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Research Article
Evaluation of Inclusion of Medicinal Plants Seeds and Alpha-tocopherol on Broilers Meat Fatty Acids Content and Blood Parameters

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Abstract

Background and Objective: Poultry meat has many desirable nutritional characteristics, which affected with many factors like feed additives. The medicinal plants as one of important feed additives has strong effects on fat contents and blood parameters. This study was aimed to evaluate Black seeds (*Nigella sativa*), Fenugreek (*Trigonella foenum-graecum*), Moringa (*Moringa oleifera*), Clitoria (*Clitoria ternatea*), Sunflower (*Helianthus annuus*) and Vitamin E effects on broiler fatty acids content and blood parameters. **Materials and Methods:** Among 105 one day old males chicks were used, they were allotted to 7 treatments with 3 replicates. The birds were fed balanced rations, supplemented with tested seeds and Vitamin E. Fatty acids in abdominal fat pad (ADFP) were determined using Gas Chromatography Mass Spectrometer (GC-MS). **Results:** Fatty acids profile analysis showed that the use of *Moringa* (MORS) lead to highest content of short fatty acids and mono-unsaturated acids content, while the addition of sunflower (SFS) resulted in the highest medium chain fatty acids and omega-3 content, however, the use of *clitoria* (CLIS) resulted in the highest long chain fatty acids and omega-9 content. On the other hand, the fenugreek (FENS), supplements led to the highest content of total saturated fatty acids. Nevertheless, the use of black seeds resulted in the highest content of total unsaturated fatty acids, poly-unsaturated fatty acids and essential fatty acids. There was no significant difference ($p \geq 0.05$) in cholesterol, triglycerides, HDL and LDL among the different seeds, however, the use of CLIS, lead to a reduction in all the above parameters. **Conclusion:** The tested seeds affected the fatty acids content while the blood parameters did not affected significantly.

Key words: Medicinal plants seeds, alpha-tocopherol, fatty acids content, blood parameters, cholesterol

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Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Aliphatic monocarboxylic acids derived from or contained in esterified form in an animal or vegetable fat, oil or wax. Natural fatty acids commonly have a chain of 4-28 carbons (usually unbranched and even-numbered), which may be saturated or unsaturated. By extension, the term is sometimes used to embrace all acyclic aliphatic[1].

Currently, fatty acids are classified into three groups: short, medium and long chain fatty acids. Talukdar *et al.*[2] and Murphy *et al.*[3] reported that the relationship between gut flora, short chain fatty acids production and obesity remains an active and important area of investigation. Dietary supplementation with MCFAs was recommended as beneficial for preventing obesity and peripheral insulin resistance[4]. Antalis *et al.*[5] pointed out that lowers levels of long-chain poly unsaturated fatty acids, particularly n-3 omega poly unsaturated fatty acids in blood have repeatedly been associated with a variety of behavioral disorders. He *et al.*[6] indicated that men with high fish consumption were less likely to be overweight than those with low fish consumption and the proportion of overweight volunteers was inversely related to n-3 long chain polyunsaturated fatty acids intake.

Cholesterol is a waxy substance made by animal liver and also supplied in diet of animal products such as; meats, poultry, fish and dairy products. Cholesterol is needed in the body to insulate nerves, make cell membranes and produce certain hormones and it is an important lipid in some membranes. However, the body makes enough cholesterol, so any dietary cholesterol isn't needed[7].

A high triglyceride level combined with low HDL cholesterol or high LDL cholesterol seems to speed up atherosclerosis, which is the buildup of fatty deposits in artery walls that increase the risk for heart attack and stroke[7].

Black cumin (*Nigella sativa* Linnaeus), the seeds are used in folkloric (herbal) medicine in treatment and prevention of a number of diseases include asthma, diarrhea and dyslipidemia, seeds/oil has anti-inflammatory and analgesic. The oil decrease blood pressure and increase respiration[8].

Amol and Vijay[9] mentioned that *Clitoria* showed antihyperglycemic activity reported. It was reported that *Clitoria* has tranquillizing effect on the brain hence it is used in symptoms like syncope, vertigo and brain weakness[10].

Kochhar *et al.*[11] reported that supplementation of fenugreek mixture decreased serum triglycerides. Abbas[12] reported that fenugreek seed powder as capsules (750 mg kg^{-1} b.wt.) decreased blood cholesterol in broiler chickens.

In many tropical and subtropical countries, various parts of *Moringa* (leaves, fruits, immature pods, flowers and seeds) are incorporated into the traditional human's food[13]. Researchers studied *Moringa* in broiler's performance[14] and on the growth, carcass and blood indices of weaner rabbits[15].

