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Researches Concerning the Influence of the Cranberries on the Quality of Meat Products

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Abstract

The research aimed at diversifying the assortment range of the meat products belonging to the group of smoked-pasteurized specialties by exploiting of some natural sources (cranberry) in obtaining an innovative and higher quality assortment, with high uptake of biologically active natural constituents with antimicrobial, antioxidant role, and last but not least, with beneficial nutritional effects, intended in particular for children nutrition. The raw materials used in the processing were represented by the chicken meat (intended for fine minced meat), chicken pulp (coarselly minced), spices and cranberries. Four variants have been experimented: the control variant (100 percent of chicken meat), smoked pasteurized meat products with 10%, 15% and 30% cranberry. In all samples, the homogeneous composition was filled in specific casings, then was subjected to heat treatment consisting of hot smoking folowed by pasteurization. Finally, the finished products have been stored within the specific conditions. Sensory analysis (aspect,colour, texture, odour, taste and overall acceptance) and physical-chemical properties (moisture, protein, fat, ash, total carbohydrate, energy value and easyly hydrolyzable nitrogen content) have been performed. The obtained results revealed that the cranberries have improved the organoleptic characteristics (specific mosaic, color and flavor) and the physico-chemical results were in acordance with the STAS provisions. Furthermore, the cranberries have positively influenced the shelf life of the product by lowering the moisture and fat content.

Keywords: meat chicken, cowberries, physical-chemical indicators, quality

1. Introduction

Various technological rules and practices allow substitution of equivalent raw materials with others in large comparative limits. The equivalence means that from a wide range of raw materials must be manufactured finished products with similar nutritional values and sensorial properties.

Meat is the most important food product throughout the world from the perspective of human diet and health and is greatly prized by the consumer, mainly due to such valuable nutrients as protein, fats, vitamins, and micronutrients [8].

In recent years, the consumer demands for healthier meat and meat products with reduced level of fat, cholesterol, decreased contents of sodium chloride and nitrite, improved composition of fatty acid profile and incorporated health enhancing ingredients are rapidly increasing worldwide.Enrichment of raw meat with bioactive compounds and the effects on human health have been studied extensively.

Salagean *et al.* (2016) [2] revealed that "the addition of algae in combination with beef components led to obtaining a higher quality product with functional characteristics and within the quality limits imposed by STAS" [14-16].

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Cranberry (*Vaccinium macrocarpon*), have been used for centuries both as food and as medicine.This is a smaller fruit with anthocyanins and acid profiles slightly different to that of the North American variety. The medicinal properties and nutritional benefits of cranberry have been attributed to a wide range of beneficial compounds found in these berries, including quercetin and proanthocyanidin, also abundant in cranberries [7,13]. The berries contain plentiful vitamins (C, A as beta caroten, B1, B2, B3), organic acids, and elements such as potassium, calcium, magnesium, and phosphorus [6]. The antioxidant properties of cranberries are documented in the literature and cranberries are ranked one of the highest antioxidant activities among many other fruits [3,17]. The predominant bioactive compounds found in cranberries are the flavonols, the flavan-3-ols, the anthocyanins, the tannins (ellagitannins and proanthocyanidins), and the phenolic acid derivatives. These phytochemicals are commonly associated with the fruit organoleptic (sensory) qualities and have also shown diverse biological properties and physiological activities in animals [5].

Cranberry contains high levels of phytochemicals which have health promoting properties Some of these phytochemicals, which act as antioxidants, are increasingly being shown to help to optimize human health by neutralizing harmful free radicals in the body [1]. These antioxidants reduce oxidative damage by cells that can lead to cancer, heart disease, and other degenerative diseases. For example anthocyanin, compounds that give cranberries their red color are powerful antioxidants [11, 18]. Laboratory studies have shown that cranberry extract reduces oxidation of LDL-cholesterol which may be important in maintaining a healthy heart [4]. Most of the current literature is focused on antioxidant properties of mature red cranberries.

