International Journal of Food, Agriculture and Veterinary Sciences ISSN: 2277-209X (Online)
An Open Access, Online International Journal Available at http://www.cibtech.org/jfav.htm
2014 Vol. 4 (2) May-August, pp. 23-27/Indira and Ravi
Research Article

FEEDING VALUE OF AZOLLA (*AZOLLA PINNATA)* IN BUFFALO CALVES

***D. Indira and A. Ravi**
Department of LPM, College of Veterinary Science, Proddatur-516360 (A.P)
Department of Animal Nutrition, C.V.Sc, Tirupati (A.P)
**Author for Correspondence*

ABSTRACT
The study was conducted to evaluate the potential feeding value of Azolla by its chemical composition, amino acid profile, IVDMD, Insacco D M and Crude protein degradability. Azolla a potential protein replacement in concentrate mixture of ruminants, chemical composition of *Azolla pinnata* DM, CP, CF, EE, NFE, TA and AIA of *A. pinnata* were 4.23, 28.24, 22.25, 4.00, 30.71, 14.80 and 4.13, cell wall constituents NDF, ADF values were 72.05, 66.18. Amino acid composition Arginine, Cystine, Glycine, Histidine, Isoleucine, Leucine, Lysine, Methionine, Threonine, Tryptophan, Tyrosine, valine were 6.82, 2.06, 5.42, 2.31, 5.78, 9.04, 6.41, 1.68, 4.60, 2.11, 4.10, 6.65, IVDMD % was 60.20, Insacco DM degradability % was 51.56, in sacco CP degradability (%) of *A. pinnata* was 47.15. Based on the results Azolla is rich protein source and has rich Amino acid profile and the result of percent of dry matter disappearance, degradability *in vivo* and *in vitro* studies showed the best performance of *A. pinnata* in terms of dry matter utilization in buffalo cows. In sacco crude protein degradability 55 to 60 %. Hence *A. pinnata* was recommended as a good unconventional protein supplement in the rations of ruminants and non ruminants.

Keywords: *Feeding Value of Azolla, Azolla, Feeding Azolla to Calves*

INTRODUCTION
India consists of large livestock population. The milk production reached top position in the world but the productivity of livestock of our country is less when compared with other countries. There is deficit of green and dry fodder.
Hence, there is a need to identify and incorporate unconventional feeding resource which is most abundant potential source of proteins. Azolla which is most abundant nutritive value feed. According (Lumpkin and Plucknette, 1982, Vanhove and Lope Z 1987) the use of Azolla as a feed resource for fish, swine and poultry had been tested with favourable results. According (Castillo *et al.*, 1981; Alcantara and Querubin, 1989). The protein content was superior when compared to different fodders. According (Pillai, 2002). High ash content present in *Azolla pinnata* indicated the capacity of plant to deposit ash in the surface tissues and leaves.

MATERIALS AND METHODS
Samples of *Azolla pinnata* collected from pits were analysed for proximate principles as per AOAC (1990) methods. Cell wall constituents were analysed by Goering and Vansoest (1970). Amino acid analysis performed using an automated precolumn derivatisation with o-phthaldiadehyde (OPA) using reverse phase HPLC.
***In Vitro* Dry Matter Digestibility**: The dry matter digestibility of Azolla was determined by *in vitro* dry matter digestibility as suggested by (Tilley and Terry, 1963).
In sacco Dry matter disappearance was carried out as per procedures outlined by (Kempton, 1980).

RESULTS AND DISCUSSION
Chemical composition of the present study of *A. pinnata*, the dry matter, crude protein, crude fibre, ether extract, nitrogen free extract, total ash, acid insoluble ash were 4.23, 28.24, 22.25, 4.00, 30.71, 14.80,

4.13. Cell wall constituents were NDF, ADF 72.05, 66.18 respectively. Chemical composition shown in Table 1. The present study dry matter content (%). *A. pinnata* was in accordance with the DM values reported by (Men, 1995) and (Bacerra *et al.*, 1995) who reported 4.7 and 5.6 percent respectively. The percent crude protein value of 28.23 in the experiment comparable to crude protein values reported by (Faoiwara, 1947; Subudhi and Singh, 1978; Sing *et al.*, 1983; Pillai, 2002; Basak *et al.*, 2002; Alalade and Lyayi, 2006). The crude fibre content of *A. pinnata* in the study was higher than the values reported by (Parnerkar *et al.*, 1986; Men , 1995; Tamang and Samanta, 1993; Ali and Leeson, 1995) who reported the values ranged from 11 to 18 %.

