British Journal of Multidisciplinary and Advanced Studies:
Agriculture, 4(6),1-18, 2023
Print ISSN: 2517-276X
Online ISSN: 2517-2778
Website: https://bjmas.org/index.php/bjmas/index
Published by European Centre for Research Training and Development-UK

Effect of Moringa Oleifera Leaves Meal (MOLM) Supplement in Combating Heat Stress in Broiler Chickens Fed Maize Soya Bean Diet

[1]Olusiyi, J. A., [1]Adi, Z.A., [2]Ebule, K., [1]Bako, M.I., and [3]Daudu, A. M. J.
1. Department of Animal Production and Health. Federal University, Wukari.
2. Department of Animal Production. Abubakar Tafawa Balewa University Bauchi.
3. Livestock Department, Taraba State Ministry of Agriculture, Jalingo.
Corresponding author: Olusiyi, J. A. Tel: 08032857379, E-mail: niyisiyi@yahoo.com

doi: https://doi.org/10.37745/bjmas.2022.0356 Published November 26, 2023

Citation: Olusiyi, J. A., Adi, Z.A., Ebule, K., Bako, M.I., and Daudu, A. M. J. (2023) Effect of Moringa Oleifera Leaves Meal (MOLM) Supplement in Combating Heat Stress in Broiler Chickens Fed Maize Soya Bean Diet, *British Journal of Multidisciplinary and Advanced Studies*: Agriculture, 4(6),1-18

ABSTRACT: *A growth experiment was conducted for 56 days to study productive performance, carcass characteristics and some blood parameters of broiler chicks fed corn-soybean meal diets supplemented with Moringa Oleifera leaves meals (MOLM) under heat stress condition. Three hundred a day old chicks were randomly assigned to five treatments designated as T_1, T_2, T_3, T_4 and T_5 supplemented with MOLM (0, 5, 7.5, 10 and 12.5%) respectively. The results did not show body weight gain, feed intake and final weight increased with increased inclusion levels of MOLM, so also was the feed conversion ratio. The cumulative feed conversion ratio was better in T2. The levels of MOLM had no significant effect on carcass relative weight, Haemoglobin (HB), white blood cells (WBC), albumin and total plasma protein increased with increasing levels of MOLM. Mortality rates decreased with increasing levels of MOLM. The best result however, was obtained in T2 (5%) inclusion level. It could be concluded that addition of Moringa Oleifera leaves improved broiler performance, physiological parameters and enhanced the ability to resist heat stress conditions of broilers fed corn-soybean meal diet*

KEYWORDS: Maize, Moringa Oleifera Leaves meal (MOLM), Broiler Chicken.

INTRODUCTION

One of the major factors militating against poultry production in Nigeria especially in the arid and semi-grid zone of the country is harsh weather condition especially between February and April of most years. At this period, broiler production is almost practically impossible due to high temperature that usually range between 38^{0C}-42^{0C} (NMS, 2015). A temperature above 30^{0}C represents a heat stress condition that affect production criteria. High mortality, decreased feed intake, lower body weight gain and poor feed efficiency are common adverse effects of heat stress often seen in meat type poultry flocks (Salin et al., 2002a, b). Heat stress increase lipid oxidant as a consequence of increase free radical generation which enhances the formation of reactive oxygen species and induces oxidative stress in cells (Altan et al., 2003).

Thermal stress is a fundamental feature of poultry management in the tropics; it partly forms the basis of the difference between the temperate regions and the tropics in poultry management (Oluyemi and Roberts, 2003). Thermal stress is of great economic threat to the poultry industry. Heat waves result in heavy losses through heat prostration in some parts of the world especially in the arid and semi-arid zone of Nigeria. According to Obeng – Asamoah, (1982), poultry generally perform better (if not best) between the temperatures of 65^{0F}-75^{0F} (18-24^{0C}). According to him at the temperature between 75^{0F} – 85^{0F} birds eat less and drink more water. This efficient feed performance saves extra feed under both colder and warmer climatic conditions. The high temperature in this region is a major impediment to poultry production. The relatively high environmental temperature is considered a major constraint to poultry production in tropical countries. Published Research work showed that high environmental temperature that exceeds those of safe thermal zone resulted in low growth, poor feed conversion, low live body weight (Estevez, 2007) and consequently heat stroke which resulted into great mortality and economic loss.

Antioxidants are known to be helpful agents that can combat the effect of heat stress. Amongst the most popular antioxidants is vitamin C which is a natural component of different plants. Moringa Oleifera has been identified to contain natural antioxidants (Siddhuraju and Beeker, 2003). Moreover, the antioxidant effect of Moringa Oleifera leaf was due to the presence of polyphenols tannis, anthocyanin, glycoside and thiocarbamates which removes free radicals activate antioxidants enzymes and inhibit oxidaxes (*Lugmans et al.,* 2012). Although, some drugs have been found capable of inducing resistance to heat stress. Some of these are transquilizers like reserpine and chlorpromazine, aspirin (acetylsacylic acid), Ascorbic acid (vitamin C) and other have been tried with some beneficial results, especially in reducing body temperature and improving egg quality. All these drugs are used in human medication and their use in poultry feeding is subject to abuse and other implications. In view of this, there is need to look for an alternative, Moringa Oleifera leaves easily come to mind as it is reported to exhibit numerous medical properties, including antioxidant, hepatotrotective, anti-bacteria and antifungal activities as well as antihepatoxic and hypoglyceridemic features (Allan et al., 2016). According to Khan et al. (2012), MOL is reported to possesses antimicrobial and immunomodulatory properties. Furthermore, different natural medicinal plants and their extracts as feed supplements have been used as a substitute for antibiotics in poultry production (*Moyo et al., 2011*; Sreelatha and Padma (2009). In addition, Mahfuz et al. (2018) reported that poultry scientists are now dedicated to applying unconventional natural feed supplement, which may play a role in possible therapies to improve the health as well as production performance of chickens. Thus, poultry researchers are searching for potential natural feed resources that will be both environmentally friendly and safe for human society (*Pourhossein et al.*, 2015 and *Mahfuz et al.,* 2018). This study therefore aimed to investigate beneficial effects of MOLM (dry) in combating heat stress and other related challenges in broiler production under heat stress conditions.

