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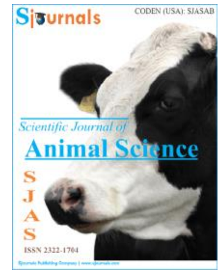

Original article

Use of *Carica papaya* leaf as growth promoter and anti-parasitic in guinea fowl in Benin

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A B S T R A C T

Carica papaya is a widespread plant in the tropics that has shown excellent nutritional potential. This plant is also rich in bioactive compounds. This study aimed at determining the effect of different levels of *Carica papaya* leaf meal (PLM) on growth parameters of guinea fowl and its use for pest control. Feeding trial was conducted on forty-five growing guinea fowls for six weeks. The anti-parasitic effect evaluation trial was realized for six weeks using also forty-five eight-week-old guinea fowl. For the two trials, 3 treatments with 3 replicates (5 birds per replicate) were made. A completely randomized design was arranged with R5 (Diet with 5% PLM), R10 (Diet with 10% PLM), Control (Diet without PLM). The parameters measured were feed intake, daily weight gain, feed convertion ratio (FCR) and faecal egg count. The results for the animal performances showed a significant weight difference in favor of groups R5 and R10 compared to the control group. The incorporation of PLM in the diets led to a significant increase (p <

0.01) in daily weight gain compared to the control group. There was no significant difference ($p > 0.05$) among the treatments for the feed intake and FCR. The inclusion of PLM in the diets at 5% and 10% (R5 and R10) significantly decreased EPG count for *Ascaridia spp* ($p < 0.01$), *Eimeria spp* ($p < 0.001$), *Heterakis spp* ($p < 0.01$), *Syngamus spp* ($p < 0.01$) compared to control group. It can be concluded that PLM can be used at the rates of 5% and 10% of feed for guinea fowls with benefit effect on growth performance and health.

1. Introduction

Poultry farming, because of its many advantages (short cycle of reproduction, accessibility, easy production and low investment) and its social, economic and nutritional importance, occupies in Benin, a place of choice in the development strategies and the fight against poverty and aiming food self-sufficiency in animal protein (FAO, 2015). Among poultry, guinea fowl meat is regarded as very lean, with high protein content, tender and flavorful. Its taste is more reminiscent of pheasant, without the excessive gamey flavor. Regarding all these characteristics, guinea fowl meat is popular and has a higher price than chicken meat in restaurants (Musundire et al., 2017). However, poultry production profitability is reduced by the high cost of feed ingredients that provide the required protein and energy and by internal parasites, which cause major economic losses worldwide (Ebenebe et al., 2011; Odhong et al., 2014; Banjoko et al., 2020). One of the solutions to this problem is the incorporation of plant leaf meal into the diet of poultry as a means of reducing the cost of conventional protein sources and to improve the profit margin. Plants also have the advantage of containing bioactive substances that can treat animal diseases.

Carica papaya Linn is an herbaceous well known plant in the tropics which belongs to the Caricaceae family. It has been used as ethnomedicine for decades in tropics and subtropics. Many parts of this plant such as roots, leaves, latex, flowers, fruits, and seeds possess nutritional and medicinal significance (Ali et al., 2011). Earlier reports of Onyimonyi and Onu (2009), and Ogbuokiri et al. (2014) indicated that incorporation of pawpaw leaf meal in the diet of finishing and starter broilers improved performance, feed intake, weight gain, feed conversion ratio, carcass and organoleptic indices, respectively. Saulawa et al. (2015) reported no effect on feed intake, feed conversion ratio, dressing percentage and carcass indices of weaned rabbits fed diets supplemented with Pawpaw leaf meal. This study was therefore designed to evaluate the effects of *C. papaya* leaf meal on zootechnical parameters and its antiparasitic properties in guinea fowl.

2. Materials and methods

2.1. Experimental site

The experiment was carried out in the poultry unit in a private farm located Agbangnizoun district in southern Benin.

2.2. Source of feed ingredients for the experimental diets

Mature and disease-free *C. papaya* leaves were collected from pawpaw trees in Agbangnizoun district in southern Benin. They were separated from the stalk and dried for two weeks at room temperature. After drying, they were hammer milled and kept in an airtight container for futher use in ration formulation with other ingredients such as maize, wheat bran, cottonseed meal, soya, oyster shell, junior, idafix and premix sourced from a local feed miller.

