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Impact of Partially Replacing Corn with Ground Pea (*Vigna subterranea*) on Broiler Chicken Performance and Profitability

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Abstract: ***Rising feed costs pose a challenge to poultry farming, prompting exploration of affordable alternatives like ground pea (Vigna subterranea) to replace corn. This study assessed the effects of substituting corn with 10% and 20% ground pea in the diets of 45 Arbor Acres broiler chicks, compared to a corn-only control. Over 35 days, we measured live weight, daily gain, feed conversion, and consumption, finding significant improvements (p<0,0001) with ground pea diets. Feed intake dropped as ground pea levels rose, while a 20% substitution cut production costs by 13, 31%. These results suggest that partial corn replacement with ground peas enhances both zootechnical performance and farm profitability, offering a practical solution for broiler production in resource-limited settings.***

Keywords: Broiler, substitution, ground peas, Madagascar, profitability

1. Introduction

The poultry sector continues to develop and industrialize in many regions of the world. In 2015, global poultry production reached 114.8 million tons, according to FAO estimates [1] and poultry farming contributes significantly to the fight against poverty in developing countries [2]. In addition, it is a solution to meet the ever-increasing demand for animal protein for many countries in tropical regions and particularly in Africa [3]. Despite this socio-economic importance, poultry farming faces many constraints that hinder its development [4]. Among these obstacles, feeding represents a major constraint due to the gradual increase in the price of inputs for food, which leads to low productivity in poultry farms [5]. This problem has led to a decrease in farmers' profits and increased their vulnerability. The increase in production costs has led researchers to develop alternative resources that are available locally and at a lower cost. In order to reduce the use of corn, which is very variable in price depending on the season, other raw materials of plant origin have been the subject of research in chicken feed. These are ground peas, soybeans, cowpeas, *Mucuna*, fava beans and *Azolla* [6], [7], [8]. Among these local food resources, the use of ground peas (*Vigna subterranea*) is interesting due to its richness in nutritional value such as protein, essential amino acids, vitamins and mineral salts [9], [10], [11]. Its use in poultry feed in Burkina Faso does not have negative effects on food consumption and promotes good growth of the animal [12]. Ground peas are used by some breeders in Madagascar in other animal breeds, but without scientific precision well determined from the point of view of quantity used and the yield obtained. The general objective of this study is to analyze the effectiveness of partial substitution of corn by ground pea (*Vigna subterranea*) in the zootechnical performance and profitability of the broiler farm. This research is significant as it offers a sustainable, locally sourced feed option that could alleviate economic pressures on small-scale poultry farmers while meeting growing protein demands.

2. Materials and methods

2.1 Study site

The study is carried out in the Village of Ambohimpihaonana in the Sub-Urban area of Betafo. The Commune is part of the Vakinakaratra Region. It is located between 46°51’ and 23°22’ West longitude; 19°50’ and 18°26’ South latitude and is located 22 km west of the city of Antsirabe. It is a high altitude city located more than 1400 m above sea level. According to the climatic characteristics, Betafo enjoys a sub-humid climate with an annual rainfall between 1000 mm and 1500 mm, a slightly cold temperature below plus or minus 5°C. The tropical climate of altitude marked by two distinct seasons: the hot and rainy season from October to April and the dry and cool season from May to September favors field activities. This type of climate favors the emergence of very flourishing types of agricultural activities in Betafo. The fields are always cultivated, the off-season no longer exists because the alternation of irrigated crops and off-season crops explains this agricultural dynamism [13]. The test is carried out for 35 days of breeding from July 3 to August 6, 2023.