Moringa Tree

Moringa Oleifera is a well cultivated species in the genus Moringa (family Moringaceae) under the order Brassicales. The common names of Moringa Oleifera include Moringa drumstick tree horseradi tree, and ben oil or benzoil tree or miracle tree (*Arora et al.,* 2013; *Gopalakrishnan et*

British Journal of Multidisciplinary and Advanced Studies:
Agriculture, 4(6),1-18, 2023
Print ISSN: 2517-276X
Online ISSN: 2517-2778
Website: https://bjmas.org/index.php/bjmas/index
Published by European Centre for Research Training and Development-UK

al., 2016 and *Gupta et al., 2018*). Moringa tree is a native to the Sub-Himalayan regions of the northwest India. It is now indigenous to many countries in Africa, Arabia and South America (*Fordl et al.,* 2001). Moringa is well known for its multipurpose attributes, wide adaptability and ease of establishment. The drought tolerant nature of the tree make it particularly suited to those marginal areas (like arid and semi arid zone) where the cost associated with cultivation and harvesting of other commercial crops like soyabeans is high. The tree is resistant to most pests and diseases, thus making it a cheap source of feed for animals. It has a high biomass yield per hectares, it has a high protein value which can support livestock production. The M. Oleifera tree is globally known for its economic and therapeutic roles (*Anwar et al.,* 2007).
It was honoured as the "Botanical of the year 2007" by the National Institute of Health (USA) (*Gupta et al.,* 2018).

Moringa Oleifera leaves are packed with nutrients important both for human and animals (Nautiyal and Venhatara-man, 1987). A crude protein percentage of 25 – 27% is suggestive that the leaves are a good source of protein for livestock. The high proportion of this protein is available in the intestine (Makkar and Becker, 1997). The presence of adequate levels of essential amino acids (higher than levels of present in the FAO reference protein and low level of anti-nutrients indicate their nutritional quality). The high pepsin soluble nitrogen (82 – 90%) and the low acid detergent insoluble protein (1-2%) values for the meal suggest that most of the protein in the meal is available to most animals (Makkar and Becker, 1997). Makkar and Becker (1997) also concluded that the amino acid profile of Moringa Oleifera leaves is comparable to that of soyabean meal. Research have indicated that Moringa leaves have negligible tannins, saponin content is similar to that present in soyabean meal and trypin inhibitors and lectins were not detected (Makkar and Becker, 1997). Moringa Oleifera is very useful as feed supplemented for animals, as its leaves are highly nutrition. The leave of M. Oleifera are the most nutrition part being a significant source of vitamin B complex, vitamin C, vitamin K, manganese and protein among other essential nutrients (*Leone et al.,* 2015). M. Oleifera tree leaves posses various phytochemical that have antioxidant properties and roles in controlling a wide range of diseases like diarrhea, asthma and various cancer (*Gupta et al.,* 2018). The presence of antioxidant in M. Oleifera plays a major role in combating heat stress. Natural antioxidant such as vitamin C, tocopherols, flavinoids and other phenolic compounds are known to be present in certain plants. M. Oleifera is one of such plant that has been identified to contain natural antioxidant (Siddhuraju and Becker, 2013). Moreover, the antioxidant effect of Moringa Oleifera leaf was due to anthocyamin, glycosides and thiocarbametes which removes free radicals, activate antioxidant enzymes and inhibit oxidases (*Lugmans et al.,* 2012) and the antimicrobial properties of M. Oleifera are well established. The extract derived from M. Oleifera leaves have been reported to be potential antibacterial and antifungal, functions against various bacteria and fungal species (Gupta et al., 2018; Chuang et al., 2007 and Oluduro, 2012). The immune function of M. Oleifera in vitro studies (*Gupta et al.,* 2018). Finally, M. Oleifera is also very popular for its nutritional values. It is reported as a good source of six major nutrients: carbohydrate, especially dietary fibres; proteins; vitamins; minerals; lipids, and water. The leaves have been reported to enclose a range of essential amino acids and are a good source of alphalinoleic acid (*Moyo et al.,* 2011), and it has been seen to exhibit high contents of vitamin A, C and E (*Hekmat et al.,* 2015).

Study Site

The study was carried out between March and April, 2015 (peak of heat period) with the environmental temperature range of 35-42^{0C}) at the Taraba State College of Agriculture Jalingo, poultry units of the Teaching and Practical Farm. The College is located in Ardo-Kola Local Government Area in the North East geo-political zone of Nigeria. It lies between latitude 8^{0} 53' North and longitude 11^{0} 23' East of the equator in the guinea Savannah zone of northern Nigeria (Taraba State Diary, 2008). There are two main seasons existing in the area of study, these are dry and rainy seasons. The rainy season usually commences in the month of March or April and ends in October or November as the case may be. The dry season then starts in late October and ends in March/April (Taraba State Diary, 2008). It has an annual rainfall of between 1000 – 15000mm with a temperature of 30-42^{0C} depending on the season (Taraba State Diary, 2008). The state is characterized by tropical climate marked by dry and rainy/wt season.

MATERIALS AND METHODS

Experimental Procedures and Design

A total of 300 a day old chicks were used. They were randomly distributed into five treatments of 60 birds per treatment designated as T_1, T_2, T_3, T_4 and T_5. Each treatment was replicated into three replicates (20 birds) also coded as R_1, R_2 and R_3 respectively. As can be observed Tables 1 and 2 diets were formulated for both starter and finisher phases with MOLM inclusion levels 0%, 5%, 7.5%, 10% and 12.5% for T_1, T_2, T_3, T_4 and T_5 respectively. The starter diet contained 23% CP and about 2910kal/kg, while the finisher diet contained about 20% CP and about 2936kcal/kg. All groups were maintained under same environmental and management conditions. Water and feed were provided ad-libitum 24h/day during the experimental period.

Statistical Analysis

All data generated from the experiment were subjected to one way analysis of variance (ANOVA) in a Completely Randomized Design (CRD) according to Steel and Torrie (1980). Differences between treatment means were compared using Duncan Multiple Range test (DMRT) (Duncan, 1955).

Print ISSN: 2517-276X
Online ISSN: 2517-2778
Website: https://bjmas.org/index.php/bjmas/index
Published by European Centre for Research Training and Development-UK

Table 1: Ingredients and Composition of Broiler Starter (1-4 weeks) Diets

Inclusion Levels of MOLM **Ingredients**	**T_1(0%)**	**T_2(5%)**	**T_3(7.5%)**	**T_4(10%)**	**T_5(12.5%)**
Maize	48.75	46.32	45.32	44.18	43.04
Soya-Bean Meal	31.85	29.14	27.78	28.43	25.06
MOLM	**0.00**	**5.00**	**7.50**	**10.00**	**12.50**
Wheat Offal	10.00	10.00	10.00	10.00	10.00
Fish Meal	5.00	5.00	5.00	5.00	5.00
Bone Meal	2.00	2.00	2.00	2.00	2.00
Oyster Shell	1.50	1.50	1.50	1.50	1.50
*Premix	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
Methionine	0.20	0.20	0.20	0.20	0.20
Lysine	0.20	0.20	0.20	0.20	0.20
TOTAL	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Calculated Analysis:					
ME (kcal/kg)	2909.85	2910.33	2910.06	2911.15	2911.10
Crude protein (%)	23.00	23.00	23.00	23.00	23.00
Crude fibre (%)	4.04	4.33	4.37	4.43	4.47
Calcium (%)	1.41	1.45	1.33	1.47	1.49
Phosphorus (%)	0.94	0.93	0.92	0.91	0.91
EE (%)	7.49	7.67	7.56	7.27	7.14
NFE	48.70	51.20	51.05	47.07	54.7

