Nig. J. Anim. Prod. 2022, 49(2):75-85.https://doi.org/10.51791/njap.v49i2.3464 *Nigerian Journal of Animal Production*

Breast meat yield response and organ weight of broiler chickens to *Ocimum gratissimum* (Lyn) administered orally and in feed

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Abstract

Phytogenic feed additives are added in poultry diets as appropriate replacement for antibiotics. This experiment was aimed at accessing the effect of Ocimum gratissimum (Lyn) extracts on carcass yield of broiler chickens specifically to enhance breast meat and its effect on organ weights. A total of 195 Cobb-500-day-old broiler chicks were randomly distributed into three treatment groups of 65 birds each, having five replicates of 13 birds per replicate. Broiler chicks allotted to treatment 1 (T1) served as the control group and were not administered O. gratissimum extract orally or via feed. Birds in treatment two (T2) were given O. gratissimum extract as component of commercial feed while birds in treatment three (T3) were administered aqueous extract of O. gratissimum orally – 1 mL per bird per replicate once weekly. Commercial broiler starter and broiler finisher diets were provided for the birds all through the experimental period. The experiment was arranged in a completely randomized design and lasted 54 days. Data on carcass weight, weight of different carcass cut-up parts and internal organs was determined. Data were collected twice (on day 40 and day 54). Data were subjected to one-way analysis of variance and means separated with Duncan's multiple range test. Aqueous O. gratissimum extract improved ($p<0.05$) final live weight and breast meat weight of T3 on day 54 (2137.75 and 536.25), compared to T1 (1684.20 gm/bird and 395.25 gm/bird). Ocimum gratissimum extract in feed (T2) also enhanced ($p<0.05$) live weight and breast meat weight - 1858.80gm/bird and 420.50 gm/bird; respectively, compared to T1. A similar trend was observed on day 40. Consumption of O. gratissimum in either feed or orally did not influence ($p>0.05$) organ weights in T2 and T3. The study showed that O. gratissimum (Lyn) improved breast meat yield with no adverse effect on organ weights.

Keywords: Breast meat, broiler chicken, carcass yield, *Ocimum gratissimum*

Réponse du rendement en viande de poitrine et poids des organes des poulets à griller à l'Ocimum gratissimum (Lyn) administré par voie orale et dans les aliments

Résumé

Des additifs alimentaires phytogéniques sont ajoutés aux régimes alimentaires des volailles en remplacement approprié des antibiotiques. Cette expérience visait à accéder à l'effet des extraits d'Ocimum gratissimum (Lyn) sur le rendement en carcasse des poulets à griller spécifiquement pour améliorer la viande de poitrine et son effet sur le poids des organes. Un total de 195 poussins de chair Cobb âgés de 500 jours ont été répartis au hasard en trois groupes de traitement de 65 oiseaux chacun, avec cinq répétitions de 13 oiseaux par répétition. Les poussins de chair affectés au traitement 1 (T1) ont servi de groupe témoin et n'ont pas reçu d'extrait d'O. gratissimum par voie orale ou via l'alimentation. Les oiseaux du deuxième traitement (T2) ont reçu de l'extrait d'O. gratissimum comme composant

d'aliments commerciaux, tandis que les oiseaux du troisième traitement (T3) ont reçu un extrait aqueux d'O. gratissimum par voie orale - 1 ml par oiseau par répétition une fois par semaine. Des régimes commerciaux de démarrage et de finition pour poulets de chair ont été fournis aux oiseaux tout au long de la période expérimentale. L'expérience a été arrangée dans une conception complètement randomisée et a duré 54 jours. Les données sur le poids de la carcasse, le poids des différents morceaux de carcasse et les organes internes ont été déterminées. Les données ont été recueillies deux fois (au jour 40 et au jour 54). Les données ont été soumises à une analyse unidirectionnelle de la variance et des moyennes séparées avec le test à plages multiples de Duncan. L'extrait aqueux d'O. gratissimum a amélioré ($p < 0,05$) le poids vif final et le poids de la viande de poitrine de T3 au jour 54 (2137,75 et 536,25), par rapport à T1 (1684,20 g/oiseau et 395,25 g/oiseau). L'extrait d'Ocimum gratissimum dans les aliments (T2) a également amélioré ($p<0,05$) le poids vif et le poids de la viande de poitrine - 1858,80 g/oiseau et 420,50 g/oiseau ; respectivement, par rapport à T1. Une tendance similaire a été observée au jour 40. La consommation d'O. gratissimum dans les aliments ou par voie orale n'a pas influencé ($p>0,05$) le poids des organes en T2 et T3. L'étude a montré que O. gratissimum (Lyn) améliorait le rendement en viande de poitrine sans effet néfaste sur le poids des organes.

