

Preliminary Results for the Biochemical Profile Before Slaughtering and Meat Quality of Three Commercial Beef Hybrids

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Abstract

This research is subscribed of an extensive project that has as main objective the production of crossbred specialized beef hybrids from reformed Romanian Black Spotted cattle's with bulls from breeds specialized in meat production (Blue Blanch Belgique, Aberdeen-Angus and Limousin). The average biochemical indicators analyzed showed a normal state of animal's health. The obtained half-breeds products (bulls) were raised under semi-intensive conditions and slaughtered at 12 months of age. Live weight, back-fat thickness and carcass traits were significantly influenced by breed, all fat parameters being lower at this age than at the standard minimum age of slaughter for meat production (18 months). Drip loss and chemical composition were similar for the breeds. The meat was lighter and pH₂₄ values of *longissimus* muscle were between 5.57 and 5.64. Sensory panel tenderness and Warner-Bratzler shear force values indicated tougher meat at RBSxAA than at RBSxLi or RBSxBBB. Differences in meat quality were probably due to the combined effects of raw chemical composition and pH dynamics during ripening. It was concluded that slaughtering steers at younger ages may require supplementary feeding; the recommended slaughter age was between 18 and 25 months old.

Keywords: beef meat quality, beef commercial hybrids, biochemical profile.

1. Introduction

Dairy cattle are an important first line for the universal agriculture due to its volume, diversity and value of production and products obtained from this activity. In Romania, this activity has a tradition among the rural population, their low power consumption and their natural diets give a character of sustainable activity for the future [1]. The national strategy is focused on the continuous improvement of the indigenous breeds with the economic support of the farmers. From this point of view, the indigenous cows breed, reformed on the

basis of the annual milk production (selective reform) can be used in industrial crosses at first generation with bull breeds specialized in meat production, the resulting products being entirely fattened and slaughtered for the meat production.

This transition solution in dairy cows is a viable alternative for many farmers, especially if they face or will face difficulties in achieving required milk quality according to the EU standards or for those that have an insufficient milk quota [2].

2. Materials and methods

This research is subscribed to an extensive project that has as main objective the production of crossbred specialized on beef hybrids from the

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reformed Romanian Black Spotted cattle's with bulls from breeds specialized in meat production (Blue Blanch Belgique, Aberdeen-Angus and Limousin). The experiment was conducted on the affiliated farm for *Cattle Breeding Research Station from Dancu, Iași* (47°09'23.2" N, 27°38'55.8" E), Romania. It started in October 2011, being in progress at this time.

Throughout this period, the obtained bulls of each hybrid (RBSxBBB, RBSxAA, RBSxLi) were housed in a free stalls system (~5.0 m² per bull) in an uninsulated barn with straw bedding. After weaning, at approximately 6 months old, they were given a mixed diet available *ad libitum* based on daily energetic and protein concentrates: approximately 56% dry matter (DM) (6.09 kg DM), 0.599 kg PDIN, 0.559 kg PDIE and minerals as: 0.038 kg Ca and 0.025 kg P.

The bulls were weighed once a month to determine their daily average live weight gain. The feed intake was not measured exactly because the bulls of each breed were housed in the same barn and there were no individual observations for the feed intake.

Before slaughtering, the animals were weighed on two consecutive days. At this time, the blood samples were taken using sterile needles from the jugular venipuncture in tubes with clot activator (Kima Italy, 8 mL). All blood samples were centrifuged at 2.3 x g for 15 minutes, the resulting serum was transferred into Eppendorf tubes and stored at -20°C until the biochemical analyzes were made. Total protein, cholesterol, triglyceride, glucose, calcium, magnesium, alkaline phosphatase, GGT, ALT, AST, creatinine and BUN levels were spectrophotometrically measured (ACCENT 200) in serum using Cormay commercial kits. The results are presented in the study as mean±standard error.

