Research Article

Evaluating *Arachis pintoi* as a Forage Supplement in Diets for Growing Guinea Fowls (*Numidia meleagris*): Impacts on Nutrient and Energy Intake, Growth, and Profitability

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Abstract | A controlled feeding trial was conducted to evaluate the effects of supplementing Arachis pintoi in the basal concentrate diet of growing Guinea fowls. A total of 150 six-week-old birds were randomly assigned to five dietary treatments in a completely randomized design, with three replicates per treatment and ten birds per replicate. The treatments included a control group fed 100% commercial concentrate (Conc.100), and four experimental groups where the concentrate was reduced by 10%, 15%, 20%, and 25% (Conc.90, Conc.85, Conc.80, and Conc.75), with *Arachis pintoi* offered ad libitum in all but the control. The trial lasted 10 weeks and measured feed intake, growth performance, nutrient and energy consumption, and economic efficiency. The Conc.85 diet, which included 85% concentrate and ad libitum *Arachis pintoi*, emerged as the most effective treatment. Birds in this group recorded a dry matter intake of 102.4 g/day, crude protein intake of 27.4 g/day, ether extract intake of 5.9 g/day, and metabolizable energy intake of 275.2 kcal/day. This treatment also supported an average daily weight gain of 22.8 g/day, final body weight of 1,054 g, and carcass yield of 69.2%, values comparable to the control group but achieved at lower feed costs. The Conc.85 group demonstrated the highest feed cost savings and superior economic return per bird, without compromising performance. These findings indicate that replacing 10.0-15.0% of concentrate with *Arachis pintoi* offers a cost-effective strategy for maintaining optimal growth and maximizing returns in Guinea fowl production.

Keywords | Arachis pintoi, Feed intake, Guinea fowl, Growth rate, Meat performance, Profitability

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INTRODUCTION

Guinea fowl (*Numida meleagris*) are increasingly valued in poultry production due to their high-quality meat, characterized by elevated protein content, essential fatty acids, low cholesterol, and game-like flavour (Moreki, 2009). However, feed expenses typically account for 60-80% of total production costs, representing a major constraint to the economic viability of Guinea fowl farming (Adeyemo *et al*., 2006). To improve profitability and sustainability, identifying cost-effective, locally available feed resources is essential. Guinea fowl exhibit a strong preference for green forages, which can significantly contribute to their nutrient intake (Moreki, 2005). The Mekong Delta offers abundant forage resources that remain underutilized in commercial poultry diets. Previous study has demonstrated the potential of green forages such as water hyacinth and *Ipomoea aquatica* to partially replace concentrate feed without compromising growth performance (Linh, 2011). *Arachis pintoi*, a high-protein leguminous ground cover (16-22% CP), is widely grown in the Mekong delta of Vietnam and has shown promise as a forage crop in rabbits

(Dong and Thu, 2023a). This study aims to evaluate the effects of *Arachis pintoi* supplementation on feed intake, growth performance, and economic efficiency in meat-type Guinea fowl, thereby contributing to the development of more sustainable feeding strategies for smallholder poultry systems in the Mekong Delta.

MATERIALS AND METHODS

Location and time

The experiment was conducted in 2023 at the Experimental Animal Farm located in the Binh An area, Long Hoa ward, Binh Thuy district, Can Tho city. Feed samples were analyzed at the Laboratory of the Animal Science Faculty of Agriculture University.

Experimental animals

The experimental birds were medium-line p z`Xurebred Guinea fowls, originating from a parent stock imported from Hungary. The birds were produced and then, introduced into the experiment at the beginning of the 6th week of age, with an initial body weight ranging from 419 to 428 grams.

Experimental design

A total of 150 Guinea fowls were arranged in a completely randomized design (CRD) with five dietary treatments, corresponding to five different feed formulations. The control diet consisted of 100% concentrate (Conc.100). In the remaining four treatments, the level of concentrate feed was reduced by 10%, 15%, 20%, and 25% relative to the control (resulting in Conc.90, Conc.85, Conc.80, and Conc.75), while *Arachis pintoi* forage was provided *ad libitum*. There were three replications per treatment, with 10 birds per replicate unit.