Table 1
Ingredients and chemical composition of the experimental diets.

Ingredients (kg)	Control (0% PLM)	R5 (5% PLM)	R10 (10% PLM)
Maize	51.3	51.3	51.3
Roasted soy	15	12	10
Palm kernel cake	3.5	2.5	2
Cottonseed meal	13	12	9.5
Wheat bran	10	10	10
Oyster Shell	2	2	2
Premix Po, 25	2.5	2.5	2.5
C. papaya leaf meal	00	05	10
Junior	2.5	2.5	2.5
Idafix	0.2	0.2	0.2
Total	100	100	100
Calculated composition			
Crude protein	15.8	21.35	17.5
Ether extract	5.5	4.8	4.5
Crude fiber	8.7	7.9	8.4
Ash	9.6	8.2	6.7
Dry matter	92.31	93.9	92.65
Moisture content	7.69	6.1	7.35
Nitrogen free extract	52.71	51.65	55.55
Metabolizable energy (Kcal/kg)	2905.705	3016.165	2987.625

2.3. Experimental animals, design and management

2.3.1. Evaluation of the effect of *C. papaya* on growth performance of guinea fowls

Forty-five (45) height (8) week-old local breed guinea fowls were randomly allotted to three treatments in a completely randomized design. Each treatment was replicated thrice, having five guinea fowls each. The treatments were as below:

- Control = Diet without *C. papaya* leaf meal (control group),
- R5 = Diet with 5% *C. papaya*,
- R10 = Diet with 10% *C. papaya.*

The trial lasted six weeks (42 days). The poultry house was cleaned and disinfected before introduction of the day-old-guinea fowls. All routine vaccinations and bio security measures were carried out as prescribed. The birds were dewormed before experimentation and were fed twice daily ad-libitum at 7.00 am and 5.00 pm. Clean drinking water was also offered to them ad-libitum. Experimental diet was served to the birds throughout the duration of the experiment.

2.3.2. Evaluation of the effect of *C. papaya* on parasitological profile

Forty-five naturally infested local breed guinea fowls aged height (8) weeks were allotted into three experimental treatments with 15 birds per treatment and replicated thrice, having five guinea fowls each using a completely randomized design. The guinea fowls were housed in above-ground cages with a mesh bottom. The treatments were as below:

R5 = Diet with 5% *C. papaya*,
R10 = Diet with 10% *C. papaya,*
Control = Diet without *C. papaya* leaf meal (control group).

The trial lasted for 6 weeks (42 days). Each bird was vaccinated against prevalent disease but was naturally infested by gastro-intestinal parasites. The birds were fed twice daily ad-libitum by 7.00 am and 5.00 pm. Clean drinking water was also offered to them ad-libitum. Waterers and feeders are washed every morning and evening.

2.4. Data collection

2.4.1. Zootechnical data

Initial weights of the birds were taken with a sensitive weighing scale. Data were collected daily for feed intake and weekly for weight gain. Feed intake was determined by the difference between the feed supplied and the left over in the feeding trough the next day. Body weight gain was measured using weekly weigh-back mechanism by subtracting the present week's weight from that of the previous week. Feed Conversion Ratio (FCR) was determined by dividing the average total feed intake by the average total body weight gain.

2.4.2. Parasitological data

Fresh faecal samples were collected in the morning once a week across each guinea flock unit on plastic bags attached under each. For coproscopic analysis, the mini-FLOTAC technique was used (Cringoli et al., 2010). The number of eggs per gram (EPG) of faeces was determined by the formula:

EPG = (n1+n2) x 5
n1 = number of eggs counted in cell 1
n2= number of eggs counted in cell 2

2.5. Statistical analysis

To assess the effect of the feed on zootechnical performance, the Ryan Joiner normality test was performed to verify normality. An analysis of variance was carried out in case of normality. Otherwise, the Kruskal Wallis non-parametric test was performed. When the probability was significant ($p < 0.05$), an average was structured using the SNK function of the "agricolae" package (de Mendiburu, 2021). The arithmetic means of EPG were calculated for each parasite. Differences between the EPG obtained for each parasite were analyzed using two-ways Analysis of Variance (ANOVA). Where significant variations were noted, Tukey-Kramer HSD post hoc test was performed. All analyzes were performed with R 3.5.1 software (R Core Team, 2018).

