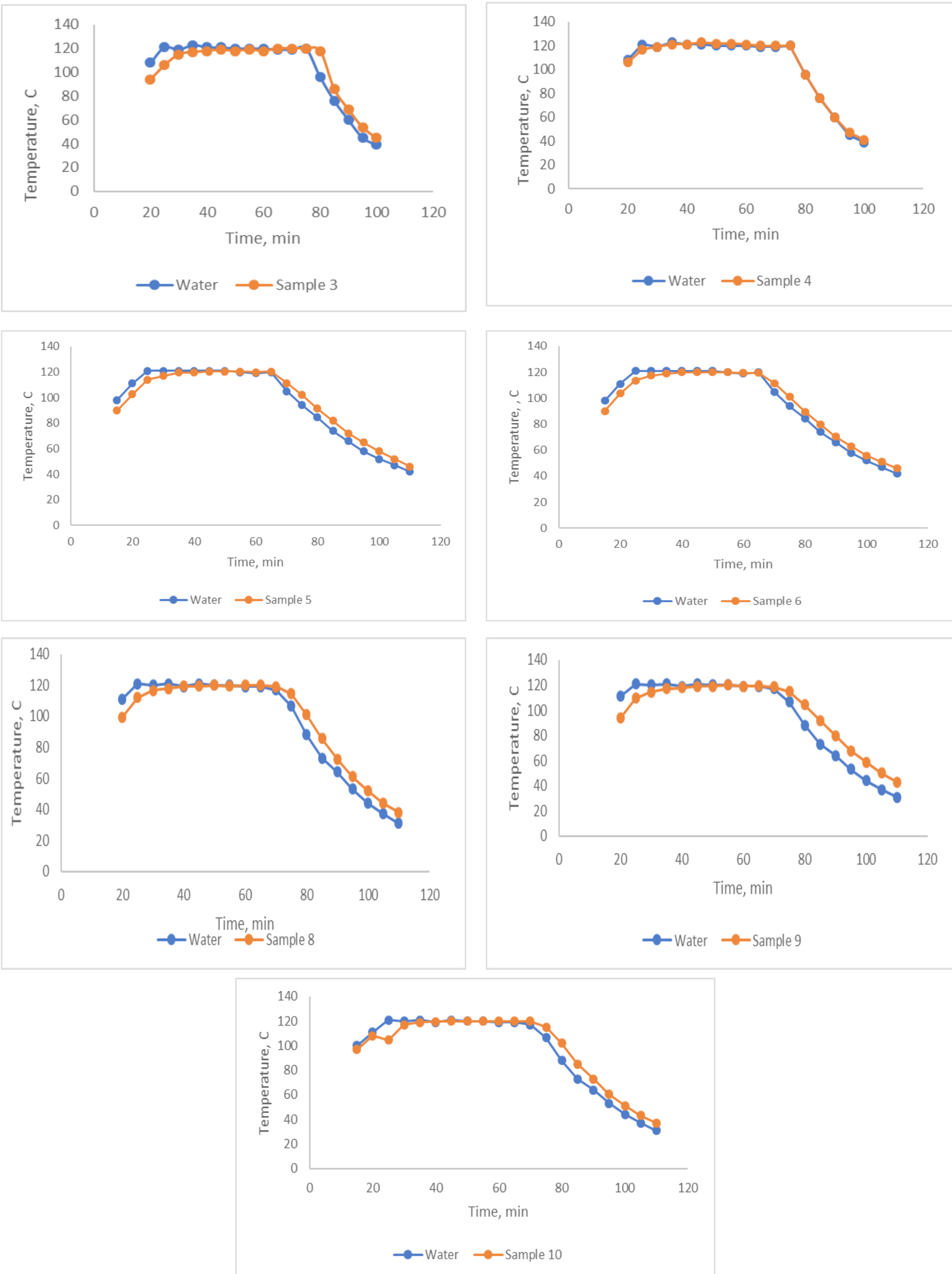

Figure 1. Curves of the heat treatment of different meat-vegetable pates.

