Effect of Slaughter Weight on Carcass Characteristics and Economics of Pig Production

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Abstract

A study to evaluate the effect of slaughter weight on carcass characteristics of pigs was conducted using twenty four Landrace X Large White crossbred pigs. Twelve castrates and twelve gilts with average initial weight of 35 ± 4.4 kg were randomly assigned to three targeted slaughter weights. Pigs were slaughtered at live weights of 60, 75 and 90 kg and measurements of carcass characteristics were taken. Cost effectiveness of each slaughter weight based on feed cost was determined. Slaughter weight of the pigs had significant (P < 0.05) influence on carcass characteristics. Increase of slaughter weight from 60 kg to 90 kg caused a rise in killing out percentage, loin eye area, carcass length and backfat thickness from 65.0 to 69.1 %, 24 to 34 cm², 85.1 to 92.3 cm and 2.2 to 3.3 cm, respectively. The proportion of kidney fat also increased with slaughter weight. Generally, the weights of carcass joints, fillet muscle (M. psoas major), liver and kidney as percent of carcass weight decreased with increasing slaughter weight of the pigs (P < 0.05). Castrates had significantly heavier kidney fat and lighter shoulders than gilts but there was no significant sex difference in killing out percentage, carcass length, weights of liver, kidney, fillet muscle, ham, loin and belly, back fat thickness and loin eye area. The slaughter weight of 60 kg was found to be more cost effective than the rest of the slaughter weights and was therefore recommended for areas where there is demand for lean meat.

Key words: Pigs, Slaughter weight, Carcass characteristics, Cost effectiveness

Introduction

The preference for lean to fatty meat has been widespread throughout the world. This is due to the awareness that lean meat is generally healthier than fatty meat. It is evident that back fat thickness, and hence body fat content of pigs, increases with increasing weight at slaughter (Whittemore, 1980; Chertkov and Zaporozhets, 1985; Thomke et al., 1995). In evaluating the effect of slaughter weight on carcass traits of swine, Christian et al. (1980) found that carcasses with less ham and loin percentages, larger loin eye area, increased carcass length, thicker back fat and higher dressing percentage were associated with heavy slaughter weights. It is therefore certain that, heavy slaughter weights of pigs lower carcass quality due to excessive fattening. In the same line, Braude (1972) degraded fatty meat against lean meat thereby complying with the preference of pork consumers.

In Tanzania, pigs are mostly fed on food remnants, grass, roots not consumed by human beings and brewery by-products, with minimum or no supplementation with hominy feed and/or waste grains. In this kind of operation, there is no justification for economic considerations other than minimizing investment. As a result, such animals grow very slowly, resulting in unprofitable pig enterprises by the smallholder farmers (Sibuga et al., 1993). What is more discouraging is that, in many parts of the country pigs are allowed to fatten excessively and may reach a liveweight of 150-200 kg before slaughter. Hence, there is a need to lower the slaugh-
ter weight to a level that is both economical to
the farmer and can meet consumers preferences
(Makauki and Lekule, 1997).

Although there is ample information on the
effect of slaughter weight of pigs on carcass
characteristics, the economics of different
slaughter weights of these animals under Tanza-
nian situation is little documented. The available
literature is also deficient on information on the
optimum slaughter weight of pigs under tropical
management (Makauki and Lekule, 1997).

The objective of the present study was there­
fore to explore the effect of slaughter weight on
carcass characteristics of pigs and determine the
cost effectiveness of slaughtering pigs at differ­
ent slaughter weights in Morogoro (Tanzanian)
region.

Materials and Methods

Experimental procedure

Twenty four Landrace X Large White cross­
bred pigs weighing $35 \pm 4.4$ kg were housed in
individual pens fitted with feeders and drinkers
at the Department of Animal Science and Pro­
duction, Sokoine University of Agriculture. A
randomized complete block design was adopted
and a total of four castrates and four gilts were
randomly allocated to each of the three levels of
slaughter weight (60 kg, 75 kg and 90 kg).There
was a balance in initial body weight for each
slaughter category. The pigs were fed
twice a day at 0900 and 1500 h throughout the
experimental period. The experimental diet
composition (in percentages) was: hominy meal
(69.5), cotton seed cake (25), fish meal (3),
"pigmix" (1), limestone (1) and common salt
(0.5). The pigmix consisted of vitamins and
mineral premix whose contents (%) were Cal­
cium (35), Phosphorus (6), Sodium (11), Iron
(0.45), Copper (0.10), Manganese (0.80), Zinc
(0.10), Iodine (0.015) Selenium (0.002), Nico­
tinic acid (0.15) and Pantothenic acid (0.10).

