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THE RELATIONSHIP BETWEEN AGE AND SEX OF MASHONA CATTLE AND THEIR CROSSES IN FEEDLOT PERFORMANCE

BY

EGNAH FAY MATANDA
(B1647356)

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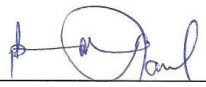
DATE: 31 JULY 2020

Declarations

I, EGNAH FAY MATANDA proclaim that this research is my own work and I confirm that it has not been submitted to any university or institution in fulfilment of any qualification.

Student..... Date……

Supervisor  18 August 2020

Approval form

The undersigned certify that they have supervised this thesis and recommend thatit be accepted for assessment and grading.

Name of supervisor: Dr Paul Chatikobo

Signed 

Date. 18 August 2020

Dedication

I dedicate this important dissertation to my parents, brothers, sisters and supervisor who supported, prayed and inspired me through my studies. Last but not least I would like to thank the Almighty God for his guidance and protection throughout my life.

Acknowledgements

This work would not have been possible without the direct or indirect participation of numerous people, and I am very grateful to all of them. I would like to thank my supervisor Dr Chatikobo for his support throughout this research project. I also give thanks to Mr K.Kunaka and Mr. M. Dhliwayo for their support during his absence. I cannot go without mentioning Isaac Nyanhongo, Trevor Sibanda and R B Chibwe for the assistance with editing, furthermore my colleagues for their contribution to this thesis. I am so grateful to my boss Mr Swan, who allowed me to carry out my research work at Koala Park Farm and Abattoir. I cannot go without thanking Mr Kembo from Koala Park Farm and Abattoir who helped me in dealing with aggressive beef cattle. I would like to express my gratitude to my family, Dad, Mum, Jay, Gay, Mutsa, Mufaro and Tawananyasha for being a supporting force along the way

Abstract

The study was conducted to investigate the effects of induction weight, age and sex of Mashona cattle and their crosses on weight gain and carcass grade in a feedlot. The age, sex, induction weight, weight gain in the feedlot, and carcass grade of 1047 Mashona cattle that were brought in for feedloting at Koala Park Farm Abattoir was monitored for 4 months between June 2019 and September 2019. The ages of cattle at time of entry into the feedlot ranged from 11 months to 72 months of age. Three age categories were drawn with milk or 0 to 2 teeth of ages 11 months to 30 months regarded as young, 4 teeth of age group 30 months to 48 months was regarded as middle aged, while those with 6 to 8 teeth of age group 48 months to above 72 months was regarded as old. The total number of cattle in each age category were 546, 300 and 201 respectively. Generally, cattle that entered the feedlot with 0 to 4 teeth had a higher weight gain compared to those that entered the feedlot at older ages with 6 to 8 teeth ($p<0.05$).

The ages of cattle at time of entry into the feedlot ranged from animals with milk or 0 teeth to 8 teeth. Three age categories were drawn with 0 to 2 teeth regarded as young, 4 teeth regarded as middle aged, while 6 to 8 teeth regarded as old. The total number of cattle in each age category were 546, 300 and 201 respectively to make them 1047 cattle. Generally, cattle that entered the feedlot at a younger age with 0 to 4 teeth had a higher weight gain compared to those that entered the feedlot at older ages with 6 to 8 teeth ($p<0.05$). The mean weight of cattle with 0 teeth 1.17±0.184 Kgs; 2 teeth 1.24±0.188 Kgs; 4 teeth with a mean of 4 teethed 1.29±0.181 Kgs; 6 teeth 1.17± 0.172 Kgs and 8 teeth 1.05± 0.139 Kgs. At entry into the feedlot, the average weight of females was 330 kg (range 135 to 456 kg), while that of males was 403 kg (range 160 to 576 kg).

The sex of animal significantly affected the average daily weight gains in the feedlot. Of the 1047 animals, 756 (72%) were males and 291 (28%) were females. The sex of animal significantly affected the average daily weight gains in the feedlot. The mean weight of bulls was 114.4±15.9 Kgs; steers 120.1±3.66 Kgs; cows 71.3±5.19 Kgs and heifers 44.5±7.19 Kgs. Heifers and cows recorded lower weight gains relative to their male (bulls and steers) counterparts.

The age of animal at entry into the feedlot was significantly correlated to the carcass grade attained after 3 months feedloting. The distribution of carcass grades attained were: super 846 heifers and steers (representing 81% of total animals that enter the feedlot), commercial 134 cows (13 %) and economy 67 bulls (6%).

The sex of animal at entry into the feedlot was significantly correlated to the carcass grade attained after 3 months feedloting. Of the 1047 animals, 756 were males and 291were females. The distribution of carcass grades among the females were: super 157 carcasses (15% of the female population), commercial 134 carcasses (13%) and economy 0 carcasses (0%). Among the males, the distribution of carcass grades were: super 689 carcasses (66% of the male population), commercial grade 0 carcasses (0%) and economy 67 carcasses (6%). Overall, the implications of the results are discussed in the text.