Mots-clés : Viande de poitrine, poulet à griller, rendement en carcasse, Ocimum gratissimum

Introduction

The sole aim of broiler chicken production is to provide healthy and good quality meat, with minimal losses. To achieve this aim, antimicrobial growth promoters (AGPs) known as antibiotics have been proficiently used over time to enhance feed efficiency, reduce mortality, ensure digestibility and improve general performance of broiler chicken. However, the effect of AGPs residues in the animal body on human health cannot be over emphasized, as they can cause hypersensitivity, injury to the liver, discoloration of teeth, and gastrointestinal disorder in human being (FAO, 2002; Jing *et al.,* 2009). The use of AGPs has been banned in many countries (Bajpai *et al.,* 2012; Tehseen *et al.,* 2016). Recent poultry research is focused on alternatives to antibiotics, for better broiler performance (carcass yield and quality inclusive) and optimizes gut health (Chand *et al.,* 2014; Tanweer *et al.,* 2014). Phytogenic (natural growth promoters derived from plant)feed additives (PFA) augment nutrient utilization in the gastrointestinal tract (GIT) by enhancing production of digestive secretions and enzymatic activity and may also influence mucosal thickness, thus contributing to diffusion of nutrients to the apical surface of epithelial cells, increased absorption and feed efficiency (Murugesan *et al.,* 2015). Medicinal plants may exert various functions in an animal body system which includes ameliorating poultry bird performance by improving digestive tract function (Fascina *et al.,* 2017), eliciting anti-inflammatory action, anti-oxidative and anti-microbial effects (Anugom and Ofongo, 2019; Zhu *et al.,* 2019). In addition, some have an effect on different physiological functions. Furthermore, studies have observed positive effects of PFA on the morphology of small intestinal tissues, such as increased villus height, decreased crypt depth, and increased goblet cell counts (Namkung *et al*., 2004; Jamroz *et al*., 2006; Reisinger *et al*., 2011; Murugesan *et al*., 2015). Such effects on gastrointestinal morphology have been postulated to increase nutrient digestibility in poultry (Murugesan *et al.,* 2015). Overall, PFA are capable of reducing

microbial threat and promoting intestinal health, which is imperative for optimal bird performance and profitability (Murugesan *et al.,* 2015). The potential benefits, such as increased feed intake, stimulation of digestion and improved feed efficiency among, others have therefore raised interest among animal nutritionists. *Ocimum gratissimum* (scent leaf) is a plant widely known and used for both medical and nutritional purposes. It is a perennial plant that is widely distributed; therefore, there would be no problem of unavailability when required for economic production. Growth performance promoting potential of *O. gratissimum* (Lyn) has been earlier reported (Anugom and Ofongo, 2019) but its benefit in enhancing carcass breast meat yield in broiler chickens is limited. This study was designed to access the effect of *O.gratissimum*(Lyn) extracts on carcass yield of broiler chickens, **specifically;** to evaluate the possibility of enhancing breast meat and the impacts on organ weights of broiler chickens.

Materials and methods

Experimental site

The was conducted at the Poultry Unit, Teaching and Research Farm, Niger Delta University, Wilberforce Island, Bayelsa State, Nigeria. Wilberforce island falls between latitude 4.9703200 and longitude 6.10915000.

Management practice

The birds were given "anti-stress" (vitalite) on their arrival, to minimize the adverse effect of long-distance transportation on them. Afterwards, no vaccine or medication was administered. Farm hygiene/maintenance practices and clean water/feed in clean drinkers/feeders were observed.

