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Effect of zeranol and estradiol-17β on carcass and sensory characteristics of zero-grazed White Fulani bulls

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Abstract

Transhumance is one of the major factors contributing to farmers-herders conflict. Therefore, a strategy that encourages zero-grazing without adversely affecting cattle growth may contribute to reducing such conflict. This study investigated a method for zero-grazing. Twenty-seven stocker White Fulani bulls were evaluated over 60 days in feedlot to determine the effect of zeranol and estradiol-17β as growth promoters on carcass and beef sensory characteristics. Cattle, finished on 14% CP ration, were allotted to non-implanted (control), estradiol- and zeranol-implanted treatments at nine animals/treatment in three replicates of three animals each. Carcass characteristics of finished cattle were determined, liver samples were assayed for hormone residue and beef samples were assessed for eating qualities. Implanted animals had significantly (P<0.05) greater loin eye area and heavier live and hot carcass weights than non-implanted but similar (P>0.05) dressing % and relative weights of cut-up carcass parts and organs. Hormone residues of liver from implanted and non-implanted cattle were comparable and significantly lower than the maximum recommended safe limits, indicating that meat from implanted cattle pose no health risk for consumption. Consumer panelists preferred beef from implanted cattle for tenderness, juiciness and flavor and beef from estradiol-implanted cattle very much liked above that from zeranol-implanted or non-implanted cattle. Implanting finishing White Fulani cattle with estradiol is beneficial for improving carcass value and beef eating quality. Adoption of this management strategy or a modification may contribute significantly towards reducing the incessant herders-farmers conflict because of its low pressure on land resources.

Keywords: Indigenous cattle, Zeranol, Estradiol-17β, Carcass evaluation

Introduction

The current imperative for cattle ranching, as a remedy to deadly incessant farmers-transhumant herders conflicts in Nigeria, demands urgent and pragmatic solution or validation. In order to discourage transhumance with its stressors such as low productivity and returns, disease transmission and unwanted crossbreeding (ITC, 2015), more beneficial and proven alternatives are required. One alternative is to zero-graze animals or keep under a feedlot system, which ensures adequate and continuous supply of nutrients. In addition, application of growth promoters (especially anabolic agents) by implantation or dietary supplementation, which improves growth rate and feed conversion (Song and Choi, 2001; Smith *et al*., 2007; Thompson *et al*., 2008), allows cattle to reach market weight earlier (MLA, 2011) or become heavier at same age with those without growth promoters (Reiling and Johnson, 2003; Berthiaume *et al*., 2006). Use of anabolic implants such as zeranol and estradiol-17β, is long established in many other climes, especially USA (Preston, 1999) but not in Nigeria. Further, there is little research in Nigeria evaluating the effect of anabolic implants on performance of indigenous cattle in spite of the potential benefits. A potential of such application was given by (Obi *et al*., 1980) who reported relative positive effects of zeranol implantation on weight gain of Nigerian zebu fattening bulls of Sokoto Gudali and White Fulani. However, apart from improved growth performance and

economical animal production, safety, quality and acceptability of products from implanted animals are equally important. Concerns about the safety of such products in terms of residues in products or organs are valid and must be evaluated (EEC, 1996). Therefore, the objective of this study was to further evaluate the effect of anabolic steroid implants of zeranol and estradiol-17β on carcass and sensory characteristics of zero-grazed White Fulani cattle.

Materials and methods

Animals and management

A 60-day feedlot trial involving 27 White Fulani stocker bulls (average body weight 102.70 kg ± 1.84) was carried out at the Dairy Unit of the Teaching and Research Farm, Obafemi Awolowo University, Ile-Ife. After 15 days acclimatization, they were treated with broad-spectrum antibiotic (Oxytet L.A.), and internal (Ivomec) and external (Cypermethrin) anti-parasites. Implants, 36 mg zeranol and 25.7 mg estradiol-17β (Ralgro® and Compudose®, respectively - Elanco Animal Health, USA) were placed with the use of the implanting gun between the skin and cartilage below the midline on the back side of the ear of each animal in a weighing restraint or chute. Implants were inserted 4 cm to implantation site after ear and insertion needle were disinfected, and ear palpated to ensure the pellet was inserted and securely placed. All animals were tagged and tattooed, given trace mineralized salt lick, water and fed the same finishing feedlot diet (Table 1) *ad libitum* containing 40% ground shelled maize as the main grain source. Animals were randomly allocated to three treatments (Zeranol-implanted, Estradiol-implanted and Non-implanted control) at nine animals per treatment, three animals per pen and three pens per treatment. Feed consumption was recorded weekly and animals weighed at the commencement of the feedlot trial and subsequently, every 14 days. At the end of the feedlot trial, three animals per treatment (one per replicate) were randomly selected, slaughtered, and carcass parts weighed and used for carcass evaluation comprising hot carcass weight (HCW); kidney, heart, liver, spleen, lungs, blood, head, bones, the four quarters, hump, neck and tongue weights. Dressing percentage was computed as (HCW/live weight) × 100. Growth implant residue was quantitatively determined for residual estrogenic activity in liver samples, from implanted and non-implanted cattle, at the Hormone Assay Laboratory, Obafemi Awolowo University Teaching Hospital Complex (OAUTHC) using an Enzyme Immunoassay Test Kit (Inteco Diagnostics, UK Ltd.). Residue values were compared to recommended maximum residue limits (MRLs), which are considered safe (Codex Alimentarius, 2017).

