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

ABSTRACT

Context : The presence of lysine in the feed ration of pigs optimizes their growth rate and feed efficiency. **Objective** : This study was to evaluate the effect of lysine supplementation on the production performance of weaned piglets. **Methods** : A total of 120 Large White weanlings were subjected to four treatments (L0.95, L1, L1.15, and L1.3) with four replicates. Animals in batches L0.95, L1, L1.15 and L1.3 were fed a base ration supplemented with 0.95%, 1%, 1.15% and 1.3% lysine, respectively. 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 that live weight and feed intake were statistically similar for all batches; however, batch L1 gave the best feed intake index and average daily gain compared to the other batches. The strongest correlation was observed between weight and chest circumference. Economic evaluation revealed that the best production costs were found in batches L1 and L1.15. **Conclusion** : Lysine supplementation at 1% in the diet resulted in better production and economic performance in large white piglets. **Implications** : Lysine is a limiting factor in the growth of weaned pigsand it will be strongly recommended to breeders.

Keywords : Lysine, genetics, growth, piglets

INTRODUCTION

Pigs are reared all over the world. In rural areas, in particular, many families own a small number of pigs, which they let roam freely and use for family consumption. There are also pig farms in peri-urban areas, which contribute to the population's food supply. In the context of strong demographic growth in most African countries, pork offers many advantages in areas where religious prohibitions do not prevent its consumption. To effectively help reduce poverty and the shortage of meat products, it is important to improve the production of short-cycle animals, particularly pork (Faye, 2001). This is a species with a short reproduction and production cycle, high prolificacy and the ability to make the most of a wide range of diets (Missohou et al., 2001). The contribution of the livestock sub-sector represents 16.56% of agricultural GDP, and pig rearing in Togo is practised by 21.1% of farm households (FAO, 2017).

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Several factors influence pig growth, including feed. It represents the most costly item in pig breeding, accounting for 60 to 80% of production costs (Somenutse et al., 2022). The availability of new free amino acids on the market makes improving animal performance possible. Lysine is the most limiting essential amino acid in pig feeds, and the other limiters are methionine, threonine and tryptophan (Henry, 1988). However, pig diets are generally based on maize and soya; moreover, cereals such as maize are generally low in lysine, while legumes such as soya are low in methionine. Protein resources such as fishmeal and soya face competition for feed with other livestock or scarcity, leading to higher prices (Hamidou et al., 2021). Fishmeal, especially that available in Togo and the sub-region, is also of dubious quality, limiting its use by livestock farmers (Attivi, 2017).

Due to these challenges, some studies have shown the possibility of using lysine and methionine in their free state for supplementation with improved performance in pigs (Lougnon, 1970). Thus, for an amino acid such as lysine, extreme levels of deficiency or excess adversely affect feed intake and growth (Goodband and Nelssen, 1990). Those studies as references have been conducted to determine the limit of lysine supplementation in weaner piglet diets; however, very few data exist in tropical environments, particularly in Togo. In this context, our study was initiated to assess the effect of lysine supplementation in the diet on the genetic growth performance of weaned piglets.

MATERIALS AND METHODS

Study area

This study was carried out at the Farm named "CARREFOUR" at Agamahè (Latitude: 06°43'12.39" North, Longitude: 01°10'46.92" East), Gamé canton (Figure 1). Agamahè is located on National Road N° 1, in the Zio district, about 70 km north of the city of Lomé (Maritime region) in Togo. The area has a sub-equatorial Guinean climate with four seasons (02 rainy seasons and 02 dry seasons). The main rainy season covers the period from March to mid-July and the short rainy season, the period from mid-September to November (Seme et al., 2015). Average annual rainfall ranges from 800 to 950 mm. Average annual temperatures range from 27 °C to 30 °C (Agbodan et al., 2020).

Experimental animals

One hundred and twenty 10 weeks-old weaned piglets from a Large White sow x boar cross, including 40 females, 40 whole males and 40 castrated males with an average live weight of 10.77 ± 0.42 kg, were selected from the herd. The 120 piglets were then divided into four (04) batches of six (06) subjects each: 2 castrated males, 2 whole males and 2 females. Each batch was repeated four times. Each batch is associated with a treatment such as:

- Treatment L0.95: diet supplemented with 0.95% lysine ;
- Treatment L1 : diet supplemented with 1% lysine ;
- Treatment L1.15 : diet supplemented with 1.15% lysine ;
- Treatment L1.3: diet supplemented with 1.3% lysine.

