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Performance of broiler chickens fed graded levels of tamarind pulp reared under high environmental temperature

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Target audience:

Abstract

A study was conducted to determine the effect of graded levels of tamarind pulp (Tamarindus indicus) on growth performance at the starter and finisher phase of broiler chicken under high ambient temperature. The study was carried out at the poultry unit of Federal University Gashua Teaching and Research farm, Yobe State. One hundred and eight (108) marshal day old broiler chicks were divided into 4 treatment groups replicated 3 times in a completely randomized design. The test ingredient was fed at 0gTP/L, 30gTP/L, 35g TP/L and 40gTP/L for T1, T2, T3, and T4 respectively in drinking water. Feed and water were provided ad libitum throughout the experimental period. Results showed significant (P<0.05) differences in daily feed intake, daily weight gain, feed conversion ratio and water intake for both starter and finisher phases compared to control treatment. while significantly (p<0.05) higher mortality was recorded in birds fed 0g TP/L The result shows that inclusion level of up to 40gTP/L of tamarind pulp in drinking water will reduce the heat stress and rate of mortality.

Keywords: Growth, Heat stress, Starter and finisher phase, Farmers.

Description of Problem

Poultry production is an important component of Nigeria's livestock sub sector. The enterprise is unique and offers the highest turnover rate and quickest returns to investment outlay in livestock enterprises (1). The major drawback of poultry production in tropical and subtropical countries is high environmental temperature and humidity as it induces a heat stress to the birds by altering its thermoregulatory mechanisms (2). Thermoneutral zone of broilers ranges between 18-22 °C (3), and it is not easy to maintain that temperature in arid and semi-arid zones where ambient temperature varies from 23-28 °C in July - February and reaches up to 38-43 °C in March – June especially in Yobe-North, Nigeria. Heat stress depresses the birds' immunity, feed intake, weight gain, egg production, hatchability of fertile eggs, number of eggs laid and carcass quality, mineral balance, semen quality, and fertility in male birds (4). The issue of controlling stressful conditions and their consequences is becoming a big challenge, that is, combating heat stress remains a major problem of broiler industry in the arid, semi-arid, subtropics and tropic zones, which is even aggravated by the changing climatic

conditions. Vitamins and minerals play a vital role in animal growth and metabolism, as they are essential for many physiological processes (5). During thermal stress, a reduction in levels of vitamins (vitamin C, E, folic acid) and minerals (Zinc, Chromium) in plasma and tissues was observed, which may be associated with reduced food intake and high water consumption in chicken (6). Thus, supplementation of exogenous vitamins and ascorbic acid (vitamin C) is a water soluble and natural antioxidant to protect the animals under heat stressors conditions and also has an activity against oxidation (7).

The development of novel dietary measures such as supplementation of anti-stress agents, vitamins, and minerals may be beneficial in ameliorating heat stress and enhancing optimum performance in broiler chickens. (8). Several strategies have been developed to modify poultry diet in order to reduce heat stress. Vitamin C inclusion in poultry diet is one of the cheapest means of alleviating stress; this is due to its antioxidant properties, neutralizing the free radicals generated during heat stress. One of the most preferred could be accomplished using traditional antioxidants such as vitamin C, Vitamin E, and acetysalicylic acid to attenuate the effects of heat stress on performance of birds (9). Ascorbic acid occurs naturally in many plant parts such as the leaves and fruits. Tamarind *(Tamarindis indicus)* fruit pulp has been found to contain a significant amount of ascorbic acid. (10) reported 0.7-3.0 mg /100g of ascorbic acid in the Tamarind dry fruit pulp. Hence this study was designed to determine the effects of feeding tamarind pulp in ameliorating heat stress in broiler chickens.

MATERIALS AND METHODS

The Study Area

This study was carried out at the poultry unit of Federal University Gashua Teaching and Research Farm, Yobe State. The study area is located between latitude 12.8755° N and longitude 11.0316 $_0$E (11). The area falls within the Sahelian region of West Africa, which is noted for its great climatic and seasonal variations. Annual rainfall ranges from 500-1000 mm. While the ambient temperature varies from 23-28 °C in July - February and reaches up to 38-43 °C in March - June (12). The mean relative humidity ranges from 30-35% with minimum in February-April when it drops to as low as 10% and maximum of about 70% in August (13).

