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PHYSIOLOGICAL RESPONSE OF BROILER CHICKENS TO ACETYLSALICYLIC ACID (ASA) SUPPLEMENTATION IN DRINKING WATER

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ABSTRACT
This study evaluated the effects of Acetylsalicylic Acid (ASA) supplementation in drinking water on the growth performance and physiological responses of broiler chickens raised under tropical conditions. A total of 144 two-week-old broilers were randomly assigned to four treatments (0.00, 1.00, 1.50, and 2.00 g ASA/L of water) in a completely randomized design. Birds were monitored over six weeks for growth parameters (weight gain, feed intake, feed conversion ratio) and physiological indices (cloacal temperature, respiratory rate, and pulse rate). Results revealed that while initial weight and feed intake were not significantly affected (p>0.05), ASA supplementation significantly (p<0.05) improved final weight, daily weight gain, and feed conversion ratio, with the highest performance observed at 2.00 g/L. Physiological responses also improved with increasing ASA levels, as evidenced by reduced cloacal temperature, respiratory rate, and pulse rate, suggesting better thermal regulation and reduced metabolic stress. These findings indicate that ASA supplementation, particularly at 2.00 g/L, enhances broiler performance and welfare under heat stress, making it a viable management strategy in tropical poultry production.

Keywords: Acetylsalicylic Acid, Broiler Chickens, Drinking Water, Physiological Response Supplementation

1.0 INTRODUCTION

Broilers are chickens bred for rapid growth and efficient feed conversion to produce quality meat (Adene and Oguntade, 2006). Typically hybrids of Cornish White, New Hampshire, and White Plymouth Rock, they are globally important for meat production (Agbabiaka *et al*., 2013). Being homeothermic, broilers maintain a stable body temperature (Smith, 2000; Genc, 2005) but are especially vulnerable to heat stress during growth (Abioja, 2010). Their thermo-neutral zone ranges from 18–22°C (Charles, 2002; Villanova & Smith, 2004), and temperatures beyond this cause physiological stress (Chaiyabut, 2004). In tropical climates like Nigeria, where ambient temperatures can reach 25–40°C (Amhakhian, 2009), broilers often experience reduced productivity (Oladele *et al*., 2001). Thermal stress negatively impacts broiler health, growth, and meat quality (Roushdy *et al*., 2018; El-Tarabary, 2016), leading to reduced feed intake, hormonal imbalance, and immune suppression (Mujahid *et al*., 2009; Sahin *et al*., 2005). Due to the high cost of mechanical cooling, dietary strategies offer a practical solution. Acetylsalicylic Acid (ASA or aspirin), a non-steroidal anti-inflammatory drug, improves heat-stressed birds' responses by modulating prostaglandin synthesis and the hypothalamic thermostat (Abdel Fattah, 2006; Wu *et al*., 2016). This study investigates ASA's effects under Nigeria's tropical climate to enhance broiler adaptability and productivity affordably.

2.0 MATERIALS AND METHODS

2.1 Experimental Location

The experiment was conducted at the poultry unit of the Teaching and Research Farm, Department of Animal Production, Prince Abubakar Audu University Anyigba, located in Nigeria's derived savannah zone at latitude 7°30'N and longitude 7°09'E, with an average altitude of 420 meters above sea level. The region experiences a tropical wet and dry climate with an annual rainfall of 1600mm and temperatures ranging from 25°C to 35°C (Aderibigbe *et al*., 2022).

2.2 ASA Inclusion Process

Acetylsalicylic acid (ASA) was purchased from a local pharmacy, while feed was sourced from a commercial outlet. Birds had *ad-libitum* access to feed and water. ASA was incorporated into drinking water at four levels: 0, 0.5, 1.0, and 1.5 grams per liter for treatments T1, T2, T3, and T4, respectively, with T1 serving as the control.

2.3 Experimental Layout and Bird Management

One hundred and forty-four, two-week-old broiler chickens were used in a Completely Randomized Design (CRD), with 36 birds per treatment and 12 birds per replicate. The birds were raised on a deep litter system for six weeks, with ad-libitum feeding and water and standard management practices.

2.4 Performance Data

The birds were weighed at the start and weekly thereafter. Performance metrics collected included weight gain, feed intake, feed conversion ratio (FCR), and mortality.