2.2 Characteristics of the inputs used

Table 1: Food composition of each diet

	Growing phase (11-21th day)

Raw material	Control	T1	T2
Corn (%)	55	45	35
Ground peas (%)	0	10	20
Peanut cake (%)	10	10	10
Concentrate CD16 (%)	35	35	35
Concentrate CCF16 (%)	0	0	0
Total (%)	100	100	100
	Finishing Phase (22-45th day)		
	Control	**T1**	**T2**
Corn (%)	59	49	39
Ground peas (%)	0	10	20
Peanut cake (%)	9	9	9
Concentrate CD16 (%)	0	0	0
Concentrate CCF16 (%)	32	32	32
Total (%)	100	100	100

GP: Ground pea, T1: Treatment with diet containing 10% ground pea, T2: Treatment with diet containing 20% ground pea, Control: treatment with diet without ground pea.

The manufacture of feed was carried out one week before the arrival of the chicks. The raw materials (dry corn grain, dry ground pea grain *Vigna suberranea*, peanut cake, PSA concentrate / CD16 for growth and CCF16 for finishing) were broken using a grinding machine. The ground peas were roasted before grinding to eliminate the antinutritional factors they contain. Ground peas were roasted at 120°C for 20 minutes. Then, the raw materials were mixed to obtain a homogeneous composition, in accordance with the established food formulas (**Table 1**). The mixing was carried out as follows: the raw material in greater quantity was spread on a clean and smooth cemented floor, then the other ingredients were added gradually, in decreasing order of quantity. The mixture obtained was granulated using a machine.

2.3 Equipment and livestock building

The livestock is kept in a brick wall building with cemented coating, floor with paving, sheet metal roof, pine wood ceiling. The room was equipped with a window and a door for ventilation and daylighting. This building had a surface area of 12 m^2 which was divided into three lots. Each lot has a surface area of 4 m^2 identical for groups of animals measuring 2 m x 2 m. The brooding circle was enlarged according to the growth of the subjects. The lots are separated by cardboard walls. Each lot had a homemade coal heating equipment made of clay, a homemade feeder built of pine wood, a plastic drinker and a thermometer.

2.4 Experimental device

A test was carried out to test the effect of partial substitution of corn by ground peas. The study used the "Completely Randomized Block" device. It involved 45 unsexed *Arbor acres* strain chicks, randomly divided into 3 batches corresponding to the number of treatments that are differentiated by the amount of ground peas contained in each prepared diet. Each batch had 15 subjects considered as the number of repetitions. Batch T1 received a diet containing 10% ground peas. Batch T2 was treated with a ration containing 20% ground peas. The control batch was fed with a diet without ground peas whose corn was not replaced. The chickens were raised in controlled conditions, with permanent food and water at will.

2.5 Data collection

All chickens were weighed at the beginning of the trial and every 10 days. Average consumption and average weekly weight gains were noted in order to determine the average consumption indices.

2.6 Calculation of the zootechnical parameters considered

To estimate the growth of broiler chickens, the following different zootechnical parameters were calculated: Average daily gain, Consumption index and Average daily consumption by the following relationships:

1) Average Daily Consumption (ADC)

$$ADC = \frac{QFD - QFR}{n} \quad (1)$$

ADC: Average Daily Consumption, QFD: Quantity of Feed distributed, QFR: Quantity of Feed Refused, n : Number of Individuals in Batch

2) Average Daily Gain

$$ADG = \frac{Wf - Wi}{t} \quad (2)$$

ADG: Average Daily Gain, Wf : Final Weight, Wi : Initial Weight, t : Duration of breeding

3) Feed Conversion Ratio

$$FCR = \frac{ADC}{ADG} \quad (3)$$

FCR: Consumption Index, ADC: Average Daily Consumption, ADG: Average daily gain

$$Mortality\ rate = \frac{\text{Number of Initial individuals}}{Number\ of\ Deal\ Individuals} x100 \quad (4)$$

4) Cost of Production (CP)

$$CP = Livestock\ Cost + Feed\ Cost + Processing\ Cost \quad (5)$$

2.6 Statistical analysis

The data obtained are treated in the one-way analysis of variance (ANOVA). The comparisons of the batch means are made using "All pairs Tukey Kramer HSD" at the significance level of 0.05, 0.01 and 0.001. The JMP/SAS software version 11.0.0 was used for statistical process.

