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RESEARCH ARTICLE

ACCEPTABILITY, MARKETABILITY AND ECONOMICS OF ORGANICALLY GROWN BROILER FED WITH AZOLLA

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ABSTRACT

To improve commercial broiler production, basal diets have been supplemented with antibiotics for increased growth rate, disease prevention and control of pathogens but are expensive thus always limits the growth of the industry and results to adverse effects in animals and humans. Consequently, the use of organic supplements as alternative such as azolla are generally believed to be cheaper, safer, healthier, less subject to hazards and thus improve birds' physiological digestion. The study aims to determine how azolla in the ration affects the growth, blood lipid profile, meat cholesterol, organoleptic properties, economics and marketability of raising organically grown broilers fed with azolla. All data was analyzed using ANOVA following Completely Randomized Design and significant differences between treatment means was further analyzed using Tukey's Test while Friedman's Test for organoleptic evaluation. Results revealed that feeding azolla for organically grown broilers significantly ($p < 0.05$) improved the feed conversion ratio, lowers the blood and meat cholesterol, enhanced the meat color, flavour, tenderness and juiciness, and increases the net income, income per bird and return on investment. However, feeding azolla have comparable ($p > 0.05$) effects on the body weight, HDL, LDL and triglycerides content, odor, texture and general acceptability of the meat. Findings also show that all panellists are willing to pay higher price from the existing for organically grown broiler chicken with proven lower cholesterol level and enhanced meat quality. Moreover, 70% of the panellists indicated that social media is the best mode of information dissemination for the consuming public to be aware of the natural production and nutritional benefits of growing broilers fed with azolla. In general, results suggests that feeding 50% azolla has significant ($p < 0.05$) and potential effects as alternative protein source for broiler raisers to reduced feed cost, lower blood and meat cholesterol, enhanced meat quality and consequently maximized profit margin.

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INTRODUCTION

Department of Agriculture (2016) reported that chicken meat and egg are presently the most progressive animal enterprises in the Philippines. The poultry industry in fact began as a backyard enterprise but has shifted to the formation of very large integrated contract farming operations both for better income and food security. The growth of the poultry industry in the Philippines has been impressive but the rapid increasing price of commercial feeds, inefficient management and occurrence of several destructive diseases and parasites must be taken into consideration. In the Philippines, the Philippine Statistics Authority (PSA, 2016) reported that chicken population was estimated 174.5 million that is predominantly (47%) accounted for native chicken raised in backyard farms while the remaining. Almost 50 percent of the total chicken population was accounted for native or village chicken raised in backyard farms while the remaining 34% (broilers) and 19% (layers) were raised by commercial farms.

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Commercial feeds have always played a vital role in livestock feeding and nutrition, but its rapid increasing price is always limits the growth of broiler production. Either in a fresh or dried form, azolla (*Azolla pinnata*) can be fed to livestock and fed directly or mixed with concentrates to cattle, poultry, sheep, goats, pigs and rabbits. It takes a few days for the animals to get used to the taste of azolla, therefore it is better to feed it with the concentrates in the initial stages. (Giridhar *et al.*, 2013). There is a general consensus that dried azolla in broiler diets should be limited to 5 percent as higher levels tend to depress nutrient utilization and performance (Parthasarathy *et al.*, 2002; Basak *et al.*, 2002). In pullet chicks, azolla could be included safely at up to 10% (Alalade *et al.*, 2006). Fresh azolla could replace 20% or more of a commercial broiler diet (Subudhi *et al.*, 1978; Namra *et al.*, 2010). Despite the known benefits of azolla, limited research have been done specially about the higher level of feeding azolla to broilers, hence this study is to be conducted. Farmers and raisers wasnefit in this study not only because they can lessen their cost of production in terms of feed expenses but most specifically in producing organically grown broiler that will offer health benefits to the consuming public.

The study aims to determine the effect of higher level of azolla in the growth, meat quality, organoleptic properties, acceptability and marketability as supplement for cheaper broiler production. Specifically, it aims to: determine how different higher level of azolla affects the growth performance of broilers in terms of weight gain, average daily gain, feed conversion ratio and dressing percentage; determine the meat quality of broilers given with higher level of azolla in terms of meat pH, drip loss, breast muscle thickness and abdominal fat pad; determine the organoleptic properties of broilers given with higher level of azolla in terms of color, texture, flavour, juiciness, texture and general acceptability; establish the optimum proportion of azolla that would show the best result in terms of growth, meat quality and organoleptic properties of broilers; and compute for the return on investment, profit per head and net income of broilers given with higher level of azolla as supplement.

