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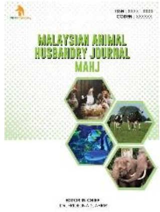

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RESEARCH ARTICLE

COMPARATIVE EFFECT OF TAMARIND (*TAMARINDUS INDICA L.)* EXTRACT AND SYNTHETIC VITAMIN AS FEED ADDITIVES IN BROILER CHICKEN PRODUCTION

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ABSTRACT

This study analyzed the comparative effect of *T. indica L.* extract and synthetic vitamin (probiotics) as feed additives in broiler chicken production. Forty (40) birds were used for the experimental trial; and divided into two treatments, T1 and T2, each replicated. Analytical techniques adopted include proximate and photochemical analyses, descriptive statistics and ANOVA. Proximate composition of dry tamarind pulp indicated the presence of moisture (15.20% ± 5. 79%), ash (3.95 ± 0.38%), protein (1.90% ± 0.15%), crude fiber (5.6% ± 0.35%), carbohydrate (70.9% ± 5. 98) and ascorbic acid (0.35% ± 0.13%). Phytochemical screening of the *T. indica L.* extract indicated seven positive chemical constituents (alkaloid, steroidal ring, flavoids, tannin, saponin, glycosides, protein and amino acids); with significant interactive effects. The survival rate of broilers for the duration of the feeding trial was significant for T1 (97%). Further, the average weight gain was significant for T1 in weeks 2 (1.15kg) to 3 (1.5kg); and significant for T2 (0.74kg) in week 1. Feed conversion ratio was significant for T2 in weeks 2 (2.27) to 3 (1.85); and significant for T1 (2.05) in week 1. Furthermore, both feed additives indicated progressive increase in the broilers growth parameters during the experimental trial. This study recommends cultivation of *T. indica L.* at commercial scale and intensifying utilization of its extract as a replacement or alternative to synthetic vitamin (probiotics) in broiler production. Improved extension services; and additional research on *T. indica L.* and other related plant parts as feed additives and their effects on carcass yield are required.

KEYWORDS

T. indica L. extract, synthetic vitamin, growth parameters of broilers, proximate and phytochemical analysis

1. INTRODUCTION

Broiler chicks are reared for meat production from day-old to about eight weeks and serve as a source of animal protein (Onuwa, 2022). However, profitability in poultry enterprises has been constrained by a number of factors; critical among which is feed quality and cost. Feed is the major component of input cost accounting for up to 70% -80% of the total variable cost of production (Onuwa, 2022; USDA, 2015; and Keservani et al., 2010). The high feed cost has largely been attributed to competition between man and animals for limited grains (Velmurugu, 2012). The situation has been further exacerbated by the high cost of operating feed mills (CBN, 2010). Poultry production is an important component of the agricultural system in Nigeria (Velmurugu, 2012). The two most important factors responsible for phenomenal increase in poultry production in Nigeria were identified as its profitability and the quick-return on invested capital (Onuwa, 2022). Poultry is considered to be a means of livelihood and a way of achieving a certain level of economic independence in Nigeria. The primary purpose for keeping poultry in all parts of country is for both dietary and economic reasons. Nowadays, poultry keeping has developed from a micro/medium enterprise to a commercially oriented industry (Velmurugu, 2012). Poultry production is unique and it offers the highest turnover rate and the quickest returns to investment outlay. A study conducted indicated that poultry have the highest feed conversion rate and produces the cheapest and the best source of animal protein (Velmurugu, 2012). The major constraints of poultry production in Nigeria are the high and rising costs of production of inputs, especially feed, day-old chicks and medications (Onuwa, 2022; Velmurugu, 2012). Synthetic vitamins (probiotics) are expensive, because of the high technology involved during blending of compounds and the high cost of shipping from foreign countries. Its continuous use in poultry production will raise the cost of production and minimize the profit; hence, there is a need to find more efficient alternatives or combinations of different alternatives for maintaining health and improving performance of poultry and other livestock species. The use of plants as herbs or medicine for both man and livestock has a very long history (Librandi et al., 2007). Alternatives are sourced such as tamarind pulp extracts; which are cheap, available and can be used in broiler production without significant adverse effects (Ovaskarnen et al., 2008). Plant active elements are chemical compounds present in the entire plant or in specific parts of the plant used for therapeutic activity or with beneficial effects (Selfert, 2006).