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1 INTRODUCTION

Unfortunately, the livestock sector contribution to GDP has been moderate and declining due to lack of animals, low productivity, poor quality and low off-take (Adams, 2013). According to Arizona Annual report (2016), livestock contribution have declined from 7.5% in 2010 to 4.6% in 2013 and the global cattle population amounted to about 989.03 million head in 2019, down from over one billion cattle in 2014. The current beef cattle herd is at around 5.5 million heads in Zimbabwe (Bennet, 2018).Beef production in Zimbabwe has declined from 1980 to 2000 whereby from 1980 to 1990 there was a growth of 2% in beef cattle production but it moved to -1.2% in 1990 to 2000 due to land reform and drought (Table 1)

Table 1: Growth rate of beef cattle in Zimbabwe

Years	1980-1990	1990-2000
Annual growth rate %	2.0	-1.2

Communal farmers owning a larger cattle population than commercial farmers in Zimbabwe of 22% and 6% respectively. The population and distribution of beef cattle in communal areas in Zimbabwe range from 500 000 to 1000 000 beef cattle in 5 natural regions where the highest population was in Masvingo province, followed by Mashonaland East, Manicaland, Midlands, Matebeleland South, Matebeleland North, Mashonaland West and lastly Mashonaland Central with the lowest beef cattle population (Table 2)

Table 2: Cattle population and distribution in Zimbabwe (communal areas)

Province	Ecological Region	Population	Proportion (%)
Manicaland	I	700 000	13.1
Mashonaland East	II	800 000	15.0
Mashonaland Central	II	500 000	9.4
Mashonaland West	II; III	550 000	10.2
Midlands	III; IV	650 000	12.2
Masvingo	IV	1 000 000	18.7
Matebeleland North	V	550 000	10.2
Matebeleland South	V	600 000	11.2

The downside of this is that these smallholder farmers keep cattle for multiple purposes including draught power, wealth and other personal things but in most cases meat production is not a priority production objective, hence, the country continues facing beef meat shortages because the huge indigenous cattle resource base is mostly geared for other purposes (Bennet, 2018).

Melton (2015) concluded that market off-take rate is low in the communal cattle production system of Africa, with off-take rates of between 5 and 10%, compared to 25% in the commercial sector. Bray (2014) stated that the average off-take rate in the sampled municipalities was 12%, which was much lower than that of the commercial sector (25%). Off-take is affected by the level of education, market distance, body condition, and herd size (Bray, 2014). According to Christian (2019) the only solution is to have a joint effort by the government, municipalities,

smallholder farmers, producer organizations, and private sector role players' inorder to make decisions to sell cattle amongst the smallholder farmers.

David (2014) concluded that Zimbabwe's beef industry, collapsed in the 2000s following outbreaks of foot-and-mouth disease. Lewis (2014) showed that he Southern African country's global beef exports resumed in 2017, 10 years after they slowed when the country's economy tumbled. In addition to the foot-and-mouth disease, the beef industry had been hit by crippling economic sanctions imposed on the country by Western nations, which contributed to hyperinflation, huge foreign debts and obsolete transport fleets (Mugabe, 2018). Mugabe (2018) also concluded that mismanagement of livestock farms worsened the situation and the quality of herds is still a disadvantage.

Another problem is that corrupt beef dealers buy up bulls from rural farmers at ridiculously low prices and make huge profits selling to the CSC which affect rural farmers (Bratzler, 2014) . According to (Sta, 2015) doubling herd size strains grazing grass and water while climate change is a reality so farmers should feed cattle with crop residues that would have been cut in winter, use of maize stalks and other grasses that would have been cut during the rainy season. Another huge challenge occurs when Zimbabwean livestock, some diseased, wander into neighbouring Botswana and are killed by officials acting on the orders of that country's agriculture ministry (Catherine, 2016). According to Marlowe (2015) factors affecting feedlot performance are age, sex, genetic merit, breed, body condition, health status, diet composition, diet nutrient content, diet intake, growth promotants, previous nutritional history and duration or time in feedlot.

Harvey (2010) mentioned that animals can be placed in the feedlot at any age, usually after weaning at 7 to 9. Sta (2015) stated that cattle placed on high energy rations at an early age tend to deposit fat more rapidly than if they are kept on low energy diets for a time before being placed on a high energy rations.

On animal sex, Cures (2015) concluded that females are earlier maturing than steers and steers in turn are earlier maturing than bulls. Bulls can do well in feedlots, but often cause problems by fighting. Females often have poor growth rates partly because they reach carcass finish at an earlier age. Breeds also affect feedlot performance because different breeds reach maturity at different times. Klosterman (2018) observed that early maturing like exotic breeds start depositing fat at an earlier age and can be market ready at a live mass of 380 to 400 kg and late maturing like indigenous breeds reach market readiness at a live mass of 500kg or more. Feedlot Management being one of the factors that affect feedlot performance like being able to ensure that the right type of animal is bought at the right price and at the right time, the feedlot ration must be balanced in respect of nutrient contents among others and if not done it will affect feedlot performance (Masse 2010). Henderson (2018) stated that feedloting which is also called pen fattening involves the feeding of beef cattle with a protein balanced, high-energy diet for a period ranging from 120 days under confinement to increase live weights and improve degree of finish inorder to obtain better grades at the abattoir.

1.1 Problem statement

Koala Park being one of the biggest abattoirs in Zimbabwe is facing financial losses because they are feeding their beef cattle with the same type and amounts of feed regardless of breed, age

and sex of the animal of which farmers bring more of mashona and their crosses so the researcher want to see if these cattle's age and sex can affect feedlot performance.

1.2 Justification

The performance of Mashona cattle or their crosses when given standard pen fattening diets is not known, yet currently, Mashona cattle or their crosses are the dominant cattle breeds in the country and which are being fattened by feedlotters.

1.3 Objectives

The main objective of this study was to access the feedlot performance of Mashona cattle and their crosses at Koala Park Abattoir

The specific objectives were to:

1. Determine the effect of age on weight gain and carcass quality in Mashona cattle or their crosses when fed the same pen fattening diet over a period of 50-70 days in feedlot;

2. Determine the effect of sex on weight gain and carcass quality in Mashona cattle or their crosses when fed the same pen fattening diet over a period of 50-70 days in feedlot; and

3. Establish the feed conversion efficiency of male and female Mashona cattle of different ages when fed standard feedlot rations for 50-70 days in winter.

1.4 Hypothesis

1. H_0 There is no significant effect of age on weight gain;

2. H_0 There is no significant effect of sex on weight gain; and

3. H_0 There is no significant effect of sex and age on feed conversion efficiency.

2 LITERATURE REVIEW

2.1 Introduction

This chapter review theoretical and literature relevant to the current study with a critical focus on the relationship between age and sex of mashona cattle and their crosses on feedlot performance. This chapter is going to provide review of empirical literature which is from other sources and finally conclude by in sighting from literature.