**Vitamin – Mineral Premix (Bio-Mix) provided per kg the following: Vitamin A 500iu; Vitamin D_3, 888, 00iu; Vitamin E, 12, 000mg; Vitamin K_3, 15, 000mg; Vitamin B_1, 1000mg; B_2, 2000mg; Vitamin B6, 15000mg; Niacin, 1200mg; Pantothetic acid, 2000mg; Biotin, 1000mg; Vitamin B_{12}, 3000mg; Folic acid, 1500mg; Chlorine Chloride, 60, 000mg; Manganese, 10, 000mg; Iron, 1500mg Zinc, 800mg; Copper, 400mg; Iodine, 80mg; Cobalt, 40mg; Selenium, 800mg.*

MOLM = *Moringa Oleifera* Leaves Meal
EE = Ether Extract
NFE: = Nitrogen Free Extract
ME = Metabolizable Energy

Table 2: Ingredients and Composition of Broiler Finisher (5-8 weeks) Diets

Inclusion Levels of MOLM					
Ingredients	**T_1(0%)**	**T_2(5%)**	**T_3(7.5%)**	**T_4(10%)**	**T_5(12.5%)**
Maize	52.98	51.03	49.89	48.75	47.61
Soya-Bean Meal	22.62	19.57	18.21	16.85	15.49
MOLM	**0.00**	**5.00**	**7.50**	**10.00**	**12.50**
Wheat Offal	10.00	10.00	10.00	10.00	10.00
Fish Meal	5.00	5.00	5.00	5.00	5.00
Bone Meal	2.00	2.00	2.00	2.00	2.00
Oyster Shell	1.50	1.50	1.50	1.50	1.50
*Premix	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
Methionine	0.20	0.20	0.20	0.20	0.20
Lysine	0.20	0.20	0.20	0.20	0.20
TOTAL	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Calculated Analysis:					
ME (kcal/kg)	2935.07	2936.07	2936.07	2936.55	2936.84
Crude protein (%)	20.00	19.94	19.90	19.84	19.76
Crude fibre (%)	3.95	3.97	3.55	3.45	3.34
Calcium (%)	1.25	1.42	1.43	1.44	1.46
Phosphorus (%)	0.88	1.87	0.86	0.85	0.84
EE (%)	6.06	5.66	5.67	5.54	5.41
NFE	55.77	55.46	55.31	55.14	55.00

**Vitamin – Mineral Premix (Bio-Mix) provided per kg the following: Vitamin A 500iu; Vitamin D_3, 888, 00iu; Vitamin E, 12, 000mg; Vitamin K_3, 15, 000mg; Vitamin B_1, 1000mg; B_2, 2000mg; Vitamin B6, 15000mg; Niacin, 1200mg; Pantothetic acid, 2000mg; Biotin, 1000mg; Vitamin B_{12}, 3000mg; Folic acid, 1500mg; Chlorine Chloride, 60, 000mg; Manganese, 10, 000mg; Iron, 1500mg Zinc, 800mg; Copper, 400mg; Iodine, 80mg; Cobalt, 40mg; Selenium, 800mg.*

MOLM = *Moringa Oleifera* Leaves Meal
EE = Ether Extract
NFE: = Nitrogen Free Extract
ME = Metabolizable Energy

RESULTS AND DISCUSSION

Productive Performance: As demonstrated in Tables 3 & 4, broiler fed on 0% MOLM (control) exhibited highest feed intake in the starter and finisher phases with 69.577 and 104.556g respectively, it exhibited a significantly ($P<0.05$) higher value than birds fed MOLM based diets. Feed intake do not significantly ($P>0.05$) increased with increasing levels of MOLM across treatment groups. However, there were significant ($P<0.05$) different across treatment group. Feed intake decreased significantly ($P<0.05$) within treatment group. This can be attributed to the fact that: one of the obvious signs of heat stress is decreased feed intake; the high inclusion levels of moringa, which is higher than 0.1 – 03% as reported by Hassan et al. (2016). He reported that MOLM had a positive effect on productive performance, physiological responses and enhances the ability of broilers to resist the heat stress conditions and the best level of MOLM was 0.2% compared with the least of 5% in this experiment. This is consistent with the result of Ayssiwede et al. (2011), Pagula et al. (2014) and Karthivashan et al. (2015) who reported that feed intake was not affected by the diet supplemented with MOLM. This is also in agreement with Elkloub et al. (2015) and Laxman, (2016), who reported that MOLM supplemented diets significantly reduced the feed consumption of broiler fed 0.2, 0.4 and 0.6% MOLM. As can be observed in Tables 3 and 4, the body weight gain (BWG) was highest in T1 (34.470g) for the starter and highest in T2 (32.487g) for the finisher. Generally, the BWG final weight decreased significantly ($P<0.05$) with increased inclusion of MOLM, likewise the final weight. This confirmed the observation made by Ash and Petaia (1992) and Olugbemi et al. (2010) that increasing level of MOLM in broiler chicken diets results in depressed growth performance.

This is also consistent with some studies that reported that growth performance of broiler was not affected by the diets supplementation with MOLM (*Paguia et al.,* 2014 and *Adejola et al.,* 2016). The reason may be as a result of increased fibre content of the diet which might have impaired nutrient digestibility and absorption (Onu and Aniebo, 2011). It could also be attributed to the higher crude protein palatability in the control diet which enhanced its acceptability and utilization by the birds fed control diet. The feed conversion ratio (FCR) was best in T_1 (2.02) in the starter and best in T_2 (3.25) in the finisher. The best cumulative FCR was obtained in T2. As it can be observed, in the starter phase, T1 (0%) MOLM was significantly ($P<0.05$) better performance compared to the birds fed MOLM based diets that had lesser utilization potential of the nutrients probably because of the increased bulkiness in the diets. However, there was no significant ($P>0.05$) difference among the treatment groups of the birds fed MOLM based diet. The reason for the best cumulative FCR in T2 (5%) MOLM is in agreement with the findings of Onu and Aniebo (2011), that birds fed MOLM at 2.5% or 5% gained significantly ($P<0.05$) higher BWG and superior FCR than birds fed the control diet. Improved FCR in T2 (5%) may be attributed to the fact that birds fed MOLM based diets adequately utilized the nutrients they consumed (Laxman, A. I., 2016).

