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The effect of slaughter weight on organ and by-product weights of pigs

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Abstract

The effect of slaughter weight on organ and by-product weights in pigs was determined by slaughtering 101 pigs at six slaughter weights ranging from 22 to 97kg. Slaughter weight had a highly significant influence on the weight of all organs and by-products such as liver, spleen, kidney, heart, hair, skin, head, blood, bone and kidney fat. Heavier slaughter weights above 74kg appear more advantageous in terms of the amount of by-products obtained but also produced excessively fat carcasses. Breed and sex had no significanty effect on organ and by-product weights. The proportion of organs declined while non-organ by-products increased with increasing body weight. The utilisation of abattoir by-products for food, feed and as industrial raw materials has the potential to increase the profitability of pig production.

Introduction

The swine production industry is important not only because of its potential to rapidly meet protein demands, but also because of the array of by-products it produces. These by-products have potential use as food, feed and industrial raw material. Thus, the edible by-products such as liver, kidney, heart, spleen and tongue are consumed directly by man. Others, hitherto used mainly as animal feed – blood, tripe and head can now be processed into foods of high protein content and biological value (Levin, 1971; Drepper and Drepper, 1979).

The non-edible by products are equally valuable. The skin is valued for making gloves and bags and for replacing burned human skin. Adrenal glands, ovaries, pancreas, spleen etc. are used for the production of various hormones by the pharmaceutical industry. Hair is used for manufacture of artist brushes. McMeekan (1940) showed by dissection and carcass studies, that organ growth rate varies from one to another, with individual cell types within an organ also growing at different rates. Early after birth,

the stomach, liver and kidneys increase in weight proportionately faster than the whole body (Brooks and Davis, 1969) while the rate of fat deposition exceeds the rate of deposition of other organic and inorganic components in the carcass (Manners and McCrea, 1963).

With such a variety of uses for pig by-products as indicated above, there is a need to determine the optimum slaughter weight at which the proportions of by-products to carcass weight is optimum for meeting both the meat protein and industrial raw material needs.

Materials and Methods

A random sample of 101 pigs made up of 72 large white and 29 Nigerian Local pigs were slaughtered at six live-weights of 22, 56, 66, 74, 84 and 97kg. The total number of pigs slaughtered at each of these endpoints was 10, 13, 26, 28, 14 and 10 pigs respectively. Breed and sex distribution within each of the slaughter weight is as shown in Table 1. Blood was collected for 5 min. after sticking and weighed immediately.

Carcasses were scalded for four minutes at 60°C water temperature and the hair scraped manually to ensure maximum hair recovery. The head was then removed behind the ear at the atlas joint leaving the jowl on the carcass. In 22 carcasses (10 males, 12 females), the head was opened, and the brain excised, weighed, and thereafter expressed as a percentage of the head.

After skinning, the carcasses were split open, and the heart was dissected free from the great veins and arteries. The gall bladder and cystic duct were removed from the liver, while the spleen was removed and trimmed at the hilus. The kidneys were freed from the blood vessels, ureters and kidney fat. Finally, the carcasses were completely deboned taking care to scrape as much muscle as possible from the bones which were then weighed.

The weights of the various by-products listed above were expressed as percentages of the live weights and subjected to analysis of variance according to the method of Snedecor and Cochran (1974). Since sex effects were not significant for any of the by-products, and the data was insufficient to test breed effects at every slaughter weight, data for large White and Locals, gilts and barrows were combined leaving slaughter weight as the only variable.

Results

The actual weights of by-products are presented in Table 2. In general there was a linear increase in by-product weight with slaughter weight.

The greatest absolute increments occurred in kidney fat weights which increased about 25% as fast as slaughter weight. Apart from blood and head, which had greater absolute increments and the kidney which had lower increment, all other by-products were similar in weight increments over the weight range studied.

Heavier slaughter weights produced greater by-product weights but also resulted in fatter carcasses as the kidney fat data show (Table 2). However, kidney fat weight did not increase uniformly over the range studied. There were relatively greater increases between 22kg and 56kg and between 74kg and 97kg slaughter weights with a peak increment of 0.92kg occurring between 22 and 56kg slaughter weights.

Between the slaughter weight range of 66 and 74kg, the amount of carcass fat as indicated by kidney fat was not different ($P > .05$). On the other hand the amounts of skin, head, and blood were higher ($P < .05$) in the 74 kg carcasses.

The brain weight as a percent of head weight was greater in females ($2.4 \pm 0.20\%$) than in male (1.9 ± 0.25) though the differences were not significant ($P > 0.5$).