Preparation of O. gratissimum leaves extract

Fresh *O. gratissimum* (scent) leaves were obtained from Amassoma market, Bayelsa State. The leaves were rinsed in clean water to remove dirt and debris, and the water was allowed to drain off the leaves. The leaves were cut into small particle size, weighed then milled with an electric milling machine (electric blender – Binatone blender/grinder BLG 450). One kilogram (1kg) of leaves was blended with 1500mL of clean table water in an electric milling machine until a smooth consistency is obtained. After blending, the filtrate (aqueous extract) was obtained by passing through a cheese cloth and quantity obtained determined with a measuring cylinder. The filtrate was placed in a big container, rice husk was weighed and added to the filtrate until it was completely absorbed then the quantity noted. Thereafter, the rice husk filtrate mixture was dried in an oven at 50ºC to keep the protein and other nutrients in *O.gratissimum* intact. Rice husk was used as a carrier of the extract. A total of 30.15 kg of the chopped *O. gratissimum* leaf was milled and the filtrate absorbed into 45.24 kg of rice husk. Aqueous extract of *O. gratissimum* was also prepared (1kg milled with 750 mL of clean water) using the above stated method however, it was not added to a carrier but prepared on a weekly basis and administered orally – 1 mL/bird in each replicate of birds allocated to its specific treatment group.

Feeding trial

A total of one hundred- and ninety-five, one-day old Cobb 500 broiler chicks were used for this study. They were procured from Agrited Hatchery, Ibadan, Oyo State. The birds were brooded together for a period of ten days. They were thereafter, randomly distributed into three treatment groups, represented as T1, T2 and T3 having five replicates of 13 birds per replicate. Birds in treatment (T1) served as control, they were given only concentrate feed (commercial broiler starter and finisher diet). The birds in T2 were fed a

commercial broiler diet (starter and finisher) supplemented with one aqueous *O. gratissimum* extract absorbed in rice husk at an inclusion rate of 75 g/ kg of diet. Birds in T3 were also fed commercial diet, alongside oral administration of aqueous extract of *O. gratissimum*–1ml *per bird per week per respective replicate*. Feed and water were supplied *ad libitum* throughout the experiment. The experiment was designed as a completely randomized design and lasted 54 days.

Data collection

Data on initial live weight and final live weight on day 40 and day 54; respectively were recorded. One bird per replicate was randomly selected to determine carcass yield on days 40 and 54, respectively. Selected birds were separated from the flock overnight with access to only water. It was weighed and slaughtered by severing the jugular vein. Defeathered and eviscerated weights was determined after removal of the feathers and viscera. After removal of the head, neck, shanks, spleen, digestive tract, liver, heart, gizzard, and abdominal fat, the rest of the body were weighed to determine the dressed weight. The defeathered weight, eviscerated weight, and weight of the different parts of the bird were recorded. The breast meat was separated after cutting up the carcass to different cut-up parts and weighed both on day 40 and day 54. The cut-up parts were expressed as percentage of the final live weight. Data collected were subjected to one way analysis of variance using IBM SPSS version 25 and means were separated using Duncan's multiple range test at $\alpha_{0.05}$.

Results and discussion

Analyzed nutrient composition of experimental diet

The dry matter composition of the experimental diets ranged between 908.85 to 918.80 gm as indicated in Table 1 below. The crude protein concentration was within acceptable range for both starter and finisher diet (NRC 1994). A slight increase in ash concentration was only observed in both starter and finisher diet after inclusion of *O. gratissimum* extract as component of rice husk. Rice husk has been earlier reported to have a high ash, soluble and insoluble non-starch polysaccharide concentration (Ofongo *et al*., 2008), which possibly added to the observed higher crude fibre and ash concentration of the diets.

Table 1: Nutrient composition of experimental diets (g/kg DM)

	Diets			
Nutrients	Starter	Finisher	Starter + OGE	Finisher + OGE
DM (g)	908.85	909.00	918.80	910.95
Crude protein	220.10	186.65	225.20	186.90
Ether extract	84.50	74.75	84.95	70.10
Crude fibre	80.10	104.50	105.10	132.70
Ash	105.00	63.35	118.00	95.00
NFE	510.30	570.80	464.75	515.30

OGE (*Ocimumgratissimum* extract as component of rice husk);DM: dry matter; NFE: Nitrogen Free Extract

