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Growth Performance and Cost Implication of Broiler Chickens Fed Yellow Maize Diet Supplemented with Graded Levels of Synthetic Methionine

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Abstract

Eight weeks (56 days) feeding trials carried out using a total of three hundred (300) day old broiler chicks to determine the growth performance and cost implication of broiler chicks fed yellow maize supplemented with graded levels of methionine. Five dietary treatments of sixty birds per treatment with three replicates of 20 birds as T1, T2, T3, T4 and T5 and R1, R2 and R3 respectively. Diets were formulated in which yellow maize was supplemented with graded levels of methionine at 0.1, 0.2, 0.3, 0.4 and 0.5% for T1, T2, T3, T4 and T5 respectively. The study was conducted in a Completely Randomized Design (CRD), and birds were randomly assigned to five dietary treatments. The experiment lasted for 8 weeks in two phases, 1 – 4 weeks (starter phase) and 5 – 8 weeks (finisher phase). All data generated were subjected to one way analysis of variance (ANOVA) in a Completely Randomized Design (CRD). Differences between means were compared using Duncan Multiple Range Test or the IMB Statistical package for Social Science (SPSS)/modified MINITAB. The result of growth performance revealed that the daily feed intake (DFI) was significantly ($P<0.05$) different in all the phases, the daily weight gain (DWG) were not significantly ($P>0.05$) different also. The feed conversion ratio (FCR) was significantly ($P<0.05$) influence also, but the best performance in the finale phase was in T5 (2.34).

The study also revealed that, yellow maize can be supplemented with graded levels of synthetic methionine at up to 0.5% level without any adverse effect on the productive performance of the birds. The feed cost (FC) was highest in T5 (246.98) N/kg and least value in T1 (219.41) N/kg, while the total feed cost (TFC) also highest in T5 (N1,063.46) and least in T1 (N891.13). As can be observed, FC per kg body weight gain increased with increasing levels of methionine across the treatments. Therefore, diet 1 which had 0.1% methionine gave the least cost per kg gain (N517.81) is recommended for broiler chickens production.

Keywords: Yellow Maize; Broiler and Methionine

Introduction

Available information and data on the animal protein availability and consumption in Nigeria clearly indicate protein crises [1]. described Nigeria as a protein deficient country with the daily animal protein consumption reported to be below the Food and Agriculture Organization recommend of (20g) for developing countries. Majority of Nigerians consume for less than this recommendation which does not augur well with physical wellbeing of citizenry. Efforts have been intensified by animal scientists especially animal nutritionists to bridge this gap since the major obstacles militating against achieving this lofty goal is the cost of conventional feedstuff especially those that are being consumed by human beings and are also being used for various industrial purposes. Poultry has been identified as the fastest means of bridging in the protein deficiency gap prevailing in most tropical countries like Nigeria [2]. But the future development of the poultry industry in many regions of the world depends to a large extant on the availability of feedstuff in these areas that are suitable or can be suitable for use in poultry feed. Conventional poultry diets are mostly corn and soyabean based. Cereal grains especially maize has been for long used as conventional energy source in broiler production. This is simply because maize served as the basis against which other grains are compared [3]. Maize is the most widely used cereal grain in poultry feeding around the world and is regarded as possessing better nutritional attributes than other cereal grains [4]. Maize is the most utilized cereal in

formulation of broiler feeds in the world (Panda et al., 2010). It constitutes about 50-60% in most poultry diets [5], contributing approximately 65% of the total Metabolizable Energy (ME) requirement for the chicken [6].

Since the conventional poultry diets are mostly corn and soyabean based, grains are usually low in lysine, while legumes especially soyabean are low in methionine. With this combination of feed ingredients, one way of meeting the methionine requirements is to feed excessive protein to meet daily intake of methionine which is not economical as it increases feed cost and also result in an excessive nitrogen excretion and is not environmentally friendly. Supplementing it synthetic methionine will definitely improve its nutritional value and prevents feeding excessive dietary protein. The use of synthetic methionine in poultry diets makes it possible to feed lower levels of dietary protein and still meet the daily methionine requirement and at the same time save feed cost. Methionine is an essential amino acid that cannot be produced by commercial broilers in adequate amounts to support maximum growth. Broilers have a high methionine requirement that cannot be obtained from the corn and soyabean fraction of diets; therefore, broilers require an additional ingredient source of methionine as synthetic methionine has been used in corn-soyaben-based diets to meet broiler requirement of methionine without providing excessive crude protein.

