RESEARCH ARTICLE

Effect of Weaning Age on Carcass Characteristics of Crossbred Piglets Reared under Intensive System and Slaughtered at 70 Kilogram Body Weight

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Abstract

This study investigated the effect of weaning age on carcass characteristics of crossbred piglets reared up to 70 kg body weight (BW) under intensive system. A total of 24 piglets were used in a completely randomized design. The experiment comprised three treatments: piglets weaned at 21, 28, and 35 days of age with four replicates each with two piglets (castrate and female). At 70 kg BW two piglets (castrate and female) were randomly selected from each replicate and sacrificed for carcass evaluation. Hot carcass weight (HCW) was measured and thereafter dressing out percentage was calculated. Carcasses were chilled at 7 ^{0}C for 24 hours to determine cold dressed weight (CDW). Carcasses were cut into the left and right halves along the median line. The left half of the carcass was used to measure carcass length (CRLTH), average backfat depth and longissimus muscle area (LMA) at the 10th rib, while the right half of the carcass was physically dissected into bone, muscle and fat and thereafter tissue ratios calculated. Longissimus muscle was removed at the 10th and 11th ribs from the left half of the carcass for chemical composition analysis. Data were analysed using General Linear Model. Weaning age had no influence ($p > 0.05$) on HCW, dressing percentage, CDW, CRLTH, average backfat thickness, average backfat depth, LMA and carcass lean percentage. No significant differences ($p > 0.05$) were observed on average percentages of bone, muscle and fat tissue and their tissue ratios. Weaning age did not influence ($p > 0.05$) moisture, protein, fat and ash contents of the meat. In addition, weaning age had no ($p > 0.05$) effect on carcass characteristics, physical and chemical body composition of meat. These results indicate that piglets can be weaned at 21, 28 and 35 days of age without detrimental effects on carcass characteristics, physical and chemical body composition of pork.

Keywords: Carcass characteristics, Chemical body composition, Pigs, Weaning age, Physical body composition.

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Introduction

Weaning age is a management strategy adopted by producers and scientists to improve carcass characteristics of pigs. Segregated early weaning systems have been suggested as a management approach to improve carcass characteristics in the pig industry (Schinckel et al., 2008). Several researchers have studied the effects of early weaning systems on carcass characteristics and reported inferior carcass performance compared to late weaning (Main et al., 2005; Ko et al., 2014) and reduced profits (Main et al., 2005). Late weaning improves backfat depth and consequently body composition compared to early weaning (Edge et al., 2008). Early weaning influences carcass characteristics during the early stages of growth but the effects disappear during slaughter (Collins et al., 2009). There is paucity of information on the effect of weaning age on carcass characteristics of piglets reared under intensive system and slaughtered at 70 kg body weight (BW). Therefore, the objective of this study was to investigate the effect of weaning age on carcass characteristics of crossbred piglets reared under intensive system and slaughtered at 70 kg BW.

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Materials and Methods

Management of Slaughter Piglets Before and During Slaughter

A total of 24 Landrace × Large white × Topiglets × Topiglets cross piglets were purchased from a local pig producer

in Gaborone (the capital city of Botswana) and used in this experiment. Piglets were assigned to three weaning treatments (i.e., 21, 28 and 35 days weaning) in a completely randomised design. Each treatment had four replicates, each with two piglets (castrate and female). At 70 kg BW two piglets (castrate and female) were randomly selected from each replicate and sacrificed for carcass evaluation. Prior to loading, piglets were weighed individually and BW recorded. The piglets were loaded according to their pen replicates. Piglets were transported to the slaughterhouse in the morning to minimise heat stress and were inspected by authorised veterinary personnel at Mochudi in Kgatleng district of Botswana and transported to a local slaughterhouse in Gaborone. Piglets were starved for 10 hrs before slaughter to decrease gut fill, thus minimising the risks of rupturing the gastrointestinal tract and carcass contamination by pathogens (Miller et al., 1997). To prevent dehydration, piglets had free access to water during starvation. Ante-mortem procedures were according to the requirements of Botswana's Ninth Schedule of the Livestock Meat Industries Act, 2007 (CAP 36:03).

Slaughter piglets were stunned behind the ears at 250 V for 10 seconds using electric stunner (Dube et al., 2011) and the jugular vein severed within 30 seconds to bleed the carcass. Carcasses were scalded at 60°C for five minutes (Warris, 2000), and thereafter washed and eviscerated. Dressing of carcasses was in accordance with the 10th Schedule, Regulation 1 h(ii) of the Livestock Meat Industries Act, 2007. After removal of the viscera, carcasses were singed and rewashed to remove blood and singed hair. Water was left to drip from the carcasses and hot carcass weight (HCW) recorded for all the age groups. Thereafter, carcasses were inspected and passed by authorised veterinary personnel as wholesome for consumption according to the requirements of the 13th Schedule, Regulation 3(a) and (b) of the Livestock Meat Industries Act, 2007 Carcasses were then dispatched to the Meat Science Laboratory at the Botswana University of Agriculture and Natural Resources for analysis.