2.2 Effects of age of cattle on weight gain in the feedlot

The age of an animal at time of entry into feedlot affects its performance. Foster (2018) showed that early weaned calves which enter into the feedlot at 2 months of age had the lowest weight gain (517kg) , compared to cattle placed in the feedlot at 8 months of age (582kg) or at 12 months (682kg) because Charrette (2011) observed that animals that enter the feedlot at an older age will be near the end of their growth period and will partition most of their nutrient intake into finishing unlike younger ages which will partition a proportion of their intake towards skeletal and muscle development. Similar findings were reported by Black (2010) who also observed that yearlings at 12 months had the highest weight gain (531kg) than early weaned calves at 2 months and 18days (434kg).

According to McClain (2010) an animal that enters the feedlot at 30 months of age have a higher weight gain than cattle that enter the feedlot at 96 months of age because older cattle had low digestibility than younger ones. Harvey (2010) observed that18months cattle have a higher

weight gain than 30 months old cattle because feed efficiency decrease with the increase in age. The highest weight gain was obtained in 18 months old cattle compared to and 6 months of age because 6 months old cattle will use all the nutrients for skeletal development instead of growth (Harvey 2010).

Champagne (2012) stated that cattle should not enter feedlot above 36 months of age because older cattle will be using feed for fat accumulation which result in health disorders if not monitored. 11 months of age is the ideal age group to enter the feedlot (Sta, 2015). Similar findings were reported by Herrings (2015) who also observed that cattle should enter the feedlot between 9 and 11 months old. They both concluded that younger cattle have a high residual feed intake for maintenance and growth which will result to a higher weight.

According to Christian (2019), the weight gain of Simmental bulls was greater in older ones at 22 months than the younger ones at 10 months because the younger bulls are still growing strongly, and tend to be leaner, carrying less body fat reserves, are usually fitter and more agile, although not necessarily stronger than older bulls. Beef cattle that enter the feedlot at 60 months of age recorded lower weight gains compared to those that enter the feedlot at 12 months of age (Mackintosh, 2016). This was attributed to the fact that younger cattle have make better feed conversion efficiency and thus gain more weight compared to older cattle when exposed to the same quality of feed (Oliver and Boyd 2012).

Several other authors have reported no effects of age at time of entry into the feedlot on weight gains. (Brannang, 2010) stated that age has no effect on weight gain because there was no differences in calf growth rates observed at 3 months compared 6months of beef cattle.

Bums (2016) stated that, age has no effect on weight gain by using weanlings at 6 months and yearlings at 12 months of steers because it did not affect diet digestibility of nutrients.

2.3 Effects of age at time of entry into feedlot on carcass quality

Age of beef cattle at time of entry into feedlot has been shown to have positive effects on carcass quality (Aitken, 2013). Cattle that enter feedlot at 9 to 12 months of age yielded the highest carcass quality grades of choice or super grades compared to those that entered the feedlot at 20 months of age or older, which mostly yielded commercial grades because older cattle utilise more of high energy diets resulting in heart and kidney fat (Henderson, 2016). Other studies have shown that beef cattle under the age of 36 months attained higher carcass conformation grades of super or choice, relative to older cattle over the age of 36 months because the meat is more tender (Andreae, 2019).

Simmental, Bonsmara and Nguni cattle had the best proportion of lean meat to fat and bone ratios as compared to their 30 months old counterparts (Homb, 2011). The effect of age was also seen in bulls with younger Simmental bulls yielding higher carcass grades relative to older bulls (Bray, 2014). The effects of age on carcass quality was attributed to the fact that as the age of an animal increases, carcass quality decreases to commercial or economy grade because the levels of fat in carcass increases whilst proportions of water and protein decreases (Meiske, 2020).

The increase in age of beef cattle from 44 months upwards results in an increase in pH which lowers the carcass quality to commercial or economy grade (Bocsor, 2013). Meat from older animals has also been observed to be less tender.

Adams (2013) concluded that tissues from older animals are darker in colour while carcasses from younger cattle are dark yellow because of lacking the ability to convert yellow carotene to colourless vitamin A due to the animals consuming large amounts of green forages.

2.4 Effects of sex on weight gain in the feedlot

Sex of animal affects the weight gain in the feedlot. Martin (2016) stated that bulls were shown to have, higher weight gains than steers. This was attributed to the fact that bulls had a better feed conversion ratio than steers (Bocsor, 2013). You need to find explanation why bulls will have a better feed conversion ration than steers. Bulls also perform better than heifers.

Bradley (2012) reported that bulls reached significantly higher daily weight gains of 1,383g/day compared to heifers with 1,106g/day and at slaughter, the bulls weight ranged from 550 to 620 Kgs per carcass whereas the carcass weights of heifers ranged from 480 to and 550kg because there is more fat deposition than muscle growth in heifers.

Studies show that steers perform better than heifers. In one study, steers gained 25 kg more than heifers Arthaud (2015)This was attributed to the fact that steers ate less and had higher feed conversion efficiency than heifers (Oliver and Boyd 2015). Hiner (2010), stated that Steers have a greater weight gain than heifers because of a greater intakes of dry matter of heifers.

According to Migda (2019)feed intake of heifers decrease due to fat exerts which is a direct influence because of physical limitations provided by the abdominal fat on the rumen and an indirect influence on feed intake through the secretion of leptin which result in heifers having a lower weight gain than steers.

2.5 Effects of sex of animal on carcass quality

Field (2014) stated that heifers have a higher carcass quality than steers which had high marbling score and quality grades. Brannang (2010) concluded that heifers have a higher carcass quality than steers because heifers presented with a greater subcutaneous fat thickness, a greater fat proportion in the carcass. For the finishing carcass fat cover, heifers need 90 days in the feedlot because they take time depositing fats than muscle growth.

