EFFECTS OF ANIMAL AGE, SEX, AND POSTMORTEM AGEING ON SOME QUALITY CHARACTERISTICS OF BUFFALO MEAT

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BACKGROUND

The influence of breed, age, sex, level of fatness and the muscle type has been the objective of a lot of research work (Prost *et al.*, 1975, Lee *in* Seuβ& Honikel, 1990, Shorthose & Harris, 1990, and Huff & Parrish, 1993). The authors above mentioned drew the following conclusions: the ageing process has a distinct, though unequal, influence on the different individual muscles and this influence depends to a great extend on the age of the animals. In general, shear and sensorial evaluation indicate that the tenderness of meat decreases as the animals grow older and that the sex of the animals is not a tangible factor affecting meat tenderness (Prost *et al.*, 1975). The same authors reported a highly significant ($p<0.01$) correlation coefficient ($r = - 0.64$) between sensory data and shear values. *Psoas major* muscles were almost unaffected by increasing animal age whereas high connective tissue strength muscles, such as *Biceps femoris*, tripled in toughness. The comparison of the different muscles revealed that one of the least representative was the often-used *Longissimus dorsi* (Shorthose & Harris, 1990). Ageing is widely known to improve tenderness of beef (Huff & Parrish, 1993). A gradual reduction of shear force values takes place during the first 20 days postmortem. In a previous study Arima *et al.* (1997), studying the quality of buffalo caps of rump, 27 to 30 month old in average, concluded that the maximum tenderising effect was 30%, which was completed after 14 days of ageing, and that even not aged cuts presented acceptable tenderness, that is, under the limit of 5.4kg, above which the meat is considered tough (Carpenter, 1988).

OBJECTIVES

The objective of the present work was to identify the factors that influence some of the quality characteristics of buffalo cap of rump - dorsal portion of the *Biceps femoris* muscle - which is a very popular value-added meat cut on the Brazilian market.

METHODS

Sample preparation. Caps of rump of both sides from 3 lots: 12-, 18- and 24-month-old Mediterranean breed buffaloes (13 males and 9 females) were taken 72h *postmortem*. Each sample of cap of rump (weights averaging 0.6kg, 0.8kg and 1.2kg for 12-, 18- and 24-month old animals) was vacuum packed. One of the sides (individual control) was chosen at random, cryogenically frozen and stored at -18°C. The other sides were sorted at random after 1 to 4 weeks of ageing (after 5-9 days, 12-16 days, 19-23 days and 27-29 days, respectively) at 0-2°C. After each period of 1 week these sides were also frozen and stored using the same testing procedures and conditions. The cuts were packed in bags made of low-permeability thermoforming shrinkable film (80°C) with a Supervac chamber vacuumizing machine. The paired sides were taken at random and thawed for 24h at 8°C. Upon completion of the thawing process, $25Cm^2$ of the surface area were swabbed for microbiological analysis. Slices about 0.3cm thick were cut off the ventral end of the caps of rump and discarded. Next, slices about 1.5cm thick were cut off and submitted for analysis. The remainders of the caps of rump were broiled in an electric oven at 165±25°C to internal temperature of 75°C. Cores of the broiled slices with a diameter of 0.5 inches and cut parallel to muscle fibers were separated for instrumental shear force measurement, in addition to sensorial evaluation.

Analysis. a) fresh meat: surface pH; b) thawed meat: surface pH, moisture, fat and total count of mesophilic and psychrophilic bacteria. The chemical and the microbiological analyses were carried out according to Koniecko (1985) and Vanderzant & Splittstoesser (1992), respectively. pH values were determined with a pH-meter Ingold Lot 406-M6-S7. c) cooked meat: cooking loss, shear force, pressed juice, and sensorial evaluation. Instrumental tenderness in terms of shear force was determined using an Instron instrument equipped with Warner-Bratzler accessories; instrumental juiciness according to Verma *et al.*, (1984); and cooking loss by difference in weight. A sensorial panel of 14 members evaluated the samples for tenderness, flavor, juiciness and overall quality, using the following evaluation scales and/or scorings: from 0=very tough to 10=very tender, 0=not characteristic to 10=characteristic, 0=very dry to 10=very juicy and 0=very bad to 10=excelent, respectively. The scores and ratings were computed with the Compusense 4.2 program/methodology. The data were evaluated at 5% level by variance analysis, mean values compared using least significative difference method (Statgraphics program).

RESULTS AND DISCUSSIONS

The obtained mean values as well as the statistical evaluation of the test results of the experiment are shown in Table 1.

The pH mean values after thawing were statistically around 0.2 higher in comparison to those of fresh caps of rump (5.60). Also, the pH mean value of the male fresh cuts (5.48) was statistically higher ($p=0.000$) than those of females fresh cuts which averaged 5.36, this difference did not change after thawing ($p=0.037$). There was statistical difference of pH values determined by animal age ($p=0.004$) in fresh surface meat; the highest values were obtained by 18-month-old buffaloes.

Total plate count of mesophilic and psychrotrophic bacteria increased during ageing, from less than $3.6UFC/cm^2$ in not aged meat to $2.8 \times 10^3 UFC/cm^2$ after 3 weeks of ageing, and from less than $3.6UFC/cm^2$ to $1.6 \times 10^6 UFC/cm^2$ after 4 weeks ageing, respectively.

