

Research Article



Effect of Gradual inclusions of *Dacryodes edulis* Pulp Cake in a Basal Diet for Common Guinea Fowl

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Abstract | The valorization of non-conventional feedstuffs, such as *Dacryodes edulis* oil cake, as a local source of crude protein, may be one way to improve poultry production, such as guinea fowl meat, in developing countries. The present study aimed to evaluate the effect of *Dacryodes edulis* oil cake by incorporating gradual amounts into the diets of common guinea fowl. The study involved sixty 4-week-old Hubbard broiler guinea fowl, randomly divided into three groups of 30 each. Diets contained 5% and 15% of *Dacryodes edulis* pulp cake during the growth phase, and 10% and 18% during the finishing phase. The guinea fowl were compared based on growth and economic parameters. The results showed that the incorporation of *Dacryodes edulis* meal at 15% in the growth phase and 18% in the finishing phase induced significant ($p < 0.05$) differences in all variables at the 5% threshold. In addition, the treatment significantly ($p < 0.05$) improved final live weight (1571g vs. 1400g), ADG (32g/d vs. 26g/d), voluntary feed intake (160g/d vs. 139g/d), and feed conversion ratio (4.8 vs. 5.3). The incorporation of *Dacryodes edulis* meal reduced feed costs by 8% and 9% in the growth and finishing phases, respectively, compared to the control. This study opens up interesting prospects for fruit and poultry farming in tropical zones.

Keywords | African pear, Feeding, Growth, *Numida meleagris*, Safou, Congo-Brazzaville

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INTRODUCTION

The guinea fowl (*Numida meleagris*) is a bird native to Central and Eastern Africa. It has a high resistance to diseases, is not very demanding in terms of its diet, and is highly prized for its meat and egg production. As an alternative to chicken, guinea fowl farming has already proven to be a cost-effective activity in the Congo. At the same time, guinea fowl and poultry farming have be-

come increasingly attractive, leading to a growing number of farmers around major cities, including Brazzaville and Pointe-Noire, as well as in most of the departments (DGE, 2023). Despite the interest in increasing meat production, Congolese farmers are limited by feedstuffs such as maize and soybean oil cake. Maize is the cereal most commonly used in the feed of meat guinea fowl, as it has a higher energetic value compared to other cereals (Dahouda *et al.*, 2008; Houndonougbo *et al.*, 2013). Maize is incorporated

up to 60% in poultry feed (Nguefack *et al.*, 2022). This percentage varies depending on the species (broiler or layer) or rearing phase (starter, grower, finisher, pullet, or layer).

Soybean meal is the most widely used ingredient in poultry diets due to its high crude protein content and fewer anti-nutritional factors compared to other meals. To promote indigenous livestock breeds, such as guinea fowl, which have high adaptability, it is necessary to use local feed resources suited to local climatic conditions, such as *Dacryodes edulis* oilcake waste. In fact, safou pulp cake is derived from the safou tree, an oleaginous fruit from which two types of cake can be obtained, depending on the part of the fruit used to extract the oil for kitchen and cosmetic purposes. Either the pulp cake (Adzona, 2019; Adzona *et al.*, 2023; Saboukoulou *et al.*, 2024a) or the safou seed cake (Saboukoulou *et al.*, 2024b) is produced. The pulp meal studied has a gross energy content of 2,500 kcal/kg and a crude protein content of 18% (Bratte, 2011; Onuegbu *et al.*, 2016; Agbalaya *et al.*, 2017; Ano *et al.*, 2018; Saboukoulou *et al.*, 2024a). This meal has already been successfully utilized in broilers and laying hens. Despite the interest in broiler chickens, most of the data have been extrapolated to guinea fowl. Based on this hypothesis, incorporating this meal into the feed of meat guinea fowl will improve their growth performance and reduce the high cost of feed due to the rising prices of corn and certain conventional cakes.

Table 1: Experimental design.

