

Analysis of Meat Quality from Mangalitsa Breed

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Abstract

The Mangalitsa breed is known as being one of the most popular breeds from Europe, having excellent properties regarding the taste, the marbling and the very reduced amount of cholesterol.

In the last years, more information about meat quality has become available and especially about the fat of Mangalitsa pigs from Romania, according to which their meat is also very suitable for obtaining dried products and for the popular grill. Also, this breed has become popular in Spain, Switzerland, Austria and Germany.

In this study, meat and fat quality were examined for 22 Mangalitsa pigs. Compared to the German Saddlepack breed, also considered fat, the German Landrace breed has the meat darker in color, the fat is whiter and intramuscular fat content in meat and the backfat thickness are considerably higher.

The high amount of intramuscular fat and its fine and equal dispersion are favorable in terms of palatability (flavor, juiciness and tenderness) and overall, it is considered an excellent quality.

Keywords: cholesterol, color, fat, intramuscular, pig

1. Introduction

In the past, consumers preferred well marbled meat, the one rich in intramuscular fat [1, 2], which was particularly important in the preparation of steak in Anglo-Saxon areas. The effects of intramuscular fat on meat quality are to reduce dripping and cooking losses, improve doneness and juiciness [3]. Deliberate breeding work, which began in the 1960s, has yielded spectacular results in increasing the lean meat content of pigs. This has led to the elimination from breeding of pig breeds with lower reproductive rates, slower growth and poorer feed conversion [4].

However, selection for increased amounts of colored meat has been associated with changes in muscle fiber types in pork, an increase in the

proportion of glycolytic muscle fibers and in the average muscle fiber diameter, which contributes to the development of PSE trait [5]. And on the other hand, intramuscular fat content decreased to such an extent that it already had a negative effect on the organoleptic properties and taste value of the meat [6].

Currently, in many countries, research is directed towards increasing the intramuscular fat content [7] and towards the production of high-quality bacon [8]. To achieve this objective, the use of “traditional” varieties such as Duroc, Tamworth, Berkshire, Large Black, Meishan in crossbreeding procedures is suggested.

Also, in the last years, more information has become available about the quality of the meat and especially the fat of Hungarian Mangalitsa pigs [9, 10], according to which their meat is also very suitable to produce dried products and for the currently popular barbecue.

Thus, in addition to Hungary, Mangalitsa has also become popular in Spain (Serano pig), Switzerland, Austria and Germany. In addition, there is a general trend of increasing interest in

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traditional, indigenous animal species which Table 1. emphasize local specialties in the manufacture of products, where the original region-specific raw materials and there, unique properties and decisive. According to Szabó (1999) [4], this also offers a great opportunity for Mangalitsa in the future, as there is small doubt that it could be a basis for globalization in our country.

2. Materials and methods

In this experiment, a total of 12 Mangalitsa fattening pigs with an average live weight of 155 kg (carcass weight of 127 kg) were slaughtered. The pigs were chosen randomly, and no replicates were used. The fattening pigs were fed a mixed grain-based feed (maize, wheat, barley) supplemented with potatoes (winter) and green fodder (summer) depending on the season. The animals have been slaughtered in accordance with ethical guidelines. The time interval between slaughter and sample collection was one hour. The post-mortem time point at which measurements were taken was 24 hours.

During the routine slaughtering of the pigs, in addition to measuring the data required for certification, the thickness of the back fat, the pH value (pH, pH) in the long flesh, the color of the meat and back fat were measured. The pH has been measured direct by inserting a sensor into the meat for obtaining accuracy of the results. This is based on a polymer reference system which helps having the correct results.

The color measurements (long-pulp, bacon) were carried out with a Minolta CR 200. Samples were taken from the musculus longissimus dorsi (musculus longissimus dorsi, abbreviated m. l. d.) between ribs 11 and 12 for determination of the chemical composition and fatty acids.

The samples for analysis were transported frozen to the research institute. After thawing, the intramuscular fat content was determined by Soxhlet extraction procedure, and the fatty acid composition of the muscle samples was determined after extraction (Chloroform/Methanol) by saponification and esterification by gas chromatography according to Nürnberg et al. (2001) [12].

The results were evaluated by comparing the data from the Mangalitsa breed with those from German Belted and German Flat pigs with similar

fat level. These breeds were slaughtered at 110 kg live weight after intensive fattening (mixed grain-based feed).

Statistical analysis was carried out with SPSS 10.0 – ANOVA, with significance set at $p,0.05$.

3. Results and discussion

The meat quality parameters for the pig breeds studied are summarized in When evaluating the results, it should be noted that Mangalitsa fattening pigs were slaughtered at a higher live weight, as indicated by the difference in carcass weight of about 43-45 kg.

