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Thermoregulatory and growth performance of weaner rabbits fed diets supplemented with brewers dried grain

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***Target Audience:** Researchers, Nutritionists, Farmers,*

Abstract

An experiment was carried out to determine the thermoregulatory parameters and growth performance of weaner rabbits fed diets supplemented with brewers dried grain (BDG). A total of 20 weaner rabbits were used for the study with different inclusion levels (0%, 10%, 15%, and 20%) of BDG. The rabbits were randomly allotted to four treatment groups with five replicates for each treatment (1 rabbit per replicate). T1 was the control diet with 0% BDG inclusion, T2 had 10% inclusion, T3 had 15% and T4 had 20% BDG inclusion. Thermoregulatory parameters; rectal temperature, ear temperature, skin temperature, heart rate, and respiratory rate were measured weekly, initial weight was recorded, weight gain was recorded weekly and feed intake was measured daily. The result of the thermoregulatory parameters showed significant difference in rectal and ear temperatures; the lowest rectal and ear temperatures were recorded in rabbits on T1 (39^0C and 38.05^0C), followed by T2 (38.83^0C and 37.98^0C), T3 (39^0C and 38.05^0C), and T4 (39.83^0C and 38.63^0C). No significant difference was recorded for heart rate, respiratory rate and skin temperature. The result of the experiment showed that the control treatment had the best performance in terms of thermoregulation. Significant differences were ($p<0.05$) observed in the total weight gain, rabbits on T1 had the highest value (660.0g), followed by those on T3 (545.0g), T4 (505.0g) and T2 (450.0g). There was no significant difference ($p<0.05$) observed in the weight gain per day, mortality, total feed intake and feed intake per day across treatments. However, T3 (30% inclusion) showed a very plausible performance after T1 both in terms of growth performance and thermoregulation. T4 and T2 gave a good performance, though not as strong as T1 and T3. The experiment showed that brewers dried grain (BGD) could be successfully incorporated in rabbit feed to obtain a favorable performance while maintaining a normal body temperature.

***Keywords**: Rabbit, Thermoregulation, Growth Performance, Brewers Dried Grain,*

Description of Problem

The variability and extremity of climate in tropical regions has made livestock production in developing countries vulnerable (1, 2 and 3). This worsens the existing factors affecting livestock production, resulting in shortage of animal protein supply in the tropical region (4and 5). Most critical factors affecting livestock production such as water and feed availability, reproduction and health are also influenced by temperature (6). High temperature coupled with pro-oxidants can lead to heat and oxidative stress (7). There are temperature ranges unique to different livestock species in which their body physiology works optimally (known as the thermal comfort zone). When temperature exceeds the upper critical level of the range, the animal begins to suffer heat stress.

Rabbits are homeothermic (capable of maintaining constant body temperature), regulating their body temperature using physiological, morphological and behavioral means (8 and 9). However, imbalances in the body temperature of rabbits can be induced by exposure to high ambient temperatures (10). Under heat stressed conditions, rabbits are forced to acclimatize which results in reduced feed intake, feed utilization and water intake and water metabolism; intake energy, protein and mineral imbalances which alters physiological functions such as reproductive and productive efficiency as well as a change in respiratory rate (6 and 9). Feed intake and digestibility have been shown to reduce with increase environmental conditions (11)

Dietary fibre constitutes low energy and has been used to reduce the negative consequences of heat stress; it is necessary in rabbit diet for normal functioning of the digestive tract. Rabbits require about 9% crude fibre for normal growth and to reduce the incidence of diarrhoea and gastric enteritis (12). It has been shown that failure to meet the dietary need of livestock during heat stress negatively affects metabolic and digestive functions (6).

Agro-industrial by-products especially from the processing of plant materials such as brewers dried grain, cassava peel, orange pulp, rice bran, maize bran, and palm kernel cake can be used as livestock feeds (12 and 13). They are relatively high in crude fibre. Brewer's dried grain (BDG) is a by-product of the brewery industry which is available and not required for man's consumption. It is readily available and cheap but difficult to dry due to its high moisture content which makes its storage and use difficult. The proximate composition of BDG varies in nutritional value and composition depending on the brewery that produced it, grain used, industrial process (temperature, fermentation, etc.), and the method of preservation (14). In general, BDG contains about 19-25% crude protein, 10-22% crude fibre, metabolizable energy of 7.38MJ/kg and gross energy of 3030-3170 Kcal/kg (15).

