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ORIGINAL RESEARCH ARTICLE

Effects of Graded Inclusion Levels of Eleusine indica Seeds on Growth Performance and Feed Utilization of Indigenous Chickens

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ABSTRACT

With the increasing cost of conventional feed ingredients, this study evaluated the potential of Eleusine indica seeds as an alternative feed resource for native chickens (Gallus gallus domesticus). Nutritional analysis revealed that Eleusine indica seeds contain a high level of dietary fiber (37.1%) and essential minerals, but exhibit a moderate metabolizable energy (ME) content of 2355 kcal/kg of dry matter. An eight-week feeding trial was conducted using 57 indigenous chickens randomly assigned to four experimental diets containing graded inclusion levels of Eleusine indica seeds (0%, 10%, 20%, 40%) in indigenous chickens. The experimental diets were formulated to achieve comparable crude protein contents but were not isoenergetic, as the objective was to evaluate the nutritional and zootechnical effects of increasing levels of Eleusine indica seed incorporation under practical feeding conditions. Growth performance parameters, including feed intake, average daily gain (ADG), and feed conversion ratio (FCR), were monitored. The diet containing 10% Eleusine indica seeds yielded the highest growth performance, with an ADG of 17.4 g/day, exceeding that of the control diet. However, higher inclusion levels (20% and 40%) led to reduced growth; this limitation is primarily attributed to the elevated crude fiber content and the resulting decrease in energy density of the diets, which hindered efficient nutrient assimilation. The 10% inclusion level resulted in higher feed intake and average daily gain, although feed conversion ratio did not differ significantly among dietary treatments ($p > 0.05$). These results indicate that moderate incorporation of Eleusine indica seeds (10%) may represent a promising feeding strategy to enhance the productivity of indigenous chickens while promoting the utilization of locally available feed resources.

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1. INTRODUCTION

In Madagascar, traditional poultry farming, particularly the rearing of indigenous chickens—plays a crucial role in both food security and rural development across many regions. Although these birds exhibit slower growth rates compared with imported breeds, they are distinguished by their hardiness and remarkable adaptability, traits that are especially valued in low-input production systems. Consequently, their conservation and promotion remain important priorities. According to Raoeliarisoa (2004), cited by Razafinarivo et al. (2021), indigenous chickens generally attain a live weight of approximately 900 g to 1 kg after five months of rearing, while hens typically begin laying eggs relatively late.

Feed represents a key determinant of productivity and economic profitability in indigenous poultry systems. In most cases, these chickens are reared under extensive management conditions and therefore rely heavily on the availability and quality of locally accessible feed resources, which directly influence their growth and productive performance (Gueye, 2000). However, access to conventional feed ingredients such as corn and soybean remains limited, primarily because of their high cost and the strong competition they face with human food consumption (Food and Agriculture Organization, 2018).

In this context, diversifying feed resources for local poultry represents a relevant and strategic approach. It aims not only to reduce dependence on imported feed ingredients but also to enhance the sustainability of poultry production systems through the valorization of underutilized local resources. Furthermore, this approach contributes to the preservation of biodiversity and the maintenance of the genetic diversity of indigenous chicken populations (Dal Bosco et al., 2021).
These considerations highlight the importance of exploring underutilized feed resources whose seeds possess nutritional characteristics capable of meeting the specific requirements of local poultry. In this context, the seeds of *Eleusine indica* (**Figure 1**), commonly known as goosegrass, represent a potential resource. This species is a widespread tropical grass frequently regarded as an agricultural weed (Randall, 2012). It is classified as a “serious weed” in at least 42 countries (Holm et al., 1979), particularly in annual row cropping systems, where it grows vigorously and produces large quantities of seeds.

The potential value of *Eleusine indica* seeds is assessed through a detailed analysis of their bromatological properties and an experimental evaluation of their effects on the zootechnical performance of indigenous chickens.
In this study, the bromatological characteristics of *Eleusine indica* seeds were determined in order to evaluate their nutritional potential as an unconventional feed resource for local chicken breeds. Subsequently, an experimental trial was conducted to assess the effects of incorporating different levels of these seeds into poultry diets on growth performance, ensuring the food's safety following monitoring of its acceptability, and analyzing the effectiveness of using the food. At the end of the experiment, the impact of dietary inclusion of *Eleusine indica* seeds was examined through a comparative analysis of zootechnical performance indicators, including live weight, average daily gain, feed conversion ratio, and feed efficiency.

