Research Journal of Medicinal Plant

ISSN 1819-3455

Academic Journals Inc.

www.academicjournals.com

Research Journal of Medicinal Plant 9 (3): 105-115, 2015
ISSN 1819-3455 / DOI: 10.3923/rjmp.2015.105.115

Tribal Way of Livestock Husbandry: An Ethnobotanical Survey of Purulia District, India in Search for Fodder Plants: Neutraceutical and Pharmaceutical Relevance

[1]Abhijit Dey and [2]Anuradha Mukherjee
[1]Department of Biological Sciences, Presidency University (Erstwhile Presidency College), 86/1 College Street, Kolkata, 700073, India
[2]MMHS, South 24 Paraganas, West Bengal, India

Corresponding Author: Abhijit Dey, Department of Biological Sciences, Presidency University (Erstwhile Presidency College), 86/1 College Street, Kolkata, 700073, India Tel: +919903214237

ABSTRACT

An ethnobotanical survey was conducted in the Purulia district, India in order to explore the use of plants as fodder as a part of the traditional livestock husbandry practiced by the aboriginal groups such as Santhal, Bhumija, Munda, Oraon, Birhor, Mal Paharya, Kharia, Kharwar, Gond and Ho. A total number of 103 informants (78 males and 25 females) were chosen for the interviews and 33 ethnobotanicals were reported as fodder plants for the domesticated animals. Poaceae and Moraceae represent maximum number of forage plants (6 each) whereas, leaves represent the most prolific plant part consumed by the animals. Aspects such as nutrient and anti-nutrient content, pharmacological and neutraceutical significance of the forage plants were added which reflects the scientific and economic aspects of such folkloric uses.

Key words: Traditional, livestock husbandry, purulia, neutraceuticals

INTRODUCTION

From prehistoric time, plants have been consumed by man and animals for nutrition squires. Ever since the human race had started domesticating animals, they had to depend on natural vegetation to feed them. Plants have always provided food, fodder, fuel, fibre and medicine to the mankind. Civilizations have flourished amidst plants in order to build an intimate relationship between man and the surrounding vegetation. A branch of botany, now known as ethnobotany studies these relationships and seeks to explain the nutritional and pharmaceutical wisdom of the people who rely so heavily on plants for food, medicine and other therapeutic uses.

In the modern world also, the plants and plant based foods are considered as the prime source of nutrients for the domesticated animals especially for the cattle. Ethnobotanical investigations have always played a crucial role in documenting the fodder plants used throughout the world (Omino and Kokwaro, 1991; Guarrera *et al*., 2005; Bussmann, 2006; Bussmann and Sharon, 2006; Bussmann *et al*., 2006; Gonzalez *et al*., 2011). Fodder plants were evaluated for nutritional and elemental resources, anti-nutrient contents, edibility related toxicity, pharmaceutical and neutraceutical considerations. Nutritional analyses were performed in some of the fodders reported from the traditional systems (Bahadur *et al*., 2011). Some of these plants were also evaluated for their potential use in terms of nutrient and anti-nutrient contents (Ngodigha and Oji, 2009). Fodder plants are considered as one of the prime aspects of agroforestry considering its economic aspects

(Von Carlowitz, 1989). The fodder and food trees not only provide food security but can add to the economic benefits to the aboriginals using them in the rural livelihood. The present study focuses on some of the well and less known or non-conventional food resources used by the ethnic groups of a remote district of West Bengal, India. The article also provides a light on the possible exploitation of such forage plants by considering their nutrient, anti-nutrient, pharmacological and neutraceutical aspects.

MATERIALS AND METHODS

Study area: Purulia, the Western-most district of West Bengal state of India is located between 22°51'N and 23°42'N and 85°51'E and 86°54'E and represented by undulated terrain and extreme weather. It constitutes an area of 6529 sq km with an altitudinal variation from 250-700 m above sea level (asl). Ajodhya is one of the important hill ranges of the district with a highest peak of Gorgaburu (677 m asl). Santhal, Bhumija, Munda, Oraon, Birhor, Mal Paharya, Kharia, Kharwar, Gond and Ho are the various ethnic groups present in the area (Dey and De, 2012a, b). Several small hills and hillocks are present throughout the landscape. Unsuitable topography and less rainfall are responsible for lack of cropping agriculture in the district. As a result of that, the tribal people residing in the forests of hills and hillocks and open villages, depend on the surrounding wild vegetation for survival. Similarly, the livestock forage is also collected from the forest botanicals.

Data collection: Initially, several surveys were conducted at different parts of the rural areas of the district. Informal camps were arranged and villagers were asked for the use of ethnobotanicals to feed the domestic animals. It was a venture associated with the study of ethnomedicine for human being and cattle. An ethnobotanical approach was taken during the surveys as described by Dey and De (2012a, b) with slight modifications in approach as and when required. A total number of 103 informants (78 males and 25 females) were chosen on the basis of their relevant experience and a semi-structured questionnaire was given to them regarding the use of plants as fodder for the cattle. The data was collected and documented as name of the plant, family, vernacular names(s), reporting tribe, consumed part(s) and reporting area(s). Authors have noted a social hierarchy among the tribals and domesticated animal husbandry was found to be a privilege of the upper segment.

RESULTS AND DISCUSSION

A total number of 33 ethnobotanicals were reported as fodder (Table 1). Among the plant families, Poaceae and Moraceae represent the maximum number of forage plants (6 each) followed by Fabaceae (4), Combretaceae, Malvaceae, Commelinaceae, Rubiaceae (2 each) and others (1 each) (Fig. 1). Among the consumed part(s), leaves were found to be the most popular diet eaten by the animals (50% of the total plant parts), followed by stem (21%), whole plant (15.8%), fruits (10.5%) and receptacles (2.6%) (Fig. 2).