Yellow Maize

Maize is a stable food for millions of people in sub-Saharan Africa. Although white maize is more popular in most household, few know that yellow maize is more nutrietous than white maize. According to [7], maize is an excellent and most popular source of energy and that white and yellow maize exist but yellow maize (which was used in this experiment) is preferred for animals because it contains cryptoxanthin, which is a precursor of vitamin A, it is low in crude protein (8-9%), crude fibre (2.7%) and calcium. In addition to the taste and colour, research has shown that yellow corn has a higher nutritional value than the ordinary white maize, due to its higher levels of lutein corotenoids and vitamin A. Vitamin A deficiency is very common in Africa and afflict millions of children, resulting in diseases, blindness and even death [8]. One large cob of boiled yellow maize contain almost 4g of protein, 3.5g of dietary fibre, about 30g of carbohydrates, 1.5g of fat and 3.6g of sugar and 100 grams of water [8]. The reports also confirms that it contains cholesterol and has about 126 kilo-calories. Yellow maize also contains both pro-vitamin A and non-pro-vitamin A carotenoids, which promotes general growth and eye health [8]. Although most people prefer white maize, it's better to know that carotenoids are mainly found in yellow maize. White maize has little or no carotenoids. This beta-carotene content is an important source of vitamin A. Finally, the carcass of broiler chicks fed with yellow maize is more attractive with yellow body pigment especially the legs as a result of all these additional qualities mentioned.

Materials and Methods

Study Area / Experimental Site

The study was carried out at the Poultry Units of Teaching and Practical Farm of Taraba State College of Agriculture, Jalingo. The state is in the North-East geo-political zone of Nigeria. It lies between latitude 8" 53" North and between longitudes 11" 23" East of the equator in the Savannah zone of Northern Nigeria [9].

Experimental Birds and Management

Three hundred (300) day old Anak white broiler chicks of mixed sexes were used for the experiment. The chicks were raised/brooded on a deep litter management system for a period of one week. Thereafter, the chicks were randomly allocated to various experimental treatments with all necessary managements like vaccination carried out as at when due.

Experimental Diets and Design

The study was conducted in a Completely Randomized Design (CRD). Five (5) dietary treatments of sixty (60) birds per treatment in which each treatment was replicated into three (3) replicates of twenty (20) birds per replicate coded as R1, R2 and R3. Diets were formulated in which yellow maize was supplemented with graded levels of synthetic methionine at 0.1, 0.2, 0.3, 0.4 and 0.5% for T1, T2, T3, T4 and T5 respectively. Feeding trials lasted for eight (8) weeks where feeds and water were supplied ad libitum.

Data Collection

The performance data evaluated were daily feed intake (DFI), which was obtained by subtracting the quantity of feed left over from the quantity of feed given per day. Daily weight gain (DWG) was obtained by dividing the total weight gain per replicate by the number of birds and seven (7) days per week. Feed conversion ratio (FCR) was calculated as the feed intake per unit weight gain, this was done for each replicate by dividing the average daily feed intake/bird with the average daily weight gain/bird.

$$\text{FCR} = \frac{\text{Daily feed intake / bird } (g)}{\text{Daily weight gain / bird } (g)}$$

The economic benefits of production were determined according to [10]. The indices obtained include cost of producing 1kg of feed (N/kg), cost saving due to inclusion of methionine, feed cost/bird, cost of feed/kg weight gain. Cost of feed was determined using market process of ingredients during the experiment. Cost of producing 100kg of each feed was estimated and then used to determine consumed feed cost/bird, cost of feed and cost of feed/kg weight gain per bird.