3. Results

3.1 Effect on the average daily consumption

The following Table 2 describes the average feed consumption in g per day and per head of the subjects. On the 15th day of rearing, the chickens treated with 10% of ground peas (T1) presented higher feed consumption (51.38±5.92 g). The chickens fed with 0% of ground peas (Control) had intermediate consumption (50.92±5.81 g). Chickens from the diet with 20% ground peas (T2) showed lower feed consumption (50.84±4.21 g). According to the analysis of variance, there is a significant difference between the tested batches (p=0.0001).

Table 2: Average feed consumption according to the quantity of peas (g/d)

Duration	Treatment	Pr>F	S

	T1 (10%)	T2 (20%)	Control (0%)		
15 d	51,38a±5,9	50,84c±4,2	50,92b±5,8	0,0001	***
25 d	117,41b±16,7	117,29c±15,2	124,37a±17,2	0,0001	***
35 d	179,78c±6,6	185,69b±5,6	187,4a±5,0	0,0001	***
45 d	194,8b±5,9	189,72c±4,3	197,22a ±2,5	0,0001	***

*a, b and c: In the same row, values assigned to the same letter are not significantly different (P > 0.05), S: Signification, ***:* significance at p< 0.001, d: day

On the 25th day of rearing, chickens fed with the control diet without ground peas showed higher feed consumption (124.37±17.24 g). Chickens treated with 10% ground peas (T1) showed intermediate feed consumption (117.41±16.79 g). Individuals from the diet with 20% ground peas (T2) showed lower feed consumption (117.29±15.25 g). According to the analysis of variance, there is a significant difference between the tested batches (p=0.0001). This result showed the consequence of the substitution of corn by ground peas because feed consumption is reduced for animals treated with this product.

On the 35th day of rearing, chickens fed with the control diet showed higher feed consumption level (187.4±5.03 g). Those treated with the 20% ground pea diet (T2) showed intermediate feed consumption level (185.69±5.62 g). Individuals from the 10% ground pea diet (T1) exhibited lower feed consumption level (179.78±6.60 g). According to the analysis of variance, there is a significant difference between the three tested batches (p<0.0001). On the 45th day of rearing, animals from the control batch showed higher feed consumption (197.22 ±2.53 g). Chickens treated with the 10% ground pea diet (T1) showed intermediate feed consumption (194.8±5.94 g). Individuals from the 20% ground pea diet (T2) had lower average feed consumption value (189.72±4.32 g). According to the analysis of variance, there is a significant difference between treatments (p=0.0001) (**Table 2**).

From the 25th day to the 45th day, the results always showed that if the amount of ground peas increases, the feed consumption of chickens gradually decreases. While the substitution of corn with ground peas reduces the level of feed consumption of broilers.

3.2 Effect on weight growth

Weight growth is the first element to take into account to evaluate the effectiveness of one or more feed rations distributed to the animals. The evaluation of growth is studied from the live weight gain of each subject. Figure 1 presents the evolution of the weight of chickens throughout their production period.