Experimental flock and management

One hundred and eight (108) Marshal day-old broiler chicks obtained from a reputable hatchery were used for the experiment. Before arrival of the birds, the brooder house was cleaned, washed and disinfected, 10% fomaldehyde and allowed to dry properly for a week, afterwards fresh clean dry wood shaving was spread on the floor. The drinkers and feeders were also washed with detergent and disinfectant before sun-drying and other routine management practices was carefully observed. The chicks were brooded together for the first 14 days on deep litter. The chicks were fed a commercial feed that contain 24.09 CP and 2953.30 Kcal for starter and 22.86CP and 3247.34Kcal for the finisher phase. The birds were fed in the morning and evening and water were given *ad-libitum* throughout the experimental period. The chicks were vaccinated with Newcastle disease vaccine (lasota), at first week and Gumboro vaccine at second week, also at the third week, lasota booster was administered and at fourth week, Gumboro vaccine booster was administered.

Source of experimental Materials and its preparation

The tamarind fruits were collected within the Federal University Gashua, and synthetic vitamin C was purchase from Gashua market, Yobe State, Nigeria. Tamarind fruits were collected from Federal University Gashua, sun dried for 72 hours and the pulp was separated from the seed. The tamarind pulp was ground and sieved to produce tamarind powder (TP). Four treatments including 0g TP/L, 30g TP/L, 35g TP/L and 40g TP/L of drinking water representing T1, T2, T3 and T4 respectively were fed *ad-libitum* to the birds throughout the experimental period of 56 days.

Table 1: Ingredient composition (%) of the broiler starter and finisher diets

Ingredients (%)	Starter Phase	Finisher Phase
Sorghum	50	56
Wheat bran.	10	10
Groundnut cake	28	22
Bone meal	3	3
Fish meal	8	8
Salt	0.03	0.03
Methionine	0.03	0.03
Lysine	0.02	0.02
Vit, trace mineral premix	0.02	0.02
Total	**100kg**	**100 kg**
Calculated analysis		
Crude protein	24.09	22.86
Crude fibre	3.33	3.15
Ether extract	3.8	3.7
Phosphorus	1.2	0.94
Calcium	1.6	1.2
Lysine	1.06	1.0
Methionine	0.35	0.36
Metabolizable energy (Kcal/kg)	2953.30	3247.34

*Each kg premix contains Vit. A (10000000 iu), Vit. D6 (2000000 iu), Vit. E (15000 iu), Vit. B (3000mg), Niacin (15000ng),Vit. B6 (3000mg), Vit. B12 (10mg), Vit. K3(2000mg), Biotin (20mg), Folic Acid (500mg), Calcium pantothenate (800mg), Chlorine Chloride (250000mg), Manganese (75000mg), Iron (25000mg), Copper (5000mg), Zinc (70000mg), Selenium (150mg), Iodine (1300mg), Magnesium (100mg),Ethoxyquine (500g),BHT (700g).

Experimental Design

The birds were randomly divided into four treatment groups. Each group was replicated three times with nine (9) birds per replicate in the three blocks in Randomized Complete Block Design

Data Collection

Feed was given daily and the leftover weighed to obtain feed intake by difference. The birds were individually weighed at the beginning of the experiment and weekly, thereafter, weight gain was calculated. At the

end the experiment, one bird was randomly selected from each replicate, starved of feed overnight (6pm-6am), weighed the next morning using a digital weighing balance and slaughtered for carcass analysis. The dressed weight (carcass) and the weight of cut-up parts were expressed as percentages of the live weight.

Data Analysis

All data collected were subjected to the analysis of variance using general linear model (14). Variance for the responses of birds to the diets were performed. Where difference was observed, means were separated using Duncan's Multiple Range Test (9).