In addition, better FCR in birds fed MOLM diets might be due to antimicrobial activity (*Abd El-Maz et al.,* 2014) and immune-stimulant activities (*Allam et al.,* 2016). Generally, the FCR was on the high side across the treatment group and this is consistent with other scientists that reported same with diets supplemented with MOLM (*Teteh et al.,* 2013; *Paguia et al.,* 2014 and *Makanjola et al.,* 2014). A total of (43) mortalities were recorded despite the necessary prophylactic and hygienic management measures put in place. Ten (10) of these occurred at the starter phase due to other factors but not associated with heat stress because at that stage, the birds needed a lot of heat/warm as such cannot be affected by heat stress. The remaining 33 mortalities occurred at the finisher phase, 23 due to heat stress and 10 due to other factors. In total, 43 represents 14.33% mortality which is far above the recommended 5% by Oluyemi and

Robert (2003) who opined that mortality rate should not exceed 5% to minimize the lost in the cost of chicks, which accounts for upto 20-25% of the production cost of broilers. As can be observed, the highest mortality rate was in T1 (0%) MOLM. Here, 15 chicks were lost due to heat stress and other factors. The mortality rate decreased with increased inclusion of MOLM. As can be observed, most of the mortalities was as a result of heat stress. It can also be seen that T1 recorded 35% mortality rate compared to T5 (5%). This is a little lower than 40% reported by Gadzirayi et al. (2012). He also reported that excessive inclusion of MOLM (100%) become detrimental to birds and can also results in high mortality. The highest mortality rate in T1 and least in T5 is probable confirmation of effectiveness of MOLM as possessing antioxidant, therapeutic, anti-microbial, antibacterial, immune stimulating and hypocholesterolemic plus high nutritional properties as postulated by Mahfuz et al. (2018). Antioxidants are known to be helpful agents that can combat the effect of heat stress.

Amongst the most popular, antioxidants is vitamin C which is a natural component of different plants. Khan et al. (2012) showed that vitamin C supplementation to the diets of birds removed the oxidative injuries of chicks raised under heat stress conditions. Lugman et al. (2012) and William et al. (2014) showed that Moringa Oleifera leaves are a rich source of vitamin C and E and polyphenolic compounds which are considered important agents in combating the free radicals. Vitamin E level in the diet is also essential for the performance of birds as it affects the nervous system and the immune system (*Habibian et al.*, 2014). Vitamin E supplementation to broiler diets at higher levels during heat stress has resulted in positive effects on growth performance (*Salin et al.*, 2002). This justifies the decreasing mortality rate with increased levels of MOLM. Also, the improvement of performance with increased levels of MOLM may be due to the high content of vitamin C in Moringa Oleifera, which is able to convert the adverse effect of heat stress and enhance the productive responses. Also, Moringa Oleifera leaves are highly nutritious containing significant qualities of vitamins especially vitamin C (Onu and Aniebo, 2011 and *Asante et al.*, 2014), which play a significant role as an antioxidant in alleviating the negative responses to heat stress condition on birds to become healthy. El-Moniary et al. (2010), reported that supplementing vitamin C to broiler diets under summer stress conditions could improve the productive performance. The reduced mortality rates with increased inclusion levels of MOLM was also established by Hassan et al. (2016) that the antimicrobial and antioxidant properties of Moringa may be responsible for these findings; this indicate that the experimental levels of MOLM enhance the birds ability to ward off infection. This also may be due to high inclusion level of MOLM in the treatments as a result of high content of antioxidant particularly vitamin C which is able to alleviate the adverse effect of heat stress and enhance the physiological responses of birds to overcome heat stress.

As can be seen, the high mortality recorded among the adult birds was due to high ambient temperature and this confirmed the submission of Alaku (2010). The effects of dietary treatments on carcass yield and internal organ characteristics are shown in Table 5. Liveweight was highest in T1 (1926.67g) followed by T2 (1826.00g) with the least in T5 (1576.67g), but plucked weight was highest in T2 (1776.67g) followed by T1 (1710.00g). Also, the Dressing Percentage (D%) was best in T1 and T2 (71.89%). The carcass weight, liveweight, dressing percentage and back weight were lower ($P<0.05$) on treatments with MOLM inclusion. This is contrary to Karthivasan et al. (2015) who reported that broiler feeds supplemented with 0, 0.5, 1.0 and 1.5%

MOLM extracts yielded significantly increased dressing percentage and meat fat compared with control broilers feed, whereas 1.0% MOLM exhibited the highest dressing percentage and meat fat among treatments. Increased inclusion of MOLM resulted in the decreased in liveweight and carcass weight. These results are in agreement with Nuhu (2010), who reported that there were no significant (P>0.05) difference among treatments in carcass characteristics of weaned rabbits fed MOLM. Also, Ayssiwede at al. (2011) reported that inclusion of MOLM had no significant effect on the dressing percentage of indigenous chicken. With the trend of decreased weight as the levels of MOLM increased, this can be a consequent of reduced feed intake and growth rate observed and this is consistent with the findings of Iheukwumere et al. (2008). This is also in agreement with Ashong and Brown (2011) where the weight gain compared with diets with MOLM inclusion. It is also in line with Ayssiwede et al. (2011) who reported no adverse effect on carcass cuts due to inclusion of MOLM up-to 24% in the diet of growing indigenous Senegal chickens. The organ proportions showed that the lung, kidney, pancreas and large intestine weights were significantly (P<0.05) affected by the inclusion of MOLM. However, the heart, liver, gizzard, small intestine, caecal weights and length and large intestine length were not significantly (P>0.05) affected.

Generally, trends of change of weights and lengths of the different cut parts were not consistent in all the parameters measured. Thus, could not be totally attributed to the MOLM inclusion in the diets (*Aderinola, et al.*, 2013). The weight of the abdominal fat followed a decreased trend as the level of MOLM inclusion increases, this could probably be attributed to the hypocholesterolemic property of MOLM (*Olugbemi et al.*, 2010.) The result therefore, agrees with the report by Aderinola et al. (2013) that, the utilization of MOLM in broiler diet as a supplement could be adopted when the motive is production of broiler with low fat content. All these reports are in agreement with Nkukwana et al. (2014) who found that addition of MOLM (0.1-2.5%) to broiler diets have no significant effects on carcass weight, dressing percentage and relative weight of the liver, gizzard, heart and spleen. Heamatological and Biochemical indices are presented in Table 6. The best value of packed cell volume (PCV) was recorded and the least in T4 (26.33%). While the best value for WBC was in T5 (123.23 x 10^9/L) followed by T2 (199.16 x 109/L). The results of the haematological indices showed no significant (P>0.05) difference among the treatments group for most of the parameters except for the white blood cells (WBC) count which was significantly (P<0.05) different, with T5 (123.23 x 10^9/L) having the highest value. This shows that the principal function of phagocytes, which is to defend against invading micro-organisms by ingesting and destroying them was enhanced (*Aderinla et al.*, 2013). This is in line with Aderinola et al (2013) who reported that dietary supplementation of MOLM may increase the immune ability of broilers as can be explained with decreased in mortality with increasing levels of MOLM inclusion.

