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Research Article

Intestinal Morphologic Response to Spiny Amaranth (*Amaranthus spinosus*) Leaves as a Dietary Supplement for Sasso Chickens (*Gallus gallus*)

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Abstract

The objectives of the study were to determine the effects of varying levels (%) (0, 5, 10, and 15) of spiny amaranth leaves in the diet of Sasso broilers, a free-range type of chicken. Further, the proximate composition of diets, growth production and carcass quality parameters, and intestinal morphology were assessed in a feeding trial. A total of 120 Sasso broilers were randomly assigned in four treatments following Completely Randomized Design (CRD); each treatment had three replications with 10 Sasso broilers per replicate. The experimental treatments were without spiny amaranth, with 5% spiny amaranth, 10% spiny amaranth, and with 15% spiny amaranth. When expressed on a dry matter (DM) basis, spiny amaranth contained 89.00% DM, 20.20% crude protein, 10.80% crude fiber, 0.70% crude fat, and 16.50% ash. Intestinal morphology was evaluated with the use of a stereomicroscope equipped with a micrometer (mm) as a measuring unit and set to scanner magnification and low power objective (LPO) magnification. Gain in weight and carcass quality of Sasso broilers during the seven weeks was not influenced *(P > 0.05)* by spiny amaranth feeding. However, under scanner magnification setting, the intestinal morphology of Sasso broilers supplemented with 15% spiny amaranth had a numerically greater measurement of the duodenum (105mm) and jejunum's (130mm) villi while Sasso broilers fed 5% spiny amaranth attained greater width of ileum's (65mm) villi than their counterparts. Numerically, measurement in width of villi for *Sasso* broilers fed 10% spiny amaranth leads with 11mm among treatments. The results showed that spiny amaranth leaves as a supplement in the ration of Sasso broilers merit consideration.

Keywords: Dry Matter; Spiny Amaranth; Sasso Broilers; Intestinal Morphology

Introduction

Sasso chickens are native to France and are currently gaining popularity with both large and small livestock producers. Resembling the native chickens in the Philippines, the Sasso chicken grows faster and their meat has less cholesterol and fat since they are free-range chickens [8]. They can be raised as broilers and are good layers too when they reach six months of age. Sasso hens lay naturally brown, tasty, nutritious, and with fewer cholesterol eggs may be due to the natural ingredients they eat as they graze around the field [16]. Though some leafy vegetables and grains are often lacking in essential amino acids, spiny amaranth *(Amaranthus spinosus)* has a good source of lysine that is essential for growing animals in terms of the creation of new cells and tissues, as well as for more immediate energy needs and metabolic functionality [12]. Also, amaranth seeds are unusually high in protein for a non-legume (14 to 16% crude protein) with nearly twice the lysine content of wheat and three times that of maize [11]. With that, even the

green parts of amaranth can be used as feedstuffs for some species of farm animals. Dry matter of amaranth biomass contains based on plant age 16.3 to 29.5% of crude protein, 2.0 to 3.02% of fat, 11.1 to 24.4% of fiber, and 13.1 to 17.8% ash [1,20,21]. It has also been used in many countries as a grain, forage, or silage crop for many animals, including cattle, chickens, pigs, and rabbits. Therefore, the study was conducted to assess the proximate composition, and its effect on growth production, carcass quality parameters, and intestinal morphology when used as a supplement in the diet of Sasso broilers.

Materials and Methods

Animals and treatments

A total of 120 three-week-old Sasso broilers with an average weight of 560g were used in the study. They were randomly assigned to four treatments following Completely Randomized Design (CRD). Each treatment had three replications with 10 Sasso broilers per replicate. The experimental treatments were: 1) without spiny amaranth leaves (commercial feeds; CF only), 2) CF +5% spiny amaranth leaves/Sasso broiler/day, 3) CF +10% spiny amaranth leaves/Sasso broiler/day, and 4) CF +15% spiny amaranth leaves/Sasso broiler/day.

The proximate composition of commercial feed is listed in table 1.

Proximate analysis	Feed type	
	Broiler starter	Broiler finisher
Crude Protein (%NLT)	19.50	18.00
Crude Fat (%NLT)	5.00	6.00
Crude Fiber (%NMT)	4.50	5.50
Moisture (%NMT)	12.00	12.00
Calcium (%)	0.80-1.10	0.80-1.10
Phosphorus (%NLT)	0.70	0.70

Table 1: Nutrient standards for poultry feeds as basis of commercial producers.

Note: NLT (not less than); NMT (not more than).

Source: PhilSAN (Philippine Society of Animal Nutritionists, 2010).

