Acta fytotechn zootechn, 21, 2018(4): 152–154
http://www.acta.fapz.uniag.sk

Original Paper

Fatty acid composition of Baranjski kulen from two diverse production systems

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Article Details: Received: 2018-05-07 | Accepted: 2018-05-14 | Available online: 2018-11-26

https://doi.org/10.15414/afz.2018.21.04.152-154

The aim of the present study was to compare the fatty acid composition of dry fermented sausage made from Crna slavonska pig and modern hybrids reared in diverse production systems. The study was performed on Baranjski kulen, a traditional PGI (Protected Geographical Indication) labelled sausage. Baranjski kulen produced from pigs included in the study differed in their fatty acid profile, with kulen made from Crna slavonska pigs having a higher content of MUFA, lower content of PUFA and a more favourable PUFA/SFA ratio. The results of the present study demonstrate that meat originating from breeds raised in specific production system affects the fatty acid composition as one of the major determinants of nutritional product quality.

Keywords: autochthonous breed, fatty acids, nutritional quality, pigs

1 Introduction

Today there is a growing interest in the consumption of traditional meat products made from local pig breeds, as these products are considered to be of higher eating and nutritional quality than those made from conventional pig breeds and their hybrids. The fatty acid composition of pig muscle and fat tissue, being one of the most important nutritional quality traits, is influenced by several factors including fatness, body weight, age, gender, diet as well as the genetic background (Karolyi et al., 2007; Kasprzyk et al., 2015; Nevrkla et al., 2017). Crna slavonska (CS) pig is an autochthonous fatty-lean type of pig, with fat/meat ratio at *longisimus lumborum* cut being around 1 when raised outdoor (Djurkin Kušec et al., 2017) and with better meat quality traits (colour, final pH, water holding capacity) than PIC hybrids (Komlenić et al., 2018), making it particularly suitable for the production of traditional meat products. However, the investigations on its meat fatty acid composition are scarce and most certainly they have never been performed on traditional meat products.

Therefore, the aim of the study was to compare the fatty acid profile of Baranjski kulen as a traditional meat product, made from CS pigs and modern pig hybrids as two genotypes raised in diverse production systems.

2 Materials and methods

The study was performed on traditional PGI labelled Croatian sausage Baranjski kulen (BK) produced from CS pigs and PIC hybrids. The pigs (16 animals per group) were raised according to the production system optimized for a particular breed, i.e. Crna slavonska pigs outdoor (on pasture) and PIC hybrids indoor (intensive production system). After the end of fattening period, pigs were slaughtered in a commercial slaughterhouse. At 24 hours *post mortem* ham and shoulder were sectioned from the carcasses and used for production of BK.

BK were produced according to recipe and technology described in details in the Specification (HR/PGI/0005/01207). From each production system, six parallel samples were analyzed for fatty acid profile.

The fat was extracted using Soxhlet method, in which the samples are digested with acid hydrolysis and the fats are then extracted with petroleum ether using a Soxtherm 2000 automated device (Gerhardt, Munich, Germany). The extracted lipids were converted into fatty

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acid methyl esters (FAMEs) for gas chromatography (GC) analysis according to ISO 12966-2:2011. The procedure of preparing the samples for GC analysis and determination of fatty acid composition is described in detail by Medić et al. (2018). The determination of fatty acid composition was performed using GC/MS 5975C device (Agilent Technologies, Palo Alto, CA, USA) equipped with flame ionization detector and split/splitless injector. A TriPlus auto-sampler (Thermo Scientific, Austin, TX, USA) was used for the injection.

The obtained data were analyzed using ANOVA procedure of Statistica ver. 10.0 Software (StatSoft Inc. 1984–2011, USA). Least square (LS) means were computed and compared using the Tukey's honest significant difference (HSD) test, where P <0.05 was classified as significant difference and P <0.1 as a tendency.

3 Results and discussion

The profile of fatty acids in BK produced from pigs reared in two production systems is presented in Table 1.

Table 1 Fatty acid profile (LS means) of pork with regard to the production system

Fatty acid	Production system		SEM
	CS	PIC	
C 6:0	0.053	0.054	0.007
C 10:0	0.050^{b}	0.058^{a}	0.002
C 12:0	0.100^{a}	0.076^{b}	0.005
C 14:0	1.408^{a}	1.260^{b}	0.012
C 15:0	0.070^{a}	0.034^{b}	0.002
C 16:0	25.065^{a}	24.292^{b}	0.147
C 16:1	3.040^{a}	2.262^{b}	0.018
C 17:0	0.378^{a}	0.216^{b}	0.002
C 17:1	0.353^{a}	0.186^{b}	0.002
C 18:0	12.655B	12.968A	0.100
C 18:1	45.183^{a}	42.090^{b}	0.100
C 18:2	10.445^{b}	14.920^{a}	0.252
C 18:3	0.425^{b}	0.694^{a}	0.024
C 19:0	0.038^{a}	0.024^{b}	0.002
C 20:0	0.243^{a}	0.214^{b}	0.002
C 20:4	0.508	0.542	0.035
*P/S	0.284^{b}	0.411^{a}	0.011
Total fat g.100 g^{-1}	29.175^{a}	18.780^{b}	0.443

