Effect of bioflavonoids and other antioxidant agents on colour acceptability of beef packaged with oxygen permeable film or modified atmosphere

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Abstract

Three batches of heifers of Parda de Montaña breed (Spanish unimproved Brown Swiss) reared intensively were supplemented during 62 days with either vitamin E (2.000 IU per head per day), natural citric bioflavonoids (2 grams per head per day of Biocitro®) or without any additive to the concentrate (control batch: 150 IU of vitamin E per head per day). Sixteen consumers assessed meat colour acceptability during 13 days, displayed in commercial conditions and packaged on either MAP (80% O_2 / 20% CO_2) or film permeable to O_2. The results have shown a higher acceptability of the vitamin E group, in both film and MAP, with a shelf life 3 days longer than the control group. Flavonoids increased shelf life in one day in relation to the control group. It is necessary to study further the ideal doses and compounds of the flavonoids, together with the time of administration as well as other aspects, such as cost benefits or interactions with other chemical compounds.

Introduction

In today's worldwide, it is necessary to use all the resources, in an adequate way, including the sub products that could be generated. Citric production and transformation industries generate a large amount of sub products, which are rich in specific chemical compounds. One important group of these compounds are the bioflavonoids (Katalinic *et al.*, 2006), included in the group of polyphenols, with an important role in the vitamin C metabolism. The main characteristic is their antioxidant role. In meat they could have an important ability to act as efficient free radical scavengers (Langely Evans, 2000) and, therefore, in the muscle colour stability. Also, these compounds could have an important effect on human health because of their therapeutic effects and their capacity to prevent the formation of cholesterol derivates increasing the intracellular content of vitamins C and E.

On the other hand, the increasing demand of meat with higher content in PUFA (specially CLA), that can be easily oxidized and the increasing presence in the market of raw meat sold in trays, where the increase of the shelf life of the product, even one day, is an important target, demands meat with more capacity to maintain intact its sensorial characteristics, including colour.

Additionally, the moment of consumer choosing is a basic point in all market routine. Colour, together with fatness-marbling and price, are the most important criteria to select a meat tray in the supermarket, making meat appearance and colour stability a necessary priority in the meat studies.

The aim of the present study was to assess the effect of flavonoids (Biocitro ®) on meat colour acceptability in cattle reared intensively and in comparison with vitamin E.

Material and methods

Twenty four heifers of Parda de Montaña breed (Spanish unimproved Brown Swiss type) with an initial live weight of 330 kg were studied. The animals were from the same farm to get an expectable homogeneity. Animals were fed during all the experimental period (62 days) with a concentrate (104 UFV, 15% CP and 150 IU of vitamin E) and cereal straw *ad libitum*. The experimental groups, composed by eight animals each, were: control (without any extra addition of antioxidants); vitamin E batch (with extra 2.000 IU of vitamin E per head per day); and Biocitro batch (with Biocitro® in a doses of 2 grams per head per day). Biocitro ® is a commercial product (Quinabra, Ltd. Brasil) composed of a citric biomass from *citrus paradise*, *citrus reticulate*, *citrus aurantium* and *citrus sinensis*) containing vitamin C, bioflavonoids 4-7%, including naringine, hesperidine and rutine, and 37-48% of other components, including fatty acids, minerals, saponins, citric acid, water, etc. on a basis of SiO_2 and glycerine. Animals were slaughtered with a live weight of 413 kg in average.

The *Longissimus dorsi thoracis* muscle was aged for seven days. Then, 2 cm thick steaks from each animal were individually packaged in trays wrapped with plastic film permeable to O_2 or in MAP (80% O_2/20% CO_2). Meat was kept in a commercial display store at 2º C with 12 hours of light exposition each day. Sixteen consumers made a personal valuation of each tray (0, 1, 2, 3, 6, 7, 8, 9, 10, 13 days) with an 8

points scale (1= very disagreeable; 8= very agreeable). Each day the codes and order of the trays inside the expositor was changed. Trays with permeable film and with MAP were keeping separately in the expositor. Individual means for each sample in each treatment (film or protected atmosphere) were computed for every variable. The general GLM procedure (SPSS version 13.05) was used to perform an ANOVA considering the main effects of experimental batch, packaging system, time of display and their respective interactions.

Results and discussion

Globally, each studied effect and all their possible interactions were statically significant (Table 1). Meat from animals supplemented with vitamin E was the best accepted followed by meat from the Biocitro batch and finally meat from the no supplemented control batch. Also, it is noticed that modified atmosphere affected acceptability positively, opposite to packaging time, which produced some meat quality losses (Table 2), as it could be expected.

