Nig. J. Anim. Prod. 2022, 49(4): 97-105. https://doi.org/10.51791/njap.v49i4.3707 *Nigerian Journal of Animal Production*

Effects of African nutmeg spice in *Aspergillus flavus* infected diets on Nutrient digestibility, Haematology and Blood chemistry of Broiler chickens

[1]Ukoha, O. A, [2]Onwudike, O. C., [1]Ukachukwu, S. N. and [1]Onabanjo, R. S.
[1]Department of Animal Nutrition and Forage Science,
Michael Okpara University of Agriculture, Umudike.
[2] Rhema University, Aba- Abia State.
Corresponding author: Onyedinma26@ gmail.com (08063967602)

Abstract

Aspergillus flavus poses a lot of threat to poultry farmers in Nigeria. This is because they produce aflatoxin in stored feed ingredients thereby reducing the potency of such feed ingredients and productivity of birds fed such contaminated feeds. African nutmeg (Monodora myristica) is a spice planted locally in Nigeria and has the potential to improve feed flavour and is used as an additive in human diets. An experiment was conducted to evaluate effects of Monodora myristica in an Aspergillus flavus infected diets of Broiler chickens using a 2 x 3 factorial arrangement in a Completely randomized design that lasted for 42 days on haematology, blood chemistry and nutrient utilization. Three (3) out of the six (6) dietary treatments were infected with 1mg of pure culture of Aspergillus flavus and Monodora myristica included at 0%, 0.5% and 1.0%, while the other diets were infection-free but with 0, 0.5 and 1.0% M. myristica included. Each treatment was replicated three times with 30 chickens per replicate. Nutrient digestibility, haematological and blood chemistry indices were measured. . Monodora myristica at 0.5 and 1.0% levels of inclusion significantly (P<0.05) improved digestibility of all nutrients in both infected and non-infected diets. Haematological parameters except the MCHC were higher (P<0.05) in the non-infected diets while the level of inclusion of the spice at 0.5% and 1.0% had (P<0.05) impact only on the haemoglobin. As the level of inclusion increased, there was a (P<0.05) reduction in the serum cholesterol and urea. In conclusion, Monodora myristica spice improved the digestibility of nutrients as well as haematology and blood chemistry of Broiler chickens especially at levels of inclusion below 1.0%.

Keywords: *Aspergillus flavus, Monodora myristica*, broiler diets

Effets de l'épice de noix de muscade africaine dans les régimes infectés par Aspergillus flavus sur la digestibilité des nutriments, l'hématologie et la chimie du sang des poulets de chair

Résumé

Aspergillus flavus représente une grande menace pour les éleveurs de volaille au Nigeria. En effet, ils produisent de l'aflatoxine dans les ingrédients alimentaires stockés, réduisant ainsi la puissance de ces ingrédients alimentaires et la productivité des oiseaux nourris avec ces aliments contaminés. La noix de muscade africaine (Monodora myristica) est une épice plantée localement au Nigeria et a le potentiel d'améliorer la saveur des aliments pour animaux et est utilisée comme additif dans l'alimentation humaine. Cette étude a évalué les effets de Monodora myristica dans des régimes alimentaires infectés par Aspergillus flavus de poulets à griller. Une expérience factorielle 2 x 3 dans une conception entièrement randomisée qui a duré 42 jours a été menée pour évaluer les effets de la noix de muscade africaine (Monodora myristica) dans les régimes de poulets de chair infectés par l'aflatoxine sur l'hématologie, la chimie du sang et l'utilisation des nutriments des poulets de chair. Trois *des six traitements diététiques étaient infectés avec 1mg de culture pure d'Aspergillus flavus et Monodora myristica inclus à 0%, 0,5% et 1,0%, tandis que les autres régimes étaient sans infection mais avec 0, 0,5 et 1,0% M. myristica inclus. Chaque traitement a été répété trois fois avec 30 poulets par répétition. La digestibilité des nutriments, les indices hématologiques et chimiques sanguins ont été mesurés. . Monodora à des niveaux d'inclusion de 0,5 et 1,0 % a amélioré de manière significative (p < 0,05) la digestibilité de tous les nutriments dans les régimes alimentaires infectés et non infectés. Les paramètres hématologiques à l'exception de la MCHC étaient plus élevés (P<0,05) dans les régimes non infectés tandis que le niveau d'inclusion de l'épice à 0,5% et 1,0% avait un impact significatif (P<0,05) uniquement sur l'hémoglobine. Au fur et à mesure que le niveau d'inclusion augmentait, il y avait une réduction significative (P <0,05) du cholestérol sérique et de l'urée. En conclusion, l'épice Monodora myristica a amélioré la digestibilité des nutriments ainsi que l'hématologie et la chimie du sang des poulets de chair, en particulier aux niveaux d'inclusion. inférieur à 1,0 %.*

