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Research Article

NUTRIENT ANALYSIS OF GRASS SPECIES CONSUMED BY GREATER ONE-HORNED RHINOCEROS (*Rhinoceros Unicornis*) IN CHITWAN NATIONAL PARK, NEPAL

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Abstract

The Greater One-horned Rhinoceros (*Rhinoceros unicornis*) is found almost exclusively in Nepal and North-Eastern India. There have been only a few studies made on the food and the nutrient compositions of fodder species preferred by The Greater One- horned Rhinoceros. The present study identifies the nutrient content of the fodder species consumed by One-horned rhinoceros which would be helpful to develop proper strategies for rhinoceros food management. For this altogether 8 grass species which were most preferred by rhinoceros were collected from Chitwan National Park. Systematic sampling was applied for sample collection and collected samples were taken to the Animal Nutrition Laboratory, Khumaltar for nutrient analysis. Among all the collected species the highest OM% was seen in Faank (93.98 ± 0.88) while Ash% and CP% was found to be highest in *Eragrastic Tenella* (13.67 ± 2.92) and *Phragmatic karka* (11.94 ± 2.26) respectively. Lowest NDF% was again seen in *Eragrastic tenella* (76.76 ± 2.93) and lowest ADF% and ADL% were found in Mala dubo with mean values (43.50 ± 6.86) and (6.41 ± 2.16) respectively showing high digestibility of these grasses. There were only slight variation in the EE% of the grass species with highest mean value of (3.702 ± 1.73) of *Imperata cylindrical* to lowest mean value of (1.722 ± 0.11) of *Eragrastic tenella*. Highest energy was found in Faank (4181.90 ±1.10) and Calcium content was seen highest in *Cynodon dactylon* (1.30 ± 0.83).

Key words: Nutrient composition; One-horned Rhinoceros; Nutrient analysis

Introduction

Rhinoceros, also known as rhino, is a group of five extant species of odd-toed ungulates in the family Rhinocerotidae. The Greater One-horned Rhinoceros (*Rhinoceros unicornis)*, Javan Rhinoceros (*Rhinoceros sondaicus)* and Sumatran Rhinoceros (*Dicerorhinus sumatrensis)* are found only in South Asia and South East Asia where as the White Rhinoceros (*Ceratotherium simum)* and Black Rhinoceros (*Diceros bicornis)* now inhabit mainly in South and Western Africa (Cerdeno, 1995). Both African species and the Sumatran Rhinoceros have two horns, while the Indian and Javan Rhinoceros have a single horn.

The Indian Rhinoceros or the Greater One-horned Rhinoceros (*Rhinoceros unicornis*) is now found almost exclusively in Nepal and North-Eastern India. The rhino once inhabited many areas of Pakistan to Burma and may have even roamed in China. But because of human influence their range has shrunk and now they only exist in several protected areas of India (in Assam, West Bengal, Gujarat and a few pairs in Uttar Pradesh) and Nepal (in Chitwan and Bardia), plus a few pairs in Lal Suhanra National Park in Pakistan. It is confined to the tall grasslands and forests in the foothills of the Himalayas. At present only two national parks contains >300 One-Horned Rhinoceros, Royal Chitwan National Park in Nepal, and Kaziranga national park in India. Kaziranga holds the largest population with an estimated present population of about 1500 animals (www.india-wildlife-tours.com).

The recent population census conducted by the Department of National Parks and Wildlife Conservation (DNPWC, 2011) has revealed that the number of *One-Horned rhinoceros* has increased to 534, marking an increase of 99 from 435 recorded in the last census in 2008. Of the total rhino population, 503 are in Chitwan, 24 in Bardia and the remaining seven in Shuklaphata Wildlife Reserve.

The rhinoceros is solitary though several may occupy the same patch of forest. In Nepal, during the monsoon, they frequently enter into farmlands. They have particular places for dropping its excreta; so mounds accumulate in places. In approaching these spots a rhinoceros walks backwards and falls an easy victim to poachers Croplands attract Greater One-horned Rhinoceroses, and require nightly vigilance by farmers to scare the animals away. Rhinoceros

are partial to rice, corn, and wheat at ripening. They seek out and devor hot chilli plants, but feed only sparingly on the mustard crop. Most of the damage to crops by rhino is restricted to a kilometer from park boundaries.

