

EFFECT OF SUPPLEMENTING *AZOLLA PINNATA* ON GROWTH PERFORMANCE OF WEANED PIGLETS

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ABSTRACT: The main objective of the study was to determine the effect of supplementing *Azolla pinnata* on the growth performance in weaned piglets. A total of 28 piglets were used for the study. It was divided into four treatment groups using a Randomized Complete Block Design. The piglets in the control group were fed with concentrate feed alone; piglets in Treatment 1 were supplemented with 10% Azolla, Treatment 2 with 20% Azolla supplement, and Treatment 3 with 30% Azolla. The trial was conducted for 42 days. The study showed a significant difference ($p < 0.05$) in the overall weight gain. The lowest overall weight gain 2.9 ± 0.20 kg was in Control and the highest overall weight gain 6.32 ± 0.48 kg was in Treatment 3. The Average Daily Gain showed a significant difference ($p < 0.05$) among the groups. The highest ADG of 0.12 ± 0.1061 kg was recorded in Treatment 3 and the lowest 0.06 ± 0.0057 kg was recorded in the control group. There was no significant difference in the FCR of the four treatment groups. Therefore, it can be concluded that supplementing Azolla has noticeable results on weight gain, FCR, and ADG. Besides, it is suggested to conduct an in-depth study taking a larger sample size in weaned piglets with the supplementation of a higher percent of *Azolla pinnata* in feed and assess their performance for one production cycle.

Keywords: ADG; *Azolla pinnata*; FCR; weight gain; weaned piglets.

1. INTRODUCTION

Nearly a billion people's livelihoods and food security are supported by livestock, which makes up 40% of the value of the world's agricultural output (FAO2009a). Among livestock, pigs play a crucial role in agro-ecosystems. With the increase in expanding population over the world, there is increased demand in livestock products. Pigs are reared in Bhutan for social, cultural and economic purposes. Under the prevailing pig farming

system, about 80-90% of households rear pigs for meat purposes while 10-20% rear for breeding purposes (RLDC 2019). Even though there is evidence that the religious stigma to pig raising is growing, annual increases in pork consumption, which is mostly met through imports are observed (Nidup et al. 2011).

There was an increase of 16% of total meat imports in the country in 2018 compared to

2017 (DAMC 2009). This line unequivocally demonstrates that while demand for meat is rising, the country's production of meat is not keeping pace with rising demand. The price of commercial feed (Karma Feed) was raised by 7% due the increase in the prices of raw materials in India (Kuensel 2019) which pose a huge challenge to the farmers to sustain piggery farming.

Brewery wastes, kitchen wastes, bran, weeds, nettle leaves, sorghum, grains and corns make up the majority of pig diets as an alternative feeding resource. Feed supplements are defined as products used in animal nutrition which supply nutrients in the diet of livestock. Pigs are supplemented with oil cakes, wheat, and soya beans. However, most of the pig farmers are not familiar with *A. pinnata* which can be fed to pigs as feed supplement to improve the growth performance. *A. pinnata* being the cheapest of all the feeds can reduce the cost of production. Azolla has a high protein content and low lignin level, which makes it easier for animals to digest. Therefore, from the perspectives of ease cultivation, production, and nutritional value, Azolla is a promising and as alternative green feed for feeding animals (Mishra et al. 2020).

Feed efficiency strongly influences financial returns (Patience et al. 2015). Supplementing Azolla to pigs will not only reduce the expenses but also bring down the imports of commercial feeds. In addition, supplementing Azolla ensures better utilization of the available resources and also increase feed availability. Azolla being the fast-growing feed, large biomass production, high nitrogen content and it is easy to decompose. It is capable of absorbing air nitrogen directly through the blue-green algae, Anabaena by biological nitrogen fixation (Shamsudin et al. 2021). Due to its high palatability and increased yield, *A.*

pinnata has been used as a substitute for green fodder and as a supplement to protein diets. However, till date, very minimal research has been conducted on supplementing Azolla in pig diet and its effect on growth performance, Feed Conversion Ratio (FCR) and reduction on the cost of pig production in the country.

