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SCICELL

GROWTH PERFORMANCE, CARCASS YIELD, GASTROINTESTINAL INDICATORS AND MEAT QUALITY OF BROILER CHICKENS SUPPLEMENTED VARYING LEVELS OF SIAM WEED (*CHROMOLAENA ODORATA*) EXTRACT IN DRINKING WATER

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ABSTRACT

A total of 150 one-day-old broiler chicks of Arbor acre strain were used to determine the growth performance, carcass yield, gastrointestinal indicators and meat quality of broiler chickens administered varying levels of Siam weed (*Chromolaena odorata*) extract (SWE). After brooding for two weeks, the birds were evenly divided into five treatments after carefully balancing for body weight for a 28-day experimental trial. The five treatments represented a control group (T1: 0 ppm) and four groups of inclusion levels of SWE (T2: 500 ppm T3: 1000 ppm, T4: 1500 ppm and T5: 2000 ppm). Each treatment comprising of 30 chicks had 5 replicates of 6 birds per replicate. On the last day of the study, two birds per replicate were randomly selected, weighed and slaughtered for carcass and breast meat quality analyses. Data obtained were subjected to one-way Analysis of Variance using General Linear Model. Results revealed that feed intake was significantly ($p < 0.05$) highest in birds in the T4 group and lowest in their counterparts in the T2 group. However, the best FCR was recorded in birds in the T2 group. Breast significantly ($P = 0.003$) ranged from 15.31 % in birds in T5 to 24.37 % recorded in birds of the T1 group. Proventriculus values significantly ($P = 0.005$) ranged from 0.41 % in birds of the T5 group to 0.67 % in birds of the T2 group. Furthermore, panellists score for breast meat colour was significantly ($p < 0.05$) higher in the control than meats from birds administered varying SWE levels. Saltiness was ranked significantly ($p < 0.05$) highest in theT4 group, while overall acceptability was significantly ($p < 0.05$) highest in T2 and T4 groups. In conclusion, improved FCR and proventriculus weight, with excellent sensorial acceptability of breast meat of broiler chickens can be achieved via administration of 500 ppm SWE.

Key words: *Chromolaena odorata*; growth performance; gastrointestinal indicators; meat quality; broiler chickens

INTRODUCTION

Sub-therapeutic dosages of antibiotics are known for positively influencing growth and immune response in different poultry species (Lee *et al.*, 2012; Mehdi *et al.*, 2018). Its mechanism of action is mostly due to gastrointestinal infections control and modification of intestinal microbiota (Torok *et al.*, 2011; Singh *et al.*, 2013). In the broiler industry, antibiotic growth promoters (AGPs) have been used to improve meat production via improved feed efficiency and disease prevention (Mehdi *et al.*, 2018; Jha *et al.*, 2019). However, due to the growing public health concerns about the indiscriminate use of AGPs and other synthetic drugs, such as antibiotic-resistant bacteria, drug residues in animal products along with antibiotic-induced environmental

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contamination (Safiyu *et al.*, 2023), the poultry industry is at present reevaluating its nutrition and medication programs to ensure sustainable production of safe and wholesome poultry products as restrictions have been placed on the use of AGPs in several countries (Ajuwon, 2016). As a consequence, phytochemicals derived from medicinal plants have gained significant recognition in the potential management of both food animal and human diseases. Extracts from plants (Dhama *et al.*, 2014; Cimrin *et al.*, 2020), mushrooms (Sogunle *et al.*, 2021), citrus-coconut electrolytes (Safiyu *et al.*, 2023) to mention but a few are prominent alternatives to AGPs that have shown health-related benefits in poultry production.