Mots-clés : *Aspergillus flavus, Monodora myristica*, alimentation des poulets de chair.

Introduction

Spices are micro feeding stuff used as feed additives in relatively small amounts to improve the intrinsic value of the nutrient mix in animal diets (Rosen, 1996). Even at low levels, they contribute to the nutrient requirement of man and animal. The use of spices in poultry feed is not popular due to the argument that the number of taste buds in chicken is small (8 in a day old chick; 24 at 3 months and 40 in adult birds) and not well developed (Holds and May, 1966). However, this has been refuted by some reports that chickens find tannin distasteful (Esmail, 2004) and that they have well defined taste mechanism (Leeson, 2002). Spices and their extracts have been used for increasing flavor of feed, for health and nutrition of animals (Kim *et al.,* 1994).

Mycotoxicosis resulting from feed contamination by microorganisms such as fungi especially *Aspergillus flavus* is a major problem in poultry industry. About 80% of the poultry feed ingredients are chronically exposed to uncontrolled amounts of aflatoxin from *Aspergillus spp.* The current control measures aimed at controlling the fungal growth and mycotoxin formation in these ingredients especially in the store require sophisticated equipment and expensive chemicals. Also, a ban of antibiotics as feed additives in animal nutrition has necessitated the search for alternatives especially of plant origin. There are also reports on the harmful effects of sulfating agents on sensitive consumers, particularly asthmatics (Taylor *et al*., 1986) and link between solutions containing bisulfate and raised enzyme levels in humans and rats (Norman, 1991). Attention is now focused on the use of plant products as alternatives to synthetic additives (Adegoke and Gopalakrishna, 1998). Of emerging importance for use as a natural feed additive is the spice *Monodora myristica.*

Monodora myristica is planted locally in Nigeria and used commonly as a spice in local salad (tapioca and nsisa which are processed and sliced form of cassava, Ugba or African oil bean (*Pentacletra macrophylla* and okazi (*Gnetum Africana*) in Nigeria.

Material and methods

Experimental design and location

The experiment which was a 2 x 3 factorial arrangement laid out in a Completely randomized design was carried out at the Poultry Unit of the Research Farm of Michael Okpara University of Agriculture, Umudike. The factors considered were; (a)

Aspergillus flavus infection status (infected and non-infected status) and (b) inclusion level of African nutmeg (*Monodora myristica)* at 0%, 0.5% and 10%. Seeds of *M. myristica* were bought from Ndoro market in Ikwuano Local Government Area of Abia State. They were cleaned, toasted at 65°C for one hour, milled into powder and put into airtight container for use. *Aspergillus flavus* was obtained from the plant pathology laboratory of the National Root Crop Research Institute, Umudike, Abia State, Nigeria

Six diets were formulated out of which three were each infected with 1mg of pure culture of *Aspergillus flavus* and *M. myristica* supplemented at 0%, 0.5% and 1.0%. The remaining three were infection-free but had *M. myristica* included also at 0%, 0.5% and 1.0%. Each treatment was replicated 3 times with 30 chickens per replicate. The experiment lasted for 42 days. Prior to the allocation of the birds to the experimental diets, they were stabilized for seven days in a deep litter brooding pen. The birds were allocated, thereafter, feed and water given *ad-lib*. All routine vaccinations were duly administered. The aim of the study was to evaluate the effects of *M. myristica* with or without *Aspergillus flavus* on the nutrient utilization, haematology and blood chemistry of broilers.

