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Assessment of Nutritional Status in Selected Indigenous and Exotic Rangeland Grasses

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Abstract: Forage biomass is generally the most important resource for animal production in grass ecosystems that is rapidly being depleted due to heavy grazing over vast areas of rangelands. So a comprehensive study was conducted to determine the comparative nutrient value of available forage resources during various seasons and the ability of these resources to meet the animal feeding requirements for optimum livestock production. In the following study, ten native and exotic grass species were evaluated to find out the different nutritional characteristics viz. moisture, ash, protein and crude fiber on percent basis in the field area of department of Forestry, Range Management & Wildlife, UAF. Mean maximum moisture (%) was gained by *P. purpureum* (79.42%) while minimum moisture percentage recorded in *F. arundinacea* (20.86%), Maximum and minimum ash (%) was gained by *C. ciliarus* (10.62) and *L. codensatus* (4.39%) respectively. High crude protein (%) was recorded in *B. pertursa* (9.70%) and low was reported in *L. codensatus* (3.05%). Mean maximum and minimum crude fiber (%) was gained by *B. pertursa* (29.83) and *C. gayana* (0.56). Results show that *B. pertursa* can be a useful adition for the maintenanace and enhancing the livestock productivity because it has high crude protein and fiber percentage (%).

Key words: Moisture % Crude fiber % Crude Protein % Ash % % Rangeland Grasses

INTRODUCTION

Rangelands play a significant role in the incomes of huge number of rural people by providing forage and feed to livestock. Livestock grazing represents a system of land management in non-agricultural marginal areas, whereas, on rangeland livestock grazing signifies the most suitable land use [1]. Rangelands support 30 million herds of livestock, which contribute US $ 400 million to Pakistan's annual export earnings [2]. Past policies have often favored crops over livestock production, resulting in misuse of land having economically inefficient production potentials. Good pastures are being converted into cropland leaving increasingly poorer lands for livestock production [3] without thinking about the conservation of soil. There was no appreciation of the value of grasses and their ability to hold the soil against destructive erosion [4]. In the northern areas of Pakistan, livestock contributes nearly 55% to the gross provincial income by the agriculture sector. The mostly hilly terrain (73%) of the province has little land for crop agriculture; hence, dependence on livestock is relatively high, particularly for rural subsistence [5]. To match the maintenance requirements of livestock, there is a need of 13.5 and 110.30 million tons of crude protein (CP) and total digestible nutrients (TDN), respectively [2]. However, present feed resources provide 40% CP and 75% TDN to the livestock [6]. The deficiency of nutrients leads to under nourishment, low productivity and predisposes the livestock to parasitism, epidemics and breeding problems. The improper utilization of rangelands has resulted in great changes in their ecosystem. The more palatable

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grass species are becoming extinct and are replaced by less palatable weeds [7]. An indicator to range deterioration, in NWFP is the decline in range dependent sheep and goat population by 10.43% and 39.23%, respectively during 1986 and 1996 [8].

There is handsome share of various grass species to the feeding regimens of animals during scarcity periods. For prolonged winter scarcity, the grasses are harvested from protected hillside rangelands and stored as hay. Grasses from fertile cropland sides and adjacent uneven areas are also cut several times during summer and fed to livestock. Free grazing at rangelands is however, still the main way of procuring feed but macro and micro minerals composition, potential intake rate (PIR), relative preference (RP) and In vitro dry matter digestibility (IVDMD) of locally available free rangeland grass species have never been explored. Therefore, this study was conducted to determine PIR, RP and IVDMD of free rangeland grasses of Northern grasslands of Pakistan.

