Effects of Dietary Purple Maize on Growth Performance, Health Status, and Meat Quality of Ross 308 Broiler Chickens

Abstract

Premise of Research: This study aimed to evaluate the effects of incorporating anthocyanin-rich purple maize into the diet of Ross 308 broiler chickens and to assess its potential as an alternative to conventional yellow maize.

Methodology: A total of one hundred and fifty (150) one-day-old Ross 308 broiler chicks were randomly allocated to two groups of 75 birds each: a control group fed a yellow maize-based diet and an experimental group fed a diet containing purple maize. Zootechnical performance, health status, and the organoleptic quality of the meat were evaluated over a 35-day rearing period.

Pivotal Results: At the end of the trial, the average live body weight was 1518.7 ± 32.3 g in the control group and 1445.0 ± 28.0 g in the experimental group. The average daily gain was 42.42 ± 0.10 g/day and 34.25 ± 1.43 g/day, respectively, while the feed conversion ratio was 4.0 ± 0.12 and 4.3 ± 0.43. Mortality and morbidity rates remained low in both groups. Despite these numerical differences, no statistically significant differences ($P > 0.05$) were observed between treatments in terms of growth performance or health status. However, the inclusion of purple maize significantly improved the organoleptic characteristics of the meat.

Conclusion: Purple maize can be used as an alternative energy source in broiler diets without adversely affecting growth performance or health status, while improving the sensory quality of the meat.

Key words: Broiler chicken; Purple maize; Growth performance; Health parameters; Meat quality;

Introduction:

Broiler production has become one of the main contributors to global food security by providing an affordable and high-quality source of animal protein (Mottet and Tempio, 2017). In sub-Saharan Africa, as in many other parts of the world, the poultry industry has increasingly shifted toward intensive production systems to meet the rapidly growing demand for poultry meat driven by population growth and urbanization (Mottet and Tempio, 2017; Erdaw and Beyene, 2022). Poultry meat is widely appreciated because of its short production cycle, high nutritional value, affordability, and broad consumer acceptance, largely due to the absence of major religious restrictions on its consumption (Métayer-Coustard et al., 2019; Mottet and Tempio, 2017).

Despite its remarkable growth, the poultry sector faces significant challenges that threaten its sustainability and profitability. Feed accounts for the largest proportion of production costs (Bergeron et al., 2026), while the widespread use of antibiotic growth promoters has accelerated the emergence of antimicrobial resistance, raising serious concerns for both animal and public health (Kimera et al., 2020). Consequently, many countries have introduced strict regulations or complete bans on the use of antibiotics as growth promoters in livestock production (Kimera et al., 2020; Touzani et al., 2021; Odey et al., 2024). At the same time, the rising cost of conventional feed ingredients has further increased production expenses, highlighting the urgent need for safe, sustainable, and economically viable alternatives.

In recent years, considerable attention has been directed toward locally available feed resources with functional and bioactive properties because of their ability to improve animal performance while promoting health and reducing dependence on synthetic feed additives (Righi et al., 2021; Kadjo et al., 2026). Among these resources, purple maize (Zea mays L.) has emerged as a promising candidate. This traditional maize variety is cultivated mainly in the central-northern region of Côte d'Ivoire, particularly in the Katiola Department, where it represents approximately 47% of the maize varieties grown. Locally known as "Violet de Katiola", it is highly valued for its sensory qualities and its long-recognized medicinal properties (Kouakou et al., 2010).

Purple maize is distinguished by its exceptionally high concentration of anthocyanins, a class of polyphenolic compounds with potent antioxidant and free radical-scavenging activities (Cai et al., 2023). Increasing evidence suggests that these bioactive compounds exert multiple physiological benefits, including improvements in blood circulation, antioxidant status, and overall health (Cao et al., 2026; N'da et al., 2023). Although recent studies have characterized the agromorphological and molecular diversity of this indigenous genetic resource (N'da et al., 2023), its nutritional and functional value in poultry feeding remains largely unexplored.