Statistical Analysis

All data generated from experiment were subjected to one way analysis of variance (ANOVA) in a Completely Randomized Design (CRD) according to [11]. Differences between treatment

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means were compared using Duncan Multiple Range Test (DMRT) [12] or the IMB Statistical Package for Social Science [13] modified MINTAB.

Proximate Analysis

Proximate analysis of food/diet is the determination of the major components of food which include moisture, lipids (fats), ash (mineral), protein, carbohydrate and fibre. These methods are however not in any way perfect but act as guide for empherical estimations. Procedures recommended by [14], that is Association of Official Analytical Chemistry, were used for the analysis.

Results and Discussion

The ingredients composition of broiler starter and finisher diets were as presented in (Tables 1 & 2). In the starter, the yellow maize ranged between 46.57– 47.10%. While in the finisher it ranged from 52.56 – 53.09%, this can be explained for the fact that in the starter phase, birds requires less energy and more of crude protein unlike in the finisher phase where more energy is require to less crude protein. The inclusion levels of soyabean (crude protein) is 33.60 – 33.73% from T1 – T5 in the starter phase and 22.61 – 22.74% in the finisher phase. The obvious reason being that at starter phase birds requires more protein in the diet and less in the finisher phase. Every other ingredient remains the same except the synthetic methionine that was varied from T1 – T5. The proximate composition (%) of experimental starter and finisher diets were as presented in (Tables 3 & 4) respectively. It's ranged from 22.05 – 23.20% crude protein in the starter phase and 20.15 – 21.55% in the finisher phase. This is observed to be within the recommended protein requirement of 22 – 24% and 18 – 20% by [15] for starter and finisher phase. In young animals, protein requirement is high but decreased with age or on progressive maturity. This also agree with the submission of [16], that young growing poultry requires greater amount of protein than adults.

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

Diets					
Ingredient	**T1 (0.1%)**	**T2 (0.2%)**	**T3 (0.3%)**	**T4 (0.4%)**	**T5 (0.5%)**
Yellow Maize	47.1	46.96	46.82	46.69	46.57
Soya bean	33.6	33.64	33.68	33.71	33.73
Wheat offal	10	10	10	10	10
Methionine	0.1	0.2	0.3	0.4	0.5
Fish Meal	5	5	5	5	5
Bone Meal	2	2	2	2	2
Lime Stone	1.5	1.5	1.5	1.5	1.5
Salt	0.25	0.25	0.25	0.25	0.25
Premix*	0.25	0.25	0.25	0.25	0.25
Lysine	0.2	0.2	0.2	0.2	0.2
Total	100	100	100	100	100
Calculated analysis					
Crude Protein	23.03	23	23	23	23
ME/kcal/kg	2927.09	2921.05	2917.48	2913.95	2910.44
Crude fibre (%)	3.83	3.82	3.82	3.82	3.82
Calcium (%)	1.61	1.61	1.61	1.61	1.61
Phosphorous (%)	0.82	0.82	0.82	0.82	0.Lysine
(%)	1.46	1.49	1.41	1.41	1.47
Methionine (%)	0.56	0.58	0.56	0.59	0.58

Containing yellow maize Supplemented with varying Levels of methionine (%).

*Vitamin-mineral premix provided per kg; Vit. A 1500 IU; Vit.D3 3000 IU; Vit.E 30 IU; Vit. K 2.5mg; Thiamine B1 3mg; Riboflavin B2¬ 6mg; Pyrodoxine B6 4mg; Niacin 40 mg; Vit. B12 0.02mg; Pantothenic acid 10mg; Folic acid 1mg; Biotin 0.08mg; Chloride 0.125mg; Mn 0.0956g; Antioxidant 0.125g; Fe 0.024g; Cu 0.006g; 10.0014g; Se 0.24g; Co 0.240g.