Grass plants create most extensive part of range vegetation. Usually grasses are more easily manageable; better in taste and quicker in digestion than shrubs and trees for grazing and browsing animals [9]. As compared to any other cultivated plant the grasses have highest potential of starch and protein. Being the most delicious and nutritive feed stuff grasses is deliberated as ice cream species for the domestic grazing animals. By the proliferation of new roots and decay of old ones, the organic matter and nitrogen in the soil is also increased due to growing grasses which also cause to improve soil structure, texture and fertility [10-12]. Livestock feed is deficit by 21% dry matter, 29% energy and 33% crude protein requirements [13]. Apart from the forage available from the rangelands, about 2.7 m ha of the cultivated commanded area is under fodder production, which is also not sufficient even to feed the maintenance requirements of livestock [14]. The stage at which the plants are harvested is very critical in determining the forage yield and quality. Forages when harvested at early stages of their development have relatively higher crude protein content than other extract and ash content, but crude fibre, acid detergent lignin, hemicellulose and cellulose increase with later harvesting resulting in decreased dry matter digestibility [15]. A brief description of the grasses selected for study given below:-

Dhaman Grass (*Cenchrus ciliarus*): It is tufted, tussock- perennial grass, 15-120 cm heigh rhizomatous grass. It produces branches from the base. Leaves are 10 to 25 cm long and 3-7mm wide, glabrous or hairy with ligule narrow and ciliate membranous. The seeds are dimorphic and differ in size and weight. Dhaman is native to tropical and subtropical Asia, Africa, Latin Amrica, Pakistan, India and Indonesia. In Pakistan, it is found in pothowar range, salt range, Thal, Cholistan, D.G. Khan, Kohistan, Balochistan and Tharparkar desert rangelands [11].

Rhodes Grass (*Chloris gayana*): It is native grass to Kenya with fine stemmed leafy prostate to erect turf forming up to 1.5m high, palatable for hay not for silage, drought and grazing resistant, salt tolerant [16].

Palwan Grass (*Bothriochloa pertursa*): It is a stoloniferous sward farming perennial grass. Its culms are erect, geniculately ascending up to 60 cm height. Leaf blades are 5 to 30 cm long, 2.5 to 5 mm wide; the lower ones are shorter than upper ones and crowed at the base of the culm. The basal diameter is about 7 mm with 8 to 12 tillers. The flowering stems terminate in 6 to 10 radiating brownish seed spikes. It is distributed in South East Asia, Arabian Peninsula and Tropical Africa. In Pakistan, it is found in plains and hills [11].

Green Panic Grass (*Panicum maximum*): It is a Tanzania tufted perennial grass which is up to 3.5m tall, very succulent and nutritious, suitable for mix seeding with other legumes [16].

Blue Panic, (*Panicum antidotale*): It is a coarse, vigorous and leafy, much branched perennial grass which spread by short stout rhizomes or stolens. Leaves are linear and blue green, leaf blades are 25 to 50 cm long and 5 to 12 mm wide. Flowering stems are up to 2 m in height. Spikelets are 2.5 to 3.5 cm long. Blue panic is native to Pakistan, India, Nepal and Afghanistan. It is now extensively grown from Arabia in the west to Australia in the East [11].

Love Grass (*Eragrostis superba*): It is native to Kenya which is up to 30-75 cm tall and palatable for cattle. It is used for reseeding of denuded land in dry areas. It is tufted annual and perennial grasses of the genus Eragrostis (family Poaceae). About 250 species are native to tropical and temperate regions of the world. Love grass (*E. intermedia*) is forage species formed in southern North America introduced and also in other countries as an ornamental grasses and also is used to reclaim abandoned or eroded areas formerly under cultivation [16].

Vetivar Grass (*Vetiveria zizynoides*): The grass has profusely branches with stem length of 60 cm. It is suitable for mix seeding with other legumes [13, 16].

Mott Grass (*Pennisetum purpureum*): It is native to Tanzania. It has tall, erect and thick stems of 4.5 m height. It is planted like sugarcane. The culms have three nodes which are cut into pieces and are buried in the soil up to two nodes and 3rd above ground [16].

***Tall Fescue* (*Festuca arundinacea*):** It is cool season grass that is adopted to the transition zone and into Canada. Tall fescue species are easily seeded [16].

Cayon Prince Wild Rye Grass (*Lymus codensatus*): Plant is perennial grass. Its height varies from 1-3 feet and carries blue flowers [16].