MATERIALS AND METHODS

The study was conducted on February 02, 2017 – July 03, 2017 at Animal Production Project, MINS CAT, Victoria, Oriental Mindoro. Proximate analysis for the azolla was conducted at Animal and Dairy Science Cluster, Nutrition laboratory, UPLB Laguna.

Materials

One hundred twenty (120), straight run day old chicks that are caged in well-ventilated housing facilities was used in the study. Other materials include 24 drinker and feeder, azolla, hand gloves (for collection of feces), face masks, commercial feeds, used newspapers and/or sacks, cleaning materials, weighing scale, record book, calculator and individual identification for proper recording.

Experimental Animals and Feeding Management

A total of one hundred twenty (120) straight run day old chicks was used for feeding trials for 35±5 days using different levels of azolla. The broilers was provided commercial feeds and different level of azolla. Clean drinking water was made available throughout the duration of the study. The experimental animals should be in good body condition prior to and throughout the duration of the study.

Experimental Design and Treatments

The study was conducted following a Completely Randomized Design. The 120 straight run day old chicks was randomly distributed to three treatments with four replication and 10 birds per replicate. The treatments are as follows:

- T1 - 100 % Pure commercial feeds
- T2 - 50 % Commercial feeds + 50% Azolla
- T3 - 100% Azolla

Feed formulation and gathering of raw materials

Different level of azolla as a supplement for commercial feeds was done on the basis of parts per hundred. Commercial feeds was purchased in the nearest Agricultural Supplies at Victoria and/or in Calapan, Oriental Mindoro.

Data Gathering

The data to be gathered are as follows.

Initial and Final Body Weight

The initial body weight was computed by the weight of chicks before treatment implementation divided by the total number of chicks per treatment replication. On the other hand, final body weight was computed by the weight of broilers after 35 days of feeding trial using the following formula:

$$BW = \frac{\text{Total weight of broiler chicken per replication}}{\text{Total number of broiler chicken}}$$

Weekly cumulative feed consumption

This was determined by adding the previous amount of feed consumed to the current feed consumption.

Feed Conversion ratio

The feed conversion efficiency of pekin ducks refers to their ability to convert feeds into meat. This is computed by dividing the total feed consumption of pekin ducks by their total body weight gain.

Organoleptic properties

After 35±5 days of feeding trial, 9 dressed chicken (3 birds per treatment) was used in sensory evaluation. Breast muscles and thigh was steamed for about 30 to 45 minutes, cool and then slice for evaluation. The cooked breast meat was tested by 20 panellists (10 faculty and/or trained panellist and 10 students) using a score sheet with 5 point hedonic scale in terms of color, flavor, texture, juiciness, tenderness and general acceptability of the meat.

Cost and Return. The cost of producing broiler fed with different levels of azolla was recorded and compared with the control. The net income was computed using the formula:

$$\text{Net Income} = \text{Total sales} - \text{Total cost}$$

$$\text{Income per bird} = \text{Net Income} / \text{No. of bird}$$

$$\% \text{ ROI} = \frac{\text{Net Income} \times 100}{\text{Total Expenses}}$$

Acceptability and Marketability

After the sensory evaluation, test panelists was asked on the amount they are willing to pay for a certain treatment per kilogram basis using the price range below:

Are you willing to pay higher price for dressed broiler meat that was proven to have lesser cholesterol and enhanced organoleptic properties?

Yes No, why? _____

By how much?

140 per kg as existing price + 5/kg

- 140 per kg as existing price + 10/kg
- 140 per kg as existing price + 15/kg
- 140 per kg as existing price + 20/kg

Considering the quality of the meat, if 20/kg is not yet enough for you to add, by how much are you willing to add? _____

If your willing to recommend the acceptability and consumption of broiler meat with higher organoleptic value while having lower meat and blood cholesterol, how can you disseminate/promote the product?

- Social media
- Personal selling
- Word of mouth
- BULLETIN board posting
- Tri-media (TV, radio, newspaper)
- Others, please specify

Statistical analysis

All data collected was consolidated, organized, encoded and tabulated. Data was analyzed using the Analysis of Variance of the SAS Software (SAS Version 9.1.3) following the Completely Randomized Design (CRD). Tukey's Test was used to determine significant differences between treatments while Friedman's Test for organoleptic evaluation and level of significance and tendencies was set at $P \leq 0.05$ for all statistical tests.