Epidemiological studies have consistently demonstrated that consumption of plant derived feeds rich in bioactive photochemical has a protective effect against oxidation stress (Librandi et al., 2007; Ovaskarnen et al., 2008), carcinogenesis aging and atherosclerosis (Clark, 2009; USDA, 2015). The bioactive photochemical compounds thus decrease the risk of chronic diseases, cardiovascular disease, cancer and degenerative diseases of aging (Keservani et al., 2010). In recent times, photogenic feed additives have been generating interest as a replacement for banned antimicrobials (Keservani et al., 2010). These photogenic feed additives also called photobiotic or botanicals are usually derived from plant parts and used to improve productivity of livestock through improved feed intake, gut function, antimicrobial activity and anti-oxidative actions (Dougschies et al., 2007). Phytogenic compounds are the groups of feed additives that have been reported to possess a potential for

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growth enhancement of poultry due to presence of a number of pharmacologically active substances. They are supposed to enhance feed intake, activate digestive enzymes and stimulate immune function. Photogenic feed additives are supposed to help regular digestion while improving performance along with various other way of action including reducing bacterial colony counts and fermentation products, decreasing the activity of gut associated lymphatic system, boosting pre-ceacal nutrient digestibility and keeping anti-oxidative properties (USDA, 2015). Herbs, plant extracts and spices can be valuable alternatives for the health and nutrition of broilers (El-Siddig and Vijayand, 2006; Komutarin et al., 2004). One of the alternatives could be tamarind pulp extracts; Tamarind (*Tamarindus indica L.*) is a tree type of plant which belongs to the *leguminosea* family. Tamarind (*Tamarindus indica L.)* is an important and indigenous food in African tropics, it is a multipurpose tree of which almost every part finds at least some use; either nutritional or medicinal (El-Siddig and Vijayand, 2006). Its photochemistry and pharmacology has been reviewed in several research studies (Spiegelhalder, 2005). Tamarind has been reported to have anti-diabetic, anti-inflammatory cholesterol lowering, anti-obesity, antifungal, antioxidant, antipyretic and antimicrobial properties (Dougschies et al., 2007; Traore et al., 2013; Spiegelhalder, 2005; Hernandez et al., 2004; Dougschies et al., 2007; Balasundran et al., 2006; Clark, 2009; Gupta, 2007). In addition, it has appetizing and stimulatory effect in the digestive process (USDA, 2015). The found polyphenol compounds in the extracts could reduce heat stress in broiler chickens, with all these beneficial properties of tamarind, report on its value for poultry are limited (Traore et al., 2013). Based on the foregoing, this study will attempt to provide answers to the following research questions:

1. What is the proximate composition of dried tamarind pulp?
2. What are the phytochemical properties of *T. indica L.* extract?
3. What are the effects of the feed additives on broilers growth parameters?

2. Material and Methods

2.1 Experimental Site

The study was conducted at the poultry unit, Federal College of Forestry, Jos (FCF, Jos), Plateau State, Nigeria (Onuwa and Charles, 2023).

2.2 Experimental Birds and Pen

Forty day old broilers chicks were purchased from a commercial poultry bird distributor (Amo) at Jos, Plateau state, Nigeria. The pen was cleaned and disinfected two weeks before the arrival of the birds. The pens were partitioned to take care of all the treatments and replicates. The birds were brooded for a period of three weeks (21 days) for the experimental trial. Adequate heat and all routine management practices duly observed; vaccination and medication was carried out at due time. Room temperature was monitored at interval, known quantity of feed was served to them daily and the left over feed was measured with a scale to determine feed intake.

2.3 Experimental Design

The birds were randomly allocated to two (2) treatments 1 (*T. indica L.* extract) and 2 (synthetic vitamin) (T1 and T2); at twenty (20) birds per treatment; while each treatment was replicated twice; Treatments $T1_a$, $T1_b$, $T2_a$ and $T2_b$, i.e. ten (10) birds per replicate. The limited number of birds and replicates used for this study was attributable to the high cost of raising additional broilers (feed and day-old chicks); smallholder production facilities, and constrained access to additional financing. These factors were the critical barriers that affected the capacity to scale-up the experimental study. The *T. indica L.* extract was applied at the recommended quantity of 5g per litre of water, while the synthetic vitamin (probiotics) was administered at recommended quantity of 1.5g per litre of water.

2.4 Experiment Diet

Standard commercial broiler starter and finisher diets were purchased and administered to the birds during the period of the experimental trial. The commercial feed comprised all the required nutritional composition and the broilers were adequately fed at scheduled times during the period of the experimental trial.

