CARCASS GRADING OF CULL COWS AND ITS RELATION WITH THE NUTRITIONAL AND SENSORY QUALITY OF MEAT

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SUMMARY: Cull cows are commercially classified in Cuba according to a visual appreciation and live weight, without consideration of meat or carcass quality grade. Agreement between nutrition and sensory quality of cull cow meats with an age classification system, based on the visual appraisal of the animal spine and its comparison with photographic standards were studied. The longissimus dorsi of 30 animals belonging to 3 groups (2-3, 4-5, 6 or more years) were analysed in order to determine bromatologic composition, energetic value, fatty acids and cholesterol contents. Cooked meat were evaluated by 6 trained sensors who studied flavor, juiciness and hardness. The last attribute was also measured with a Texturometer Instron. Means values of some variables were: humidity 73,6-74,9% ; protein: 18,7-21,2%; fat: 3,2-6,2%; energetic value 115-133 kcal/100g; juiciness: lightly dry-dry; hardness: lightly soft-lightly hard. A good correlation was obtained between sensory and instrumental hardness (r=0,72). According to the discriminant analysis 10 variables were significants: cholesterol, fatty acids (C18:1, C18:3, C14:0, C16:1, C16:0, C18:0), hardness (by Instron and sensory determination) and humidity. Good results were obtained in the evaluation of the proposed grading method, with only 2 misclassified animals and a total of 93% correctly classified. These results show good agreement between the age classification system and cow meat quality.

INTRODUCTION; In the last 20 years population awareness concerning nutritional value of food has increased steadily. This interest is even stronger in the case of compounds that could constitute a risk to health as is the case for cholesterol and saturated fats.

Meat is an important source of proteins and fats animal origin. Therefore it is of great interest to learn chemical composition of animal carcass, which is also of economic significance. Fundamental constituents of beef may vary among other factors according to animal feeding, sex, stabling time previous to sacrifice and age (Lyaskovskaya,1969; Westerling, 1979; Beryosa,1981).

Some of these influence flavor and meat texture causing changes in its quality, whether it be positive or negative.

This study aimed at defining a classification system for cull cows according to age should be highly profitable since to date in Cuba those animals are commercially classified according to visual appreciation without consideration of meat or carcass quality grade.

MATERIALS AND METHODS: Sampling and chemical analysis. A total of 30 cull cows carcass were selected according to age and separated in 3 groups: a)animals 2-3 years old b) animals 4-5 years old c) animals 6 or more years old.

Classification was based on visual appraisal of the animal spine and its comparison with photographic standards.

A piece of raw meat of each of the 30 animals was ground (3 times) in an Electrolux model B grinder to analyze humidity, protein and ash, all by AOAC, 1980; total lipid content was determined by Folch procedure (Folch et al., 1957) using chloroform-methanol (2/1, v,v); carbohydrate by difference; energetic value by factors 4 kcal/g for protein and carbohydrate and 9 for fat. Saturated and unsaturated fatty acids through gas liquid chromatography using a flame detector and a glass column 2m x 4mm i.d., packed with 10% diethylenglycol on silane support. Inyector and column temperature were 250 and 200ºC respectively. Methilation was done with methanolic boron trifluorine (AOAC, 1980); cholesterol, after saponification with 15% methanolic KOH in a water bath-shaker at 60ºC during 1 hour, non saponifiable components were extracted twice with 5 ml of hexane and analyzed by Watson's (1960) colorimetric procedure.

Sensory and texture evaluation. Samples were cooked in a microwave oven to 80ºC of internal temperature, then cooled to room temperature. Cooled samples of the longissimus muscle, were cut into 1,2 cm cubes and served to a trained six members sensory panel. Panelist scored the samples for tenderness, juiciness and flavor, using a 6 points hedonic scale (very desirable = 6, to very undesirable = 1). Hardness was also evaluated by an Instron Texturometer Model 1140 , using a Warner-Bratzler blade with a head speed of 10 cm/min. In the graphic obtained plotting power vs lenght hardness was

estimated in the maximum peak of the curve.

