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Body weight asymmetry as an animal welfare concern on carcass yield, ham proximate composition, mineral and lipid profiles of growing pigs

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***Target audience:** Pig Farmers, Scientists, Welfare Officers, Extension Agents*

Abstract

The experiment was carried out to evaluate effect of weight asymmetry on carcass yield, ham proximate composition, minerals and lipid profiles of growing pigs. A total of fifty four (54) Large White growing pigs with mean weight of 15.33±0.02 kg was placed into three treatment groups based on weight range (Homozygous heavy weight, homozygous light weight and heterozygous weight) for a twenty week study. Eighteen growing pigs served as a treatment group which was further divided into 3 replicate groups of 6 pigs per replicate. At the end of 20Th week study, 6 pigs per treatment i.e. 2 pigs per replicate were selected, fasted and slaughtered for carcass yield evaluation. The ham muscle was excised and used to determine pork proximate composition, minerals and lipid profiles. Data collected were subjected 1-way Analysis of Variance utilizing SAS software while significant differences were separated using New Duncan Multiple Range Test as contained in the same statistical package. Result revealed that the prime cut parts (ham, shoulder and puck weights) were significantly higher in homogeneous light weight pigs. Most of ham proximate composition were positively influenced by weight asymmetry. Likewise, weight asymmetry affected total cholesterol, triglycerides, high density lipoprotein, potassium and magnesium values of growing pigs. Heterogeneous weight pigs had highest total cholesterol value of 94.67±2.77 mg/dl and the least value of 85.33±3.41 mg/dl was noted for homogeneous light weight pigs. It can be concluded from this present study that grouping pigs on uniform weight basis especially light weight groups enhanced the welfare of pigs as shown by improvement in pork characteristics and composition.

***Key words**: Animal; proximate composition; meat yield; pork quality; mineral contents*

Description of Problem

Issue relating to the welfare of an animal is pertinent since its affect the productivity, as well the quality of the products derived from the animal. Consumers' behaviours in recent time designate that high premium is placed on products from animals with high degree of welfare (1). Ngapo et al. (2) observed that there is a notion among pork consumers that, pigs managed under welfare friendly environment produces better pork in terms of quality and quantity. The nature and safety of pork products are pointers to improved welfare indices during rearing phases which in turn influences the overall acceptability and quality of the products. According to Caporale et al. (3), deviation from the fundamental needs of the animal could lead to large variance in quality of products and general acceptability among the end users. The consumers' concerns pertaining to pigs' welfare and health need to be addressed effectively in order to ascertain the future of pork production enterprise. According to Kittawomrat and Zimmeman (4), an issue relating to welfare ensues when there is a mismatch in pig's instincts and its environment, this result to positive or negative experiences as imposed on the animal by man actions or inactions.

The act of pooling and managing pigs of varied weight categories together in the same facility in a commercial pig enterprise in developing countries of the world can constitute a major welfare problem since social conflict can ensued from this act (5), leading to poor production and reproduction as a result of elevated physiological stress, injuries, disease conditions, reduced immunity and decline in pork quality (6, 7, 8). Different approaches to the problem of aggression in pigs have been studied previously (9) but the problem still persist over time as the approaches so far adopted have failed to proffer long lasting effect. This has led to investigation to alternative solutions to the earlier studied aggressive management approaches which can easily be adopted among resource poor citizens of developing countries of the world that constitute the majority of animal protein producers in these parts of the world. Among the more practicable approach to this problem is sorting and managing pigs on equal weight basis. Weight asymmetry have been used to obtained pigs with equal market weight (10). But to only a hand full of information are available in literature on the impact of weight asymmetry on meat quality characteristics of growing pigs reared in a hot humid environment of the world. To this effect, this study was conceived to investigate the effects of weight asymmetry on carcass yield, ham proximate composition and lipid profile of growing pigs.

Materials and Methods

Study Area Description

This study was conducted at the Piggery Unit of Teaching and Research Farm of College of Animal Science and Livestock Production of Federal University of Agriculture, Abeokuta, Ogun State, Nigeria. The farm is located in derived Savannah vegetation zone of South-Western part of Nigeria, located at altitude of 169 m with latitude 7°13' 49"N and longitude 3°26'37"E. It has a mean annual rainfall of 1037 mm and average temperature and humidity of about 34.7°C and 83%, respectively (11).