Proximate analysis of feed ingredients and the
diet was done according to standard procedures
described by AOAC (1990). Samples were ana­
lyzed for contents of dry matter, crude protein,
crude fibre, ether extract, ash, calcium and
phosphorus. Methionine and cystine, lysine and
digestible energy (DE) content of the diet were
calculated based on the potential of individual
feed ingredients according to Pond and Maner
(1974). Metabolizable energy (ME) content of
the diet was calculated by using the formula de­
developed by NRC (1988) for a well compounded
pig ration; that is ME = 0.96DE.

The animals were weighed once per week
but when weight was about 10 kg below the in­
tended slaughter weight, the frequency of
weighing was changed to daily. On reaching the
liveweights of $60 \pm 1$ kg, $75 \pm 1$ kg and $90 \pm 1$
kg, the pigs were slaughtered before being fed
in morning session by rendering them insensi­tive
by hitting the forehead with a steel pipe. After
immediately bleeding the animal by cut­
ting the throat, the head was detached at the at­
as joint and its weight was recorded. Dehairing
and suspension of the carcass were followed by
evisceration and halving along the pelvis fusion
and backbone.

Carcass characteristics were recorded from
8 pigs which were slaughtered at 60 kg, while
for each of the slaughter weights of 75 and 90
kg the parameters were recorded from 7 pigs
following death of two pigs which was caused
by white muscle disease and peritonitis and
Pasteurella multocida infection, respectively.
The two sides of the hot carcass were
weighed and all carcass measurements were
taken from the left side according to Danish
standards (Clausen and Gerwing, 1958; Lekule
et al., 1988). Empty body weight was obtained
as the weight of the carcass including the head
but after removing the entrails. Carcass weight
was obtained from the sum total of the weights
of the two carcass halves exclusive of the head
and the feet. The warm carcass expressed as a
per cent of the liveweight, was recorded as kill­
ing out percentage. Using a steel measuring/tape, carcass length was measured from the an­
terior edge of the aitch bone (Os pubis) to the
atlas. Backfat thickness was measured in centi­
metres at five points, viz. at the thickest point
near the first rib (over the shoulder), at the thin­
est point near the last rib (loin) and at the ante­
or, mid- and posterior end of M. gluteus me­
dium (in the lumbar region). Fillet muscle,
liver, kidney and kidney fat were separated
from the warm carcass and weighed. The left
side of the carcass was partitioned into such
carcass joints as shoulder (jowl, picnic shoulder
and Boston butt), ham, loin and belly whose weights were recorded. The area of longissimus dorsi muscle was taken between the 11th and 12th rib by tracing on a translucent paper and measuring by using a planimeter.

Statistical analysis

The data collected were statistically analyzed with the aid of a computer. General Linear Models (GLM) procedure of the Statistical Analysis Systems package (SAS, 1988) was adopted in which effects due to differences in sex and slaughter weight were compared. The parameters were corrected by the initial body weights of the pigs as a covariate. The statistical model used was:

\[ Y_{ijk} = \mu + S_i + W_j + b(X_{ijk} - x) + e_{ijk}, \]

where,

- \( Y_{ijk} \) = observation from kth pig belonging to ith sex (block) slaughtered at jth weight
- \( \mu \) = overall mean
- \( S_i \) = effects due to ith sex (block)
- \( W_j \) = effects due to jth slaughter weight
- \( b \) = regression coefficient
- \( X_{ijk} \) = initial body weight of kth pig of ith sex slaughtered at jth weight
- \( x \) = mean initial weight of all the experimental pigs
- \( e_{ijk} \) = residual effect peculiar to kth pig of ith sex slaughtered at jth weight

Results and Discussion

Chemical composition of the experimental diet

Chemical composition of the diet used is shown in Table 1. The composition of the diet was in agreement with standard requirements of growing and finishing pigs recommended by ARC (1981) and NRC (1988). Compared to the standards given, the diet of the present study was suitable not only for growing-finishing pigs but also for young growers of 10 kg liveweight. In terms of energy concentration, the diet had higher levels than the recommended concentrations of 13 MJ ME / kg DM (ARC, 1981) but was more or less similar to NRC (1988) recommendation of 13.7 MJ ME / kg diet.

