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Effect of Diet Types and Slaughter Ages on Carcass Characteristics of the Domestic Rabbits in Humid Southern Nigeria

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Abstract: This study was conducted to assess the effect of feed types (rabbit grower's mash, chicken grower's mash and chicken layer's mash) and age at slaughter (10wks, 13wks and 16wks) on the characteristics of rabbit fresh meat. The parameters evaluated were the pH change during slaughtering (during rigor mortis development) and carcass characteristics in terms of dressed weights, dressing percentage, organ weights, physical cuts and meat/bone ratio to establish practice viability. On the average, it took the rabbit meat 4.76 hours to attain the ultimate pH of 5.69 at 2±2^{o}C. The dressed carcass weight, on the average was 47.9% of live weight. Dressed carcass percentage was significantly influenced by slaughter age with rabbit slaughtered at 10 weeks having lower value than that of 13 and 16 weeks slaughter ages. Slaughter age influenced the absolute weight of each physical cut. As the slaughter age increased, the average meat/bone ratio of 3.46 increased significantly. Diets did not have significant effect on meat/bone ratio and on the relative organ weights. Moistened chicken feeds (Layers and Growers mash) could be fed to rabbits with heavy forage supplementation for optimal rabbit meat production.

Key words: Carcass, chicken, feeds, rabbit, slaughter ages, ultimate pH

Introduction

One cannot over-emphasize the role of food in the development, growth and survival of a nation. The Nigerian population of over 130 million is severely at great risk now more than ever before, given the high level of food insecurity and deprivation. Without abundant, accessible, assorted, safe, wholesome and affordable supply of food, Nigerian nation may forfeit her life of hope and dignity (Igene, 2001). The seeming interminable food and economic crises in Nigeria, pose a serious threat to her growth and survival.

A liberal meat supply has always been associated with a happy and a virile people as well as a stable and progressive economy. Throughout recorded history, the consumption of meat has indicated a prestigious position of social and economic status (Forrest *et al*., 1975). It has also been postulated that if the people of the underdeveloped nations of the world could have adequate access to enough meat or at least, meat-like high quality protein food, their capacity for rapid intellectual, social, political and industrial development would increase many times (Forrest *et al*., 1975; Ikeme, 1990).

The meat supply situation in Nigeria remains critical in spite of the relatively large animal population of 14 million cattle, 34 million goats, 24 million sheep and over 104.3 million local poultry and about 20 million exotic poultry (FMEDR, 2000). It is also true that enormous amount of money; energy and time have been directed towards research and development efforts in these conventional livestock. The average Nigerian still consumes less (3.894g/h/d) than the FAO recommended level (34g/h/d) of animal protein consumption per day (Igene, 1992; Lamorde, 1993). Comparatively, animal protein consumption per head per day for United States of America, Western and Eastern Europe and Africa are 66, 39, 33, and 11g/h/d respectively as well as 11g/h/d for Africa (Lamorde, 1993). This situation in Nigeria may get worse in the near future unless there is a drastic re-evaluation and re-orientation in the country's livestock delivery system. Lamorde (1993) reported that a study carried out by the Central Bank of Nigeria (CBN) and Nigerian Institute of Social and Economic Research (NISER) in 1992 indicates that there has been a declining trend in livestock production since the inception of the then Structural Adjustment Programme (SAP) in Nigeria. The decline index was accounted for, mainly by a decline in poultry and swine production due to scarcity and high cost of feed. Olomu (1995) reported that feeds share over 65% of the cost of poultry production in Nigeria. Nigerians compete with livestock for grains that are the major feed ingredients for monogastric animals.

Several research workers have observed that short cycle production animals like the rabbit (*Oryctolagus cunniculus*), which subsists satisfactorily on high roughage diets and less on grains will fit into the present food situation in Nigeria for better food delivery especially the provision of the much-needed animal protein supply. Since the competition between humans

Table 1: Standard diet formulas*

Ingredients	Diets (%)		
	RGM	CGM	CLM
Maize	30.00	24.00	25.00
Soya bean Meal	16.00	6.00	12.00
Wheat bran	18.15	34.15	18.15
Bone Meal	2.00	2.00	3.50
Periwinkle Shell	1.00	1.00	8.50
Premix	1.00	1.00	1.00
Salt	0.35	0.35	0.35
Palm Kernel Cake	31.50	31.50	31.50
Total	100.00	100.00	100.00
Crude Protein	19.00	16.00	16.40
Energy (ME Kcal/kg	2450.00	2174.00	2174.00
Methionine/Cysteine (%)	0.68	0.64	0.62
Lysine (%)	1.04	0.80	0.88