2.5 Experimental Procedure

Tamarind pulp was sourced from a local commodity market in Jos, Plateau State, Nigeria for the purpose of the experiment. The dried pulp was soaked in water for 12 hours in other to get good volume of the extract for the experiment. The extraction process was carried out to get a clear solution and facilitate the phytochemical test to determine the nutritional composition. 10g of tamarind pulp was extracted and soaked with 100ml of methanol for 8 hours using Soxhlet apparatus until a clear solution is derived and the extraction process is stopped; the derivatives are allowed to cool. The extract is filtered and concentrated under vacuum; to facilitate further processes in line with stipulated procedures as adapted from (AOAC, 2012; Perez-Jimenez, 2008).

2.6 Data Collection

Feed intake and weekly weight gain was recorded to determine the feed conversion ratio.

3. Analytical Techniques

3.1 Chemical Analysis

The properties of *T. indica L.* extract were analyzed using photochemical methods in the laboratory at FCF, Jos.

3.2 Statistical Analysis

Descriptive statistics (percentages and means) was used to estimate the proximate composition of dried tamarind pulp and the effects of the feed additives on the growth parameters of the broilers.

The Feed intake and weekly weight gain values were recorded; and used to estimate the feed conversion ratio (F.C.R) as presented in equation (1) as adapted from (Thornley and France, 2007):

$$\text{Feed Conversion Ratio (FCR)} = \frac{\text{Feed Intake(FI)}}{\text{Weight gain(WG)}} \quad (1)$$

4. Results and Discussion

4.1 Proximate Analysis of Dried Tamarind Pulp

Table 1: Proximate Composition of Dried Tamarind Pulp (100g/Fruit)

Constituents	Mean±SED
Moisture	15.20 ± 5. 79
Ash	3.95 ± 0.38
Protein	1.90 ± 0.15
Fiber	5.60 ± 0.35
Carbohydrate	70.90 ± 5. 98
Ascorbic acid	0.35 ± 0.13

Source: Authors computation (2020)

Table 1 presents the proximate composition of dry tamarind pulp. The moisture content of the tamarind pulp was found to be 15.20% ± 5. 79% which is bit lower than the documented values by (Mbajiorgu et al., 2011). The variation in moisture content of tamarind was attributable to environmental conditions (temperature) or processing techniques adopted. The ash represents total content of minerals in a food (Onuwa and Charles, 2023). In this study the ash content of tamarind fruit pulp was 3.95% ± 0.38%; this value falls within the range of result obtained who reported a range of 2.6% - 3. 9% in their study, however, the values presented in this study were higher than the results of who reported value of 2.44% by (Prabakran and Dhanapal, 2009; Mohammed, 2007). The protein content of tamarind fruit pulp is 1.90% ± 0.15% which indicates lower values relative to the reports who reported values of 3.01% and 2.58%, respectively by (Scanes et al., 2004; Morton, 1987). The value of crude fiber of tamarind pulp obtained in this study is 5.6% ± 0.35% which is in line with the and at variance with who reported higher values of 8.04% and 13.05%, respectively (Traore et al., 2013; Mbajiorgu et al., 2011; Mohammed, 2007). The carbohydrate content of tamarind pulp is 70.9% ± 5. 98 which is higher than the value (55%) as reported by (Mohammed, 2007). High amount of carbohydrate in tamarind fruit pulp promotes its utilization in feed products. It must be converted by enzymatic or acid hydrolysis process to obtain readily fermented sugar as supplementary source of energy (Onuwa and Charles, 2023). Ascorbic acid content of tamarind pulp is 0.35% ± 0.13% which has a low value as reported by (Prabakran and Dhanapal, 2009; Mohammed, 2007). Ascorbic acid (vitamin C) contributes to the nutritional value of feeds and is an essential water-soluble vitamin. It plays a vital role in protecting the body against accumulation or retention of the toxic minerals. It also serves as antioxidants as well as co-factor function for enzyme metabolism in the birds. This corroborates with who also posited comparable outcomes (Selfert, 2006).

4.2 Phytochemical Screening

Table 2: Phytochemical properties of *T. indica L.* extract

Phytochemical Properties	Standard Deviation	Observations
Alkaloids	2.60±0.04	+
Steroids	2.15±0.02	+
Flavoids	5.30±0.01	++
Tannins	2.80±0.03	+
Saponin	2.40±0.02	+
Glycosides	2.25±0.03	+
Protein and amino acids	1.95±0.02	+

Source: Authors computation (2020); + = (Presence); ++ = (High presence)