After sterilization, the pH of the meat-vegetable pates was reduced. Again at the inulin added samples were measured significantly higher pH values than the other samples (P <0.05). Lower values of hydrogen ion concentration after sterilization can be explained by changes in total charge (Rao et al., 1996), as a result of both denaturation changes in protein molecules as well as thermal induced carbohydrate degradation processes at temperatures above 100°C. In the heat treatment, there are conditions in which the hydrogen bonds are mainly disrupted, which can be explained mainly by the greater difference in pH values of the raw pate masses and of the preservatives after sterilization.

Table 3. Physicochemical characteristics and fructan content (inulin) in the meat-vegetable pate.

Sample	Indicator			
	pH of the meat filling mass	pH of the can	Fructans* g/100gproduct	TBA, mg MDA.kg^{-1}
1	6,83±0,01^{g}	6,39±0,025b^{c}	0±0^{a}	0,94±0,11^{ab}
2	6,81±0,01^{g}	6,48±0,03^{c}	1,54±0,07^{c}	0,83±0,01^{a}
3	6,56±0,03^{c}	6,31±0,02^{ab}	0,21±0,02^{a}	1,11±0,02^{bc}
4	6,76±0,005^{f}	6,47±0,05^{c}	2,98±0,51^{d}	0,96±0,05^{ab}
5	6,61±0,01^{d}	6,46±0,09^{c}	0,17±0,01^{a}	1,25±0,08^{c}
6	6,44±0,04^{a}	6,29±0,02^{a}	1,36±0,01^{c}	1,51±0,14^{d}
7	6,55±0,02^{c}	6,33±0,02^{ab}	0,81±0,15^{b}	1,6±0,08^{d}
8	6,72±0,01^{e}	6,36±0,05^{ab}	0,62±0,05^{b}	1,89±0,05^{e}
9	6,71±0,01^{e}	6,3±0,12^{a}	1,59±0,13^{c}	2,94±0,22^{g}
10	6,52±0,05^{b}	6,27±0,04^{a}	0,67±0,03^{b}	2,17±0,2^{f}

* Fructans, including inulin, fructooligosaccharides, sucrose and fructose

Note: The values given are the arithmetic mean of the relevant sample of three measurements for the given indicator.

a-g - values on columns with the same alphabetic characters are statistically indistinguishable (P> 0.05).

Determination of fructans (inulin)

Comparing the fructan content in the meat-vegetable pates after the sterilization regime, large statistically significant differences (P <0.05) were found between the individual samples (Tab. 3). These differences cannot be explained alone by the different amounts of added fructo-oligosaccharides (inulin), due to the initial formulation of the samples. According to Bohm et al. (2005) and Wang et al. (2009), the content of fructans (inulin) decreases with increasing temperature. We also experienced loss of inulin versus input quantity after heat treatment. Obviously, there was also an additional factor influencing the changes in this indicator. Most likely, this was the different fat content as well as the different consistency of the tested samples and hence the different heating curves under the same sterilization regime and the achieved F-value effects in them.

This is confirmed by almost statistically indistinguishable results (P>0.05) for the number of fructans in samples 6 and 9, which is a consequence of both the amount of inulin used in these two samples and their close actual sterilizing effects. For the same reasons, between samples 8 and 10 there are also no significant differences in the final amount of fructans. In samples with the addition of a significant amount of lentils flour with or without less inulin gel (samples 3 and 5), minimal amounts of fructans were reported. At sample 4, the largest statistically distinct amount of residual fructans in the finished meat-vegetable pates (P<0.05) was observed. In this sample, although the highest actual sterilization effect was recorded, the amount of added pork fat can prevent the thermal destruction of the incorporated fructooligosaccharide in the form of an inulin gel.

