PERFORMANCE AND ECONOMIC BENEFITS OF WEST AFRICAN DWARF GOATS ON FIVE HOUSING PATTERNS.

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Abstract
An experiment was conducted to evaluate the effect of five novel housing patterns on growth performance, carcass characteristics of WAD goats and the cost of building these structures. Five housing patterns designated T_1CH, T_2ZH, T_3MH, T_4BH and T_5TH were erected which served as (T_1 - T_5) treatments. Twenty West African dwarf bucks were divided into five (5) groups of four animals each. Each group was assigned to one of the five treatments (housing pattern) in a completely randomized experiment. The experiment lasted 56 days.Data on growth parameters, carcass and cost was collected. Investigations revealed that for growth performance, zinc housing (T_2ZH) pattern had a high body weight gain and least feed conversion ratio followed by bamboo (T_4BH) and thatch (T_5TH) housing pattern. However, values obtained for carcass characteristics varied significantly ($P<0.05$) across zinc, mud, bamboo and thatch housing patterns but were higher than the values recorded in concrete (T_1CH) housing pattern except for dressing percentage and lean to meat ratio. For economics of production, zinc housing pattern had comparable cost/kg feed, cost of feed consumed lower value for cost/kg weight gain and least output/unit cost of housing. It can be concluded that goats on zinc housing pattern (T_2ZH) performed better comparatively in terms of the parameters tested hence, can easily be adopted by smallholder farmers.

Key Words: Production, WAD goats, economic benefit, carcass.

INTRODUCTION

Animal protein consumption in Nigeria and other developing countries has been reported to be comparatively low (Ayorinde and Aromolaran, 1998). The average Nigerian consumes about 54 grams of protein per day, with 6.5 grams coming from animal sources. This is a far copy from the recommended daily protein intake of 80 grams with 28 grams derivable from animal protein (FAO, 1985).

The West African dwarf goat is most prevalent in the hot humid forest zone of southern Nigeria. Its relative tolerance to excessive humidity and trypanosomiasis which are important factors in animal production in the forest zone, singled it out as a breed of choice (Odoemelam, 2012). Akusu and Ajala (2000) noted that West African dwarf is early maturing, prolific and a non - seasonal breeder.

In most parts of the tropics, goats lack a proper housing pattern and this may invariably contribute to the reduced performance of West Africa dwarf goats together with poor feeding leads to a staircase growth pattern (Davies and Onwuka, 1993).

However, there is dearth of information on some novel housing patterns which are affordable besides providing comfort to the animals. This research therefore evaluates the effects of five housing patterns on growth performance and carcass characteristics together with cost implication of the housing patterns.

MATERIAL AND METHODS

The study was carried out at the AkwaIbom State University, ObioAkpa Campus. ObioAkpa is located between latitude 5^0 17^1N and 5^0 27^0N between longitude 7^0 27^1N and 7^0 58^1E with an annual rainfall ranging from 3500mm - 5000mm and average monthly temperature of 25^0C. AkwaIbom is a coastal state, lying between latitude 4^0 28^1N and 5^0 3^1N and between longitudes 7^0 27^1E and 8^0 20^1E with a relative humidity between 60 - 90%. It is in the tropical rainforest zone of Nigeria.Five different housing systems were built to accommodate the experimental animals. Housing unit 1 was made up of concrete block walls, cemented floor and zinc roof. Housing unit 2 was constructed with zinc roof, zinc walls and earthen floor. A building with thatch roof, mud walls and earthen floor was housing unit 3. Housing unit 4 was built with bamboo walls, tarpaulin roof and earthen floor while the last unit had thatch walls, thatch roof and earthen floor. All these housing units measured 3m x 4m each. The five housing systems were used as treatments as follows:

T_1CH – Concrete house
T_2ZH - Zinc house
T_3MH – Mud house
T_4BH – Bamboo house
T_5TH – Thatch house

Twenty (20), five months (20 weeks) old weaner goats (10 bucks and 10 does) of average initial body weight of 8.62kg and 10.25kg respectively of the West African Dwarf (WAD) type commonly reared by small-holder livestock owners were used for the experiment. These animals were dewormed and

treated against ectoparasites. The goats were randomly assigned to each of the five housing units, designated as T_1 – Concrete house (CH), T_2 – Zinc house (ZH), T_3 – Mud house (MH), T_4 – Bamboo house (BH) and T_5 – Thatch house (TH) respectively in a Randomized complete block design (RCBD). The animals were allowed to come out on daily basis to exercise themselves in a paddock (25m x 25m) from 7.30 – 9.00a.m.

