International Journal of Innovation and Applied Studies
ISSN 2028-9324 Vol. 45 No. 1 Mar. 2025, pp. 35-42

http://www.ijias.issr-journals.org/

Evaluation of coccidiosis impact on the productivity of *Numida meleagris* guinea fowl farms in northern Côte d'Ivoire

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ABSTRACT: The aim of this study is to determine the share of coccidiosis in the mortality of young guinea fowl (keets) on farms in northern Côte d'Ivoire. Thus, a study was carried out on 192 one-day-old guinea fowl, divided into two (2) batches. The control batch did not receive treatment. The experimental batch was treated with an anticoccidial. Then, the zootechnical parameters and the degree of infestation were measured in each of the batches. The control batch recorded EPG values of 600; 7371.43 and 5442.86 respectively for age groups 0-21d; 22-48d and 49-90d. these values are significantly and respectively 8.6 times; 81.7 times and 63.19 times higher ($p < 0.001$) than those of the experimental group for the same age groups. As for mortality, it is 75% in the Control batch, three times higher than that of the experimental batch. Also, keets subjected to anticoccidial treatment recorded the best growth performance. Coccidiosis is therefore one of the main causes of the high mortality observed in guinea fowl farms in northern Côte d'Ivoire. Thus, the prevention of coccidiosis could help improve the profitability of guinea fowl farms in Côte d'Ivoire. However, the use of biological solutions as an alternative to synthetic antibiotics would be an avenue to explore in order to prevent the solution to this problem from being the start of another problem, in particular that of the resistance of germs to antibiotics.

KEYWORDS: Coccidiosis, Keets, Mortality, Guinea fowl farms, Côte d'Ivoire.

1 INTRODUCTION

Coccidia are protozoa that develop in animal digestive tract. They are responsible for dysentery, enteritis and generally bloody diarrhea, often leading to high mortality in infested animals [1]. They are known to affect various animal species, namely mammals, birds and particularly poultry [2]. It is responsible for huge economic losses across the world [3], [4]. Indeed, by extrapolating the economic impacts of eight countries based on health expenditure devoted to the treatment and control of coccidiosis, [5] estimated losses between 9.62 and 15.75 billion euros for 2016 alone. Also, other work has shown that in addition to losses linked to the reduction in egg and meat production, morbidity and mortality, coccidiosis also generates expenses linked to the treatment and prevention of the disease. ([6], [7]). Four species of the genus Eimeria have been described in guinea fowl, notably, *Eimeria grenieri; Eimeria numidae; Eimeria gorakhpuri* and *Eimeria khobahensis* [8]. Several studies around the world and particularly in West Africa have shown that the main constraint linked to guinea fowl breeding remains the high mortality of keets ([9], [10], [11], [12]). Indeed, according to several authors, guinea fowl, although resistant in adulthood to most diseases (Gumboro, Newcastle) which are prevalent among chickens, seem vulnerable from a very young age [13]. The same observation is made in guinea fowl farms in northern Côte d'Ivoire [14]. However, although coccidiosis is suspected, to our knowledge, no confirmatory study has been carried out on the responsibility of coccidiosis in keet mortality. The objective of this study is therefore to determine the share of coccidiosis in the mortality observed among young guinea fowl on farms in the north of the country.

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2 MATERIAL AND METHODS

2.1 CHOICE OF STUDY LOCATION

This study was carried out in the north of Côte d'Ivoire, precisely in the locality of Korhogo. Cette zone est caractérisée par un climat de type tropical Soudanien marqué par deux grandes saisons dont une saison de pluie qui s'étend de mai à octobre et une saison sèche de novembre à avril. The choice of this locality lies in the fact that it's not only a guinea fowl breeding area but, also that it records very high young guinea fowl mortality. Aussi, cette zone est reputée pour sa forte prévalence de parasites gastro-intestinaux dont la coccidiose [14].

2.2 EGG COLLECTION AND PRODUCTION OF DAY-OLD GUINEA FOWL

To carry out this study, 297 guinea fowl eggs were collected from breeders in the localities of Korhogo, Sinématiali, Niakaramadougou and Dikodougou. The collection principle was based on obtaining eggs laid and transported to the Korhogo hatchery in less than two days in order to have a good hatching rate for these eggs.

