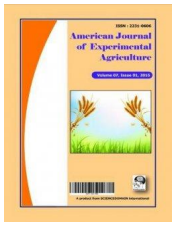

American Journal of Experimental Agriculture
8(2): 130-136, 2015, Article no.AJEA.2015.155
ISSN: 2231-0606

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Dietary Inclusion of Ethanolic Extracts of *Jatropha curcas* on the Performance and Carcass Characteristics of Broiler Chickens

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Authors' contributions

This work was carried out in collaboration between both authors. Author GOA designed the study, wrote the protocol and all drafts of the manuscript. Author FAO reviewed the experimental design, managed the analyses of the study, performed the statistical analysis and wrote the first draft of the manuscript. Both authors read and approved the final manuscript.

Article Information

DOI: 10.9734/AJEA/2015/10580
Editor(s):
(1) Javier Alarcon Lopez, School of Engineering, University of Almería La Cañada de San Urbano, Spain.
(2) Anonymous.
Reviewers:
(1) Aliyu Abdullahi Mohammed, Department of Animal Science, Usmanu Danfodiyo University, Sokoto, Nigeria.
(2) Anonymous, Nigeria.
Complete Peer review History: http://www.sciencedomain.org/review-history.php?iid=1076&id=2&aid=8879

Original Research Article

Received 1st April 2014
Accepted 22nd December 2014
Published 18th April 2015

ABSTRACT

A study was conducted to evaluate the effect of *Jatropha curcas* leaf extract on the performance and carcass characteristics of broiler chickens. One hundred and fifty day old Arbor Acre broiler chicks were used. They were divided into five treatments and each treatment was replicated five times. Treatment one, (Negative control, no antibiotics), Treatment two (positive control, with antibiotics) while treatments three, four and five had varying inclusion levels of the *Jatropha curcas* leaf extract (0.25 g/100 kg, 0.50 g/100 kg and 0.75 g/100 kg of feed respectively). The birds were raised for a total number forty two days during which, they were fed *ad libitum* on a deep litter system of management. Weekly weight gained and feed consumed were recorded. Evisceration of carcass was done after forty two days; each part was weighed and recorded. Performance characteristics indicated no significant (P>0.05) difference in feed consumed and feed conversion ratio, but treatment 4 with 0.50 g/100 kg of *Jatropha curcas* extract has the best feed conversion ratio, but there were significant (P<0.05) differences in total weight gain.

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Keywords: Broilers; broiler carcass; Jatropha curcas; performance.

1. INTRODUCTION

Antibiotics are used in poultry production as non-nutritive feed additives to increase overall performance of poultry and improve their immune status. Such antibiotics are used as growth promoting agents, prophylactic, chemotherapeutic and other medicinal purposes. Non-stop use at sub therapeutic levels as done in animal feeding may result in drug resistant microorganisms in humans because of drug residues in animal products finding their way into man through consumption.

Antibiotic growth promoters have been banned in first world countries. This ban on the use of synthetic feed additives has triggered intensive research to develop alternative strategies to maintain health and performance in poultry production system. Researchers have identified several metabolites in medicinal plants, which play beneficial roles in the production and immune system of birds against many diseases, have excellent medicinal worth and could be use as natural growth promoters to in place of antibiotics and other non natural feed additives.

Bacterial diseases are tackled world-wide with anti-microbial agents that kill microorganisms or inhibit their growth. Antimicrobial agents that reversibly inhibit growth of bacteria are called bacteriostatic whereas those with irreversible lethal action on bacteria are known as bactericidal [1]. Microbial processes or structures are disrupted by antimicrobial agents making them different from those of the host. They may damage pathogens by hampering cell wall synthesis, inhibiting microbial protein and nucleic acid synthesis, disrupting microbial membrane structure and function, or blocking metabolic pathways through inhibition of key enzymes [2]. It has been reported that plant extracts and their products provide active curative ingredients in herb remedies which are used in many parts of the world [3].

