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Evaluation of Four Commercial Sources of Synthetic Methionine on the Growth Performance, Carcass and Meat Quality of Broiler Chickens

Onimisi P. A* Ifer J. S., Oyebanji R. S. and Moses O.

Department of Animal Science, Ahmadu Bello University Zaria

Corresponding author: onimisiphil@yahoo.com +234 8057228486

Target Audience: Poultry farmers, Poultry Researchers, Feed millers

Abstract

A total of 252 day old Ross broiler chicks was used in a feeding trial to evaluate the effect of four different commercial brands of synthetic methionine supplement on the performance of broiler chickens. The chicks were distributed into four dietary treatments each with three replicates and 21 chicks/replicate; in a Completely Randomized Design. Four diets were formulated to meet standard requirements at both starter and finisher phases in which the four commercial brands of synthetic methionine; CHL Rhodimet Analogue and DSM were supplemented in diets to represent treatments 1, 2, 3 and 4, respectively. Eight weeks period of the experiment. Data was collected on feed intake weight gain feed conversion protein efficiency and feed cost/Kg gain to evaluate growth performance. Blood samples were collected at the finisher phase over EDTA and analysed for heamatological parameters. Carcass study was conducted and meat quality evaluation of cut portions of breast muscles was carried out. All data collected were subjected to Analysis of Variance and differences in means were separated using Duncan Multiple Range Test. Significant ($P<0.05$) differences were observed for final weight, weight gain, feed conversion ratio, feed cost/Kg gain and mortality rates but no significant ($P>0.05$) difference for feed consumption across the treatments at both starter and finisher phases. Birds fed with DSM Methionine has a significantly ($p<0.05$) higher performance in terms of weight gain and feed conversion ratio but consumed less feed and required least cost to produce a kg of broiler meat compared to other treatments. Blood quality parameters were similar for all treatments. DSM Methionine had better digestibility for all nutrients measured. There was significant ($P<0.05$) difference in dressed weights, dressing percentages, back, heart, liver, kidney and intestinal length but no significant ($P>0.05$) difference in their breast muscles, thigh, drumsticks, gizzard, lungs, abdominal fat and intestine weight. DSM Methionine showed the best dressed weight and dressing percentage. F Meat from birds fed DSM Methionine gave highest crude protein and lowest fat content. It was therefore concluded that DSM methionine is of highest quality above the other brands evaluated and is recommended for best performance and most economical broiler chicken production enterprise.

Key words: Methionine, broiler chickens, performance, carcass and meat quality

Description of Problem

Poultry refers to any domesticated and/or commercialized types of birds used for production of meat and egg for human food; like chickens, turkey, ducks, geese, quails and pigeons. In poultry production, feed accounts for 70-75% of the total cost of production. Therefore profit of poultry farming mainly depends on economic feeding of balanced, cheap and quality diets. It is important to pay attention to the formulation of economical poultry diet using local feed ingredients supplemented with cheap but qualitative nutritional supplements. Improved nutritional management is necessary to assist in achieving optimal performance in terms of diet intake, growth rate, feed conversion ratio, live weight, high meat yield and low mortality, especially when commercialization of the birds is of utmost importance. Such approach may help farmers to improve productivity of their chickens (1).