Carcass weight of birds fed experimental diets –day 40 and day 54

The results presented in Table 2 shows difference ($p<0.05$) between live weight of birds across the three treatment groups at day 40. Birds in T3 recorded had the highest live weight (1501.25gm), while birds in T1 weighed 1268.50gm, which was the lowest weight recorded. The birds in T2 showed a higher ($p<0.05$) live weight to birds in T1. Bled weight was significantly different ($p<0.001$) across the treatment group with

the least value of 1172.25g recorded for birds in T1. A similar trend observed for final live weight was also observed in bled weight values across the treatments. Defeathered weight and eviscerated weight expressed as a percentage of live weight was not significantly different ($p>0.05$) a across the treatment groups as indicated in Table 2. Carcass weight of broilers at day 54 is presented in Table 3. Administration of aqueous *O. gratissimum* and supplementation of *O. gratissimum* in broiler diet resulted in higher ($p<0.001$) final live weight and bled weight. Defeathered and eviscerated weight expressed as percentage of final live weight followed a similar trend as recorded at day 54 in birds administered *O. gratissimum* orally at day 40. Live weight recorded for T3 was 2137.75gm, while birds in T1 weighed 1684.25gm, which was the lowest weight recorded. The birds in T2 had higher ($p<0.001$) live weight (1858.50) compared to birds in T1 – 1684.25.

Table 2: Carcass weight of birds fed experimental diets (gm) – day 40 (% of live weight)

	Treatments				
Variables	1	2	3	*P value*	SEM
Initial live weight	140.8	140.8	140.8		
Final live weight	1268.50^{c}	1407.25^{b}	1501.25^{a}	0.001	23.50
Bled weight	1172.25^{c}	1285.75^{b}	1347.75^{a}	0.001	4.36
Defeathered weight (%)	88.77^{ns}	85.13^{ns}	85.42^{ns}	0.110	1.95
Eviscerated weight (%)	67.19^{ns}	69.67^{ns}	66.94^{ns}	0.185	1.06

1: Control group; 2: OGE + Feed; 3: Aqueous *O.gratissimum* extract.
^{ab}: Means along the same row with superscript are significantly different ($P<0.05$); ns: not significant ($p>0.05$)

Table 3: Carcass weight of birds fed experimental diets (gm) - day 54 (% of live weight)

	Treatments				
Variable	1	2	3	*P value*	SEM
Final live weight	1684.25^{c}	1858.50^{b}	2137.75^{a}	0.001	6.71
Bled weight	1572.50^{c}	1702.25^{b}	1920.00^{a}	0.041	18. 21
Defeathered weight (%)	88.18^{ns}	86.02^{ns}	86.46^{ns}	0.322	1.42
Eviscerated weight (%)	70.91^{ns}	70.98^{ns}	71.48^{ns}	0.479	0.349

1: Control group; 2: OGE in Feed (OG + Feed); 3: Aqueous *O.gratissimum* extract.
^{ab}: means along the same row with different superscripts are significantly different ($P<0.05$); ns: not significant ($p>0.05$)

Carcass cut-up parts at day 40 and day 54

The wing, fore back, shank and neck expressed as percentage of the final live weight were significantly different ($p<0.05$) across the treatment on day 40 as indicated in Table 4. While values recorded for other cut-up parts such as hind back, drum stick, thigh and head were similar ($p>0.05$) across all treatments. At day 54 of the experiment, the fore back, hind back, drumstick, thigh, neck and head expressed as percentage of the live weight were significantly different ($p<0.001$) across the treatment groups – Table 5. The wing and shank were not significantly different ($p>0.05$) across the treatment groups.

Table 4: Weight of Carcass cut-up parts (% of final live weight) - day 40 of the experiment

	Treatments				
Carcass part	1	2	3	*P value*	SEM
Wings	7.69[a]	6.96[b]	6.84[b]	0.001	0.108
Fore back	2.62[a]	2.33[b]	2.32[b]	0.001	0.037
Hind back	10.82	10.86	11.03	0.665[ns]	0.174
Drumstick	10.56	10.50	10.08	0.120[ns]	0.159
Shank	4.20[a]	3.77[b]	4.24[a]	0.001	0.067
Thigh	10.41	10.66	10.29	0.317[ns]	0.162
Neck	1.36[a]	1.28[b]	1.32[ab]	0.054	0.021
Head	3.47	5.07	3.61	0.278[ns]	0.727

1: Control group; 2: OGE in Feed (OG + Feed); 3: Aqueous *O. gratissimum* extract.
ab: Means along the same row with different superscripts are significantly different ($p<0.05$); ns: not significant ($p>0.05$).