Table 1. Supplementation, packaging system and packaging time effect on visual beef acceptability (1=Very disagreeable; 8=Very agreeable) in untrained consumers (*n*=16) in *Longissimus dorsi* slices

	Visual scoring	
Supplementation (Batch)	***	(0.024)
Control	3.61a	
Vit. E	4.15c	
Biocitro	3.76b	
Packaging system (PS)	***	(0.019)
MAP (80%O_2+20%CO_2)	4.25b	
Film	3.43a	
Packaging time (days) (PT)	***	(0.043)
0	6.92h	
1	6.80h	
2	6.23g	
3	5.72f	
6	3.26e	
7	2.75d	
8	2.35c	
9	1.67b	
10	1.50b	
13	1.20a	

Least square means (± standard error).

a-h: different letters means significant differences ($p<0.05$) inside treatment; *** ($p<0.001$).

In the Table 2 it can be appreciated that vitamin E group maintained higher meat acceptability, at any time, than the other two experimental groups. These notes were higher than the average note until 8 days post packaging in MAP, 6 days in the Biocitro batch and until 3 days in the control group. In the case of meat packaged in film, for all the groups, the notes higher than the average were given until 3 days of packaging in all the three experimental groups. As scoring in the days four and five after packaging was not performed, it is not possible to know exactly how long the extent of the shelf life of the product was. In any case we could consider that vitamin E extended it by 3 days and Biocitro by one day.

Table 2. Visual acceptability of beef made by untrained consumers (n=16) in m. *Longissimus dorsi* upon different antioxidants added in the diet and aged in MAP (80% O_2 + 20% CO_2) or film (FILM)

	Packaging time											
	0	1	2	3	6	7	8	9	10	13	s.e.	Sig.
Control												
MAP	7.02 gx	6.61 fw	6.23 efxy	5.86 ex	3.89 dy	3.02 cy	2.43 by	1.57 aw	1.49 aw	1.31 ax	0.046	***
FILM	6.88 fwx	6.55 fw	5.61 Ew	4.67 dw	2.50 cx	1.61 bw	1.38 abw	1.34 abw	1.20 abw	1.07 aw	0.041	***
Vitamin E												
MAP	7.11 gx	6.98 gw	6.74 Fy	6.43 ey	5.22 cz	4.48 dz	3.98 dz	2.78 bx	2.36 abx	1.55 ay	0.042	***
FILM	6.96 gwx	6.95 gwx	6.14 efx	5.40 ex	1.79 dw	2.16 cx	2.02 cxy	1.58 bw	1.36 bw	1.08 aw	0.051	***
Biocitro®												
MAP	7.01 fx	6.83 efwx	6.70 efy	6.43 ey	4.30 dy	3.18 cy	2.38 by	1.31 aw	1.21 aw	1.10 aw	0.047	***
FILM	6.56 ew	6.87 ex	5.97 dwx	5.54 dx	1.88 bcw	2.08 cwx	1.9 1bcx	1.43 abw	1.35 aw	1.11 aw	0.050	***
Sig.	**	*	***	***	***	***	***	***	***	***		

a-g: different letters in the same row indicate significant differences by packaging time; w-z: different letters in the same column indicate significant differences by lots ($p<0.05$); *($p<0.05$); **($p<0.01$); *** ($p<0.001$)
s.e. = standard error.

Conclusions

Shelf life of beef packaged in MAP or film could be extended using natural antioxidants in the animal diet. Although vitamin E was more effective than natural bioflavonoids, it is necessary to make more studies to achieve the ideal doses and compounds, together with the time of administration. Also the study of the cost benefits, considering possible effects of animal health, animal welfare, and synergies and interactions should be analysed.

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References

Katalinic, V., Milos, M., Kulisic, T. & Jukic, M. 2006. Screening of 70 medicinal plants extracts for antioxidant capacity and total phenols. *Food Chemistry*. **94**, 550-557.

Langley-Evans, S.C. 2000. Antioxidant potential of green and black tea determined using ferric reducing power (FRAP) assay. *International Journal of Food Science* **51**, 181-188.

SPSS (2005). Statistical Package for the Social Sciences for Windows User's Guide Release 11.5, IL, USA, SPSS Inc., 44aN, Michigan Avenue, Chicago.