Experimental periods	Treatments	Code	Number
Growth period (28-56 days)	Diet containing 0% of <i>Dacryodes edulis</i> pulp oil cake	T0	30
	Diet containing 5% <i>D. edulis</i> pulp oil cake	T1	30
	Diet containing 15% <i>D. edulis</i> pulp oil cake	T2	30
Finishing period (57-84 days)	Diet containing 0% <i>D. edulis</i> pulp oil cake	T0	30
		T3	30
	Diet containing 10% <i>D. edulis</i> pulp oil cake	T4	30
	Diet containing 18% <i>D. edulis</i> pulp oil cake		

Therefore, the aim of this study was to evaluate the effect of variable doses of *Dacryodes edulis* pulp cake in diets of guinea fowl. This work supports the hypothesis that the incorporation of *Dacryodes edulis* pulp cake may improve the growth performance and the economic efficiency of guinea fowl.

MATERIALS AND METHODS

THE STUDY AREA

This study was conducted in Brazzaville, Republic of Congo, on an agricultural farm aimed at developing local re-

sources. It is located in Arrondissement 1, Makélékélé, specifically in the Diata district. Brazzaville has a humid tropical climate of the Bas-Congolese type, with mean annual temperatures around 25°C and slight temperature variations not exceeding 5°C. Maximum temperatures do not exceed 35°C, and minimum temperatures remain above 20°C (Samba and Moundza, 2007). Rainfall ranges from 1,400 to 1,600 mm. The climate is characterized by two rainy and two dry seasons: a long rainy season from October to December, a short rainy season from March to May, a long dry season from June to September, and a short dry season from January to February.

EXPERIMENTAL SETUP

This study involved 90 guinea fowl of Hubbard strain aged 4 weeks which were divided as follows Table 1. Before conducting the experiment, the guinea fowl were reared together for 4 weeks as previously described by Adzona (2019) and Saboukoulou *et al.* (2024a, 2024b). Permanent heating was provided by 100-watt bulbs, and the average temperature under the brooders ranged from 38°C to 32°C during the starting stage, in the mornings and evenings, respectively.

After the starting stage, the guinea fowl were transferred to another building. The experimental building was emptied, washed with bleach, and whitewashed. It was then partitioned into 3 compartments, each 3 m long and 1.2 m wide, using wire mesh. The *Dacryodes edulis* pulp cake used in this experiment was obtained through the process described in Figure 1. Diets contained 5% and 15% *Dacryodes edulis* pulp cake during the growth phase, and 10% and 18% during the finishing phase. The centesimal formulas for the diets during the growth and finishing phases are listed in Tables 2 and 3.



Figure 1: Daycryodes edulis oil cake process.

Table 2: Ingredients (%) and calculated chemical analysis of experimental diets for guinea fowl during the growth period.

Ingredients (%)	Control (0%)	T 1 (5%)	T 2 (15%)
Maize	35	30	26
<i>D. edulis</i> oil cake	0	5	15
Wheat bran	13	12	12
Cassava flour	14.5	15.5	135
Palm oil	4	4	4
Soybean meal	23	22	18
Fish meal	9	10	10
Calcium carbonate	1	1	1
NaCl	0.4	0.4	0.4
Vitamin-mineral complex*	0.1	0.1	0.1
Total	100	100	100
Calculated chemical analysis			
Metabolizable energy (Kcal/kg)	2975	2940	2956
MAT (%)	19.62	19.48	19.15
Lysine (%)	1.10	1.10	1.20
Methionine (%)	0.49	0.49	0.5
Cellulose (%)	3.85	4.11	4.5
Ca (%)	1.10	1.10	1.10
P (%)	0.60	0.60	0.60
Energy/MAT ratio	151.63	150.92	154.36

* Vitamin-mineral complex: Vitamin A: 10 M IU; Vitamin D3: 3 M IU; Vitamin E: 2500mg; Vitamin k3 :4000mg; Vitamin B1: 5000mg; Vitamin B2 :500mg; Vitamin B6: 2500mg; Vitamin B12: 5mg; Vitamin C: 10000 mg; Vitamin PP: 2000mg; Calcium pantothenate: 5000 mg; Biotin: 5mg; Folic acid: 250mg; trace elements : Iron; copper; zinc; manganese; cobalt; magnesium; sodium iodine: 70mg; potassium chloride: 15mg.

