African Journal of Biological Sciences

https://doi.org/ 10.48047/AFJBS.6.5.2024. 7947-7961

Impact of dietary methionine supplementation on the growth performance of Large White pigs in tropical environments

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Article History
Volume 6, Issue 5, 2024
Received: 22 March 2024
Accepted: 29 May 2024
doi: *10.48047/AFJBS.6.5.2024. 7947-7961*

ABSTRACT

Objective : This study aimed to assess the effect of dietary methionine supplementation on the productive performance of growing pigs. **Methods** : A total of 200 Large White pigs including 100 sows and 100 castrated with an average body weight of around 41.09 ± 7.08 kg were assigned to five treatments of basal diet supplemented with 0% (M0), 0.25% (M0.25), 0.50% (M0.50), 0.75% (M0.75) and 1% (M1) of methionine having 4 replicates of 10 pigs each. All treatments were subjected to the same prophylactic plan. Data were collected on feed intake, body weights and body measurements, such us back length, thoracic perimeter and height at the withers. The data collected were analyzed using one-way ANOVA. **Results**: This study showed a significant reduction in feed intake in M0.50 and M0.75 pigs compared to the other treatments. On day 60, pigs in M1 treatment showed significantly lower body weights than the pigs in M0.50. Pigs in the M0.75 treatment had the lowest feed conversion ratio compared to M1 treatment. The economic evaluation revealed that M0.50 and M0.75 treatment groups had the best production costs. **Conclusion:** Supplementing diets with 0.50% methionine resulted in better production costs in Large White pigs and this is strongly recommended to farmers.

Key words: Methionine, pigs, Large White, supplementation and production performance

INTRODUCTION

According to Mopate et al. [1], poverty reduction in Africa can only be achieved by considering income-generating activities. These include pig farming, which is considered a secondary income activity for all socio-professional groups of the population in different parts of Africa [2]. In Togo, pig rearing plays a major role in meeting food security and self-sufficiency in animal protein for the most disadvantaged and marginalized population [3]. To effectively help reduce poverty and the deficit in meat products, improving the rearing of short-cycle animals, particularly pigs is crucial [4].

Pigs are omnivorous monogastric animals that transform agricultural products and by- products that humans cannot consume into the highest quality meat [5]. It takes 8 to 10 months to fatten a piglet weighing 8 to 10 kg for 90 to 120 kg body weight, with carcass yields ranging from 65 to 80% [6]. Pig growth depends on several factors namely breed, breeding environment and feed. It should be noted that feed also has a major influence on meat quality in addition to improving pig growth. An adequate feed formulation, especially regarding amino acids, helps animals improve growth rate, feed conversion ratio and meat quality. Indeed, lysine and methionine are essential amino acids for maximizing production performance and carcass quality in pigs [7]. However, pig feed is generally based on maize and soya, which are low in lysine and methionine, respectively [8]. The combination of these ingredients in pigs' diets limits the essential amino acid requirements and, therefore, affects their growth performance [8].

To meet these challenges, Rerat et al. [9] have shown that methionine and lysine can be used by incorporation or supplementation to improve pig performance. However, there is a scarcity of studies regarding the incorporation of methionine or lysine in growing pigs' diets. Besides, a detrimental effect on growth performance has been reported with a high level of methionine in the diet [10]. Therefore, the current study was carried out to assess the effect of methionine supplementation on the productive performance of Large White pigs.

MATERIAL AND METHODS

Study Area

This study was carried out at the CARREFOUR farm in Gamé-Agamahé (Latitude: 06°43'12.39" North, Longitude: 01°10'46.92" East) (Figure 1), a village located in the Zio prefecture about 70 km north of Lomé (Maritime region) in Togo. This area has a subequatorial Guinean climate with four seasons (02 rainy and 02 dry seasons). The major rainy season covers the period from March to mid-July and the minor rainy season covers the period from mid-September to November [11]. Average annual rainfall is between 800 and 950 mm, and average annual temperatures are 27 °C and 30 °C [12].

