IS RESIDUAL FEED INTAKE ASSOCIATED TO CARCASS AND MEAT QUALITY TRAITS?

Santiago Luzardo[1*], Guillermo de Souza[1], Gustavo Brito[1], Pablo Peraza[2], Elly A. Navajas[2]

[1] Instituto Nacional de Investigación Agropecuaria (INIA), Estación Experimental Tacuarembó, Tacuarembó, Uruguay.

[2] Instituto Nacional de Investigación Agropecuaria (INIA), Estación Experimental Las Brujas, Rincón del Colorado, Uruguay

*Corresponding author email: sluzardo@inia.org.uy

I. INTRODUCTION

Improving feed efficiency is a key factor in livestock systems to reduce feeding costs and enhance profitability [1], and it is also associated with beef production sustainability. Residual feed intake (RFI) is one of the methodologies for calculating feed efficiency of growing beef cattle, which is a moderately heritable characteristic enabling genetic improvement through selection [2]. However, literature is not entirely conclusive about the effect of RFI genetic selection on beef quality. Therefore, the aim of the present study was to evaluate the association between RFI at finishing and carcass and beef quality traits of Hereford steers.

II. MATERIALS AND METHODS

Residual feed intake of 136 Hereford steers was measured in 2 years (n = 67 in 2022 and n = 69 in 2023) at the Central de Pruebas Kiyú, San José, Uruguay. All methods and procedures used in live animals were approved by the Committee for the Ethical Use of Animals of the Instituto Nacional de Investigación Agropecuaria, Uruguay (Protocol number 2018-11). Steers were fed in a feedlot system and daily feed intake of each animal was recorded using a GrowSafe™ automated system (GrowSafe Systems Ltd., Alberta, Canada). Feed intake was adjusted by the dry matter percentage to determine the dry matter feed intake. Steers were categorized into three groups: high RFI (HRFI; >0.5 SD above the RFI mean; n = 44), medium RFI (MRFI; RFI mean ± 0.5 SD; n = 55), and low RFI (LRFI; <0.5 SD below the RFI mean; n = 37). Steers achieved an average pre-slaughter live weight (LW) of 535.8 ± 2.87 kg. At slaughter, hot carcass weight (HCW) was recorded, and dressing percentage was calculated as: ((HCW/LW) *100). After quartering ribeye area (REA, cm^2) and subcutaneous fat thickness (FAT, mm) were measured between the 10^{th}-11^{th} ribs. A 2.5 cm steak was removed from the *Longissimus thoracis* muscle between the 11^{th} to 13^{th} rib, vacuum-packed individually and transported to the Meat Laboratory of INIA Tacuarembó. Steaks were aged for 5 days and then instrumental meat color (CIE L*: lightness, a*: redness and b*: yellowness) was measured in triplicate with a Minolta colorimeter CR-400 (Konica Minolta Sensing Inc., Osaka, Japan) after 45 min blooming. Subsequently, Warner- Bratzler shear force (WBSF; model D2000- WB, G-R Electric Manufacturing Co, Manhattan, KS, USA) was assessed according to the American Meat Science Association guidelines [3]. Steaks were weighed before and after cooking and cooking losses were calculated as: ((weight of raw steak - weight of cooked steak)/weight of raw steak) x 100. The statistical model included RFI groups as fixed effects and year as a random effect. Data was analyzed using the Mixed procedure of SAS (SAS Institute, Cary, NC, USA, version 9.4).

III. RESULTS AND DISCUSSION

Steers from the three RFI groups did not differ (P > 0.05) in final live weight, hot carcass weight, dressing percentage, degree of marbling, ribeye area and subcutaneous fat thickness which agree with previous research [1] [4] [5]. However, Herd et al. [6] reported greater subcutaneous fat depth at the $10/11^{th}$ ribs on high-RFI (less efficient) Angus steers than low-RFI animals. Our findings indicate a lack of association between RFI and carcass traits. In terms of beef quality, no differences were observed among RFI groups on instrumental lean color, cooking losses and WBSF values. Blank et al. [7] did not observe differences on WBSF of beef aged for 14 days between high and low feed efficient British x Continental crossbred steers and Pravia et al. [5] did not find differences on WBSF values of beef aged for 5 days from Hereford steers neither. Nevertheless, Zorzi et al. [8] found greater WBSF values (less

tender beef) in low compared to high RFI Nellore bulls when beef was aged for 7 and 21 days. Beef color is an important characteristic affecting consumer´s purchase decision [9]. As in the study previously carried out by our research group [5], no differences were detected on L*, a* and b* coordinates of lean color among RFI groups which agree with the findings reported by Reis et al. [10] in heifers.

Table 1 – Carcass traits and beef quality characteristics by RFI group.

