Productive Performance and Carcass Characteristics of Broiler Chickens Supplied with Tamarind (Tamarindus indica) Pulp Water During Hot Season in Mubi Area, Nigeria

[1]Augustine, C., [1]Sarki, I., Abaya, Y., [1]Mojaba, D.I. [2]Toma, I. and [3]Danladi, Y.

1. Department of Animal Production, Adamawa State University, Mubi
2. Department of Biochemistry, Adamawa State University, Mubi
3. Department of Animal Science, Taraba State University, Jalingo

DOI: https://doi.org/10.56293/IJASR.2024.6101

IJASR 2024
VOLUME 7
ISSUE 5 SEPTEMBER - OCTOBER **ISSN: 2581-7876**

Abstract: Heat stress is one of the major environmental factors affecting the productivity and survival of broiler chickens in the North east region of Nigeria. *Tamarindus indica* (*T. indica*) fruit pulp is an alternative cheaper plant product with the potential to mitigate heat stress in broiler chickens. An experiment was conducted for 21 days to evaluate the effects of *T.indica fruit* pulp solution on the productive performance and carcass characteristics of broiler chickens during heat period (March to April, 2024) in Mubi area of Adamawa State, Nigeria. The experiment consist of five treatments, the first treatment has zero supplementation anti-stress T1 (0 g/L), second treatment has commercial anti-stress T2 (CAS) in water, while treatments three, four and five (T3, T4 and T5) contain clean dried *T. indica* fruit pulp soaked in water for 24 hours at room temperature at concentrations of 10, 20 and 30 g/L, respectively and thereafter sieved to obtained the *T. indica* fruit pulp solution that was supplied to the chickens. A total of 150 four weeks old broiler chickens were randomly allotted to the treatments in a Completely Randomized Design replicated three times with 10 broiler chickens each. The result of productive performance revealed significant variation ($P<0.05$) except for the total and daily feed intake. The highest weight gain and the best feed conversion ratio were recorded in T5 (2250 g) and (2.05) while the worst feed conversion ratio was observed in T1 (3.15). The carcass characteristics were not significantly ($P<0.05$) affected by the treatments except for the wings which indicated higher values in T3 (7.05%), T4 (7.22%) and T5 (7.17%). However, the dressing percentage of the broiler chickens ranged from 76.6 to 78.20%. It was concluded from this study that *T. indica* fruit pulp can be supplemented in drinking water of broiler chickens up to 30 g/L without compromising the productive performance and carcass characteristics of broiler chickens and is therefore the recommended level for combating heat stress in broiler chickens.

Keywords: Performance, Heat stress, tamarind and hot season

INTRODUCTION

The acute shortage of protein intake in Nigeria especially in the North-eastern part of Nigeria can be easily addressed by promoting poultry production. Awodola-Peter *et al.* (2015) further buttressed that poultry production is one of the fastest means of correcting shortage of animal protein supply and consumption in developing regions of the world. This is because of their short generation interval, high rate of reproduction and efficiency of nutrient transformation into high quality protein (Akinpelu *et al.,* 1999). Despite the benefits of poultry to humanity, heat stress as a result of climate change and global warming have adversely affected poultry production in hot climate regions like the North-eastern region of Nigeria.

Heat stress is among the most significant stressors influencing the productivity of poultry causing substantial economic losses in the poultry industry. These economic losses are speculated to increase in the coming years with the rise of global temperature (Abdel-monein *et al.,* 2021). For performance of poultry to be enhanced in hot environments, there is urgent need for scientists to deliberately focus attention on the mitigation of heat stress using cheaper and naturally available anti-heat stress. In this context, Tamarind fruit pulp have the potentials to combat heat stress in poultry. Natural product such as tamarind fruit is rich in minerals and vitamins which confer on it anti-oxidant and anti-stress properties in livestock. Tamarind is a tropical tree that belongs to the legume family which produces pods that dangled from the branches (Komutarin *et al.* 2004). Herbs and their extract have been used in poultry nutrition as antimicrobial, antioxidant, anti-stress and growth promoters (Mara *et al.* 2024). At the

moment, enough studies have not been conducted during hot season to investigate the effect of tamarind fruit pulp solution on the productive performance and carcass characteristics of broiler chickens in Mubi area located in the North eastern region of Nigeria hence, the need to conduct more studies and bridge this information gap.

