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ORIGINAL ARTICLE

A study on the nutritive value of *Azolla pinnata*

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Abstract

Azolla is a good source of protein and it contains almost all essential amino acids, minerals such as iron, calcium, magnesium, potassium, phosphorus, manganese etc, apart from appreciable quantities of vitamin A precursor beta-carotene and vitamin B_{12}. In view of the above facts, the present experiment was undertaken to explore the nutritive value of Azolla *pinnata* as a feed. Azolla was cultivated, harvested and sundried. Sun dried azolla sample was analyzed for proximate principles. The dry matter (DM) content of sun dried azolla meal was 89.73 percent. It contained 75.73 percent organic matter, 23.49 percent crude protein , 14.7 percent crude fibre, 3.7 percent ether extract, 24.26 percent total ash, 7.94 percent acid insoluble ash, 2.58 percent calcium and 0.26 percent phosphorus.

Keywords: Azolla, proximate, composition, evaluation, dry matter.

Introduction

Aquatic plant, free floating fern Azolla which belongs to the family *Azollaceae* is a good source of protein and it contains almost all essential amino acids, minerals such as iron, calcium, magnesium, potassium, phosphorus, manganese etc, apart from appreciable quantities of vitamin A precursor beta-carotene and vitamin B_{12}. It is also found to contain probiotics and biopolymers (Pillai *et al.,* 2002). Thus, azolla appears to be a potential source of nutrients and has a considerably high feeding value (Hossiny *et al.,* 2008).

The water fern azolla, grows in association with the blue-green algae, Anabaena *azollae*, is considered to be the most promising because of the ease of cultivation, high productivity and good nutritive value (Singh and Subudhi, 1978; Prabina and Kumar, 2010). Azolla *pinnata* was used as feed in broiler chicken (Balaji *et al.,* 2009), laying hens (Alalade *et al.,* 2007), Juvenile Black Tiger Shrimp (Sudaryono, 2006), goats (Samanta and Tamang, 1995) and buffalo calves (Indira *et al.,* 2009). Azolla *filiculoides* was also used in diets for sows (Leterme *et al.,* 2010) and as partial replacement of protein source for growing-fattening pigs (Becerra *et al.,* 1990; Duran, 1994).

In view of the above facts, the present experiment was undertaken to explore the nutritive value of Azolla *pinnata* as a feed.

Methodology

The work was undertaken at the department of Livestock Production Management, N.T.R. College of Veterinary Science, Gannavaram, Krishna District in Andhra Pradesh.

Azolla cultivation in pits

Three pits, each having the dimensions 5 m X 4 m (20 m^2) were made with 0.3 m depth (1ft). Care was taken to see that the floor of the pits were even. All the roots and other unwanted particles were cleared from the pits and precautions were taken such that all corners of the pit were of the same level in order to maintain a uniform water level. Silpaulin sheets of 24 ft X 18 ft were spread out over the pits such that sheets were longer and broader than the pits, with no holes. Sheets were spread out uniformly and the outer edges of the sheets were fixed so that they don't slip down. A thin layer of 10-15 cm soft soil was spread evenly over the sheet of each pit such that no large stones or any other contaminants existed.

Later, water was filled to a three fourth level in each pit and regular care was taken to maintain the water upto the same level. About 15 kg of fresh buffalo dung dissolved in 35 liters of water was added into each pit with thorough mixing such that the mixture was spread evenly throughout the area. About 30 g of super phosphate dissolved in 10 liters of water was added to the soil in a zigzag manner.

Once the preparation was completed, each pit was inoculated with 5 kg of fresh and pure culture of azolla and water was sprinkled over it. pH of the bottom organic matter and the top water were tested regularly. Once in every 15 days, application of 15 kg buffalo dung, 30 g super phosphate and 30 g of mineral

mixture (Ranmix) was done to obtain continuous growth of azolla and to avoid nutrient deficiency. In case of contamination of the pits by pests and diseases, a fresh inoculation was done with pure culture of azolla after clearing the previous biomass of azolla and water from the affected pit.

Collection, yield and storage of azolla

Azolla multiplied rapidly and filled the pits within 7 days. Fully grown azolla was harvested every week from the pits created in the department of Livestock Production Management, NTR College of Veterinary Science, Gannavaram. Every fortnight about 25 azolla samples were collected from each pit to measure the dimensions of plant. Harvested azolla was washed thoroughly in clean water, weighed and sun dried for 2 to 3 days such that it becomes crispy while green colour still retained in the dried azolla. Sun dried azolla was collected, packed in air tight bags and stored in aluminium feed bins until further use.

Chemical evaluation of azolla

Sun dried azolla sample was analyzed for proximate principles viz., dry matter, crude protein, ether extract, total ash, crude fibre and nitrogen free extracts as per the methods described by AOAC (2007).