Statistical analysis and model

The data collected were subjected to analysis of variance (ANOVA) in a 2 x 3 factorial arrangement in a completely randomized design experiment and where significant differences were observed, means were further subjected to Duncan's multiple Range Test (Duncan, 1952) as packaged in SPSS (2006) for windows, version 16, SPSS Inc.

$Y_{ijkl} = \mu + A_i + M_j + (AM)_{ij}\, \Sigma_{ijk}$

μ = population mean

$A_{i\,=}$ effect of infection of *Aspergillus flavus*

$M_{j\,=}$ effect of inclusion level of *Monondora myristica*

$(AM)_{ij}$ = interaction of infection of *Aspergillus flavus* and inclusion level of *Monondora myristica*

$\Sigma_{ijk\,=}$ Residual error estimate

Table 1: Composition of *Aspergillus flavus* -infected broiler diets supplemented with *Monodora myristica*

	Infected diets			Non-infected diets		
Ingredients	**0%**	**0.5%**	**1.0%**	**0%**	**0.5%**	**1.0%**
Maize	53.00	53.00	53.00	53.00	53.00	53.00
Soybean meal	20.00	20.00	20.00	20.00	20.00	20.00
Fishmeal	2.00	2.00	2.00	2.00	2.00	2.00
GNC	12.00	11.50	11.00	12.00	11.50	11.00
PKC	3.00	3.00	3.00	3.00	3.00	3.00
Wheat offal	4.25	4.25	4.25	4.25	4.25	4.25
Monodora myristica	0.00	0.50	1.00	0.00	0.50	1.00
Bone meal	3.00	3.00	3.00	3.00	3.00	3.00
Oyster	2.00	2.00	2.00	2.00	2.00	2.00
Lysine	0.10	0.10	0.10	0.10	0.10	0.10
Salt	0.30	0.30	0.30	0.30	0.30	0.30
Vit/min premix	0.25	0.25	0.25	0.25	0.25	0.25
Total	**100**	**100**	**100**	**100**	**100**	**100**
Calc ME (kcal/kg)	2912.35	2901.37	2890.40	2912.35	2901.37	2890.40
CP (%)	21.68	21.58	21.49	21.68	21.58	21.49
Ca (%)	1.89	1.91	1.94	1.89	1.91	1.94
P (%)	0.94	1.13	0.43	0.94	1.13	0.43
Lys (%)	1.13	1.12	1.12	1.13	1.12	1.12
Meth (%)	0.43	0.42	0.42	0.43	0.42	0.42
CF (%)	3.70	3.71	3.71	3.70	3.71	3.71

Vitamin/mineral premix supplying the following per kg diet: vit A (1599 I.U.), vit D_3 (1600.U), Riboflavin (9.0mg), Biotin (0.25mg), Pantothenic acid (11.0mg), vit K (3.0mg), vit B_2 (2.5mg), vit B_6 (0.3mg), vit B_{12} (8.0mg), Nicotinic acid (8.0mg), iron (5.0mg), selenium (0.01mg), Magnesium (10.0mg), zinc (4.5mg), Cobalt (0.02mg)

Results and discussion

Effects of Aspergillus flavus infection and Monodora myristica on the nutrient utilization

