Nigerian J. Anim. Sci. 2018, 20 (1): 163-172

Comparative effect of honey, orange juice, glucose and milk as water additives on performance and carcass qualities of broiler chickens

Ugwuene, M. C., Onunkwo, D. N., Eze, J. C. R. and Okpechi, F. C.

Department of Animal Nutrition and Forage Science, College of Animal Science and Animal Production, Michael Okpara University of Agriculture, Umudike. P.M.B. 7267, Umuahia, Abia State, Nigeria.

Corresponding Author: *donunkwo1@gmail.com*

Target Audience: Poultry Farmers, Additive Manufacturers, Processors, Researchers

Abstract

A fifty-six day experiment was carried out to determine the effect of using honey, orange juice, glucose and milk as water additives on the performance and carcass qualities of broiler chickens. Water alone served as treatment 1 (control) while 100ml of honey, orange juice, glucose and milk each served as treatments 2, 3, 4 and 5 respectively in a completely randomized design. The treatments were replicated thrice during the eight weeks of the experiment. The final weight, and feed conversion ratio improved significantly ($P<0.05$) in T_5. The final weights of T_2-T_4 were similar ($P>0.05$) but T_5 is significantly ($P<0.05$) greater than T_1. The FCR of T_1-T_5 were similar ($P>0.05$). T_3 and T_4 were similar ($P>0.05$) while T_5 is significantly better than T_3. Feed intake was higher ($P>0.05$) in T_3 and T_4 and lowest in T_1. The water/additive intake of birds given T_4 was significantly higher ($P<0.05$) than those on T_1, T_2, T_3 and T_5. The carcass weight, thigh and drumstick of broiler given T_4 and T_5 were significantly better ($P<0.05$) than other treatments. The breast weight, wing and back of T_1 and T_5 were similar ($P>0.05$). However, T_5 had better breast weight than others while wing and back were significantly better ($P<0.05$) in T_4. The liver of T1-T4 were not significantly different ($P>0.05$) but T_5 is higher than T_3. The heart, proventriculus and intestines of T_4 and T_5 were not significantly different ($P>0.05$) but were better ($P<0.05$) than those of T_1-T_3 which were similar ($P>0.05$). The kidney and lungs in T_2-T_5 were similar ($P>0.05$) but significantly better than T_1. The values of spleen and gizzard were generally not significant ($P>0.05$) in all the treatments. Furthermore, the cost of production, cost/weight gain of birds given orange juice were significantly higher ($P<0.05$) than others. The revenue generated from broilers given milk was significantly higher ($P<0.05$) than those given orange juice but not significantly different ($P>0.05$) from others. Gross margin (profit) of broilers given milk was significantly higher ($P<0.05$) than those given water alone, honey, orange juice and glucose respectively. It is therefore recommended that milk be mixed in the water given to broilers for better growth rate, carcass values and profitability.

Key words: Water additives, honey, glucose, orange juice, milk, water.

Introduction

The issue of global warming occasioned by depletion of atmospheric ozone layer and its attendant high environmental temperature currently pose a great threat to human and livestock especially in the humid tropics which naturally is characterized by high temperature and humidity [1]

High humid tropical environmental temperature which averages about 32^0C tend to adversely affect poultry production by reducing their feed intake, lowering body weight and increasing mortality [2, 3]. Poultry species such as broiler chickens are usually susceptible to heat stress as a result of high ambient temperature due to absence of prominent sweat glands [4, 5]. Success in breeding for high growth rate in broilers has compromised the development of their cardiovascular and respiratory systems, thereby predisposing them to heat-stress [6]. These anatomical cum physiological deficiencies in combination with confined system of rearing birds make it difficult for broiler chickens to withstand heat stress.