The CONSORT-style flow diagram for guinea fowl assignment experment.

Enrollment

Total birds identified

n = 150

- Inclusion: Healthy birds suitable for study
- Exclusion: None (assuming all 150 birds meet criteria)

Random allocation

Randomly assigned to 5 treatments

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n = 150
 |-------------------------------------------------|---------------------------------------|
 |               |                 |                |
Treat. Conc 0  Treat. Conc.90 Treat. Conc 85 …... ……………..Treat. Conc 75
n = 30        n = 30        n = 30          n = 30
|-------------------|---------------------|---------------------|---------------------------|
Rep1 Rep2 Rep3  Rep1 Rep2  Rep3  Rep 1 Rep 2 Rep 3…--…Rep 1 Rep 2 Rep 3
n=10  n=10  n=10  n=10 n=10  n=10   n=10  n=10  n=10 …….. n=10  n=10  n=10
```

Table 1: Feed ingredient composition of the concentrate diet (% of DM).

Feed	Feed
Broken rice	Broken rice
Soybean meal	Soybean meal
Fish meal	Fish meal
Rice bran	Rice bran
Bone meal	Bone meal
Total	Total

Note: Premix, minerals, and vitamins were added at a rate of 0.3% in the concentrate diet.

Table 2: Chemical composition and nutritional values of concentrate used in the experiment (%, DM).

Item (%)	Concentrate
DM	87.7
OM	93.2
CP	20.1
EE	5.16
CF	4.14
NDF	10.4
ADF	6.68
Ash	6.83
ME (MJ/kg DM)	12.6

Housing and feeding

Birds were kept in elevated wire-mesh cages (1.2 m^2/unit). The concentrate diet (20% CP, 12.6 MJ/kg DM) was formulated from broken rice, soybean meal, fish meal, rice bran, and bone meal (Table 1). *Arachis pintoi* was chopped and fed fresh. Feed and forage were offered twice daily in separate feeders at 08:00 and 16:00; refusals were collected daily to calculate intake. Water was provided *ad libitum* throughout the trial.

Figure 1: *Arachis pintoi.*

Feed chemical analysis

Feed samples were analyzed for chemical composition prior to the experiment (Table 2). Chemical composition of feed samples including dry matter (DM), organic matter (OM), crude protein (CP), ether extract (EE), and ash was analyzed following AOAC (1990) procedures. Neutral detergent fiber (NDF) and acid detergent fiber (ADF) were determined according to Van Soest *et al.* (1991), and metabolizable energy (ME) was estimated by the formula (Janssen, 1989) as the followings: Broken rice and rice bran: ME = (46.7 x DM) – (46.7 x Ash) – (69.55 x CP) + (42.95 x EE) – (81.95 x CF), fish meal: ME = (35.87 x DM) – (34.08 x Ash) + (42.09 x EE) and soybean meal ME= (36.63 x CP) + (77.96 x EE) + (19.87 x NFE).

Figure 2: Guinea fowls fed *A. pintoi.*

Measurements

Body weights were recorded at the start, weekly, and at the end of the 10-week trial. Measured parameters included daily feed and nutrient intake (g/bird/day), final live weight, weight gain (g), feed conversion ratio (FCR) and survival rate. At the end of the experiment, representative live weight four birds (sexual balance) per experimental unit, were slaughtered for the evaluation of meat production. Carcass value and meat quality were assessed, and body measurements were recorded following the methodology described by Salomon (1996). Economic efficiency was evaluated based on total costs and income per treatment. Total cost included expenses for chicks, housing, feed, and veterinary care, while total income was calculated from the market value of birds at the end of the trial.

Statistical analysis

Data were processed using Excel (2018) and subjected to analysis of Variance (ANOVA) using Minitab 18.1 (2017). Treatment means were compared using Tukey's test at a 5% significance level.

RESULTS AND DISCUSSION

Chemical composition of experimental feeds

Chemical composition of feeds used in the experiment is presented in Table 3.