Determination of the lipolytic and oxidative changes of the lipid fraction of the samples

It has been found that the amount of the lipid oxidation byproducts determined by TBA and expressed as mg MDA kg-1 of pate ranges from 2.94 mg MDA kg-1 in sample 9 to 0.83 mg MDA kg-1 for sample 2, where there were full substitution of fat with inulin (Tab. 3). High TBA values for samples 6, 7, 8, 9 and 10 are most likely due to inappropriate ratios in these samples between lentils flour, inulin gel and fat, necessary to form a stable meat emulsion. This is also confirmed by data on the emulsion stability of the samples of pates (data not shown here).

Table 4. Fatty acids content of meat-vegetable pates.

Fatty acids	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6	Sample 7	Sample 8	Sample 9	Sample 10
C4:0 Buteric /Buanoic acid	ND	ND	0.08 ± 0.01^{a}	0.09 ± 0.01^{b}	0.05 ± 0.01^{ab}	0.07 ± 0.01^{a}	0.04 ± 0.01^{a}	0.08 ± 0.01^{a}	0.06 ± 0.01^{a}	0.08 ± 0.01^{a}
C6:0 (Caproic acid)	ND	0.07 ± 0.01^{a}	0.05 ± 0.01^{a}	0.14 ± 0.01^{d}	0.11 ± 0.01^{c}	0.15 ± 0.01^{ab}	0.11 ± 0.01^{a}	0.09 ± 0.01^{a}	0.14 ± 0.01^{a}	0.15 ± 0.01^{ab}
C8:0 (Caprylic acid)	ND	0.05 ± 0.01^{a}	0.04 ± 0.01^{a}	0.06 ± 0.01^{a}	0.04 ± 0.01^{ab}	0.2 ± 0.01^{b}	0.05 ± 0.01^{a}	0.04 ± 0.01^{ab}	0.07 ± 0.01^{a}	0.08 ± 0.01^{a}
C10:0 (Capric acid)	ND	0.07 ± 0.01^{a}	0.07 ± 0.01^{a}	0.15 ± 0.01^{d}	0.03 ± 0.01^{a}	0.08 ± 0.01^{a}	0.03 ± 0.01^{a}	0.14 ± 0.01^{abc}	0.04 ± 0.01^{a}	0.06 ± 0.01^{a}
C11:0 Undecylic acid)	ND	ND	ND		0.09 ± 0.01^{bc}	ND	ND	ND	ND	ND
C12:0 (Lauric acid)	0.91 ± 0.01^{e}	1.03 ± 0.01^{e}	0.95 ± 0.01^{e}	1.09 ± 0.01^{h}	0.96 ± 0.01^{f}	0.98 ± 0.01^{e}	0.94 ± 0.01^{e}	0.16 ± 0.01^{abc}	3.9 ± 5.28^{b}	0.82 ± 0.01^{d}
C13:0 (Tridecylic acid)	ND	0.03 ± 0.01^{a}	ND	ND	0.02 ± 0.01^{a}	ND	ND	ND	ND	ND
C14:0 (Mieistic acid)	ND	0.06 ± 0.01^{a}	ND	0.07 ± 0.01^{a}	0.03 ± 0.01^{a}	ND	ND	0.09 ± 0.01^{a}	ND	ND
C14:1 (Myristoleanic)	ND	ND	ND	0.11 ± 0.01^{c}	0.06 ± 0.01^{ab}c	ND	ND	ND	ND	ND
C16:0 (Palmitic acid)	25.06 ± 0.01^{k}	25.7 ± 0.1^{l}	25.56 ± 0.01^{i}	25.73 ± 0.1^{l}	26.04 ± 0.01^{k}	25.28 ± 0.01^{j}	25.43 ± 0.1^{k}	26.2 ± 0.01^{h}	24.4 ± 0.1^{e}	24.46 ± 0.01^{i}