The preliminary study was conducted to determine the nutritional characteristics of some native and exotic grass species in rangeland.

MATERIALS AND METHODS

Research studies on "Comparative Study of Some Indigenous Range Grasses" was carried out during 2010 in the experimental area of the Department of Forestry, Range Management and Wildlife, University of Agriculture, Faisalabad.

Experimental Material: The seed of grasses were collected from research station of range section of PARC, Islamabad, Pakistan.

No. of Treatments: Each grass was considered one treatment and in this way, 10 grasses were representing 10 treatments in total.

No. of Observations: Nutritional characteristics

- Moisture %
- Ash contents %
- Protein contents %
- Crude fiber %

Nutritional Characteristics: At the time of harvest, plant samples of the grasses species were collected and the following chemical determinations were recorded.

Moisture Contents (%): To determine the moisture content thoroughly cleaned empty crucible with lid was dried in an oven and weighed. One gram of accurately weighed plant sample was taken in this crucible and placed in an oven at 105°C till constant weight arrived. Then the crucible was cooled and weighed. The crucible was again heated, cooled and weighed till constant reading was recorded. The loss in weight was the moisture [17]. The percentage was calculated as:

$$\text{Moisture (\%)} = \frac{\text{Wt. of sample lost after heating}}{\text{Wt. of sample before heating}} \times 100$$

Ash Contents (%): The oven dried plant sample (1 gram) was taken in an already weighed crucible. The crucible was placed in a furnace for ignition at 600°C for one hour, cooled and weighed to calculate the percentage of ash contents [17].

$$\text{Ash contents (\%)} = \frac{\text{Wt. of Ash}}{\text{Wt. of sample}} \times 100$$

Crude Protein (%): One gram of the dried plant sample was taken in digestion flask. One gram of digestion mixture was added to the flask along 25 ml of conc. H_2SO_4 carefully so as to wash down the solid particles of the plant sample adhering to the neck of the flask. The flask was shacked very well until the contents were completely mixed. The flask then was hanged on a tripod stand inclining the neck at an angle of about 60° in the fume cup-board. The flask was heated gently and when the fuming stopped, the heat was increased till the mixture started boiling. The mixture was heated until a clear solution was obtained. The solution was cooled down and volume up to 100 ml was prepared. Five ml of this prepared solution was poured in kjeldahl apparatus through the funnel and steam distillation was started by placing the flame under the Kjeldahl's apparatus. 40% NaOH was added drop-wise till the color of the solution changed to dark-brown. Nitrogen evolved from solution was trapped and collected in the Boric Acid indicator flask which turned to dark blue color. The flask was removed and titrated the contents against N/70 HCI [17].

Total N was calculated by the following method.
5ml of N/70 HCl = 1 mg of N
Total protein = Nitrogen content X 6.25

Crude Fiber (%): Two gram of moisture free and ether extracted plant sample was taken in 500 ml digestion flask. 200 ml of 1.25 percent l-l2 so was also added. The sample was digested for 30 minutes on crude fiber extraction apparatus. The sample was filtered through Buckner funnel with the help of suction pump. After filtration the

residue was washed with hot water and 15 ml ethanol. The sample was dried in an oven at 135°C for 2 hours. Cooled, weighed and then ignited in a furnace at 600°C for 30 minutes and weighed again [17]. The crude fiber contents were calculated by using the following formula. Wt. of residue after acid/alkali treatment - wt. after ignition

$$\text{Crude fiber (\%)} = \frac{\text{Wt. of residue after acid/alkali treatment - wt. after ignition}}{\text{Total weight of sample}} \times 100$$

Harvesting: The grasses were harvested at maturity stage.

Statistically Analysis: The data was collected and analyzed statistically by applying Fisher's analysis of variance technique and least significant difference test was applied at 5% probably level to test the significance of the treatments' means [18].