During the period of heat stress, broilers make major thermoregulatory adaptations by diverting energy needed for growth and development to thermoregulation, thereby reducing their productivity [7]. Panting by broilers occasioned by increasing in temperature beyond thermo-neutral zone of the birds and changes in their haematological plasma ions and blood metabolites are further physiological attempts by broilers to maintain homeostasis; all tending to divert energy meant for growth [8, 9, 10, 11].

Concerted research efforts are being made to the best management techniques that can be adopted to reduce the effect of heat stress on poultry production. Some of these researches are on the use of ventilators, fans and toggers in the poultry pen, feed and feeding methods, stocking density, vitamin and mineral supplementation and genetic breeding for heat tolerance [12, 13, 14, 15].

Current trend in livestock production is embracing organic agriculture which involves the use of natural materials such as honey etc. rather than synthetic ones. Honey is a carbohydrate-rich syrup produced by bees, primary from floral nectars [16]. Honey is a natural source of vitamin C, a natural anti-oxidant which has been used by man for several purposes especially as an anti-bacteria and ant-diarrhea. Honey can therefore be used to combat the effect of heat stress since it contains high amount of Vit. C. Supplementation of Vit. C in water has been reported to be effective ameliorating heat stress in broiler chicken by improving feed intake, weight gain, and efficiency [17,18]. Honey is also a growth promoter by its antibacterial activities such as low water activity, which inhibits microbial growth and its low pH, a result of the formation of gluconic acid which has antibacterial effect [19].

Orange juice (syrup from orange) is said to have good content of Vit. C (Ascorbic acid). Vit. C which is an active ingredient in orange juice plays a major role in biosynthesis of Corticosterone, a hormone that enhances energy supply during heat stress [20].

The effect of glucose, a hexose monosaccharide in the amelioration of heat stress is not only in improving performance of birds but also in thermo-regulation. Thermoregulation was more effective in birds drinking glucose-water solution than in birds drinking tap water under high ambient temperature [21].

Milk, a nutritious cost efficient source of protein, mineral and vitamin nutrient [22] helps in osmotic regulation of the birds' thermoregulation and control of heat stress.

The use of honey, orange juice, glucose and milk as water additive in this study was a research geared towards finding a solution to the problem of heat stress. This allows for poultry adaptation in the tropical environments.

Materials and Methods

Experimental Location

The experiment was conducted at Poultry Unit of Teaching and Research

Farm of Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria. Umudike lies in the coordinate of 5^0N and 7^0S and on the altitude of 122m above sea level. It is located within the tropical rain forest zone of South Eastern Nigeria. The annual rainfall is about 2180mm with mean relative humidity of 72%. Its monthly environmental tempera-ture ranges from 20-30^{0}C with the month of March having the warmest condition with an average temperature of about 26^{0}C [23].

Experimental Design and Duration

The design of the experiment was Completely Randomized Design (CRD) with water additives as treatments replicated thrice. The study lasted eight (8) weeks during which feed and water were served *ad libitum.*

Treatment Additives and Concentrate Diets

Four additives namely, honey, orange juice, glucose and milk constituted the experimental treatments in this study. The additives were applied through drinking water at a concentration of 100ml/litre of water each (Table 1). Glucose and milk in powdered form were first dissolved in water before their application. The additives were procured from reputable stores at Umuahia, Abia State, Nigeria.

Table 1. Experimental Layout

	Treatments				
Additives/ Water Only	**1**	**2**	**3**	**4**	**5**
Water only	Water only	--	--	--	--
Honey	--	Honey + Water	--	--	--
Orange juice	--	--	Orange juice + water	--	--
Glucose	--	--	--	Glucose + water	--
Milk	--	--	--	--	Milk+ water

Broiler starter and broiler finisher diets (Table 2) were formulated to conform to the nutrient requirement of broiler chicken [24]. The starter diet was given to the birds from week 1-4 while the finisher diet was served to the birds from 5-8 weeks of age.