Experimental Pigs and Management

A total of fifty four growing pigs with mean weight of 15.33±0.02 kg were obtained from the existing commercial stock in the Piggery Unit of Teaching and Research Farm of Federal University of Agriculture, Abeokuta. The pigs were grouped into three treatment groups (homogeneous light weight groups with mean weight of 12.83±0.57 kg, heterogeneous weight groups with average weight of 14.00±1.08 kg and homogeneous heavy weight comprises of pigs with mean weight of 18.22±1.02 kg) of 18 pigs per treatment and further divided into 3 replicates of 6 pigs per replicate. The homogeneous light group are pigs of the same age group whose weight were significantly less than the mean weight of the group while the homogeneous heavy weight group comprises of pigs of the same age whose weights were significantly higher than the group average. The heterogeneous weight group contained mixture of homogeneous light and heavy weight pigs in ratio 1 to 1. The pigs serving as replicate group were housed together in a naturally ventilated pen of floor area of 12 m^2 that is furnished with concrete feeders, drinkers and wallowing baths. Routine management practices that involves cleaning of the pens, observing the pigs for any symptoms of disease or injury, supplying of feed and water *ad libitum*, were carried out daily. The diet offered to the experimental pigs was formulated to meet up with physiological requirement of growing pigs as recommended by NRC (12) and consists of 2441.99 kcal metabolizable energy kg^{-1}, 18.87% crude protein, 6.40% crude fibre and 4.84% ether extract (Table 1).

Table 1: Percentage composition of experimental diets of growing pigs

Ingredients	Percentage (%)
Maize	50
Palm kernel cake	10
Basil Leaf	0
Moringa Leaf	0
Neem Leaf	0
Soya Bean Meal	18
Groundnut cake	9
Fish Meal	2
Wheat Offal	6.9
Bone Meal	3
Lysine	0.3
Methionine	0.25
*Premix	0.3
Salt (NaCl)	0.25
Total	**100**
Calculated Nutrients (%)	
Metabolizable energy (kcalME/kg)	2834.59
Crude protein	20.9
Ether extract	4.56
Crude fibre	4.68
Ash	3.05

*To supply the following per kg diets; VitA 12600 IU; vit D3 2800 IU; vit E 49 IU; vit k 32.8mg; vitB1 1.4mg; vit B2 5.6mg; vit B6 1.4mg; vitB12 0.014mcg; Niacin 21mg; Pantothenic Acid 14mg; Folic Acid 1.4mg; Biotin 0.028mg; Chlorine chloride 70mg; Manganese 70mg; Zinc 140mg; Iron 140mg; Copper 140mg; Iodine 1.4mg; Celenium 0.28mg; Cobalt 0.7mg; Antioxidant 168mg.

Data Collection

At the end of twentieth week of the study, six pigs per treatment (2 pigs per replicate) whose weights were within the mean weight of the replicate groups were selected, slaughtered and used to assess the carcass characteristics and qualities parameters of the pork. The selected pigs were weighed before subjected to 16 hours fasting in order to reduce the gastro-intestinal contents. Fasted weight of the pigs were also obtained before they were stunned by percussion method and bled by making an incision with a sharp knife that severe both the jugular vein and carotid arteries at the atlanto-occipital arhuculation. The stomach of the slaughtered pigs were cut opened along the greater curvature and the visceral organs were excised and weighed accordingly. The carcass weight and cut up parts were determined as outlined by Barca et al. (13) and Njoku et al. (14) and expressed as a percentage of live weight.

Chemical analysis of ham muscle was carried out in accordance to AOAC (15) procedures. Samples of oven dried pork that was free from bone, and ground were used for determination of dry matter, crude protein, ash and crude fat at the Meat Processing Laboratory of the Department of Animal Production and Health of Federal University of Agriculture, Abeokuta, Nigeria. The dry matter was determined by putting samples of ham muscle in a hot air oven at 105°C for 16 hours while the ash content was obtained by burning in a muffle furnace at 600ºC for 6 hours. Total fat was gotten by extraction with petroleum ether.

Potassium, sodium, calcium and magnesium contents of the ham muscle were determined using flame atomic absorption spectrophotometry (Model 3510, SPEX Industries, Inc., Edison, NJ). The Spectrometer was standardized with specific mineral standard at each time the digested sample was quantified in triplicate for each mineral.