Siam weed (*Chromolaena odorata*), which belongs to *Asteraceae* family, is a scrambling perennial shrub with straight, pithy and brittle stems, bear three-veined ovate-triangular leaves and with a shallow fibrous root system (Tiamiyu and Okunlade, 2020). Siam weed is referred to as Obiarakara, Osiwumuo, Inini Eliza or Diochie in eastern Nigeria, while it is called Ewe Awolowo in western Nigeria (Jiwuba *et al.*, 2018). *C. odorata* possess distinctive aromatic odour and has been reported to have multipurpose medicinal properties (Akinmutimi and Akufo, 2006; Akinmoladun *et al.*, 2007). Siam weed leaves reduce bleeding considerably, when applied to wounds (Phan *et al.*, 2000), serves as a mosquito repellent, as well as poses antimicrobial and antifungal properties (Moses *et al.*, 2010). It also has anticancer, antidiabetic, anti-hepatotoxic, anti-inflammatory and antioxidant properties (Igwe *et al.*, 2020). Proximate composition of Siam weed leaf meal showed that it has dry matter value of 95.70 %, crude protein of 20.52 %, crude fibre of 5.58 % and ash of 9.29 % (Jiwuba *et al.*, 2018). According to Anyasor *et al.* (2011) and Tiamiyu *et al.* (2019), Siam weed contains reasonable number of bioactive compounds such as alkaloids, flavonoids, phenolics, saponins, steroids and tannins, and these could be the factors responsible for various biological and health benefits ascribed to *C. odorata*. The efficacy of Siam weed feeding on growth and blood constituents of broiler chickens have been reported by previous studies (Jiwuba *et al.*, 2018; Igwe *et al.*, 2020). However, information on the effect of *C. odorata* extract especially on gastrointestinal health and meat attributes of broiler chickens is limited. Based on this background, the growth performance, carcass characteristics, gastrointestinal indicators and meat quality of broiler chickens administered Siam weed (*Chromolaena odorata*) extract were investigated in this study.

MATERIALS AND METHODS

Experimental site

This study was performed in accordance with the recommendations of the Animal Use and Care Committee guidelines of the Federal Republic of Nigeria (C38 LFN 2004). Experimental birds' rearing was carried out in the Poultry Unit of the Teaching and Research Farm of the Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria. The site is located in the tropical rainforest zone of Nigeria on latitude 5° 29' N and longitude 7° 33' E with an elevation of 122 m above sea level, annual rainfall of about 2177 mm a monthly ambient temperature range of 22 – 36 °C and relative humidity of 50 – 95 % depending on the season and location. The slaughtering of selected birds as well as laboratory studies were carried out in the Animal Processing Laboratory of the College of Animal Science and Animal Production of the same institution.

Preparation of Siam weed (*Chromolaena odorata*) extract (SWE)

Fresh leaves from *Chromolaena odorata* plants at the maturing stage were collected from the surroundings of Michael Okpara University of Agriculture, Umudike. The leaves were carefully separated from the stems with approximately 2 kg of these leaves immersed in 8 litres of water and boiled for 15 mins. Afterwards, the resulting mixture was filtered to get the extract. This extract was then stored in PET bottles under appropriate conditions to maintain its stability. It was later administered to the experimental birds following predetermined treatment guidelines.

Experimental animal management

A total of 150 one-day-old broiler chicks of Arbor acre strain procured from a reputable source in Umuahia, Abia State, were brooded for two weeks before being evenly divided into five treatments after carefully balancing for body weight. The five treatments represented a control group (T1: 0 ppm) and four groups of inclusion levels of SWE (T2: 500 ppm T3: 1000 ppm, T4: 1500 ppm and T5: 2000 ppm). Each treatment comprised of 30 chicks had 5 replicates of 6 birds per replicate. The Siam Weed Extract was supplemented via drinking water provided daily for each group of birds at their respective predetermined dosages for 28 days. All experimental birds were fed the same basal diet (Table 1) and water *ad libitum*, and they were

Table 1. Composition (%) of the diet fed to experimental birds

Ingredients	Quantity (%)
Maize	58.60
Soybean meal (48 % CP)	36.10
Vegetable oil	1.65
Bone meal	1.75
Limestone	1.00
Salt (NaCl)	0.35
Lysine	0.10
DL-methionine	0.20
*Vitamin-mineral premix	0.25
Total	100.00
Calculated composition	
Metabolizable energy (kcal/kg)	3036.26
Crude fiber (%)	2.98
Crude protein (%)	20.49
Available P (%)	0.38
Total calcium (%)	0.88
Ether extract (%)	3.43
Total lysine (%)	1.29
Total methionine (%)	0.52

*Vitamins and minerals premix contains vitamin A, 10,000,000 IU; vitamin D3, 2,000,000 IU; vitamin E, 12,500 IU; vitamin K, 1.30 g; vitamin B1, 1.30 g; vitamin B2, 4 g; D-calcium pantothenate, 1.3 g; vitamin B6, 1.3 g; vitamin B12, 0.01 g; nicotinic acid, 15 g; folic acid, 0.05 g; biotin, 0.02 g; copper, 0.05 g; cobalt, 0.20; iron, 25 g; iodine, 0.06 g; manganese, 48 g; selenium, 0.10 g; zinc, 45 g; choline chloride, 200 g; butylated hydroxytoluene, 50 g.

vaccinated against Newcastle disease (on the 5th and 24th day) and infectious bursal disease (on the 10th and 20th day).