2.3 BATCHES CONSTITUTION

At hatching, after sorting, 192 keets were retained and divided into two batches of 96 individuals. Each batch was divided into sub-batches of 32 keets in order to better evaluate the effect of the treatment on the zootechnical parameters of the animals. The management of the keets took place in a building subdivided into two compartments. Each compartment was subdivided into three galvanized mesh parks according to the sublots. The batches constitution first required individual weighing of all subjects in order to have a substantially identical average weight per batch. Among the two batches, one served as a control (T) and the second was identified as an experimental batch (E).

2.4 KEETS MANAGEMENT

The trial lasted three months during which water was served ad libitum. Also, all animals were fed ad libitum with industrial feed and subjected to the same dewormer, in particular Levasol 20%. During this phase, the control batch (T) did not receive any anticoccidial unlike the experimental batch which was treated with an anticoccidial in particular VETACOX to 1 g for 5 liters of water every 15 days from the 15th day of the trial. In fact, each anticoccidial treatment lasted three (3) successive days with a renewal of the treatment every morning. After three days of treatment, simple water is given to the animals until the next treatment, 15 days later. Random samples of 10 g of droppings were taken twice a week from the first treatment and outside treatment days. Thus, 12 samples per sub-batch were taken in 7 weeks, for a total of 72 samples in all batches combined. After each collection, the samples are immediately sent to the laboratory for coprological analyses, by flotation and the Mac Master method.

2.5 FEEDING AND GROWTH CONTROL

Intake was monitored daily in each batch by the difference between the amount of food fed and the food remaining in the feeders at the end of the day. The ingested is given by the formula (1):

$$Food\ consumed\ =\ quantity\ of\ food\ distributed\ -\ quantity\ of\ food\ remaining \quad (1)$$

To evaluate growth performance, weekly weighings were carried out throughout the duration of the experiment. In fact, once a week, 10 young guinea fowl from each batch taken at random were weighed. These weighings made it possible to determine the average weight per aniaml within each batch according to formula (2):

$$\text{Average Body Weight} = \frac{\Sigma(\text{Body weight of each individual})}{\text{Number of individuals weighed}} \quad (2)$$

In addition, the Feed Conversion Ratio (FCR) was determined from weight gain and the quantity of food consumed according to the formula (3).

$$\text{FCR} = \frac{\text{Total Feed Consumed (g)}}{\text{Total Weight Gain (g)}} \quad (3)$$

2.6 YOUNG GUINEA FOWL HEALTH CONTROL

Health monitoring was carried out twice a day, morning and evening. The dead are evacuated while the sick are isolated until they recover or die. The mortality rate was determined by the number of deaths on the initial workforce multiplied by 100 as indicated in formula (4):

$$\text{Mortality } (\%) = \frac{\text{Number of deaths during test}}{\text{Number present at start}} x\ 100 \quad (4)$$

2.7 YOUNG GUINEA FOWL DROPPINGS ANALYSIS

The qualitative analysis of the droppings consisted of determining the presence or absence of parasitic elements using the flotation technique. Indeed, for each sample, 3 g of feces were homogenized in 42 ml of sodium chloride (Nacl) solution with a density of 1.2. After sieving, the resulting mixture was transferred into a test tube until a convergent meniscus was obtained. Then, a coverslip is applied to the top of the tube, thus promoting contact between the coverslip and the liquid. Ce contact permet l'adhésion des oocystes à la lamelle. This coverslip is removed 10 minutes later and placed on an object slide. Then, the observation is carried out for the whole at x10 magnification and the identification of the parasitic elements at x40 magnification. The quantitative analysis consisted of determining the number of parasitic elements contained in one gram of feces for each sample. To do this, the same process as the qualitative analysis was carried out until the liquid was obtained. The mixture obtained after filtration is poured onto a MacMaster slide. Thus, after 10 minutes the parasitic elements rise towards the upper part of the slide and can be observed under a microscope at x10 magnification. The number of oocysts per gram of fecal matter (EPG) was determined by multiplying the total parasitic elements of both compartments by 50 or by 100 when it comes to the elements of a single compartment of the Mac Master slide.

2.8 STATISTICAL ANALYZES

The parameter values obtained in the two batches were subject to statistical analysis. Indeed, the data presented in proportion were subject to a Chi square test while a Student test was applied to the data presented as an average. The software used is R software version 3.5.1. The significance Threshold for each test was 5%.

