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A comparative study on chemical composition of wild fodder grasses at different stages of maturity of South-East Rajasthan

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ABSTRACT
In the present study 20 fodder grasses were collected depending on their abundance, availability, maturity and preference of livestock of South-East Rajasthan. Percentage of crude protein, ether extract, crude fibre, nitrogen-free extract, total ash and mineral contents was measured on dry matter basis. The aim of this study was to assess the chemical composition of fodder grasses as comparatively good cattle feed for South-East Rajasthan. Dry matter varied from 20.0-27.0% in young stage, 44.45-76.20% in prime stage and in ripe stage 83.34-89.59%. Crude protein value 4.29-18.01% in young stage, 3.10-14.50% in prime stage, 2.17- 9.10% in ripe stage. While Ether extract ranged from 0.65-1.80% in young stage, in prime stage 0.80- 2.15% and 1.20- 3.20% in ripe stage. But Crude fibre ranged between 9.75- 18.40% in young stage, 20.40-32.80% in prime stage and 29.90- 43.25% in ripe stage. Nitrogen-free extract varies from 59.29- 74.71% in young stage, in prime stage 42.60- 62.75% and 38.10- 52.93% in ripe stage. Total ash content exhibited a wide variation range in young stage 4.50- 11.20%, in prime stage 9.15- 13.30% and in ripe stage 10.00- 18.60%. Among the minerals showed the highest percentage in prime stage, Na- 0.85%, Ca- 0.75%, K- 3.50%. According to data grasses showed reasonably have good protein content in young stage and it decreases towards maturity.
Key words: *Forder grasses; Chemical composition; Calorific value, Maturity stages; South-East Rajasthan.*

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INTRODUCTION

In India cattle are the backbone of agriculture and play a major role in rural economy. Animal husbandry and agriculture are economically intertwined (1). To keep the good health and working condition of the cattle available balance natural diet is necessary (2). In developing countries there are a deficiency of high-quality fodder crops (3). So now a days fodder grasses attract more and more attention in the developing countries. Cattle rearing plays a very important role in the state Rajasthan and ethnobotanical study on grasses are immense importance (4).

Grasses grow rapidly and shows sustainable growth with environmental tolerance. Chemical composition as well as nutritive value of grasses, established them the most valuable group for live stocks. Nutritive values were the important determinant of herbivores body sizes and the range of values promoted species coexistence (5). The objective of this study was to evaluate the chemical composition and calorific value of wild grasses in South-East parts of Rajasthan, India.

MATERIAL AND METHODS

The study was conducted in districts of South-East Rajasthan, located between latitude 23.3N and 30.12N and longitude 69.30E and 78.17E. The altitude ranges from 100m to 350m a.s.l. The average annual rain fall is 393.33- 419mm. The mean annual temperature is 28-33^{0}C. Sample were collected in the month of July –December, 2018.

The wild grasses were collected depend on information of local farmers use to feed their livestock. All the experimental samples of fodder grasses have been collected on different stages (young, prime and ripe) of maturity. The collected samples were allowed to air-dry and placed at 80°C for 24 hours in a hot air oven and then the dried samples were kept at 103°C temperature for 4 hours to determine dry matter (DM) content. Oven dried samples were powdered in Willey mill to pass through 1mm mesh sieve size and packaged in air- tight polythene bags until further chemical analysis. Percentage of crude fat (Ether extract), crude protein, crude fiber, ash, nitrogen free extract, mineral content and calorific value were carried out. Total nitrogen was determined by micro-Kjeldahl method and the crude protein (CP) content was estimated by multiplying the nitrogen (N) content by 6.25 (6). Contents of crude fat, crude fiber and ash

were also determined by AOAC procedure. Total ash content was determined by oven drying the samples at 105^{0}C overnight and by combusting the samples in a muffle furnace at 550^{0}C for 6 h (6).
Calculation of nitrogen free extract was done by subtracting sum of all other fractions (crude protein, crude fat, crude fiber, and ash,) from 100% total content. Sodium potassium and calcium contents were estimated by Flame photometer and energy values of the grasses were determined by Oxygen Bomb Calorimeter (7). All the experiments were performed in triplet and mean values were calculated.