$^{a, b}$ different letters in the same row show statistically significant difference (P <0.05); $^{A, B}$ P <0.1; *CS-Crna slavonska; PIC-Pig Improvement Company; *P/S ratio of polyunsaturated and saturated fatty acids; SEM-standard error of the mean

Regardless of the production system used for production of BK, the monounsaturated oleic acid (C18:1) was the most abundant fatty acid. Its content was significantly higher (P <0.05) in sausages produced from CS pigs than in ones made from PIC hybrids. It is well known that oleic acid, also found in olive oil at similar content as in pork or pork products, has many health benefits, such as reducing the blood cholesterol, and is therefore particularly interesting for human health. Interestingly, BK produced from PIC hybrids had significantly more linoleic (C18:2) fatty acid than ones produced from CS pigs, while the content of palmitoleic acid (C16:1) was higher in BK made from CS pig. Recent studies have shown that this naturally occurring omega-7 monounsaturated fatty acid acts through activation of AMPK and enhances insulin production and secretion, increases fat breakdown, and has a significant anti-inflammatory properties (Morse, 2015). BK made from CS pig had a higher content of palmitic acid (C16:0) and myristic acid (C14:0), while the content of the steraic acid (C18:0) was around 3% in both products. Although it is generally accepted that saturated fatty acids have a negative impact on human health through increase of the risk for coronary heart disease, this opinion is being recently seriously questioned by researchers.

One of the most important parameters used for assessment of nutritional quality of the food lipid fractions is P/S ratio and is generally accepted that it should not exceed 0.4. In the case of BK made from CS pigs this ratio was below the threshold, and was significantly lower (P <0.05) than in BK made from PIC pigs. Interestingly, the P/S ratio was in those sausages somewhat higher than 0.4. The results of the present study are in agreement

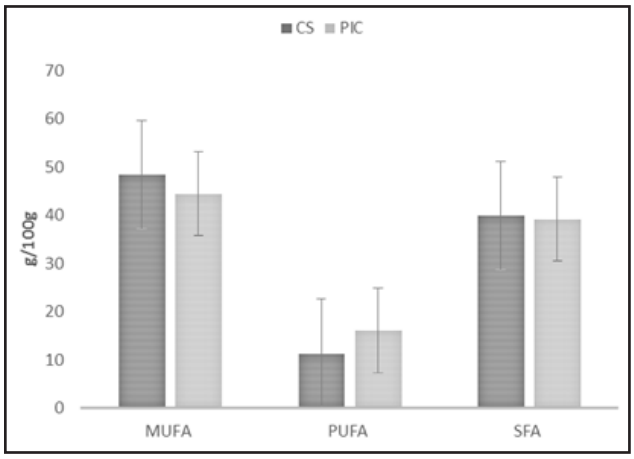

Figure 1 The differences between Baranjski kulen made from CS and PIC pigs in total MUFA, PUFA and SFA

CS-CSpig; PIC-Pig Improvement Company; MUFA-monounsaturated fatty acids; PUFA- polyunsaturated fatty acids; SFA-saturated fatty acids; $^{a, b}$ P <0.05; $^{A, B}$ P <0.1

with those reported by Parunović et al. (2017) for kulen made from Mangalitsa, Moravka and Swedish Landrace pig breeds.

BK made from CS pigs had in total higher MUFA content and lower PUFA content, while in SFA a tendency can be observed (Figure 1). The similar levels of fatty acids were also found by others in the meat of traditional pig breeds, such as Pulawska pig (Kasprzyk et al., 2015) or in the traditional sausages made from Mangalitsa and Moravka breeds (Parunović et al., 2017).

4 Conclusions

The results of the present study demonstrate that meat originating from breeds raised in their specific production system affects the fatty acid profile of the fermented sausages, such as BK. Kulen made from CS pigs raised outdoors has reasonably more healthful fatty acid composition than one made from modern pig hybrids raised in indoor intensive production system. These results should encourage the pig producers on sustainable breeding of CS pigs.

Acknowledgements

This work has been supported by Croatian Science Foundation under the project number 3396 and Horizon2020 EU project TREASURE (Grant Agreement No. 634476).

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