Evaluation of growth performance

The birds were weighed at the beginning of the study and subsequently on weekly basis. The initial mean live weights were subtracted from the final mean live weight to determine the weight gained by the birds. Feed offered to birds were measured weekly and residual feed were also measured to evaluate the feed intake. Feed conversion ratio was obtained by dividing feed intake and weight gain.

Evaluation of carcass yield and gastro-intestinal tract development

Two birds per replicate were randomly selected, weighed and slaughtered on the last day of the study via cutting the jugular vein and carotid arteries. Afterward, birds were defeathered and their heads, necks, shanks, feet and viscera were carefully removed. The resulting carcasses were dressed and weighed with the dressing percentages estimated, as enunciated by Safiyu *et al.* (2019). Organs (lungs, heart, liver, empty gizzard, pancreas, thymus, spleen, proventriculus and bursa of Fabricius) were weighed and their values were expressed as a percentage of the live weight. The weights and lengths of intestinal segments were expressed in cm/100 g live weight (Sogunle *et al.*, 2018).

Evaluation of meat quality

Chilling loss (%): Twenty grams (20 g) of meat from the breasts of carcasses from each replicate were placed in an airtight polythene bag, then labelled and placed in a refrigerator at 7 °C for 24 hours. The samples were then weighed again, and chilling loss was determined as a percentage loss of initial weight (Safiyu *et al.*, 2019).

Drip loss (%): This was determined by weighing 20 g of breast meat from each replicate and stored at -20 °C for 24 hours. Thereafter, the samples were thawed until the temperature in the centre of the meats reached 0 °C. The weight of the samples obtained were expressed as percentages of the initial weight (Benli, 2016).

Cooking loss (%): This was determined by collecting 20 g of meat from the breast region of carcasses per replicate. Samples were then placed in an airtight polythene bag, labelled and immediately cooked in a water bath at 70 °C for 15 minutes. Thereafter, meat samples were allowed to cool at room temperature and weight of the samples obtained were expressed as percentages of the initial weight (Safiyu *et al.*, 2019).

Sensory Attributes: A total of 20 untrained panellists evaluated the sensory attributes of cooked breast meats from each replicate, all of whom were college students with ages ranging from 18 to 30 years consisting of 50 % males and 50 % females, as enunciated by Safiyu *et al.* (2020). The panellists were screened and trained accordingly. Cooked breast meat samples from each replicate were cut into small 2 cm³ pieces and given random code numbers for identification. The panellists were instructed to observe and taste meat samples from left to right and to take water between each sample. The serving order of meat samples was also rotated to reduce potential bias caused by positions. Panellists rated sensory attributes using hedonic scales based on a 9-point Likert scale for Colour = 1 (extremely dark) to 9 (extremely light), chewiness (1 = extremely chewy, 9 = extremely crumbly), flavour (1 = extremely bland, 9 = extremely tasty), oiliness (1 = extremely dry, 9 = extremely oily), Saltiness = 1 (extremely tasteless) to 9 (extremely salty) and overall acceptability (1 = dislike extremely, 9 = like extremely).

