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Seasonal variation in leaf chemical composition of *Ougienia oojeinensis*

MANASI R NAVALE, DR BHARDWAJ, CL THAKUR and ROHIT BISHIST

Department of Silviculture and Agroforestry, College of Forestry
Dr YS Parmar University of Horticulture and Forestry
Nauni, Solan 173230 Himachal Pradesh, India
Email for correspondence: mansi.navale@gmail.com

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ABSTRACT

The nutritional importance of *Ougienia oojeinensis* as a fodder species has been proved in many previous studies. However there is a lack of information to indicate whether nutrients and anti-nutrients in *Ougienia* are consistently present throughout the plant growth stages or are affected by the seasons. Such a study can help to decide the best feeding time for this species. In order to answer these questions chemical composition of *O oojeinensis* leaves during three seasons was studied. The results showed that dry matter (51.64%), total ash (11.14%), Ca (5.48%), P (0.28%), Cu (17.60 ppm), Mn (38.27 ppm) and Zn (12.30 ppm) were highest during autumn while crude protein (14.00%), K (1.70%), organic matter (91.82%) and total carbohydrates (75.53%) were highest during summer season. Winter season depicted highest acid detergent fibre (27.00%), neutral detergent fibre (44.22%), nitrogen-free extract (48.81%) and Fe (691.90 ppm) contents. The anti-nutrient study revealed that except saponins all the anti-nutrients were within safe limit during all the seasons. These findings indicate that *O oojeinensis* is a potential nutritious fodder species.

Keywords: Nutrients; anti-nutrients; fodder; *Ougienia*; seasons

INTRODUCTION

Livestock sector is an integral component of agricultural system supporting livelihood of more than two third of the rural population in India. This sector contributes about 25 per cent to the overall agricultural GDP and 4.11 per cent to total GDP of the country. Animals provide nutrient-rich food products, draught power, domestic fuel and organic manure and thus provide regular source of income to rural households. Despite significant increase in livestock numbers their productivity remains at low level. Scarcity of green forage still holds a big challenge in India (Sarwar et al 2002). At present the country is facing a net deficit of 61.1 per cent green fodder, 21.9 per cent dry crop residues and 64 per cent concentrate feeds (Datta 2013). It is therefore imperative that beside improving animal breeds a major focus be devoted to supply of adequate feed and green forage. Trees due to their long life span are one of the most reliable fodder sources especially in hilly areas. Farmers in hilly areas have been using tree fodder for feeding their cattle since old times by maintaining naturally regenerating tree species raised on the terraces of farming fields under traditional agroforestry system (Roder 1992). Nearly 279 tree species have been reported in the western Himalayas which have been used to feed livestock (Samant 1998).

Trees are considered as a valuable protein source of fodder in cold regions (Singh and Kanstra 1981, Roder 1992, Long 1997) particularly during winter months when green fodder becomes scarcely available in quantity and quality. Though trees are an underutilized source of feed protein they also contain anti-quality compounds such as soluble phenolics, saponins and tannins that can adversely influence an animal's performance (Provenza 1995, Freeland et al 1985). Hence it is necessary to evaluate both nutrient and anti-nutrient components in trees before using them as fodder. *Ougienia oojeinensis* is one such potential fodder species; it belongs to family Fabaceae and is

commonly known as sandan. It is medium-sized, semi-deciduous tree occurring at an altitude of 300-1500 m amsl (Orwa et al 2009). The leaves of this species are used as fodder and dry branches as fuelwood. Wood is a good fuel with a calorific value of 4900-5200 Kcal/kg. There are many studies on the nutritional evaluation of *O oojeinensis* leaves however the literature on seasonal variation in the leaf nutrient and anti-nutrient content is lacking. Keeping this point in view present investigations were conducted to study the variation in nutrient and anti-nutrient content of *O oojeinensis* leaves during three seasons.

MATERIAL and METHODS

Location

The site from where samples were collected was located at an elevation of 1250 m amsl in the mid-Himalayan zone which lies between 30°51´ N latitude and 76°11´ (Survey of Indian Topo sheet Number 53F/1). The soil is well drained and of silty loam type. The terrain is undulating, hilly and marked with elevations and depressions and has a gentle slope towards the southeastern aspect. Climatically the site lies in the sub-tropical belt but is slightly skewed towards the temperate climate. May and June are the hottest months whereas December and January are the coldest months.

Nutritional content evaluation

Collection and preparation of sample: Leaves of *O oojeinensis* were collected from random trees spread over the study area for three study seasons viz summer (May-June), autumn (September-November) and winter (December-February) in the year 2014-2015. Healthy disease-free trees were selected and leaves were collected from whole of the tree representing all parts uniformly. A composite sample was made from the leaves collected. The representative samples were packed in the paper bags and taken to laboratory for further analysis. Fresh leaf samples brought to the laboratory were immediately washed in order to make them free from dust or other adhering substances. After washing all samples were air-dried to reduce chemical and biological changes in the leaf samples. Samples were then dried in the hot air oven at 60 ± 5°C till a constant weight was achieved to obtain the moisture free samples. The oven-dried samples were ground in a Willey mill fitted with stainless steel blades so as to pass the samples through a 40-mesh sieve. After grinding the plant samples were mixed thoroughly and transferred to polyethylene bags labelled clearly and stored till further analysis.