RESULTS

Growth performance at starter phase

Table 2 shows the performance of broiler chickens fed tamarind pulp in drinking water at starter phase. The values recorded for this study were range between 62.03 – 71.08g/day, 185.00 – 221.67ml/day, 23.15 – 28.30g/day and 2.51 – 2.68 for feed intake, water intake, weight gain, and feed conversion ratio respectively (Table 2) feed intake and weight gain were significantly ($p<0.05$) higher in birds fed test diets while significantly ($p<0.05$) higher values were recorded in terms of water intake and feed conversion ratio in the control treatment group. This indicated that natural ascorbic acid (Tamarind pulp) fed to birds could effectively improve broiler performance raised under high ambient temperature. This agreed with the work of (15) who reported that high ambient temperature reduced feed consumption and body weight in broiler chicks,

Table 2: Performance of broiler chickens fed tamarind pulp in drinking water at starter phase

Parameters	T1 (0gTP/L)	T2 (30gTP/L)	T3 (35gTP/L)	T4 (40gTP/L)	±SEM
Initial weight(g)	60	59	61 60	1.9	
Final weight (g)	648.20^{b}	750.40^{a}	768,32^{a}	792.40^{a}	43.01
Feed intake (g/day)	62.03^{b}	68.15^{a}	69.59^{a}	71.08^{a}	5.58
Water intake (mL)	221.67^{a}	186.67^{b}	185.00^{b}	188.33^{b}	5.76
Weight gain (g/day)	23.15^{b}	26.80^{a}	27.44^{a}	28.30^{a}	2.67
Feed conversion ratio	2.68^{b}	2.54^{a}	2.53^{a} 2.51^{a}	0.25	

^{abc} = means on the same row with different superscript differs significantly among treatments, NS=not significant SEM: standard error of mean.

Supplementation of ascorbic acid ameliorates heat stress as evidence of increase feed intake and growth rate. The reduced feed intake and growth rate in broiler chickens fed control diet is the first response of the heat stress in broiler chickens; feed consumption is reduced by 50% for every 1^{0}C rise in temperature between 32^{0}C to 38^{0}C (10). but disagreed with the report of (16) who found that there were no significant differences ($p>0.05$) in terms of average daily gain and average daily feed intake in birds exposed to heat stress.

Water intake was found to be significantly ($p<0.05$) higher in birds fed control diet when compared with birds fed

test diets which agreed with the report of (16) who found that water consumption can double or quadruple during periods of high temperature.

Similar trend was observed in term of feed conversion ratio as significantly ($p<0.05$) higher value was recorded in birds fed control diet compared with birds on test material. This agreed with the finding of (16) who reported a significant effect ($p<0.05$) of Vitamin C and E supplements on feed conversion ratio of the chickens with highest feed conversion ratio obtained in chickens that were not fed supplements of Vitamins C and E. The values recorded at the finisher phase ranged from 84.44 – 130.07g/day, 330 – 357.70ml/day, 30.68 – 44.32 g/day, 2.36 – 2.75 and 0 – 5 for feed intake, water intake, weight gain, feed conversion ratio and mortality respectively. Similar trends were followed at the starter phase in which significantly ($p<0.05$) higher daily feed intake and weight gain as well as better feed utilization were found in birds fed test ingredient while significantly ($p<0.05$) higher water intake, feed conversion ratio and mortality were recorded in birds fed control diet. The result revealed that tamarind pulp have beneficial effects in birds raised under high ambient temperature (40 – 43$_0$C). This agreed with the work of (17) who have shown that vitamin C (40–200 ppm) improved growth of broiler chicks exposed to multiple environmental stressors. It was indicated by (18) that chickens under heat stress had a significant lower bodyweight than the control group, which clearly demonstrated the adverse effects of heat stress and also (19) stated that high environmental temperature stimulates the peripheral thermal receptors to transmit suppressive nerve impulse to the appetite center in the hypothalamus causing the decrease in feed consumption. Ascorbic acid at the level of 200 mg/kg in the diet of heat stressed broilers increase weight gain, improve the feed efficiency, nutrients retention (CP, CF, EE, ME) and decreased body temperature (20).