Carcass characteristics and cost effectiveness of the slaughter weights

The effect of slaughter weight on carcass characteristics of pigs is presented in Table 2. Killing out percentage and empty body weight per cent increased with increasing slaughter weight of the pigs. Pigs slaughtered at 60 kg liveweight had lower killing out percentage than those slaughtered at 75 kg (P < 0.05) and 90 kg (P < 0.01). The pigs had lower (P < 0.01) empty body weight per cent than those slaughtered at 90 kg. Pigs slaughtered at 60 kg had lower empty body weight per cent than those slaughtered at 75 kg, but the difference was not statistically significant. Additionally, the pigs had shorter carcasses (P < 0.001) and smaller cross-sectional areas of the longissimus dorsi muscle (P < 0.01) than pigs slaughtered at liveweights of 75 kg and 90 kg.

Pigs slaughtered at 75 kg liveweight had lower killing out and empty body weight percentages than those slaughtered at 90 kg but the difference was not statistically significant. The former had shorter carcasses (P < 0.05) than those slaughtered at liveweight of 90 kg. The increase of slaughter weight from 60 to 90 kg caused the proportions of ham, shoulder and belly as per cent of carcass weight, to decrease from 13.6 to 11.6 %, 15.1 to 13.7 % and 10.5 to 9.9 %, respectively. However, the decrease in per cent of belly was not statistically significant. The decrease in proportions of carcass joints with slaughter weight observed in the present study, is in line with the previous work (Babatunde et al., 1966; Christian et al., 1980; Pond and Maner, 1974). Similar with carcass joints, the proportions of individual internal organs and fillet muscle decreased with increase in slaughter weight of the pigs. The proportion of fillet muscle decreased from 0.83 % to 0.76 % but the difference was not statistically significant. The proportions of kidney and liver were also found to decrease from 0.23 % and 3.0 % to 0.16 % and 2.5 %, respectively as the slaughter weight increased from 60 kg to 90 kg agreeing with Thomke et al. (1995).

Significant sex effect on carcass characteristics was observed only on the weights of shoulders and kidney fat, unlike all other parameters studied (Table 3). Gilts were found to have
Table 1: Chemical composition of feed ingredients and diet

<table>
<thead>
<tr>
<th>Item</th>
<th>Hominy meal</th>
<th>Fish meal</th>
<th>Cotton seed cake</th>
<th>Diet</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Analysed</td>
<td>Calculated</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dry matter, %</td>
<td>90.51</td>
<td>92.49</td>
<td>93.02</td>
<td>91.85</td>
</tr>
<tr>
<td>% of dry matter</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crude protein</td>
<td>13.6</td>
<td>62.31</td>
<td>34.48</td>
<td>19.27</td>
</tr>
<tr>
<td>Crude fibre</td>
<td>7.62</td>
<td>1.1</td>
<td>14.41</td>
<td>8.86</td>
</tr>
<tr>
<td>Ether extract</td>
<td>12.96</td>
<td>11.46</td>
<td>7.13</td>
<td>12.51</td>
</tr>
<tr>
<td>Ash</td>
<td>5.15</td>
<td>20.1</td>
<td>5.69</td>
<td>7.7</td>
</tr>
<tr>
<td>Nitrogen free extract</td>
<td>60.67</td>
<td>5.03</td>
<td>38.29</td>
<td>51.66</td>
</tr>
<tr>
<td>Calcium</td>
<td>0.59</td>
<td>4.58</td>
<td>0.24</td>
<td>0.81</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>0.71</td>
<td>0.29</td>
<td>1.12</td>
<td>0.86</td>
</tr>
<tr>
<td>Lysine a</td>
<td>0.88</td>
<td>7.94</td>
<td>1.86</td>
<td>1.31</td>
</tr>
<tr>
<td>Methionine and cystine</td>
<td>3.91</td>
<td>1.64</td>
<td></td>
<td>1.06</td>
</tr>
<tr>
<td>Energy content^a</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MJ DE/kg DM</td>
<td>16.21</td>
<td>13.84</td>
<td>12.04</td>
<td>14.56</td>
</tr>
<tr>
<td>MJ ME/kg DM</td>
<td></td>
<td></td>
<td></td>
<td>13.98</td>
</tr>
</tbody>
</table>

^a calculated based on the potential of different feed ingredients (Pond and Maner, 1974) and the formula ME = 0.96DE for a compounded pig ration (NRC, 1988).

