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Research article

NUTRIENT EVALUATION OF COMMON VEGETATION OF RAJASTHAN: *Pennisetum Typholdenum, Cenchrus ciliaris, Cenchrus setigerus and Lasiurus Sindicus.*

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ABSTRACT: The agriculture and animal husbandry practices in the tropics are diversified and change with change in the rainfall and soil. Livestock are considered as way of life rather than auxiliary occupation because of its immense importance on the different sphere of rural economy. The farmer in general, in most of the Asian countries does not understand and practice the nutrient requirement in ruminant animals. They feed their animal on the local feed resources available in their region. The main roughages available in the tropics are the crop residues, mature tropical grasses and the like. Shortage of quality forage is one of the limiting factors affecting adversely the health and productivity of livestock in the tropical environment. Therefore feeding system should be developed with the local feed resources with supplement of nutrient so as to achieve optimum production. Keeping this in view the present investigation was undertaken to garner information regarding the nutrient content of commonly available species of forage in the region of Rajasthan. Common vegetation such as *Pennisetum Typholdenum, Cenchrus ciliaris, Cenchrus setigerus and Lasiurus Sindicus* fig (I) from Jodhpur district of Rajasthan were analysed for their nutritional constituent. The Crude protein content ranged from 6.5 to 9.0%, Cellulose from 28.6 to 30.8%, Hemicellulose from 28 to 32.5%, Lignin from 6.9 to 7.9%, Crude Fiber from 30.43 to 31.9%, Neutral detergent fiber from 68.8 to 71.3% and Acid detergent fiber from 38.1 to 40.8% on dry matter basis. Fourier transform infrared (FTIR) analysis was also used to investigate the chemical structure and characteristic of Lignocellulose, Cellulose and Hemicellulose constituent present. This study will also help not only to understand the elemental and nutritional status of vegetation, but also a suitable fertilizer management for conservation of arid land and production of greens for live stock of Rajasthan.

Key Words: Lignocelluloses; Hemicelluloses; Organic Matter; Dry matter; Neutral Detergent Fiber; Cell Content.

INTRODUCTION

Arid Region of Rajasthan has harsh, unfavorable climatic conditions coupled with poor soil make agricultural production system a gamble due to high risk and uncertainties [1, 2]. Live stock is an integral part of social, economic and environmental system in Rajasthan [3]. Rearing of animals is challenging in arid ecosystem and need diversified source of vegetation. Providing appropriate palatable vegetation with nutrient is also one aim of green science. In arid zone vegetations having low concentration of recalcitrant lingo-cellulose have excellent medicinal and fodder value on the contrary vegetations having high recalcitrant lingo-cellulose are unpalatable in nature [4]. In Rajasthan animal husbandry is not merely a subsidiary to agriculture, but it is major economic activity and source of livelihood in arid semi-arid and harsh ecosystem, thus providing an insurance against prominently occurring scarcity conditions [5, 6].Income from the live stock account for 30 to 50% of the rural household's income with wide variation in region and households [7]. The animal population growth rate is very high in the state and the availability of fodder that is already in short supply by nearly 50% is likely to get aggravated .For growing ruminant population, there is need to explore new feed resources which do not compete with human feed chain [8, 9]. The major constraint in the development of livestock sector is poor availability of nutrients to fulfill the requirement of livestock; therefore it needs to improve efficient use of available feed resources for increasing the livestock production in the developing countries. There is limited information about the extent of nutrient availability through various feed and fodders to animals of this region. The present investigation was therefore undertaken to assess the nutritional status of commonly available vegetation of this region.