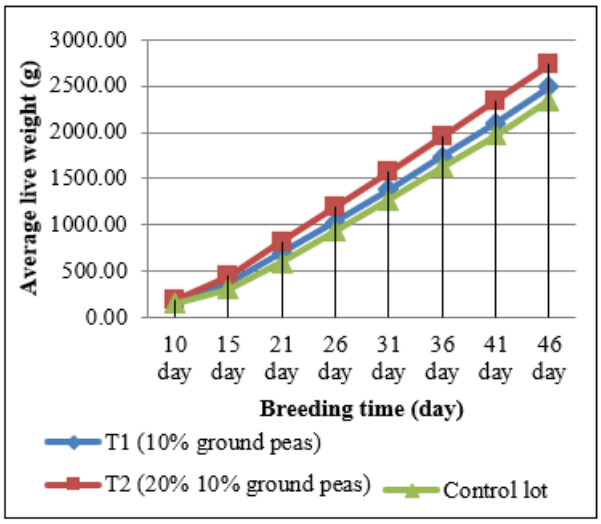

Figure 1: *Average growth graphs of chickens*

At the beginning of the trial, the average weights of broilers in all batches were similar. From the 15th day of rearing, significant differences were observed in the weight development of the chickens according to the batches. The growth curve of the subjects (Figure 1) showed a steeper slope in the animals treated with the experimental diet 20% of ground peas (T2) than those of the other batches. The subjects fed with the ration containing 10% of ground peas (T1) represented an average growth. Meanwhile, control diet chickens showed slower growth, reflected by a flatter slope in **Figure 1**. The weight growth of broilers is then influenced by the incorporation of ground peas in their rations. These results demonstrate the success of the test of partial substitution of corn by ground peas in the broiler diet.

3.3. Average Daily Gain

The Average Daily Gain (ADG) is an experimental quantity intended to measure the zootechnical performance of an animal. It is evaluated using the live weights of the animals during the period considered (daily or weekly). The following Table 3 expresses the effect of the feed on the ADG of chickens.

Table 3: Average daily gain of chickens (g/d)

Duration	Treatment			Pr >F	S
	T1 (10%)	T2 (20%)	Control		
15 d	39,36a±5,8	41,13a±4,1	31,10b±3,9	0,001	***
25 d	67,27b±6,7	71,56a±2,7	64,85b±3,2	0,001	***
35 d	74,67a±3,3	76,57a±2,8	62,33b±7,2	0,001	***
45 d	75,65b±4,5	79,41a±2,2	73,57b±2,3	0,001	***
10-45 d	62, 55b±1,5	68,02a±0,9	59,16c±1,0	0,001	***

*a, b and c: In the same row, values assigned to the same letter are not significantly different (P > 0.05), S: Signification, ***:* significance at p< 0.001, d: day

At the 15th day of rearing, chickens fed with the control diet showed higher FCR value (1.68±0.13). The experimental chickens (T1 and T2) showed lower FCR (1.34±0.26 and 1.25±0.13 respectively). The values found between these two batches are statistically identical (p>0.05). According to the analysis of variance, there is a significant difference between the control and the experimental batches (p=0.0001).

At the 25th day, chickens fed with the control diet showed higher FCR (1.22±0.09). Those of the experimental batches (T1 and T2) were low (1.77±0.25 and 1.64±0.06 respectively). According to ANOVA, there is a significant difference between the control and experimental groups (p=0.0001).

At day 35, chickens treated with the control diet showed a higher FCR (3.02±0.37). Experimental flocks (T1 and T2) had a lower FCR (2.41±0.11 and 2.33±0.10 respectively). According to analysis of variance, the distinction between the control diet and experimental diets is very clear (p=0.0001).

At day 45, chickens on the control diet and the 10% ground pea diet (T1) showed a higher FCR value (2.68±0.09 and 2.58±0.17 respectively). The values found in these two groups are statistically identical (p>0.05) between them. Individuals from the diet with 20% ground peas (T2) had lower FCR (2.39±0.07). According to the result of the analysis of variance, the distinction of mean FCR between the diet containing 20% ground peas (T2) and the other two treatments is very clear (p=0.0001).

For the overall result of FCR during the trial, chickens treated with the control diet had higher FCR (2.4±0.00). Individuals fed with the diet with 10% ground peas (T1) had intermediate FCR (2.2±0.06). Animals fed with the diet containing 20% ground peas (T2) had lower FCR value (2.0±0.00). The analysis of variance showed the existence of a highly significant difference between the three tested batches. When the FCR is low, the tested feed is better. Therefore, these results obtained indicate the excellent feed conversion of the experimental batches (20% and 10% of ground peas) which testify the positive efficiency of substituting corn with ground peas on the FCR of broiler chicken.

3.4. Effect on Feed Conversion

To highlight the use of ground peas in chicken feed, the table below shows the feed conversion ratio for each batch.