The study was carried out to determine the effect of BDG supplementation on the performance of weaner rabbits and its ameliorating effect on heat stress, thermoregulatory under sub-humid environment.

Materials and Methods

Experimental site

The study was carried out at the National Animal Production Research Institute (NAPRI), located in Shika, Zaria, Kaduna State, Nigeria. Shika is geographically situated on latitude 11^0 12'42''N of the equator and longitude 7^0 33'14''E with an altitude of 691m above sea level. The area falls within the Northern Guinea Savannah zone of Nigeria having an average rainfall of 1100mm, which starts from April to September. The mean maximum temperature varies from 19^0C to 38^0C depending on season (16).

Experimental animals and management

Twenty weaner rabbits, 6-8 weeks old, were obtained from National Animal Production Research Institute (NAPRI), Shika. Mixed breeds of rabbits were used: chinchilla, dutch, new Zealand white, and California white. The rabbits were randomly allotted to 4 treatments with 5 replicates per treatment (one rabbit to a replicate). Treatments were according to the level of BDG inclusion with T1 as the control diet, T2 with 10% BDG dietary inclusion, T3 with 15% BDG inclusion and T4 with 20% BDG.

All equipment and housing facilities were thoroughly cleaned and disinfected before the rabbits were introduced to the

environment. The rabbits were individually placed in metal wire cages measuring 120 x 50 x 60 cm and 75cm above the ground. 100g of experimental feed and 400ml of water were provided every morning in earthen pots. No anti-stress medications were administered, although the rabbits were treated with coccidiostat, ivermectin and antibiotics at the beginning of the 8-weeks experiment. This experiment did not take into account the breed differences.

Proximate composition

BDG sample was analyzed according to the methods described by (17).

Table 1: Proximate composition of brewers dried grains

Parameters	Percentage
Dry matter	87.74
Crude protein	22.50
Crude fibre	10.61
Ether Extract	3.69
Nitrogen Free Extract	45.20
Ash	5.74

Data collection

Thermoregulatory and growth performances were monitored as well as feed and water intake of the rabbits. Experimental feeds and fresh water were given to the animals every morning, and leftovers were collected and measured 24 hours after the feeds were given (the next morning) using a weighing scale and a measuring cylinder, respectively. Daily feed intake was calculated by deducting the amount of leftover feed from the amount of feed given. This was done repeatedly daily over the 56 days experimental period. The experimental animals were weighed once a week using a weighing scale to monitor their weight gain and growth performance. Two rabbits were randomly selected from each treatment and their thermoregulatory indices were observed/measured as follows: the heart rate was taken with the aid of a stethoscope placed at the right side of the rabbit's chest, measured in heart beats per minute; it was taken once a week. Digital thermometer was used to measure skin, ear and rectal temperatures; it was taken once a week at 9:00am. Respiratory rate was taken by observing the respiratory movement of the nose/ abdomen, measured in cycles per minute; taken once a week.

Feed composition

The feeds were milled and mixed at the National Animal Production Research Institute feed mill. The composition of the feeds is shown in table 2 below.

Statistical analysis and modelling

Data for thermoregulatory parameters, feed intake and growth parameters were analysed using the analysis of variance (ANOVA) of (18), significant means were compared using Duncan Multiple Range Test.

