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Seasonal variation in nutritional characteristics of forage species in Rakh Choti Dalana in District Dera Ghazi Khan "Pakistan

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ABSTRACT

The study was conducted in Rakh Choti Dalana (D. G. Khan) to investigate the seasonal variations of nutritional characteristics of *Lasiurus sindicus* (Gorkha), *Eleusine flagellifera* (Chimber), *Cenchrus ciliaris* (Dhaman), *Acacia nilotica* (kikar), and *Zizyphus nummularia* (mallah) in Rakh Choti Dalana D. G. Khan. The three seasons (spring,monsoon,winter) were evaluated for assessment of the nutritive value of major forage species, such as proteins, biomass production, fats, carbohydrates, fiber and mineral matter (%) comparisons among the grasses and the forage trees in arid area of Pakistan. The result indicated that the *Lasiurus sindicus* (Gorkha) gave the highest percentage of dry matter in spring seasons among the fall and monsoon seasons. In crude protein the grass *Eleusine flagellifera* (Chimber) indicated the highest crude protein was recorded in fall season as compared to spring and in monsoon seasons. In crude fiber the result indicated that the grass *Lasiurus sindicus* (Gorkha) showed the maximum crude fiber during the spring season. The ash content was recorded that the grass *Eleusine flagellifera* (Chimber) gave the highest ash content in spring among other grasses in three seasons. The grass *Eleusine flagellifera* (Chimber) gave the highest ether content in fall seasons with other three grasses. *Lasiurus sindicus* (Gorkha) gave the highest digestible nutrient was observed in fall season. Nitrogen free extract was also examined for the grass species in three seasons and result indicated that the grass *Lasiurus sindicus* (Gorkha) gave the maximum Nitrogen free extract during the summer season. Fodder trees also played a vital role to enhance nutritional value in all livestock's in their intake. Therefore two fodder trees (*Acacia nilotica* (kikar) and *Zizyphus nummularia* (mallah) were also introduced in arid area to find out their nutritional content. The result indicated that *Zizyphus nummularia* dry matter was more in spring than *Acacia nilotica* in all seasons. Crude protein was more in *Zizyphus nummularia* than in *Acacia nilotica* in spring season. Crude fiber was recorded maximum in *Zizyphus nummularia* in spring season as compared to *Acacia nilotica.* Ash content was recorded for two trees and indicated that the *Zizyphus nummularia* having more ash content in fall season. Ether extract content was more in *Zizyphus nummularia* in spring than *Acacia nilotica.* Total digestible content was more recorded in *Acacia nilotica* in fall season as compared to *Zizyphus nummularia* in all seasons. Nitrogen free extract was indicated maximum in *Acacia nilotica* in all season than the tree species in *Zizyphus nummularia.*

Keywords: Nutritional value in grasses and in trees in dry areas

INTRODUCTION

Pakistan has great climatic diversity due to variation in topography, altitude, and season. Most of the rangelands of Pakistan are arid and semi arid zones characterized by low precipitation and extremes of temperature and low humidity. A major constraint in Dera Ghazi Khan is the scarcity and fluctuating quality and quantity of the year round supply of fodder due to seasonal variation. Over 52.2 million hectares of land are classified as rangelands. More than 43 million ha area is rangeland in the country which is 51 % of the total area. Similarly more than 18.5 million ha area is having potential of rangeland and can be used for grazing (Pakistan National Forest Policy, 2010). These rangelands provide more than 60% of the total feed requirements for sheep's and goats and 5% for the cattle and buffaloes (FAO, 2016). Dera Ghazi Khan 1.2 million ha range areas lie between the base of Suleiman hills and the Indus River and stretches over D. G. Khan and Rajan Pur districts. It also includes bela land along the Indus River (Quraishi *et al.,* 1993). Total area of Rakh Choti Dalana 7608 ha is divided into 10 pastures. Pakistan is an agriculture country having more than of 181.2 million of livestock heads which contribute 12% towards the GDP (FAO, 2016). Nutritional requirements of these animals are mainly met through fodder crops, grasses and shrubs. The quality of produced forage is very important because balanced nutrition and protein and mineral requirements of people fed on animal products. The higher production of forage will only be appreciable if its quality simultaneously is acceptable as well because of milk, meat, and associated products of livestock depends upon hereditary factors by approximately 25% while 75% is dependent on feed quality and quantity.

