FATTY ACID COMPOSITION IN PIGS OF VARIOUS GENOTYPES COMPARED TO MANGALIZA

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Introduction

In the past fifty years radical changes have taken place in all areas of life. This also applies to the nature of our diet.

The development and standard of living of a country can be expressed by several parameters. Over the last decades, the consumption of meat per person per year was associated to some degree with the growth of material prosperity. While this value is 80 – 100 kg in the member countries of the EU (FAO, 2000), it reaches less than 60 kg in Hungary. The increase in meat consumption of the EU, however, came to a halt in recent years. Quantity has been replaced by quality (E. Kalm, 1994). In Denmark and Austria, pork consumption is higher than total meat consumption in Hungary.

Healthy eating has become an important principle. Poultry meat consumption is forecast to rise in regions of the EU and the U.S. to such an extent that it will exceed pork consumption by several times.

Vascular diseases are often due to lack of exercise combined with excessive energy intake. The best-known energy source of the diet is fat. Therefore, we continue to hear the good advice: eat less fat and fatty meat dishes! According to I. KISS, I. EMBER (2000), development of colon and breast cancer can be the result of eating high fat meals. At the same time they report, with reference to other authors, a decreased risk of stomach cancer with increased fat intake.

Pig breeders have been trying for half a century to reduce the fat content of a pig. Instead of the once 40-50, or even 70 % (B. DORNER, 1921, F. CSÁKY, 1933) a pig today contains at most 20 - 30% fat (K. Gosztonyi - R. LÁSZTITY, 1993). Fat production and fat build-up capacities differ in different breeds. Breeds with strong growth intensity reach their slaughter weight before the start of intensive formation of fat. Proper feeding is also used to reduce the formation of fat. The deposition of fat in the animal organism will also change according to gender or with sterilisation. The fat content of the cuts of meat from individual parts of the body, and even the fatty acid content of fats is different. The "battle" against fat has meant that meat has lost its taste due to a reduction of intramuscular fat and is enjoyed less because of a lack of taste and flavours. Food preparation can also disrupt the balance of our energy intake. If you fry Schnitzel (pork steak coated in breadcrumbs) with meat containing 3 – 4 % fat, this will increase the fat content of the dish by at least 10%. The fat content of different prepared pork products also varies greatly. (K. INCZE – I. CSAPÓ, 2000)). (Cured Ham (5%), Paris sausage (10%, Debrecen sausage (28%) or winter salami (47%) (K. Incze - I. Csapo, 2000)).

Experts in food sciences draw our attention to fat content, but also to the importance of the fatty acid composition of fats. Amount and proportion of saturated and unsaturated fatty acids

differ depending on species and body part, and can even be changed by feeding (J. GUNDEL - I-né Herman, 2001). Saturated fatty acids adversely affect nutrition. The consumption of unsaturated fatty acids containing one or more double bonds is healthier (Scheeder et al., 1998) but carcinogens may occur because of increased lipid peroxidation. In physiological terms, the ratio of mono- and poly- unsaturated fatty acids is also of importance (L. Boross - M. SAJGÓ, 1993).

Materials and methods

We have fattened 10 groups of pigs of different genotypes under precisely the same housing and feeding conditions in the faculty's experimental farm. The faculty conducted the herd book control of the Hungarian white pig, the Hungarian Landrace, the Duroc and the Pietrain. The faculty also organised gene storage for the breed of Mangaliza and Cornwall pigs and holds the archives on trials of Mangaliza and Duroc pigs for genetic mapping purposes. This offered us a rare opportunity to compare the growth performance and carcass values of the different genotypes.

The pigs were kept in groups of 10 animals, not separated by gender, in pens with litter and fed from combined animal feeding facilities. The experiment was repeated twice. Each animal was allocated a space of 1.2 $m^{2.}$ The pigs were fattened from a start weight of about 30 kg and received feed mixture I up to a total body mass of 60 kg, and then feed mixture II. Composition and ingredients of these diets are given in **Table 1.**

The final weight of the modern pig breeds (Hungarian white Landrace, Hungarian Landrace, Duroc and Pietrain) was 130 kg, while the breeds Mangaliza, Cornwall and their crosses were fattened up to a final mass of 140 kg. Accordingly, the percentage values for live weight gain for each day of life and fattening period, slaughter age, lean meat content and white fat only can only be assessed within the two use types **(Table 2).** The final weight is 140 kg at the request of the Spanish buyer. We have fixed the final weight of the "modern" pigs at 130 kg to create similar conditions for the study of the fattening process, meat and fat content.

