Lipids and glutathione-dependent enzymes in the pig neck

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Abstract

A pig neck is meat predominantly used for barbecues and the amount of lipids and cholesterol in relation to the activities of lipid peroxide reducing enzymes is important also for the prevention of oxysterol formation during a thermal preparation. We examined lipid peroxide reducing enzymes activities in the pig neck as well as the amount of lipids and cholesterol. We found high activity of both selenium-dependent glutathione peroxidase (GSH-Px; EC 1.11.1.9) and glutathione reductase (GR; EC 1.6.4.2) enzymes in the pig neck as well as high content of lipids and cholesterol. Our results are discussed in relation to the balance between synthesis, oxidation, and intracellular transport of fatty acids in muscles as the main factor responsible for muscle lipid content variations in animals undergoing a normal growth.

Introduction

In meat-producing animals a sensory quality of meat may benefit from moderately higher lipid content in muscles than the average level encountered nowadays in pigs. Prevention of lipid peroxidation may be of the utmost importance for the quality of such meat (Fernandez *et al*., 1999). Pork neck is consisted of several muscles with tipically red fibers that have expressed intensive oxidative metabolism. Organism deposits a large amount of fat in this area, especially intramuscular fats, which contribute to desirable sensory properties such as softness and tenderness. Lipid peroxides are a substrate for the selenium-dependent glutathione peroxidase (GSH-Px; EC 1.11.1.9). Glutathione reductase (GR; EC 1.6.4.2) catalyses the reduction of oxidised glutathione (GSSG) back into reduced glutathione (GSH), the latter being the co-substrate of GSH-Px (Nikolic *et al*., 2006).

The aim of this work was to determine lipid peroxide reducing enzymes activities (GSH-Px and GR) in the pig neck as well as the amount of lipids and cholesterol. Our results are discussed in relation to the balance between synthesis, oxidation, and intracellular transport of fatty acids in muscles as the main factor responsible for muscle lipid content variations in animals undergoing a normal growth.

Materials and methods

Meat samples were taken from five pigs (Swedish Landrace, fed for 145 -160 days, being slaughtered at body mass of 95-115 kg). Male pigs were in the period foreseen for castration, i.e. two weeks after farrowing. All pigs were fed with feed mixture (up to 3 kg daily), composition of which is shown in Table 1. An average carcass yield was 80%. Pig neck was then cut into small pieces, frozen in liquid nitrogen, and stored at −75 °C before biochemical analyses. Frozen muscle tissues (approximately 10 g) were homogenized in chloroform/methanol buffer (2:1 v/v) for the estimation of fat content, using the total lipid extraction procedure outlined by JUS ISO method (1992). Cholesterol content was determined according to the method from China meat research centre (2000). Meat glutahione dependent enzyme activities were determined using a Shimatzu UV-160 spectrophotometer, according to the methods described by Nikolić *et al*., (2006). The data are presented as mean ± standard deviation (SD). Statistical significance was established by protocols as described in Hinkle *et al*. (1994).

Results and discussion

The mean value of lipid content in the examined samples of pig neck (Figure 1) in comparasion with fat content in the examined samples with selected groups of muscles (loin, silverside, rump and thick flank) showed that the highest value was in pig neck, while fat content in loin, silverside, rump and thick flank was similar (less than 3%).

The mean value of cholesterol content in the examined samples of pig neck (Figure 1) in comparation with mean values of cholesterol content in other examined pork muscles (loin (58.62±20.45mg/100g), silverside (61.40±19.71mg/100g, rump (67.58±5.34mg/100g) and thick flank (64.18±6.40 mg/100g) showed that the lowest cholesterol content was found in pig neck (Turubatović *et al*., 2006).