Vari**o**us studies have been carried out on nutrient evaluation of arid species. Wood et al [10] discussed general description of farming and feeding systems for small ruminants and nutritive value of major dry season feed resources available for goats in Bhilwara and Udaipur districts. Rathore et al [11] studied proximate composition of some famine foods of Rajasthan and also determined the average chemical composition of food samples. Chemical composition and nutritional value of legume shrubs, trees leaves and straws were also evaluated by several researchers [12, 13,]. They also evaluated their potentiality as fodder for livestock. Bakshi et al [14] evaluated the fodder value of forest grasses for livestock, but the present study is quite different because it contains nutritional, lignocellulosic and IR characterization of selected species in a thread of one research context. Plant cell wall material is composed of three important constituents: cellulose, lignin, and hemicelluloses [15]. Cellulose is a long chain of glucose molecules, linked to one another primarily with $\beta(1\text{-}4)$ glycosidic bonds. The simplicity of the cellulosic structure, using repeated identical bonds, means that only a small number of enzymes are required to degrade this material [16]. Lignin is a complex polymer of phenyl propane units, which are cross-linked to each other with a variety of different chemical bonds. This complexity in its structure has thus proven it as a recalcitrant material. Lignin is particularly difficult to biodegrade, and reduces the bioavailability of the other cell wall constituents [17, 18]. Hemicelluloses are branched polymers of xylose, arabinose, galactose, mannose, and glucose. Hemicelluloses bind bundles of cellulose fibrils to form micro fibrils, which enhance the stability of the cell wall [19]. Anaerobic rumen microorganisms mainly bacteria, protozoa and fungi degrade ligno-cellulosic feeds consumed by the ruminants [20, 21, 22]. The ruminants in developing countries are predominantly maintained on low grade roughage and grazing on degraded range land resulting in their poor nutrient utilization and productivity, so there is an urgent need to characterize the lignocellulosic constituent of the feeds consumed by ruminants. Laboratory analysis is expensive, laborious and time consuming so that results often come late after consumption. With the recent introduction of infrared spectroscopy (FTIR), fast evaluation of feeding quality is now a possibility.

Furthermore, the use of Fourier transform infrared (FTIR) spectroscopy is increasing in many sectors such as in the field of fiber [23, 24] and wood science technology [25, 26], plant physiology [27, 28] food and carbohydrate analysis [29, 30], oil and medicinal analysis [31, 32], microbial characterization [33], pigment and paper analysis [34], also including drug discovery studies by Guillen et al [32]. It has been a workhorse technique for materials analysis in the laboratory for over seventy years. An infrared spectrum represents a fingerprint of a sample with absorption peaks which correspond to the frequencies of vibrations between the bonds of the atoms making up the material [35]. Since every different material is a distinctive combination of atoms, no two compounds generate the same infrared spectrum. Therefore, infrared spectroscopy can result in a positive identification of qualitative analysis in different kinds of materials. In addition, the range of the peaks in the spectrum is a direct indication of the amount of compound present. By means of this modern software algorithm, infrared is an outstanding tool for quantitative analysis.

Hence the present study is to evaluate vegetations quality, with regard to lignocellulosic and nutritional content, and confirm their lignocellulosic structure by Infra red spectroscopy, and their suitability for feed. *Pennisetum Typholdenum*/ Bajra (Pearl Millet) is most widely grown type of millet. It is highly drought tolerant and can grow well in the areas with a rainfall of 25–75cm. Pearl Millet is the fourth most important ceral food crop in India. *Cenchrus ciliaris* /Anjan grass grew in Rajasthan, Haryana, Punjab, Gujarat and parts of western Uttar Pradesh and Tamil Nadu state. It grows well in rainfall zones ranging between 125 and 1,250 mm in arid and semi-arid regions of the country in light red colored to medium textured soils and calcareous in nature. It is highly nutritive grasses for desert environmental conditions, provides very good hay. *Cenchrus setigerus Vahl*/ motha Dhaman/ Birdwood is usually grows in on alkaline soils and is extremely tolerant to heat and drought conditions, hard in nature and has the ability to grow in low rainfall areas. *Lasiurus sindicus* /Sewan grass is a native grass of India and found predominantly in arid zones of Rajasthan, extending to the parts of Haryana and Punjab.

EXPERIMENTAL:

Sampling and preparation of samples.

