POLISH JOURNAL OF FOOD AND NUTRITION SCIENCES
Pol. J. Food Nutr. Sci. 2006, Vol. 15/56, No 2, pp. 137–140

INFLUENCE OF PIG MEATINESS ON PORK MEAT QUALITY

Eugenia Jacyno, Arkadiusz Pietruszka, Anita Kołodziej

Department of Pigs Breeding, Agricultural University, Szczecin

Key words: meatiness, intramuscular fat, fatty acids, cholesterol

The investigation was carried out on 72 fatteners of both sexes divided into two groups. Carcass meatiness determined after the slaughter of fatteners was a factor differentiating respective groups: group I with meatiness 49–54.4%, and group II with meatiness 54.7–60%. The *m. longissimus dorsi* was determined for the content of dry matter, protein, intramuscular fat and total cholesterol.

Intramuscular fat and cholesterol contents in the *m. longissimus dorsi* of more muscled fatteners (group II) were significantly lower ($p \leq 0.01$) than those in the muscle of fatteners of group I. The intramuscular fat of fatteners of group II contained less saturated fatty acids ($p \leq 0.01$), while more unsaturated ones ($p \leq 0.01$), including polyunsaturated fatty acids ($p \leq 0.01$).

INTRODUCTION

The pork meat contains considerable amounts of saturated fatty acids and of cholesterol. Excessive supply of these components in a diet favours the formation of arteriosclerosis and diseases development on its base [Grys, 1995]. In connection with the above, dietitians recommend limitation of pork meat consumption.

Cholesterol content of *m. longissimus dorsi* of pigs ranges from 58 to 73 mg/100 g fresh tissue, however the lipid fraction of the muscle contains from 37 to 43% of saturated fatty acids, from 59 to 63% of unsaturated fatty acids, including from 9 to 12% of polyunsaturated fatty acids [Lenartowicz & Kulisiewicz, 1998; Chizzolini *et al.*, 1999; Migdał *et al.*, 1999; Jacyno *et al.*, 2002].

The level of cholesterol in fatteners' tissues depends on the type of fatty acids. A higher cholesterol content is typical of meat containing more saturated fatty acids, whereas a higher quantity of polyunsaturated fatty acids is accompanied by a lower amount of that sterol [Brooks, 1998].

The research by Lenartowicz & Kulisiewicz [1998] and Dorado *et al.* [1999] show that pork meat dietetic value improvement (*i.e.* lowering the content of fatty acids and cholesterol and increasing that of polyunsaturated fatty acids) may be obtained through increasing pig meatiness. However, higher pig meatiness is also accompanied by a lower content of intramuscular fat in the meat [Sellier, 1998; Jacyno *et al.*, 2002]. In consequence of that, deterioration is observed in the sensory properties of meat (tenderness, juiciness and flavour), as these traits are positively correlated with intramuscular fat quantity [Eikelenboom *et al.*, 1996].

The present study was aimed at determining the effect of pig meatiness on the content of nutrients and cholesterol and the composition of fatty acids in pork meat.

MATERIAL AND METHODS

The tests covered 72 fatteners (36 gilts and 36 barrows). During the fattening period (30–100 kg of body weight), the animals were kept and fed individually with balanced feed rations – according to the Polish Norm of Pigs Nutrition [1993]. The fattening has been terminated with slaughter and the evaluation of meatiness was carried out according to the methodology applied in the Polish Pig Testing Stations [Różycki, 1996].

A sample of *m. longissimus dorsi*, taken from between 1st and 4th lumbar vertebra, was determined for the contents of dry matter, protein (with the Weende analysis) and total cholesterol [Rhee *et al.*, 1982]. The intramuscular fat was extracted from the muscle by the method of Weibull-Stoldt [Skulmowski, 1974]. In the extracted fat of the *m. longissimus dorsi*, the content of fatty acids was determined according to the gas chromatography method following saponification and esterification of 14% BF_3 in methanol. The separation of fatty acids was carried out in a Philips PU-4550 gas chromatograph under the following conditions: glass column 2.1 m × 4 mm, temperature of column 225°C, temperature of detector and injector 250°C, carrier gas flow (argon) 40 mL/min.