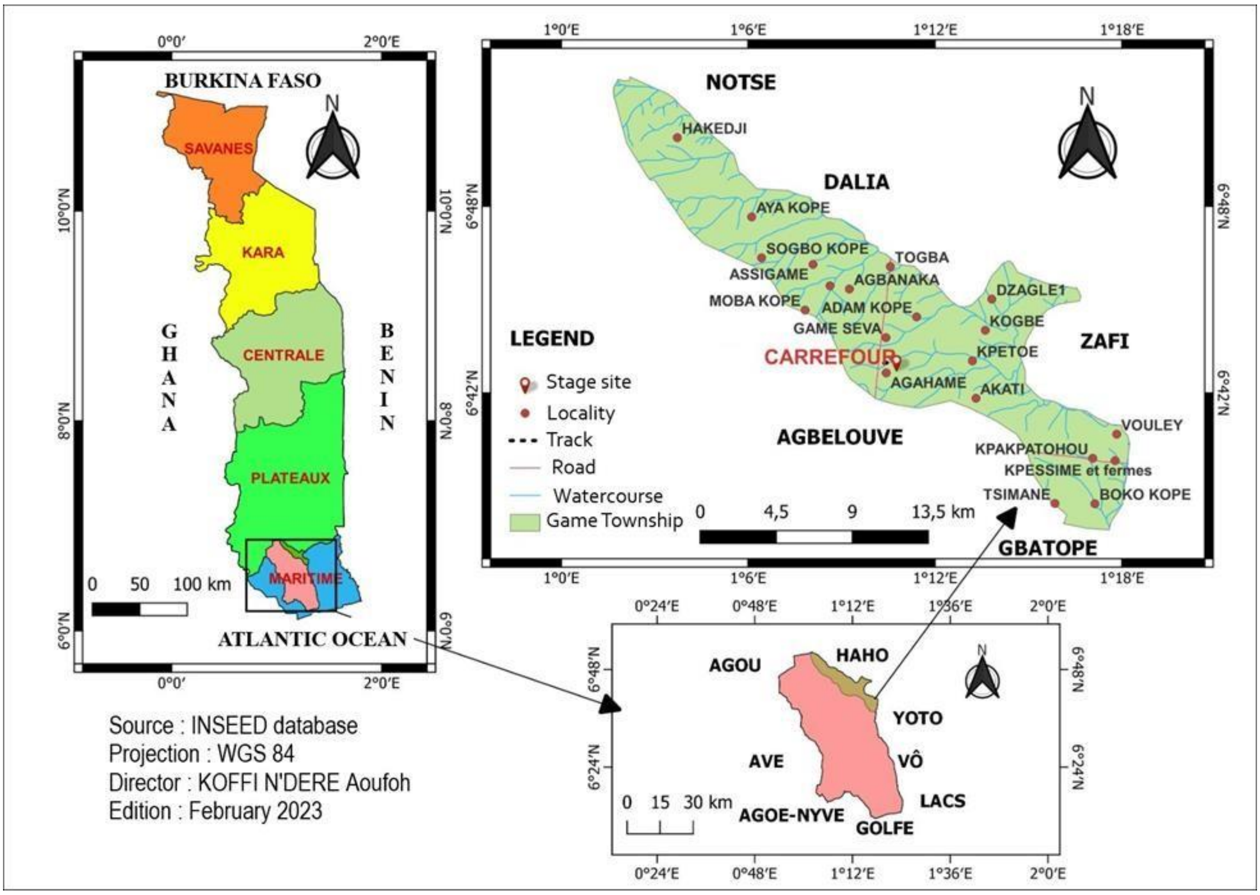

Figure 1: Location of the canton of Gamé on the map of Togo

Study animals

A total of 200 pigs, including 100 sows and 100 castrated boar, were chosed from the flock with an average body weight of around 41.09 ± 7.08 kg. The 200 pigs were then assigned into five (05) treatments of eight (40) animals each (20) sows and 20 castrated boar, having four replicates per treatment.

The treatments were:

- basal diet containing 0% of methionine (M0) ;
- basal diet containing 0.25% of methionine (M0.25) ;
- basal diet containing 0.50% of methionine (M0.50) ;
- basal diet containing 0.75% of methionine (M0.75) ;
- basal diet containing 1% of methionine (M1).

