CRECIMIENTO, RENDIMIENTO Y CALIDAD DE LA CARNE DE TORETES Y NOVILLOS BRAHMAN EN ESTABULACIÓN

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ASOCIACION DE CRIADORES DE GANADO CEBU DE COSTA RICA

Julio Rodríguez

TEC Tecnológico de Costa Rica

INTRODUCCIÓN

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Predictability of lean product, bone, and fat trim in beef carcasses from Costa Rica

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ABSTRACT

Data from 292 hot fat trimmed carcasses derived from Costa Rican cattle were used to predict yield of fabricated boneless, closely-trimmed, high-valued cuts (BVS, by weight and percentage); yield of total saleable product (TSP, by weight and percentage); and percentage yields of bone and trim fat. Backfat thickness was not significantly associated with weight of BVS or TSP. Carcass weight explained 93.7% and 95.9% of the total variation in weight of BVS and TSP, respectively. Equations for predicting percentage yields of BVS and TSP showed little predictive efficacy. Conversely, the greater precision of the equations selected to predict the quantity (kg) of BVS or TSP, offers a practical alternative of using them in hot fat trimmed carcasses.

1. Introduction

Costa Rica has around 1.3 million head of cattle and its beef cattle industry has a huge impact on the economy even though there has been an 8.4% downward trend in production since 2010 (INEC, 2014). During the mid 2000s two beef chain diagnostic studies (Blandino-Herrera, 2005; Holmann et al., 2008) consistently identified a deficient marketing system for live cattle and beef produced in Costa Rica and recommended the implementation of a beef grading system to increase industry competitiveness. Several grading systems for beef carcasses have been developed or proposed to assist in the uniform marketing of beef in Latin America (Huerta-Leidenz, 2010). However, Costa Rica has never officially implemented a grading system (Murillo-Bravo et al., 2012). Previous attempts of the Livestock Corporation of Costa Rica (CORFOGA) to develop and implement quality standards faced some reticence or lack of interest on the part of some industry organizations, (J.D. Obando, personal communication). Nevertheless, according to this source, a change of attitude is very possible through adoption of a voluntary, yield grading (grid) system by the larger packers to stimulate livestock productivity. Initiatives to market beef cattle/carcasses on the basis of value are growing around the world. Value-based transactions for which premiums or discounts are applied, depending on the carcass USDA yield grade, can alter the final value of the carcass, and these commercial practices are commonly accepted in marketing of beef cattle/carcasses in the U.S. (Lawrence, 2018). A rapid, huge marketing impact of a yield standard could be expected in Costa Rica because three large meat companies have traditionally controlled 80% of the domestic slaughter and all beef exports (Holmann et al., 2008). In 2017, 21% of total beef production was exported and 41% of exports were targeted for the US market as lean beef trimmings (CORFOGA, 2017).

Only a limited characterization of the Costa Rican beef carcass population is available in the literature (Murillo-Bravo et al., 2012; Rodriguez et al., 2014) and there are few studies in tropical America aimed to develop beef yield prediction equations (Atencio-Valladares, Huerta-Leidenz, & Jerez-Timaure, 2008; da Luz Silva et al., 2012). Clearly, there is a need for: (a) analysing larger observational data aimed to better assess variation in cutting yield of the beef carcass supply in Costa Rica, and (b) development of prediction equations for estimating cutability or product weight as the first step to develop a yield grade standard. A standardized scoring appraisal of carcass fat

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Carcass and meat quality characteristics of Brahman cross bulls and steers finished on tropical pastures in Costa Rica

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ABSTRACT

Forty-eight male calves (3/4 Brahman × 1/4 Charolais) were used to determine carcass cutability and meat tenderness of *Longissimus lumborum* (LL), *Gluteus medius* (GM), *Semitendinosus* (ST) and *Psoas major* (PM) steaks from lighter weight carcasses of bulls and steers castrated at 3, 7, or 12 mo of age grown under tropical pasture conditions. Steaks from steers had lower (more tender) LL Warner–Bratzler shear force (WBSF) values than those from bulls. Steaks from steers castrated at 3 mo had lower GM WBSF than those from bulls. For PM steaks, those aged 28 d had lower WBSF than those aged 2 d. Steaks aged 28 d had the lowest LL and GM WBSF and steaks aged 2 d had the highest LL, GM, and ST WBSF. Castration at younger ages is recommended because it provides improvement in LL and GM tenderness over bulls with no differences in carcass traits or subprimal yields.

1. Introduction

In Costa Rica, beef cattle production is based primarily on *Bos indicus* bulls utilizing pasture/forage-based diets in a tropical environment. Finishing cattle on forage-based diets to similar carcass weights and degree of fatness as grain-fed diets can result in similar beef quality characteristics (Muir, Deaker, & Bown, 1998). However, beef production in Costa Rica is challenged with lower quality forages and a challenging tropical environment. Finishing cattle on lower quality pasture diets can have negative consequences on carcass tenderness and organoleptic properties of the meat (Mitchell, Reed, & Rogers, 1991), and grass-finished cattle may have decreased average daily gain, longer finishing periods to reach a target endpoint, reduced dressing percentages, and lower quality grades than cattle fed more energy-dense concentrate diets (Bidner, Schupp, Montgomery, & Carpenter, 1981; Bidner et al., 1986).

It has been generally accepted that intact bulls provided adequate nutrition grow faster and more efficiently and produce carcasses with less fat than castrated steers (Mach, Realini, Furnols, Velarde, & Devant, 2009; Seideman, Cross, Oltjen, & Schanbacher, 1982). In addition, meat from steers is often preferred by consumers over meat from bulls because improved sensory traits, particularly tenderness, have been shown in some trials (Field, 1971; Seideman, Cross, & Crouse, 1989).

Postmortem aging is a technology that enhances beef palatability, and it is among the most popular options for improving tenderness (Dransfield, 1994). This practice is not widely adopted in Costa Rica and has been used by only a few beef retailers. Individual muscles can respond differently in their extent of tenderization improvement after postmortem aging periods because of differences in connective tissue (Rhee, Wheeler, Shackelford, & Koohmaraie, 2004), in the rate and extent of pH decline, in activity of calpains (Ilian et al., 2001), and thus in the extent of proteolytic degradation (Rhee et al., 2004; Taylor, Geesink, Thompson, Koohmaraie, & Goll, 1995).

Beef cattle production in Costa Rica is facing many challenges including improvement of beef quality. Because of this interest, castration has been reintroduced to Costa Rica as production tool. For some niche markets, producers have incorporated late castration (>12 mo of age) to potentially increase the fatness and meat quality of subprimals from steers compared with subprimals from bulls yet take advantage of the believed superior growth rate and efficiency of bulls compared with early castrated steers. Few research trials have been conducted in Costa Rica using antemortem and postmortem technologies to improve beef quality and tenderness. Ardaya and Zapata (1999) found no difference in live animal performance between bulls and late-castration steers. Both Ardaya and Zapata (1999) and Arce and Murillo (2004) found *Longissimus* steaks from steers had lower (more tender) WBSF

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INTRODUCCIÓN

CHARACTERISTICS OF BEEF CARCASSES DERIVED FROM COSTA RICAN CATTLE AS AFFECTED BY GENDER AND DENTITION AGE

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Introduction

Costa Rica beef production is mainly grassfed cattle. This leads to harvest cattle at 36 months of age in average when these animals can reach a final weight acceptable to the market. In addition; there is a general preference locally for quantity or salable product rather than quality. Intact males (bulls) and females are harvested almost in similar proportion, just a slight percentage of the steers killed goes for differentiated niche market.

