ESTIMATION OF SEASONAL VARIATION IN NUTRITIONAL CHARACTERISTICS OF MAJOR RANGE GRASS SPECIES IN KHERIMURAT SCRUB FOREST

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ABSTRACT

Rangelands of Pakistan are mostly arid, the majority of them are seasonal in character which supply forage throughout spring and summer seasons of growth but are incapable to provide feed in fall and winter. These seasonal variations affect the livestock production. There is a dire need to be aware of the seasonal variations in the nutritive value of grasses in order to optimize their forage use. The research was conducted to determine the seasonal variation in nutritional value of five grass species found in Kherimurat scrub forest and rangelands. General observations of increasing percentage of all nutrients except for dry matter were observed from summer to winter season and then reverse from winter to spring in the major range grass species of Kherimurat.

INTRODUCTION

The availability of feedstuff (such as grass) nutrients in minimal possible time defines its feed quality, the crude protein and crude fiber are considerably the most apposite feed quality evaluation parameters (PARC, 1998). Feed requirements are based on the need for explicit amounts of various nutrients classes. Each nutrient fulfills specific roles in growth, production or metabolism. Nutrient classes are defined by their chemical structure or by their function in metabolism. The most advantageous usage of forage can be ensured by managing on a strategy based upon seasonal variation. The properly formulated feed supplies ample amounts of all nutrients to allow cattle to achieve a desired level of production. The defined supply depends upon precise portrayal of the nutrient contents of the available feeds. (FAO, 1987).

The Pakistani livestock sector faces a major challenge because of nutrient scarcity. The rangelands (such as Kherimurat scrub forest) are nutrient reservoirs suffering from degradation; no sufficient attempts have been made into sustainable range production and improvement. The 121.1 million livestock of Pakistan require 10.9 million tons crude protein (CP) but availability is 6.7 million tons (38.10% shortage) and also requires 90.36 million tons total digestible nutrients (TDN) but availability is 69.0 million tons (24.02% shortage) annually. At present grazing in range lands and post harvested agriculture lands provides

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only about 3 and 6% of available animal nutrients respectively (Sarwar *et al*., 2002).

The booming animal production systems depend upon adequate forages. This is even more so for ruminants (livestock) which are heavily reliant on forages for their health and production in a sustainable commercial conduct. While forages are a cheap supply of nutrients for animal production, they also help conserve the environment (soil integrity, water supply and air quality). Although the role of these forages for animal production could differ depending upon the local preferences for the animal and forage species, climate and resources, their billion hectares of land is being used for livestock grazing as well as the one forth production from the croplands. This amounts to more than two-thirds of total agricultural land area and a third of total land area. Forage species are thus a major facet of agricultural landscapes around the world (Animus, 2009).

The total area of Pakistan is 79.61 m.ha. out of which 62% (about 49.5 m.ha.) comes under rangelands, that comprise of a wide variety of soil, climate and vegetation (Quraishi *et al*., 1993). These rangelands extending from northern alpine pastures to southern arid rangelands provide about 60% of forage requirements of sheep, goats, and 5% of cows and buffaloes (Mohammad, 1989). About 11.1% of Pakistani GDP is generated from livestock, whose own production revolves around nutritional supply provided by feed and forage. The commercial livestock products (meat, milk and other produce) depends up to 75% on the quality and quantity of available forage, rest of 25% depends on genetic characteristics (Anonymous, 2008).

Pakistan is an arid country with most of its rangelands seasonal in nature which provide forage during spring and summer seasons of growth but unable to provide feed in fall and winter, these seasonal variations affect the livestock production. Over grazing, vegetation cover depletion, forage shortage and poor livelihood of pastoral communities affected by fragile environment. These are some of the major issues and problems for the food security in the country. There is a dire need to understand the role of seasonal variations in the nutritional value of various grasses to optimize their forage use (Khan, 2003).

