

Research Article

# Assessments of the Slaughter Characteristics and Meat Quality of Different Cattle Strains Finished on Three Dietary Treatments

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## Abstract

A study was conducted at Kongwa Ranch to examine the effects of three diets and two cattle strains of Tanzanian Short Horn Zebu (Iringa red and Singida White) and Boran breed as a control breed. A total of forty-five bulls (15 Boran, 15 Iringa red and 15 Singida white) were confined in a feedlot and supplied with three (3) diets (D1, D2 and D3) formulated for finishing cattle using energy based feedstuffs obtained from locally available feed materials. The diets were fed to the three that groups of bulls for 80 days, and thereafter slaughtered. After evisceration, the carcass and non-carcass components, that are head, skin, tail, feet, tail and testis were weighed. A sample of longissimus dorsi muscle (LD muscle) was removed from the left side of each carcass along the 6-13th ribs and the 6th rib joint was removed from the right side of each carcass. The samples were taken to laboratory for assessments of carcass composition and meat quality. The results showed that the highest values of non-carcass components, such as weights (kg) of head (13.4), pluck (5.20), feet (5.73), testis (0.76) and penis (1.2) were observed on Boran bulls, though not different ( $P>0.05$ ) from those of Iringa Red strain [head (12.85), pluck (4.64), eet (5.63), testis (0.780) and penis (1.12)]. The mean values of pH (5.24) and tenderness (64.7N/cm<sup>2</sup>) were lowest in the Boran followed by Iringa Red bulls [pH (5.26) and tenderness (74.05N/cm<sup>2</sup>)] compared to those of Singida White [pH (5.32) and tenderness (75.5N/cm<sup>2</sup>)], however these values were not different ( $P>0.05$ ). Significant interaction effects between diets and strains were observed on the fat weight and proportion of fat, that the Iringa Red bulls when fed on diet D1 the fat increased above that of Boran and Singida White, while when fed with D3 the weight of fat decrease below that of Boran and Singida strains, The right proportion of fat observed when fed on diet D2. In conclusion, the Iringa Red cattle strain finished in feedlot using diet D2 produced heavy carcasses with right proportions of edible meat and quality attributes matched well with those of Boran. Stakeholders of beef cattle are advised to opt for Diet D2 for finishing the Iringa Red strain in feedlot for enhancing productivity and quality of beef in the sector. Further studies are needed in screening more locally available feed resources to develop formulations for finishing different strains of the TSHZ cattle to increase the demanded prime beef in the country.

## Keyword

Boran, Iringa Red, Singida White, Feedlot, Slaughter Characteristics, Carcass Composition, Meat Quality Attributes

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## 1. Introduction

The 95% of meat producer strains of cattle in Tanzania are Tanzania Short Horn Zebu (TSHZ), [2]. These TSHZ cattle are genetically characterized with low production potentials in meat and milk compared with the exotic breeds [3]. Researcher shows Tanzania and other tropical countries produce low-quality beef in terms of tenderness, juiciness and flavour [1]. The low production of quality meat resulted from several factors which including low genetic potential of TSHZ cattle and low feeds availability due to prolonged drought season. In addition, other factors, such as improper handling of animals during transportation, long transport hours in the trucks improper handling and processing of the meat reduce its quality [4]. The low quality meat produced by TSHZ affects the local and international markets, as they demand high quality meat that small-scale farmers fail to supply, hence reduce the domestic gross income of the country [5]. The improvement of feeding and selection of suitable strains for meat production from TSHZ cattle will be additional gear to add values of traditional herds into important strains for production. [6]. There are 12 strains of TSHZ cattle known from Tanzania with several distinguishing characteristics features, such as coat colour, body morphology and hump size [7]. Some researchers have reported that Iringa red strain have characteristics features, such as long hind leg length and circumference, which are indicators for suitable strain for beef production [8]. This strain of TSHZ cattle originated from the highest highlands of Iringa region that are Kilolo and Mufindi districts. They have medium to large body size, which make them be used for draught power similar to other strains of TSHZ. They survive and produce under harsh environment and management condition [9]. Other research reported that Iringa Red bulls are at risk of disappearing due to ongoing discriminate interbreeding with other strains as they are preferred to other TSHZ cattle strains. It has been documented that Iringa Red produce largest values of slaughter and carcass characteristics compared to other strains [10]. On the other hand, Singida White strain originated from Singida region has silver - grey to white colour. Similar to Iringa Red strain, Singida White belong to medium sized TSHZ cattle [11]. It produces a tender meat compared with other strains of TSHZ [10]. Boran cattle is a large East African cattle originated from Ethiopia. It is an improved breed recommended in Tanzania for upgrading TSHZ cattle for meat production due to its large body size and good morphology suitable for meat production. They have high ability to walk long distances, ability to digest low quality feeds, and when finished in feedlot it produces heavy carcass with tender meat [12, 13]. The feeding strategies for TSHZ cattle for improving meat production and quality of meat was conducted from several researchers [14-16]. However, limited research conducted to investigate on specific dietary package suitable for finishing the TSHZ cattle in feedlot aiming at improving the meat quality. Previous studies developed a dietary package from the agro industrial by

