FEED AND BREED INFLUENCE ON MEAT QUALITY AND SHELF LIFE OF BEEF

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Abstract

Microbiological meat quality from two feed systems (low vitamin level, LVL; and high vitamin level, HVL) and three cattle breeds (Retinta, RB; Charolais, CB; Limousine, LB) has been studied. Samples were obtained from loin, in two different cuts (ragout and steak), packed in modified atmosphere and refrigerated until analysis. Temperature, pH and instrumental color measurements (CIE *L*, a*, b), aerobic plate counts (APC) and total enterobacteria counts (TEC) were determined at 0, 4th, 8th and visual deteriorated day from sampling. Results showed that, in both treatments LVL and HVL, pH meat values and animal breeding showed a similar trend at the time when the deteriorated day was reached. Among breeds, deteriorated RB meat samples exhibited significantly lowest APC and TEC counts values with respect to CB and LB breeds. Color coordinates showed no significant differences at the beginning of the study between LVL and HVL treatments among all meat samples, although meat coming from animals receiving HVL diets gave a higher value in the luminosity and red components at the end of the study. In general, the use of HVL diets, as well as RB, contribute to increase the microbiological shelf life in meat samples, however further chemical analysis will be necessary to fully explain the visual meat detriment.**

Keywords: Beef; Shelf life; Microbiological meat quality; meat quality

I. INTRODUCTION.

The use of products with high unsaturated fatty acids content for diets increase the susceptibility to oxidation of meat and, consequently, decreases its shelf-life. Thereby, the incorporation of dietary antioxidants, such as vitamin E (vit E) and / or vitamin A (vit A) is necessary to reduce this effect. The most widely natural antioxidants studied as additives in meat production is probably vit E. It is well accepted that vitamin E supplementation in animal diet can improve the quality of fresh meat and meat products by limiting protein and lipid oxidation. Most studies support that vit E supplementation can improve meat color and reduce lipid oxidation in pork, beef [1] and lamb. Otherwise, studies with vit E supplementation in cattle affected by naturally acquired respiratory tract disease was associated with decreased treatment costs, suggesting that vit E presents an antimicrobial effect [2].

Supplementing the diet with vit E, the tissue concentration of alpha-tocopherol increases in cattle [3]. However, the concentration of vit E required to increase their deposition in tissues and to reduce lipid oxidation is variable depending on the species [4] and can be influenced by the breed, slaughter weight and rearing system.

The objective of this experiment is to compare the shelf-life, in terms of temperature, pH, instrumental color measurements, aerobic plate counts (APC), total enterobacteria counts (TEC) and CO_2 and O_2 composition, of beef calves of Retinta breed, Charolais cross breed and Limousin cross breed from two feeding systems based in two different levels of supplementation of vit E and vit A.

II. MATERIAL AND METHODS.

To conduct this experiment a total of 90 male animals distributed in three homogeneous groups based on breed were used: Retinta breed, RB (n = 30), Charolais cross breed CB (n = 30) and Limousine cross breed LB (n = 30). These animals were randomized into two groups of 45 animals each (15 animals per breed) and feed with two different systems with respect to the level of vitamin supplementation (see Table 1): low vitamin level, LVL; and high vitamin level, HVL.

Table 1. Levels of vit E, vit A and vit D3 diet supplementation.

	Diet 1	Diet 2
Vit E (mg/Kg)	53.34	106.68
Vit A (UI/Kg)	16000	32000
Vit D3 (UI/Kg)	3330	6660

The first 45 animals group was fed with diet 1 plus hay or straw freely available, considered as conventional way, from 250-300 Kg BW to 400-450 Kg BW. Then, and until slaughtering, the animals received only concentrate (diet 1). The 45 remaining animals were fed with a ration of wet mixtures, whose components were corn silage, straw, beet pulp and concentrate (diet 2), with levels of vitamin supplementation higher than used in diet 1, as detailed in table 1.