Data collection

The spiny amaranth leaves were collected using a pruning shear. After collection, it was washed with clean water and air dried for 7 days. Air-dried spiny amaranth was chopped and ground into small pieces enough to ground even the sharp spines. Dried samples of 200 g Spiny Amaranth were placed in separate zip lock plastic bags marked and sealed and were sent personally to the Department of Agriculture- Regional Feed Analysis Laboratory for proximate analysis. The laboratory determined the moisture content by oven drying the sample; the crude protein was analyzed using the Kjeldahl Method, and the ash content was measured using the ignition method while the crude fat and crude fiber were evaluated using the ANKOM™ filter Bag Technology.

Sasso broilers were weighed individually at the start of the experiment (day 22) and the end of the experiment (day 60). Total feed offered was also weighed and *ad libitum* feeding was followed. The left-over feed was also noted to determine the feed consumed by the Sasso broilers. Feed conversion efficiency (FCE) was calculated by dividing the average daily feed intake by the average gain weight.

During the carcass evaluation of Sasso broilers, sample parts of intestines; duodenum, jejunum and ileum were collected in each treatment. Every specimen was soaked in 37% formalin solution in a sealed receptacle to prevent it from deterioration for histology [5].

The intestine was subjected to laboratory examination in Hi-Precision Diagnostic Laboratory in Angeles City, Pampanga, to determine if there is an effect on the lengths and thickness of the intestine supplemented by spiny amaranth leaves. Further, every slide was observed and measured by a microscope with a micrometer and noted for data variations.

The result from the laboratory examination was viewed and validated with the use of a Motic™ Stereo Microscope and a micrometer at the College of Arts and Sciences Laboratory in Central Luzon State University in Muñoz, Nueva Ecija, Philippines.

Statistical Analysis

Data were analyzed using ANOVA (Analysis of Variance) of STAR (Statistical Tool for Agricultural Research), version 2.0. [9]. The least-significant differences (LSD) test was used to determine significant differences between treatment means at $P = 0.05$.

Results and Discussion

Proximate Analysis

The chemical composition (%) of the spiny amaranth *(Amaranthus spinosus)* leaves on a dry weight basis were the following: moisture content (11.0 ± 0.3), crude protein (20.2 ± 0.6), ash content (16.5 ± 0.2), crude fat (0.7 ± 0.1) and crude fiber (10.8 ± 0.4) and was presented on table 2. The amount of crude protein in the recent study was high and better than the claims of [13] and [17] reported that the amaranth leaves contained 3.37% to 4.42% only. Moreover, ash content was consistent with the data gathered by [4] stated that dietary fiber in amaranth range between 9.8 and 14.50%. However, crude fat was lower as compared to amaranth leaves having 1.79-2.15% [15]. The variation may be due to the stored fats reserve which helps in seedling germination. Ash contents indicate the mineral content of the feeds and amaranth leaves contain adequate minerals such as calcium and phosphorus in contrast to other vegetable leaves [18]. Though the crude fiber was higher than 1.7-3.0% [3,13,17], still, crude fiber has recently attracted particular interest due to its practical relevance in enhancing the gut health of monogastric animals. For poultry species, 10 to 20% inclusion of amaranth leaves could be added as a potential protein source [7].

Parameter	Results
Moisture Content	11.0 ± 0.3
Crude Protein	20.2 ± 0.6
Ash Content	16.5 ± 0.2
Crude Fat	0.7 ± 0.1
Crude Fiber	10.8 ± 0.4

Table 2: Proximate composition (%) of Spiny Amaranth leaves.

Growth production of *sasso* broilers

The initial weight (550g to 570g), final weight (1,483.33g to 1,536.57g), gain in weight (923.33g to 966.67g), feed consumption (4,228.67g to 4,266.75) and feed conversion efficiency (2.76 to 2.87) of Sasso broilers fed Spiny Amaranth leaves were presented in table 3. The initial weight of Sasso broilers was homogenous at day 22 (after 3-week adaptation) of the rearing period. After a 38-day of the feeding trial, the final weight of Sasso broilers was tolerable compared with the final body weight of purebred Sasso chickens having 2,778.00g but fed for up to 8 weeks [10]. Moreover, the feed consumption per broiler fattening chicken fed spiny amaranth leaves was consistently within 3,930.00g to 4,670.00g regardless of sex [19]. However, gain in weight and feed conversion efficiency were lower compared with the former literature [10,14,19] but no negative effects of diets with spiny amaranth leaves.

Carcass quality of *sasso* broilers

At the end of the experiment on day 60, six Sasso chickens per treatment were taken carcass quality (Table 4) and intestinal morphology (Table 5; Figures 1 to 6) were determined. The inclusion of spiny amaranth leaves on Sasso broiler diets did not affect slaughter weight, dress and carcass yield and internal organs. However, Sasso chickens fed spiny amaranth leaves in the recent study gained better carcass yield (%) compared to 72.15 to 74.67 and 70.8 ± 1.74 to 75.1 ± 2.44 obtained by [2] and [19], respectively.