products observed positive results in increasing yield and production of good quality meat [16, 9]. The information of Iringa Red strains and Singida White when finished in feedlot with different concentrates diets is scarce. Therefore, it is crucial to assess the quality attributes of meat produced by the different strains of the TSHZ when finished under feedlot to ensure compliance to the standards of the international market. This study aims at investigating the role of the Iringa Red and Singida White strains in the production of prime beef when finished in feedlot with concentrate diets formulated using locally available feed resources.

## 2. Materials and Methods

### 2.1. Description of the Study Area

The study was carried out at Kongwa Ranch, which is located in Kongwa District. The district lies between latitudes 6°12'0" South and longitudes 36°25'0" East. The annual rainfall of the area ranges from 500 to 800mm and the temperature varies from 20 °C to 33 °C.

### 2.2. Experimental Design, Treatments and Feeding

Forty five (45) bulls, composed of 15 Boran, 15 Iringa Red and 15 Singida White strains of cattle were randomly selected from the 54 bulls finished under feedlot study, of which the findings were published recently [17]. The bulls were allocated into three dietary treatments (D1, D2, and D3) formulated based on energy sources to contain maize bran and various levels of molasses (D1), maize bran (D2) and cassava meal and rice polishing (D3). Sunflower seed cake (SSC) was used as a major source of protein to all diets. The details on the feed ingredients, physical and chemical composition of the diets were also reported by [17]. The bulls were sourced from the Kongwa ranch. They were housed individually in a timber feedlot structure, where they were supplied with the respective diets with plenty of clean drinking water. The feeding and management practice followed in feedlot were detailed by [17]. After 80 days of feedlot finishing, the bulls were taken to the slaughter house, where they were slaughtered.

### 2.3. Slaughtering Procedure and Assessment of Carcass and Non-carcass Components

The 45 bulls were slaughtered following the established halal procedures in the abattoir [14]. Bulls were stunned to make them unconscious then slaughtered with skilled personnel by cutting sharply to the atlanto - occipital joint. The skinning and removal of head and Gastro -intestinal tract

(GIT) were done, the carcass and GIT were separated. The fore feet were removed by cutting at the the carpal-metacarpal joint, while the hind feet were removed by cutting through the tarsal-metatarsal joint. Then the feet were weighed and recorded. The weight of tail and other non-carcass components, such as penis liver, kidneys and heart were taken and recorded. The carcass was separated into two halves by cutting along the mid-line of the vertebral column and hanged on the hanging rail guards for 45 minutes then weighed to obtain hot carcass weight. The carcasses were transferred to the cold room set at 0 °C where the ultimate pH was taken and recorded after 24 hours post-mortem (PM) using pH-meter (Knick port amess 911, Germany). The Longissimus dorsi muscle (LD muscle) was removed from the left side of the carcass along the 7-13<sup>th</sup> ribs 24 hrs PM for assessment of cooking loss and tenderness determination. The 6<sup>th</sup> rib joint was removed from the right side of the carcass by cutting perpendicular from the vertebral part of the rib to the sternum. All the collected meat samples were packed and labelled, then stored in a deep freezer before being transported for detailed laboratory assessment at Sokoine University of Agriculture (SUA).

## 2.4. Physical and Chemical Composition of the Carcasses

The samples of the 6<sup>th</sup> rib were weighed and dissected into muscle, fat and bone. The weight of each component was taken and expressed as percentages of carcass weight, 6<sup>th</sup> rib and ratios of lean: fat, lean: bone, lean+fat: bone, and lean+fat: bone. The samples of LD muscle were minced separately to homogeneity and the chemical composition of meat was determined by proximate analysis according to AOAC (2000).

## 2.5. Assessment of the Meat Quality

The meat quality was assessed by measuring the pH<sub>24</sub>, cooking loss and toughness or tenderness of the meat. The pH<sub>24</sub> was determined at the chilling room, 24 hours post-mortem, which is considered as ultimate pH (pHu). It was done using an electrode Toledo by penetrating 2.5 cm deep at the junction between the 5<sup>th</sup> and 6<sup>th</sup> rib targeting the longissimus dorsi area. For the determination of the cooking loss the samples LD muscle were taken from the deep freezer and thawed for 12 hours. Then the samples were resized to 250-300gms (WI) sealed using machine and heated at 75-80 °C for 1 hour in thermostatic controlled heater bath. Sample were removed from the heater bath and left to cool for 2 hours on the tap water. They were placed in refrigerator set at 4 °C overnight. The sample were removed from the

polythene bag, wiped with clean gauze and re-weighed to get W2. Cooking loss (CL) was calculated as;

$$CL = ((W1 - W2)/W1) * 100 \quad (1)$$

For the determination of tenderness, the samples of LD were sized through the muscle fibre direction to get about 1cm<sup>3</sup>. Four to five samples were then sheared through four times perpendicular to muscle fibre direction using Warner Bratzler Shear Force machine (WBSF). A shear blade attached to Zwick/Roell (Z2.5, Germany) machine used to measure the force (N cm<sup>-2</sup>) required to shear through the muscle cube at a right angle towards the direction of the muscle cube. The Zwick/Roell machine was set with 1 kN load cell with a crosshead speed of 100mm min<sup>-1</sup> [4].