Salari *et al.*[16] evaluated the use of various levels of full-fat sunflower (*Helianthus annuus*) seeds on broiler basal diet at 70, 140 and 210 g kg^{1} it was reported that activity of HDL and LDL were not affected by incorporation of full-fat sunflower seed in the broiler diet. Although, concentration of HDL increased and LDL decreased, these effects were not significant.

Guo *et al.*[17] reported that addition of vitamin E (200 mg kg^{-1}) improved ($p<0.05$) Total Cholesterol (TC) concentrations and HDL-C reached a maximum. whilst HDL-C levels increased when the 100 mg kg^{-1} vitamin E diet was fed. This study was conducted to evaluate Black Seeds (BS), Fenugreek (FEN), *Moringa* (MORS), *Clitoria* (CLIS), Sunflower (SFS) and Vit E effects on broiler fatty acids content and blood parameters.

MATERIALS AND METHODS

Study area: The performance experiment was carried out at Elbashair farm at Elshukaba area, 10 km south Wad Medani city. The experiment started on the 23rd of September through the 22rd of October, 2012. Fat samples were analyzed at the central laboratory, Ministry of Science and Technology Sudan and the blood samples were analyzed at Renal Hospital laboratory, Gezira state, Sudan.

Experiment pens: Twenty one pens with (1×1.5×1) dimension were used. These pens were constructed using steel post and wire netting that has a mesh size of 1.25 cm. The pens were constructed inside an open sided poultry house roofed with corrugated zinc sheets, with wire netting on 2 sides (east-west) to allow for maximum ventilation. The roof and the walls were painted with white paint to reflect the solar radiation. The floor was made of cemented red bricks and covered with sand as a litter, the poultry house and the pens are parts of Elbashair farm. Each pen was provided with aplastic round fountain drinker and a metal round feeder.

Experimental birds: One hundred and five, one day old male broiler chicks (Ross 308) divided into equal groups; a control group and 6 experimental groups, each group was subdivided into three groups with 5 chicks each (3 replicates) in a Completely Randomized Design (CRD).

Table 1: Ingredients percentage per treatment

Treatments/Ingredients (%)	FEN seeds	BS seeds	CLIS seeds	MORS seeds	SFS flowers seeds	Vit E	Control
SG	68.88	68.88	66.38	66.38	60.38	66.38	68.88
GNM	14	5.8	5.8	5.8	5.8	5.8	14
M. meal	5	6	6.5	6.5	6.5	6.5	5
WB	5.8	8	10	10	16	10	5.8
SC	5	5	5	5	5	5	5
D. cal	1.02	1.02	1.02	1.02	1.02	1.02	1.02
NaCl	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Lysine	1.17	1.07	1.15	1.09	1.15	1.14	1.17
Methionine	0.47	0.45	0.48	0.46	0.48	0.49	0.47
Meth+Cys	0.66	0.62	0.74	0.64	0.66	0.74	0.66

SG: Sorghum, GNM: Ground Nuts Meal, M. Meal: Meat Meal, WB: Wheat bran, SC: Super Concentrate, D. cal: Dicalcium, NaCl: Sodium chloride

Experimental diets: The birds were fed a pre starter diet during the first week of age and then they received a normal balanced starter diet during the next 3 weeks. Then a finisher rations were offered during the last 3 weeks, the control group receiving feed based on iso-nitrogenous and iso-caloric ration as shown in Table 1 and the experimental groups were fed a diet as same as the control diet supplemented with FENS, BS, MORS, CLIS and SFS at 5% of the ration and Vitamin E α-tocopherol tablets at 200 mg kg^{-1} of the ration as shown in Table 1.

Management and data collection: The birds were weighed and distributed to pens as described before. They were offered quantity of food and free access to water. Three birds were selected from each treated group then samples of blood were collected from the birds in tubes contained anticoagulant (Heparin), the tubes were shacked gently, samples from abdominal fat bad of broiler chicken from each treatment were taken.