Model for thermoregulatory parameters and growth parameters is as follows:

$y_{ij} = \mu + A_i + e_{ij}$

where:

y_{ij}= the j^{th}observation in the i^{th}BDG levels

μ= overall mean

A_i= fixed effect of BDG levels (T1,T2,T3,T4)

e_{ij}= random error (all error terms were assumed to be random, normally distributed and independent with expectation equal to zero)

Table 2: Gross Feed Composition

Ingredients	0% BDG	20% BDG	30% BDG	40% BDG
Maize	45.00	36.50	32.25	28.00
BDG	0%	11.34	17.01	22.68
Groundnut cake	35.00	35.00	35.00	35.00
Maize offal	15.00	12.16	10.74	9.32
Bone meal	2.55	2.55	2.55	2.55
Limestone	0.5	0.5	0.5	0.5
Common salt	0.25	0.25	0.25	0.25
Vitamin/Mineral premix	0.25	0.25	0.25	0.25
Lysine	0.77	0.77	0.77	0.77
Methionine	0.68	0.68	0.68	0.68
Total	100	100	100	100
Calculated values				
%CP	22.16	23.61	24.84	25.07
ME:Kcal/kg	2781.15	2617.82	2656.15	2614.48
EE%	4.41	4.78	4.96	5.15
CF%	4.67	5.54	5.98	6.42
Ca%	0.93	0.96	0.97	0.99
Available P %	0.47	0.48	0.49	0.49
Ca: P ratio	1.99	1.99	1.99	1.99
Lysine%	1.42	1.49	1.53	1.56
Met + Lys	1.21	1.29	1.33	1.37

BDG= Brewers Dried Grain, CP=crude protein, EE=ether extract, CF=crude fibre, Ca=Calcium, Met=methionine, Lys=Lysine, P=phosphorus, ME=metabolizable energy.

Results and Discussion

The result for thermoregulatory parameters is as presented in table 3. The highest value for rectal temperature was recorded in T4 (39.38^0C), which is statistically similar ($p<0.05$) to T3 (39.0^0C) inclusion. Treatment 2 (38.83^0C) was statistically the same ($p<0.05$) with T1 (38.70^0C) and T3 (39.0^0C). The highest value for Ear temperature was recorded in T4 (38.63^0C), which was statistically similar ($p<0.05$) to T3 and T2 with mean values of 39.25^0C and 39.15^0C respectively. The lowest value recorded was in T1 (37.63^0C), and it was statistically similar ($p<0.05$) to T3 (39.25^0C) and T2 (39.15^0C).

The body temperatures obtained fall within the range of normal body temperature for rabbits (19).The values obtained from heart rate, respiratory rate and skin temperature were not significantly different. Heat production is the result of the heat produced due to energy utilization associated with digestion processes and the absorption of nutrients. These processes are part of the increment caused by feed consumption (20). Kits grow faster at higher temperatures than at lower temperatures; at lower temperatures more energy needs to be devoted to heat regulation. However, kits born with large litter require less energy for thermoregulation due to their huddling behavior (21).

Some physiological parameters of domestic rabbits have been influenced by ambient temperatures as well as direct and indirect influence on feed intake, reproduction and production performance (22).

The pulse rate and respiratory rates were

seen to be higher in T1 (130.25 beat/min, 140.75 breath/min) and T4 (130.50beat/min, 140.50breath/min), and lower in T2 (127.25beat/min, 138.50breath/min), and T3 (129.25beat/min, 139.75breath/min). Coarse diets may allow more water to be absorbed from the gastro intestinal tract compared to fine diets. If more water is available from metabolism, heat loss via evaporation of moisture during panting may be facilitated. Panting as a method of cooling down increases the metabolic rate of the rabbits, this can be expressed as an increase in heart rate and respiratory rate. Lower values of these parameters could suggest an impact of feed on heat regulation. According to (23), under moderate and severe heat stress birds minimize heat production through the evaporation of water from respiratory tract (panting), this process requires considerable energy expenditure. Birds respond by reducing their metabolizable energy (ME) and feed intake to reduce thermogenesis.

Table 4 shows the growth performance of weaners rabbit fed varying levels of brewers dried grain. The highest value for final weight was recorded on rabbits fed, control diet (2285g), which is statistically similar ($p<0.05$) to T3 (2050g). Treatment 4 (1975g), was statistically ($p<0.05$) the same with T2 (1950g) and statistically similar to T3. The highest value for total weight gain was recorded on rabbits fed, control diet (660g), which was statistically the same ($p<0.05$) with T3 and T4 with mean values of 545g and 505g respectively, while the lowest value for total weight gain was recorded on rabbits fed T2 (450g).