At the intermediary target age of 12 months, the animals were transported for 150 km to an abattoir and slaughtered, using the standard Romanian techniques and conditions for the handling procedures. After slaughter, the carcasses were weighed hot, the weight of cold carcasses being estimated as 0.98 of the hot carcass weight [3].

After a chill period of approximately 24 h *post-mortem*, the carcasses were quartered, and all carcasses measurements were recorded and the sampling was conducted: *m. longissimus lumborum* and *thoracis* being collected somewhere between the 9th and 11th rib.

Slaughtering yield (SY) was calculated as the proportion of the hot carcass weight (CW) at live weight (LW). Back-fat thickness (BFT) was measured in the 12th rib, *ca.* 5 cm from the dorsal midline. All kidney (KF) and omental fat (OF) were removed, weighed and expressed as a CW percentage.

Longissimus muscle was immediately dissected, labeled and kept at 0–4°C until drip losses were determined later on the same day. Cooking losses were determined 48 hours *post-mortem* (cooked for 45 minutes at 75°C). Cooked samples were cooled at the room temperature under running water for 30 min. (~25°C) prior to the final weight determination [4].

To determine the Warner-Bratzler shear force values (WBS), five 15 mm diameter cores were cut perpendicular to the longitudinal axis of the muscle fibers at a crosshead speed of 100 mm/min from the same samples used to determine cooking losses, the maximum force required for cutting the piece being the indicator of the meat tenderness. In order to determine the forces it was used a specific blade (a 60° angle and a 1000 N cutting force) attached to the TA Plus Lloyd Instruments machine, the mean WBS values of the five cores being calculated [4, 5].

The pH was measured at 24 hours *post mortem* before packaging, practicing the successive immersion in a suspension of distilled water and triturate of each studied piece, using the Hanna Instruments 98240 ohmmeter electrode (aqueous extract).

For the basic chemical analysis it was homogenized a total of 27 tissue samples. The raw protein content was determined through the Kjeldahl method (the TURBOTHERM infrared digestion system+the TURBOSOG suction system+the VAPODEST distillation systems). Dry matter content was determined through oven drying at 105°C to a constant weight. Dried samples were analyzed for total lipids through the Soxhlet method (petrol ether extract, Soxtherm 416) and ash (6 h, 550°C) [6].

Meat colour was evaluated after thawing the samples, on the transversal section of *longissimus* muscles with a portable Minolta CM-2600d colorimeter, which characterises colour based on the L* (lightness), a* (red colour intensity), b* (yellow colour intensity) coordinates of the CIELAB system—CIE “Comission International de L'Eclairage system”. The reading observer used

the standard angle of 10° and the D65 illuminant with an included specular reflectance [7].

Before the analysis, a total of 27 tissue samples (*m. longissimus* from 9-RBSxBBB, 7-RBSxAA, 11-RBSxLi) were vacuum-packaged, aged for 4 days at approx. 4°C, frozen at -20°C, then slowly thawed and maintained at 4°C for 24 h. To highlight the sensory properties, they were subjected to the conventional baking at 150°C achieving a sample temperature of 67–72°C, all parameters used for sensory meat evaluation being defined according to literature's protocol. After cooking, the samples were immediately cut into 2 x 2 cm thick slices, coded and presented without delay to the panellists. The sensory properties (aroma, flavor, texture and juiciness) of the cooked samples were evaluated on a 7 point scale regarding their expression intensity (1–worst, 7–best). The average panellist's scores for each sample were used for statistical analyses [8].

Mean differences between breed were tested using the Tukey's t-test [9].

3. Results and discussion

The metabolic profile comparison of these breed genetic types bulls has been made with the reference values for cows in the literature. As it is obvious from Table 1, most breeding bulls values are similar to those found in the literature [10], although the data are for cows. The differences between groups in the results for some biochemical parameters could be explained by the lack in animal's nutrition, although the values

were within the safety range. From this point of view we can say that the animals were healthy before slaughter.