The major rangelands areas are Thal, Cholistan, D.G. Khan and Pothowar etc. The problems of rangelands are shortage of funds for development/non- development works like reseeding, development of water points and water spreading, inadequate staff, non-availability of palatable grass seeds, trend of encroachment towards Rangelands and especially non-cooperation of pastoral public in rotational grazing and disrespect of law in D.G. Khan Rangelands.

Among several factors, crude protein (CP) and crude fiber (CF) have been considered more appropriate attributes for evaluation of range forage quality. Forage quality of twigs and leaves of forage trees varies in different months but the change in Forage quality at different localities is not regular as it is influenced by edaphic and climate changes (Malik, 1988). This proposed study is designed to evaluate the seasonal variations of nutritional characteristics of *Lasiurus sindicus* (Gorkha), *Eleusine flagellifera* (Chimber), *Cenchrus ciliaris* (Dhaman), *Acacia nilotica* (kikar), and *Zizyphus nummularia* (mallah) in Rakh Choti Dalana D. G. Khan, because the chemical analysis is the first step in the assessment of the nutritive value of major forage species, such as proteins, fats, carbohydrates, fiber and mineral matter. It enables us to evaluate either this forage is fit and sufficient to maintain the health of the animal without loss or gain of weight (i.e., when it does not work or produces no milk) (Narayanan and Dabadghao, 1972). The parameters to be analyzed include; moisture, dry matter (DM), crude protein (CP), crude fiber (CF), acid detergent fiber (ADF), neutral detergent fiber (NDF) and lignin.

MATERIALS AND METHODS

The study was carried out in Rakh Choti Dalana (D. G. Khan) to investigate the seasonal variations of nutritional characteristics of *Lasiurus sindicus* (Gorkha), *Eleusine flagellifera* (Chimber), *Cenchrus ciliaris* (Dhaman), *Acacia nilotica* (kikar), and *Zizyphus nummularia* (mallah) in Rakh Choti Dalana D. G. Khan. The chemical analysis will be the first step in the assessment of the nutritive value of major forage species, such as proteins, fats, carbohydrates, fiber and mineral matter.

Collection of foliage samples

The foliage samples including leaves and twigs and shoot portion from five different forage species (grasses, trees, and shrubs) as mentioned above of similar height and age and from various range sites including slopes, channel beds and plains were collected randomly. Samples were prepared for analysis of moisture, dry matter, and crude protein, crude fiber, acid detergent, neutral-detergent fiber and Lignin. Kjeldhal apparatus, spectrophotometer, were used for the determination of the above mentioned parameters. The samples of leaves and twigs portions of *Lasiurus sindicus* (Gorkha), *Eleusine flagellifera* (Chimber), *Cenchrus ciliaris* (Dhaman), *Acacia nilotica* (kikar), and *Zizyphus nummularia* (mallah) were repeated during different seasons including spring, summer and winter months to investigate seasonal variation in its nutritional value evaluation value. Forage quality analysis was carried out at Animal Nutrition Laboratory, NARC, and Islamabad. The analysis of the samples i.e. moisture, dry matter (DM), crude protein (CP), and crude fiber (CF) were carried out by the method of AOAC (1990). Acid detergent fiber (ADF), Neutral detergent fiber (NDF), and Lignin by the method of (Van Soest *et al.,* 1991) was carried out at nutrition laboratory in National Agricultural Research Center, Islamabad using the following prescribed procedure.

