AZOLLA *(AZOLLA PINNATA*) SUPPLEMENTATION IN BUFFALO CALVES ON GROWTH PERFORMANCE

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ABSTRACT: At rural levels from the angle of domestic needs and export market potentiality there is a great market demand for veal production. Improvement in weight gain, less feed intake, more feed conversion efficiency, less dry matter intake, better nutrient utilization and less cost of feed per kg wt gain was obtained in male buffalo calves with the inclusion of Azolla meal in experimental diet. The average daily gain is 240 gm in control diet, experimental diet is 294 gms. Average dry matter intake 3.21. The average daily gain, average dry matter intake, average feed conversion efficiency and average feed cost Rs./kg B. weight gain for control and experimental diet were 240 gms and 294 gm, 3.21 and 2.91, 13.24 and 10.07 and 17.87 and 13.58 respectively. Higher average daily gain was recorded in experimental diet than the control diet. Feed conversion efficiency which was significantly (P<0.01) superior in experimental diet. The cost of control diet per kg body weight gain was significantly ((P<0.01) higher than the experimental diet. The results also suggests that fresh Azolla meal also a potential unconventional protein source for buffalo calves as well as adult ruminants.

Key words : Azolla,feeding Azolla,Supplementation of Azolla.

Introduction: India is having large livestock population. But there is deficit of fodder and cost of feeding also more and natural calamities causes the shortening of availability of fodder. All these leads to less productivity when compared to other countries. There is a need to compensate above conditions hence Azolla which fullfil the above conditions because it is rich in protein. Amino acids and it can be easily digested due to low lignin content. The cost of production of Azolla also low. The present study was conducted to study the effect of Azolla supplementation to the extent replace 50 per cent GNC nitrogen in concentrate mixture on nutrient utilization and growth performance in male buffalo calves and cost effectiveness of Azolla supplementation. The total feed intake, less dry matter intake, B.wt gain, average daily gain, feed conversion efficiency, nutrient utilization also superior in experimental diet when compared with the control diet. The similar reports are given by (Farrel, 1978, Singh *et al*., 1983, Tamang and Samanta, 1993). The cost of feed per kg B. wt gain also less which were in accordance with the (Singh *et al*., 1983).

Materials And Methods: Experiment was conducted in male buffalo calves (six in each group of two groups) in a completely randomized design for 90 days to assess the replacement of GNC nitrogen with Azolla nitrogen on growth performance. At the end of the growth trial 7 days digestion trial was conducted by using TiO_2 indicator method to assess the nutritive value of experimental diets. Faecal samples collected and analysed. *In vitro* dry matter digestibility and in sacco dry matter and degradability was assessed in triplicate samples. Twelve graded murrah male buffaloe calves divided into 2 groups (6 in each group) based on their body weights were used as experimental animals. Control diet consists of concentrate mixture. Hybrid napier and paddy straw experimental diet consists of concentrate mixture replacing 50 % of groundnut cake nitrogen with Azolla + paddy straw, Hybrid napier. Diets were analysed for proximate principles as per (AOAC, 1990) methods Selval constituents analyzed as per procedures described by (Goering and Vansoest, 1970).

Results And Discussion: Total feed intake of control diet was 492.3 kg against 411.3 kg in experimental diet. Significantly (P < 0.01) lower feed intake was recorded in experimental diet compared to control diet. The dry matter intake of control diet was 286.5 kg against 266.4 kg in experimental diet, which was significantly (P < 0.05) higher shown in Table 1. Significantly (P < 0.01) lower feed intake was recorded in the experimental diet compared to control diet. The results were in accordance with the report of (Farrel 1978, Alalade and Lyayi, 2006, Bhuyan *et al*., 1998, Costello *et al*., 1981 and Basak *et al*., 2002). On the contrary to the above results sheep could consume on an average 3 kg dry mater per 100 kg with in a week time and palatability was not a problem for them (Parnerkar *et al*., 1986).