To determine the Nutritional composition of Grass species consumed by rhinoceros in Chitwan in National Park is the main objective of this study. Particularly, to identify and evaluate the nutrient content Organic Matter(OM), Total Ash(T.Ash), Crude Protein(CP), Ether Extract(EE), Energy, Nutrient Detergent Fiber(NDF), Acid Detergent Fiber(ADF), Acid Detergent Lignin (ADL), Hemicelluloses(HC), Cellulose and Calcium) of different grass species consumed by One-horned Rhinoceros in Chitwan National Park, Nepal and to documents and interpret the data and compare with the results of previous data and make available to the users are specific objective of the present study.

Materials and Methods

Selection of grasses species

An extensive review was done to collect pertinent data regarding most grazed grass species of with consultation of proceedings, journals, annual report, thesis works, pamphlets and booklets from different National, international, private and governmental organizations and libraries. All together 8 grass species were collected based on review of kandel (2003), Fjellstad and Steinheim (1996), Jnawali (1995), Laurie (1978) ,Ghosh and Das (2007) and among those 2 local grass species (Faank & Mala dubo) were selected based on information of local people and maoths which elephants preferred a lot.

Table 1: List of grass species and browse species collected from Chitwan National Park consumed by One-horned Rhinoceros during monsoon season

SN	Scientific name	Local name	Family	Habit	Edible part
1.	*Cynodon dactylon*	Dubo	Poaceae	Perennial grass	Young shoot
2.	*Eragrastic tenella*	Banso	Poaceae	Perennial grass	New leaves
3.	*Imperata cylindrica*	Siru	Poaceae	Perennial grass	New leaves
4.	*Phragmites karka*	Narkat	Poaceae	Perennial grass	New leaves
5.	*Saccharum spontaneum*	Kans	Poaceae	Medium Perennial grass	New leaves
6..	*Saccharum bengaliensis*	Baruwa	Poaceae	Tall perennial grass	Tips with new leaves
7.	*NA*	Faank	Poaceae	Perennial grass	New leaves
8.	*NA*	Mala dubo	Poaceae	Perennial grass	New leaves