The scarcity of scientific evidence regarding the incorporation of purple maize into broiler diets raises important questions about its potential to replace conventional yellow maize without compromising productive performance, while simultaneously improving the physiological and health status of birds. The aim of this study was to investigate the effects of dietary purple maize on the growth performance and health status of broiler chickens.

Material and methods:

Biological Materials

A total of 150 one-day-old Ross 308 broiler chicks, with an average initial body weight of 40.0 ± 1.2 g, were used. Purple maize was purchased from the Katiola local market in northern Côte d'Ivoire, whereas yellow maize was obtained from Korhogo commercial supplier. Experimental diets were formulated using either yellow maize or purple maize as the principal energy source.

Diet Formulation and Feeding

Yellow maize and purple maize were used as the primary energy sources in the experimental diets. During the starter phase (day 0-21), birds were fed diets containing 50% maize (yellow or purple, depending on the treatment) and 50% KBC® (Koudijs Broiler Concentrate). During the grower phase (day 22-28), the diets consisted of 66.5% maize and 33.5% KBC®. During the finisher phase (day 29-35), the maize inclusion level was increased to 75%, while the KBC® proportion was reduced to 25%. Feed was prepared before each feeding period and offered twice daily during the cooler hours of the day. Birds had free access to feed and drinking water throughout the experimental period.

Proximate Analysis of Experimental Diets

Samples (300 g) of each experimental diet were collected for proximate chemical analysis to determine their nutritional composition. Moisture, crude protein, crude fat, crude fiber, ash, and other nutritional components were analyzed according to the official methods of the Association of Official Analytical Chemists (AOAC, 2023).

Experimental Management

The experiment was conducted in an open-sided poultry house located in Korhogo, northern Côte d'Ivoire, over a five-week rearing period. Birds were stocked at a density of 10 birds m^{-2}. The chicks were randomly allocated to two dietary treatments: a control group (T), which received the diet based on yellow maize, and an experimental group (E), which received the diet containing purple maize. Each treatment consisted of three replicates of 25 birds, giving a total of 75 birds per treatment. Feed and fresh drinking water were provided ad libitum throughout the trial. All birds were managed under identical environmental conditions, and standard sanitary and veterinary prophylactic measures, including vaccination and disease prevention practices, were implemented during the experimental period.

Growth Performance Measurements

Growth performance was evaluated throughout the 35-day experimental period. Birds were individually weighed at the beginning of the trial and subsequently at weekly intervals until the end of the experiment. Feed offered and feed refusals were recorded daily for each replicate to determine feed consumption. These values allowed us to calculate the average daily gain (ABW, g), the Average daily gain (ADG, g day^{-1}), the Average daily feed intake (ADFI, g $bird^{-1}$ day^{-1}), and the Feed conversion ratio (FCR).

Health Status Assessment

Daily clinical observations were performed to detect any signs of disease or abnormal behavior. The health status of broiler chickens was monitored throughout the experimental period by recording morbidity and mortality rates. These indicators were used to calculate the Health Risk Index (HRI) according to Pattison et al. (2008).

Sensory Evaluation

At the end of the feeding trial, breast meat samples were collected from birds in each treatment group for sensory evaluation. The breast muscles were cooked in boiling water without seasoning until fully cooked. After cooling to room temperature, the meat was cut into uniform portions (30 g) and randomly coded to prevent sample identification bias. The sensory evaluation was conducted by a panel of 15 untrained assessors, comprising eight females and seven males, with a mean age of 22 years. The evaluation took place in a quiet, well-lit room under standardized conditions. Samples were presented to each assessor in a randomized order. Drinking water was provided between successive samples to cleanse the palate and minimize carry-over effects. The sensory attributes evaluated included appearance, aroma, flavour, texture, and overall preference. Each attribute was scored using a five-point hedonic scale ranging from 1 ("dislike extremely") to 5 ("like extremely").