## 2.6. Statistical Analysis

A 3 x 3 factorial model was used to analyse the effects of breed/strains, diets and their interaction effects on the weight of non-carcass components, carcass composition and meat quality attributes. The differences between breed/strains and diets and the interaction of diets and breed/strains were considered significant at ( $P \leq 0.05$ ).

The model used

$$Y = \mu + T_i + S_j + TiSj + \epsilon_{ij}$$

Where;

$Y_{ij}$  = Responses as affected by dietary treatments, strains and interaction effects

$\mu$  = Overall mean

$T_i$  = Effect due to dietary treatments

$S_j$  = Effect due to cattle strains

$TiSj$  = Effect due to interaction of dietary treatment and strain

$\epsilon_{ij}$  = Random Error term.

## 3. Results

### 3.1. The Effects of Diets and Strains on the Non-carcass Components

The weights of the non-carcass components as influenced by the diets and strains are presented in Table 1. There were no significant ( $P > 0.05$ ) differences between diets and the interaction effect between diets and strains on all the non-carcass components except the weights of the head and plunk were higher ( $P < 0.05$ ) in BRN than those of IRR and SWT strains.

**Table 1.** Effects of diets and strains of weight of non-carcass components.

<sup>1</sup> Parameter (kg)	Diet			Strain						
	D1	D2	D3	SEM	P value	BRN	IRR	SWT	SEM	P value
Head	13.1	13.0	12.72	2.68	0.4358	13.4 <sup>a</sup>	12.86 <sup>a</sup>	12.56 <sup>b</sup>	0.56	0.025
Skin	21.0	21.03	22.2	10.42	0.073	22	20	21	7.0	0.1663
Feet	5.73	5.80	5.76	0.33	0.701	5.92	5.63	5.73	0.016	0.9821
Pluck	4.68	4.76	4.56	3.31	0.006	5.20 <sup>a</sup>	4.40 <sup>b</sup>	4.64 <sup>b</sup>	1.768	0.0562
Testis	0.76	0.80	0.66	0.03	0.573	0.69	0.78	0.76	0.078	0.2933
Penis	1.10	1.17	1.16	0.052	0.620	1.10	1.12	1.21	0.024	0.7982

<sup>a, b</sup> Means with different superscript in the same row are significant different ( $P \leq 0.05$ ).

<sup>2</sup>BRN = Boran, IRR=Iringa Red, SWT = Singida White, <sup>3</sup>SEM =Standard error of the mean, <sup>4</sup>Interaction of diets and strains.

### 3.2. Effects of Diets and Strains on the Physical Composition of the Carcass

Table 2 presents the effects of diets and strains on the slaughter weight and weights of hot carcass, 6<sup>th</sup> rib and LD muscle. The highest values of slaughter weight and hot carcass weight were shown on bulls fed on D2 followed by those fed on D1 and least in those fed on D3. Boran (BRN) bulls showed higher values of slaughter weight and carcass weight, followed by Iringa red (IRR), while lowest values were observed on the Singida White (SWT) strain. The mean weight of the 6<sup>th</sup> rib was similar ( $P>0.05$ ) between dietary treatments,

but heavier ( $P<0.05$ ) in BRN than other strains. The mean weight of LD muscle was similar ( $P>0.05$ ) between diets and breed/strains. The mean weights of lean, fat and bone were not significantly ( $P>0.05$ ) different between the dietary treatments, but were heavier ( $P<0.05$ ) in BRN than in other strains, except the mean weights of bone, which were similar ( $P>0.05$ ) between strains. Expressing the weights of lean, fat and bone as percent of carcass weight, similar trends were observed with regards to the effects of dietary treatments and strains, except that the mean percent values of bone to the carcass weight were lowest ( $P<0.05$ ) in BRN and highest ( $P<0.05$ ) in SWT strain compared to IRR strain.

**Table 2.** LS means on the effects of diets and strains on the physical composition of the carcass from the experimental bulls.