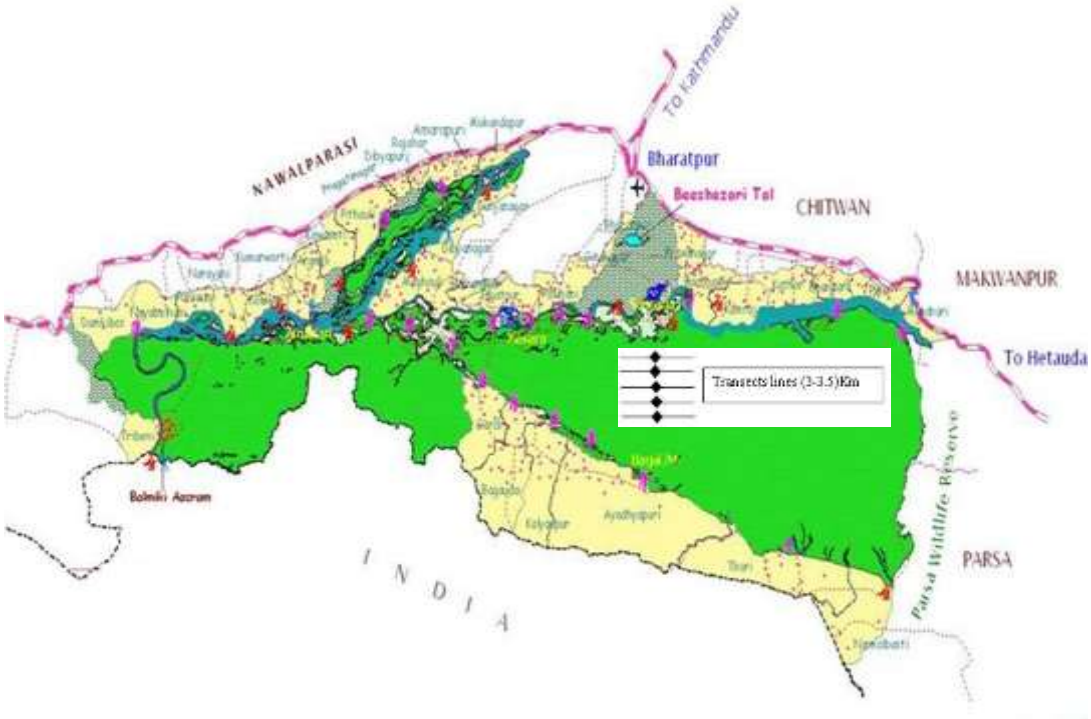

Fig. 1: Chitwan National Park and its Buffer Zone

Research design

The study was concentrated along the northern flood plain of RCNP (84o 20' E 27o30' N) along the Rapti river, near Sauraha at 100 m masl covering an area of 20 km2 on the month of July. Survey area was first determined in the topographic map. Systematic sampling was applied for sample collection, whereas, the first transect line was selected randomly west to east, inside the survey block. Other 4 transects were drawn parallel to the first transect line. Transects were 1 km apart from each other and were 3 to 3.5 km in length. In each transect line 1 circular sampling plot of radius 15 m was selected and samples of fifteen different fodder species were collected. Each sample was collected in separate plastic bags with appropriate tags and taken to the Animal Nutrition Laboratory, Khumaltar for further analysis.

Method of sample preparation for laboratory

Available grasses were harvested and air dried and stored in polyethylene bags for further analysis. The air-dried fodder species samples was further dried in a hot air oven at 60°C and were analyzed for Organic Matter (OM), T.Ash ,Crude Protein (CP), Ether Extract (EE), Calcium, Neutral Detergent Fiber (NDF), Acid Detergent Fiber (ADF), Acid Detergent Lignin (ADL) Hemicellulose, Cellulose and Energy.

Proximate analysis of fodder leaves

Proximate analysis was done according to procedure recommended by AOAC, 1990**.**

Results

Mean, Standard Deviation, Maximum and Minimum values of the nutritional composition (OM, T.ash, CP, NDF, ADF, ADL, Hemicellulose, Cellulose, EE, Energy and Calcium) of 8 different grass species consumed by Rhino in Chitwan National Park during the study are presented below (Table 2).

