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National Animal Production Research Institute
Ahmadu Bello University
P.M.B 1096, Shika-Zaria,
Kaduna State, Nigeria.
Email:*japr@napri.gov.ng* Url:journals.napri.gov.ng

EFFECT OF AMINO ACID SUPPLEMENTATION (METHIONINE) IN TOASTED PIGEON PEA SEED DIET ON GROWTH PERFORMANCE OF GROWING PIGS

[1]Adama, I. S., [2]Mbahi, T. F. and [2]Yakubu, B.

[1]National Animal Production Research Institute/ Ahmadu Bello University, Zaria, Nigeria
[2]Department of Animal Science and Range Management, School of Agriculture and Agricultural Technology, Modibbo Adama University of Technology, Yola, Nigeria.

ABSTRACT

The objective of this study was to investigate the effects of supplemental graded levels of methionine in toasted pigeon pea seed (TPSM) diet on growth performance, carcass characteristics and cost effectiveness of growing pigs. Forty pigs were randomly allotted to five experimental treatments in a completely randomized design and each replicated four times with two pigs per replicate. The pigs were offered the following diets at 4% body weight; control diet (T1) contained 0.1% methionine, while treatments T2, T3, T4 and T5 contained 0.2% 0.3, 0.4% and 0.5% methionine, respectively. The performance parameters measured were growth performance, carcass characteristics and cost effectiveness. Inclusion of graded levels of methionine significantly ($P < 0.05$) improved final weight gain but feed intake, weight gain, feed conversion ratio and carcass characteristics of the growing pigs were not significantly affected, however the weight gain numerically increased as the methionine inclusion increased. Pigs fed diet T5 indicated the best feed conversion. The values were 5.03, 5.09, 4.80, 4.52 and 4.06 for pigs fed diet T1, T2, T3, T4 and T5 respectively. Economic analysis showed significant ($P<0.05$) increase in feed cost per kg feed and cost per kg weight gain. Feed cost/kg gain was lowest in T5 (₦ 419.71) while the highest cost was recorded in diet T2 (₦ 499.09). Methionine supplementation at 0.05% of growing pig's diets was more profitable than feeding 0.1% - 0.4%-supplemented diets. In can therefore be concluded that methionine supplementation of growing pigs diets produce positive results in pig production.

Keywords: Amino acid, supplementation, toasted pigeon pea seed, growing pigs

INTRODUCTION

Feed supply has remained a major constraint in livestock production due to the ever-increasing cost of conventional feedstuff occasioned by the competition between man and livestock (Ameafule *et al.*, 2004). Consequently, the prices of meat is not affordable, hence the reduced protein intake. An average Nigerian does not consume enough of protein of animal origin that nourishes the body for tissue development, repairs and healthy living (FAO, 2003). Serious malnutrition has been reported especially among the vulnerable group (e.g children and pregnant women) of the poor/low class people that form majority in Nigeria (Taiwo *et al.*, 2006a). Nutrition is the most important aspect of livestock production, which can be used to enhance animal productivity and reduce the cost of production, Mahadi (2002). Within the pig industry, 75- 80 percent of the total cost of production is attributed to feeding costs. Of this, nearly thirty percent is due to supplying protein in rations (Coon, 2002). According to Mukhtar *et al*., (2007) the ideal diet should satisfy the requirement of the largest species for amino acid to achieve the maximum economic return. However, in Nigeria, the major problem facing pig farmers is not just high cost of protein feed resources but supplying the right quantity and quality of protein (amino acid) in the diets (Okpaniezeali

et al., 2001). In addition, the proportion of methionine to all other essential amino acid is of great concern for optimal performance of pig production. Lawlor *et al.,* (2003a) stated that the most essential amino acids that are likely to be deficient in pig diets is methionine. Unfortunately, protein from a single source is not always adequate to satisfy these essential amino acid requirements (Lawlor *et al.,* 2003). This problem has tended to reduce the rate of growth of animals and has added to the low level of animal protein intake of Nigerians. A possible way of optimizing the productivity of our animals and maximize efficiency of protein use is by improving the dietary levels of essential amino acid.