Statistical Analysis

Data were processed by one-way analysis of variance (ANOVA) using SAS (16) package. Significantly ($p<0.05$) different means among variables were separated using New Duncan's Multiple Range Test as contained in the same statistical package.

Results

Effect of weight asymmetry on carcass yield

The effect of weight asymmetry on carcass yield of growing pigs is shown in Table 2. Live weight, bled weight, hot carcass, eviscerated, left carcass length, fore-leg, hind-leg, ham, shoulder, tail, kidney, liver, pluck weight, full gastrointestinal content and empty stomach weights were significantly ($P<0.05$) influenced by weight asymmetry. Homogenous heavy weight pigs had the highest live weight value of 69.15±2.08 kg compared to 56.15±2.12 kg documented for heterogeneous weight pigs. The bled and eviscerated weights of growing pigs followed the same trend with live weight. Statistically similar left carcass length was documented for homogenous heavy and light weight pigs. The highest fore-legs and hind-legs values 1.38±0.08 and 1.98±0.10%, respectively) were noted for the homogenous heavy weight pigs, followed by heterogeneous weight pigs and the least values were recorded for the homogenous light weight pigs. The homogeneous light weight pigs recorded the highest ham weight values while the least value of 11.98±0.81% was observed for the homogeneous heavy weight group. Homogeneous heavy and heterogeneous weight pigs had statistically similar shoulder weight values that differed statistically from 13.48% noted for homogeneous light weight pigs. Tail weights of homogeneous light and heterogeneous weight pigs were comparable but differed significantly from 0.39±0.04% noted for the homogeneous heavy weight pigs. Kidney, liver, full gastrointestinal tract and empty stomach values were statistically highest in heterogeneous weight pigs and lowest in homogeneous heavy weight pigs. Homogeneous heavy weight pigs had lower pluck weight (1.46±0.10%) when compared to the value of. 1.67±0.09% observed for homogeneous light weight pigs.

Effect of body weight asymmetry on proximate composition of ham muscle

The effect of body weight asymmetry on ham proximate composition is shown in Table 3. All the proximate parameters considered were significantly influenced by body weight asymmetry except crude protein. Homogeneous light and heterogeneous weight pigs had statistically similar dry matter and ether extract values that differed significantly from the values of 8.92±0.35% and 10.03±0.40% respectively noted for homogeneous heavy weight pigs. Homogeneous heavy body weight pigs had lower ash value compared to statistically similar values documented for homogeneous light weight and heterogeneous weight pigs.

Table 2: Effect of body weight asymmetry on carcass yield of growing pigs

Parameters	Homogeneous heavy weight	Homogeneous light weight	Heterogeneous weight
Live weight (kg)	69.15±2.08[a]	60.38±2.44[b]	56.15±2.12[c]
Bled weight (kg)	66.47±2.32[a]	58.46±2.29[b]	53.42±2.36[c]
Hot carcass weight (kg)	52.77±4.01	49.72±2.22[ab]	45.69±1.93[b]
Eviscerated weight (kg)	45.75±3.39[a]	43.80+1.99[ab]	39.99±1.69[b]
Left carcass weight (kg)	21.93±1.67	20.25±1.49	19.63±0.64
Left carcass length (cm)	90.10±1.68[a]	92.70±1.09[a]	83.93±1.42[b]
Dressed weight (%)	71.60±4.71	78.79±1.62	77.20±0.65
Cut parts (% live weight)			
Head weight	9.10±0.58	9.37±0.09	9.73±0.25
Trotter	2.67±0.16	2.43±0.21	2.83±0.03
Fore-legs	1.38±0.08[a]	1.14±0.10[b]	1.33±0.01[ab]
Hind-legs	1.98±0.10[a]	1.76±0.04[b]	1.88±0.06[ab]
Ham weight	11.98±0.81[b]	14.44±0.54[a]	13.03±0.18[ab]
Shoulder weight	11.11±0.76[b]	13.48±0.42[a]	11.46±0.31[b]
Tail weight	0.39±0.04[a]	0.25±0.02[b]	0.20±0.01[b]
Organs weight (% live weight)			
Spleen	0.24±0.06	0.32±0.09	0.20±0.01
Heart	0.37±0.01	0.35±0.01	0.38±0.04
Lung	0.85±0.05	1.00±0.05	1.02±0.01
Kidney	0.30±0.02[b]	0.32±0.02[ab]	0.37±0.01[a]
Liver	1.73±0.14[c]	2.13±0.09[b]	2.40±0.07[a]
Pluck	1.46±0.10[b]	1.67±0.09[a]	1.60±0.07[ab]
Full GIT	15.81±0.42[b]	16.20±0.53[b]	18.86±0.46[a]
Empty Stomach	0.78±0.03[b]	0.95±0.09[b]	1.31±0.10[a]