On the basis of an average meatiness (54.6%) of the analysed groups of fatteners, the animals were divided into two groups: with lower (I) and higher (II) meatiness on average. Group I (meatiness 49–54.4%) included 35 fatteners, and group II (meatiness 54.7–60%) included 37 fatteners. Both groups were compared.

Author's address for correspondence: Eugenia Jacyno, Department of Pigs Breeding, Agricultural University, ul. Dr. Judyma 10, 71-460 Szczecin, Poland; tel.: (48 91) 4541521 ext. 352; e-mail: eugenia.jacyno@biot.ar.szczecin.pl

The results were worked out statistically by means of the STATISTICA PL software, using a single-factor analysis of variance in the non-orthogonal system.

RESULTS AND DISCUSSION

According to the methods applied, the muscling of carcasses differed statistically significantly between experimental groups (Table 1). The carcasses of group I fatteners contained by 5.4% more meat when compared with those of group II ($p \leq 0.01$). The analysis of *m. longissimus dorsi* showed that dry matter and protein contents were independent of carcass meatiness. On the other hand, the content of intramuscular fat in the muscle of the fatteners of higher meatiness (group II) was by about 35% lower that that of the fatteners of group I. The decrease in intramuscular fat content along with the increase in pig carcass meatiness was confirmed in research of other authors [De Vries *et al.*, 1994; Lenartowicz & Kulisiewicz, 1998]. The content of that component in the *m. longissimus dorsi* of both groups of fatteners was within optimum ranges (2–3%) reported by other authors [Laube *et al.*, 2000].

A highly positive correlation demonstrated between intramuscular fat content and sensory attributes [Baulain *et al.*, 2000] allows supposing that the meat of fatteners with lower meatiness (group I) will be characterised by better consumption quality than that of fatteners of group II. However, a larger quantity of intramuscular fat was accompanied by a higher content of cholesterol. Consequently, the meat of more muscled fatteners (group II), which contained by 9.5% less cholesterol ($p \leq 0.01$) when compared with the meat of pigs of group I, will be characterised by a better dietetic value. A similar relationship has also been reported by Lenartowicz & Kulisiewicz [1998] and Dorado *et al.* [1999].

The analysis of intramuscular fat of the *m. longissimus dorsi* (Table 2) also points to a better dietetic value of the meat of more muscled fatteners (group II) when compared with that of fatteners of group I. A significantly lower content ($p \leq 0.01$) of saturated fatty acids (SFA) was found in the intramuscular fat of muscle of group II fatteners, while a significantly higher one ($p \leq 0.01$) of unsaturated fatty acids (UFA). The higher concentration of UFA in the muscle of pigs of group II, when compared with that of group I pigs, was a consequence of a larger amount ($p \leq 0.01$) of polyunsaturated fatty acids (PUFA), in particular of PUFA n-6 ($C_{18:2}$, $C_{18:3\ n-6}$, $C_{20:4}$). From the nutritional point of view, the increase in PUFA content is favourable to humans, as these acids inhibit the synthesis of cholesterol, in particular its LDL fraction.

TABLE 1. Carcass meatiness and chemical composition of *m. longissimus dorsi*.

Item		Groups – meatiness (%) I 49–54.4 n-35	Groups – meatiness (%) II 54.7–60 n-37	F
Carcass meatiness (%)	$\bar{x}$	51.8	57.2	178.1**
	s	1.43	1.93	
In *m. longissimus dorsi* (in 100 g fresh tissue):				
Dry matter (g)	$\bar{x}$	27.9	27.3	18.7
	s	0.60	0.62	
Protein (g)	$\bar{x}$	23.5	24.1	2.9
	s	0.96	1.72	
Intramuscular fat (g)	$\bar{x}$	2.79	2.07	37.1**
	s	0.61	0.35	
Total cholesterol (mg)	$\bar{x}$	63.2	57.7	34.7**
	s	4.35	3.42	

**$p \leq 0.01$

TABLE 2. Fatty acid composition of the intramuscular fat of *m. longissimus dorsi* (% of total fatty acids).