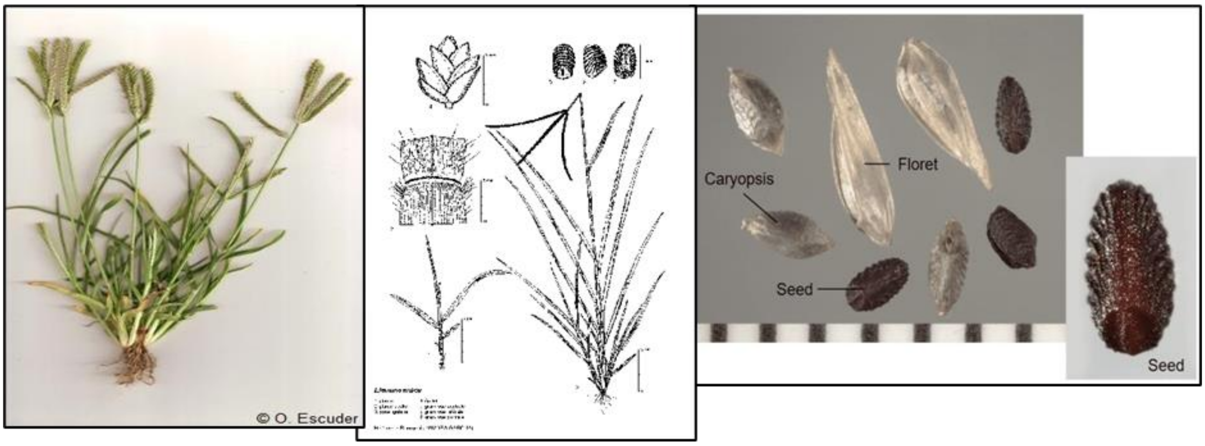

Fig. 1. Eleusine indica: plant, seeds, florets, and caryopses (Scale in mm)
Source: ISMA (2011); INPN (accessed January 24,2025)

2. MATERIALS AND METHODS

2.1 Biological material

At the start of the study, 80 chicks of the native Malagasy breed, aged two to three months, were evenly randomly divided into eight groups of 10 each. Before the experiment began, though, the animals went through an adaptation period to get used to their new housing environment as well as the experimental diet. This adaptation phase took place during the coldest days of winter, around 10 to 11°C, a high sensitivity to hypothermia, during which a fairly high mortality rate was observed. By the end of this period, only 57 birds, consisted of 30 males and 27 females, were still alive. To avoid any further disruption from redistributing the animals, the remaining numbers in each group were kept as they were at the start of the experiment. So, the groups were no longer even and consisted of between 6 and 8 chickens (which initial mean body weighed from 349 g to 534 g) depending on the case. The eight groups represent four diets, each performed done in duplicate.

It should be noted that the observed mortality occurred exclusively during the adaptation period, before the start of the experimental treatments. Therefore, the losses recorded cannot be attributed to the diets evaluated in this study, but are more likely related to the conditions of the adaptation phase, particularly the low winter temperatures, the stress associated with changing housing, and the chicks adapting to their new rearing environment. The numbers available at the end of this period thus made up the initial numbers for the experiment. Each group was housed in simple cages made with wooden frames and wire-mesh walls to ensure proper ventilation, and covered with bamboo roof to provide protection while maintaining good air circulation. Each cage measures 100 x 100 x 90 cm, which corresponds to a density of about 7 birds/m^2. During the winter period, these cages were heated with electric bulbs to provide a uniform heat source. In addition, a shared feeder and a waterer were set up in each breeding unit to ensure all the birds had equal access to food and drinking water.

2.2 Animal health and welfare management

The experiment was conducted through thanks the coordinated collaboration of three laboratory sections specializing in animal health, animal reproduction and genetics, and animal nutrition, which regularly collaborate on poultry experiments. Before the trial began, all chickens received the same traditional preparation made from *Ageratum conyzoides* as a routine preventive health treatment, commonly used by Malagasy farmers. The treatment was given consistently to all birds before feeding distribution to minimize potential health-related variations (Debray, 1975). In addition, to ensure better health control before the experiment, all the birds were vaccinated with Pestavia against Newcastle disease, Varavia against fowlpox, and Avichol against fowl cholera. Veterinary staff from the animal health section administered all preventive treatments and carried out daily health monitoring throughout the experiment. Daily observations included appetite, behavior, overall condition, and any clinical signs of illness. Newly hatched chicks and all health events were regularly recorded to ensure continuous health monitoring.

The staff from the animal reproduction and genetics section oversaw the housing facilities and general rearing conditions throughout the study to ensure proper management and animal welfare. No illness or death occurred during the eight-week feeding trial that followed. Birds showing serious clinical signs, inability to access food or water, or marked distress would have received immediate veterinary care and, if necessary, would have been removed from the study. However, no bird met these criteria; therefore, no humane euthanasia or early removal from the study was required.

2.3 Feed preparation and experimental diets

Eleusine indica seeds were manually harvested in April, at the start of the dry season, when the ambient temperatures were around 20 to 26 °C, in Madagascar, in the Analamanga Region, in the rural municipality of Talatavolonondry, specifically in the Fokontany of Mamoriarivo (the smallest administrative unit in Madagascar). After harvesting, the seeds were sun-dried in an open yard for several days until they reached a constant moisture level. The dried seeds were then stored in airtight containers at room temperature until the diets were formulated. The formulation of the experimental diets was done with the nutritional needs of poultry in mind, especially protein needs, which are essential for growth, muscle development, and production performance. To assess the effects of increasing the inclusion *of Eleusine indica* seeds, the diets were formulated with comparable crude protein levels while allowing metabolizable energy to to differ among diets according to ingredients composition. Five main ingredients were incorporated into the experimental rations:

Corn bran: This ingredient represents an important source of starch, providing highly digestible energy for chickens. It also improves the palatability of the ration, thereby promoting feed intake. Its inclusion level generally ranges from 30% to 60%, depending on nutritional objectives and its complementarity with other ingredients (National Research Council, 1994; Leeson et al., 2005).

Rice bran (fine): Widely available and relatively inexpensive, fine rice bran constitutes an economical and locally accessible ingredient for feed formulation.