The chemical composition of *Arachis pintoi* showed a relatively low dry matter (DM) content (19%) but moderate crude protein (CP) concentration (17.3%) and metabolizable energy (ME) of 9.03 MJ/kg DM. These values are consistent with previous finding (Dong and Thu, 2018), who reported 17.5% CP and 9.02 MJ/kg DM when *A. pintoi* was evaluated as a forage supplement for rabbits. These results indicated that *A. pintoi* demonstrates potential as a green forage supplement due to its sufficient protein content and energy level, supporting its use as a partial replacement for conventional concentrates in poultry production systems (Moreki and Tiroesele, 2014; Ravindran *et al.*, 2016).

Table 3: Chemical composition and metabolizable energy (ME) of feed ingredients used in the experiment (% dry matter basis).

Item	Broken rice	Rice bran	Soybean meal	Fish meal	Bone meal	*A. pintoi*
DM	86.7	87.5	87.2	92.5	92.3	19.0
OM	99.1	90.3	93.0	75.2	35.9	89.3
CP	8.9	11.6	41.6	45.0	21.7	17.3
EE	2.86	12.9	3.06	12.6	5.0	3.50
CF	0.70	11.0	5.00	13.5	0.56	13.2
NDF	7.8	22.9	14.2	10.2	4.5	51.0
ADF	4.9	16.2	10.2	4.90	3.4	30.3
Ash	0.90	9.70	7.00	24.8	64.1	10.7
ME (MJ/kgDM)	14.0	10.6	11.3	10.1	5.46	9.03

DM: dry matter; OM: organic matter; CP: crude protein; EE: ether extract; CF: crude fiber; NDF: neutral detergent fiber; ADF: acid detergent fiber; ME: metabolizable energy (Janssen, 1989).

Feed and nutrient intake of guinea fowls

The nutrient and energy intake of Guinea fowl in different treatments is showed in Table 4.

The results demonstrate that the inclusion of *Arachis pintoi* (*A. pintoi*) forage significantly influenced feed intake patterns in Guinea fowls. As the proportion of concentrate feed decreased, birds significantly increased their intake of fresh *A. pintoi*, suggesting a compensatory mechanism to meet their nutritional requirements. This substitution effect aligns with the findings of Abbas *et al.* (2020), who observed similar adaptive behavior in poultry offered mixed diets with forage inclusion.

The highest dry matter (DM) intake was recorded in the Conc.100 group (63.1 g/bird/day), which gradually declined to 54.5 g/bird/day in the Conc.75 group ($P < 0.05$). Despite this reduction, total DM intake in all treatments exceeded the 45.6 g/bird/day reported by Saina (2005), indicating that *A. pintoi* can support comparable or improved feed intake levels when partially replacing conventional concentrate. Crude protein (CP) intake

Table 4: Daily feed and nutrient intake of guinea fowls (g/bird/day).

Item	Treatment					± SE	P
	Conc. 100	Conc. 90	Conc. 85	Conc. 80	Conc. 75		
Conc. (DM)	63.1^{a}	57.1^{ab}	53.8^{bc}	50.5^{bc}	47.3^{c}		
A. pintoi (fresh)	-	24.1^{b}	31.2^{ab}	36.1^{ab}	37.9^{a}	2.67	0.001
A. Pintoi (DM)	-	4.57^{b}	5.92^{ab}	6.85^{ab}	7.2^{a}	0.509	0.001
Total DM	63.1^{a}	61.2^{a}	59.7^{ab}	57.3^{ab}	54.5^{b}	1.45	0.011
OM	58.8^{a}	57.2^{a}	55.4^{ab}	53.2^{ab}	50.5^{b}	1.36	0.011
CP	12.7^{a}	12.3^{ab}	11.8^{ab}	11.3^{b}	10.8^{c}	0.294	0.007
EE	3.25^{a}	3.10^{ab}	2.98^{abc}	2.84^{bc}	2.69^{c}	0.076	0.003
CF	2.61^{c}	2.96^{ab}	3.01^{ab}	2.99^{ab}	2.91^{bc}	0.074	0.019
NDF	6.57^{b}	8.27^{a}	8.62^{a}	8.74^{a}	8.06^{a}	0.250	0.001
ADF	4.22^{b}	5.27^{a}	5.49^{a}	5.56^{a}	5.47^{a}	0.157	0.001
Ash	4.31	4.38	4.30	4.18	4.00	0.102	0.137
ME (MJ/kgDM)	0.796^{a}	0.761^{ab}	0.731^{abc}	0.698^{bc}	0.662^{c}	0.019	0.004

Different superscript letters within rows indicate significant differences (P<0.05). Conc.: concentrate feed, *A. pintoi: Arachis pintoi.*

followed a similar trend, with significantly higher values in Conc.100-85 groups (12.7-11.8 g/bird/day) and the lowest in Conc.75 (10.8 g/bird/day). These values were slightly higher than the CP intakes reported by Cuong (2011), who documented 11.3-11.4 g/bird/day for Guinea fowls aged 5-15 weeks. The increased protein intake in our study likely reflects the relatively high CP content of *A. pintoi* forage (17.3%), consistent with reports by Truc (2012) and validated by recent compositional analyses of tropical legumes (Nguyen *et al.*, 2023).