The data show that there are no statistically verifiable significant differences in final pH values between breeds. However, there was a significant difference between the breeds in terms of meat lightness (L^*). Despite visible fat deposition, the meat color of Mangalitsa is darker ($L^*=37.9$) than that of German Belted or Plaice (47.9-46.7). This trend contrasted with the bacon color. Compared to the other two genotypes, the Mangalitsa bacon is lighter in color ($L^*=75.3$).

As expected, the back fat thickness of the Mangalitsa pig (5.7 cm) is significantly higher than that of the German Belted and Flatback (2.3 cm).

The intramuscular fat content of the meat is also important for taste value and cooking technique. The fat content of 7.7% in the flesh, determined by laboratory analysis, is almost three times higher than that of German Belted pigs, which are fat, and significantly higher than the intramuscular fat content of 1-2% in the flesh of the most common breeds of pigs.

The fat content of 1% in the meat of German Belted flank meat has demonstrated the effectiveness of selection over the last decades to reduce the proportion of white meat while increasing lean meat content and yield. This also indicates that the low-fat content in meat from currently widespread pig breeds and hybrids has a negative impact on the meat's palatability (tenderness, juiciness) and its technical characteristics (e.g. suitability for frying).

In this respect, the distribution of intramuscular fat content is not only of interest, but also its absolute value.

Video image analysis was therefore used to assess the fat distribution, i.e. meat marbling, on the

surface of sliced meat slices cut from the long back of Mangalitsa pigs. The results obtained were compared with the results obtained by

Albrecht et al. (1996) [11], who evaluated the meat marbling of different cattle breeds by analyzing video images.

Table 1. Evolution of meat quality parameters

Parameter	Mangalitsa	German Belted Pork	German Flatfish
Slaughter weight, kg	124	85.9	84.6
pH,m.l.d.	5.7	5.8	5.8
Color m.l.d., L	37.9	47.9	46.7
Bacon color, L	75.3	73	73
Bacon thickness, cm	5.7	3.6	2.3
Intramuscular fat m.l.d, %	7.7	2.5	1.2

The data in Table 2 show that the quality characteristics of Mangalitsa meat obtained by video image analysis are close to those of beef cattle breeds with meat with excellent 'roasting'

characteristics, e.g. high intramuscular fat content, higher proportion and number of fat areas and favorable fat area distribution, i.e. uniform and fine penetration of fat meat.

Table 2. Analysis of intramuscular fat deposition (marbling) of the *Longissimus dorsi* (m. l. d.) using video image analysis

Parameter	Mangalitsa	Wagyu	German Angus	Galloway	Black and colored	Belgian White and Blue
Cross sectional area m.l.d, cm	36.2	76.9	111.0	92.9	85.9	146.9
Fat areas, cm	5.2	11.9	1.5	1.2	1.2	1.0
Number of fat areas	414	439	419	619	537	169
Percentage of fat areas, %	13.9	14.2	5.9	8.9	7.9	1.3
Number of fat areas, cm	12.1	5.5	3.8	6.5	6.0	1.2
Fat areas distribution, %	7.4	4.1	5.6	4.3	5.5	9.7
Intramuscular fat	8.9	21	3.5	5.3	4.7	0.7

Optimal intramuscular fat content and uniform and fine fat loading and distribution in the meat are important from a human nutrition point of view, but they are not the only characteristics of desirable meat quality. Equally important is the fatty acid composition of the meat, the favorable development of which has a positive effect on the incidence of cardiovascular disease and cancer. The fatty acid composition of the long lobe fatty acids (L. L. D.) of the three breeds of pigs that have been studied is shown in Table 3.

Monogastric animal species, e.g. on pigs, diet significantly influences the fatty acid composition of different body tissues. Therefore, the data in Table 3 should be interpreted in the light of the fact that the two German breeds were fat-fed on a mixed cereal-based feed, whereas Mangalitsa pigs were also fed green fodder, potatoes, during fattening. An analysis of the fatty acid composition of the long dorsal muscle (m. l. d.) shows that the high intramuscular fat content in the meat of the Mangalitsa resulted in an increase

in the proportion of neutral fats typical of fat depots. At the same time, the proportion of phospholipids and polyunsaturated fatty acids (PUFA) decreased and was present in lower amounts than in the meat of the other two breeds (German belted and German flatfish). The saturated fatty acid (SAFA) content was lower in Mangalitsa meat, except for lauric acid (C 12:0) and myristic acid (C 14:0). Nutritionally, high levels of myristic acid (C 14:0) and palmitic acid (C 16:0) are unfavorable).