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

Diets					
Ingredient	**T1 (0.1%)**	**T2 (0.2%)**	**T3 (0.3%)**	**T4 (0.4%)**	**T5 (0.5%)**
Yellow Maize	53.09	52.97	52.82	52.7	52.56
Soya bean	22.61	22.63	22.68	22.7	22.74
Wheat offal	13	13	13	13	13
Methionine	0.1	0.2	0.3	0.4	0.5
Fish Meal	5	5	5	5	5
palm oil	2	2	2	2	2
Bone Meal	2	2	2	2	2
Lime Stone	1.5	1.5	1.5	1.5	1.5
Salt	0.25	0.25	0.25	0.25	0.25
Premix*	0.25	0.25	0.25	0.025	0.025
Lysine	0.2	0.2	0.2	0.2	0.2
Total	100	100	100	100	100
Calculated Analysis					
Crude Protein	20	20	20	20	20
ME/kcal/kg	2990.98	2987.48	2982.33	2980.38	2976.81
Crude fibre (%)	3.42	3.42	3.41	3.41	3.41
Calcium (%)	1.61	1.61	1.61	1.61	1.61
Phosphorous (%)	0.79	0.79	0.74	0.76	0.74
Lysine (%)	1.18	1.18	1.18	1.18	1.18
Methionine (%)	0.55	0.55	0.55	0.55	0.55

Containing yellow maize Supplemented with varying Levels of methionine (%)

*Vitamin-mineral premix provided per kg; Vit. A 1500 IU; Vit.D3 3000 IU; Vit.E 30 IU; Vit. K 2.5mg; Thiamine B1 3mg; Riboflavin B2¬ 6mg; Pyrodoxine B6 4mg; Niacin 40 mg; Vit. B12 0.02mg; Pantothenic acid 10mg; Folic acid 1mg; Biotin 0.08mg; Chloride 0.125mg; Mn 0.0956g; Antioxidant 0.125g; Fe 0.024g; Cu 0.006g; 10.0014g; Se 0.24g; Co 0.240g.

Table 3: Proximate Composition (%) of Experimental starter Diets Containing Containing yellow maize Supplemented with varying Levels of methionine in Experiment 1 (%).

Diets					
Nutrients	**T1(0.1)**	**T2(0.2)**	**T3(0.3)**	**T4(0.4)**	**T5(0.5) Dry**
Matter	86.9	87.4	85.9	86.1	86.1
Moisture Content	13.1	12.6	14.1	13.9	13.9
Crude Protein	22.05	22.95	22.4	23.2	22.65
Crude Fibre	3.7	3.5	4.1	4.3	3.4
Ash	2.9	4.3	4.2	4.9	4.9
Ether Extract	8.26	7.68	7.55	7.9	8.35
NFE	49.99	51.97	47.65	43.8	46.8
ME (Kcal/kg)	2359.56	3205.17	3131.93	3127.2	3175.8

NFE =Nitrogen Free Extract

ME = Metabolizable Energy

ME(kcal/kg) = 37 x % CP + 81 x % EE + 35.5 x % NFE (Pauzenga, 1985).

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Table 4: Proximate Composition of Experimental finisher Diets Containing Containing yellow maize Supplemented with varying Levels of methionine in Experiment 1 (%).

	Diets				
Nutrients	**T1(0.1)**	**T2(0.2)**	**T3(0.3)**	**T4(0.4)**	**T5(0.5)**
Nutrients(g)					
Dry Matter	85.8	86.6	87	86.8	87.4
Moisture Content	14.2	13.4	13	13.2	12.6
Crude Protein	20.85	21.2	20.15	21.55	20.85
Crude Fibre	4.2	3.9	5.4	5.4	4.2
Ash	3	2.9	3.1	4.3	4.7
Ether Extract	8.71	8.71	8.29	6.58	9.13
NFE	52.04	52.63	53.06	50.87	52.52
ME(Kcal/kg)	3226.16	3268.34	3189.67	3025.22	3227.44

NFE = Nitrogen Free Extract

ME = Metabolizable Energy

ME (kcal/kg) = 37 x % CP + 81 x % EE + 35.5 x % NFE (Pauzenga, 1985).

Table 5: Performance of Broiler Chickens fed Yellow Maize Supplemented with Graded Levels of Synthetic Methionine (1 – 8 weeks).