MEASUREMENTS OF GROWTH AND FEEDING PARAMETERS

Body live weight (BLW) was obtained by weighing each guinea fowl at the beginning of the experiment and then weekly using an electronic scale. The quantity of feed voluntarily consumed (VFI) was calculated using the following formula:

$$VFI = \frac{\text{Quantity distributed} - \text{Quantity refused}}{\text{Period duration}}$$

The Average daily gain (ADG) was calculated according to the following formula:

$$ADG = \frac{\text{Final weight} - \text{initial weight}}{\text{Period duration}}$$

The Feed efficiency (FE) was calculated as the ratio be-

tween the quantity of feed consumed over a period. It was calculated using the following formula:

$$FE = \frac{\text{Average feed intake}}{\text{Final weight} - \text{initial weight}}$$

Table 3: Ingredients (%) and calculated chemical analysis of experimental diets for guinea fowl during the finishing period.

Ingredients (%)	Control T0 (0%)	T3 (10%)	T4 (18%)
Maize	37	30	24
<i>D. edulis</i> pulp oil cake	0	10	18
Wheat bran	18	15	15
Coarse cassava flour	13.4	17	18
Palm oil	5	4.4	4.4
Soybean meal	15	11	9
Fish meal	10	10	10
Lysine	0.1	0.1	0.1
Limestone	1	1	1
NaCl	0.4	0.4	0.4
Vitamin-mineral complex*	0.1	0.1	0.1
Total	100	100	100
Calculated chemical analysis			
Metabolizable energy (Kcal/kg)	3060	3049	3070
MAT (%)	17.35	17.21	17.08
Lysine (%)	1.01	1.00	1.00
Methionine (%)	0.42	0.47	0.48
Cellulose (%)	4.23	4.55	4.85
Ca (%)	1.15	1.10	1.10
P (%)	0.55	0.50	0.58
Energy/MAT ratio	176.36	177.16	179.74

*Vitamin-mineral complex: Vitamin A: 10 M IU; Vitamin D3: 3 M IU; Vitamin E: 2500mg; Vitamin k3 :4000mg; Vitamin B1: 5000mg; Vitamin B2 :500mg; Vitamin B6: 2500mg; Vitamin B12: 5mg; Vitamin C: 10000 mg; Vitamin PP: 2000mg; Calcium pantothenate: 5000 mg; Biotin: 5mg; Folic acid: 250mg; trace elements: Iron; copper; zinc; manganese; cobalt; magnesium; sodium iodine: 70mg; potassium chloride: 15mg.

ECONOMIC PARAMETERS

According to the formula (diet composition), the price and quantity of each ingredient were included in the calculation of the production cost of 1 kg of feed, as indicated below: total cost of the ingredients divided by the number of kg produced. The calculation included all expenses such as baby guinea fowl, housing, equipment, feeding, electricity, water, healthcare, and labor. The production cost was calculated as total charges divided by the number of guinea fowl produced. All costs were expressed in FCFA. FCFA

is the local currency of the African Financial Community and 1 FCFA equals 0.0017 US dollars or 0.015 euros.

STATISTICAL ANALYSIS

The data obtained in this experiment were entered into Excel and then transferred to SAS (Statistical Analysis System, 2013). Feed type (Control T0, and treatments 1, 2, 3, and 4) was the only factor in the analysis of variance model. Fisher's F test was used to determine the significance of the treatment factor, and Student's t test was used to compare the means pairwise.

RESULTS AND DISCUSSION

EFFECT OF SAFOU PULP MEAL ON THE MORTALITY RATE OF GUINEA FOWL

A mortality rate of 5% (n = 1) was observed among birds in the control, treatment 1, and treatment 2 groups during the growing phase. This result is similar to the report of Saboukoulou et al. (2024b). The mortality rates observed in the growing stage were lower than those reported by Lombo et al. (2018), who evaluated the effect of feed on guinea fowl. They are also lower than those obtained by Dahouda et al. (2008), who carried out a comparative study on the performance of local guinea fowl both on station and in village settings. In contrast, no mortality was observed in any group during the finishing phase. These results corroborate those of Onuegbu et al. (2016), who studied broiler finishing by substituting safou seed with maize. They are also similar to those obtained by Adzona et al. (2023), who found no mortality in broilers during the finishing phase when incorporating *D. edulis* pulp cake. Furthermore, the results are better than those reported by Adzona and Banga-Mboko, (2017) and Saboukoulou et al. (2024b) in Congo Brazzaville, who evaluated the effect of separate energetic feeding on the growth performance of broiler guinea fowl.