The effects of *Aspergillus flavus* and *M. myristica* inclusion level are summarize in Table 2 and Table 3. There were significant (P<0.05) effects with respect to infection status and the inclusion level of *M. myristica*. *Aspergillus flavus* reduced (P<0.05) the ash digestibility only with 63.99% and 73.99% for the infected and non-infected diets respectively. 0% recorded the least digestibility of all the nutrients investigated with 52.52%, 42.74%, 49.32% and 61.65% for ash, ether extract, protein and fibre digestibility, respectively. About 0.5% *M. myristica* in broiler diets was observed to have 74.85% ash, 77.70% ether extract, 75.42% protein and 81.25% fibre digestibility. Birds fed the infected feed without any spice had lower (P<0.05) ash digestibility of 42.73%. There was no significant (P>0.05) difference between values obtained with 0.5% and 1.0% *M. myristica*. 1.0% *M. myristica* recorded the highest values for these parameters except the ether extract digestibility of 67.80%. There were significant (P<0.05) differences in all the parameters for the interaction between the infection status and level of inclusion of the spice. In the birds fed infected diets, digestibility of ether extract increased (P<0.05) as level of *M. myristica* increased from 0% to 0.5% but decreased (P>0.05) beyond this point. Protein digestibility was least in infected diet containing 0% *M. myristica* (44.13%), followed by non-infected *Monodora*-free diet (54.50%)

Aspergillus flavus infection reduced the digestibility of all nutrients evaluated. However, the digestibility of these nutrients were observed to improve as the inclusion level of the spice increased. Birds fed *M .myristica* –free diets (*0*%) recorded the least digestibility of all the nutrients investigated. The lowest ash, ether extract, protein and fibre digestibility were observed in the *M. myristica*-free diets, while digestibility of ash, ether extract and fibre in the infected diets that were supplemented with *M. myristica* especially at 1.0% was not inferior to the non-infected group. Crude protein digestibility increased as the level of *M. myristica* supplementation increased in the infected group, while in the non-infected group, similar trend was observed up to 0.5% but no significant (P>0.05) difference was observed between 0.5% and 1.0% *M. myristica* supplementation.

Table 2: Effects of *Aspergillus flavus* and *Monodora myristica* on nutrient utilization of Broiler chickens

Factors	AD (%)	ED (%)	PD (%)	FD (%)
Infection status				
Infected	63.99^{b}	58.33	68.72	70.19
Non-infected	73.99^{a}	66.88	68.39	79.94
SEM	1.91	6.60	1.47	1.24
***Monodora myristica* level (%)**				
0	52.52^{b}	42.74^{b}	49.32^{b}	61.65^{b}
0.5	74.85^{a}	77.70^{a}	75.42^{a}	81.25^{a}
1.0	79.60^{a}	67.80^{a}	80.93^{a}	82.30^{a}
SEM	2.34	8.09	1.80	1.52

a,b, means on the same column with same superscripts are not significantly different (P>0.0%) from one another. AD, ED, PD and FD represent ash digestibility, Ether extract digestibility, protein digestibility and fibre digestibility respectively.

Table 3: Interaction of *Aspergillus flavus* and *Monodora myristica* on nutrient utilization of Broiler chickens

Infection status	*M. myristica* level (%)	AD (%)	ED (%)	PD (%)	FD (%)
Infected	0	42.73^{c}	47.72^{b}	44.13^{c}	53.54^{c}
Non Infected	0	62.30^{b}	37.77^{b}	54.50^{c}	69.77^{b}
Infected	0.5	70.33^{ab}	73.70^{ab}	75.67^{b}	77.37^{a}
Non Infected	0.5	79.37^{a}	80.83^{a}	75.17^{b}	85.13^{a}
Infected	1.0	78.90^{a}	53.57^{ab}	86.39^{a}	79.66^{a}
Non Infected	1.0	80.30^{a}	82.03^{a}	75.50^{b}	84.93^{a}
	SEM	3.31	11.44	2.54	2.15

a,b,c means on the same column with same superscripts are not significantly different (P>0.0%) from one another. AD, ED, PD and FD represent ash digestibility, ether extract digestibility, protein digestibility and fibre digestibility respectively.