Table 2. Percentage Composition of Broiler Starter and Finisher Diets

Ingredients	**Starter**	**Finisher**
Maize	48.0	58.0
Soyabean meal	33.0	23.0
Brewers Dry Grain	10.0	10.0
Fish meal	5.0	5.0
Bone meal	3.0	3.0
Salt	0.5	0.5
Vit/Mineral Premix	0.5	0.5
Total	**100**	**100**
Calculated Composition		
CP(%)	21.98	19.02
ME(Kcal/Kg)	2807	2959

Experimental Birds and Manage-ment

A total of one hundred and twenty day-old unsexed broiler chicks of strain Marshal were procured from a reputable hatchery at Owerri, Imo State, Nigeria. The birds were brooded together in an apartment within the experimental pen, for three weeks using kerosene stoves and electric bulbs as brooding devices. Broiler starter diet and water without the treatment additives were given to the birds *ad libitum*. At the end of brooding, birds were randomly allotted into five treatment units in three replicates each. The study lasted for five weeks. During the experiment, birds were given water mixed with the treatment additives whereas broiler finisher diet was fed after one week of feeding starter diets. Routine vitamin, anticocidiostat, antibiotics and vaccines were administered to the birds from brooding till the end of the study.

Table 3. Growth Performance of Broilers Given Different Additives in water as Treatments.

	Treatment					
Parameters	**1**	**2**	**3**	**4**	**5**	**SEM**
Initial weight (g/bird)	670	682.68	620.22	734.42	761.82	0.30
Final weight (g/bird/day)	1720.00^{b}	1753.00^{ab}	1586.70^{b}	1890.00^{ab}	1966.70^{a}	50.17
Feed intake (g/bird/day)	78.61^{b}	83.46^{ab}	93.29^{a}	90.86^{a}	88.61^{ab}	1.04
Weight gain (g,bird/day)	30.00^{ab}	30.58^{ab}	27.62^{b}	33.02^{ab}	34.42^{a}	0.90
Feed conversion Ratio	2.62^{b}	2.73^{b}	3.38^{a}	2.75^{ab}	2.57^{b}	0.11
Water/Additive intake(litre/bird/day)	0.15^{b}	0.16^{b}	0.17^{b}	0.20^{a}	0.18^{ab}	0.07

^{ab}Means in the same row with different superscripts are significantly different (P<0.05).

Table 4. Carcass Cut-parts of Broilers Given Different Additives in Water as Treatments.

	Treatments					
Parameters (%)	**1**	**2**	**3**	**4**	**5**	**SEM**
Carcass weight	68.55^{b}	66.49^{b}	65.38^{b}	78.58^{a}	78.73^{a}	1.82
Breast	23.87^{ab}	22.34^{b}	22.60^{b}	23.66^{b}	26.16^{a}	0.64
Thigh	16.28^{b}	15.85^{b}	15.81^{b}	18.34^{a}	16.57^{a}	0.71
Drumstick	16.83^{b}	13.67^{c}	15.23^{b}	17.47^{a}	18.57^{a}	0.62
Wing	14.39^{ab}	12.94^{b}	16.15^{a}	15.47^{a}	12.19^{b}	0.63
Back	0.15^{b}	0.16^{b}	0.17^{b}	0.20^{a}	0.18^{ab}	0.07

^{abc}Means in the same row with different superscripts are significantly different (P<0.05).

Data Collection

Data were collected on growth performance, carcass cut parts, internal organ proportions and economics of production of the broiler chickens.

Growth performance

The birds were weighed at the start of the experiment after three weeks of brooding to determine initial weights. Feed intake was determined by the difference between the quantity of feed supplied to the birds and the left over at the end of each day. The birds were weighed weekly using table scale and weekly weight gained determined by the difference between the weight at the end of each week and the beginning of the next. Feed Conversion ratio (FCR) was determined by using weight gain to divide the feed consumed. Average daily water intake was determined by difference between water offered and the left over the next day. Mortality was determined by recording the number of birds lost per treatment at the end of the experiment which was used to calculate weeklypercentage morta-lity.