EFFECT OF SAFOU PULP MEAL ON LIVE WEIGHT, ADG, VFI AND FE IN GROWING GUINEA FOWL

Table 4 presents data on body live weight, ADG, VFI and

FE of growing guinea fowl. This table shows that during the growth phase, the treatment produced a significant difference (P<0.05) in three parameters (live weight, VFI). These results corroborate Nguetack et al. (2022) who, by evaluating the protein levels of the ration on the performance of local pearl grey Guinea fowl in Cameroon from 0 to 8 weeks of age who obtained a significant difference on all variables. They are also close to Adzona et al. (2023) who, by valorizing *D. edulis* pulp cake on broilers in the growth phase, obtained a significant difference on all variables. However, they contrast to those obtained by Adzona and Banga-Mboko, (2017) in the growth phase where using separated feeding energetic feed did not obtain a significant difference on all variables.

In addition, the live weight of 968 g (in T2 group) is much higher than that of 600 g obtained by Houndonougbo et al. (2013), who evaluated the effect of source and amino acid content (lysine and methionine) on the economic performance of local grey guinea fowl.

With regard to ADG, that obtained in treatment 2 was also higher than that obtained by these authors, i.e. 26.14 g/d versus 12.23 g/d. This is due to the different guinea fowl strain and the safou pulp cake, which has an interesting protein and essential amino acid (lysine and methionine) content (Houndonougbo et al., 2013).

EFFECT OF SAFOU PULP MEAL IN FINISHING STAGE OF GUINEA FOWL ON LIVE WEIGHT, ADG, VFI AND FE

Table 5 presents data on *D. edulis* oil cake on live weight, ADG, VFI and FE of finishing stage on guinea fowl. From this study, a significant difference was observed at the 5% threshold in the finishing phase on all variables. These data corroborate Adzona et al. (2023) who evaluated *D. edulis* pulp cake on broilers in the finishing phase. They are also similar to those obtained by Adzona and Banga-Mboko (2017) who, when evaluating the effect of separate energetic feed on the growth performance of broiler guinea fowl, obtained a significant difference on all variables.

Table 4: Effect of gradual inclusion of *Dacryodes edulis* pulp oil cake in guinea fowl diets on live weight, average daily gain (ADG), voluntary feed intake (VFI) and feed efficiency (FE) during the growing stage.

Growth and feed parameters	Control T0 (0%)	T1 (5%)	T 2 (15%)	P value
Initial weight at start of growth (g)	282.33 ± 84.66	278. 5 ± 78.25	280.63 ± 55.27	>0.05
Final body weight (g)	824.66±240.36 ^a	800.89 ± 235.0 ^a	968 ± 330.22 ^b	0.03
Initial ADG (g)	12.76 ± 6.60	13.28 ± 9.43	13.14 ± 9.48	0.87
Final ADG (g)	28.71 ± 5.89	25.71 ± 9.01	26.4 ± 6.27	0.55
Initial voluntary feed intake (g/d)	38.09 ± 13.17	43 ± 12.22	45.28 ± 8.81	0.61
Final voluntary feed intake (g/d)	73.80 ± 7.31 ^a	84.58 ± 19.68 ^b	96.07 ± 9.36 ^c	0.03
Initial feed efficiency	3.36	3.23	3.46	0.63
Final feed efficiency	2.57 ^a	3.28 ^b	3.68 ^c	0.03

^{a-c} On the same line, two means with different superscript letters are significantly different at the 5% threshold.