Blood meal (beef): This low-cost ingredient provides a high-quality source of animal protein and is particularly rich in lysine while remaining highly digestible (VetAgro Sup, 2025). Its recommended inclusion level in poultry diets generally ranges between 5% and 10% (Janssen, 1985). Fresh bovine blood is collected from slaughterhouses, then cooked and steamed to eliminate potential pathogens and improve protein digestibility while reducing antinutritional factors (Khawaja et al., 2007). The dried product is subsequently ground to obtain a homogeneous meal suitable for incorporation into feed rations.

Fish residues: Fish by-products were incorporated to improve the overall protein supply. Their inclusion rate depends on both the composition of the residues and the nutritional requirements of the poultry, generally ranging between 5% and 10% (Janssen, 1985). Higher inclusion levels may result in undesirable effects, such as alterations in meat or egg flavor, nutritional imbalances, increased oxidation, and higher production costs.

Eleusine indica seeds: These seeds were incorporated into three experimental diets at inclusion levels of 10%, 20%, and 40%. The objective was to evaluate their acceptability by chickens and to determine the optimal incorporation threshold without causing adverse effects on health or growth. A control diet without Eleusine indica seeds was used as a reference for comparison.

The experimental diets, detailed in **Table 1**, were formulated to meet the nutritional requirements of growing indigenous chickens, with gradually increased levels of *Eleusine indica* seeds (0%, 10%, 20%, and 40%). To ensure the reliability and representativeness of the data, two replicates were carried out for each type of diet, with randomly selected samples. The corresponding experimental design is illustrated in **Figure 2**.

Table 1. Formulation of experimental diets (in %)

Ingredients	Control diet	Diet T10%	Diet T20%	Diet T40%
Corn bran	43%	33%	23%	13%
Rice bran	40%	40%	30%	30%
Eleusine indica	0%	10%	20%	40%
Blood meal	7%	7%	7%	7%
Fish residues	10%	10%	10%	10%
Total	100%	100%	100%	100%

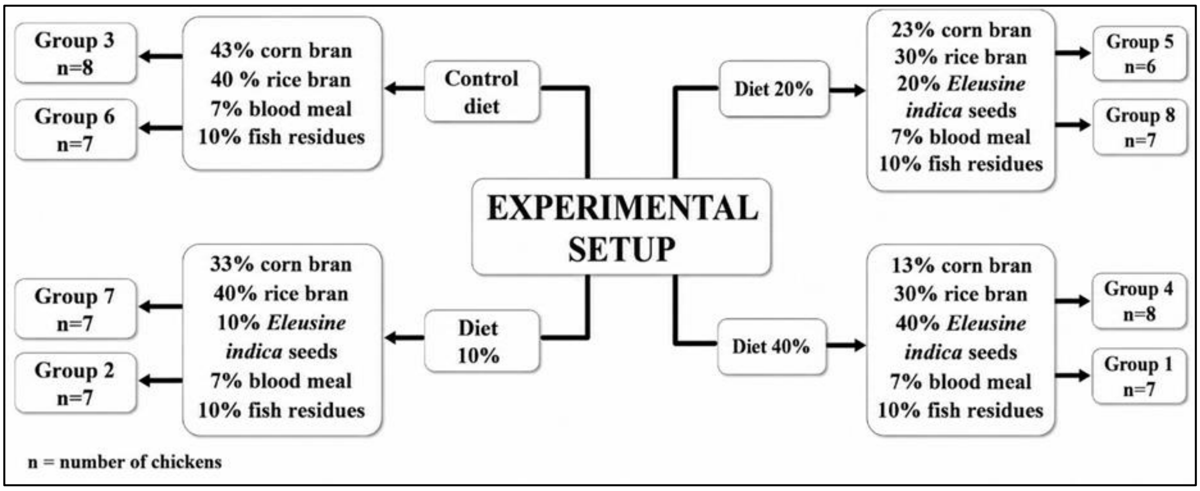

Fig. 2. Experimental setup

From hatching to 12 weeks of age, daily feed intake generally increases from approximately 40 g to 100 g per bird, depending on age and growth stage (Gadzirayi & Mupangwa, 2014). To ensure consistent intake while minimizing waste, a fixed daily ration of 100 g per bird was given throughout the experiment. The food was distributed twice a day, with 50 g in the morning (at 7:00 a.m.) and 50 g in the afternoon (at 4:00 p.m.), and clean drinking water provided *ad libitum* throughout the trial. Food was given twice daily, with 50 g in the morning at 7:00 a.m. and 50 g in the afternoon at 4:00 p.m., to ensure a regular and consistent feeding schedule.

2.4 Experimental protocol and measurements

The experimental feeding protocol followed common practices for poultry trials to ensure consistent intake and health (Aziz & Masoud, 2021). The chickens were housed in groups according to their respective treatments. Since the birds were raised in groups, food intake was measured at the group level. The average daily food consumption per bird was calculated by weighing the feed given and the leftovers daily, then dividing the amount consumed by the number of birds in each replicate. Live weights were recorded weekly using a precision electronic scale, and their health was monitored daily. The feed conversion ratio (FCR), a key economic parameter in poultry production, was calculated as the ratio between the amount of food consumed and the corresponding body weight gain (Aviagen, 2024; TECHNA Group, 2024).

