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Effect of *Azolla Pinnata* and *Moringa Oleifera* Leaves on Meat Yield and Sensory Quality Evaluation Score of Meat of Broiler Chickens

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ABSTRACT

Twenty four representative male and broiler chickens from 4 dietary groups; D1 (Control diet); D2 (Diet with 5% Azolla pinnata-AP), D3 (Diet with 2% Moringa oleifera leaves-MOL), and D4 (Diet with 5% AP and 2% MOL) having 3 replications in each and 2 birds/replication were sacrificed to measure meat characteristics. Thigh and breast meat samples as cut-up parts replication-wise were considered to measure sensory quality evaluation scores. Diet was not different for meat yield traits ($p>0.05$). Diet D4 tended to perform the best in terms of meat yield traits. However, D2 was comparable to D4 concerning meat yield traits. Test diets showed a higher sensory quality evaluation score than the control diet ($p<0.01$). Breast meat was superior to thigh meat considering overall sensory evaluation scores. Therefore, a combination of 5% Azolla + 2% MOL (D4) may be the most effective and beneficial dietary group for producing safe and quality broilers. The diet D2 (5% Azolla) may also be a useful group for broiler production.

Keywords

Azolla, Broiler, Meat parameter, Moringa leaves, Sensory evaluation.

Introduction

Poultry meat is the cheapest and most available animal protein source food items preferred by all classes of people. Now-a-days, consumers are so conscious of taking safe, quality, and cost-effective products. The price of conventional feed ingredients is very high, which affects production costs. That is why substituting conventional feed ingredients with cheaper unconventional feed resources is essential to produce safe, quality, and profitable broiler chicken meat. Of the various types of unconventional feeds, *Azolla pinnata* and Moringa leaves are available, micronutrient-rich, and preferable to poultry [1,2].

Azolla (*Azolla pinnata*) is an aquatic fern that floats on the surface of the water and contains protein, essential amino acids (lysine, leucine, arginine, and valine), minerals (Ca, Fe, P, K, Fe, Mg, Mn, Cu, zinc, and Na, etc), vitamins (vita A, Vita B_{12}, Beta carotene), and chlorophylls [1]. Azolla (*Azolla pinnata*) is available in ponds, fellow land, lakes, and paddy fields. The dried and ground Azolla can be used in poultry diet as an unconventional plant protein, vitamin, and mineral source that improves feed conversion efficiency, energy efficiency, economic performance, meat quality, taste of meat, and reduced blood cholesterol without any harmful effects on poultry as well as on the human body [3-6]. Islam and Khatun reported that 5% or 10% of Azolla may be used to produce safe, quality meat, and profitable broilers. Scientists suggested that the 5% Azolla may be the most effective feed item to produce safe, quality meat, cost-effective broilers, and improved sensory quality score of broiler meat. Azolla improved the meat yield and sensory

quality score of the broiler [7].

The pods and leaves of the Moringa tree are popular with human beings for their nutritional food value and herbal medicinal quality [8]. *Moringa oleifera* leaves are rich in protein, fat, vitamins (vitamin B complex, Vita C, K, Beta-carotene), and minerals, especially for Mn, which improves broiler meat quality. It has antimicrobial functions and low amounts of polyphenols, which affect blood lipid metabolism [9,10].

Therefore, the study was aimed at assessing the effect of *Azolla pinnata* and *Moringa oleifera* leaves on meat yield and sensory quality evaluation scores of meat of broiler chickens to produce quality and safe broiler meat.

Materials and Methods

a) Approaches

The experiment was carried out to measure meat yield and sensory quality evaluation score of meat of broiler chickens from control, 5% *Azolla pinnata*, 2% *Moringa oleifera* leaves**,** and their combination in the diet of broiler chickens at Gazipur Agricultural University (GAU) Poultry Farm, Bangladesh.

b) Meat/Carcass characteristics

At the end of the experiment under the project "Use of *Azolla pinnata* and *Moringa oleifera* leaves in the diet of broiler chickens" a total of 24 representative male and female birds replication-wise (4 dietary groups, 3 replications/dietary group, 1 male 1 female birds/replicate) were slaughtered to record the following parameters and then expressed as percentages:

Carcass yield/dressed yield, Breast meat, Thigh meat, Drumstick meat, Dark meat.