3. Results

Table 2 shows the growth performance characteristics of guinea fowls fed diets with graded levels of PLM. The result showed that there was no significant difference among all the treatments for the feed intake and FCR ($p > 0.05$). The incorporation of PLM in the diets led to a significant increase ($p < 0.01$) in daily weight gain compared to the control group.

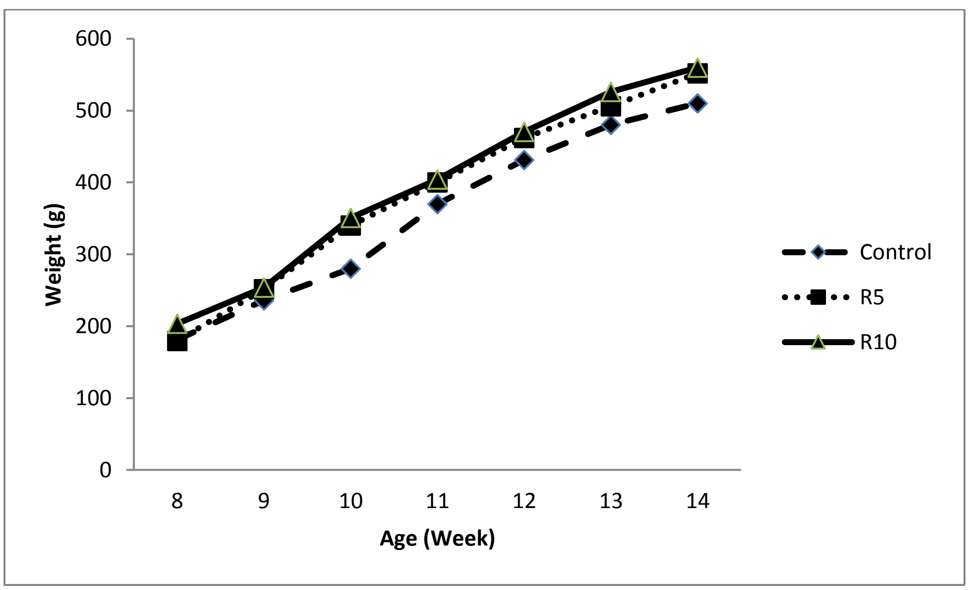

Fig. 1. Body weight evolution of guinea fowl.

Table 2
Zootechnical performance characteristics of guinea fowls fed diets with graded levels of PLM.

	Diets				
Parameters	**Control**	**R5**	**R10**	**F**	**P**
Feed intake (g/day)	$77.14^{a}\pm2.48$	$82.79^{a}\pm3.48$	$84.57^{a}\pm0.60$	2.43	0.130
Daily weight gain (g/day)	$7.72^{b}\pm0.08$	$8.07^{a}\pm0.08$	$8.09^{a}\pm0.06$	8.23	0.006
FCR	$6.15^{a}\pm0.31$	$6.05^{a}\pm0.15$	$6.00^{a}\pm0.27$	0.10	0.910

Letters on the same row compare the results of different treatments. Different letters show significant difference ($p < 0.05$).

Coprological analysis revealed in all the guinea fowls the presence of *Ascaridia spp*, *Eimeria spp*, *Heterakis spp* and *Syngamus spp.* The evolution of EPG of parasitics of guinea fowls fed diets containing varying levels of *C. papaya* leaf meal is as shown in figures 2, 3, 4 and 5. At the onset, all experimental groups had almost the same level of EPG count. The inclusion of PLM in the diets causes significant differences among treatments. The inclusion of PLM in the diets at 5% and 10% (R5 and R10) significantly decreased EPG count for *Ascaridia spp* ($p < 0.01$), *Eimeria spp* ($p < 0.001$), *Heterakis spp* ($p < 0.01$), *Syngamus spp* ($p < 0.01$) compared to control group.