Statistical analysis

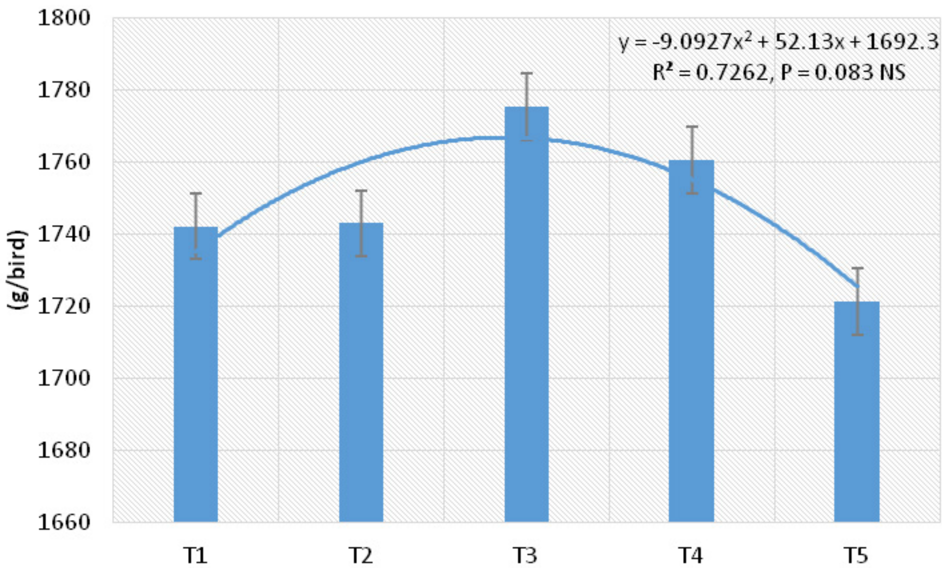
Data obtained in this study were subjected to one-way Analysis of Variance using General Linear Model, as contained in the Minitab® software (version 21.1.0) at 5 % significance level. Significant differences among treatment means were determined using Tukey test of the same software. The responses in final weights (FW), feed intake (FI), weight gain (WG) and feed conversion ratio (FCR) of broilers to the varying SWE levels used in this study were modelled using the quadratic model: $Y = a + b_1x + b_2x^2$, where:
Y = FW, FI, WG, and FCR; a = intercept; b_1 and b_2 = coefficient of the quadratic equation; x = SWE levels.

Data for sensory meat quality were illustrated using a radar chart.

RESULTS AND DISCUSSION

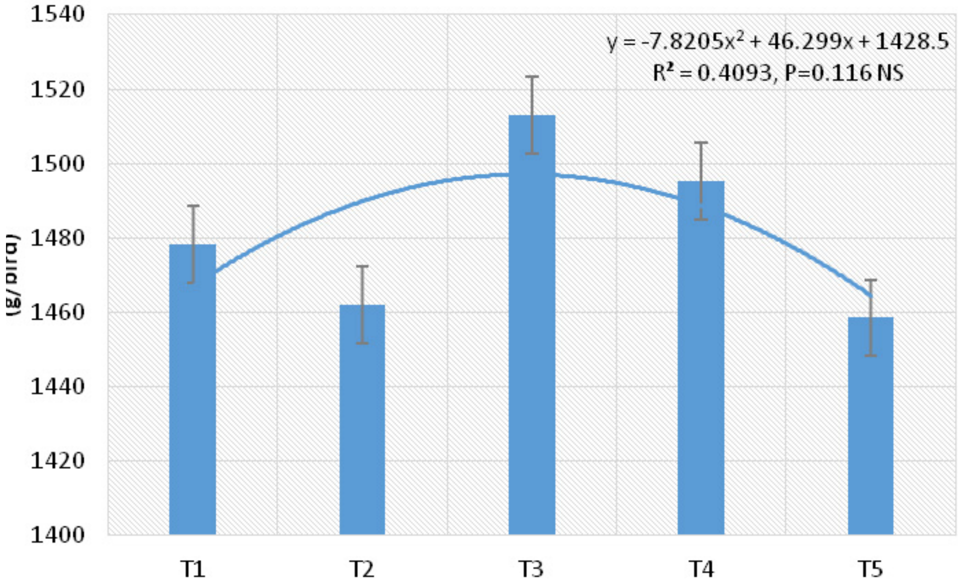
Effect of Siam weed (*Chromolaena odorata*) extract on growth performance of broiler chickens

The final weights (Figure 1) and weight gains (Figure 2) were not significantly (p > 0.05) different across treatments. This implies that SWE has good potential



T1: control, T2: 500 ppm of SWE, T3: 1000 ppm of SWE, T4: 1500 ppm of SWE, T5: 2000 ppm of SWE, R^2: regression coefficient, P: probability, NS: not significant

Figure 1. Final weight (g/day) of broilers administered Siam weed (*Chromolaena odorata*) extract