The result showed that there was no significant difference ($P>0.05$) in weight gain/day, mortality, total feed intake and Feed intake/day. This showed that inclusion of brewers dried grain did not influence feed consumption in rabbits. This is contrary to the results of (24), who reported that an increase in crude fibre would result in increased voluntary feed intake for growing rabbits. (25) reported that the use of increasing levels of brewers dried grain as a replacement for soybean had no effect on the feed intake, weight gain and feed conversion ratio of experimental animals (up to 28% inclusion level). The highest average daily weight gain was recorded in T1 which also had the lowest average daily feed intake. Animals fed on T3 had the most efficient weight gain amongst the BDG substituted diets, second to animals on T1. This agreed with the work of (26) who recorded the control treatment (having 0% BDG inclusion level), as the most efficient treatment with the highest average weekly weight gain and the lowest average weekly feed intake.

There was an increase in the daily feed intake values recorded with increasing level of BDG. This is opposite to what was observed in daily weight gain values; this could mean a decrease in feed conversion efficiency with increasing levels of BDG inclusion. The result agreed with the report of (27), that BDG contains high concentration of non-starch polysaccharides and some tannins which have been shown to interfere with efficiency of feed utilization in monogastrics, and inhibits the absorption of essential nutrients. It also inhibits digestive enzymes in-vitro and in-vivo, hence, decreases feed utilization (28). This result was in line with the reports of (29) that feed intake increased with increasing level of crude fibre in the diet of weaner rabbits. It was also reported by (30) that there was increase in feed intake when varying levels of BDG was fed to broilers chick. This result was in contrast with the report of (31) who reported that feed intake decreased with increasing level of BDG when Brewers dried grains was fed to swine.

Table 3: Thermoregulatory parameters of weaner rabbits fed varying levels of brewers' dry grain

Parameters	T1	T2	T3	T4	SEM	LOS	P-value
PR (beat/min)	130.25	127.25	129.25	130.50	3.25	NS	0.8899
RR (breath/mim)	140.75	138.50	139.75	140.50	1.64	NS	0.7703
RT (^{0}C)	38.70^b	38.83^b	39.00^{ab}	39.38^a	0.11	*	0.6051
ST (^{0}C)	38.75	39.15	39.25	39.10	0.21	NS	0.3802
ET (^{0}C)	37.63^b	37.98^{ab}	38.05^{ab}	38.63^a	0.19	*	0.0193

PR= Pulse rate, RR= Respiratory rate, RT= Rectal temperature, ST= Skin temperature, ET= Ear temperature SEM= Standard Error of Mean, LOS= Level Of Significance. ^{ab} mean value within row carrying different superscript differ significantly.

Table 4: Growth performance of weaner rabbits fed varying levels of brewers' dry grain

Parameters	T1	T2	T3	T4	SEM	LOS
Initial weight(g)	1625.00	1500.00	1505.00	1465.00	65.38	NS
Final weight(g)	2285.00^a	1950.00^b	2050.00^{ab}	1975.00^b	92.22	*
Total weight gain(g)	660.00^a	450.00^b	545.00^a	505.00^a	69.09	*
Weight gain/day	10.02	8.04	9.73	9.02	1.24	NS
Mortality	0.10	0.10	0.10	0.20	0.11	NS
Total feed intake	4519.00	4834.50	4934.50	4889.50	3.30	NS
Feed intake/day (g/d)	80.66	86.32	88.11	89.11	3.30	NS

SEM= Standard Error of Mean, LOS= Level of Significance. ^{ab} mean value within row carrying different superscript differ significantly.

Conclusion and Applications

1. It can be concluded from the results of this study, that the control diet (0% BDG inclusion) performed better than the experimental diet in both thermoregulatory parameters and growth performance.
2. Thermoregulatory parameters recorded were within the normal range for apparently healthy rabbit body.
3. Brewers dried grain can be included in the diet of rabbits up to 15% without affecting intake.

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