According to Mitchell (2013) bulls have a higher carcass dressing percentage, and their carcases had higher lean meat content than steers because hormones like androgen assist in growth. Steers had higher intramuscular fat content, it was less tough, more tender and palatable because steers were relatively younger than the bulls (Cundiff, 2016).

Amschler (2010) also said, bulls exhibited lower contents of dry matter and intramuscular fat, and a higher content of collagen in musculus longissimus lumborum than heifers but meat from heifers was assessed by the sensory panel as more tender because of high fat deposition.

Bulls gained 22kg more per day than steers who, in turn, gained 11kg more than heifers and bulls had less marbling and were about one-third grade lower than steers and heifers and muscle from bulls was less tender because heifer consume more but have high fat deposition, bulls have a high pH due production of adrenaline (Bocsor, 2013).

2.6 Effects of breeds on weight gain

The type of breed a cattle is also affects weight gain because it will be depending on the animal's genotype, Catherine (2016) stated that Bonsmara have the highest weight gain than Brahman and Drakensberger. This is because Bonsmara have the highest average daily feed intake followed by Drakensberger then lastly Brahman, Bonsmara also uses less feed per unit gain than others and Bonsmara are more efficient feed converters than Brahman and Drakensberger. Bonsmara breed have the highest weight gain than the Brangus breed because it had the highest feed conversion efficiency and highest feed intake than the Brangus breed (Adams, 2013).

According to Matsushina (2014) there was higher weight gain for cattle grazing coniferous which are suitable for extensive areas and stocking at moderate densities like Hereford unlike charolais and limousine. Martin (2016), observed that Simmental x Limousin heifers and bulls reached significantly lower daily gains of 1119g than pure Simmental breeds of 1317g and Simmental x Charolais of 1298g which resulted in pure Simmental breeds having the highest weight gain followed by Simmental x Charolais then lastly Simmental x Limousin.

Cahill (2016) concluded that during the fattening period the biggest daily weight gain was showed for Simmental breed bulls of 849 g than blonde and Hereford breed bulls, but the biggest live weight increase was recognized for Blonde breed bulls of 295 kg than Hereford and Simmental breed bulls. According to Cahill (2016), the imported breeds like beefmaster showed higher weight gain than the local breeds like mashona because a beefmaster have a higher average daily gain, dry matter intake and gain efficiency than mashona breeds at 18.5 months of age but imported breeds like limousine have a lower weight gain than a local breed like mashona. Charolais breed has a higher average daily gain than Limousin breed because extremely hot climate was unfavourable for growth performance of Limousin breed (Brown 2013).

Andreae (2019) concluded that imported cattle breeds had better growth performance, carcass traits and economic benefits compared with the local cattle breeds at 18.5 months old. The imported like Brahman breeds showed higher weight gain than the local breeds like mashona breeds. Martin (2016) indicated that it is possible to achieve acceptable weight gains for cattle grazing coniferous forest by finding breeds suitable for these extensive areas like Hereford and stocking at moderate densities unlike breeds like charolais and limousin.

2.7 Effects of breeds on carcass quality

According to Brinks (2010) local breeds like Brahman breed have higher carcass quality of a higher marbling score than imported breeds like limousine because local breeds are heat tolerant because heatstress increase the pH which lower marbling score (Andreae, 2019).

Imported breeds like beefmaster have a higher carcass and bone weight because genetically a beefmaster have a bigger frame and high feed efficiency than Brahman breeds (Field, 2014). Adams (2013) stated that animals with a high weight gain produce more muscle fibres with greater glycolytic activity, which is likely to favour meat ageing and hence tenderness.

Limousin bulls has a higher body condition score and less fat carcass than Angus bulls because Limousin bulls can digest grass-silage grain based diet well than the angus bulls (McClain, 2010). A breed like beefmaster is more tender than mashona breed or tuli because a beefmaster contain do not contain an enzyme inhibitor called calpastatin for the enzyme calpain that help in meat tenderisation (Casas, 2014). Andreae (2019) stated that the type of breed an animal is influence tenderness, juiciness, amount of fat as well as the pH level and the fatty acid composition of the meat because the genotype of the animal, preslaughter handling and type of nutrients being given to the animal affect carcass quality.

2.8 Effects of duration of pen fattening on carcass quality

Duration or period of pen fattening is for the beef cattle to be able to obtain the right amount of fat on and in the muscle, and a higher carcass quality in a reasonably short period of time (Cundiff, 2016). Pen fattening duration of 90, 120 and 150 days on breeds like Brahman bulls and Lai Sind bulls resulted in cattle that had 150days duration in the feedlot lost weight and lower carcass quality from pen fattening exercise due to increase in pH of the carcass (Brungardt, 2013).

Amschler (2010) observed that final body weight was significantly higher in charolais and Brahman compared with Jeju native cattle for a 70 days duration in the feedlot because Brahman and charolais consumed less dry matter than Jeju native cattle .Charolais and Brahman carcass quality was also higher than of Jeju native whereby beef shear force value, percent water holding capacity, juiciness and tenderness were significantly greater (Brungardt, 2013)

The normal 90 days increase live weights and improve degree of finish and thus obtain better grades at the abattoir, so if the farmer takes less or more days cattle will go to slaughter without reaching its maximum growth, lose weight due to excess exercises and losses in feed because the growth of cattle will remain constant when it reached its maximum growth rate (Cahill, 2016). Higher weight gain and carcass quality was observed when cattle had a duration of 93days in the feedlot than 75days (Meiske, 2020).