Carcass cut parts

At the end of the experiment, one bird closest to the mean weight from each replicate was weighed (live weighed) and slaughtered by severing the jugular vein to bleed out the birds. Thereafter, the head, neck and shanks as well as the internal organs were removed leaving the carcass. The carcass weight was determined and used to calculate the percentage carcass weight. Individual cut parts (thigh, breast, drumstick, back and wings) was detached from the carcass weighed and used to calculate percentage cut parts.

Internal Organ Proportion

The individual internal organs (liver, heart, lungs, gizzard, kidney and intestine) were separated, weighed and used to calculate the percentage weight of each organ over the live weight of each bird slaughtered and recorded as internal organ proportion of birds.

Economics of Production

Cost of feed was calculated and was used to determine the average cost of feed consumed per bird in each treatment. Cost of each additive consumed via the drinking water was also determined. Cost of production was calculated by adding the average cost of feed consumed per bird to the cost of additives consumed. Cost per weight gain was calculated by using the weight gain to divide cost of production per bird. Revenue accrued per bird was determined by adopting ₦800 as the market price for 1kg live weight of broiler. Gross margin (profit) was calculated by finding the difference between the revenue and cost of production.

Statistical Analysis

Data generated was subjected to analysis of variance (ANOVA) according to the procedures of [25] and where significance occurred means were separated according to Duncan's Multiple Range Test [26].

Table 5. Internal Organ Proportions of Broilers Given Different Additives in Water as Treatments.

	Treatments					
Parameters (%)	**1**	**2**	**3**	**4**	**5**	**SEM**
Live weight (g)	1680.0^{ab}	1712.8^{ab}	1546.5^{b}	1849.0^{ab}	1927.0^{a}	50.31
Liver	2.17^{ab}	1.72^{ab}	1.67^{b}	2.29^{ab}	2.63^{a}	0.13
Heart	0.51^{b}	0.58^{b}	0.46^{b}	0.73^{a}	0.76^{a}	0.04
Kidney	0.53^{b}	0.81^{a}	0.72^{a}	0.89^{a}	0.83^{a}	0.04
Lungs	0.67^{b}	0.78^{ab}	0.78^{ab}	0.81^{a}	0.87^{a}	0.02
Gizzard	2.14	2.54	2.28	2.83	2.88	0.12
Proventriculus	0.45^{b}	0.50^{b}	0.58^{b}	0.71^{a}	0.71^{a}	0.04
Spleen	0.20	0.12	0.18	0.16	0.12	0.24
Intestines (small/large)	5.50^{b}	5.81^{b}	4.36^{b}	8.34^{a}	7.59^{a}	0.44

^{ab}*Means in the same row with different superscripts are significantly different (P<0.05).*

Table 6. Economics of production of Broilers Given Different Additives in Water as Treatments.

	Treatments					
Parameters (%)	**1**	**2**	**3**	**4**	**5**	**SEM**
Cost of feed (₦/g)	0.11	0.11	0.11	0.11	0.11	0.01
Total feed intake (g/bird)	4402.2^{b}	4673.8^{ab}	5224.0^{a}	5088.0^{a}	4961.8^{ab}	1.04
Cost of production (₦/bird)	484.3^{d}	514.2^{c}	574.7^{a}	559.7^{b}	545.8^{b}	70.14
Total weight gain (g/bird)	1680.0^{b}	1712.5^{ab}	1546.5^{b}	1849.0^{ab}	1927.7^{a}	50.17
Cost/weight gain	0.29^{b}	0.30^{b}	0.37^{a}	0.30^{b}	0.28^{b}	0.04
Revenue (₦/bird)	1376.0^{a}b	1402.4^{ab}	1269.4^{b}	1512.0^{ab}	1573.4^{a}	40.13
Gross margin (₦/bird)	891.8^{b}	888.8^{b}	694.8^{c}	952.4^{b}	1027.6a	70.63