Azolla is also addressed as 'super plant' because it grows very fast (Mishra et al., 2020). It is beneficial feed additive for livestock animals. Furthermore, Azolla contains probiotics and biopolymers. Das et al.(2022) stated that the nuclear genome of Azolla is the first fern to have been completely sequenced. Livestock that is linked with Azolla farming was able to guarantee long-term neighborhood security and income for farmer's livelihood diversification (Kumar et al., 2018). It usually grows and multiplies within 15-17 days. Due to its high palatability and increased yield when fed under rainfed conditions during a lean period, Azolla has been used as a substitute for green fodder and as a supplement to protein diets (Kumar & Chander, 2017). Thus, this study was designed to determine the effect of supplementing *Azolla pinnata* on the growth performance in weaned piglets and also to determine its nutrient compositions of *Azolla pinnata*.

2. MATERIALS AND METHODS

2.1 Study site

The study was conducted at National Piggery Research and Development Centre (NPiRDC), Gelephu during the year 2022-2023. The study location was situated at the latitude of 26° 51' 50.22" N and longitude of 90° 16' 2.82" E and altitude of 347 meters above sea level (masl). It falls under the wet sub-tropical agro-ecological zone which has an average temperature and humidity of 26.36°C and 62.27% respectively.

2.2 Experimental design

Randomized Complete Block Design (RCBD) was adopted and piglets were divided into four Treatment groups. The piglets were supplemented with different concentration of Azolla with the concentrate feed. The treatment groups were Control (C) without Azolla supplement, Treatment 1 (T1) with 10% Azolla, Treatment 2 (T2) with 20% Azolla and Treatment 3 (T3) with 30% Azolla supplementation. A total of 28 weaned crossbred piglets were used for the experiment for the duration of 42 days. The initial weights were taken prior to the commencement of the study. Thereafter, the piglets were weighed once in every week. Azolla was supplemented with the concentrate feed depending on different treatment groups. All piglets were fed Dhejung commercial feed along with apportioned Azolla supplement at 5% of the body weight for entire study period. Every piglet was given an ear notch number for easy identification, documentation and management.

2.3 Data collection

The data on Average Daily Gain (ADG), FCR and feed consumption were collected and evaluated during the study on weakly basis for duration of 42 days.

2.4 Average Daily Gain

ADG was calculated and derived using the formula.

$$ADG = \frac{\text{Final weight} - \text{Initial weight}}{\text{Number of days in feed}}$$

2.5 Feed Conversion Ratio

The Feed Conversion Ratio (FCR) was calculated using the formula.

$$FCR = \frac{\text{Total feed intake}}{\text{Weight gain}}$$

2.6 Statistical analysis

The data was compiled in Microsoft Excel 2019. The collected data was analyzed using SPSS version 23. The arranged data was subjected to normality test using Shapiro-Wilk's test. Comparison among the treatment groups was done using One- way Analysis of variance. Tukey HSD (Honestly Significant Difference) *post hoc* test was done for pair wise comparison. The graphs were plotted using ggplot2 (Grammar of Graphics) 2 R-Studio software version 4.3.3.

3. RESULTS AND DISCUSSION

3.1 Nutrient composition of feed

The values of proximate composition of *Azolla pinnata* used in the trial period are presented in the Table 1. The nutrient compositions such as DM%, CP%, CF%, Moisture and Ash were taken into consideration for the study. The chemical composition of *A. pinnata* sample revealed that the dry matter content was 85.75% which was in close agreement with the results (Cherryl et al. 2014). In contrast, the dry matter content was lower than the value obtained by (Kumar et al.2018). The CP content of *A. pinnata* was 27.75% which was similar with the findings of (Bhatt et al. 2020). On the otherhand, the CP content of 17.59% was obtained by Das *et al.* (2022) which was lower than the CP value obtained in the present study. The difference in the values could be attributed due to the nutritive value of the inputs added such as soil types, manure, Single Super Phosphate and other minerals. The total ash content of *A. pinnata* was 14.28%, lower than the findings of (Cherryl et al.2014, Kumar et al. 2018 and Das et al. 2022). The variations in the factors such as soil nutrients, pH of water, light, temperature and humidity during the studies could be the reason for differences in nutrient compositions of *A. pinnata*.