The protein requirement of animals is more accurately a requirement for the building blocks of protein known as amino acids. Once consumed, proteins are broken down into amino acids, which are then absorbed by the animal to produce the specific proteins that they require. While all amino acids are important, some cannot be produced by some animals and must therefore be supplied in the diet. Such amino acids are referred to as essential amino acids (2). Amino acids can exist as D- or L-isomers or mixture of two products. The D-isomers are biologically inactive while L-form is commonly occurring in most of the tissues. However, birds possess the ability to utilize both D and L-forms also called racemic mixture (3). Methionine is usually the first limiting amino acid in maize and soya beans meal based diets. Methionine is a sulfur-containing amino acid that is essential for healthy and productive poultry, and is important for many different functions in the body. This includes the nonspecific mechanisms such as in the skin and mucosa, and the specific mechanisms that include T and B lymphocytes which is particularly important for newly hatched chicks that are highly susceptible to infection during the first two weeks of life (4). By producing methyl groups, methionine is responsible for a variety of metabolic reactions. It is also essential for cell proliferation and development (2). It is required to provide the building blocks for immune cells and tissues. Methionine is a major component of feathers. Methionine and cysteine are critical to feather formation. A deficiency of methionine results in poor feather growth and increased feather pecking. A methionine-deficient bird will tend to eat feathers in an attempt to obtain enough methionine. Feather pecking can quickly turn into cannibalistic behavior in a flock (4). Methionine is commonly supplemented as dry DL methionine (DL-Met; 99% pure) or as liquid DL-Methionine hydroxy analog-free acid (MHA-FA, containing 88% of active substance). Most of the produced methionine is used for animal feed in livestock production. The chemically produced synthetic DL-Methionine can be used for most applications. Supplementing broiler rations with synthetic DL-Methionine represents a major contribution towards alleviating environmental

pollution, compared with use of methionine rich protein sources such as soybean meal or rapeseed meal. Chemical production requires less energy input to achieve the same performance levels and produces far less environmental emissions, resulting in long term savings on resources and reduced emissions of nitrogen and other compounds. Therefore there is a need to purchase good and assured quality synthetic methionine from a reliable source because of its importance in the performance of the birds in term of optimum growth and proper utilization of the feed and in order to reduce cost of the feed and maintain optimum profit in the poultry production. Problems of low quality and adulterated methionine products has often been a major cause of very poor performance of broiler chickens but many times unknown to the poultry farmer.

The main aim of this work was to evaluate the comparative performance of broiler chickens fed four different commercial brands of synthetic methionine. The specific objective was to evaluate the effects of the different commercial brands of methionine on broiler chickens' growth performance, heamatological parameters, nutrient digestibility, carcass characteristics and meat quality.

Materials and Methods

Experimental Site

The experiment was conducted at the Teaching and Research farm, Department of Animal Science, Ahmadu Bello University, Zaria Nigeria. Zaria Nigeria is located within the Northern Guinea Savannah zone with latitude 11^{0}9' 45"N, longitude 7^0 38' 8"E, and an altitude of 610m above sea level. The area is predominantly a hot environment with a sub humid tropical climate characterized by distinct wet and dry seasons. The mean annual rainfall of is about 1093mm with most of it falling between the months of April and October. The mean monthly minimum air temperature is lowest (13.8 ^{0}C) during the period of strongest and most constant northeast winds (Harmattan) in December and January and highest (35.7 ^{0}C) prior to and during the onset of rains in late April (5).

Experimental Design and Management

A total of 252 day old Ross broiler chicks were randomly distributed into four treatments of three replicates each having 21 birds per replicate. Four treatment diets were formulated at both the starter finisher phases using different brands of commercial methionine to meet standard requirements as shown in tables I and II.

Treatment 1: CHL Methionine
Treatment 2: Rhodiment Methionine
Treatment 3: Analogue Methionine
Treatment 4: DSM Methionine

Birds were housed in deep litter pens and supplied with the appropriate diet and clean water *ad libitum.* The experiment lasted for eight weeks. All necessary routine management practices and vaccination were observed within the period of the experiment.

Growth study

The initial and final weight of birds were taken at the beginning and end of each phase. Weight gain and feed

consumption were measured weekly, while feed conversion ratio, protein efficiency ratio and feed cost/kg gain were computed for each treatment at both the starter and finisher phases.

Haematological study

At the end of the experiment, 2mls blood samples were taken from one bird per replicate into sterile universal sample bottles containing Ethylene Diamine Tetra acetic Acid (EDTA) and were taken to the pathological laboratory of the Faculty of Veterinary Medicine, Ahmadu Bello University, Zaria. The samples were analyzed for packed cell volume (PCV), Total protein (TP), White blood cell, Red blood cell, Heamoglobin, Lymphocytes and heterophils.