At this intermediary age there were found significant differences ($p < 0.001$) between breeds in final LW, CW and SY. The carcass weight of the RBSxBBB was 24.84% and 19.91% higher than that of the RBSxAA and RBSxLi, a summary of slaughter indicators is shown in Table 2.

The amount and proportion of KF were the highest in RBSxLi and the lowest in RBSxAA, the breed having no influence on these parameters ($p > 0.05$). The OF proportion was influenced by breed, being the highest in RBSxLi ($p < 0.01$), while the BFT was not influenced by this genetic factor ($p > 0.05$).

The results of the chemical analysis are shown in Table 3. *Longissimus* muscle samples from RBSxAA bulls had a higher ($p < 0.001$) lipid content than the samples from RBSxBBB or RBSxLi, the highest content of dry matter being found in the same breed line ($p < 0.001$), while RBSxBBB had the highest protein content ($p = 0.007$). These results indicate that the increase in the lipid concentrations was associated with the increased dry matter content and the decreased protein content, which is in accordance with the findings of Van Koevering et al., (1995) [11] and Bureš et al., (2006) [12].

The pH₂₄ (Table 3) did not differ ($p > 0.05$) among the genetic breed types, but was lower in RBSxLi than RBSxAA or RBSxBBB muscle samples. No significant differences among breed types were observed for drip and cooking losses.

Table 1. Mean±S.E. values of some blood biochemical parameters in breeding bulls' serum, before slaughter

Parameter	Breed			Reference values*
	RBSxBBB n=9	RBSxAA n=7	RBSxLi n=11	
Total protein [g/dL]	7.03±0.12	6.78±0.04	6.81±0.03	6.7–7.5
Cholesterol [mg/dL]	116.7±7.56	104.7±5.28	66.4±8.20	62–193
Triglycerides [mg/dL]	22.8±0.13	22.5±0.09	22.7±0.15	24–27
Glucose [mg/dL]	50.2±4.28	68.5±3.84	58.3±7.29	40–100
Calcium [mg/dL]	8.53±0.14	8.72±0.11	13.49±0.07	8–11.4
Magnesium [mg/dL]	3.41±0.08	2.82±0.10	2.32±0.04	1.5–2.9
Alkaline phosphatase [UI/L]	118.8±2.86	132.4±2.16	121.1±5.42	18–153
GGT (gamma glutamyltransferase) [UI/L]	10.2±1.07	14.12±1.61	16.6±0.94	6–17.4
ALT (alaninaminotransferase) [UI/L]	30.9±1.55	26.5±1.96	22.6±3.17	6.9–35
AST (aspartataminotransferase) [UI/L]	93.3±9.55	69.07±11.31	81.8±11.29	60–125
Creatinine [mg/dL]	2.44±0.43	1.17±0.20	1.05±0.08	0.5–2.2
BUN (blood urea nitrogen) [mg/dL]	9.91±5.11	11.59±3.69	10.77±3.08	10–25

* The Meck Veterinary Manual, online at:

http://www.merckmanuals.com/vet/appendixes/reference_guides/serum_biochemical_reference_ranges.html [10]

Table 2. Effect of breed on some slaughter parameters

Parameter	Breed			p value
	RBSxBBB n=9	RBSxAA n=7	RBSxLi n=11	
Live weight (kg)	352.27 ^a ±9.80	303.82 ^b ±10.13	310.63 ^b ±5.73	< 0.001
Hot carcass weight (kg)	200.52 ^a ±4.62	160.61 ^b ±8.81	167.22 ^b ±5.80	< 0.001
Cold carcass weight (kg)	196.51 ^a ±4.51	157.40 ^b ±8.90	163.88 ^b ±5.75	< 0.001
Slaughter yield (%)	56.92 ^a ±1.12	52.86 ^b ±0.95	53.83 ^b ±1.31	< 0.001
Fat characteristics				
Kidney fat (g)	1383.31±22.58	1295.60±17.68	1421.32±23.41	0.442
Kidney fat (%)*	0.69±0.051	0.81±0.042	0.85±0.039	0.709
Omental fat (g)	1502.92±30.15	1411.62±21.64	1544.22±24.10	0.627
Omental fat (%)*	0.75 ^b ±0.048	0.88 ^{ab} ±0.053	0.92 ^a ±0.061	0.005
Back fat thickness (mm)	1.13±0.13	1.83±0.41	1.37±0.21	0.063