[abc]Means within rows with different superscripts are significantly ($P<0.05$) different

Table 3: Effect of body weight asymmetry on ham proximate composition

Parameters (%)	Homogeneous heavy weight	Homogeneous light weight	Heterogeneous weight
Dry matter	8.92±0.35[a]	5.90±0.86[b]	7.78±0.46[b]
Crude Protein	36.88±0.63	37.86±0.34	36.73±0.54
Ether extract	10.03±0.40[a]	8.10±0.39[b]	10.12±0.64[b]
Ash	53.38±0.99[b]	62.93±1.14[a]	62.67±2.96[a]

[ab]Means within the same row with different superscripts are significantly ($p<0.05$) different

Effect of body weight asymmetry on mineral composition of ham muscle

The effect of body weight asymmetry on mineral composition of ham muscle is shown in Table 4. Potassium and Magnesium were significantly influenced by body weight asymmetry. Heterogeneous weight pigs had significant higher potassium compared to the value noted for homogeneous light body weight pigs. Statistically similar magnesium values were observed for heterogeneous body weight and homogeneous light body weight pigs that significantly differed (P<0.05) from 38.67±0.81 mg/100g recorded for homogeneous heavy body weight pigs. Sodium and calcium contents of the ham muscle did not differ significantly in all categories of pigs in the present study.

Table 4: Effect of body weight asymmetry on mineral composition of ham muscle

Parameters (mg/100g)	Homogeneous heavy weight	Homogeneous light weight	Heterogeneous weight
Potassium	63.67±2.96[ab]	57.00±3.29[b]	71.00±3.74[a]
Sodium	37.67±2.18	38.00±2.56	41.33±1.67
Calcium	4.63±0.26	4.70±0.17	4.80±0.21
Magnesium	30.00±1.24[b]	32.00±0.10[b]	38.67±0.81[a]

[ab]Means within the same row with different superscripts are significantly (P<0.05) different

Effect of body weight asymmetry on lipid profile of ham muscles

Total cholesterol, triglycerides and high density lipoprotein were significantly influenced by weight asymmetry. Heterogeneous weight pigs had highest total cholesterol and High density lipoprotein values of 94.67±2.77 mg/dl and 61.53±2.63[a] mg/dl while the least value of 85.33±3.41 mg/dl and 53.60±1.88[b] mg/dl were respectively noted for homogeneous light weight pigs. The highest triglyceride value of 68.67±5.11 mg/dl was noted for homogeneous heavy weight pigs while the least value of 56.33±2.60 mg/dl was recorded for heterogeneous weight pigs.

Table 5: Effect of body weight asymmetry on lipid profile of ham muscle

Parameters (mg/dl)	Homogeneous heavy weight	Homogeneous light weight	Heterogeneous weight
Total cholesterol	93.00±2.79[ab]	85.33±3.41[b]	94.67±2.77[a]
Triglycerides	68.67±5.11[a]	61.00±3.30[ab]	56.33±2.60[b]
High density lipoprotein	58.27±2.48[ab]	53.60±1.88[b]	61.53±2.63[a]
Low density lipoprotein	21.00±1.98	19.53±1.49	21.87±2.02

[ab]Means within the same row with different superscripts are significantly (P<0.05) different.