These treatments were based on the modified methodology of [7]. A twoweek acclimatisation period was observed before the start of the experiment. All the diets used had similar levels of crude protein and metabolisable energy and met the requirements of the pigs according to their stage of development (Table 1). The pigs were supplied with feed and water *ad libitum*.

Trial piggery

The piggery used consisted of thirty-two (32) pens and was covered entirely with galvanised sheet metal. All the experimental pens were cleaned every morning before serving feed. The maintenance consisted of collecting the feces, leaving the drinker to empty the rest of the water, leaving the feeder to empty and weigh the rest of the food.

Table 1: Feed composition

Raw material	**Witness**	**Methionine-based ration**			
	M0	M0.25	M0.50	M0.75	M1
Maize	20	20	20	20	20
Wheat bran	35	35	35	35	35
Soya meal	15	15	15	15	15
Beer brew	10	10	10	10	10
Palm kernel meal	20	20	20	20	20
Methionine	0	0.25	0.5	0.75	1
Total	**100**	**100.25**	**100.5**	**100.75**	**101**
Chemical values of rations					
DE porc kcal / kg	3022	3036	3051	3065	3080
Crude protein (%)	18.005	18.15175	18.2985	18.44525	18.592
Crude cellulose (%)	10.07	10.07	10.07	10.07	10.07
Fat content (%)	9.47	9.47	9.47	9.47	9.47
Calcium (%)	0.13	0.13005	0.1301	0.13015	0.1302
Total phosphorus (%)	0.7725	0.7725	0.7725	0.7725	0.7725
Lysine (%)	0.8005	0.8005	0.8005	0.8005	0.8005
Methionine (%)	0.292	0.5395	0.787	1.0345	1.282
Methionine + cystine (%)	0.5205	0.768	1.0155	1.263	1.5105
Sodium (%)	0.141	0.141	0.141	0.141	0.141
Chlorine (%)	0.072	0.072	0.072	0.072	0.072

Veterinary care

All the animals received preventive treatment during the acclimatisation period and one month after the beginning of the experiment. The veterinary products used were (i) Intermectin at a dose of 2 ml per animal ; (ii) Teroxylin 20% LA at a dose of 4 ml per animal ;

(iii) Vit AD3E 300 INJ at a dose of 5 ml per animal.

Data collection

Measurements such as animal weight and body dimensions (thoracic perimeter: TP, back length: BL, height at withers: HW) were taken on day 0, day 15, day 30, day 45 and day 60). The different body parts measured on the pigs were correlated with average weight pearson correlation analysis. All these data were collected in the morning before feeding.

Production parameter

Feed intake (FI)

$$FI\ (kg) = \frac{\text{Quantity of feed supplied - quantity of feed remaining}}{\text{Total number of animal}} \quad (1)$$

Body weight (BW) BW (kg) =

$$\frac{\sum \text{weights of pigs}}{\text{Total pigs weighed}} \quad (2)$$

Feed conversion ratio (FCR)

$$IC = \frac{\text{Quantity of feed consumed during a period}}{\text{Weight gain during the same period}} \quad (3)$$

Body weight gain (BWG)

$$\text{Body weight Gain (BWG)} = \frac{\text{Average final weight - average previous weight}}{\text{Total of days between weighings}} \quad (4)$$

Production cost (PC)

$$\text{PC (F CFA)} = \frac{\text{Cost of feed consumed}}{\text{Weight gain}} \quad (5)$$

Production costs include the cost of feed, veterinary products, labour, electricity and water. Electricity costs for pumping water from the borehole are estimated at F CFA 5,000 or F CFA 1,250 per treatment. The cost of veterinary products was around F CFA 8,800, or F CFA 1,760 per group over the trial period. Labour costs were determined based on the salary received by the pig farmer on the farm.