Four forages were combined in the ratio 1:1:1:1 and offered to the animals in their respective housing units. These forages included *Andropogon tectorum, Aspiliaafricana, Panicum maximum,* and *Gmelinaarborea*. Clean fresh water and salt licks (TANLICK®) were provided *ad libitum.* Feed offered and refused were recorded on daily basis. Average weekly weight gains were computed

Carcass Evaluation

After the 56 days feeding period, twqgqats from each treatment were selected and used for carcass analysis. They were fasted for twenty-four hours during which they were given plenty drinking water, and sacrificed by severing the jogularvein, bled and the following carcass cuts obtained: loin, shoulder, thigh, ends, set and left half. The following carcass by products and visceral organs were also obtained: head, leftlimb, tail, kidney, lungs, liver and lean to bone ratio. study goats were starved 24 hours prior to slaughter. Slaughtering was done by severing the jugular vein of the goats. Pre-slaughter weight, weight at slaughter and dressing weight was carried out. Calculation of dressing percentage was based on the weight of dressed warm carcass was made of what remained of the carcass after the removal of the head, skin, contents of the thoracic and pelvic cavities (including the diaphragm and kidney) and the limbs distal to the carpal and tarsal joints.

The guts in each case was weighed, cleaned and reweighed. The hearts, liver (without gall bladder), lungs, spleen, pelvic fat and limbs (four feet) distal to the carpals and tarsals were also weighed and recorded.

The procedure employed by Akinsoyinu (1974) was adopted for the meat cuts of the carcass. The leg plus loin cuts were then dissected into muscles and bones with ligaments to obtain the meat to bone ratio.

Cost Analysis

The estimation for cost analysis is stated thus:

i) Cost/ kg of feed: This is the cost paid for fetching of forage i.e. ₦3.85.

ii) Cost of feed consumed: Cost/ kg of feed x feed intake.

iii) Cost/ kg weight gain: this is the total feed cost divided by the weight gain.

iv) Cost/ housing unit (₦): This is the cost of purchasing the building materials and labour for building added together for the various housing units.

v) Total feed cost: This is given as cost/ kg feed multiplied by the feed intake.

vi) Output/ unit cost of housing: This is calculated as output/ unit cost of housing divided by weight gain.

vii) Cost of housing/ goat/ year: Calculated by taking the total cost of each housing unit divided by the number of goats per treatment, and then divided by one year i.e. (12 months). This gives the actual cost of housing units. For example in concrete housing, $\frac{14300}{4} = \frac{3575}{12} = 297.92$

Statistical Analysis

The data collected were subjected to analysis of variance procedures. Significant means were separated using Duncan's New Multiple Range Test (Duncan, 1955).

RESULT AND DISCUSSION

The effect of housing systems on body weight gains, feed intake and feed conversion ratio of WAD goats is summarized in Table 1. The initial body weight at the start of the experiment did not differ significantly among the experimental groups. Housing systems had statistically significant ($P<0.05$) effect and final body weight, weight gains daily weight gain, feed intake, daily feed intake and feed conversion ratio of WAD goats. WAD goats raised in Zinc housing system recorded higher values for body weight gains than WAD goats raised in concrete house (control) and was statistically similar ($P>0.05$) to WAD goat raised in bamboo and thatch housing system concrete (control) and mud housing systems recorded the least values for body weight gains and were statistically similar. Feed intake values also follow similar patterns like the body weight gains. For feed conversion ratio values, WAD goats kept in zinc housing system had the least values (1.22) followed by thatch housing system (1.41) and bamboo housing system with 1.42. Whereas concrete housing system which serves as control and mud housing system recorded higher values of 1.86 and 1.91 respectively.

The significantly poor performance recorded for concrete and mud housing systems may be due to inadequate exchange of air which may lead to respiratory problems from an accumulation of respiration gases, volatile gases from manure, dust and mold from excessive moisture (ESGPIP, 2009; Kalyan*et al*., 2015; MohitAntil*et al*., 2019). However, Zinc bamboo and thatch housing systems which perform better ($P<0.05$) where packed with earthen floor, this minimized moisture building within the house (ESGPIP, 2009). These housing systems also provides for excellent air circulation and quality and easy access for manure removal for prevention of outbreak of diseases (ESGPIP, 2009; Kalyan *et al*., 2015; MohitAntil*et al*., 2019).