Sampling and preparation of samples are performed according to Allen and Amma [36, 37]. Matured Leaves of plants were collected from the Central Arid Zone, Jodhpur, Rajasthan. About 500 g fresh samples were collected. Individual contaminations were removed by thorough washing under running tape water followed by rinsing with distilled water, dried at 60º-70^{O}C in a well ventilated oven or plant sample dryer till constant weight is attained. The dried plant tissues are usually grinded in a grinder. Finely grinded plant tissues passed through 100 mesh sieve. The grinded sample kept in air tight polythene container such as plastic bottles with screw cap to prevent adsorption of water from the humid environment and stored.

Analysis Methods

All the parameters were estimated by internationally accepted method. Total nitrogen is determined by kjeldahl method and multiplies the percentage value with 6.25 to get crude protein. Since nitrogen content in protein is 16 percent for almost all crops hence the factor for crude protein is 6.25 to get crude protein. The structural component, viz., Neutral Detergent Fiber (NDF), Acid Detergent Fiber (ADF) Cellulose, Hemicellulose and Lignin were determined by the method of van soest [38, 39]. All feeds contain lignin, cellulose and fibrous components. The treatment with H_2SO_4 dissolves the functional carbohydrate subsequent treatment with NaOH dissolves protein and other binding materials living sparingly digestible cell wall or structure carbohydrates and non digestible lignin fraction as insoluble residual. The unreacted portion of the feed is termed as crude fiber, which is estimated by filtering and ashing the residue (40). Statical analysis is also carried out according to Snedecor and Cochran [41].

For Fourier Transform Infrared Spectroscopy (FTIR), 5 gm sample were, ground to particle size ≤0.125 mm. Sample (0.5mg powdered sample and 200mg dry KBr) for IR spectroscopy were mulled to produce an even distribution in KBr pellets. FTIR Spectra were recorded on ABB Bomem Spectrometer model MB3000 with Zn Se detector in transmittance acquisition mode over the wave number (500-4500 cm^{-1}) with a resolution of 4 $cm^{-1}$and 10 scan were averaged for each spectrum. Sample was run in a triplicate and all of them undertaken with a day period. The spectra were run and processed with a "HORIZON MB^{TM} FTIR Software" Program.

RESULS AND DISCUSSION

The proximate composition of these vegetations determined in this study is presented in Table 1. Dry matter content ranged from 24.4% in *Pennesiesetum Typholdenum* to 18.8 in *Cenchrus ciliaris*. *Pennisetum Typholdenum* contains highest crude protein value. The mean content of this nutrient was 7.45% ranging from 6.5% in *Lasiurus Sindicus* to 9.0% in *Pennisetum Typholdenum on* DM basis. The highest neutral detergent fibre content of 71.3% DM was recorded in *Lasiurus Sindicus* while *Pennisetum Typholdenum* had the lowest value of 68.8% DM. The acid detergent fibre levels in the experimental vegetations ranged from 38.1%DM in *Cenchrus setigerus* to 40.8% DM *Pennisetum Typholdenum*. The least lignin content of 6.9% DM in these vegetations were recorded in *Cenchrus setigerus* while *Pennisetum Typholdenum* had the highest value of 7.9% DM. Cellulose levels in these vegetations were within the range of 28.6% DM in *Lasiurus Sindicus* to 30.8% DM in *Pennisetum Typholdenum* while Hemicellulose content ranged from 28.0% DM in *Pennisetum Typholdenum* to 32.5% DM in *Cenchrus* ciliaris. The value of crude fiber was ranged from 30.43% in *Cenchrus ciliaris* to 31.9% in *Pennisetum Typholdenum* on dry matter basis.

Plant nutrients can be classified as either cell contents (starches and many plant proteins) which are generally rapidly digested in the rumen or cell walls (also known as fiber) which are slowly digested by the rumen microbes.

The detergent fiber analysis system separates forages into two parts: cell contents or neutral detergent soluble, which include sugars, starches, proteins, nonprotein nitrogen, fats and other highly digestible compounds; and the less digestible components found in the fiber fraction (NDF). The fiber fractions are contained in the cell walls of plants and provide structural support for upright. NDF contains hemicellulose, cellulose, and lignin. Hemicellulose is fairly digestible, cellulose is less digestible, and lignin is indigestible in the rumen. Hemicellulose is a branched chain of different types of sugars. Its non-uniformity makes it relatively more digestible in the rumen. Cellulose is a linear chain of one type of sugar called glucose. Cellulose chains become tightly compacted in plants and are therefore, more difficult for the rumen microbes to digest. Lignin is actually a polymerized product of many non-carbohydrate compounds [42].