On the 15th day of rearing, chickens fed the control diet showed higher FCR values (1.68±0.13). Experimental chickens (T1 and T2) showed lower FCR values (1.34±0.26 and 1.25±0.13 respectively). The values found between these two groups are statistically identical (p>0.05). According to the analysis of variance, there is a significant difference between the control and experimental groups (p<0.0001).

Table 4: Variation in Feed Conversion Ratio of chickens depending on the amount of ground peas

Duration	Treatment			Pr >F	S
	T1 (10%)	T2 (20%)	Control		
15 d	1,34b±0,2	1,25b±0,1	1,68a±0,1	0,0001	***
25 d	1,77b±0,2	1,64b±0,0	1,22a±0,0	0,0001	***
35 d	2,41b±0,1	2,33b±0,1	3,02a±0,3	0,0001	***
45 d	2,58a±0,1	2,39b±0,0	2,68a±0,0	0,0001	***
10-45 d	2,2^{b}±0,0	2,0^{c}±0,0	2,4^{a}±0,0	0,0001	***

*a, b and c: In the same row, values assigned to the same letter are not significantly different (P > 0.05), S: Signification, ***:* significance at p< 0.001, d: day

On the 25th day, chickens fed the control diet showed higher FCR values (1.22±0.09). Those of the experimental groups (T1 and T2) were low (1.77±0.25 and 1.64±0.06 respectively). According to ANOVA, there was a highly significant difference between the control and experimental groups (p=0.0001).

At day 35, chickens treated with the control diet showed a higher FCR (3.02 ± 0.37). The experimental flocks (T1 and T2) had a minimal FCR (2.41 ± 0.11 and 2.33 ± 0.10, respectively). According to analysis of variance, the distinction between the control and experimental diets was very clear (p=0.0001).

At day 45, chickens on the control diet and the 10% ground pea diet (T1) showed higher FCR values (2.68 ± 0.09 and 2.58 ± 0.17, respectively). The values found in these two groups were statistically identical (p > 0.05). Individuals fed the 20% ground pea diet (T2) had a lower FCR (2.39±0.07). According to the results of the analysis of variance, the mean FCR difference between the 20% ground pea diet (T2) and the other two treatments was very clear (p=0.0001).

For the overall FCR result during the trial, chickens treated with the control diet had a higher FCR (2.4±0.00). Individuals fed the 10% ground pea diet (T1) had an intermediate FCR (2.2±0.06). Animals fed the 20% ground pea diet (T2) had a lower FCR value (2.0±0.00). The analysis of variance showed a highly significant difference between the three groups tested. When the FCR is low, the tested feed is better. Therefore, these results obtained indicate the excellent feed conversion of the experimental batches (20% and 10% of ground peas) which demonstrate the positive effectiveness of substituting corn with ground peas on the FCR of broiler chicken.

3.5. Mortality rate

During the experiment, the animals remained alive in the 3 batches despite some disease during breeding. Indeed, the breeding practices (feed distributed to the animals, transition respected, well-conditioned building including the humidity of the litter, the internal temperature of the henhouse) and the hygiene practices (treatment, disinfection of equipment every day) are well controlled. No sign of toxicity is detected during the test. This is the reason why the breeding is very successful with a mortality rate of 0% for all batches.

3.6. Effect of incorporation on economic evaluation

Economic evaluation is a very important test in poultry production to identify the breeder's objective. The calculations were made taking into account variable costs consisting of the total production cost (livestock purchase, feed costs and treatment costs) during the breeding period. After calculating the production cost, Table 5 represents the evaluation of economic profitability at the end of the trial.