Table 3: Performance of broiler chickens fed tamarind pulp in drinking water at finisher phase

Parameters	T1 (0%)	T2 30gTP/L	T3 35gTP /L	T4 40gTP/L	SEM
Initial weight (g)	802 .24	801.04	801.32	800.06	2.0
Final weight (g)	859.04 ^{b}	1132.04^{a}	1240.96^{a}	1189.44^{a}	108.93
Feed intake (g/day)	84.44^{b}	102.35^{a}	104.61^{a}	108.07^{a}	22.50
Water intake (mL)	357.7^{a}	330.00^{b}	340.00^{b}	336.67^{b}	22.56
Weight gain (g/day)	30.68^{b}	40.43^{a}	44.32^{a}	42.48^{a}	5.00
Feed conversion ratio	2.75^{b}	2.53^{a}	2.36^{a}	2.54^{a}	0.25
Ns Mortality	5^{a}	1^{b}	1b	0.0^{b}	0.1

^{abc} = means on the same row with different superscript differs significantly among treatments, NS=not significant SEM: standard error of mean.

This result disagreed with the works of (21) who reported that there were no significant differences ($p>0.05$) in terms of body weight, average daily gain, average daily feed intake and feed conversion ratio in bird under heat stress from day old to forty two days and also (22) indicated that either alone or in combination, Cr methionine (1,200 μgCr+3) and vitamin C (800 mg vit. C/kg of diet) had no significant effect on final body mass, body mass gain, feed intake, and feed conversion ratio of broilers subjected to heat stress. The result also disagreed with the work of (23) who reported no influence of up to 8% dietary tamarind on feed intake of layers and also disagrees with work of (24) who showed that no significant ($P> 0.05$) difference among treatments group offered an aqueous solution of tamarind pulp in drinking water in terms of daily weight gain and feed conversion ratio.

Significantly ($P<0.05$) higher mortality was recorded in birds fed 0gTP/L (control) and similar result was reported by (25) that increasing the dietary levels of baobab pulp meal led to a decrease in percentage mortality.

Conclusion and Application

The result showed that inclusion of up to 40g/L of tamarind pulp in drinking water increase performance and reduced mortality of broiler chickens raised under high ambient temperature.

REFERENCES

1 Ogundipe, S. O. and Sanni, S. A. (2002). Economics of poultry production in Nigeria. A Training Manual on Poultry production in Nigeria, NAPRI, ABU Zaria Training Workshop 6th September. pp 27 – 45.

2 Ramasamy A., Subramaniyam, S., Marimuthu S., Chandrasakaran, C.V., and Prashanth, D.(2018). Alleviation of heat stress by a polyherbal Formulation, Phytocee : Impact of phamacognosy resource. 10(1): 1-8

3 Charles D.R., (2002): Responses to the thermal environment. In: poultry environment problems, a guide to solutions (Charles, D.A. and Walker, A.W. Eds.), Nottingham University Press, Nottingham, United Kingdom., p.1-16

4 Ayo, J. O., Oladele, S. G. and Fayomi, A (2011) Effects of heat stress on livestock production, a review. Nigerian Veterinary Journal, Vol. I, No 1. Page numbers???

5 Richards J. D., Zhao J., Harrell R. J., Atwell C.A., & Dibner, J.J., (2010): Trace mineral nutrition in poultry and swine. Asian-Australasian Journal of Animal Sciences, 23(11): 1527-1534.

6 Abudabos A. M., Al-Owaimer A. N., Hussein E. O., Ali M. H., (2018): Effect of natural vitamin C on performance and certain haemato-biochemical values in broiler chickens exposed to heat stress. Pakistan Journal of Zoology, Vol …. Nos 3: page???

7 Lin, H., Jiao, H.C., Buyse, J., and Decuypere, E. (2006). Strategies for preventing heat stress in poultry. World's Poultry. Science. Journal. 62, 71–86.64

8 Erwan E, Tomonaga S, Yoshida J,

Nagasawa M, Ogino Y, and Denbow, DM. (2012). Central administration of L- and D- aspartate attenuates stress behaviors by social isolation and CRF in neonatal chicks. Amino Acids.., 43:1969-76

9 Stillborn HL, Harris GC., Bottje, WG., and Waldroup PW.(1988). Ascorbic acid and acetysalicyclic acid (aspirin) in the diet of broilers maintained under heat stress conditions. Poultry Science 67:1183-1187