These treatments were based on the updated methodology of Lougnon (1969). All the pigs underwent a two-week acclimitization period with each experimental formula.

Experimental Pigsty

The 32-stall barn was completely covered with galvanized sheet metal. All experimental pens are cleaned every morning before feeding. Troughs and drinkers are made in cement inside.

Experimental feed

Various local ingredients were used in the feed formulation (Table 1).

Veterinary care

The animals were subjected to preventive treatment during the pre-trial phase and a month after starting the experiment. The veterinary products used were: (i) Intermectin at a dose of 1 ml per subject; (ii) Teroxylin 20% LA at a dose of 2 ml per subject; (iii) Vit AD3E 300 INJ at a dose of 2 ml per subject.

Data collection

Measurements such as animal weight and body dimensions (thoracic perimeter: TP, back length: BL, height at withers: HW) were taken throughout the experiment (D0, D15, D30, D45 and D60). All these data were collected in the morning, just after cleaning and before feeding.

Parameters

Daily individual feed consumption (DIFC)

$$\text{DIFC (kg)} = \frac{\text{Supplied feed} - \text{Remaining feed}}{\text{Number of pigs}} \qquad (1)$$

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Average Live Weight (ALW)

$$\text{ALW (kg)} = \frac{\sum \text{pigs weight from a treatment}}{\text{Number of pigs}} \quad (2)$$

Feed comsumption index (FCI)

$$\text{FCI} = \frac{\text{Quantity of food consumed over a period of time}}{\text{Weight Gain during the same period}} \quad (3)$$

Average Daily Gain (GMQ)

$$\text{GMQ (g)} = \frac{\text{Average weight of last weighing - average weight of previous weighing}}{\text{Number of days between weighings}} \quad (4)$$

Production cost (PC)

$$\text{PC (F CFA)} = \frac{\text{Feed intake cost}}{\text{Weight gain}} \quad (5)$$

Production costs include feed, veterinary products, labour, electricity and water. Electricity was used for pumping water, estimated at 5,000 F CFA, or 1,250 F CFA for each batch. The charge for veterinary products amounts to 8,800 F CFA or 1,760 F CFA per batch throughout the experiment. Labour costs are based on the salary received by the pig farmer. For a salary of 35,000 F CFA/month to maintain 120 pigs, the labour to maintain the 40 pigs over two months is estimated at 5,850 F CFA.

Statistical analyses

The experiment was organized according to a completely randomized design. Data were analyzed using GraphPad Prism 8.0.1 (244) statistical software, using the ANOVA one-way test for analysis of variance. Means were compared using the TUKEY test, and the probability $p<0.05$ was taken as the significance threshold. Results are presented as means plus or minus the standard error on the mean (M ± S.E.M).

RESULTS

Effects of lysine on production performance

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The average daily feed consumption per subject showed no general variation in lysine levels over the experimental period (Figure 2). With regard to feed conversion rates, a significant difference was observed between batches L0.95; L1.3 and L1; L1.15 (Figure 3). Live weight was statistically identical in all batches (Figure 4). With regard to GMQ, lot L1 was statistically superior ($p<0.05$) to lot L0.95; however, no significant difference was obtained between lot L0.95 and L1.3, or between lot L1 and L1.15 (Figure 5).

Body dimensions

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

Production cost

Supplementation with 1% lysine gave the best production cost (867.49 F CFA). On the other hand, the highest production cost was obtained with lot L0.95 (1,191.70 F CFA) (Table 6).

DISCUSSION

This study assessed the effect of lysine supplementation on the production performance of weaned piglets. It was found that supplementation did not affect feed intake. This may be linked to the energy balance of the different feed rations formulated. These results corroborate those of Kendall et al. (2008) on the commercial validation of true digestible lysine requirements in pigs from 11 to 27 kg. However, these results differ from those obtained by Millet et al. (2017), who showed a decrease in feed intake when lysine supplementation exceeded 0.98%. The average live weight of piglets at the start of the experiment, 10.77 ± 0.42 kg, is similar to that obtained by Lougnon and Brette (1971), Gaudré et al. (2007) and Kendall et al. (2008) in their work. The GMQ obtained over the entire trial period is similar to those reported by Millet et al. (2017). These similar results may be linked to the source of the lysine used.