The fatty acids were analysed in the laboratory of the Centre for Biology in Szeged, the meats in the central laboratory of the University of Debrecen, Centre of Agricultural Sciences.

Table 1: **Composition and ingredients of feed mixtures**

Description	Unit	Fattening feed I.	Fattening feed II
		Food mixture	
Primary products:			
Corn	%	58	50
Wheat	%	20	32
Concentrate Optima Energy	%	22	18
Ingredients calculated:			
DE_s	MJ / kg	14.023	14.06
ME_s	MJ / kg	13.69	13.73
Crude protein	%	16.06	15.31
Crude fibre	%	3.91	3.65
Crude fat	%	4.39	3.98
Lysine	%	0.93	0.83
Methionine	%	0.31	0.29
Methionine + cystine	%	0.63	0.61
Ca	%	0.737	0.612
P	%	0.556	0.513
Na	%	0.17	0.149
Vitamin A	Ne / g	6.032	4.936
Vitamin D	Ne / g	1.043	0.853
Vitamin E	Ne / g	20.02	16.38

Results and discussion

The Mangaliza pigs and their crosses achieved their slaughter weight two months later (23%). During this time they built up a total of 15.05% fat, relating to 52.4% more fat in absolute terms, and a total of 13.2% meat, relating to 23% less meat in their bodies. In practice, these breeds are held and fed differently as they serve as raw material for manufacturing different products.

Samples for the investigation of the fat content of each type were, with approval of the slaughterhouse, taken from the neck meat only.

The average dry matter content of the neck meat cuts in different genotypes of pigs was 35.21% **(Table 3).** The variance analysis of data from 100 animals, from the 10 genotypes, differs only by 10% on the level P. This means that neither genotype nor gender cause a statistically reliable difference in dry matter content. The highest dry matter content was found in the meat of the D x Mangaliza F1 and F2 crosses (38.03 –36.50), the lowest among the Pietrain and Landrace breeds (33.53 to 32.58).

Table 2: Growth and Carcass Parameters of the Experimental Groups

Description	Hungarian White Landrace (LW)	Hungarian Landrace (LR)	Duroc (D)	Pietrain (P)	Cornwall (C)	Mangalitza Blonde	Mangalitza Red	Duroc x Mangalitza F_1	Duroc x Mangalitza F_2	Duroc x Cornwall
Body weight gain g/day	554	538	545	527	501	420	434	451	434	570
Increase before fattening g/kg	725	698	664	686	599	496	516	532	522	703
Slaughter age*, day	235	241	255	246	277	329	321	308	320	243
% Share of white (fat)	29.5	27.0	31.5	26.9	39.4	49.1	47.5	42.8	46.0	37.1
Lean meats %	56.0	58.2	55.0	58.6	48.0	38.4	39.9	44.2	41.5	51.0

* Final mass of LW, LR, D, P = 130kg, remaining breeds 140kg

Table 3: Components of Meat (neck cut)

Description	Hungarian White Landrace (LW)	Hungarian Landrace (LR)	Duroc (D)	Pietrain (P)	Cornwall (C)	Mangalitza Blonde	Mangalitza Red	Duroc x Mangalitza F_1	Duroc x Mangalitza F_2	Duroc x Cornwall	Average Value	Significance between pig breeds	
												P%	Lsd 5%
Dry Matter %	34.01	32.58	35.93	33.53	34.96	35.93	36.13	38.03	36.50	34.49	35.21	10	3.37
Fat %	14.06	12.93	16.41	14.17	15.81	16.94	16.90	19.14	17.08	14.88	15.83	0.1	1.43
Protein %	18.67	18.26	18.10	18.52	17.76	17.96	17.88	17.35	18.04	18.11	18.07	ns	1.21

The average protein content of the meat samples was 18.07%. The variance analysis has again shown no reliable difference between breeds and crosses. According to the variance analysis, the effect of gender is stronger than that of genotype, but a variance of 10% can only be proven in level P. We found the highest protein content in the Hungarian white Landrace and Pietrain (18.67 to 18.52%), the lowest in the meat of the D x Mangaliza F1 hybrids.

