



*Research Article*

## **Influence of various cold-pressed oils on the chemical composition and microbiological quality of sausages**

Boban Malinov<sup>1</sup>✉, Aco Kuzelov<sup>1</sup>, Elena Joshevska<sup>2</sup> Verica Ilieva<sup>3</sup> Elizabeta Barbareeva<sup>1</sup>

<sup>1</sup>Department of Food Technology and Processing of Animal products. Faculty of Agriculture, „Goce Delchev”, University – Shtip, Krste Misirkov 10 – A, 2000 Shtip, Republic of N. Macedonia

<sup>2</sup>Department of Food Technology. Faculty of Biotechnical sciences, “St. Kliment Ohridski”, University -Bitola, Partizanska b.b. 7000 Bitola, Republic of N. Macedonia

<sup>3</sup>Department of Crop Production. Faculty of Agriculture, „Goce Delchev” University - Shtip, Krste Misirkov 10 – A, 2000 Shtip, Republic of N. Macedonia

### **Abstract**

This paper presents the results from examination on impact of cold-pressed sunflower and pumpkin oil on the chemical composition and microbiological quality of Bacon Folk sausages. For this purpose, eight groups of Bacon Folk sausages have been produced. The first group was produced without addition of sunflower oil (control group), the second one with addition of 3g/kg, and the third one with addition of 4g/kg and the fourth group with addition of 5g/kg olive oil. According to the same order were produced the sausage groups with the addition of pumpkin oil. Sausage groups with cold pressed sunflower oil and pumpkin, have a slight decrease in the water content on the sixtieth day of production compared to the first day of production. The water content of the first day of production was (52.86% to 54.73% for sunflower sausages group; 52.24% to 54.61% for sausages with addition of pumpkin oil) and (52.71% up to 54.48%; 51.59% to 53.58%) on the sixtieth day of production. Protein content in cold pressed sunflower oil and pumpkin sausages group ranged from (10.85 to 11.54%; 11.65 to 11.95) on the first day and (11.52% to 12.01%; 11.52% to 12.01%) sixtieth day of production. The content of fats and minerals in both produced sausage groups were increasing to the end of production. Pathogenic bacteria were not detected. Used concentrations of cold-pressed sunflower and pumpkin oil in the groups of sausages do not have statistically significant impact on the chemical composition and microbiological quality of the sausages.

**Keywords:** Bacon Folk sausages, sunflower oil, pumpkin oil, quality

✉ Corresponding author: Boban Malinov, MSc Student <sup>1</sup>Department of Food Technology and Animal Products Processing. Faculty of Agriculture, University „Goce Delchev”, 2000 Shtip, Republic of Macedonia, [tel:++38971793860](tel:+38971793860);  
E – mail: [bobanmalinov@yahoo.com](mailto:bobanmalinov@yahoo.com)

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## Introduction

The meat industry is one of the most important branches in the food industry, which requires the continuous introduction of new products, either due to market needs or pressure from competition in the given area (Grujić et al. 2012). The development of the meat industry and the ever-increasing consumer demand for healthy meat products that will have an extremely positive effect on the human body has led to the production and marketing of meat products in which different types of vegetable products and their extracts and different types of refined and cold pressed vegetable oils are applied. The production of meat products with increased content of polyunsaturated fatty acids in recent years has been a constant tendency due to the ever-increasing demands of consumers to consume quality and safe meat products (Maminokyan 2010; Pryanishnikov 2010 quoted by Miteva Daniela et al. 2015). Sunflower (*Helianthus annuus L.*) besides soybeans, rapeseed and peanuts is one of the four most important oilseed crops worldwide. It is believed that the cultivation of sunflower in North America was performed by Native Americans (Indians) in Arizona and New Mexico. In Europe the sunflower was brought by the Spaniards (Putt 1997) quoted by Vračarić et al. 2004. The sunflower seed oil was first produced in Russia in 1835. Cold pressed sunflower oil is produced by cold pressing without the use of chemical solvents and heat, producing an oil that preserves the nutritional value, taste and aroma of the seed. The color of the oil is golden - yellow. This oil has a high biological-nutritional value because of its beneficial effect on the functioning of the heart and cardiovascular system and on the maintenance and improvement of the general health of the body (Škorić et al. 2000; Lepšanović and Lepšanović 2000) quoted by Premović et al. 2015. It contains a high percentage of linoleic and oleic acid, vitamin E, choline, phenolic acids which are useful for the cardiovascular system. Cold pressed sunflower oil is increasingly present in the cold pressed oil market (De Leonardis et al. 2001; Dimić 2005; Bendini et al. 2011) quoted by Dimić et al. 2016.

