CRPS Current Research in Poultry Science

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Carcass Traits and Nutrient Digestibility of Broilers Fed Varying Levels of Synthetic Methionine

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ABSTRACT

Background and Objective: It is a known fact that the growth and development of poultry birds is parallel to the level of nutrients digested and absorbed by the animal via their bloodstream. Therefore, the focus of this research work levels on the carcass characteristics and nutrient digestibility profile of finisher broiler birds fed replacement levels of synthetic methionine. **Materials and Methods:** A total of 150, four-week-old Ross 308 strain broiler birds were used to conduct the experimental work for twenty-one days period. The birds were distributed into five groups, each consisting of thirty (30) birds per treatment and ten (10) birds per replicate, programmed in the order of the completely randomized design (CRD). Thus, a total of five diets were used for the experiment, with naturally compounded materials (NCM) included at the rate of 0, 25, 50, 75 and 100%, respectively, to substitute for synthetic methionine. Feed and water were given *ad-libitum* throughout the research. The experiment lasted for 28 days (4 weeks); one week for brooding and three weeks for data collection. Blood samples were collected from one bird each per replicate via the wing web vein. All data were analyzed using ANOVA, and significant means were separated by Duncan's Multiple Range Test at a 5% level of significance. **Results:** Results recorded for carcass characteristics were significantly ($p<0.05$) influenced across the treatment groups for all the parameters studied (live-weight, carcass weight, dressing percentage, thigh, breast muscle, back muscle, wings and drumstick) with superior values in treatments fortified with naturally compounded materials (NCM). Nutrient digestibility values also differed ($p<0.05$) across the treatments for dry matter, crude protein, crude fiber, ether extract, ash and nitrogen free extract. **Conclusion:** From the results obtained in this research work, it can be concluded that the inclusion of NCM in the diets of the bird's proof positive with superior values when compared to the control, with the inclusion level at 75% NCM been better off.

KEYWORDS

Carcass characteristics, nutrient digestibility, finisher broiler birds, replacement levels, synthetic methionine

INTRODUCTION

The measure of growth in poultry production is usually tied to how efficient the birds are able to convert the feed they consume into meat and muscle[1]. A major challenge of poultry production all over the world, especially in Africa is the availability of quality raw materials (feed ingredient) and high cost of feed for

ISSN: 2152-212x (Online)
ISSN: 2152-2111 (Print)
https://doi.org/10.3923/crps.2025.19.23

Received: 21 Oct. 2025
Accepted: 15 Dec. 2025
Published: 31 Dec. 2025

the poultry industry that readily meets the nutrient requirement of the poultry birds and this has been a challenge which has span over the years. Synthetic growth promotants usage in poultry birds has been the nun over the years, which has largely been responsible for the improvement in the level of poultry production around the world[2,3]. But the ban on antibiotic growth promotants in farm animals in recent times due to the various negative effects of which include the development of microbial resistance and the mutation effects which have resulted to high levels of morbidity and mortality, and also the zoonotic effects on humans, the end point consumer of the poultry produce[4].

Most protein sources (which include both plant and animal) have a level of methionine in them, but the required methionine for the poultry birds cannot be readily met by these alone, since the first limiting amino acid in poultry birds is the methionine[5]. The common source of methionine in poultry diet is the DL-methionine, which is produced by chemical synthesis from acrolein, methyl mercaptan, and hydrogen cyanide[6]. Obviously, the inclusion of methionine in poultry diet cannot be overemphasized as it is an essential amino acid which is necessary for normal growth and proper development in poultry birds.

It is important to note that methionine cannot be made by the body, so it must be consumed in the diet. Methionine may also act as an antioxidant and helps to protect damaged tissues in the body of the birds. It is also the precursor to S-adenosylmethionine, the methyl donor for many enzymatic methylations. Methionine can also be used to synthesize Sulphur containing proteins such as cysteine and glutathione (antioxidant and whitening agent)[7]. This study aimed to evaluate the effect of replacing synthetic methionine at different levels on the carcass characteristics and nutrient digestibility profile of finisher broiler birds, in order to determine the optimal replacement level for improved growth performance and feed utilization efficiency.

MATERIALS AND METHODS

Ethical statement: There was no violation of human rights, abuse, or animal rights in the course of the research work, and there was total compliance with rules guiding the use of products relating to animals and avoidance of any zoonotic transfer via full biosecurity measures and compliance.