Objectives

To evaluate variation of carcass traits and cutability by gender and dentition age of cattle harvested in Costa Rica.

Methods

Cattle produced in Costa Rica were harvested in one of the three main federally-inspected plants of the country. The *Bos indicus* influenced animals were selected randomly and sex class was recorded (CLASS; 193 intact males [bulls], 123 castrates [steers] and 61 cull females predominantly cows). Liveweight (LIVEW) was taken immediately before harvesting, and the hot carcass weight (HCW) was recorded after processing to calculate the dressing percentage (DRESS%).

Dentition age (AGE) was estimated postmortem to segregate the animals in 12 mo (12MOA), 24 mo (24MOA) and 36 mo (36MOA). Scores for carcass finish (FINISH) and muscling (MUSCLING), and other carcass linear measurements (carcass length = CLENGTH; round circumference = ROUND; and Achilles tendon length = TENDONL) were taken before chilling. After 24 h postmortem, chilled carcasses were evaluated for determining ribeye area (REA), backfat thickness (BACKFAT), and fat color (FATCOL) scores. Chilled carcasses were weighed and fabricated following precise instructions on style and maximum fat cover, removing subcutaneous fat in excess to 2 mm. The weight of boneless, closely trimmed, total saleable cuts (TSP), clean bone (BONE%) and trim fat (FAT%) from the whole carcass were computed as a percentage of the chilled carcass weight (CCW). Descriptive and variance analyses were performed to determine the variation associated with gender, dentition age and their interaction.

Results

The LIVEW, HCW and CCW had a moderate variation (CV 15 to 18%) which corresponded well with the moderate variation observed in ROUND, REA, and BONE% (CV 13 to 15%). However, with this HCW range, FINISH and BACKFAT had a high variation (CV > 30%), as well as MUSCLING and FATC. In contrast, a low variation was detected (CV < 10%) for DRESS%, CLENGTH, TENDONL, and TSP%.

As expected, mean values of traits related to carcass meat yields were in favor of the bull and steer carcasses, which dressed the heaviest carcasses, with the most convex profile (MUSCLING) and bulging leg muscle (ROUND), the longest carcasses, the largest ribeye area and higher yields of TSP as compared to female carcasses ($P < 0.05$). In contrast, carcasses from females exhibited more abundant/uniform distribution FINISH, thicker BACKFAT, yellowish FATC, and higher BONE% ($P < 0.05$) than those from steers or bulls. As AGE advanced, carcasses were heavier, had longer TENDONL and CLENGHT, exhibited more abundant fat cover, and yielded more BONE% and TSP%. Analysis of variance detected a significant effect of the CLASS x AGE interaction on LIVEW, HCW, CCW, ROUND, FINISH, BONE%, TSP ($P < 0.05$). Both bulls and steers at 36MOA showed a noticeable heavier body and carcasses with higher TSP yields with respect to the female carcasses; however, steer carcasses at 36MO presented most bulging round, more abundant/uniform FINISH and lower BONE% with respect to bull and female carcasses at the same AGE ($P < 0.05$).

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INTRODUCCIÓN

- ✓ En Costa Rica la práctica de castrar es casi nula, sólo algunos nichos de calidad de carne lo exigen

- ✓ El mercado está más orientado a altos pesos de canal (volumen), que a factores asociados con la calidad

- ✓ A Finca San Julián le interesa tanto volumen como calidad, ya que ofrece sus productos a un nicho diferenciado

INTRODUCCIÓN

- ✓ Investigaciones revelan que en un plano nutricional mediano-bajo los toros no difieren de los novillos en PFF (Kg), PFP (Kg), PCC (Kg), RP/CC (%), CV (%), *SUAVIDAD ?*

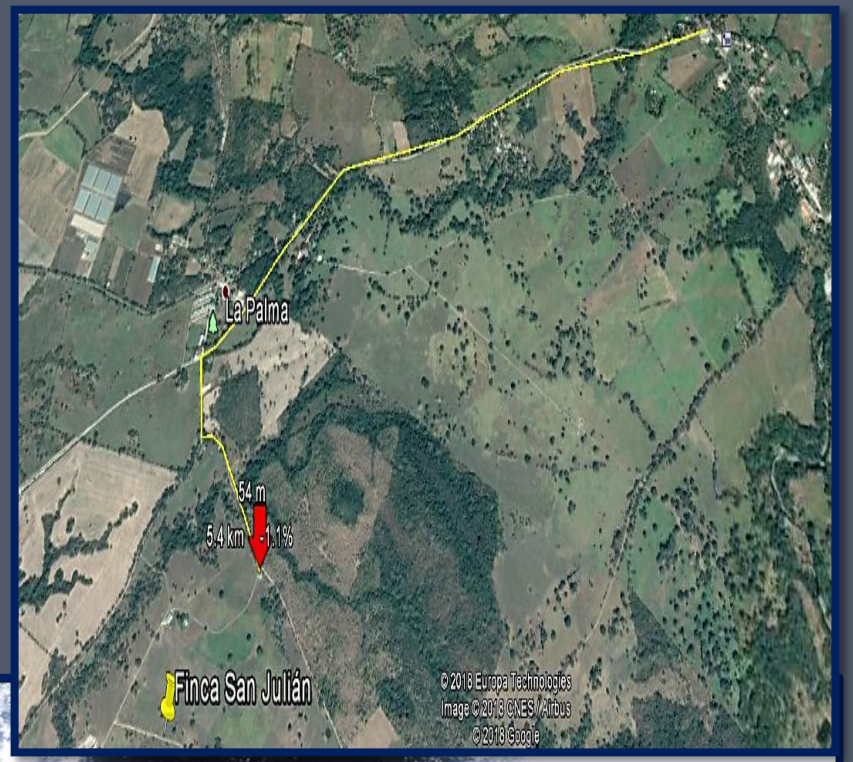
- ✓ Hipótesis: en un plano nutricional alto, los toretes (bullocks) producen más volumen de carne, misma que compite en suavidad con la de los novillos.

OBJETIVOS

- ✓ Evaluar el crecimiento entre novillos y toretes Brahman estabulados.
- ✓ Determinar la composición de la canal entre novillos y toretes Brahman estabulados.
- ✓ Comparar la terneza de la carne a los 14 días post-mortem de novillos y toretes Brahman estabulados.

DESCRIPCIÓN

*Propietario: Sr. Gilberto Rojas.
*Ubicación: Limonal de Abangares, Guanacaste.
*Área: 450 Ha.
*Sistema: Cría-engorde; Engorde en estabulación.
*Razas: Brahman, Angus, Charolais.