3 RESULTS

3.1 WEEKLY FOOD CONSUMPTION

Figure 1 shows the food consumption in grams per subject from both batches during the different weeks of age. statistically, animals in both groups recorded similar food consumption between 0 and 2 weeks. ($p > 0,05$). Consumption per animal reaches 18 g per day at the end of the second week. However, from the start of the third week (W3), the group treated with the anticoccidial recorded significantly higher food consumption than the control group. Indeed, the experimental batch (E) recorded a food consumption per individual of 18g, 25g and 55g per day respectively at the 2nd, 3rd and 4th week compared to only 15g, 18g and 20g per day in young guinea fowl in the control group (T) respectively during the same weeks. From the 4th to the 9th week, food consumption remained statistically higher in batch E ($p < 0,05$). Indeed, consumption per subject increased from 55g per day in the 4th week to 75g per day in the 9th week in animals from batch E. compared to a food consumption per animal in the control batch of 35 g per day at the 4th week which increased to 61 g per day at the 9th week. From the 9th to the 12th week, food consumption evolved statistically in a similar manner in both batches ($p > 0,05$). Indeed, while the subjects treated with the anticoccidial (lot E) show a consumption of 80g/day/animal, those in lot T untreated, are at 67 g/day/animal at the 12th week.Over the entire duration of the experiment, the animals treated with the anticoccidial recorded a significantly higher daily food consumption than that of the control group. ($p < 0,05$).

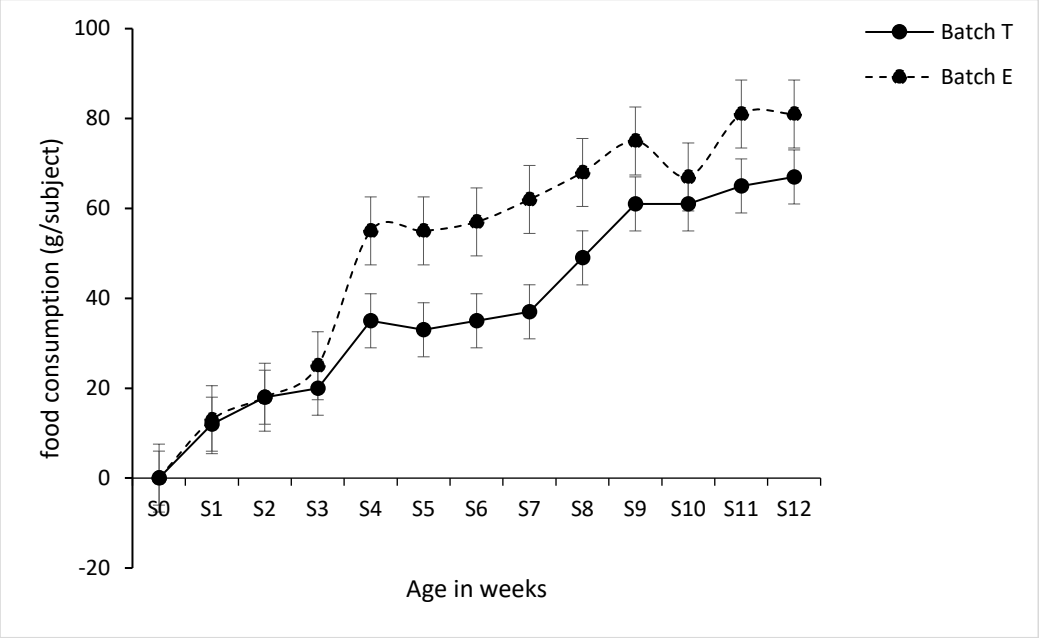

Fig. 1. Evolution of weekly food consumption per keet in each batch (control batch and experimental batch)

3.2 GROWTH OF SUBJECTS

Treated (group E) and untreated (group T) guinea fowl showed statistically similar growth during the first two weeks of age, with a mean weight gain of 67 ± 2.5 g ($p > 0.05$). However, between weeks 3 and 7, treated subjects experienced significantly higher weight gain than untreated subjects ($p < 0.05$). Indeed, at the age of seven weeks, the subjects of batch T recorded an average weight of 201 ± 9.3g. at the same time, those from batch E recorded an average weight of 303.5 ± 13.32g. However, from the eighth week, the average weight of guinea fowl in batch T improved to approach that of batch E. During this period, no statistical difference was recorded between the weights of the two batches ($p > 0.05$). During the remainder of the test period, notably from week 9 to week 12, the average weight of the guinea fowl in the control group T remained statistically lower than that of the experimental group E ($p < 0.05$). Indeed, for this period, the weight of the untreated control batch varied from 381.5g to 546.4g compared to 427.3g to 622.8g for the experimental batch having received the anticoccidial treatment. Figure 2 shows the evolution of the average weight of the two batches.