Digestibility Study

Twelve birds (a bird per replicate) of similar weight were selected and placed in individual cage for total tract feacal collection. The birds were allowed to adjust to the cage for 3 days. Known weight of feed and water was given while total feacal collection was done for five consecutive days. Feacal collections were oven dried at 1050C and weighed for each chicken. Samples were thereafter analysed alongside samples of the starter and finisher diets, for proximate composition at the Biochemical Laboratory of the Department of Animal Science, Faculty of Agriculture, Ahmadu Bello University, Zaria using the methods described by (6).

Carcass Evaluation

At the end of feeding trial, two birds per replicates with weights closest to the average mean body weight of the replicate were used for carcass analysis. Birds were starved of feed overnight, and thereafter weighed and slaughtered. Parameters determined included live weight, dressed weight, dressing percentage; weight of cut parts included back, breast, thigh, drum stick all expressed as a percentage of dressed weight; weight of organs included heart, gizzard, liver, lungs, kidney, spleen, intestine and intestine length as well as abdominal fats, all expressed as a percentage of live weight.

Meat Quality Evaluation

Samples of meat collected from breast muscle from each bird used for carcass evaluation were analysed for proximate composition using the method described by (6) at Biochemical Laboratory of the Department of Animal Science, Ahmadu Bello University, Zaria.

Statistical Analysis

Data generated were subjected to Analysis of Variance (ANOVA) using the General Linear Model of (7). The difference between treatments means were separated using Duncan Multiple Range Test (8).

Result and Discussion

The performance of broilers fed **four different Commercial Brands of Methionine** is shown in tables III. There is a significant difference between the final weights, weight gain, feed consumed, feed conversion ratio, feed cost, feed cost/kg gain and protein efficiency ratio. Birds fed with DSM Methionine had a significantly ($p<0.05$) higher performance in terms of weight gain, and feed conversion ratio but the birds consumed less feed compared to

Table I Broiler Starter Diets

	Brand of Synthetic Methionine			
Ingredient	**CHL**	**Rhodimet**	**Analogue**	**DSM**
Maize	56.85	56.85	56.85	56.85
GNC	17.00	17.00	17.00	17.00
SBC	22.00	22.00	22.00	22.00
Bone meal	3.00	3.00	3.00	3.00
Limestone	0.30	0.30	0.30	0.30
Common Salt	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25
Lysine	0.10	0.10	0.10	0.10
Vit-min premix	0.25	0.25	0.25	0.25
Total	**100.00**	**100.00**	**100.00**	**100.00**
Calculated Analysis				
ME Kcals/kg	2,950	2,950	2,950	2,950
Crude protein %	23.00	23.00	23.00	23.00
Crude Fibre %	4.41	4.41	4.41	4.41
Ether Extract %	3.62	3.62	3.62	3.62
Calcium %	1.25	1.25	1.25	1.25
Total Phosphorus %	0.87	0.87	0.87	0.87
Lysine %	1.32	1.32	1.32	1.32
Methionine %	0.50	0.50	0.50	0.50
Cost per Kg	96.39	97.14	97.01	98.01

Broiler vitamin premix supplied the following vitamins and trace elements per kg diet: vit A (7812.5IU), vit D3 (1562.5 IU), vit E (25.0mg), vit K3 (1.25mg), vit B1 (1.8mg), vit B2 (3.44mg), niacin (34.4mg), calciumpantothenate (7.19mg), vit B3 (3.1mg), vit B12 (0.02mg), choline chloride (312.5mg), folic acid (0.6mg), biotin (0.1mg), manganese (75mg), iron (62.5mg), zinc (50.0mg), copper (5.3mg), iodine (0.9mg), cobalt (0.2mg), selenium (0.1mg), antioxidant (75mg).