Data Collection

Carcasses were chilled at 7°C for 24 hrs and thereafter weighed to measure cold dressed weight (CDW). A hand saw was used to cut carcasses straight along the median line in order to divide them into right and left halves. The hind feet were removed with a sharp knife from the pork leg by cutting through the hock joints and fore feet through the knee joints. The head was removed by dislocating the atlanto-occipital joint (Bark et al., 1992) and the right and left halves of the carcasses weighed. Carcass length was measured in a straight line from the anterior edge of the first rib to the anterior edge of the aitch bone (pelvis symphysis).

Longissimus muscle was cut between the 10th rib perpendicular to the backbone from the left half of the carcass (Burson, 2010). Backfat depth was measured on ribbed carcasses at the 10th rib over the longissimus muscle at three sites (quarter, half and three quarters of the width LMA) (Smith et al., 1982) using a Vernier calliper Starrett® 798 B 12"/300 mm (Fig. 1).

The LMA was measured by tracing the periphery of the longissimus muscle with a midmadex media superiority acetate paper (A4, 297*210 mm double coated film). The plastic grid (pork and lamb publication AS-235e, 2013) was placed over the tracing of the loin eye.

The number of dots confined within the loin eye tracing was counted and divided by 20 dots, which are equal to a square inch (equivalent to 6.4516 cm^2) (Iowa University, 2013). Thereafter, the calculated area in square inches was converted to square centimetres. Dissection of the right half of the carcass was based on wholesale cuts (Bark et al.,

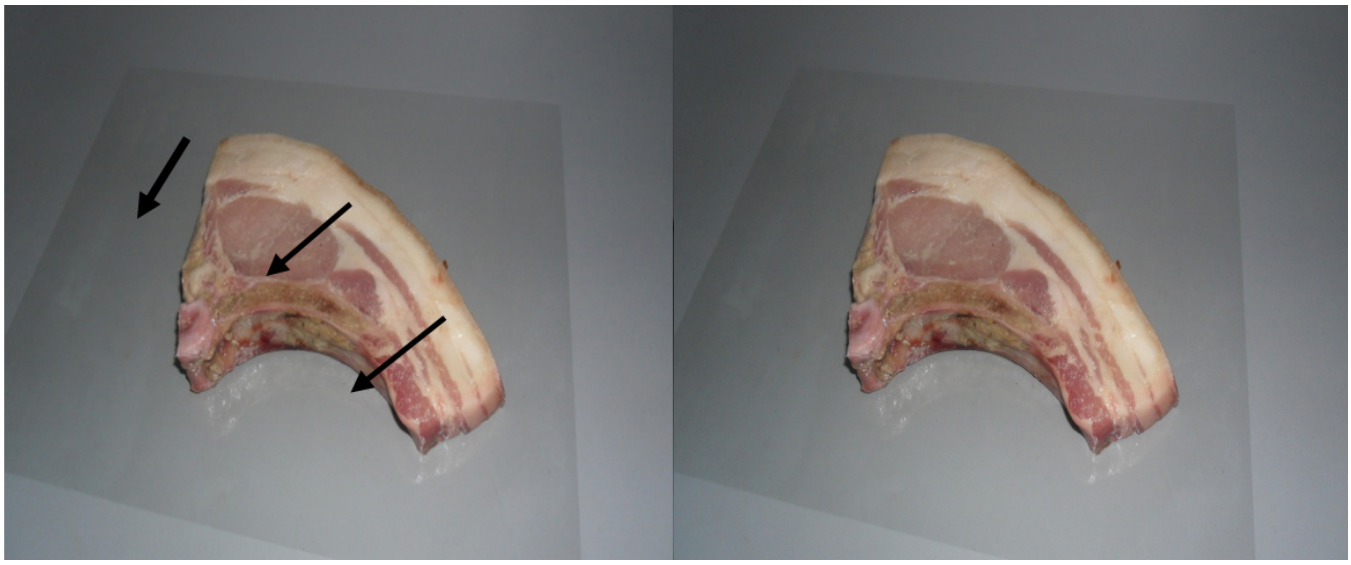

Fig. 1: Measurement of fat depth at three sites along the longissimus muscle of crossbred piglets slaughtered at 70 kg BW using Vernier caliper

1992). Physical separation of the right half of each carcass into muscle, fat and bone was according to Neely et al. (1979) as illustrated in Fig. 2.