The aim of this study was to investigate the effect of the cranberry incorporated in smoked-pasteurized meat products on their quality characteristics during prolonged storage, up to 8 days at 1-2˚C, including physicochemical measurement and sensory evaluation.

2. Materials and Methods

The raw materials used in the process were represented by the chicken meat (intended for fine minced meat), chicken pulp (coarselly minced).

The raw materials used for manufacturing the smoked pasteurized meat products were purchased from a local butchery (Cluj-Napoca, Romania). The cranberry fruits were dried in a laboratory oven at 35 ˚C for 24 h and were grounded into a fine powder using a laboratory mill, mixed to obtain a homogeneous sample, and kept at 4 °C.

Four varieties of smoked pasteurized meat products have been experimented: the control sample was prepared from 100 % of chicken meat, the followed proposed variant, in which 10% of the raw material meat was substituted by the cranberry. In the last two meat products 15% respectively 30% chicken meat was replaced by cranberry (tab.1).

All samples varieties to obtaining a traditional smoked pasteurized meat product were prepared without synthetic food additives. The spices and the cranberries provided color and product retention for the products.

To establish the preferred sample for each type of smoked pasteurized product with 10%, 15% and 30% of cranberry samples were sensory evaluated using the 9-point hedonic test.

The selected sample and the control sample were further stored in a refrigeration room at 2°C, for 7 days to determine their stability during the intended storage period. To this purpose, smoked pasteurized products were sampled initially, at day 4, and at 7 of storage then subjected to physicochemical (protein, fat, moisture, ash, total carbohydrates, energy value and ammonia contents) analysis.

2.1.Smoked pasteurized product with cranberry manufacture

The manufacturing of the smoked pasteurized product included the following process steps:

- preparation of raw materials (choice of skin and connective tissue);
- preparation of the semi-product (grape);
- chopping (chicken meat intended for the branch through a sieve with 2-3 mm mesh sieve and the pulp for the grate through the worschneider sieve);

- salting (2% salt) and storage for maturation at + 5 °C, 48 hours);
- Branch production (by casing the minced meat, salted and matured with ice / ice-cooled water and spices);
- preparation of the composition (kneading together with the grape, adding the dehydrated cranberry to the end of the kneading);
- stuffing of the composition into the pork intestinal casings with a diameter of 55-60 mm. (using a vacuum filling machine);
- thermal treatment: membrane hydration (45 ... 75 °C, 25 minutes), hot smoking (75 to 95 °C about 30 minutes to reddish red color) and pasteurization (72 ... 75 °C, 1,5 hours);
- cooling (in air with natural circulation) and storage under specific conditions (+2 ... + 5 °C, relative air humidity 75 ... 80%, maximum 5 days).

2.2. Determination of moisture content

Determination of moisture content consists in drying 5g of sample can at 103±2 ºC until it reaches constant weight.

DW= G2-G/G1-G*100

MC= 100- DW/%

Where DW – dry weight, G2 – mass of the sample after drying, G1 – mass of the sample before drying, G – mass of the sample, MC – moisture content

2.3.Determination of fat content (Soxhlet extraction methods)

Standard SOX extraction method keeps the sample in contact with the solvent for a longer time. Petroleum ether was the solvent, fraction 40–60 ºC and the parameters for samples were 6 hours. The volume of solvent was 80 ml during the extraction process. Before the solvent extraction step can begin the sample must be dried. Three g of sample were weighed into the thimble and 1 - 1.5 g of sand were added and mixed with a glass rod. The glass rod was wiped with a piece of cotton wool and this was placed in the top of the thimble. After the thimble was inserted in a Soxhlet liquid/solid extractor a clean, dried 150 mL round bottom flash was accurately weighed and about 80 mL of solvent were introduced into the flask. The assembled extraction unit was heated over an electric heating mantle until the solvent in the flask boils. The extraction continued for 6 hours [10, 14].