RESULTS AND DISCUSSION

Body Weight

The initial body weight and final body weight among broilers used in the experiment are comparable ($p > 0.05$). This can be associated with the nutrient composition of azolla having almost the same to that of commercial poultry feeds, apart from azolla having a higher content of protein but low in calcium (Kathirvelan *et al.*, 2015).

Feed consumption and feed conversion ratio

Broilers fed with 50% and 100% azolla consumed higher amount feed compared to the controlled treatment. Higher total feed consumption of broilers fed with 50% and 100% azolla was due to the higher amount of fresh azolla to meet the dry matter requirement for poultry.

On the other hand, despite the higher consumption of broilers fed with 50% azolla, it is more efficient ($p < 0.05$) in converting feeds into kilogram of meat than the broilers fed with 100% azolla that are comparable ($p > 0.05$) to the FCR of broilers fed with 100% commercial feeds. These results suggest that based on FCR, feeding azolla higher than 50% is decreases the feed efficiency of broilers.

Blood lipid profile

Findings revealed that the HDL, LDL and triglycerides of broilers fed with azolla or commercial feeds are comparable ($p > 0.05$). On the other hand, the blood cholesterol of broilers fed with 100% azolla has significantly ($p < 0.05$) lower than the broilers fed with 100% commercial feeds and 50% azolla. However, the meat cholesterol of broilers fed with 50% azolla has significantly ($p < 0.05$) lower than the meat cholesterol content of broilers fed with 100% azolla and commercial feeds. Results can be attributed to the presence of polyunsaturated fatty acids of azolla that serves as cholesterol lowering agents (Nierop *et al.*, 2014). In addition, azolla contains nutrients like lysine (essential amino acid) that enhance nutrient absorption, can combat heat stress and had favorable immune-modulatory effect in poultry without any toxicity (Mishra *et al.*, 2016) that consequently lower the level of blood and meat cholesterol.

Organoleptic Properties

Findings showed that the odor, texture and acceptability of broiler meat were comparable ($p > 0.05$) and are not affected by feeding azolla. On the other hand, findings revealed that color, flavor, tenderness and juiciness of broiler meat provided with azolla in the dietary ration was significantly ($p < 0.05$) enhanced. These results can be associated to the higher digestibility rate of azolla due to its high protein but low lignin content, essential minerals like iron, calcium, magnesium, phosphorus, copper, manganese, magnesium, bio-active substances and bio-polymers 12,14,16; has appreciable quantities of vitamins A and vitamins B12, and chlorophyll; and contain almost all the essential amino acids like lysine, many probiotics, Biopolymers and B carotene (Norman, 2015; Ndegwa, 2015; Norman, 2015; Prasanna, 2010; Tran, 2015; Hasan *et al.*, 2009; Pillai *et al.*, 2002) that may enhances feed intake that consequently improved the meat quality in terms of the color, flavor, juiciness and general acceptability of broilers fed with azolla.

Economics

Results revealed that broilers fed with 50% azolla showed the significantly ($p < 0.05$) higher net income, income per bird, and return on investment. This can be associated with the cheaper production cost by using unconventional feed source with sufficient nutrient content resulting to proper growth performance. In addition, Acharya *et al.*, (2015) reported that economization of feed cost in poultry by dietary inclusion of azolla at different levels has been reported by several authors (Basak *et al.*, 2008; Seth *et al.*, 2008; Naghshi *et al.*, 2014) to be beneficial and potential alternative protein source.

Marketability

Findings show that all panellists are willing to pay (Willingness to Pay Test, Van Loo and Ricke, 2015) organically grown broiler chicken with lower cholesterol level and enhanced meat quality. In addition, 45% of the panellists stated that they are willing to pay additional 20 pesos per kilogram from the existing price. Moreover, 70% of the panellists indicated that social media is the best mode of information dissemination for the consuming public to be aware of the natural production and nutritional benefits of growing broilers fed with azolla.

Table 1. Body weight of organically grown broilers fed with azolla

LEVEL OF AZOLLA	INITIAL BODY WEIGHT(g)	FINAL BODY WEIGHT (kg)
100% CF	52.25 ^a	1.71 ^a
50% CF + 50% AZOLLA	52.37 ^a	1.64 ^a
100% AZOLLA	55.00 ^a	1.08 ^a

Means within column having different superscripts are significantly different (p<0.05).