	Diets					
Parameters	**T1**	**T2**	**T3**	**T4**	**T5**	**SEM**
Starter phase (1 – 4 weeks):						
Initial Weight (g)	91.67	92.67	92	91.83	93	0.67^{NS}
Final Weight (g)	607.00^{d}	606.33^{d}	613.33^{c}	621.33^{b}	631.67^{a}	1.26*
Daily Feed Intake (g)	59.22^{d}	58.92^{d}	59.67^{c}	61.79^{b}	63.92^{a}	0.22*
Total feed intake	1658.16	1649.76	1670.76	1730.12	1789.76	0.38*
Daily weight gain (g)	18.4	18.35	18.62	18.91	19.24	0.35NS
FCR	3.22^{c}	3.21^{c}	3.20^{c}	3.27^{b}	3.32^{a}	0.02*
Mortality	3	4	2	1	0	-
Finisher phase (5-8 week)						
Week 4 Weight (g)	607.00^{d}	606.33^{d}	613.33^{c}	621.33^{b}	631.67^{a}	1.26*
Final Weight (g)	1823.33^{c}	1843.33^{c}	1840.00^{c}	1893.33^{b}	1986.67^{a}	11.98*
Total Feed Intake (g)	3104.20^{e}	3107.57^{d}	3128.24^{c}	3143.58^{b}	3176.26^{a}	1.52*
Daily Feed Intake (g)	110.86^{e}	110.98^{d}	111.72^{c}	112.27^{b}	113.44^{a}	0.05*
Daily weight gain	65.12	65.83	65.71	67.62	70.95	072NS
FCR	2.56^{a}	2.52^{ab}	2.55^{a}	2.48^{b}	2.34^{c}	0.02*
Mortality	3	2	2	1	1	-
(Overall 1-8 weeks)						
Initial Weight (g/bird)	91.67	92.67	92	91.83	93	13.41*
Final Weight (g/bird)	1823.33	1843.33	1840	1893.33	1986.67	62.62*
Total weight gain	1731.66	1750.66	1748	1801.55	1893.67	30.12*
Daily feed intake	85.04	84.95	85.69	87.03	88.68	2.34*
Daily weight gain	30.92	31.26	31.21	32.17	33.82	1.12NS
Total feed intake	4762.24	4757.2	4798.64	4873.68	4966.08	0.85*
FCR	2.75	2.72	2.75	2.71	2.62	
Mortality	6	6	4	2	1	

^{abcd}Means within rows with different superscript differed significantly (P<0.05),

* = significant

NS= Not significant

FCR= Feed conversion ratio

SEM= Standard Error of means

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Productive Performance: Results of Daily Feed Intake (DFI), Body Weight Gain (BWG), Feed Conversion Ratio (FCR) and Mortality for the experimental periods (56 days) are presented in (Table 5).

The results showed that DFI increased significantly (P<0.05) with increased in the level of synthetic methionine. This agree with the report of [17,18] who reported similar findings. This can be buttress by the report of [19], that the levels and balance of essential amino acids (EAAs) significantly affected feed intake, consequently weight gain and carcass composition. Broiler chicks appear to react to amino acid deficiencies within a short period (hours) by adjusting their feed intake and/or selection and these responses are influenced by age and prior experience [20]. However, [21-23], reported that methionine deficiencies depressed feed intake of broiler chicks due to amino acid imbalance. It can be assumed that under amino acid imbalance, chicks lose the potentials to adjust feed intake to satisfy their amino acid requirement. The main positive effect of methionine supplementation may come from its improvement of feed intake via the amino acid imbalance. As it can be observed, feed intake increased slightly with increased levels of synthetic methionine supplementation with the lowest (110.86g) in T1 and highest 113.44g in T5 in the finisher phase which is in the range of 83.64 – 100.77g reported by [17] and 85 – 115g per day reported by [24].