The significantly ($P<0.05$) higher values of feed conversion ratio (FCR) of 1.86 and 1.91 recorded for WAD goats in concrete and mud housing systems respectively, implied that the animals utilized the feed in those housing systems with loser efficiency as compound to the FCR values of 1.22, 1.41 and 1.42 in Zinc, thatch and bamboo housing systems

respectively. This is because the higher the value of the feed conversion ratio, the less desirable is the treatment, as the animal consumes more feed to produce a unit weight gain (Tona*et al*., 2014; Yusuf *et al*., 2014).

Table 2 presents carcass characteristics of WAD goats raised in five different housing systems. Results of carcass by-products and visceral organs showed significant difference (P<0.05) for dressing percentage, loin, left half, set, thigh, shoulder, end, left limb, head, tail, kidney, lungs, liver and lean to meat ratio. Values obtained varies significantly across zinc, mud, bamboo and thatch housing systems and were higher than values obtained in concrete housing system except for dressing percentage and lean to meat ratio.

Dressing percentage is both a yield and value determining factor and is therefore an important yard stick in assessing performance of meat producing animals. Significantly higher dressing percentage was observed in goats kept in concrete housing system when compared to other housing systems. The values observed for goats in all the housing systems were within the expected range of 43.9% to 55.7% as reported for Boer goats, South African indigenous, Angora and Kacang crossbred goats (Yusuf *et at*., 2014; Johnson *et al*., 2010).

Ends percent values in this study did not agree with the non significance reported earlier by Udo*et al*., (2018), though percentages herein are higher. The ends has as part of it the neck should guaranteed more capable carriage of the head and its structures, necessary for survival of the animal. Shoulder percent values herein did not agree with values reported by Udo*et al*., (2018) in the same environment, as a result of recorded lower values. Loin percent values appear higher than those reported by Udo*et al*.,(2018) and are interpreted to be capable of providing the needed support and protection for body framework. Thigh percent values revealed higher comparable values across the treatments. It is interpreted that the housing systems encouraged development of thigh muscles. Head percent values of this work did not agree with the fidings of Wuanor and Carew,(2018) because it was high in terms of values but it is noted that the latter workers used a different breed of goat.

Lungs percent values in this work were higher than that reported by Udo*et al*., (2018) and means that there was no serious challenge to the oxygen supplying function of the blood or carbondioxide removal. Liver percent values were higher for mud housing system than in concrete & thatch but compared favourably with zinc, and bamboo housing system. This means there was no challenge to the liver caused by the housing treatments and also connotes absence of injury to the liver (Wuanor and Carew, 2018). Kidney percent values where higher than that reported by Udo*et al*., (2018) with the same animal. This revealed that the treatments did not cause any challenge to the kidney.

The relatively high but comparable (P>0.05) lean to meat ratio for concrete and zinc housing systems as against other treatments could be explained by more efficient digestion of nutrients (Yusuf *et al*., (2014); Udo*et al*, 2018).

The economic benefit analysis is presented in Table 3. Cost of feed consumed in zinc housing pattern (T_2ZH) was comparable to concrete, mud and bamboo housing patterns. The cost of feed/kg weight gain was lower compared to other treatments which is in direct response with growth performance which shows that it recorded a higher weight gain and least feed conversion ratio (1.22). Cost/kg weight gain can be interpreted as the cost/kg feed that can give a unit weight gain. This implies that the lower the cost/kg weight gain, the superior the treatment. For cost housing unit, zinc housing pattern recorded the highest (₦15175.00) as a result iof the high price incurred in purchasing zinc and wood. However, zinc housing pattern recorded the least cost (₦281.25)in output/unit cost of housing implying that zinc housing pattern encourages better growth performance with least cost of production.

TABLE 1: Growth Performance of West African dwarf goats under five housing patterns

Parameters	T_1 (CH)	T_2(ZH)	T_3(MH)	T_4(BH)	T_5(TH)	SEM
Initial weight(kg)	8.62^{b}	10.00^{a}	10.13^{a}	10.25^{a}	9.75^{a}	0.29
Final weight (kg)	9.68^{b}	11.58^{a}	11.12^{a}	11.63^{a}	11.15^{a}	0.35
Weight gain (kg)	1.05^{b}	1.60^{a}	1.01^{b}	1.37^{ab}	1.39^{ab}	0.11
Daily feed intake (g)	34.73^{ab}	34.95^{a}	34.53^{b}	34.69^{ab}	34.73^{ab}	0.07
Feed intake (kg)	1.94^{ab}	1.96^{a}	1.93^{b}	1.95^{ab}	1.95^{ab}	0.01
Daily weight gain (g)	18.67^{b}	28.57^{a}	18.04^{b}	24.40^{ab}	24.82^{ab}	2.02
F C R	1.86^{a}	1.22^{b}	1.91^{a}	1.42^{ab}	1.41^{ab}	0.14