As shown in Table 2 Faank has highest Organic Matter % with mean value of (93.98 ± 0.88) followed by *Saccharum bengalensis* (93.82 ± 0.35), *Imperata cylindrica* (93.33 ± 0.43), *Phragmites karka* (90.15 ± 0.61), Mala dubo (88.23 ± 3.48), *Saccharum spontanium* (87.90 ± 6.48), *Cynodon dactylon* (87.16 ± 4.14) and *Eragrastic tenella* (86.33 ± 2.92) respectively. Ash % of the grasses is found to be in the reverse of the Organic Matter % with *Eragrastic tenella* having the maximum mean value (13.67 ± 2.92) and Faank having the lowest mean value (6.02 ± 0.88). Crude protein is found to have mean value ranging from high value of (11.94 ± 2.26) of *Phragmites karka* to the low value of (3.58 ± 0.85) of *Cynodon dactylon*. *Phragmites karka* is followed by Mala dobo (7.81 ± 1.59), *Imperata cylinderica* (7.22 ± 0.41), *Saccharum spontanium* (6.60 ± 2.24), *Eragrastic tenella* (6.44 ± 0.975), *Saccharum bengalensis* (6.31 ± 1.61) and Faank (4.41 ± 2.58) respectively. Mean value of NDF is found to be highest in *Saccharum bengalensis* (85.53 ± 0.99) followed by *Imperata cylindrica* (83.34 ± 2.10) and Faank (81.56 ± 2.63). Lowest mean value of NDF is found to be in *Eragastric tenella* (76.76 ± 2.93). ADF % is highest in *Saccharun bengalensis* with mean value of (71.87 ± 7.31), followed by *Phragmites karka* (69.64 ± 2.316) and *Imperata cylindrical* (69.48 ± 6.41). Lowest ADF% is seen in Mala dubo (43.50 ± 6.86) and *Eragastric tenella* (56.33 ± 6.91) respectively. ADL% is highest in *Saccharum bengalensis* (18.81 ± 9.14) and lowest in Mala dubo (6.41 ± 2.16). Similarly Mala dudo is seen to have highest mean value of Hemicelluloses (34.45 ± 9.94) followed by *Eragastic tenella* (20.54±5.75) and Faank (15.21±1.10) respectively and lowest value is seen in *Saccharum spontanium* (10.54±7.67). Cellulose is found highest in *Imperata cylindrica* (61.01±4.61) followed by *Phragmites karka* (57.30±4.61) and *Saccharum spontanium* (57.24±4.28) respectively and lowest in *Eragastric tenella* (48.59±5.64) and *Saccharum bengalensis* (53.06 ±1.09) respectively. There is only slight variation in the EE% of the grass species with highest mean value of (3.702 ± 1.73) of *Imperata cylindrical* to lowest mean value of (1.722 ± 0.11) of *Eragrastic tenella* and all other species having intermediate values between highest and lowest values. There is quite difference in highest and lowest mean value of energy % with highest value of that of Faank (4181.90 ±1.10) and lowest value of that of *Cynodon dactylon* (3296.16 ± 1.90). Calcium % is found to be greatly high in *Cynodon dactylon* (1.30 ± 0.83) followed by *Eragastric tenella* (0.870±0.10) and lowest is found in *Imperata cylindrical* and Mala dubo combinely (0.166 ± 0.02).

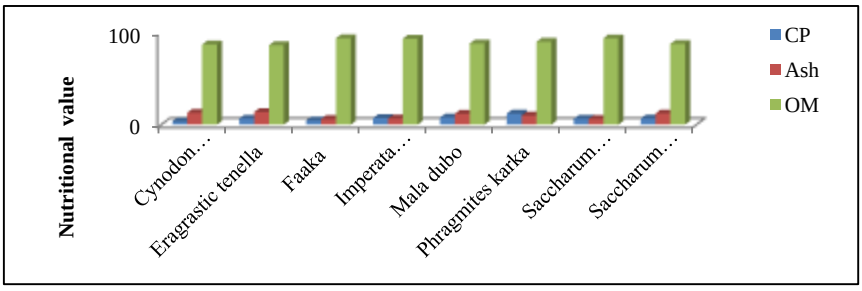

Fig. 2: Crude Protein, Ash and Organic Matter of grass species

Table 2. Maximum, Minimum and Mean values of nutritional composition of different grass species consumed by Rhino collected during 1st July, 2011 to 15th January, 2012 in Chitwan National Park, Nepal