Dressing out percentage (killing out percentage) was calculated by dividing HCW by live BW and then multiplying by 100 (Warris, 2000). Lean meat in pounds (lb) was calculated using the formula; lean meat pound = 8588 – (21896 × 10^{th} rib fat depth inches) + (0.465 × HCW, pound) +3.005 × 10^{th} rib loin muscle area square inches (AMSA, 2001). Lean meat in pounds (equivalent to 0.4536 kg) was then converted to kilogram lean meat. Lean meat percentage was calculated by dividing lean weight (kg) with HCW (kg) and multiplying by 100 (AMSA, 2001).

Proximate Composition

Longissimus muscles were cut at the 10^{th} and 11^{th} ribs from the right side of the carcass using a hand saw to determine proximate composition (moisture, protein, fat and ash percentage) following AOAC procedures (AOAC, 1996). Longissimus muscles were then trimmed of visible fat (Okrouhlá et al., 2008) and cut into small cubes, freeze-dried, ground and passed through a 2 mm sieve to form a homogeneous mix for fat analysis.

Statistical Analysis

Analysis of variance (ANOVA) was used to analyse carcass characteristics in completely randomised design using GLM procedures of SAS version 9.2 (SAS Institute, 2003). The reported least squares means were separated using 5% level of significance.

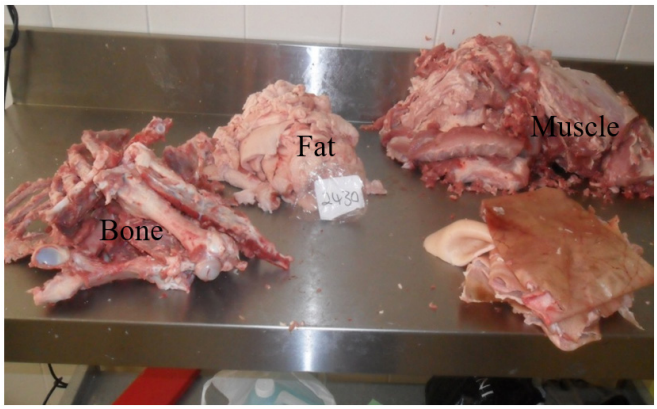

Fig. 2: Separation of bone, muscle and fat percentage of crossbred piglets slaughtered at 70 kg BW

Results and Discussion

The data presented in Table 1 reveal that there was no significant difference in the various carcass characteristics, viz., Hot carcass weight (kg), Cold dressed weight (kg), Dressing out percentage, Carcass length (cm), Average backfat depth 10^{th} rib (mm), Longissimus muscle area (cm^2), and Carcass lean percentage after slaughter of piglets at 21, 28 and 35 days and 70 kg BW.

Hohenshell et al. (2000), Partanen et al. (2007) and Heyer and Lebret (2007) also found no significant difference in HCW. However, numerically slight higher HCW obtained by Heyer and Lebret (2007) may be attributable to breed difference, carcass lean percentage and fat percentage.

Non-significant changes in CDW was in disagreement with Main et al. (2005). The difference in CDW between the current study and that of Main et al. (2005) could be due to slaughter weight. Slaughter weight in this study was lower (70.62 to 71.54 kg) compared to 103.9 to 117.3 kg in the study by Main et al. (2005). Hohenshell et al. (2000) and Partanen et al. (2007) found no significant differences in dressing out percentages in piglets weaned between 10 to 26 and 30 to 36 days of age. Gentry et al. (2002) weaned piglets at 21 days of age and found that CRLTH was 88.2 cm compared to 70.47 cm in this study. This may be due to difference in the breed as Gentry *et al*. (2002) used PIC (Cambrough-22 × (Hampshire × Duroc) which has a long body compared to crossbreds used in the current study.

Venegas-Vargas et al. (2011) weaned Landrace × (Landrace × Large white) piglets at 21 days of age and reported average backfat depth values (15.7-15.8 mm) lower than the backfat depth value of 22.23 mm found in this study. The difference could be attributable to the breed difference and their genetic potential for depositing muscle. However Dunshea et al. (2003) found significant difference in backfat depth between early weaned (14 days) and late (28 days) weaned

Table 1: Effect of weaning age on carcass characteristics in Landrace × Large white × Topiglets × Topiglets cross reared under intensive system and slaughtered at 70 kg BW

	Weaning age (Days)		
Parameter	*21*	*28*	*35*
Hot carcass weight (kg)	54.47±0.46	54.38±0.53	53.23±0.46
Dressing out percentage	77.55±0.85	75.56±0.64	75.17±0.98
Cold dressed weight (kg)	52.69±0.42	52.47±0.48	51.45±0.42
Carcass length (cm)	70.47±0.97	70.17±0.73	68.23±1.12
Average backfat depth 10^{th} rib (mm)	22.23±1.88	21.00±1.40	21.17±2.15
Longissimus muscle area (cm^2)	26.94±2.25	28.08±1.70	21.85±2.60
Carcass lean percentage	48.09±1.82	49.45±1.37	46.98±2.10