Azolla has poor dry matter content (4.23 %) hence supplementation of fresh Azolla along with other dry roughages and replacement of the conventional feed ingredients might be the better choice of using of fresh Azolla. The initial body weights were 98.83 and 99.83 and final body weight after growth trial were 120.5 and 126.33 kg control and experimental diets respectively. The B. weight gain 26.5 kg were recorded for experimental diet was significantly (P < 0.01) higher than the B. wt gain of 21.67 kg recorded

for control diet. Average daily gain of control diet was 240 g against 249 g in experimental diet. Significantly ($P < 0.01$) higher average daily gain was recorded in experimental diet than the control diet. B. wt gain and average daily gain recorded significantly ($P < 0.01$) higher with Azolla supplemented diet than the control diet. The average daily gain of 294 g with Azolla supplemented diet in present study was comparable with the reports of (Singh *et al.*, 1983) in cross bred heifers. (Tamang and Samanta, 1993) when fed the castrated male black bengal kids.

Feed conversion efficiency % of Azolla supplemented experimental diet was 10.07 against 13.24 in control diet which was significantly ($P < 0.01$) superior. The digestibility coefficients (%) of different nutrients of experimental diets are shown in Table 2. The digestibility coefficients (%) of dry matter was 58.2 $\pm$ 0.30 and 54 $\pm$ 0.5 in experimental and control diet respectively. The digestibility coefficient (%) of crude protein was 58.0 $\pm$ 0.25 and 52.0 $\pm$ 0.68 for experimental and control diets respectively. The digestibility coefficients (%) of ether extract, crude fibre and nitrogen free extract were 57.1 $\pm$ 0.22, 62.0 $\pm$ 0.25 and 66.06 $\pm$ 0.44 for Azolla supplemented experimental diet against 55.1 $\pm$ 0.32, 58.0 $\pm$ 0.25 and 62.0 $\pm$ 0.25 for control diets respectively. Feed conversion efficiency % was superior for experimental animals than the control animals in the present study was comparable with the reports of Singh *et al.* (1983) in cross bred heifers. The decreased feed conversion ratios at 10 to 15 % Azolla meal were also reported by (Querubin *et al.*, 1986, Muzlar *et al.*, 1978 and Buckingham *et al.*, 1978. The digestibility coefficients (%) of cell wall constituents are presented in Table 2.. The digestibility coefficients (%) of NDF and ADF were 61.5 $\pm$ 0.34 and 42.36 $\pm$ 0.32 for experimental diet compared to 58.0 $\pm$ 0.25 and 42.0 $\pm$ 0.44 for control diet respectively. Significantly ($P < 0.01$) higher digestible coefficients (%) were observed for experimental diet compared to control diet and no significant difference was observed between the experimental and control diets in the digestibility coefficient (%) of acid detergent fibre. The % of digestibility coefficient of dry matter higher in Azolla supplemented experimental diet over the control diet.

results reported by (Singh *et al.*, 1983, Tamang and Samanta, 1993) reported higher values of dry matter digestibility (%) in black Bengal goats supplemented with *Azolla pinnata* at 5 to 10 % levels. Crude protein digestibility was significantly ($P < 0.01$) higher in Azolla supplemented diet over the control diet indicated higher quality of protein present in Azolla meal. Similar results reported by (Singh *et al.*, 1983, Tamang and Samanta, 1993, Ali and Leeson, 1995 and Parnerkar, 1986) reported that by supplementation of Azolla meal to Indian sheep could meet their maintenance requirements which was also in agreement with the present study results. The CF, EE, NFE digestibility coefficients significantly ($P < 0.01$) higher in Azolla supplemented diet over the control diet. The results were inagreement with the findings of (Tamang and Samanta, 1993). The digestibility coefficients of cell wall components and NDF and ADF were higher in experimental diet supplemented with Azolla than control diet these results were in agreement with the (Singh *et al.*, 1983). The cost of Azolla production is present in Table 3 which was calculated as Rs. 0.70. Cost of ingredients used in the preparation of experimental diet is shown in Table 4. The cost of control diet was Rs. 749 against Rs. 566 per quintal of experimental diet supplemented with Azolla. The cost of feed per kg B. wt gain is presented in Table 5. The cost of control diet per kg B. wt gain was significantly ($P < 0.01$) higher than the experimental diet (Rs. 17.87 vs Rs. 13.58). The cost of cultivation of Azolla was found to be very cheaper which accounted to Rs. 70 per quintal and concentrated mixture was replaced with 50 % of GNC nitrogen by Azolla meal the feed cost per kg was reduced and become very cheaper. The feed cost per kg B.wt gain was Rs. 4.29 lower in Azolla supplemented diet than the control diet. The similar trends in the feed cost reduction per kg B. wt gain observed by (Singh *et al.*, 1983) when fed diets replaced with Azolla meal at 30, 60 and 100 % levels. Based on above results concluded that the total feed intake is less in Azolla supplemented diet and the B.wt gain, average daily and feed conversion efficiency was higher in experimental diet. The nutrient utilization is also superior. By taking less dry matter more B. wt gain obtained by this experimental diet. The cost per kg B. wt gain is also less in case of experimental diet. Azolla has better results in ruminants.