Use Value (UV) was calculated following the equation reported by Phillips *et al*. (1994):

$$UV = \Sigma U/n$$

where, U is use report number for a forage plant reported by each informant, n is total informants interviewed for a specific forage plant). Quotation Frequency (QF) was calculated following

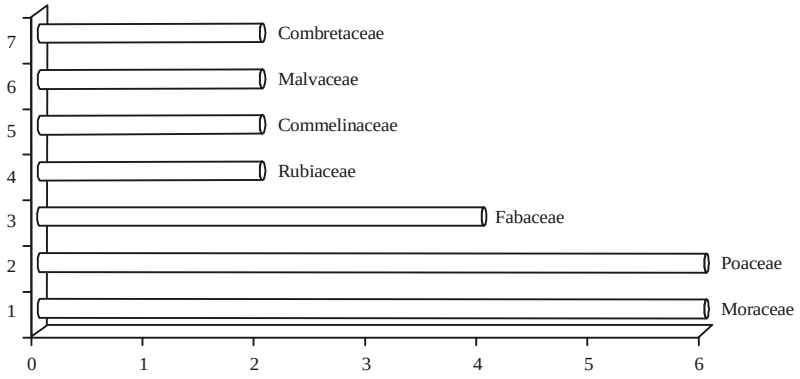

Fig. 1: Distribution of fodder plant families

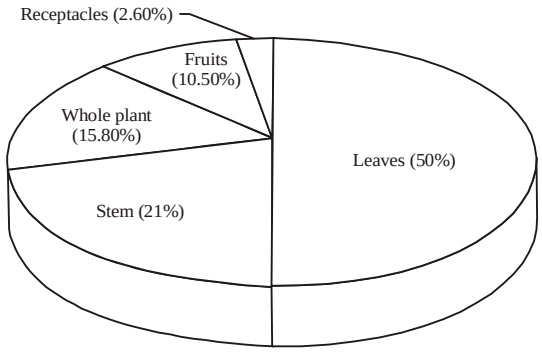

Fig. 2: Percentage distribution of the consumed plant part(s)

Table 1: Use of ethnobotanicals as fodder plants by the tribals of Purulia district

Botanical names	Family(s)	Vernacular name(s)	Reporting tribe(s)	Consumed plant part(s)	Reporting area(s)	Use Value (UV)	Quotation Frequency (QF)
Acacia nilotica (L.) Willd. ex Delile	Fabaceae	*Babur*, *Babla*	S, Bh, M	Fruits	Dhabani, Kulai	0.45	+++
Ailanthus excelsa Roxb.	Simaroubaceae	*Pirinim*	S, Bh, M, O	Stem	Kushtaur, Jambad	0.44	+++
Anogeissus latifolia (Roxb. ex DC.) Wall. ex Bedd.	Combretaceae	*Dhaunta*, *Dhaontha*	S, Bh, O	Leaves	Kantadih, Jabarra	0.56	+++
Bombax ceiba L.	Malvaceae	*Simbali*, *Simul*	S, Bh, M	Stem, leaves	Neturia, Bahara	0.32	++
Bridelia retusa (L.) A. Juss.	Phyllanthaceae	*Kaji*, *Kaj*	S, M, H	Leaves	Baghmundi, Bundwan	0.55	+++
Coix lacryma-jobi L.	Poaceae	*Bakri horenga*	S, O, M	Leaves	Hura, Neturia	0.09	+
Commelina benghalensis L.	Commelinaceae	*Golgola sag*	S, O	Whole plant	Pakhuria, Pilai	0.78	+++
Commelina longifolia Lam.	Commelinaceae	*Mad konga ara*	M	Leaves	Jindaru	0.09	+
Dalbergia sissoo Roxb. ex DC.	Fabaceae	*Sisu*	S, Bh,O	Leaves, green stem	Siringi, Korang	0.21	++
Diospyros embryopteris Pers.	Ebenaceae	*Gara tiril*	S, Bh, M	Fruits	Kalma, Matha	0.32	++
Ehretia laevis Roxb.	Boraginaceae	*Chamror*, *Kindar kan*	S, Bh, M, Kh	Leaves	Balarampur, Naogarh	0.49	+++
Ficus cunia Buch.-Ham. ex Roxb.	Moraceae	*Ari*	S, Bh, M, H	Receptacles	Chorda, Panchakot	0.33	++