C16:1 (Palmetoelic acid)	1.97 ± 0.01^{h}	1.87 ± 0.01^{j}	2.1 ± 0.1^{f}	1.98 ± 0.01^{i}	2.02 ± 0.01^{h}	1.84 ± 0.01^{g}	1.85 ± 0.1^{h}	2.02 ± 0.01^{h}	ND	2.02 ± 0.01^{h}
C 17:0 (Heptadecanoic acid) /Margaric/	0.07 ± 0.01^{a}	0.03 ± 0.01^{a}	0.1 ± 0.1^{ab}	ND	ND	ND	ND	ND	ND	ND
C17:1 (Margarinoleic acid)	0.34 ± 0.01^{b}	0.41 ± 0.01^{c}		0.48 ± 0.01^{e}	0.32 ± 0.01^{d}	0.41 ± 0.01^{a}	0.43 ± 0.1^{d}	0.4 ± 0.01^{abc}	0.47 ± 0.01^{a}	0.43 ± 0.01^{bc}
C18:0 (Stearic acid)	7.96 ± 0.01^{i}	9.95 ± 0.01^{h}	9.69 ± 0.01^{g}	10.96 ± 0.01^{j}	10.6 ± 0.1^{i}	11.02 ± 0.1^{h}	9.4 ± 0.01^{i}	10.6 ± 0.1^{i}	9.2 ± 0.1^{c}	9.4 ± 0.1^{g}
C18:1 (Oleic)	44.07 ± 0.01^{l}	40.84 ± 0.01^{k}	43.37 ± 0.01^{j}	39.99 ± 0.01^{m}	41.78 ± 0.01^{l}	40.54 ± 0.01^{k}	41.54 ± 0.01^{j}	43 ± 0.01^{i}	39.5 ± 0.1^{f}	41.54 ± 0.01^{j}
C18:2 (Linolic) /Lnoleic	15.65 ± 0.01^{j}	16.81 ± 0.01^{i}	15.75 ± 0.01^{h}	16.96 ± 0.01^{k}	15.77 ± 0.01^{j}	18.8 ± 0.01^{i}	17.65 ± 0.01^{j}	15.77 ± 0.01^{j}	18.5 ± 0.1^{d}	17.65 ± 0.01^{h}
C18:3 (α-Linolenic)	1.06 ± 0.01^{f}	1.28 ± 0.1^{f}	1.02 ± 0.01^{e}	1.01 ± 0.01^{g}	1.11 ± 0.01^{d}	1.6 ± 0.01^{f}	1.29 ± 0.01^{e}	0.88 ± 0.01^{d}	1.32 ± 0.01^{a}	1.29 ± 0.01^{e}
C20:0 (Arachidic acid)	0.05 ± 0.01^{a}	ND	ND	ND	ND	ND	ND	ND	ND	ND
C20:4 (Arachidonic)	1.42 ± 0.01^{g}	0.31 ± 0.1^{b}	0.16 ± 0.01^{b}	0.09 ± 0.01^{b}	$0.05\pm0.01a^{b}$	0.6 ± 0.01^{d}	0.67 ± 0.01^{e}	0.05 ± 0.01^{ab}	0.58 ± 0.01^{a}	0.67 ± 0.01^{cd}
C22:0 (Behenic acid)	0.7 ± 0.01^{c}	0.75 ± 0.1^{d}	0.47 ± 0.01^{c}	0.51 ± 0.01^{f}	0.6 ± 0.1^{e}	ND	0.38 ± 0.01^{c}	0.49 ± 0.1^{bcd}	0.4 ± 0.1^{a}	0.83 ± 0.49^{d}
C24:1 (Lignoceric acid)	0.75 ± 0.01^{d}	0.73 ± 0.1^{d}	0.6 ± 0.1^{d}	0.51 ± 0.01^{f}	0.65 ± 0.01^{e}	ND	ND	ND	ND	ND
Saturated FA (SFA)	36.87	39.19	37.77	39.99	38.35	40.03	38.28	39.82	38.28	37.5
Unsaturated FA (UFA	62.8	60.8	62.24	59.94	58.66	62.78	62.33	61.67	59.33	62.5
Mono-unsaturatedFA (MUFA)	45.52	45.55	44.44	41.01	43.03	40.54	41.92	43.54	39.9	52.37
PolyunsaturatedA(PUFA)	18.13	18.4	16.93	18.06	16.93	21	19.61	16.7	20.4	19.61
PUFA/UFA	0.29	0.5	0.45	0.45	0.44	0.52	0.51	0.42	0.53	0.52
MUFA/PUFA	2.51	2.48	2.62	2.27	2.54	1.93	2.14	2.61	1.96	2.67