Herbs were used and are still been used locally in the treatment of infections, many centuries before scientific studies were discovered. Before an antimicrobial agent is accepted for use in human beings it passes through several stages among which are the following (a) has selective toxicity (it should act on bacteria without damaging the host tissues); (b) be bactericidal rather than bacteriostatic; it should be effective against a broad range of bacteria; [3] should not be allergic; (d) should remain active in plasma, body fluids etc.; (e) should be stable and preferably water soluble; (f) desired levels should be reached rapidly and maintained for adequate period of time; (g) it should not give rise to resistance in bacteria; (h) it should have long shelf life; (i) it should not be expensive [1].

The chemical treatment of diseases which has gain acceptance world over also have conditions for its successive use, some of which include; the route of administration and location of the infection, the presence of interfering substances, the concentration of the drug in the body, the nature of the pathogen, the presence of drug allergies and drug resistance by microorganisms. Increasing number of drug resistance pathogens is of serious public health concern. Bacteria often become resistant in several different ways. Unfortunately, a particular type of resistance mechanism is not confined to a single class of drugs. Two bacteria may use different resistance mechanisms to withstand the same chemotherapeutic agent. Furthermore, resistant mutants arise spontaneously and are then selected for in the presence of the drug. Bacteria can become resistant to a drug by excluding it from cell, pumping the drug out of the cell, enzymatically altering it, modifying the target enzymes or organelles to make it less drug sensitive and effective [3]. Thousands of species of different medicinal plants exist and are used globally for the cure of different diseases. These plants are used as antimicrobial agents and several studies have been done by researchers to find out their scientific bases [4]. Some of these plants include; *Anacardium occidentale* (cashew), *Pilostigma recticulatum*, *Anogeissus leiocarpa*, *Enantia chlorantha*, *Senna occidentalis*, *Jatropha curcas* ("Lapalapa"), *Azadirachta indica* ("Dogonyaro, Nigeria local name") *etc.* The presence of some substances in plants such as alkaloids, glycosides, volatile oils, gums, tannins, steroids, saponins, phlobatannins, flavonoids and a host of other chemical compounds referred to as secondary metabolites. The actions of these plants on microorganisms have been found to be due to these secondary metabolites that are present in them [5-7]. Medicinal plants like *J. curcas* have played a major role in the treatment of various diseases including bacterial and fungal infections. The extracts of *Jatropha* species including *J. curcas* displayed potent cyto-toxic,

anti-tumor and anti-microbial activities in different assays. The latex of *J. curcas* also showed antibacterial activity against *Staphylococcus aureus* [8], however the antimicrobial activity of the other parts have not been fully investigated.

Jatropha curcas Linn. (Family Euphorbiaceae) Physic nut, is *J. curcas* plant has been initially considered a traditional herb in many parts of the world [9]. This is partially true of this drought resistant shrub because it is widely grown in Africa, India Central and South America and South-East Asia,. It has gained importance in Malaysia as a source of biofuel production. *J. curcas* have been used in different forms for the treatment of different types of infection. The leaves part has been used as an antiseptic substance during birth, the root part is also being used to treat sexually transmitted diseases and the seed is used to treat skin diseases [9] However, its application as a remedy for many of these ailments has not been fully established by identifying the phyto-chemical compounds responsible for the various treatments they are used for. Hence, this study was conducted to evaluate the performance and carcass characteristics of broiler chickens fed *Jatropha curcas* and substantiate the effect of the phyto-chemicals present in it on broiler production.

2. MATERIALS AND METHODS

The study was carried out at the poultry unit of the Department of Animal Science Teaching and Research farm, University of Ibadan, Nigeria (latitude 7 73" N and longitude 3 5' to 3 36 E). Ibadan is located 228 m above sea level and has a mean annual rainfall of 1289.2 mm based on 27 year of records [10]. The experimental pens were thoroughly cleaned, washed and disinfected. The condition of housing and management of birds were the same in all groups.