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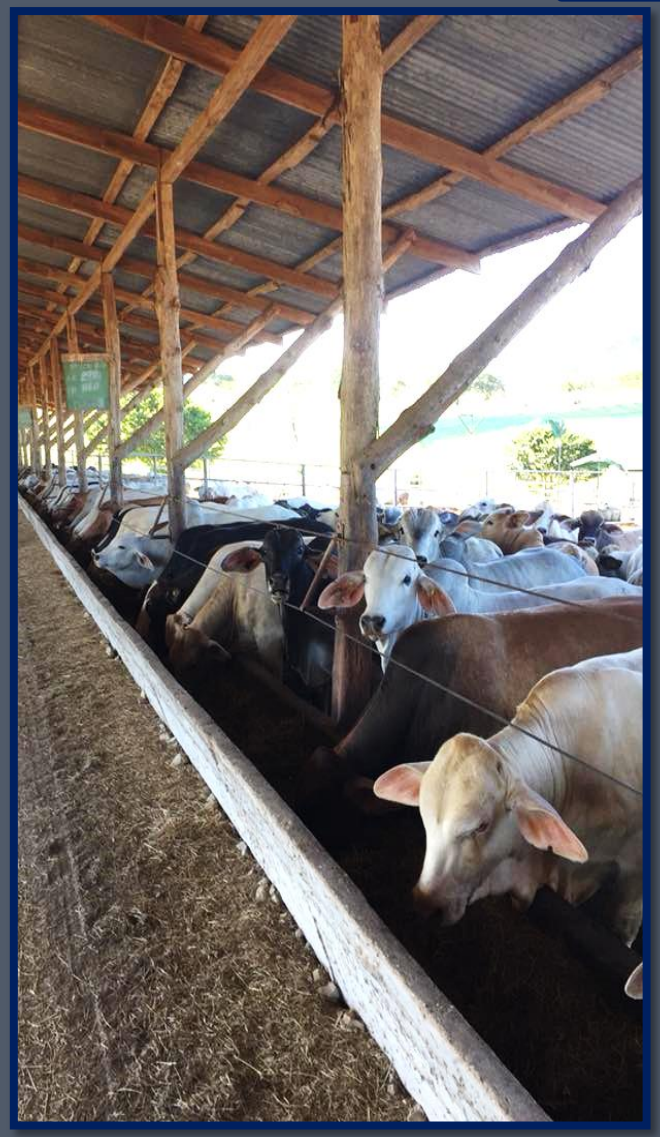
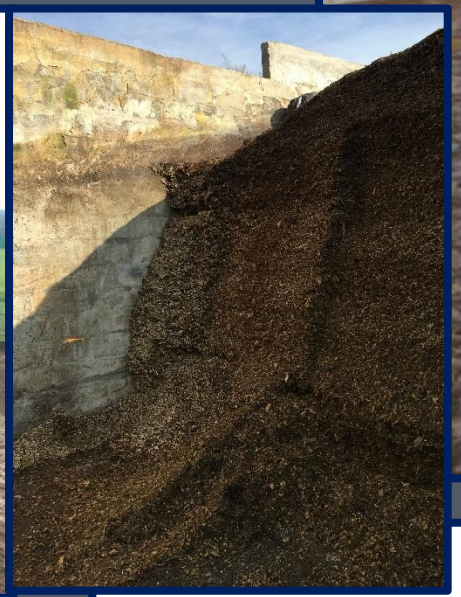
DESCRIPCIÓN





METODOLOGÍA-FASE DE CAMPO

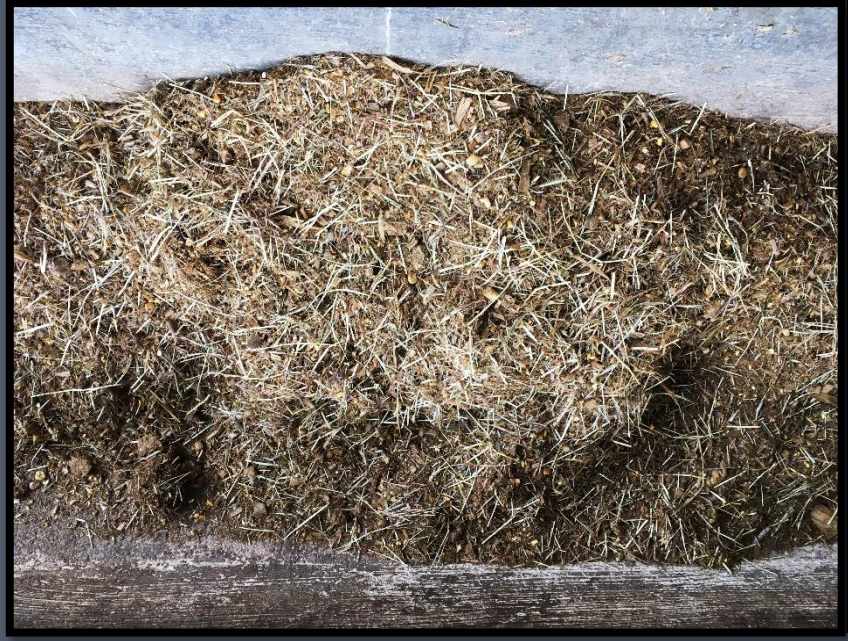
- ✓ 24 Animales, Brahman:
  - 11 TORETES (Uno descartado por problemas físicos).
  - 12 NOVILLOS (Castrados al nacer, elastrador).
- ✓ Destetados a los 7 meses.
- ✓ Ingresan a estabulado.
- ✓ Pesados mes a mes post-destete.