Pumpkin (*Cucurbita pepo L.*) is used for human and livestock nutrition. The pumpkin family (*Cucurbitaceae*) includes about 800 species of

plants and 125 genera. Pumpkin seeds are a source of protein, phytosterols, vitamins, glyceride oil, carotenoids, tocopherols, microelements (K, Mg, Mn, Zn, Se, Co, Cr, Mo); (Applequist et al. 2006; Glew et al. 2006; Philips et al. 2005) quoted by Petkova and Antova 2014. Pumpkin seeds are rich in biologically active substances and are used in human nutrition and medicine, (Jiao et al. 2014) quoted by Petkova and Antova, 2014. Oil made from pumpkin seeds was first produced in the XVIII century in south-eastern Austria by cold pressing. The oil has dark green and characteristic sweetness. It is mostly used to enhance salad taste but is also used as a cure in shape of gelled capsules as it is rich in unsaturated fatty acid minerals and vitamins, (Petkova and Antova 2014). According to Dimić et al. 2008; Fruhwirth and Hermetter 2008; Siger et al. 2008; Lončar et al. 2009, Dimić et al. 2009, the main carriers of many of the positive nutritional and pharmacological characteristics of pumpkin seeds and oils are essential fatty acids, tocopherols, phenolic compounds, phytosterols, seeds and pumpkin oil. As a medicament it has effect on prostate diseases and has a beneficial effect on the cardiovascular system.

The purpose of our research was to investigate the effect of different concentrations of cold pressed sunflower and pumpkin oil on the chemical composition and microbiological status of sausages.

## Materials and Methods

**Samples collection.** Eight groups of Bacon Folk Sausages were produced by complying with all the sanitary veterinary regulations applicable in the Republic of North Macedonia in the domestic meat industry. The sausages were produced according to the following recipe: 3kg chicken MDM; chicken drumstick 12 kg; pork trimming 35 kg; solid fat 40 kg; leek 3 kg; nitrite salt 1.7 kg; spice mix 0.400 kg; polyphosphate 0.500 kg; emulsifier 2.0 kg; hard water - ice 5kg. The first group of sausages was produced without the addition of cold pressed oils the second group with the addition of 3 g / kg cold pressed sunflower oil, the third group with 0.4 g / kg, the fourth with 0.5 g / kg cold pressed sunflower oil. In the same order the other four groups was made in which cold pressed pumpkin oil was



applied. After filling and draining, the sausage groups were thermally processed by the following recipe: Drying - 35 minutes; Smoking - 20 minutes at 62°C; Boiling - 35 minutes at 78 ° C, or until the center of the product reaches a temperature of 69-72 ° C. After heat treatment, the sausages were showered with cold water for 5 minutes and then transported to the cooling chamber for 24 hours. The groups of sausages were then vacuumed. Samples for the necessary examination were taken from the sausage groups on the 1st day and on the 60th day of production. As a material research were produced eight groups.

**Examination of the chemical composition.** For the required chemical examinations, samples were taken from all produced groups of Bacon Folk Sausages on the 1st day and on the 60th day after production. The chemical composition was tested using standard test methods commonly used in the chemical composition: Water by drying method at 105 °C; fats by the Gerber method; proteins was tested by the Kjeldahl method; mineral substances

## Results and Discussion

Chemical composition and microbiological status are one of the most important indicators of the quality properties of the product. The chemical parameters and microbiological quality of the

(ash) by the burning method. Three repetitions were made ( n=3).

**Microbiological analysis.** The microbiological analysis was done on the 1st, and the 60th day of production, in accordance with the Rulebook on the special requirements for food safety in relation to the microbiological criteria in the Republic of Macedonia. For the microbiological analysis the presence of *Listeria monocitogenes* by the method MKC EN ISO 11290-1: 2008 was investigated. Salmonella species by method MKC EN ISO 6579: 2008; *Escherichia coli* by the method MKC EN ISO 16649 - 2: 2008; *Staphylococcus aureus* by method MKC EN ISO 6888-2: 2008; Total number of aerobic bacteria by the method MKC EN ISO 4833 - 1: 2013 . Five repetitions were made ( n=5).