Table 1. Nutrient analysis of selected vegetations:

Parameter (%)	P.M.	C.C.	C.S.	L.S.
D.M (Dry Matter)	24.40	18.80	19.30	19.80
C.P. (Crude Protein)	09.00	07.40	06.90	06.50
N.D.F.	68.80	71.00	69.20	71.30
Hemi-cellulose	28.00	32.50	31.10	32.30
Cellulose	30.80	29.00	28.80	28.60
Lignin	07.90	07.40	06.90	07.10
A.D.F.	40.80	38.50	38.10	39.00
C.F.	31.90	30.43	30.66	31.00

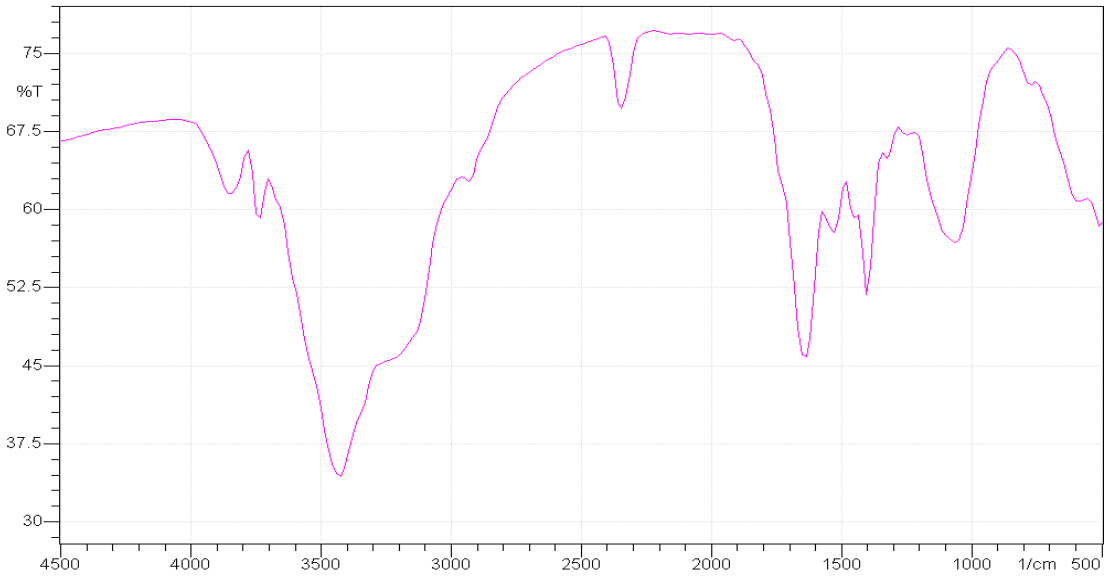
(a) Pennisetum Typholdenum/ Bajra (Pearl Millet)

(b) Anjan Grass (Cenchrus ciliaris)