METODOLOGÍA-FASE DE CAMPO

- ✓ DIETAS:
  - 220 – 280 Kg
  - 280 – 400 Kg
  - 400 – 520 Kg

MINERALES
SAL
UREA
MELAZA
SILO DE MAÍZ
HENO ANGLETON
COQUITO
MAÍZ
SOYA
IONÓFOROS
LEVADURA

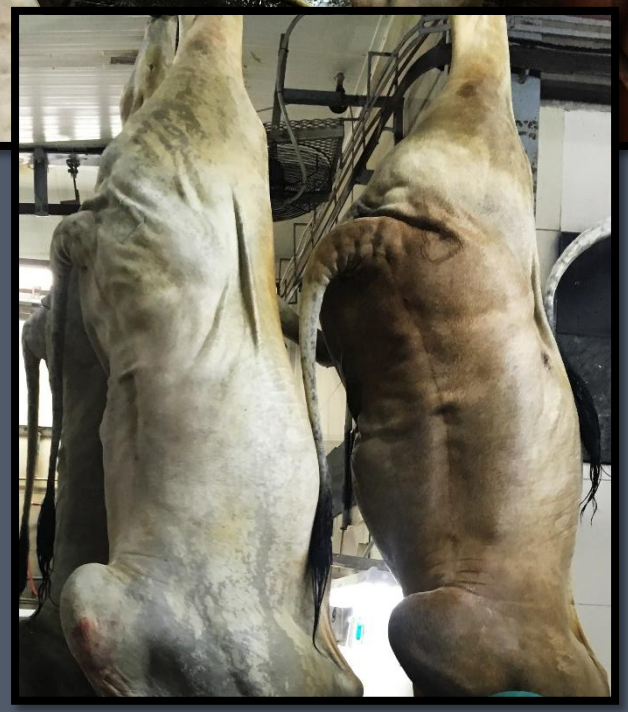


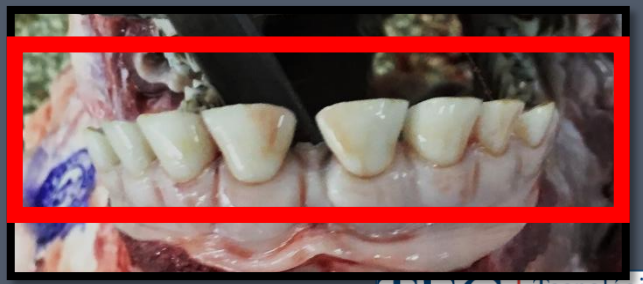



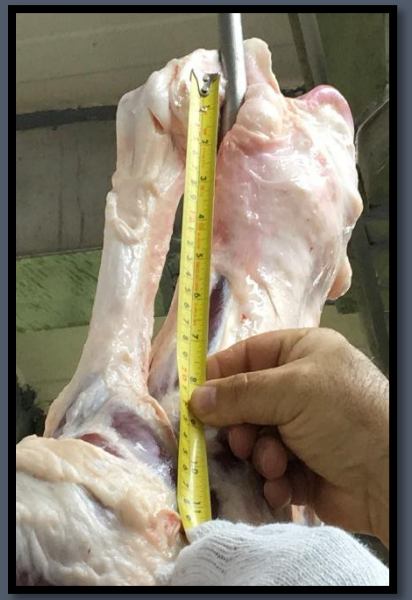
METODOLOGÍA-FASE DE PLANTA

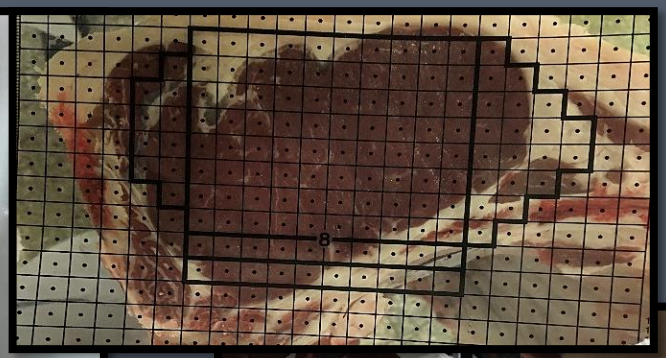
- ✓ **COSECHA, CIISA-ARREO:**
  - PPP (Kg), PCC (Kg), RPC (%), Dentición, Conformación muscular, Grasa de cobertura, Color de grasa.

- ✓ **DESHUESE, CIISA-ARREO:**
  - PCF (Kg), Merma CC/CF (%), pHu, T°, Longitud de canal (cm), Perímetro de pierna (cm), AOL (cm^2), Marmoleo, Espesor de grasa dorsal (mm), Largo de tendón de Aquiles.
  - Composición de la canal (músculo, hueso y sebo; %-Kg), Carne vendible (%-Kg).









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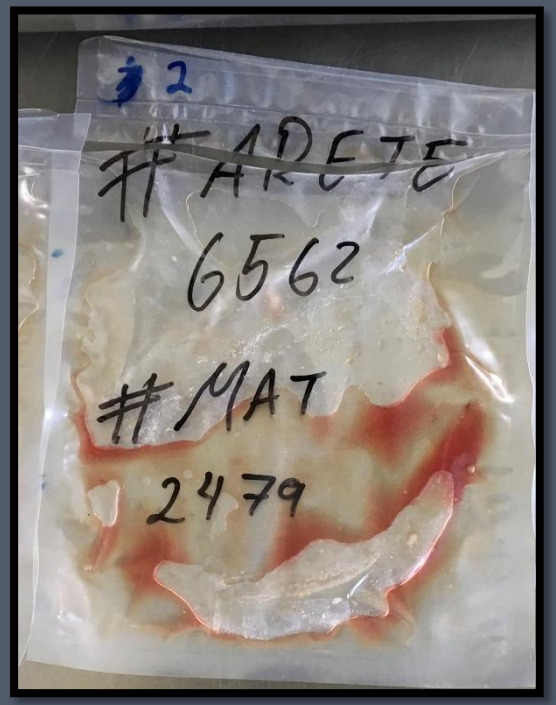
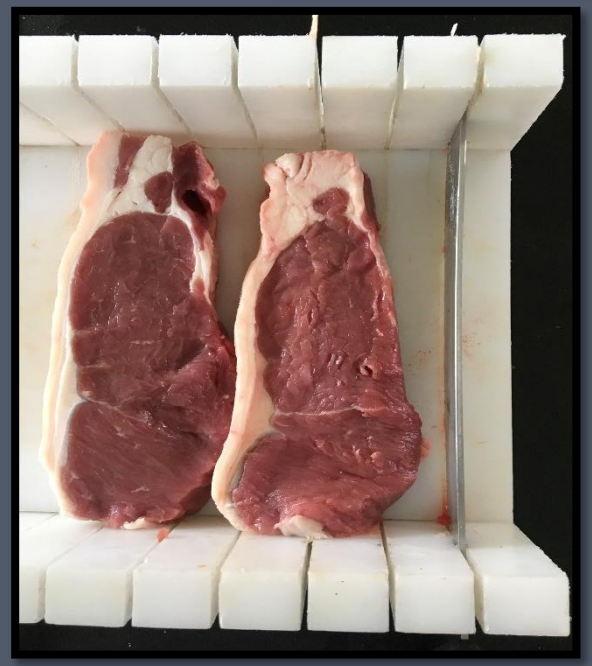
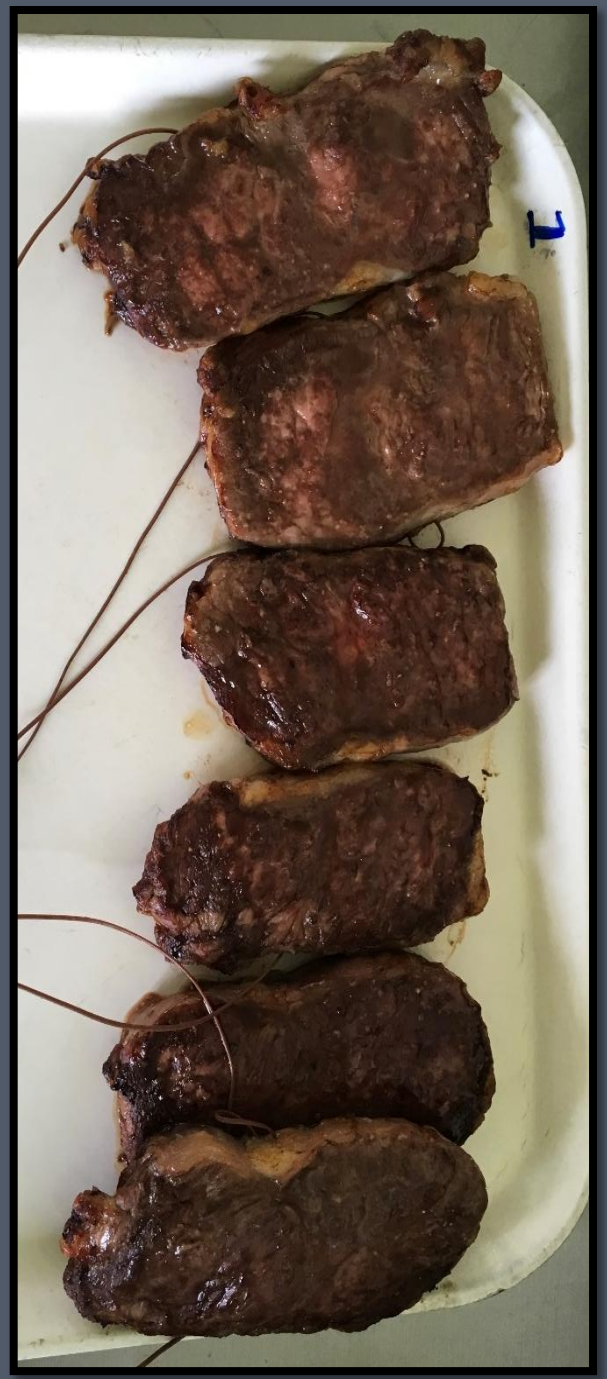
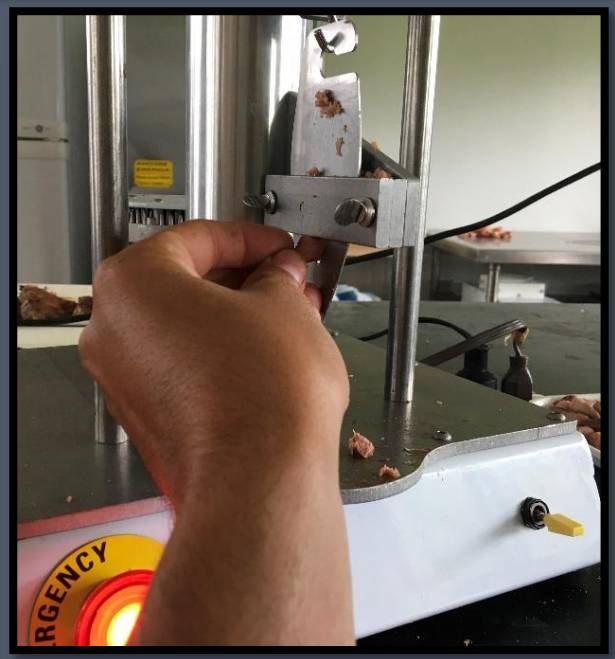
METODOLOGÍA-FASE DE LABORATORIO