The observations made on the digestibility trial is an indication that *Monodora myristica* can stimulate the digestive system by probably increasing pancreatic digestive enzymes in agreement with the report of Langhout (2002) and Kamel (2001). It is also an evidence of improvement in liver function. Nutrients in the *Monodora*-free diets may have been unavailable for utilization by the birds as evidenced in their low body weight gain in line with the reports of Kamel (2001) and Bestami and Guler (2009). The low digestibility of nutrients in the both infected and non-infected diets containing 0% *M. myristica* may be an indication of low availability of the nutrients for utilization. This result is in line with the findings of Kamel (2001) and Guler *et al.* (2006).

Effects of Aspergillus flavus infection and Monodora myristica on haematology of Broiler chickens

Table 4 and Table 5 present effects of *Aspergillus flavus* and *M. myristica* on haematology of Broiler chickens. Values of the MCV, Hb, MCH, MCHC and platelets were 124.48fl, 6.65g/dl, 38.82pg/dl, 33.23g/dl and 20.50 x$10^{3/}$µl respectively for the birds fed infected diets, while for birds fed non-infected diets, the values were 128.60fl, 8.87g/dl, 41.17pg, 31.93g/dl and 30.67 x$10^{3/}$µl respectively.

All the haematological parameters except the white blood cells and red blood cells were significantly (P<0.05) affected by inclusion of varying quantities of *M. myristica.* However, inclusion of *M. myrisitca* above 0.5% did not produce any significant (P>0.05) impact on the Hb, MCV, MCH and MCHC. There were interaction effects (P<0.05) of infection and *M. myristica* level on the Hb, MCV, MCH, MCHC and platelets not beyond 0.5% in both infected and non-infected diets. Lowest (P<0.05) Hb and MCH of 4.45g/dl and 28.80pg respectively were observed in the infected diet with no *M. myristica* inclusion. Birds fed infected diets were observed to have depressed (P<0.05) haematological parameters except the white and red blood cells. All parameters except the white and red blood cells were observed to increase (P<0.05) as the level of inclusion of *M. myristica* increased in the diets. 0.5% and 1.0% *M. myristica* did not show any difference (P<0.05) in the Hb and MCH. There were also significant (P<0.05) interaction effects of *M. myristica* and *Aspergillus flavus* in all haematological parameters except WBC and RBC. The reduction in the haemoglobin and mean corpuscular haemoglobin and mean corpuscular haemoglobin concentration observed in the birds fed diets containing 0% *M. myristica* may be an indication of the adverse effect on the blood formation and may lead to anemic condition as pointed out by Bolu *et al*. (1999). The aflatoxin metabolite in the *A. flavus* may also have caused poor transportation of oxygen from the respiratory organs to the peripheral tissues in agreement with Rosen (2003) and deficiency in protein and energy metabolism (Olomu, 1995). Apart from the infected diets, the haemoglobin and mean corpuscular haemoglobin in other treatments were within the normal ranges of 7-13g/dl and 33- 47 pg respectively as reported by Mitruka and Rawnsley (1997). The MCV, MCHC and platelets were also within the normal ranges of 90 -140fl, 26 - 35% and 20 -30,000µl (Mitruka and Rawnsky, 1997). The level of infection of the diets with *A. flavus* may not have been enough to cause serious deleterious effects on the serum.