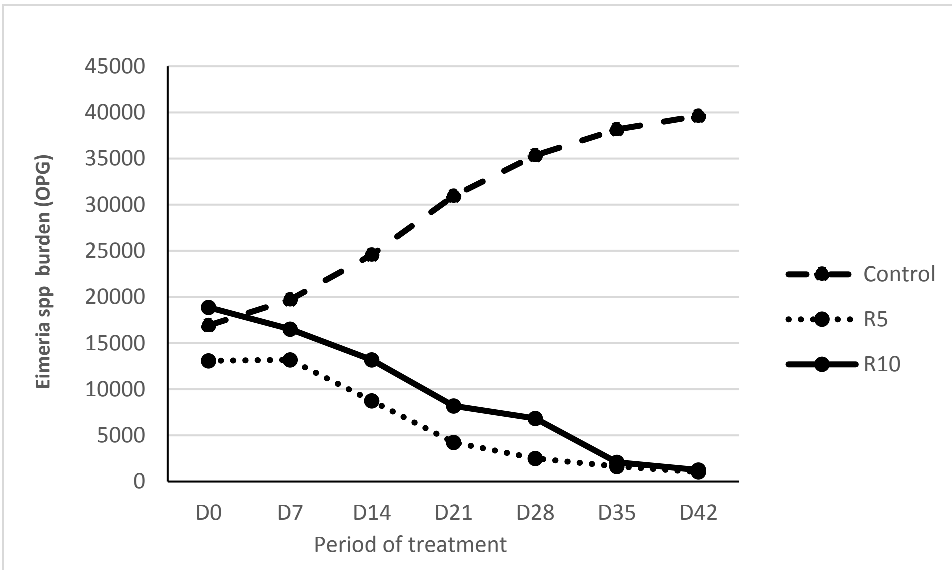

Fig. 2. *Eimeria spp.* count of guinea fowl fed diet containing varying levels of *C. papaya* leaf meal.

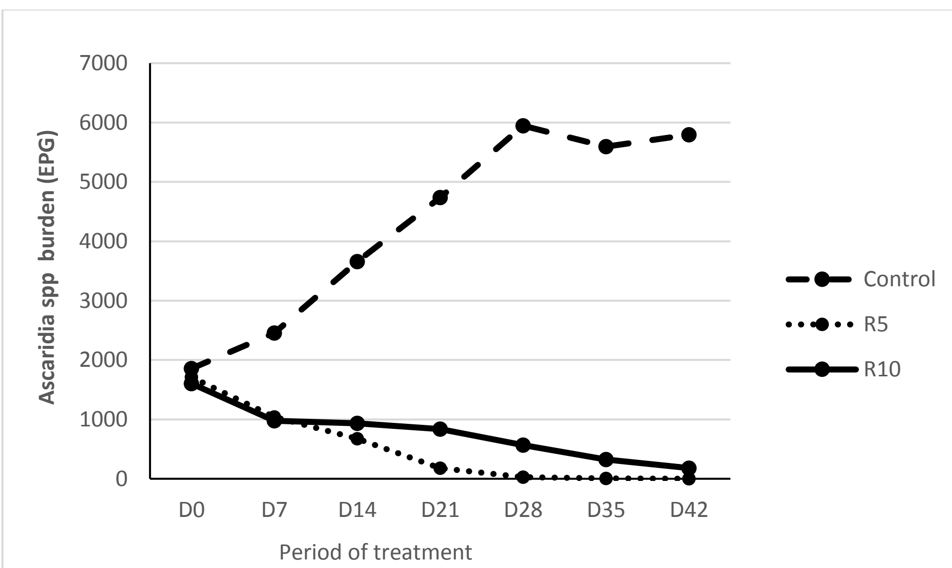

Fig. 3. *Ascaridia spp.* count of guinea fowl fed diet containing varying levels of *C. papaya* leaf meal.

