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Survey of beef carcass quality graded in Tabasco State, Mexico

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Abstract. A survey of beef carcass grading included 22 294 carcasses produced in tropical humid (Am) and sub-humid (Aw) climates subjected to the Mexican norm NMX-FF-078-SCFI-2002, between November 2009 and February 2010, at the No. 51 Federal Inspected Abattoir, in Tabasco State. The aim was to identify areas for improvement of carcass quality as influenced by four gender groups (young bull or heifer, up to 2 years of age; mature bull or cow), using five basic evaluation criteria: 1) maturity (age), 2) conformation (muscularity), 3) meat color, 4) fat color, and 5) subcutaneous fat distribution. Quality grades were designated: Supreme, Select, Standard, Commercial and Out of Grade. The effect of gender groups on the final quality grade and on each of the five criteria assessed was expressed as percentage proportions of the total number of observations per gender group. Carcasses with final classification as Select were present only in the young bull (18.7%) and heifer (1.1%) groups. Young bull and heifer carcasses were most frequently Standard grade, while those of mature bulls and cows were mostly Commercial grade and Out of grade. No carcass merited a final grade of Supreme due to inadequate conformation. It may be concluded that this application of the Mexican beef carcass classification norm in question to a sample population of tropically-produced carcasses highlights an industry capable of producing slaughter animals of early age, with carcasses showing adequate meat and fat color and subcutaneous fat distribution, but wanting improved conformation.

Key words: Beef, Carcass, Classification, Gender, Quality Grader

Encuesta de la calidad de canales bovinas clasificadas en el Estado de Tabasco, México

Resumen. Un sondeo de la calidad de canal de bovino que incluyó 22 294 canales de bovinos generados en climas tropical húmedo (Am) y sub-húmedo (Aw), evaluadas aplicando la norma mexicana de calidad NMX-FF-078-SCFI-2002, entre noviembre del 2009 y febrero del 2010 en el rastro TIF No. 51 del estado de Tabasco, permitió identificar el efecto de cuatro géneros (torete, vaquilla, toro y vaca) sobre la calidad, conforme a cinco criterios normativos de evaluación: 1) madurez (edad), 2) conformación (muscularidad), 3) color de la carne, 4) color de la grasa y 5) distribución de la grasa subcutánea, originando los grados: Supremo, Selecto, Estándar, Comercial y Fuera de Clasificación. El efecto de género en el grado final y en cada criterio de juzgamiento se expresa porcentualmente en relación al total de observaciones de dada género. El grado Selecto se obtuvo únicamente para canales de torete (18.7%) y vaquillas (1.1%), géneros cuya frecuencia mayor fue del grado Estándar (63.2% y 39.8% respectivamente). Las canales de toros y vacas se concentraron en el grado Comercial y Fuera de Clasificación. La falta de conformación adecuada ocasionó la ausencia de canales con el grado de Supremo. Se concluye que la presente aplicación de la norma Mexicana de clasificación en cuestión a un muestreo de canales generados en condiciones tropicales, proveyó información indicativa de una industria ganadera capaz de producir animales de temprana edad con canales que se caracterizan por color de carne y de grasa y distribución de grasa subcutánea adecuados, pero requiriendo mejorar conformación.

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Palabras clave: Bovinos de carne, Canales, Clasificación por calidad, Género

Introduction

Beef production in the Mexican tropics is going through a stage of evolution with the introduction of husbandry practices such as a significant level of concentrate supplementation under grazing conditions and/or finishing for short periods of time in confinement. These changes in management strategies are geared towards intensification of the traditional off-pasture finishing system (Sanchez and Sanchez, 2005). The use of Continental breeds within the region has increased significantly in recent years, crossed with *Bos indicus* types of cattle (Peel, 2010; UGRT, 2007; Vilaboa *et al.*, 2008; Ganadero, 2010; García, 2011). This trend has resulted in a wider range of beef carcass quality and is recognized by some sectors of the industry as requiring differentiation of carcasses based on additional quality criteria across Mexico (Mendez *et al.*, 2009).