Table 5: Weight of Carcass cut-up parts (% of final live weight) – day 54 of the experiment

	Treatments				
Carcass part	1	2	3	*P value*	SEM
Wings	8.10	7.59	7.36	0.381	0.320
Fore back	3.59[a]	3.38[b]	3.19[c]	0.001	0.009
Hind back	10.31[b]	11.04[a]	9.82[c]	0.001	0.039
Drumstick	11.09[a]	10.63[b]	9.41[c]	0.001	0.051
Shank	5.10	3.70	3.39	0.253	0.718
Thigh	11.50[a]	11.23[b]	10.21[c]	0.001	0.039
Neck	1.37[a]	1.12[b]	0.87[c]	0.001	0.005
Head	3.80[a]	3.30[b]	2.88[c]	0.001	0.013

1: Control group; 2: OGE in Feed (OG + Feed); 3: Aqueous *O.gratissimum* extract.
[ab]: means along the same row with different superscripts are significantly different ($P<0.05$); ns: not significant ($p>0.05$).

Breast meat yield

Inclusion of *O. gratissimum* in diet and administration of aqueous *O.gratissimum* extract (AOGE) orally resulted in higher weight ($P<0.05$) of breast meat at both day 40 and day 54 (Fig 1). Weight of breast meat of birds in T3 was higher (331gm and 536.25gm) at day 40 and day 54; respectively, while birds in T1 recorded a lower weight of breast meat (264.25gm and 395.25gm) at day 40 and day 54, respectively.

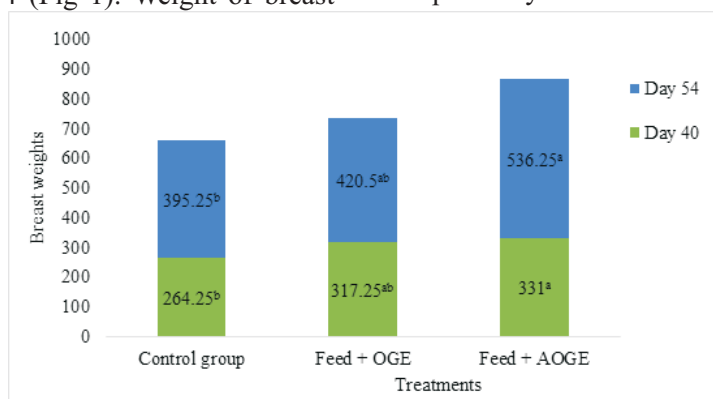

Fig.1: Breast meat weight of birds (gm) at day 40 and 54

Effect of O. gratissimum on carcass yield of broiler chickens

Poultry meat quality has become a growing demand of both international and domestic markets. Factors that can affect poultry meat quality are complex and occur throughout the production cycle. The goal is to produce high-quality carcasses and critical factors such as nutrition, rearing conditions and pre-slaughter management cannot be overemphasized nor over looked in achieving this goal. Interestingly, the results showed that birds in treatments 2 and 3 which consumed *O. gratissimum* either via feed or orally performed better in terms of live weight and carcass yield when compared to the control group. The breast meat of birds that consumed *O. gratissimum* had more weight than the control group. This result agreed with Ryan (2018); who reported that adding herbs to poultry feed has an effect on digestive enzymes which results in an overall improvement on performance parameters such as weight gain and carcass yield. The result of this study is also in line with an earlier report by Anugom and Ofongo (2019), indicating the impact of orally administered aqueous *O. gratissimum* (Lyn) extract on growth performance, gut pH and bacterial counts in broiler chickens. Improved growth performance – final live weight and weight gain of broilers – was attributed to gut bacteria modulatory effect of aqueous *O. gratissimum* leaf extract. Other studies with *O. gratissimum* and *O. sanctum* have reported positive impact of this herb on growth and carcass yield. Singh *et al*., (2014) reported that feeding of *Ocimum* leaf powder to broiler chicks at 1 %level in feed resulted in significant increase in muscle weight of breast, thigh, and legs resulting in higher body weight compared to control chicks. According to Hasan *et al.* (2016) supplementation of *Ocimum* leaf extract in water significantly increases body weight of cobb broiler by 16.97% compared to control group. The inclusion of *O. gratissimum* leaf meal in diets of broiler chickens was reported to have no detrimental effect on performance characteristics but improved the livability of the birds (Olumide *et al*., 2018). The report of Biswas *et al.* (2017) with broiler chickens administered *O. sanctum* leaves extract at 1ml/litre in drinking water resulted in significantly higher body weight in comparison to control group. The result of the present study also corresponds with earlier report by Onu (2010), who evaluated two herbal spices as feed additives for finisher broilers and reported a significant difference in weight gain of birds among the treatments. Birds that were fed with garlic and ginger supplemented diets recorded the highest body weight gain, while birds fed with non-supplemented diet had the lowest body weight gain. The significant difference in body weight between birds in the treatments of this study also substantiated the reports of Nadia *et al*. (2008) and Al-kassie *et al*. (2011). According to the authors, feeding herbs to broiler chickens stimulate secretion of digestive enzymes, thereby improving nutrient digestibility and ultimately enhance performance of birds and hence, more carcass yield