Table II Composition of Broiler Finisher Diets

	Brand of Synthetic Methionine			
Ingredient	**CHL**	**Rhodimet**	**Analogue**	**DSM**
Maize	58.00	58.00	58.00	58.00
SBC	14.00	14.00	14.00	14.00
GNC	16.00	16.00	16.00	16.00
Maize Offal	7.60	7.60	7.60	7.60
Bone Meal	3.00	3.00	3.00	3.00
Limestone	0.50	0.50	0.50	0.50
Common Salt	0.30	0.30	0.30	0.30
Methionine	0.25	0.25	0.25	0.25
Lysine	0.10	0.10	0.10	0.10
Vit-min Premix[A]	0.25	0.25	0.25	0.25
Total	**100.00**	**100.00**	**100.00**	**100.00**
CalculatedAnalysis				
ME Kcals/kg	2933	2933	2933	2933
Crude Protein %	20	20	20	20
Crude Fibre %	4.55	4.55	4.55	4.55
Ether Extract %	3.51	3.51	3.51	3.51
Calcium %	1.32	1.32	1.32	1.32
Phosphorus %	0.88	0.88	0.88	0.88
Lysine %	1.07	1.07	1.07	1.07
Methionine %	0.53	0.53	0.53	0.53

Broiler vitamin premix supplied the following vitamins and trace elements per kg diet: vit A (7812.5IU), vit D3 (1562.5 IU), vit E (25.0mg), vit K3 (1.25mg), vit B1 (1.8mg), vit B2 (3.44mg), niacin (34.4mg), calciumpantothenate (7.19mg), vit B3 (3.1mg), vit B12 (0.02mg), choline chloride (312.5mg), folic acid (0.6mg), biotin (0.1mg), manganese (75mg), iron (62.5mg), zinc (50.0mg), copper (5.3mg), iodine (0.9mg), cobalt (0.2mg), selenium (0.1mg), antioxidant (75mg).

those on other treatments

Table IV shows the result of the finisher phase. Significant ($p<0.05$) difference were observed for final weight, weight gain, feed conversion ratio, feed cost/kg gain and protein efficiency ratio. Feed consumption was similar for all the treatments.

Birds fed diet supplemented with DSM methionine showed significantly better performance in most parameters measured at both starter and finisher phases, particularly final weight, weight gain, feed conversion and feed cost per Kg weight gain; followed by Analogue and then CHL while Rhodimet showed the least performance. Also, methionine source was observed to significantly affect feed cost. The lowest cost of producing a kilogram of feed was observed in CHL followed Analogue, Rhodimet and highest for DSM methionine. However, the cost of producing a Kg of meat was least and best for the DSM methionine, followed by Analogue, Rhodimet and highest for CHL. This indicates that it is most economical and most profitable to use DSM methionine in formulating diets for broiler chickens. Mortality rates was generally minimal and less than the 5% acceptable levels in production. DSM methionine is of highest quality and efficacy probably due to superior production material and/or manufacturing process and also the integrity of the marketing chain from the manufacturer to the end user.

Table III Effect of using Four Different sources of synthetic methionine supplement on the Growth Performance of Broiler chicks

	Brand of Synthetic Methionine				
Parameters	**CHL**	**Rhodimet**	**Analogue**	**DSM**	**SEM**
Initial weight (g)	45.88	46.03	45.71	45.87	0.39
Final weight (g)	997.7^{b}	933.3^{c}	992.3^{b}	1045.3^{a}	10.07
Total weight gain (g)	951.7^{b}	887.3^{c}	946.7^{b}	999.3^{a}	9.84
Daily weight gain (g)	33.9^{b}	31.7^{c}	33.8^{b}	35.7^{a}	0.35
Total feed consumption (g)	1739.7^{a}	1720.3^{a}	1698.7^{a}	1702.0^{b}	16.01
Daily feed consumption (g)	62.1^{a}	61.4^{a}	60.6^{a}	60.8^{b}	0.57
FCR	1.82^{b}	1.92^{c}	1.79^{b}	1.70^{a}	0.02
Feed cost/kg gain (₦/Kg)	176.28	188.34	174.05	166.91	0.005
Mortality %	3.17	1.59	1.59	1.59	-

a, b, c = means with different superscripts on the same row differ significantly ($P<0.05$),
SEM= Standard Error of Means

Table IV Effect of using Four Different sources of synthetic methionine supplement on the Growth Performance of Broiler Finisher