Methylation steps: Two grams from the sample (abdominal fat bad of broiler chicken from each treatment) was put in a test tube. Then 7 mL from alcoholic sodium hydroxide was added (2 g NaOH→100 mL Methanol). Then 7 mL from alcoholic sulfuric acid (conc.) was added (1 mL H_2SO_4→99 mL Methanol). Then, the mixture was shaken gently for 3 min and then it was kept at the room temperature for overnight. A suitable volume from the supper saturated sodium chloride was added and then a suitable volume from the normal hexane (n-hexane) added. Then the mixture was shaken gently. Two layers were appeared, organic layer (upper layer) and aqueous layer (lower layer). The upper layer (organic) had been taken by syringe (containing the fatty acids) and adulation by diethylether was made from it. One micro liter from the sample was transferred and injected in the Gas Chromatography Mass Spectrometer (GC.MS), Detector: Mass Spectrometer, Model: GC.MS, qp. 2010, Company: Shimadzu, Country: Japan, Carrier gas mobile phase: Helium, Column: (1. Name: Rtx. 50, 2. Diameter: 0.25 Mm, 3. Thickness: 0.25), Injection temp: 250.00°C, Injection mode: split, pressure: 53.6 KPa, Total flow: 24.0 mL min^{-1}, Column flow: 1.00 mL min^{-1}[18].

Determination cholesterol (LDL, HDL and TG): The concentrations of, High Density Lipoprotein (HDL), Low Density Lipoprotein (LDL), Total Cholesterol (TC) and triglyceride (TG) in the blood serum were determined using an automatic blood analyzer (spectrophotometry), BioSystems (from BioSystem S.A Costa Barava, 30.08030 Barcelona (Spain)) was the reagents who manufacturer recommended the followed steps for measurement. The reagents and standard are provided ready to use.

Statistical analysis: The data was analyzed by using MSTAT program.

RESULTS

Fatty acids: With respect to short chain fatty acids all treatments lead to a reduction in short chain fatty acids except the addition of MORS which recorded the highest content of the short chain fatty acids, while the BS, Vit E and FENS had the lowest value compared to the control. The results showed that all treatments led to an increase in medium chain fatty acids, while the use of SFS recorded the highest level in medium chain fatty acids and the lowest level was recorded by control. With the respect to long chain fatty acids content the use of MORS, CLIS and Vit E increased the content, while the use of FENS and SFS reduced their content. The highest level of long chain fatty acids was recorded by CLIS and the lowest recorded by FENS. All seeds had similar effect on long chain fatty acids as recognized from their range. The overall level of Total Saturated Fatty Acid (TSFA) among the different seeds supplements and the difference in t heir contents was small. Nevertheless, FENS, SFS, CLIS and Vit E showed a

Table 2: Abdominal fat pad fatty acids contents affected by different tested seeds

	Samples						
FAs types	Vit E	BS	SFS	CLIS	MORS	FENS	Control
SCFA	00.00	00.00	00.01	00.05	00.97	00.00	00.06
MCFA	10.37	10.18	50.33	00.52	20.36	00.75	00. 42
LCFA	87.18	87.6	84.23	89.28	88.66	83.87	88.06
TSFA	13.99	13.06	15.85	13.44	13.18	16.20	13.22
TUSFA	86.01	87.08	84.15	86.55	86.79	84.55	86.81
MUSFA	64.90	64.79	77.69	71.11	82.27	66.60	71.17
PUSFA	19.95	22.29	60.46	15.79	40.52	17.95	14.91
EFA	13.75	18.41	10.79	13.26	90.46	14.49	11.41
Omega-3	10.38	10.44	00.15	20.49	30.34	30.86	10.59
Omega-6	20.72	00.41	00.00	00.30	10.7	00.29	00.31
Omega-9	76	74.71	76.27	76.71	74.45	75. 92	75.39
Omega-6: Omega-3	10.97	00.23	00.00	00.12	00.51	00.08	00.20
PUSFA: TSFA	10.43	10.71	00.42	10.18	00.34	10.11	10.13

FA: Fatty Acids, SCFA: Short chain fatty acids, MCFA: Medium chain fatty acids, LCF A: Long chain fatty acids TSFA: Total saturated fatty acid, TUSFA: Total unsaturated fatty acids, MUSFA: Mono-unsaturated fatty acids, PUSFA: Poly-unsaturated fatty acids, EFA: Essential fatty acids

relatively higher levels of TSFA, while MORS and BS had the lowest level of TSFA and the FENS had highest level of TSFA as Table 2 showed.

Treatments of MORS, FENS, SFS, CLIS and Vit E had lower levels of total unsaturated fatty acids TUSFA as compared with the control, with the SFS having the lowest level. On the other hand BS was the supplement that had a higher level of (TUSFA) as compared with control. Nevertheless, the difference in (TUSFA) among the different seeds supplements was very small units, that means the experimented seeds can be used in the broiler chickens feed to produce high amount of (TUSFA) in their meat. It was clear that the different seeds contain similar amount of total unsaturated fatty acids. With respect to Mono-unsaturated fatty acids (MUSFA), the MORS and SFS had the higher level compared with control, while BS, CLIS, FENS and Vit E had a lower levels compared with control, with the BS had the lowest level, this group make up the higher percentage of MUSFA.