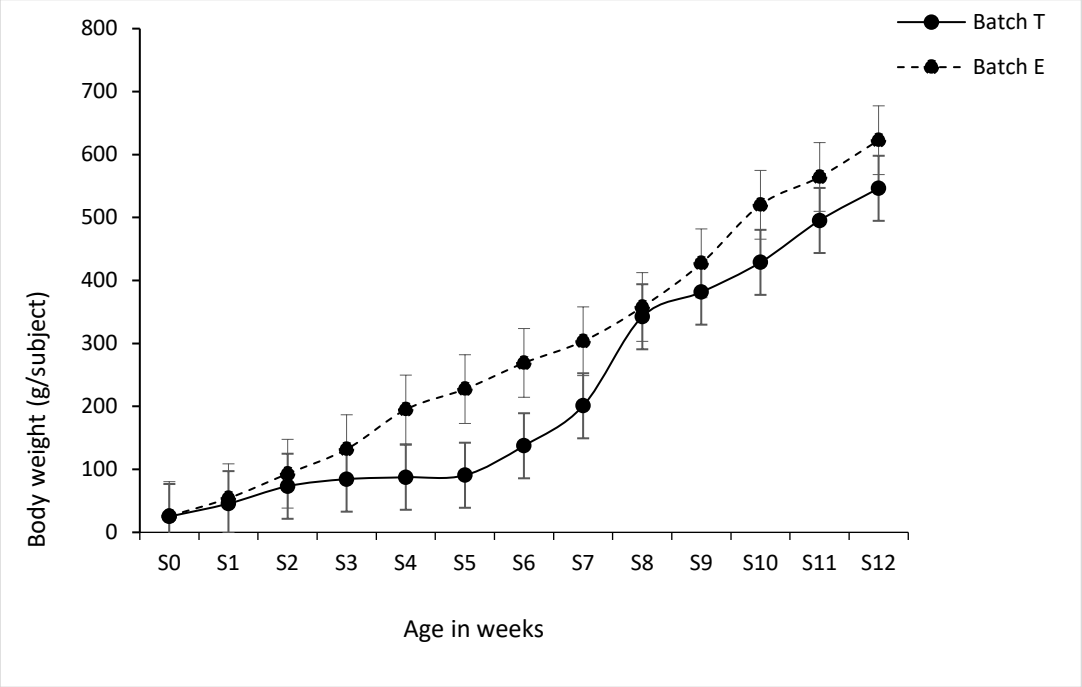

Fig. 2. Evolution of the body weight of keets from the control group and the experimental group during the 12 weeks of the trial

3.3 INFESTATION BY EIMERIA SPP. AND MORTALITY OF BATCHES

Table 1 presents the level of infestation by Eimeria spp of guinea fowl in the two batches. The number of eggs per gram of feces (EPG) in the treated batch was significantly lower than that in the untreated batch over the entire trial period. In batch E, the number of eggs per gram of feces ranged from 70 for the 0-21 day period to 90.18 for the 22-48 day period. That of the untreated batch T varied from 600 from 0-21 days to 7371.43 from 22-48 days. Additionally, among untreated subjects, the number of EPG was significantly higher in the period from 22 to 48 days than in the other two periods, including 0 to 21 days and 49 to 90 days. In the experimental group, the number of EPG experienced its highest values during the age groups of 22 to 48 days and 49 to 90 days, however, no significant difference was recorded between the number of EPG for these two periods. Mortality was highest between the first and 7th weeks of age in both groups. However, over this period, the cumulative mortality rate of batch T was significantly higher than that of the experimental batch ($p < 0.05$). Cumulative mortality peak of batch T for this period was 34.4%, approximately three times that of batch E for the same period. Furthermore, between the 7th and 12th weeks of rearing, the cumulative mortality recorded in the subjects of the two batches was 3% and 1% respectively in the batch T and batch E. For this period, no significant difference was recorded between the cumulative mortality rates of the two batches. Taken over the entire trial period, batch T recorded a mortality of 37.5%, three times statistically higher than that of batch E. The figure 3 shows the mortality of each batch.