Table 4: Effects of *Aspergillus flavus* and *Monodora myristica* on haematological pa rameters of Broiler chickens

Factors	WBC ($x10^3$/ul	RBC ($x10^3$/ul	MCV (fl)	Hb (g/dl)	MCH (pg)	MCHC (g/dl)	PLT ($x10^3$/ul
Infection status							
Infected	20.47	2.29	124.48^b	6.65^b	$38..82^b$	33.23	20.50
Non-infected	22.00	2.93	128.60^a	8.87^a	41.17^a	31.93	30.67
SEM	0.50	0.21	0.65	0.21	1.07	0.45	0.87
***M. myristica* level (%)**							
0	21.42	2.25	118.43^b	6.65^b	33.83^b	31.73^b	23.00^b
0.5	20.95	2.86	128.89^b	8.05^a	41.28^a	32.25^{ab}	19.25^c
1.0	21.34	2.72	132.80^a	8.58^a	44.88^a	33.78_a	34.50^a
SEM	0.61	0.29	0.90	0.25	1.31	0.55	1.06

a,b,c means in the same column with the same superscrip ts are not significantly (P>0.05) different from one another. WBC, RBC, MVC, Hb, MCH, MCHC and PLT represent white blood cells, red blood cells, mean corpuscular volume, haemoglobin, mean corpuscular haemoglobin, mean corpuscular haemoglobin concentration and platelets respectively

Table 5: Interaction of *Aspergillus flavus* and *Monodora myristica* on haematological parameters of Broiler chickens

Infection status	*M. myristica* level (%)	WBC ($x10^3$/ul	RBC ($x10^3$/ul	MCV (fl)	Hb (g/dl)	MCH (pg)	MCHC (g/dl)	PLT ($x10^3$/ul
Infected	0	20.00	2.05	130.35^{bc}	4.45^c	28.80^c	32.95^{ab}	23.50^b
Non Infected	0	22.84	2.45	126.50^c	8.85^a	38.85^b	30.50^b	22.50^b
Infected	0.5	20.80	2.36	129.98^b	7.25^b	41.75^{ab}	32.55_{ab}	19.00^b
Non Infected	0.5	21.10	3.36	127.80^b	8.85^a	40.80^{ab}	31.95^{ab}	19.50^b
Infected	1.0	20.62	2.46	134.10^a	8.25^{ab}	45.90^a	34.20^a	19.00^b
Non Infected	1.0	22.05	2.98	131.50^{ab}	8.90^a	43.85^{ab}	33.35^a	50.00^a
	SEM	0.86	0.42	1.12	0.04	1.85	0.78	1.50

a,b,c means in the same column with the same superscripts are not s ignificantly (P>0.05) different from one another. WBC, RBC, MVC, Hb, MCH, MCHC and PLT represent white blood cells, red blood cells, mean corpuscular volume, haemoglobin, mean corpuscular haemoglobin, mean corpuscular haemoglobin concentration and platelets respectively

Effects of Aspergillus flavus infection and Monodora myristica on Blood chemistry of Broiler chickens

Table 6 and Table 7 expresses effects of *Aspergillus flavus* and *M. myristica* on the blood chemistry of Broiler birds. The infection status of the diets were observed to have significant (P<0.05) effects on the serum cholesterol and creatinine, while the level on inclusion of *M. myristica* significantly (P<0.05) affected all serum chemistry parameters evaluated except creatinine. The cholesterol and creatinine levels in the birds fed infected diets were

154.5mg/dl and 0.46mg/dl respectively and 142.83mg/dl and 0.40mg/dl in non-infected diets.

The serum cholesterol of birds decreased ($P<0.05$) as the inclusion level of the spice increased. 158mg/dl, 145.50mg/dl and 142.50mg/dl cholesterol were observed in birds fed 0%, 0.5% and 1.0% *M. myristica.* The urea levels were 4.95mg/dl, 2.73mg/dl and 2.05mg/dl for birds fed diets containing 0%, 0.5% and 1.0% *M. myristica* levels. Also, conjugated bilirubin was decreased as the level on inclusion of the spice increased in the diets.

There were interaction effects ($P<0.05$) on all the blood chemistry parameters evaluated. Both in the presence and absence of infection, increasing the level of *M. myristica* reduced the cholesterol level as well as urea, while the reverse was the case for total bilirubin which was observed to increase in infected diets only.