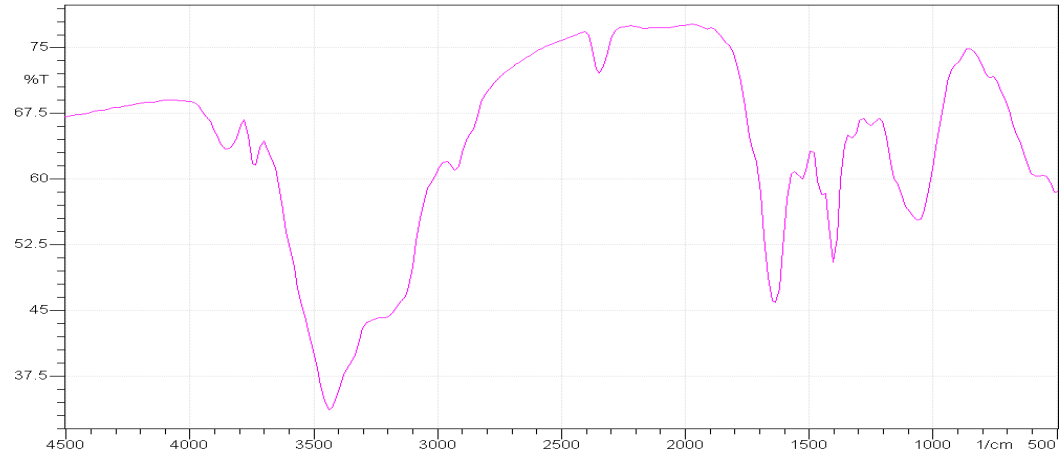
(c)Cenchrus setigerus Vahl Motha Dhaman (Birdwood Grass)

(d) Lasiurus sindicus (Sewan Grass)

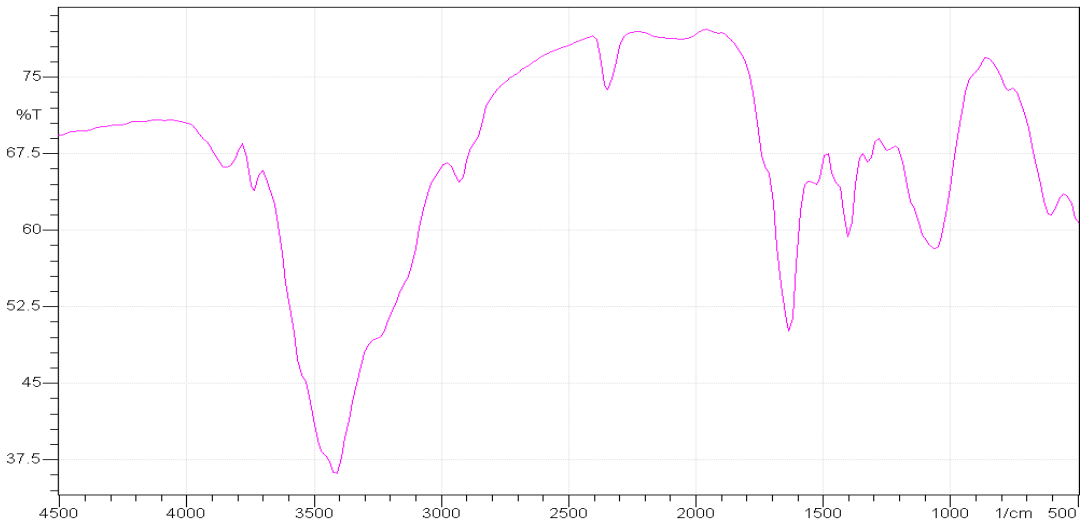
Fig. 1. Some selected plants of vegetation.



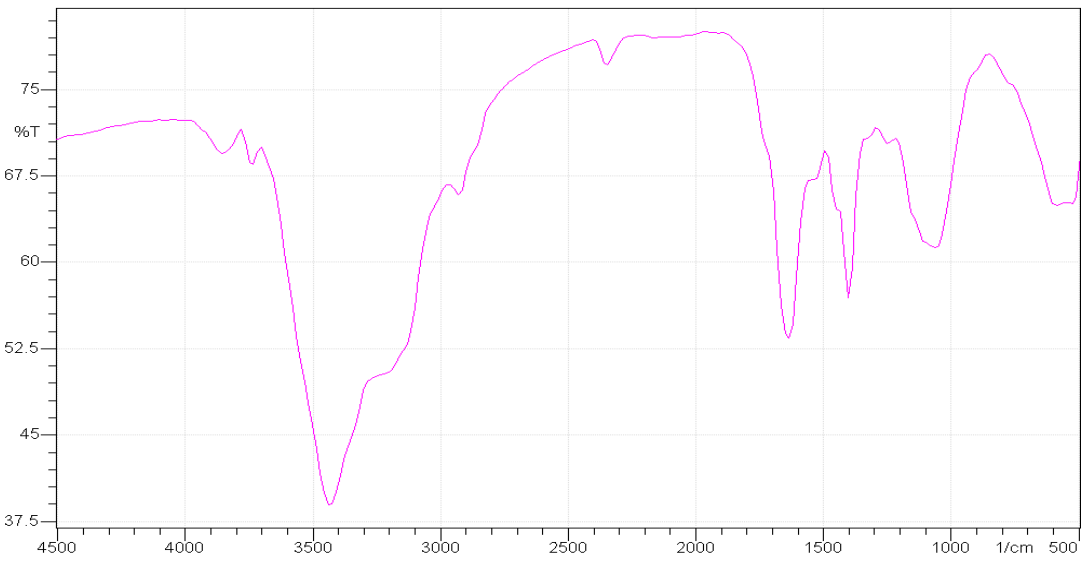
(a) Pearl Millet (Pennisetum Typholdenum)