Table 1. EPG of the control batch and the experimental batch by age

Batches	**EPG by age group**			***G-test***	***P-value***
	0-21 day	**22-48 day**	**49-90 day**		
Batch T	600^{a}	$7371,43^{b}$	$5442,86^{c}$	*7369,5*	*< 0,001*
Batch E	70^{a}	$90,18^{b}$	$86,14^{ab}$	*7,79*	*< 0,001*
P-value	*< 0,001*	*< 0,001*	*< 0,001*		

The superscripts a, b and c indicate whether there is a significant difference ($p < 0.05$) or not ($p > 0.05$) in the number of eggs per gram of feces analyzed in the two batches.

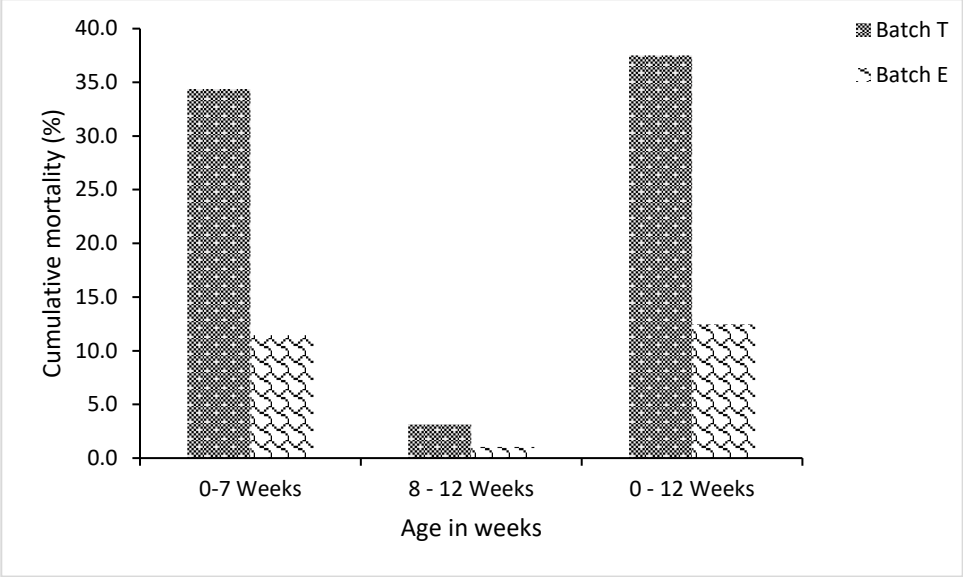

Fig. 3. Evolution of cumulative mortality in the two batches (control batch and experimental batch) of young guinea fowl