Statistical Analysis

Prior to statistical analysis, data were tested for normality using the Shapiro–Wilk test and for homogeneity of variances using Levene's test. Growth performance variables, including average body weight (ABW), average daily gain (ADG), average daily feed intake (ADFI), and feed conversion ratio (FCR), were analyzed using Student's t-test to compare the two dietary treatments. Health-related variables as well as sensory evaluation scores were analyzed using the G-test (likelihood ratio chi-square test), which is appropriate for the analysis of categorical data. Differences between treatments were considered statistically significant at $P < 0.05$. All statistical analyses were performed using R software.

Results and discussion

Nutritional composition of the experimental diets

The experimental diets formulated with yellow maize and purple maize exhibited comparable nutritional compositions (Table 1), allowing a direct comparison of the effects of the two maize sources.

The gross energy content of the diets remained relatively similar throughout the different rearing phases. During the starter phase (0-21 days), gross energy was 3000 kcal/kg for the yellow maize-based diet and 3005 kcal/kg for the purple maize-based diet. During the grower phase (22-28 days), the corresponding values were 3067 and 3018 kcal/kg, respectively. In the finisher phase (29-35 days), the purple maize diet exhibited higher gross energy content (3203 kcal/kg) than the yellow maize diet (3100 kcal/kg). These differences were minor and were mainly attributable to the intrinsic nutritional characteristics of the two maize varieties.

The crude protein content gradually decreased across the successive rearing phases in both diets, reflecting the declining protein requirements of broiler chickens as growth progressed. In the yellow maize diet, crude protein decreased from 24.50% during the starter phase to 19.33% during the grower phase and 16.75% during the finisher phase. Comparable values were obtained for the purple maize diet, with crude protein contents of 23.95%, 19.52%, and 16.68%, respectively. Although the crude protein content of the purple maize diet was slightly lower during the starter phase, it became slightly higher during the grower phase. Overall, the protein levels of both diets complied with the nutritional recommendations for broiler chickens.

The concentrations of essential amino acids also declined with advancing age. Lysine content decreased from 1.60% to 0.95% in the yellow maize diet and from 1.63% to 1.05% in the purple maize diet. Similarly, methionine concentrations decreased from 0.65% to 0.48% in the yellow maize diet and from 0.67% to 0.51% in the purple maize diet. Regardless of the rearing phase, the purple maize diet consistently contained slightly higher levels of lysine and methionine than the yellow maize diet.

Phosphorus and calcium contents also declined progressively from the starter to the finisher phase. In the yellow maize diet, phosphorus decreased from 0.53% to 0.41%, while calcium declined from 0.78% to 0.72%. In the purple maize diet, phosphorus ranged from 0.49% to 0.43%, whereas calcium decreased from 0.74% to 0.69%. Despite these variations, the mineral concentrations in both diets remained within the recommended nutritional requirements for broiler chickens at the different stages of growth.

Overall, both experimental diets met the nutritional requirements of broiler chickens. The progressive increase in dietary energy content, together with the gradual reduction in crude protein, essential amino acids, and mineral concentrations throughout the rearing period, reflects the nutritional adjustments commonly recommended to meet the changing physiological requirements of growing broilers.

Growth performance

The evolution of broiler live body weight showed a steady increase in both treatment groups throughout the experimental period (Figure 1). At one day of age, the mean body weight was 40.1 ± 1.3 g in the control group and 40.0 ± 1.2 g in the experimental group. Body weight increased progressively throughout the rearing period. At the end of the trial, broilers fed the yellow maize-based diet reached a mean body weight of 1518.7 ± 32.3 g, compared with 1445.0 ± 28.0 g for those fed the purple maize-based diet. Statistical analysis revealed no significant difference between the two treatment groups ($P > 0.05$), indicating that replacing yellow maize with purple maize did not impair broiler growth performance. These findings differ from those reported by Luo et al. (2022), who observed a significant increase in body weight following supplementation with a concentrated purple maize anthocyanin extract. This discrepancy may be explained by differences in the nature of the dietary treatments. In the present study, whole purple maize grain was used as the primary energy source, whereas Luo et al. used a highly concentrated anthocyanin extract, which is likely to exert more pronounced biological effects.