Experimental site: The research work was conducted at the poultry section of the Animal Production Technology Department, Federal College of Agriculture, Ishiagu, Ivo Local Government Area of Ebonyi State, from the month of September to November, 2023.

Source and processing of raw materials: The feed ingredients used for the experiment were obtained at Ishiagu, in Ebonyi State, and a new market in Enugu State, and milling of the raw materials equally took place at the feed-mill at the College of Agriculture, Ishiagu, Ebonyi State.

Experimental design and management of birds: Four weeks old broiler birds of Ross 308 strain were used for the research work. Each treatment was divided into three sections in a completely randomized design (CRD) with 10 birds each per replicate and a total of 30 birds per treatment. The birds were obtained from 'Cosin farm' in Enugu, Enugu State. The birds were raised on a cemented floor covered with wood shavings as a source of litter. Bulbs were provided as a source of light. Feed and water were given *ad-libitum* throughout the research work.

Five experimental diets were compounded, with diet 1 containing 0.35% of synthetic methionine. Diets 2, 3, 4, and 5 contained naturally compounded material (NCM) at the level of 0.25, 0.50, 0.75, and 100% (Table 1).

Three birds from each treatment (one per replicate, of similar size and weight) were removed and kept in a metabolic cage for the nutrient digestibility trial. Two days for adaptability, while data was collected for five days. Faecal samples collected were dried and analyzed in the laboratory.

Table 1: Experimental diet for finisher broiler birds

	Treatment				
Ingredient	T1	T2	T3	T4	T5
Maize	58.00	58.00	58.00	58.00	58.00
Wheat offal	6.90	6.90	6.90	6.90	6.90
Soybean-meal	6.00	6.00	6.00	6.00	6.00
Groundnut cake	12.00	12.00	12.00	12.00	12.00
Fishmeal	1.50	1.50	1.50	1.50	1.50
Blood meal	3.50	3.50	3.50	3.50	3.50
Palm kernel cake	7.00	7.00	7.00	7.00	7.00
Limestone	1.50	1.50	1.50	1.50	1.50
Bone meal	2.50	2.50	2.50	2.50	2.50
Lysine	0.20	0.20	0.20	0.20	0.20
Methionine	0.35	0.26	0.175	0.09	0.00
NCM	0.00	0.09	0.175	0.26	0.35
Finisher premix	0.35	0.35	0.35	0.35	0.35
Salt	0.25	0.25	0.25	0.25	0.25
Total	100	100	100	100	100
Calculated value					
Crude protein (%)	19.45	19.68	19.76	19.93	19.99
MEnergy (Kcal/kg)	3007.90	3039.90	3075.15	3107.61	3119.80

NCM= Naturally compounded material

Table 2: Carcass characteristics of finisher broiler birds fed replacement levels of synthetic methionine

	Treatment					
Parameters	T1	T2	T3	T4	T5	SEM
Live-weight (g)	2900.90^{d}	2955.10^{c}	2975.81^{b}	3015.10^{a}	2950.60^{c}	10.65
Carcass Wt. (g)	2642.45^{d}	2733.90^{c}	2799.81^{b}	2861.75^{a}	2709.60^{c}	6.47
Dressing %)	91.09^{b}	92.52^{b}	94.09^{a}	94.91^{a}	91.83^{b}	2.11
Thigh (%)	27.60^{c}	28.35^{c}	32.80^{b}	36.41^{a}	28.10^{c}	2.01
Breast (%)	38.17^{d}	41.38^{c}	44.54^{b}	48.33^{a}	40.92^{c}	2.83
Back (%)	28.47^{ab}	29.38^{a}	29.66^{a}	31.22^{a}	29.30^{a}	1.84
Wing (%)	9.40^{b}	9.61^{b}	9.84^{b}	11.38^{a}	9.59^{b}	0.38
Drumstick (%)	14.92^{b}	15.06^{b}	15.10^{b}	16.78^{a}	15.06^{b}	1.05

^{abcd}Means on the same row with different superscripts are significantly ($p<0.05$) different and SEM = Standard error of mean

One bird of similar weight was removed from each replicate and slaughtered at the end of the research work for carcass characteristics analysis, the birds were fasted overnight and weighed to obtain the live weight, thereafter bled by severing the jugular vein. They were then dipped in hot water and de-feathered. The head, neck and shank were removed to determine the dressed weight and percentage dressed weight and calculated as shown below. The wings were removed by cutting anteriorly, severing at the humeral scapular joint. The cut was made close to the body line. Lateral cuts were made through the rib heads to the shoulder girdle and the breast was removed by pulling anteriorly. The thighs, drumsticks and back were dissected from each carcass.

