EFFECT OF WEANING AGE OF CROSSBRED DAIRY CALVES ON MEAT QUALITY AND FATTY ACID PROFILE OF BEEF LOIN AND TOPSIDE

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I. INTRODUCTION

Rearing calves destined for grazing on concentrate feeds adds a transition from concentrate to pasture which is challenging to manage in an extensive grazing system. There are emerging niche markets for early finished and grain-free beef products that require supplies of calves reared only on forages. Lastly, research conducted to date was primarily focused on weaning calves within the first 2 months of age [1] with limited efforts to understand the effects of delaying weaning age on the carcass and meat quality of calves finished early on pasture. Thus, the aim of this study was to evaluate the effect of weaning age on crossbred dairy calves finished on pasture at 7 months old on meat quality and fatty acid profile of loin and topside.

II. MATERIALS AND METHODS

This study artificially reared (1 kg calf milk replacer/day until weaning) and milk-weaned dairy-beef calves (Friesian-Hereford cross steers) onto ryegrass pasture either at 10 (Early weaning, n=12) or 20 (Late weaning, n=12) weeks of age and evaluated the effect of weaning age on carcass and meat quality traits. Calves were slaughtered at the average age of 210 days and the live and carcass weights (carcass weight included the hide, hooves, head and tail) were recorded. Hot-boned loin (*M. Longissimus thoracis*) and topside (*M. Semimembranosus*) were held at 10 °C for 48 hours then vacuum-packaged and stored frozen at -20 °C for up to three months. Frozen samples were thawed at 0 °C for 24 h before sub-samples were taken for further meat quality and fatty acid profile analysis. Meat pH was measured using a pH probe directly into the samples. Instrumental colour of freshly cut and bloomed steak surface were measured using a Minolta Chroma Meter at three random locations on each steak. Meat portions (3 cm thick) were placed in a plastic bag and cooked in a boiling water bath to a core temperature of 75 °C. Cook loss was calculated by the percentage difference between raw weight and cooked weight. Cooked steaks were cut into 10 mm × 10 mm cross sections to measure the force (N) required to shear perpendicular to the fibre axis using a texture analyser with a fitted Warner-Bratzler blade (ten replicates). Intramuscular fat (IMF) content and fatty acids (FA) profile of meat samples were measured using a direct trans-methylation method [2]. Data were analysed using R software using “lme4” and “predictmeans” packages. One-way ANOVA and Tukey’s honest significant difference were used to separate the means at $P<0.05$.

III. RESULTS AND DISCUSSION

Results from this study showed that late weaning significantly increased ($P<0.05$) the live (221.81 *vs* 200.65 kg, mean values) and carcass weights (145.47 *vs* 126.43 kg, mean values) of calves without affecting the measured meat quality traits including pH, colour, cook loss and shear force ($P>0.05$, Table 1). Overall, low levels of IMF (<1.5%) were observed across meat samples regardless of weaning age and muscles. Significantly lower IMF level ($P=0.011$) was observed in topside from the early weaning group with no impact on the loin. Weaning age mainly affected polyunsaturated fatty acids (PUFA) content with higher levels of n-6 PUFA and reduced levels of n-3 PUFA resulting in higher n-6:n-3 ratios in both muscles from the late weaning group ($P<0.001$). The increase of lipid and PUFA content due to delaying or not weaning have also been reported for Rubia Gallega calves [1]. Late weaning also reduced branched-chain fatty acids (BCFA) in loin, increased levels of saturated fatty acids (SFA) in topside, and comparable PUFA:SFA ratios in meat from both groups of animals.

Table 1 Meat quality traits, intramuscular fat (IMF) content (%) and fatty acid profile (mg/g meat) of veal loin and topside from calves following different weaning regimes.