The mean PCV values were not significantly (P>0.05) different among treatments. This is in line with Madubuike and Ekenyem (2006) who recorded no significant among treatments. The values of serum biochemical indices obtained showed non significant (P>0.05) difference in serum biochemical indices of broiler diets fed MOLM. The results of Haemoglobin highest value was in T3 (9.50g/dl) followed by T2 (9.47g/dl). This is similar to the result of Hassan et al. (2016) who recorded the highest values in T4 (9.46gldl and 9.33g/dl) respectively. This result may be due to the high content of MOLM as reported by Ogbe and Affiku, (2012) and the Red Blood

Cells (RBC) was highest in T4 (3.43 x 10^{12}/L) followed by T2 (3.40 x 10^{12}/L), but there was no significant (P>0.05) difference within the treatment. Olugbemi et al. (2010), mention that RBC are responsible for the transportation of oxygen and carbondioxide in the blood as well as manufacture of haemoglobin hence, higher values indicate a greater potential for this function and a better state of health. The values of serum biochemical indices showed a non significant (P>0.05) difference across the treatments. This implies that the diets did not altar these parameters, however, this is in contrast with the report of Aderinola et al. (2013) who recorded significant (P<0.05) difference in serum biochemical indices of broiler diet fed MOLM or feed supplement. Despite the fact that insignificant difference (P>0.05) was recorded across all dietary treatments, a numerical reduction in values of cholesterol was observed with increased levels of MOLM inclusion. This agrees with the report of Olugbemi et al. (2010) and Aderinola et al. (2013) who reported a reduction in serum cholesterol levels with increasing levels of MOLM inclusion in the diet of rats and layers respectively. The low cholesterol content observed in the birds fed MOLM based diets as compared with T1(0) without MOLM would have been as a result of the hypocholesterolemic properties of MOLM included in the diets Olugbemi et al., (2010), while the decreased cholesterol content with increase MOLM inclusion may also be responsible for the low fat content observed in the meat (*Aderinola et al.*, 2013).

The plasma total protein increased slightly with increased inclusion of MOLM with the highest value in T4 (32.67g/L). It is postulated that plasma protein profile of a given activities related to protein synthesis and/or degradation. Since, it is well known that stress conditions could stimulate the adrenal gland cortex for curticosterone secretion, which caused a considerable increase in protein catabolism due to its glucozeogenic activity (Tollba and Hassan, 2001). Increasing the levels of MOLM in the diet significantly elevated the plasma protein which is consistent with the findings of Teye et al. (2013). Increased total protein in chicken fed the MOLM diet may reflect a more intensive metabolism of the protein in the chicken's organ as suggested by Melesse et al. (2013). This may be due to high content of moringa from antioxidant (Onu and Aniebo, 2011; *El-Wardary et al.*, 2012; *Asante et al.*, 2014) which increased blood total protein by decreasing corticosterone secretion which could limit protein catabolism under heat stress. Finally most of the parameters range were within the range recommended for healthy birds as reported by wikivet (2012).

Table 3
Effect of *Moringa Oilefera* Leaves Meal (MOLM) as a protein source supplement of soyabean cake on the performance of broiler chicken (1-4 weeks) starter phase

Inclusion Levels of MOLM						
Parameters	**T_1(0%)**	**T_2(5%)**	**T_3(7.5%)**	**T_4(10%)**	**T_5(12.5%)**	**SEM**
Initial Weight(g)	114.58	112.50	114.58	114.50	114.58	1.85^{NS}
Final Weight(g)	1079.85^{b}	916.80^{a}	917.68^{a}	889.01^{a}	906.49^{a}	22.98^{*}
FI (g)	69.58^{b}	64.50^{a}	66.96^{ab}	64.64^{a}	66.14^{ab}	0.84^{*}
BWG(g)	34.47^{b}	28.73^{a}	28.68^{a}	27.66^{a}	28.28^{a}	1.45^{*}
F C R	2.02^{b}	2.25^{a}	2.34^{b}	2.33^{b}	2.35^{b}	0.07^{*}
Mortality:						
Due to Heat Stress	-	-	-	-	-	
Due to other factors	2	2	2	2	2	

a,b = Means within the same row bearing different superscripts are significantly (P<0.05) different

MOLM = *Moringa Oleifera* Leaves Meal
SEM = Standard Error of Means
FI = Feed Intake
BWG = Body Weight Gain
FCR = Feed Conversion Ratio
NS = Not Significant
* = Significant

Table 4
Effect of *Moringa Oilefera* Leaves Meal (MOLM) as a protein source supplement of soya bean cake on the performance of Broiler Chicken (5-9 weeks) Finisher Phase

Inclusion Levels of MOLM						
Parameters	**T_1(0%)**	**T_2(5%)**	**T_3(7.5%)**	**T_4(10%)**	**T_5(12.5%)**	**SEM**
Initial Weight(g)	1079.85^{b}	916.80^{a}	917.68^{a}	889.01^{a}	906.49^{a}	22.995^{*}
Final Weight(g)	1926.67^{b}	1826.67^{ab}	1770.00^{ab}	1680.00^{ab}	1576.67^{a}	91.72^{*}
A D F I (g)	104.21	98.56	103.04	96.30	100.50	3.46^{*}
A D W G (g)	30.16	32.49	30.44	28.25	23.94	4.54^{*}
F C R	3.52	3.25	3.49	3.47	4.24	0.47^{NS}
Mortality:						
Due to Heat Stress	15	5	2	1	0	
Due to other factors	4	2	2	1	1	
Total	21 (35%)	9 (15%)	6 (10%)	4 (6.67%)	3 (5%)	

Print ISSN: 2517-276X
Online ISSN: 2517-2778
Website: https://bjmas.org/index.php/bjmas/index
Published by European Centre for Research Training and Development-UK

a,b = Means within the same row bearing different superscripts are significantly (P<0.05) different

MOLM	=	*Moringa Oleifera* Leaves Meal
SEM	=	Standard Error of Means
FI	=	Feed Intake
BWG	=	Body Weight Gain
FCR	=	Feed Conversion Ratio
*****	=	Significant
NS	=	Not Significant

Table 5
Carcass yield and internal organ characteristics of Broiler Chickens Fed various Levels of Moringa Oleifera leaves meal as a protein source supplement of soyabean cake.