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Table 1 : Feed and drymatter intake (kg) and feed conversion efficiency (%) of experimental diets

S. No.	Animal No.	Feed intake in 90 days			Dry matter intake in 90 days			Total feed intake (kg)	t-value	Total dry matter intake (kg)	t-value	Weight gain (kg)	t-value	Feed conversion efficiency (%)	t-value	Cost of feed/kg body weight gain (Rs.)	t-value
		Paddy straw	Hybrid Napier	Concentrate mixture	Paddy straw	Hybrid Napier	Concentrate mixture										
Control diet																	
1.	1	164.7	224.1	114.3	146.7	43.2	102.6	503.1	6.72**	292.5	2.78*	22.0	6.87**	13.29	7.07**	18.13	11.11**
2.	2	165.6	225.0	115.2	147.6	44.1	103.5	505.8		295.2		21.0		14.05		18.13	
3.	3	144.9	198.9	100.8	129.6	38.7	90.0	444.6		258.3		20.0		12.91		17.04	
4.	4	160.2	219.6	111.6	143.1	42.3	99.9	491.4		285.3		24.0		11.88		17.68	
5.	5	164.7	224.1	114.3	146.7	43.2	102.6	503.1		292.5		22.0		13.29		18.13	
6.	6	165.6	225.0	115.2	147.6	44.1	103.5	505.8		295.2		21.0		14.05		18.13	
Mean ± SE		160.95 ± 3.31	219.45 ± 4.19	111.9 ± 2.28	143.55 ± 2.87	42.6 ± 0.82	100.35 ± 2.13	492.3 ± 9.78		286.5 ± 5.83		21.66 ± 0.55		13.24 ± 0.33		17.87 ± 0.18	
Experimental diet																	
1.	1	164.7	150.3	114.3	146.7	28.8	102.6	429.3		278.1		25.0		11.12		14.45	
2.	2	161.1	148.5	113.4	144.0	27.9	101.7	423.0		273.6		26.0		10.52		14.27	
3.	3	149.4	135.9	103.5	133.2	26.1	92.7	388.8		252.0		27.0		9.33		12.96	
4.	4	156.6	142.2	108.9	139.5	27.9	97.2	407.7		264.6		28.0		9.45		12.58	
5.	5	161.1	148.5	113.4	144.0	27.9	101.7	423.0		273.6		26.0		10.52		14.27	
6.	6	149.4	135.9	103.5	133.2	26.1	97.2	388.8		256.5		27.0		9.50		12.96	
Mean ± SE		157.13 ± 2.66	143.55 ± 2.66	109.5 ± 2.04	140.1 ± 2.37	27.45 ± 0.45	98.85 ± 1.56	41.13 ± 7.33		266.4 ± 4.27		26.5 ± 0.42		10.07 ± 0.30		13.58 ± 0.34	

* ($P < 0.05$)
** ($P < 0.01$)

Table 2 : Digestibility coefficients (%) of different nutrients of experimental diets