Fiber intake, particularly neutral detergent fiber (NDF) and acid detergent fiber (ADF), was significantly higher in treatments incorporating *A. pintoi* (P < 0.01). This is expected due to the higher fiber content of legumes compared to concentrate feed. Metabolizable energy (ME) intake declined significantly from 0.796 MJ/bird/day in the Conc.100 group to 0.662 MJ in the Conc.75 group (P < 0.05), consistent with the lower energy density of forage compared to concentrate. This finding is in agreement with Janssen (1989) who emphasized the critical role of energy-dense diets in sustaining growth performance in poultry.

The inclusion of *Arachis pintoi* forage significantly influenced feed intake patterns in Guinea fowls. As the level of concentrate feed decreased, birds increased their consumption of fresh *A. pintoi*, indicating a compensatory response to maintain nutrient intake. This substitution effect is consistent with findings by Abbas *et al.* (2020), who reported similar adaptive behavior in poultry offered forage-based diets.

Overall, *A. pintoi* forage can effectively replace up to 20% of concentrate in Guinea fowl diets without compromising DM or CP intake. Beyond this level, nutrient and energy intakes decline, potentially affecting performance. These results support the integration of locally available forages to reduce feed costs and improve sustainability in poultry systems (Makkar, 2020; Adekiya *et al.*, 2021).

Growth performance and feed conversion

The results presented in Table 5 show a significant influence of dietary treatment on daily weight gain and final live weight of Guinea fowls (P < 0.05), while feed conversion ratio (FCR) remained statistically unaffected (P > 0.05). Birds in the Conc.85-100 treatments exhibited the highest weight gains (17.7–18.1 g/day), significantly greater than those in Conc.80 and Conc.75, with the lowest gain observed in Conc.75 (16.6 g/day). These findings indicate that partial replacement of concentrate with *Arachis pintoi* forage up to 15% does not compromise growth performance. This is likely attributable to higher nutrient intakes, especially of DM, CP, and ME in the higher concentrate groups (Table 4).

The recorded daily weight gains are comparable to the 18.3 g/day reported by Huynh (2011), and exceed the 12.3 g/ day; 16.2-17.3 g/day, observed by Saina (2005) and Dong and Thu (2023b), respectively, for Guinea fowls under traditional feeding systems. Final live weights followed a similar pattern. The highest weights were observed in the Conc. 85-100 groups (1546-1566 g), while the Conc.75 group showed a significantly lower final live weight (1463 g; P < 0.05). Although numerical differences were observed in FCR (ranging from 3.30 to 3.55), these were not statistically significant (P > 0.05), suggesting that partial substitution of concentrate with *A. pintoi* did not compromise feed efficiency. The CP per kg of weight gain

Table 5: Daily weight gain, final live weight, and feed conversion ratio (FCR) of Guinea fowls in experiment.

Item	Treatment					± SE	P
	Conc. 100	Conc. 90	Conc. 85	Conc. 80	Conc. 75		
Initial weight (g/bird)	419	426	427	424	428	3.71	0.532
Final weight (g/bird)	1546[ab]	1559[a]	1566[a]	1514[b]	1463[c]	8.61	0.001
Weight gain (g/bird/day)	17.7[ab]	18.0[a]	18.1[a]	17.3[b]	16.6[c]	0.124	0.001
FCR	3.55	3.43	3.30	3.32	3.30	0.089	0.243
CP per gain (g/kg)	751	682	655	565	652	17.6	0.115
ME per gain (MJ/kg)	44.8	42.3	40.4	40.4	40.1	1.79	0.540
CP/ME	16.0[c]	16.1[b]	16.2[ab]	16.2[ab]	16.3[a]	0.022	0.001