Inclusion Levels of MOLM						
Parameters	**T_1(0%)**	**T_2(5%)**	**T_3(7.5%)**	**T_4(10%)**	**T_5(12.5%)**	**SEM**
Liveweight(g)	1926.67^{b}	1826.00^{ab}	1770.00^{ab}	1680.00^{ab}	1576.67^{a}	91.72*
Pluck weight(g)	1710.00	1776.67	1610.00	1560.00	1436.67	2489.41^{NS}
Eviscerated wt(g)	1650.00	1436.60	1386.67	1286.67^{ab}	1166.67	1891.49^{NS}
Carcass weight (g)	1433.33^{b}	1320.00	1243.33^{ab}	1166.67^{ab}	1036.67^{a}	90.27*
Dressing (%) (D%)	71.89^{b}	71.89^{b}	70.75ab^{ab}	69.38^{ab}	65.59^{a}	2.48*
Head (g)	47.00	51.50	50.83	45.17	42.33	4.14^{NS}
Neck (g)	107.67	98.33	84.67	80.67	75.83	10.16^{NS}
Breast (g)	362.67	321.33^{ab}	325.00^{ab}	288.50^{ab}	243.00^{a}	28.55*
Wings (g)	170.00	163.67	153.50	143.67	139.50	9.39^{NS}
Chest (g)	110.33^{a}	98.17^{ab}	95.00^{ab}	82.33^{a}	75.00	7.00*
Thighs (g)	227.50^{a}	209.83^{ab}	196.00^{ab}	179.17^{ab}	154.67^{a}	18.14*
Drumstick (g)	196.50	193.17	176.67	173.83	154.33	12.56^{NS}
Back (g)	171.67^{b}	158.17^{b}	136.33^{ab}	120.33^{a}	113.33^{a}	11.09*
Shanks (g)	87.33	89.67	78.33	85.00	73.50	6.74^{NS}
Internal Organs (%)						
Heart (g)	0.42	0.45	0.37	0.44	0.41	0.461^{NS}
Liver (g)	2.02	2.14	1.84	1.96	2.14	2.88^{NS}
Lungs (g)	0.67^{a}	0.70^{b}	0.49^{a}	0.55^{ab}	0.65^{ab}	3.24*
Gizzard (g)	2.60	2.91	2.51	3.02	3.12	1.12^{NS}
Kidney (g)	0.61^{a}	0.37^{a}	0.56^{ab}	0.67^{b}	0.70^{b}	0.85*
Pancreas (g)	0.13^{c}	0.12^{bc}	0.09^{a}	0.10^{a}	0.08^{ab}	14.53*
SIW (g)	3.49	4.24	5.25	5.63	6.28	0.85^{NS}
LIW (g)	0.18^{a}	0.29^{a}	0.26^{a}	0.28^{a}	0.53^{b}	1.62*
Caecal wt (g)	0.56	0.58	0.53	0.57	0.79	1.91^{NS}
SIL (cm)	200.00	207.33	180.83	229.67	196.00	1.91 ^{NS}

LIL (cm)	8.33	10.33	11.83	11.50	10.33	15.69 ^{NS}
Caec. Lght (cm)	37.33	39.27	40.50	41.33	42.33	2.52 ^{NS}
Abd. Fat wt (g)	01.07	1.01	0.43	0.10	0.10	10.19 ^{NS}

SIW = Small Intestine Weight,
LIW = Large Intestine Weight
SIL = Small Intestine Length
Abd. Fat= Abdominal Fat
a,b,c = Mean with different superscripts on the same row are significantly different
SEM = Standard Error of Means
***** = Significant
NS = Not Significant

Table 6
Haematological and Biochemical Indices of Broiler Chicken fed various levels of MOLM as Protein source supplement of soya bean cake.

Diets / Treatment						
Parameters	**T_1(0%)**	**T_2(5%)**	**T_3(7.5%)**	**T_4(10%)**	**T_5(12.5%)**	**SEM**
Haematological Indices						
PCV (%)	28.33	29.33	30.00	26.33	26.67	2.31^{NS}
MCV (FL)	90.40	90.70	90.03	89.90	90.33	0.37^{NS}
MCHC (g/100ML)	32.03	31.60	31.63	31.63	32.90	0.70^{NS}
MCH (Pg)	29.00	28.57	28.07	29.03	30.13	0.66^{NS}
Hb (g/dL)	9.10	9.47	9.50	8.40	8.77	0.89^{NS}
WBC (x 10^9/L)	103.00^b	119.16^a	112.00^{ab}	111.16^{ab}	123.23^a	4.27^*
RBC (x 10^{12}/L)	3.10	3.40	3.37	3.43	2.99	0.21^{NS}
Biochemical Indices						
Glucose (MMOl/L)	8.13	7.83	7.73	9.30	9.07	1.04^{NS}
Urea (MMOl/L)	0.95	0.85	1.22	1.01	1.63	0.23^{NS}
Creatinine (MMOl/L)	42.77	42.73	39.80	41.27	50.13	3.45^*
Cholesterol (MMOl/L)	3.00^a	2.47^b	2.20^c	2.18^c	1.80^d	0.28^{NS}
Albumin (g/L)	9.27	26.40	26.53	32.67	31.27	3.74^{NS}
Total Protein (g/L)	23.63	26.40	26.53	32.67	31.27	3.74

a,b,c,d = Means of different superscripts were significantly ($P<0.05$) different
MOLM = *Moringa Oleifera* Leaves Meal
SEM = Standard Error of Means
***** = Significant
NS = Not Significant

CONCLUSION

On the basis of the results obtained, it can be concluded that supplementation of MOLM in broiler diets during heat stress condition has positive effects on productive performance, physiological responses and enhance the ability of broilers to resist the heat stress condition, consequently reducing mortality rate. Therefore, supplementation of MOLM is highly recommended for broiler production in a heat stress environment.

REFERENCES

Abd El-Moez, S. I; El-Badawy, A. Y. and Omer, H. A. A. (2014). Assessment of antimicrobial effect of moringa: In vitro and in vivo evaluation. Afr. J. Microbiol. Res., 8: 3630 – 3638.
Adejola, Y. A; Sobayo, R. A; Muhammed, S. B; Akinbola, D. D. and Olarewaju, A. (2016). Effects of two herbal feed additives with or without grits on growth performance and nutrient digestibility of broiler chickens. J. Anim. Sci. Adv., 6: 1548 – 1554.
Aderinola, O. A.,Alabi T. A. and Adeagbo, O. A. (2013). Utilization of Moringa Oliefera leaf as feed supplement in broiler diets. International journal of food Agricultural and veterinary sciences 3(3): 94-102.
Alaku, S. O. (2010), Introduction to animal science – First Edition. Jee communication Enugu-Nigeria, pp 13-16,236.
Allam, H., Abdelazemn, A. M. Farag, H. S. and Hamed, A. (2016). Some hematobiochemical, bacteriological and pathological effects of Moringa Oleifera leaf extract in broiler chickens. Int. J. Basic Applied Sc., 5: 99 – 104.
Altan, O; Pabuccuoglu, A., Altan, A; Konyalioglu, S. and Bayraktar (2003). Effect of heat stress on oxidative stress, lipid peroxidation and some stress parameters in broilers. Br. Poult. Sci., 44: 545 – 550.
Anwar, F., Sajid, L. M. Muhammad, A. and Anwaru, H. G. (2007). Moringa Oleifera: A dood plant with multiple medicinal uses. Phytother. Res. 21:17-25 (crossRef) [PubMed]
Arora, D. S; Onsare, J. G. and Kaur, H. (2013). Bioprospecting of Moringa moringalea): microbiological perspective. J. Pharmacogn. Phytochem. 1:193-215.
Asante, IN.J. Nasane, I. L., Tom-Dery, D. ,, Ochire – Boadu, K. and Kenil K. B. (2014) composition of Moringa Oleifera leaves from two agro ecological zones in Ghana. Afr. J. plant Sci., 8: 65-71.
Ash, A. J. and Petaia, R. (1992). Nutritional value of Serbania grandiflora leaves for Ruminant and Monogastric. Tropical Agriculture (Trinidad), 60: 223-228.
Ashong, J. O. and Brown, D. L. (2011). Safety and Efficacy of Moringa Oliefera powder for Growing poultry. Journal of animal science, 89:84
Ayssiwede, S. B; Dieng, A. Bello, H. Chrysostome, C. A. A. M and Hane, M. B. (2011). Effect of Moringa Oleifera (Lam) leaves meal incorporation in diets on growth performances, carcass characteristics and economic results of growing indigenous Senegal chickens. Pak. J. Nutr., 10: 1132 – 1145. (crossRef/Direct Link).