Chemical analysis of sample: The dry matter (DM), crude protein (CP), crude fibre (CF), ether extract (EE) and total ash (TA) were estimated following the procedure of Anon (1990). Acid detergent fibre (ADF) and neutral detergent fibre (NDF) were estimated by following procedure given by Van Soest (1963, 1967) and Goering and Van Soest (1970). The total carbohydrates of the samples were calculated by adding the percentage of crude fiber and the percentage of nitrogen free extract. For mineral analysis the samples were digested using di-acid mixture (HNO_3 + $HClO_4$). Calcium, phosphorous and potassium were estimated using method given by Chapman and Pratt (1961) and Jackson (1987) while trace elements like copper (Cu), zinc (Zn), iron (Fe) and manganese (Mn) by the procedure given by Kalra (1998). Folin-Ciocalteu method (Makkar 2000) was used for determination of phenols and tannins were determined using the method of Makkar et al (1993). Nitrates (NO_3) were analysed according to the method given by Cataldo et al (1975) while saponin was estimated using method given by Nwinuka et al (2005). Data were analysed using one-way ANOVA ($p < 0.05$) (Gomez and Gomez 1984) and analysis was carried out in IBM SPSS statistics version 21.0 software.

RESULTS and DISCUSSION

The nutrient study revealed that nutrient and anti-nutrient contents of *O oojeinensis* leaves varied significantly during three seasons (Tables 1, 2). Dry matter content was highest during autumn (51.64%) and lowest in summer season (38.50%). The crude protein was highest during summer season (14%) and decreased with advancement of season. The fibre constituents acid detergent fibre and neutral detergent fibre increased with leaf maturity recording highest values during winter (27.00 and 44.22% respectively). This reverse trend in increase and decrease of fibre and crude protein constituents has been previously reported by different workers (Khosla et al 1982, Elseed et al 2002, Das 2005, Kokten et al 2012). Ether extract was observed to be highest during winter season (3.69%). Hussain and Durrani (2009) observed highest ether extract content in *Perovskia* spp during post-reproductive stage. The total ash content was observed to vary inconsistently across different seasons and highest (11.14%) was recorded during autumn season. Nitrogen-free extract was highest

Table 1. Nutrient content of *O oojeinensis* during different seasons

Season	Nutrient content (%)								
	Dry matter	Crude protein	Ether extract	Total ash	Acid detergent fibre	Neutral detergent fibre	Nitrogen-free extract	Organic matter	Total carbohydrates
Summer	38.50	14.00	2.29	8.18	22.64	33.13	39.92	91.82	75.53
Autumn	51.64	13.42	3.53	11.14	25.79	37.09	44.76	88.86	71.91
Winter	48.80	10.50	3.69	10.54	27.00	44.22	48.81	89.46	75.26
Mean	46.31	12.64	3.17	9.95	25.15	38.15	44.50	90.05	74.23
SE±	1.08	0.48	0.20	0.14	1.02	0.04	0.42	0.14	0.42
$CD_{0.05}$	2.65	1.17	0.49	0.33	2.49	0.09	1.03	0.33	1.03

Table 2. Mineral and anti-nutrient content of *O oojeinensis* during different seasons

Season	Mineral content							Anti-nutrient content			
	Ca (%)	P (%)	K (%)	Fe (ppm)	Cu (ppm)	Mn (ppm)	Zn (ppm)	Phenols (%)	Tannins (%)	Nitrate (ppm)	Saponins (%)
Summer	3.48	0.14	1.70	671.07	15.70	27.20	8.30	2.70	0.78	5.37	11.17
Autumn	5.48	0.28	1.68	683.60	17.60	38.27	12.30	3.23	1.38	0.00	24.45
Winter	5.32	0.11	1.05	691.90	21.00	34.50	7.20	4.73	2.58	0.00	26.41
Mean	4.76	0.18	1.48	682.19	18.10	33.32	9.27	3.55	1.58	1.79	20.68
SE±	0.00	0.00	0.54	0.52	0.42	0.31	0.22	0.28	0.21	0.07	1.16
$CD_{0.05}$	0.00	0.00	1.32	1.26	1.03	0.76	0.54	0.69	0.51	0.18	2.84

(48.81%) during winter season while organic matter (91.82%) and total carbohydrate content (75.53%) were highest during summer season. In the leaf mineral content study Ca was highest during autumn season (5.48%) and followed the patterns observed by Verma et al (1992) except the slight decrease during winter. Fe and Cu showed increasing trend with leaf maturity depicting highest values during winter season (691.90 and 21.00 ppm respectively) which is in accordance with the findings of Ahmed et al (2012), Ayanda et al (2016) and Siulapwa et al (2016). Highest Mn (38.27 ppm) and Zn (12.30 ppm) content was observed during autumn season. Anti-nutrients like phenols, tannins and saponins depicted increase with the leaf maturity as seen by their highest values during winter season (4.73, 2.58 and 26.41% respectively) as also reporte by Salaj and Kormutak (1995) and Achakzai et al (2009). Nitrate content (5.37 ppm) was recorded only during summer season. Phenol, tannin and nitrate contents in present study were found to be below toxic levels for animals (Patel et al 2013). The palatability study of *O oojeinensis* on cattle by Navale et al (2017) revealed 93.36 relative palatability per cent which indicated that this species was highly relished by animals.

CONCLUSION

The present investigations revealed that leaves of *O oojeinensis* have sufficient nutrient contents to be a potential fodder species. The seasonal study showed that summer season was the best due to high crude protein, but sufficient fibre content and low level of anti-nutrients. This information can be used to prepare balanced diet combination using *O oojeinensis* and other feed sources to meet animals' nutrient requirements and increase their productivity.

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