Infecting broiler diets with *A. flavus* had significant ($P<0.05$) effect on the blood cholesterol and creatinine which were observed to increase. All blood chemistry parameters except creatinine were affected ($P<0.05$) by the inclusion of *M. myristica* in the broiler diets. Cholesterol and urea decreased with increasing level of *M. myristica* especially from 0% to 0.5% in the diet. Total protein increased only when the spice increased beyond 0.5%. Interaction effects were significant ($P<0.05$) for all the blood chemistry parameters investigated. Supplementation of 0.5% and 1.0% *M. myristica* to *A. flavus*- infected diets caused a reduction ($P<0.05$) in the cholesterol level of the birds. The results were comparable to that observed in non-infected diets. Urea level in both infected and non-infected diets decreased as level of *M. myristica* increased in the diets. Creatinine level in the infected group increased as level of the *M. myristica* spice increased up to 0.5% but declined slightly when the spice level rose to 1.0%. For the birds fed non-infected diets, the reverse was observed as *M. myristica* increased from 0% to 0.5% only. Cholesterol levels recorded with 0.5% and 1.0% *M. myristica* in non-infected diets were lower than that obtained by *monodora*-free non-infected diet. An elevated blood cholesterol has been reported to be the risk factors indicating susceptibility of the birds to atherosclerosis as opined by Eggum (1970). Supplementing infected diets with 1.0% *M. myristica* reduced creatinine content to a level comparable to the non-infected diet. The elevation in the cholesterol level could be as a result of the obstruction of the biliary flow as reported by Eggum (1970). The high level of urea observed in the *Monodora*-free infected and non-infected diets may be an indication of poor protein quality of the diets (Alerto *et al.*, 1998). High creatinine content observed in the birds fed 0.5% *M. myristica*-supplemented infected diets could suggest higher muscular wastage than those from other treatments indicating that the birds were surviving at the expense of their body reserves according to Ross *et al.* (1978). This was evident in the low value of their average daily weight gain.

Table 6: Effect of *Aspergillus flavus* and *Monodora myristica* on Blood chemistry parameters of Broiler chickens

Factors	Cholesterol (mg/dl)	Urea (mg/dl)	TB (mg/dl)	CB (mg/dl)	TP (mg/dl)	Creatinine (mg/dl)
Infection status						
Infected	154.50[a]	3.21	0.31	0.04	3.47	0.46[a]
Non-infected	142.83[b]	3.28	0.29	0.06	3.17	0.40[b]
SEM	0.95	0.29	0.02	0.07	0.38	0.01
***M. myristica* level (%)**						
0	158.00[b]	4.95	0.25[b]	0.06[ab]	3.40[a]	0.45
0.5	145.50[b]	2.73	0.30[ab]	0.07[a]	3.15[b]	0.44
1.0	142.50[a]	2.05	0.35[a]	0.04[b]	3.40[a]	0.40
SEM	1.16	0.36	0.02	0.09	0.46	0.02

a,b:means in the same column with the same superscripts are not significantly (P>0.05) different from one another. TB, CB and TP represent total bilirubin, conjugated bilirubin and total protein respectively

Table 7: Interaction of *Aspergillus flavus* and *Monodora myristica* on Blood chemistry parameters of Broiler chickens