Table 2: Effect of weaning age on physical and chemical body composition of Landrace × Large white × Topiglets × Topiglets cross reared under intensive system and slaughtered at 70 kg BW

	Weaning age (Days)		
Parameter	*21*	*28*	*35*
Bone (%)	12.15±0.65	11.63±0.49	12.00±0.75
Muscle (%)	62.71±1.77	65.56±1.33	64.88±2.04
Fat (%)	24.96±1.88	22.91±1.41	24.98±2.16
Muscle to fat ratio	2.49±0.30	2.96±0.29	2.76±0.35
Muscle to bone ratio	5.19±0.29	5.67±0.22	5.35±0.33
Muscle + fat to bone ratio	7.25±0.43	7.67±0.32	7.53±0.50
Moisture	75.41± 0.57	75.52±0.43	74.92±0.67
Crude protein	20.92±0.46	20.98±0.34	20.97±0.53
Intramuscular fat	2.53±0.35	2.30±0.26	2.98±0.40
Ash	1.15±0.02	1.20±0.02	1.13±0.02

piglets due to difference in ADG. In another study, O'Connel et al. (2005) weaned piglets at 28 days of age and reported average backfat depth of 11.3 mm which is lower than 21.00 mm reported in piglets weaned at 28 days of age in the current study.

Gentry et al. (2002) weaned piglets at 21 days of age and reported LMA of 43.9±0.19 cm^2 as compared to our observations (26.94±2.25 cm^2). The difference in LMA values of piglets weaned at 21 days of age in the present study and that of Gentry et al. (2002) could be due to breed and CDW as they used Cambrough-22 × (Hampshire × Duroc) with higher CDW (104.2±3.47 kg) compared to the CDW of 52.69±0.42 kg in this study.

In a related study, Jiang et al. (2012) weaned piglets at 35 days of age and reported carcass lean percentage values of 46.82±3.66, 56.65±1.27, 65.78±2.45 and 66.40±2.12% for Landrace × Meishan, Duroc (Landrace × Meishan), Duroc × (Landrace × Yorkshire) and PIC crossbreeds, respectively, compared to 46.98 ±2.10% in Landrace × Large white × Topiglets × Topiglets cross in this study. This indicates that the carcass lean percentage in this study was only comparable to the Landrace x Meishan cross, but was lower than other breeds studied by Jiang et al. (2012).

Bone, Muscle and Fat Percentage:

No significant difference in bone, muscle and fat percentage was recorded in the present study. Our results corroborated with that of Heyer and Lebret (2007) and Jiang et al. (2012) for piglets weaned at 28 and 35 days of age, respectively. However our results contradicted Seve and Bonneau (1986), who weaned piglets at 12 and 23 days of age and found that weaning piglets at 12 days of age decreased muscle by 1.9%, and significantly increased fat by 6.8%.

Muscle to Fat Ratio, Muscle to Bone Ratio and Muscle + Fat to Bone Ratio

As revealed from Table 2 there was no significant difference in muscle to fat ratio, muscle to bone ratio and muscle + fat to bone ratio due to weaning age. In this aspect our results corroborated with Rao et al. (1978), who studied weaning of Kindles at 28, 42 and 56 days of age. Muscle + fat to bone ratio is an important parameter in the meat industry as it helps to determine the appropriate use of meat in processing establishments if a classification system exists.

Moisture, Crude Protein, Intramuscular Fat and Ash Percentage

No significant changes were observed in moisture, crude protein, Intramuscular fat and ash percentage (Table 2). Water is a major constituent of lean tissue and it is inversely related to fat content in the lean tissue (Sankar et al., 2013). Intramuscular fat ranged from 2.30±0.26 to 2.98±0.40. Okrouhlá et al. (2008) stated that the optimum range of intramuscular fat in meat is 2.5 to 3% and values above 3.5% lead to deterioration of meat quality, which according to Fernandez et al. (1999) is unacceptable to the consumers due to visible fat in the meat. This indicates that the intramuscular fat percentage values in this study fell within the range considered desirable. The current results suggest that meat from three age groups is of good quality and would be acceptable to consumers. Heyer and Lebret (2007) weaned Duroc cross × (Large white × Landrace) breed piglets at 28 days and reported lower intramuscular fat (1.49 ±0.61 %) than that found in this study, probably due to differences in breed, slaughter age and diet composition.

Conclusion

Weaning age had no influence on carcass characteristics, physical and chemical body composition of pigs. These results suggest that piglets can be weaned at 21, 28 or 35 days of age with 70 kg BW without any detrimental effects on carcass characteristics, physical and chemical body composition. It is recommended that further studies be carried out to determine the profitability of weaning at 21, 28 and 35 days of age.

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