DWG were not significantly (P>0.05) different in all phases. The result of DWG in the finisher phase ranged from 65.12 – 70.95g. This is consistent with the result of [25-29] who observed that DWG were influenced positively by DL– methionine in their work on effect of dietary supplementation of DL– methionine and sodium sulphate on growth performance, carcass characteristics and cost benefits analysis of broiler chickens fed maize – cassava based diet. As can be observed in the finisher phase, DWG increased slightly with increased levels of methionine inclusion. This is consistent with [30] and cardiac and [31] who reported that there is a trend of increasing daily body weight gain as methionine intake increases and that chickens grow significantly faster and ate more when there was an increase in the level of methionine in the diet.

The FCR were significantly (P<0.05) influenced with the values of 2.34 – 2.56 in the finisher phase, which agree with [32,33] who reported 1.90 – 2.50 and observed that FCR in a well-managed broiler houses should be in that range (1.90 – 2.50) or better depending on the nutrient density, time of year and other factors. However, [34] recommended FCR of 2.10 – 5.10. The best value in this experiment is in T5 (2.34). The lowest values in this experiment is an indication of better utilization of the feed. The mortality rate of 6.33% is higher than 5% recommended by [34], who suggested that mortality rate should not exceed 5% to maximize profit and minimize the cost of feed lost which account for up to 20-25% of the production cost of broiler chickens. The highest mortality was in T1 and T2 (6 birds), following by T3 (4 birds) with the least in T5 (1 bird). As can be observed, mortality decreased with increased inclusion levels of methionine. This is consistent with the report of [35], who stated that adding methionine to a low protein diet reduced the mortality rate of hens under heat stress when compared to positive control groups. This is also in agreement with [18,36], who reported that the nutrients which have immune-modulating effect include protein and energy, vitamins A, E and C. the presence of vitamin A, increased in methionine and lutein in yellow maize boost immunity of birds. Final weight gain and total weight gain were significantly (P<0.05) increased with increasing level of synthetic methionine. Improved weight gain with increasing levels of methionine was reported by [37]. The improvements observed at the finisher phase could be associated with advanced digestive tract of the finisher birds which enhanced better nutrient digestion and utilization. The older the birds the better the ability to utilize nutrients [38,39].

Table 6: Financial Benefits of Using Yellow Maize Supplemented with Methionine for Broiler Chickens Production.

	Diets				
Parameters	T1(0.1)	T2(0.2)	T3(0.3)	T4(0.4)	T5(0.5)
TFI (kg)	4.18	4.38	4.28	4.36	4.49
FC (N/kg)	219.41	221.47	228.56	234.3	246.98
TFC (N)	891.13	959.7	963.17	1069.07	1,063.46
TWG (kg)	1.17	1.2	1.15	1.15	1.04
FC (N/kg gain)	517.81	539.4	540.39	555.29	575.46

TFI= Total feed intake

FC=Feed cost

TFC= Total feed cost

TWG= Total weight gain

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The economics of feeding yellow maize supplemented with graded levels of methionine is presented in (Table 6). The total feed intake (TFI) ranged. From 4.18kg in T1 to 4.49kg in T5, while the feed cost (FC) ranged between 219.41 (N/kg) in T1 to 246.98 (N/kg) in T5. Total feed cost (TC) ranged between N891.13 and N1,063.46 in T5, while total weight gain ranged between 1.04kg in T5 to 1.20kg in T2. As can be observed, the TFI increased slightly with increased inclusion levels of methionine from T1 – T5, same also is FC (N/kg) is better in T1 for the simple reason that with increased inclusion levels of methionine the FC increased as a result of the high cost of methionine.

Conclusion

From the results of the experiment, it may be concluded that yellow maize when supplemented with graded levels of synthetic methionine at up to 0.5% level did not have any adverse effects on the production performance of the birds.

Recommendation

Based on the results obtained from the study, feed intake, growth performance, feed conversion ratio were not significantly different across dietary treatments. However, feed cost per kg body weight gain increased with increasing levels of methionine across the treatments. Therefore, diet 1 which had 0.1% methionine gave the least cost per kg gain of N517.81 is recommended for broiler chickens.

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