Pigeon pea protein (the choice of plant protein) is a rich source of lysine, but is usually deficient in sulphur-containing amino acids, methionine and cystine, Saxena *et al*., 2004. It becomes necessary that supplementary synthetic methionine be added to the diets in order to provide sufficient essential amino acids for the building of body proteins. The use of synthetic amino acids to meet the amino acid needs of pig leads to production of cost effective diets. However, little attention has been given to the effects of graded levels of methionine supplementation on growth performance, carcass characteristics and cost effectiveness of pig production in Nigeria. Thus, the present study was conducted to evaluate the growth performance, carcass characteristics and cost effectiveness of feeding graded levels of synthetic methionine in TPSM diets to growing pigs.

MATERIALS AND METHODS

Experimental Site: The study was carried at the Swine Research Station, National Animal Production Institute, Otukpo out-station, Benue State, Nigeria.

Experimental Diets

Five isoenegetic and isonitrogenous diets of TPSM supplemented with graded levels of methionine formulated to meet the nutrient requirement of growing pigs according to (NRC, 2012). Each of diet was included at 60% of the whole diet such that control diet (T1) contained 0.1% methionine, while treatments T2, T3, T4 and T5 contained 0.2% 0.3%, 0.4% and 0.5% methionine, respectively. The ingredients composition ofr the experimental diets are shown in (Table 1).

Experimental pig management, Design and Data collection

A total of forty (40) growing pigs with an average weight of 60.28kg were obtained from Swine Research Station, National Animal Production Research Institute, Ahmadu Bello University, Zaria, out station, Otukpo were used for the experiment. The pigs wer5e individually weighed, and randomly distributed in five treatments. Each of the five treatments had eight growing pigs, which were further divided into four replication of two pigs each in a completely randomized design. The experimental diets were served at 4% body weight while water was provided *ad libitum* throughout the experimental period that lasted for eight weeks (56 days). The pigs were fed the experimental diet twice daily, in the morning (8.00-8.30 am) and afternoon (2.30 3.00 pm).The wallowing trough contained water at all time while drinking water was provided *ad libitum*. The pigs were treated against ecto- and endo-parasites with Ivomectin injection prior to the start of the study. They were prophylatically administered antibiotics (Tetracycline LA) injection to ensure good health. Before the start of the experiment, one-week adjustment period (adaptation period) was observed, using a common diet. Feed consumption was determined by subtracting the quantity of feed leftover from the total quantity offered on a daily basis. Weighing of the pigs was at the beginning of the experiment and subsequently on a weekly basis usually in the morning (8.00 - 9.00 am) hours when the pigs had empty stomach. Weight gain was calculated as final weight minus initial weight and feed

conversion ratio (FCR) as feed intake divided by weight gain.

Carcass and economic analysis
At the end of the feeding trial four pigs from each treatment (a pig per replicate) group were randomly taken for carcass evaluation**.** The pigs were fasted overnight, individually weighed early in the morning (7.00am) and slaughtered. They were slaughtered by cutting the jugular vein, two fingers below the ear. The carcasses were then bled and scalded. Scalding was carried out by pouring sufficiently heated water (65-75C) on the body of the pigs and scraping off the hair with not-too sharp knife.

The dissection of the carcass was carried out in a manner similar to the description of the dissection of turkey carcass as described by Hansen *et al.,* (2006). The carcass of each pig was split open longitudinally through the thorax and abdomen, and then eviscerated. The empty carcass weight was taken (head and shanks inclusive), the empty carcass was split into two longitudinal equal halves (without the head) noting the weight of each half. The dressed pig (carcass) was weighed and weight expressed as a percentage of the weight of the living pig before slaughter. During the evisceration, the internal organs and other parts were carefully removed and weighed. Their weights were expressed as a percentage of the dressed carcass weight.

Average Back Fat Thickness
The back fat thickness was measured at the 1st rib, last rib and last lumber vertebra. These measurements were added and divided by 3 to obtain the average back fat thickness.

The Kidney Fat
This was measured by carefully peeling off the kidney fat and weighing to the nearest 0.05kg.

The ham cut
This was cut between the 2nd and 3rd sacral vertebra and perpendicular to the spinal column.