Internal organs of experimental birds –day 40 and day 54

Inclusion of *O. gratissimum* in diet and oral administration of aqueous *O. gratissimum* extract (AOGE) had no ($P > 0.05$) effect on internal organs of birds when compared to birds in the control group at day 40 (Fig: 2). At day 54 of the experiment, the weight / size of gizzard, liver and heart of birds across all treatments was similar ($P > 0.05$) as indicated in Fig: 3.

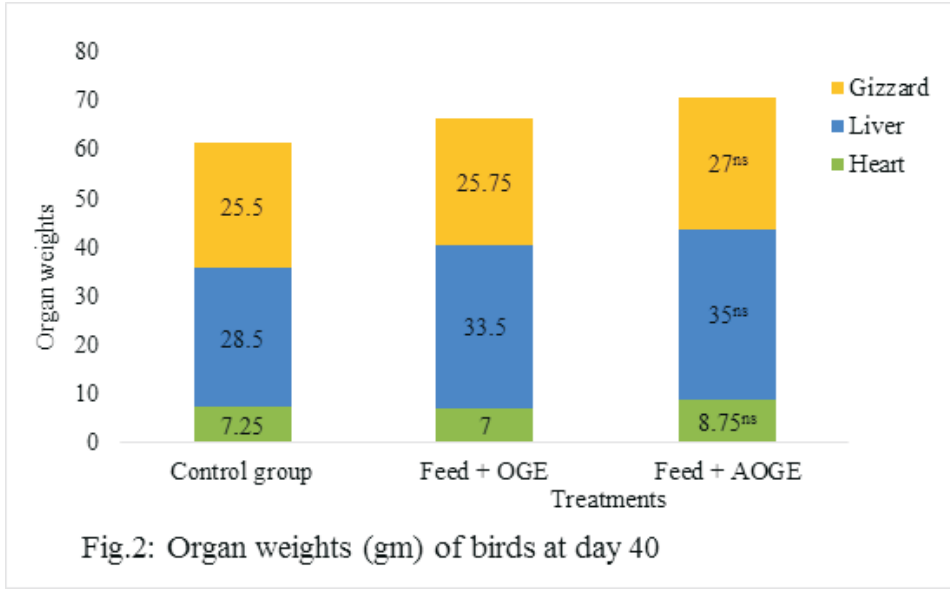

Fig.2: Organ weights (gm) of birds at day 40

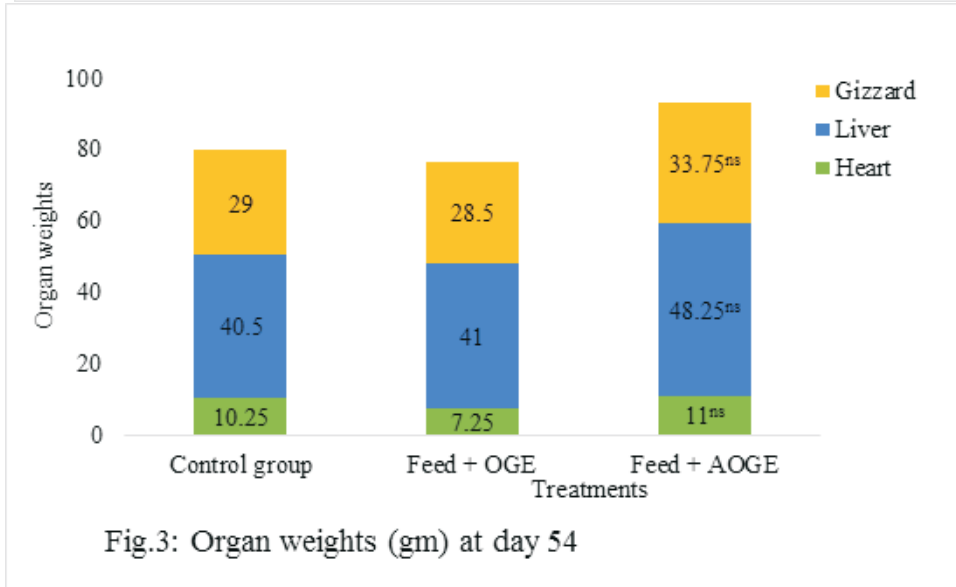

Fig.3: Organ weights (gm) at day 54

Effect of O. gratissimum on internal organ weight of broiler chickens

Consumption of *O. gratissimum* extract either via feed or orally had no effect on organ weight of broiler chickens across the treatment groups. This further attest to the report of Cabuk *et al*. (2006) which stated that internal organs such as liver, pancreas, proventriculus, gizzard and small intestines were not affected by addition of herbal essential oil mixture to diet of broiler chickens. Furthermore, poultry disease called "Ascites" (water belly) which affects fast growing chickens, causes the right side of their hearts to become enlarged in response to increased workload during the bird's rapid growth. The bird has to breathe more rapidly thereby making its lungs become congested. The liver function can also be affected and the abdomen filled with fluid, increasing the rate of heart failure. However, the result of this study

showed that administration of *O. gratissimum* had no negative effect such as reduction or enlargement of internal organs of birds that could bring about disease in birds, despite the rapid/better growth rate of birds that consumed it.

Conclusion