% Crude fat = (W2 – W1) x 100/ S

where S = Sample weight

W2 = Weight of flask after extraction
W1 = Weight of flask prior to extraction

2.4. Determination of protein content (Kjeldahl method)

The amount of the protein is calculated from the nitrogen concentration of the food. The Kjeldahl method is divided into three steps: digestion, neutralization and titration. The analyzed food sample (1g) was weighed into a digestion flask and then digested by heating it in the presence of concentrate sulfuric acid (20 ml), copper sulphate (1g) and potassium sulfate (10g). After the digestion has been completed the digestion flask is connected to a receiving flask by a tube. The solution in the digestion flask is then made alkaline by addition of sodium hydroxide 30%. The ammonia gas that is formed is liberated from the solution and moves out of the digestion flask and into the receiving flask - which contains an excess of sulfuric acid 0.1 N and indicator phenolphthalein. The nitrogen content is then estimated by titration of sodium hydroxide 0.1 N. [10, 15].

P%= VH2SO4 – VNaOH*0.0014*5.7*100/ml.

Where:

VH2SO4 - volumes of sulphuric acid
VNaOH – volume of sodium hydroxide used at titration

Ash content was determined by incineration of the sample in a muffle furnace. About 3 g of sample was weighed in a porcelain melting pot and maintained at 600 °C for 6 h in the muffle furnace. The following Equation 1 was used to calculate the ash content:

Ash content= wa/ws*100

where: wa is the weight of ash, in grams; Ws is the weight of sample, in grams.

Total carbohydrates were calculated based on the following formula from the content of moisture, protein, lipid, and ash [9]:

Total carbohydrates (g/100g) =100-(g moisture+g protein+g lipid+g ash)

Energy value was calculated based on the following formula from the content of protein, carbohydrate, and lipid using the energy factors [9]:

Energy value (kcal/100 g) = 4*(g protein+g carbohydrate) +9* g lipid

2.5. Sensory analysis - Acceptance test

Sensory characteristics of smoked pasteurized samples were evaluated by a panel of 35 members and were presented in random order in plastic dishes and coded numerically.

The 9-point hedonic scale test (1 being "dislike extremely" and 9 being "like extremely") was used to evaluate all smoked pasteurized samples. Aspect, colour, texture, odour, taste, and overall acceptability were the sensory attributes evaluated.

Table 1. The production recipe of the finished products

The production recipe for 100 kg raw material					
		SP – control sample	SPC 10% – sample with 10% cranberry	SPC 15% – sample with 15% cranberry	SPC 30% – sample with 30% cranberry
Raw materials [kg]	Chicken meat	100	90	85	70
	Cranberry	-	10	15	30
Auxiliary materials [kg]	Salt	2,00	2,00	2.00	2.00
	Black pepper	0,240	0,240	0.240	0.240
	Garlic	0,320	0,320	0.320	0.320
	Paprika	0,320	0,320	0.320	0.320
	Nutmeg	0,050	0,050	0,050	0,050
	Polyphosphate	0,400	0,400	0,400	0,400
Materials	Pork intestinal casings with a diameter of 55-60 mm.				

Table 2. Results of Sensorial Evaluation

Sample	*Aspect*	*Color*	*Texture*	*Taste*	*Odor*	*Overall acceptance*
SP	7,1	7,7	6,8	7,4	7,6	7,2
SPC 10%	7,5	7,9	7,1	7,6	7,7	7,6
SPC 15%	8	8	7,5	7,8	8	8.0
SPC 30%	7,6	7,7	7	7,4	7,6	7,7

SP- control sample, SPC 10% - smoked pasteurized product with 10% cranberry, SPC 15% - smoked pasteurized product with 15% cranberry, SPC 30% - smoked pasteurized product with 0% cranberry

3. Results and discussion

3.1. Sensorial Analysis

The sensorial analysis was conducted for all four smoked pasteurized meat product formulations samples using a 9-point hedonic scale to select the panellists preferred sample.

The results of hedonic scores for sensory attributes (aspect, colour, texture, taste, odour and overall acceptability) of smoked pasteurized product samples are shown in Table 2.