The average fat content of neck meat samples was 15.83%. The variance analysis provided evidence of 0.1% on level P, a significant difference. We found the highest fat content in the meat of the D x Mangaliza F1-F2-crosses (from 19.14 to 17.08%), followed by the blonde and the red Mangaliza pigs (from 16.94 to 16.90%). The least fat, differing significantly from the previously mentioned breeds, is in the meat of the Pietrain (14.17%), white Landrace (14.06%) and Landrace (12.93%) breeds.

In addition to the fat recoverable from the pig carcasses, the amount and proportion of saturated and unsaturated fatty acids in the fats is of importance. We found a significant difference of 5% among the average values of genotypes with regards to content of saturated fatty acids on level P, while the unsaturated fatty acids showed a difference of 1%. The details are listed in Table 4 and Figure 1. The average value of saturated fatty acids is 41.99%, and of unsaturated 58.01%. The fat of the red Mangaliza pig contains 36.99% saturated fatty acids. Therefore it is, with the exception of the blond Mangaliza pig; significantly lower, i.e. better than in the other eight genotypes examined. The content of unsaturated fatty acids is 63.01% and is on level P 0.with 1% significantly higher than in the other breeds. Gender has caused no significant difference in the average of the genotypes with regard to the amount of saturated and unsaturated fatty acids.

For saturated fatty acids averaged over the various genotypes, the proportion of palmitic acid was highest (62.01%). The proportion of stearic acid is 33.4%, that of miristin acid 4.6% (Figure 2).

The average values of the three types of saturated fatty acids found most often in pig fat - miristin, palmitic and stearic acid - vary significantly according to genotype in position P by 1% and 5%. The values in the Mangaliza colour variations are lower than the average of the total population studied.

Among the unsaturated fatty acids, oleic acid is the most common, giving 71.27% of all unsaturated fatty acids. Miristoleic and Palmitoleic acids are only represented by 1.06 and 4.24 % (Figure 3).

More important in nutritional terms, among fatty acids containing several double bonds, the proportion of linoleic fatty acids was approximately one fourth of all unsaturated fatty acids (22.59%), while linolenic acid, which contains 3 double bonds, was present only with 0.84%.

Table 4: Fatty Acid composition in backfat of different genotypes (%)

Description	Hung. White Landrace (LW)	Hung. Landrace (LR)	Duroc (D)	Pietrain (P)	Cornwall (C)	Man-galitza blonde	Man-galitza Red	Duroc x Man-galitza F_1	Duroc x Man-galitza F_2	Duroc x Corn-wall	Average Value	Significance between Breeds	
												P%	$SzD_{5\%}$
Myristic Acid	1,71	1,81	2,06	1,76	1,59	1,68	1,77	2,18	1,88	2,15	1,86	1	0,35
Palmitic Acid	24,77	24,87	25,38	24,60	24,92	24,98	23,00	26,71	25,22	26,02	25,05	5	1,79
Stearic Acid	14,05	14,47	14,19	14,48	14,08	11,51	11,00	13,56	13,15	14,37	13,49	5	2,33
Myristoleic Acid	0,63	0,43	0,75	0,70	0,49	0,24	0,55	0,83	0,65	0,63	0,59	5	0,31
Palmitoleic Acid	2,12	2,23	2,32	2,11	2,19	2,74	2,66	2,63	2,46	2,20	2,36	1	0,32
Oleic Acid	39,47	38,92	37,94	38,89	39,54	42,70	43,65	40,17	40,48	36,50	39,78	0,1	2,94
Linoleic Acid	13,37	12,88	13,73	12,95	13,14	12,26	13,59	9,65	11,66	12,90	12,61	0,1	1,69
Linolenic Acid	0,49	0,46	0,51	0,50	0,52	0,42	0,49	0,36	0,45	0,49	0,47	1	0,078
Saturated Fatty Acid (SFA%)	41,95	42,84	43,17	42,54	42,07	39,55	36,99	44,18	41,95	44,65	41,99	5	3,64
Unsaturated Fatty Acid	58,05	57,16	56,83	57,46	57,44	60,45	63,01	55,82	58,05	55,35	58,01	1	3,79
MUFA (%)	42,22	41,58	40,56	41,70	42,22	45,68	46,86	43,63	43,59	39,93	42,73	-	-
PUFA (%)	13,86	13,34	14,24	13,45	13,66	12,68	14,08	10,01	12,11	13,39	13,08	-	-