The study showed that the broiler chickens administered aqueous *O. gratissimum* extract (AOGE) performed better. The carcass cut-up parts such as breast and drumsticks of birds administered 'AOGE' yielded more meat than those of birds fed concentrate +OGE and birds in the control group. Weight of carcass cut-up parts of birds fed concentrate +OGE was relatively higher than those of birds in control group. Consumption of *O. gratissimum* extract either orally or via feed improved carcass yield of broiler chicken without eliciting any detrimental effect on internal organs of broiler chickens.

References

A. O. A. C. 1990. Official Methods of Analysis, (Sections 926.08, 925.09, 955.04C, 979.09,922.06, 954.02, 923.03, 962.09), (Washington, DC: Association of Official Analytical Chemists) 15th edn. (1990).

Al-Kassie, G.A.M., Mohseen, A.M. and Abd-Al-Jaleel, R.A. 2011. Modification of productive performance and physiological aspects of broilers on the addition of a mixture of cumin and turmeric to the diet. *Research Opinions in Animal and Veterinary Sciences,* 1: 31-34.

Anugom, Y. and Ofongo, R.T.S. 2019. Impact of Aqueous *Ocimum gratissimum* (Lyn) Leaf Extract on Growth Performance, Gut pH and Bacteria Counts in Broiler Chickens. *International Journal of poultry science.* Vol 18: 309 – 316.

Bajpai, V.K., Baek, K. and Kang, S.C. 2012. Control of Salmonella in foods by using essential oils, a review. *Food Res Inter.* 45:722–734.

Biswas, A.K., Rahman, M.M., Hassan, M.Z., Sultana, S. and Rahman, M.M. 2017. Effect of Tulsi (*Ocimum sanctum*) leaves extract as a growth promoter in broiler production. *Asian J Med Biol Res*3(2): 226-232.

Chand, N., Ihsanudin, K.S. and Khan, R.U. 2014. Replacement of soybean meal with yeast single cell protein in broiler ration: the effect on performance traits. *Pak J Zool.*46:1753–1758.

Cubak, M., Bozkurt, M., Ahmet, A. and Yavuz, A. 2006. Effect of a herbal essential oil mixture on growth and internal organ weight of broilers from young and old breeder flocks**.** *South African Journal of Animal Science*(36)2.DOI:10.3923/ijps.2019.309.316

FAO (food and agricultural organization) 2002. Evaluation of certain veterinary drug residues in food: fifty eighth report of the Joint FAO/WHO Expert Committee on Food Additives, WHO technical report series,No. 911. FAO, Rome. (2002), 33.