Means in the same row with different superscripts (a, b, c) differ significantly at P < 0.05.

Table 6: Carcass values and internal organs of Guinea fowls over experimental treatments.

Item	Treatment					± SE	P
	Conc. 100	Conc. 90	Conc. 85	Conc. 80	Conc. 75		
Live weight, g	1577[ab]	1610[a]	1606[a]	1528[ab]	1489[b]	23.6	0.019
Carcass weight, g	1.106[ab]	1.137[a]	1.144[a]	1.070[ab]	1.027[b]	20.5	0.012
Carcass yield, %	70.1	70.6	71.2	70.3	69.0	0.71	0.314
Breast meat weight, g	254[ab]	272[a]	277[a]	252[ab]	232[b]	8.53	0.027
Breast meat yield, %	23.0	23.9	24.2	23.5	22.6	0.51	0.224
Thigh meat weight, g	285[ab]	292[a]	298[a]	271[ab]	256[b]	7.93	0.025
Thigh meat yield, %	25.8	25.7	26.0	25.3	24.9	0.57	0.659
Small intestine length, cm	95.7	91.4	94.0	97.7	91.3	4.26	0.797
Large intestine length, cm	13.2	12.9	13.0	12.8	12.1	0.84	0.909
Cecum length, cm	15.2	14.9	15.0	14.6	14.5	0.45	0.865

Means in the same row with different superscripts (a, b) differ significantly at P < 0.05.

decreased from 751 g in Conc.100 to 565 g in Conc.80, although differences were not statistically significant (P > 0.05). This suggests improved protein efficiency in treatments with moderate forage inclusion. Likewise, ME consumption per kg of gain decreased as concentrate levels declined.

The CP-to-ME ratio (g/MJ) increased significantly (P < 0.01) from 15.95 in Conc.100 to 16.27 in Conc.75. This indicates a relative shift toward more protein-dense energy utilization in the higher-forage diets. Given that *A. pintoi* contains moderate CP (17.3%) and high fiber (NDF: 51%), its inclusion likely enhanced protein supply while diluting dietary energy, as observed in previous studies (Makkar, 2018; Adekiya *et al*., 2021).

These findings collectively support the feasibility of incorporating *Arachis pintoi* into Guinea fowl diets at levels of up to 15-20% replacement of concentrate, without adverse effects on growth performance. Similar strategies to integrate legume forages into poultry systems for improved sustainability have been endorsed by Makkar (2020); Alemayehu *et al*. (2020) and recent works on indigenous feed resources in tropical systems (Nguyen *et al*., 2023), who emphasized the role of leguminous forages in improving the resilience and cost-effectiveness of poultry production.

Carcass traits evaluation

The highest carcass weight was observed in the Conc.90 and Conc.85 treatments (Table 6), while the lowest was in the Conc.75 treatment (P < 0.05). Similarly, breast meat and thigh meat weights were lowest in the Conc.75 treatment and highest in the Conc.85 treatment (P < 0.05). The obtained values for carcass weight, breast meat, and thigh meat weight, along with carcass yield and breast meat yield, were consistent with findings by Nhan (2012) in Guinea fowls, where carcass weight ranged from 1,036 -1,113 g, breast meat weight from 245-267 g, thigh meat weight from 255-276 g, carcass yield from 71.8-72.6%, and breast meat yield from 23.2-23.9%.

Nutrient composition of Guinea fowl meat in the experiment

The nutrient composition of Guinea fowl meat over the experimental treatments (Table 7) showed no significant differences in dry matter (DM), organic matter (OM), crude protein (CP), ether extract (EE), or ash content (P >

0.05). This indicates that varying levels of *A. pintoi* inclusion in the diet did not affect the nutritional profile of the meat. These results align with previous study (Cuong, 2011), suggesting that the protein and fat content in Guinea fowl meat remain stable despite dietary changes. The content of DM, CP and EE, ranging from 25.6-26.6%; 20.8% - 22.2% and 1.69-2.03%, respectively, aligns with findings from Nhan (2012); Hai and Dong (2014). Ash content also remained stable across treatments, supporting the conclusion that dietary adjustments, including *A. pintoi*, do not significantly affect meat quality. These findings indicate that *A. pintoi* can be incorporated into Guinea fowl diets without compromising meat quality, offering a viable alternative feed ingredient for producers.