RESULTS AND DISCUSSION

Moisture Contents (%): Treatment means revealed that all grass species statistically showed highly significant results as given in the (Fig. 1). Treatment grand means showed that among all grasses species, maximum moisture contents (%) was gained by *P. purpureum* (79.42%) followed by *P. antidotale* (77.92%), *V. zizynoides* (77.14%), *P. maximum* (70.98%), *B. pertursa* (68.61%), *C. ciliarus* (66.20%), *C. gayuana* (63.64%), *E. superba* (60.23%), *L. codensatus* (21.00%) and *F. arundinacea* (20.86%) in decreasing order respectively and these were statistically significant except *V. zizynoides, P. purpureum, P. antidotale* and *C. ciliarus, B. pertursa and* also *L. codensatus, F. arundinacea* were statistically similar. Similar findings were also reported by [19].

Ash Contents (%): Treatments means revealed that all the grass species showed statistically highly significant results as shown in (Fig. 2). Treatment grand means showed that among all grasses species, maximum ash contents (%) was gained *B. pertursa* (10.62%) followed by *C. ciliarus* (10.44%), *E. superba* (8.53%), *P. purpureum* (4.39%), *V. zizynoides* (4.09%), *P. maximum* (4.08%), *P. antidotale* (3.61%), *F. arundinacea* (3.06%), *C. gayuana* (2.92%) and *L. codensatus* (2.35%) in decreasing order respectively and these were statistically significant except *V. zizynoides, P. maximum* and *C. ciliarus, B. pertursa*

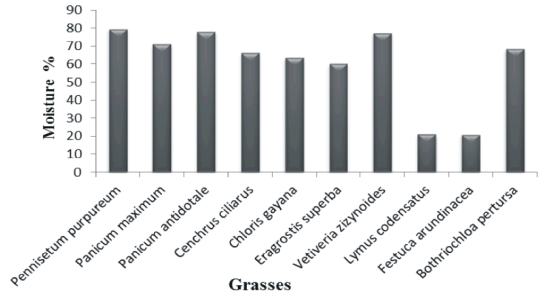

Fig. 1: Moisture percentage (%) recorded from different rangeland grasses.

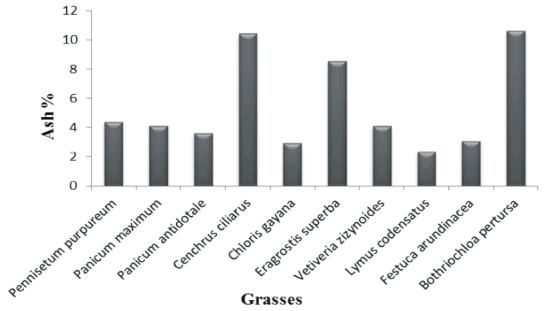

Fig. 2: Ash percentage (%) recorded from different rangeland grasses.

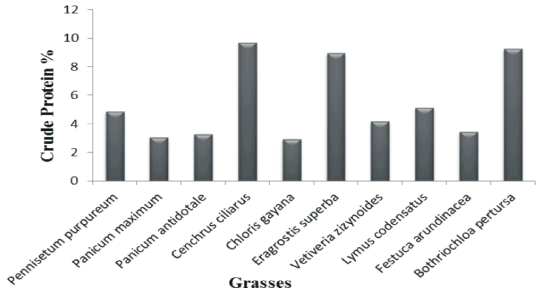

Fig. 3: Crude Protein percentage (%) recorded from different rangeland grasses.

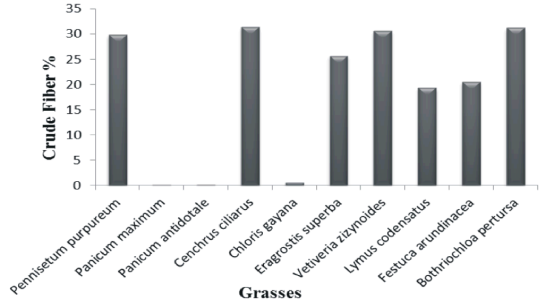

Fig. 4: Crude Fiber percentage (%) recorded from different rangeland grasses.

were statistically similar. These findings are also in line with the results obtained by [20, 21].