(b) FTIR spectra of Anjan grass Cenchrus ciliaris)



(c) Cenchrus setigerus Vahl Motha dhaman (Birdwood grass)



(d) Lasiurus sindicus (Sewan grass)

Fig. 2: FTIR spectra of some selected plants of Rajasthan.

Forage quality can greatly influence how animals produce their products. A portion of the performance variation can be explained by the fact that as forage quality decreases, feed intake will also decrease, in addition, forage digestibility will be reduced. Non-ruminant animals such as horses are able to eat larger quantities of poor quality forages and pass them through the digestive tract faster to compensate for the lower quality [43]. Ruminants, however, cannot alter intake to compensate for poorer quality forage. The poorer the forage quality, the longer it remains in the ruminant digestive tract, which in turn, decreases animal productivity [44]. Fig.(2) shows the FTIR peaks of all four species. The broad spectral band at 3441c m^{-1} was assigned to the stretching vibration of the hydrogen-bonded, alcoholic and phenolic hydroxyl groups [45]. Most of the remaining pronounced bands on the spectra were attributed to the fatty acids and esters comprising lignocellulosic polymer. These include a strong absorption bands located at 2932, associated with the asymmetric or symmetric stretching vibrations of the methylene groups of general organic material content of the fibre [46], as well as smaller bands at 1404, which corresponded to methyl group bending vibrations due to lignin molecules. A relatively strong band at 1636cm^{-1} assigned to the O-H bending vibration of adsorbed water molecules or potentially hydrogen-bonded, C-O stretching vibration of the carbonyl bond in the ester group of lignin within the lignocelluloses polymer[47]. The aromatic domain of the Lignocelluloses was associated with a weak adsorption band located at 1650–1500 cm^{-1}, which corresponded to the presence of phenolic compounds present in plant cellular level [48]. Broad peak around 1065 cm^{-1} clearly indicates the higher content of cellulosic polysaccharides of carbohydrates [49]. The vibration located at 1,528 cm-1 is attributed to NH_2 deformation and likely indicative of proteins or amino acids [50].

Bands at 1250cm-1 correspond to acetyl group present in pectin in lignin compound [51]. Pectin is also part of hemicelluloses. It is recognized that acetyl group occur generally in hemicelluloses [52]. A band at below 800 cm^{-1}, corresponding to C-H and C-C out-of-plane bending vibration in the aromatic ring. A band at 2345cm^{-1} assigned to the presence of cyanide group as a secondary compound. Fourier transform infrared (FTIR) analysis also supports the presence of Lignocelluloses, Cellulose and Hemicelluloses constituent present in the selected vegetation.

CONCLUSION AND RECOMENDATION:

The above study presents the nutritional and lignocellulosic status and IR spectra also authenticates the result of all the selected vegetations. However all the selected vegetations have high NDF and ADF levels which score poorly, because of the lowered ability of the animals to meet their requirements. Since these vegetations are evergreen and extensively distributed in this region, farmers of the area can very ideally use them as fodders, so suitable supplementary feed products should be incorporated with these fodder sources for higher livestock production.

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