Table 5: Economic evaluation per chicken (Ariary)

Processing	Treatment		
	T1 (10%)	T2 (20%)	Control
CP/Chicken	19737	19848	19908
CP/100g of LW	629	586	676
Sales Price/LW	23654	25988	22247
Gross Margin/Chicken	5583	7807	4005

CP: Cost of production, LW: Live Weight

It is recorded that the production cost per chicken was not identical for the three batches. The animals treated with the control diet (without ground peas) had higher costs (19 908 Ariary) compared to the other batches. The animals raised with the diet containing 20% ground peas (T2) showed intermediate value production cost (19 848 Ariary). The chickens from the diet with 10% ground peas (T1) presented lower total production cost (19 737 Ariary). These results mean that the subjects treated with ground peas have less food costs compared to the control. Elsewhere, considering the sum of food production of each individual, the economic evaluation is counted by the quantity of food consumed by the animals to obtain 100 g of weight gain. The chickens in the control batch (without ground peas) showed always higher production cost (676 Ariary per 100 g of weight gain). Subjects from batch T1 (10% ground peas) had an average production cost (629 Ariary per 100 g of weight gain). Animals from the batch fed with 20% ground peas (T2) had a lower production cost (586 Ariary per 100 g of weight gain). While animals receiving the new ration had more profit on the weight gain of the subjects for this study. The variation in the production cost then had impacts on the gross margin of the farm. It is noted that the ration with a replacement rate of 20% ground peas (T2) was the most profitable. A higher profit margin of 7807 Ariary per chicken was recorded for animals raised in T2. Then, the ration comprising 10% ground peas (T1) represented the intermediate margin of 5583 Ariary per chicken. The control ration without ground peas generated a lower profit margin of 4005 Ariary per chicken. Therefore, the use of ground peas in poultry feed reduces the cost of production and increases the economic profitability of production.

4. Discussion

4.1 Consequence of corn substitution by ground pea on feed consumption

According to the result obtained, the animal's consumption level gradually decreases according to the amount of ground pea incorporated in this study at Betafo. This trend of result is similar with previous research concerning the effect of the level of incorporation of cassava flour in the ration on the growth performance of broiler chickens [14]. This disposition of result even corroborates with other findings concerning the impact of *Azolla* varied on the diets of male chickens in conditions of economic feasibility and physiological performance [15]. These research results showed that if the amount of protein incorporated increases, the consumption level gradually decreases. A previous research result found that consumption is also influenced by the protein content of the diet [16], [17]. In case of sub-deficiency, chickens have over-consumed feed to try by this means to ensure sufficient ingestion of amino acids. While the digestibility of the feed gradually decreases according to the amount of protein incorporated in the diet which is the cause of the reduction in consumption. This discovery is proven in experiments on the feeding of broiler chickens: distribution of *Azolla pinnata* [15], distribution of *Mucuna* grain [18]. On the other hand, the presence of anti-nutritional factor is not negligible. This product is moderately high in the ground pea. According to the results of previous research, this factor has acted in synergy depressing food consumption by slowing down digestion [2]. When digestion is slowed down, the food stays long in the digestive tract of the animal which is the origin of reduction in consumption level. According to these results of previous research, the reduction in feed consumption detected in this study is due both to the increase in protein level in the ration and also to the existence of nutritional factor in the ground pea.

4.2 Effect of the substitution of corn by ground pea on the consumption index

The best FCR recorded in this study is found in the batch treated with 20% ground pea (FCR = 2.0). This value is lower than previous results in Niger [19]. This discovery recorded a high FCR (FCR = 2.59) during its studies concerning the effect of supplementation of *Moringa oleifera* leaf flour in broiler chicken production. This result in Betafo itself is lower than other consequences found in Burkina Faso [20]. In this case, the trial found a FCR = 2.93 on its research on the effect of incorporating *Moringa oleifera* leaf flour on weight performance and carcass characteristics of chickens. This result in Betafo itself is lower than the discovery found by researchers in Cameroon. They worked on the effect of the rate of incorporation of raw sweet potato flour in the feed on the growth performance of broiler chickens. As a result, they recorded a FCR equal to 2.23 between 22 and 49 days of breeding [21]. Compared to these three discoveries in Niger, Burkina Faso and Cameroon, this study in Betafo still has a lower FCR. While the minimal FCR indicates the excellence of breeding. This comparison highlights the clear benefits of replacing corn with ground peas.