*Calculated: RG = Rabbit growers' mash
CG = Chicken growers' mash
CL = Chicken layers' mash

and livestock for grains in Nigeria is unfavourable, the feeding attributes of the rabbit are therefore now very relevant. The rabbit appear to assume a competitive advantage over such other short cycle livestock like the poultry and pigs that cannot be raised on high roughage diets that are low in grains. This is of special importance in lesser-developed countries (LDC), where population pressures and food shortages are high. Rabbit scientists have advocated for years that a tremendous potential exists for rabbits in the lesser-developed countries, based on the virtues of the rabbit (Owen, 1977). This potential has been realized in Cameroon, China, Egypt, Ghana, and Mexico. Rabbit has other two major advantages over ruminants: its family-sized carcass, which renders refrigerating storage facilities unnecessary and the absence of religious obstacles to its consumption. Rabbit production is promising in Nigeria where grains are expensive and scarce, but forages are cheap and abundant, and the need for maximum meat production is acute.

Poultry mash forms were used as the study diets because rabbitry in Nigeria, in its present state, depends mainly on poultry feeds. Very few or none of the feed mills produce rabbit feed pellets. The effects of these feeds (grower's mash and layer's mash) and the age at slaughter on rabbit meat characteristics are scarce. This study therefore assessed the pH change during slaughtering and carcass characteristics in terms of dressed weights, dressing percentage, organ weights, physical cuts and meat/bone ratio to establish practice viability.

Materials and Methods

Source of rabbits: A total of 54 five-week old New Zealand White rabbits (*Oryctolagus cunniculus*) were used in this study. They were purchased from Abe Modern Rabbitry located at Ibdan in Nigeria. They were carefully transferred in the early hours of the day (to reduce heat stress) to University of Benin Teaching and Research farm after which, they were immediately given anti stress drug (Vitalyte).

Source of feed: Standard chicken growers' mash (CG), layers' mash (CL) and rabbit grower's mash (RG) were formulated and compounded as experimental diets. The feed ingredients for the diets formulation were purchased from a research grade ingredients marketing outfit at Federal Housing Estate Shopping Complex, Opposite University of Benin, Ugbowo Campus, Benin City. Greens (*Panicum maximum*, *Leucaena leucocephala* and *Tridax procumbens* of equal weights) were offered to the experimental animals. These washed clean greens were used as supplements because they are nutritious and well cherished by the rabbits. These greens were likely to offset nutrient deficiency in poultry feed used. The high fibre in the greens augments for example the crude fibre, which is very low in poultry feeds.

Feeding: The rabbits were fed on the experimental diets (CG, CL, RG) according to the 3 x 3 treatment arrangement. The experimental diets (Table 1) were offered every morning (9.00am) while the greens were offered every evening (4.00pm). Enough of the experimental diets were given to each rabbit at 9.00am and expected to last in the feeding troughs till 4.00pm the next evening. Equally, the greens were fed in such a way that the greens would last in the cage from 4.00pm in the evening to 9.00am, the next morning. Weekly feed intake and weight gains of the rabbits were taken.

Slaughtering

At predetermined ages (10, 13, and 16 weeks), the rabbits were fasted for 24 hours and weighed. A blow at the back base (*Medulla oblongata*) of the head was used to stun each rabbit. At every slaughter age, the rabbits were flayed and eviscerated according to Alaku and Attah (1986). The eviscerated carcasses were washed clean and dried with a clean cloth (absorbent-type). The weight of the live rabbit prior to slaughter, the weights of the whole carcass and internal organs were recorded.

pH determination: The pH of the fresh carcasses was measured directly from three points in the thigh muscle of each sample at 0 to 1^{o}C using digital pH meter with external electrodes according to Awonorin and Ayoade (1992). Three pH readings were taken: the initial, onset and ultimate pH according to Lawrie (1991) to monitor the *Rigor mortis* development (Fig. 1).