Animal number	Dry matter	t-value	Crude protein	t-value	Ether extract	t-value	Crude fibre	t-value	Neutral detergent fibre	t-value	Acid detergent fibre	t-value	Nitrogen free extract	t-value
Control diet														
1	53	6.93**	50	8.22*	55	6.03**	58	10.95**	58	8.17**	43	0.66NS	62	7.85**
2	54		52		56		58		59		42		62	
3	55		50		55.2		59		57		40		61	
4	53		53		54.2		58		58		43		62	
5	56		54		54.2		57		58		42		63	
6	53		53		56		58		58		42		62	
Mean ± SE	54.0±0.51		52.0±0.68		55.1±0.32		58.0±0.25		58.0±0.25		42.0±0.44		62.0±0.25	
Experimental diet														
1	58		59		57		62		62		42		65	
2	58		58		58		62		62		43		68	
3	58		57		57		62		60		41		65	
4	57		58		58		61		61		43		66.0	
5	59		58		58		62		62		42.2		66.2	
6	59		58		57		62		62		43		66.2	
Mean ± SE	58.2±0.30		58.0±0.25		57.1±0.22		62.0±0.25		61.5±0.34		42.36±0.32		66.06±0.44	

* ($P < 0.05$) ** ($P < 0.01$)

Table 4 : Cost of experimental diets (Rs.)

Ingredient	Ingredient cost/quintal	Control diet	Experimental diet
Maize	670.00	268.00 (40)	268.00 (40)
GNC	1150.00	391.00 (34)	196.00 (17)
DORB	361.00	85.00 (23.5)	85.00 (23.5)
MM	200.00	4.00 (2.0)	4.00 (2.0)
Salt	50.00	1.00 (0.5)	1.00 (0.5)
Azolla pinnata	70.00	-	12.00 (17)

Total		749.00	566.00
Paddy straw	198.00		
Hybrid Napier	200.00		

Note : The values in parentheses indicate the ingredient level in the ration

GNC – Groundnut cake; DORB – Deoiled rice bran; MM – Mineral mixture

Table 5 : Live weight changes and feed conversion efficiency (%) during growth trial

S. No.	Parameters	Control diet						Experimental diet					
		1	2	3	4	5	6	1	2	3	4	5	6
1.	Live weight change (kg)												
	a) Initial body weight (kg)	100	105	94	91	99	104	105	100	95	102	101	96
	b) Final body weight (kg)	122	126	114	115	121	125	130	126	122	130	127	123
2.	Body weight gain (kg)	22.0	21.0	20.0	24.0	22.0	21.0	25.0	26.0	27.0	28.0	26.0	27.0
3.	Days of experiment	90	90	90	90	90	90	90	90	90	90	90	90
4.	Average daily gain (ADG) (kg)	0.244	0.233	0.222	0.267	0.244	0.333	0.278	0.289	0.300	0.311	0.289	0.300
5.	Dry matter intake (DMI) (kg)	3.30	3.3	2.90	3.20	3.30	3.30	3.0	3.0	2.8	2.90	3.0	2.8
6.	Feed conversion efficiency (%)	13.29	14.05	12.91	11.88	13.29	14.05	11.21	10.52	9.33	9.45	10.52	9.50
7.	Total body weight (kg)	222	231	208	206	222	231	235	226	217	232	226	217
8.	Average body weight (kg)	111	115.5	104	103	111	115.5	117.5	113	108.5	116	113	108.5
9.	Dry matter intake (DMI) (%) body weight	2.70	2.86	2.79	3.12	2.70	2.86	2.79	2.88	2.75	2.69	2.88	2.75
10.	Cost Rs./kg body weight gain	18.13	18.13	17.04	17.67	18.13	18.13	14.45	14.27	12.96	12.58	14.27	12.96
	Average ADG	0.240											0.294**
	Average DMI (%) body weight	3.21											2.91
	Average feed efficiency (FCR)	13.24											10.07
	Average feed cost (Rs.)/kg body weight gain	17.87											13.58