4.3 Effectiveness of the substitution of corn by ground pea on the Average Daily Gain

The best ADG recorded in this study in Betafo is 79.41±2.28 g/d found in the batch treated with 20% ground pea (T2) at 45 days of breeding. This value is significantly higher than other results for research on the effect of incorporating local date waste into the ration on broiler growth [22]. This trial found an ADG of 67 g/d between 43 and 49 days of rearing. The value recorded in Betafo itself is significantly higher than a result of research on the effect of incorporating local barley draff into the ration on broiler growth performance [23]. These authors found an ADG of 38.4 g/d between 34 and 48 days of rearing. This value recorded in Betafo is tripled by the figure found in Côte d'Ivoire on the effect of cassava peel flour in broiler feed. The latter obtained an ADG of 24.98 g/d [24]. The ADG of this study itself is largely superior to those found in Burkina Faso for the incorporation of boiled Guinea sorrel grains (*Hibicus sabdariffa L*) in rations on the growth performance of broiler

chickens. The value recorded was 45.86 g/d [20]. All the results found in other countries are largely inferior to this study in Betafo. This indicates both the superiority of the nutritional value provided by the ground pea (Protein 17.15-19.39%, Carbohydrate: 61.3%, Lipid: 6.2%, Crude cellulose: 4.3%, Ca: 0.28%, P: 0.07% [25], [26], [27] but also the effectiveness of the balance of the animals' needs provided by the diet tested by the complementarity of the different sources of vegetable protein [28]. The ground pea is richer in protein than corn. In addition, its seed provides a fairly high quantity of Lysine (8.2 g in 16 g of protein) and has slightly low Methionine (0.95 g in 16 g of protein) [29]. These two amino acids are elements necessary to stimulate animal growth and its quantities considered important in the ground pea are very low in the corn grain (Lysine: 0.28% DM and Methionine: 0.22% DM) [30]. While the exceptional chemical composition rich in protein and essential amino acid in the ground pea promotes the obtaining of good animal growth recorded in the experimental batches of this study. Hence the effectiveness of the partial substitution of corn by ground pea recorded.

4.4 Consequence of the test on the Mortality rate

All the batches presented 0% mortality rate. This result indicated the good adaptation of the digestive tract of broiler chicken with the tested ground pea. The amount incorporated in the diet was well balanced with the whole diet formulated and distributed. Which always means the positive effectiveness of the partial substitution of corn by ground pea. The absence of mortality in this study is similar to other previous research results [22], [31].

4.5 Economic improvement trend

The economic results recorded in this study mentioned the decrease in the cost of production of broiler chickens by the method of partial substitution of corn by ground pea. This trend of result is similar with the use of *Azolla pinnata* in India [7], [32], the distribution of mango feed and a concentrate of maggot in Burkina Faso [33] and the improvement of breeding system in Cameroon [34]. In this study in Betafo, the substitution of corn up to 20% of ground peas generates a reduction of 13.31% in chicken production costs. This reduction in expenditure induces an increase in the operator's profit margin. While the partial substitution of corn by ground peas improves the profitability of the broiler farm. This economic consequence helps motivate the actors in the broiler sector [35] in order to ensure both the sustainability of the income-generating breeding activity and guarantee the recovery of the supply of animal protein resources for the population. In addition, the result of this study encourages and leads to the creation of a business through the new supply of more efficient feed as well as the possibility of job creation for those who are interested. Indeed, four major advantages are obtained from this study: progress in the family income of breeders, creation of a new product supply for the feed milling company or industry, improvement of the employability of young people and strengthening of the food security of the population. The ground pea is continuously available at the regional market.

5. Conclusion

Poultry farming's growth is increasingly hampered by soaring feed costs, but this study shows ground peas (*Vigna subterranea*) offer a promising fix. Replacing corn with up to 20% ground peas not only slashed production costs by 13,31% but also boosted broiler growth and feed efficiency ($p < 0.0001$ across key metrics). Beyond the numbers, this approach taps into a local, sustainable resource that could ease economic burdens for Madagascar's farmers while supporting protein needs. It's a practical step forward-one that invites further exploration into scaling this strategy for wider impact.

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