Table 1: Continue

Botanical names	Family(s)	Vernacular name(s)	Reporting tribe(s)	Consumed plant part(s)	Reporting area(s)	Use value (UV)	Quotation Frequency (QF)
Ficus lucescens Blume	Moraceae	*Phutkal*	S, M	Leaves, stem	Berada, Arsha	0.29	++
Ficus racemosa L.	Moraceae	*Poroh*, *Dumbari*	S, M, Bh, O	Leaves	Kalma, Chatni	0.87	+++
Ficus rumphii Blume	Moraceae	Not found	S, M	Leaves	Tentulhiti, Parbelia	0.34	++
Ficus tomentosa Roxb. ex Willd.	Moraceae	*Barun*, *Lupu hesa*	S, Bh, M	Stem, leaves	Kandyar hills, Darodih	0.18	++
Gmelina arborea Roxb. ex Sm.	Lamiaceae	*Kashmar*	S, Bh, O	fruits	Bara Urma, Jhalda	0.45	+++
Grewia tiliaefolia Vahl	Malvaceae	*Dhamil*, *Ahsing*	S, Bh, Kh	stem, leaves	Sharberya, Ajodhya	0.56	+++
Habenaria plantaginea (Lindl.) Lindl.	Orchidaceae	*Maradichad ba*	M	Whole plant	Takriya, Para	0.07	+
Heteropogon contortus (L.) P. Beauv. ex Roem. and Schult.	Poaceae	*Saiya*, *Sauri ghas*	S, M, Kh, H	Whole plant	Khenna, Pakhuria	0.54	+++
Lannea coromandelica (Houtt.) Merr.	Anacardiaceae	*Nanam*, *Genjon*	S, Bh, M	Stem	Bansketia, Santuri	0.47	+++
Leptochloa chinensis (L.) Nees	Poaceae	Not found	Bh	Whole plant	Ajodhya	0.26	++
Merremia aegyptia (L.) Urb	Convolvulaceae	Not found	S, M	Leaves	Ichhar	0.67	+++
Mitragyna parviflora Korth.	Rubiaceae	*Guni*	S, M	Leaves	Jaipur	0.31	++
Phragmites karka (Retz.) Trin. ex Steud.	Poaceae	Not found	M	Stem	Balrampur, Jhalda	0.52	+++
Pithecelobium dulce (Roxb.) Benth.	Fabaceae	*Bilati amli*	Bh, M	fruits	Gobria forest, Kuilapal	0.58	+++
Pterocarpus marsupium Roxb.	Fabaceae	*Bija-sal*	S, Bh, M, O	leaves	Matha	0.76	+++
Schleichera oleosa (Lour.) Oken.	Sapindaceae	*Pusra*	S, Bh, Kh	Leaves	Sarajang	0.25	++
Setaria glauca (L.) P. Beauv.	Poaceae	*Kaun*	S, O, M	Whole plant	Palma, Puncha	0.15	++
Streblus asper Lour.	Moraceae	*Soor*, *Saroa*	S, Bh, H	Leaves	Matha, Berada	0.67	+++
Terminalia chebula Retz.	Combretaceae	*Hara*, *Hadra*	S, Bh, O	Leaves	Punura	0.77	+++
Triticum aestivum L.	Poaceae	*Gom*	S, Bh, M	Whole plant	Neturia, Kalma	0.89	+++
Vangueria spinosa Roxb.	Rubiaceae	*Maina*	S, Kh	leaves	Jhalda, Siringi	0.20	++

(Mustafa *et al*. 2012). +, ++ and +++ indicate "quoted by <10, >10 and <40 and >40% of the informants, respectively (Table 1). In the end, the collected data was supported by consulting with the existing reports on the botanicals value as fodder/forage, nutrient, anti-nutrient content, pharmacological and neutraceutical aspects (Table 2).

The results reflect the potential of fodder plants used by the indigenous people of Purulia district in animal husbandry. Earlier ethnobotanical excursions were carried out in the area and plants were reported as active against gastrointestinal problems, snake venom and as potential

Table 2: Relevant reports on fodder, nutrient/anti-nutrient content and pharmaceutical/neutraceutical aspects of the reported botanicals

Botanical names	Relevant reports as fodder/forage/dietary inclusion as livestock feed	Nutrient/ anti-nutrient content	Pharmaceutical/neutraceutical aspects
Acacia nilotica (L.) Willd. ex Delile	Chaudhary and Taparia (1990)	Sotohy *et al*. (1997)	Gastroprotective (Bansal and Goel, 2012), antioxidant (Maldini *et al*., 2011)
Ailanthus excelsa Roxb.	Kumar (1999)	Lavhale and Mishra (2007)	Gastroprotective (Melanchauski *et al*., 2010), antihistaminic (Kumar *et al*., 2011)
Anogeissus latifolia (Roxb. ex DC.) Wall. ex Bedd.	Kumar and Bhatt (2006)	NCF	Hepatoprotective (Pradeep *et al*., 2009), antiulcer (Govindarajan *et al*., 2006)
Bombax ceiba L.	Chand and Singh (1999)	NCF	Antioxidant (Vieira *et al*., 2009), hypoglycaemic (Saleem *et al*., 1999)
Bridelia retusa (L.) A. Juss.	Burte *et al*. (2008)	Burte *et al*. (2006)	Antifungal (Jayasinghe *et al*., 2003)
Coix lacryma-jobi L.	Arora (1977)	NCF	Gastroprotective (Chung *et al*., 2011), anti cancer (lung and colon) (Lee *et al*., 2008)
Commelina benghalensis L.	Lanyasunya *et al*. (2008)	Souza *et al*. (1999) and Gupta *et al*. (2005)	Sedative, anxiolytic (Raquibul Hasan, 2009)
Dalbergia sissoo Roxb. ex DC.	Larbi *et al*. (2005)	Larbi *et al*. (2005)	Nitric oxide inhibitory (Shrestha *et al*., 2007), anti-inflammatory (Hajare *et al*., 2001)
Ficus racemosa L.	NCF	Bhatta *et al*. (2012)	Hypercholesterolemia and diabetes protective (Velayutham *et al*., 2012), antidiarrheal (Mukherjee *et al*., 1998; Patil *et al*., 2012), antihyperglycemic (Ahmed *et al*., 2011)
Gmelina arborea Roxb. ex Sm.	Okagbare *et al*. (2004)	NCF	Hepatoprotective (Anthony *et al*., 2012)
Grewia tiliaefolia Vahl	Gad and Shyama (2011)	NCF	Antioxidant (Ahamed *et al*., 2010), wound healing (Ahamed *et al*., 2009)
Heteropogon contortus (L.) P. Beauv. ex Roem. and Schult.	Siebert and Kennedy (1972), Hunter and Siebert (1985a, b), McSweeney *et al*. (1998) and Naidum and Swamy (2000)	Blake and Richards (1970), Playne and Haydock (1972) and Thirumalai *et al*. (1990)	NCF
Lannea coromandelica (Houtt.) Merr.			Zoosporicidal (fungi) (Islam *et al*., 2002)
Pithecelobium dulce (Roxb.) Benth.	Kundu *et al*. (1983), Chaudhary and Taparia (1990) and Paengkoum and Paengkoum (2010)	Pinos-Rodriguez *et al*. (2007)	Antiulcerogenic (Megala and Geetha, 2012), Hepatoprotective (Manna *et al*., 2011)
Pterocarpus marsupium Roxb.	Ally and Kunjikutty (2003)	Ally and Kunjikutty (2003)	Hepatoprotective (Devipriya *et al*., 2007), hypoglycaemic (Dhanabal *et al*., 2006)
Schleichera oleosa (Lour.) Oken.	Prasad *et al*. (1991) and Sreemannarayana *et al*. (2001)	Makkar *et al*. (1990)	Cytotoxic, radical-scavenging (Thind *et al*., 2012)
Setaria glauca (L.) P. Beauv.	Marten and Andersen (1975)	Marten and Andersen (1975)	NCF
Streblus asper Lour.	Akbar and Alam (1991) and Paengkoum (2011)	Akbar and Alam (1991)	Anti hepatitis B (Chen *et al*., 2012; Li *et al*., 2012), anti-inflammatory (Sripanidkulchai *et al*., 2009)
Terminalia chebula Retz.	Rana *et al*. (2012)	Khanal and Subba (2001)	Antioxidant, anti-diabetic (Kim *et al*., 2011; Sasidharan *et al*., 2012)
Triticum aestivum L.	Obert *et al*. (2004)	Gahlawat and Sehgal (1993) and Masud *et al*. (2007)	Antioxidant (Liyana-Pathirana and Shahidi, 2005, 2006)
Vangueria spinosa Roxb.	NCF	NCF	Antibacterial (Chatterjee *et al*., 2009, 2011)