Table 5: Effect of variable doses of *Dacryodes edulis* pulp meal in finishing guinea fowl diets on live weight, average daily gain (ADG), voluntary feed intake (VFI) and feed efficiency (FE).

Growth and feed parameters	T0 Control (0%)	T 3 (10%)	T 4 (18%)	P value
Initial weight (g)	982 ± 286.65 ^a	951.94 ± 195.22 ^a	1125.25 ± 323.92 ^b	0.02
Final weight (g)	1402.71 ± 412.79 ^a	1420.83 ± 211.99 ^a	1571 ± 485.58 ^b	0.02
Initial ADG (g)	22.47 ± 8.98	21.51 ± 6.44	22.42 ± 5.66	0.3
Final ADG (g)	26.15 ± 4.23 ^a	34.68 ± 8.12 ^b	32.85 ± 7.35 ^b	0.04
Initial VFI (g)	96.66 ± 9.42 ^a	115.87 ± 21.42 ^a	135 ± 27.62 ^b	0.03
Final VFI (g)	139.28 ± 11.65 ^a	148.41 ± 13.56 ^a	160 ± 25.26 ^b	0.02
Initial feed efficiency	4.30 ^a	5.6 ^b	5.91 ^c	0.04
Final feed efficiency	5.33 ^a	4.7 ^b	4.86 ^c	0.02

^{a-c} On the same line, two averages with different superscript letters, are significantly different at the 5% threshold.

However, the live weight and ADG were higher than those obtained by Adzona and Banga-Mboko (2017), Houndougbo *et al.* (2017). Similarly, they are also higher than those obtained by Dahouda *et al.* (2008) in finishing, i.e. 1571 g versus 1029 g, which used cassava pods and leaves in the Guinea fowl feed. These results obtained in the finishing stage of treatment are justified by the interesting energetic composition of the *Dacryodes edulis* seed cake, and also by the strain of guinea fowl used in this study. The VFI was higher than that obtained by Dahouda *et al.* (2008) and Adzona and Banga-Mboko (2017). The feed conversion ratio obtained in treatment 4 at 11th week of age was better than that obtained by (Adzona and Banga-Mboko, 2017) at the same age.

EFFECT OF *DACRYODES EDULIS* (SAFOU) PULP MEAL ON ECONOMIC PARAMETERS OF GUINEA FOWL

The results for the economic parameters are shown in Table 6. The economic analysis showed that incorporating *Dacryodes edulis* pulp cake at 15% in the growth phase and 18% in the finishing phase reduced the feed price by 9% and 10% respectively in the growth and finishing phases compared with the control. These results are better than those obtained by Adzona and Banga-Mboko (2017) in Congo Brazzaville.

Table 6: Effect of variable doses of *Dacryodes edulis* pulp cake in guinea fowl diet on the cost of feed and meat production.

Cost (F CFA)*	T0 (Control)	Treatments (1 and 2)	Treatments (3 and 4)
Growth feed	504	480	460
Finishing feed	483	445	435
Guinea fowl meat production cost	5775	5625	5325

*F CFA is a local money denominated African Financial French Community; 1 F CFA equals 0.0017 American dollar; 1 F CFA equals 0.015 Euro.

CONCLUSIONS AND RECOMMENDATIONS

The results obtained showed that the incorporation of safou oil cake in guinea fowl diets improved significantly body live weight, ADG, VFI and FE. In economic terms, the treatment reduced the price of feed for growth and finishing stages, as well as the cost of production and the selling price of guinea fowl. Therefore, the incorporation of 15% safou meal during the growing stage and 18% in the finishing phase is recommended.

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NOVELTY STATEMENTS

In our knowledge this paper reports for the first time the use of *Dacryodes edulis* oil Cake, non-conventional waste in guinea fowl diets

AUTHOR'S CONTRIBUTIONS

Prudence Pitchou Adzona and Alain Juste Saboukoulou: Wrote the research project, conducted the experimental design and wrote the article paper project.

Midrack Vincy Ntsoumou and Pronaldo Batonini: Collected the data of the experiment.

Henri Banga-Mboko and Issaka Youssao Abdou Karim: Supervised the experimented trial and the statistical analysis.

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