Data analysis

The experiment was laid out in a completely randomised design. Statistical analysis was performed using GraphPad Prism 8.0.1 (244). One-way ANOVA was used to evaluate the effects of methionine on production performance. Turkey test was used to test the difference of means, and the probability $p<0.05$ was considered the significance level. Results are presented as means plus the standard error of mean (M ± S.E.M).

RESULTS

Effect of methionine on production parameters

The feed consumption decreased with increasing dietary methionine supplementation and was significantly lower ($p<0.05$) in M0.75 and M1 treatments compared to the control group (Figure 2).

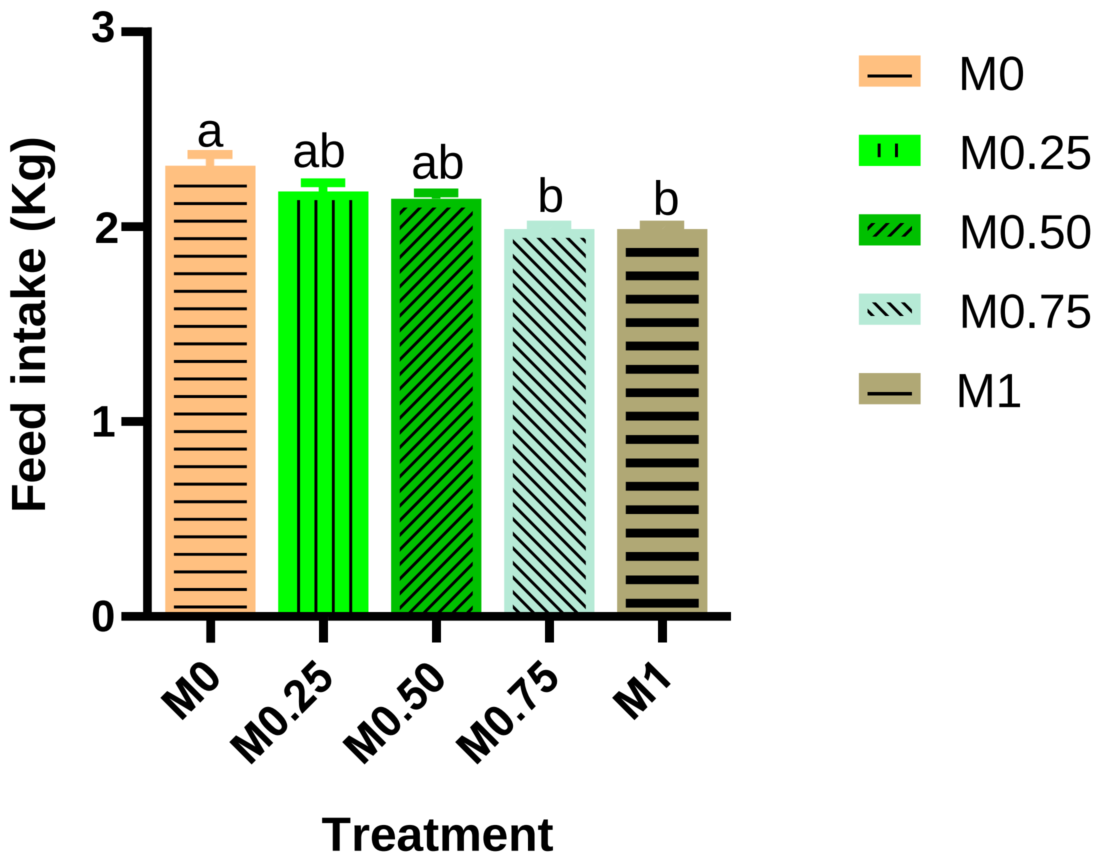

Figure 2 : Feed intake according to the treatment. At each age, means with different superscripts are significantly different (p<0.05).

The body weights increased within a narrow range without significant difference across the treatments from J0 to J15. However, from J30 onward, pigs of M0.5 showed an increasing tendency and had statistically higher values (p<0.05) than those of M1 but similar to M0, M0.25 and M0.75 (Figure 3). In terms of body weight gain, pigs in M0.50 had significantly higher values ($p<0.05$) compared to M1 (Figure 4). As regards the feed conversion ratio, pigs in M1 had higher values ($p<0.05$) than those of M0.75 but were statistically similar to M0, M0.25, and M0.50 treatments (Figure 5).