Ayssiwede. S. B., Dieng, A.,Bello, H; chrystome, C. A. A. M. and Have , M. B. (2011). Effects of moringa Oleifera (lam) leaves meal incorporation in diets on growth performances carcass characteristics and economics results of growing indigenous Senegal chickens. Pak. J. Nutr. 10: 1132-1145.

Chuang, P. H., Lee, A.C.W; Chou, J. Y., Murugan, M., Shieh, B. J. and Chen, H. M. (2007)Antifungal activity of crude extract and essential oil of Moringa Oleifera Lam. Bioresour. Technol. 98: 232 – 236 (crossRef) [PubMed]

Duncan, D. B. (1955). Multiple Range and Multiple F. Test Biometrics. 1:1-42.

El- Moniary, M. M. A., Hemid, A.A., El- wardany, I, gehead, A. E. and Gouda,A. (2010). The effect of early age head conditioning and some feeding programs for heat-stressed broiler chicks on: 1- productive performance. World J. AGRIC. Sci, 6:689-695.

El- Wardary, I., EL-Moniery, M. M. A, Hemid, A. A., Gehad A. E. and Gouda,. (2012).the effect of easy age heat conditioning and some feeding programs for heat- stressed broiler chicks on 2—physiology response. Egypt. J. Nutr. Feeds, 15; 265-277.

Elkloub, K; Moustafa, M. E. L; Riry, F. H; Mousa, M. A. M. and Henan, A. H. (2015). Effect of using Moringa Oleifera leaf meal on performance of Japanese quail . Egypt Poul. Sci. J. 35: 1095 – 1108.

Estevez, I. (2007). Density allowances for broilers. Where to set the limits? Poult. Sci. 86: 1265 – 1272.

Fordl, N., Makkar, H.P.S and Becker, K. (2001). The potential of Moringa Oleifera for Agricultural and industrial uses. The miracle tree: The multi uses of Moringa. Ed. Lowell J. Fugile, CTA, Wageningen, The Netherland, Pp. 45-76.

Gadzirayi, C.T., Masamba, B; Mupangwa, J.F. and Washoya, S. (2012), performance of broiler chickens feed on mature moringa oleifera leaf meal as a protein supplement to soyabean meal. Int. J. Pouscl. Scl. 11: 5-10 (Cross Ref).

Gopalakrishnan, L., Doriya, K. and Kumar, D. S. (2016). Moringa Oleifera: A review on nutritive importance and its medicinal application. Food Sci. Human Wellness. 5: 49-56 (crossRef.)

Gupta, S; Jain, R; Kachhwaha, S. and Kothari, S. L. (2018). Nutritional and medicinal application of Moringa Oleifera Lam-Review of current status and future possibilities. J. Herbal Med. 11:1-11 (crossRef).

Habibian M., Ghazi; , S., Maeini; , M. M.and Abdol Mohammadi;, A. (2014) Effect of dietary selenium and vitamin E on immune response and biological blood parameters of broilers reared under thermo neutral or heat tress conditions. International journal of Biometrology, 58 (5): 741-752.

Hassan, H. M. A; El-Moniary, M. M; Hamouda, Y., Eman, F. El-Daly, F. Amani W. Yousseef and Nafisa A. Abd El-Azeem (2016). Effect of Different levels of Moringa Oleifera Leaves Meal on Productive Performance, Carcass Characteristics and some Blood Parameters of Broiler Chicks Reared under Heat Stress Conditions. 11(1): 60-66.

Hekmat, S; Morgan, K; Soltani, M. and Gough, R. (2015). Sensory evaluation of Locally-grown fruit purees and inulin fibre on probiotic yogurt in Mwanza, Tanzania and microbial analysis of probiotic yogurt fortified with Moringa Oleifera. J. Health population Nutri. 33: 60 – 67.

Iheukumere, F.C., Ndubusi, E. C., Mazi, E A. and onyekwere, M. U. (2008). Performance, nutrient utilization and organ characteristics of broilers fed cassava leaf meal (Mani hot

Esculenta crant3). Pakistan Journal of Nutrition, 7:13-16. Intentional Journal of poultry science 9 (4); 363-367.

Karthivashan, G. O; Arulselvan, P. Almon, A. R; Ismail, I. S. and Fakurazi, S. (2015). Competing role of bioactive constituents in Moringa Oleifera extract and conventional nutrition feed on the performance of Cobb 500 broilers. Biomed Res. Int. 10. 1155 / 970398.

Khan, R. U., Naz, S; Nikousefatz and Selvaggi, M. (2012). Effect of ascorbic acid in heat stressed poultry. World's Poultry Sci. J., 68: 477-490.

Laxman, A. I. (2016). Effect of supplementation of Moringa Oleifera leaf powder on performance of broilers. M.Sc Thesis University of Maharashtra Animal and Fishing Science. Nagpur, India.

Leone, A. Spada, A; Battezzati, A; Schiraldi, A; Aristic, J. and Bertoli, S. (2015). Cultivation, genetic, ethnopharmacology, phytochemistry and pharmacology of Moringa Oleifera leaves: An overview. Int. J. Mol. Sci. 16: 12791 – 12835. (crossRef).

Lugmans, S. Srivastava, S; Kumar, R; Maurya, A. K; and Chanda, D. (2012). Experimental assessment of Moringa Oleifera leaf and fruit for its anti-stress, anti-oxidant and scavenging potential using in vitro and in viro assays. Evidence-Based Complement. Altern. Med. 10:1155/2012/519084.

Madubuike, F. N. and Ekenyem, B. U. (2006). Haematology and Serum Biochemistry characteristics of Broiler chicks fed varying dietary levels of ipomaesarifolia leaf meal. International Journal of Poultry Science, 74; 672-684.

Mahfuz, S. U; Chen, M., Zhou, J. S; Wang, S., Wei, J; Liu, Z. and Song, H. (2018). Evaluation of golden needle mushroom (Flammuling velutipes) stem waste on pullet performance and immune response. South African J. Anim. Sci. 48: 563 – 571 (Cross Ref.).