2.4.1 Bromatological analyses

Bromatological analyses were carried out in a laboratory specializing in animal nutrition. The macronutrients (dry matter, crude protein, fats, starch, and ash) were determined using near-infrared spectroscopy (NIRS). Predictions were based on pre-existing calibration models developed for poultry feed matrices. These models showed strong predictive reliability, with cross-validation coefficients of determination (R^2cv) ranging from 0.85 to 0.96, standard errors of calibration (SEC) from 0.83 to 3.86, and standard errors of cross-validation (SECV) between 0.85 and 3.89. During this study, the spectra were acquired from local samples and processed using these established equations without additional recalibration. To ensure high accuracy, each sample was scanned 5 to 10 times in different spots, and the average value was kept after removing the outliers. Furthermore, calcium and phosphorus were analyzed using classic wet chemistry methods (AOAC, 2019). The metabolizable energy (ME) of the experimental diets was calculated using Sibbald (1980) prediction formula:

$$ME\ (kcal/kg\ DM) = 3951 + 54.4 \times Ft - 88.7 \times CF - 40.8 \times MM$$

Where: DM = Dry Matter; Ft = Fat; CF = Crude Fiber; MM = Mineral Matter

For comparative analysis, our results were compared to the findings reported by Conan and al. (1992), Abede & Aletor (2005), and Dahouda and al. (2009).

2.5 Ethics statement

At the time this study was conducted, no formal institutional animal ethics committee was available. Nevertheless, all procedures involving animals were carried out under the supervision of qualified veterinary staff and specialized laboratory members. Preventive care, daily monitoring of well-being, proper housing management, and veterinary supervision were maintained throughout the experiment to minimize stress and ensure animals' welfare.

2.6 Statistical analyses

All statistical analyses were carried out using Microsoft Excel and RStudio (version 2023.12.1). The cage (enclosure) was defined as the experimental unit for all performance parameters (ADG, feed intake, and FCR), since the birds were in groups. The data were analyzed using a one-way analysis of variance (ANOVA) to compare the average performance of the cages across the different diets. Normality of the data distribution was checked with the Shapiro–Wilk test. Differences between treatments were identified using Tukey's post hoc test, while the non-parametric Wilcoxon test was used when normality was not met. Significance was set at $p < 0.05$. Due to the constraints related to the experimental design and the limited number of replicates, performance was assessed by averaging responses over the entire duration of the trial rather than applying a repeated measures mixed model. This limitation is acknowledged, and it is recommended that future studies use larger sample sizes and repeated-measures mixed models to better examine temporal trends. Since body weight measurements were recorded at the group level rather than for each bird, comparisons between sexes were limited to a descriptive presentation and were not included in the inferential statistical analyses.

3. RESULTS AND DISCUSSION

3.1 Nutritional composition of Eleusine indica seeds

The results of the nutritional analyses of *Eleusine indica* seeds are presented in **Figure 3**. These values were compared with those of commonly used reference cereals, wheat, corn, barley, and rice, as well as with alternative protein-rich crops such as *Amaranthus hybridus hypochondriacus* and *Mucuna pruriens*.

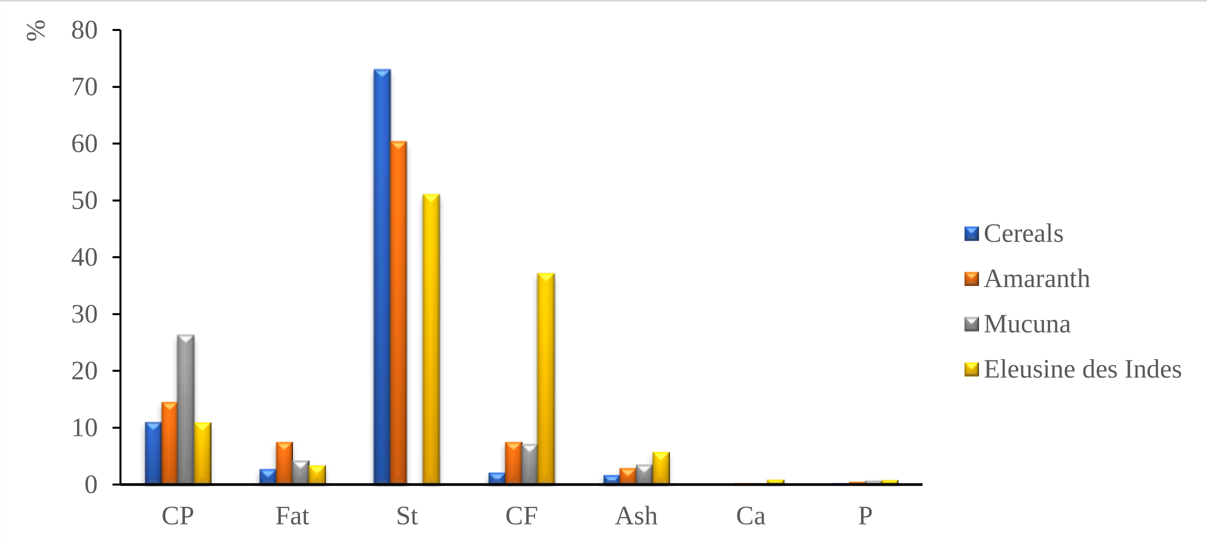

Fig. 3. Comparison of the nutritional value of *Eleusine indica* with that of amaranth, mucuna and common cereals (average of wheat, corn, barley and rice) *Source: Ritchie, 1979; Rakotomanana, 2010; Razafinarivo et al, 2021; Dahouda et al, 2009*