Moisture and dry matter determination (DM)

The moisture was determined by drying the sample at 75^0C to a constant weight. The difference between the fresh and dry weight was used for calculation of moisture content of the sample. The dry matter % was calculated using the following formula:

$$\text{Dry matter \% (DM)} = \frac{\text{Dry weight of the sample}}{\text{Fresh weight of the sample}} \times 100$$

Nitrogen and crude protein determination (CP)

The nitrogen of protein and other compounds was transformed into ammonium sulphate by sulphuric acid digestion in macro Kjeldahl nitrogen digestion assembly. The digest was cooled, diluted with water and alkalified with sodium hydroxide. The released ammonia was distilled into a boric acid solution. Boric acid was titrated with standardize acid to quantify the ammonia evolved. For the latter case, the standardized alkali was used to back the titration of the excess acid so that the quantity of the acid neutralized by the ammonia was found. That was equal to ammonia evolved. For nitrogen estimation, 1.5g sample was weighed and transferred to Kjeldahl flask. 30ml H_2SO_4 and 4g of catalyst was added. The sample was digested for 30 minutes. The sample was distilled for 5 minutes and collected into a conical flask containing 5ml of 2% boric acid and collected the dripping from condenser for one minute. The sample was titrated against standardized H_2SO_4 (a reagent blank will be run through all the steps of the procedure). The crude protein was calculated using the following formula (AOAC, 1990):

$$\text{Crude protein \% (as fed)} = \frac{(V1-V2)N}{1000W} \times 14 \times 6.35 \times 100$$

While V_1 = sample titer (in ml), V_2 = blank titer (in ml), N = Normality of standardized H_2SO_4, W = sample weight, Adjusting to dry matter (DM) basis:

$$\text{Crude Protein \% (DM)} = \frac{\text{Crude Protein (as fed)}}{\text{Dry matter of sample \%}} \times 100$$

Crude fiber determination (CF)

2g of a moisture free and ether extracted sample was weighed and placed in a tall farm beaker and added into 200ml boiling dilute H_2SO_4. The sample was digested for 30 minutes and filtered through sintered glass buchner funnel with an aid of suction air pump. Acid free sample was transferred in a tall farm beaker again and added. The sample was made acid free by washing with 10ml of dilute H_2SO_4 and with hot water and transferred into gooch crucible dried in oven at 135^0C for 2 hours. Then it was ignited at 600^0C, cooled in desiccator and weighed.

Crude fiber % (as fed) = Sample weight x (100 – moisture % - ether extract %)

Adjusting to on dry matter basis:

$$\text{Crude fiber \% (DM)} = \frac{\text{Crude protein (as fed)}}{\text{Dry matter of sample \%}} \times 100$$

Acid detergent fiber determination (ADF)

Acid detergent fiber (ADF) was determined boiling 1.5g with 100ml acid-detergent solution for 10 minutes. The samples were filtered through buchner funnel with an aid of suction bump. Filtered map was filled up 2/3 with hot water, socked dry and repeated hot water washing twice. The residue was transferred to gooch crucible and dried for 3 hours in oven at 105^0C. The residue was ash at 600^0C for 30 minutes and weighed again after one hour. The calculated of ADF was shown below:

$$\text{Acid detergent fiber \% (as fed)} = \frac{\text{Weight of residue}}{\text{Sample weight}} \times 100$$

Converting to dry matter (DM) basis:

$$\text{Acid detergent fiber \% (DM)} = \frac{\text{Acid \% - detergent fiber (as fed)}}{\text{Dry matter of sample \%}} \times 100$$

Neutral-Detergent fiber determination (NDF)

1.5g sample was boiled in 100ml neutral detergent solution and 0.5g sodium sulphite for ten minutes. The mixture was refluxed for 60 minutes and filtered through buchner funnel with the aid of suction bump. The filtered mat was filled up to 2/3 full with hot water after soaking. The residue was transferred to gooch crucible and dried for 3 hours at in oven at 105^0C and weighed after 30 minutes. The neutral-detergent fiber was calculated using the following formula below:

$$\text{Neutral detergent fiber \% (as fed)} = \frac{\text{Weight of the residue}}{\text{Sample weight}} \times 100$$

Converting to dry matter (DM) basis:

$$\text{Neutral detergent fiber \% (DM)} = \frac{\text{Neutral detergent fiber \% (as fed)}}{\text{Dry matter of sample}} \times 100$$

