ANTIOXIDANT STATUS OF THE MEAT FROM BULLS AND STEERS

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Abstract – The objective of this work was to compare the antioxidant enzymes [catalase (CAT), superoxide dismutase (SOD), and glutathione peroxidase (GPx)] activities, glutathione (GSH) content, and lipid oxidation [thiobarbituric acid-reactive substances (TBARS)] in meat aged from bulls and steers. The *Longissimus dorsi* muscle from 12 male cattle (5 bulls and 7 steers) of the Nellore breed was used. Meat samples were collected 48 h *post-mortem* for the antioxidant enzymes and GSH analyses. Also, all the steaks were vacuum-packaged and aged for 1, 7, 14, and 21 days for the TBARS analysis. The results showed no differences for the CAT, SOD, GPx, GSH, and TBARS between bulls and steers. Furthermore, there was no effect of castration and aging time for the TBARS. In conclusion, the antioxidant status between bulls and steers is similar. The stability of the lipid oxidation in beef remains stable for 21 days with the use of vacuum packaging.

Key Words – antioxidant enzymes, castration, lipid oxidation.

I. INTRODUCTION

The castration of male cattle is a widely used technique in Brazil, which facilitates the handling of the animals and increases the amount of fat in carcasses, improving the meat quality. Previous reports have observed that the unsaturated and polyunsaturated fatty acids in meat can trigger the process of lipid oxidation [1]. Loss of color, odor, and flavor in meat and meat products are some of the harmful effects of lipid oxidation [2].

The final potential of the lipid oxidation is determined by the balance between endogenous pro-oxidants and antioxidants that are present in the meat [3]. A major defense mechanism against the oxidation process is given by the catalase (CAT), superoxide dismutase (SOD), and glutathione peroxidase (GPx) enzymes as well as the glutathione (GSH) content. Antioxidant enzymes can be used as a good indicator of the oxidative status in muscular tissue [4]. Differences in activities of those enzymes may exist among the meats from different species, the muscles from the same animal [3,5,6], and the animals from different sex conditions [7].

Therefore, this work aimed to compare antioxidant enzymes (CAT, SOD, and GPx) activities, GSH content, and lipid oxidation [thiobarbituric acid-reactive substances (TBARS)] in meat aged from bulls and steers.

II. MATERIALS AND METHODS

A. Animals

Twelve cattle (5 bulls and 7 steers) of the Nellore breed (*Bos indicus*) with 23 months of age were used. All the animals were confined for 140 days with a common diet composed of sugarcane bagasse, corn grain, soybean meal, soybean hull, urea and mineral trace. The animals were slaughtered at an average weight of 516 ± 33 kg.

B. Muscle

After 48 hours *post-mortem*, meat samples from the *Longissimus dorsi* (*LD*) muscle were collected for the analyses of SOD [8], CAT [9], GPx [10], and GSH [11]. Next, the steaks with 2.5-cm thick were vacuum-packaged and aged for 1, 7, 14, and

21 days at 2 ± 2 ºC to perform the TBARS analysis [12].

C. Statistical Analysis

A completely randomized design was used to investigate the effect of castration on the CAT, SOD, GPx, and GSH. The same experimental design using a 2 (castration) x 4 (aging time) factorial scheme with repeated measures on time was used on the TBARS. The data were analyzed by the PROC MIXED procedure of the SAS. Significant differences were only considered for the P values at 5%.

III. RESULTS AND DISCUSSION

The results for the antioxidant enzymes (CAT, SOD, and GPx) activities in *LD* muscle from bulls and steers are shown in Table 1.

Table 1 Antioxidant enzymes activities (units/g of tissue) in meat from bull and steer

Antioxidant enzymes	Bull	Steer	P
CAT	66.1 (5.19)£	60.5 (4.39)	0.43
SOD	685.3 (93.37)	800.8 (78.91)	0.37
GPx	2.7 (0.18)	2.6 (0.15)	0.68

Legend: CAT = catalase; SOD = superoxide dismutase; GPx = glutathione peroxidase; £ = least squares means (standard error).

No differences (P > 0.05) were observed for the antioxidant enzymes activities between bulls and steers. Such results suggest that castration had little influence on the activities of these enzymes. There is no work comparing the antioxidant enzymes activities in muscle from bulls and steers. However, there is a report showing that the SOD activity in castrated rats is lower than in intact ones [7]. The lack of the differences for the antioxidant enzymes activities may be explained by the differences in gene expression of those antioxidant enzymes that exist among the species [13].

The values for the CAT, SOD, and GPx enzymes activities in this work were, in most cases, lower than those found in other works in beef [14,15,16]. This may have occurred due to the differences among the breeds, rearing systems, feeding, and age of the animals used in the different works.

The GSH content in *LD* muscle from bulls and steers is shown in Fig. 1.

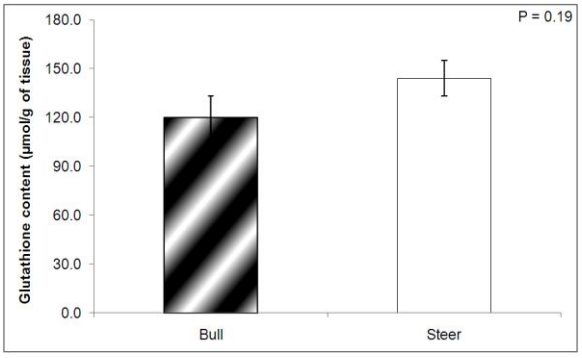

Figure 1. Glutathione content in meat from bull and steer

Similar to the results obtained for the antioxidant enzymes activities (Table 1), the GSH content did not differ (P > 0.05) between bulls and steers.

In turn, there were no differences (P > 0.05) for the TBARS values between bulls and steers (data not shown). This result could be related to the lack of differences for the antioxidant enzymes (CAT, SOD, and GPx) between those groups. Furthermore, the similar fat thickness observed in carcasses from those animals (data not shown) may contribute to explain the similarity of the TBARS values between bulls and steers. The TBARS values in meat aged from bulls and steers are presented in Table 2.

Table 2 Lipid oxidation [thiobarbituric acid-reactive substances (TBARS) expressed in mg of malonaldehyde (MDA)/kg of tissue] of the meat aged from bull and steer

Aging time (day)	Bull	Steer
1	0.33 (0.051)£	0.30 (0.044)
7	0.25 (0.061)	0.28 (0.051)
14	0.30 (0.042)	0.27 (0.041)
21	0.23 (0.032)	0.30 (0.027)

Legend: £ = least squares means (standard error)

The mean of the TBARS values in this work was of 0.28 mg of MDA/kg of tissue, which is

considered low [17]. These authors established a maximum TBARS level of 1.0 mg of MDA/kg of tissue for a good consumer acceptance.

During the aging of the meat, the TBARS values remained constant ($P > 0.05$). This may be attributed to the use of the vacuum packaging. Oxygen-free packaging has been an efficient technique to increase the oxidative stability of aged meat [18]. To corroborate with our results, other works also found no changes of the TBARS values in *LD* muscle aged for 21 days [19] as well as in *LD*, *Semimembranosus*, and *Gluteus medius* muscles aged for 47 days [20], all being vacuum-packaged.

According to our results, we believe that the favorable conditions to oxidation of meat such as a longer time of aging and/or the use of the aerobic packaging would allow detecting possible effects of castration on the TBARS content of aged meat.

IV. CONCLUSION

The oxidative potential for the *LD* muscle from bulls and steers was similar and corroborates with the TBARS results. Also, the aging time of 21 days did not affect the lipid oxidation of beef for vacuum-packaged steak.

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