Meat characteristics: The meat quality characteristics were determined by examining the following traits: the pH during slaughtering (during *Rigor mortis*

Table 2: Effect of diets and slaughter ages on the dressed weight of rabbit carcass

Slaughter ages (wks)	10	13	16	Avg.
Diet				
RG	46.35 ± 0	49.91 ± 0.71	50.20 ± 2.69	48.82 ± 1.43
CG	45.61 ± 1.13	50.34 ± 0.10	50.13 ± 1.0	48.70 ± 0.97
CL	48.25 ± .86	49.86 ± 0.10	50.26 ± 0.87	49.45 ± 0.54
Avg.	46.74 ± .12[b]	50.04 ± 1.10[bc]	50.20 ± 0.98[c]	

[a]Each value is an average of 6 rabbits ± SE. [b,c]Means bearing different superscripts in the same row are significantly different (P < 0.05)

Table 3: Effect of diets and slaughter ages on physical cuts of rabbit carcass[a]

Diets	RG			CG			CL		
Slaughter age (wks)	10	13	16	10	13	16	10	13	16
Carcass wt (g)	773.2	1139.0	1485.3	744.8	1187.8	1526.4	911.3	1241.8	1463.5
Rib (%)	22.0	21.6	22.3	23.6	22.3	23.0	21.6	21.6	22.2
Loin (%)	24.4	25.8	26.3	25.3	26.6	24.3	24.6	25.8	26.2
Rump (%)	4.6	5.6	3.9	4.2	5.1	4.3	4.7	4.0	4.8
Legs (%)	29.3	28.8	29.0	28.1	27.4	29.0	28.7	30.0	29.1
Arms (%)	17.1	17.7	18.5	18.7	17.3	18.1	18.6	18.6	17.7

[a]Percentage of each cut was calculated on carcass weight

development) and carcass characteristics in terms of dressed weights, dressing percentage, organ weights, physical cuts and meat/bone ratio to establish practice viability.

Results and Discussion

pH Changes: Lawrie (1991) reported that the lowering of pH in muscles is due to the accumulation of lactic acid after stunning and Hulot and Ouhayoun (1999) also indicated that it is one of the most significant post-mortem changes that occur during the conversion of muscles to meat. Fig. 1 showed that, on the average, it took the rabbit meat 4.76 hours to attain the ultimate pH of 5.69 at 2±2^{o}C. Dransfield *et al*. (1980) previously reported that all slaughtered pieces of meat stored at 0 to 1^{o}C after stunning reached ultimate pHs as early as 5 hours for rabbit, 20 hours for pork, 24 hours for beef, 28 hours for lamb and 30 hours for veal and this is in agreement with this study.

The ultimate pH of rabbit is almost the same with most species and however, the rate of pH fall differ significantly (Blasco and Piles, 1990). Lawrie (1991) also reported that both the rate and the extent of the post-mortem pH fall are influenced by intrinsic factors such as species, the type of muscles and variability between animals. It is also affected by extrinsic factors such as the administration of drugs pre-slaughter and environmental temperature. Ouhayoun and Delmas (1988) mentioned also, that comparatively, the initial pH levels are lower in rabbit than in the horse. In addition, they reported that the level of ATP/P at the onset of rigor mortis is particularly high in the *L. dorsi* (L.D) of the rabbit. The fast phase of the onset of *rigor mortis* starts when ATP/P has fallen to about 15% soluble phosphorous (Blasco and Piles, 1990). They also observed that the reserve of creatine phosphate, which is the most immediate mechanism for re-synthesis of ATP during *rigor mortis* development, is highest in horse and lowest in rabbit, apparently reflecting their relative capacity for rapid energy production with relatively easy exhaustion.

Lawrie (1991) reported that comparatively, the high rate of glucose accumulation (mg/hr/g at 20^{o}C) in the muscles of rabbit is 0.50 and horse is 0.04. This variation is due to the difference in the activity of "-amylase enzyme between the corresponding muscles of the different species of animals. This enzyme converts muscle glycogen to glucose and competes with the system whereby glycogen is converted to lactic acid. This factor is partly responsible for the short duration of rigor mortis development in the rabbit muscles. It was observed that recorded pH in our study is lower than that reported by Dransfield *et al*. (1980). It may be due to difference in pre-slaughter handling that probably resulted in differences in glycogen reserve before slaughter.