- **Initial Body Weight:** Recorded at the start of the experiment for each replicate.
- **Weight Gain:** Calculated as the difference between initial and final body weight.
- **Average Daily Weight Gain (g):** Calculated by dividing total weight gain by the number of birds and days.
- **Daily Feed Intake (g):** Determined by subtracting leftover feed from the amount offered.
- **Feed Conversion Ratio (FCR):** Calculated by dividing daily feed intake by daily weight gain.

2.5 Physiological Evaluation

Physiological responses to ASA were measured:

- **Cloacal Temperature:** Measured using a digital thermometer inserted into the bird's vent for one minute.
- **Respiratory Rate:** Determined by counting flank movements for one minute at 6:00 am.
- **Pulse Rate:** Measured with a stethoscope placed under the bird’s wing for one minute.

2.6 Statistical Analysis

Data were analyzed using One-Way ANOVA with SPSS version 16. Significant differences were further analyzed using Fisher's Least Significant Difference.

3.0 RESULTS AND DISCUSSION

3.1 Growth Performance of Broilers Offered Varied Inclusion Levels of ASA

The effect of different inclusion levels of ASA in drinking water on the growth performance of broilers is presented in Table 1. The results indicate that initial weight and daily feed intake were not significantly affected ($p>0.05$) by the treatments, with values ranging from 280.42 g in the 1.00g/L group to 282.25 g in the 2.00 g/L group. However, significant differences ($p<0.05$) were observed in final weight, weight gain, daily weight gain, daily feed intake, and feed conversion ratio (FCR) across treatments. Final weight values ranged from 2925.32 g in the control group (0.00 g/L) to 3556.80 g in the 2.00 g/L group, with the 1.50g/L and 2.00 g/L groups recording significantly higher values compared to the control. Weight gain followed a similar trend, ranging from 2643.71 g in the control group to 3274.57 g in the 2.00 g/L group. Daily weight gain was significantly ($p<0.05$) enhanced with increasing inclusion levels, ranging from 62.94 g in the control group to 77.97 g in the 2.00 g/L group. Similarly, daily feed intake increased slightly, with values ranging from 149.70 g in the control group to 152.03 g in the 2.00 g/L group. The feed conversion ratio (FCR) improved with increasing ASA levels, with the best FCR (1.95) recorded in the 2.00 g/L group, while the control group had the least efficient FCR (2.38). The results of this study demonstrated a clear trend in the growth performance of broilers offered diets with varying inclusion levels of ASA. The final weight of broilers increased with increasing levels of ASA inclusion up to 1.50g/L and

2.00g/L, with the highest final weight observed in the 2.00g/L treatment group (3556.80g). The control group (0.00g/L) had the lowest final weight at 2925.32g. These findings are consistent with previous research by Alagawany *et al.* (2017) and Al-Obaidi *et al.* (2010) who reported increase in growth of broilers with increase inclusion of acetylsalicylic acid in the broiler chicken's drinking water. The improvement in final weight with values obtained ranging from 2473.90 to 2917.33g with moderate ASA inclusion suggests that ASA contains osmoregulatory compounds, which enable the birds combat environmental stress, improve feed intake and nutrient digestion, thereby stimulating growth, and contributing to better health in the broiler chickens (Derakhshanfar *et al.*, 2013). However, there was no significant difference (p>0.05) in final weight between the 1.50g/L and 2.00g/L ASA offered bird. These however are in harmony with findings by Dei (2014), when measuring Egg production response of laying chickens to feather clipping, cool water, and aspirin during hot weather conditions. He further suggested that excessive levels of certain feed additives can lead to saturation, beyond which no further growth benefits are observed. Similarly, weight gain followed the same trend as final weight, with broilers in the 2.00g/L group exhibiting the highest weight gain (3274.57g). The 1.50g/L group also showed substantial weight gain (3146.38g), while the control group recorded the lowest weight gain (2643.71g). The increase in weight gain observed with ASA supplementation is consistent with previous studies by Anwar *et al.* (2014) who measured the effects of ascorbic acid and acetylsalicylic acid supplementation on the performance of broiler chicks exposed to heat stress. Mohammed (2020), however reported increased weight gain values of 1970.88 to 2410.00g for 7weeeks broiler chickens when acetylsalicylic acid (ASA) was added to their drinking water. The daily weight gain of broilers also increased with higher levels of ASA inclusion. The 2.00g/L group exhibited the highest daily weight gain (77.97g), followed by the 1.50g/L group (74.94g), and the control group (62.94g). This further support the hypothesis that ASA supplementation promotes growth by enhancing nutrient digestion and absorption (Alagawany *et al.*, 2017). The observed increase in daily weight gain at moderate inclusion levels is also consistent with findings by Al-Obaidi *et al.* (2010), who reported improvements in daily weight gain from 71.02 in the control to 84.17g in the 1.3g/L aspirin inclusion in the drinking water.