The amount of this group of FA is a little bit low among the different treatments the BS, FENS and CLIS showed relatively higher content compared with control, with BS had the highest level of poly-unsaturated fatty acids (PUSFA), while the SFS and MORS had lower content compared with control, with SFS had the lowest level of PUSFA. There was relatively big difference in PUSFA among the different supplements.

Nutritionally, the essential fatty acids are considered of high importance to humans, the food should contain some essential fatty acids. The BS, FENS, CLIS and Vit E had the higher content of Essential Fatty Acids (EFA) compared with the control where BS had the highest level, while the MORS and SFS had lowest levels of EFA compared with the control. Nutritionally, omega-3 is a very important type of FA. The amount of Omega-3 FA was relatively low. Treatments of FENS, MORS and CLIS had higher content levels of omega-3 compared with the control, where FENS had the highest level, while BS, Vit E and SFS showed a lower of Omega-3 levels, where SFS had the lowest level compared with the control. With respect to omega-6 the Vit E had higher content level of omega-6 compared with the control, while SFS showed a lower Omega-6 levels compared with the control. With respect to omega-9 the CLIS had higher content of omega-9 compared with the control, while SFS showed a lower level Omega-6 compared with the control. With respect to Omega-6/Omega-3 ratio the Vit E had higher ratio of Omega-6/Omega-3 compared with the control, while SFS showed a lower ratio compared with the control.

With respect to PUSFAS/SATUFAS ratio the BS had higher ratio of PUSFAS/SATUFAS compared with the control, while MORS showed a lower ratio compared with the control. The PUFA/SFA and n 6/n 3 ratio are normally used to assess the nutritional value of fat. Fats having a low PUFA/SFA (<0.4) and high n-6/n-3 (>5) ratio are considered unfavorable because they may induce an increase in cholesterolaemia.

The results showed that SFS reduced most of lipid groups by this action it had reflected clear effect on lipid profile of the abdominal fat pad of the chickens, which indicated that sun flower seeds supplementation to the broiler chicken rations must have attention and more deep studies.

Hematology parameters: In studying the effects of incorporating of the tested seeds BS, MOS, FENS, SFS, CLIS and Vitamin E in broiler diets on TC, TG, HDL and LDL compared with the control treatment. The data showed that there was no significant differences among in TC level among the different treatments, however, the lowest value was recorded for CLIS treatment. The TG showed no significant difference

Table 3: Effects of supplementation of different tested seeds on some hematological parameters

Hematology parameters	Treatments								
	BS	SFS	CLIS	MORS	FENS	Vit E	Control	SE±	CV (%)
TC	102.3^{ab}	104.0^{ab}	83.33^{ab}	120.7^{a}	85.00^{b}	112.70^{a}	120.7^{a}	3.71	90.99
TG	115.3^{a}	108.7^{b}	31.67^{b}	600.67^{a}	27.00^{b}	710.33^{ab}	970.00^{ab}	8.87	36.94
HDL	66.67^{ab}	650.67^{ab}	55.00^{b}	830.00^{a}	60.67^{b}	750.00^{ab}	750.00^{ab}	2.45	11.51
LDL	26.00^{ab}	340.00^{a}	26.33^{ab}	350.00^{a}	17.67^{b}	370.00^{a}	380.00^{a}	1.97	21.83

Means having similar letter in rows or columns have no significant differences between them at p≤0.05, BS: Black seeds, SFS: Sun flowers seeds, CLIS: *Clitoria* seeds, MORS: *Moringa* seeds, FENS: Fenugreek seeds, Vit E: Vitamin E

among treatments, the highest level of TG was found in BS while the lowest level was found in FENS. The HDL showed no significant differences among BS, MORS, SFS, Vit E and control. The highest level of HDL was found MORS treatment, while CLIS treatment showed the lowest level in HDL. With respect to LDL there was significant difference among BS, MORS, SFS, CLIS, Vit E and control, on the other hand the control treatment shows the highest level of LDL and the lowest level was found in FENS Table 3.

DISCUSSION

According to this research findings, the incorporation of the tested seeds and Vitamin E hadn't significant effect on TC, HDL and TG which indicated that it can be used in broilers diets at 5% without hematology problems hazards.