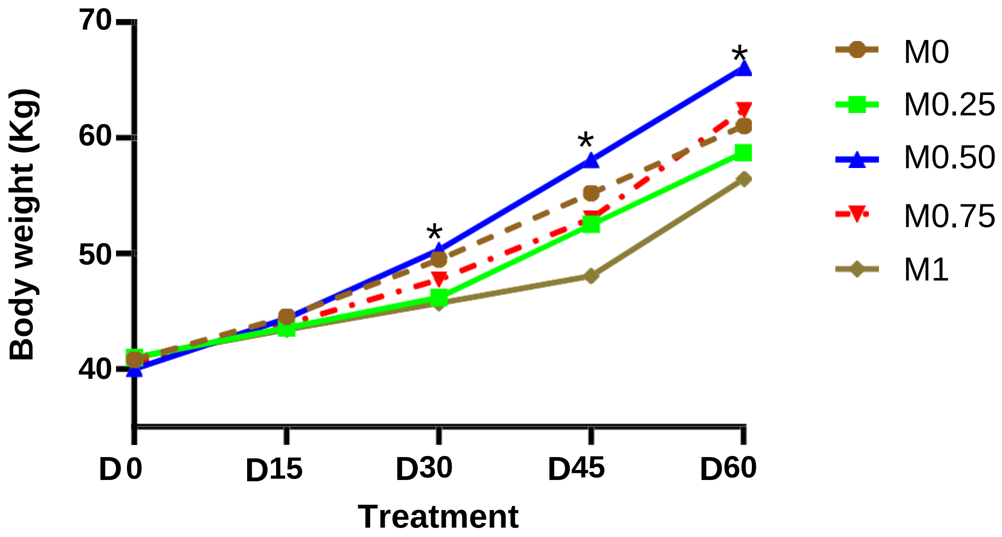

Figure 3 : Body weight according to the treatment and age. At each age, significant differences are indicated by *($p<0.05$)

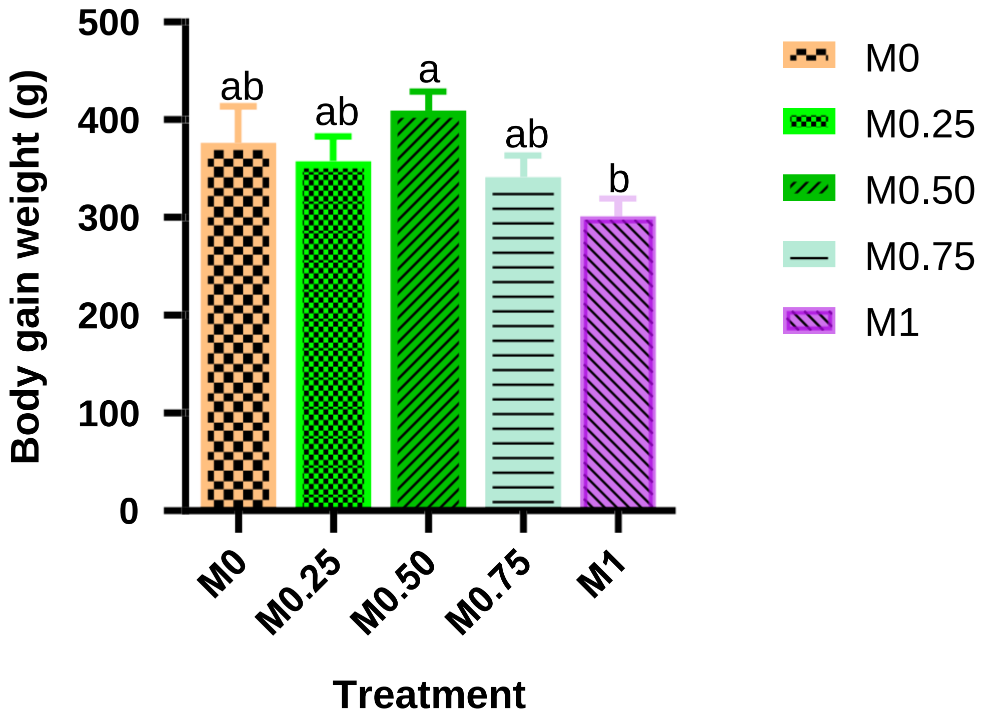

Figure 4 : Body gain weight according to the treatment. At each age, means with different superscripts are significantly ($p<0.05$).

