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Macro-Minerals Concentrations of Major Fodder Tree Leaves and Shrubs of District Chakwal, Pakistan

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Abstract: The aim of present study was to find out the margin macro-mineral composition of 15 different fodder tree leaves and shrubs of district Chakwal of Pakistan. The climate of this region is characterized by a moderately low annual rainfall (350-500 mm.) Temperature during winter is 4-25°C and during summer is 15-40°C. Samples of fifteen tree leaves (*Acacia nilotica, Acacia modesta, Albizzia lebbeck, Capparis decidua, Elaeagnus angustifolia, Grawia optiva, Gymnosporia royleana, Indigofera gerardiana, Morus alba, Prosopis cineraria, Panicum antidotale, Nerium odorum, Moringa oleifera, Ziziphus mauritiana* and *Zizyphus mummularia)* were collected in march and April and analyzed for macro-minerals, i.e. Na (Sodium), K (Potassium), P (Phosphorus) and Ca (Calcium). The mean percentage values for Ca, P, Na, and K were 1.66, 0.26, 0.08 and 0.069, respectively. Our current investigations on nutritional evaluation of fodder tree leaves and shrubs revealed that these are good source of macro-minerals and can be used as substitute feed in the district of Chakwal, especially during the feed deficient periods.

Key words: Macro-Mineral composition, fodder tree leaves

INTRODUCTION

Many minerals are essential for small ruminants for getting optimum production for them. The most important minerals are calcium, phosphorus and common salt. The body can tolerate deficiency of vitamins longer than deficiency of minerals (Grunes and Welch, 1989). Deficiency and excess of macro-minerals in the ruminants cause poor performance. Knowledge of the levels of the minerals concentration present in the tree leaves may suggest minerals supplementation strategies to get better growth and reproductive efficiency of the ruminants. Fodder trees and shrubs have always played a role in feeding livestock. They are good source of minerals for the ruminants (Ahmad *et al*., 2008) and also, they are readily accepted by livestock (Paterson *et al*., 1998). It has been recommended that the species with higher P and K in their leaves are more beneficial for livestock, because these elements are very important for livestock (Ashraf *et al*., 1992; Irigoyen *et al*., 1992). Ca and Mg are also useful for livestock because both of these elements are essential for normal growth of livestock (Walker, 1980; Aregheore and Hunter, 1999; Khan *et al*., 2004).

Herbivore animals under natural grazing conditions obtain their minerals from forage plants. Inadequate mineral intake leads to reduced productivity. The adequacy of the diet in essential minerals can be determined by chemical analysis of animal body tissue and fluids and of forages which are being eaten by the animals. In Pakistan, ruminant production depends largely on the use of natural pastures throughout the year. Only rarely, however, can pasture forages completely satisfy all minerals requirements (McDowell *et al*., 1993; Khan *et al*., 2006).

There is need for information on this aspect in Pakistan before recommendations for specially formulated mineral supplements can be made. The use of mineral supplements without looking upon to local conditions can cause mineral imbalance and is therefore, likely to impede rather than promote livestock production. The Chakwal district of the province of Punjab, in which the present investigation was carried out, is the medium region to low rainfall which only fragmentary data is available relating to the mineral status of livestock and forages existing at that ranch.

So far, very little work has been done on the identification, prioritization and characterization of indigenous fodder trees and shrubs in Pothwar Scrub rangeland of Chakwal Pakistan. Similarly, farmers' local knowledge on indigenous fodder trees and shrub species are not strongly supported by scientific investigations. The present study was therefore undertaken to explore Marco-minerals contents of fodder tree leaves of this region and to share this information with the extension people as well as with farmers.

MATERIALS AND METHODS

Location and climate: Chakwal is located in the south of Rawalpindi at a distance of 97 km (Fig. 1). It lies between 32° 56' north and 72° 54' east. The environment

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Fig. 1: Location map of study area

is cool with subhumid climate. The colour of the soil of this area is brown. Almost 90% population lives in rural areas. Vegetation of Chakwal is scrubby (Anonymous, 2007). The rainfall is mostly received during monsoon season in between mid of July to the mid of September with the range of 350-500 mm. The winter rain begins in January and persists up to beginning of March. The mean monthly temperature ranges 5.9-38.4°C, whereas January is the coldest and June the hottest month of the year. Temperature during summer is 15-40°C and during winter is 4-25°C. In winter the temperature often drops below zero, usually in December and January.