Figure 1: Fatty acid composition of bacon in different breeds

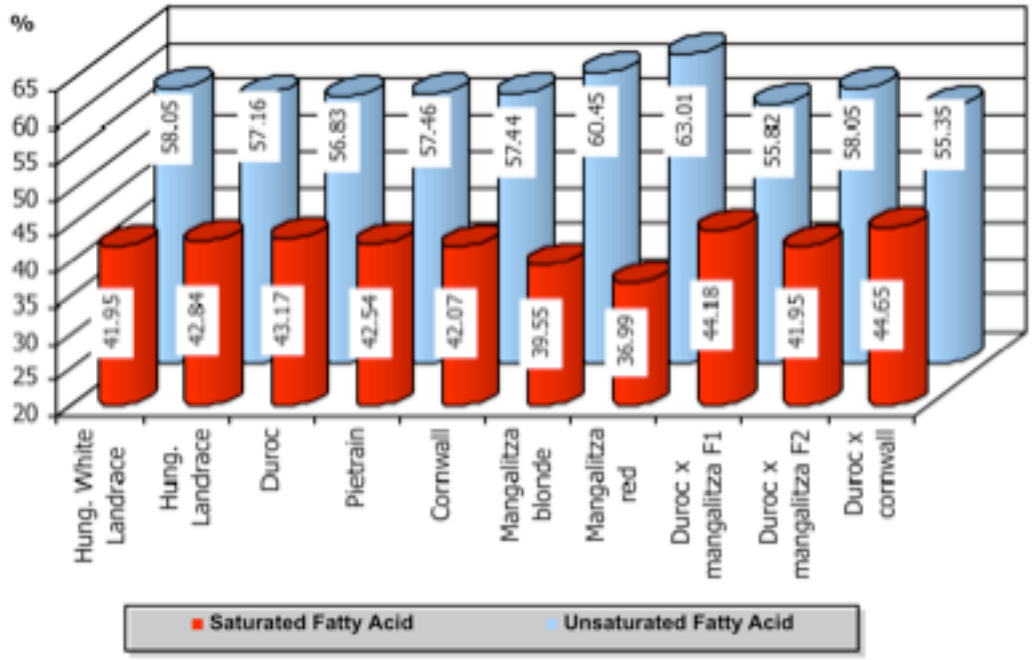

Figure 2: Components of saturated fatty acids

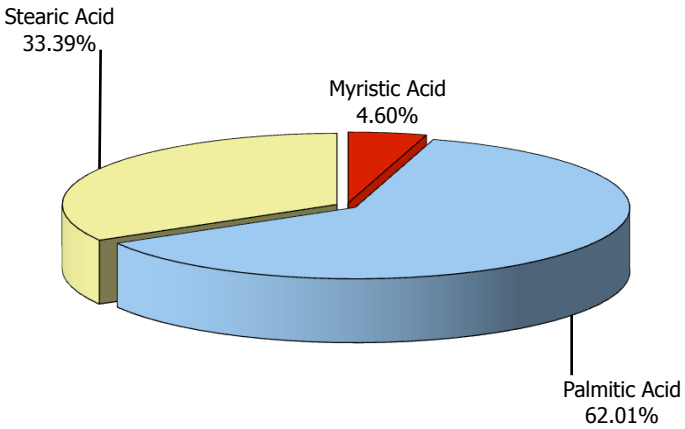

Figure 3: **Composition of unsaturated fatty acids**

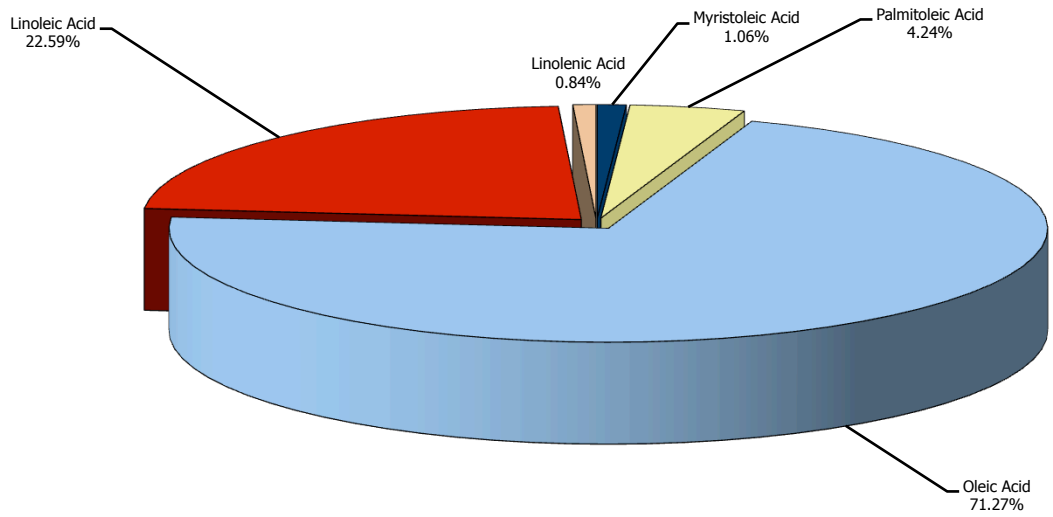

Figure 4: **Proportion of mono- and polyunsaturated fatty acids in Mangaliza bacon**

The average proportion of unsaturated fatty acids in the red Mangaliza pig was significantly higher than in the other groups. The proportion of monounsaturated