Materials and Methods

Location of the study area

The study was conducted at the Poultry Unit of the Livestock Teaching and Research Farm, Adamawa State University, Mubi, Nigeria. The area is located between latitude 10^{o} 06^{1} to 10^{o} 29^{1}North of the equator and longitude 13^{0} 07^{1} and 13^{o} 30^{1} East. The dry season of the area commences in early October and lasts up to April, while the wet season begins from May and attains its peak between July and August and declines in September (Adebayo *et al.*, 2020). The minimum and maximum temperatures of the area as at the time of the experiment were 23.5^{o}C and 32.1^{o}C (Adamawa State University Meteorology Station, 2024).

Ethical consideration

Ethical approval with number ADSUIACEC/2024/013 for the use of experimental chickens was obtained from the Animal Welfare and Ethical Committee of the Adamawa State University, Mubi.

Source of tamarind and experimental treatments

Dry tamarind fruit pulps were purchased from local market in Mubi area of Adamawa State, Nigeria. Impurities were properly removed to obtain clean tamarind fruit pulps which were used to constitute tamarind water used for the experiment. The experiment consisted of five treatments. The first treatment (T1) has no supplementation of anti-stress in water, second treatment (T2) has commercial anti-stress (vitamax) supplemented in water, at 10 g /L while treatments three, four and five (T3, T4 and T5) contain clean dried *T. indica* fruit pulps soaked in water at room temperature at concentrations of 10 20 and 30 g per litre for 24 hours. The mixture was sieved to obtain the tamarind solution using a locally improvised sieve.

Determination of daily temperature and relative humidity during the period of study (March to April, 2024)

A digital temperature and relative humidity recorder (HTC-2) model was used to take and record daily temperature and relative humidity of the poultry house at 8 am, 12, 4 and 6 pm, respectively.

Experimental birds and management

One hundred and fifty (150) 4 weeks old broiler chickens were purchased and managed on deep litter system. The birds were fed with measured quantity of commercial broiler finisher diets *adlibitum* and measured quantity of clean experimental drinking water was supplied as well. The chickens were vaccinated second dose against Gumboro disease at the fourth week.

Experimental design

A total of one hundred and fifty (150) broiler chickens were randomly allotted to 5 treatments in a Completely Randomized Design replicated three times with ten (10) broiler chickens per replicate.

Supply of the experimental water to the broiler chickens

The experimental water was supplied to the broiler chickens for five days every week throughout the experimental period from March to April, 2024 which was the hottest part of the season in the study area.

Data Collection

Data were collected on the following parameters:

Feed intake

Daily feed intake was determined by the difference between daily feed offered and daily feed leftover. Total feed intake was obtained by cumulative addition of the daily feed intake.

Weight gain

The chickens were weighed at the beginning of the experiment and subsequently on weekly basis to determine weekly weight gain. Daily weight gain was then obtained by dividing weekly weight gain by seven while the total weight gain was determined by cumulative addition of the daily weight gains.

Feed conversion ratio

Feed conversion ratio was calculated as the ratio of feed intake to weight gain as shown in the formula below:

$$FCR = \frac{\text{Feed intake}}{\text{Weight gain}}$$

Determination of carcass characteristics of broiler chickens supplied with T. *indica* fruit pulp solution during hot season

At the end of the experiment, three (3) broiler chickens were randomly selected from each replicate in each treatment in order to obtain the mean values for each carcass parameter. The chickens were starved of feed overnight but allowed access to the experimental water. The fasted live weights of each individual chicken was recorded. The chickens were slaughtered and bled by severing the jugular vein. They were immersed in hot water at 55^{0}C, defeathered, eviscerated and dressed. The dressed weight and cut-up parts and the organs (heart, lungs, liver, gizzard, kidney, and intestine) were weighed using a sensitive digital scale and expressed as percentage of their live body weights. Dressing percentage (DP) was calculated using the formula below:

$$DP\ (\%) = \frac{\text{Dressed weight (kg)}}{\text{Live weight (kg)}} \times 100$$

Results and Discussion

The results of the average daily house temperature and relative humidity during the period of the study (March to April, 2024) is presented in Table 1. It was observed that the highest temperature was recorded at 12 pm and the lowest recorded at 8 am and 6 pm, respectively. This therefore suggests that the birds are likely to be affected by the heat stress between the hours of 12 to 3 pm. The mean daily temperature during the period of the study is higher than the thermal comfort zone (18 – 25^{o}C) for poultry as reported as by Gicheha *et al.* (2021). This is an indication that the chickens have suffered from heat stress.