S.N.	Scientific Name	Local name	Description	OM%	T.Ash%	CP%	NDF%	ADF%	ADL%	HC%	Cellulose%	EE%	Energy(cal/g)	Ca%
1	*Cynodon dactylon*	Dubo	Mean	87.16	12.84	3.58	79.57	66.68	12.86	12.89	53.83	2.686	3296.16	1.30
			Std	4.146	4.146	0.857	4.468	1.433	0.896	5.038	2.179	0.210	1.903	0.83
			Max	91.11	19.34	5.06	85.11	68.59	14.41	20.30	56.39	2.88	3539.20	1.41
			Min	80.66	8.89	3.00	78.58	64.81	12.20	7.03	50.41	2.34	3072.60	1.21
			n	5	5	5	5	5	5	5	5	5	5	5
2	*Eragrastic tenella*	Banso	Mean	86.33	13.67	6.44	76.76	56.22	7.63	20.54	48.59	1.722	3829.70	0.87
			Std	2.925	2.925	0.975	2.983	6.917	1.534	5.757	5.644	0.113	1.152	0.10
			Max	88.43	18.52	7.59	82.07	63.62	9.29	27.36	54.33	1.88	3954.70	0.95
			Min	81.48	11.63	4.91	75.09	47.93	6.13	15.09	41.80	1.57	3667.80	0.76
			n	5	5	5	5	5	5	5	5	5	5	5
3	*Imperata cylindrica*	Siru	Mean	93.33	6.67	7.22	83.34	69.48	8.47	13.86	61.01	3.702	4052.10	0.16
			Std	0.433	0.433	0.416	2.106	6.416	2.144	7.256	4.618	1.731	1.482	0.02
			Max	93.75	7.39	7.64	85.35	79.13	11.86	22.57	67.27	6.69	4166.20	0.20
			Min	92.61	6.25	6.66	79.86	61.89	6.57	4.74	55.32	2.26	4022.30	0.14
			n	5	5	5	5	5	5	5	5	5	5	5
4	*Phragmites karka*	Narkat	Mean	90.15	9.85	11.94	80.55	69.64	12.34	10.92	57.30	2.940	3986.20	0.16
			Std	0.610	0.610	2.266	4.398	2.316	2.799	7.256	4.618	1.731	1.482	0.02
			Max	90.85	10.61	14.97	85.61	72.12	16.84	15.07	59.98	3.32	4099.80	0.21
			Min	89.39	9.15	9.96	75.27	66.80	9.27	7.68	58.28	2.59	3799.10	0.14
			n	5	5	5	5	5	5	5	5	5	5	5

Table 2 (Contd.): Maximum, Minimum and Mean values of nutritional composition of different grass species consumed by Rhino collected during 1st July, 2011 to 15th January, 2012 in Chitwan National Park, Nepal

S.N.	Scientific Name	Local name	Description	OM%	T.Ash%	CP%	NDF%	ADF%	ADL%	HC%	Cellulose%	EE%	Energy(cal/g)	Ca%
5.	*Saccharum*	Baruwa	Mean	93.82	6.18	6.31	85.53	71.87	18.81	13.67	53.06	2.230	3770.50	0.47
	bengalensis		Std	0.354	0.354	1.616	0.999	7.319	9.140	7.834	1.099	0.145	0.019	0.95
			Max	94.41	6.47	8.84	86.36	76.88	30.01	26.75	65.12	2.43	4338.90	0.57
			Min	93.53	5.59	5.05	84.71	59.28	11.56	7.34	41.62	2.05	1951.70	0.33
			N	5	5	5	5	5	5	5	5	5	5	5
	Saccharum	Kans	Mean	87.90	12.10	6.60	78.23	67.69	10.45	10.54	57.24	3.316	3822.13	0.47
6.	*spontaneum*		Std	6.486	6.486	2.247	2.366	5.869	2.599	7.670	4.283	1.346	8.477	0.17
			Max	95.01	22.75	9.22	81.84	72.61	14.26	24.22	61.32	4.94	3921.10	0.70
			Min	77.25	4.99	4.54	75.96	57.62	7.68	6.49	49.94	1.34	3718.90	0.21
			n	5	5	5	5	5	5	5	5	5	5	5
7.	NA	Faank	Mean	93.98	6.02	4.41	81.56	66.35	10.44	15.21	55.90	3.350	4181.90	0.19
			Std	0.889	0.889	2.583	2.643	1.165	2.536	1.1053	9.275	0.457	1.1048	0.15
			Max	95.44	6.88	8.10	83.79	77.45	13.17	27.93	65.68	3.78	4336.10	0.44
			Min	93.12	4.56	1.95	77.96	52.61	7.46	6.14	44.57	2.81	4076.70	0.06
			n	5	5	5	5	5	5	5	5	5	5	5
8.	NA	Mala Dubo	Mean	88.23	11.77	7.81	77.95	43.50	6.41	34.45	57.09	1.734	3521.60	0.16
			Std	3.485	3.485	1.593	5.684	6.861	2.168	9.946	8.024	0.142	9.354	0.64
			Max	91.80	17.15	9.27	85.68	51.73	9.92	51.12	45.12	1.91	3656.80	0.27
			Min	82.85	8.20	5.08	69.67	34.56	4.07	27.12	24.64	1.56	3423.40	0.10
			n	5	5	5	5	5	5	5	5	5	5	5

Discussion

Data obtained on food habit helps to develop habitat and animal management program. So that domestic and wild animals are compatible or complementary. Often the degree of competition may be reduced if information becomes available on where the competition exists.