Note: The values given are the arithmetic mean of the relevant sample of three measurements for the given indicator.
a-m - values in rows with the same alphabetic characters are statistically indistinguishable (P>0,05)

According to some authors (Joo et al., 1999, Sasaki et al., 2001, Estevez et al., 2003, Lorenzo & Pateiro, 2013), the higher fat content results in a higher amount of the oxidation reaction products. However, in our samples, more significant oxidation processes were observed in samples with a fuller reduction of the fat, containing a lentil flour in combination with more inulin gel. In these samples, the more easily oxidized muscle phospholipids remain more vulnerable to the oxidation processes occurring during the heat treatment.

The analysis of the fatty acid composition of the pate samples revealed significant differences between the individual samples (Tab. 4). The different patterns of the three-component mixture used for the individual samples differ from one another in the presence, respectively, of inulin, animal fat, and lentils, as well as their concentration. The differences in the fatty acid composition of the individual pate samples are mainly due to the type and quantity of these ingredients and to a lesser extent to the sterilization effect achieved. The difference in the percentage of unsaturated fatty acids (PUFA) was obviously. The highest content of PUFA was marked at the samples 3, 6, 7, 10 and control sample 1, and the lowest percentage - at sample 5. A widely used indicator characterizing the healthy profile of lipid fraction in food is the PUFA/SFA ratio (Decker&Park, 2010; Hathwar et al., 2012; Wood et al., 2003). PUFA/SFA ratio values ≥ 0.40 are considered useful for human health (COMA, 1994). The highest value - 0.53, was recorded in sample 9, followed by 0.52 in samples 10 and 6 and 0.51 in sample 7. By comparing the fatty acid composition of all samples tested for essential fatty acids such as linoleic and linolenic, it should be noted that these two fatty acids were at the highest levels in sample 6, followed by samples 7,10 > 2 > 4. For each of these samples, the established amount of these two polyunsaturated fatty acids was higher than that obtained for the control sample 1. This can be considered as an additional nutritional advantage of these fortified with fibres and reduced fat content canned foods.

CONCLUDING REMARKS

By selected sterilization regime, a sterilization value was achieved in all samples of meat-vegetable pates which was higher than the sterilization effect required to ensure industrial sterility. In the all tested samples of pates, the fructan (inulin) content decreases as the highest amount of fructans (inulin) are recorded in sample 4, followed by sample 2 and 6. These amounts are acceptable in terms of the desired potential functional prebiotic effect and reported by Bodner and Sieg (2009) limiting amount of fructan (inulin) in meat products - 4 g / 100g. The results allow to conclude that the mode of sterilization, even if there were changes, preserves the positive effect of the incorporated functional ingredients on the nutritional, technological and functional characteristics of the tested meat-vegetable cans.

REFERENCES

Baltic, M.Z.& Boskovic, M. (2015). When man met meat: meat in human nutrition from ancient times till today.Procedia Food Science, 5, 6 – 9.

Bhat, Z.F. & Bhat, H. (2011). Milk and Dairy Products as Functional Foods: A Review. International Journal of Dairy Science, 6 (1), 1-12

Bligh, E.G., & Dyer, W.J. (1959). A rapid method of total lipid extraction and purification. Canadian Journal of Biochemistry and Physiology, 37(8), 911–917.

Bohm, A., Kaiser, I., Trebtein, A. & Henle, T. (2005). Heat-induced degradation of inulin. European Food Research and Technology, 220, 466-471.