**Statistical processing . .** The obtained results were statistically elaborated with the computer program Microsoft Excel 97/2003. The results are presented with a mean value  $\pm$  Sd.

groups of sausages produced with the addition of different amounts of cold pressed sunflower oil and pumpkin are given in (Table 1, 2 and 3).

**Table 1.** Chemical composition of sausage groups produced by applying cold pressed sunflower oil

1st day of production				
Chemical composition %	Group I Mean $\pm$ SD	Group II Mean $\pm$ SD	Group III Mean $\pm$ SD	Group IV Mean $\pm$ SD
Water	54.73 $\pm$ 0.18	54.77 $\pm$ 0.40	52.86 $\pm$ 0.58	53.53 $\pm$ 0.20
Fat	29.50 $\pm$ 0.80	28.00 $\pm$ 0.52	28.50 $\pm$ 0.28	30.00 $\pm$ 0.48
Proteins	11.54 $\pm$ 0.18	11.18 $\pm$ 0.12	11.54 $\pm$ 0.10	10.85 $\pm$ 0.18
Ash	4.03 $\pm$ 0.22	3.14 $\pm$ 0.48	3.29 $\pm$ 0.22	3.65 $\pm$ 0.12
60th day of production				
Chemical composition %	Group I	Group II	Group III	Group IV
Water	54.48 $\pm$ 0.10	54.39 $\pm$ 0.18	53.70 $\pm$ 0.40	52.71 $\pm$ 0.20
Fat	28.00 $\pm$ 0.22	27.00 $\pm$ 0.58	27.50 $\pm$ 0.42	30.25 $\pm$ 0.58
Proteins	11.50 $\pm$ 0.12	11.51 $\pm$ 0.20	11.44 $\pm$ 0.42	11.02 $\pm$ 0.18
Ash	3.27 $\pm$ 0.10	3.37 $\pm$ 0.18	3.34 $\pm$ 0.22	3.18 $\pm$ 0.08



**Table 2.** Chemical composition of groups of sausages produced with cold pressed pumpkin oil

1st day of production				
Chemical composition %	Group I Mean±SD	Group II Mean±SD	Group III Mean±SD	Group IV Mean±SD
Water	54.61±0.12	53.35±0.42	52.24±0.72	52.83±0.20
Fat	26.50±0.08	29.75±0.18	30.25±0.48	30.00±0.22
Proteins	11.86±0.12	11.95±0.52	11.65±0.42	11.88±0.18
Ash	4.46±0.52	4.37±0.48	4.24±0.20	4.32±0.40
60th day of production				
Chemical composition %	Group I	Group II	Group III	Group IV
Water	51.59±0.12	50.57±0.28	50.98±0.18	53.58± 0.48
Fat	26.50±0.10	28.00±0.40	29.50±0.70	28.50±0.40
Proteins	11.52±0.20	11.70±0.48	12.01 ±0.40	12.00 ±0.18
Ash	4.46±0.52	4.37±0.22	4.44±0.78	4.57 ±0.42

**Table 3** Microbiological quality of Bacon Folk Sausages produced by applying cold-pressed oils (log CFU/g)

Sausage groups produced by applying cold pressed <b>sunflower oil</b>								
Production Groups	Gup I Mean ± SD		Group II Mean ± SD		Group III Mean ± SD		Group IV Mean ± SD	
Day of Production	1 <sup>st</sup>	60 <sup>th</sup>	1 <sup>st</sup>	60 <sup>th</sup>	1 <sup>st</sup>	60 <sup>th</sup>	1 <sup>st</sup>	60 <sup>th</sup>
<i>Total number of microorganisms</i>	1.47± 0.10	2.57±0.20	2.66±0.18	2.90±0.25	2.54±0.42	3.30±0.28	3.00±0.50	3.59±0.12
Sausage groups produced by applying cold pressed <b>pumpkin oil</b>								
Production Groups	Group I Mean ± SD		Group II Mean ± SD		Group III Mean ± SD		Group IV Mean ± SD	
Day of Production	1 <sup>st</sup>	60 <sup>th</sup>	1 <sup>st</sup>	60 <sup>th</sup>	1 <sup>st</sup>	60 <sup>th</sup>	1 <sup>st</sup>	60 <sup>th</sup>
<i>Total number of microorganisms</i>	1.90±0.18	2.47±0.25	2.36±0.28	2.95±0.40	2.25±0.58	2.95±0.48	2.81±0.22	3.17±0.40