- ✓ Muestra de *Longissimus dorsi lumborum* (lomo ancho), 1 pulg.
- ✓ Maduración en húmedo (14 días).
- ✓ Color del músculo (L*, a*, b*).
- ✓ Pérdida de liquído.
- ✓ Pérdidas por cocción.
- ✓ Fuerza de corte (WBSF).









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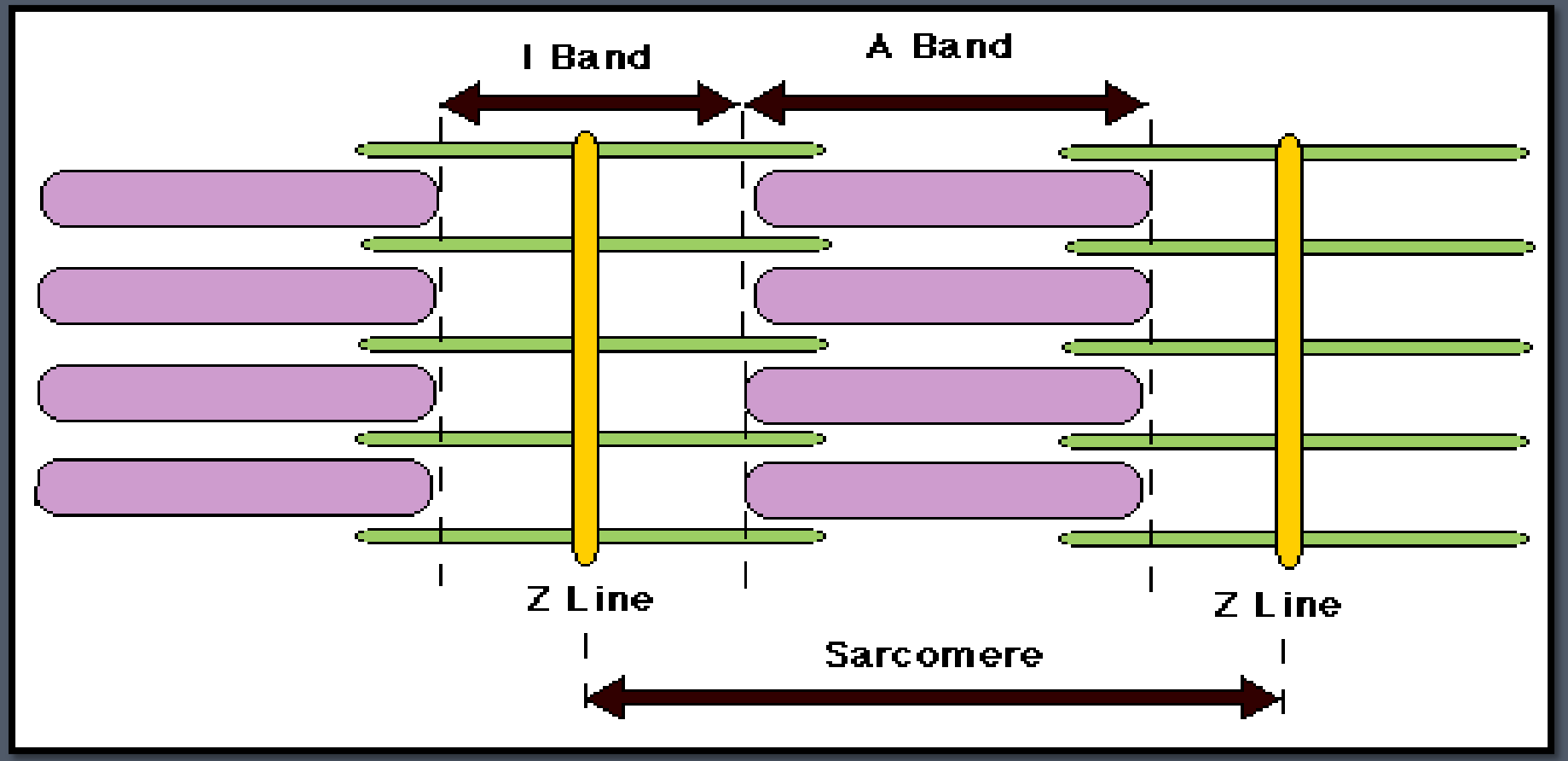
MADURACIÓN DE LA CARNE



MEDICIÓN FUERZA DE CORTE WARNER BRAZTLER SHEAR FORCE

Huffman et al., (1996) la fuerza de corte en el Warner-Bratzler de 4.1 Kg puede considerarse el punto límite (indica que el 98% de los consumidores podrían encontrar el lomo aceptable en términos de terneza o suavidad)

¿QUÉ DICE EL VALOR DEL WBSF?