Adams (2013) also added that bulls with 90 days duration of were characterised by a greater carcass dressing percentage by 1.17% on average, greater carcass conformation scores, greater external fat thickness and a greater intramuscular fat content than bulls with a pen fattening duration of 120days. Beef cattle on a pen fattening duration of 90days had a higher marbling score which increased 30 units for each 1-mm increase in fat. Its meat has a high shear force, juiciness, tenderness, flavour, or overall palatability. The normal 90 days pen fattening duration in beef cattle result in a higher weight gain and high carcass quality (Klosterman, 2018).

2.9 Effects of induction weight on weight gain in the feedlot performance

According to Bocsor (2013), induction weight affects, final birth weight and body condition score whereby animals with a low induction weight that yield less meat at about 30 months of age, adverse effects on composition due to increased fatness, or on indices of beef quality. Underweight cattle at induction, usually due to hind malnutrition, will take a long time in the feedlot which result in losses due to high feed intake and low weight gain. Bratzler (2014) stated that higher induction weight of cattle result in a higher body condition score at calving more heifers at oestrus and more pregnant heifers by 40 to 60 days but if the induction weight is low, it will result in dystocia in females and to avoid it the cows should be properly fed at 90 days before calving.

Although reproductive performance is not affected by induction weight gain, it affects milk production because all the nutrients consumed by the animal will be for its animal's survival (Amschler, 2010). Low induction weight is caused by poor housing, malnutrition and poor animal welfare which will affect the final weight by beef cattle taking a long duration or period in the feedlot which results in losses in beef enterprises (Meiske, 2020).

According to Bums (2016), liverfluke and tickborne diseases result in low induction weight in beef cattle and also the presence of other diseases like bloat, footrot and FMD which will led to low final weight which lead to losses in the beef enterprise. Field (2014) stated that low induction weight can affect final weight gain of beef cattle especially due to heatstress when beef cattle consume less or have a low feed intake due to less of appetite and low digestibility of feed.

Matsushima (2015) concluded that low induction weight result in low carcass quality because as the beef cattle matures or gets older, the lower the carcass quality whereby amounts of external fat on a beef carcass are undesirable.

2.10 Conclusion of literature review

The literature was composed of facts about other crosses of Mashona and few information on pure Mashona breeds. The researcher learnt that that according to other sources age and sex affect feedlot performance.

3 METHODOLOGY

3.1 Description of study site

Koala Park Farm and Abattoir is located at Fort Concrete Premises along Seke Road, just outside Harare Zimbabwe. The farm and abattoir is in Natural Region 2 and it consists of about many hectares of land where crop production is done under the irrigation system because there is a dam on the farm that facilitates crop and for animal production there is an electronic borehole in order for our animals to have clean water to drink. This region is located in the middle of the north of the country. The rainfall ranges from 750 to 1 000 mm per year. It is fairly reliable, falling from November to March or April. Natural region 2 is suitable for pen fattening. Koala Park Abattoir is located at the following coordinates-17.9254565, 31.073779

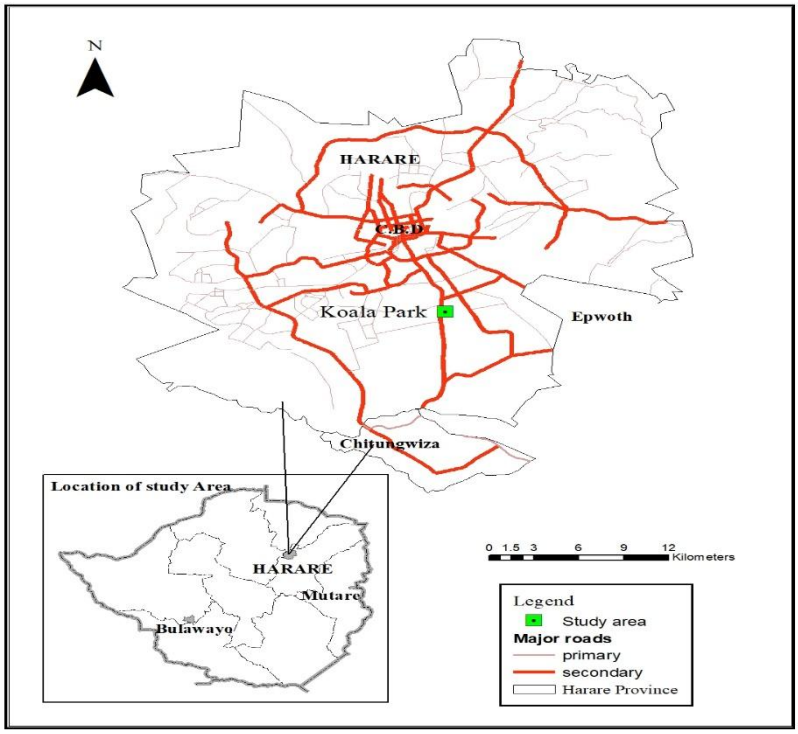

Figure 1:Map of Koala Park Farm Abattoir

At Koala Park Farm and Abattoir, most of the cattle is bought from farmers every morning as a daily routine but a process of selection is done before purchasing the cattle to avoid buying sick cattle. Weight, body condition score, sex and age of the animal affect the price of the cattle brought by the farmer or producer whereby, in terms of sex younger steers cost more than younger heifer, followed by a cow or ox then a bull cost less. Age is determined by the number of teeth and if the cattle has from milk to 4 teeth it will cost more but if it has 6 to 8 teeth then it cost less because it will be older. Lastly, the higher the weight of the animal, the more money is given to the farmer. Before quarantining the new cattle, they are sprayed first to prevent both external parasites like ticks and prevent footrot. Dosing process is done to prevent internal and external parasites like ticks and liverfluke. Vitamin B-complex is given to the animals to reduce stress and increase appetite. Vaccination is also done to prevent diseases like FMD, Anthrax and

Lumpy skin. Castration of younger males is done to increase performance in the feedlot and also dehorning for animals to be able to feed without restrictions from long horns or prevent from injuries. Ear tags are also placed on each animal for identification and can be tracked if lost or stolen because they are computerised.

