BEEF CATTLE DIETS SUPPLEMENTED WITH CANOLA OIL, SELENIUM AND VITAMIN E INFLUENCING MEAT SHELF LIFE

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Abstract – The antioxidant effect of selenium and vitamin E can be valuable for health, since they can be carried to meat, improving quality and shelf life. The aim of this study was to determine the influence of using canola oil added by selenium and vitamin E on meat shelf life. Cattle diets were constituted by: Control: basal diet; Antioxidants: control diet + 2.5mg Se/kg of dry matter (DM) + 500UI of vitamin E/kg DM; Oil: control diet + 3% of canola oil/kg DM; Oil + Antioxidants: control diet + 2.5mg of Se/kg DM + 500UI of vitamin E + 3% of canola oil/kg DM. At 24 hours *post-mortem*, *Longissimus dorsi* muscle was collected. Meat samples were disposal in display life (DL), modified atmosphere (ATM) and vacuum (V) and analyzed for mesophile, psychrotrophic and lactic bacteria counts on days 0 (control), 2, 4 and 6 (DL), 10, 20 and 30 (ATM), 30, 60 and 90 (V). There was effect of packing during storage for all treatments and interaction treatment-packing for mesophile and psychrotrophic counts. Results among treatments were not different, indicating that beef cattle diets supplemented with canola oil, selenium and vitamin E did not influence meat shelf life.

Key Words – Antioxidants, Bacteria, Feedlot cattle

- INTRODUCTION

The antioxidant effect of selenium and vitamin E can be valuable for health, since they can be carried to meat, improving quality and shelf life. Including canola oil in bovine diet can change fatty acids profile in meat, by increasing unsaturated and decreasing saturated fatty acids. In order to improve the oxidative characteristics, antioxidants can be also added to diets.
In fact, research studies and field trials have demonstrated that supplementation, such as feeding with vitamin E, has positive and desirable effects on meat quality and shelf-life [1].

Therefore, the aim of this study was to determine the influence of using canola oil, as fat source, added by selenium and vitamin E on meat shelf life.

- MATERIALS AND METHODS

- *Local*

The experiment was conducted in the Faculty of Animal Science and Food Engineering of University of São Paulo, Pirassununga *Campus*, State of São Paulo, Brazil, during 84 days.

- *Animals*

Forty eight Nellore bulls with approximately 2 years-old, in the finishing phase, were used. The animals were placed in Calan Gate feed system, with individual feeding.

- *Treatments*

On arrival, the animals went through a period of adaptation (28 days) to the diet and to the feed system and then were divided into four groups, as described: 1) Control (C): basal diet without supplementation; 2) Antioxidants (CA): control diet plus 2.5mg Se/kg of dry matter (DM) and 500UI of vitamin E/kg DM; 3) Oil (CO): control diet plus 3% of canola oil/kg DM; 4) Oil + Antioxidants (CAO): control diet plus 2.5mg of Se/kg DM (as organic selenium), 500UI of vitamin E and 3% of canola oil/kg DM. All animals received diet containing 30% corn silage and 70% concentrate. Diets were formulated to meet the nutrient requirements recommended by the NRC [2].

- *Experimental procedure*

The slaughter was performed following humanity standard procedures at a local slaughterhouse. The captive bolt method was used to stun the animals. Carcasses were split, weighed and then chilled at 0-3ºC before processing on the following day after slaughter. At 24 hours *post-mortem*, *Longissimus dorsi* muscle (13^{th} through the 10^{th} rib) from right carcasses were removed and cut into 2.5 cm thick steaks. Samples of 5g were collected for analyzes.

Samples for Display Life (DL) and Modified Atmosphere (ATM) were placed on expanded polystyrene trays and covered with poly (vinyl chloride) films. The DL trays were placed in refrigerated display counter (model LX 125 vega, mark Auden) at 4ºC and stored for up to 6 days.
The ATM trays were placed in a second masterpack - MP (Cryovac) with high gas barrier property, containing 75% O_2:25% CO_2 gas composition. After sealing, the atmosphere composition inside the MP was checked using a Dansensor gas analyzer (CheckPoint O2/CO2). No significant variation on the mixture was found during the storage. The trays were stored in a refrigerated chamber (2.0±1.0ºC) for 30 days.
The steaks for Vacuum Packed (V) were stored in a refrigerated chamber (2.0±1.0ºC) for up to 90 days.

- *Analytical Procedures*

Every other day, 10 trays from each treatment were taken to analyses (DL at 2, 4 and 6 days of storage).

At 10^{th}, 20^{th} and 30^{th} days of storage, 10 MP were taken to analyses (ATM at 10, 20 and 30 days of storage).

At 30^{th}, 60^{th} and 90^{th} days, samples were collected and analyzed (V at 30, 60 and 90 days).
All samples were submitted to mesophile, psychrotrophic and lactic bacteria counts, according

to APHA procedures [3].

- *Statistical Analysis*

Statistical analyses were performed using Proc Mixed of SAS system [4].