$^{a-d}$ means in same row with different superscripts are significantly different (P<0.05). SEM: Standard error of mean, T_1 (CH) – Concrete house, T_2 (ZH) – Zinc house, T_3 (MH) – Mud house T_4 (BH) – Bamboo house, T_5 (TH) – Thatch house

TABLE 2: Carcass Characteristics of West African dwarf goats in five housing patterns

Parameter	T_1 (CH)	T_2 (ZH)	T_3 (MH)	T_4 (BH)	T_5(TH)	SEM
Live weight (kg)	8.0	11.0	9.5	11.0	10.0	0.30
Dressed weight (kg)	4.4	5.0	4.6	5.0	4.6	0.18
Dressing percentage (%)	54.38^{a}	45.45^{b}	48.39^{b}	45.45^{b}	45.71^{b}	1.79
Cut parts						
Loin	7.18^{c}	13.82^{a}	8.15^{b}	8.51^{b}	8.18^{b}	1.18
Left half	28.16^{c}	33.80^{a}	31.5^{b}	34.04^{b}	32.01^{b}	1.06
Set	6.92^{c}	9.02^{b}	7.28^{ab}	9.74^{a}	8.63^{b}	0.53
Thigh	8.33^{b}	8.50^{b}	8.44^{b}	9.01^{a}	8.63^{b}	0.12
Shoulder	7.44^{b}	6.99^{c}	7.61^{b}	8.26^{a}	7.40^{b}	0.21
End	6.35^{c}	7.48^{b}	8.95^{a}	9.77^{a}	9.02^{a}	0.62
Left limb	2.32^{b}	2.88^{b}	2.90^{b}	3.38^{a}	3.21^{a}	0.09
Head	14.43^{c}	17.77^{b}	16.01^{b}	18.74^{a}	15.14^{c}	0.81
Tail	0.28^{b}	0.37^{b}	0.40^{a}	0.43^{a}	0.08^{c}	0.06
Kidney	0.44^{a}	0.33^{a}	0.30^{b}	0.35^{a}	0.32^{b}	0.02
Lungs	1.17^{b}	1.14^{b}	1.57^{a}	1.47^{a}	1.06^{c}	0.10
Liver	0.06^{b}	0.07^{a}	0.09^{a}	0.07^{a}	0.06^{b}	0.01
Lean to bone ratio	4.09^{a}	3.68^{a}	3.62^{b}	3.12^{c}	3.49^{b}	0.16

$^{a-d}$Means in same row with different superscripts are significantly (P<0.05) different. SEM: Standard error of mean, T_1 (CH) – Concrete house, T_2 (ZH) – Zinc house, T_3 (MH) – Mud house, T_4 (BH) – Bamboo house, T_5 (TH) – Thatch house

TABLE 3: Economic benefits of West African dwarf goats in five housing patterns

Parameters (₦)	T_1 (CH)	T_2 (ZH)	T_3 (MH)	T_4 (BH)	T_5 (TH)	SEM
Cost/kg of feed	3.85	3.85	3.85	3.85	3.85	0.00.
Cost of feed consumed	7.47^{ab}	7.55^{a}	7.43^{a}	7.47^{ab}	7.51^{b}	1.58
Cost/ kg weight gain	7.11^{ab}	4.71^{bc}	7.36^{a}	5.45^{b}	5.40^{b}	2.24
Cost / housing unit	14300.00^{ab}	15175.00^{a}	2662.50^{b}	2025.00^{c}	2312.50^{bc}	27604.52
Total feed cost	28.76	29.07	28.61	28.91	28.91	0.08
Cost of housing/goat/year	297.92^{ab}	316.15^{a}	55.47^{b}	42.19^{d}	48.18^{c}	63.40
Output/unitcost housing	428.57^{ab}	281.25^{c}	445.54^{a}	328.47^{b}	323.74^{b}	32.03

$^{a-d}$ means on the same row with different superscripts are significantly (P<0.05) different. SEM: Standard error of mean, T_1 (CH) – Concrete house, T_2 (ZH) – Zinc house, T_3 (MH) – Mud house, T_4 (BH) – Bamboo house, T_5 (TH) – Thatch house

CONCLUSION

The results of this study indicate that managing WAD goat in zinc housing pattern would significantly improved their growth performance, carcass characteristics and meat production. Nevertheless, further study should be carried out to investigate other forms of housing patterns that can improve goat production.

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