RESULTS AND DISCUSSION

The nutritional value of the herbage depends on its chemical composition and stages of maturity as well as on the interaction of these two attributes. In this study results of proximate analysis (oven dry basis) were done on 20 wild fodder grasses sample, enlisted in table 1.
Dry matter (DM) content varied from 20.00% (*Echinochloa colonum*) to 27.00% (*Themeda quadrivalvis*) in young stage, 44.45% (*Sorghum helepense*) to 76.20% (*Apluda mutica*) in prime stage and in ripe stage 83.34% (*Brachiaria ramosa*) to 89.59% (*Rottboellia exaltata*). DM content in all the grasses is maximum in ripe stage and minimum in young stages.
The chemical composition at different stages of growth showed that the percentage of crude protein varies from 4.29% (*Dichanthium annulatum*) to 18.01% (*Setaria verticillata*) in young stage (July to August) and in prime stage (September to October) 3.10% (*Dichanthium annulatum*) to 14.50% (*Setaria verticillata*) and 2.17% (*Echinochloa colonum*) to 9.10% (*Setaria verticillata*) in ripe stage (November to December). The table 1 shows that all the grasses have reasonably good protein content in young stage and it decreases towards maturity. It has been reported several grass species showed reasonably good protein content in young stage, during the month of late August or early September and thereafter, the protein content decreases rapidly (8).
While, percentage of ether extract varies from 0.65% (*Sehima nervosum*) to 1.80% (*Pennisetum purpureum*) in young stage and 0.80% (*Sehima nervosum*) to 2.15% (*Cenchrus ciliaris*) in prime stage and 1.20% (*Cynodon dactylon*) to 3.2% (*Pennisetum purpureum*) in ripe stage. The data shows that crude fat content increases with maturity. During fibre study, it appeared all the samples was found varied from 9.75% (*Heteropogon contortus*) to 18.40% (*Cynodon dactylon*) in young stage and 20.40% (*Heteropogon contortus*) to 32.80% (*Brachiaria ramosa*) in prime stage and 29.90% (*Cynodon dactylon*) to 43.25% (*Acrachne racemosa*) in ripe stage. The data shows that crude fibre content increases with maturity.
Ash content in all the grasses is minimum in young stage is 4.50% (*Eleusine indica*) to 11.20% (*Brachiaria ramosa*) and in prime stage 9.15% (*Cynodon dactylon*) to 13.30% (*Brachiaria ramosa*) and in ripe stage 10.0% (*Chloris barbata*) to 18.60% (*Dichathium annulatum*). The data shows that ash content increases with the stages of maturity.
In case of nitrogen free extract, it varies from 59.29% (*Setaria verticillata*) to 74.71% (*Themeda quadrivalvis*) in young stage, in prime stage 42.60% (*Brachiaria ramosa*) to 62.75% (*Chloris barbata*) and 38.10% (*Coix lacryma-jobi*) to 52.93% (*Chloris barbata*) in ripe stage. Nitrogen free extract is maximum in young stage and minimum in ripe stage. The data also shows that the percentage of nitrogen free extract decreases with the stages of maturity (9).
Mineral content (Na, K and Ca) of all the grasses is recorded in prime stage. It was recorded highest Na (0.85%) in *Rottboellia exaltata,* and K (3.50%) in *Cenchrus cillilaris* while *Cynodon dactylon* showed highest Ca (0.75%). In this study calorific value of all the grasses ware also observed in the prime stage due to its high growth rate than other stages. It was lowest *in Chrysopogon fulvus* 2667.24 Cal/gm (dry wt. basis) and 3039.29 Cal/gm (ash free wt. basis) and highest in *Paspalum scrobiculatum*, 4929.90Cal/gm (dry wt. basis) and 5445.02Cal/gm (ash free wt. basis) respectively (Table 1).
The aim of nutritive value of fodder grasses at different stages of maturity is to secure a continuous supply of maximum output of fodder. Forage crops show wide difference amongst themselves in nutritive value. Despite these differences it may be said in general that there is a progressive deterioration in the quality of forage plants with advancing maturity and the percentage of nutritive constituents diminish with ripening. In this respect, *Paspalum scrobiculatum* are not considered good fodder due to presents of HCN in all stages, although its calorific value is comparatively high. It also noted, *Setaria verticillata* and few other grasses used in young and prime stages only, but not used in ripe stage due to presence of sharp awns on inflorescence, create mouth injuries in cattle during feeding. Considering all the aspects, *Cynodon dactylon* and *Apluda mutica* consider ideal fodder for cattle due to its easy availability and abundantly presence in South East Rajasthan.