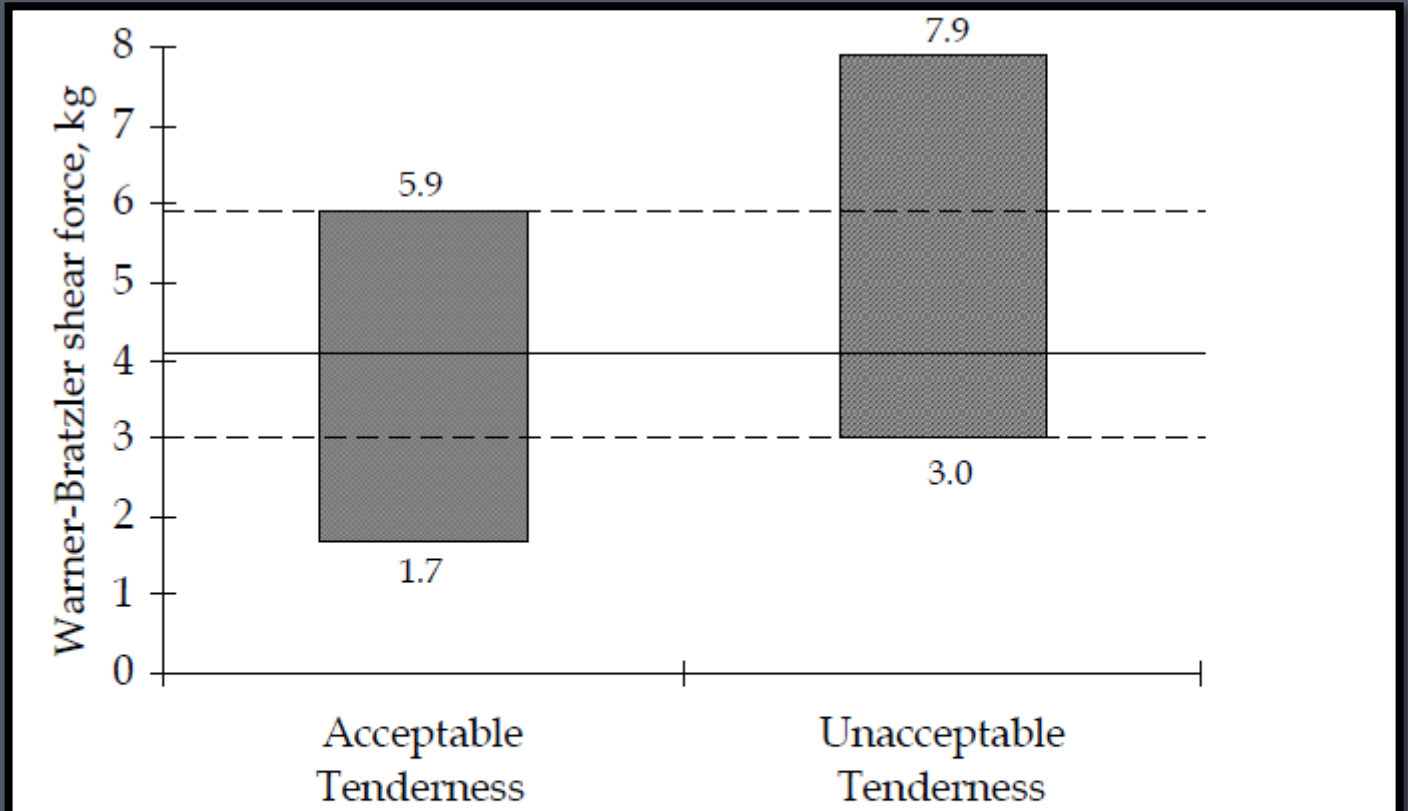


Figure 5. The range in Warner-Bratzler shear force for steaks consumers identified as unacceptable in tenderness and those identified as acceptable in tenderness. The proposed tenderness acceptability threshold was 4.1 kg. Adapted from Huffman et al. (1996).

RESULTADOS CRECIMIENTO

VARIABLE	NOVILLOS	TORETES
Peso al nacer (Kg)	35 ± 1.9	35.7 ± 1.5

[a,b] **Valores con diferente letra indican diferencias entre tratamientos. P <0,05.**

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RESULTADOS CRECIMIENTO

VARIABLE	NOVILLOS	TORETES
Peso al nacer (Kg)	35 ± 1.9	35.7 ± 1.5
Peso al destete (kg)	214 ± 30	223 ± 22.4
Peso Ajust. al destete (Kg)	217 ± 27.5	221 ± 21.3

[a,b] **Valores con diferente letra indican diferencias entre tratamientos. P <0,05.**

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Peso al destete (kg)	214 ± 30	223 ± 22.4
Peso Ajust. al destete (Kg)	217 ± 27.5	221 ± 21.3
GDP($^{kg \cdot día-1}$) post-destete	1.0^{a} ± 0.1	1.2^{b} ± 0.1

^{a,b} Valores con diferente letra indican diferencias entre tratamientos. P <0,05.

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GDP($^{kg \cdot día-1}$) post-destete	1.0^{a} ± 0.1	1.2^{b} ± 0.1
Peso Final Finca (Kg)	436^{a} ± 42.4	512^{b} ± 42

^{a,b} Valores con diferente letra indican diferencias entre tratamientos. P <0,05.

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GDP($^{kg \cdot día-1}$) post-destete	1.0^{a} ± 0.1	1.2^{b} ± 0.1
Peso Final Finca (Kg)	436^{a} ± 42.4	512^{b} ± 42
Edad (Días)	444 ± 7.8	446 ± 6

^{a,b} Valores con diferente letra indican diferencias entre tratamientos. P <0,05.

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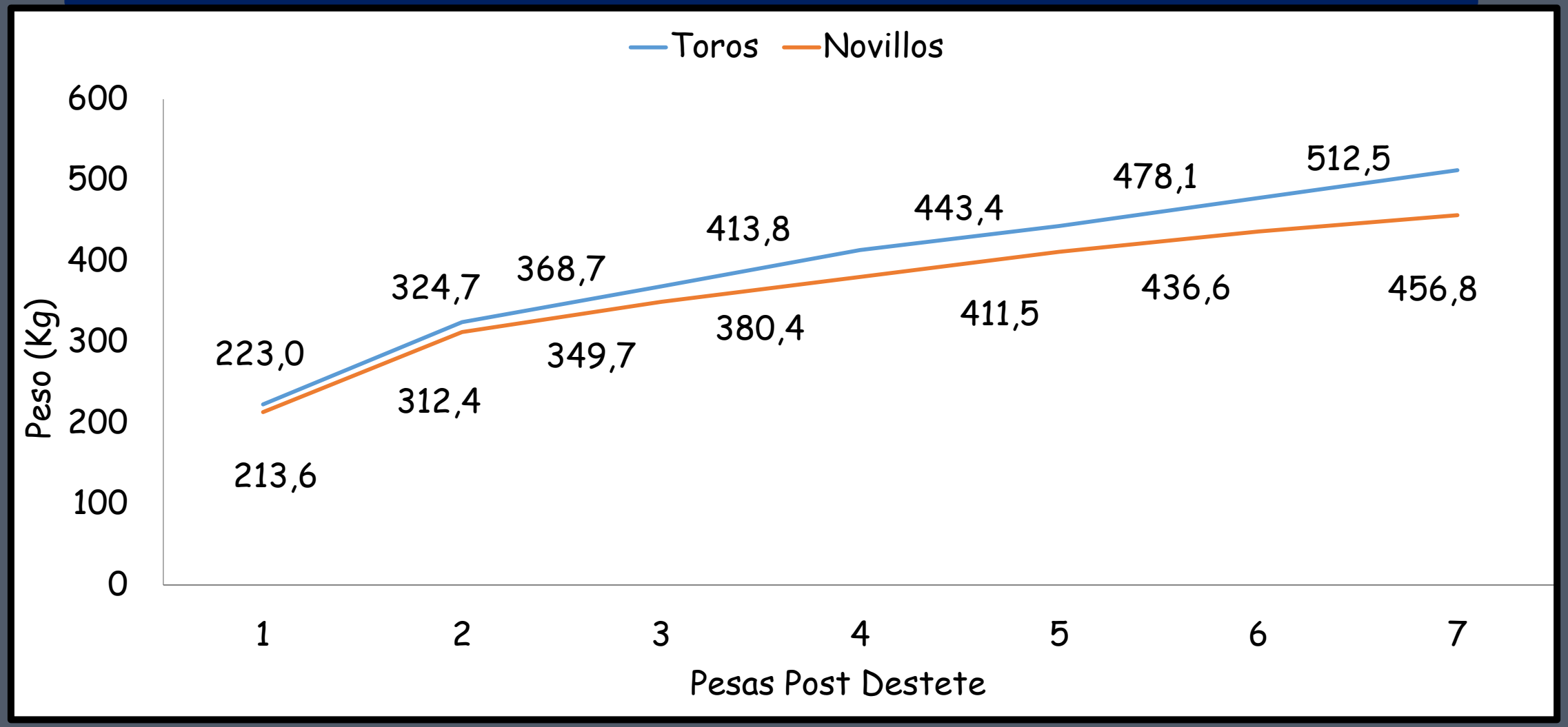
CURVA DE CRECIMIENTO TORETES vs. NOVILLOS, FINCA SAN JULIÁN