Statistical analysis. Mean value ($\bar{x}$) and standard deviation (SD) of each variable were determined. Data was evaluated by a discriminant analysis with a microcomputer AT using a Statistical Package of Social Science (SPSS, 1987). Simple correlation between sensor's score for hardness and Instron determinations was made.

RESULTS AND DISCUSSION: Table 1 shows nutritional composition of the longissimus dorsi in animals studied. All these variables were in the range of values reported by other authors or in Food Composition Tables (Manev, 1985; Browing et al.,1990; Carnovale and Miuccio, 1977; IIIA-INHA, 1987). Nevertheless there was a tendency to a dicrease in protein contents and an increase in fat and energetic value with age. This of course is not good from the nutritional point of view. Price(1970), considered age a factor which has a direct influence on those constituents. For this reason cull cows meat is fatter and more energetic than younger animals.

Fat values reported by Rhee et al. (1982) in the longissimus dorsi of 80 animals were between 2,73 and 12,08%, comparable with those obtained in the present study (1,30 -12,10%).

Fatty acids (Table 2) showed difference between groups. Myristic acid (C14:0), stearic acid (C18:0) and linolenic acid (C18:3) were higher in the younger cows and decreased with ageing; the opposite occurs with oleic acid (C18:1).

Total of various types of fatty acids are summarized in table 3. These results are in agreement with those obtained by Beryosa (1981) in cows 8 or more years old. He found 45 % of saturated fatty acids and the rest were unsaturated; but are in contradiction with Sinclear and O'Dea (1987) who reported a reduction of monounsaturated and an increase of polyunsaturated fatty acids with the increase of muscle fat, which could be due to sex difference.

Cholesterol values are shown in table 4. This alcohol increased with age. Standard deviation was high, more marked in younger cows, which show a great individual variability.

Cholesterol levels for cows 4-5 years old and 6 or more were higher than those reported by Tu et al (1967), Rhee et al, (1982); Wheeler et al 1987) and Hood, (1987) in young animals. The fact that cholesterol contents were higher in the older animals affected quality of the meat, since this component is harmful to health when consumed in high quantities.

Sensory and instrumental evaluation of samples is shown in table 5. Hardness as determined by an Instron Texturometer was very variable and mean values were typical of hard meat (de Hombre, 1990). Similar results were obtained from panelists who determined that hardness increased with age. No differences were observed in juiciness and flavor. Meat of all animals was considered relatively dry, with good taste.

There was a good correlation between hardness results, as determined by sensors and with the Instron Texturometer (r= 0,72) comparable with those reported for beef by Hosteller et al, 1978 (r=0,56 - 0,92) and Martin et al, 1971 (r=0,80).

Through this study discriminant analysis was made with only 29 animals, since sensory information from one of the samples was missing.

Animals were regrouped to this analysis, as follows: Group 1= 2-3 years old; Group 2= 4-5 years; Group 3= 6 years or more.

Results showed that 10 variables were significants: cholesterol, oleic, linolenic, myristic, palmitoleic, palmitic and stearic fatty acids, hardness as determined by the Instron and by the sensors as well as humidity.

Data used to obtain the discriminant functions for each group are presented in table 6. According to these functions cows were classified in predicted groups and results are presented in table 7. Percentage of correctly classified animals was very high with only 2 animals missclassified, one from Group 2 and the other from Group 3. This means that this age classification system based on visual appraisal of the animal spine was in good agreement with nutritional and sensory properties of meat.

These results can be applied in Cuba in cull cows trade between Agriculture and Food Industry ministries.

CONCLUSIONS: Age classification of cull cows was in good agreement with nutritional and sensory properties of meat, with a total of 93,1 % animals correctly classified.

Variables used to classify cull cows were: cholesterol, fatty acids (C14:0; C16:0; C16:1; C18:0; C18:1; C18:3) hardness measured by instrumental and by sensory determination and humidity.