fatty acids (MUFA) is higher in both Mangaliza breeds, the proportion of polyunsaturated fatty acids (PUFA) only in the red Mangaliza pigs than in the other 9 groups **(Table 4 and Figure 4).**

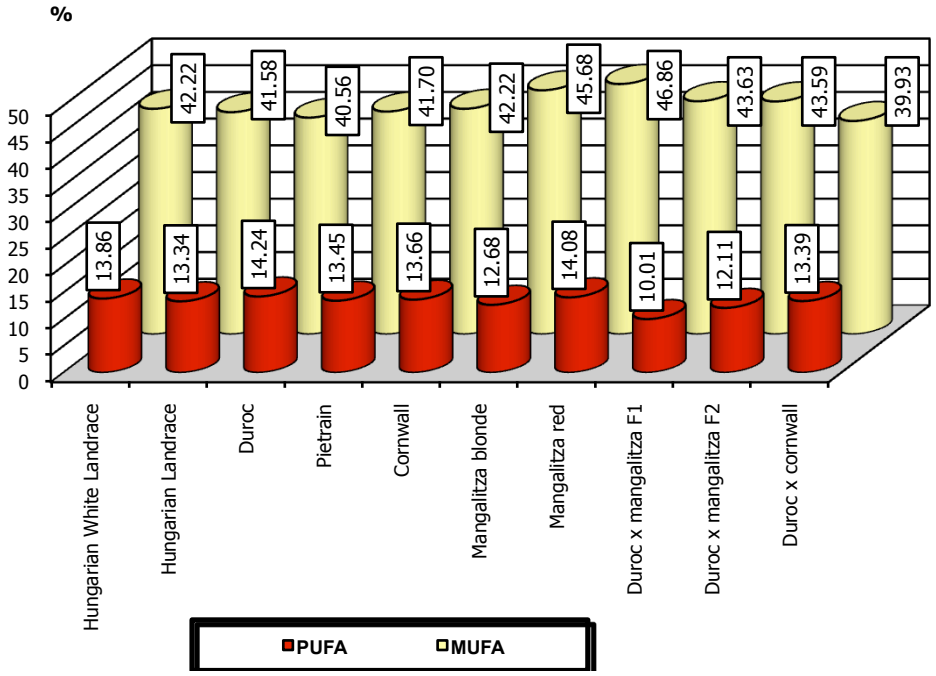

Table 5 clearly illustrates the advantage of the Mangaliza pig with its 12 - 16% lower saturated fat and its 8 -10 % higher unsaturated fatty acid content. From a nutritional point of view, the higher 12% share of oleic acid in the fat of the Mangaliza pig is particularly advantageous.