The *T. indica L.* extract was subjected to a standard phytochemical screening for various constituents according to the method of (Trease and Evans, 2002). The result from the phytochemical screening carried out (Table 2) showed that seven (7) chemical constituents of *T. indica L.* extract were observed to be positive. Also, there was a level of interaction among the chemical constituents; with significant effects. Alkaloid (2.60±0.04) was present as indicated by the formation of the precipitate. Alkaloids represent the active principle of vegetable drugs. They are alkaline in reaction and richly combine with acid forming salts soluble in water; excess alkaloids may become antagonistic (USDA, 2015). Alkaloid produces analgesic, anti-inflammatory and androgenic effects which help to develop resistance against disease and endurance against stress (Gupta, 2007). Test for Steroidal Ring revealed a reddish-brown precipitate; indicative of the presence of a steroidal ring (2.15±0.02) in the extract, which has anti-tumor effects (Onuwa et al., 2020; Clark, 2009). Also, the phytochemical test also revealed high presence of flavoids (5.30±0.01) which is good for the performance of the birds, due to its ability to regulate cellular activity and fighting off free radicals that causes oxidative stress in the birds as well as protection against toxins; the solution was not as colorless as put forward by (Trease and Evans, 2002). Test for Tannin revealed a deep green coloration which indicates the presence of Tannin (2.80±0.03). The faint bluish coloration after treating the filtrate with iodine solution confirmed the presence of Tannin (USDA, 2015). Tannins are used in septic preparations, which produce contractions of blood vessels, stopping bleeding and have the quality of retaining hemorrhages when applied to the bleeding part (Onuwa et al., 2020; Dougschies et al., 2007). Test for saponin revealed that frothing persisted and was taken as preliminary evidence for the presence of saponin (2.40±0.02) (Traore et al., 2013). Hemolysis of red blood cells around the disc after 6 hours was taken as further evidence of the presence of saponin (Trease and Evans, 2002). The presence of saponin in plants has expectorant effects, which are very useful in the management of inflammation of the upper respiratory tract in addition to its cardio-tonic properties, as reported by (Onuwa et al., 2020). Saponins have the property of causing hemolysis of cells even at low dilution and tend to be deposited on the surface of cells with which they come in contact with and are not observed by the normal epithelium of the alimentary canal (USDA, 2015). Test for glycosides showed a reddish-brown precipitate which indicates the presence of glycosides (2.25±0.03). Glycosides have a tendency to block the conduction of the electrical impulse that causes contraction as it passes from the arteries to the ventricles of the heart (Onuwa et al., 2020). Cardiac glycoside also have a tendency to produce an abnormal cardiac rhythm by causing electrical impulses to be generated at points in the heart other than the normal face maker region; the cells that rhythmically maintain heartbeat (Onuwa et al., 2020). Protein and amino acids (1.95±0.02) were present at minimal levels; and as such supplementation of synthetic vitamin (probiotics) with *T. indica L.* extract will have no adverse effect on their growth parameters.

4.3 Comparative Effect of Feed Additives on Broilers Growth Parameters

Table 3: Average comparative effect of feed additives on growth parameters

Parameters	Weeks 1		Weeks 2		Weeks 3	
	T1	T2	T1	T2	T1	T2
Feed intake (kg)	1.5	1.5	2.5	2.5	2.5	2.5
Survival rate (%)	97	95	97	95	97	95
Weight gain (kg)	0.73	0.74	1.15	1.1	1.5	1.35
Feed conversion ratio	2.05	2.03	2.17	2.27	1.67	1.85

Source: Authors computation (2020)

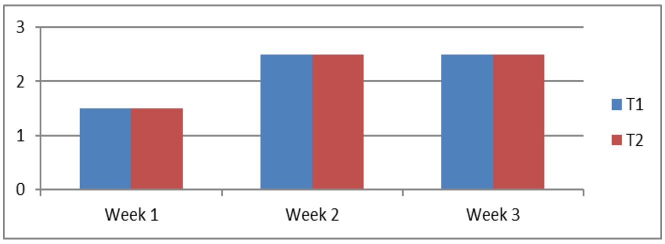

Figure 1: Feed intake (kg)

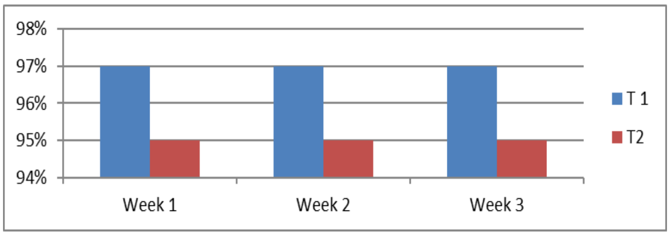

Figure2: Survival rate

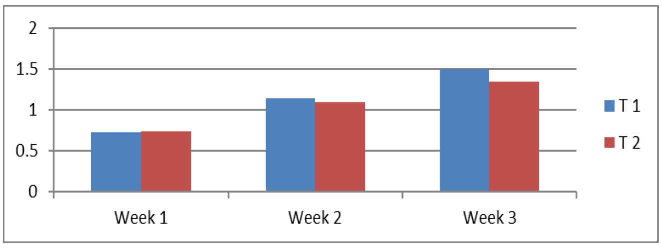

Figure 3: Weight gain (kg)