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RESULTADOS COSECHA

VARIABLE	NOVILLOS	TORETES
Peso en planta (Kg)	$427.1^{a} \pm 9.2$	$472.7^{b} \pm 11.6$

[a,b] Valores con diferente letra indican diferencias entre tratamientos. P <0,05.

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RESULTADOS COSECHA

VARIABLE	NOVILLOS	TORETES
Peso en planta (Kg)	$427.1^{a} \pm 9.2$	$472.7^{b} \pm 11.6$
Peso Canal Caliente (Kg)	$258.5^{a} \pm 6$	$276.8^{b} \pm 6.1$

[a,b] Valores con diferente letra indican diferencias entre tratamientos. P <0,05.

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RESULTADOS COSECHA

VARIABLE	NOVILLOS	TORETES
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Peso Canal Caliente (Kg)	$258.5^{a} \pm 6$	$276.8^{b} \pm 6.1$
Rendimiento P/C (%)	$60.6^{a} \pm 0.5$	$58.6^{b} \pm 0.4$

^{a,b} Valores con diferente letra indican diferencias entre tratamientos. P <0,05.

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RESULTADOS COSECHA

VARIABLE	NOVILLOS	TORETES
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Rendimiento P/C (%)	$60.6^{a} \pm 0.5$	$58.6^{b} \pm 0.4$
Peso cuero (Kg)	$40.2^{a} \pm 1.3$	$48.5^{b} \pm 1.6$

[a,b] Valores con diferente letra indican diferencias entre tratamientos. P <0,05.

Salas y Rodríguez, SF

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RESULTADOS COSECHA

VARIABLE	NOVILLOS	TORETES
Peso en planta (Kg)	$427.1^{a} \pm 9.2$	$472.7^{b} \pm 11.6$
Peso Canal Caliente (Kg)	$258.5^{a} \pm 6$	$276.8^{b} \pm 6.1$
Rendimiento P/C (%)	$60.6^{a} \pm 0.5$	$58.6^{b} \pm 0.4$
Peso cuero (Kg)	$40.2^{a} \pm 1.3$	$48.5^{b} \pm 1.6$
Peso de Canal Fría (Kg)	$253^{a} \pm 5.9$	$271.2^{b} \pm 6$

[a,b] Valores con diferente letra indican diferencias entre tratamientos. P <0,05.

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RESULTADOS COSECHA

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Peso cuero (Kg)	$40.2^{a} \pm 1.3$	$48.5^{b} \pm 1.6$
Peso de Canal Fría (Kg)	$253^{a} \pm 5.9$	$271.2^{b} \pm 6$
Peso Media Canal Fría (Kg)	129 ± 3	137 ± 3.1

^{a,b} Valores con diferente letra indican diferencias entre tratamientos. P <0,05.

Salas y Rodríguez, SF

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RESULTADOS COSECHA

VARIABLE	NOVILLOS	TORETES
Grasa Dorsal (mm)	0.4 ± 0.1	0.3 ± 0.03

[a,b] **Valores con diferente letra indican diferencias entre tratamientos. P <0,05.**

Salas y Rodríguez, SF

RESULTADOS COSECHA

VARIABLE	NOVILLOS	TORETES
Grasa Dorsal (mm)	0.4 ± 0.1	0.3 ± 0.03
Área Ojo del Lomo (cm^2)	61.3^a ± 2.4	71.7^b ± 1.5

^{a,b} Valores con diferente letra indican diferencias entre tratamientos. P <0,05.

Salas y Rodríguez, SF

RESULTADOS COSECHA

VARIABLE	NOVILLOS	TORETES
Grasa Dorsal (mm)	0.4 ± 0.1	0.3 ± 0.03
Área Ojo del Lomo (cm^2)	61.3^a ± 2.4	71.7^b ± 1.5
pH (24 h post-mortem)	5.9^a ± 0.03	5.4^b ± 0.04

^{a,b} Valores con diferente letra indican diferencias entre tratamientos. P <0,05.

Salas y Rodríguez, SF

RESULTADOS COSECHA

VARIABLE	NOVILLOS	TORETES
Carne Vendible (%)	74^{a} ± 0.01	78^{b} ± 0.03
Carne Vendible (Kg)	95.2^{a} ± 2.3	107^{b} ± 2.5

^{a,b} Valores con diferente letra indican diferencias entre tratamientos. P <0,05.

Salas y Rodríguez, SF

RESULTADOS COSECHA

VARIABLE	NOVILLOS	TORETES
Carne Vendible (%)	$74^{a} \pm 0.01$	$78^{b} \pm 0.03$
Carne Vendible (Kg)	$95.2^{a} \pm 2.3$	$107^{b} \pm 2.5$
Hueso (%)	17.4 ± 0.01	17.7 ± 0.01
Hueso (Kg)	$24.3^{a} \pm 0.4$	$22.4^{b} \pm 0.5$

^{a,b} Valores con diferente letra indican diferencias entre tratamientos. P <0,05.

Salas y Rodríguez, SF

TEC Tecnológico de Costa Rica

RESULTADOS COSECHA

VARIABLE	NOVILLOS	TORETES
Carne Vendible (%)	74^{a} ± 0.01	78^{b} ± 0.03
Carne Vendible (Kg)	95.2^{a} ± 2.3	107^{b} ± 2.5
Hueso (%)	17.4 ± 0.01	17.7 ± 0.01
Hueso (Kg)	24.3^{a} ± 0.4	22.4^{b} ± 0.5
Grasa (%)	8.7 ± 0.01	4.3 ± 0.01
Grasa (Kg)	11.1^{a} ± 0.7	5.9^{b} ± 0.6

^{a,b} Valores con diferente letra indican diferencias entre tratamientos. P <0,05.