After these processes, the cattle are put in quarantine for induction or background being provided with both pasture and small amounts of feed for the animals to be able to adapt to the feed. At Koala Park Farm and Abattoir, animals in the induction or quarantine are moved to feedlot if only they reach 250kg so if it's less than 250kg the animal stays in the induction section. At the feedlot, cattle are no longer given pasture only feed. 3 tonnes of feed is given to the animals daily with clean water in automatic trophs. Some anima ls stay in the feedlot longer than others so animals with a larger body condition score are moved from the feedlot to slaughter.

Animals are slaughtered after 15 hours from the feedlot in order to reduce stress which result in optimum pH which does not affect carcass quality. Younger animals with m ilk to 4 teeth either heifer or steer are graded as super meat because the meat is more tender while older animals with 6 to 8 teeth either cow or ox are graded as commercial meat because it's tougher and consist of more fat. Lastly, bulls are graded as economy meat because the m eat is more red in colour due to a higher pH.

3.2 Research design

This study employs a descriptive research design to agree on the effects of age and sex of mashona cattle and their crosses on feedlot performance. Therefore, this research design enabled

the researchers to gather data from a wide range of respondents. And this helped in analysing the response obtained on how age and sex affects feedlot performance.

3.3 Data collection

3.3.1 Primary data collection methods

It was used when the researcher was conducting by observing at Koala Park Farm and Abattoir. The researcher looked at each objective and recorded the starting weight and the finishing weight of 1054 animals. The researcher took note of the observations.

3.3.2 Secondary data collection methods

Literature review and industry documents and reports were used to achieve the dissertation's objectives, the researcher has conducted excessive document review and reports of the companies in both online and offline modes.

A literature search was conducted using the database sources and other related materials. A sample of more than 2000 articles, websites, reports, and guidelines to determine whether they should be included for further review or reject. Discrepancies were thoroughly identified and resolved before the review of the main group of more than 300 articles commenced. After excluding the articles based on the title, keywords, and abstract, the remaining articles were reviewed in detail, and the information was extracted on the instrument that was used to assess the dimension of research interest. A complete list of items was then collated within each research targets or objectives and reviewed to identify any missing elements.

3.4 Statistical analysis

3.4.1 Quantitative data analysis

Quantitative data were obtained from primary and secondary data discussed above in this chapter. This data analysis was based on their data type using Excel, R.Studio, Office Word format, and other tools. This data analysis focuses on numerical or quantitative data analysis. Before analysis, data coding of responses and analysis were made. In order to analyse the data obtained easily, the data were coded to R.Studio software as the data obtained from Excel. This task involved identifying, classifying, and assigning a numeric or character symbol to data, which was done in only one way pre-coded 9 and 10. In this study, all of the responses were pre-coded. They were taken from the list of responses, a number of corresponding to a particular selection was given. This process was applied to every earlier question that needed this treatment. Upon completion, the data were then entered to a statistical analysis software package, SPSS version 20.0 on Windows 10 for the next steps.

Under the data analysis, exploration of data has been made with descriptive statistics and tables. The analysis included exploring the relationship between age and sex on how they affect feedlot performance. This has been done using regression analysis.

3.4.2 Qualitative data analysis

Qualitative data analysis used for triangulation of the quantitative data analysis. The observation and report records were used to support the findings. The analysis has been incorporated with the quantitative discussion results in the data analysis parts.

3.4.3 Data analysis software

The data were entered using R.Studio on Windows 10 and analysed. The analysis supported with R.Studio software much contributed to the finding. It had contributed to the data validation and correctness of the results. Excel is also used to calculate some analytical solutions.

4 RESULTS

4.1 Effects of age on weight gain

The ages of cattle at time of entry into the feedlot ranged from animals with milk or 0 teeth to 8 teeth. Three age categories were drawn with 0 to 2 teeth regarded as young, 4 teeth regarded as middle aged, while 6 to 8 teeth regarded as old. The total number of cattle in each age category were 546, 300 and 201 respectively. Generally, cattle that entered the feedlot at a younger age with 0 to 4 teeth had a higher weight gain compared to those that entered the feedlot at older ages with 6 to 8 teeth ($p<0.05$). The mean weight of cattle with 0 teeth 1.17±0.184 Kgs/day; 2 teeth 1.24±0.188 Kgs/day; 4 teeth with a mean of 4 teethed 1.29±0.181 Kgs/day; 6 teeth 1.17± 0.172 Kgs/day and 8 teeth 1.05± 0.139 Kgs/day.

4.2 Effects of age on carcass grades after feedloting

The age of animal at entry into the feedlot was significantly correlated to the carcass grade attained after 3 months feedloting. The distribution of carcass grades attained were: super 846 heifers and steers (representing 81% of total animals that enter the feedlot), commercial 134 cows (13 %) and economy 67 bulls (6%).

4.3 Effects of sex on weight gains

Of the 1047 animals, 756 (72%) were males and 291 (28%) were females. At entry into the feedlot, the weight of females was 330 kg (range 135 to 456 kg), while that of males was 403 kg

(range 160 to 576 kg). The sex of animal significantly affected the average daily weight gains in the feedlot.

The mean weight of bulls was 114.4±15.9 Kgs/day; steers 120.1±3.66 Kgs/day; cows 71.3±5.19 Kgs/day and heifers 44.5±7.19 Kgs/day. Heifers and cows recorded lower weight gains relative to their male (bulls and steers) counterparts.

4.4 Effects of sex on carcass grades after feedloting

The sex of animal at entry into the feedlot was significantly correlated to the carcass grade attained after 3 months feedloting. Of the 1047 animals, 756 were males and 291were females. The distribution of carcass grades among the females were: super 157 carcasses (15% of the female population), commercial 134 carcasses (13%) and economy 0 carcasses (0%). Among the males, the distribution of carcass grades were: super 689 carcasses (66% of the male population), commercial grade 0 carcasses (0%) and economy 67 carcasses (6%).