Figure 1: Dressed broiler.

c) Sensory evaluation/organoleptic test

Sample preparation: A total of 24, fresh meat samples (thigh and breast meat/replication) were taken and weighed. After that, meat samples were washed and mixed with different spices, soybean oil, tomato sauce, and chili powder and then cooked as a barbecue using a coal oven under moderate heat (190-200°C) for indirect heat until brown color according to the method described by [11].

The cooked barbecue thigh and breast meat replication-wise was tested and evaluated by the panelists of 14 persons (3 x 14 = 42 replications/diet) of similar age and status in rank considering the fixed criteria; general appearance, flavor, juiciness, and taste against the set value of 10 marks per criterion. The water was provided to panelists between testing samples to eliminate the effect of each previous sample. After analyzing the data from panelists, a grading of diet was prepared based on the ranking of the analyzed sensory score.

Figure 2: Barbecued broiler for sensory evaluation.

Statistical Analysis

The collected data were analyzed in a completely randomized design for meat yield traits and diet x cut-up parts factorial design for sensory evaluation score using the Statistix10 computer package program.

Statistical Model

1) The following statistical model was used for the meat yield data analysis.

$Y_{ij} = \mu + D_i + e_{ij}$

Where Y_{ij} is the observation in the jth replication of the ith dietary group.

μ is the overall mean

D_i is the fixed effect of the ith dietary group (i = 1, 2, 3, 4)

e_{ij} is the random error

2) The following statistical model was used for the sensory quality evaluation score data analysis.

$Y_{ijk} = \mu + D_i + C_j + (D \times C)_{ij} + e_{ijk}$

Where Y_{ijk} is the observation in the kth replication of the ith dietary group and jth cut-up parts ©.

μ is the overall mean

D_i is the fixed effect of the ith dietary group (i = 1, 2, 3, 4)

C_j is the fixed effect of the jth cut-up parts (j = 1, 2)

$(D \times C)_{ij}$ is the interaction effect of the ith dietary group and jth cut-up parts

e_{ijk} is the random error

Animal Welfare and Ethical Approval

All animal care and data collection procedures in this study were

approved by the Institutional Committee on Animal Research Ethics Committee (AREC) of Bangabandhu Sheikh Mujibur Rahman Agricultural University (No. FVMAS/AREC/2023/40).

Results and Discussion

Meat yield of broiler chickens

Diet did not differ statistically for the meat yield traits; live weight, dressing yield, thigh meat weight, breast weight, drumstick meat weight, and dark meat (p>0.05) (Table 1). However, diet D_4 tended to show the highest meat yield traits among the dietary groups.

Despite the diet being found similar for the meat yield traits, diet D_4 showed the highest meat yield traits among the dietary groups partially supported by [12]. They reported the improved carcass yield on diet with Moringa leaves. However, diet D_2 was comparable to D_4 in terms of meat yield traits. Rana et al. reported the improved meat yield of broilers in the diet with 5% Azolla. No literature was found on the combination effect of Azolla and Moringa leaves on the meat yield of broiler chickens.

Sensory Evaluation Score of Broiler Chicken Meat

Diet was different for the sensory evaluation traits of general appearance, flavor, taste, and overall sensory evaluation score (Table 2), while Juiciness and firmness did not differ statistically among diets (p>0.05). The highest sensory evaluation value of general appearance, flavor, and overall sensory evaluation score was recorded in D_4, followed by D_3, D_2, and D_1, respectively. Nevertheless, the highest taste was observed in D_3, followed by D_4, D_2 and D_1, respectively. Despite no significant difference was noticed among diets, the values for juiciness and firmness were higher in the test diets than in the control diet. Therefore, test diets showed higher evaluation scores than the control diet.

Cut-up parts© were significantly different for the sensory evaluation traits, except for juiciness and taste (p>0.05). Juiciness and taste were similar between the thigh (C_1) and breast meat (C_2). Breast meat showed higher evaluation values for general

Table 1: Meat yield traits of broiler chickens fed diets with Azolla pinnata and Moringa oleifera leaves at 35 days of age.