Table 1. Nutritional values of different species of fall season

SPECIES	DM %	CP %	CF %	ASH %	EE %	TDN %	NFE %
Cenchrus ciliaris (Dhaman)	56.09	4.62	29.80	10.38	1.45	43.64	53.75
Eleusine *flagellifera* (Chimber	45.48	9.01	27.80	11.85	1.86	50.74	49.48
Lasiurus sindicus (Gorkha)	54.18	4.42	30.85	11.68	1.81	53.89	51.11
Acacia nilotica (kikar)	51.47	14.88	15.86	7.18	2.80	88.97	59.28
Zizyphus nummularia (mallah)	53.67	16.35	17.90	7.19	3.41	56.46	55.15

Lignin determination

1.5g sample was extracted with ethanol benzene mixture for 4 hours, washed twice with diethyl ether and dried at 45^0C. The extract was kept at 40^0C. Pepsin solution was filtered off, washed with hot water, ethanol and then with ether. 5% H_2SO_4 was added to extract in 250ml conical flask. Again it was washed as previously. 72% H_2SO_4 was added and let stand for 2 hours. Acid solution will be filtered off and washed as previously. Then the extract was refluxed for 2 hours and washed as previously. The extract was dried at105^0C for 2 hours and weighed (W1). Then it was ignited at 600^0C for 30 minutes weighed (W2) Lignin was calculated by following formula:

$$\text{Lignin \%} = \frac{(W1 - W2)}{\text{Sample weight}} \times 100$$

Statistical analysis

The data collected for various characteristics was subjected to Analysis of Variance and the means obtained was compared by LSD at 5% level of significance (Steel *et al.,* 1997). The samples were analyzed in the laboratory and statistical analysis of the data was performed using Completely Randomized Block Design (CRBD) two factor factorial, replicated five times in three seasons. The means obtained were compared by Duncan's Multiple Range Test (DMRT) at 5% level of significance (Douglas, 2009).

RESULTS AND DISCUSSION

Nutritional requirements of the animals were mainly met through fodder crops, grasses, and shrubs. However, the quality of produced forage was also of equal importance because balanced nutrition of protein and mineral requirements of people feeding on animal products should be of good quality. The higher production of forage was only appreciable if its quality simultaneously was acceptable as well as for milk, meat and associated products of livestock depends upon hereditary factors by approximately 25% while 75% is dependent on feed quality and quantity. Production of increased biomass of forage was important in the developing countries in order to meet the requirements of enhancing number of livestock that was in turn necessarily desired for meeting the demands of ever increasing population. Five samples of leaves and twigs portions of *Lasiurus sindicus* (Gorkha), Eleusine *flagellifera* (Chimber), *Cenchrus ciliaris* (Dhaman), *Acacia nilotica* (kikar), and *Zizyphus nummularia* (mallah) were collected at random with similar height and age from rangeland Rakh Chotio Dalana D.G. Khan. Samples of leaves and twigs were harvested from branches at the height up to 5 feet. The sampling procedures were repeated in 3 different seasons i.e., spring, summer, and fall to analyze the seasonal variation in the quality of browsing and grazing material of *Lasiurus sindicus* (Gorkha), Eleusine *flagellifera* (Chimber), *Cenchrus ciliaris* (Dhaman), *Acacia nilotica* (kikar), and *Zizyphus nummularia* (mallah). Forage quality analysis was carried out in Animal Nutrition Labouratory, NARC, and Islamabad. Chemical evaluation of forage can be grouped under two categories, viz proximate analysis and Van Soest method was used. Dry matter, moisture content, crude protein, ash, ether extract, crude fiber, and nitrogen free extract were determined by proximate analysis (or) Weende method (AOAC, 1990). The crude fiber (carbohydrate component) of proximate analysis was further partitioned to neutral detergent fiber (NDF), acid detergent fiber (ADF) and acid detergent lignin (ADL). The parameters were analyzed with Van Soest method (Soest et al., 1991). Table 1.