^{abcd}*Means in the same row with different superscripts are significantly different (P<0.05) from another.1kg live weight of broiler = ₦800*

Results and Discussion

Growth Performance

Significant differences (P<0.05) existed in the growth parameters as shown in table 3. Final weight of birds given milk, glucose and honey (treatments 5, 4 and 2) were not significantly different (P>0.05) from one another. The final weight of birds given milk is significantly higher (P<0.05) than those given water alone and orange juice. These results could be because milk, glucose and honey are energy giving additives due to their carbohydrate and fat content [16]. These additives could also serve as growth promoters and influence weight gain [17, 19].

There was no significant difference (P>0.05) in the feed intake of birds given treatment 1, 2 and 5, but that of treatments 3 and 4 were significantly higher (P<0.05) than treatment 1 (water only). The numerical values of feed intake of birds given the additives were higher than those on water alone. The additives must have positively influenced the feed intake of birds [18].

There was no significant difference (P>0.05) in the weight gain and feed conversion ratio of birds given treatments 1, 2, 3 and 5. The numerical values of weight gain on birds given treatment 5 (milk and water) was higher than others while the FCR of birds given treatment the least (2.57). This showed that the birds given treatments 5 (milk + water) was most efficient in converting feed to meat. Milk is known to regulate osmotic pressure and control of heat stress [27]. This might have enhanced the feed conversion efficiency and weight gain of the birds. There was no significant difference (P>0.05) in the water intake of birds given treatments 1, 2, 3 and 5. Water intake of birds given treatment 4 (glucose + water) was significantly higher (P<0.05) than that of diets 1, 2 and 3. This result agrees with the findings of [28] who reported that birds given glucose + water solution drank more water than those given water alone. The use of glucose in drinking water reduces the influence of high temperature in growing broiler [28]. The water intake of birds given the treatment was similar to what was reported by [5, 29].

The percentage carcass weight of birds (table 4) given treatments 4 and 5 (glucose and milk respectively) were significantly higher (P<0.05) than others. This result was similar to what was obtained in thigh and drumsticks. However, the breast of broiler treatment 5 (milk + water) was significantly higher (P<0.05) than others.

This result is similar to what was obtained in final weight, weight gain and FCR where birds given glucose and milk performed better than others. This could be due to inherent energy content of glucose and milk [16, 17, 19]. There was no significant difference (P>0.05) in the wings of birds given treatment1 and that of birds on additives, 2 to 5. The back region of broilers given treatment 2 (honey) was significantly higher (P<0.05) than others except that of 5. Birds given glucose and milk did better than treatment 1 (water alone) and others in terms of carcass weight, breast, thigh and drumstick. Since protein content of birds is higher in breast than other cut parts [30], treatment 5 was most preferred, followed by glucose.

With the exception of gizzard and spleen (table 5), significant differences (P<0.05) existed among the other parameters. There was no significant difference (P>0.05) in liver of birds given treatments 1, 2, 3, and 4; while that of treatment 5 was significantly higher (P<0.05) than others. The heart of birds given treatment 4 and 5 (glucose and milk) were significantly higher (P<0.05) than others. The kidney of broilers given treatments 2 to 5 were significantly higher (P<0.05) than treatment 1. This result may imply than more metabolic and excretory activities took place on birds fed additives than those in ordinary water. This seems to agree with the report [28] that more cellular activities occurred in birds given additives than water alone, thereby increasing the size of the internal organs. The lungs of broilers given treatments 4 and 5 were significantly higher (P<0.05) than others with that of treatment 1 (control) being the least. This result is similar to what was obtained in the heart, indicating that more respiratory activities took place in birds given additives than those on water alone. In both the proventriculus and intestine, the value of broilers given treatments 4 and 5 were significantly higher (P<0.05) than others. The numerical values of most of the internal organs of birds given the additives were higher than treatment 1 (control). This could be attributed the increase in metabolic, excretory and respiratory activities due to the additives.