Table 2. Feed consumption and feed conversion ratio of organically grown broilers fed with azolla

LEVEL OF AZOLLA	TOTAL FEED CONSUMED (g)	FEED CONVERSION RATIO
100% CF	7355 ^b	1.108 ^b
50% CF + 50% AZOLLA	8275 ^a	1.323 ^b
100% AZOLLA	8225 ^a	1.975 ^a

Means within column having different superscripts are significantly different (P<0.05).

Table 3. Blood lipid profile and meat cholesterol of organically grown broilers fed with azolla

Level Of Azolla	Hdl (good cholesterol, mmol/dL)	LDL (bad cholesterol, mmol/dL)	Triglycerides (mmol/dL)	Blood Cholesterol (mmol/dL)	Meat Cholesterol (mg/100g)
100% CF	2.073 ^a	0.978 ^a	0.950 ^a	3.425 ^a	85.00 ^a
50% CF + 50% AZOLLA	2.293 ^a	0.806 ^a	0.708 ^a	3.420 ^a	74.00 ^b
100% AZOLLA	2.133 ^a	0.784 ^a	0.817 ^a	3.350 ^b	81.00 ^a

Means within column having different superscripts are significantly different (p<0.05).

Table 4. Organoleptic properties of organically grown broiler fed with azolla

LEVEL OF AZOLLA	COL	ODOR	FLA	TEX	TEN	JUI	ACC
100% CF	4.14 ^b	3.91 ^a	3.70 ^b	3.90 ^a	3.88 ^b	3.65 ^b	4.11 ^a
50% CF + 50% AZOLLA	4.35 ^{ab}	3.98 ^a	4.09 ^{ab}	3.93 ^a	4.16 ^{ab}	4.14 ^a	4.30 ^a
100% AZOLLA	4.61 ^a	4.00 ^a	4.18 ^a	4.04 ^a	4.20 ^a	4.12 ^{ab}	4.41 ^a

Means within column having different superscripts are significantly different (P<0.05).

Legend: COL – color; FLA – flavour; TEX – texture; TEN – tenderness; JUI – juiciness; ACC- acceptability

Table 5. Economics of raising organically grown broilers fed with azolla

LEVEL OF AZOLLA	NET INCOME	INCOME PER BIRD	RETURN ON INVESTMENT
100% CF	549.78 ^b	54.98 ^b	36.37 ^c
50% CF + 50% AZOLLA	867.60 ^a	86.76 ^a	68.62 ^a
100% AZOLLA	519.18 ^b	51.92 ^b	55.19 ^b

Table 6. Marketability of organically grown broiler fed with azolla

PARAMETER	PANELLIST (n=20)	PERCENTAGE
Willingness to pay for organically grown chicken with lower cholesterol level and enhanced meat quality		
Yes	20	100
No	0	0
By how much additional price per kg		
Existing price + 5/kg	2	10
Existing price + 10/kg	5	25
Existing price + 15/kg	4	20
Existing price + 20/kg	9	45
Mode of dissemination		
Social Media	14	70
Word of Mouth/Personal Selling	2	10
Bulletin Board Posting	2	10
Others (publication and conferences)	2	10

Furthermore, social media is a way of promoting a business by interacting and attracting the interests of current and/or prospective customers. Facebook, Twitter and YouTube are the most popular social media that are widely used by the companies in their product. With the number of users rising each day in Facebook and other social networking sites, it is bound to bring in more consumers for the business and much

more promotions and marketing thus making social media the better platform for marketing (Saravanakumar and SuganthaLakshmi, 2012).

Conclusion

Results revealed that feeding azolla for organically grown broilers significantly (p<0.05) improved the feed conversion

ratio, lowers the blood and meat cholesterol, enhanced the meat color, flavour, tenderness and juiciness, and increases the net income, income per bird and return on investment. However, feeding azolla have comparable ($p > 0.05$) effects on the body weight, HDL, LDL and triglycerides content, odor, texture and general acceptability of the meat. Findings also show that all panellists are willing to pay higher price from the existing for organically grown broiler chicken with proven lower cholesterol level and enhanced meat quality. Moreover, 70% of the panellists indicated that social media is the best mode of information dissemination for the consuming public to be aware of the natural production and nutritional benefits of growing broilers fed with azolla.

Recommendation

In general, results suggests that feeding 50% azolla has significant and potential effects as alternative protein source for broiler raisers to reduced feed cost, lower blood and meat cholesterol, enhanced meat quality and consequently maximized profit margin and were recommended for utilization.

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