The bromatological analysis of *Eleusine indica* seeds revealed an exceptionally high fiber content of 37.1%, markedly higher than that of the other cereals evaluated. Although less rich in protein than *Mucuna pruriens* (26.3%), *Eleusine indica* has a protein content of 10.9%, comparable to that of reference cereals (~11%), and its fat content (3.4%) was also comparable to that of conventional grains (Ritchie, 1979; Dahouda et al., 2009)

On the other hand, its carbohydrate content (51%) remains relatively moderate, offset by a remarkable richness in dietary fiber. In addition, *E. indica* seeds are distinguished by their high mineral content, particularly ash (5.7%), calcium (0.9%), and phosphorus (0.8%), giving this cereal a particularly interesting nutritional profile. These characteristics make *Eleusine indica* a potential source of fiber and minerals, particularly calcium, complementing the cereals traditionally used in animal feed. A comparative analysis of the metabolizable energy (ME) value of different cereals (**Figure 4**) showed that the *Eleusine indica* seeds contain 2355 kcal/kg DM, which is lower than that of maize or sorghum, confirming that *E. indica* should be considered primarily as a source of fiber and minerals rather than energy. Similar observations were reported by Conan et al. (1992) and Abede & Aletor (2005), who highlighted the relatively low energy density of unconventional feed resources. This nutritional characteristic may partly explain the reduced growth performance observed at higher inclusion levels.

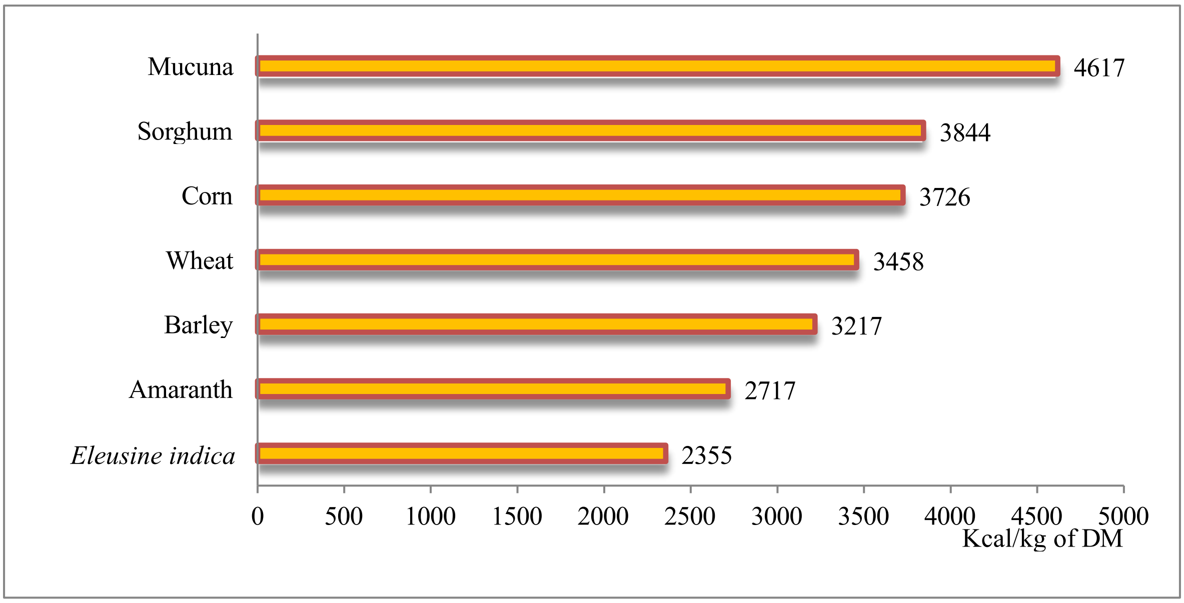

Fig. 4. Comparison of the metabolizable energy (ME) content of Eleusine indica with that of other cereals (Mucuna, sorghum, corn, wheat, barley, and amaranth) *Source: Conan et al, 1992; Abede & Aletor, 2005; Dahouda et al., 2009*

3.2 Nutritional analysis of experimental diets

Table 2, which presents the energy and nutritional values of the various food components, highlights the functional complementarity of the ingredients used in the formulation of the experimental diets, each playing a specific role in the ration. *Eleusine indica* seeds are distinguished by an exceptionally high proportion of crude fiber (CF: 37.1%**)**, the highest among all the ingredients analyzed. They also have a significant mineral content, particularly calcium (0.67%), and phosphorus (0.81%). These characteristics position *Eleusine indica* more as a source of fiber and minerals than as a major source of energy or crude protein (CP: 10.9%). In contrast, blood meal and fish residues serve as the main protein concentrates in the diets, with crude protein contents of 89.2% and 20.0%, respectively, thereby meeting the protein requirements essential for poultry growth. Fish residues additionally provide significant mineral content, including calcium (6.56%) and phosphorus (3.26%), contributing to the overall mineral balance of the feed. Corn bran and rice bran form the energy base and the bulk of the diets. Rice bran, in particular, offers a considerable amount of phosphorus, further improving the mineral balance of the formulation.