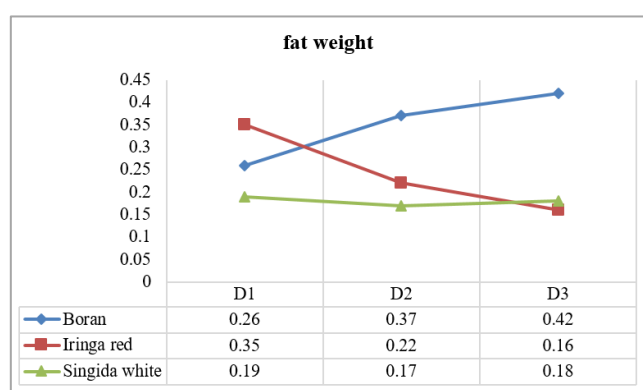
<sup>1</sup> Parameter (kg)	Diet			<sup>2</sup> Strain						
	D1	D2	D3	<sup>3</sup> SEM	P value	BRN	IRR	SWT	SEM	<sup>4</sup> P value
Slaughter weight (kg)	254.3 <sup>b</sup>	268.5 <sup>a</sup>	246.1 <sup>b</sup>	4.40	0.0063	264.5 <sup>a</sup>	259.1 <sup>ab</sup>	255.4 <sup>b</sup>	4.40	0.0036
HCW	131.5 <sup>ab</sup>	140.8 <sup>a</sup>	125.7 <sup>b</sup>	2.43	0.0004	138.2 <sup>a</sup>	136.4 <sup>ab</sup>	129.3 <sup>b</sup>	2.43	0.0269
6 <sup>TH</sup> Rib	1.33	1.31	1.24	0.07	0.6649	1.57 <sup>a</sup>	1.20 <sup>b</sup>	1.11 <sup>b</sup>	0.07	0.0005
Lean	0.870	0.81	0.73	2.43	0.5443	0.975 <sup>a</sup>	0.726 <sup>b</sup>	0.666 <sup>c</sup>	2.43	0.0014
Fat	0.270	0.260	0.243	0.02	0.9500	0.35 <sup>a</sup>	0.25 <sup>b</sup>	0.18 <sup>c</sup>	0.02	0.0003
Bone	0.25	0.24	0.24	0.013	0.9819	0.24	0.23	0.25	0.013	0.7354
As% carcass weight										
Lean	0.870	0.81	0.73	0.04	0.8191	0.70 <sup>a</sup>	0.56 <sup>b</sup>	0.51 <sup>b</sup>	0.04	0.0167
Fat	0.270	0.260	0.243	0.02	0.6984	0.26 <sup>a</sup>	0.19 <sup>b</sup>	0.14 <sup>b</sup>	0.02	0.0028
Bone	0.25	0.24	0.24	0.02	0.7910	0.17 <sup>c</sup>	0.18 <sup>b</sup>	0.20 <sup>a</sup>	0.02	0.6309
Ratios of 6 <sup>th</sup> rib										
Lean:: fat	3.4	3.4	3.5	0.41	0.7379	3.4	3.3	3.7	0.41	0.9936

<sup>1</sup> Parameter (kg)	Diet			<sup>2</sup> Strain						
	D1	D2	D3	<sup>3</sup> SEM	P value	BRN	IRR	SWT	SEM	<sup>4</sup> P value
Lean: bone	3.8	3.9	3.7	0.58	0.9836	5.4 <sup>a</sup>	3.3 <sup>b</sup>	2.8 <sup>b</sup>	0.58	0.0090
(Lean+fat): bone	5.1	5.1	5.0	0.50	0.9673	4.1	4.3	5.2	0.50	0.2609
(Lean+bone): fat	4.5	4.5	4.7	0.50	0.9925	3.7 <sup>b</sup>	4.2 <sup>ab</sup>	4.8 <sup>a</sup>	0.50	0.0041

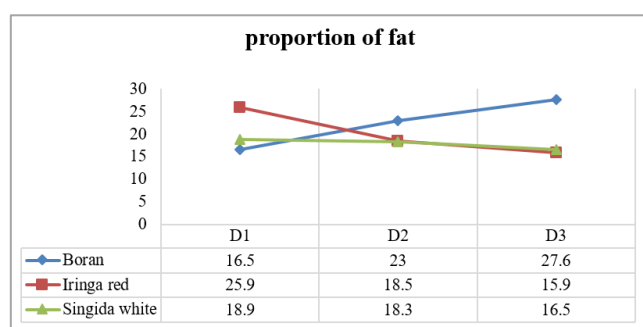
In this and subsequent tables:

<sup>1</sup> HCW = Hot carcass weight, LD = Longissimus dorsi <sup>2</sup>BRN = Boran, IRR=Iringa Red, SWT = Singida White, <sup>3</sup>SEM =Standard error of the mean, <sup>4</sup>Interaction of diets and strains.

<sup>a, b</sup> Means with different superscript in the same row are significant different ( $P \leq 0.05$ ).