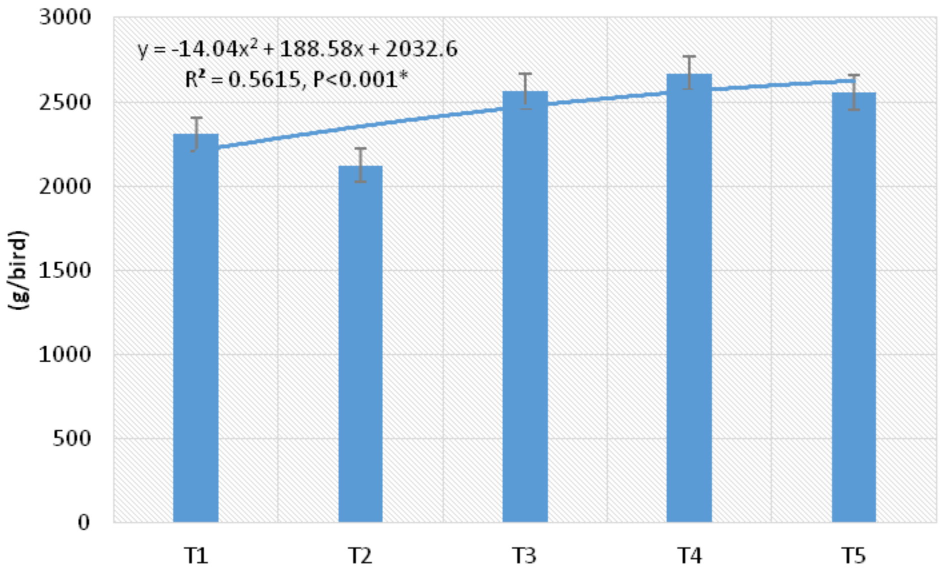
T1: control, T2: 500 ppm of SWE, T3: 1000 ppm of SWE, T4: 1500 ppm of SWE,
T5: 2000 ppm of SWE, R^2: regression coefficient, P: probability, NS: not significant

Figure 2. Weight gain (g/day) of broilers administered Siam weed (*Chromolaena odorata*) extract

for broiler nutrition as the different dosages, used in this study, were not detrimental to the body weights of broiler chickens. This observation is in accordance with findings of Bamikole *et al.* (2004), where weight gains were not significantly different in *Chromolaena odorata* leaf meal diets. Contrarily, Jiwuba *et al.* (2018) reported significantly higher final live weights in birds fed diets 0 and 4 % of Siam weed leaf meal, than those fed diets 8 and 12 % of Siam weed leaf meal. Igwe *et al.* (2020) also recorded increased final body weight and weight gain in birds given 40 ml of Siam weed extract, while birds in the control had the lowest value. The discrepancies regarding trends in weights could be attributed to variations in conditions, such as administered *C. odorata* form, method of extract preparation, dosage and concentration of bioactive molecules in the plants. The feed intake was significantly ($p < 0.05$) highest in birds with access to 1500 ppm of SWE and lowest in their counterparts administered with 500 ppm of SWE (Figure 3). The phytogenic components in plant extracts affect flavour and palatability of feed, thereby, stimulating dietary intake in poultry (van der Aar *et al.* 2017). However, this observation does not support previous studies (Bamikole *et al.*, 2004; Ekenyem *et al.*, 2009; Jiwuba *et al.*, 2018), where experimental animals fed graded levels of *Chromolaena odorata* leaf meal had reduced feed intake upon comparison with their counterparts in the control. Igwe *et al.* (2020) also observed feed intake decline in birds given 40 ml of *Chromolaena odorata* leaf extract. Since the inclusion levels of SWE in this study was lower than those reported by previous authors, this may be due to the inconsistencies in results. In addition, SWE administration significantly ($p < 0.05$) influenced feed conversion ratio in broiler chickens with the best FCR recorded in birds administered with 500 ppm of SWE (Figure 4). These results confirmed the findings of Windisch *et al.* (2008) and Alhajj *et al.* (2015), who revealed phytogenic feed additives caused reduction in feed intake, improved FCR with largely unchanged body weight.