In the year 2002, an updated voluntary norm for quality classification of beef carcasses was officially published by the Mexican Ministry of Economics: norm NMX-FF-078-SCFI-2002, Productos Pecuarios-Carne de Bovino en Canal-Clasificación (Cancela a la NMX-FF-078-1991), Cattle Product--Bovine Carcasses Flesh–Classification (Secretaría de Economía, 2002).

The purpose of this survey was to characterize beef carcasses at an abattoir located in a tropical region of Mexico (Tabasco State) through the application of the above mentioned norm and identify possible areas for improvement. The Beef Cattle Union of Tabasco State, has applied an updated norm in a pilot program from which the present data set was collected.

Materials and Methods

Twenty-two thousand two-hundred and ninety-four beef carcasses were classified according to the Mexican norm NMX-FF-078-SCFI-2002 at the No 51 Federal Inspected Type abattoir located in the State of Tabasco, owned by the Beef Cattle Union of Tabasco. Classification of the carcasses took place between November 2009 and February 2010. The Tabasco State is located in the southeast region of the country between latitude 17°15´ and 18°39′ North and longitude 91°00´and 94°17´ West. The climate is described as tropical humid (Am) and sub-humid (Aw) with rains concentrated in summer. Mean precipitation is 2.750 mm per year with a mean temperature of 26°C and maximum of 42°C (García, 1988).

In its application at the federal level, the classification norm bases grading on five criteria: maturity as representative of age and evaluated according to the degree of ossification of the vertebras; conformation, a reflection of muscle yield and distribution; color of meat and of fat; and distribution of subcutaneous fat, the desired condition being an even distribution over the whole carcass rather than thickness at particular spots. For each criterion applied standard photographs are available for use as references by classifiers.

The classification norm was implemented using a mechanistic approach in which each one of the five basic evaluation criteria were applied in the following sequential order: 1) maturity (age), 2) conformation (muscularity), 3) meat color, 4) fat color, and 5) distribution of subcutaneous fat over the whole carcass. Each evaluation criterion contained its own range of specifications corresponding to one of five quality grades: Supreme (Sp), Select (Se), Standard (St), Commercial (Co) and Out of Grade (OG).

An OG carcass corresponds to one which as judged for maturity, is determined to come from an animal over 48 mo of age and therefore, requires no further judging to be designated OG. If a carcass as judged for maturity is found to be Sp, Se, St, or Co, then the carcass is judged based on the next criterion in order, conformation. If the carcass fulfills the requirement of conformation for the same grade found for maturity, the carcass remains in that grade. However, if the carcass is found to have a grade for conformation corresponding to a different category, the carcass is then placed in this new grade. This procedure is continued with the grading for color of the meat and fat, and the distribution of subcutaneous fat. As the carcass is subjected to the different criteria for evaluation, it may remain at the grade it received previously or be moved to the grade which corresponds to the last applied criterion, always following the sequence Supreme→Select→Standard→Commercial. In no case can a carcass be moved back to a higher grade previously assigned according to that former criterion. For the present survey all carcasses were judged for all five criteria even though this is not required by the norm, as in the case of the OG carcasses.

All carcasses were inspected by trained employees of the abattoir, 18-20 h after slaughtered and maintained in a cold room at 2-4°C.

The genders identified in the present survey were young bull (an entire male with vertebra ossification up to 24 mo of age); heifer (a female with vertebra ossification up to 24 mo); bull (an entire male with vertebra ossification greater than 48 mo) and cow (a female with vertebra ossification greater than 48 mo).

The frequency distribution of carcass by gender in final grade and for each of the five grading criteria within each carcass grade, is expressed as a percentage of the total number of observations per respective group.

Results and Discussion

One objective of a population survey is to describe its components in terms of specific characteristics and derive from such information, possible interpretations, actions, and programs. As no treatments are applied, statistical comparisons thereof do not apply and simple quantitative descriptors are employed for the population components and comparisons among them.