Table 1: Growth performance of broilers offered varied inclusion levels of ASA

Parameters	**0.00g/L**	**1.00g/L**	**1.50g/L**	**2.00g/L**	**SEM**	**LOS**
Initial weight (g)	281.66	280.42	280.76	282.25	1.52	NS
Final weight (g)	2925.32^{c}	3235.78^{b}	3427.13^{a}	3556.80^{a}	75.39	*
Weight gain (g)	2643.71^{c}	2955.36^{b}	3146.38^{a}	3274.57^{a}	75.34	
Daily weight gain (g)	62.94^{c}	70.36^{b}	74.94^{a}	77.97^{a}	1.80	*
Daily feed intake (g)	149.70	149.63	151.95	152.03	2.96	NS
Feed conversion ratio	2.38^{d}	2.13^{c}	2.04^{b}	1.95^{a}	0.04	*

^{abcd} Means with different superscripts along the same row show significant difference at p<0.05, SEM= Standard Error of the Mean. NS not significant.

The FCR, which measures feed efficiency, improved significantly with higher ASA inclusion levels. The 2.00g/L group had the lowest FCR (1.95), suggesting that the birds in this group were more efficient in converting feed into body weight compared to other treatments. This improvement in feed efficiency is a critical finding, as lower FCR values indicate better feed utilization, which is a key factor in enhancing the profitability of poultry farming. Derakhshanfar *et al*. (2013), reported improved feed conversion when broilers were supplemented with, including acetylsalicylic acid with obtain values of 2.71 to 3.01 for the 1.4g/L and the control respectively. The improved FCR observed in this study suggests that ASA supplementation may positively influence the broilers' digestive processes and overall health, leading to more efficient use of the provided feed (Poźniak *et al*., 2023).

3.1.2 Physiological Response of Broilers to Varying Levels of ASA in Drinking Water

The effect of varying levels of Acetylsalicylic Acid (ASA) in drinking water on the physiological response of broilers is presented in Table 2. The results showed that ASA levels significantly influenced ($p<0.05$) the rectal temperature pulse rate and respiratory rate of the broilers. Rectal temperature values significantly decreased with increase in the inclusion level of ASA ranging from 39.44°C to 43.00°C across all treatments. There was a gradual decrease in pulse rate as the ASA concentration increased, with values ranging from 71.48 b/min in the control (0.00g/L) to 70.11 b/min in the group receiving 2.00g/L ASA. Similarly, the respiratory rate showed a steady decline, with values starting at 220.00 b/min in the control group and decreasing to 213.51 b/min in the group receiving the highest ASA concentration (2.00g/L). The rectal temperature of the significantly dropped as ASA inclusion increased. This might be due to the osmoregulating properties of ASA. This is usually done by inhibiting cyclooxygenase (COX) enzymes, which decreases prostaglandin production (Sohail *et al*., 2012). As an anti inflammation and fever reducing agent ASA aids in the alleviation of heat stress by reducing inflammation and improving circulation, helping the broilers better regulate their body temperature (Awoneye *et al*., 2024). Result obtained is in line with reports by Awoneye *et al*. (2021) who reported a significant reduction in cloaca temperature from 41.20ºC to 37.88ºC when ASA as administered to the broiler. However, Rokade *et al*. (2016) reported the ability of ASA to reduce heat stress when broilers were subjected to chronic heat stress, the result revealed significantly lower cloaca temperature from at 42.37ºC to 39.74ºC. Pulse rate was significantly affected ($p<0.05$) by ASA inclusion, with the control group (0.00g/L) having the highest pulse rate of 220.00 beat per minute (b/min), and the 2.00g/L treatment showing the lowest rate (213.51 b/min). This decrease in pulse rate as ASA inclusion increased indicates that the broilers in the higher ASA treatment groups experienced better homeostasis and less stress. This suggests that ASA inclusion may have a calming or stabilizing effect on the cardiovascular system of the birds, possibly due to aspirin helping to lower systemic inflammation and reduces the stress response, which can lead to a decreased heart rate (Kumari and Nath, 2018). This reduction in stress and inflammation can also help improve the overall cardiovascular function, leading to a more stable and lower pulse rate, especially under heat stress conditions (Rokade *et al*., 2016). The reduction in pulse rate with increasing ASA levels might reflect a decrease in physiological stress or an improvement in overall well-being, as a lower pulse rate is often associated with a more relaxed state in poultry (Awoneye *et al*., 2024). Lajoie *et al.* (2021) reported pulse rate reduction from 234.11b/min to 209.00b/min when 0.80g/L acetylsalicylic acid were offered broiler chickens. Similarly, Awoneye *et al*. (2021) reported a reduction from 246.00 to 219.14b/min with the administration of 0 to 2g/L of acetylsalicylic acid. The respiratory rate of the broilers significantly ($p<0.05$) decreased with increasing levels of ASA in the drinking water. The control group had the highest respiration rate of 71.48 beats per minute (b/min), while the respiration rates of the 1.00g/L, 1.50g/L, and 2.00g/L treatments were significantly lower. The respiration rate is closely tied to the bird's metabolic rate and stress levels, and a decrease in respiration rate can indicate a more stable physiological condition (Kumari and Nath 2018).