Statistical collection: Data obtained were subjected to Analysis of Variance (ANOVA), and the significant means were compared using Duncan's Multiple Range Test at a 5% significance level.

RESULTS AND DISCUSSION

Table 2 presents the Carcass characteristics of finisher broiler birds fed naturally compounded materials (NCM) to replace synthetic methionine (SM). Data obtained showed that all values for carcass were significantly ($p<0.05$) influenced across the treatment groups studied. Live-weight had a value of 3015.10 g which was significantly ($p<0.05$) different across the treatment groups. Live-weight was least in treatment 1 with 2900.90 g. Treatment 3 had a value of 2975.81 g, which differed from those in treatments 2 (2955.10 g) and 5 (2950.60 g), which are by themselves similar ($p>0.05$) to each other. Data obtained for carcass weight showed a similar trend to that of live-weight, with the highest ($p<0.05$) value

Table 3: Nutrient digestibility of finisher broilers fed replacement levels of synthetic methionine

	Treatment					
Parameters	T1	T2	T3	T4	T5	SEM
Dry matter (%)	80.35^{c}	82.11^{b}	84.21^{a}	85.39^{a}	82.09^{b}	0.65
Crude protein (%)	73.93^{d}	75.41^{c}	77.62^{b}	80.92^{a}	75.02^{c}	0.49
Crude fiber (%)	68.30^{a}	60.35^{c}	60.17^{c}	59.45^{c}	66.72^{b}	0.36
Ether extract (%)	64.66^{d}	68.21^{b}	69.82^{a}	69.95^{a}	66.51^{c}	0.32
Ash (%)	69.32^{c}	72.11^{b}	74.06^{a}	74.89^{a}	72.44^{b}	0.60
Nitrogen free extract	70.19^{d}	74.33^{c}	77.68^{b}	79.55^{a}	74.28^{c}	0.65

^{abcd}Means on the same row with different superscripts are significantly ($p<0.05$) different and SEM = Standard error of mean

obtained in treatment 4 (2861.75 g) which was followed by those in treatment 3 with 2799.81 g. The lowest value for carcass weight was seen in treatment 1 with 2642.45 g. Treatment 2 had a value of 2733.90 g which did not differ ($p>0.05$) from those of 2709.60 g recorded in treatment 5, respectively. Superior ($p<0.05$) value for dressing percentage was obtained in treatment 4 (94.91%) which was not significantly ($p>0.05$) different from those obtained in treatment 3 (94.09%), but differ from the least value of 91.09% observed in treatment 1, which was similar ($p>0.05$) to those in treatments 2 and 5 with values of 92.52 and 91.83% respectively.

Data recorded for the thigh muscle was highest ($p<0.05$) in treatment 4 with 36.41%, while the lowest value of 27.60% was seen in treatment 1, which was similar ($p>0.05$) to those in treatments 2 and 5 with 28.35 and 28.10%, respectively. Breast muscle had the largest ($p<0.05$) value in treatment 4 (48.33%), while the smallest value of 38.17% was seen in treatment 1. Values for breast muscle in treatments 2 (41.38%) and 5 (40.92%) were similar ($p>0.05$) to each other, but differed ($p<0.05$) from those of 44.54% obtained in treatment 3. Significant ($p<0.05$) difference was recorded for back muscle with the highest in treatment 4 (31.22%) which was similar ($p>0.05$) to those of treatments 2 (29.38%), 3 (29.66%) and 5 (29.30%), but differ ($p<0.05$) in treatment 1 (28.47%), respectively. Wing and drumstick had similar trend with higher values obtained in treatment 4 (11.38 and 16.78%), while the least value of 9.40 and 14.92% was observed in treatment 1, respectively.