Table 1: Nutrient Compositions of commercial feed and *Azolla pinnata*

Test parameters	Dhejung Feed (%)	<i>Azolla pinnata</i> (%)
Dry matter	87.74	85.75
Moisture	12.26	14.25
Crude protein	18.50	27.75
Crude fat	2.50	4.82
Total ash	9.20	14.28

Nutrient compositions of the Dhejung commercial feed fed to the animal during the study period was also analyzed. The nutrient contents of Dhejung feed were 87.97% Dry matter, 12.03% Moisture, 18.50% Crude protein, 2.50% Crude fat and 9.20% Total ash. The result was in line with the findings of (Penjor et al., 2019) who reported 87.74% Dry matter and 12.26% Moisture content in the concentrate feed.

3.2 Body weight gain

3.2.1 Overall weight gain

Azolla pinnata was supplemented to the weaned piglets to evaluate the growth performance. The study showed significant difference in the overall weight gain $F(3,24) = 14,921, p = 0.000$ among the Treatment groups. In contrast, the findings of Gavina (1994) stated that the dietary treatments did not significantly differ in terms of the average gain in the weight and the piglets in Control group had significantly higher growth performance than the other groups

Table 2: Overall weight gain (M±SEM)

	Control (kg)	Treatment 1 (kg)	Treatment 2 (kg)	Treatment 3 (kg)
Overall weight gain	2.99 ± 0.20	3.67 ± 0.33	4.26 ± 0.41	6.32 ± 0.48

Table 3: Pair-wise comparison of weekly weight gain of the weaned piglets (M±SEM)

Experimental week	Control (kg)	Treatment 1(kg)	Treatment 2 (kg)	Treatment 3 (kg)
Week 1	0.17±0.09 ^a	0.34±0.07 ^a	0.43±0.17 ^a	0.61±0.27 ^a
Week 2	0.38±0.07 ^a	0.72±0.07 ^a	0.59±0.17 ^a	0.86±0.18 ^a
Week 3	0.49±0.14 ^a	0.40±0.07 ^a	0.53±0.14 ^a	0.66±0.14 ^a
Week 4	0.47±0.12 ^a	0.52±0.12 ^a	0.68±0.22 ^a	0.73±0.19 ^a
Week 5	0.61±0.09 ^a	0.95±0.13 ^{abc}	0.85±0.08 ^b	1.48±0.23 ^c
Week 6	0.86±0.11 ^a	0.75±0.17 ^{ab}	1.19±0.16 ^{bc}	1.97±0.30 ^d

*Values with different superscripts within the column are significantly different [$p < 0.05$]

supplemented with *A. pinnata*. This could be because of different levels of azolla supplemented.

The overall weight gain in Control, Treatment 1, Treatment 2 and Treatment 3 was 2.99 ± 0.20 kg, 3.67 ± 0.33 kg, 4.26 ± 0.41 kg and 6.32 ± 0.48 kg respectively. Piglets in Treatment 3, fed with 30% Azolla supplement had the highest overall weight gain and the lowest overall weight gain was in Control group as shown in the Table 3. Kendra and Rajasthan (2013) also reported that there was increase in milk yield of cows by 20.96% when supplemented with *A. pinnata*.