Discussion

Statistical differences in live weight values noticed in this present study, with pigs of uniform weight groups (homogeneous heavy and light weight groups) managed together having an upper hand over the groups with variance weight. This difference could be linked to improved welfare indices in uniform weight pigs housed together resulting from less social and behavioural distresses that must have enhanced feed utilization of the pigs, leading to better growth and development. This observation is in line with the report of Arey and Edward (17) that attested to the fact that sorting and managing together of pigs of equal weight decreased aggressive behaviours, thereby improving reproductive and growth performances of pigs. The study of (18) also observed higher weight gain in homogeneous weight pigs over their heterogeneous weight counterparts reared together on the same pen. The enhancement in the bled weight, hot carcass and eviscerated weights of the homogeneous weight pigs over the heterogeneous groups could be a resultant effect of the differences in body size of the pigs that favoured the homogeneous weight groups over the heterogeneous groups. High correlation between live weight and carcass yield in Chato Murciano pigs have been established (19). Ciric (20) observed that hot and cold carcass weight had the strongest correlations with the weight at which an animal was slaughtered. The improvement observed in the fore-leg, hind-leg and tail weight of the homogeneous heavy weight group over their homogeneous light weight and heterogeneous weight counterparts could point to the degree of physical activities occurring among the uniform weight pigs, although behavioural study was not determine in this present investigation. Fels and Hoy (21) and Rushen (22) reported that sorted-heavy weight pigs takes longer time in aggressive interaction than the sorted-light weight and unsorted weight groups. The similarity in weight among these sets of pigs could have prolonged the establishment of the social hierarchy as no individual wants to submit easily to the other. This must have led to better development of muscle connected to locomotion as observed in this present study. Since increased physical activity reduces the rate at which muscle strength is loss, thereby enhancing muscle tone and bone mass (23). ACSMPS (24) revealed that the rate of improvement in muscle tone and bone mass depends on the type of physical activity that one engages in, the intensity, frequency and duration of the physical activity, likewise the characteristics of the individual undertaking the physical activity. Likewise, the significant difference in live weight of the pigs at the beginning of the study could have led to the variation in these parameters. This result is in accordance with the data reported by Carama et al (25) who indicated that statistically distinct weights at the beginning and end of sorted and unsorted pigs. The statistically higher ham and shoulder weight values observed in homogeneous light weight groups over the homogeneous heavy weight and heterogeneous weight pigs could be linked to earlier onset of feeding behaviour in homogeneous light weight pigs as reported by Bruinix et al (26). It has been reported that feed intake behaviour are modulated by many factors such as stocking density, feeder size (27), complexity of ration (28) and the body size of the pigs. The improved feeding behaviour and probably less aggressive behaviours could have led to enhancement in the growth rate of the homogeneous light weight pigs as the growth superseded that of heterogeneous weight pigs that had higher initial weight at the beginning of the study. The observed highest organ weights (kidney, liver, full gastrointestinal tract and empty stomach) in heterogeneous weight pigs compared to their corresponding values documented for homogeneous heavy and light weights pigs could suggest higher energy utilization as a result of prolonged social stress in this set of pigs. The variation in body size of pigs in the heterogeneous weight groups could have resulted to constant bullying of those with weight disadvantages and this must have resulted to substantial increment in energy demand in form of ATP. The higher expenditure of energy must have led to higher gut fill which must have influenced the development of visceral organs. This is in agreement with Sheri *et al.* (29) that reported that physical activity involves the movement of body parts by skeletal muscles requires more energy utilization than energy needed for resting. The increment in energy demand with increasing social stress could have led to high production of anabolic hormones in order to meet up with the rate of energy expenditure, this must have led to higher tissue accretion of organs associated with active metabolic activities. Patience *et al.* (30) affirmed the fact that social, physiological and environmental conditions of farm animals determine the levels of daily energy intake which in turn regulate the rate of tissue growth.

The statistical differences observed in the dry matter and ether extract contents with better results recorded for pork from homogeneous heavy weight pigs point to improved pig welfare due to less behavioural and social stresses among this set of pigs, this could have led to improvement in the ability of the pigs to maintain energy, water, hormonal, thermal and mineral balances that could have resulted to better pork quality. Habeeb *et al.* (31) avers that stress resulting from establishment of social order could upshot changes in biological function of pigs like reduction in feed intake and utilization, disturbance in water metabolism, protein, energy and mineral balances, enzymatic reactions, hormonal secretions and blood metabolisms that have a consequential effects on pork quality. Also, Lowe *et al.* (32) deduced that protracted social conflicts induced adrenergic stress response that influenced the process of conversion of muscle to meat. Correa *et al.* (33) reported that fast growth rate with higher proportion of fat compared to slow growth rate with lower fat proportion in pigs, which was consistent with the results of this present study. The ether extract result of the present study is in variance with the observation of

Bostami *et al.* (18) that noted higher crude fat in heterogeneous weight over homogeneous weight pigs. Marin et al (34) indicated that adipose tissue mass and crude fat content of meat can be greatly influenced by behavioural stress. In the present study, the statistical difference observed in crude ash content could be attributed to higher social and behavioural stress in the pigs with variance weight and those of homogeneous light weight groups which must have induced reduction in moisture content of the meat and enhanced muscular tissue accretion due to exercise. This observation contradicted report of Smith and Teeter (35) that mineral excretion increased with intensity of social and environmental stress. Likewise, Bostami *et al.* (18) reported no significant difference in crude ash content of pork from pigs on different weight groupings.