High proportion of grasses in diet of Rhinos during monsoon and hot season in Chitwan was explained by availability of high quality *Saccharum spontanium* that keeps sprouting immediately after grazing and grass cutting (Dinnerstein et.al 1995), burning (Laurie, 1978) and due to high substrate moisture (Jnawali, 1995). Grasses made up the bulk of the rhino diet during all seasons, but the proportion was highest during the monsoon. The tall grass *Saccharum spontaneum* was a very important species in the rhino diet during all three seasons comprising 18.5-31.5% (Pradhan *et al*., 2008).

The nutritional composition of *Saccharum spontanium* found in my study is more or less similar with the values reported by Upreti and Shrestha (2006). Mean value of OM %, T.ash %, CP % and NDF % is similar as reported by Upreti and Shrestha (2006) but ADF % and ADL % was bit different. The mean value of ADF% and ADL% reported by Upreti and Shestha (2006) was (43.44 ± 3.67 and 7.70 ± 0.65) respectively. Calcium content is same with mean value of (0.47 ± 0.17) as reported by Upreti and Shrestha (2006). Osti *et al*. (2006) reported the calcium content to be (0.5 ± 0.11) which is also almost same in my study. Hemicellulose (24.5 ± 9.26) and cellulose (39.35 ± 8.6) as reported by Osti *et al*. (2006) is different than my findind which is Osti *et al*. (2006) also reported the high CP content (8.29 ± 3.2) then my finding.

Cynodon dactylon is found to be low in mean value of OM, T.ash, CP, and ADL content than reported by Upreti and Shrestha (2006). Most difference is found in CP content which was reported to be (12.44 ± 4.28) by Upreti and Shrestha (2006) and Osti *et al.* (2006). Calcium content is high than reported by Upreti and Shrestha (2006) and Osti *et al*. (2006) which was (0.62 ± 0.22). NDF and ADF content is found to be high than reported by Upreti (2008) and Upreti and Shrestha (2006) which was (68.57 ± 8.16 and 46.93 ±13.78) respectively.

Similary *Imperata cylindrica* is found to be low in calcium content than reported by Osti et al. (2006) and Upreti, (2008) which was (0.97 ± 3.7 and 0.32 ± 0.41), respectively. Mean value of OM, Tash, EE and CP was in line as reported by Upreti and Shrestha (2006), Upreti (2008) and Osti et. al.(2006). *Eragastic tenella* is found to be almost same in mean nutritional composition of OM, Tash, ADL as reported by Osti *et al.* (2006) and Upreti and Shrestha (2006) but CP content is found to be low than reported by them which was (11.70 ± 4.1 and 10.80 ±2.58) respectively. Calcium content NDF and ADF content is found to be bit slight high than reported by Upreti and Shrestha (2006). HC content was little high (20.54 ± 5.75) but cellulose content was quite high (48.59 ± 5.64) in my finding then reported by Osti *et al*. (2006) which is (17.84 ± 4.2 and 34.12 ± 2.37) respectively. Mala dubo as reported by Upreti and Shrestha (2006) is found to have high OM, CP and EE content (94.18, 7.95 and 4.07) than the present study. Calcium content is found to be almost similar in both the cases but NDF and ADL content was found quite high and ADL content was found quite low in present study than reported by Upreti (2008). .

The difference in the nutritional composition of different grass species in present study than those reported by different writers may be due to the seasonal variation, soil composition, effect of manure and fertilizer, irrigation, stage of growth, frequency of cutting, variety and strain of feed resources (Upreti and Shrestha, 2006). As the country has great variation such as in climate, soil type, topography, fertilizer application, and different type of fodder resources (strain, variety etc) the nutrient of feed and fodder vary accordingly (Pandey and Upreti, 2005).

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