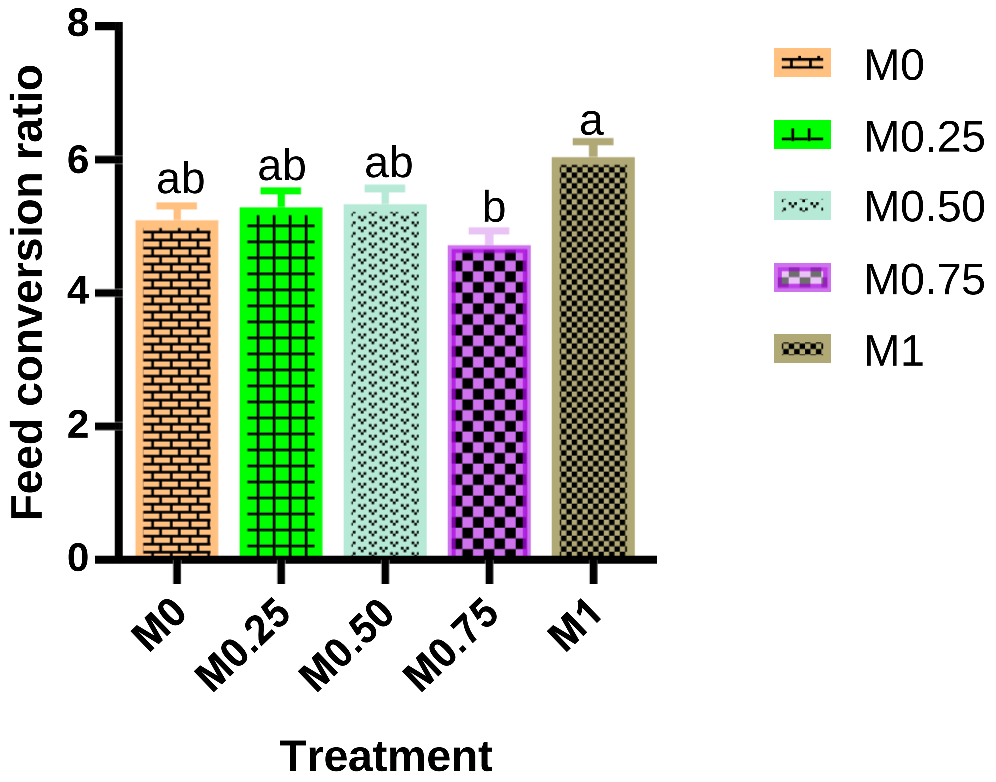

Figure 5 : Feed conversion ratio. At each age, means with different superscripts are significantly (p<0.05).

The body dimensions of the pig in the different treatments and their correlated with weights, varied according to the periods of measurements (Tables 2, 3, 4 and 5).

Table 2: Changes in pig back length (BL)

Age	Treatment				
	M0	M0.25	M0.50	M0.75	M1
J0	88.25 ± 1.78	90.38 ± 3.56	87.25 ± 2.01	85.25 ± 2.73	89.50 ± 1.18
J15	93.25 ± 0.95	97.63 ± 2.67	95.25 ± 1.75	96.13 ± 1.80	97.50 ± 1.77
J30	98.75 ± 1.93	101.37 ± 3.14	99.13 ± 1.29	98.88 ± 1.67	102.50 ± 1.32
J45	102.00 ± 2.65	107.53 ± 2.48	103.5 ± 2.78	106.50 ± 1.56	108.88 ± 1.49
J60	107.47 ± 2.65	110.75 ± 2.48	108.25 ± 2.17	109.15 ± 1.56	112.62 ± 1.50