MATERIALS AND METHODS

Study Area

The study was conducted in Kherimurat rangelands and scrub forest situated in district Attock. Geographically it is situated 33° North and 72° East. The elevation of area is about 1500–3500 feet above sea level. Trees are shrubby out of them few are thorny and often with small ever green leaves, vegetation is scarce most of the year. Monsoon season produces a fairly good grass and herb cover during rainy spell. Soil covers diversified geological formation of limestone, shale and quartzite and is mostly dry and shallow (Govt. of Punjab, 2010). *Acacia modesta* (Phulai) and *Olea ferrugenia* (Kau) are the dominant tree species. The area can be considered as having undulating topography. The area mostly foraged by nomad's livestock during winter. The increasing livestock number is resulting in over grazing and land degradation accompanied by infestation of unpalatable plants. This has also accelerated soil erosion, loss of soil fertility and biodiversity all collectively having negative impact on the carrying capacity of the rangelands. The rangeland's forage grass species are mainly the *Cenchrus ciliaris* (Dhaman), *Cymbopogon jwarancusa* (Khawi), *Cymbopogon distans* (chita grass), *Cynodon dactylon* (Khubble), *Heteropogon contortus* (Sarialla). The shrubs include *Cassisu spomerum* (Kandair) and *Adhatoda vesica* (Bhekar).

Collection of Grass Samples

Including plains and slopes were collected randomly. Samples were prepared for analysis of dry matter, moisture, crude fiber, organic matter, crude protein, ether extract, ash, nitrogen free extract and total digestible nutrients. The grass samples were collected throughout 2010 to 2011 during the seasons of summer, winter and spring to analyze the nutritive value.

Analysis of grass Samples

The analysis of samples i.e. moisture, crude protein (CP), dry matter (DM), ether extract (EE), ash, nitrogen free extract (NFE) and crude fiber (CF) were carried out by the method of AOAC (1990). The nutritional analysis was carried out at animal nutrition laboratory in Barani Livestock Production Research Institute (BLPRI) Kherimurat, Fateh Jang by using the following procedure.

Dry Matter Determination

The fresh sample was weighed in a previously clean, weighed empty moisture dish this was taken as fresh weight. The dry matter was determined by heating the sample at 105°C to a constant weight. The dry matter % was calculated by following formula:

$$\text{Dry matter \% (DM)} = \frac{\text{Weight of dried sample} \times 100}{\text{Weight of fresh sample}}$$

Moisture Content Determination

The difference between the fresh and dry weight of the sample were used for the calculation of moisture content of the sample. The moisture % was calculated by following formula;

$$\text{Moisture } (H_2O)\ \% = 100 - \text{DM}\%$$

Nitrogen and Crude Protein (CP) Determination

The protein and other compounds nitrogen were transformed into ammonium sulphate by sulphuric acid digestion in Kjeldhal 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 standardized acid to quantify the ammonia evolved. For the latter case, the standardized alkali was used to back titrate the excess acid so that the quantity of acid neutralized by the ammonia is estimated, which was equal to ammonia evolved. For nitrogen estimation, 2 gram sample was weighed and transferred to Kjeldhal flask, 25 ml H_2SO_4 and 5 gram of catalyst was added. The sample will be digested for 30 minutes. The sample was distilled and collected into a conical flask containing 5 ml 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 was run through all the steps of the procedure). The crude protein was calculated by following formula (AOAC, 1990):

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

While

V1 = sample titer (in ml),
V2 = blank titer (in ml),
N = Normality of standardized H2SO4,
W = sample weight, Adjusting to dry matter (DM) basis:

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

Ether extracts (EE) determination

Two grams moisture free sample were weighed into clean previously dried cotton plugged extraction thimble. The thimble was placed in an extractor and fixed under extraction apparatus condenser. Solvent of 150 ml were added to receiving flask connected to the apparatus. Heat and water was turned on.

Extraction was done for 10 hours at condensation rate of 3-4 drops/sec. The thimble was removed from the extractor and the extract was transferred into a clean evaporating basin with ether washing. It was evaporated on water bath and then placed in oven at 105 0C for 2 hours and was cooled in desiccators for 30 minutes. Ether extract was calculated as under:

$$\text{Ether extract \% (on DM basis)} = \frac{\text{weight of the residue x 100}}{\text{Sample weight}}$$

Ash determination

Ash was determined by giving ignition to 5 gram oven dried sample at 600°C in a muffle furnace and ash was calculated by the formula as under:

$$\text{Ash \% (on DM basis)} = \frac{\text{weight of the Ash x 100}}{\text{Dry sample weight}}$$

Crude Fiber (CF) Determination

Two grams of moisture free ether extracted sample were weighed and placed in a tall farm beaker and 200 ml boiling dilute H_2SO_4 was added into it. 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. The sample was made acid free by washing with 10 ml of dilute NaOH and with hot water. The residue was transferred into gooch crucible and was dried in oven at 135°C for 2 hours. Then it was ignited at 600°C, cooled in desiccators and weighed. The following calculation was used:

$$\text{Crude fiber \% (on DM basis)} = \frac{\text{Weight of dried residue – ash weight x 100}}{\text{Weight of moisture free sample}}$$

Organic Matter Estimation

The organic matter (OM %) was estimated by subtracting ash% of each sample from its DM%. OM % = DM % - Ash %.