- RESULTS AND DISCUSSION

Results of mesophile counts are presented in Table 1. There was effect (P<0.0001) of packing over time of storage, with increasing values during the time, and also an interaction between treatment and packing (P<0.0001). Considering that above 7 log CFU/g meat can present organoleptic changes, it could be observed that meat were suitable for consuming up to day 4 for all treatments when using display life; and up to 20 days using modified atmosphere, except for CA treatment. Counts for vacuum treatment were over log 7 CFU/g in all days evaluated. No differences were observed among treatments (P=0.94).

Table 1 Mesophile counts for meat samples

	Mesophiles (log CFU/g)			
	C	CA	CO	CAO
Day 0	4.58^{b}	4.62^{b}	4.89^{b}	4.61^{b}
DL2	3.91^{b}	3.67^{b}	3.62^{b}	3.57^{b}
DL4	4.27^{b}	4.64^{b}	4.07^{b}	4.50^{b}
DL6	7.85^{a}	10.34^{a}	9.34^{a}	10.17^{a}
ATM10	3.88^{c}	4.24^{b}	4.07^{c}	3.51^{c}
ATM20	6.50^{b}	7.11^{a}	6.43^{b}	5.87^{b}
ATM30	8.85^{a}	8.26^{a}	9.03^{a}	9.89^{a}
V30	8.80^{a}	7.78^{a}	7.25^{a}	8.06^{a}
V60	9.63^{a}	8.47^{a}	9.45^{a}	8.79^{a}
V90	9.74^{a}	9.54^{a}	9.35^{a}	10.01^{a}

C: control; CO: control+oil; CA: control+antioxidants; CAO: control+oil+antioxidants. DL: display life, ATM: modified athmosphere, V: vacuum. CFU: colonies forming unit.
Means in the same column and into the same arrangement treatment-packing, followed by the same letter do not differ by Tukey test at 1% of significance.

Regarding psychrotrophic bacteria (Table 2), no differences were noted among treatments (P= 0.08), but there was effect of packing over time (P=0.0008), with increasing values, and interaction between treatment and packing (P<0.0001). Counts were high in DL6, ATM 30, V60 and V90. Treatment CA presented higher levels on DL4 when compared to the others, while CAO presented the best result among treatments, with 5.93 log CFU/g. In the same way, CA using modified atmosphere showed a high count at 20 days of storage. Although differences among treatments were no significant (P>0.05), vacuum samples from CAO treatment presented the lowest counts, up to 90 days of storage.

Table 2 Psychrotrophic counts for meat samples

	Psychrotrophics (log CFU/g)			
	C	CA	CO	CAO
Day 0	4.97^{b}	4.65^{b}	4.93^{bc}	4.87^{b}
DL2	5.34^{b}	4.52^{b}	4.39^{c}	3.93^{b}
DL4	6.24^{b}	7.45^{a}	6.63^{ab}	5.93^{b}
DL6	9.36^{a}	9.21^{a}	7.81^{a}	8.16^{a}
ATM10	3.40^{b}	3.46^{b}	3.90^{b}	3.90^{b}
ATM20	6.39^{a}	7.00^{a}	6.24^{a}	5.78^{b}
ATM30	7.98^{a}	8.02^{a}	7.49^{a}	8.53^{a}
V30	7.19^{a}	6.79^{a}	5.82^{a}	5.44^{a}
V60	7.32^{a}	7.29^{a}	7.33^{a}	6.96^{a}
V90	7.74^{a}	7.06^{a}	7.16^{a}	6.68^{a}

C: control; CO: control+oil; CA: control+antioxidants; CAO: control+oil+antioxidants. DL: display life, ATM: modified athmosphere, V: vacuum. CFU: colonies forming unit.
Means in the same column and into the same arrangement treatment-packing, followed by the same letter do not differ by Tukey test at 1% of significance.

As expected, for lactic bacteria (Table 3) there was only effect of packing over time ($P < 0.0001$), with vacuum presenting higher counts compared to the others. This occurs due to the characteristics of lactic bacteria, which grow up predominantly in vacuum conditions.

Table 3 Lactic bacteria counts for meat samples

	Lactic bacteria (log CFU/g)			
	C	CA	CO	CAO
Day 0	3.97	3.65	3.93	3.87
DL2	3.40	3.40	3.40	6.81
DL4	3.40	3.40	3.40	3.40
DL6	3.85	3.61	3.49	3.66
ATM10	3.40	3.76	3.52	3.48
ATM20	4.81	4.94	3.50	4.61
ATM30	5.93	3.57	4.35	6.30
V30	6.85	7.89	7.47	8.06
V60	9.10	9.09	9.17	9.14
V90	9.12	9.89	9.13	9.36

C: control; CO: control+oil; CA: control+antioxidants; CAO: control+oil+antioxidants. DL: display life, ATM: modified athmosphere, V: vacuum. CFU: colonies forming unit.

Although values for CAO were higher when compared to the other treatments, differences were not significant ($P=0.26$), neither for interaction ($P=0.34$).

Results obtained in this study are in agreement with those reported by Smith et al. [1], that growth of spoilage and pathogenic bacteria did not differ on meat from cattle fed or not fed with supplemental vitamin E.

- CONCLUSION

Beef cattle diets supplemented with canola oil, selenium and vitamin E did not influence meat shelf life.

ACKNOWLEDGEMENTS

Authors thank to FAPESP (Grant 2010/20689-5) for the financial support.

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