Dewanji and Matai reported lowest crude fibre value of 2.8 CF value fluctuations due to late harvesting time. The EE value (%) reported by (Dewanji and Matai, 1991) was 9.9 which was higher than the ether extract value observed in the present study. The present values comparable with (Singh *et al*. 1983; Men, 1995; Basak *et al.*, 2002; Alalade and Lyayi, 2006; Buchingham *et al.*, 1978). NFE content of present study was similar with values of (Bhuyan *et al.*, 1998; Ali and Lesson, 1995; Puerubin *et al.*, 1986; Basak *et al.*, 2002) on contrary (Tamang and Samanta, 1993; Singh *et al.*, 1983; Parnerkar *et al.*, 1986 reported the higher values of 41-52 %.

Variations in the values due to variations in the temperature, relative humidity, light intensity, harvesting time. The NDF and ADF levels observed in the present study were higher than the values reported by Singh, *et al.*, 1983; Bacerra, *et al.*, 1995; Dominguez *et al.*, 1995. The study values higher than the values reported by (Dewanji and Matai, 1991).

Amino acid composition of *A. pinnata* (g/100 g protein) Arginine, cystine, Glycine, Histidine, Isoleucine, Leucine, Lysine, Methionine, Threonine, Tryptophan, Tyrosine, Valine were 6.82, 2.06, 5.42, 2.31, 5.78, 9.04, 6.41, 1.68, 4.60, 2.11, 4.10 and 6.65 g/100 g protein. The *in vitro* dry matter digestibility (IVDMD) % of *Azolla pinnata* shown in Table 1a. The mean $\pm$ SE of three samples analysed for *in vitro* dry matter digestibility (%) was 61.20 $\pm$ 0.58.

Ali and Leeson (1995) reported the higher values were due to soil nutrients. Higher values of lysine percent recorded in the present study indicated the optimum values of Lysine recommended by (Wang and Fuller, 1989).

Amino acid value of Azolla in present study was higher than the Amino acid profile of other aquatic plants reported by (Ali and Leeson, 1994). Azolla would not appear to be a problem of balancing of Amino acid requirement in Manogastric animals and poultry in which the inclusion of the protein supplement in GNC, Soyabean, Fish meal etc. had the problem. The report were in accordance with (Sanginga and Vanhove, 1989). Certain limiting amino acids are to be added to make Azolla a complete source of Amino acids.

Insacco drymatter degradability (%) of *Azolla pinnata* in rumen fistulated buffaloes shown in Table 2. The DM disappearance (%) at different hrs of incubation viz. at 12, 24, 36, 48 and 72 hrs was 49.33 $\pm$ 24.66, 56.55 $\pm$ 20.28, 62.28 $\pm$ 31.24, 66.15 $\pm$ 33.08 and 70.06 $\pm$ 35.25 respectively. The effective dry matter degradability (%) observed was 51.56 $\pm$ 1.22 at the hrs of incubation between, 24-36. The insacco crude protein degradability (%) of *A. pinnata* in fistulated buffaloes is presented in Table 3.

The crude protein disappearance (%) at different hrs of incubation i.e. at 3, 6, 9, 12, 15 and 24 hrs was 29.75 $\pm$ 2.84, 37.75 $\pm$ 2.17, 45.33 $\pm$ 0.59, 47.45 $\pm$ 0.54, 52.33 $\pm$ 1.03 and 57.33 $\pm$ 1.03 respectively.

The per cent of *in vitro* dry matter digestibility recorded in the present study was 60.20 in agreement with report of (Muzler *et al.*, 1978, Preston and Murguetio, 1995), also observed the higher per cent of *in vitro* digestibility in samples of Azolla. (Dominguez *et al.*, 1997) observed highest *in vitro* dry matter digestibility in Pigs fed with *A. pinnata* (Ly *et al.*, 2002) reported the similar values of % of IVDMD in pigs fed with Azolla.

Insacco crude protein degradability (%) results were in accordance with (Preston and Murgueitio, 1995; Dominguez *et al.*, 1997; Ly and Preston, 2001; Ly *et al.*, 2002). The percent of Insacco and *In vivo* digestibilities of crude protein of Azolla were comparable.