Nitrogen Free Extract (NFE) Determination

The NFE determination was carried out by deducting the determined percentages of ash, CF, EE and CP from 100%. The NFE was calculated by following formula: NFE% = 100 – (Ash % + CF % + EE % + CP %).

Estimation of Total Digestible Nutrients

Total Digestible Nutrients were estimated by putting estimated CF% in following calculation: TDN (% of DM) = 90.25 – 1.175 x CF%

STATISTICAL ANALYSIS

The data collected for various characteristics were subjected to Analysis of Variance and the means obtained were compared by LSD at 5% level of significance (Steel *et al*., 1997).

RESULTS AND DISCUSSION

The study was carried out to estimate seasonal variation of nutritional characteristics of five major range grasses of Kherimurat scrub forest. The samples were randomly collected during summer, winter and spring seasons. The nutritional analysis was carried out at animal nutrition laboratory in Barani Livestock Production Research Institute (BLPRI) Kherimurat, Fateh Jang. The proximate analysis was conducted to evaluate dry matter (DM), moisture content (MC), ash content, organic matter content (OM), ether extract (EE), crude protein (CP), crude fiber (CF), nitrogen free extract (NFE) and total digestible nutrients (TDN). The laboratory analysis data was subjected to analysis of variance (ANOVA) and the means were compared by LSD at 5% level of significance.

Dry matter (DM) was found to be statistically highest (68.901%) in the winter season, followed by the summer (40.064%) and then spring (31.175%) seasons. All three seasons showed statistically varied mean DM values from each other. Similar fidings of highest DM levels during flowering (mature) and lowest during young stages in all the species were reported by Mirza *et al*. (2002). Moisture content (MC) mean values were also notably different in all three seasons. MC was highest in the spring season (69.425%) followed by summer (59.936%) and the lowest value was observed in winter season (31.099%). The findings of Mirza *et al*. (2002) gave similar indication, as did those of Arshadullah *et al*. (2006). Findings of this study were also similar to both of these studies. Ash content values were premier in spring season (8.286%), followed by summer (7.872%) and then winter (7.114%) seasons. Ash values were drastically dissimilar in all seasons. Boutton *et al*. (2008) also reported similar findings.

Organic matter content (OM) values were also varied, the peak mean value was shown by winter (61.789%), the summer season came second (32.192%) and the lowest value was calculated in spring season (22.889%). *Cymbopogon jwarancusa* showed exceptionally high OM levels which can be attributed to essential oils present in the grass, similar observations were reported by Stowe (2003). Ether extract (EE) mean value was maximum in spring season (2.670%), than in summer (2.426%) and the winter season gave the lowest mean value (1.561 %). All three means were statistically dissimilar from each other. *Cymbopogon jwarancusa* again showed highest percentage due to essential oils. Patra *et al*. (2011) and Ajayi and Babayemi (2008) also reported matching conclusion in case of EE and lipid levels.

Crude protein (CP) values of summer and spring were similar, but they were still minor variations making them closely first and second in the same order (12.102% and 12.004%), and winter produced the appreciably buck mean value (5.466%). Similar findings about CP with regard to soil water were reported by Snyman (2006) and with respect to seasons by Mirza *et al*. (2002). Crude fiber (CF) values were statistically different in all three seasons. The highest CF value was observed in winter at 31.121%, followed by summer at 29.350% and the lowly in spring at 27.009%. The CF levels among grass species showed an inverse relation to their palatability. Less palatable *H. contortus* and the *C. jwarancusa* showed highest while highly palatable species such as *C. dactylon* and *Cenchrus ciliaris* exhibited lowest quantity of CF. Cop *et al*. (2009) and Stobbs (1975) reported similar findings.