Table 2: Least square means (± s.e.) for carcass characteristics of pigs slaughtered at different weights

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Slaughter weight</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>60</td>
</tr>
<tr>
<td>Number of pigs</td>
<td>8</td>
</tr>
<tr>
<td>Average daily gain, g</td>
<td>702±16^a</td>
</tr>
<tr>
<td>EBW per cent (%)</td>
<td>73.5±0.7^a</td>
</tr>
<tr>
<td>Killing out per cent</td>
<td>65.0±0.6^a</td>
</tr>
<tr>
<td>Carcass length, cm</td>
<td>85.1±0.5^a</td>
</tr>
<tr>
<td>Weight of carcass joints, % of CW</td>
<td></td>
</tr>
<tr>
<td>Shoulder</td>
<td>15±0.2^a</td>
</tr>
<tr>
<td>Ham</td>
<td>13.6±0.3^a</td>
</tr>
<tr>
<td>Loin</td>
<td>12.4±0.3^a</td>
</tr>
<tr>
<td>Belly</td>
<td>10.5±0.2</td>
</tr>
<tr>
<td>Backfat thickness, cm</td>
<td>2.2±0.2^a</td>
</tr>
<tr>
<td>Fillet muscle, % of CW</td>
<td>0.83±0.04</td>
</tr>
<tr>
<td>Weight of internal organs, % of CW</td>
<td></td>
</tr>
<tr>
<td>Liver</td>
<td>3.0±0.09^a</td>
</tr>
<tr>
<td>Kidney</td>
<td>0.23±0.01^a</td>
</tr>
<tr>
<td>Kidney fat</td>
<td>0.05±0.01^a</td>
</tr>
<tr>
<td>Area of longissimus dorsi muscle, cm²</td>
<td>24±1^a</td>
</tr>
</tbody>
</table>

CW = Carcass weight, EBW = Empty body weight, ^a as per cent of liveweight at slaughter NS = Not significantly different (P > 0.05), % = per cent, ^a,b,c Least square means with different superscripts in the same row are significantly (P<0.05) different.
Table 3: Least square means (± s.e) for the effect of sex on carcass characteristics of pigs

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Sex</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Castrates</td>
</tr>
<tr>
<td>Number of pigs</td>
<td>11</td>
</tr>
<tr>
<td>Average EBW, kg</td>
<td>56.9±0.44</td>
</tr>
<tr>
<td>EW percent</td>
<td>75.5±0.59</td>
</tr>
<tr>
<td>Carcass weight, kg</td>
<td>50.8±0.41</td>
</tr>
<tr>
<td>Killing out percentage</td>
<td>67.5±0.57</td>
</tr>
<tr>
<td>Carcass length, cm</td>
<td>88.6±0.49</td>
</tr>
</tbody>
</table>

Weights of carcass joints, kg:

- Shoulder: 6.8±0.07 kg vs. 7.0±0.07* kg for castrates and gilts, respectively.
- Ham: 6.2±0.10 kg vs. 6.3±0.10 NS kg.
- Loin: 7.6±0.15 kg vs. 7.5±0.15 NS kg.
- Belly: 5.3±0.13 kg vs. 5.2±0.13 NS kg.
- Backfat thickness, cm: 2.7±0.17 cm vs. 2.6±0.17 NS cm.
- Weight of FLT, g: 398±20 g vs. 359±20 NS g.

Weight of internal organs, g:

- Liver: 1350±26.2 g vs. 1295±26.2 NS g.
- Kidney: 89±4.7 g vs. 94±4.7 NS g.
- Kidney fat: 44±1.9 g vs. 33±1.9* g.
- Area of longissimus dorsi muscle, cm²: 28.6±1.05 cm² vs. 30.8±1.03 NS cm².

*Empty body weight, as percent of liveweight at slaughter; c Fillet muscle, NS = Non significant (P > 0.05), * = Significantly different (P < 0.05)

Heavier shoulders (P < 0.05) and lighter kidney fat (P < 0.01) than castrates. The average weights of shoulder and kidney fat for gilts were 7.0±0.07 kg and 33±1.9 g while those of castrates weighed 6.8±0.07 kg and 44±1.9 g, respectively.

