MONOSODIUM GLUTAMATE AND ITS EFFECT ON GUT MICROBIOME OF BROILER CHICKENS

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ABSTRACT
This study was conducted to investigate the effect of monosodium glutamate on the gut microbiome of broiler chickens. A total of One hundred and forty-four (144) day old broiler chicks were used for the experiment. The birds were randomly allotted to four dietary (4) treatment (T) groups having 36 birds per treatment which was further sub-divided into -10birds per replicate. The control groups (T1) were fed diet without monosodium glutamate (MSG) while other groups were fed diets containing different inclusion levels of monosodium glutamate of 3g/kg (T2), 6g/kg(T3) and 9g/kg (T4). At the end of the experiment intestinal cecal content was collected and analyzed according to standard procedures. Data collected were subjected to one way analysis of variance in a Completely Randomized Design using (SAS). Results obtained showed that significantly($p<0.05$) higher total bacteria count was obtained from birds fed diet containing 3g/kg of monosodium glutamate compared to lower count obtained from birds fed 9g/kg of monosodium glutamate. Total coliform count was significantly ($p<0.05$) higher in birds fed diet containing monosodium glutamate across treatment groups compared to lower mean value recorded for the control groups. Higher fungi count was obtained from birds fed diet containing 3g/kg and 6g/kg compared to lower count observed in the control groups. Therefore, it can be concluded that inclusion of monosodium glutamate in the diet of broiler is capable of lowering bacteria count in the gastro intestinal tract of broiler chickens and maintaining a balance in the intestinal microflora by increasing beneficial microorganisms and reducing harmful or pathogenic organism as identified during the study.

Keywords: Feed additive, Gut microbiome, Sodium glutamate, Broiler chickens

INTRODUCTION
Feed additives in farm animal nutrition have gained considerable interest over the years, as a result of their potential in enhancing growth, maintaining immune functions and improving intestinal environment. Several feed additives have been adopted in the poultry industry inorder to enhance the performance and well-being of broiler chickens; one of which are flavouring agents. Flavoring agents are supplements added to the ration to enhance feed intake, improve palatability and acceptability of feeds (Jay *et al*. 2010). One of these flavouring agents is Monosodium glutamate. Monosodium glutamate (MSG) is the sodium salt of glutamic acid and the main component of many proteins (Tawfik and AlBadr, 2012). Research findings by Azine *et al*. (2018) suggest that improvement in live body weight and weight gain in their study might be attributed to the multiple effects of monosodium glutamate on the digestive tract which resulted in an increase in gastric and pancreatic secretions, better digestion and absorption of nutrients with improved growth performances (Burrin and Janeczko, 2008). Gastrointestinal tract (GIT) of broiler chickens plays a major role in the growth and well-being during growth and development (Clavijo and Florez, 2018). The integrity of the intestinal structure and the gut microbial community play vital roles in nutrition, absorption (Pan and Yu 2013) immunity and disease resistance (Carter *et al*., 2009). Alteration of bacterial microbiota may adversely affect feed efficiency, productivity and chicken health (Kohl *et al.,* 2012). Hence, studies are now focused on chicken gut environment in order to understand the relationship between different gut microbiome and their effects on chicken health status. Glutamine has been reported to sustain gut microbiome balance. Glutamine plays a crucial role in promoting gut health and functionality by positively maintaining the equilibrium of the gut microbiome and enhancing the expression of tight junction proteins, thereby improving the integrity of the intestinal lining and reducing the inflammatory responses associated with gut mucosal irritation (Deters *et al*., 2021). Therefore, there is a need to investigate how dietary levels of monosodium glutamate could influence the gut microbiome of broiler chickens. Hence, this study aimed at evaluating the effects of monosodium glutamate on the gut microbiome of broiler chickens.

MATERIALS AND METHODS

Experimental Site

The experiment was carried out at the Directorate of university farms of College of Animal science and Livestock production, Federal university of Agriculture, (Latitude 7°10°N and Longitude 3°E) Abeokuta. Ogun State, Nigeria. The area has a tropical climate characterized with annual rainfall of about 1037mm, minimum and maximum temperatures of 20.66°C and 35.48°C respectively. (Google earth 2023)

Source of Test Ingredient

Monosodium glutamate was sourced from a local market within Abeokuta metropolis and kept in an air-tight container before usage.

Experimental Animal and Management

A total of one hundred and forty-four (144) day old Abor acre broiler chicks were purchased from a reputable hatchery in Ibadan, Oyo state. The pen was washed and disinfected prior (2weeks) to the arrival of the birds. The chicks were brooded separately and fed with a commercial starter and finisher ration. Feed and water were provided *ad libitum* during the experiment. Graded levels of monosodium glutamate were added into the ration of the birds at different inclusion levels. The administration of the test ingredient started from the first day of arrival of the birds and it was fed throughout the experiment. The experiment lasted for 7weeks. The birds were fed with a starter and finisher diet containing (23% crude protein and ME of 2800kcal/kg, 19% crude protein and 3000kcal/kg) respectively.