Table 3 presents the by-product weight as percentage of slaughter weights. There is a reverse trend of decreasing proportion of the slaughter weight accounted for by the by-products as slaughter weight increased. Across all slaughter weights, the head made up the greatest percentage of the slaughter weight followed by hair, bone and skin. This relationship was maintained in all slaughter weights. Some by-products such as blood did not decrease consistently with increase in body weight. This variation may be due to losses during removal and weighing.

Discussion

The data obtained in this study show that the proportion of the body weight that constitutes the vital organs continues to decrease with body weight while kidney fat increases in proportion. This result agrees with that of McMeekan (1940) and taken with that of Brooks and Davis (1969), who observed increased proportion of organ weights during the first week after birth suggest that by a live-weight of 22kg which coincides with 10 weeks of age, the relative rate of growth of the organs had started to decline.

The results of this study also showed that slaughter weight had a highly significant effect on the weight of all organs and by-products studied. However, sex had no effect on organ and by-product weights. Anderson *et al* (1979) reported a highly significant effect of carcass weight on organ

and by-product weights in cattle. These workers found, however, that except for tail and diaphragm, the effect of sex was also significant. Breed has been reported to have little or no influence on organ and by-product weights (Seebeck, 1972 and Anderson *et al.*, 1979).

The increase in weight of by-products between 22 and 65kg was consistently the greatest single increment. This may be explained by the greater interval of 35kg between these two slaughter points as compared with all other intervals which were around 10kg each.

It has been estimated that the pig carcass has a dressing of 72%, the other 28% being by-product and waste (Anonymous, 1977), Below 56kg slaughter weight, data in this present study point to about 35% by-products from the carcass. Nonetheless, these figures may not reflect the actual amount of by-products that may be available to industry or the amount that industry may find useful. For instance it is unusual to dehair and skin pig carcasses at the same time, as carcasses meant for skinning are depilated chemically such that the hair is unusuable. However, the combined porportions of skin plus hair agrees quite well with the report of Romans and Ziegler (1974) that the undehaired skin represents 5 to 7% of the liveweight of a hog. Similarly, the yield of processed hair, on the basis of 10% moisture content, is only 35% of the weight of scraped hair from the carcass (Romans and Ziegler 1974).

Of all the by-products measured, blood and bone are probably the most difficult to quantitatively recover and measure. Levin (1971) estimated that recovered blood that gushed out after sticking the pig was only about one-third of the total blood in the body.

To further aid development in the tropics, import-substituting industries must be developed, and animal by-products are a readily available source of the required raw material. For example, locally processed blood meal can successfully replace about 65% of the fishmeal in broiler starter rations and 100% of the fish meal in broiler finishing rations (Dafwang et al. 1978). Utilisation of other by-products may meet with equal success.

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TABLE 1 – BREED AND SEX DISTRIBUTION OF SLAUGHTERED PIGS

	Slaughter weights (Kg)						
	22	*56*	*66*	*74*	*84*	*97*	*Total*
Breed distribution:							
Large White	4	5	17	22	14	10	72
Local	6	8	9	9	–	–	29
Sex distribution:							
Male	3	7	15	12	6	3	46
Female	7	6	11	16	8	7	55