3.2.2 Weekly weight gain

Azolla pinnata was supplemented to the weaned piglets for six weeks. The weekly weight gain of Control, Treatment 1, Treatment 2 and Treatment 3 are given in the

Table 4: Mean comparison of Average Daily Gain (M ± SEM)

Groups	ADG (kg)
Control (100% Commercial feed)	0.06 ± 0.0057 ^a
Treatment 1 (10% Azolla supplement)	0.08 ± 0.0067 ^a
Treatment 2 (20% Azolla supplement)	0.09 ± 0.0091 ^a
Treatment 3 (30 % Azolla supplement)	0.12 ± 0.1061 ^b

*Values with different superscripts within the column are significantly different [$p < 0.05$]

Table 5: Mean comparison of FCR (Mean ± SEM)

Groups	FCR
Control (100% Commercial feed)	6.78 ± 0.56
Treatment 1 (10% Azolla supplement)	6.56 ± 0.78
Treatment 2 (20% Azolla supplement)	6.29 ± 0.58
Treatment 3 (30 % Azolla supplement)	4.75 ± 0.35

Table 3. There was no significant difference ($p > 0.05$) till week 4. However, there was a significant difference $F(3, 24) = 6.265$, $p = 0.003$ in the fifth week and $F(3, 24) = 7.677$, $p = 0.000$ in the sixth week.

3.3 Average Daily Gain

There was a significant difference in ADG $F(3, 24) = 10.103$, $p = 0.000$ among the four Treatment groups. The ADG in Control, Treatment 1, Treatment 2 and Treatment 3 was 0.06 ± 0.0057 kg, 0.08 ± 0.0067 kg, 0.09 ± 0.0091 kg and 0.12 ± 0.1061 kg respectively as shown in Table 4.

The highest ADG was in Treatment 3 and the lowest was in Control group. The result is in line with the findings of Saini *et al.* (2018) who reported that the lowest ADG was observed in Control group. However, the result was in contrast with the findings of Penjor *et al.* (2022) who reported that the ADG was highest in the Control group. This could be due to differences in the feeding rate, types of feed consumed, breeds, and temperature and health conditions of the piglets.

3.4 Feed Conversion Ratio

The Feed Conversion Ratio (FCR) in four groups was 6.78 ± 0.56 in Control, 6.56 ± 0.78 in Treatment 1, 6.29 ± 0.58 in Treatment 2 and 4.75 ± 0.35 in Treatment 3. However, there was no significant difference $F(3, 24) = 2.434$, $p = 0.090$ between the four treatment groups. The mean comparison of the Feed Conversion Ratio (FCR) is given in Table 5.

Table 5 shows that the lowest Feed Conversion Ratio was in Treatment 3 and the highest FCR was in Control group. The result was also in contrast with the findings of Penjor *et al.* (2022) who reported that the FCR was low in Control group (100% commercial feed). This could be due to difference in the type of commercial feed fed to the piglets and also the breed of piglets used for the experiment.

4. CONCLUSIONS

The results of the study revealed that supplementing *Azolla pinnata* to weaned piglets have a significant difference on the growth and weight gain of the piglets. The ADG of the experimental piglets showed significant difference between the groups. The highest ADG 0.12 ± 0.1061 kg was recorded in Treatment 3 supplemented with

30% Azolla. The lowest ADG 0.06 ± 0.0057 kg was recorded in Control group. The FCR of the experimental piglets show no significant difference among the groups. The highest FCR of the piglets 6.78 ± 0.56 was recorded in Control group. The lowest FCR of the piglets 4.75 ± 0.35 was recorded in Treatment 3.

According to the findings of the current research, there was difference between the overall performances of the piglets supplemented with *Azolla pinnata* than those piglets not supplemented with Azolla. Supplementing Azolla up-to 30% is not harmful rather it is beneficial. The chemical analysis of Azolla also indicated that it is rich in protein content. Therefore, the study concludes that supplementing *Azolla Pinnata* to the weaned piglets has better impact on the weight gain, FCR and ADG. The study recommends supplementing Azolla Pinnata with increase percentage in feed to weaned piglets for one production cycle having larger sample size to assess their performance and replicate such research in grower and finisher pigs.

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