From the results of the Table 1 and 2 it can be seen no statistically significant difference between the chemical composition of the Bacon Folk Sausages produced by applying cold pressed sunflower and

sunflower and pumpkin oil, on the 1st and 60<sup>th</sup> days after production in terms of protein and mineral content. On the first day of production at the groups of sausages produced with cold pressed sunflower oil, there was a greater variation in the water and fat content between the



first ( $54.73 \pm 0.18$ ) and third ( $52.86 \pm 0.58$ ), the second ( $54.77 \pm 0.40$ ) and third group ( $52.86 \pm 0.58$ ), (in terms of the water content) and the second ( $28.00 \pm 0.22$ ) and fourth ( $30.00 \pm 0.48$ ), the third ( $28.50 \pm 0.28$ ) and the fourth group ( $30.00 \pm 0.48$ ), (in terms of fat content). While on the 60<sup>th</sup> day of production, there are differences in water and fat content between the first ( $54.48 \pm 0.10$ ) and third ( $53.70 \pm 0.40$ ), first ( $54.48 \pm 0.10$ ) and fourth group ( $52.71\%$ ), and the second ( $54.39\%$ ) and fourth group ( $52.71 \pm 0.20$ ), (in terms of water content), and between the first ( $28.00 \pm 0.22$ ) and fourth ( $30.25 \pm 0.58$ ), second ( $27.00 \pm 0.58$ ) and fourth ( $30.25 \pm 0.58$ ), and third ( $27.50 \pm 0.42$ ) and fourth group ( $30.25 \pm 0.58$ ), (in terms of fat content).

On the first day of production of the sausage groups produced with cold pressed pumpkin oil, a greater variation in water and fat content was observed between the first ( $54.61 \pm 0.12$ ) and fourth ( $52.83 \pm 0.20$ ), second ( $53.35 \pm 0.42$ ) and fourth group ( $52.83 \pm 0.20$ ), (in terms of water content), and the first ( $26.50 \pm 0.08$ ) and second ( $29.75 \pm 0.18$ ), first ( $26.50 \pm 0.08$ ) and the third ( $30.25 \pm 0.48$ ) and first ( $26.50 \pm 0.08$ ) and fourth group ( $30.00 \pm 0.22$ ), (in terms of fat content). While on the 60<sup>th</sup> day of production there are differences in water and fat content between the second ( $50.57 \pm 0.28$ ) and fourth ( $53.58 \pm 0.48$ ) and third ( $50.98 \pm 0.18$ ) and fourth group ( $53.58 \pm 0.48$ ) (in terms of water content) and between the first ( $26.50 \pm 0.10$ ) and third ( $29.50 \pm 0.70$ ) and first ( $26.50 \pm 0.10$ ) and fourth group ( $28.50 \pm 0.40$ ) (in terms of fat content). This finding is due to the higher fat content and hard water (ice) added during the product cutting, or as a result of the packaging of insufficiently drained sausages.

The microbiological quality of each product is one of the most important criteria for quality and safety, according to the Regulations for a particular production series of meat, dairy or confectionery products.

The results in Table 3 indicate that no presence of *Listeria monocytogenes*, *Salmonella spp*, *E. coli* has been established, thus indicating that the produced sausages meet the criteria of the Rulebook on Specific Food Safety Requirements

of the microbiological criteria in the Republic of Macedonia (Criterion for Biological Food Safety, Official Gazette of the Republic of Macedonia No. 100/2013), ie the entire production process in all five iterations, meets the requirements of good hygiene and manufacturing practice. Based on the results for the total number of aerobic bacteria, it can be concluded that their number in the sausage groups are within the permissible limits.

## Conclusions

From the results obtained we can conclude that the used concentrations of cold pressed sunflower and pumpkin oil have no effect on the chemical composition of the sausage groups. The results we obtained regarding the microbiological status of the products are most likely the result of high hygiene and the antibacterial effect of the cold pressed oils used. Research is continuing to determine the antioxidant effect of these cold pressed oils in order to produce functional meat products in our meat industries.

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