4.5 Effects of age on average weight gain

Age showed a significant effect on feedlot performance as ($p<0.05$). The age of mashona cattle and their crosses affect feedlot performance were the highest weight gain was observed in cattle that entered the feedlot with 4 teeth between 36 to 48 months old with a weight gain of 149 kg, followed by cattle with 2 teeth between 24 and 30 months of age with 107 kg. 0 or milk teeth between 11 to 18 months old with 102 kg then 6 teeth cattle who had a weight gain of 76 kg and are between 48 to 72 months and lastly, cattle with 8 teeth from 72 and above months old with a weight gain of 61 kg (Table 3).

Table 3: Effects of age on average weight gains

AGE: no// of teeth	Total no// of animals	Weight at entry (kg)	Weight at exit (kg)	Weight gain (kg)
0	176	287	389	102
2	442	308	415	107
4	228	295	444	149
6	147	301	377	76
8	54	288	349	61

4.6 Least square means of age on average weight gain

The means in the same column with same superscripts were significantly different by 5% level of significance. The average weight gain of all ages are different. The highest Least Square Mean (LSM) is in animals with 4 teeth with a mean of 1.29±0.181 Kgs/day; 2 teeth 1.24±0.188 Kgs/day; 0 teeth 1.17±0.184 Kgs/day; 6 teeth 1.17±0.172 Kgs/day and lastly 8 teeth with the lowest mean of 1.05±0.139 Kgs/day (Table 4).

Table 4: Least square means (LSM) ± standard error (±SE) of age on average weight gain

AGE: no// of teeth	Mean weight gain (Kgs/ day)	± standard error
0	1.17^{c}	0.184
2	1.24^{b}	0.188
4	1.29^{a}	0.181
6	1.17^{c}	0.172
8	1.05^{d}	0.139

4.7 Effects of age on carcass quality

Age have a significant effect on carcass quality ($p<0.05$). Those that had a highest carcass quality were those that entered the feedlot at the age of 11 to 48 months old from 0 to 4 teeth with super carcass which is in grade A, then 6 and 8 teethed cattle from 48 months and above had the lowest carcass quality of commercial carcass which is in grade B. Total number of animals that ended up being of super carcass quality were 176 cattle with 0 teeth, 442 cattle with 2 teeth, 228 cattle with 4 teeth, 0 cattle with 6 teeth and 0 cattle with 8 teeth. Beef cattle that resulted in commercial carcass quality were 0 cattle with 0 teeth, 0 cattle with 2 teeth, 0 cattle with 4 teeth, 147 cattle with 6 teeth and 54 cattle with 8 teeth. Then no cattle from all the age groups entered economy carcass quality (Table 5).

Table 5: Effects of age on carcass quality

AGE: no// of teeth	Total no// of animals	No// of animals that had super carcass	No// of animals that had commercial carcass	No// of animals that had economy carcass
0	176	176	0	0
2	442	442	0	0
4	228	228	0	0
6	147	0	147	0
8	54	0	54	0

4.8 Effects of sex of animal on average weight gain

Sex showed a significant effect on feedlot performance as ($p<0.05$). Sex of mashona cattle and their crosses affect feedlot performance were the highest weight gain was observed in bulls with 169 kg, followed by steers with 145 kg, then cows with 71 kg and lastly heifers with 25 kg (Table 6). In conclusion males have a higher weight gain than females ($p<0.05$).

Table 6: Effects of sex of animal on average weight gain

Sex of animal	Total no// of animals	Weight at entry (kg)	Weight at exit (kg)	Weight gain (kg)
Steers	689	307	452	145
Heifers	157	289	314	25
Cow	134	292	363	71
Bulls	67	509	678	169

4.9 Least square means of sex on average weight gain

The means in the same column all had different superscripts at 5% level of significance. The average weight gain of males and females are different in regardless of their classes. The highest Least Square Mean (LSM) is in bulls with a mean of 114.4±15.9 Kgs/day; steers 120.1±3.66 Kgs/day; cows 71.3±5.19 Kgs/day and heifers with the lowest mean of 44.5±7.19 Kgs/day (Table 7).

Table 7: Least square means (LSM) ± standard error (±SE) of sex of animals on average weight gain

Sex of animal	Mean weight gain (Kgs/day)	± standard error
Steers	120.1^{b}	3.66
Heifers	44.5^{d}	7.19
Cow	71.3^{c}	5.19
Bulls	114.4^{a}	15.9

4.10 Effects of sex on carcass quality

Sex showed a significant effect on carcass quality ($p<0.05$). The highest carcass quality was obtained by steers and heifers with super carcass which is in grade A, followed by cows with commercial carcass which is in grade B and lastly, bulls with economy carcass which is in grade C. Those that ended up being of super carcass quality were 689 steers, 157 heifers, 0 cows and 0 bulls. Beef cattle that resulted in commercial carcass quality were 0 steers, 0 heifers, 134 cows and 0 bulls. Then 0 steers, 0 heifers, 0 cows and 67 bulls were of economy carcass quality (Table 8).

Table 8: Effects of sex on carcass quality

Sex of animal	Total no// of animals	No// of animals that had super carcass	No// of animals that had commercial carcass	No// of animals that had economy carcass
Steers	689	689	0	0
Heifers	157	157	0	0
Cow	134	0	134	0
Bulls	67	0	0	67

5 DISCUSSION

5.1 Effects of age on average daily weight gain

The age of mashona cattle and their crosses affect feedlot performance whereby the highest weight gain was observed in cattle that entered the feedlot with 4 teeth between 36 to 48 months old with an average weight gain of 149 kg, followed by cattle with 2 teeth between 24 and 30 months of age with 107 kg average. 0 or milk teeth between 11 to 18 months old with an average weight gain of 102 kg then 6 teeth cattle who had an average of 76 kg and are between 48 to 72 months and lastly, cattle with 8 teeth from 72 and above months old with an average weight gain of 61 kg.