Salas y Rodríguez, SF

RESULTADOS COSECHA

CORTES FINOS	NOVILLOS	TORETES
Lomito, Lomo Ancho, Cola de Lomo, Lomo de Aguja, Vuelta de Lomo, Punta de Solomo (Kg).	13.3 ± 0.5	14.5 ± 0.5
Lomito, Lomo Ancho, Cola de Lomo, Lomo de Aguja, Vuelta de Lomo, Punta de Solomo (%).		

Salas y Rodríguez, SF

RESULTADOS COSECHA

CORTES FINOS	NOVILLOS	TORETES
Lomito, Lomo Ancho, Cola de Lomo, Lomo de Aguja, Vuelta de Lomo, Punta de Solomo (Kg).	13.3 ± 0.5	14.5 ± 0.5
Lomito, Lomo Ancho, Cola de Lomo, Lomo de Aguja, Vuelta de Lomo, Punta de Solomo (%).	10.5 ± 0.1	10.3 ± 0.1

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RESULTADOS LABORATORIO

VARIABLE	NOVILLOS	TORETES
Pérdida de líquido (%)	$3.3^{a} \pm 0.3$	$5^{b} \pm 0.3$
Pérdida por cocción (%)	26.6 ± 0.1	26.1 ± 0.2

Salas y Rodríguez, SF

TEC Tecnológico de Costa Rica

RESULTADOS LABORATORIO

VARIABLE	NOVILLOS	TORETES
Pérdida de líquido (%)	$3.3^{a} \pm 0.3$	$5^{b} \pm 0.3$
Pérdida por cocción (%)	26.6 ± 0.1	26.1 ± 0.2
Color L* (Brillo)	46.4 ± 0.5	45.1 ± 0.6
Color a* (Rojo-Verde)	13.7 ± 0.3	14.4 ± 0.2
Color b* (Azul-Amarillo)	14.8 ± 0.3	15 ± 0.3

Salas y Rodríguez, SF

TEC Tecnológico de Costa Rica

RESULTADOS LABORATORIO

VARIABLE	NOVILLOS	TORETES
Pérdida de líquido (%)	$3.3^{a} \pm 0.3$	$5^{b} \pm 0.3$
Pérdida por cocción (%)	26.6 ± 0.1	26.1 ± 0.2
Color L* (Brillo)	46.4 ± 0.5	45.1 ± 0.6
Color a* (Rojo-Verde)	13.7 ± 0.3	14.4 ± 0.2
Color b* (Azul-Amarillo)	14.8 ± 0.3	15 ± 0.3
Fuerza de corte (Kg)	5.7 ± 0.4	5 ± 0.3

^{a,b} Valores con diferente letra indican diferencias entre tratamientos. P <0,05.

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CONCLUSIONES

- ✓ Los toretes (bullocks) presentaron mayor GDP y PFF que los novillos a la misma edad (efecto hormonal).
- ✓ Los canales de toretes produjeron más carne, menos hueso y menos grasa que los novillos a la misma edad (efecto hormonal).
- ✓ La terneza de la carne de toretes es igual a los 14 días de maduración comparada a la de los novillos, probablemente asociado a pocos enlaces cruzados de colágeno del tejido conectivo.

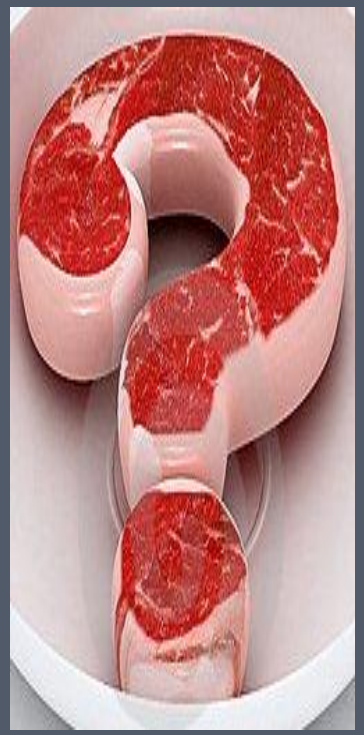
CONCLUSIONES

- ✓ Ninguno de los tratamientos presentó marmoleo, sin embargo, la terneza del lomo ancho alcanzó valores ligeramente suaves.

- ✓ A pesar de que la raza Brahman se señala como una raza productora de carne menos tierna que la de los *Bos taurus*, con un manejo nutricional alto, se logran valores de terneza bastante aceptables.

- ✓ Finca San Julián, obtiene más ingresos por producir toretes (bullocks) y logra la misma terneza de la carne que con animales castrados.

CONCLUSIONES



- ✓ CARNE ORGÁNICA---- 18,9 $/kg
- ✓ PASTOREO---------- 13.6 $/kg
- ✓ CARNE NATURAL----- 13.4 $/kg
- ✓ MAGRA------------- 6.3 $/kg
- ✓ COMMODITY--------- 5.2 $/kg

Fuente: https://www.ams.usda.gov/mnreports/lsmngfbeef.pdf

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- ✓ Familia Rojas Rodríguez (San Julián)
- ✓ ASOCEBU-CR
- ✓ CIISA-Arreo

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RESUMEN DE ESTUDIO, 2012

- ✓ 4 Tratamientos (n=48)
  - CASTRADOS A LOS 3 MESES
  - CASTRADOS A LOS 7 MESES
  - CASTRADOS A LOS 12 MESES
  - GRUPO CONTROL (TOROS)

- ✓ Brahman
- ✓ Alimentados a pasto
- ✓ Cosechados a los 22 meses de edad

RESUMEN DE ESTUDIO, 2012

TRATAMIENTO	EDAD DE CASTRACIÓN			TOROS
	3 meses	7 meses	12 meses	
Edad (Días)	652	670	662	668
Peso finca (kg)	427.5	439.1	424.3	437
GDP (kg)	0.4	0.6	0.5	0.5
Peso planta (kg)	391.6	407	391.7	403.3
Peso canal (kg)	214.2	223.6	213.4	217.3
Rendimiento canal (%)	55.1	55.2	54.8	54.3
Grosor de grasa (cm)	0.23	0.23	0.23	0.23
Área ojo de lomo (cm^2)	61.0	62.3	60.2	62.4
Total carne (kg)	82.4	86.3	81.2	82.7
Total carne (%)	76.8	76.9	75.8	75.3

Fuente: Rodríguez et al, 2012

RESUMEN DE ESTUDIO, 2012

TRATAMIENTO Fuerza de Corte (Kg)	EDAD DE CASTRACIÓN			TOROS
	3 meses	7 meses	12 meses	
2 d	10.1^{x}	10.8^{x}	9.5^{x}	10.5^{x}
7 d	9.3^{xy}	9.7^{x}	9.2^{xy}	10.1^{xy}
14 d	8.7^{y}	10.0^{x}	9.4^{x}	10.5^{x}
28 d	6.4^{z}	6.8^{y}	8.2^{y}	9.0^{y}

$^{x-z}$ En la columna ($P < 0.05$)

Fuente: Rodríguez et al, 2012