NCF: No citation found

medicine against diseases of mother, newborn and children and also as ethnoveterinary medicine (Dey and De, 2010, 2011, 2012a, b). They not only use the medicinal herbs to treat several ailments, a huge number of plants are consumed by human (unpublished data) and animals directly and/or indirectly. Table 2 represents the relevant literature survey involving the nutrient, anti-nutrient content, pharmacological and neutraceutical aspects of the plants reported in the present investigation. Interestingly, most of the plants were evaluated for nutritional and/or

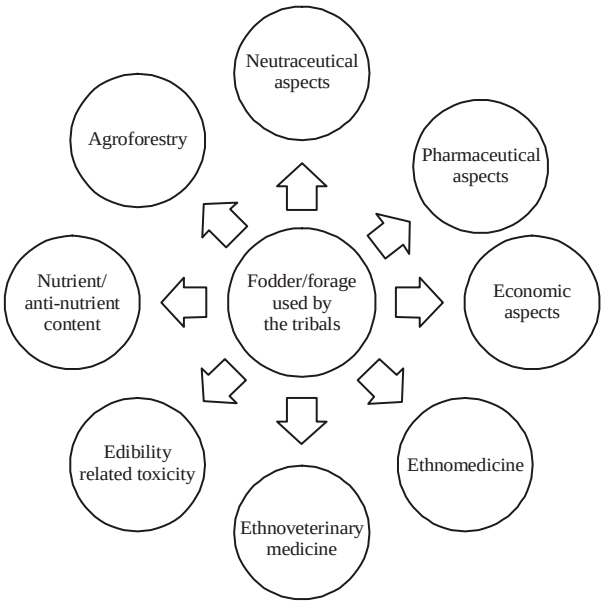

Fig. 3: Scientific and economic aspects of fodder plants used by the tribals of Purulia district

pharmacological efficacy indicating a possible role of food for healing which is these days termed as neutraceutical ability of certain foodstuff (Fig. 3). Fodder plants also hold their importance in agroforestry management. Moreover, edibility related toxicity is another important aspect of plant foods which is more often than not, ignored by the rural people. Proper scientific evaluation of forage plants for anti-nutrient content (such as phenolics, tannins etc.) and toxic chemicals prevent an error of judgement when choosing a herb to feed livestock. In the rural livelihood, the ignorant aboriginals must be conveyed with the latest scientific outcome related to herbal use in order to promote the use of botanicals and prevent the hazardous aspects of toxic plants.

CONCLUSION

Proper conservation and documentation of both the indigenous knowledge and the flora are required in order to develop a sustainable man-plant relationship. Rapid urbanization, pollution and lack of interest in traditional methods of animal husbandry result in a decline in certain practices. Proper care and scientific evaluation of the folklore is an immediate need for survival and sustenance.

ACKNOWLEDGMENT

The authors are immensely thankful to the contribution of Late Dr. J. N. De for his active participation in the field work.

REFERENCES

Ahamed, B.M.K., K. Venkatarangaiah and K.H. Malleshappa, 2009. *In vivo* wound healing activity of the methanolic extract and its isolated constituent, gulonic acid γ-lactone, obtained from *Grewia tiliaefolia*. Planta Med., 75: 478-482.