The feeds RG, CG and CL as well as the ages at slaughter (10wks, 13wks and 16wks) did not have any significant effect (P > 0.05) on the rate and extent of the post-mortem pH fall.

Compared to other meat animals, freshly slaughtered rabbit meat should be immediately chilled to tenderize rabbit meat because of the short time (4.76 hours) it takes the rabbit meat to complete rigor mortis development and reach the ultimate pH.

Carcass: The dressed carcass weight, on the average was 47.9% of live weight (Table 2). Dressed carcass percentage was significantly (P < 0.05) influenced by slaughter age with rabbit slaughtered at 10 weeks having lower value than that of 13 and 16 weeks slaughter ages. Dressing percentage values reported

Table 4: Effect of diets and slaughter ages on the meat/bone ratio of rabbit carcass[a]

Slaughter ages (wks)	10	13	16	Avg.
Diet				
RG	2.86±0.18	3.57±0.23	40.6±0.44	3.50±0.08
CG	3.28±0.54	3.81±0.54	3.89±0.35	3.66±0.14
CL	3.21±46	3.64±0.46	3.92±0.61	3.59±0.20
Avg.	3.12± 0.11[b]	3.67±18[bc]	3.96±0.15[c]	

[a]Each value is an average of rabbits ± SE. [b,c]Means bearing different superscripts in the same row are significantly different (P < 0.05)

Table 5: Effect of diets and slaughter ages on organ weights of rabbits [a]

Diets	RG			CG			CL		
Slaughter age (wks)	10	13	16	10	13	16	10	13	16
Organs (% of live weights)									
Alimentary canal	18.1±1.5	16.2±0.5	14.4±0.6	18.6±1.8	16.3±1.6	14.9±0.4	17.3±1.6	15.6±0.6	15.4±0.9
Liver	4.3±0.4	4.3±0.5	3.7±0.4	4.4±0.8	4.3±0.2	4.0±0.1	4.5±0.5	4.0±0.3	4.1±0.4
Kidney	2.1±0.4	2.0±0.2	2.2±0.1	1.5±0.3	1.6±0.2	2.2±0.7	1.6±0.3	2.0±0.4	2.0±0.4
Tail and Feet	3.7±0.3	3.2±0.3	2.6±0.2	3.7±0.2	3.3±0.3	2.7±0.2	3.5±0.2	3.1±0.1	3.0±0.1
Head	9.7±0.4	8.7±0.1	8.0±0.2	9.2±0.3	8.6±0.6	8.2±0.4	9.2±0.5	8.3±0.2	8.3±0.3
Blood	1.9±0.3	1.7±0.3	1.4±0.2	1.8±0.2	1.8±0.1	1.7±0.3	1.8±0.1	1.7±0.2	1.8±0.1
Skin	11.9±0.8	12.8±0.3	13.0±0.6	11.7±0.5	12.1±0.5	13.2±0.3	12.0±0.4	12.7±0.4	12.3±0.9
Heart and lung	1.8±0.1	1.3±0.1	1.3±0.1	1.8±0.04	1.3±0.1	1.2±0.1	1.5±0.1	1.4±0.03	1.25±0.02

[a]Each value is a mean of 6 rabbit ± SE. Effect of diets not significant (P < 0.05). Effect of Slaughter age significant at (P < 0.05).