Sample collection: Most dominant fodder tree leaves available in the area, which are used by ruminants, are *Acacia nilotica*, *Acacia modesta*, *Albizzia lebbeck*, *Capparis decidua*, *Elaeagnus angustifolia*, *Grawia optiva*, *Gymnosporia royleana*, *Indigofera gerardiana*, *Morus alba*, *Prosopis cineraria*, *Panicum antidotale*, *Ziziphus mauritiana* and *Zizyphus mummularia*. All the tree leaves were cut into small pieces so as to facilitate easy handling and uniform sampling for analysis. Samples were dried in the hot air oven at 60°C for 24 h and ground to pass through 1-mm sieve and were stored in polythene bags at room temperature. All samples were collected within 25 days to minimize effects of sampling time on nutrient composition.

Digestion: For mineral estimation, dried ground material (1 g) was taken in crucible and ignited in a muffle furnace at 550°C for 3 h. The ash was dissolved in 40 ML diluted hydrochloric acid (1+4) and few drops of per choleric acid were added in the crucibles. Placed the crucible on to the heating block and heated at 350°C until the sample was digested up to half. The volume of the extract was made up to 50 mL with deionized water. The extract was filtered through filter paper (Whatman® Gradeno. 42) and stored in the bottles for analysis.

Analysis of macro minerals: The sodium, potassium and calcium contents were analyzed with flame photometer (AFP, U.K). Phosphorus (P) was analyzed by using spectrophotometer (UVD-2960, USA) (AOAC, 1995).

RESULTS AND DISCUSSION

The tree foliages are perennial, deciduous or evergreen, which are highly preferred by ruminants in their natural habitat (Table 1). A wide variation in the concentration of macro mineral contents occurred among the foliages (Table 2).

Calcium: The Ca concentration of various foliages varied from 0.09-3.35% and the mean was 1.66±0.25%. The highest Ca value was for *Capparis decidua* followed by *Albizzia lebbeck*, *Grawia popolifdia*, *Prosopis cineraria*, *Acacia modesta*, *Acacia nilotica*, *Elaeagnus angustifolia*, *Nerium odorum*, *Ziziphus mauritiana*, *Zizyphus mummularia*, *Moringa oleifera*, *Melia azedarach*, *Indigofera gerardiana*, *Morus alba*, respectively. The lowest value was observed for *Capparis decidua*. Mean fodder tree leaves Ca levels were sufficiently higher than the critical levels established by NRC, 1978 (Anonymous, 1984) for the requirements of ruminants. These higher values of Ca in fodder tree leaves were in disagreement with those found in the literature (Espinoza *et al*., 1991; Pastrana *et al*., 1991; Ogebe *et al*., 1995; Khan *et al*., 2005, 2006). If Ca is not supplemented in adequate amounts, Ca deficiencies can result. These deficiencies will not become apparent, however, until broken bones, convulsions and death occur. Additionally, forage Ca values as found in the present study are similar to those were reported by Pastrana *et al*. (1991a,b), Tiffany *et al*. (2000, 2001) Espinoza *et al*. (1991) and Cuesta *et al*. (1993).

Phosphorus: The P content ranges between 0.11 to 0.88% with the means of 0.26±0.04%. Variations in the content of P observed in the current study with those reported in the literature could be partly explained by both species' and intra-species' variations. Variable contents of P could be due to differences between varieties and cultivars in the factors that control accumulation of P in forages. The differences could be also due to variability in the available soil P and soil pH, forages' growth stage and proportions of leaf and stem fractions and sampling season (Minson, 1990). Contents of minerals in forages including P decrease with plant maturity (McDowell, 1977).