However, our ADGs are low compared with those obtained by Aherne and Nielsen (1983). This difference may be linked to the low protein content and low energy content of the feed. The better growth obtained in piglets of batch L1 coincides with the results of Henry (1993), who obtained the best growth performance in piglets with 1% lysine supplementation. In contrast, Chauvel and Granier (1999) found better growth performance with 1.15% lysine supplementation. This may be explained by the fact that they raised their animals to 40 kg live weight, whereas the live weight of our animals at the end of the experiment was 28 kg. Similarly, Aherne and Nielsen (1983) achieved rapid growth by supplementing piglets with

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1.15% lysine. The availability of lysine can explain the better growth performance of treatments L1 and L1.15. This is the reference amino acid for improving digestibility and nutrient absorption (Bourdon and Henry, 1985).

However, the low live weights and GMQ obtained with batch L1,3 may be explained by the excessive use of lysine, which would have resulted in an antagonistic action with other amino acids, leading to adverse effects on growth performance. For example, Goodband and Nelssen (1990) have shown that excess lysine utilization antagonizes arginine and adversely affects piglet growth performance. The best consumption index obtained in our study is higher than that of Aherne and Nielsen (1983) and Millet et al. (2017); this could be explained by the difference between the breeds used.

The various body parts measured on the piglets showed a strong correlation with average weight. The coefficient of 0.91 obtained for the thoracic perimeter is higher than that found by Delate and Babu (1990) overall (0.85) on Creole pigs in rural Haiti. Of the fourteen body dimensions considered in their study, chest circumference and back length gave the best correlation, which agrees with our results. These results corroborate the work of Faarungsang and Chantsawang (1982), who showed that irrespective of genetic type, chest circumference has the strongest correlation with live weight, followed by back length and height at withers. The best predictability of weight by chest circumference was also reported by Somenutse et al. (2019) on local pigs in Togo.

CONCLUSION

The study on the effect of lysine supplementation in the diet on the genetic growth performance of weaned piglets produced several results. Supplementing piglets' diets with 1% lysine improved average daily gain, feed conversion ratio and cost of production. However, it did not affect feed consumption and average live weight for the different treatments over the entire experimental period. The technical-economic evaluation shows that lysine can be used at 1% as a feed supplement in piglets without compromising their growth performance. Chest circumference remains the best variable for predicting body weights.

DATA AVAILABILITY STATEMENT

The data used to generate the results in the paper are available at my level.

Disclaimer (Artificial intelligence)

Option 1:

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Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