2.1 Processing of Leaf Extract

Fresh leaves of *Jatropha curcas* were collected within Ibadan, South-Western Nigeria. The leaves collected per time was rinsed with clean water to remove any foreign matter, chopped and air-dried. The dried leaves were milled using a roller mill. One litre of an 80% ethanol extraction fluid was mixed with 200 g of powdered plant material. The mixtures were kept for 2-5 days in tightly sealed vessels at room temperature protected from sunlight, and mixed several times daily with a sterile glass rod. This mixture was filtered through muslin cloth and the residue, adjusted to the required concentration (500 ml of 80% ethanol for the residue of 200 g of powdered plant material) with the extraction fluid for further extraction. Further extraction of the residue was repeated 3-5 times until a clear colorless supernatant extraction liquid was obtained indicating that no more extraction from the plant material was possible [9].

The extracted liquid was subjected to rota-evaporator (Model # R) to remove the ethanol. Rota evaporation was used to concentrate the smaller quantity of extract. A 250 ml aliquot of extracted liquid was subjected to rota evaporatoration for 3-4 h. Extract from this method was then weighed and stored in desiccators until further use.

2.2 Experimental Birds and Management

A total number of 150 day old arbor acre broilers were purchased and randomly allocated to 5 treatments and 6 replicates per treatment containing 6 birds in a completely randomized design. Water and feed were supplied *ad libitum* while a standard medication and vaccination programs was adopted according to the recommendation of [11]. Weekly feed intake and individual bird weights were recorded for six weeks. Weekly weight gains and feed conversion ratio were calculated from the data obtained.

2.3 Experimental Diets

Diet 1- basal diet without Antibiotics
Diet 2– basal diet with Antibiotics
Diet 3– basal diet with 0.25 g *Jatropha curcas* leaf extract
Diet 4– basal diet with 0.50 g *Jatropha curcas* leaf extract
Diet 5– basal diet with 0.75 g *Jatropha curcas* leaf extract

The composition of experimental diet is shown in Table 1

2.4 Performance Characteristics

Feed and water were given *ad libtum*. Feed consumed (g/bird) was recorded daily, leftover was weighed and discarded. Individually, body weight (BW, g)/bird was taken on pen basis before offering feed the initial day and then at weekly intervals up to 7 weeks. Feed conversion ratio was calculated as feed intake per unit gain (g/intake/g BW gain).

2.5 Carcass Characteristics

At day 42, two birds were randomly selected from each of the replicate for carcass analysis. The selected birds were starved over night and their live weight recorded. The birds were slaughtered by severing the jugular vein and fully bled before scalding in hot water. The birds were de-feathered after scalding and their plucked weight was taken. The eviscerated weights were recorded. The head, neck, shanks, back, breast, gizzard, and organs such as liver, kidney, heart, spleen, lungs, and pancreas were removed, weighed and recorded. The different cut parts were expressed as percentage of dressed weight.

Table 1. Gross composition of experimental diets

Ingredients	Starter	Finisher
Maize	56.00	59.00
Soyabean meal	36.50	28.00
Fish meal	2.20	1.30
Wheat offal	1.60	7.50
Dicalcium phosphate	1.50	1.50
Methionine	0.10	0.10
Salt	0.25	0.25
Premix	0.25	0.25
Total	100	100
Calculated values		
Crude Protein (%)	23.02	20.00
Metabolizable energy (kcal/kg)	2995.10	2950.05
Crude Fibre (%)	3.51	3.79
Calcium (%)	1.03	1.00
Available phosphorus(%)	0.63	0.61
Lysine (%)	1.14	1.09
Methionine (%)	0.57	0.55

2.6 Chemical Analysis

Feed were subjected to proximate analysis according to [12] method. Crude Protein, Ether Extract, Ash, Dry Matter and Nitrogen Free Extracts were the nutrients analyze for.

2.7 Statistical Analysis

Data generated were subjected to one-way analysis of variance (ANOVA) using the [13] package and means were separated using Duncan multiple range test of the same software.

