Effect of diet on pH and colour of meat in young bulls.

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SUMMARY

54 Brown Swiss and 18 Pirenaico calves of 7 months of age were distributed among 12 lots and fed according to one of these diets: ad libitum on concentrates; or forages plus different amounts of concentrates, up to slaughter at 480kg. The transport to the slaughterhouse lasted 20 minutes and there the bulls fasted for 17 hours. The kidney fat and the 8-9-10th rib were removed from the carcasses and then the pH of muscle Longissimus dorsi measured. Colour was measured on a photocolorimeter at 24h on subcutaneous fat and at 48h on the M. Longissimus dorsi. At 7th day, water holding capacity, cooking losses, shear force (Warner-Bratzler) and palatability traits were measured on the M. Longissimus dorsi. Animals fed forages with a finishing period exhibited ultimate pH higher than 6 usually associated with dark cutting, the meat showed lower saturation and higher hue values than meat from the animals fed concentrates. The shear force and the water holding capacity of the meat and its palatability did not change due to the diet received by the animals. Results suggested that the meat from bulls fed concentrates or forages supplemented with different amounts of concentrates did not change fat colour, shear force, water-holding capacity or its palatability. But meat from bulls fed supplemented forage with finishing presented pH higher than 6 and darker muscle colour than concentrate fed bulls.

INTRODUCTION

In Spain concentrates are the bulls common diet, stockbreeders do not feed forages to animals because of fear of reducing their meat quality. Colour is one of the factors which most influence the decision of consumers when buying beef meat. Light colour is synonymous with young meat and therefore with quality. When muscle pH is higher than 6.0 the meat has lower lightness and more purple hue than normal meat (MacDUGALL and JONES,1981) becoming less attractive to consumers. The objective of this work was to study the influence of diet on the colour of fat and muscle on the meat palatability and other quality characteristics.

MATERIALS and METHODS

54 Brown Swiss calves of 7 months of age were allotted to 9 lots and 18 Pirenaico calves of the same age were allotted to 3 lots. The calves were fed according to one of these four diets (Table 1): a high energy diet with ad libitum on concentrates (concentrate A, from 200 to 350kg live weight; concentrate B from 350kg to slaughter); forages plus 2 or 4kg of concentrates until they reached 400kg live weight and then received a finishing period on concentrates; forages plus 4kg of concentrates until they reached the slaughter weight. Alfalfa hay and maize silage of good

Table 1. Composition of experimental diets

	Concentrate		Forage + 4kg concentrate + finishing		Forage + 2kg concentrate + finishing		Forage + 4kg concentrate
	A	B	C	D	E	F	D
Barley	66.0	86.0	96.2	71.8	95.2	45.7	71.9
Soya bean meal	15.0	10.0	.	22.5	.	45.5	.
Alfalfa dehydrated	15.0	.	.	.	.	.	.
Grease	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Limestone	0.6	0.6	.	1.5	.	2.5	1.5
Dicalcium phosphate	0.2	0.2	0.5	0.8	1.2	2.5	0.8
Vitamin Trace mineral	0.2	0.2	0.3	0.4	0.6	0.8	0.4
Mcal/kg DM	2.7	2.8	2.9	2.8	2.9	2.7	2.8
CP/kg DM	162.9	138.3	95.8	177.7	95.1	250.0	177.7

quality were the forages fed to the bulls. The composition of low or high supplement w formulated according to the kind of forage to achieve the requirements for feeding bulls. Alfalf hay was supplemented with 2kg of concentrate E or with 4kg of concentrate C, and maize silage wa supplemented with 2kg of concentrate F or with 4kg of concentrate D. Concentrate B was used fo finishing period .

Animals were slaughtered approximately at 480kg. The transport to the slaughterhouse lasted minutes and there the bulls fasted for 17 hours. This work was carried on from autumn 1989 to au tumn 1990.

The kidney and channel fat and the 8-9-10th ribs were removed from carcasses at 24h and then th pH of muscle Longissimus dorsi was measured with a penetration ph-meter. Colour was measured a photocolorimeter at 24h on subcutaneous fat and at 48h on the M. Longissimus dorsi. At 7th day water holding capacity was measured on 5g of muscle using the filter paper method.