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FIGURES

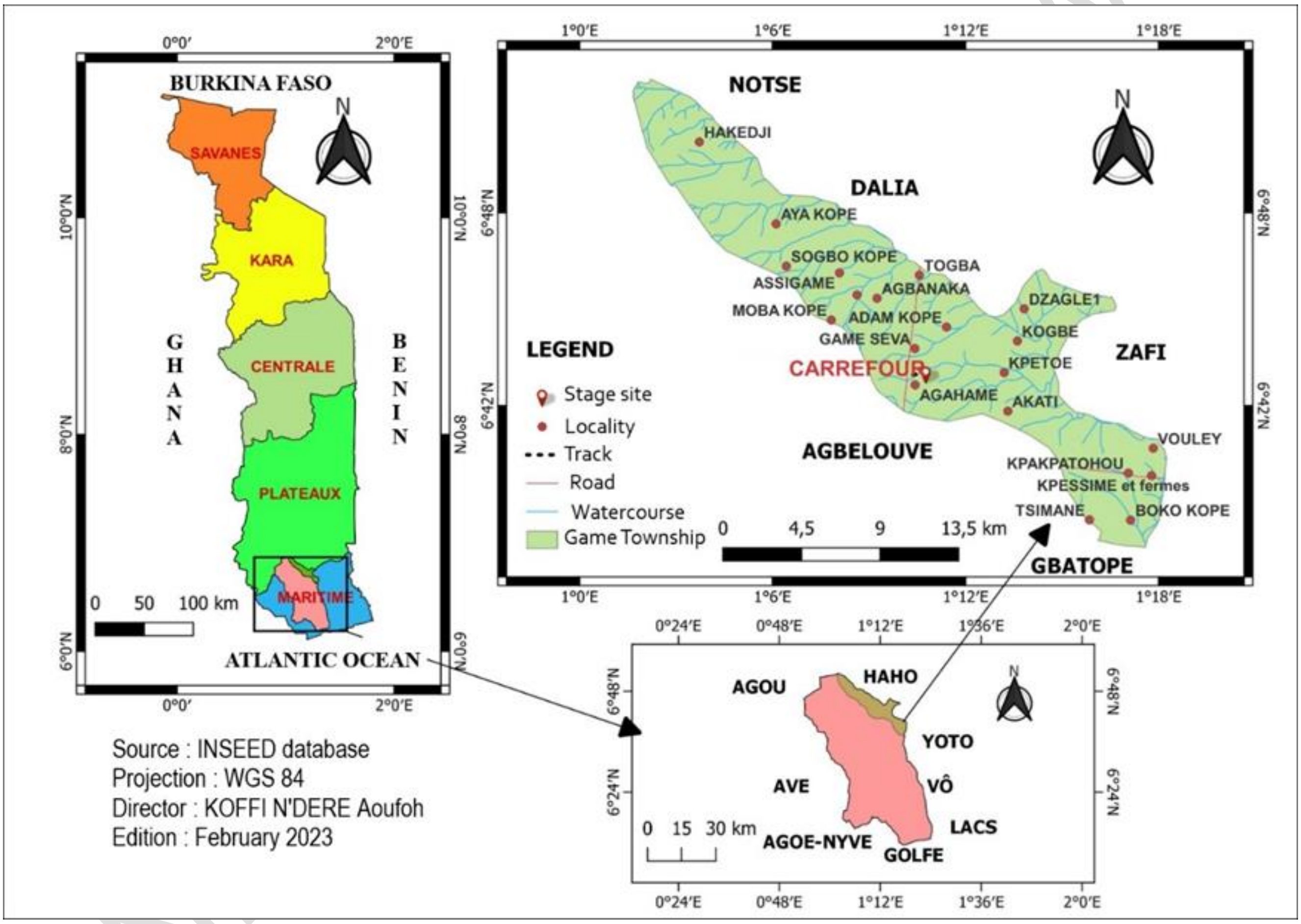

Figure 1 : Study area

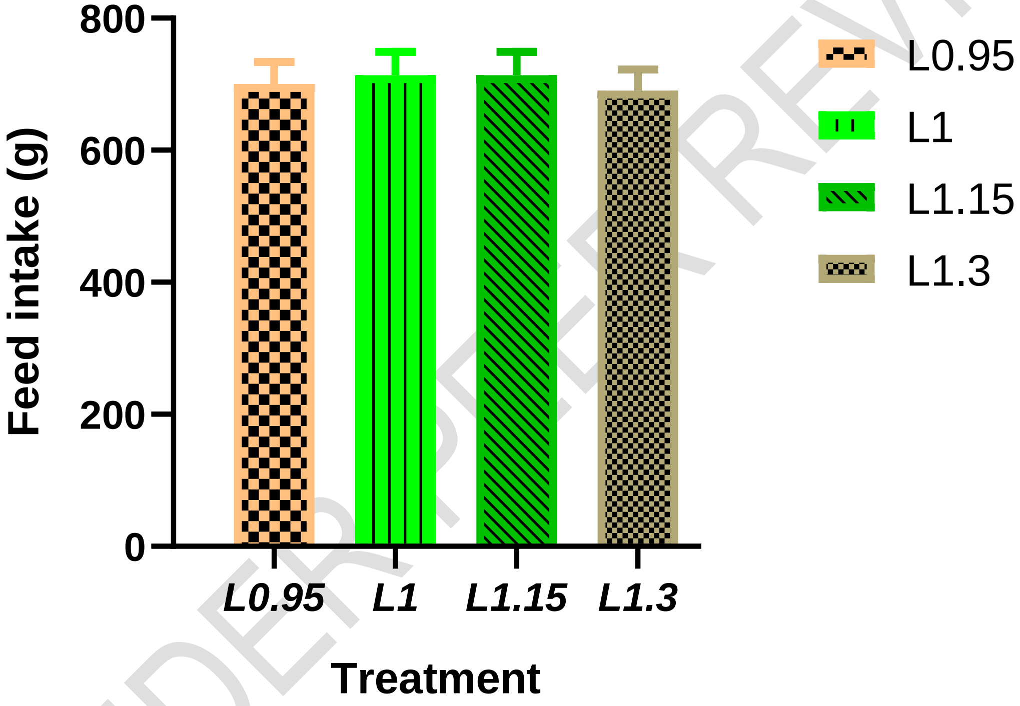

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Figure 2: Food consumption of piglets according to treatments