Sodium: Mean forage Na concentrations were 0.083% of the samples, below the critical level of 0.09% suggested by Anonymous (1985). The values of Na in the fodder tree leaves were in disagreement with those found in literature (Espinoza *et al*., 1991; Pastrana *et al*.,

Table 1: Description of the of fodder tree leaves District Chakwal, of Pakistan

Scientific name	Common name	Family	Description
Acacia modesta	Phulai	Mimosaceae	Deciduous tree; height 10-12 m; Green Biomass Yield (GBY) up to 180 kg/tree/cutting FB (fresh basis); 2-3 cuttings/year, The tree yields a gum, which is restorative.
Acacia nilotica	Kiker	Mimosaceae	Extract from wood is used as astringent in diarrhea and applied in spongy gums.
Albizzia lebbeck	Siris	Mimosaceae	The root is sued in hemicramia. The bark is bitter, cooling, alexiteric, anthelmintic. It cures leucoderma, itching, skin diseases, piles, excessive perspiration and inflammations. The leaves are good for opthalmia. The flowers are given for asthma and snake bite.
Elaeagnus angustifolia	Ghonair	Elaeagnaceae	Leaves are chief source for fodder and Fruits are also used for the dysenteric problems of the cattles.
Grewia optiva	Peepal	Moraceae	A small tree, sometimes reaching up to 15 m in height, trunk with ashy-white bark. Branches spreading, young shoots divaricate, rough with stellate tomentum. Leaves with 4-10 mm long, scabrous petiole; lamina stellate-tomentose on both sides, rough, ovate to broadly ovate, 3.5-10 cm long, 2-6.5 cm broad, 3-costate, oblique or obtuse at the base, margin glandular-crenate, acute to acuminate; stipules subulate, c. 4-5 mm long, densely hairy, caducous. Cyme 2-8-flowered, antiphyllous, very rarely axillary, peduncle solitary, 2-3.5 cm long, densely hairy to almost glabrous.
Grewia populifolia	Dhaman	Tiliaceae	A suberect to erect shrub, up to 3 m tall. Stem with ash-grey bark, young twigs stellate hairy. Leaves 3-5-costate, almost glabrous to sparsely or densely stellate hairy on both sides, ovate-elliptic or obovate to almost orbicular, 0.6-4.5 cm long, 0.4-4 cm broad, sharply serrate, cuneate at the base, acute to obtuse, rarely emarginate at the apex; petiole 2-14 mm long, hairy; stipules linear-lanceolate, caducous. Flowers solitary or rarely paired, on solitary, antiphyllous, (0.6-) 1.2 cm long, hairy peduncle, white, rarely yellowish-white, 2-2.5 cm across; pedicel c. half as long as peduncle, stellate tomentose. Sepals linear-oblong, (1-) 1.4 (-1.6) cm long, c. 3-4 mm broad, stellate hairy outside.
Capparis decidua	Gunger	Malvaceae	Low shrubs to small trees with leafless green crooked spiny branches, up to 5 m (rarely more) high. Leaves present on young twigs, caducous, linear, 4-20 mm long, 1-3 mm broad, often spine-tipped, subsessile; stipular spines 1-6 mm long, straight or slightly curved, yellow or brown
Indigofera gerardiana	Kander	Celastraceae	Shrub, 1.8-2.5 m tall. Leaflets 9-17, c. 1.0-1.3 cm long. Inflorescence 2.5-12.5 cm long, a pedunculate raceme. Fruit c. 2.5-5.0 cm long.
Melia azedarach	derek	Meliaceae	Deciduous tree. The adult tree has a rounded crown and measures between 7 and 12 metres in height. The leaves are up to 50 cm long, alternate, long-petioled, 2 or 3 times compound.
Morus alba	Toot	Oleaceae	These are also best fodder for livestock. Stem and branches are used for making handles of agricultural tools. Roots are used for diabetes and fruits are used as general tonic and sore throat.
Prosopis cineraria	Jandi	Fabaceae	Small thorny, irregularly branched tree, 5-10 in high. Evergreen or nearly so, it forms an open crown and has thick, rough gray bark with deep fissures. The leaves are an available, excellent and nutritious fodder, readily eaten by many animals including camels and goats.
Ziziphus mauritiana	Berry	Rhymnaceae	Spiny, evergreen shrub or small tree up to 15 m high, with trunk 40 cm or more in diameter; spreading crown; stipular spines and many drooping branches. Medium sized tree that grows vigorously and has a rapidly developing taproot, a necessary adaptation to drought conditions. In parts of world, the leaves of ber are used as nutritious fodder for sheep and goats. Tree, 9-15 m or large shrub, branches spreading and drooping, young branches softly tomentose, longer stipular spine, c. 5-7 mm long, sometime without spines.
Zizyphus nummularia	Jharber	Rhymnaceae	The leaves provide excellent fodder for livestock. The leaves are collected dried and stored. It is a shrub up to 2 meters high, branching to form a thicket. The dried leaves, called pala are used as fodder for goats and cows.