**Figure 1.** Lsmeans on the diets\*strains interaction effects on the weight (kg) of fat on the 6<sup>th</sup> rib joint.



**Figure 2.** Lsmeans on the diets\*strains interaction effects on the proportion (%) of fat on the 6<sup>th</sup> rib joint.

The LS means on the effects of diet and strain on the carcass components as percent of the 6<sup>th</sup> rib joint are presented in

Tables 2 and 3. Similarly, the diets did not have influence ( $P > 0.05$ ) on the carcass components as percent of the 6<sup>th</sup> rib. However, the percent of lean in the carcass was higher ( $P > 0.05$ ) in BRN and IRR than in SWT strains. The mean values of the percent fat in the 6<sup>th</sup> rib were similar ( $P > 0.05$ ), whereas those of bone were higher ( $P < 0.05$ ) in the SWT strain followed by IRR strain and lowest ( $P < 0.05$ ) in the BRN breed. The mean values of the lean to bone ratio were higher ( $P < 0.05$ ) in BRN breed and lowest ( $P < 0.05$ ) in SWT strain, whereas the ratio of (lean+bone) to fat was highest in SWT strain. There were significant interaction effects between diets and strains on the weight of fat (Figure 1) and percent of fat in the 6<sup>th</sup> rib joint (Figure 2). The BRN breed tended to deposit less fat in the carcass when was fed on D1, but the proportions of fat increased when fed on diets D2 and D3. The opposite trend was observed with the IRR strain, which had higher proportion of fat in the carcass when fed on D1 and lower mean values when fed on D3.

### 3.3. Effects of Diets and Strains on the Chemical Composition of the Carcass

Table 4 presents the results of the effects of diets and strains on the proximate composition of the samples of carcass taken from the LD muscle. Results show that the mean crude protein (CP) contents of the carcass samples from the LD muscle for the bulls fed on diets D2 and D3 were higher than that of the group fed on D1. The mean contents of ash in the carcass from the bulls fed on D1 and D2 were lower ( $P < 0.05$ ) than for those fed on D3. There was no significant ( $P > 0.05$ ) effect of strains on the chemical composition of the carcasses.



**Table 3.** *L* means on the effects of diets and strains on the chemical composition (% DM) of the carcass from the experimental bulls.

Parameter	Diet			Strain						
	D1	D2	D3	SEM	P value	BRN	IRR	SWT	SEM	P value
Dry matter	28.23	28.02	28.23	0.79	0.2432	28.72	28.85	28.52	0.79	0.9236
Crude Protein	22.91 <sup>b</sup>	25.21 <sup>a</sup>	25.17 <sup>a</sup>	0.62	0.0476	24.37	24.05	23.87	0.62	0.8478
Ash	4.74 <sup>b</sup>	4.8 <sup>b</sup>	5.71 <sup>a</sup>	0.24	0.0105	5.24	4.71	5.30	0.24	0.1707

<sup>a, b</sup> Means with different superscript in the same row are significant different ( $P \leq 0.05$ ).

<sup>2</sup>BRN = Boran, IRR=Iringa Red, SWT = Singida White, <sup>3</sup>SEM =Standard error of the mean, <sup>4</sup>Interaction of diets and strains.

### 3.4. Effects of Diets and Strains on Meat Quality Attributes

Table 4 Presents the results of the effects of diets and strains on the meat quality attributes.

The results show that there were no significant ( $P > 0.05$ )

effects between the diets and interaction between diets and strains. Numerically, diet D2 was shown to have much tender meat than diets D1 and D3 though not significant. In addition, BNR showed to have tender meat than other strains. Lowest ( $P < 0.05$ ) mean values of drip loss was shown on the meat from the BRN bulls compared to the IRR and SWT strains.

**Table 4.** *L* means on the effects of diet and strain on the quality of meat from the bulls.

Parameter	Diet			Strain						
	D1	D2	D3	SEM	P value	BRN	IRR	SWT	SEM	P value
Tenderness	71.68	66.36	76.36	5.29	0.4190	64.7	74.05	75.5	5.29	0.3078
pH <sub>24</sub>	5.26	5.29	5.28	0.04	0.8887	5.24	5.26	5.32	0.04	0.4448
Cooking loss	11.24	13.62	13.65	0.75	0.1602	11.81	13.98	12.72	0.75	0.1389
Drip loss	3.39	3.44	3.42	0.68	0.8583	3.27 <sup>b</sup>	3.44 <sup>ab</sup>	3.54 <sup>a</sup>	0.68	0.0249

<sup>a, b</sup> Means with different superscript in the same row are significant different ( $P \leq 0.05$ ).

<sup>2</sup>BRN = Boran, IRR=Iringa Red, SWT = Singida White, <sup>3</sup>SEM =Standard error of the mean, <sup>4</sup>Interaction of diets and strains.