It is advisable to introduce the age classification system in Cuban slaughterhouses in cull cows trade.

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TABLE 1. Nutritional composition of longissimus dorsi from different age culled cows.

		AGE (years)		
		2-3	4-5	6 or more
Humidity, %	$\bar{X}$	74,2	74,9	73,6
	SD	1,0	1,0	1,6
Protein, %	$\bar{X}$	21,2	19,3	18,7
	SD	0,9	0,9	2,2
Fat, %	$\bar{X}$	3,2	4,5	6,2
	SD	0,4	1,5	3,3
Carbohydrate, %	$\bar{X}$	0,3	0,4	0,5
	SD	0,2	0,1	0,2
Ash, %	$\bar{X}$	1,0	1,0	1,0
	SD	0,2	0,1	0,2
Energetic value, kcal/100 g	$\bar{X}$	115	116	133
	SD	9,4	12,1	22,2

TABLE 2. Fatty acids contents in intramuscular fat (%).

		AGE (years)		
		2-3	4-5	6 or more
C14:0	$\bar{X}$	2,6	2,9	2,5
	SD	0,6	1,0	0,7
C16:0	$\bar{X}$	24,3	29,0	28,5
	SD	2,0	5,0	4,1
C16:1	$\bar{X}$	4,1	5,7	5,0
	SD	1,2	2,1	1,1
C18:0	$\bar{X}$	21,7	17;9	15,9
	SD	2,3	3,6	4,0
C18:1	$\bar{X}$	34,9	35,4	38,5
	SD	6,4	5,5	5,6
C18:2	$\bar{X}$	5,2	4,9	5,2
	SD	2,1	2,6	4,1
C18:3	$\bar{X}$	1,3	0,5	0,6
	SD	0,9	0,7	0,6

TABLE 3. Total fatty acids contents in intramuscular fat (%).

Fatty acids	AGE (years) 2-3	4-5	6 or more
Saturated	48,6	49,8	46,9
Monoinsaturated	39,0	41,1	43,5
Polyunsaturated	6,5	5,4	5,8
Total insaturated	45,5	46,5	49,3

TABLE 4. Cholesterol contents in longissimus dorsi of animals from different groups.

		AGE (years) 2-3	4-5	6 or more
Cholesterol, mg/100g	$\bar{X}$	62,4	86,7	98,4
	SD	27,2	19,8	13,1

TABLE 5. Sensory and instrumental evaluation of muscle samples.

		AGE (years)		
		2-3	4-5	6 or more
Hardness (Instron), (kg)	$\bar{X}$	13,7	12,9	12,4
	SD	6,7	6,7	5,0
Hardness (sensory)	$\bar{X}$	5,0	4,6	4,5
	SD	1,4	1,3	0,9
Juiciness	$\bar{X}$	2,7	3,1	3,1
	SD	1,0	0,7	1,5
Flavor	$\bar{X}$	4,7	4,7	4,7
	SD	0,3	0,4	0,3

TABLE 6. Classification function coefficients (Fisher's linear discriminant function)

Group	1	2	3
Cholesterol	3,1474	3,2926	3,2857
C14:0	244,9410	249,8693	242,8965
C16:0	41,6095	42,6979	41,8149
C16:1	36,2761	37,7593	36,3962
C18:0	6,0078	5,7626	5,4507
C18:1	21.0860	21,5651	21,2728
Hardness (Instron)	24,1099	24,3209	23,5346
Hardness (Sensory)	158,2465	160,4141	155,4626
Humidity	240,6423	245,5907	239,8975
Constant	-10927,86	-11382,49	-10861,31

TABLE 7. Classification results.

New groups	No. of cases	Predicted Group Membership		
		1	2	3
1	9	9 (100 %)	0 (0 %)	0 (0 %)
2	10	0 (0 %)	9 (90 %)	1 (10 %)
3	10	1 (10 %)	0 (0 %)	9 (90 %)

93.1 % of cases correctly classified.
Figures in parenthesis: classification percentages.