Ahamed, M.B.K., V. Krishna and C.J. Dandin, 2010. *In vitro* antioxidant and *in vivo* prophylactic effects of two gamma-lactones isolated from *Grewia tiliaefolia* against hepatotoxicity in carbon tetrachloride intoxicated rats. Eur. J. Pharmacol., 631: 42-52.

Ahmed, F., S. Hudeda and A. Urooj, 2011. Antihyperglycemic activity of *Ficus racemosa* bark extract in type 2 diabetic individuals. J. Diabetes, 3: 318-319.

Akbar, M.A. and M.N. Alam, 1991. Effects of feeding mango (*Mangifera indica*) and shaora (*Streblus asper*) tree leaves to Black Bengal goats of Bangladesh. Small Ruminant Res., 6: 25-30.

Ally, K. and N. Kunjikutty, 2003. Effect of level and nature of tannins in tree leaves on feed intake and digestibility of nutrients in goats. Anim. Nutr. Feed Technol., 3: 75-81.

Anthony, O.E., A.F. Mbuh and M.P. Emmanuel, 2012. Phytochemical screening and assessment of ameliorating effect of aqueous and ethanolic extracts of *Gmelina arborea* on drug induced hepatic and renal insufficiency in rats. Pak. J. Pharm. Sci., 25: 457-461.

Arora, R.K., 1977. Job's-tears (*coix lacryma-jobi*)-a minor food and fodder crop of northeastern India. Econ. Bot., 31: 358-366.

Bahadur, A., Z. Chaudhry, G. Jan, M. Danish and A. ur Rehman *et al*., 2011. Nutritional and elemental analyses of some selected fodder species used in traditional medicine. Afr. J. Pharm. Pharmacol., 5: 1157-1161.

Bansal, V.K. and R.K. Goel, 2012. Gastroprotective effect of *Acacia nilotica* young seedless pod extract: Role of polyphenolic constituents. Asian Pacific J. Trop. Med., 5: 523-528.

Bhatta, R., M. Saravanan, L. Baruah and K.T. Sampath, 2012. Nutrient content, *in vitro* ruminal fermentation characteristics and methane reduction potential of tropical tannin-containing leaves. J. Sci. Food Agric., 92: 2929-2935.

Blake, J.D. and G.N. Richards, 1970. Polysaccharides of tropical pasture herbage. I. Studies on the distribution of the major polysaccharide components of spear grass (*Heteropogon contortus*) during growth. Aust. J. Chem., 23: 2353-2360.

Burte, R.G., P.V. Jadhav, S.S. Jadhav, V.V. Wadekar and C.V. Bhambure, 2006. Chemical composition, digestibility, nutritive value and mineral balances of Asana (*Bridelia retusa Spreng*.) tree leaves in goats. Indian J. Small Ruminants, 12: 107-109.

Burte, R.G., V.D. Patil, C.V. Bhambure, J.M. Talathi, P.V. Jadhav and R.S. Rathod, 2008. Utilization of Asana (*Bridelia retusa*) and Bhend (*Thespesia populnea*) tree leaves in complete feeds for goats. Indian J. Small Ruminants, 14: 248-251.

Bussmann, R.W. and D. Sharon, 2006. Traditional medicinal plant use in Loja province, Southern Ecuador. J. Ethnobiol. Ethnomed, Vol. 2. 10.1186/1746-4269-2-44

Bussmann, R.W., 2006. Ethnobotany of the Samburu of Mt. Nyiru, South Turkana, Kenya. J. Ethnobiol. Ethnomed., Vol. 2. 10.1186/1746-4269-2-35

Bussmann, R.W., G.G. Gilbreath, J. Solio, M. Lutura and R. Lutuluo *et al*., 2006. Plant use of the Maasai of Sekenani Valley, Maasai Mara, Kenya. J. Ethnobiol. Ethnomed., Vol. 2. 10.1186/1746-4269-2-22

Chand, S. and A.K. Singh, 1999. *In vitro* propagation of *Bombax ceiba* L. (Silkcotton). Silvae Genet., 48: 313-317.

Chatterjee, S.K., I. Bhattacharjee and G. Chandra, 2009. *In vitro* synergistic effect of doxycycline and ofloxacin in combination with ethanolic leaf extract of *Vangueria spinosa* against four pathogenic bacteria. Indian J. Med. Res., 130: 475-478.

Chatterjee, S.K., I. Bhattacharjee and G. Chandra, 2011. Isolation and identification of bioactive antibacterial components in leaf extracts of *Vangueria spinosa* (Rubiaceae). Asian Pacific J. Trop. Med., 4: 35-40.

Chaudhary, J.L. and A.L. Taparia, 1990. Utilization of Inga dulcis (*Pithecellobium dulce*) and babul (*Acacia nilotica*) by leaves by goats. Indian J. Anim. Nutr., 7: 41-44.

Chen, H., J. Li, Q. Wu, X.T. Niu and M.T. Tang *et al*., 2012. Anti-HBV activities of *Streblus asper* and constituents of its roots. Fitoterapia, 83: 643-649.

Chung, C.P., S.M. Hsia, M.Y. Lee, H.J. Chen and F. Cheng *et al*., 2011. Gastroprotective activities of adlay (*Coix lachryma-jobi* L. var. ma-yuen Stapf) on the growth of the stomach cancer AGS cell line and indomethacin-induced gastric ulcers. J. Agric. Food Chem., 59: 6025-6033.

Devipriya, D., S. Gowri and T.R. Nideesh, 2007. Hepatoprotective effect of Pterocarpus marsupium against carbon tetrachloride induced damage in albino rats. Ancient Sci. Life, 27: 19-25.