Nutrient digestibility of finisher broiler birds fed replacement levels of synthetic methionine was presented in Table 3 with all parameters significantly ($p<0.05$) influenced across the treatment group. Values obtained for dry matter was superior ($p<0.05$) in treatment 4 (85.39%) which was closely followed by those in treatment 3 with 84.21%, while the least value of 80.35% was recorded in treatment 1. Treatments 2 and 5 had a similar ($p>0.05$) value of 82.11 and 82.09%, respectively. Crude protein value was highest ($p<0.05$) in treatment 4 with 80.92% which differed ($p<0.05$) from that in treatment 3 with 77.62%. The least value of 73.93% was recorded in treatment 1, which was not similar ($p<0.05$) to those of treatments 2 and 5 with 75.41 and 75.02%, respectively. The increase in the crude protein values of treatments fortified with NCM connotes increase access to body-building materials for the birds in these treatments. Data recorded for crude fiber was superior ($p<0.05$) in treatment 1 (68.30%) which was followed by those in treatment 5 (66.72%). The least value of 59.45% was observed in treatment 4 which was not significantly ($p>0.05$) different from those in treatment 2 (60.35%) and 3 (60.17%), respectively. Ether extract was higher ($p<0.05$) in treatment 4 with 69.95% which was similar to that in treatment 3 with 69.82%. The least value of 64.66% was observed in treatment 1. Treatment 2 had a value of 68.21% which differed from those in treatment 5 with 66.51%, respectively.

Values for ash content were significantly ($p<0.05$) higher in treatment 4 (74.89%), which was similar ($p>0.05$) to that of 74.06% obtained in treatment 3, which differed ($p<0.05$) from the lowest value of 69.32% observed in treatment 1. Ash content value had 72.11 and 72.44% in treatment 2 and 5, respectively. Values recorded for Nitrogen free extract was higher ($p<0.05$) in treatment 4 with 79.55%,

which was followed by 77.68% obtained in treatment 3. 74.33 and 74.28% were obtained in treatment 2 and 5, which were by themselves similar ($p>0.05$) to each other, but differed ($p<0.05$) from the least value of 70.19% recorded for Nitrogen free extract in treatment 1.

Superior values obtained for live-weight and carcass in treatments fortified with NCM could suggest that the birds were able to synthesize more nutrients and convert it to weight. This was in agreement with the observations of Chattopadhyay *et al*.[8] who reported higher carcass weight and dressing percentage when herbal methionine was used to replace synthetic methionine in broiler birds. Also, Lilian *et al*.[4] observed higher live-weight and carcass weight in treatments fortified with *Costus afer* when compared with the control. The results obtained in this study contradicts the report of Makinde *et al*.[5] and Kumar *et al*.[9] who recorded no significant difference while working on alternative source to synthetic methionine. The weight of cut-parts: thigh, breast, back, wing and drumstick were found to be higher when compared to the control. This agrees with the report of Chattopadhyay *et al*.[8] who observed significantly ($p<0.05$) higher values in terms of breast and back yield than the control. However, Makinde *et al*.[5] and David *et al*.[10] differ in their observations. According to David *et al*.[10] when dietary nutrient requirements of poultry birds are met, there is the possibility of higher carcass yield especially when the alternative feedstuffs in the diet are properly annexed by the experimental birds. Thus, the difference in the carcass values could be traced also to the differences in the nutritional contents of the diets based on quantity added in each treatment and the ability of the birds to optimize the nutrients to their advantage.

Higher values obtained for nutrient digestibility in the present study (dry matter, crude protein, ether extract, ash and nitrogen-free extract) suggest that birds in treatments fortified with NCM were able to extract more nutrient in the diet when compared with the control. This could be due to the extra amino acid build up in these treatments. According to Makinde *et al*.[5], David *et al*.[10] and Bhutyal *et al*.[11], poultry birds exposed to extra levels of dietary protein perform better than others. Also, these authors reported that nutrient digestibility values above 70% especially for dry matter, crude protein and nitrogen free extract suggests better assimilation and digestibility of nutrient in those birds.

CONCLUSION

The findings of this study indicate that natural crude methionine (NCM) can effectively replace synthetic methionine at up to 100% inclusion level without compromising carcass quality. Broiler birds fed diets fortified with NCM exhibited improved carcass characteristics and enhanced nutrient digestibility compared to those in the control group. Furthermore, the inclusion of NCM promoted better nutrient accessibility and utilization, suggesting its potential as a sustainable and effective alternative to synthetic methionine in finisher broiler diets.

SIGNIFICANCE STATEMENT

This study discovered the positive impact of replacing synthetic methionine with naturally compounded materials (NCM) on carcass characteristics and nutrient digestibility in finisher broiler birds, which can be beneficial for improving growth performance and achieving cost-effective poultry production. The findings highlight the potential of NCM as a superior alternative, especially at the 75% inclusion level. This study will help researchers to uncover the critical areas of nutrient substitution strategies that many researchers were not able to explore. Thus, a new theory on sustainable methionine replacement in poultry nutrition may be arrived at.

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