Traits		Treatments			Pr > F		
		HRFI	MRFI	LRFI	RFI	Year	RFI* Year
Final live weight, kg		543.6 ± 5.0	532.2 ± 4.4	534.8 ± 5.3	0.2177	0.2108	0.9353
Hot carcass weight, kg		293.9 ± 2.3	288.3 ± 2.1	290.2 ± 2.5	0.1968	0.6600	0.6219
Dressing percentage, %		54.1 ± 0.2	54.4 ± 0.2	54.3 ± 0.2	0.6860	<0.0001	0.0695
Marbling (USDA scores)[1]		499 ± 7.3	497 ± 6.5	483 ± 7.8	0.2893	0.0754	0.1958
Ribeye area, cm^2		63.3 ± 0.9	64.3 ± 0.8	66.2 ± 1.0	0.1074	0.0002	0.2142
Fat thickness, mm		14.7 ± 0.6	14.9 ± 0.5	14.8 ± 0.6	0.9608	<0.0001	0.1377
Meat Color (5 d aging)	L*	38.1 ± 0.4	38.3 ± 0.4	38.5 ± 0.4	0.8076	0.0201	0.3693
	a*	22.4 ± 0.2	22.3 ± 0.2	22.3 ± 0.3	0.9384	0.0003	0.4970
	b*	11.1 ± 0.2	11.1 ± 0.1	10.9 ± 0.2	0.7427	0.0008	0.7371
Cooking losses, %		20.4 ± 0.4	20.8 ± 0.4	20.8 ± 0.4	0.7689	<0.0001	0.0523
WBSF (5 d aging), kg		3.59 ± 0.15	3.73 ± 0.13	3.45 ± 0.16	0.3921	0.5478	0.0658

[1]: USDA marbling scores were encoded as follows: slight = 300 to 399, small = 400 to 499.

IV. CONCLUSION

The present study and previous research conducted by our team did not find any association between carcass traits and beef quality attributes and RFI in Hereford steers. Therefore, improving RFI would improve beef production economic equation reducing feeding costs with non-detrimental effect on product quality.

REFERENCES

1. Baker, S.D.; Szasz, J.I.; Klein, T.A.; Kuber, P.S.; Hunt, C.W.; Glaze, J. B. Jr.; Falk, D.; Richard, R.; Miller, J. C.; Battaglia, R.A.; Hill, R.A. (2006) Residual feed intake of purebred Angus steers: effects on meat quality and palatability. Journal of Animal Science, 84: 938-945.
2. Pravia, M.I., Navajas, E.A., Aguilar, I., Ravagnolo, O. (2022) Evaluation of feed efficiency traits in different Hereford populations and their effect on variance component estimation. Animal Production Science, 62: 1652-1660.
3. American Meat Science Association (2016). Research Guidelines for Cookery, Sensory Evaluation, and Instrumental Tenderness Measurements of Meat, 2nd ed.; Version 1.02; AMSA: Champaign, IL, USA; pp. 82–87.
4. Cruz, G.D.; Rodríguez-Sánchez, J.A.; Oltjen, J.W.; Sainz, R.D. (2010) Performance, residual feed intake, digestibility, carcass traits, and profitability of Angus-Hereford steers housed in individual or group pens. Journal of Animal Science, 88: 324-329.
5. Pravia, M.I.; Navajas, E.A.; Macedo, F.L.; Clariget, J.; Luzardo, S. (2018) Association between feed efficiency and carcass and meat quality traits in Hereford steers. Proceedings of the 11th World Congress on Genetics Applied to Livestock Production (pp. 604) 11, February 2018, Auckland, New Zealand.
6. Herd, R.M.; Arthur, P.F.; Bottema, C.D.K.; Egarr, A.R.; Geesink, G.H.; Lines, D.S.; Piper, S.; Siddell, J.P.; Thompson, J.M.; Pitchford, W.S. (2014) Genetic divergence in residual feed intake affects growth, feed effciency, carcass and meat quality characteristics of Angus steers in a large commercial feedlot. Animal Production Science, 58: 164-174.
7. Blank, C.P.; Russell, J.; Lonergan, S.M.; Hansen, S.L. (2017) Influence of feed efficiency classification and growing and finishing diet type on meat tenderness attributes of beef steers. Journal of Animal Science, 95: 2986-2992.
8. Zorzi, K.; Bonilha, S.F.; Queiroz, A.C.; Branco, R.H.; Sobrinho, T.L.; Duarte, M.S. (2013) Meat quality of young Nellore bulls with low and high residual feed intake. Meat Science, 93: 593-599.
9. Faustman, C.; Cassens, R.G. (1990) The biochemical basis for discoloration in fresh meat: A review. Journal of Muscle Foods, 1: 217–243.
10. Reis, S.F.; Paulino, P.V.R.; Medeiros, S.R.; Valadares Filho, S.C.; Feijo, G.D.; Torres Junior, R.A.A.; Cristaldo, R.O.; Silva, R.A.; Fausto, D.A.; Cavali, J. (2010). Residual feed intake in three-cross beef heifers: color and chemical composition of Longissimus dorsi muscle (M155). J. Anim Sci. Vol. 88, E-Suppl. 2. American Society of Animal Science, Joint Annual Meeting. July 2010, Denver, United States.