Table 1: Chemical composition and cell wall constituents of *Azolla pinnata* and Experimental diets (% DM basis)

S.No	Nutrients	*AzollaPin-nata*	Hybrid napier	Paddy straw	Control diet	Experimental diet
1. Chemical composition						
	DM	4.23	19.64	89.60	90.01	90.01
	CP	28.24	7.91	4.01	19.93	17.62
	CF	22.25	30.06	36.60	10.00	11.90
	EE	4.00	3.42	2.53	4.33	4.64
	NFE	30.71	43.81	45.11	41.06	57.04
	ZA	14.80	16.00	13.80	7.70	8.80
	AIA	4.13	6.78	8.70	5.04	5.03
2. Cell wall constituents						
	NDF	72.05	83.10	83.60	43.2	44.2
	ADF	66.18	62.88	89.70	19.2	20.1

Table 1a: *In vitro* dry matter digestibility (IVDMD) (%) of *Azolla pinnata* (Tilley and Terry technique)

Sample 1	59.20
Sample 2	60.20
Sample 3	61.20
Mean ± SE	61.20 ± 0.58

Table 2: *In sacco* DM degradability (%) of *Azolla pinnata*

Hours of incubation	DM disappearance (%) at different hours of incubation					Constants			Effective DM degradability (%)
	12	24	36	48	72	a	b	c	
Dry matter disappearance ± SE	49.33±24.66	56.55±28.28	62.28±31.14	66.15±33.08	70.06±35.25	37.06±3.89	40.76±1.18	0.301±0.01	51.56±1.22

Table 3: *In sacco* CP degradability (%) of *Azolla pinnata*

Hours of incubation	CP disappearance (%) at different hours of incubation						Constants			Effective protein degradability	RDP	UDP
	3	6	9	12	15	24	A	B	C			
CP disappearance ± SE	29.75 ± 2.84	37.75 ± 2.17	45.25 ± 0.59	47.45 ± 0.54	52.33 ± 1.03	57.33 ± 1.03	16.58 ± 6.10	46.82 ± 3.04	0.1092 ± 0.03	47.15 ± 1.50	13.32 (47.17 %)	14.92 (52.83 %)

It was concluded that the potential feeding value of Azolla evaluated from chemical composition and cell wall constituents. The amino acid profile of Azolla showed that it had 56 % amino acids, 47 % of EAA and 53 % non EAA. *Azolla pinnata* was poor source of sulphur containing Amino acids i.e. Methionine, Cystine.

The per cent of *in vitro* dry matter digestibility of *A. pinnata* was 60.20 and % of Insacco dry matter digestibility and the effective dry matter degradability (%) at the outflow rate of 0.05 / hr was 51.65 %. The per cent of Insacco crude protein degradability of *A. pinnata* in rumen fistulated buffaloes showed that effective % of crude protein degradability at the outflow rate of 0.05 /hr was 47.17 per cent.

Higher values of NDF indicated better utilization of *A. pinnata* as a fibre source of large ruminants. The percent dry matter degradability had taken place during early hrs of incubation which indicated the early digestion and efficient utilization of dry matter in ruminants.

REFERENCES

Alalade and Lyayi EA (2006). Chemical composition and the feeding value of Azolla (*Azolla pinnata*) meal for egg-type chicks. *International Journal of Poultry Science* **5** 137-141.

Alcantara PF and Querubin LJ (1989). Feeding value of Azolla of Azolla meal (Mix varieties) for starter and growing pigs. *Philipines Journal of Veterinary Animal Science* **15** 22-29.

Ali and Leeson (1995). Azolla : Biology and agronomic significance. *Botanical Review* **35** 17-35. **Instead found -A. W. Moore** (1969). Azolla: Biology and agronomic significance Volume 35, Issue 1, January–March, 1969 Pages 17-34

AOAC (1990). Official methods of analysis. *Association of Official Analytical Chemists* 540 (Washinton DC) 15th edition.

Bacerra M, Murgueitio E, Reyes G and Preston TR (1995). Azolla filiculoide as practical replacement or traditional protein supplements in diets for growing finishing pigs based no sugarcane juice. *Livestock Research for Rural Development* **2** 15-22.

Basak Ahasn, Habib Pramanik, Md. Muhammad Siddique Rahman and Bimol Chandra Roy (2002). Azolla (*Azolla pinnata*) as a feed ingredient in broiler ration. *International Journal of Poultry Science* **1** 29-34.

Basak B, Pramanik AH, Rahman MS, Taradar SV and Roy BC (2002). Azolla (*Azolla pinnata*) as a feed ingredient in broiler ration. *International Journal of Poultry Science* **1** 29-24.