A number of studies reported that BS reduced TC in albino rats[19], while other study reported that BS decreased the TG[20], increased the HDL contents compared with control[21]. This may be attributed to the possible cholesterol lowering mechanisms of tocopherols explored in number of research investigations, i.e., inhibition of cholesterol oxidation[22]. The present results were agreed with study was indicated that an increase in the TC and TG in MORS group of adult male albino Wistar rats[23]. The results were disagreed with the report that MORS administration for 120 days lowered the serum TC, TG and LDL compared to the control groups in rabbits[24]. This might be due to inhibition of hepatic biogenesis, enhancing the metabolism of exogenous free fatty acid, by promoting ketogenesis at the expense of esterification into TG in the liver. Also, the present study results were in agreement with the report that the supplementation FENS, decreased TG, TC and LDL in both raw and cooked forms[11,25], however, the results differ from study was indicated that the FENS increased HDL with the increase level of supplementation of medicinal plants[11,25]. This may be due to the fact that FENS is containing fiber which had an effect on lipoprotein cholesterol that maybe due to its association with absorption and transport of lipids[26]. The lipid-lowering effect of FENS or may be attributed to its estrogenic constituent, indirectly increasing thyroid hormone[27].

The results were similar to the findings that TC, HDL and LDL were not significantly affected by the level of Full-fat SFS inclusion[27,28], which were disagreed with the report that the plasma TG concentrations tended to be lower in the birds fed higher levels of full-fat SFS[29] and with report of increase in HDL by using SFS[30].

Moreover, these results were similar to study reported that oral administration of CLIS seeds resulted in a significant ($p<0.05$) reduction of serum TC, TG, HDL and LDL levels[31] and similar to study of oral administration of aqueous extract of CLIS leaves and flowers (400 mg kg^{-1} b.wt.) for 84 days significantly reduced serum TC and TG in rats[32]. The cholesterol-lowering effect of CLIS may be attributed to increased biliary excretion and decreased absorption of dietary cholesterol. The results were in agreement with the study reported that the birds receiving supplements of both vitamin E and selenium produced significantly ($p<0.01$) lowering in TC, TG, LDL and significantly ($p<0.01$) increasing in HDL[33-34].

The results showed that all treatments lead to a reduction in SCFA, while other studies reported that dietary supplementation with *Moringa oleifera* leaves meal improved fatty acid profiles in broiler[35]. Also, the results showed that all those treatments led to an increase in MCFA which indicated that the producted meat was safe, because diets containing MCFA appear to be safe and well-tolerated according to the previous clinical studies[36]. Moreover, the results were agreed with study reported that dietary supplementation with *Moringa oleifera* leaves meal improved fatty acid profiles in breast meat from broiler [35].

The content of LCFA with use of MORS, CLIS and Vit E was increased the content, while the use of FENS and SFS reduced LCFA content which may lead to a variety of behavioral disorders[4,7,5]. The treatment with FENS, SFS, CLIS and Vit E showed a relatively higher level of TSFA which associated with coronary heart diseases, while MORS and BS were reduced the level of TSFA and the FENS was showed greatest effect. These results similar to study reported that FENS exhibit highest effect on increasing SFA levels among all groups[37], while BS

reduced SFA levels in broiler fats[38] and also similar to other study reported that by inclusion of SFS result in lowering the saturated fatty acids[39].

Also, treatments with MORS, FENS, SFS, CLIS and Vit E were reduced the levels of TUSFA where SFS showed the lowest effect. On the other hand BS was the supplement that showed a higher effect on the level of TUSFA compared to control. These results were differ from finding that FENS exhibit lowest effect on TUSFA levels among all groups[37]. On the other hand these results were similar to previous study results reported that by inclusion of SFS monounsaturated fatty acids were the major FA[39]. The results were in agreed with finding that by inclusion of SFS decrease for the favor of PUSFA in all tissues[39], which indicated that the addition of 0.5-1% BS oil into the diets of broiler creating meaningful changes in meat fatty acid profiles, especially in terms of total PUSFA[40] and with results that breast muscles of birds given 100 or 200 mg kg^{-1} of supplemental vitamin E were characterized by higher concentrations of n-6 polyunsaturated fatty acids and hypocholesterolemic fatty acids[41].

The treatment with BS, FENS, CLIS and Vit E showed higher effect on content of EFA compared to the control where BS exhibited the highest effect, while the MORS and SFS showed the lowest effect on the levels of EFA.[42].

Moreover, treatments with FENS, MORS and CLIS showed higher effect on omega-3 levels compared to the control, where FENS exhibited the highest effect on the omega-3 level, where SFS showed the lowest effect. Many studies confirmed that meat of poultry which fed with shmeal, high levels of peroxide increased during refrigeration[43]. Also, treatment with Vit E appear with higher content level of omega-6 compared to the control, while SFS showed a lower effect on Omega-6 levels compared to the control.