Fatty acids	Groups – meatiness (%) I 49–54.4 n-35	Groups – meatiness (%) II 54.7–60 n-37	F
Myristic C14:0	1.35	1.29	9.7**
Palmitic C16:0	23.68	22.95	15.6**
Palmitoleic C16:1	4.65	4.63	0.1
Stearic C18:0	11.84	11.50	2.7
Oleic C18:1	44.95	44.27	3.7
Linoleic C18:2 n-6	9.02	10.26	28.8**
γ-Linolenic C18:3 n-6	0.25	0.38	16.8**
α-Linolenic C18:3 n-3	0.54	0.59	1.7
Arachidic C20:0	0.48	0.53	3.9
Gadolenic C20:1	1.22	1.13	3.1
Eicosadienoic C20:2	0.42	0.45	0.6
Eicosatrienoic C20:3	0.22	0.31	8.2**
Arachidonic C20:4 n-6	0.92	1.26	18.2**
Other fatty acids	0.25	0.23	0.2
Saturated fatty acids (SFA)	37.57	36.46	12.7**
Unsaturated fatty acids (UFA)	62.17	63.33	13.6**
Monounsaturated fatty acids (MUFA)	50.79	50.05	1.1
Polyunsaturated fatty acids (PUFA)	11.38	13.28	30.8**

**$p \leq 0.01$

The content of monounsaturated fatty acids (MUFA) in the *longissimus dorsi* muscles of both fattener groups was very similar (50.8 *vs.* 50.1%), which indicates that it depended inconsiderably on carcass muscling.

The relationship observed in the present study, namely: the higher the pig carcass meatiness the lower the content of intramuscular fat, cholesterol and saturated fatty acids and the higher the concentration of polyunsaturated fatty acids, has been corroborated by studies of other authors [Cameron & Enser, 1991; Kołodziej *et al.*, 2000].

CONCLUSION

The results obtained indicate that the pork meat of more muscled fatteners is characterised by a better dietetic value (a lower content of cholesterol and saturated fatty acids and a higher one of polyunsaturated fatty acids), while it contains less intramuscular fat, which is responsible for the sensory quality of meat.