## 4. Discussion

The highest slaughter weight shown on bulls fed on D2, was associated with the highest levels of nutrients in this diet, which contained cassava meal as a major source of energy. Cassava meal contain high starch level (80%), which is a good source of energy for ruminant feeding [18]. The obtained slaughter weight shown by bulls fed on D2 could as well be attributed to the observed higher feed intake observed on D2 relative to other diets (Khatibu, 2024). Inclusion of molasses in diet D2 enhanced palatability and digestibility; hence, could stimulate fast growth and increase muscle and fat deposition. This observation is in agreement with other studies conducted [19]. Cassava meal, when processed correctly to inactivate the toxicity effects, could be used as a source of

energy feed for finishing beef cattle in feedlots and producing positive results in growth performance and quality of meat. This observation is in agreement with other studies [20].

The highest hot carcass weight shown by bulls fed with D2 was associated with the suitability of the diet, the formulated diets with high energy and protein contents have highest feed intake and growth rate and therefore produce heavy carcasses [16]. The values of hot carcass weight obtained from this study were slightly goes parallel with those reported by [10, 21]. The heavier hot carcass obtained by Boran (BRN) bulls were associated with the highest weight gained by BRN bulls during the feeding period. The carcass weight produced by BRN bulls of the current study were lower than that reported by [14]. This difference could associated with their known large frame size make them to have slightly heavier weight than TSHZ. Previous studies show that bulls which enter into

feedlot with heavy weight tend to finish with heavier weight than their counterparts [22]. The heaviest lean weight and large fat percentage produced by BRN bulls than other strains from this study were associated with the well-known breed differences, that Boran bulls produced heavier carcasses with high amount of fat than the Tanzania Short Horn Zebu (TSHZ) when both finished in feedlots with energy-based diets [23]. However, Iringa Red (IRR) bulls produce also a carcass with higher lean and fat percentages, which no different from that reported by Asimwe [14]. The weight of carcass and fat deposits obtained by BRN bulls and IRR bulls statistically do not differ. The observed comparable weights are indicative of the suitability of the IRR strain on meat production. Other studies indicate the IRR strain has a large body frame size, which is suitable for meat production [24]. The highest proportion of fat shown when Iringa Red bulls (IRR) fed on the D1 and D2 were associated with the interaction effects of the diets and strain (Figure 1), The diets containing highest proportion of energy have highest performance in fat deposition, together with ability of IRR strains in converting low quality feeds into valuable products the performance of cattle in fat deposition will increased, this observation were in agreement with other studies [25, 26]. Other research shows diets rich with high proportional of energy feeds have highest score in fat deposition as observed also by Schumacher et al., [27] observe diets containing all essential nutrients required for growth including energy, protein vitamins and minerals have high carcass weight and fat deposition when fed animals with high feed utilization efficiency, Iringa Red strain of cattle are indigenous breed which have high ability in digesting low quality feed due to large number of microorganism in their rumen which produce enzyme phytase for rumen digestion therefore they have high feed utilization efficiency [28]. Research conducted by Chenyambuga in 2008 indicates Iringa Red strains have high abilities in disease resistance, drought resistance, as well as feed utilization [26]. The interaction of proportion of fat shown in Figure 2 indicates that breed/strain and diets have influence on increasing the percentage of edible parts of feedlot bulls. In Iringa Red, when fed with formulated diets containing cassava meal with molasses, the percentage of fat increases above that of Singida White (Figure 2). The reason might be due to the diets containing the highest level of energy and protein, which was 11.27 MEMJ/kgDM and 14 g/kgDM [17]. Other study shows the diets containing molasses have the highest palatability and digestibility, therefore increase feed intake and hence have the highest muscle and fat deposition [14]. The influence of strain was shown from the ability of Iringa Red to absorb and digest nutrients from low-quality roughages, digest and convert them into valuable products, such as muscle and fat, which give them an ability to survive under harsh environments; this observation was also revealed from other studies [29]. When IRR bulls were fed on D1 and D2 the percentage of fat increases above that of Boran and Singida white. The reason might be due to breed differences; breeds

differ in their ability to digest and absorb nutrients from diets according to the structure of their villi. For example, exotic breeds have long villi, which make them have a higher ability to absorb nutrients than the villi of local breeds such as TSHZ. The present study shows the Iringa red bulls have the highest percentage of edible parts than Singida white bulls, similar to Boran bulls. Boran bulls, when fed with D3 diets that contain rice polish as a source of energy feed, the proportion of edible parts of the carcass decreases to reach that of Singida White due to the low energy and protein content of 11.03MJME/kgDM and 14g/kgDM [17]. than other diets. The previous study indicates diets containing rice polish have low digestibility due to the high fiber and silica found in rice polish [14]. On the chemical composition of meat, the highest CP and ash contents shown from the meat from bulls fed on D2 did not differ from that reported from other studies [30]. The reason for the highest value obtained was attributed to the high intake of crude protein feeds assigned in D2. Other researchers indicated the high crude protein content in the meat is associated with high-quality nutrients in feeds with the recommended level of energy and protein contained in the diets [31]. The relatively higher ash content observed in the meat from bulls fed on diet D3 could be associated with relatively higher amounts of tendons and nature of the fiber in the meat samples compared to samples from other bulls. Meat samples containing fibrous and tendon, when analyzed for chemical composition in the laboratory, produced the highest values of ash [32]. The Iringa red and Boran bulls show no statistical difference in the chemical composition of meat as well as the weight of non-cassis components and cooking loss. This indicates that the bulls of Iringa Red strain has the high potential to be used as beef producing strain of cattle in Tanzania.