Beef carcasses quality classification norms applied commercially are frequently based on subjective appreciation of their judgment criteria as in the case of maturity judged by degree of ossification of vertebras and marbling for the USA system (USDA, 1996) and muscling and subcutaneous fat distribution in Europe (CEE, 1981a; CEE, 1981b; CEE, 1991). In all cases, cards with photographic images are common tools used as visual reference. A similar procedure was applied for the classification of beef carcasses in the present survey.

The information presented here corresponds to the voluntary application of the Mexican norm NMX-FF-078-SCFI-2002 in its federal version in which only five basic criteria for judgment are required. Within the sample population surveyed, each carcass was evaluated for each of the five basic criteria described in the norm. This allowed determining the relative frequencies of occurrence for each criterion independent of the final grade. The percentage proportions of the 22 294 carcasses with final classification of Sp, Se, St, Co, and OG for each of the four genders considered are presented in Table 1.

The absence of carcasses with final grade Sp was mainly due to the lack of proper conformation. Young bulls performed better for conformation than any other gender, in particular when compared to heifers. Young bulls accumulated 18.7% of their total carcasses in the Se grade, heifers 1.1% and none for bulls and cows. That a large portion of bull and cow carcasses were graded Co and OG was expected due to the age (maturity) criterion within the norm.

The sample distribution within each gender for each of the five grading criteria within each final grade is presented in Table 2.

When each one of the criteria for classification were analyzed and compared among the final grades (Table 2), a larger relative proportion of young bulls graded Se for the maturity and conformation criteria, followed by heifers in second place. The criteria of meat and fat color as well as subcutaneous fat distribution favored the Se and St grades for both the young bull and heifer genders.

A high proportion of animals were sent to slaughter at 24 mo of age or less, which is a reflection of adequate animal husbandry. Marketing of young beef carcasses promotes an acceptable degree of tenderness (Hiner and Hankins, 1950; Shorthose and Harris, 1990; Purchas *et al*., 2002; Meyer *et al.,* 2005). However, when the criterion for carcass conformation was considered only 20 out of the 23 484 carcasses evaluated under these conditions had the degree of muscularity required to classify as Sp. Therefore, attention to the predominant genotypes in the beef cattle population of the region and/or managerial strategies in terms of nutrition, from the suckling stage to the finishing phase, deserve consideration.

The voluntary application of the Mexican beef carcass classification norm NMX-FF-078-SCFI-2002 on a sample population of beef cattle under a tropical production environment provided an insight into the strengths and weaknesses of the primary production sector for Tabasco State in particular and the Mexican tropics in general. The present survey suggests that conformation is a primary characteristic requiring attention in order to improve the present distribution of carcass grades.

A beef production system involves the interaction of genetic and environmental factors. Under tropical conditions, climatic factors have important implications for husbandry, management, and genetics used in the beef production system (SAGARPA, 2006). As the type of carcasses produced depends on the interaction between genetic and managerial factors (Coleman *et al.,* 1993), beef producers need to relate their available environmental and genetic resources to the quality of carcasses produced under a bio-economically sustainable system. Environmental conditions of the tropics impose the need to

Table 1. Gender distribution of final carcass classification (expressed as % of total observations for each gender)

	Young		Mature	
Carcass grade	Bull	Heifer	Bull	Cow
Supreme	0.0	0.0	0.0	0.0
Select	18.7	1.1	0.0	0.0
Standard	63.2	39.8	1.0	1.4
Commercial	17.7	51.9	67.2	56.0
Out of Grade	0.4	7.2	31.8	42.6
Total observations	15 888	752	195	5 459

Table 2. Percentage distribution by gender among each of the criteria applied for judging, within the final classification grade (expressed as % of total observations for each gender).