Infection status	*M.myristica* level (%)	Cholesterol (mg/dl)	Urea (mg/dl)	TB (mg/dl)	CB (mg/dl)	TP (mg/dl)	Creatinine (mg/dl)
Infected	0	162.50[a]	4.63[a]	0.22[b]	0.08[b]	3.00[ab]	0.43[b]
Non Infected	0	153.50[b]	5.27[a]	0.27[ab]	0.04[bc]	3.80[ab]	0.47[b]
Infected	0.5	153.00[bc]	3.07[b]	0.34[a]	0.02[c]	4.40[a]	0.54[a]
Non Infected	0.5	138.00[d]	2.38[b]	0.26[ab]	0.12[a]	1.90[b]	0.34[c]
Infected	1.0	148.00[c]	1.92[b]	0.35[a]	0.04[bc]	3.00[ab]	0.40[bc]
Non Infected	1.0	137.00[d]	2.19[b]	0.34[a]	0.03[c]	3.80[ab]	0.40[bc]
	SEM	1.65	0.50	0.03	0.01	0.65	0.03

a,b,c: means in the same column with th e same superscripts are not significantly (P>0.05) different from one another. TB, CB and TP represent total bilirubin, conjugated bilirubin and total protein respectively.

References

Adegoke, G.O. and Gopalkrishna, A. G. 1998. Flavour fragrance. *Journal America oil chemistry Society,* 75: 1047

Aletor, V. A., Laseinde, E. A. O. and Ogunyemi, O. 1998. Equi-protein replacement of Fishmeal with Soybean meal in diets for Broiler chicken diet in: Effects on carcass characteristics and the development of certain muscles of the chest and hund limit. *Nigerian Journal* of *Technological Research* 1: 11-15.

Bolu, S. A., Balogun, O. O. and Oniyinde. 1999. Comparative Feeding and haematology values of broilers fed locally produced and natural vitamin/mineral premix and two commercial vitamin premix. *NSAP proceedings*. P. 110-111.

Eggum, B. O. 1970. Blood urea measurement as a technique for assessing protein quality. *British Journal of Nutirtion* 24;985-988.

Esmail, S. H. M. 2004. Flavouring poultry feeds can be beneficial. In *World Poultry Journal*, 20 (5): 14-18.

Guler, T., Dalkilic, T., Ertas, O. N. and Ciftci, M. 2006. The effects of dietary black cumin seeds (*Nigella sativa*) on the performance of broilers. *Asian-Australian Journal of Animal Science,* 19 (3): 425-430.

Holdas, A. and May, K .N. 1966. Fish oil and fishy flavor of Eggs and carcasses of hens. *Poultry Science*, 45: 1405 -1408.

Kamel, C. 2001. Tracing methods of action and roles of plant extracts in non-ruminants. In Recent advances in

Animal Nutrition (eds). Gams Worthy P. C. and J. Wiseman. Nottingham University Press, Nottingham United Kingdom, P 453 -461.

Kim, S. Y., Kim, J. H., Kim, S. K., Oh, M. J.and Jung, M. Y. 1994. Antioxidant activities of selected oriental herb extracts. *Journal of American Oil Chemistry Society,* 71: 633 – 640.

Langhout, P. 2000. New additives for broiler Chickens. *World poultry-Elsevier,* 16:22 -27.

Leeson, S. 2002. What motivates chickens to eat specific nutrients. *World poultry –Elsevier,* 18 (3): 98 -102.

Mitruka, B. M. and Rawnsley, H. M. 1977. Clinical biochemical of haematological reference value in normal experimental animal. Masoa publishing Company, New York. 35 -50.

Norman, J. 1991. The complete Book of spices. Viking studio Books, a Division of penguin books, New York.

Olomu, J. M. 1995. Monogastric animal nutrition; Principles and practice. Jachem publishers, Benin City, Nigeria. 77- 84.

Rosen, G. D. 1996. Feed additives nomenclature. *World Poultry Science. Journal*, 52: 53 -56.

Ross, J. G., Christie, G. I., Holliday, W.G. and Jones, R. M. 1978. Haemtological and blood chemistry companion values for clinical pathology in poultry. *Veterinary Record* 102; 29 -31.

Taylor, S. I., Highley, N. A. and Bush, R. K. 1986. *Journal of Food Science.* 30: 1-9.

Date received: 27th February, 2022.
Date accepted: 9th July, 2022.