REFERENCES

1. Baulain U., Köhler P., Kallweit E., Brade W., Intramuscular

fat content in some native German pig breeds. EAAP publication, Wageningen, 2000, 100, 181–184.
2. Brooks P.H., Effect of nutrition on the composition of deposit fat. Pol. J. Food Nutr. Sci., 1998, 7/48, 100–114.
3. Cameron N.D., Enser M.B., Fatty acids composition of lipid in *longissimus dorsi* muscle of Duroc and British Landrace pigs and its relationship with eating quality. Meat Sci., 1991, 29, 295–307.
4. Chizzolini R., Zanardi E., Dorigoni V., Ghidini S., Caloric value and cholesterol content of normal and low-fat meat products. Trends Food Sci. Technol., 1999, 10, 119–128.
5. De Vries A.G., Van Der Wal P.G., Long T., Eikelenboom G., Merks J.W.M., Genetic parameters of pork quality and production traits in Yorkshire populations. Livest. Prod. Sci., 1994, 40, 277–289.
6. Dorado M., Gómez E.M.M., Jiménez-Colmenero F., Masoud T.A., Cholesterol and fat contents of Spanish commercial pork cuts. Meat Sci., 1999, 51, 321–323.
7. Eikelenboom G., Hoving-Bolink A.H., Van Der Wal P.G., Die Verzehrsqualität von Schweinefleisch. 2. Einfluss des intramuskulären Fettes. Fleischwirtschaft, Frankfurt/M, 1996, 76, 559–560.
8. Grys S., The role of gamma-linolenic acid in human organism. 2005, *in*: Mat. of II symp. ref. "Oil from evening primrose in prophylaxis and therapy". 6–7 October 1995, Łódź Poland, Makolab, 22–34 (in Polish).
9. Jacyno E., Pietruszka A., Kołodziej A., Czarnecki R., Content of lipid components in *m longissimus dorsi* of progeny of the boars descending from reciprocal crossing of the Pietrain and Duroc bredss. Arch. Tierz., Dummerstorf, 2002, 45, 237–245.
10. Kołodziej A., Pietruszka A., Jacyno E., Czarnecki R., Relationship between meatiness, intramuscular fat and cholesterol content and fatty acids in pork meat. Ann. Anim. Sci., Supll., 2000, 2, 325–329 (in Polish).
11. Laube S., Henning M., Brandt H., Kallweit E., Glodek P., Die Fleischbeschaffenheit von Schwienekreuzungen mit besonderen Qualitätseigenschaften im Vergleich zum heutigen Standard – und Markenschweineangebot. Arch. Tierz., Dummerstorf, 2000, 43, 463–476.
12. Lenartowicz P., Kulisiewicz J., Effect of the genetic background and lard – or soya oil enriched diet on carcass meat deposition and lipid fractions in porkers. Pol. J. Food Nutr. Sci., 1998, 7/48, 183–188.
13. Migdał W., Koziec K., Koczanowski J., Tuz R., Borowiec F., Furgał K., Gardzińska A., Tissue traits of cross-breed fatteners. Medycyna Wet., 1999, 55, 403–407.
14. Polish Norms of Pig Nutrition. 1993, Omnitech Press. IF i ŻZ, Warszawa (in Polish).
15. Rhee K.S., Dutson T.R., Smith G.C., Hostetler R.L., Reiser R., Effects of changes in intramuscular and subcutaneous fat levels on cholesterol content of raw and cooked beef steaks. J. Food Sci., 1982, 47, 716–719.
16. Różycki M., Results of pig tested at pig testing stations. Report on pig breeding in Poland. 1996, Inst. Zoot., Kraków, pp. 69–81 (in Polish).
17. Sellier P., Genetics of meat and carcass traits. 1998, *in*: The Genetics of the Pig (eds. M.F. Rothschild, A. Ruvinsky). CAB International, Wallingford, Oxon, UK, pp. 463–510.
18. Skulmowski J., Estimation methods of feeds composition and their quality PZWL, Warszawa, 1974 (in Polish).

Received May 2005. Revision received October and accepted November 2005.

JAKOŚĆ MIĘSA WIEPRZOWEGO W ZALEŻNOŚCI OD MIĘSNOŚCI ŚWIŃ

Eugenia Jacyno, Arkadiusz Pietruszka, Anita Kołodziej

Katedra Hodowli Trzody Chlewnej, Akademia Rolnicza, Szczecin

Badania przeprowadzono na 72 tucznikach obu płci, podzielonych na dwie grupy. Czynnikiem różnicującym poszczególne grupy była mięsność tusz określona po uboju tuczników: grupa I – mięsność 49–54.4%, grupa II – mięsność 54.7–60%. W mięśniu *m. longissimus dorsi* oznaczono zawartość: suchej masy, białka, tłuszczu śródmięśniowego i cholesterolu ogólnego. W tłuszczu śródmięśniowym mięśnia oznaczono skład kwasów tłuszczowych.

Zawartość tłuszczu śródmięśniowego i cholesterolu w *m. longissimus dorsi* tuczników bardziej umięśnionych (grupa II) była istotnie ($p \leq 0.01$) mniejsza niż w mięśniu tuczników grupy I (tab. 1). Tłuszcz śródmięśniowy tuczników grupy II zawierał mniej ($p \leq 0.01$) nasyconych kwasów tłuszczowych, natomiast więcej ($p \leq 0.01$) nienasyconych kwasów tłuszczowych, w tym wielonienasyconych kwasów tłuszczowych ($p \leq 0.01$), (tab. 2).