Mahfuz, S; Song, H; Miao, Y. and Liu, Z. (2018). Dietary inclusion of mushroom (Flammulina valutipe) stem waste on growth. Performance and immune responses in growing layer hens. J. Sci. Food Agric 99: 703 – 710.

Makanjuola, B. A; Obi, O. O; Olorungbohunmi, T. O; Morakinyo, O. A; Oladele-Bukola, M. O. and Boladuro, B. A. (2014). Effect of Moringa Oleifera leaf meal as a substitute for antibiotics on the performance and blood parameters of broiler chickens. Livest. Res. Rural Dev., Vol. 26, No. 8.

Makkar, H. P. S and Becker, K. (1997). Nutrient and anti-quality factors on different morphological parts of the Moringa tree. J. Agric Sci. 128: 311 – 322.

Melesse, A., Getye, Y., Berilun, k. and Barnejee, s. (2013). Effect of feeding graded levels of moringa stenoetala leaf meal on growth performance, carcass traits and some serum Biochemical Parameters of Koekoek chickens. Sci; , 157: 498-505. Cross Ref/link.

Moyo, B; Masika, P. J; Hugo A. and Muchenge, V. (2011). Nutritional characterization of Moringa (Moringa Oleifera Lam) leaves. Afr. J. Biotechnol, 10: 12925 – 12933.

Nautiyal, B. S. and Venhatarama, K. G. (1987). Moringa (Drumstick) an ideal tree for social forestry. 1: Growing conditions and uses. Myforest, 23:53-58.

Nigeria Metrological Service (NMS), Taraba State Weather Forecast Reports, April, 2015.

Nkuwana, T. T., Mucherije, V., Pieterse,P. E. Masika, P. J., Mabusela, T. P. Hoffmen, I. C. and D, Zama, K. (2014). Effect of Moringa Oliefera leaf meal on growth performance apparent digestibility, digestive organizes and carcass yield in broiler chickens. Livest. Sci., 161: 139-146.

Nuhu, F. (2010). Effect of morninga oleifera leaf meal on nutrient disgeshibity, growth, carecess and blood indices of wears rabbits. Ph.D. These Kwame Nkrumah University of science and Technology, Kumasi, Ghana.

Obeng – Asamoah, J. E. (1982). The secret of profitable poultry production. (P.hD Research Summary) Gaskiya Corporation Ltd. Zaria, Nigeria.

Ogbe, A. O. and Affiku, J. P. (2012). Effect of polyhrbalaqueuns extract (Moringa Oleifera, Gum Arabic and wild Ganoderma incidum) in comparison with antibiotic on growth performance and heamatological parameters of broiler chickens. Res. J. Recent Sci., 1-10-18

Oluduro, A. O. (2012). Evaluation of antimicrobial properties and nutritional potential of Moringa Oleifera Lam leaf in South-Western Nigerian. J. Microbiol. 8: 59 – 67.

Olugbemi, T. S; Mutayoba, S. K. and Lekule, F. P. (2010). Effect of Moringa Oleifera inclusion in cassava based diets fed to broiler chickens. International Journal of Poultry Science 9 (4): 363 – 367.

Oluyemi, J. A. and Roberts, F. A. (2003). Poultry Production in Warm Climates Spectrum Book Limited. 2nd edition Macmillan Publisher Limited London, Pp. 168 – 169.

Onu, P. N. and Aniebo, A. O. (2011). Influence of Moringa Oleifera leaf meal on performance and Blood Chemistry of starter broilers, Nigeria International Journal of Food and Agricultural Science 1 (1) 38 – 44.

Paguia, H. M; Paguia, R. Q; Balba, C. and Flores, R. (2014). Utilization and evaluation of Moringa Oleifera leave as poultry feeds. APCBEE Procedia 8, 343-347. Crossref / Google scholar.

Pourhossein, Z; Qotbi, A. A. A; Seidari, A; Laudadio, V., Centoducati, G. and Tufarelli, V. (2015). Effect of different levels of dietary sweet orange (citrus sinensis) peel extract on humoral immune system responses in broiler chickens. Anim. Sci. J. 86: 105 – 110 (cross Ref. (PubMed).

Salin, K., Salin, N. and Yaralioglu (2002a&b). Effects of vitamin C and vitamin E on lipid peroxidation, blood serum metabolites and mineral concentration of laying hens reared at high ambient temperature. Biol. Trace Elem. Res. 85:35-45

Salin, K., Kucuk, O; Salin, N. and Sari, M. (2002). Effects of vitamin C and vitamin E on lipid peroxidation status, serum hormone, metabolite and mineral concentrations of Japanese quails reared under heat stress (340C). Int. J. Vitam. Nut. Res; 762:91-100

Siddhuraju, P. and Becker, K. (2013). Anti-oxidant properties of various solvent extracts of total phenolic constituents from three different agroclimatic origins of drumstic tree (Moringa Oleifera Lam) leaves. J. Agric. Food Chem., 51: 2144 – 2155.

Siddhuraju, P. and Becker, K. (2003). Antioxidant properties of various solvent extracts of total phenolic constituents from three different agroclimatic origin of drumstick tree (Moringa Oleifera Lam) leaves. J. Agric Food Chem., 51: 2144 – 2155.

Sreelatha, S. and Padma P. R. (2009). Antioxidant activity and total phenolic content of Moringa Oleifera leaves in two stages of maturity. Plant Foods Hum Ntur., 64: 303 – 311.

Steel, R. G. D. and Torrie, J. A. (1980). Principles and Procedures of statistics. A Biometrical Approach 2nd Ed. McGraw-Hill Kogakusha Ltd., Tokyo.

Taraba State Diary (2008). Taraba State Annual Official Diary.

Teteh, A; Lawson, E; Tona, K; Decuy-Pere, E. and Gbeassor, M. (2013). Moringa Oleifera leave: Hydro-alcohol extract and effects on growth performance of broilers. Int. J. Pout. Sci. 12: 401 – 405: (crossRef/Direct Link).

Teye, G.A., Baffoe, F. and Teye, M. (2013) Effects of (Moringa Oleifera) leaf powder and dawadawa (parkia biglobosa), on sensory characteristics and nutritional quality of frankfurter type sausages a preliminary study. Global Adr. Res. J. Agric Sci., 2: 29-33

Tollba, A. A. H. and Hassan, M. S. H. (2001). Using some natural additives to improve physiological and productive performance of broiler chicks under high temperature conditions. 2. Black cumin (nigella sativa) or garlic (Allium sativum).Egypt. Poult. Sci, 23:327-340. Direct link.

Wikivet (2012). Chicken Haematology httl:llen.wikivet.net/chickens.

William, J. A., Nasara, I.L., Tom-Dery, D.Ochire-Boadu K. and kentil, K.B. (214).nutrient composition of moringa oleifera leaves from two agro ecological zone in Ghana Afr. J. plant Sci, 8(1): 65.