A decrease in acceptability was observed when the level of cranberry was higher than

15%. The sample with 15% cranberry substitution had the highest acceptability score (8.0) as well as for the other organoleptic characteristics.

Also, it can be observed that the smoked pasteurized meat product with 10% added cranberry showed similar results to the sample with 30% cranberry.

The control sample and sample with the highest mean values of overall acceptance score were further undergone to physicochemical evaluation to determine their stability during the 7 days of storage under refrigeration.

3.2. Compositional analysis

The moisture, protein, fat, ash, carbohydrate content as well as the energy of the two smoked pasteurized meat product formulations were determined using AOAC procedures. The chemical composition of the different types of smoked pasteurized meat products is shown in table 3.

Table 3. Compositional analysis of smoked pasteurized meat product with addition of cranberry

Sample	Storage time	Moisture (g/100 g)	Protein (g/100 g)	Fat (g/100 g)	Ash (g/100 g)	Carbohydrates (g/100 g)	Energy (kcal/100 g)	EHN (mg NH3/100 g)
SP	initial day	67,05	25,32	3,47	2,72	1,44	138,27	3,2
	4 days	65,86	25,97	4,02	2,98	1,17	144,74	11,5
	7 days	65	26,27	4,65	3,17	0,91	150,57	20,3
SPC 15%	initial day	64,51	22,41	2,01	3,15	7,92	139,41	3,5
	4 days	63,84	21,93	2,84	3,74	7,65	143,88	10,4
	7 days	63,07	21,01	3,53	3,98	8,41	149,45	18,5

Results show that the control sample, smoked pasteurized product without cranberry contained more than 67% moisture, protein content was greater than 25%, and total fat content was below 3%. Final values of protein content in these control sample was higher than the sample with 15% cranberry because in smoked pasteurized product with fruit was substituted 15% of meat to 15% of cranberry.

The lowest fat content was found in smoked pasteurized product with 15% cranberry, this explain that addition of vegetable source, cranberry, had positive influence on the final product.

Moisture content decreased with storage time from 67.05% to 65% in control sample and from 64.51% to 63.07% in sample with 15% of cranberry. For this reason, the contents of fat, protein, ash, easily hydrolysable nitrogen and energy value increased during storage in each assortment.

Easily hydrolysable nitrogen content, an indicator of freshness, also increased with storage time in 3.2 mg NH_3/100 g to 20.3 mg NH_3/100 g in control sample. The same variation of easily hydrolysable nitrogen content we can observe in smoked pasteurized product with 15% cranberry (in 3.5 mg NH_3/100 g to 18.5 mg NH_3/100 g). According to the Romanian legislation, Order no. 975/1998 [12], the easily hydrolysable nitrogen content in this samples must be less than or equal to 45 mg NH3/100g sample. Therefore, all smoked pasteurized samples is in line with legislation.

4. Conclusion

The results of this research indicate that dehydrated cranberry affects the chemical and sensory characteristics of traditional smoked pasteurized meat product.

Addition of cranberries contributed to lowering the water content in the finished product, which has contributed to the increase of the preservation power of the proposed product.

Replacing 15% of meat with cranberry decreased the amount of fat content, which has positively influenced the quality of the finished product and its shelf life.

It was found that the amount of easily hydrolysable nitrogen in all the samples was in the limits imposed by the current legislation and positively influences the hygienic quality and the shelf life of the finished product.

Comparative analysis of easily hydrolysable nitrogen content (mg/100 g) in both samples varieties highlights the preservative potential of cranberry by the high value of biologically active compounds.

The additions of the cranberries have improved the organoleptic characteristics (specific mosaic, color and odor) and the physical-chemical results which were in accordance with the STAS provisions. Furthermore, the cranberries have positively influenced the shelf life of the product by lowering the hydrolysable nitrogen content as well as the water and fat content.

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Compliance with Ethics Requirements. Authors declare that they respect the journal’s ethics requirements. Authors declare that they have no conflict of interest and all procedures involving human / or animal subjects (if exist) respect the specific regulation and standards.

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