Samples of 10th M. Longissimus dorsi for Warner-Bratzler shear force determination were boile on bain marie to 70ºC for 45 minutes, after boiled juice losses were evaluated. Two 2.54cm core were removed from each sample in the direction of the muscle fibres and the average of shear fiber values was reported. After aging 7 days at 4ºC the 8-9 M. Longissimus dorsi ribs were frozen fo subsequent taste panel evaluation. The frozen ribs were cut into 2.5cm steaks, thawed at 4ºC fo 24h prior to cooking and serving. One steak per diet evaluated at the same time were placed a preheated grill at 160ºC and removed when internal temperature was 55ºC. Muscle strips were served on preheated plates to eight trained taste panel members. The panel sampled for tenderness juiciness and flavour. The rating scale was 100 = extremely tender, extremely juicy, intense bee flavour and 1= extremely tough, extremely dry, tasteless.

The data presented in this paper forms part of a wide experimental design which is still

process, therefore there is an unbalanced number of bulls from each breed. As there were no important significant effects of breed within each diet grouped data are presented. Variance analysis was carried out, covariance analysis was used to adjust live-weight gain and carcass data for variation in the carcass weight. Meat quality measurements were not adjusted.

RESULTS and DISCUSSION

Bulls fed concentrates diet (Table 2) grew faster 1.570 kg/day significantly different from bulls fed forages plus high supplement 1.416 kg/day or low supplement 1.385 kg/day, and finishing period. The bulls fed forage plus high supplement without finishing grew faster than expected 1.432 kg/day. A portion of this rate of gain could possibly be attributed to the different gut fill, that caused a higher killing out proportion of bulls finished on concentrates but not significantly different from the bulls fed without finishing period. Kidney and channel fat weight increased with the quantity of concentrate of each diet. Bulls fed with forages plus a finishing period exhibited ultimate pH higher than 6 usually associated with dark cutting. These high pH could be caused by mixing bulls before slaughter which causes stress and lowers the glycogen concentration (LACOURT and TARRANT, 1985) more than by diet. Shear force, water holding capacity, cooking loss and palatability traits of the meat did not change due to the diet received by the animals. The meat of bulls fed forages plus finishing (Table 3) showed lower saturation, a^*, b^*, and higher hue values than meat from the animals fed concentrates. The muscle colour variation did not always involve palatability variations as pointed by Jeremiah et al. (1972). Subcutaneous fat colour was similar for all nutritional regimens.

CONCLUSIONS

Results suggested that the meat from bulls fed concentrates o forages supplemented with different amounts of concentrates did not change fat colour, shear force, water-holding capacity or its palatability. But meat from bulls fed supplemented forage plus finishing presented pH higher than 6 and darker muscle colour than concentrate fed bulls.

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Table 2. Live-weight gain, carcass data palatability attributes and several characteristics of *Longissimus* muscle of bulls by nutritional regimen.

	Concentrate	Forage + 4kg concentrate + finishing	Forage + 2kg concentrate + finishing	Forage + 4kg concentrate	s.e.
Number animals	24	24	11	12	
Live-weight gain, kg/day	1.570c	1.416d	1.385d	1.432cd	0.0504
Hod carcass wt, kg	288.6a	275.5b	269.8b	274.3b	4.42
Killing-out, %	57.3	56.6	57.1	56.2	0.48
Kidney and channel fat, kg	2.670c	2.421c	2.247c	1.257d	0.2065
pH 24 h	5.89	6.21	6.18	6.04	0.137
Water-holding capacity, %	15.80	13.05	13.75	15.17	1.530
Cooking loss, %	7.61	5.98	4.81	8.91	1.214
WB shear, kg	13.1	12.2	10.8	12.9	1.22
Tenderness	55.3	60.2	60.3	58.7	2.22
Juiciness	56.5	60.5	57.6	57.7	1.60
Flavour	63.5	66.2	64.3	64.8	1.12

a,b: means in rows followed by the different letter differ P <0.05

c,d: means in rows followed by the different letter differ P <0.001

Table 3. Mean values colour of *Longissimus* muscle and subcutaneous fat

	Concentrate	Forage + 4kg concentrate + finishing	Forage + 2kg concentrate + finishing	Forage + 4kg concentrate	s.e.
M.longissimus					
Lightness	38.5c	35.1d	37.2cd	38.5c	1.19
Saturation	15.6a	13.4b	12.6b	13.6ab	0.90
Hue	2.0c	2.5d	2.6d	2.3cd	0.18
a*	13.9a	12.4b	11.7b	12.3ab	0.73
b*	7.0c	5.0d	4.5d	5.6cd	0.63
Subcutaneous fat					
Lightness	72.1	73.0	73.0	73.2	0.87
Saturation	8.7	8.8	9.0	8.8	0.81
Hue	-0.1	0.0	0.1	-0.5	0.44
a*	4.8	4.7	4.7	4.6	0.63
b*	7.2	7.3	7.6	7.4	0.64

a,b: means in rows followed by the different letter differ P <0.05

c,d: means in rows followed by the different letter differ P <0.001