Dey, A. and J.N. De, 2010. Ethnoveterinary uses of medicinal plants by the aboriginals of purulia district, West Bengal, India. Int. J. Bot., 6: 433-440.

Dey, A. and J.N. De, 2011. Traditional use of medicinal plants in pediatric and maternal care practiced by the ethnic groups of Purulia district, West Bengal, India. Int. J. Med. Aromatic Plants, 1: 189-194.

Dey, A. and J.N. De, 2012a. Anti-snake venom botanicals used by the ethnic groups of Purulia District, West Bengal, India. J. Herbs, Spices Med. Plants, 18: 152-165.

Dey, A. and J.N. De, 2012b. Ethnobotanical survey of Purulia district, West Bengal, India for medicinal plants used against gastrointestinal disorders. J. Ethnopharmacol., 143: 68-80.

Dhanabal, S.P., C.K. Kolkate, M. Ramanathan, E.P. Kumar and B. Suresh, 2006. Hypoglycaemic activity of *Pterocarpus marsupium* Roxb. Phytother. Res., 20: 4-8.

Gad, S.D. and S.K. Shyama, 2011. Diet Composition and Quality in Indian Bison (*Bos gaurus*) based on fecal analysis. Zool. Sci., 28: 264-267.

Gahlawat, P. and S. Sehgal, 1993. Antinutritional content of developed weaning foods as affected by domestic processing. Food Chem., 47: 333-336.

Gonzalez, J.A., M. Garcia-Barriuso and F. Amich, 2011. Ethnoveterinary medicine in the Arribes del Duero, western Spain. Vet. Res. Commun., 35: 283-310.

Govindarajan, R., M. Vijayakumar, M. Singh, C.H.V. Rao, A. Shirwaikar, A.K.S. Rawat and P. Pushpangadan, 2006. Antiulcer and antimicrobial activity of *Anogeissus latifolia*. J. Ethnopharmacol., 106: 57-61.

Guarrera, P.M., G. Forti and S. Marignoli, 2005. Ethnobotanical and ethnomedicinal uses of plants in the district of Acquapendente (Latium, Central Italy). J. Ethnopharmacol., 96: 429-444.

Gupta, S., A. Jyothi Lakshmi, M.N. Manjunath and J. Prakash, 2005. Analysis of nutrient and antinutrient content of underutilized green leafy vegetables. LWT-Food Sci. Technol., 38: 339-345.

Hajare, S.W., S. Chandra, J. Sharma, S.K. Tandan, J. Lal and A.G. Telang, 2001. Anti-inflammatory activity of *Dalbergia sissoo* leaves. Fitoterapia, 72: 131-139.

Hunter, R.A. and B.D. Siebert, 1985a. Utilization of low-quality roughage by *Bos taurus* and *Bos indicus* cattle. 2. The effect of rumen-degradable nitrogen and sulphur on voluntary food intake and rumen characteristics. Br. J. Nutr., 53: 649-656.

Hunter, R.A. and S.D. Siebert, 1985b. Utilization of low-quality roughage by *Bos taurus* and *Bos indicus* cattle. Br. J. Nutr., 53: 637-648.

Islam, M.T., T. Ito, T., M. Sakasai and S. Tahara, 2002. Zoosporicidal activity of polyflavonoid tannin identified in *Lannea coromandelica* stem bark against phytopathogenic oomycete *Aphanomyces cochlioides*. J. Agric. Food Chem., 50: 6697-6703.

Jayasinghe, L., B.M. Kumarihamy, K.H.R. Jayarathna, N.W.M. Udishani, B.M. Bandara, N. Hara and Y. Fujimoto, 2003. Antifungal constituents of the stem bark of *Bridelia retusa*. Phytochemistry, 62: 637-641.

Khanal, R.C. and D.B. Subba, 2001. Nutritional evaluation of leaves from some major fodder trees cultivated in the hills of Nepal. Anim. Feed Sci. Technol., 92: 17-32.

Kim, J.H., C.O. Hong, Y.C. Koo, S.J. Kim and K.W. Lee, 2011. Oral administration of ethyl acetate-soluble portion of *Terminalia chebula* conferring protection from streptozotocin-induced diabetic mellitus and its complications. Biol. Pharm. Bull., 34: 1702-1709.

Kumar, V.K., 1999. *Prosopis cineraria* and *Ailanthus excels*-fodder trees of Rajasthan, India. Int. Tree Crops J., 10: 79-86.

Kumar, M. and V.P. Bhatt, 2006. Plant biodiversity and conservation of forests in foot hills of Garhwal Himalaya. Lyonia, 11: 43-59.

Kumar, D., Z.A. Bhat, P. Singh, S.S. Bhujbal and R.S. Deoda, 2011. Antihistaminic activity of aqueous extract of stem bark of *Ailanthus excelsa* Roxb. Pharmacogn. Res., 3: 220-224.

Kundu, H., N.C. Panda and B.K. Sahu, 1983. Leaves of inga dulcis (Manila tamarind: *Pithecellobium dulce*) as a fodder for goats. Indian J. Anim. Sci., 53: 669-671.

Lanyasunya, T.P., H. Wang, S.T. Kariuki, E.A. Mukisira, S.A. Abdulrazak, N.K. Kibitok and J.O. Ondiek, 2008. The potential of *Commelina benghalensis* as a forage for ruminants. Anim. Feed Sci. Technol., 144: 185-195.

Larbi, A., N.J. Anyanwu, U.I. Oji, I. Etela, L.D. Gbaraneh and D.O. Ladipo, 2005. Fodder yield and nutritive value of browse species in West African humid tropics: response to age of coppice regrowth. Agrofor. Syst., 65: 197-205.