Similarly, treatments means revealed that all the grasses (species) showed statistically highly significant results.

Crude Protein (%): Analysis of variance (ANOVA) showed that treatments difference were highly significant with respect to crude protein (%) (Fig.3). The results showed that among all grasses species, maximum crude protein (%) was gained for *C. ciliarus* (9.70 %) followed by *B. pertursa* (9.26%), *E. superba* (8.94%), *L. codensatus* (5.12%), *P. purpureum* (4.87%), *V. zizynoides* (4.16%), *F. arundinacea* (3.45%), *P. antidotale* (3.28%), *P. maximum* (3.05%) and *C. gayuana* (2.93%) in decreasing order respectively and these were statistically significant except *B. pertursa, E. superba, C. ciliarus and V. zizynoides, P. maximum, V. zizynoides, L. codensatus, P. purpureum, C. gayuana* and *F. arundinacea* were statistically similar. The present results are also in agreement with the results reported by many other researchers [9, 22-30].

Crude Fiber (%): The data regarding the ash percentage given in the (Fig. 4) show statistically significant results. Treatment grand means showed that among all grass species, maximum crude fiber (%) was gained by *C. ciliarus* (31.34%) followed by *B. pertursa* (31.2%), *V. zizynoides* (30.57%), *P. purpureum* (29.83%), *E. superba* (25.66%), *F. arundinacea* (20.48%), *L. codensatus* (19.31%), *C. gayuana* (0.56%), *P. antidotale* (0.20%) and *P. maximum* (0.17%) in decreasing order respectively and these were statistically significant except *P. purpureum, C. ciliarus, V. zizynoides, B. pertursa and P. maximum, P. antidotale, C. gayuana and also L. codensatus, F. arundinacea* were statistically similar. Similar findings were reported by [9, 22, 23, 31-34].

DISCUSSION

The present study was conducted to determine the nutritional values, such as moisture, ash, crude protein and crude fiber percentage (%) present in ten different species of rangeland grasses. The results showed that percentage of nutritional values varies from species to species, age and different plant parts. A similar finding was also reported by [24, 35, 36] both leaves and stems decreased in their nutritive value with plant maturity, however, the nutritive value of stems decreased more rapidly than that of leaves. This was also reported by [9] who studied chemical composition of Mott grass harvested at 40 and 60 days of age and reported that the early cut grass had higher CP than that of the later cut. Rusland *et al.* [19] carried out a research in addition to higher yield; digestibility is one of the main qualities of forage. Apart from other factors, it also depends upon succulence of the forages. Mott grass was the most succulent forage grass among all the grasses as it contained about 74% moisture contents. Mott grass is also an excellent grass used for silage purpose and digestibility of Mott silage has been reported to be higher than that of corn silage.

While studying the effect of different clipping patterns on production and nutritive value of six grasses and six legumes, [37] investigated that in grasses, CP concentration declined by 4% between 4 and 10 weeks of age. Sleugh *et al.* [38] determined forage nutritive value of various Amaranth species harvested six times at 2 week intervals, The CP concentration was the highest at 42 days after planting and declined steadily thereafter. This was due to decreasing leaf to stem ratio with advancing grass maturity. [33] reported that the late sowing resulted in increased CP concentrations.

The chemical and nutrient composition of plants and plant communities in rangelands varies according to climate, species, soil type, plant phenology and other abiotic factors [39]. The nutrient deficiency leads to under nutrition and low productivity of livestock [40]. The daily nutrient demand of livestock varies in accordance with the physiological functions of the grazing animals and patterns of maintenance, gestation; fattening and lactation play major roles in determining daily nutrient requirements [41]. It has been concluded that all the species have different nutritional values, so grow only such grass species which have high nutritional values and effective for the livestock productivity. *B. pertursa* can be proving as a best rangeland grass species for the maintenance and enhancing the livestock productivity because it has high crude protein and fiber percentage (%).

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