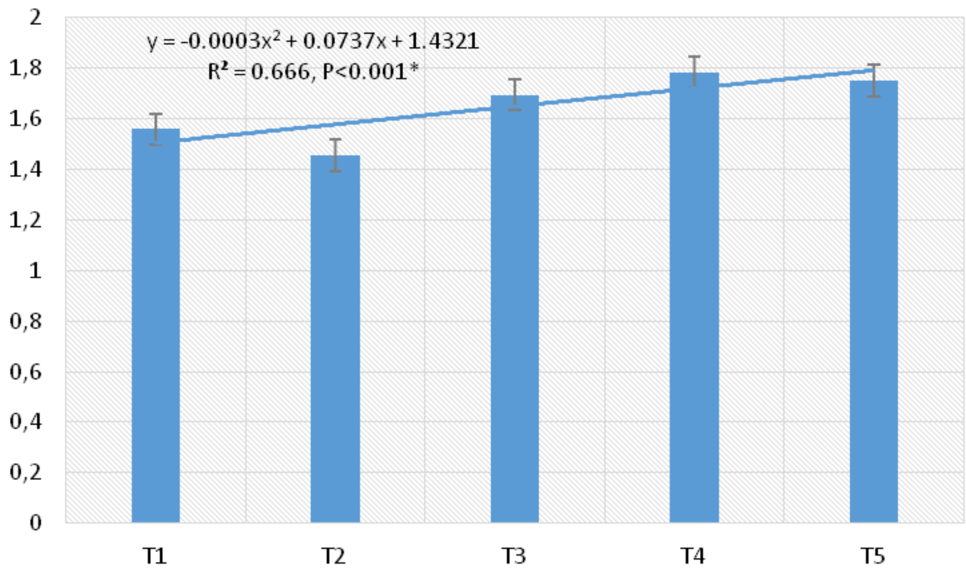
Effect of Siam weed (*Chromolaena odorata*) extract on carcass yield and gastro-intestinal indicators of broiler chickens

It was revealed that Siam weed (*Chromolaena odorata*) extract had no significant ($p > 0.05$) influence on all carcass yield indicators measured except for breast (Table 2). Values recorded for carcass weights in this study fell within the range of 1383.30 – 2033.30 g in broilers fed Moringa leaf meals, as reported by Aderinola *et al.* (2013). Moreover, the similarities in dressing percentages, recorded in this study, were in line with the study of Jiwuba *et al.* (2018), where



T1: control, T2: 500 ppm of SWE, T3: 1000 ppm of SWE, T4: 1500 ppm of SWE,
T5: 2000 ppm of SWE, R^2: regression coefficient, P: probability, *: significant

Figure 3. Feed intake (g/day) of broilers administered Siam weed (C*hromolaena odorata*) extract



T1: control, T2: 500 ppm of SWE, T3: 1000 ppm of SWE, T4: 1500 ppm of SWE,
T5: 2000 ppm of SWE, R^2: regression coefficient, P: probability, *: significant

Figure 4. Feed conversion ratio of broilers administered Siam weed (*Chromolaena odorata*) extract

dressing percentage remained statistically unchanged in broilers fed SWLM-based diets. Ashour *et al.* (2020) also revealed that herbal mixture had no impact on carcass yield of broilers. Despite no differences in carcass weights and dressing percentage, breast significantly ($P = 0.003$) ranged from 15.31 % in birds of the T5 group to 24.37 % recorded in birds of the T1 group. This decrease in breast weight in the T5 group may

Table 2. Effect of Siam weed (*Chromolaena odorata*) extract on carcass yield of broiler chickens

Parameters	T1	T2	T3	T4	T5	SEM	P value
Live weight (g)	1625.00	1675.00	1650.00	1700.00	1600.00	35.40	0.398
Dressed weight (g)	1050.00	1075.00	1100.00	1150.00	1025.00	57.00	0.618
Dressing percentage (%)	64.58	64.17	66.64	67.53	64.53	2.16	0.715
Breast (%)	24.37[a]	20.18[ab]	17.89[bc]	18.25[bc]	15.31[c]	0.76	0.003
Back (%)	10.45	10.21	9.12	9.03	9.25	0.98	0.760
Thigh (%)	8.65	8.38	6.88	7.39	7.07	0.44	0.113
Drumsticks (%)	8.58	8.39	7.22	7.00	6.88	0.55	0.215
Wings (%)	5.60	5.06	5.19	4.83	4.95	0.44	0.767
Neck (%)	2.91	2.68	2.50	2.23	2.34	0.22	0.319

T1: control, T2: 500 ppm of SWE, T3: 1000 ppm of SWE, T4: 1500 ppm of SWE, T5: 2000 ppm of SWE.
[a,b,c] Means within the same row with different superscripts are significantly different ($p < 0.05$).