The treatment with CLIS also exhibited higher effect on the content of omega-9, while SFS showed a lower effect on Omega-6 level compared to the control. The Omega-6/Omega-3 ratio result in higher ratio when treated with Vit E compared to the control, while SFS showed the lowest effect. The imbalance in the n-6 vs. n-3 proportion is responsible for the pathogenesis of many diseases, including cardiovascular disease, cancer and in ammatory and autoimmune diseases[44]. The results were contradicted with studies reported dietary supplementation with *Moringa olevera* lives meal to result a reduction in n-6: n-3 ratios in goat meat[45].

With respect to PUSFAS/SATUFAS ratio the BS treatment result in higher ratio compared to the control, while MORS showed a lowest effect on the ratio. According to this results, BS inclusion was recommended for producing healthy meat as many studies reported that low ratios (PUFA/SFA) in Western diets have been considered as major risk factors for cardiovascular diseases[46].

Therefore, this study indicated that clear positive modulations on fatty acids composition of broilers by dietary inclusion of medicinal plants seeds and vitamin E, according to these results it was recommended that to be incorporated in broilers rations to produced healthy meat with long shelf life.

CONCLUSION

The fatty acids profile shows that the use of MORS lead to highest content of short fatty acids and mono-unsaturated acids content, while the addition of sunflower seeds resulted in highest medium chain fatty acids and omega-3 content, however the use of CLIS resulted in the highest long chain fatty acids and omega-9 content. On the other hand, the fenugreek seeds supplements led to the highest content of total saturated fatty acids. Nevertheless, the use of black seeds resulted the highest content of total unsaturated fatty acids, poly-unsaturated fatty acids and essential fatty acids.

There was no significant difference ($p \geq 0.05$) in TC, TG, HDL and LDL among the different seeds, however, the use of CLIS lead to a reduction in all the above parameters.

SIGNIFICANCE STATEMENT

This study discovers the possible synergistic effect of medicinal plants seeds and Vitamin E inclusion in broiler ration had effects on fatty acids and blood parameters. This study will help the researcher to uncover the critical area of feed additives that many researchers were not able to explore. Thus, a new theory on these medicinal plant seeds inclusions in broiler rations and other inclusion maybe arrived.

REFERENCES

1. McNaught, A.D. and A. Wilkinson, 1997. IUPAC Gold Book: Compendium of Chemical Terminology. 2nd Edn., Blackwell Scientific Publications, London, UK.
2. Talukdar, S., J.M. Olefsky and O. Osborn, 2011. Targeting GPR120 and other fatty acid-sensing GPCRs ameliorates insulin resistance and inflammatory diseases. Trends Pharmacol. Sci., 32: 543-550.
3. Murphy, E.F., P.D. Cotter, S. Healy, T.M. Marques and O. O'Sullivan *et al.*, 2010. Composition and energy harvesting capacity of the gut microbiota: Relationship to diet, obesity and time in mouse models. Gut, 59: 1635-1642.