	Brand of Synthetic Methionine				
Parameters	**CHL**	**Rhodimet**	**Analogue**	**DSM**	SEM
Initial weight (g/bird)	997.7	990.0	993.0	1005.3	10.16
Final weight (g/bird)	2348.3^{c}	2337.3^{c}	2468.0^{b}	2618.7^{a}	35.08
Total weight gain (g/bird)	1350.7^{c}	1347.3^{c}	1475.0^{b}	1572.7^{a}	32.34
Daily weight gain (g/bird)	64.3^{c}	64.2c	70.2^{b}	74.9^{a}	1.54
Total feed consumption (g/bird)	3224.3	3262.7	3256.3	3257.7	51.14
Daily feed consumption (g/bird)	153.5	155.4	155.1	155.1	2.44
FCR	2.41^{c}	2.33^{b}	2.25^{b}	2.10^{a}	0.05
Feed cost/kg gain (₦/Kg)	217.20^{c}	211.75^{c}	203.59^{b}	192.10^{a}	4.84
Mortality %	1.67^{a}	0.67^{c}	1.33^{b}	1.00^{b}	0.41

a, b, c = means with different superscripts on the same row differ significantly (P<0.05),

SEM= Standard Error of Means.

The result obtained for haematology of broiler chickens fed the different commercial brands of methionine is shown in table V. Non-significant (P > 0.05) differences were observed for all the parameters measured. Values obtained for all the parameters fall within the normal ranges for healthy chickens. The different methionine sources did not adversely affect blood quality of broiler chickens.

Table V Haematology of Broiler Chickens Fed on Four different Commercial Brands of Methionine

	Brand of Synthetic Methionine				
Parameters	**CHL**	**Rhodimet**	**Analgue**	**DSM**	**SEM**
PCV %	24.67	23.00	24.33	25.00	1.43
HB (g/dl)	8.07	7.40	8.03	8.27	0.47
TP (g/dl)	2.47	3.00	2.80	2.87	0.32
WBC (g/dl)	8.07	6.50	7.73	7.23	2.02
RBC (g/dl)	4.17	4.97	5.43	3.73	0.94
Heterophils	17.33	15.33	13.33	13.00	3.68
Lymphocytes	82.67	83.67	84.00	86.67	3.89

SEM = Standard Error of Means, PCV = Packed cell volume, HB = Haemoglobin, TP = Total protein, WBC = white blood cell, RBC = red blood cell,

The result obtained for nutrient digestibility of broiler chickens fed finisher diets is shown in table VI. There was significant (p<0.05) differences in the digestibility of CP, CF, EE, ASH and NFE across the treatments. Birds fed the DSM methionine showed a significantly higher digestibility for CP, CF, EE, Ash and NFE. The DSM methionine significantly improved nutrient digestion. This may have been responsible for the higher growth performance of the birds fed this diet

Table VI Nutrient Digestibility of Broiler Chickens Fed on Four different Commercial Brands of Methionine

	Brand of Synthetic Methionine				
Parameters	**CHL**	**Rhodimet**	**Analgue**	**DSM**	**SEM**
CP (%)	92.94[b]	92.38[c]	93.56[a]	93.59[a]	0.02
CF (%)	87.31[d]	87.50[c]	89.36[b]	90.53[a]	0.01
EE (%)	95.57[d]	95.86[c]	96.11[b]	96.23[a]	0.01
ASH (%)	92.79[b]	91.58[c]	89.43[d]	93.83[a]	0.01
NFE (%)	85.51[d]	86.64[c]	86.80[b]	87.52[a]	0.03

[abcd]means with the same letter are not significantly different, SEM = Standard Error of Mean, CP = crude protein, CF=crude fibre, EE=ether extract, NFE=nitrogen free extract

Table VII shows result on the effect of using four different sources of synthetic methionine supplement on the carcass characteristics of broiler finishers. Most parameters measured were significantly ($p<0.05$) affected by methionine source.

The DSM methionine resulted into a better performance than the others in terms of dressing percentage, breast and back cuts. The result of this study is in accordance with the findings of (9) who reported a significant difference ($p<0.05$) in the live, dressed weights and dressing percentages of birds fed with different methionine types. There was no significant difference ($p>0.05$) in the thigh and drum sticks cuts expressed as a percentage of their dressed weights and in the gizzard, lungs and spleen, abdominal fat and intestine. The result of this study agrees with the findings of (10) who reported no significant difference in the abdominal fat and lungs of broilers fed with different methionine types. The significant differences observed amongst dietary treatments in their liver, kidney and intestine length agrees with the findings of (10) who observed a significant difference ($p<0.05$) in the liver percentage of broiler chickens fed with different graded levels of different methionine types.