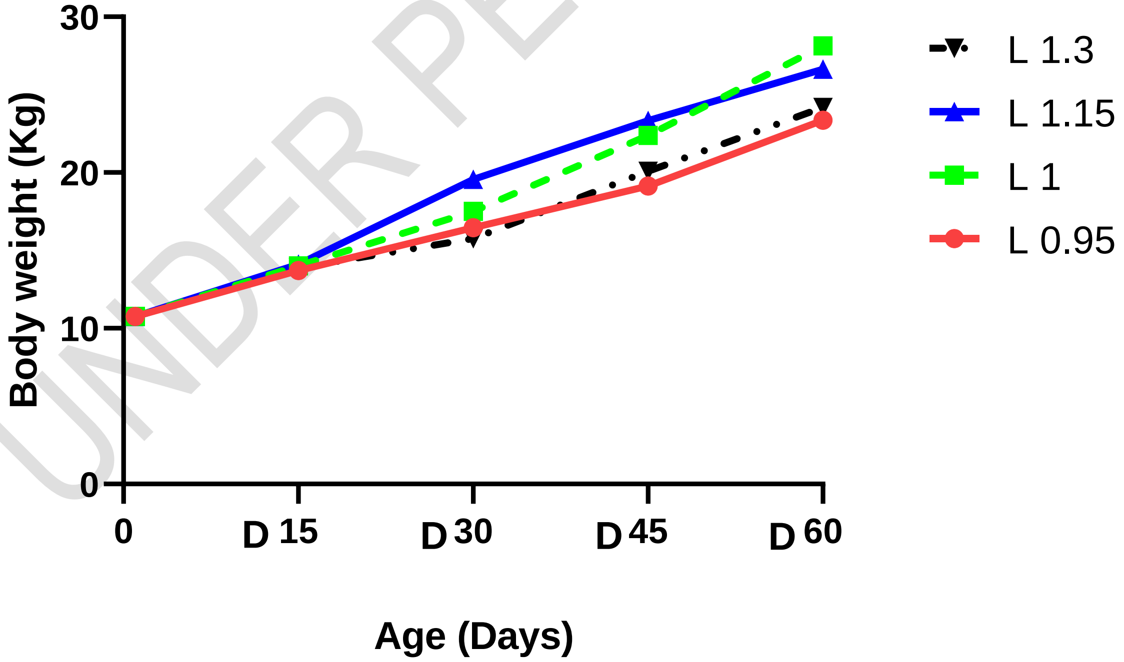

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Figure 3: Body weight according to treatments