The average daily gain (ADG) of broiler chickens followed a similar pattern in both treatment groups throughout the experimental period (Figure 2). During the first two weeks of rearing, the experimental group recorded slightly higher ADG values than the control group. In the first week, ADG was 5.62 ± 0.13 g/day in the control group and 5.90 ± 0.48 g/day in the experimental group. During the second week, the corresponding values increased to 56.39 ± 0.79 g/day and 57.89 ± 0.74 g/day, respectively. In the third week, this trend was reversed, with the control group exhibiting a higher ADG than the experimental group (53.89 ± 1.71 vs. 49.21 ± 2.64 g/day). During the fourth week, both treatments showed comparable growth performance, with ADG values of 46.39 ± 1.43 g/day for the control group and 47.21 ± 1.00 g/day for the experimental group. In contrast, during the fifth week, the control group maintained a higher ADG (42.42 ± 0.10 g/day) than the experimental group (34.25 ± 1.43 g/day). However, despite these numerical variations throughout the rearing period, no statistically significant difference was observed between the two treatments ($P = 0.10$). These variations may be related to the nutritional characteristics of purple maize. Indeed, several studies have demonstrated that differences in digestibility among maize varieties directly influence growth performance (Rochell et al., 2023). Maize varieties with higher amylopectin content generally exhibit greater starch digestibility, whereas higher amylose content slows starch digestion and reduces the efficiency of energy utilization (Xu et al., 2025).

Feed conversion ratio and feed intake

The feed conversion ratio (FCR) remained similar between the two treatment groups (Fig.3), with values of 4.00 ± 0.12 for the control group and 4.32 ± 0.43 for the purple maize group ($P > 0.05$). However, these values were higher than those typically reported for modern broiler chickens (1.5-1.9), suggesting that factors other than the type of maize, particularly the overall dietary energy formulation or the rearing conditions, may have limited feed efficiency. This interpretation is consistent with the findings of Afolabi et al. (2024) and Attakpa et al. (2019), who reported that the overall nutritional quality of the diet has a greater influence on feed conversion ratio than the source of cereal used.

Feed intake increased progressively with age in both dietary treatments (Table 2). During the fifth week, broilers fed the yellow maize-based diet consumed an average of 169.23 ± 4.77 g/day, compared with 147.54 ± 8.46 g/day for those fed the purple maize-based diet. There is no statistical significant difference between treatments ($P > 0.05$). This slight reduction in feed intake may explain the slightly lower average daily gain (ADG) observed in broilers fed the purple maize diet, while also indicating that purple maize maintained good palatability.

Health status

Health indicators remained satisfactory throughout the rearing period (Table 3). A mortality rate of only 1.33% was observed in the group fed the purple maize diet, compared with no mortality in the control group, while morbidity was slightly lower in the purple maize group (4.0% vs. 5.33%). The health risk index remained identical in both groups (5.33%), with no statistically significant difference ($P > 0.05$). These results indicate that the inclusion of purple maize had no detrimental effect on animal health. They are consistent with the findings of Luo et al. (2022, 2025), who demonstrated that anthocyanins from purple maize enhance antioxidant capacity and certain immune parameters in broiler chickens, thereby supporting good health status without adversely affecting growth performance.

Organoleptic quality of meat

The sensory evaluation (Table 4) revealed a significantly better appearance of meat from broilers fed the purple maize-based diet ($P = 0.018$), whereas no significant differences were observed for aroma, flavor, or texture ($P > 0.05$). However, the preference test showed that 72.73% of the panelists preferred meat from broilers fed purple maize, compared with only 27.27% for those fed yellow maize. The higher consumer acceptability may be attributed to the high anthocyanin content of purple maize, which is well known for its potent antioxidant properties. By limiting the oxidation of lipids and muscle proteins, these bioactive compounds help preserve meat color, tenderness, juiciness, and overall sensory quality after slaughter (Luo et al., 2022; Tian et al., 2025). In addition, anthocyanins improve the antioxidant status and muscle metabolism of poultry, thereby enhancing both the technological and organoleptic quality of the meat.