The reduction in respiration rate observed in this study could be attributed to the stress-reducing effects of ASA, possibly due to its laxative properties and its potential to regulate metabolic functions (Rokade *et al*., 2016). In poultry, an increased respiration rate often reflects physiological stress or higher metabolic demands (Lajoie *et al*., 2021), and the observed decrease in the higher ASA treatments suggests that the broilers were less stressed or experienced lower metabolic stress, likely contributing to improved physiological responses (Awoneye *et al*., 2021).

Table 2: Physiological response of broilers to varying levels of ASA in drinking water

Parameters	0.00g/l	1.00g/L	1.50g/L	2.00g/L	SEM	LOS
Rectal Temperature (°C)	43.00	41.05	40.20	39.44	1.01	NS
Respiratory rate (b/min)	71.48[a]	70.30[b]	70.24[b]	70.11[b]	0.27	*
Pulse rate (b/min)	220.00[a]	219.72[a]	219.07[a]	213.51[b]	1.67	*

[a,b]means with different superscripts along the same row shows significant difference at $p<0.05$, SEM= Standard Error of the Mean. LOS=level of significance, *=Significantly different, NS=Not Significantly Different.

4.0 CONCLUSION AND RECOMMENDATIONS

4.1 Conclusion

Based on the findings from this study, the following conclusions are drawn:

Supplementation of Acetylsalicylic Acid (ASA) in the drinking water of broiler chickens significantly improved growth performance and physiological responses under tropical conditions. The most pronounced improvements were observed at the 2.00 g/L inclusion level, where birds recorded the highest final weight, weight gain, daily weight gain, and the most efficient feed conversion ratio (FCR). These improvements are likely due to ASA's role in alleviating heat stress, enhancing metabolic stability, and supporting better nutrient utilization. Physiologically, ASA supplementation led to a reduction in cloacal temperature, pulse rate, and respiratory rate indicators of reduced thermal and metabolic stress. These responses suggest that ASA helps broilers better adapt to high ambient temperatures by stabilizing internal physiological functions. The absence of adverse effects on feed intake or growth at the highest ASA level indicates its safety and potential for practical use in broiler production systems. Therefore, ASA inclusion in drinking water particularly at 2.00 g/L can be considered a viable strategy for improving broiler productivity in heat-stressed environments.

4.2 Recommendations

Based on the outcome of this research, it is recommended that

Acetylsalicylic Acid (ASA) should be supplemented in broiler drinking water at a concentration of 2.00 g/L to achieve optimal growth performance, improved feed efficiency, and better physiological adaptation to heat stress.

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