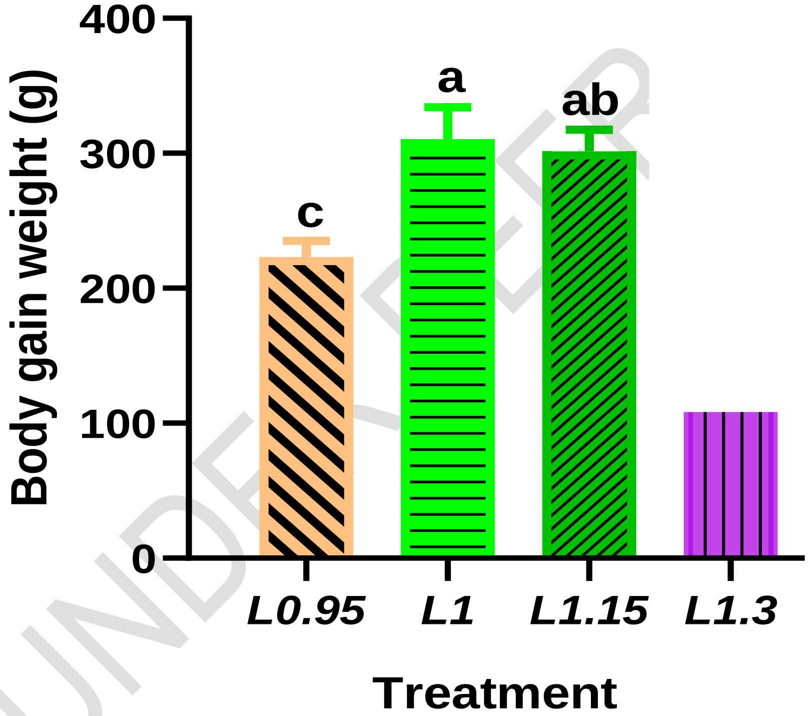

Figure 4: Average daily gain of piglets according to treatments

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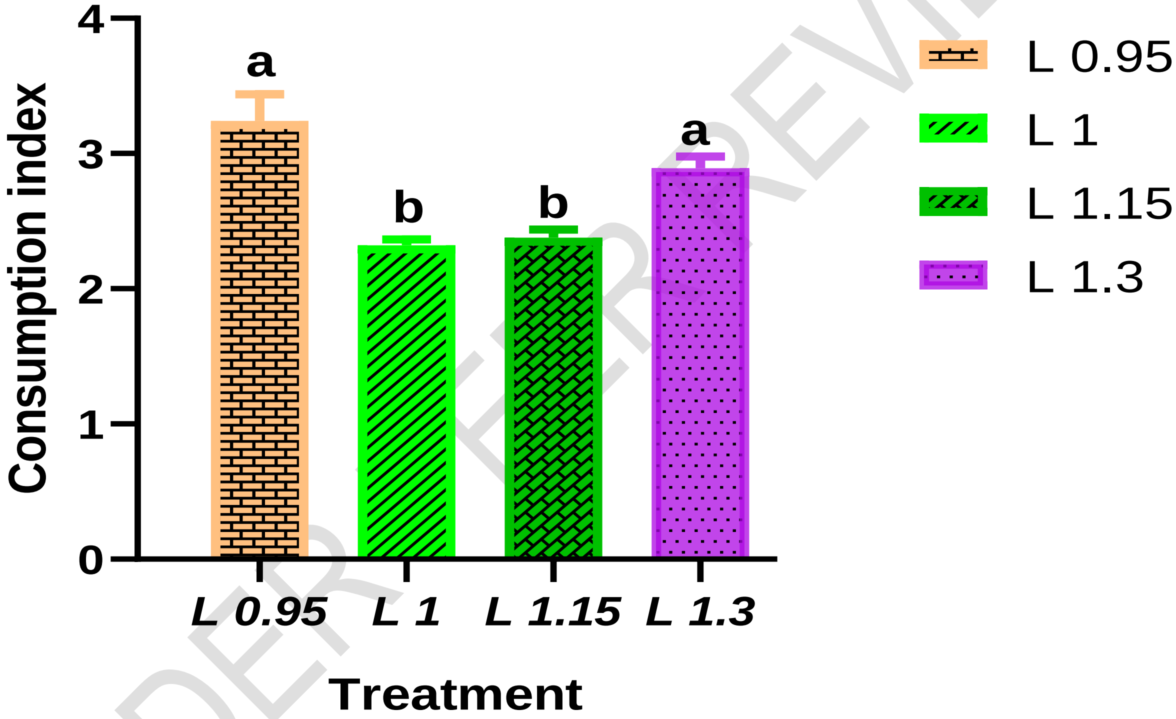

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Figure 5: Variation of consumption index according to treatments

TABLES

Table 1: Feed composition

Raw materials	**Witness**	**Lysine-based ration**			
	L0	L0.95	L1	L1.15	L1.3
Maize	43.5	43.5	43.5	43.5	43.5
Rice bran	6	6	6	6	6
Wheat bran	6	6	6	6	6
Soya	16	16	16	16	16
Cotton cake	5	5	5	5	5
Palm kernel cake	12	12	12	12	12
Beer spent grains	10	10	10	10	10
Lysine	0	0.95	1	1.15	1.3
Shell	1	1	1	1	1
Salt	0.5	0.5	0.5	0.5	0.5
TOTAL	**100**	**100.95**	**101**	**101.15**	**101.3**
Bromatological values of rations					
DE porc kcal / kg	3124.5	3171.7	3174.2	3181.6	3189.1
Crude protein (%)	18.1	19.01	19.05	19.2	19.35
Crude Cellulose (%)	7.3	7.3	7.3	7.3	7.3
Lysine (%)	0.7	1.54	1.58	1.7	1.81
Methionine (%)	0.3	0.3	0.3	0.3	0.3
Methionine + cystine (%)	0.5	0.5	0.5	0.5	0.5