## 5. Conclusion and Recommendations

It is concluded that finishing the Iringa Red cattle strain in feedlot with formulated diet D2, which contained cassava meal and molasses improves the finished bulls produced heavy carcasses with right proportions of lean and fat or edible parts of carcass similar to that of Boran breed. The meat quality parameters matched well to those of Boran breed. Stakeholders of beef cattle are advised to opt for Diet D2 for finishing the Iringa Red strain in feedlot for enhancing productivity and quality of beef in the sector. Further study are needed in screening more locally available feed resources to develop formulations for finishing different strains of the TSHZ cattle to increase the demanded prime beef in the country.

## Abbreviations

DI	Diet 1
D2	Diet 2
D3	Diet 3

BRN	Boran
IRR	Iringa Red
SWT	Singida White
CL	Cooking Loss
W1	Weight 1
W2	Weight 2
W3	Weight 3
LD Muscle	Longissimus Dorsi Muscle
TSHZ	Tanzania Short Horn Zebu
CP	Crude Protein
LS	Least Squares

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## Conflicts of Interest

The authors declare no conflicts of interest.

## References

- [1] Muchakilla, M. B., Asimwe, L., Kimambo, A. E., Mtenga, L. A., & Laswai, G. H. (2014). Effect of diet and muscle type on meat quality characteristics of Tanzania Shorthorn Zebu. *Livestock Res Rural Dev*, 26(10).
- [2] Msalya, G., Kim, E. S., Laisser, E. L., Kipanyula, M. J., Karimuribo, E. D., Kusiluka, L. J.,... & Rothschild, M. F. (2017). Determination of genetic structure and signatures of selection in three strains of Tanzania Shorthorn Zebu, Boran and Friesian cattle by genome-wide SNP analyses. *PLoS One*, 12(1), e0171088.
- [3] Maltin, C. A., Lobley, G. E., Grant, C. M., Miller, L. A., Kyle, D. J., Horgan, G. W., & Sinclair, K. D. (2001). Factors influencing beef eating quality 2. Effects of nutritional regimen and genotype on muscle fibre characteristics. *Animal Science*, 72(2), 279-287.
- [4] Mushi, D. E. (2020). Feedlot performance of Tanzanian Shorthorn Zebu finished on local feed resources. *Tropical Animal Health and Production*, 52(6), 3207-3216.
- [5] Kurwijila, L. R., Ogutu, C., & Omore, A. O. (2014). Review of successes and failures of dairy value chain development interventions in Tanzania.
- [6] Mwilawa, A. J. (2012). Effects of breed and diet on performance, carcass characteristics and meat quality of beef cattle. Ph. D. thesis, Sokoine University of Agriculture, Morogoro, Tanzania.
- [7] Das, S. M., & Mkonyi, J. I. (2003). Important aspects of conservation of indigenous cattle in Tanzania: A review. In *Tanzania Society of Animal Production Conference series*, 30, 59-70.
- [8] Dagne, T., & Ameha, N. (2017). Review on beef eating quality attributes (tenderness, juiciness and flavor) and quality standards in Ethiopia.
- [9] Msanga, Y. N., Mwakilembe, P. L., & Sendalo, D. (2012). The indigenous cattle of the Southern Highlands of Tanzania: distinct phenotypic features, performance and uses. *Livest. Res. Rural Dev*, 24, 1-14.
- [10] Mushi, D. E., & Baruani, J. M. (2021). Preliminary study on slaughter and meat quality characteristics of selected strains of Tanzania shorthorn Zebu. *Tanzania Journal of Agricultural Sciences*, 20(2), 278-294.
- [11] Rege, J. E. O., & Tawah, C. L. (1999). The state of African cattle genetic resources II. Geographical distribution, characteristics and uses of present-day breeds and strains. *Animal Genetic Resources/Resources génétiques animales/Recursos genéticos animales*, 26, 1-25.
- [12] Haile, A. (2011). Breeding strategy to improve Ethiopian Boran cattle for meat and milk production (Vol. 26). ILRI (aka ILCA and ILRAD).
- [13] Theron, H. (2020). Investigating the meat quality of Boran cattle. *Stockfarm*, 10(8), 44-45.
- [14] Asimwe, L., Kimambo, A. E., Laswai, G. H., Mtenga, L. A., Weisbjerg, M. R. and Madsen, J. (2016). Economics of finishing Tanzania Shorthorn Zebu cattle in feedlot and optimum finishing period. *Livestock Research for Rural Development*, 28(11).
- [15] Rangi, W. S. (2017). Commercial Viability of Beef Cattle Production: A Case of Traditional Feedlots in Lake Zone, Tanzania (Doctoral dissertation, The Open University of Tanzania).
- [16] Kimirei, S. O. G., Chenyambuga, S. W., Mushi, D. E., Msalya, G. M., & Mpenda, Z. (2022). Feedlot performance and profitability of Tanzania Shorthorn Zebu finished on local feed resources in Kongwa District, Tanzania texture, and micro-structure of meat from spent Pekin ducks. *Poultry Science*, 99(2), 1232-1240.
- [17] Salum, K. A., Laswai, G. H., and Mushi, D. E. (2024). Performance of Boran and two strains of Tanzania Short Horn Zebu cattle fed on three different diets. *International Journal of Animal Science and Technology*, 8(2), 21-29. <https://doi.org/10.1164 8/j.ijast.20240802.12>
- [18] Ross, R. A. (2005). Evaluation of Techniques to Estimate Carcass Composition of Beef Cattle (Doctoral dissertation, Oklahoma State University).
- [19] Mayulu, H., Daru, T. P., & Tricahyadinata, I. (2024). In vitro evaluation of ruminal digestibility and fermentation characteristics of local feedstuff-based beef cattle ration. *F 1000 Research*, 11, 834.