Fascina, V.B., Pasqual, G.A.M., Carvallo, F.B., Muro, E.M.,Vercese, F., Aoyagi, M.M., Pezzato, A.C. Gonzales, E. and Sartori, J.R. 2017. Effects of Phytogenic Additives and Organic Acids, alone or in combination, on the Performance, Intestinal Quality and Immune Responses of Broiler Chickens. *Braz. J. of poult. Sci.* Vol. 19 (3): 497 – 508.doi.org/10.1590/1806-9061-

2016-0422

Hasan, M.N., Mostofa, M., Sorwar, M.G., Hasan, M.T., Das, K. and Hossain, D.M.N. 2016. Effects of tulsi leaf extract on body weight gain in broiler production. *Bangl J Vet Med* 14(1): 21-15.

Jamroz D, Wertelecki T, Houszka M, Kamel C. 2006. Influence of diet type on the inclusion of plant origin active substances on morphological and histochemical characteristics of the stomach and jejunum walls in chicken. *J Anim Physiol Anim Nutr* 90:255–68. doi:10.1111/j.1439-0396.2005. 00603.x 17.

Jing, T., Gao, X.D., Wang, P., Wang, Y., Yan, F.L., Hu, X.Z., Hao, Q.L., Zhuo, Y.K and Mei, S.R. 2009. Determination of trace tetracycline antibacterial in foodstuffs by liquid chromatography-tandem mass spectrometry coupled with selective molecular-imprinted solid-phase extraction. *Analytical Bioanalytical Chemistry*. (2009); 393:2009-2018.

Murugesan GR, Syed B, Haldar S and Pender C. 2015. Phytogenic feed additives as an alternative to antibiotic growth promoters in broiler chickens. *Front. Vet. Sci.* 2 : 2 1 . d o i : 10.3389/fvets.2015.00021

Nadia, R.L., R.A. Hassan, E.M. Qota and H.M. Fayek, (2008). Effect of natural antioxidant on oxidative stability of eggs and productive and reproductive performance of laying hens. *Int. J. Poult. Sci.,* 7: 134-150.

Namkung H, Li M, Gong J, Yu H, Cottrill M, de Lange CFM. 2004. Impact of feeding blends of organic acids and herbal extracts on growth performance, gut microbiota and digestive function in newly weaned pigs. *Can J Anim Sci* 84:697–704. doi:10.4141/A04-005 18.

National Research Council, (1994). Nutrient Requirements of Poultry. 9thRev.ed. National Academy Press, Washington, Dc.

Ofongo, S.T., Kehraus, S., Iyayi, E.A. and Südekum, K. H. (2008). Rice Mill Feed: An Agro-industrial By-product with Potential for Rural Development. In: Proceedings of Tropentag (Conference on International Research on Food Security, Natural Resources Management and Rural Development) University of Hohenheim, Stuttgart - Germany. 7th - 9th October, 2008. Pp 439

Olumide, M.D. and Akintola, A.S. 2018. Effect of scent leaf meal (*Ocimumgratissimum*) supplementation on performance, carcass and meat quality of broiler chicken. *Niger. J. Amin. Prod.*Vol.45 No.3 pp.228-236. D O I : https://doi.org/10.51791/njap.v45i3.436

Onu, P.N. 2010. Evaluation of two herbal spices as feed additives for finisher broilers. *Biotechnology in Animal Husbandry* 26 (5-6), p 383-392.

Reisinger, N., Steiner, T, Nitsch S, Shatzmayr G, Applegate T. 2011. Effects of a blend of essential oils on broiler performance and intestinal morphology during coccidial vaccine exposure. *J Appl Poult Res* 20:272–83. doi:10.3382/japr. 2010-00226 19.

Ryan J. 2018. Herbs and spices: a sustainable alternative to antibiotics. The Poultry Site.

Singh A, Doley P, Gogoi S, Neeraj. 2014. Effect of dietary tulsi (*Ocimum*

sanctum)leaves powder on muscle growth of broiler chicks. *Int J Biol&Pharmaceu Res* 5(1): 1-3.

Tehseen M, Tahir M, Khan RU, Jabbar A, Ahmad B, Ahsan T, Khan S, Abudabos AM. 2016.*The Philippine Agricultural Scientists.* 99:408–413.

Zhu N, Wang J, Yu L, Zhang Q, Chen K, Liu B. 2019. Modulation of Growth Performance and Intestinal Microbiota in Chickens Fed Plant Extracts or Virginiamycin. *Front. Microbiol.* 10: 1333. doi.org/10.3389/fmicb.2019.01333

Received: 5th November, 2021
Accepted: 25th February, 2022