Table VIII below shows result of the effect of using four different sources of synthetic methionine supplement on meat quality of broiler finishers. Dietary treatments had no significant ($p>0.05$) difference in their dry matter compositions. However, methionine source significantly ($p<0.05$) affected dietary treatments in their levels of crude protein. Meat from birds fed the DSM methionine showed higher level of crude protein and low level of fat deposition. The result of this study is similar to the findings of (11) and (12) who reported that supplementation of methionine in methionine-deficient diets significantly reduced fat deposition and increased crude protein level. Majorly, cholesterol is the challenge with meat containing high levels of fat depositions. The DSM methionine showed least contents of NFE which represents the soluble carbohydrate portion of the product. Usually, high percentages of nitrogen free extract are not desirable in meat but rather lower levels are most preferred. Generally therefore, the meat from chickens fed the DSM methionine is highest nutritional quality than the others

Table VII Effect of using Four Different sources of Synthetic Methionine Supplement on the Carcass Characteristics of Broiler finisher

	Brand of Synthetic Methionine				
Parameters	**CHL**	**Rhodimet**	**Analgue**	**DSM**	**SEM**
Live weight(g)	2366.7[b]	2400.0[a]	2466.7[a]	2500.0[a]	37.31
Dressed weight(g)	1950.7[c]	2000.0[b]	2080.7[a]	2150.0[a]	40.87
Dressing percentage	82.5[b]	83.3[a]	84.4[a]	86.0[a]	1.17
Back %	15.7[b]	17.5[a]	16.3[a]	17.8[a]	0.48
Breast %	25.5[b]	25.4[b]	25.9[b]	28.7[a]	1.23
Thigh %	12.8	12.3	12.1	13.0	0.65
Drum sticks %	11.7	11.1	11.1	11.6	0.36
Heart %	0.43[a]	0.35[b]	0.42[a]	0.44[a]	0.02
Gizzard %	2.75	2.88	3.31	2.72	0.22
Liver %	1.93[a]	1.70[b]	1.97[a]	1.65[c]	0.09
Lungs %	0.59	0.49	0.53	0.49	0.06
Kidney %	0.55[a]	0.47[a]	0.39[a]	0.35[b]	0.05
Spleen %	0.04	0.04	0.04	0.04	0.00
Abdominal fats %	1.23	1.59	1.42	1.61	0.34
Intestine %	3.57	3.11	3.77	3.29	0.36
Intestine (cm)	90.0[a]	77.0[b]	82.3[a]	87.0[a]	3.70

a, b, c = means with different superscripts on the same row differ significantly (P<0.05), SEM= Standard Error of Means.

Table VIII Effect of u sing Four Different Sources of Synthetic Methionine Supplement on the Meat Quality of Broiler finishers

	Brand of Synthetic Methionine				
Parameters	**CHL**	**Rhodimet**	**Analgue**	**DSM**	**SEM**
Dry matter %	28.00	29.22	28.15	27.93	0.70
Crude protein %	47.68[a]	49.26[a]	45.14[b]	50.39[a]	0.88
Crude fibre %	0.00	0.00	0.00	0.00	0.00
Ether extract %	4.02[a]	4.20[a]	3.85[a]	3.44[b]	0.23
Ash %	5.03[a]	2.67[b]	3.70[a]	4.00[a]	0.82
NFE %	43.27[b]	43.87[b]	47.31[a]	42.17[c]	0.94

a, b, c = means with different superscripts on the same row differ significantly (P<0.05),
SEM= Standard Error of Means.

Conclusion

Performance of birds fed with DSM Methionine had a significantly better weight gain, nutrient digestibility, carcass and meat quality and least cost of production than all the other methionine brands evaluated. DSM Methionine is therefore recommended for optimal results in broiler production.

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