4 DISCUSSION

In poultry, the protein and energy requirements necessary for maintenance and growth have a direct impact on the live weight of the animals. In terms of food intake, our results are similar to those obtained by [15] during a study carried out in Botswana on the diet of guinea fowl. Indeed, these authors observed that food consumption increased with age in the different batches despite the level of substitution of fish meal by that of *Imbrasia belina* larva meal. However, the drop in food consumption observed in our work between the fourth and seventh week in untreated subjects could be attributed to coccidia given the high value of the number of EPG. [16] showed that the multiplication of sporozoites in the intestinal tract of poultry leads to damage to the epithelial tissue, thus inducing the interruption of nutrition. The similar growth of guinea fowl from the two groups between 0 and 2 weeks of age could be explained by the fact that at this age, the animals are not yet infested or at least that the degree of infestation is still low. However, the low growth observed between the 3rd and 8th weeks in the control group (T) could be attributed to the coccidian load. Similar results were reported by [17] in chickens. According to this author, the clinical manifestations of coccidiosis appear in the fourth week. These manifestations are marked by the destruction of epithelial cells by coccidia, leading to a reduction in food consumption and a slowdown in growth. At the 8th week, the young guinea fowl had similar growth in all batches. The resumption of growth observed in young guinea fowl, particularly those in batch T, would probably be due to the immunity acquired by the animals. Indeed, according to [18], poultry become immunized over time against the pathogen depending on the degree and duration of the infestation. These authors report that infested individuals develop immunity against the pathogen, but sometimes succumb. Work by other authors has also shown that disease resistance in poultry increases with age ([19], [20]. Additionally, similar studies conducted by [21] on the prevalence of coccidiosis in poultry farms in western Ethiopia revealed a higher prevalence of coccidiosis in subjects aged 2 to 8 weeks. In chickens, coccidiosis generally occurs between the 5th and 7th week ([22], [23]). Still according to [22] beyond the 7th week, subjects develop immunity and therefore increase their resistance to the disease. From the 9th week until the end of the trial, a significant growth delay was recorded in guinea fowl in the control batch compared to the experimental batch. This could be due to the low level of food consumption of this batch compared to the experimental batch. This low consumption would result in a protein and energy intake lower than the guinea fowl's needs. The presence of coccidia in young guinea fowl treated with anticoccidials and in those not treated could be due to a continuous infestation of the subjects. Indeed, in poultry farming, litter constitutes the support and the first channel of contamination between the host and the parasites. The condition of the litter could constitute a favorable reservoir for the development of coccidia. The confinement of poultry in the same enclosure for long periods would be a factor favoring the proliferation of coccidia due to contact over a very small area. In addition, climatic conditions (hot and humid season) are favorable for oocyst sporulation. Thus, guinea fowl become infected by ingesting the oocysts contained in droppings, litter, water and contaminated food. These same observations have been made in Nigeria in most poultry farms. ([24], [25]) In his work, [26] recorded a permanent presence of coccidia in the various poultry farms surveyed in Nigeria. According to this author, heavy rains contribute to raising the humidity level, thus promoting the sporulation of oocysts. However, the low infestation rate observed in young treated guinea fowl could be attributed to the effect of the anticoccidial. In fact, anticoccidial treatment made it possible to reduce the number of

oocysts per gram of stool in treated subjects by approximately 77%. Similar results were obtained by [27] in Ethiopia and by [28] in Uganda. These authors showed that the use of anticoccidial drugs such as Sulfonamide and Diclazuril significantly reduced the number of oocysts per gram of feces in naturally infested poultry. Thus, the administration of anticoccidial drugs could considerably reduce the level of infestation and improve the health status of young guinea fowl. The mortalities observed in all batches during the first weeks of rearing could be linked to the fragility of the guinea fowl and/or insufficient heating. Indeed, during their work on the effects of prophylactic measures on the productivity of local guinea fowl in Burkina Faso, [29] noted that the mortalities recorded during the first weeks mainly concerned guinea fowl with low hatching weight. However, the cumulative mortality rate of 37.5% recorded in the batch not treated with the anticoccidial could be attributed to coccidios. Indeed, coccidia during their multiplication cause the destruction of epithelial cells. In most cases, this results in anorexia, anemia, diarrhea, weakening and death of infested subjects. These observations were made by ([29], [30]) during similar studies in Burkina Faso. The mortalities could be due to the deterioration of the animals' immune systems by coccidiosis, making them vulnerable to other pathogens such as Salmonella spp. and *E. coli* as shown in the work of [31]. Reducing the mortality rate through the use of anticoccidials or other control methods constitutes an avenue to explore with a view to reducing the losses suffered in traditional guinea fowl breeding which is the primary source of guinea fowl supply in the African countries.

5 CONCLUSION

This study showed that one of the causes of the high mortality of the young guinea fowl recorded on farms in northern Côte d'Ivoire is coccidia parasitism. Indeed, the highest mortality rates were recorded in the control group which did not receive any anticoccidial. Also, the lowest feed consumption and bad zootechnical performances were recorded in this batch. The results of this work show that the implementation of a prophylaxis plan in guinea fowl farms in the north of the country would be an ideal way to considerably reduce the mortality of young guinea fowl. This preventive measure would make it possible to improve the zootechnical performance of the subjects therefore, increase the income of breeders. However, given the growing resistance of germs to synthetic antibiotics, would it not be interesting to turn to biological inputs with antiparasitic properties to effectively reduce the mortality of young guinea fowl linked to coccidia.

ACKNOWLEDGMENT

I thank all co-authors for their participation in the development of this article. this participation concerns fieldwork, data analysis, writing the article, revising the article and its supervision.

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