Nitrogen free extract (NFE) was highest in winter season (54.738%), followed by spring (50.031%) and then summer season (48.250%); all seasonal NFE mean values were statistically diverse from each other. Nyambati *et al*. (2010) also reported analogous results. Total digestible nutrients (TDN) seasonal mean values were also statistically mottled, the highest TDN value was of spring at 58.512 %, and then summer at 55.764 % whereas winter produced the lowest TDN mean value at 53.683%. Arshadullah *et al*. (2011) and Arzani *et al*. (2006) also reported similar findings.

The *Cynodon dactylon* (Khabble), *Cenchrus ciliaris* (Dhaman) and even *Heteropogon contortus* (Sarialla) were found to contain good levels of crude protein, ash (minerals) and ether extract (crude fat) and so are considered good nutritional supplements for livestock. *Cymbopogon distans* (Chitta), *Cymbopogon jawarancusa* (Khavi) and *Heteropogon contortus* (Sarialla) because of their high dry matter, organic matter and crude fiber contents can provide bulk of animal feed, especially in dry condition.

Cynodon dactylon (Khabble), Cenchrus ciliaris (Dhaman) and *Cymbopogon distance* (Chitta) showed highest availability of total digestible nutrients. Based upon high nutritional levels and availability of total digestible nutrients *Cynodon dactylon* (Khabble), *Cenchrus ciliaris* (Dhaman), *Cymbopogon distance* (Chitta), and also *Heteropogon contortus* (Sarialla) have high potential nutritive value, as livestock feed.

RECOMMENDATIONS

a. *Cynodon dactylon* and *Cenchrus ciliaris* are recommended to be the most nutritional major range grasses in Kherimurat scrub forest.

b. Livestock feed should be supplemented with *Cymbopogon distance* (Chitta), *Cymbopogon jawarancusa* (Khavi) and *Heteropogon contortus* (Sarialla) in dry conditions.

c. Seasonal variation in nutritional composition of range grasses should be kept in mind at the time of grazing.

d. Rotational grazing should be practiced for giving proper regeneration time to the grasses.

e. Proper management of the area is emphasized to make sure sustainable availability of the natural forage.

Table 1. Summer analysis

S. No.	Species	H_2O%	DM%	Ash%	OM%	EE%	CP%	CF%	NFE%	TDN%
1	*Cynodon dactylon*	56.64	43.36	7.25	36.11	2.95	13.85	24.65	51.30	61.285
2	*Cenchrus ciliaris*	71.05	28.95	9.73	19.22	1.75	12.76	29.08	46.98	56.081
3	*Cymbopogon distance*	54.71	45.29	7.50	37.79	1.38	10.57	31.57	48.98	53.15525
4	*Cymbopogon jawarancusa*	60.66	39.34	7.00	32.34	3.20	10.57	30.25	48.98	54.70625
5	*Heteropogon contortus*	56.62	43.38	7.88	35.50	2.85	12.76	31.20	45.31	53.59

Table 2. Winter analysis

S.No	Species	H_2O %	DM %	Ash %	OM %	EE %	CP %	CF %	NFE %	TDN%
1	*Cynodon Dactylon*	36.90	63.10	8.64	54.46	1.35	7.66	25.85	56.50	59.875
2	*Cenchrus Ciliaris*	39.93	60.07	8.44	51.63	1.55	6.56	29.83	53.62	55.19975
3	*Cymbopogon distance*	29.66	70.34	5.31	65.03	1.44	4.37	34.16	54.72	50.112
4	*Cymbopogon jawarancusa*	16.79	83.21	6.37	76.84	2.23	4.37	32.65	54.38	51.88625
5	*Heteropogon contortus*	32.21	67.79	6.80	60.99	1.42	4.37	33.12	54.29	51.334

Table 3. Spring analysis

S.No	Species	H_2O %	DM %	Ash %	OM %	EE %	CP %	CF %	NFE %	TDN%
1	*Cynodon dactylon*	71.82	28.18	8.97	19.21	3.62	14.62	21.23	51.56	65.3045
2	*Cenchrus ciliaris*	72.61	27.39	8.97	18.42	3.28	11.49	26.76	49.50	58.807
3	*Cymbopogon distance*	69.74	30.26	6.64	23.64	1.55	10.94	26.23	54.64	59.42975
4	*Cymbopogon jawarancusa*	71.50	28.50	5.54	22.96	2.31	11.48	31.10	49.57	53.7075
5	*Heteropogon contortus*	58.46	41.54	11.38	30.16	2.59	11.48	29.73	44.82	55.31725

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