BENEFITS OF *MORINGA OLEIFERA* LEAVES MEAL (MOLM) AS A NATURAL FEED SUPPLEMENT OF BROILER CHICKS REARED UNDER HEAT STRESS CONDITIONS

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ABSTRACT
A growth experiment was conducted 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 week-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 that 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 ($P>0.05$) 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 in most of the parameters however, was obtained in T2 (5%) inclusion level. It could be concluded that addition of *Moringa oleifera* leaves improved broiler performance, blood parameters and enhanced the ability to resist heat stress conditions of broilers fed corn-soybean meal diet
Keywords: *Moringa oleifera l*eaves meal (MOLM), Broiler, Diets

INTRODUCTION
One of the major factors militating against poultry production in Nigeria especially in the arid and semi-arid 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. A temperature above 30^0C 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 (Altan *et al*., 2003). 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 certain natural antioxidants. 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. Although, some drugs have been found capable on inducing resistance to heat stress. Some of these are tranquilizers 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 (Altan *et al*., 2003).

MATERIALS AND METHODS
The study was carried out between March and April, 2015 (at the 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).
A total of 300 a week-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 three times also coded as R_1, R_2 and R_3, respectively. As can be observed in 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. All data generated from the experiment were subjected to one-way analysis of variance 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).

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; Pantothenic 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

As demonstrated in Tables 3 and 4, feed intake did not significantly (P>0.05) increased with increasing levels of MOLM across treatment groups. However, there were significant (P<0.05) different across treatment groups. Feed intake decreased significantly (P<0.05) within treatment groups. 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 Aderinola *et al*. (2013). 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. The effects of dietary treatments on carcass yield and internal organ characteristics are shown in Table 5. The carcass weight, liveweight, dressing percentage and back weight were lower (P<0.05) ontreatments with MOLM inclusion. This is contrary to Aderinola *et al*. (2013) 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.

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. This shows that the principal function of phagocytes, which is to defend against invading micro-organisms by ingesting and destroying them was enhanced. 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.

Table 3. Effect of *Moringa Oilefera* Leaves Meal (MOLM) as a protein source supplement of soybean 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
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

Table 4. Effect of *Moringa Oleifera* 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}	22.985
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^{b}	0.47
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%)	

^{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

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 soybean 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
Eviscerated wt(g)	1650.00	1436.60	1386.67	1286.67^{ab}	1166.67	1891.49
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
Neck (g)	107.67	98.33	84.67	80.67	75.83	10.16
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
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
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	8.33	85.00	73.50	6.74
Internal Organs (%)						
Heart (g)	0.42	0.45	0.37	0.44	0.41	0.461
Liver (g)	2.02	2.14	1.84	1.96	2.14	2.88
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
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
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
SIL (cm)	200.00	207.33	180.83	229.67	196.00	1.91
LIL (cm)	8.33	10.33	11.83	11.50	10.33	15.69
Caec. Lght (cm)	37.33	39.27	40.50	41.33	42.33	2.52
Abd. Fat wt (g)	01.07	1.01	0.43	0.10	0.10	10.19

^{a,b,c}- Mean with different superscripts on the same row are significantly dif
ferent; SIW- Small Intestine Weight; LIW- Large Intestine Weight; SIL- Small Intestine Length; Abd. Fat; Abdominal Fat; SEM- Standard Error of Means

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	30.0	26.33	26.67	2.31
MCV (FL)	90.40	90.70	90.03	89.90	90.33	0.37
MCHC (g/100ML)	32.03	31.60	31.6	31.63	32.90	0.70
MCH (Pg)	29.00	28.57	28.0	29.03	30.13	0.66
Hb (g/dL)	9.10	9.47	9.50	8.40	8.77	0.89
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
Biochemical Indices						
Glucose (MMOl/L)	8.13	7.83	7.73	9.30	9.07	1.04
Urea (MMOl/L)	0.95	0.85	1.22	1.01	1.63	0.23
Creatinine (MMOl/L)	42.77	42.73	39.8	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
Albumin (g/L)	9.27	26.40	26.53	32.67	31.27	3.74
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

CONCLUSION AND RECOMMENDATION

On the basis of the results obtained, it could be concluded that supplementation of MOLM in the diets during heat stress condition with the present experimental levels (0, 5, 7.5, 10 and 12.5%) has positive effects on productive performance physiological responses and enhance the ability of broilers to resist the heat stress condition. The best level of MOLM is 5%. This improvement can lead to increasing broiler production under heat stress conditions in tropical and sub-tropical countries. However, more studies are needed to evaluate the best level of supplementation.

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