Values with different superscripts (a, b) differ significantly (p<0.05)

Table 3. Effect of breed on meat quality of *longissimus* muscle

Parameter	Breed			p value
	RBSxBBB n=9	RBSxAA n=7	RBSxLi n=11	
Chemical analysis				
Dry matter (%)	22.95 ^b ±1.19	25.62 ^a ±1.30	25.03 ^a ±2.13	<0.001
Protein (%)	21.88 ^a ±0.71	19.87 ^b ±0.88	20.50 ^{ab} ±0.61	0.007
Lipid (%)	1.54 ^b ±2.11	2.07 ^a ±2.27	1.53 ^b ±1.38	<0.001
Ash (%)	1.07±0.05	1.15±0.03	1.10±0.08	0.382
pH ₂₄	5.63±0.08	5.58±0.05	5.51±0.04	0.072
Drip loss (%)	1.27±0.21	1.32±0.08	1.47±0.16	0.057
Cooking loss (%)	33.61±0.40	34.26±0.32	33.81±0.17	0.068
Colour				
L*	32.91 ^b ±0.51	33.28 ^{ab} ±0.34	34.17 ^a ±0.19	0.029
a*	14.57 ^a ±0.83	12.20 ^{ab} ±0.21	11.23 ^b ±0.37	<0.001
b*	10.25±0.40	9.15±0.20	10.05±0.18	0.638
Warner-Bratzler shear force (N)	48.72 ^c ±3.07	56.03 ^a ±3.12	51.03 ^b ±2.86	<0.001

Values with different superscripts (a, b, c) differ significantly (p<0.05)

In the present study, the meat was slightly lighter, the L* and a* values being influenced by the breed (p<0.05), the color of the *longissimus* muscle from RBSxLi having the highest L* mean values and the lowest a* mean values.

The Warner-Bratzler shear force values indicated a tougher meat for the RBSxAA than for the RBSxLi or RBSxBBB, differences between groups being significant (p<0.001).

There were significant but generally small differences in sensory traits between breeds (Table 4). The meat from the RBSxAA bulls received the highest scores for all sensory parameters, this being associated with intramuscular fat content. Our results are in accordance with those described by Gregory et al. (1994b) [13], who also found high correlations between these scores and the intramuscular fat percentage.

Table 4. Effect of breed on sensorial meat quality

Parameter	Breed			p value
	RBSxBBB n=9	RBSxAA n=7	RBSxLi n=11	
Aroma	5.73 ^{ab} ±0.063	5.92 ^a ±0.128	5.67 ^b ±0.129	0.0012
Flavour	5.65 ^b ±0.072	5.85 ^a ±0.172	5.53 ^b ±0.072	< 0.001
Texture	4.83 ^c ±0.131	5.66 ^a ±0.082	5.18 ^b ±0.059	< 0.001
Juiciness	5.00 ^b ±0.092	5.29 ^a ±0.091	4.82 ^c ±0.211	< 0.001

Values with different superscripts (a, b, c) differ significantly (p<0.05)

4. Conclusions

The results of the physicochemical and sensory analyses point the high processing suitability and eating quality of the studied meat samples. An evaluation of the functional properties revealed normal pH values, low values for the technological losses and a desirable color, especially at the RBSxBBB, while the results of the sensory parameters described satisfactory meat desirability at the RBSxAA.

Regarding the slaughter traits, it was concluded that slaughtering steers at younger ages may require supplementary feeding, being recommended a slaughter age between 18 and 25 months old.

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