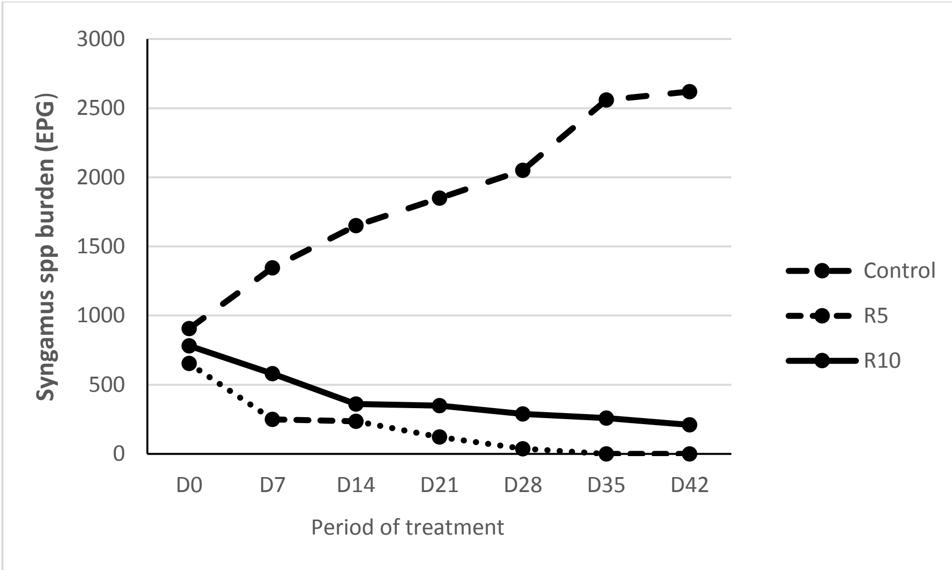

Fig. 4. *Syngamus spp.* count of guinea fowl fed diet containing varying levels of *C. papaya* leaf meal.

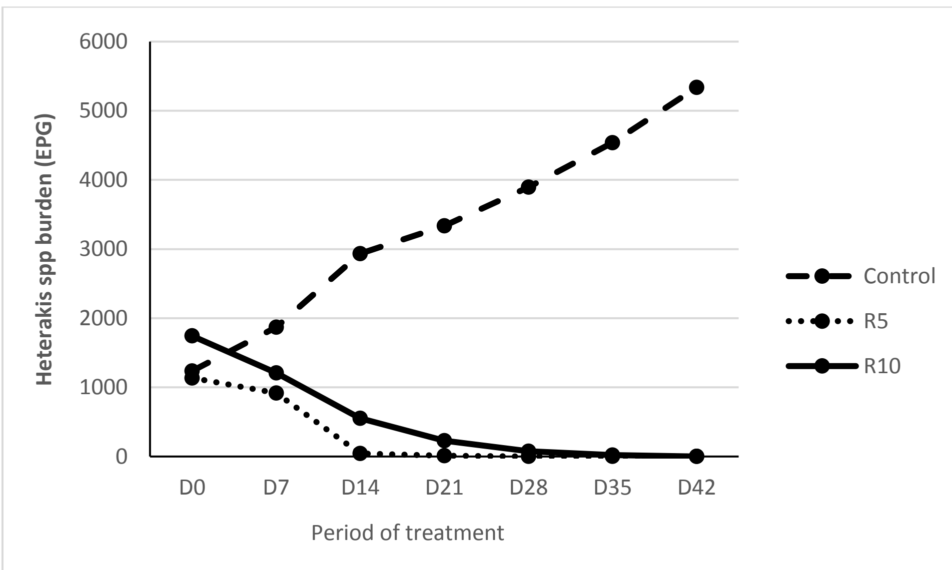

Fig. 5. *Heterakis spp.* count of guinea fowl fed diet containing varying levels of *C. papaya* leaf meal.

4. Discussion

Diets containing PLM significantly improved the growth performance of guinea fowls. This result is in agreement with the findings of Onigwe et al. (2014) and Abd-Elghany et al. (2021) who reported respectively an improvement of the weight gain in broilers with addition of papaya leaf extract in diet and in rabbits with addition of papaya leaf extract in diet.

The analysis of the different diets showed that the diets containing PLM had higher protein and energy contents than the control diet. PLM is therefore a good source of protein but also of energy. However, the same ingredients were used to prepare all the rations. Only the levels of soybean meal, palm kernel meal and cottonseed meal have been reduced in favor of the incorporation of PLM, used as a source of protein. The incorporation of 5% PLM gave the best energy and protein content. Since the other ingredients were not analyzed individually, we cannot discuss the results of the chemical composition of the experimental rations in the present study. In fact, the chemical composition of feed ingredients can be influenced by several factors. Thus, despite the appreciable content of soybeans in nitrogenous matter, they contain heat-labile or non-thermal antinutritional factors that reduce the nutritional value of all soybean proteins. The effect of heat on the inhibition of these antinutritional factors varies according to the mode and the duration of cooking. However, in the case of soybeans, as with all oilseeds, excessive treatments lead to problems of the digestibility of essential amino acids and, for some of them, losses through chemical modification (Quinsac et al., 2012; Carré, 2020).