Overall, these findings indicate that the inclusion of *Eleusine indica* seeds introduces a nutritional dilution effect due to their high fiber content. To compensate, the proportion of other ingredients with higher energy and protein density must be adjusted to ensure that the nutritional requirements of growing indigenous chickens are adequately met.

Table 2. Chemical composition of diet components (in %DM)

Parameter	*Eleusine indica*	Corn bran	Rice bran	Blood meal	Fish residues
DM	92.3	85.3	93.1	94.2	88.4
CP	10.9	8.3	13.6	89.2	20.0
FC	3.4	8.7	7.9	0.8	2.3
CF	37.1	-	7.6	-	-
Am	51	32.4	27.3	-	-
MM	5.7	6.1	10.6	7	24.2
Ca	0.67	0.05	0.15	0.50	6.56
P	0.81	0.55	1.64	0.26	3.26
IA	0.3	0.2	1.4	5	5.8

DM: Dry Matter; CP: Crude Protein; FC: Fat Content; CF: Crude Fiber; Am: Amylose; MM: Minerals; Ca: Calcium; P: Phosphorus; IA: Insoluble Ash

Table 3 presents the nutritional composition of the experimental diets. Analysis of these diets revealed that crude protein (CP) content was highest in Diet 3, which contained 20% *Eleusine indica* seeds, reaching 17.9%.

Conversely, fat content (FC) decreased progressively with increasing levels of *Eleusine indica* inclusion, declining from 8.9% in the control diet to 5.7% in Diet 3. This reduction contributes to a lower overall energy density of the rations, underscoring the diluting effect of *Eleusine indica* on dietary energy intake. This trend is consistent with the findings of Rakotomanana (2010), who reported that incorporating alternative seeds such as amaranth leads to a dilution of dietary energy due to their lower lipid content.

Table 3. Chemical composition of experimental diets (in % DM)

Parameter	T0%	T10%	T20%	T40%
DM	89.9	88.2	89.0	89.3
CP	15.1	15.3	17.9	15.8
FC	8.9	7.0	5.7	5.9
CF	11.8	17.9	17.8	19.3
NDF	37.3	45.1	50.3	50.8
ADF	15.5	20.6	22.9	24.6
ADL	4.6	6.6	6.8	5.7
Am	17.9	15.6	14.6	16.8
MM	12.8	14.7	15.4	14.5
Ca	0.38	0.21	0.55	0.91
P	0.37	0.63	0.30	0.47
IA	6.6	11.5	9.9	9.6
DMD	61.6	46.5	46.3	51.0
OMD (%OM)	65.5	46.8	48.7	53.6

T0%: Diet 1 without *Eleusine indica*; T10%: Diet 2 with 10% ; T20%: Diet 3 with 20% ; T40%: Diet 4 with 40% ; DM: Dry Matter; CP: Crude Protein; FC: Fat Content; CF: Crude Fiber; NDF: Neutral Detergent Fiber; ADF: Acid Detergent Fiber; ADL: Acid Detergent Lignin; Am: Starch; MM: Minerals; Ca: Calcium; P: Phosphorus; IA: Insoluble Ash; DMD: In vitro Enzymatic Digestibility of Dry Matter; OMD: In vitro Enzymatic Digestibility of Organic Matter; OM: Organic Matter.

Digestibility data confirmed the diluting effect of *Eleusine indica* seeds on the nutritional value of the rations. Specifically, the digestibility of dry matter (DMD) and organic matter (OMD) decreased in diets containing *Eleusine indica*, with Diet 3 exhibiting the lowest values (DMD = 46.3%; OMD = 48.7%). Furthermore, the inclusion of *Eleusine indica* also affected the mineral composition of the diets: Diet 4 showed a notable increase in calcium (0.91%), while Diet 2 exhibited the highest phosphorus content (0.63%). Metabolizable energy (ME) for each diet was calculated using an equation incorporating lipid, crude fiber, and mineral content. The results, presented in **Figure 5**, illustrate the combined effects of increasing fiber concentration and mineral content on dietary energy density of the experimental rations. This compositional analysis indicates that increasing *Eleusine indica* inclusion levels elevates fiber and mineral content but reduces energy density and digestibility, emphasizing the need to balance diets with energy- and protein-rich ingredients when formulating feeds for optimal growth.

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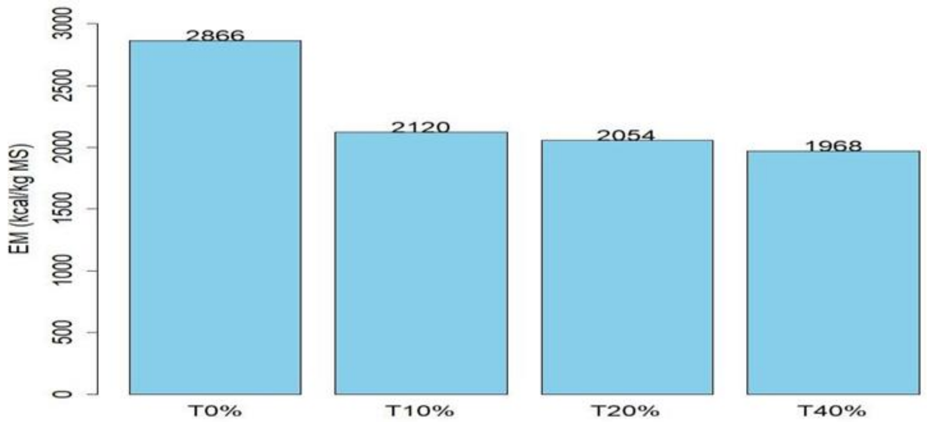