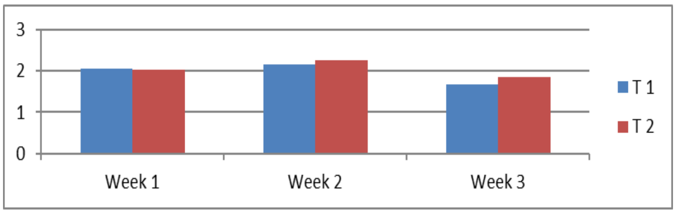

Figure 4: Feed conversion ratio

The result in Table 3; and Figures (1), (2), (3) and (4) reveals the quantity of feed intake and growth parameters of the broilers during the period of the experimental trial (3 weeks); the 3weeks experimental period ensured adequate time for quantitative data collection of growth parameters and observation of the broiler chicks. Also, the selected parameters (survival rate, weight gain and feed conversion rate) were key indicators of growth in the broiler chicks and provided the necessary quantitative data for the comparative analysis. In T1: At week 1 the estimated amount of feed consumed was 1.5 kg, survival rate was 97%, daily weight gain was 0.73 kg and feed conversion ratio was 2.05. At week 2 the estimated amount of feed consumed was 2.5 kg, survival rate was 97%, daily weight gain was 1.15 kg and feed conversion ratio was 2.17. At week 3 the estimated amount of feed consumed was 2.5 kg, survival rate was 97%, daily weight gain was 1.5 kg and feed conversion ratio was 1.67. In T2: At week 1 the estimated amount of feed consumed was 1.5 kg, survival rate was 95%, daily weight gain was 0.74 kg and feed conversion ratio was 2.03. At week 2 the estimated amount of feed consumed was 2.5 kg, survival rate was

95%, daily weight gain was 1.1kg and feed conversion ratio was 2.27. At week 3 the estimated amount of feed consumed was 2.5 kg, survival rate was 95%, daily weight gain was 1.35 kg and feed conversion ratio was 1.85. Therefore, the survival rate of broilers for the duration of the feeding trial was significant for T1 (97%); this suggests a positive correlation between *T. indica L.* extract and the survival of the broiler chicks. Further, the average weight gain was significant for T1 in weeks 2 and 3; the estimates were 1.15 kg and 1.5 kg, respectively. Also, the average weight gain was significant for T2 (0.74 kg) in week 1. This implies that the feed additives had significant effects on the weight gain of the broiler chicks for the duration of the feeding trial. In addition, feed conversion ratio was significant for T2 in weeks 2 and 3; with an index of 2.27 and 1.85, respectively. The feed conversion ratio was significant for T1 in week 1; with an index of 2.05. This result clearly indicates efficiency in feed conversion per broiler chick which consequently affects the growth parameters. The implication of these findings suggests that *T. indica L.* extract is a very suitable feed additive in poultry rations, with significant effects on the growth parameters of broilers. This corroborates with who also reported similar outcomes in their respective studies (Murwani and Murtini, 2009; Scanes et al., 2004).

5. Conclusion

This study analyzed the effect of *T. indica L.* extract and synthetic vitamin (probiotics) as feed additives in broiler production. The proximate composition of the dry tamarind pulp indicated the presence of moisture, ash, protein, crude fiber, carbohydrate and ascorbic acid. The result of the phytochemical screening indicated that seven (7) chemical constituents of the *T. indica L.* extract were observed to be positive; and the level of interaction among the chemical constituents had significant effects. More so both feed additives indicated progressive increase in the growth parameters of the broiler chicks over the period of the experimental trial. From the results obtained, the following recommendations are proposed: Cultivation of *T. indica L.* be encouraged and enhanced at commercial scale; increased intensification, administration and utilization of *T. indica L.* extract as a replacement or alternative to probiotics in broiler production; more research work should be carried out on using different parts of *T. indica L.* and other related plant parts to determine their utility as feed additives in poultry production; more extension services on poultry management practices that optimizes productivity should be provided for broiler farmers in the area; and additional scientific research is required to determine the degree of efficacy of *T. indica L.* extracts on carcass yield in broiler production.

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