TABLE 2 -- WEIGHTS OF BY-PRODUCTS OBTAINED FROM PIG CARCASSES AT DIFFERENT SLAUGHTER WEIGHTS

	Slaughter weights (Kg)					
By-products (Kg)	*22*	*56*	*65*	*74*	*84*	*97*
Hair	1.53 ± 0.08^{a}	2.53 ±0.07^{b}	2.76 +0.06^{c}	2.86 + 0.07^{c}	3.27 ±0.10^{d}	3.49 + 0.13^{d}
Skin	0.95 ± 0.04^{a}	2.08 + 0.06^{bc}	2.02 ± 0.07^{b}	2.27 ± 0.13^{c}	2.27 ± 0.13^{c}	2.15 + 0.27^{bc}
Head	2.20 ± 0.05^{a}	4.39 ± 0.11^{b}	5.25 ± 0.09^{c}	5.76 ± 0.07^{d}	6.25 ± 0.10^{c}	7.15 + 0.22^{f}
Blood	0.61 ± 0.05^{a}	1.45 ± 0.07^{b}	1.60 ± 0.08^{b}	2.25 ± 0.18^{c}	2.61 ±0.12^{d}	2.24 + 0.10^{c}
Bone	0.94 ± 0.09^{a}	2.45 ± 0.21^{b}	2.60 ± 0.18^{b}	2.61 ±0.10^{b}	3.01 ± 0.12^{c}	3.53 + 0.29^{d}
Spleen	0.13 ± 0.01^{a}	0.19 ± 0.03^{b}	0.21 ± 0.01^{b}	0.23 ± 0.01^{b}	0.23 ± 0.00^{b}	0.26 + 0.01^{c}
Liver	0.84 ± 0.05^{a}	1.34 ± 0.04^{b}	1.48 ± 0.04^{c}	1.50 ± 0.05^{c}	1.57 ± 0.05^{cd}	1.68 + 0.09^{d}
Kidney	0.20 ± 0.02^{a}	0.25 ± 0.02^{b}	0.25 ± 0.01^{b}	0.25 ± 0.01^{b}	0.31 ± 0.02^{c}	0.37 + 0.03^{c}
Heart	0.16 ± 0.02^{a}	0.27 ± 0.01^{b}	0.28 ± 0.01^{b}	0.28 ± 0.01^{b}	0.33 ± 0.02^{c}	0.35 + 0.02^{c}
Kidney Fat	0.25 ± 0.01^{a}	1.17 ± 0.06^{b}	1.30 ± 0.05^{c}	1.44 ± 0.01^{b}	1.98 ± 0.02^{d}	2.25 + 0.17^{e}
Total	7.81 ± 0.20^{a}	16.12 ± 0.39^{b}	17.75 ± 0.46^{c}	19.45 ± 0.50^{d}	21.83 ± 0.54^{e}	23.47 + 0.62^{f}

^{abcdef} Means in the same row bearing different superscripts are significantly different ($P < .05$).

TABLE 3 – BY-PRODUCTS EXPRESSED AS PERCENT OF SLAUGHTER WEIGHTS

Slaughter weight (Kg)

By-product % slaughter wt.	*22*	*56*	*65*	*74*	*84*	*97*
Hair	6.75 ± 0.25^{a}	4.46 ± 0.11^{b}	4.20 ± 0.10^{c}	3.90 ± 0.10^{d}	3.92 ± 0.12^{d}	3.56 ± 0.10^{e}
Skin	4.20 ± 0.13^{a}	3.65 ± 0.11^{b}	3.21 ± 0.10^{c}	2.93 ± 0.17^{cd}	2.74 ± 0.18^{de}	2.30 ± 0.32^{e}
Head	9.78 ± 0.19^{a}	7.92 ± 0.21^{b}	7.98 ± 0.10^{b}	7.87 ± 0.10^{b}	7.47 ± 0.14^{c}	7.32 ± 0.15^{c}
Blood	2.70 ± 0.19^{a}	2.59 ± 0.10^{a}	2.55 ± 0.14^{a}	2.92 ± 0.24^{a}	3.15 ± 0.16^{b}	2.35 ± 0.12^{c}
Bone	4.15 ± 0.43^{a}	4.32 ± 0.36^{a}	4.10 ± 0.30^{a}	3.48 ± 0.14^{b}	3.59 ± 0.15^{b}	3.61 ± 0.35^{b}
Spleen	0.56 ± 0.06^{a}	0.33 ± 0.14^{b}	0.29 ± 0.01^{b}	0.30 ± 0.01^{b}	0.28 ± 0.01^{b}	0.24 ± 0.02^{c}
Liver	3.72 ± 0.20^{a}	2.35 ± 0.08^{b}	2.26 ± 0.07^{b}	2.05 ± 0.07^{c}	1.88 ± 0.07^{d}	1.71 ± 0.09^{e}
Kidney	0.91 ± 0.08^{a}	0.43 ± 0.03^{b}	0.39 ± 0.01^{b}	0.34 ± 0.01^{c}	0.37 ± 0.02^{bc}	0.38 ± 0.03^{bc}
Heart	0.74 ± 0.09^{a}	0.47 ± 0.02^{b}	0.43 ± 0.01^{c}	0.39 ± 0.02^{d}	0.40 ± 0.02^{cd}	0.36 ± 0.02^{d}
Kidney Fat	1.10 ± 0.09^{a}	2.06 ± 0.11^{b}	1.98 ± 0.08^{b}	1.93 ± 0.14^{b}	2.38 ± 0.20^{c}	2.32 ± 0.19^{c}
Total	34.70 ± 0.69^{a}	28.40 ± 0.41^{a}	26.94 ± 0.33^{c}	26.25 ± 0.31^{cd}	26.11 ± 0.48^{d}	24.09 ± 0.37^{e}

abcde: Means in the same row bearing different superscripts are significantly different ($P < .05$)

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