	Young		Mature	
Criteria/carcass grade	Bull	Heifer	Bull	Cow
Maturity:				
Supreme	45.8	23.7	0.0	0.0
Select	26.8	16.5	1.0	0.2
Standard	22.1	27.1	3.1	2.6
Commercial	5.0	25.8	66.2	54.9
Out of Grade	0.3	6.9	29.7	42.4
Conformation:				
Supreme	0.14	0.0	0.0	0.0
Select	8.0	9.6	8.2	0.8
Standard	48.2	64.9	55.4	44.9
Commercial	3.4	23.9	20.0	34.9
Out of Grade	0.3	1.6	16.4	19.4
Meat color:				
Supreme	2.4	0.8	0.0	0.0
Select	55.2	44.8	1.0	2.9
Standard	35.6	45.5	19.5	60.4
Commercial	6.6	7.8	62.1	17.7
Out of Grade	0.3	1.1	17.4	19.0
Fat color:				
Supreme	12.7	1.1	0.0	0.1
Select	51.8	29.8	2.6	9.2
Standard	31.8	54.8	27.2	36.1
Commercial	3.4	13.3	47.7	34.0
Out of Grade	0.3	1.1	22.6	20.6
Subctuaneous fat:				
Supreme	5.3	2.9	0.0	1.4
Select	44.4	29.1	5.1	22.5
Standard	41.4	43.6	20.5	31.0
Commercial	8.5	22.9	51.8	23.6
Out of Grade	0.3	1.5	22.6	21.6

incorporate a proportion of *Bos indicus* genetics in the breeding cow herd to enhance the proportion of cows weaning a calf. Nevertheless, the implications of this practice for carcass muscularity of offspring should be considered, as Comerford *et al.* (1988) and Bidner *et al.* (2002) have shown that the influence of Brahman-derivative breeds decreases carcass muscularity. In addition, the limited seasonal availability of feed resources in terms of both quantity and quality directly affects the growth of calves at an early stage, with the subsequent impact on carcass quality. In view of the present survey, a reasonable course of action for the beef industry in the tropics may be to focus on achieving a carcass quality grade of Se at the expense of St and Co grades.

In order to meet the criteria for a final grade of Sp, a predominately *Bos taurus* crossbred bull would be advantageous to sire offspring with the genetic potential for high carcass quality (Ensminger, 1987). However, the production system in Tabasco for growing and finishing beef cattle must rely heavily on predominately *Bos indicus* crosses to perform well under the climatic conditions of the region (UGRT, 2007). Thus, a realistic goal under the local tropical environment may be a final grade of Se. A Se grade could be considered as an optimum level achievable without relying on additional inputs which may be uneconomical, unsustainable and may even have a negative impact on meat quality (use of hormonal and beta-analog anabolics), if a final grade of Sp were the goal.

Adoption of the Se grade as a goal for a significant proportion of the commercial beef population of Tabasco is further supported by the fact that it was achieved already by 34% of the carcasses for the conformation criterion, while the criteria of meat and fat color and subcutaneous fat distribution were all adequate to allow around 40% of the carcasses to grade Se when these factors were considered individually. However, when considered in the entirety of the classification norm, only 13.4% of the carcasses had a final grade of Se, indicating considerable room for improvement.

The commercial application of the beef carcass classification norm to a sample beef population in the tropics of Mexico has provided useful information to highlight the strengths and weakness of the local beef production system. Animals were marketed with carcasses classifying in four of the five grades according of the existing norm. It is proposed that the challenge for tropical beef producers of Mexico, Tabasco in particular, is to generate a greater proportion of select carcasses through implementation of sustainable and innocuous animal husbandry practices and genetic improvement programs.

In conclusion, the updated version of the beef carcass classification norm NMX-FF-078-SCFI-2002 based on the criteria and ranges as specified under commercial conditions, seems to be appropriate for the differentiation of carcasses as well as a guide for the functional strategy to be adopted. Its implementation under production systems representative of temperate and semiarid environments would be desirable to test its suitability under those conditions as well.

Literature cited

Bidner, T. D., W. E. Wyatt, P. E. Humes, D. E. Franke, and D. C. Blouin. 2002. Influence of Brahman-derivative breeds and Angus on carcass traits, physical composition and palatability. J. Anim. Sci. 80:2126.

CEE. 1981a. Grille Communautaire de classement des carcasses de gros bovins. Règlement (CEE) no 1208/81.

CEE. 1981b. Grille Communautaire de classement des carcasses de gros bovins. Règlement (CEE) no 2930/81.

CEE. 1991. Grille Communautaire de classement des carcasses de gros bovins. Règlement (CEE) no 1026/91.