Bhuyan MAH, Hasanat MR, Ali MA and Rahman MA (1998). Effect of feeding Azolla (*A. pinnata*) on the performance of broiler. *Bangladesh Journal of Animal Science* **27** 77-82.

Buckingham KE, Stepher WE, James GM and Charles RG (1978). Nutritive value of nitrogen fixing aquatic fern Azolla filiculoides. *Journal of Agricultural and Food Chemistry* **26** 1230-1234.

Castello LS, Gerpacio AL and Paseual FSD (1981). Exploratory studies on Azolla and fermented rice hulls in broiler diets. College, Leguna (Philippines) 6.

Dewanji CE and Matai (1991). Fresh water plants, a potential source of protein. *Economic Botany* **22** 359-365.

Dominguez PL, Yamilet Molinet and Ly (1995). Ideal and *in vitro* digestibility in the pig of three floating aquatic macrophytes. Institutes Investigations Porcinas. Corretera del Guatao kml. Punta Brava La Habana, Cuba.

Fuoiwara TD (1947). *Biology of Micro-Organisms* Third edition (Engle Wood Cliffs, Prentice Hall).

Goering HK and Vain Soest PJ (1970). *Forage Fibre Analysis* (USDA Agricultural Hand Book, Washington D C) 379.

Kamalasanana Pillai (2002). Technology Resource Centre of the natural resource development project (NARDEP) an Organ of Vivekananda Kendra in Kanyakumari, Tamil Nadu.

Kempton TJ (1980). The use of Nylon bags to characterize the potential degradability of feeds for ruminants. *Tropical Animal Production* **5** 107-116.

Lumpkin TA and Plucknett DL (1982). *Azolla as a Green Manure: Use and Management in Crop Production, West View Tropical Agricultural Series* (West Press Inc., Colorado) **5** 230.

Ly J and Preston TR (2001). *In vitro* estimates of nitrogen digestibility for pigs and water soluble nitrogen are correlated in tropical forage feeds. *Livestock Research for Rural Development Electronic Version* **13**(1).
Ly J, Pok Somkol and Preston TR (2002). Nutritional evaluation of aquatic plants for pigs : pepsin / pancereation digestibility of six plant species. *Livestock Research for Rural Development* **14**(1).
Men PV (1995). Percentage yield of parts of cut up broiler. *Journal of Poultry Science* **33** 1074.
Muziar AJ, Slinger SJ and Burton JH (1978). Chemical composition of aquatic macrophytes III. Mineral composition of fresh water macrophytes and their potential for mineral nutrient removal from lake water. *Canadian Journal of Plant Science* **58** 851-862.
Parnerkar S Patel, Bhagoji JM, Patel AP and Dave AD (1986). *Proceedings of the National Symposium on the role of Animal Production and Management in Rural Development of India*. Assam Agricultural University, Guwahati.
Preston TR and Murgueitio E (1995). Strategy for sustainable livestock production in the tropics. *CIPAV SAREC CONDRIT* second edition (Editorial Claridad Ltd., Cali, Colombia) 90.
Querubin LJ, Alcantara PF and Princesa AO (1986). Chemical composition of three Azolla species (*A. caroliniana, A. microphylla* and *A. pinnata*) and feeding value of Azolla meal (*A. microphylla*) in broiler ration II. *The Philippine Agriculturist* **69** 479-490.
Sanginga N and Van Hove C (1989). Amino acid composition of Azolla as affected by strains and population density. *Plant and Soil* **117** 263-267.
Singh YP, Naik DG and Sharma GL (1983). Nutritive value of a water fern (Azolla anabaena). *Indian Journal of Animal Research* **17** 98-102.
Subudhi PR and Singh PK (1978). Nutritive value of water fern *Azolla pinnata* for chicks. *Journal of Poultry Science* **57** 378-380.
Tamang Y and Samanta G (1993). Feeding value of Azolla (*Azolla pinnata*) an aquatic fern in black Bengal goats. *Indian Journal of Animal Science* **63** 188-191.
Tilley and Terry RA (1963). A two stage technique for the *in vitro* digestion of forage crops. *Journal of British Grassland Society* **18** 104-111.
Van Hove C and Lopez Y (1987). Fisiologia de Azolla: In workshop on the assessment of Azolla use in tropical latin America. Chicklaya : Perce.
Wang TC and Fuller MF (1989). The optimum dietary amino acid pattern for growing pigs : Experiments by amino acid deletion. *British Journal of Nutrition* **62** 77-89.