Lavhale, M.S. and S.H. Mishra, 2007. Nutritional and therapeutic potential of *Ailanthus excelsa*: A review. Pharmacognosy Rev., 1: 105-113.

Lee, M.Y., H.Y. Lin, F. Cheng, W. Chiang and Y.H. Kuo, 2008. Isolation and characterization of new lactam compounds that inhibit lung and colon cancer cells from adlay (*Coix lachryma-jobi* L. var. ma-yuen Stapf) bran. Food Chem. Toxicol., 46: 1933-1939.

Li, L.Q., J. Li, Y. Huang, Q. Wu and S.P. Deng *et al*., 2012. Lignans from the heartwood of *Streblus asper* and their inhibiting activities to Hepatitis B virus. Fitoterapia, 83: 303-309.

Liyana-Pathirana, C.M. and F. Shahidi, 2005. Antioxidant activity of commercial soft and hard wheat (*Triticum aestivum* L.) as affected by gastric pH conditions. J. Agric. Food Chem., 53: 2433-2440.

Liyana-Pathirana, C.M. and F. Shahidi, 2006. Importance of insoluble-bound phenolics to antioxidant properties of wheat. J. Agric. Food Chem., 54: 1256-1264.

Makkar, H.P.S., B. Singh and S.S. Negi, 1990. Tannin levels and their degree of polymerisation and specific activity in some agro-industrial by-products. Biol. Wastes, 31: 137-144.

Maldini, M., P. Montoro, A.I. Hamed, U.A. Mahalel, W. Oleszek, A. Stochmal and S. Piacente, 2011. Strong antioxidant phenolics from *Acacia nilotica*: Profiling by ESI-MS and qualitative-quantitative determination by LC-ESI-MS. J. Pharm. Biomed. Analysis, 56: 228-239.

Manna, P., S. Bhattacharyya, J. Das, J. Ghosh and P.C. Sil, 2011. Phytomedicinal role of *Pithecellobium dulce* against CCl 4-mediated hepatic oxidative impairments and necrotic cell death. Evidence-Based Complementary Alternative Med., Vol. 2011. 10.1093/ecam/neq065

Marten, G.C. and R.N. Andersen, 1975. Forage nutritive value and palatability of 12 common annual weeds. Crop Sci., 15: 821-827.

Masud, T., T. Mahmood, A. Latif, S. Sammi and T. Hameed, 2007. Influence of processing and cooking methodologies for reduction of phytic acid content in wheat (*Triticum aestivum*) varieties. J. Food Process. Preservation, 31: 583-594.

McSweeney, C.S., A. Dulieu and R. Bunch, 1998. *Butyrivibrio* spp. and other xylanolytic microorganisms from the rumen have cinnamoyl esterase activity. Anaerobe, 4: 57-65.

Megala, J. and A. Geetha, 2012. Antiulcerogenic activity of hydroalcoholic fruit extract of *Pithecellobium dulce* in different experimental ulcer models in rats. J. Ethnopharmacol., 142: 415-421.

Melanchauski, L.S., A.P.G.S. Broto, T.M. Moraes, A.L.M. Nasser and A. Said *et al*., 2010. Gastroprotective and antisecretory effects of *Ailanthus excelsa* (Roxb). J. Nat. Med., 64: 109-113.

Mukherjee, P.K., K. Saha, T. Murugesa, S.C. Mandal, M. Pal and B.P. Saha, 1998. Screening of anti-diarrhoeal profile of some plant extracts of a specific region of West Bengal, India. J. Ethnopharmacol., 60: 85-89.

Mustafa, B., A. Hajdari, Q. Pajazita, B. Syla, C.L. Quave and A. Pieroni, 2012. An ethnobotanical survey of the Gollak region, Kosovo. Gen. Resour. Crop Evol., 59: 739-754.

Naidum, C.V. and P.M. Swamy, 2000. Studies on some physiological parameters in leaves of *Lannea coromandelica* used as fodder. Ann. Forestry, 15: 273-273.

Ngodigha, E.M. and U.I. Oji, 2009. Evaluation of fodder potential of some tropical browse plants using fistulated N'dama cattle. Afr. J. Agric. Res., 4: 241-246.

Obert, J.C., W.P. Ridley, R.W. Schneider, S.G. Riordan and M.A. Nemeth *et al*., 2004. The composition of grain and forage from glyphosate tolerant wheat MON 71800 is equivalent to that of conventional wheat (*Triticum aestivum* L.). J. Agric. Food Chem., 52: 1375-1384.

Okagbare, G.O., O.J. Akpodiete, O. Esiekpe and O.M. Onagbesan, 2004. Evaluation of *Gmelina arborea* leaves supplemented with grasses (*Pennisetum purpureum*) as feed for West African dwarf Goats. Trop. Health Anim. Prod., 36: 593-598.

Omino, E.A. and J.O. Kokwaro, 1991. Ethnobotany of Apocynaceae species in Kenya. J. Ethnopharmcol., 40: 167-180.

Paengkoum, P. and S. Paengkoum, 2010. Effects of supplementing rice straw with Leucaena (Leucaena leucocephala) and Madras thorn (Pithecellobium dulce) foliages on digestibility, microbial N supply and nitrogen balance of growing goats. J. Anim. Physiol. Anim. Nutr., 94: 59-65.

Paengkoum, P., 2011. Effects of *Streblus asper* Lour foliage on digestibility, rumen fermentation and nitrogen balance of growing goats. Trop. Anim. Health Prod., 43: 491-494.