Coleman, S. W., B.C. Evans, and J. J. Guenther. 1993. Body and carcass composition of Angus and Charolais steers as affected by age and nutrition. J. Anim. Sci. 71:86

Comerford, J. W., L. L. Benyshek, J. K. Bertand, and M. H. Johonson. 1988. Evaluation of performance characteristics in a diallel among Simmental, Limousin, Polled Hereford and Brahman beef cattle. II. Carcass traits. J. Animl Sci. 66:306.

Ensminger, M. E. 1987. Breeds of cattle. In Beef Cattle Science. (6th Ed.) The Interstate Printer and Publishers, Inc. Danville, Illinois. p. 47.

Ganadero, 2010. La ganadería Mexicana 2010. Rev. Ganadero S. A. de C. V. www.revistaganadero.com.

García, E. 1988. Modificación al sistema de clasificación climática de Koppen (para adaptarlo a las condiciones de la República Mexicana) (4ª Ed.). DR@1981. México. p. 13.

García, Y. K. 2011. Experiencias de producción de carne en el trópico húmedo. 1er Congreso Ganadero Virbac Bovinos Carne. Guadalajara, Jalisco, México. Memorias.

Hiner, R. L. and O. G. Hankins. 1950. The tenderness of beef in relation to different muscles and age of the animal. J. Anim. Sci. 9:347.

Méndez, R. D., C. O. Meza, J. M. Berruecos, P. Garces, E. J. Delgado, and M. S. Rubio. 2009. A survey of beef carcass quality and quantity attributes in Mexico. J. Anim. Sci. 87:3782.

Meyer, D. L., M.S. Kerley, E. L. Walker, D. H. Keisler, V. L. Pierce, T. B. Schmidt, C. A. Stahl, M. L. Linville, and E. P. Berg. 2005. Growth rate, body composition and meat tenderness in early vs. traditionally weaned beef calves. J. Anim. Sci. 83:2752.

Peel, D., R. J. Johnson, and K. H. Mathews. 2010. Cow-calf beef production in Mexico. A report from the Economic Research Service, USDA. LDP-M-196-01, November 2010.

Purchas, R. W., D. L Burnham, and S. T. Morris. 2002. Effects of growth potential and growth path on tenderness of beef longissimus muscle from bulls and steers. J. Anim. Sci. 80:3211.

Sanchez, R. G. y V. A. Sanchez. 2005. Tendencias de la industria nacional de la carne de bovino. En: La Ganadería Bovino del Estado de Michoacán. Fundación Produce Michoacán, A.C. p. 1.

SAGARPA, 2006. Situación actual y perspectiva de la producción de carne de bovino en México. 2006. Coordinación General de Ganadería. Secretaria de Agricultura, Ganadería, Desarrollo Rural, Pesca y Alimentación. Publicación 14-11-2006. http://www.sagarpa.gob.mx/ganaderia/Publicaciones/Lists/Estudios%20de%20situacin%20actual%20y%20perspectiva/Attachments/3/sitbov06.pdf. Accessed September 29, 2011.

Secretaría de Economía, 2002. México. Diario Oficial de la Federación, 2002. NMX-FF-078-SCFI-2002.

Shorthose, W. R. and P. V. Harris. 1990. Effect of animal age on the tenderness of selected beef muscles. J. Food Sci. 55:1.

UGRT, 2007. «70 años son un buen comienzo: Frigorífico y Empacadora de Tabasco». Unión Ganadera Regional de Tabasco. México 2007. p. 121-131.

USDA. 1996. Standards for Grades of Slaughter Cattle and Standards for Grades of Carcass Beef. Agric. Mkt. Serv., United States Department of Agriculture. Washington, D.C. Govt. Print. Off.

Vilaboa, A. J., R. P. Diaz, R. O. Ruiz y R. D. E. Platas. 2008. Caracterización de la cadena agroalimentaria de ganadería bovino en la Región del Papaloapan, Veracruz. http://www.engormix.com/s-articles_view.asp?art=1942&AREA=GDC. Accessed April 04, 2008.