The pattern shown between the age of the animal at entry and daily weight gain is daily weight gain of mashona cattle and their crosses decreases as the animal gets older. Younger animals with 0 to 4 teeth have a higher weight gain than older animals with 6 to 8 teeth because younger animals are still growing which means there is room for development which allows high nutrient deposition and high feed conversion efficiency which result in muscle development. Older beef cattle have a lower weight gain because there will be no room for development due to the animal already reached its maximum growth rate and the older animal will be converting all the nutrients to fats which makes the animal weigh less than the younger ones.

Older animals spend less of that time lying and more standing or walking due to high level of restlessness because of new environment and new surroundings which is a higher period of stress and result in older animals having a lower weight gain in the feedlot. An increased weight:

height ratio at younger ages at puberty is due to the utilisation of nutrients to growth and development. Our results are in agreement with the findings of Melton and Koger (2015).

5.2 Effects of age on carcass quality

Those that had a highest carcass quality were those that entered the feedlot at the age of 11 to 48 months old from 0 to 4 teeth with super carcass which is in grade A, then 6 and 8 teethed cattle from 48 months and above had the lowest carcass quality of commercial carcass which is in grade B.

The pattern shown between the age of the animal at entry and carcass quality is as the animal get older, the carcass quality decreases. Younger animals with 0 to 4 teeth have a higher carcass quality than older animals with 6 to 8 teeth because an increase in age result in shear force, protein content, hydroxyproline content, redness, and muscle fiber diameter and density significantly increasing leading to poor quality meat. Animals that enter the feedlot at an older age result in cooking loss, low water content, dark coloured meat, and muscle fiber gap due to low pH. Due to more intramuscular fat in the muscular substance of older beef cattle, it is concluded as poor quality meat.

The longissimus thoracic lumborum area lowers whereby marbling increase as cattle get older and decrease the carcass quality of beef which is not favoured by consumers. The dressing percentage decreased with the increase of age, while meat percentage and carcass meat yield increased gradually with age because as the age of the animal increases so will the muscles and also marbling, back-fat thickness and rib eye area increased with age. The moisture content

decrease with age which result in tougher meat. The pattern or behaviour of the researcher's results agrees with those of Hiner and Black (2010).

5.3 Effects of sex of animal on average daily weight gains

Sex of mashona cattle and their crosses affect feedlot performance where the highest weight gain was observed in male cattle than females because bulls had a weight gain of 169 kg, followed by steers with 145 kg, then cows with 71 kg and lastly heifers with 25 kg.

The pattern shown between the sex of the animal and daily weight gain is male cattle have a higher weight gain than their female counterparts. This is because male cattle have the hormone androgen that help in the growth rate and feed conversion efficiency of male animals unlike females that do not have the hormone androgen. During early lactations cows were not fully grown and thus continued to grow till attaining in adult size. Our results are in agreement with the findings of Nix and Bakir (2018).

5.4 Effects of sex on carcass quality

The highest carcass quality was obtained by steers and heifers with super carcass which is in grade A, followed by cows with commercial carcass which is in grade B and lastly, bulls with economy carcass which is in grade C. The lower pH of meat from steers, as compared with bulls, could result from lower testosterone levels in the former, which prevented the depletion of energy reserves needed for lowering the pH of muscles. High pH values typical of DFD (dark, firm and dry) meat were noted more frequently in the meat of bulls and less frequently in steers because bulls release adrenaline during fighting which even result in blood splash in the muscle which is a sign of contamination.

Steers had a higher shear value, pH, drip and cooking losses, and contents of ash and hydroxyproline than cows and heifers, as well as lower ether extract content and lightness because females are more difficult to handle when taking them for slaughter due to their aggressiveness which increase the pH levels in females.

Males had lower water content and higher protein content than females because female deposit fat more in their bodies than males while males focus on muscle growth. Heifers had greater 12th rib fat thickness, marbling score, subcutaneous fat, and lower cutability and trimmed round compared with steers because females have a higher feed intake than male cattle which result to even more fat accumulation. The carcass performances of steer were significantly higher than heifer.In conclusion, the pattern or behaviour of the researcher's results agrees with those of authors like Oliver and Boyd (2015)

6 CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

Age affects weight gain and carcass quality of Mashona cattle or their crosses when fed the same pen fattening diet over a period of 50-70 days in feedlot. As the age of the animal at entry in the feedlot increases, both weight gain and carcass quality decreases. The sex of the animal also affects weight gain and carcass quality of Mashona cattle or their crosses when fed the same pen fattening diet over a period of 50-70 days in feedlot. This is because males have a higher weight gain than their female counterparts but steers have a higher carcass quality than other classes, followed by heifers, cows and lastly bulls with the lowest carcass quality. Males have a higher feed conversion efficiency than females and younger cattle have a higher feed conversion efficiency than older beef cattle.

6.2 Recommendations

1. For a farmer to have high production which is a highest weight gain and highest carcass quality, the adequate age of entry of beef cattle in the feedlot is younger cattle with 4 teeth that is cattle between 30 to 48 months of age and avoid older cattle with 8 teeth that are above 72 months of age.

2. The best sex for beef production is male cattle because they produce the highest weight gain but on carcass quality a farmer should pen fatten steers than bulls because they produce the highest carcass quality.

3. Farmers should pen fatten male cattle than females because they have a higher feed conversion efficiency and also younger aged cattle because they also have a higher feed conversion efficiency than older cattle.

4. Lastly, the researcher recommends farmers to pen fatten for 50-70 days in the feedlot.

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