Table 1: Mean Temperature and Relative Humidity of the Experimental House at Various Times of the Day during Period of the Study (March to April, 2024)

Time	8am	12pm	4pm	6pm	Mean
Temperature (^{o}C)	31.60	35.87	35.30	32.30	33.77
Relative Humidity (%)	62.00	48.00	44.00	44.00	49.50

The productive performance of the broiler chickens supplied with the experimental water is presented in Table 2. The total feed intake, overall weight gain and feed conversion ratio which are indices of productive performance were significantly affected by the treatments except for the total and daily feed intake. The best productive performance was recorded in T5 (30 g TIP) while the lowest performance was in T1 (0 g TIP). It is very clear that the broiler chickens supplied with 30 g/L of tamarind fruit pulp solution performed even better than the positive control group supplied with commercial anti-stress (vitamax). This showed that tamarind fruit pulp is very effective and can mitigate heat stress in broiler chickens. This finding, is in agreement with the report of Saja *et al.* (2019) who reported better productive performance of broiler chickens supplied with tamarind solution. Iskander *et al.* (2017)

further buttressed that tamarind fruit pulp possess antimicrobial and antioxidant properties which might boost and promote feed conversion efficiency and growth in poultry. Heat stress is known to cause oxidative stress which stimulates the production of reactive oxygen species (ROS) or free radicals that distabilized vital physiological activities that are connected to production function.

Table 2: Production Performance of Broiler Chickens Supplied Tamarind Water during Heat Period

Parameters	T1(0 gTIP)	T2(CAS)	T3(10g TIP)	T4(20gTIP)	T5(30g TIP)	SEM
Initial weight (g)	1200.00	1203.30	1296.70	1206.70	1216.70	63.99^{NS}
Final Weight (g)	2600.00^{d}	2766.70^{cd}	2866.70^{bc}	3033.30^{b}	3366.70^{a}	74.54*
Total weight gain (g)	1340.00^{d}	1563.30^{c}	1570.00^{c}	1860.00^{b}	2250.00^{a}	69.01*
Daily weight gain (g)	63.81^{d}	74.44^{c}	74.76^{c}	88.57^{b}	107.14^{a}	3.15*
Total feed intake (g)	4692.30	4632.00	4633.00	4605.30	4603.70	19.44*
Daily feed intake (g)	223.44	220.57	220.61	219.30	219.22	3.00^{NS}
FCR	3.15^{d}	2.96^{c}	2.95^{c}	2.39^{b}	2.05^{a}	0.09*
Mortality (No.)	3.00	1.00	2.00	0.00	0.00	-

a,b,c,d = Means in the same row with different superscripts are significantly (0.05) different. TIP = Tamarind indica pulp, CMA = Commercial antistress.

Furthermore, it was observed that the group of broiler chickens without supplementation of anti-stress recorded similar feed intake with other treatment groups but exhibited poor feed conversion ratio and weight gain which was majorly attributed to the impact of heat stress. Estevez (2015) explained that heat stress can lead to oxidative stress consequently generating free radicals that cause inhibition of enzyme activities and loss of protein function. It was further supported by Alhenaky *et al.* (2017) that heat stress causes morphological alterations and mucosal damage in the intestine of chickens, these might be the reasons why the broiler chickens in T1(0 gTIP) showed poor productive performance.

The highest mortality was observed in broiler chickens with zero supplementation of anti-stress. The mortalities were mostly recorded between the hours of 1 to 3 pm which is a clear evidence of heat stress. This might be due to the over production of free radicals resulting to serious cellular damage and impaired vital physiological functions such as liver and kidney functions which is connected to the survival of the broiler chickens. This is in agreement with the report of Livingstone (2022) who reported that heat stress can increase mortality rate.

The carcass characteristics of the broiler chickens supplied with the experimental water is summarized in Table 3. The dressing percentage and cut-up parts were not significantly (P>0.05) different. However, the dressing percentage obtained was within the standard dressing percentage (70 -72%) as reported by (Colt, 2020). This therefore suggest that tamarind level of up to 30 g/litre of water did not compromise the carcass yield of the broiler chickens.

Table 3: Carcass Characteristics of Broiler Chickens Supplied Tamarind Water During Hot Period

Parameters	T1(0gTIP)	T2(CAS)	T3(10g TIP)	T4(20gTIP)	T5(30g TIP)	SEM
Fasted life weight	2600.00	2766.70	2800.00	3033.30	3366.70	68.31
Dressed weight	2000.00	2166.70	2166.70	2166.70	2733.30	90.00
DP	76.60	78.31	77.47	78.00	78.20	0.91
***Cut-up parts**						
Neck	3.92	3.85	4.10	4.07	4.33	0.36
Breast	24.80	24.32	26.59	23.96	23.69	1.14
Back	12.17	11.73	12.54	12.27	11.77	0.58

Thigh	12.46	11.23	12.07	11.78	11.37	0.95
Drum stick	9.85	9.99	10.50	9.78	10.13	0.71
Wing	6.50^{b}	6.70^{ab}	7.05^{ab}	7.22^{a}	7.17^{a}	0.19*

a, b = Means in the same row with different superscripts are significantly (0.05) different. TIP = Tamarind indica pulp, CAS = Commercial antistress. *Cut-up parts = expressed as percentage of live body weight and DP = Dressing percentage.