COMA (1994). Nutritional aspects of cardiovascular disease. Report of the Cardiovascular Review Group Committee on Medical Aspects of Food Policy. Reports on Health & Social Subjects, 46, 1-186.

De Smet, S. & Vossen, E. (2016). Meat: The balance between nutrition and health. A review. Meat Science, 120, 145–156.

Decker, E.A. &Park, Y. (2010). Healthier meat products as functional foods. Meat Science, 86 (1), 49-55.

Estévez, M., Morcuende, D., Ventanas, S. & Cava, R. (2003). Analysis of volatiles in meat from Iberian pigs and lean pigs after refrigeration and cooking by using SPME-GC-MS. Journal of Agricultural and Food Chemistry, 51 (11), 3429-3435.

Gavin A., & Weddig L.M. (1995). Canned foods: Principles of thermal process control, acidification and container closure evaluation. 6-th edition, Food Processors Inst.,USA.

Hathwar, S.C., Rai, A.K., Modi, V.K.& Narayan B. (2012). Characteristics and consumer acceptance of healthier meat and meat product formulations - a review. Journal of Food Science and Technology, 49 (6), 653-664.

Iqbal, A., Khalil, I. A., Ateeq, N., & Khan, M. S. (2006). Nutritional quality of important food legumes. Food chemistry, 97(2), 331-335.

Joo, S.T., Kauffman, R.G., Kim, B.C. & Park, G.B. (1999). The relationship of sarcoplasmic and myofibrillar protein solubility to colour and water-holding capacity in porcine longissimus muscle. Meat Science, 52 (3), 291-297.

Latoch, A., Glibowski, P., & Libera, J. (2016). The effect of replacing pork fat of inulin on the physicochemical and sensory quality of guinea fowl pate. Acta Scientiarum Polonorum Technologia Alimentaria, 15(3), 311-320.

Lorenzo, J. M. & Pateiro, M. (2013). Influence of fat content on physico-chemical and oxidative stability of foal liver pâté. Meat Science, 95, 330–335.

Lorenzo, J. M., Pateiro, M., García Fontán, M. C. & Carballo J. (2014). Effect of fat content on physical, microbial, lipid and protein changes during chill storage of foal liverpâté. Food Chemistry, 155, 57–63.

McNeill, SH. (2014). Inclusion of red meat in healthful dietary patterns. Meat Science 98, 452–460.

Méndez-Zamora, G., García-Macías, J.A., Santellano-Estrada, E., ChávezMartínez, A., Durán-Meléndez, L., Silva-Vázquez, R.&Quintero-Ramos, A. (2015). Fat reduction in the formulation of frankfurter sausages using inulin and pectin. Food Science and Technology, 35 (1), 25-31.

Pasichnyi, V., Ukrainets,A., Shvedyuk,D., Muhamed, A.H. &Yuliia, M.(2017). Investigation of the influence of the temperaturelevel on the bilateral meat frying process. Eureka: Life Sciences, 4, 21-26.

Pereira, PMCC. & Vicente FRB (2013). Meat nutritional composition and nutritive role in the human diet.Meat Science, 93, 586–592.

Petkova N., Ivanova, M. Todorova, M., Vlaseva, R.& Denev, P. (2014). Spectrophotometric method for determination of inulin and fructooligosaccharides in lactic acid fermented dairy products. Acta Scientifica Naturalis, 1, 91-98.

Rao, V.K., Kowale, B.N., Babu, N.P., & Bisht, G.S. (1996). Effect of cooking and storage on lipid oxidation and development of cholesterol oxidation products in water buffalo meat. Meat science, 43(2), 179-185.

Richi, E.B., Baumer, B., Conrad, B., Darioli, R., Schmid, A. & Keller, U. (2015). Health Risks Associated with Meat Consumption: A Review of Epidemiological Studies. International Journal for Vitamin and Nutrition Research, 85, 70-78.