10 Morton, J.F (2007). Tamarind in Fruits of Warm Climates. Florida Flair Books, Florida

11 Google earth. (2023). http://earth.google.com. Retrieved on 20/06/2023

12 Sunday Tribute (2020),. Archived from the original on 22 February 2013. Retrieved.

13 Ugherughe, P.O., and Ekelodum, P.A. (1986). Pasture and range potentials of Borno state, animal of Borno. Livestock Research for Rural development. 22 (84). 3: 107-192.??? Relevance

14 Statistical Analysis System (2007) Statistical Users Guide, SAS Institute Inc. Cary, North Carolina, USA.

15 Deeb, N. and A. Cahaner, (2001). Genotype–by–environment interaction with broiler of high ambient temperature on dwarf versus normal broilers. Poultry Science., 80: 541–8

16 Criste R. D., Panaite T. D., Tabuc C., Saracila M., Soica C., Olteanu M., (2017): Effect of oregano and rosehip supplements on broiler (14-35 days) performance, carcass and internal organs development and gut health. AgroLife Scientific Journal, 6 (1):2285-5718.

17 Perai A.H, Kermanshahi H, Nassiri H, Zarban A (2013): Effects of supplemental vitamin C and chromium on metabolic and hormonal responses, antioxidant status, and tonic immobility reactions of transported broiler chickens, Biological Trace Elements Research, 157: 224–233.

18 Maisa M. Gharieb and M. K. Moursi (2013). Comparative Efficacy of Different Supplement Used to Reduce Heat Stress and Their Impact on Performance, Immunity and Some Biochemical Parameters in Broilers Chickens Egypt. J. Vet. Sci. Vol. 44, pp. 49 – 67 write journal names in full 65

19 Farina M., Thomas K.h., Acamovic, N. S., Talat N. P., Mussarat H. J., Zafar, H. and Zulifqar, A. (2012) Comparative Efficacy of Different Supplements Used to Reduce Heat Stress in Broilers. Pakistan J. ??Zool., 44 (1), 31-41

20 Jahejo A.R., Rajput N., Tian W.X., Naeem M., Kalhoro D.H., Kaka A., & Jia F.J., (2019) Immunomodulatory and Growth Promoting Effects of Basil (Ocimum basilicum) and Ascorbic Acid in Heat Stressed Broiler Chickens, Pakistan Journal of Zoology, 5 (3): pages

21 Mihaela S, Tatiana P., Cristina T, Cristina S, Arabela U, Tugay A, Rodica D. C. (2020). dietary ascorbic

acid and chromium supplementation for broilers reared under thermoneutral conditions vs. high heat stress Scientific Papers-Animal Science Series: Lucrări Ştiinţifice - Seria Zootehnie, vol. 73 41- 47

22 Perai AH, Kermanshahi H, Nassiri Moghaddam H, Zarban A., 2015: Effects of chromium and chromium+vitamin C combination on metabolic, oxidative, and fear responses of broilers transported under summer conditions. Int J Biometeorol, vol. 59, p. 453–462.????

23 Chowdhurry, S.R., Sarker, D.K., Chowdhurry, S.D., Smith, T.K., Roy, P.K. and Wahid, M.A. (2005). Effects of dietary tamarind on cholesterol metabolism in laying hens. Poultry Science, 84:56- 60.

24 Saleh B, Duwa H, Diarra, SS, Vandi TJ and Abdullahi H.A. (2012). Influence of tamarind pulp on growth and carcass characteristics of broiler chickens. Research. Opinion. Animal. Veterinary. Science., 2(10), 511-514.

25 Stella (2012). Effects of synthetic ascobic acid and baobab fruit pulp meals supplimentation as sources of Ascorbic acid in Layer and Broiler diets during Cool-wet and hot-dry seasons

10 Jacquie, L.B. (2010). Impact of heat stress on poultry production. Poultry science, 3,356–369.??

24 Steel, R. G.D. and Torrie J. H. (1980) Principles and Practice of Statistics: A Biometric Approach. 2nd edition. McGrew–Hill Book Co., Inc. New York??