Economics of Production

The cost of production and cost per weight gain (table 6) of broilers given treatment 3 (orange juice) were significantly higher (P<0.05) than others, whereas the cost of production of treatment 1 (water alone) was the least. There was no significant difference (P<0.05) in the cost (₦) per weight gain of birds given treatments 1, 2, 4 and 5. The value of cost (₦) per kg weight gain of broilers given treatment 5 (milk + water) was the least. This means that it is most economical to raise broilers on milk-water solution. The revenue and profit of birds given treatment 5 (milk + water) were higher than others. Since net income per bird is generally considered to be the most accurate index of flock performance [31, 32], it is more profitable to give broilers treatment 5 (milk + water) than others.

Conclusion and Application

1. Growth performance, carcass qualities and economics of production of broilers raised on water additives such as honey, orange juice, glucose and milk were enhanced.
2. The use of milk as water additive in this study was most effective and profitable.

3. Farmers can add milk at the rate of 100ml/litre in water for good performance and profitability of broilers.

References

1. Allen, J. (2008). Chemicals in the Air: Latest Results from NASA's Aura Satellite, ChemMatters, April, 26 (2), pp 15–17.
2. Mushtag, T., Sawar, M., Nawaz, H., Mirza, M. A. and Ahmad, T. (2005). Effect and Interactions of Sodium and Chloride on Broiler Starter Performance one to twenty days under substropical summer condition. *Poultry Science* 84:1716-1722.
3. Ahmad, T. and Sawar, M. (2006). Dietary Electrolyte Balance: Implications in Heat Stress Broilers. A Review. *World's Poultry Science Journal* 62:638-653.
4. Obioha, F. C. (1992). A Guide to Poultry Production in the Tropics. ACENA Publishers, Enugu, Enugu State, Nigeria.
5. Olomu, J. M. (2003). Poultry Production. 1st edn A JACHEM Publication, Benin City, Nigeria. Pp 61-75.
6. Yahav S. and Hurwitz S. (1996) Induction of thermotolerance in male broiler chickens by temperature conditioning at an early age. Poult. Sci. 1996; 75: 402–406.
7. Brake, J. T. (1987). Stress and Modern Poultry Management: Animal Production Highlight. F. Hoffman- La Roche & Co Ltd., 4002 Basle, Switzerland.
8. Shane, S. M. (1988). Factors Influencing Health and Performance of Poultry in Hot Climate. *Poultry Biology* 1:247-269.
9. Altan, O., Altan, A., Oguz, I., PabuAscuoglu, A. and Kanyalioglu, S. (2000[a]). Effects of heat stress on growth, some blood variables and lipid oxidation in broilers exposed to high temperature at an early stage. *British Poultry Science.* 41 (4): 489-493.
10. Borges, S. A., Fischer da Silva, A – V., Ariki, J., Hooge, D. M. and Cummings, K. R. (2003). Dietary Electrolyte Balance for Broiler Chicken Exposed to Thermoneutral or Heat-stress Environment. *Poultry Science* 82:428-435.
11. Moraes, V. M. B., Malheiros, R. D. Bruggeman, V., Colin, A., Tona, K., Van AS, P., Onagbesan, O. M., Buyse, J., Decuypere, E. and Macari, M. (2004). The Effects of Thermal Conditioning During Incubation of Embryo Physiological Parameters and its Relationship to Thermotolerance in Adult Broiler Chickens. *Journal of Thermal Biology.* 29:55-61.
12. Yahav, S. and McMurty, J. P. (2001). Thermotolerance Acquisition in Broiler Chickens at Temperature Conditioning Early in Life- the Effect of Timing and Ambient Temperature. *Poultry Science* 80:1662-1666.
13. Curca, D., Andromie, V., Andromie, I. C. and Pop, A. (2004). The Influence of Feed Supplementation with Ascorbic Acid and Sodium Ascorbate on Broilers, under Thermal Stress. Book of Abstract of XXII Worlds Poultry. Congress WPSA, Istanbul, Turkey, pp 290.
14. Aradas, M.E.C.; Nääs, I.A.; Salgado, D.D. (2005). Comparing the Thermal Environment In Broiler Houses Using Two Bird Densities Under