Roberfroid, MB. (2004). Inulin-Type Fructans: Functional Food Ingredients. CRC Press Taylor & Francis Group, 392.

Sasaki, K., Mitsumoto, M. & Kawabata, K. (2001). Relationship between lipid peroxidation and fat content in Japanese Black beef Longissimus muscle during storage. Meat Science, 59 (4), 407-410.

Serdaroglu, M., Yildiz-Turp, G., Abrodimov, K. (2005). Quality of low-fat meatballs containing legume flours as extenders. Meat Science, 2005, 70, 99–105

Shoaib, M., Shehzad, A., Omar, M., Rakha, A., Raza, H., Sharif, H.R., Shakeel, A., Ansari, A. & Niazi, S. (2016). Inulin: Properties, health benefits and food applications. Carbohydrate Polymers, 147, 444–454.

Sørensen, G. & Jørgensen, S.S. (1996). A critical examination of some experimental variables in the 2-thiobarbituric acid (TBA) test for lipid oxidation in meat products. Zeitschrift für Lebensmitteluntersuchung und-

Forschung A, 202(3), 205-210.

Totosaus, A. & Perez-Chabela M.L. (2006) Handbook of Food Science, Technology and Engineering. Chapter 167: Processed Poultry Products: Nugget and Pate. Organoleptic Physical and Microbial Aspects of Thermal Treatment, Vol. 4, Eds by Yiu H. Hui, CRC Press, 2006, Taylor&Francis Group.

Wang, J., Sun, B., Cao, Y., Tian, Y. & Wang, C. (2009). Enzymatic preparation of wheat bran xylooligosaccharides and their stability during pasteurization and autoclave sterilization at low pH. Carbohydrate polymers, 77 (4), 816-821.

Wood J.D., Richardson, R.I., Nute, G.R., Fisher, A.V., Campo, M.M., Kasapidou, E., Sheard, P.R. & Enser M. (2003). Effects of fatty acids on meat quality: A review. Meat Science, 66 (1), 21-32.

ВЛИЈАНИЕ НА ПРОЦЕСОТ НА СТЕРИЛИЗАЦИЈА НА ФИЗИЧКО-ХЕМИСКИТЕ И НУТРИТИВНИТЕ КАРАКТЕРИСТИКИ НА ПАШТЕТА ОД МЕСО И ЗЕЛЕНЧУК

Марија Момчилова[1], Дилјана Градинарска[2*], Динко Јорданов[2], Тодорка Петрова[1] Иван Бакалов[1], Надежда Петрова[3]

[1]Институт за чување и квалитет на храна Пловдив, Земјоделска академија, Република Бугарија

[2]Катедра за технологија на месото и рибата, Универзитет за прехранбени технологии, Бул. Марица 13, Пловдив, Република Бугарија

[3] Катедра за органска и неорганска хемија, Универзитет за прехранбени технологии, Бул. Марица 13, Пловдив, Република Бугарија

**Автор за контакт: gradinarska_d@abv.bg*

Резиме

Целта на ова истражување беше да се испита можноста за производство на стерилизирана паштета од месо и зеленчук со намалена содржина на масноти и дополнување на функционалните состојки, како и да се оцени термичкиот ефект на физичко-хемиските и липидните содржини на крајните производи. Во студијата беа произведени десет експериментални групи на паштети од живинско месо со различно ниво и тип на супституција на масти, додаток на инулин и леќа во прав. Преостанатата количина на фруктани се испитуваше за да се оцени термичкиот ефект врз функционалните состојки. Анализата по промените во липидната фракција беше изведена со цел да се одреди присвоениот термички ефект кај различни содржини на паштета. Паштетата од примероците 4 и 6, во која количината на маснотијата е намалена и делумно супституирана со инулин или леќа, имала најприфатливи нутритивни карактеристики.

Клучни зборови: *конзервирано месо, паштета, инулин, леќа, ефект на стерилизација.*