Traits	Diet (D)				LSD & level of significance+
	D_1	D_2	D_3	D_4	
Live weight(g/bird)	2158.70	2065.30	1997.30	2041.00	225.99^{NS}
Dressed yield (%)	67.43	68.06	66.52	68.57	4.073^{NS}
Thigh meat (%)	9.28	9.32	9.70	10.58	1.492^{NS}
Breast meat (%)	16.26	15.25	16.81	15.07	2.892^{NS}
Drumstick meat (%)	8.24	8.64	8.69	9.14	1.038^{NS}
Dark meat (%)	51.17	52.81	49.70	53.50	4.114^{NS}

+NS, p>0.05; D_1 = Control diet; D_2 = Diet with 5% *Azolla pinnata*; D_3 = Diet with 2% *Moringa oleiferea* leaves; D_4 = Diet with 5% *Azolla pinnata* and 2% *Moringa oleifera* leaves.

Table 2: Sensory quality evaluation score of broiler chickens fed diets included *Azolla pinnata* and/or *Moringa oleifera* leaves at 35 days of age.

Traits	Cut up parts (C)	Diet (D)				Mean	LSD		
		D_1	D_2	D_3	D_4		D	C	D x C
General Appearance	C_1	6.81	7.39	7.69	7.77	7.42	0.307^{***}	0.217^{***}	0.435^{NS}
	C_2	7.72	7.81	7.93	8.13	7.90			
	Mean	7.26	7.60	7.81	7.95	7.66			
Flavor	C_1	6.91	7.33	7.35	7.48	7.27	0.312*	0.221*	0.442^{NS}
	C_2	7.31	7.53	7.58	7.77	7.55			
	Mean	7.11	7.43	7.46	7.63	7.41			
Juiciness	C_1	7.12	7.37	7.28	7.54	55.83	0.296^{NS}	0.209^{NS}	0.419^{NS}
	C_2	7.22	7.32	7.37	7.34	57.75			
	Mean	7.17	7.34	7.32	7.44	7.32			
Firmness	C_1	6.52	6.98	6.69	6.86	6.76	0.316^{NS}	0.224^{***}	0.447^{NS}
	C_2	7.32	7.58	7.16	7.19	7.31			
	Mean	6.92	7.28	6.93	7.02	7.04			
Taste	C_1	7.17	7.52	7.72	7.65	7.51	0.301^{*}	0.213^{NS}	0.425^{NS}
	C_2	7.47	7.67	7.92	7.69	7.69			
	Mean	7.32	7.59	7.82	7.67	7.60			
Overall sensory evaluation score	C_1	34.53	36.59	36.73	37.31	36.29	1.128^{**}	0.797^{***}	1.595^{NS}
	C_2	37.04	37.91	37.96	38.13	37.76			
	Mean	35.78	37.25	37.35	37.72	37.03			

+NS, p>0.05; *, p<0.05; **, p<0.01; ***, p< 0.001; D1 = Control diet; D2 = Diet with 5% *Azolla pinnata*; D3 = Diet with 2% *Moringa oleiferea* leaves; D4 = Diet with 5% *Azolla pinnata* and 2% *Moringa oleifera* leaves; C1 = Thigh meat; C2 = Breast meat; Total set score 50 (Set score in each trait=10)

appearance, flavor, firmness, and overall sensory evaluation score than thigh meat. There was no interaction between the thigh (C_1) and breast meat (C_2) for the sensory traits ($p>0.05$).

Test diets were superior to the control diet concerning sensory evaluation traits. Of the test diets, D4 was found to be the most effective dietary group, followed by D3 and D2 which was corroborated by [13]. They reported that *Moringa oleifera* leaves (0.6 or 0.8%) influenced the sensory evaluation score of broilers or scavenging chicken meat. Azolla influenced sensory evaluation score of broiler meat suggested by [7] which supports the present findings. The breast meat was superior to the thigh meat of the broiler recorded in the sensory evaluation test. The interaction of Cut-up parts © (Thigh x Breast) did not influence the sensory evaluation score. None of the previous work was found for the combination effect of Azolla and Moringa leaves on sensory evaluation scores.

Conclusions

The results of the present study indicate that the test diets were found to be better than the control diet considering the sensory quality evaluation score. Diet D_4 yielded the highest meat among diets. Nevertheless, diets D_2 and D_4 were comparable for meat yield traits.

Therefore, a combination of Azolla and *Moringa oleifera* leaves may be the most suitable dietary group for broiler production. Therein 5% Azolla may also be beneficial for safe and quality broiler production. However, more studies are needed to investigate the single or combination effect of Azolla and Moringa leaves at different levels on safe and quality broiler production.

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