Table 1. Feed composition for pigs

	Pre-starter	Starter	Grower	Finisher I (25-60 kg)	Finisher II (60-100 kg)
Dry maize, grain	52.60	57.25	62.90	21.19	12.55
Maize silage, grain	-	-	-	30.00	37.00
Feed meal	-	3.00	3.0	5.00	10.00
Wheat	-	3.00	4.0	20.00	22.00
Succrose	4.00	-	-	-	-
Soybean meal	20.60	16.40	19.3	12.50	11.50
Sunflower meal	-	2.50	3.5	5.50	3.50
Fish meal	5.00	4.50	4.0	2.50	-
Soybean groats	10.00	10.00	-	-	-
Premix (Prasilac)	5.00	-	-	-	-
Calcium carbonate	0.60	0.70	0.8	0.70	0.90
Dicalcium phosphate	1.20	1.20	1.0	0.90	0.80
Sodium chloride	0.10	0.10	0.2	0.31	0.40
Premix (vitamin-mineral)	0.50	1.00	1.0	1.00	1.00
Lysine	-	0.10	0.05	0.15	0.10
Minazel (Adsorbent)	0.40	0.25	0.25	0.25	0.25
Total	100.00 kg	100.00 kg	100.00 kg	100.00 kg	100.00 kg

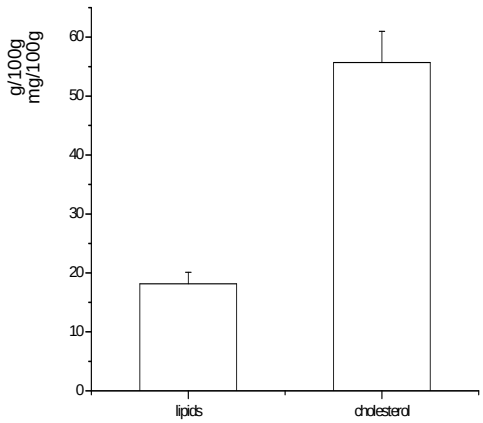

Figure 1. Lipids and cholesterol in pig neck (all data are presented as mean±SD).

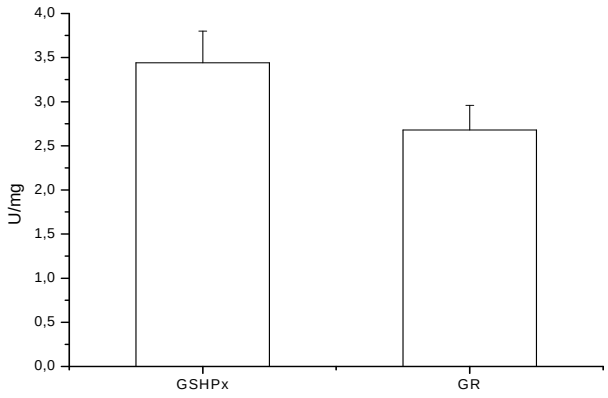

Figure 2. Glutathione dependent enzymes in pig neck (all data are presented as mean ±SD).

The activity of glutahione dependent enzymes GSH-Px and GR is presented on Figure 2. Our previously examination of the muscle anti-oxidant defence enzymes in pigs (Turubatović *et al*., 2007) showed similar activity of mitochondrial MnSOD and CAT in neck, loin and thick flank of pigs, while determined lower CuZnSOD in pig muscles in comparison to bovine muscles may indicate conditions for possible higher oxysterol formation in pig meat during a thermal preparation. Skeletal muscles are composed of myofibres with different contractile and metabolic properties. There is no strict association between the relative proportions of oxidative fibres in the muscles and their respective total fat content (Larzul *et al*., 1997), which mainly results from the fact that intramuscular fat content consists not only of lipids within muscle fibres, but also of fat deposited in adipocytes located along fibre fasciculi. The balance between synthesis, oxidation, and intracellular transport of fatty acids in muscles, rather than the regulation of a single metabolic pathway was recently assigned as the main factor responsible for muscle lipid content variations in rabbits undergoing a normal growth (Gondret *et al*., 2004). Both enzymes (GSH-Px and GR) depend of NADPH for their activities.The main supplier of NADPH in

pigs is malic enzyme (Mourot & Kouba, 1998) and reduced activities of NADPH producing enzymes have been previously shown in the white longissimus muscle at least after feed restriction in pigs.

Conclusions

We found high activity of the both (GSH-Px and GR) enzymes in the pig neck as well as high content of lipids and cholesterol. Balanced activity of GSH-Px and GR and lipid and cholesterol content in pig neck favorise this type of meat for a thermal preparation such as barbacue.

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