The effect of PLM on growth could also be linked to the presence of phytochemicals which lead to a stimulation of digestive fluid secretion and decreased intestinal pH, which result in enhanced nutrient utilization efficiency (Ayodele et al., 2016). In addition, papain present in PLM, plays an important role in biological processes because of its ability to break down organic molecules made of amino acids which are crucial nutrients for growth (Kadiri et al., 2016).

Feed intake increased progressively in all groups with age. This increase may be the consequence of the growth of birds, which results in higher nutritional requirements (Hossain et al., 2016; Lombo et al., 2018).

The average body weight of the guinea fowls at 12 weeks recorded during this study was equal to 455 g and is lower than that reported by Dahouda et al. (2008) on station in guinea fowls of the same age (686.7 g in males and 695 g in females). This could be explained firstly by the fact that the guinea fowls were not subjected to the same diets. On the other hand, the hatching weights of the guinea fowls used for this study are not known. The hatching weight of guinea fowl, which is itself related to egg weight, influences weight growth (Sanfo et al., 2018).

The incorporation of PLM led to a modification of the energy and protein content of the diets, which could be the cause of the difference observed in the growth of the birds. According to Lombo et al. (2018), the reduction in energy content and the protein content kept balanced led to increased weight gain in guinea fowls. On the other hand, the reduction in the protein content of the feed led to a decrease in weight gain in them.

The average daily gains (8.07 g/day, 8.09 g/day, and 7.72 g/day obtained respectively with diets R5, R10 and Control) are higher than the average of 5.68 g/day reported by Dahouda et al. (2008) for the entire growing period.

Dahouda et al. (2008) reported a FCR equal to 8.85 for the entire growing period. This value of the FCR is higher than those found in this study whatever the group. However, these authors recorded better FCR values during the first three months after birth (2.8-4.7). They also indicated a fairly significant increase in this parameter to reach a maximum value (23.88) during the 6th month of age. The increase in this value in the 6th month could be the consequence of the slowdown in growth during this period.

The parasite species found in guinea fowl in this study are *Ascaridia spp*, *Eimeria spp*, *Heterakis spp* and *Syngamus spp*. These results confirm those reported by Dahouda et al. (2008) who also indicated the presence of these parasites in guinea fowl in Benin. PLM significantly reduced parasite load in guinea fowl regardless of parasite species. The antiparasitic effect of PLM would be due to the bioactive substances or secondary metabolites it contains. In fact, phytochemical analysis of *C. papaya* leaf extract revealed the presence of alkaloids, flavanoids, terpenes, tannins, phenols, glycosides, saponins, and steroids (Banjoko et al., 2020). The presence of these compounds has been reported in other studies with antiparasitic properties (Banjoko et al., 2020). PLM also contain benzyl isothiocyanate (BITC), which is proven with alkaloids to hold anti-protozoal and anti-amoebic properties (Sarker et al., 2010). According to Zhang and Chen (2017), The BITC is thought to be specifically responsible for the mitochondrial dysfunction of amoeba.

Saarinen et al. (2001) showed that the use of plant extracts could reduce oxidative stress in chickens, thus reducing lesions and delaying parasite development. In addition to the antioxidant and immunostimulant effects of plant extracts and in particular the saponins and tannins that these extracts contain, the cytotoxic effects of these substances can also be mentioned to explain the positive effects of plant extracts (Francis et al., 2002; Makkar, 2003).

5. Conclusion

The incorporation of *Carica papaya* leaves at 5 or 10% in guinea fowl feed resulted in improved weight gain while reducing the feed conversion ratio. They also reduced the shedding of parasite eggs. *Carica papaya* leaf meal (PLM) could therefore constitute a good source of dietary protein and an alternative to conventional anti-parasites used for treating digestive tract parasitosis in guinea fowl.

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