3. RESULTS AND DISCUSSION

The chemical composition of the experimental diets is shown in Table 2. Performance indices of the experimental birds fed *Jatropha curcas* extract supplemented diets are shown in Table 3 The final body weight(kg) obtained (1.73, 1.84, 1.61, 1.75 and 1.67) for birds on diets 1,2,3,4, and 5 respectively varied significantly ($p<0.05$). Values obtained for weight gain (kg) (1.72, 1.87, 1.56, 1.72 and 1.65 for birds on diet 1,2,3,4 and 5 respectively) varied significantly ($p<0.05$). Values obtained for feed intake (kg/bird) 4.11, 4.39, 3.85, 4.02 and 3.94 respectively) for treatment 1,2,3,4 and 5 were not statistically different ($p>0.05$). Also the values obtained for Feed Conversion Ratio (FCR) were 2.37, 2.43, 2.52, 2.35 and 2.41 respectively were not statistically different ($p>0.05$) but birds on diet 4 had the best FCR.

Table 2. Chemical composition of experimental diets

Parameter	Starter	Finisher
Dry matter	90.20	90.50
Crude protein	23.05	20.90
Crude fibre	3.70	5.10
Ether extract	2.70	2.50
Ash	6.50	6.00

Various reports [14-16], indicated that plant extracts has the ability to improve FCR and increase BWG (Body Weight Gain). However, plant extracts are also known to exert anti-microbial actions in vitro against important pathogens including fungi [17]. This is due to the abundance of very complex mixture of bioactive components [17].

Results for weight gain showed that T2 had the highest value, followed by T4. This high value may be due to the ability of antibiotics to suppress sensitive populations of bacteria in the intestine which was in line with the findings of [18]. Also, diversion of nutrients from being used by the gut microorganism for the use of birds may be responsible for values observed. Treatment 4 values can be said to be due to growth promoting effect of plant extract as explained by [14,15].

The higher feed intake observed in treatment 4 among the treatments with *Jatropha curcas* plant extract may be due to the effect of plant bioactive on digestion as this was in agreement with the work of [19] who believes that some plant extract may stimulate the production of saliva and of gastric and pancreatic juice favoring the

secretion of enzymes and therefore improving nutrient digestibility. Once there is increase in pancreatic and gastric juices the animal tends to consume more because feed is quickly degraded. Also it can be said that the synergistic effect of all primary and secondary component may be responsible for the higher feed intake.

There is improvement in feed conversion ratio of T4 when compared with other treatments with different level of *Jatropha curcas* leaf extract which further confirms the antibacterial and antifungal properties of *Jatropha curcas*. It can be said that the low body weight gain (BWG) recorded in treatment 3 may be due to low inclusion rate of the extract in the feed of the birds on that treatment. This is in support with [20] who stated that discrepancy may be attributed to differences in the inclusion level of products containing plant extracts and essential oils or in the main components of the essential oil. Also the level of active ingredient in supplements, the environmental conditions and the composition of the basal diet [20,21] has effect on the performance of the birds.

Table 4 shows the summary of different parts of broiler and organ weight as expressed in percentage of dressed weight. The average live weight of the birds at the end of the experiment ranges from 1710 g to1880 g in T3 and T4 respectively. Value obtained showed, there were no significant ($p>0.05$) differences.

The average dressed weight of the birds at the end of the experiment ranges from 1390 g to 1540 g in T2 and T5. Values obtained for T1 and T4 are 1500 g and 1510 g respectively, no significant ($p\geq0.05$) difference across the treatment.

The carcass and organ parts were expressed as the percentage of the dressed weight. The values obtained for breast, thigh, drumstick, back, neck, liver, gizzard, heart, feet, spleen, lungs kidney and head were not statistically different across the treatment. Values for breast obtained for T2, T3 and T4 are 26.34, 26.78 and 27.62 respectively. Also values obtained for Thigh ranges from 14.04 to 12.88 in both T3 and T4 respectively. Values obtained for T2 and T5 are 13.20 and 13.00.