Conclusion

Based on the findings of this investigation, it was concluded that *T. indica* fruit pulp can be supplemented up to 30 g/L of water for mitigating heat stress in broiler chickens without compromising the productive performance and carcass characteristics of broiler chickens.

Acknowledgements

The authors thank the Management of the Tertiary Education Trust Fund (TETFUND) of the Federal Republic of Nigeria for providing the fund used to conduct this experiment. They also appreciate the Management of Adamawa State University, Mubi for proper management and disbursal of the funds to the authors.

References

1. Abdel-Monein, E.A.M., Abdrelrazeq, M.S., Raafat, E.I., Sayed, K. and Paswan, V.K. (2021). Nutritional Manipulation to Combat Heat stress in Poultry. A Comprehensive *Review.https://www.researchgate.net>350*. Retrieved 20th February, 2024
2. Adebayo, A.A., Tukur, A.L and Zemba, A.A. (2020). *Adamawa State in Maps*. Second Edition Paraclete Publishers Pp13.
3. Adamawa State University Meteorology Station (2024). Weather Report of the Department of Geography for the Month of March and April, 2024.
4. Akinpelu, D.A. (1999). Antimicrobial activity of *Vernonia amygdalina* leaves. *Fitoterapia Journal of Medicinal Plants Studies, 70:432-435*.
5. Alhenaky, Abdelgader, A., Abuajamieh, M., Al-fatah, A. (2017). The effects of heat stress on intestinal integrity and salmonella invasion in broiler birds. *Journal of Thermal Biology*, 70:9-14.
6. Awodola-Peters, O., Ajiboye Adesola, A. O. and Longe Oyebiodun, G. (2015). Effects of graded levels of Roselle (*Hibiscus sabdarifta*) levels Calyx extract on performance and carcass characteristics of broiler chickens*, International Journal of Poultry Science,14 (6): 343 – 247*.
7. Colt,W.K. (2020). Understanding poultry yields. Cooperative university of Maine extension publication. *https://extension.unimaine.edu>pub*. Retrieved 5th March, 2023.
8. Estevez, M. (2015). Oxidative damage to poultry: From farm to fork. Poultry *Science*, 94:1368-1378.
9. Gicheba, M.G. (2021). The effects of heat stress on production, reproduction, health in chickens and its dietary amelioration In: Adavances in poultry nutrition research, Amlan Kumar Patra intech open, London. Doi: http://dx.doi.org/10.5772/intechopen.9728.
10. Isakander, I., Setiawan, F., Sasongko, L.D.N. and Adnyana, I.K. (2017). Six month chronic toxicity study of Tamarind pulp (*Tamarindus indica* L.) water extract. *Scientia Pharmaceutica*, 85:do:10.3390/scipharm85010010.
11. Komutarin, T., Azadi, S., Butterworth, L., Kell, A., Chitsombron, B., Shuttajit, M. and Meade, B.L. (2007). Extract of the seed coat of *Tmaridus indica* inhibit oxide production by mourine macrophages in vitro. *Food and Chemical Toxicology*, 42:649-658.
12. Livingstone, M.L., Pokoo-Aikins, A., Frost, T., Laprade, L., Hoang, V., Mogal, B., Philips, C. and Cowleson, A.J. (2022). Effect of heat stress dietary electrolytes and vitamin E and C on growth performance and blood biochemistry of broiler chickens. *Frontier Animal Science*, 3:807267.
13. Saja, T.A and Basil, I. (2019). Effect of adding different level of tamarind pulp to drinking water on the productive performance of broiler. *Biochemical Cellular Archive*, 19(1):1327 – 1331.
14. Mara, H., Verena, S., Ivana, D., Theresa, G., Michaela, F., Verena, A., Stefanie, A., Bettina, S., Clement, R., Bernhard, B.L. and Julian, W. (2024). Identification of oxidative stess-reducing plant extract from a novel extract library comparative analysis of cell free and cell based in vitro assay to qualitate antioxidant activity. *Antioxidants*, 13(3):297. *https://doi.org/10.3390/antiox13030297*.