1991; Ogebe *et al*., 1995; Khan *et al*., 2005; 2006). This Na deficiency in fodder tree leaves is corroborated with some earlier findings (McDowell *et al*., 1993), that the most common mineral deficiencies for grazing animals in the world are those of Na. In addition, deficiency of this element has already been reported in many regions of the world (Pastrana *et al*., 1991a).

Table 2: Macro-minerals concentration (%) of shrub and tree leaves of Chakwal District

	Elements			
Foliage*	Ca	P	Na	K
Acacia modesta	2.27	0.17	0.06	0.98
Acacia nilotica	2.26	0.19	0.04	0.95
Albizzia lebbeck	2.78	0.11	0.19	0.96
Elaeagnus angustifolia	2.09	0.15	0.05	0.98
Grawia optiva	3.35	0.18	0.15	0.64
Grawia popolifdia	2.75	0.25	0.12	1.01
Capparis decidua	0.09	0.26	0.09	1.27
Indigofera gerardiana	0.61	0.30	0.10	0.36
Melia azedarach	0.69	0.22	0.04	0.77
Moringa oleifera	0.90	0.44	0.09	0.78
Morus alba	0.59	0.88	0.08	0.09
Nerium odorum	2.04	0.33	0.08	0.47
Prosopis cineraria	2.43	0.16	0.04	0.41
Ziziphus mauritiana	1.08	0.16	0.05	0.56
Zizyphus mummularia	1.05	0.13	0.07	0.26
Mean±SE	1.66±0.25	0.26±0.04	0.08±0.01	0.69±0.08
Normal requirement range**				
Minimum	0.19	0.12	0.06	0.5
Maximum	0.82	0.48	0.18	1.0

Ca = Calcium, P = Phosphorus, Na = Sodium, K = Potassium, SE = Standard Error. *Value represents assays of single sample collected from a single tree. **Recommended range of mineral elements (for all classes of ruminants) as suggested by the National Research Council (1984)

Potassium: The K value varied from 0.09-1.27% and the mean was 0.699±0.086%. The highest K value was for *Capparis decidua* followed by *Grawia popolifdia*, *Acacia modesta*, *Elaeagnus angustifolia*, *Albizzia lebbeck*, *Acacia nilotica*, *Moringa oleifera*, *Melia azedarach*, *Grawia optiva*, *Ziziphus mauritiana*, *Nerium odorum*, *Prosopis cineraria*, *Indigofera gerardiana* and *Zizyphus mummularia*, respectively. The lowest value was observed for *Morus alba*. K content was found to be higher than the required level. Since all value under utmost bearable limit of 3% (NRC, 1980). It is unlikely that K toxicosis would occur. It has been well studied that ingested K beyond requirement is rapidly excreted through renal system of dairy cattle so K toxicity is unlikely and is not know to be a practical problem in dairy cattle (NRC, 2001). Deficiencies in K can result in reduced intake, weight loss and stiff joints. Cattle stressed due to long transport distances may necessitate increased levels of K to replenish lost body reserve.

Conclusion: Our current investigations on nutritional evaluation of fodder tree leaves and shrubs, we have revealed that these are good source of macro-minerals and can be used as substitute feed in the district of Chakwal, especially during the feed deficient periods.

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