Table 7: The nutrient composition of Guinea Fowl meat (% in fresh form).

Item. %	Treatment					± SE	P
	Conc. 100	Conc. 90	Conc. 85	Conc. 80	Conc. 75		
DM	26.6	25.6	26.4	25.9	26.3	0.35	0.340
OM	98.1	98.2	97.8	98.1	97.5	0.28	0.142
CP	21.5	21.8	20.8	22.2	21.3	0.53	0.492
EE	1.80	1.69	1.91	2.03	1.71	0.20	0.426
Ash	1.91	1.85	2.22	1.90	2.49	0.27	0.136

Throughout the rearing period, Guinea fowls exhibited a high survival rate and good growth performance. Between 6 and 15 weeks of age, there were virtually no incidences of disease, and the survival rate remained at 100% across all five experimental treatments. This suggests that Guinea fowls are well-adapted to the climate conditions of the Mekong Delta and possess strong disease resistance.

In overall the improvement of final live weight, daily weigh gain and carcass yield without compromising the meat quality by *A. pintoi* supplementation in the Conc. 85 and 90 treatments could be impacted by the mechanisms of nutritional balancing, intake optimization, protein and energy supplementation, fiber-mediated digestion and better gut health, which were indicated by Lisanne *et al.* (2016), Sossidou *et al.* (2015), Tufarelli *et al.* (2018) and Sojinou *et al.* (2024).

Economic analysis

Economic analysis (Table 8) revealed that the highest total expenses were observed in the Conc.100 treatment, while the lowest costs were found in the Conc.75 treatment due to differences in feed cost. Despite this, the highest income from chicken sales occurred in the Conc.85 treatment, resulting in the highest profit of 3.20 USD/chicken. This also indicated that the Conc. 85 treatment could be considered for recommendations with more utilization of locally cheap *A. Pintoi* in the remote villages.

Table 8: The economic analysis of the Guinea fowl supplemented *Acrachis pintoi (USD/bird).*

Item	Treatment				
	Conc. 100	Conc. 90	Conc. 85	Conc. 80	Conc. 75
Total cost	4.61	4.49	4.43	4.36	4.28
Concentrate	1.61	1.46	1.39	1.32	1.24
A. pintoi	0	0.036	0.038	0.039	0.042
Vet med.+ Vaccin	0.20	0.20	0.20	0.20	0.20
Chick	2.80	2.80	2.80	2.80	2.80
Total income	7.31	7.41	7.45	7.19	6.99
Profit	2.70	2.92	3.02	2.84	2.71
% profit to Conc. 100	100	108	112	105.2	100.5

Price: Concentrate feed (0.32 USD/kg), *A. pintoi* (0.024), chick (2.80 USD/chick) and live chicken (4.40 USD/kg).

CONCLUSION AND RECOMMENDATION

Arachis pintoi is a viable green feed ingredient for Guinea fowl diets. Reducing concentrate feed by 10.0–15.0% and incorporating *A. pintoi* in the diet improves weight gain, final live weight, and carcass traits of the Guinea fowl while yielding the highest profit. This suggests *A. pintoi* as an economically feasible and nutritionally beneficial feed option for Guinea fowl production.

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NOVELTY STATEMENT

This research work could be the first one to feed poultry *Arachis pintoi* for seeking the novelty in poultry sciences.

AUTHOR'S CONTRIBUTION

NTKD conceived, designed and performed the experiments, analyzed the data. NTKD and NVT wrote the paper. All authors reviewed and approved the final manuscript.

Generative AI and AI-assisted technology statement

No generative AI or AI-assisted technologies were used in this research, analysis, writing, or preparation of this manuscript. All content of it was done by the authors.

Conflict of interest

The authors have declared no conflict of interest.

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