Table 3. Performance characteristics of broilers fed *Jatropha curcas* leaf extract diets

Parameters	1	2	3	4	5	SEM
Initial body weight (g)	0.40	0.40	0.41	0.39	0.40	0.11
Final body weight (kg)	1.73^{a}	1.84^{a}	1.61^{b}	1.75^{a}	1.67^{b}	0.06
Total weight gained (kg)	1.33^{ab}	1.44^{a}	1.20^{b}	1.34^{ab}	1.27^{b}	0.14
Total feed consumed (kg)	4.11	4.39	3.85	4.02	3.94	0.25
Feed conversion ratio	3.09	3.05	3.21	3.00	3.10	0.21

ab: Means in the same row with different superscripts are significantly(P<0.05) different

Table 4. Carcass characteristics and organ weight of broilers fed *Jatropha curcas* leaf extract diets

Parameters	1	2	3	4	5	SEM
Live weight(kg)	1.84	1.80	1.71	1.88	1.84	0.097
Dresses weight (kg)	1.50	1.54	1.39	1.51	1.54	0.08
Thighs(% of dressed wt)	14.04	26.34	26.78	27.62	25.46	0.37
Drumsticks (√√)	11.64	12.32	12.68	12.07	12.25	0.36
Wings (√√)	9.69^{ab}	10.08^{ab}	10.4^{a}	9.26^{b}	9.88^{ab}	0.67
Backs (√√)	16.59	17.23	16.60	17.91	18.51	0.67
Breasts (√√)	27.62	26.34	26.78	27.85	25.46	0.85
Neck (√√)	5.31	5.80	5.38	6.04	5.53	0.29
Livers (√√)	3.50	3.24	3.32	2.92	3.16	2.28
Gizzards (√√)	4.46	4.25	3.99	4.19	4.37	0.34
Hearts (√√)	0.58	0.61	0.57	0.53	0.61	0.06
Feet (√√)	3.77	4.97	5.23	4.39	4.85	0.49
Pancreas (√√)	0.43^{a}	0.36^{ab}	0.23^{b}	0.25^{b}	0.42^{a}	0.05
Spleens (√√)	0.21	0.16	0.20	0.12	0.11	0.04
Lungs (√√)	0.78	0.72	0.65	0.59	0.78	0.42
Kidneys (√√)	0.81^{a}	0.89^{ab}	0.71^{a}	0.44^{b}	0.85^{ab}	0.10
Heads (√√)	3.04^{ab}	3.19^{ab}	3.66^{a}	2.91^{a}	3.11^{a}	0.22

ab:Mean in the same row with different superscripts are significantly(P<0.05) different; Key: % of dressed weight = √√

Values obtained for wing in T3 and T4 shows significant differences with the value ranges from 10.4 to 9.26. The pancreas also showed significant differences which ranges from 0.43 to 0.23 respectively in T1 and T3. Results of the carcass analysis and organ weights are shown in Table 4. Best performance in terms of live weight and dressed weight were recorded for birds on treatment 1, 2, 4 and 5. Treatment 4 had the highest among the treatment especially in terms of live weight, thigh, and breast .Treatment 2 and 5 had the highest value for dressed weights while the highest values for drumstick and wing were observed in treatment 3. The highest value for breast were also seen in T4. This means the treatments with extract had the best total edible meat yield compared to birds from the control.

Although, the result showed that treatment 2 had the highest body weight values, treatments with leaf extract competes favourably with birds on control treatments (T1 and T2) in terms of dressed weight which means there were better distribution and location of meat on several parts especially the thigh, drumstick and breast.

Wing values differ significantly between treatments while values for liver, gizzard, heart, spleen and lungs did not differ significantly. This development showed there were reduced concentration of anti-nutritional factors and leaf extract in diets fed to the birds. This is because higher physiological values in organs and offals are stimulated by the presence of anti-nutritional factors and other harmful secondary metabolites. The lower values observed in treatments 3 and 4 for pancreas and treatment 4 for kidney showed that plant bio-actives present in *Jatropha curcas* leaf extract enhance the functioning of pancreas and kidney as digestive and excretory organs.

4. CONCLUSION

Most performance characteristics measured indicated no differences between the treatments. But broilers fed diet with 0.50 g/100 kg of *Jatropha curcas* extract gave the best feed conversion ratio and total weight gain.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sciencedomain.org/review-history.php?iid=1076&id=2&aid=8879