Table 3: Changes in thoracic perimeter in pigs (TP)

Age	**Treatment**				
	M0	**M0.25**	**M0.50**	**M0.75**	**M1**
J0	81.50 ± 1.40	77.20 ± 3.20	82.50 ± 1.18	80.25 ± 1.76	79.55 ± 1.65
J15	84.63 1.30	81.50 ± 2.40	86.00 ± 0.98	86.88 ± 1.36	81.75 ± 1.03
J30	86.75 ± 1.52	85.25 ± 1.85	87.00 ± 1.10	91.13 ± 1.14	85.25 ± 1.11
J45	92.50 ± 1.27ab	90.00 ± 1.80ab	91.50 ± 1.39ab	97.38 ± 0.94a	87.00 ± 1.08b
J60	96.32 ± 1.44ab	94.13 ± 1.00ab	95.63 ± 2.22ab	101.75 ± 1.37a	90.19 ± 1.24b

Table 4: Change in height at withers of pigs (HW)

	Treatment				
	M0	M0.25	M0.50	M0.75	M1
J0	56.25 ± 0.75	54.38 ± 1.05	57.38 ± 1.49	58.13 ± 1.64	54.25 ± 1.10
J15	59.75 ± 1.03	57.75 ± 1.35	62.25 ± 1.30	61.50 ± 1.18	60.50 ± 1.20
J30	62.50 ± 0.65	61.25 ± 1.42	66.63 ± 1.13	65.25 ± 1.08	63.75 ± 0.75
J45	65.34 ± 1.11	65.25 ± 0.90	69.63 ± 0.73	70.13 ± 1.13	66.63 ± 1.18
J60	69.50 ± 0.72	67.38 ± 0.68	72.50 ± 0.57	73.50 ± 0.68	70.38 ± 1.02

Table 5: Correlation coefficients between weight and each body dimension

Parameter	**Treatment**					**Correlation**
	M0	**M0.25**	**M0.50**	**M0.75**	**M1**	
Weight	51.20	50.90	55.80	52.10	46.92	
BL	97.94	101.53	98.68	99.18	102.2	0.727
TP	88.34	85.62	91.48	88.53	84.75	0.915
HW	62.67	61.20	65.68	65.70	63.10	0.882

Production Costs

The low production costs per kilogram of body weight were 1240.32 francs CFA and 1268.93 francs CFA in M0.50 and M0.75 group, respectively (Table 6).

Table 6: Evaluation of production cost per kilogram of live weight

Treatment

Parameter	**M0**	**M0.25**	**M0.50**	**M0.75**	**M1**
Feed quantity (kg) **(A)**	139.20	130.80	128.40	118.80	115.20
Unit cost (F CFA) **(B)**	165.00	173.75	182.50	191.25	200.00
Feed cost (F CFA) **(C)**	22 968.00	22 726.50	23 433.00	22 720.50	23 040.00
Weight gain (Kg) **(D)**	20.23	19.73	26.04	24.89	18.43
Veterinary products **(E)**	1 760.00	1 760.00	1 760.00	1 760.00	1 760.00
Labour **(F)**	5 850.00	5 850.00	5 850.00	5 850.00	5 850.00
Electricity and water costs **(G)**	1 250.00	1 250.00	1 250.00	1 250.00	1 250.00
Cost of production per kg live weight (FCFA) **(C+E+F+G)/D**	**1 573.70**	**1 601.34**	**1 240.32**	**1 268.93**	**1 731.34**

DISCUSSION

The aim of the present study was to evaluate the effect of dietary methionine supplementation on the production performance of pigs growing with an average body weight of around 41.09 ± 7.08 kg. The varied effects on the different parameters evaluated in the current study have demonstrated that methionine supplementation reduced feed consumption in pigs. This result

can be attributed to the energy level of the feed. Indeed, methionine is rich in energy and its supplementation could increase the energy value of feed. This observation is in agreement with the findings of Beaulieu et al.[13], who showed that feeding diets rich in energy reduced feed consumption. Similarly, Rerat et al. [9] reported that an increase in LD-Met from 0.15% to 0.3% in the diet reduced feed intake. Although feed consumption was higher in M0 compared to M0.75 and M1 pigs, body weights and weight gain showed no significant difference between these three treatments. In addition, the lowest feed conversion ratio was obtained in M0.75. These results could be explained by the fact that a part of the methionine is transformed into cysteine, which could reduce feed consumption without leading to a proportional reduction in weight gain [14].

