COMPARISON OF THE MUSCLE ANTI-OXIDANT DEFENCE ENZYMES IN PIGS AND BULLS

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Introduction

Anti-oxidant defence (AD) system prevent oxidative cell damage through the coordinated expression of anti-oxidant defence enzymes. Main AD enzymes are: Mn SOD –mitochondrial manganese containing superoxide dismutase and CuZn-superoxide dismutase (SOD, EC 1.15.1.1), catalyses the dismutation of superoxide ($O_2^{\cdot-}$) to hydrogen peroxide (H_2O_2) which is then independently converted to water by catalase (CAT, EC 1.11.1.6) or by selenium-dependent glutathione peroxidase (GSH-Px, EC 1.11.1.9) (Chance at al., 1979). Glutathione reductase (GR, EC 1.6.4.2) catalyses the reduction of oxidised GSH back into GSH, the latter being the co-substrate of GSH-Px (Gul et al., 2000). An imbalance between oxidative stress and the cell's anti-oxidant defence system may have adverse effects on cell membranes through the indiscriminate oxidation of susceptible molecules such as polyunsaturated fatty acids (PUFAs), the main substrates for lipid peroxidation (Crastes de Paulet, 1987). Some investigators (de Haan et al., 1995; Percy et al., 1990) have suggested that the alteration in the SOD/GSH-Px + CAT ratio correlate well with increases in lipid damage. Animals (pigs and bulls) have different lipid metabolism, different plasma lipid profiles and different erythrocyte anti-oxidant defence compositions, but have similar content of cholesterol in meat (Nikolić et al., 2006; Turubatović et al., 2006). Since mitochondrias are both the main source and the main target for ROS in skeletal muscle, the comparative study on specific mitochondrial antioxidative defence systems (e.g. mitochondrial superoxide dismutase) and citosolyc antioxidative defence enzymes in pigs and bulls is of particular interest. Therefore, the aim of the task was the comparative study on specific mitochondrial antioxidative defence systems (mitochondrial SOD) and citosolyc antioxidative defence enzymes (CAT, GSH-Px and GR) in the selected identical groups of beef and pork muscles (thick flank, loin and neck).

Materials and Methods

Meat samples were from ten pigs and ten young bulls. The pigs were Swedish Landrace and the young bulls were from crosses between Charolais and Domestic Spotted breeds. Meat anti-oxidant 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

Figure 1 shows comparison of pork and beef thick flank and loin antioxidative enzymes and Figure 2 shows comparison of pork and beef neck antioxidative enzymes.

There were no significant differences in Mn SOD activity between any sample nor between two examined species. CuZn SOD activitiy was higher in beef neck when compared to pork neck which may be explained by higher activity CAT and GPx. CAT activities were higher in pork thick flank and loin compared to beef thick flank and loin. Only in beef neck, CAT activity was higher compared to pork neck and other examined samples of bulls and pigs. GSH-Px activity was the highest in beef neck, lower in pork neck, but higher in pork thick flank and loin compared to beef thick flank and loin. The highest GSH-Px activity observed in beef neck may be explained by the increased formation of peroxides, and this activity was significantly higher in comparison with other beef samples, thick flank and loin. GR activities were higher in beef thick flank and beef loin, compared to pork thick flank and pork loin. Contrary to GSH-Px, GR activity was higher in pork neck compared with beef neck. The main source of reactive oxygen species in muscles is the production of $O_2^{\cdot-}$ during oxidative phosphorilation in mitochondria. Under normal conditions meat contain sufficient scavenger enzymes such as SOD, CAT and GSH-Px to protect against free radical injury. The activities of these enzymes in meat are less than in most other tissues in the body (Guemouri et al., 1991). Higher CAT activity suggests an increase in H_2O_2 generation in beef neck. Comparison of the mean values of fat content in the examined samples (loin, neck and thick flank) of pigs and bulls showed that the highest values of fat content were in pork and beef neck muscles.

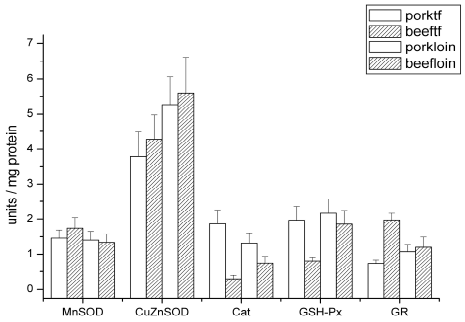

Figure 1: Antioxidative defence enzymes in pig and beef thick flank and loin. All data are presented as mean±SD.

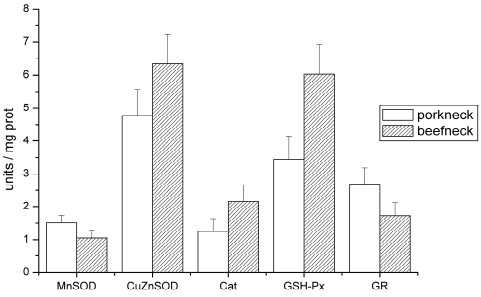

Figure 2: Antioxidative defence enzymes in pig and beef neck. All data are presented as mean±SD.

Fat content in loin and thick flank was similar in all examined samples of both species and significantly lower in compared with fat content in pork and beef neck muscles. The examined samples of beef and pork (thick flank, loin and neck) showed no significant difference in cholesterol content. The lowest cholesterol content was found in beef loin compared to other examined anatomical regions of this two species (Turubatović et al., 2006). The activities of the erythrocyte anti-oxidant enzymes showed that there were no differences in the activities in both GSH-Px and GR between the two species. In bull erythrocytes SOD activity was significantly higher when compared to pig erythrocytes. CAT activity was found to to be significantly higher in pig erythrocytes when compared to bull erythrocytes (Nikolić et al, 2006).

Conclusions

- We found similar activity of mitochondrial MnSOD in neck, loin and thick flank of pigs and bulls.
- In the present study lower CuZnSOD in pig muscles in comparison to bovine muscles may indicate conditions for possible higher oxysterol formation in pig meat during thermal preparation.
- The highest CAT activity was found in beef neck and was significantly higher in compared with other examined beef meat, thick flank and loin. This higher CAT activity suggests an increase in H_2O_2 generation in beef neck.
- CAT activity in all examined samples of pork meat was similar.

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