No statistically significant effects of ageing, or ageing time were observed in the moisture content of thawed meat. Moisture was higher ($p=0.004$) in female meat (76.3%) than in male meat (75.5%). Moisture was higher in younger animals ($p=0.032$), presenting 76.2%, 75.9% and

75.4% for 12, 18 and 24 month old buffaloes.
Ageing time, age and sex did not affect cooking losses. The mean percentages of each treatment group ranged from 24 to 34%.
Shearing force values did not differ with age or sex, but ageing (p=0.006) and the ageing period (p=0.003) did. Not aged meats averaged 4.4kgf and the aged meats averaged 3.3kgf. The results showed that the tenderizing effect (reduction of 30% in shear force) was completed after 2 weeks of ageing, period after which no further improvement was detected.
Pressed juice was not affected by ageing, ageing time, age, or sex. Mean values varied from 41 to 44%.
The average score for sensorial tenderness of not aged meat (5.2) differed statistically from the average score obtained by aged meat (6.3), p=0.014. Female (6.0) cuts scored higher for tenderness than male cuts (5.4), with attaining p=0.205. Sensorial tenderness correlated moderately and inversely with the shear force rating r = - 0.54. The caps of rump were rated between 7.4 and 8.1. None of the studied effects influenced the flavor of the meat, although female meat (7.9) scored higher than male meat (7.7), at p=0.156. Juiciness scores ranged from 4.9 to 6.6 and were not influenced by any of the parameters considered.
Differences in overall quality were detected only between not aged (6.8) and aged meats (7.4). Also, overall quality showed the same profile as tenderness with correlation coefficients of r = 0.64 and shear force values of r = - 0.62.

CONCLUSIONS

Ageing of vacuum packed meat cuts stored at 0-2°C for 2 weeks is an efficient method to improve the tenderness (around 30%) of buffalo cap of rump.
pH values and moisture content are influenced by sex and the age of the animals; fat content was affected by sex; shear force by ageing and ageing time; tenderness and overall quality are influenced by the ageing process.

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Table 1. Effects of sex, animal age, ageing and ageing time on the quality characteristics of buffalo caps of rump.

Effect	Treatment	Surface pH		*Maximum UFC/cm^2		Moisture	Fat	Cooking loss	Shear force	Pressed juice	Sensorial scores			
		Fresh	Thawed	Meso-philic	Psychrotro-phic	(%)	(%)	(%)	(kgf/0.5in.)	(%)	Tender-ness	Flavor	Juiciness	Overall quality
Sex	Males	5.48^a	5.63^a	-	-	75.5^b	1.8^a	30	3.9	43	5.4	7.7	5.8	7.1
	Females	5.37^b	5.61^b	-	-	75.7^a	1.1^b	29	3.7	41	6.0	7.9	6.1	7.1
	p	*0.000*	*0.465*	-	-	*0.004*	*0.016*	*0.711*	*0.598*	*0.460*	*0.205*	*0.156*	*0.846*	*0.846*
Age	12 month	5.41^b	5.64	-	-	76.2	1.1	24	3.3	41	6.4	8.0	5.4	7.5
	18 month	5.54^a	5.66	-	-	75.9	2.0	25	3.8	44	5.0	7.7	5.7	7.1
	24 month	5.42^b	5.60	-	-	75.4	1.6	26	3.1	43	6.5	7.7	6.1	7.3
	p	*0.004*	*0.098*	-	-	*0.032*	*0.162*	*0.894*	*0.376*	*0.904*	*0.186*	*0.377*	*0.589*	*0.428*
Ageing	Not aged	5.43	5.62	-	-	75.9	-	30	4.4^a	45	5.2^b	7.8	5.8	6.8^b
	Aged	5.44	5.62	-	-	75.6	-	29	3.3^b	43	6.3^a	7.8	5.8	7.4^a
	p	*0.592*	*0.879*	-	-	*0.237*	-	*0.829*	*0.001*	*0.813*	*0.014*	*0.957*	*0.923*	*0.022*
Ageing period	Control	5.43	5.62	<3.6	<3.6	75.9	-	29	4.4^a	43	5.2	7.8	5.8	6.8
	1 week	5.45	5.60	<3.6	$1.4x10^3$	75.2	-	28	4.0^b	44	5.9	7.8	6.3	7.3
	2 weeks	5.44	5.65	5.0	$2.2x10^4$	75.9	-	32	3.1^c	43	5.2	7.8	5.9	7.5
	3 weeks	5.45	5.63	$2.8x10^3$	$3.9x10^4$	75.7	-	25	3.1^c	44	6.6	7.9	4.9	7.5
	4 weeks	5.39	5.60	-	$1.6x10^6$	75.5	-	34	2.7^c	34	6.6	7.4	6.3	7.0
	p	*0.799*	*0.569*	-	-	*0.600*	-	*0.584*	*0.003*	*0.378*	*0.177*	*0.641*	*0.240*	*0.187*

Mean values in the same column and the same effect represented by the different letters in superscript are statistically different at 5% significance level. The mean values were compared using the least significative difference (LSD) test.
* Not statistically evaluated. Minimum plate count: <3.6UFC/cm^2