The Jowl
This was cut along the folds of the neck clear off the blade bone in a traverse fashion in related to the length of the carcass.

The picnic shoulder
This was cut between the 2nd and 3rd thoracic vertebra and perpendicular to the spinal column. The cut was then separated into warm shoulders (picnic) and boston butt by cutting 1.25cm below the blade bone and perpendicular to the first cut between the 2nd and 3rd ribs.

The loin and belle
These were separated by making a cut at the tip of the tender loin and cutting about 3.80cm from the backbone following the back curvature and cutting the last rib, 1.90cm higher than the point of intersect of a straight line. Their separate weights were then recorded and expressed as a percentage of the warm carcass.

The carcass dressing percentage was calculated thus:

$$\text{Carcass yield (\%)} = \frac{\text{Weight of dressed pig}}{\text{Weight of live pig}} \times 100$$

On the termination of the study, the following records were used to evaluate the economic indices:

(i) The cost per kg feed (₦/kg) was calculated based on the prevailing market price of the ingredients used in the formulations at the time of the experiment by computing the cost of each ingredient (including the processing cost) that make a 100kg diet, and then divided by 100.

$$= \frac{\text{Total Cost of 100kg Feed}}{100}$$

(ii) Cost of total feed intake was calculated by multiplying total feed consumed in each treatment with the cost/kg

feed. = Total Feed Intake per Pig × Feed Cost per kg

(iii) Feed cost per kg weight gain was calculated as FCR x cost/ kg feed.

. (iv) Feed cost saving was obtained by the difference between the Feed Cost per kg wt Gain of the control diet (T1) and diets T2, T3, T4 and T5 respectively.

Data Analysis

To determine the response of the animals to treatments, all the data collected were subjected to Analysis of Variance using GraphPad InStat version 3.1 software Inc., 2014. Significant level of difference among treatment means were equally separated using the same statistical tool.

Results and Discussion

The results of the growth performance of growing pigs fed Toasted pigeon pea seed meal(TPSM) supplemented with graded methionine are presented in Table 2. Results on the daily feed intake (DFI) showed that pigs in the control group that received 0.1% level of methionine inclusion (LMI) were not significantly (P>0.05) different from those that received 0.2, 0.3, 0.4 and 0.5% level of methionine inclusion. The daily feed intake values ranged from 1.74kg for pigs on 0.1% LMI to 1.92kg for those on the 0.3% LMI then declined to 1.90kg and 1.77kg for pigs on 0.4 and 0.5% LMI respectivelly. The pattern of feed intake did not follow a particular trend; the undulating trend could be related to the energy values of the diet since pigs are known to eat to meet their energy requirement (Noble and Van Milgen, 2004).

There was no significant (P>0.05) difference in the daily weight gain of pigs. The daily weight gain (DWG) varied from 0.35kg for pigs fed 0.1% LMI to 0.44kg for those fed 0.5% LMI. Feed conversion ratios (FCR) were in the range of 4.02 to 5.09 for pigs on 0.5 and 0.2% LMI respectively, the values obtained for the diets were statistically similar. The weight gain steadily increased as the methionine inclusion levels increased in the TPSM diet. The observed steady improvement in weight gain of the pigs fed the experimental diets might be due to the effect of methionine in improving feed and nutrient digestibility and utilization and more availability of methionine in the TPSM diets. This corroborates with (Bawa *et al*. 2008) that consumption of methionine resulted in significant ($P < 0.05$) increase in weight gain in birds. This could also be due to more balanced nutrient combination since adequate amount of the essential amino acids is necessary for protein synthesis, which results in increased weight gain. The result also suggests that the levels of methionine inclusion (0.2 - 0.5%) met the requirement of the pigs and is within the tolerable limits, NRC,(2012). The lower weight gain of pigs fed 0.1 and 0.2% methionine supplemented diets compared to those fed 0.3-0.5 methionine supplemented diets suggest insufficiency of methionine in the diet for optimum growth and an indication that the pigs could not compensate for their nutrient deficiency. This observation strengthens the findings of Okpaniezeali *et al*. (2001); Etuk *et al*. (2004) and Razaei *et al*. (2004) that protein in the diet must be enough to supply sufficient essential amino acid needed for the building up of body protein.