Intestinal morphology of *sasso* broilers

The gut organ weights (g) and lengths (cm) of Sasso broilers fed spiny amaranth leaves were identified (Table 5). In this study, the small intestine was surprisingly projected higher values than [14] findings. In some way, it agrees with the mentioned literature

Item	Treatments				
Growth Performance	Without Spiny Amaranth Leaves (SAL)	5% SAL	10% SAL	15% SAL	Coefficient of variation (%)
*Initial weight, g	570	560	560	550	3.42
Final weight, g	1,536.67	1483.33	1516.67	1487.67	4.03
Gain in weight, g	966.67	923.33	956.67	937.67	4.03
Feed consumption, g	4,229.17	4,246.58	4,266.75	4,228.67	1.78
Feed conversion efficiency	2.76	2.87	2.81	2.86	5.47

Table 3: Growth performance of *Sasso* broilers fed Spiny Amaranth Leaves on their ration.
*started after 3-week old adaptation of Sasso broilers.

Item	Treatments				
Carcass quality	**Without Spiny Amaranth Leaves (SAL)**	**5% SAL**	**10% SAL**	**15% SAL**	**Coefficient of variation (%)**
Slaughter weight, g	1,527.78	1,533.33	1,600.00	1,616.67	4.90
Dress yield (%)	87.89	88.70	89.58	89.38	6.17
Carcass yield (%)	84.80	84.43	84.60	84.44	6.37
*Internal organs, g	204.06	211.71	220.71	224.86	6.84

Table 4: Carcass quality of *Sasso* broilers in terms of slaughter weight (g), dress and carcass yield (%), and internal organs (g) as influenced by Spiny Amaranth Leaves on their ration.

*Internal organs were composed of spleen, heart, liver, proventriculus and gizzard or progizzard.

where chickens given amaranth leaves gained longer size of the small intestine than the chickens without amaranth leaves.

The length (mm) and width (mm) of the Sasso broiler's villi fed spiny amaranth leaves could be found in Figures 1 to 6. Dietary

Item	Treatments				
Intestinal Morphology	**Without Spiny Amaranth Leaves (SAL)**	**5% SAL**	**10% SAL**	**15% SAL**	**Coefficient of variation (%)**
Small intestine, g	67.26	69.06	71.82	72.30	5.07
Small intestine, cm	173.00	176.78	174.95	180.71	6.40
Large intestine, g	8.40	8.61	8.97	9.06	13.86
Large intestine, cm	9.18	9.23	8.88	8.78	6.27

Table 5: Intestinal morphology of *Sasso* broilers in terms of weight (g) and length (cm) of small and large intestine as influenced by Spiny Amaranth Leaves on their ration.

spiny amaranth meal inclusion did not statistically affect the villi of the Sasso chickens in the study. However, numerically, it was perceived that the length of Sasso chickens' duodenum, jejunum and ileum was reliably longer as they fed spiny amaranth leaves on their ration. Different growth with the width of the duodenum and ileum was observed in which it deteriorates when fed with spiny amaranth leaves compared to its counterpart. At some point, the interest of this study was that an improved gut is considerably important to maintain the gut health and overall performance of monogastric animals including chickens [6].

Length of the villi fed spiny amaranth leaves

Figure 1: Length of the duodenum measured using scanner magnification.

Note: A= Without SAL: 80mm; B= 5% SAL: 90mm; C=10% SAL: 103mm; D=15%SAL: 105mm

Figure 2: Length of the jejunum measured using scanner magnification.
Note: A= Without SAL: 68mm; B= 5% SAL: 60mm; C=10% SAL: 80mm; D=15%SAL: 130mm.

Figure 3: Length of the ileum measured using scanner magnification.
Note: A= Without SAL: 40mm; B= 5% SAL: 65mm; C=10% SAL: 54mm; D=15%SAL: 59mm.

Width of the villi fed spiny amaranth leaves

Figure 4: Width of the duodenum measured using low power objective magnification.
Note: A= Without SAL: 15mm; B= 5% SAL: 10mm; C=10% SAL: 9mm; D=15%SAL: 7mm.

Figure 5: Width of the jejunum measured using low power objective magnification.
Note: A= Without SAL: 7mm; B= 5% SAL: 9mm; C=10% SAL: 11mm; D=15%SAL: 10mm.

Figure 6: Width of the ileum measured using low power objective magnification.
Note: A= Without SAL: 15mm; B= 5% SAL: 6mm; C=10% SAL: 9mm; D=15%SAL: 9mm.

Conclusion

In conclusion, spiny amaranth leaves irresistibly contained high crude protein and crude fiber, moderately high ash content, and lower crude fat. Spiny amaranth leaves as part of the diet reasonably sustained the production and carcass performance of Sasso chickens. Moreover, intestinal morphologic characteristics specifically the gut size was also improved when spiny amaranth leaves were supplemented in the diet.

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Conflict of Interest

The authors declare that they have no conflict of interest.

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