Patil, V.V., S.C. Bhangale, K.P. Chaudhari, R.T. Kakade, V.M. Thakare, C.G. Bonde and V.R. Patil, 2012. Evaluation of the antidiarrheal activity of the plant extracts of Ficus species. Zhong Xi Yi Jie He Xue Bao, 10: 347-352.

Phillips, O., A.H. Gentry, C. Reynel, P. Wilkin and B. Galvez-Durand, 1994. Quantitative ethnobotany and Amazonian conservation. Conservation Biol., 8: 225-248.

Pinos-Rodriguez, J.M., J.R. Aguirre-Rivera, M. Mellado, J.C. Garcia-Lopez, G. Alvarez-Fuentes and J.C. Mendez-Villazana, 2007. Chemical and digestibility characteristics of some woody species browsed by goats in Central Mexico. J. Applied Anim. Res., 32: 149-153.

Playne, M.J. and K.P. Haydock, 1972. Nutritional value of Townsville stylo (*Stylosanthes humilis*) and of spear grass (*Heteropogon contortus*)-dominant pastures fed to sheep. 1. The effect of plant maturity. Anim. Prod. Sci., 12: 365-372.

Pradeep, H.A., S. Khan, K. Ravikumar, M.F. Ahmed and M.S. Rao *et al*., 2009. Hepatoprotective evaluation of *Anogeissus latifolia*: *In vitro* and *in vivo* studies. World J. Gastroenterol., 15: 4816-4822.

Prasad, N., B.S. Gupta and S.K. Singh, 1991. Effect of feeding kosum (*Schleichera oleosa*) cake on the performance of growing crossbred pigs. Indian J. Anim. Nutr., 8: 111-114.

Rana, M.S., A. Tyagi, S.A. Hossain and A.K. Tyagi, 2012. Effect of tanniniferous *Terminalia chebula* extract on rumen biohydrogenation, Δ9-desaturase activity, CLA content and fatty acid composition in longissimus dorsi muscle of kids. Meat Sci., 90: 558-563.

Raquibul, H.S., M.M. Hossain, R. Akter, M. Jamila, E.H. Mazumder and S. Rahman, 2009. Sedative and anxiolytic effects of different fractions of the *Commelina benghalensis* Linn. Drug Discoveries Ther., 3: 221-227.

Saleem, R., M. Ahmed, S.A Hussain, A.M. Qazi and S.I. Ahmad *et al*., 1999. Hypotensive, hypoglycaemic and toxicological studies on the flavonol C-glycoside Shamimn from *Bombax ceiba*. Planta Med., 65: 331-334.

Sasidharan, I., A. Sundaresan, V.M. Nisha, M.S. Kirishna and K.G. Raghu *et al*., 2012. Inhibitory effect of *Terminalia chebula* Retz. Fruit extracts on digestive enzyme related to diabetes and oxidative stress. J. Enzyme Inhib. Med. Chem., 27: 578-586.

Shrestha, S.P., Y. Amano, Y. Narukawa and T. Takeda, 2007. Nitric oxide production inhibitory activity of flavonoids contained in trunk exudates of *Dalbergia sissoo*. J. Nat. Prod., 71: 98-101.

Siebert, B.D. and P.M. Kennedy, 1972. The utilization of spear grass (*Heteropogon contortus*). I. Factors limiting intake and utilization by cattle and sheep. Crop Pasture Sci., 23: 35-44.

Sotohy, S.A., A.N. Sayed and M.M. Ahmed, 1997. Effect of tannin- rich plant (Acacia nilotica) on some nutritional and bacteriological parameters in goats. Dtsch Tierarzti Wochenschr, 104: 432-435.

Souza, L.S., E.D. Velini, R. Maimoni-Rodella and D. Martins, 1999. Contents of macronutrients and micronutrients and CN relation of several weed species. Planta Daninha, 17: 163-167.

Sreemannarayana, O., K.V.S.N. Raju and J.R. Prasad, 2001. Utilisation of *Schleichera oleosa* leaf meal as rabbit feed. Indian J. Anim. Nutr., 18: 93-95.

Sripanidkulchai, B., J. Junlatat, N. Wara-Aswapati and D. Hormdee, 2009. Anti-inflammatory effect of *Streblus asper* leaf extract in rats and its modulation on inflammation-associated genes expression in RAW 264.7 macrophage cells. J. Ethnopharmacol., 124: 565-570.

Thind, T.S., G. Rampal, S.K. Agrawal, A.K. Saxena and S. Arora, 2012. Evaluation of cytotoxic and radical-scavenging activities of root extracts of *Schleichera oleosa* (Lour.) Oken. Nat. Prod. Res., 26: 1728-1731.

Thirumalai, S., K. Vedhanayagam and V. Kathaperumal, 1990. Nutritive value of odi leaves (*Lannea coromandelica*). Indian Vet. J., 67: 88-89.

Velayutham, R., N. Sankaradoss and K.N. Ahamed, 2012. Protective effect of tannins from *Ficus racemosa* in hypercholesterolemia and diabetes induced vascular tissue damage in rats. Asian Pacific J. Trop. Med., 5: 367-373.

Vieira, T.O., A. Said, E. Aboutabl, M. Azzam and T.B. Creczynski-Pasa, 2009. Antioxidant activity of methanolic extract of *Bombax ceiba*. Redox Rep., 14: 41-46.

Von Carlowitz, P.G., 1989. Agroforestry technologies and fodder production-concepts and examples. Agroforestry Syst., 9: 1-16.