According to the report of Ekmekcioglu *et al.* (36), the healing and physiological roles of mineral elements in the body of farm animals entails the activation of biochemical processes and enhancement of enzymatic actions. Potassium is essentials for water and electrolyte metabolism and maintain the equilibrium of acid-base in the body (37). The greater variability in potassium level in the tissue of heterozygous weight pigs over their homogeneous weight group points to better metabolic activities needed to meet up with higher energy required to sustain social and physiological stresses incurred from protracted social conflicts. The enhanced metabolism must have resulted to improvement in the electrolyte, acid-base, ionic and mineral balances. This is in line with the observations of earlier workers (37, 38, 39) that reported higher concentration of potassium in the tissue of wild boars in comparison with the level documented for domestic pigs. Jarosz (40) enthused that the demand of Sodium and potassium depend on environmental temperature, physical activity and the process of growth. Potassium concentration in tissue increases with growth intensity since it is the major intercellular component of muscle (41). The significantly higher magnesium in the ham of heterozygous weight pig points to better protein metabolism as pointed out by Cygan-Szczegielniak *et al.* (42). The higher content of magnesium in the muscle of heterozygous weight pigs than their homogeneous weight counterparts may have resulted from the degree of physical activities occurring among this set of pigs. The magnesium values documented in this present study is lower than 95 -107 mg/g as reported by Cebulska (43) but higher than 26.5 mg/g observed by Galian *et al.* (44) in the muscles of domestic pigs. The variations in these values could be linked to differences in breeds, age, sex, nutrition and environmental conditions among the pigs used for the different studies (38, 45, 46).

Weight asymmetry showed effects on lipid profile of ham muscle with the heterogeneous weight groups recorded the highest total cholesterol and high density lipoprotein levels. The observed differences in total cholesterol and high density lipoprotein levels in heterogeneous weight pigs over their homogeneous weight counterparts could be linked to higher frequency of feed intake in this set of pig needed to meet up with energy expended on physical activity. According to the observation of Rauw *et al.* (47), pigs that consumed feed above their expected requirements based on their metabolic body weight, growth and fatness levels recorded higher cholesterol levels. The authors concluded that feed intakes of pigs were highly positively correlated with total cholesterol and high density lipoprotein levels. Likewise, other authors opined that the variation in cholesterol synthesis appears to be strongly dependent on meal timing (48) and meal frequency (49, 50). The significantly lowest triglycerides level in heterogeneous weight pigs could be linked to greater hypertrophy in this set of pigs caused by increased level of social tensions as a result of competition for limited resources. According to Ayuso *et al.* (51), hypertrophy is driven by triglycerides accretion in nature adipocytes. The rate of synthesis (lipogenesis) and degradation (lipolysis) regulates the quantity of triglycerides deposited in the body cells. Earlier investigators have indicated that variation in muscle fibre composition leads to differences in lipid composition, oxidative properties and intra muscular fat contents across muscle (52, 53).

Conclusion and Application

The results of this present study investigating the effect of body weight asymmetry on carcass yield, ham proximate composition, mineral and lipid profiles of growing pigs revealed:

1) improvement in left carcass length, ham, shoulder and pluck weights in homogeneous light pigs. This implies higher livestock sustainability and productivity resulting from improved welfare indices.
2) The highest dry matter and ether extract digestibility were found among homogeneous heavy weight pigs, this implies better nutrient utilization.
3) Potassium and magnesium contents of the ham muscle of the heterogeneous weight pigs were the highest, indicating enhancement in the electrolyte, acid-base, ionic and mineral balance.
4) The homogeneous light weight pigs had the best muscle cholesterol contents, indicating greater hypertrophy
5) Hence, to ensure high meat quality with improved welfare indices, it seems more appropriate to manage and rear pigs of similar weight categories together rather than pigs with variant weight category as presently carried out in commercial pig farms.

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