The carcass weight and organ characteristics are as shown in Table 3. There were no significant (P>0.05) differences among the dietary treatments with regard to their effect on slaughter weights. Nevertheless, the pigs fed diet T5 had the highest slaughter weight (83.08kg) when compared with those fed diets T4, T3, T2 and T1 weighing 83.01kg, 82.69kg, 82.50 and 82.45kg respectively. The empty carcass weight which is the eviscerated carcass was highest in the pigs fed diet T4 (59.84kg) although there were no statistical significant difference (P>0.05) among the treatments. The values obtained range from 59.83kg for diet T5 to 59.28kg for diet T1. The warm dressing percentage was highest (72.01%) in diet T4

followed by diets T5, T3, T2 and T2 with the values of 72.01%, 72.00%, 71.92% and 71.90% respectively. These differences were however not statistically significant (P>0.05). There was no significant effect of diets on the stomach percentage (P>0.05) although the pigs fed diets T3, T4 and T5 gave the highest percentages of 1.24 followed by diet T2 with the value of 1.20% while the least (1.18%) diet T1. The lean cuts (ham, loin and picnic shoulders) did not differ significantly (P>0.05) across the diets although the highest value was obtained from pigs fed .5% graded level of methionine (diet T5) The jowl and belly which make up the two fat cuts were not affected significantly (P>0.05) by the diets although the pigs fed diet T5 had the highest percentage (1.00%). There was no significant effect of diets on back fat thickness percentage (P>0.05) between control diet (0.80%) and the other diets but the highest value was obtained from the pigs fed diet T5 (1.00%). It is a common practice in feeding trials to use weights of some internal organs like the liver or kidneys as indicators of toxicity because they should differ significantly if there was any serious effect of antinutritional factors on them being major detoxification organs (Saxena *et al*., 2002). In this study, there was no significant (P>0.05) difference in the organs weights of the pigs among the treatment groups. The difference in weight would arise because of increased metabolic rate of the organs in attempt to reduce toxic elements or anti-nutritional factors to non-toxic metabolites (Bone, 1979). However, the weights were generally similar in numerical comparison to those in the control group.

Results from this study with respect to the weight of liver and kidney of pigs fed dietary toasted pigeon pea seed meal supplemented with graded levels of methionine were not significantly different, thus suggests that the antinutritional factors in the test diets were still within tolerable levels that could not exert any significant abnormalities in the internal organs. This suggested that there were no incriminating factors that can cause hypertrophy or hypotrophy of these organs; thus confirming non toxicity of the treatment diets. The result of this study show that toasted pigeon pea seed meal supplemented with 5% methionine can be included in growing pig diets at levels up to 60% without adverse effects on dressing percentage and the yield of carcass cut-up parts.

The economic analysis is as presented in Table 4**.** Diet T5 revealed significant (P<0,05) across treatments, the highest value of feed cost per kilogram diet (₦102.80) while diet T1 recorded the lowest value of ₦96.78. Diets T2, T3 and T4 showed cost value of ₦98.06, ₦99.64 and ₦101.22 respectively. The cost of total feed intake equally revealed significant (P<0.05), diet T4 had the highest value (₦ 10,738.29kg/pig) while diet T1 recorded the lowest value (₦9429.28). Diets T2, T3 and T5 recorded ₦ 9787.17, ₦ 10716.28 and ₦ 10217.29 respectively. Feed cost per kg weight gain (₦/kg gain) showed significant (P<0.05) difference among treatments. Diet T2 had the highest value (₦499.13) while diet T5 had the lowest value (₦417.37). Diets T1, T3 and T5 showed ₦ 483.80, ₦ 478.27 and ₦ 444.39 respectively. Feed cost saving indicated that diet T2 did not exert positive impact on the economy of production while diets T3, T4 and T5 showed positive values of ₦5.53, ₦39.41 and ₦66.59 respectively.