Fig. 5. Metabolizable Energy content of the different diets (in kcal/kg DM)

Reducing the energy density of the rations, along with increasing the levels of *Eleusine indica* seeds, led to a gradual drop in metabolizable energy (ME). The control diet (0% *Eleusine*) had the highest ME value at 2866 kcal/kg DM, while ME decreased to 2120, 2054 and 1968 kcal/kg DM with higher levels of *Eleusine indica* incorporation.

This reduction in ME is mainly attributable to the high fiber content of *Eleusine indica* seeds, including crude fiber (CF), neutral detergent fiber (NDF), and acid detergent fiber (ADF), which went from 11.8% in Diet 1 to 19.3% in Diet 4. While a moderate level of fiber can support gut health, too much fiber reduces the overall digestibility of feed, limiting the energy available for growth. These results are consistent with earlier studies by Kane (1990), Buldgen et al. (1992), and Mateos et al. (2012), which reported that high levels of dietary fiber reduce nutrient availability and hinder poultry growth. Also, although anti-nutritional factors were not measured in this study, their presence in unprocessed *Eleusine indica* seeds, as documented by Apata (2006), could be a limiting factor in nutrient use.

3.3 Zootechnical performance and feed efficiency

At the end of the eight-week rearing period, the zootechnical performances of the local chickens, especially changes in live weight, were recorded. The results are shown in **Figure 6**, highlighting the effects of different levels of *Eleusine indica* seed on growth performance and feed efficiency.

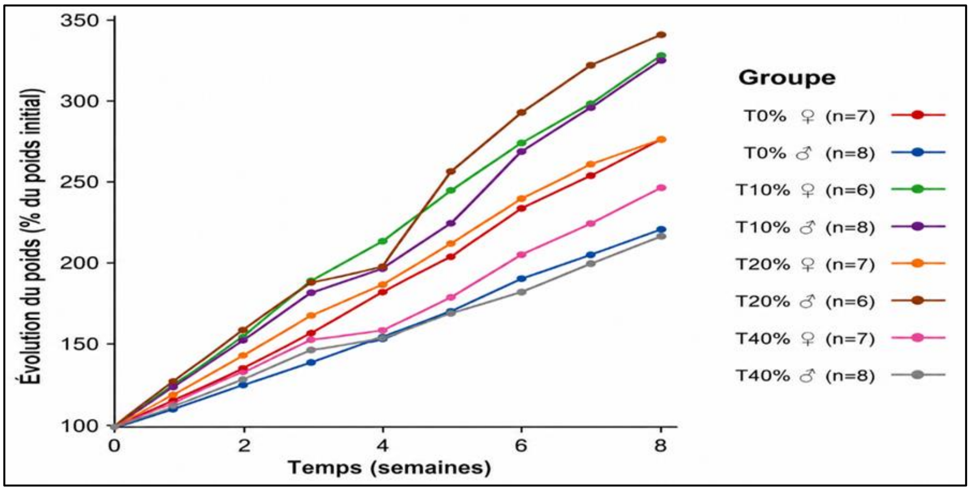

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Fig. 6. Relative change in chicken weight according to diet and sex over an eight-week period

The analysis of live weight changes over the eight-week of the trial showed a significant effect of diet on growth performance. Among the experimental diets, the one containing 10% *Eleusine indica* (T10%), which represents a moderate inclusion level, was linked to the highest weight gain, matching the greatest food intake observed in this group. However, these results should be considered within the context of this study. On the other hand, higher inclusion levels (20% and 40%) were associated with reduced growth performance, likely due to increased fiber content and decreased energy availability. Similar results were reported by Ravindran & Blair (1992), who showed that excessive use of alternative feed ingredients can negatively impact poultry performance. Overall, the results suggest that including 10% of *Eleusine indica* could support growth under the experimental conditions of this study, regardless of sex.

Food efficiency was assessed using the amounts of food given and the leftovers not eaten to calculate the Feed Conversion Ratio (FCR). This index, derived from weekly consumption and weight gain data, allows comparison of how efficiently different diets are used. The FCR values and Average Daily Gain (ADG) over the entire eight-week experimental period are summarized in **Table 4**.

Table 4. Zootechnical performance of chickens by diet

Diet	T0%	T10%	T20%	T40%	p-value
Consumption (g)	1687 ± 535^{b}	2239 ± 341^{a}	1755 ± 241^{b}	1650 ± 306^{b}	$p < 0.05$
Weight gain (g)	720 ± 100^{b}	853 ± 199^{a}	576 ± 186^{bc}	561 ± 152^{c}	$p < 0.05$
ADG (g/day)	13.7 ± 152^{ab}	17.4 ± 3.4^{a}	12.7 ± 3.5^{b}	10.7 ± 2.8^{b}	$p < 0.05$
FCR	2.4 ± 0.7^{a}	2.8 ± 0.9^{a}	3.4 ± 1.3^{a}	3.3 ± 1.6^{a}	$p > 0.05$

g: gram; Averages with the same exponent are not statistically different ($p > 0.05$)

The average food consumption was highest for the T10% diet (2239 g), followed by T20% (1755 g), T0% (1687 g), and T40% (1650 g). This pattern is reflected in weight gain, which was highest for T10% (853 g), showing a clear positive effect of this diet on growth, while the lowest gain was observed for T40% (561 g). Average Daily Gain (ADG) follows the same trend: T10% reached 17.4 g/day, followed by T0%, T20%, and T40%. These results suggest that increasing dietary fiber and reducing available energy hinders nutrient absorption, thus limiting growth in native chickens.