4. Turner, N., K. Hariharan, J. TidAng, G. Frangioudakis and S.M. Beale *et al*., 2009. Enhancement of muscle mitochondrial oxidative capacity and alterations in insulin action are lipid species dependent potent tissue-specific effects of medium-chain fatty acids. Diabetes, 58: 2547-2554.
5. Antalis, C.J., L.J. Stevens, M. Campbell, R. Pazdro, K. Ericson and J.R. Burgess, 2006. Omega-3 fatty acid status in attention-deficit/hyperactivity disorder. Prostaglandins Leukotrienes Essent. Fatty Acids, 75: 299-308.
6. He, K., A. Merchant, E.B. Rimm, B.A. Rosner, M.J. Stampfer, W.C. Willett and A. Ascherio, 2003. Dietary fat intake and risk of stroke in male US healthcare professionals: 14 year prospective cohort study. Br. Med. J., 327: 777-782.
7. Ma, H. and K.J. Shieh, 2006. Cholesterol and human health. J. Am. Sci., 2: 46-50.
8. Ali, B.H. and G. Blunden, 2003. Pharmacological and toxicological properties of *Nigella sativa*. Phytother. Res., 17: 299-305.
9. Amol, P. and R. Vijay, 2011. *Clitoria ternatea* Linn.: An overview. Int. J. Pharm. Res., 12: 20-23.
10. Taranalli, A.D. and T.C. Cheeramkuzhy, 2003. Influence of *Clitroia ternatea* extracts on memory and cerebro cholinergic activity in rats. Pharm. Biol., 38: 51-56.
11. Kochhar, A., M. Nagi and R. Sachdeva, 2007. Effect of supplementation of traditional medicinal plants on serum lipid profile in non-insulin dependent diabetics. J. Hum. Ecol., 22: 35-40.
12. Abbas, R.J., 2010. Effect of using fenugreek, parsley and sweet basil seeds as feed additives on the performance of broiler chickens. Int. J. Poult. Sci., 9: 278-282.
13. Anhwange, B.A., V.O. Ajibola and S.J. Oniye, 2004. Chemical studies of the seeds of *Moringa oleifera* (Lam) and *Detarium microcarpum* (Guill and Sperr). J. Biol. Sci., 4: 711-715.
14. Olugbemi, T.S., S.K. Mutayoba and F.P. Lekule, 2010. Effect of moringa (*Moringa oleifera)* inclusion in cassava based diets fed to broiler chickens. Int. J. Poult. Sci., 9: 363-367.
15. Nuhu, F., 2010. Effect of *Moringa* Leaf Meal (MOLM) on nutrient digestibility, growth, carcass and blood indices of weaner rabbits. M.Sc. Thesis, Faculty of Agriculture and Natural Resources, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana.
16. Salari, S., H.N. Moghaddam, J. Arshami and A. Golian, 2009. Nutritional evaluation of full-fat sunflower seed for broiler chickens. Asian-Australas. J. Anim. Sci., 22: 557-564.
17. Guo, Y., G. Zhang, J. Yuan and W. Nie, 2003. Effects of source and level of magnesium and vitamin E on prevention of hepatic peroxidation and oxidative deterioration of broiler meat. Anim. Feed Sci. Technol., 107: 143-150.
18. AOAC., 2005. Official Methods of Analysis of AOAC International. 18th Edn., AOAC International, Gaithersburg, MD., USA., ISBN-13: 978-0935584752.
19. Dehkordi, F.R. and A.F. Kamkhah, 2008. Antihypertensive effect of *Nigella sativa* seed extract in patients with mild hypertension. Fundam. Clin. Pharmacol., 22: 447-452.
20. Siddiqui, M.N., M.T. Islam, M.A. Sayed and M.A. Hossain, 2015. Effect of dietary supplementation of acetone extracts of *Nigella sativa* L. seeds on serum cholesterol and pathogenic intestinal bacterial count in broilers. J. Anim. Plant Sci., 25: 372-379.
21. Xu, Z., N. Hua and J.S. Godber, 2001. Antioxidant activity of tocopherols, tocotrienols and γ-oryzanol components from rice bran against cholesterol oxidation accelerated by 2,2'-azobis (2-methylpropionamidine) dihydrochloride. J. Agric. Food Chem., 49: 2077-2081.
22. Ha, T.Y., S. Han, S.R. Kim, I.H. Kim, H.Y. Lee and H.K. Kim, 2005. Bioactive components in rice bran oil improve lipid profiles in rats fed a high-cholesterol diet. Nutr. Res., 25: 597-606.
23. Mehta, L.K., R. Balaraman, A.H. Amin, P.A. Bafna and O.D. Gulati, 2003. Effect of fruits of *Moringa oleifera* on the lipid profile of normal and hypercholesterolaemic rabbits. J. Ethnopharmacol., 86: 191-195.
24. Eneh, F.U., H.A. Ogbunugafor, I.J. Ezeonwumelu and C.I. Eneh, 2014. Comparative effects of palm and moringa seed oils on some biochemical and haematological parameters in rats. Adv. Applied Sci. Res., 5: 226-231.
25. Bolanle, A.O., A. Olufunmilayo, O. Olorunfemi and O. Temitayo, 2014. The effect of *Moringa oleifera* oil-based diet on growth performance, ematological parameters and plasma lipid profile in albino rats. World J. Pharm. Pharm. Sci., 3: 121-130.
26. Moosa, A.S.M., U.R. Mamun, A.Z.S. Asadi, N. Ara, M.M. Uddin and A. Ferdaus, 2006. Hypolipidemic effects of fenugreek seed powder. Bangladesh J. Pharmacol., 1: 64-67.
27. Sauvaire, Y., G. Ribes, J.C. Baccou and M.M. Loubatieres-Mariani, 1991. Implication of steroid saponins and sapogenins in the hypocholesterolemic effect of fenugreek. Lipids, 26: 191-197.
28. Rao, S.V.R., M.V.L.N. Raju, M.R. Reddy and A.K. Panda, 2004. Replacement of yellow maize with pearl millet (*Pennisetum typhoides*), foxtail millet (*Setaria italica*) or finger millet (*Eleusine coracana*) in broiler chicken diets containing supplemental enzymes. Asian-Aust. J. Anim. Sci., 17: 836-842.
29. Selvaraj, R.K. and M.R. Purushothaman, 2004. Nutritive value of full-fat sunflower seeds in broiler diets. Poult. Sci., 83: 441-446.
30. Taha, F.S., G.A. Yamamah, G.F. Mohamed, S.S. Mohamed and S.M. Wagdy, 2014. Biological activities of sunflower protein hydrolysate. World Applied Sci. J., 30: 1462-1470.
31. Solanki, Y.B. and S.M. Jain, 2010. Antihyperlipidemic activity of *Clitoria ternatea* and *Vigna mungo* in rats. Pharmaceut. Biol., 48: 915-923.