Table 1: Ingredient composition of the experimental feedlot diet

Ingredient	% As fed basis
Ground shelled maize	40.00
Wheat offal	30.00
Palm kernel cake	25.00
Soybean meal	2.00
Groundnut cake	1.45
Bone meal	0.80
Mineral/Vitamin premix*	0.25
Salt	0.50
Total	100.00

Sensory evaluation

A consumer panel of 14 were selected from 20 students of the Faculty of Agriculture, Obafemi Awolowo University, Ile-Ife after subjecting them to a triangle test (Heinz and Hautzinger, 2010), which had three coded carbonated beverage samples, with two identical and the third odd. Those selected were able to identify the odd sample. Right and left ribeye muscle (between the 12th and 13th rib) from respective carcasses, previously frozen, were thawed at ambient temperature, cut into small pieces (2 × 2 cm), and cooked separately in moist-heat to internal temperature of 73 °C for sensory evaluation as described by (Perry *et al*., 2001). The evaluation was carried out in a well-lit room with sufficient space for independent work by each panelist. The panelists scored the beef on a nine-point Hedonic scale for tenderness, juiciness, flavor and overall acceptability (Heinz and Hautzinger, 2010). The panelists were trained on making inferences and recording the scores for each sample. After tasting each piece, the panelists were required to chew cracker biscuits and rinse their mouths with water to prevent lingering taste from previous sample, and wait for three minutes before tasting the next sample.

Statistical analysis

Data obtained were subjected to statistical analysis using one-way analysis of variance of the General Linear Model Procedure of the Statistical Analysis Software (SAS (2008), and the Fisher's least significant difference was used to separate differences among the means at P<0.05. The data obtained based on the Hedonic scale were considered discrete and nominal, therefore, subjected to descriptive statistics to obtain mean scores of the assessments of meat samples from each treatment group per sensory attribute. Mean scores for each attribute were rounded to the nearest whole number in congruence with the Hedonic scale which is discrete. Interpretation of results was made based on the definition of each score on the Hedonic scale. Hedonic scale ranged from 1, extreme negative evaluation to 9, extreme positive evaluation; and 5 is neutral/undecided.

Results and discussion

Table 2 shows that estradiol and zeranol-implanted cattle had similar (P>0.05) but significantly (P<0.05) higher loin eye area and heavier live and hot carcass weights than those non-implanted. This is not surprising because most studies with anabolic growth promoters involving zeranol and estradiol have long confirmed their efficacy to improve growth rates and feed efficiency with varied body composition (Mader, 1994; Guiroy *et al*., 2002). More specifically, studies have shown implants have a marked and significant enhancement on carcass weight over non-implanted cattle (Hunter *et al*., 2000; Torrentera *et al*., 2017). Growth implants had no significant (P>0.05) effect on dressing % or the cut-up parts of the carcass and internal organs except the lung (P<0.05).

Inconsistencies sometimes occur in the response to implants. Zeranol has been found to sometimes have little effect on dressing % and loin eye area in some cattle (Song and Choi, 2001) and the effect of estradiol may depend on the availability of good quality feed (MLA, 2011). The lung (%) of zeranol-implanted cattle was significantly (P<0.05) higher than that of estradiol-implanted cattle but similar (P>0.05) to that of the non-implanted cattle. This could not be explained from the data collected. However, since the lung (%) of estradiol-implanted was also similar to the non-implanted, no abnormality could be inferred. Table 2 also shows that the implant residue levels (estrogenic activity) in liver of implanted animals were not different from the non-implanted, neither critical, because they were insignificant compared