Table 3. Effect of Siam weed (*Chromolaena odorata*) extract on gastrointestinal indicators of broiler chickens

Parameters	T1	T2	T3	T4	T5	SEM	P value
Live weight (g)	1625.00	1675.00	1650.00	1700.00	1600.00	35.40	0.398
Lungs (%)	0.49	0.55	0.58	0.57	0.63	0.10	0.893
Proventriculus (%)	0.60[a]	0.67[a]	0.44[b]	0.62[a]	0.41[b]	0.03	0.005
Spleen (%)	0.15	0.16	0.16	0.13	0.14	0.05	0.994
Thymus (%)	0.27	0.31	0.37	0.29	0.36	0.11	0.872
Bursa of fbricius (%)	0.11	0.06	0.06	0.05	0.06	0.02	0.215
Heart (%)	0.45	0.54	0.44	0.42	0.42	0.05	0.528
Gizzard (whole) (%)	2.07	2.69	2.25	3.24	2.50	0.40	0.395
Pancreas (%)	0.34	0.29	0.27	0.34	0.24	0.05	0.654
Liver (%)	2.49	2.44	2.85	2.01	2.35	0.24	0.313
Duodenum (%)	1.17	0.88	0.94	1.12	0.99	0.10	0.320
Duodenum length (cm/100 g LW)	2.43	2.13	2.10	2.31	2.08	0.17	0.582
Jejunum (%)	1.74	1.91	1.78	2.27	1.61	0.22	0.386
Jejunum length (cm/100 g LW)	5.18	4.91	5.01	5.02	4.76	0.63	0.991
Ileum (%)	1.36	1.41	1.62	2.05	1.42	0.19	0.187
Ileum length (cm/100 g LW)	4.06	5.12	4.87	5.08	5.20	0.93	0.895
Caeca (%)	0.68	0.50	0.59	0.52	0.56	0.08	0.604
Caeca length (cm/100 g LW)	2.46	2.08	1.98	2.62	2.30	0.33	0.654
Colon (%)	0.34	0.39	0.27	0.37	0.32	0.07	0.851
Colon length (cm/100 g LW)	0.81	0.80	0.72	0.81	0.72	0.13	0.953

T1: control, T2: 500 ppm of SWE, T3: 1000 ppm of SWE, T4: 1500 ppm of SWE, T5: 2000 ppm of SWE.
[a,b] Means within the same row with different superscripts are significantly different ($p < 0.05$).

Table 4. Effect of Siam weed (*Chromolaena odorata*) extract on chilling loss, drip loss and cooking loss of breast meat of broiler chickens

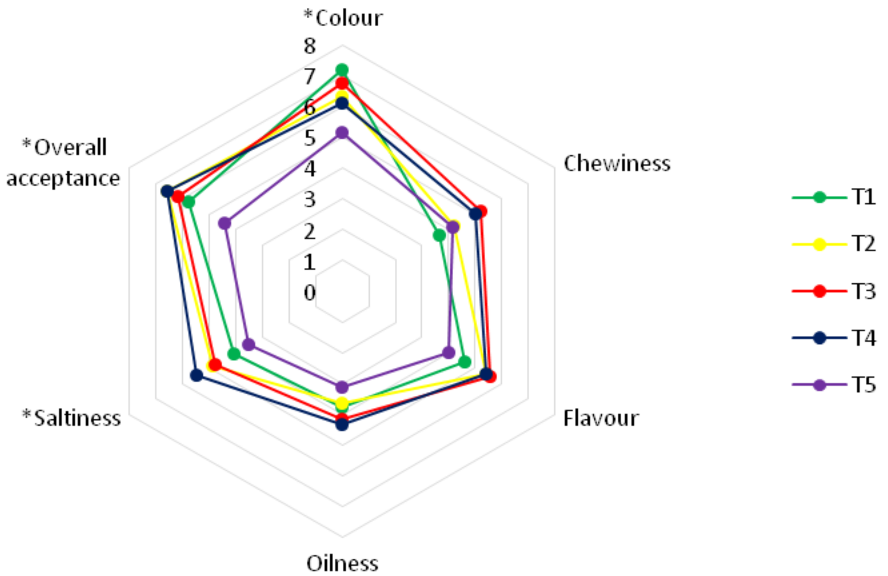
Parameters	T1	T2	T3	T4	T5	SEM	P value
Chilling loss (%)	2.85	2.17	2.64	3.07	3.70	2.75	0.221
Drip loss (%)	2.00	2.50	2.03	2.87	2.50	1.83	0.900
Cooking loss (%)	33.54	32.29	29.21	37.30	35.37	1.60	0.093

T1: control, T2: 500 ppm of SWE, T3: 1000 ppm of SWE, T4: 1500 ppm of SWE, T5: 2000 ppm of SWE.