Results and Discussion

Chemical Composition of Azolla

The values of proximate composition of sun dried azolla sample used in experimental rations of swine are presented in (Table 1). The dry matter (DM) content of sun dried azolla meal was 89.73 percent. Azolla contained 75.73 percent organic matter (OM), 23.49 percent crude protein (CP), 14.7 percent crude fibre (CF), 3.7 percent ether extract (EE), 24.26 percent total ash (TA), 7.94 percent acid insoluble ash (AIA), 2.58 percent calcium and 0.26 percent phosphorus.

Table 1: Proximate composition of azolla meal (on DMB)

SI. No	Nutrient	% DM
01	Dry matter	89.73
02	Organic matter	75.73
03	Crude protein	23.49
04	Ether extract	3.7
05	Crude fibre	14.7
06	Nitrogen free extract	33.84
07	Total ash	24.26
08	Acid insoluble ash	7.94
09	Calcium	2.58
10	Phosphorus	0.26

The chemical composition of sun dried Azolla *pinnata* sample as presented in (Table 1) revealed that the dry matter content was 89.73 percent which was in close agreement with the results of Samanta and Tamang (1995), Basak *et al.* (2002), Balaji *et al.* (2009) and slightly lower than the value obtained by Kumar *et al.* (2012). The less dry matter content of azolla may act as an impediment to use it on fresh basis as the bulk required to satisfy the DM requirements of livestock is very high.

The crude protein content of azolla estimated in the present study was 23.49 percent which indicated that azolla could be used as a potential natural protein source in livestock feeds. The CP value estimated was almost similar to the results obtained by Singh and Subudhi (1978), Balaji *et al*. (2009) and Kumar *et al*. (2012). However, Parthasarathy *et al.* (2001b) and Basak *et al.* (2002) reported higher value of 26.62 and 25.78 percent CP respectively, whereas, Samanta and Tamang (1995) obtained a lower CP value of 15.4 percent compared to the values obtained in the present study. This variation may be attributed to the nutritive value of the inputs added.

In the present study, it was found that the crude fibre content obtained was 14.7 percent which was found to be in accord with the values obtained by Samanta and Tamang (1995) and Balaji *et al*. (2009) whereas, the same was higher than the reports of Singh and Subudhi (1978) and Alalade and Iyayi (2006) and lower than the values reported by Kumar *et al.* (2012), Bolka (2011) and Basak *et al.* (2002).

The total ash content of Azolla *pinnata* obtained in this study was 24.26 percent, higher than the findings of Singh and Subudhi (1978), Samanta and Tamang (1995), Parthasarathy *et al.* (2001b), Basak *et al*. (2002), Alalade and Iyayi (2006), Titus and Periera (2006), Balaji *et al*. (2009) and slightly lesser than that reported by Kumar *et al.* (2012).

From the study it was revealed that the ether extract was 3.7 percent, which was in agreement with Singh and Subudhi (1978), Basak *et al.* (2002), Titus and Periera (2006), Balaji *et al*. (2009) but were not in accord with the findings of Parthasarathy *et al.* (2001b) and Bolka (2011), where ether extract value were reported to be higher than those obtained in the present study. EE value obtained in this study was higher to the values reported by Samanta and Tamang (1995), Titus and Periera (2007) and Kumar *et al.* (2012).

The Nitrogen Free Extract content of azolla recorded in this study was 33.84 percent, which were similar to the findings of Kumar *et al.* (2012) and Bolka (2011). On contrary to this, higher values obtained by Samanta and Tamang (1995), Parthasarathy *et al.* (2001b), Alalade and Iyayi (2006)

and Balaji *et al*. (2009), who reported 39.90 to 47.42 percent in azolla.

Present study revealed that the calcium content in dried azolla was (2.58 %), higher than the observations of Singh and Subudhi (1978), Samanta and Tamang (1995), Parthasarathy *et al.* (2001b), Alalade and Iyayi (2006), Titus and Periera (2007), Kumar *et al.* (2012) and nearer to the findings of Balaji *et al*. (2009). The phosphorus level of 0.26 percent in the present study was nearer to the observations of Samanta and Tamang (1995), whereas Singh and Subudhi (1978), Parthasarathy *et al.* (2001b), Titus and Periera (2006), Balaji *et al*. (2009) and Kumar *et al.* (2012) observed higher values in the range of 0.5 to 1.00 percent.

The variation in the nutrient composition of azolla in different studies could be attributed to differences in the soil nutrients and the differences in inputs added.

Conclusion

The chemical analysis indicated that the sun dried azolla is rich in crude protein content and could be used as a potential natural protein source in livestock feeds. Hence, Azolla could be an unconventional potent feed source to livestock.

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