to the maximum residue levels adjudged safe by FAO/WHO (Codex Alimentarius, 2017). In fact, concerns about the safety of such products for consumption have not been scientifically justified and it has been affirmed that the residue or steroidal activity from implantation are insignificant compared to normal human endogenous secretion or phytoestrogens from such plant foods as soybean oil, cabbage, peas and hen's egg (Reddy, 2010). Table 3 shows that beef from estradiol-implanted cattle was most highly rated for all sensory attributes evaluated through a 9-point hedonic scale for tenderness, juiciness and flavor and acceptability. This was followed by beef from zeranol-implanted cattle, which was preferred to non-implanted for tenderness, juiciness and flavor. Reports have been inconsistent on the effect of implantation on sensory attributes of meat. Implantation may be positive (Igo *et al*., 2011) without effect (Hawkins *et al*., 2004) or negative to sensory attributes of beef (Platter *et al*., 2003). With respect to overall acceptability, beef from estradiol-implanted cattle was rated as 'like very much' and those of zeranol-implanted and non-implanted cattle with an inferior rating of 'like slightly'. These results seem to indicate the good potential of estradiol as a growth promoter with positive effects on carcass and sensory characteristics of zero-grazed White Fulani bulls.

Table 2: Effect of estradiol and zeranol implantation on carcass characteristics and liver residue levels of White Fulani bulls

	Treatment				
Parameter	**Non-implanted**	**Estradiol**	**Zeranol**	**SEM**	**P-value**
Live weight (kg)	206.33^{b}	249.67^{a}	249.33^{a}	11.68	0.03
Hot carcass weight (kg)	114.75^{b}	140.07^{a}	144.33^{a}	8.05	0.02
Dressing percentage	55.61	56.10	57.89	0.69	0.62
Loin eye area (cm^2)	33.10^{b}	45.10^{a}	43.0^{a}	3.70	0.03
Cut up parts (%)					
Head	6.19	5.46	6.07	0.22	0.45
Left fore quarter	24.12	26.66	26.66	0.58	0.22
Left hind quarter	19.34	18.68	18.73	0.50	0.87
Right fore quarter	26.95	26.53	25.54	0.32	0.19
Right hind quarter	19.45	18.55	18.23	0.34	0.18
Internal organs (%)					
Liver	3.01	2.86	3.58	0.25	0.49
Lungs	2.06^{ab}	1.68^{b}	2.44^{a}	0.13	0.03
Kidney	0.41	0.33	0.54	0.05	0.26
Heart	0.78	0.78	0.76	0.04	0.96
Spleen	0.60	0.51	0.41	0.05	0.19
Residue level (µg/kg)	0.01 ± 0.001	0.01 ± 0.001	0.02 ± 0.003		
[1]MRLs (µg/kg) for cattle liver	*	**	10		

^{ab}Means on the same row with different superscripts are significantly different (P<0.05)

[1]MRLs = maximum residue levels (Codex Alimentarius (2017)); *Not implanted

**Codex Alimentarius (2017) = Residues resulting from the use of this substance as a growth promoter in accordance with good animal husbandry practice are unlikely to pose a hazard to human health.

Table 3: Effect of estradiol and zeranol implantation on sensory attributes of rib-eye muscle rom White Fulani bulls[1]

	Treatment		
Parameter	**Non-implanted**	**Estradiol-implanted**	**Zeranol-implanted**
Tenderness	5.93 ± 0.47 (6)	7.07 ± 0.46 (7)	7.14 ± 0.57 (7)
Juiciness	5.29 ± 0.42 (5)	7.29 ± 0.41 (7)	6.57 ± 0.53 (7)
Flavour	6.29 ± 0.29 (6)	7.79 ± 0.21 (8)	6.71 ± 0.44 (7)
Acceptability	6.21 ± 0.28 (6)	8.07 ± 0.16 (8)	6.14 ± 0.59 (6)

[1]Comparison across each row was made using a 9 -point Hedonic scale, which is discrete, strictly on the basis of rounding to whole numbers (in parentheses). Hedonic scale ranged from 1, extreme negative evaluation to 9, extreme positive evaluation; and 5 is neutral/undecided.

Conclusion

It can be deduced from this study that growth implants (estradiol and zeranol) improved loin-eye area, live and hot carcass weights, but did not affect dressing percentage, cut-up parts and internal organs of zero-grazed White Fulani cattle. Meat from implanted animals are safe and acceptable, as implant residue levels in liver were far less than the safe limit. Eating qualities (tenderness, juiciness, flavor and overall acceptability) were better enhanced by estradiol growth implant than zeranol implant relative to non-implanted White Fulani cattle. Use of growth implants as a management tool may contribute positively towards establishment of feedlots and semi-intensive beef cattle finishing programs, which require little land area, and reduce/end the endemic cattle herders/farmers conflicts in Nigeria.

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