The weights recorded at D15 are similar to those obtained by Albert [15]. At D30, pig weights in M0.50 and M1 showed different variations from those observed by Albert [15]. This could be explained by the fact that the pigs consumed sufficient feed and had time to digest a large quantity of feed. However, the low body weights and weight gains obtained in M1 may be due to the toxic effect of the high methionine content in the diet. This toxicity could be due to the ingestion of excessive quantities of methionine. These results are similar to those of Edmonds and Baker [16], who demonstrated that methionine is one of the most toxic indispensable amino acids in pigs and the addition of 2% of free DL-methionine to a diet containing 20% total nitrogenous matter significantly reduced feed intake and weight gain.

The body weight gain obtained in all the treatments over the entire trial period was lower compared to the BWG of Lougnon [7]. Pigs obtained the highest GMQ in M0.50 in the present study. Our results are similar to those obtained by Rerat et al. [9], who also observed a significant difference in BWG when a complex diet supplemented with DL-methionine was tested in pigs. These similar results may be linked to the source of the methionine used.

The different body parts measured on the pigs are correlated with average weight. The coefficients of 0.915 for thoracic perimeter and 0.882 for height at withers are lower than those observed by Delate and Babu [17]. Of the fourteen body dimensions Delate and Babu [17] considered, chest and back length had the best correlation, whereas our results showed chest circumference and height at the withers.

Overall, the present results showed that chest circumference remained the best body dimension and was strongly linked to pig weights. The results of the thoracic perimeter at the end of the trial, which varied from 90.19 ± 1.24 cm to 101.75 ± 1.37 cm in the present study were higher than those observed by Albert [15] on local pigs in Burkina Faso. These results are in agreement with the work of Somenutse et al. [18], who showed that the best indicator of weight is chest circumference. In the current study, changes in the increase in thoracic circumference were observed according to the different growth phases of the pigs. This could be due to the levels of methionine used in the diet, as the differences were significant.

The increase in length and height observed in this trial was not a consequence of the variation of methionine in the diet, as the differences was not significant either among the different growth phases of the same treatment or the different treatments. The production costs per kilogram body weight of the different treatments obtained in the present study were strongly linked to the feed conversion ratio and body weight gain.

The best cost was obtained in M0.50 pigs (1240.32 F CFA). This cost was comparable to that of M0.75 (1268.93 F CFA) but different from those of M0, M0.25, and M1 treatments. The selling price was 1,200 CFA francs per kilogram of live weight. These results indicate that it is currently difficult to make pig production profitable, given the inflationary trend in input prices in the face of the stagnation of the sale price of pigs. It is then necessary to sufficiently reduce the feed cost or increase the selling price per kilogram of live weight for better profitability.

CONCLUSIONS

The present study showed that methionine supplementation has different effects on the productive performance of growing pigs. In addition to reducing feed consumption, it also improves feed conversion ratio. Our result showed that a high level (1%) of dietary methionine supplementation affects body weight and, therefore, productive costs. Breast circumference in M0.75 was the best body dimension during the trial. The economic evaluation of methionine supplementation revealed that the best production costs were obtained in M0.50 and M0.75 groups. The technical-economic evaluation shows that methionine can, therefore, be supplemented up to 0.75% in pig feed without adversely affecting growth performance.

CONFLICT OF INTEREST

We certify that there is no conflict of interest with any author

FUNNDING

None

ACKNOWLEDGEMENT

The authors are thankful Mr. Bêhèma Cyrille LETAABA, the General Director of the CARREFOUR farm, for having accepted us, offering a favorable framework and for having made available to us the material and financial means for the smooth running of the internship.

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