Experimental Design

One hundred and forty-four (144) day old broiler chicks were randomly allotted to four (4) treatment groups having 36 birds per treatment which was further sub-divided into 9birds per replicate. The test ingredient was used as a dietary inclusion. Standard vaccination procedure was observed for all birds.
Treatment 1: Birds were fed Basal diet, Treatment 2: basal diet + 3g/kg monosodium glutamate, Treatment 3: basal diet +6g/kg monosodium glutamate, Treatment 4: basal diet+ 9g/kg monosodium glutamate.

Data Collection

Gut microbial count

On the 49th day of experiment, birds close to the average mean weight from each replicate was slaughtered, defeathered without hot water and eviscerated, after which the cecal content was collected into plain sample bottles and taken to the laboratory for further analysis.

Statistical Analysis

Data collected were subjected to One-way analysis of variance (ANOVA) in a Completely Randomized Design. Significant means were compared using Duncan multiple range test using SAS (2012) software package.

Statistical model

$\gamma ij = \mu + Ti + \varepsilon ij$
γij = Observed response on ij^{th}
μ = Overall mean
Ti = effect of i^{th} (glutamate salt*)* treatment
εij = residual error

RESULTS AND DISCUSSION

Gut microbiome of broiler chickens fed diet containing monosodium glutamate

The effect of monosodium glutamate on gut microbiomeof broiler chickens is shown in Table 1 while Table 2 shows the identified Bacteria, Fungi and Coliform isolates. The result obtained showed that gut microbiome of broiler chickens was highly influenced by the inclusion of monosodium glutamate. Significantly ($P<0.01$) higher bacteria count was obtained from birds feddiet containing 3g/kg of MSG compared to lower bacteria count recorded for birds on 6g/kg of MSG. This result showed that higher inclusion levels of MSG reduce bacteria count in the gastrointestinal tract of broiler chickens, this result

could be attributed to the presence of glutamate trying to balance the intestinal microflora thereby reducing bacteria growth.

Table1: Effect of Monosodium glutamate on gut microbiome of broiler chicken

Parameters	Control	3g/kgMSG	6g/kgMSG	9g/kgMSG	P-Value
TBC	6.833±0.12[b]	9.167±0.17[a]	1.667±0.08[d]	3.700±0.05[c]	0.01
TCC	1.467±0.14[b]	9.033±0.29[a]	8.800±0.50[a]	8.000±0.36[a]	0.01
TFC	1.917±0.04[c]	8.900±0.57[a]	8.267±0.14[a]	6.967±0.34[b]	0.01

abc: Means with different superscript are significantly different at, 0.01.
TBC:Total bacteria count, TCC:Total coliform count, TFC:Total fungi count

Table 2: Identification of Bacteria, Fungi and Coliform isolates present during isolation

Treatments	Bacteria isolate	Coliform isolate	Fungi isolate
CONTROL	*Bacillusspp; Pseudomonassp; Micrococcussp*	*Aeromonasspp; Proteusspp;E.coli, Salmonellaspp*	*Aspergillusspp; Penicilliumsp: Rhizopusspp;*
3g/kgMSG	*Bacillusspp; Pseudomonasspp; Flavobacteriumsp; Staphylococcussp*	*Aeromonasspp; Proteusspp;Ecoli' Salmonellaspp*	*Aspergillusspp; Penicilliumsp; Rhizopusspp; Candidaspp*
6g/kgMSG	*Bacillusspp; Pseudomonasspp; Staphylococcussp*	*Aeromonasspp; Proteusspp;Ecoli, Salmonellaspp*	*Aspergillusspp; Penicilliumsp; Rhizopusspp; Mucorspp*
9g/kgMSG	*Bacillusspp; Pseudomonasspp; Flavobacteriumspp; Staphylococcussp*	*Aeromonasspp; Ecoli,Salmonellaspp*	*Aspergillusspp; Penicilliumspp; Rhizopusspp; Geotricumsp; Candidaspp*

This result corroborates the findings of (Azine *et al*., 2018) who reported significantly higher bacteria count irrespective of the bacteria in broilers chickens given jumbo cube additives as monosodium glutamate compared to other groups. Significantly ($p<0.01$) higher coliform count was obtained from birds fed diet containing monosodium glutamate compared to significantly ($p<0.01$) lower count obtained from birds fed without monosodium glutamate. This result showed that inclusion of monosodium glutamate increased the proliferation of coliform within the intestinal tract of broiler chickens. This result supports the findings of Azine *et al.* (2018) who reported increasing trend of Escherichia coli in the diet of broiler chickens when monosodium glutamate was increased in the diet of broiler chickens. Also, this result contradicts the findings of Osman and Mohammed (2021) who reported decreasing trend in *Escherichia coli* of broiler chickens administered monosodium glutamate. Higher fungi count was obtained from birds fed diet containing 3g/kg and 6g/kg of monosodium glutamate compared to lower count obtained for birds in the control groups. This result showed that inclusion of monosodium glutamate at 3g and 6g/kg increased proliferation of fungi organism within the gastrointestinal tract of broiler chicken. This result could not be attributed to the test ingredient as sodium glutamate as not been reported to have any effect on total fungi count.

CONCLUSION

Based on the results obtained in this study, it can be concluded that the inclusion of monosodium glutamate in the diet of broiler chickens reduced total bacteria count in the gastrointestinal tract of broiler chickens. Also, monosodium glutamate could help in maintaining the balance in gut microbiome of broiler chickens as bacteria to coliform count was balanced at level not detrimental to the birds.

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