Table 1. Summary of comparative chemical composition of wild fodder grasses in different stages and their calorific values (Table represent the mean value)

SL No	Grasses	Stage of growth	Moisture	Dry matter (DM)	Percentage (%) on Dry Matter Basis				Percentage (%)				Calorific Value		Percentage (%) of Ash
					Crude protein	Ether Extract	Crude fibre	Nitrogen Free Extract	Ash	Ca	Na	K	Dry Wt. basis	Ash free Wt. basis	
1	*Acrachne racemosa*	Young	76.12	23.88	06.90	0.80	15.20	69.80	07.30						
		Prime	29.60	70.40	04.60	1.50	28.90	54.65	10.35	0.39	0.80	1.05	4572.00	5225.14	12.50
		Ripe	12.00	88.00	02.88	1.90	43.25	38.67	13.30						
2	*Apluda mutica*	Young	78.94	21.06	13.46	0.70	10.50	67.14	08.20						
		Prime	23.80	76.20	11.20	0.95	22.30	52.95	12.60	0.31	0.15	0.95	3350.04	3848.16	12.94
		Ripe	10.90	89.10	07.10	1.40	32.50	40.50	18.50						
3	*Borthriochloa pertusa*	Young	77.14	22.86	07.12	0.75	10.50	72.23	09.40						
		Prime	31.25	68.75	06.10	1.80	27.35	52.15	12.60	0.65	0.62	2.20	4012.00	4588.01	12.55
		Ripe	10.50	89.50	00.97	2.10	33.80	49.63	11.50						
4	*Brachiaria ramosa*	Young	78.94	21.06	12.90	0.90	15.6	59.40	11.20						
		Prime	30.00	70.00	09.30	2.00	32.80	42.60	13.30	0.48	0.55	1.20	3206.39	3957.96	18.98
		Ripe	16.66	83.34	03.85	2.35	38.90	39.90	15.00						
5	*Chrysopogon fulvus*	Young	76.00	24.00	05.30	0.90	12.50	71.80	09.50						
		Prime	33.63	66.37	04.10	1.20	27.55	56.35	10.80	0.55	0.82	1.29	2667.24	3039.29	11.26
		Ripe	10.58	89.42	03.80	1.50	38.45	43.05	13.20						
6	*Cenchrus ciliaris*	Young	78.00	22.00	11.30	1.50	11.25	66.05	09.90						
		Prime	35.00	65.00	09.28	2.15	23.50	54.17	10.90	0.72	0.45	3.50	4182.98	4526.73	09.44
		Ripe	11.66	88.34	05.06	2.40	34.20	42.34	16.00						
7	*Coix lacryma-jobi*	Young	79.00	21.00	10.30	1.30	14.50	64.80	09.10						
		Prime	32.00	68.00	08.70	1.90	25.90	51.30	12.20	0.58	0.60	0.65	4028.58	4540.85	15.50
		Ripe	10.50	89.50	06.90	2.10	37.20	38.10	15.70						
8	*Chloris barbata*	Young	75.00	25.00	12.35	0.70	10.50	67.55	08.90						
		Prime	30.00	70.00	05.25	1.20	21.60	62.75	09.20	0.45	0.60	0.90	3243.98	3593.90	9.73
		Ripe	12.00	88.00	05.12	1.45	30.50	52.93	10.00						
9	*Cynodon dactylon*	Young	76.47	23.53	09.10	0.75	18.40	64.85	06.90						
		Prime	36.84	63.16	06.84	0.95	24.10	58.96	09.15	0.75	0.35	2.92	3764.44	4288.60	12.22
		Ripe	15.00	85.00	05.15	1.20	29.90	51.55	12.20						
10	*Dichanthium annulatum*	Young	76.25	23.75	04.29	1.00	16.90	70.41	07.40						
		Prime	33.33	66.67	03.10	1.30	27.90	55.70	12.00	0.45	0.66	1.61	3895.22	4135.34	16.52
		Ripe	11.23	88.77	02.35	1.70	35.20	42.15	18.60						