	Loin				Topside			
Meat quality	Early weaning	Late weaning	SED	*P*-value	Early weaning	Late weaning	SED	P-value
pH	5.48	5.47	0.01	0.555	5.40	5.40	0.01	0.640
*L** (lightness)	45.3	44.7	0.66	0.343	45.0	44.9	0.97	0.741
*a** (redness)	14.9	15.9	0.65	0.451	16.7	16.9	0.65	0.530
*b** (yellowness)	9.61	9.7	0.44	0.931	10.6	10.3	0.59	0.414
*C** (Chroma)	17.7	18.6	0.74	0.585	19.8	19.8	0.83	0.950
*h** (hue angle)	32.9	31.5	0.78	0.263	32.4	31.3	0.84	0.057
%Cook loss	18.4	18.3	1.63	0.964	28.2	28.0	0.92	0.705
Shear force (N)	40.5	44.6	5.30	0.485	40.5	37.9	4.78	0.888
Fatty acids profile								
Total FA (mg/100 g meat)	11.7	11.5	2.05	0.706	9.34	11.1	0.88	0.009
SFA	4.68	4.67	1.01	0.663	3.36	4.24	0.39	0.009
BCFA	0.18	0.14	0.05	0.094	0.08	0.12	0.03	0.067
MUFA	3.97	3.56	0.97	0.448	2.76	3.43	0.45	0.029
PUFA	2.85	3.14	0.16	0.006	3.14	3.34	0.15	0.047
n-6	1.59	2.26	0.10	<0.001	1.84	2.40	0.15	<0.001
n-3	0.81	0.53	0.05	<0.001	0.86	0.56	0.06	<0.001
%IMF	1.49	1.46	0.23	0.689	1.23	1.42	0.10	0.011
%SFA	39.3	40.4	1.14	0.699	35.9	37.9	0.65	0.022
%BCFA	1.44	1.21	0.21	0.016	0.83	1.05	0.24	0.254
%MUFA	33.1	30.6	1.99	0.109	29.6	30.2	1.56	0.274
%PUFA	26.1	27.9	3.19	0.186	33.7	30.8	2.22	0.115
%n-6	14.6	20.1	2.11	0.001	19.8	22.2	2.00	0.260
%n-3	7.45	4.74	0.81	0.004	9.28	5.22	0.59	<0.001
PUFA:SFA	0.65	0.68	0.09	0.227	0.92	0.80	0.07	0.082
n-6:n-3	1.97	4.30	0.20	<0.001	2.19	4.34	0.44	<0.001

SED = standard error of difference between means. IMF = intramuscular fat. FA = fatty acids. SFA = saturated fatty acids = C12:0 + C14:0 + C15:0 + C16:0 + C17:0 + C18:0 + C20:0 + C24:0. BCFA = branched chain fatty acids = Iso-C15:0 + Anteiso-C15:0 + Iso-C16:0 + Iso-C17:0 + Anteiso-C17:0. MUFA = monounsaturated fatty acids = C14:1 + C16:1 + C17:1 + C18:1 *trans*-9 + C18:1 *trans*-11 + C18:1 *cis*-9 + C18:1 *cis*-11 + C24:1. PUFA = polyunsaturated fatty acids = C18:2 n-6 + C18:3 n-3 + CLA *cis*-9, *trans*-11 + C20:4 n-6 + C20:5 n-3 + C22:5 n-3 + C22:6 n-3; n-3 = Omega 3 PUFA **=** C18:3 n-3 + C20:5 n-3 + C22:6 n-3. n-6 = Omega 6 PUFA = C18:2 n-6 + C20:3 n-6 + C20:4 n-6.

IV. CONCLUSION

Delaying the weaning age of pasture-reared dairy cross calves from 10 to 20 weeks can be a potential strategy to increase the carcass weight without affecting meat quality and IMF content. Weaning age altered the fatty acid profile of two muscles, resulting in higher levels of PUFA and n-6 in meat from the late weaning group. In contrast, the n-3 levels and the n-6:n-3 ratio were more favourable from a human health perspective in meat from the early weaning group.

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