Conclusion

The results of this study demonstrate that replacing yellow maize with purple maize does not significantly affect the growth performance or health status of Ross 308 broiler chickens. However, it improves the sensory acceptability of the meat, highlighting the potential of purple maize as a functional feed ingredient capable of adding value to poultry products through its high content of anthocyanins and other bioactive compounds

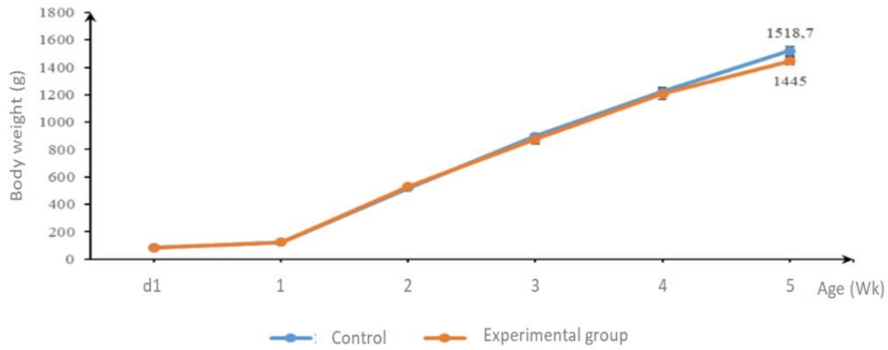

Figure 1: Mean body weight of broiler chickens as a function of age

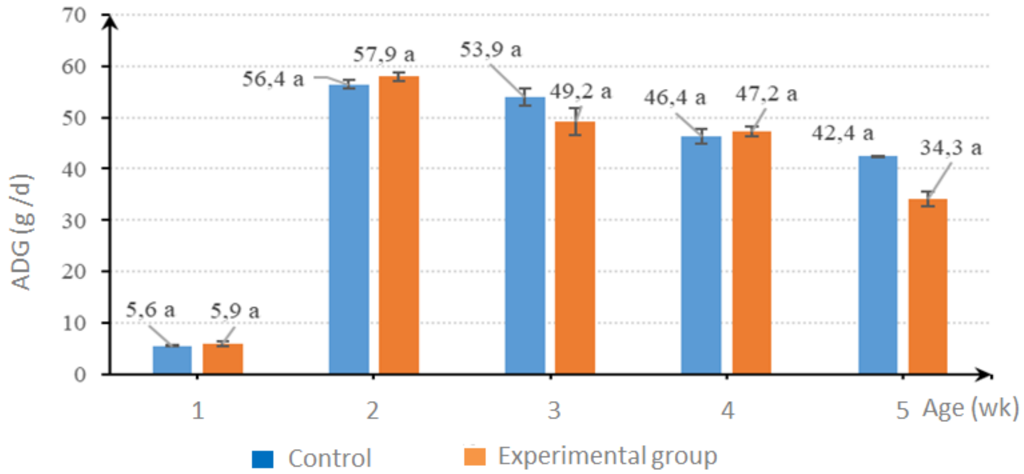

Figure 2: Changes in average daily gain (ADG) of broiler chickens with age

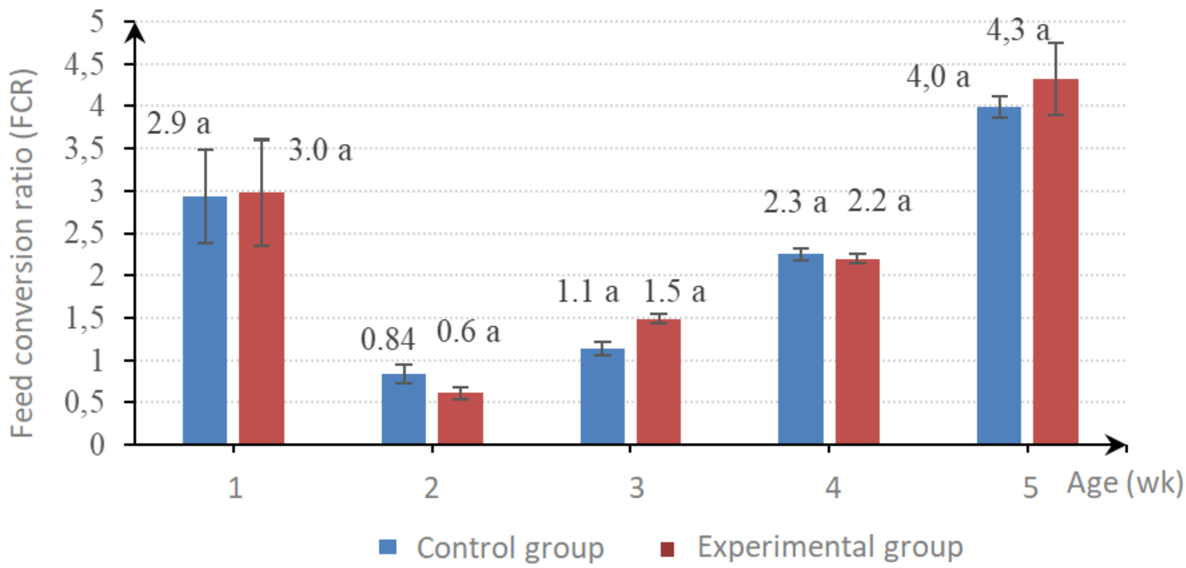

Figure 3: Feed conversion ratio (FCR) of broilers fed yellow and purple maize diets

Table 1: Composition and nutritional value of the experimental diets

	Starter (0-21d)		Grower (22-28d)		Finisher (29-35d)	
Composition	Yellow maize	Purple maize	Yellow maize	Purple maize	Yellow maize	Purple maize
Maize	50%		66.5%		75%	
KBC	50%		33.5%		25%	
Nutritional values						
Energy (kcal)	3000	3005	3067	3018	3100	3203
Crudeprotein (%)	24.5	23.95	19.33	19.52	16.75	16.68
Lysine (%)	1.6	1.63	1.17	1.21	0.95	1.05
Methionine (%)	0.65	0.67	0.53	0.58	0.48	0.51
Phosphorus (%)	0.53	0.49	0.45	0.46	0.41	0.43