Economic analysis revealed that synthetic methionine supplementation in TPSM diets of growing pig diets was more profitable than feeding normal 0.1% methionine diet. The economic data clearly indicated that methionine diet (T5) was more encouraging, feasible and economical to obtain maximum profitability from pig production. The higher weight gain and better-feed efficiency of the supplemented diets are two major possible influences that resulted in decreased cost of production and consequent increased profitability of the pigs fed these diets. Many researchers had earlier reported positive economic responses of adding

synthetic methionine (Roland *et al*., 2000; Liu *et al*., 2005) to diets.

CONCLUSION

The result revealed that as dietary methionine level increased up to 0.50% in the TPSM diets, total weight gain, daily weight gain and feed conversion of growing pigs were positively influenced. The feed cost per kg weight gain per pig reduced with increasing methionine while the dressed carcass and organ weights did not show any significant difference. The lack of abnormalities or pathologic lesions in the organs indicated that TPSM diet supplemented with graded levels of methionine up to 0.50% can be included in the diets of growing pigs. In conclusion it can be said that synthetic methionine supplementation in TPSM diet of growing pig diets produce positive results. It also enhances the productivity and cost effectiveness of pig rearing.

Table 1: Ingredients Composition of Graded levels of Methionine supplementation for Growing pigs fed toasted pigeon pea seed meal

Ingredients	Graded levels of methionine (%)				
	0.1 (T1)	**0.2 (T2)**	**0.3 (T3)**	**0.4 (T4)**	**0.5 (T5)**
Maize	22.73	22.60	22.45	22.33	22.20
Soyabean cake	3.57	3.60	3.63	3.67	3.70
Pigeon pea seed meal	60.00	60.00	60.00	60.00	60.00
Rice offal	10.00	10.00	10.00	10.00	10.00
Bone meal	3.00	3.00	3.00	3.00	3.00
Common salt	0.25	0.25	0.25	0.25	0.25
*Premix	0.25	0.25	0.25	0.25	0.25
Methionine	0.10	0.20	0.30	0.40	0.50
Lysine	0.10	0.10	0.10	0.10	0.10
Total	100	100	100	100	100
Calculated analysis					
Crude protein (%)	18.00	18.00	18.00	18.00	18.00
Crude fiber (%)	4.42	4.21	4.24	4.23	4.23
Ether extract (%)	3.46	3.08	3.08	3.08	3.08
Ash (%)	2.87	2.82	2.82	2.82	2.82
Calcium (%)	7.52	4.62	4.59	4.57	4.54
Potassium (%)	0.53	0.37	0.37	0.37	0.37
Phosphorus (%)	0.43	0.43	0.43	0.43	0.43
Lysine (%)	1.33	1.20	1.20	1.20	1.20
Methionine (%)	0.38	0.44	0.54	0.64	0.74
M.E. (Kcal/kg)	3017.84	3185.40	3181.22	3178.40	3174.90

***Vitamin/Mineral premix from** Agricare-mix® supplied per kg of diet; Vitamin A 20,000 IU; Vitamin D 4,000 IU; Vitamin E 39.96 IU; Vitamin K 5.99 mg; Riboflavin 12 mg; Vitamin B12 0.1 mg; Pyridoxine HCl 7 mg; Cal-D-Panthothenate 30 mg Nicotinic acid 70 mg; Folic acid 2 mg; Biotin 0.2 mg; Potassium 0.41%; Sodium 0.30%; Copper 24 mg; Manganese 110 mg; Zinc 100 mg; Iron 110 mg; Selenium 0.3 mg; Calcium 0.22 mg; Iodine 3 mg; Choline 1000 mg; Butylated hydroxytoluene (BHT) 140 mg and Zeolex 50 mg.