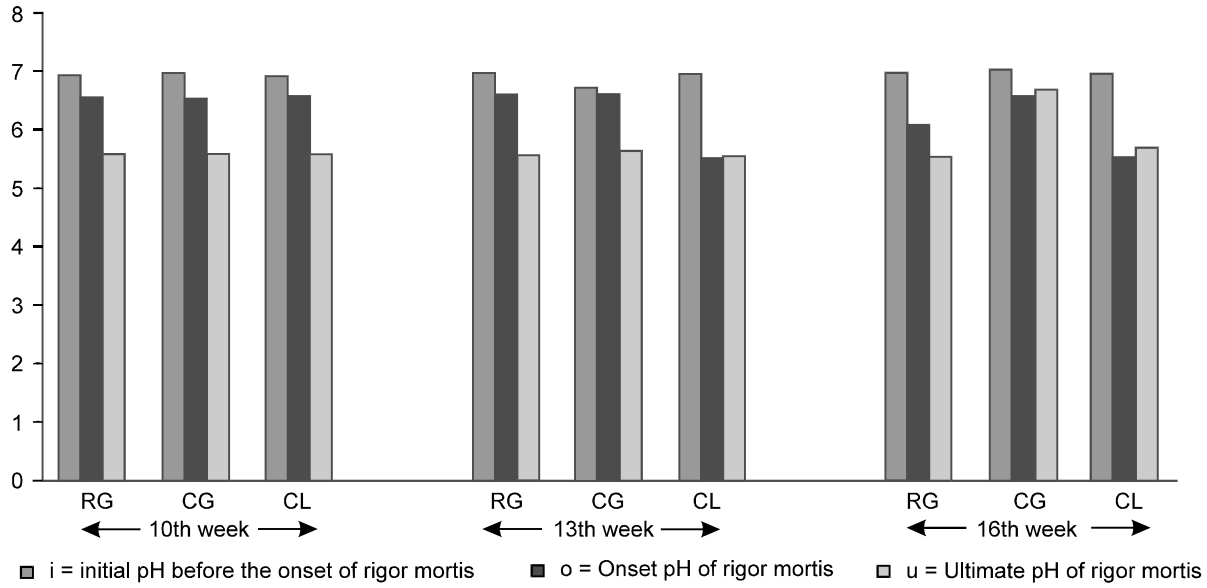

Fig 1: pH determination of rabbit (during slaughtering)

here are somewhat lower than those reported by other workers. Pla *et al*. (1996) reported that an average post fryer rabbit weighing 1.5 to 2.0kg had a carcass yield of 56%. Memieth *et al*. (2004) reported a dressing percentage from 50.7 to 58.5 depending on the grades of the rabbit carcass, while Szendro *et al*. (1998) indicated a carcass yield of 56%.

The effects of diets and slaughter ages on percentage yields of various physical cuts of rabbit carcass are shown on Table 3. The range values for different cuts were rib 21.6% to 24.6%; loin 23.6% to 26.3; rump 3.0% to 4.8%; legs 27.4% to 31.0% and arms 17.1% to 18.7% based on dressed carcass weight. Slaughter age influenced the absolute weight of each physical cut. However, it did not seem to affect the relative weights of different physical cuts (Table 3). The results reported here are in agreement with the work of Piles *et al*. (2000) who reported that dressed carcass weights had no significant (P > 0.05) effect on the proportion of retail cuts and quality of the meat.

Meat/ Bone ratio: As the slaughter age increased, the average meat/bone ratio of 3.46 increased significantly (P < 0.05) as shown in Table 4. Lawrie (1991) reported that until puberty is reached, during which the sex hormones (androgens and estrogens) increased

significantly, continuous elongation of the long bones of an animal is evident. This may explain the observed relationship between slaughter age and meat/bone ratio in this study. Diets did not have significant ($P > 0.05$) effect on meat/bone ratio. These findings suggest that the young rabbits can be fed with any of the diets (rabbit growers'-RG, chicken growers'-RG and chicken layers'-CL) rations without having significant effect on meat/bone ratio. Piles *et al*. (2000) reported that rabbit had a very thin and light bone structure, which can compare well with the chicken. Szendro *et al*. (1998) reported a meat/bone ratio of 2.8 to 3.7, which is in agreement with our values of 2.86 to 4.06. Comparatively, Romans *et al*. (1994) reported a meat/bone ratio of 3.0 for chicken that compares well with rabbit.

Organs: The organ weights as the percentage of live weight at different ages are presented in Table 5. Diets did not have any significant ($P > 0.05$) influence on the relative organ weights. Dalle–Zotte (2002) reported a similar effect. Alimentary canal and its contents (which were not flushed though the rabbits were starved for 24 hours prior to slaughter) comprised of 14% to 18% of the body weight. The ranges for other organs were; tail and feet, 2.6% to 3.7%; head, 8.0% to 9.7%; heart and lungs, 1.2% to 1.8%, and the above values decreased significantly ($P<0.05$) with increase in slaughter age. Kidneys were 1.5% to 2.2% of the body weight and increased significantly ($P < 0.05$) with an increase in slaughter age. Liver was 3.7% to 4.5%; blood 1.4% to 1.9% and skin 11.7% to 13:2% or the body weight did not show any distinct differences among various slaughter age groups and diets, which agreed with the results of Gondret *et al*., 2000.

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