Table 2: Piglet back length trends (BL)

	Batch				
Age	**L0.95**	**L1**	**L1.15**	**L1.3**	**Sign.**
J1	55.83 ± 0.70	61.00 ± 2.52	59.00 ± 0.82	60.00 ± 2.05	0.197
J15	60.33 ± 0.99	64.50 ± 1.88	62.83 ± 0.54	63.33 ± 1.50	0.188

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J30	63.50 ± 0.76	68.83 ± 2.21	67.33 ± 0.56	65.50 ± 1.48	0.075
J45	66.00 ± 0.63	70.17 ± 2.06	69.67 ± 0.56	69.00 ± 1.81	0.199
J60	67.50 ± 0.76	71.33 ± 1.89	72.50 ± 0.67	69.67 ± 1.75	0.092

Tableau 3 : Evolution of piglet thoracic perimeter (TP)

	Batch				
Age	**L0.95**	**L1**	**L1.15**	**L1.3**	**Sign.**
J1	59.33 ± 0.80	56.50 ± 2.73	53.67 ± 2.32	56.67 ± 2.39	0.366
J15	61.33 ± 0.76	59.33 ± 2.86	59.67 ± 1.17	58.67 ± 1.69	0.757
J30	62.50 ± 0.67	61.83 ± 3.08	63.33 ± 1.02	61.00 ± 1.92	0.848
J45	64.00 ± 0.86	67.00 ± 3.11	67.67 ± 0.67	64.33 ± 1.99	0.446
J60	66.33 ± 1.02	70.67 ± 2.82	72.00 ± 1.07	67.50 ± 2.08	0.155

Tableau 4 : Piglet height at withers (HW)

	Batch				
Age	**L0.95**	**L1**	**L1.15**	**L1.3**	**Sign.**
J1	39.00 ± 0.45	39.67 ± 1.76	38.67 ± 0.49	37,50 ± 0,50	0.476
J15	42.33 ± 0.67	42.67 ± 1.38	42.50 ± 0.85	42,33 ± 1,41	0.996
J30	45.83 ± 0.31	44.00 ± 1.10	45.67 ± 0.49	44.50 ± 0.81	0.257
J45	48.17 ± 0.48	46.67 ± 0.96	47.17 ± 0.60	46,33 ± 0,96	0.388
J60	49.67 ± 0.33	48.83 ± 0.60	49.67 ± 0.42	47.67 ± 0.99	0.120

Table 5: Correlation coefficients between weight and various body dimensions

	Lot batch				
Variables	**L0.95**	**L1**	**L1.15**	**L1.3**	**Correlation**
Weight	16.21	18.86	18.25	17.75	
TP	62.7	63.07	63.27	61.63	0.91
BL	62.63	67.17	66.27	65.5	0.89

HW	45	44.37	44.73	43.67	0.81

Table 6: Estimated production cost per kilogram of live weight

Variables	Batch			
	L0.95	**L1**	**L1.15**	**L1.3**
Quantity of feed intake (kg) **(A)**	29.54	30.10	30.11	29.16
Cost per unit (F CFA) **(B)**	269.00	270.00	275.00	279.00
Feed cost (F CFA) **(C)**	7 946.26	8 127.00	8 280.25	8 135.64
Weight gain (kg) **(D)**	12.50	17.38	16.89	13.42
Veterinary products **(E)**	2 200.00	2 200.00	2 200.00	2 200.00
Labor cost **(F)**	3 500.00	3 500.00	3 500.00	3 500.00
Electicity and water bills **(G)**	1 250.00	1 250.00	1 250.00	1 250.00
Production Charge or Cost of kg (F CFA) **(C+E+F+G)/D**	1 191.70	867.49	901.73	1 124.12

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