- [20] McCabe, S., McHugh, N., O'Connell, N. E., & Prendiville, R. (2020). Evaluation of production efficiencies at pasture of lactating suckler cows of diverse genetic merit and replacement strategy. *Animal*, 14(8), 1768-1776.
- [21] Zakaria, A. (2010). Effects of nutrition and breed on body measurements and meat cut yields (Doctoral dissertation, Dissertation for award of Msc. Degree at Sokoine University of Agriculture Morogoro, Tanzania).
- [22] Özdemir, V. F., & Yanar, M. (2021). Effects of age at feedlot entry on performance, carcass characteristics, and beef quality traits of Holstein Friesian bulls reared in high altitude of Eastern Turkey. *Turkish Journal of Veterinary & Animal Sciences*, 45(5), 936-943.
- [23] Mohammed, A. M. (2004). Effect of slaughter weight on meat production potential of Western Sudan Baggara Cattle (Doctoral dissertation, PhD Thesis, University of Khartoum, Khartoum).
- [24] Chenyambuga, S. W., Nalaila, S. M., & Mbagi, S. H. (2008). Assessment of uses, special qualities and management aspects of Iringa Red Zebu cattle in Tanzania. *Age*, 1(5), 3.
- [25] Mwangi, F. W., Charmley, E., Gardiner, C. P., Malau-Aduli, B. S., Kinobe, R. T., & Malau-Aduli, A. E. (2019). Diet and genetics influence beef cattle performance and meat quality characteristics. *Foods*, 8(12), 648.
- [26] Irshad, A., Kandeepan, G., Kumar, S., Ashish, K. A., Vishnu-raj, M. R., & Shukla, V. (2013). Factors influencing carcass composition of livestock: A review. *Journal of Animal Production Advance*, 3(1), 1.
- [27] Schumacher, M., DelCurto-Wyffels, H., Thomson, J., & Boles, J. (2022). Fat deposition and fat effects on meat quality. A review. *Animals*, 12(12), 1550.
- [28] Wang, Y., & McAllister, T. A. (2002). Rumen microbes, enzymes and feed digestion-a review. *Asian-Australasian Journal of Animal Sciences*, 15(11), 1659-1676.
- [29] Strydom, P. E., Frylinck, L., Van der Westhuizen, J., & Burrow, H. M. (2008). Growth performance, feed efficiency and carcass and meat quality of tropically adapted breed types from different farming systems in South Africa. *Australian Journal of Experimental Agriculture*, 48(5), 599-607.
- [30] Kokoszyński, D., Arpášová, H., Hrnčar, C., Žochowska-Kujawska, J., Kotowicz, M., & Sobczak, M. (2020). Carcass characteristics, chemical composition, physicochemical properties, texture, and microstructure of meat from spent Pekin ducks. *Poultry Science*, 99(2), 1232-1240.
- [31] Cheng, Q., & Sun, D. W. (2008). Factors affecting the water holding capacity of red meat products: A review of recent research advances. *Critical reviews in Food Science and Nutrition*, 48(2), 137-159.
- [32] Boler, D. D., & Woerner, D. R. (2017). What is meat? A perspective from the American Meat Science Association. *Animal Frontiers*, 7(4), 8-11.