An overall average daily gain (ADG) of 13.6 g/day corresponds to the typically slow growth of native chickens, as described by Kassambara (1989). The observed variations in adult weight according to sex and rearing conditions are consistent with the results reported by Bélot & Hardouin (1981) and Fotsa (1985). Additionally, genetic factors, such as the presence of the dwarfism gene, can contribute to physiological limitations affecting the growth performance of these birds (Fotsa, 2008). **Figure 7** presents a descriptive comparison of the average daily gain (ADG) between male and female native chickens for the four feeding regimes. Regarding the effect of sex, **Figure 7** shows numerical variations between males and females without any clear trend. Sex does not appear to be the predominant factor influencing growth in this study, unlike the inclusion rate of the seeds. These observations are consistent with the work of Fotsa (2008), which highlights that growth variability in local chickens is more closely related to genetic factors than to sex during this phase.

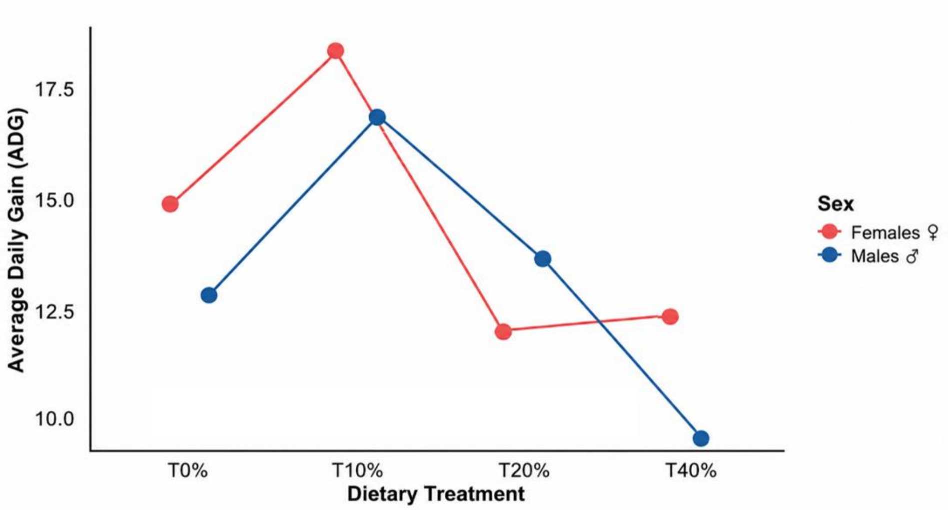

Fig. 7. Descriptive comparison of average daily gain (ADG) between male and female indigenous chickens across the four dietary treatments

3.4 Comparison of Feed Conversion Ratio (FCR)

The feed conversion rate (FCR) did not differ significantly between the diets ($p > 0.05$). Therefore, no evidence of improved feed efficiency related to the inclusion of *Eleusine indica* was observed under the conditions of this study.

CONCLUSION

This study showed that *Eleusine indica* seeds have potential nutritional value and could be considered as an alternative food ingredient for indigenous chickens. However, their high fiber content may reduce the metabolizable energy of diets when included at higher levels. Among the experimental diets, the results suggest that a 10% inclusion rate could be a suitable option under the conditions of this study, as it was associated with the highest food intake and the greatest average daily gain. Higher inclusion levels (20% and 40%) were linked to reduced growth performance, which could be related to lower energy availability and higher dietary fiber content.These findings suggest that a moderate incorporation of *Eleusine indica* seeds could contribute to a better use of locally available feed resources in village chicken production systems. However, this study should be considered a preliminary feeding trial conducted under the specific conditions described herein. Therefore, further studies involving larger sample sizes, nutritionally balanced diets, and greater experimental replication are required to validate these findings and to assess the effects of this ingredient on meat quality, long-term performance, and economic outcomes.

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CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest.

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DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author.

ETHICAL APPROVAL

All procedures involving animals were conducted in accordance with institutional animal welfare guidelines of the National Center for Applied Research in Rural Development (FOFIFA).

AI/LLM USE DISCLOSURE

AI/LLM tools were used for literature searches, gathering background information, and rephrasing/editing certain sentences for clarity and language improvement. All content was reviewed, verified, and fully approved by the authors, who take complete responsibility for the manuscript.

AUTHOR CONTRIBUTIONS

N.A.R. Conceptualization, methodology, investigation (animal feeding trials), data curation, formal analysis, writing and original draft. **O.R.R.** Investigation (animal feeding trials and observations), data curation. **O.F.M.** Investigation (animal feeding trials). **A.R**. Investigation (animal feeding trials). All authors: writing, review, editing, validation and approval of the final manuscript.

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