Once the animals reached an optimal weight for slaughtering based on genetics (Retinta 480 - 520 Kg BW, Limousine 525-570 Kg BW and Charolais 550-590 Kg BW), they were slaughtered following the current regulations of the European Community on animal welfare in a local slaughterhouse. After slaughtering the carcasses were subjected to cooling for 24 hours and then were quartered according to routine proceeding. *Longisisimus dorsi* muscle was selected for experimentation, obtained from the carcass and packaged under vacuum for 7 days prior to carry out the studies of microbiological meat quality. Then the meat was divided into two types of cut, fillet and ragout, obtaining 3 trays each. The trays were packed in modified atmosphere (MAP) with 70% O_2 and 30% CO_2, and assessed at 0, 4^{th}, 8^{th}, and visually deteriorated day to evaluate temperature and pH using a pH-meter Crison PH25 with penetration electrode, instrumental color measurements using a colorimeter Konica Minolta Chromameter CR-400, aerobic plate counts (APC), total enterobacteria counts (TEC) and CO_2 and O_2 composition using a gas analyzer PBI-Dansensor 200616E.

Both the effect of vitamin level on the meat quality and shelf-life of beef and the effect of breed on the shelf-life of beef after feeding with diet 2 (high vitamin level, HVL) was assessed by a one-way analysis of variance with fifteen animals per treatment group by means of Statgraphics plus program (version 5.1).

III. RESULTS AND DISCUSSION

Whereas at day 0 a significant difference was observed between each feed system (LVL Vs HVL; 5.57 Vs 5.53, respectively), no statistically significant differences were observed in pH measurement at 4^{th}, 8^{th} or visually deteriorated day.

The luminosity (L*) and red (a*) values displayed higher values just at the visually deteriorated day in animals fed with the HVL diet with an average value of 40.97 Vs 38.43 for L* ($p=0.0005$) and 9.19 Vs 5.81 for a* ($p= 0.0067$). On the other hand, the yellow value (b*) showed significant differences between both feed systems (LVL Vs HVL) at day 0 (11.58 Vs 9.06; $p<0,001$); contrary, at the visually deteriorated day the HVL group showed higher levels than the LVL group.

APC were significantly higher in animals fed with the LVL diet at 0, 8^{th} and visually deteriorated day ($p<0.05$), showing an average of 5.47 $\log_{10}$ CFU in LVL animals and an average of 4.69 $\log_{10}$ CFU in HVL animals. TEC displayed significant differences throughout the study, with higher counts in animals fed with LVL diet (Table 2). These results contrast with other authors who observed that meat color and bacterial load in meat of supplemented lambs were not affected by vit E supplementation [5].

Otherwise, APC were significantly lower in RB animals fed with HVL diet in visual deteriorated samples, with a clear trend in the same way for the rest of measurements. TEC showed a slight trend to lower counts in RB, follow by LB and CB.

CO_2 and O_2 composition showed significant changes between the two feed systems from the beginning until the end of the study.

Table 2: Statistically significant differences for pH, L*, a*, b*, APC, TEC and CO_2 and O_2 composition between LVL and HVL diets.

	Day 0	Day 4th	Day 8th	Visually deteriorated
pH	+	ns	Ns	ns
Luminosity (L*)	ns	+	Ns	+++
Red index (a*)	ns	Ns	Ns	++
Yellow index (b*)	+++	ns	+	+++
APC	+	ns	+	+++
TEC	+	+	+++	++
CO_2		+++	++	ns
O_2		++	+++	+++

APC: aerobic plate counts; TEC: total enterobacteria counts; ns=P>0.05; +=P≤0.05; ++= P<0.01; +++= P<0.001

IV. CONCLUSIONS

In general, the use of HVL diets contributes to increase the microbiological shelf life in meat samples.

At breeding level, RB showed significant differences regarding to microbiological counts in APC, and slight trend in TEC, comparatively with the rest. Further studies are needed in order to assess these preliminary trends, where vit E deposition in tissues and the observed antimicrobial effect could be related with the breed.

V. ACKNOWLEDGMENTS

The authors would like to thanks to COVAP slaughterhouse and Quality department their collaboration with the sampling activities.

VI. REFERENCES

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