Table 2: Effect of Toasted Pigeon Pea Seed Meal Supplemented with Graded Levels of Methionine on the Growth Performance of Growing Pigs

Parameter	Graded Levels of Methionine (%)					
	0.1 T1	0.2 T2	0.3 T3	0.4 T4	0.5 T5	SEM
Av. Initial weight (kg)	60.63	60.45	61.93	61.09	61.14	3.38^{NS}
Av. Final weight (kg)	80.00^{b}	80.08^{b}	84.34^{a}	84.86^{a}	85.60^{a}	0.16^{*}
Av. Total feed intake (kg)	97.43	99.91	107.55	106.09	99.39	0.06^{NS}
Av. Daily feed intake (kg)	1.74	1.78	1.92	1.90	1.77	0.06^{NS}
Av. Total weight gain (kg)	19.37	19.63	22.41	23.77	24.46	3.18^{NS}
Av. Daily weight gain (kg)	0.35	0.35	0.40	0.42	0 .44	0.06^{NS}
Feed conversion ratio (kg)	5.03	5.09	4.80	4.46	4.06	1.06^{NS}
Mortality	0	0	0	0	0	

Table 3: Carcass Weight and Organ Characteristics of Growing Pigs Fed Toasted Pigeon Pea Seed Meal Supplemented with Graded Levels of Methionine

Parameters	Graded Levels of Methionine (%)					
	0.1 T1	0.2 T2	0.3 T3	0.4 T4	0.5 T5	SEM
Initial weight (kg)	80.00	80.05	79.95	80.07	80.00	1.25^{NS}
Live (slaughter) weight (kg)	82.45	82.50	82.69	83.01	83.08	1.94^{NS}
Dressed (empty carcass) weight (kg)	59.28	59.33	59.52	59.84	59.83	1.68^{NS}
Warm dressing (%)	71.90	71.92	72.00	72.09	72.01	0.88^{NS}
Ham (%)	25.75	25.80	25.80	25.85	25.91	1.33^{NS}
Loin (%)	10.75	10.75	10.80	10.85	11.38	0.98^{NS}
Picnic shoulder (%)	27.78	27.82	27.85	28.00	28.41	0.45^{NS}
Jowl (%)	3.88	3.95	3.95	4.00	4.30	0.25^{NS}
Belly (%)	8.82	8.85	8.88	8.90	9.00	0.58^{NS}
Liver (%)	3.30	3.30	3.30	3.32	3.30	1.18^{NS}
Heart (%)	0.66	0.68	0.70	0.75	0.75	0.27^{NS}
Kidney (%)	0.50	0.50	0.50	0.50	0.50	0.07^{NS}
Kidney fat (%)	0.32	0.35	0.35	0.35	0.35	0.04^{NS}
Lungs/Ttrachea (%)	1.16	1.15	1.18	1.18	1.18	0.27^{NS}
Back fat thickness (cm)	0.80	0.80	0.80	0.85	1.00	0.21^{NS}
Spleen (%)	0.75	0.75	0.75	0.76	0.75	0.18^{NS}
Empty stomach (%)	1.18	1.20	1.24	1.24	1.24	0.23^{NS}
Head (%)	11.50	11.50	11.50	11.50	11.55	0.67^{NS}
Trotters (%)	3.00	3.30	3.30	3.30	3.30	0.25^{NS}

NS= Not significant
SEM= Standard error of mean

Table 4: Economic Analysis of Production of Growing Pig fed Toasted Pigeon Pea Seed Meal Supplemented with Methionine

Ingredients	Graded Levels of Methionine (%)					
	0.1 T1	0.2 T2	0.3 T3	0.4 T4	0.5 T5	SEM
Total feed intake per pig (kg/pig)	97.43	99.91	107.55	106.09	99.39	0.28^{NS}
Total feed cost (₦/kg)	96.78^{d}	98.06^{c}	99.64^{b}	101.22^{a}	102.80^{a}	0.45*
Cost of total feed intake (₦)	9429.3^{e}	9787.2^{d}	10716.3^{c}	10738.4^{b}	10217.3^{a}	0.24*
Total Weight Gain per pig (kg)	19.37	19.63	22.41	23.77	24.46	4.00^{NS}
Feed Cost per kg wt Gain (₦)	486.80^{b}	499.09^{a}	478.19^{c}	451.76^{d}	417.71^{e}	0.44*
Feed cost saving (₦)		-12.29	8.61	35.04	69.09	

*Calculated based on market price of the ingredients (₦/kg) at the time of the experiment (maize=55.0; soya bean seed=125.0; pigeon pea seed=95.0; rice offal=2.0; bone=100.0; salt=30; premix=550.0; methionine=1600.0; lysine=800); cost of live weight of finisher pig= 350.00

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