Tropical Conditions. *Cigr E-Journal*, V.7, P.1-12,

15. Gonzalez-Esquerra, R. and Leeson, S. (2006). Physiological and Metabolic Response of Broiler to Heat-implication for Protein and Amino-Acid Nutrition. World's Poultry Science Journal 62(2): 282-295.
16. White, J. W. (1975). Composi-tion of honey in Crane:. Honey, A Comprehensive Survey. Heinemann: London.
17. Gross, W. B. (1988). Effects of Ascorbic Acid on the Mortality of Leghorn-type Chickens due to over-heating. *Avian Disease*. 32:561-562.
18. Sayed, A. N. and Shoeib, H. (1996). A rapid two weeks evaluation of vitamin C and B-complex and Sodium Chloride for heat stressed broilers. *Assiat Veterinary Medical Journal* 34:37-42.
19. Allen, K.L., Molan, P. C.,Reid, M. (1991). A survey of the antibacterial activity of some New Zealand Honeys. J.Pharm.Pharmacol.43: 817-822.
20. McKeee, J. S. and Harrison, P. C. (1995). Effects of Supplemental Ascorbic Acid on the Performance of Broiler Chickens exposed to Multiplet Concurrent Stressors. *Poultry Science* 7:1772-1785.
21. Teeter, R. G. and Belay, T. (1996). Broiler Management during Acute Heat Stress. *Journal of International Feed Science Technology* 58(1&2): 127-142.
22. Aduku, A. O. (2004). Animal Nutrition in the Tropics. Feeds and Feeding Management, Davcon Computers and Business Bureau, Samaru, Zaria, Kaduna State, Nigeria. Pp 31-59.
23. NRCRI (2000). National Root Crop Research Institute, Umudike, Umuahia, Abia State, Nigeria. Meteorological Station Reading, 2000 series. Pp20.
24. Leeson, S. (2010). Nutrition & Health. Dietary allowances for poultry. *Feedstuffs, September 15, 2010.*
25. Steel, R. C. D. and Torrie, J. N. (1980). Principles and Procedures of Statistical McGraw Hill Book Co. New York. pp65-86.
26. Duncan, D. B. (1955). Multiple Range and Multiple f-test. Biometrics 11:1-2.
27. André G**,** Engel B**,** Berentsen PB**,** Vellinga T. V**,** Lansink A.G**.** (2011). Quantifying the effect of heat stress on daily milk yield and monitoring dynamic changes using an adaptive dynamic model. J Dairy Sci.94(9):4502-4513.
28. Zhou, W. T., M. Fujita, S. Yamamoto, K. Iwasaki, R. Ikawa, H.Oyama, and H. Horikawa (1998). Effects of glucose in drinking water on the changes in whole blood viscosity and plasma os-molality of broiler chickens during high temperature exposure. Poult. Sci. 77:644–647
29. Oluyemi, J. A. and Roberts F. A. (2000). Poultry Production in warm Wet Climates. 1st edition. A JACHEM Publication Benin City, Nigeria. pp61-75.
30. Coelho, M. (1996). Optimum Vitamin Supplementation Needed for Turkey Performance and Profitability. Nutrition and Health Poultry Feedstuffs. May 6, 1996.
31. Ojewola, G. S., Oguike, M. A.,

Akomas, S. C., Likita, T., Onyiro, O. M. and Wokocha, C. (2003). Comparison of the Supplemental Effects of Roxazyme – Genzyme in Palm Kernel Meal and Brewers Dried Grain- Based Diets Fed to Male Turkey Poults. Nigerian Agricultural Journal 34:116-124.