Particularly striking is the level of 7% stearic acid (C 18:0), which accounts for 14.1% in German belted pork and 12.1% in German flatfish.

Although the lower ratio of stearic acid (C 18:0) has a nutritionally neutral effect on the blood fat content, the overall saturated fatty acid (SAFA) content of Mangalitsa is lower (31%) than that of the other two breeds. Accordingly, Mangalitsa meat has a higher content of unsaturated fatty acids (SAFA), mainly due to a higher prevalence of monosaturated fatty acids (MUFA).

Table 3. Fatty acid composition of the *Longissimus dorsi* muscle m. l. d %

Parameter	Mangalitsa	Germa Saddleback	German Landrace	p-value
Intramuscular fat, %	7.5	2.6	1.1	0.435
Fatty acids, %				
Myristic acid C 14:0	1.40	1.10	1.03	0.210
Palmitic acid C 16:0	22.40	24.69	23.46	0.754
Palmitoleic acid C 16:1	5.80	2.68	2.60	0.385
Margaric acid C 17:0	0.06	0.15	0.26	0.180
Heptadecenoic acid C 17:1	0.14	0.15	0.19	0.209
Stearic acid C 18:0	7.00	14.15	12.23	0.643
Oleic acid C 18:1 cis-9	49.20	42.20	39.20	0.492
Octadecanoic acid C 18:1 cis-11	6.50	3.98	4.00	0.350
Octadecanoic acid C 18:1 trans-11	0.20	-	-	-
Linoleic acid C 18:2 n-6 cis	3.67	6.20	9.90	0.502
Linolenic acid C 18:3 n-3	0.17	0.30	0.40	0.105
Arahic acid C 20:0	0.10	0.24	0.21	0.302
Eicosanoic acid C 20:1 n-6	0.94	0.80	0.75	0.230
Eicosatrienoic acid C 20:3 n-6	0.14	0.29	0.40	0.168
Arahidonic acid C 20:4 n-6	1.16	1.29	2.40	0.307
Eicosapentaenoic acid C 20:5 n-3	0.01	0.07	0.19	0.102
Docosapentaenoic acid C 22:5 n-3	0.14	-	-	-
Polyunsaturated fatty acids PUFA	5.61	8.30	14.00	0.734
Saturated fatty acids SAFA	31.03	40.50	37.20	0.503
Unsaturated fatty acids UFA	68.97	59.50	62.80	0.623
n-3 fatty acids	0.35	0.35	0.74	0.206
n-6 fatty acids	4.97	8.00	13.30	0.382
n-6/n-3 ratio	14.2	22.8	17.9	0.407

Among the monosaturated fatty acids (MUFA), a high prevalence (49.2%) of oleic acid (C18:1 cis-9) is observed, although from a nutritional point of view oleic acid (C18:1 cis-9) can be considered neutral. The percentage of polyunsaturated fatty acids (PUFA) is 5.6%, compared to 8.3% in German Belted pigs and 14.0% in German Flathead pigs.

This was caused by the low ratios of linoleic acid (C 18:2 n-6 cis) and linolenic acid (C 18:3 n-3) in the meat of Mangalitsa. However, it also results in low oxidation and rancidity, which, in turn, is a favorable characteristic from the point of view of product production. The ratio of n-6/n-3 fatty acids is also interesting from a biological nutritional point of view. Although it is most favorable in the Mangalitsa (Mangalitsa: 14.2, German belt: 20.5, German flatfish: 17.6), it should be noted that the desirable value is 5 or lower, which is significantly lower in all three species. However, it should be emphasized that the Mangalitsa pig breed has an advantage over other breeds and hybrids in this respect, namely that it can be fed on more green forages.

Taking advantage of this property, the fatty acid composition of its meat can be improved by feeding. This is a cheaper solution than mixing oilseeds (linseed, rape) into the pig feed, as suggested by several authors [12-15].

4. Conclusions

Our results confirm the information in the literature that the quality of Mangalitsa pig meat differs in several respects (intramuscular fat content in the meat, meat color, thickness of the fat, color of the fat) from the quality of meat of widely used breeds and hybrids. The high intramuscular fat content (7.5 – 9.04) and its fine and even distribution in the meat have a positive effect on palatability, tenderness and taste, not least in the production of roasts and special products (ham, salami).

Mangalitsa pork ham has a high hardness (stearic acid content: 9,71- 13.05%) and a favorable fatty acid composition (PUFA: 12.49-15.54%), which

makes it an excellent choice to produce high quality and high value ham.

In general, our results show that Mangalitsa pigs are suitable to produce traditional products with high added value and specific qualities. The future of the breed largely depends on how we can secure a long-term market for these products.

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