32. Daisy, P., K. Santosh and M. Rajathi, 2009. Antihyperglycemic and antihyperlipidemic effects of *Clitoria ternatea* Linn. in alloxan-induced diabetic rats. Afr. J. Microbiol. Res., 3: 287-291.
33. Kanchana, G. and G.P. Jeyanthi, 2010. The effect of supplementation of diet with vitamin-E and selenium and their combinations on the Performance and lipid Profiles of layer chickens. Int. J. Pharma Bio Sci., 6: 1-11.
34. Ismail, F.S.A., M.R. El-Gogary and M.I. El-Nadi, 2014. Influence of vitamin E supplementation and stocking density on performance, thyroid status, some blood parameters, immunity and antioxidant status in broiler chickens. Asian J. Anim. Vet. Adv., 9: 702-712.
35. Nkukwana, T.T., V. Muchenje, P.J. Masika, L.C. Hoffman, K. Dzama and A.M. Descalzo, 2014. Fatty acid composition and oxidative stability of breast meat from broiler chickens supplemented with *Moringa oleifera* leaf meal over a period of refrigeration. Food Chem., 142: 255-261.
36. St-Onge, M.P. and A. Bosarge, 2008. Weight-loss diet that includes consumption of medium-chain triacylglycerol oil leads to a greater rate of weight and fat mass loss than does olive oil. Am. J. Clin. Nutr., 87: 621-626.
37. Waheed, S., A. Hasnain, A. Ahmad, O.M. Tarar, Z. Yaqeen and T.M. Ali, 2018. Effect of botanical extracts on amino acid and fatty acid profile of broiler meat. Braz. J. Poult. Sci., 20: 507-516.
38. Sohaib, M., M.S. Butt, M.A. Shabbir and M. Shahid, 2015. Lipid stability, antioxidant potential and fatty acid composition of broilers breast meat as influenced by quercetin in combination with α-tocopherol enriched diets. Lipids Health Dis., Vol. 14. 10.1186/s12944-015-0058-6.
39. Mahfoudh, M., H. Trabelsi, K. Sebei and S. Boukhchina, 2016. Effects of adding different proportions of sunflower seeds on fatty acid composition of chicken tissues. J. Food Process. Technol., Vol. 7, No. 3. 10.4172/2157-7110.1000569.
40. Demirci, M., M.A. Karslı and Y. Aluç, 2019. Determining the effects of black cumin seed oil on performance and meat fatty acid profile of broiler chickens. S. Afr. J. Anim. Sci., 49: 890-897.
41. Mazur-Kuśnirek, M., Z. Antoszkiewicz, K. Lipiński, J. Kaliniewicz and S. Kotlarczyk, 2019. The effect of polyphenols and vitamin E on the antioxidant status and meat quality of broiler chickens fed low-quality oil. Arch. Anim. Breed., 62: 287-296.
42. WHO. and FAO., 2003. Diet, nutrition and the prevention of chronic diseases. WHO Technical Report Series, No. 916. World Health Organization, Geneva, Switzerland.
43. O'Keefe, S.F., F.G. Proudfoot and R.G. Ackman, 1995. Lipid oxidation in meats of omega-3 fatty acid-enriched broiler chickens. Food Res. Int., 28: 417-424.
44. Simopoulos, A.P., 2004. Omega-6/Omega-3 essential fatty acid ratio and chronic diseases. Food Rev. Int., 20: 77-90.
45. Qwele, K., A. Hugo, S.O. Oyedemi, B. Moyo, P.J. Masika and V. Muchenje, 2013. Chemical composition, fatty acid content and antioxidant potential of meat from goats supplemented with *Moringa* leaves, sunflower cake and grass hay. Meat Sci., 93: 455-462.
46. Ganji, S.H., V.S. Kamanna and M.L. Kashyap, 2003. Niacin and cholesterol: Role in cardiovascular disease. J. Nutr. Biochem., 14: 298-305.