The results of the present study are in agreement with the previous work by Whittemore (1980), Thomke et al. (1995), Chertkov and Zaporozhets (1985) and Christian et al. (1980). All reported increasing loin eye area, carcass length, back fat thickness and dressing percentage (K.O.) with increasing slaughter weight of pigs. The killing out percentage of 65-69% observed in the present study agrees well with Sibuga et al. (1993) who reported a range of 65-75%.

The increasing killing out percentage implies that carcass components at heavy liveweights grow at a higher rate than gut components. From 60 kg to 90 kg, the pigs were increasingly putting on more fat, whose growth coefficient is greater than one as opposed to lean which is generally equal to one, thereby resulting in increased killing out percentage and decreased per cent of internal organs. The increasing fattening of pigs was manifested by the decreasing efficiency of feed conversion (Table 4) and the increasing proportion of kidney fat. This shows that more energy is required for fat deposition than for protein deposition in the body. Additionally, at higher weights there are progressively greater costs of body maintenance.

Similar results were also reported by Shields and Mahan (1980) who observed significantly heavier shoulders for gilts than for castrates and the same K.O. for both sexes. Similar to the present study, Babatunde et al. (1975) observed no significant difference between castrates and gilts in average daily gain, K.O., backfat thickness, carcass length, weight of kidney and
Table 4: Economics analysis of slaughter weights

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Slaughter weight, kg</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>60</td>
</tr>
<tr>
<td>Number of pigs</td>
<td>8</td>
</tr>
<tr>
<td>Initial LW, kg</td>
<td>42.4</td>
</tr>
<tr>
<td>Final LW, kg</td>
<td>60.6</td>
</tr>
<tr>
<td>LW gain, kg/pig</td>
<td>18.2</td>
</tr>
<tr>
<td>Feed cost per kg diet, Tsh</td>
<td>81.00</td>
</tr>
<tr>
<td>Feed conversion ratio (kg feed/kg gain)</td>
<td>3.07</td>
</tr>
<tr>
<td>Feed cost per kg LW gain, Tshs.</td>
<td>248.70</td>
</tr>
<tr>
<td>Carcass weight (CW), kg/pig</td>
<td>39.4</td>
</tr>
<tr>
<td>Feed cost per kg CW, Tsh.</td>
<td>382.50</td>
</tr>
<tr>
<td>Gross profit, per kg of meat, Tsh.</td>
<td>617.50</td>
</tr>
</tbody>
</table>

a US $ 1 = Tsh. 800, b based on feed cost only, c 1 kg of meat = Tsh. 1000, LW = Liveweight, No. = Number

weight of liver. The works also demonstrated higher shoulder weight for gilts than for castrates although the difference was not statistically significant. The significantly lighter kidney fat for gilts than for castrates observed in the present study is in agreement with Lekule et al. (1982). As adaptation to withstand mating, gilts have heavier hams than castrates, a fact which was observed in the present study although the difference was not statistically significant.

Since there was a trend of increasing back fat thickness with increasing slaughter weight of the pigs, the adoption of lighter slaughter weights (e.g. 60 kg) would be an option of choice where lean meat is preferred to fatty meat. The adoption of the slaughter weight of 60 kg is favoured by its high gross profit (Tshs. 618) per kg of meat relative to that of 75 kg (Tshs. 562) and that of 90 kg (Tshs 555) as shown in Table 4. A reverse trend was observed in terms of feed cost per kg of carcass weight. The slaughter weight of 60 kg was, therefore, more cost effective than that of 75 and 90 kg. However, where production of lard and/or fatty meat is aimed at, a heavier slaughter weight will likely be favoured.

Conclusion

The slaughter weight of 60 kg was found to be the most profitable and is hence recommended for commercial producers of pigs in Tanzania, since it would satisfy the majority of pork consumers and provide a fast turn over rate. However, in practice, pigs at heavy are fed pig finisher meal which is cheaper than growers meal, a fact which was not considered in the present study as the pigs were fed the same diet throughout the experimental period. There is therefore a need to carry out further studies on the effect of slaughter weight on economics of pork production using cheap diets as weight increases.

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References