Calcium (%)	0.78	0.74	0.75	0.71	0.72	0.69

Table 2: Daily feed intake (DFI, g/day) of broiler chickens fed different dietary treatments

Age (Wk)	Control group (g/day)	Experimental group (g/day)	P-value
1	16.53 ± 3.47	17.83 ± 5.17	0.621
2	47.38 ± 6.62	35.21 ± 4.79	0.688
3	72.26 ± 6.74	73.32 ± 6.68	0.99
4	104.44 ± 5.56	104.08 ± 4.92	0.72
5	169.23 ± 4.77	147.54 ± 8.46	0.481

Table 3: Health indicators recorded at each rearing stage of broiler chickens

		Groups			
Period	Parameter	Control	Experimental	LRS	P-value
1-21 d	Number of birds	75	75		
	Mortality (%)	0	1.33	1.84	0.17
	Morbidity (%)	5.33	4.0	0.19	0.66
	Health risk index (%)	5.33	5.33	0	1
22-28 d	Number of birds	75	74		
	Mortality (%)	0	0	0	1
	Morbidity (%)	0	0	0	1
	Health risk index (%)	0	0	0	1
29-35 d	Number of birds	75	74		
	Mortality (%)	0	0	0	1
	Morbidity (%)	0	0	0	1
	Health risk index (%)	0	0	0	1
Overall 1-35 d	Number of birds	75	75		
	Mortality (%)	0	1.33	0	0.17
	Morbidity (%)	5.33	4.0	0	0.66
	Health risk index (%)	5.33	5.33	0	1

Table 4: Sensory characteristics of meat from broilers fed yellow or purple maize-based diets

Characteristics	Yellow maize diet	Purple maize diet	P-value
Appearence	2	3	0.018
Arma	2	3	0.054
Flavor	2	3	0.158
Texture	3	3	0.298
Preference	3 (27.27%)	8 (72.73%)	0,001

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