Crude fiber was examined among the three grass species in arid condition. The result revealed that the Eleusine *flagellifera* (Chimber grass gave the highest CF (27.80%) in fall season and followed by the *Cenchrus ciliaris* (Dhaman) grass 29.80 %.Similarly among the forage trees the *Zizyphus nummularia* (mallah) gave the maximum 17.90% crude fiber in fall season and followed by the *Acacia nilotica* (kikar) tree respectively. Ash was recorded 11.85% of the grass Eleusine *flagellifera* (Chimber) during the fall season and followed by the grass *Lasiurus sindicus* (Gorkha) which gave the 11.68%. In the forage trees the *Acacia nilotica* (kikar) and *Zizyphus nummularia* (mallah)were relatively showed the same ash %(7.18 and 7.19).Ether content was recorded among the grass and the grass Eleusine *flagellifera* (Chimber) gave the highest 1.86% and followed by the grass 1.81 % by the *Lasiurus sindicus* (Gorkha). Among

Table 2. Nutritional values of different species of spring season

SPECIES	DM %	CP %	CF %	ASH %	EE %	TDN %	NFE %
Cenchrus ciliaris (Dhaman)	56.19	6.27	30.66	10.18	1.36	50.23	51.52
Eleusine *flagellifera* (Chimber	51.24	7.54	29.04	15.14	1.35	47.69	46.92
Lasiurus sindicus (Gorkha)	57.46	3.85	31.26	10.37	1.21	47.55	53.40
Acacia nilotica (kikar)	48.75	14.26	14.94	7.23	2.78	80.64	60.88
Zizyphus nummularia (mallah)	56.28	17.22	16.01	7.61	5.03	73.45	54.13

Table 3. Nutritional values of different species of summer season

SPECIES	DM %	CP %	CF %	ASH %	EE %	TDN %	NFE %
Cenchrus ciliaris (Dhaman)	54.20	4.24	28.68	10.10	1.22	47.81	55.63
Eleusine *flagellifera* (Chimber)	44.63	5.00	2.10	10.57	1.60	50.78	65.16
Lasiurus sindicus (Gorkha)	56.86	3.01	29.19	9.67	1.31	48.59	56.81
Acacia nilotica (kikar)	54.20	14.74	13.38	7.12	3.15	79.29	61.60
Zizyphus nummularia (mallah)	55.50	15.93	14.16	6.76	2.97	76.65	60.16

the trees species the *Zizyphus nummularia* (mallah) gave the 3.41% as compared to *Acacia nilotica* (kikar) 2.80%.Total digetable nutrient was also examined for three grass species and the grass *Lasiurus sindicus* (Gorkha) gave 53.89% and followed by the grass Eleusine *flagellifera* (Chimber) 50.74%. Nitrogen free extract was calculated and the grass *Cenchrus ciliaris* (Dhaman) gave 53.75 % followed by the grass *Lasiurus sindicus* (Gorkha) 51.11% respectively. Table 2.

Crude fiber was examined among the three grass species in arid condition. The result revealed that the *Lasiurus sindicus* (Gorkha) grass gave the highest CF (31.26%) in spring season and followed by the *Cenchrus ciliaris* (Dhaman) grass 30.66 %.Similarly among the forage trees the *Zizyphus nummularia* (mallah) gave the maximum 16.94% crude fiber in spring season and followed by the *Acacia nilotica* (kikar) 14.94 % tree respectively. Ash was recorded 15.14% of the grass Eleusine *flagellifera* (Chimber) during the spring season and followed by the grass *Lasiurus sindicus* (Gorkha) which gave the 10.37%. In the forage trees the *Zizyphus nummularia* (mallah) showed the highest 7.61% and followed by the *Acacia nilotica* (kikar) 7.23%.Ether extract content was recorded among the grasses and the grass dhaman gave the highest 1.36% and followed by the grass Eleusine *flagellifera* (Chimber) 1.35 %. Among the trees species the *Zizyphus nummularia* (mallah) gave the 5.03% as compared to *Acacia nilotica* (kikar) 2.78%.Total digetable nutrient was also examined for three grass species and the grass *Cenchrus ciliaris* (Dhaman) gave 50.23% and followed by the grass Eleusine *flagellifera* (Chimber) 47.69%. Nitrogen free extract was calculated and the grass *Lasiurus sindicus* (Gorkha) gave 53.40% followed by the grass *Cenchrus ciliaris* (Dhaman) 51.52% respectively. Table 3.