Table **5: Differences in the composition of fatty acids in the Mangaliza pig and modern breeds (%)**

Description	Mangalitza	Modern Breeds	Deviation		Level of significance	
			absolute	relative%	P%	SZD 5%
Saturated	38.27	42.87	-4.60	-12.0	5	3.64
	(36.99) *		-5.88	-15.9	1	
Unsaturated	61.73	57.13	+4.60	+8.05	1	3.79
	(63.01) *		+5.88	+10.3	0.1	
Myristic acid	1.73	1.85	-0.12	-6.90	1	0.35
Palmitic acid	23.99	25.09	-1.10	-4.40	5	1.79
Stearic acid	11.25	14.27	-3.02	-26.84	5	2.33
Myristoleic acid	0.40	0.60	-0.20	-50.00	5	0.31
Palmitoleic acid	2.70	2.20	+0.50	+18.50	0.1	0.32
Oleic acid	43.17	38.47	+4.70	+12.20	0.1	2.94
Linoleic acid	12.93	13.16	-0.23	-1.80	0.1	1.69
Linolenic acid	0.46	0.50	-0.04	-8.00	1	0.078

* red Mangalitza

Conclusions

The experience of the feeding trials shows that Mangaliza pigs and their crosses reach their slaughter weight 2 months later than the modern pig breeds. Their relative fat production is higher by 52%, their meat production by 23% lower than in modern breeds. The dry matter content of the meat in Mangaliza pigs and their crosses is higher than in modern breeds. On the other hand, the protein content in the meat of modern breeds is higher than in fat pigs, but the difference between the average values of each genotype, like in dry matter content, cannot be established for certain with the number of animals tested.

The fat content in fat pigs is naturally greater than for intensively reared meat pigs. We have noted in the investigation of the fatty acid composition of pork fat that blond and red Mangaliza pigs have nutritionally better values with regard to saturated and unsaturated fatty acids than currently grown modern cultivars.

The content of linoleic and linolenic acids with more double bonds shows no significant differences.

Therefore, Mangaliza pigs and their hybrids can be readily used for the production of branded goods (such as Serrano ham, with a long maturation period), for which meat or cuts (ham) of

modern pigs are unsuitable or less suitable. The breeds of Mangalitsa are suitable, when fed in a natural environment with organic feeds, for products with excellent taste requiring a longer maturation period.

FATTY ACID COMPOSITION OF THE FAT IN DIFFERENT PIG GENOTYPES AS COMPARED TO MANGALITZA

Summary

The fatty acid composition of fat samples from individuals of 7 purebred and 3 crossbred breeds fed with the same feeds were analysed.

Within the fatty acid composition in different purebred and crossbred varieties the proportions of saturated and unsaturated acids were significantly different.

The saturated fatty acid content of the red Mangalica breed was 36,99 %, and with the exception of the blonde Mangalica breed it was significantly lower, as well as their unsaturated fatty acid content of 63,01 % was significantly higher at P 0,1% level than in the other breeds.

Gender did not result in significant differences in the amounts of either saturated or unsaturated fatty acids. Out of the saturated fatty acids, the mean values of the 10 breeds analyzed showed differences of significance at the level of P 5%.

As regards the amounts of unsaturated acids of miristoleic acid (0,59%) and linolenic acid (0,47%) that occur in the smallest amounts, the differences between mean values at P 5% were also significant.

The differences between the mean values of palmitoleic acid (2,36%), oleic acid (39,74%) and linolic acids (12,59%), the latter being the most important as regards its significance for nutrition physiology, are significant at the level of P 0.1%.

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