11	*Echinochloa colonum*	Young	80.00	20.00	06.20	1.25	10.35	73.00	09.20						
		Prime	44.44	55.56	05.55	1.65	23.85	58.60	10.35	0.30	0.50	1.80	3331.76	4098.40	12.11
		Ripe	10.90	89.10	02.17	1.90	36.60	46.73	12.60						
12	*Eleusine indica*	Young	78.80	21.20	10.20	1.20	11.35	72.75	04.50						
		Prime	35.29	64.71	09.49	1.55	24.90	52.56	11.50	0.42	0.15	1.50	3635.19	4028.53	09.76
		Ripe	13.33	86.67	06.25	2.30	30.25	44.70	16.30						
13	*Heteropogon contortus*	Young	74.00	26.00	08.50	1.15	9.75	73.70	06.90						
		Prime	35.00	65.00	06.10	1.10	20.40	61.60	10.80	0.58	0.52	1.10	3606.20	4069.63	11.52
		Ripe	11.42	88.53	04.00	1.40	33.40	49.40	11.80						
14	*Paspalum scrobiculatum*	Young	76.47	23.53	07.85	1.65	10.20	73.80	06.50						
		Prime	38.09	61.91	06.90	1.80	21.60	59.10	10.60	0.62	0.21	0.98	4929.90	5445.02	09.47
		Ripe	12.50	87.50	04.70	2.20	30.55	51.95	10.90						
15	*Pennisetum purpureum*	Young	74.00	26.00	10.10	1.80	12.55	69.65	05.90						
		Prime	41.46	58.54	09.07	1.95	23.00	54.98	11.00	0.19	0.31	0.62	3599.41	4083.33	11.85
		Ripe	12.50	87.50	05.92	3.20	35.00	43.48	12.40						
16	*Rottboellia exaltata*	Young	76.00	24.00	07.80	1.30	14.30	68.50	08.10						
		Prime	47.61	52.39	06.70	1.80	22.60	57.70	11.20	0.33	0.85	1.22	3650.25	3872.80	12.58
		Ripe	10.41	89.59	04.20	2.20	32.80	48.70	12.10						
17	*Setaria verticillata*	Young	78.00	22.00	18.01	1.50	14.60	59.29	06.60						
		Prime	63.63	44.90	14.50	1.75	21.90	51.25	10.60	0.52	0.76	2.30	3819.05	4468.46	14.45
		Ripe	11.42	88.58	09.10	2.20	36.50	39.50	12.70						
18	*Sehima nervosum*	Young	75.00	25.00	10.10	0.65	10.20	71.85	07.20						
		Prime	37.14	62.86	09.69	0.80	25.00	53.31	11.20	0.35	0.51	1.01	2723.69	3277.49	16.89
		Ripe	10.71	89.29	04.91	1.25	38.00	44.34	11.50						
19	*Sorghum halepense*	Young	79.80	20.20	13.12	1.50	13.90	62.98	08.50						
		Prime	55.55	45.45	09.50	2.00	27.50	49.65	11.35	0.31	0.68	0.95	3116.83	3604.25	13.52
		Ripe	15.38	84.62	06.10	2.75	30.00	48.30	12.85						
20	*Themeda quadrivalvis*	Young	73.00	27.00	05.10	0.95	12.14	74.71	07.10						
		Prime	36.50	63.50	03.40	1.60	26.15	59.60	09.25	0.29	0.36	0.85	3358.23	3802.40	12.25
		Ripe	12.20	87.80	02.95	2.90	31.70	50.30	12.15						

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Conflict of Interest
There is no conflict of interest between authors regarding academic, commercial, financial, personal and professionally relevant to the work.

Author's Contribution
Both the authors performed the experiments and wrote the paper jointly.

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