Crude fiber was examined during the summer season among the three grass species in arid condition. The result revealed that the *Lasiurus sindicus* (Gorkha) grass gave the highest CF (29.19%) in summer season and followed by the *Cenchrus ciliaris* (Dhaman) grass 28.68 %.Similarly among the forage trees the *Zizyphus nummularia* (mallah) gave the maximum 14.16% crude fiber in summer season and followed by the kikar 13.38 % tree respectively. Ash was recorded 10.57% of the grass Eleusine *flagellifera* (Chimber) during the summer season and followed by the grass *Cenchrus ciliaris* (Dhaman) which gave the 10.10%. In the forage trees the *Acacia nilotica* (kikar) showed the highest 7.12% and followed by the *Zizyphus nummularia* (mallah) 6.76%.Ether extract content was recorded among the grasses and the grass Eleusine *flagellifera* (Chimber) gave the highest 1.60% and followed by the grass *Lasiurus sindicus* (Gorkha) 1.31 %. Among the trees species the *Acacia nilotica* (kikar) gave the 3.15% as compared to *Zizyphus nummularia* (mallah) 2.97%.Total digestible nutrient was also examined for three grass species and the grass Eleusine *flagellifera* (Chimber) gave 50.78% and followed by the grass *Lasiurus sindicus* (Gorkha) 48.59%. Nitrogen free extract was calculated and the grass Eleusine *flagellifera* (Chimber) gave 65.16% followed by the grass *Lasiurus sindicus* (Gorkha) 56.81% respectively.

CONCLUSION

The three seasons (spring, monsoon, winter) were evaluated for assessment of the nutritive value of major forage species and grasses and comparisons among the grasses and the forage trees in arid area of Pakistan. The result indicated that the *Lasiurus sindicus* (Gorkha) gave the highest percentage of dry matter in spring seasons among the fall and monsoon seasons. In crude protein the grass *Eleusine flagellifera* (Chimber) indicated the

highest crude protein was recorded in fall season as compared to spring and in monsoon seasons. In crude fiber the result indicated that the grass *Lasiurus sindicus* (Gorkha) showed the maximum crude fiber during the spring season.The ash content was recorded that the grass *Eleusine flagellifera* (Chimber) gave the highest ash content in spring among other grasses in three seasons. The grass *Eleusine flagellifera* (Chimber) gave the highest ether content in fall seasons with other three grasses. *Lasiurus sindicus* (Gorkha) gave the highest digestible nutrient was observed in fall season. Nitrogen free extract was also examined for the grass species in three seasons and result indicated that the grass *Lasiurus sindicus* (Gorkha) gave the maximum Nitrogen free extract during the summer season. Fodder trees also played a vital role to enhance nutritional value in all livestock's in their intake. Therefore two fodder trees (*Acacia nilotica* (kikar) and *Zizyphus nummularia* (mallah) were also introduced in arid area to find out their nutritional content. The result indicated that *Zizyphus nummularia* dry matter was more in spring than *Acacia nilotica* in all seasons. Crude protein was more in *Zizyphus nummularia* than in *Acacia nilotica* in spring season. Crude fiber was recorded maximum in *Zizyphus nummularia* in spring season as compared to *Acacia nilotica.* Ash content was recorded for two trees and indicated that the *Zizyphus nummularia* having more ash content in fall season. Ether extract content was more in *Zizyphus nummularia* in spring than *Acacia nilotica.* Total digestible content was more recorded in *Acacia nilotica* in fall season as compared to *Zizyphus nummularia* in all seasons. Nitrogen free extract was indicated maximum in *Acacia nilotica* in all season than the tree species in *Zizyphus nummularia.*

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