imply that nutrients were not properly utilized, as the same trend was observed in FCR. This result was not in accordance with the findings of Jiwuba *et al.* (2018), as the authors observed significantly ($p < 0.05$) lower carcass weight in broilers fed 12 % of SWLM-based diet, when compared to birds on the other three diets (0, 4, and 8 %) and no significant effect of SWLM-based diets on drumstick weight and breast muscle weight. Furthermore, significant ($P = 0.005$) changes in proventriculus were observed in this study with values ranging from 0.41 % in birds of the T5 group to 0.67 % in birds of the T2 group (Table 3). The mechanisms of action of Siam weed on GIT function is not fully elucidated. However, the main action of plant extracts as feed additives is to improve the ecosystem and digestive capacity of the GIT (Hashemi and Davoodi, 2011). It is probable that the highest proventriculus recorded in birds given 500 ppm of SWE suggests that digestion of feed was improved, as this is also evident from their observed overall best FCR. According to Rodrigues and Choct (2018), the proventriculus, which is a part of the foregut, where chemical digestion of feed takes place, can be manipulated by different feeding practices, such as frequency of feeding, feed structure and composition.

Effect of Siam weed (*Chromolaena odorata*) extract on meat quality of broiler chickens

There was no significant difference in evaluations of chilling, drip and cooking losses of meat samples collected from all 5 treatments, as depicted in Table 4. The similarities in drip loss values in this study implies that SWE had no unfavourable impact on broiler meat appearance. Meats with high drip loss typically have low consumer acceptance due to its unattractive appearance as well as decreased tenderness and juiciness (Jama *et al.*, 2008). Cooking loss, which is one of the meat quality parameters that has been habitually overlooked by meat scientists and technologists, refers to the reduction in weight of meat during the cooking process (Vasanthi *et al.*, 2006). The cooking loss values, observed in the current study, were slightly higher than 15.9 – 32.2 % in turkey meat reported by Mora *et al.* (2011). On the other hand, the parameters such as colour, saltiness and overall acceptance of broiler meat, were significant ($p < 0.05$) influenced by SWE administration based on the panellists' evaluation, as illustrated in Figure 5. Colour is another significant attribute that influences consumer acceptance of poultry meat. In particular, panellist score for colour was significantly ($p < 0.05$) higher in meats from the control than meats from



T1: control, T2: 500 ppm of SWE, T3: 1000 ppm of SWE, T4: 1500 ppm of SWE, T5: 2000 ppm of SWE,
*: indicates the significant difference ($p < 0.05$) across treatments

Figure 3. Radar chart for sensory analysis of breast meat of broiler chickens administered varying levels of Siam weed (*Chromolaena odorata*) extract

broiler chickens administered varying SWE levels. Thus, implying meats from SWE-based treatments were darker than their control counterpart, which may be attributed to the presence of flavonoids in Siam weed. This result was in line with the findings of Ashour *et al.* (2020), who reported herbal mixture lowered lightness (L*) values, while increasing redness (a*) values of broiler meats during storage. In addition, saltiness was ranked significantly ($p < 0.05$) highest in meats from birds administered 1500 ppm SWE, while the score of overall acceptability was significantly ($p< 0.05$) highest in meats from birds administered 500 or 1500 ppm SWE. The polyphenol content of SWE extract could be responsible for the better sensory acceptability in broiler meat, as previous researchers (Shirzadegan and Falahpour, 2014; Tashla *et al.*, 2020) have also reported improved sensory quality and reduced L* values of broiler meats from birds fed diets supplemented with herbs extract mixture and phytobiotics.

CONCLUSION

These results demonstrate that Siam weed extract usage up to 1500 ppm is safe and effective for broiler chickens, ensuring increased feed intake without any detrimental impact on body weight and meat quality. However, improved FCR, and proventriculus weight with excellent sensorial acceptability of broiler breast meat can be achieved via administration of 500 ppm of SWE.

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Data Curation: SAFIYU, K., ONABANJO, R., AKINSOLA, K., ADEDOKUN, O.

Writing-original draft preparation: SAFIYU, K.

Writing-review and editing: SAFIYU, K., ONABANJO, R., AKINSOLA, K., ADEDOKUN, O.,

Project administration: SAFIYU, K., NNAMDI, N., SHAIBU, O.

All authors have read and agreed to the published version of the manuscript.

DATA AVAILABILITY STATEMENT

The data presented in this study are available on request from the corresponding author.

CONFLICT OF INTEREST

There is no conflict of interest.

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