

ETHNOMEDICINAL HERBS USED FOR ORAL HEALTH AND HYGIENE IN NORTHERN PART OF PARSA DISTRICT, NEPAL

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ABSTRACT

The present study was conducted to document the ethnomedicinal practices followed for oral health and diseases by people of Parsa district, and to suggest that the traditional knowledge should be integrated with modern dental care practices to formulate their sustainable utilization. An ethnomedicinal survey was conducted using specific questionnaire subsequent to personal interview to collect information from traditional healers, local inhabitants, ayurvedic practitioners and old people about the use of medicinal plants in oral care practices. This study identified 33 species belonging to 29 genera and 20 families commonly used by the people of this area to maintain

oral health and hygiene and as remedy for dental diseases. Out of 33 plants few plants viz. *Achyranthes aspera*, *Terminalia chebula*, *Acacia Arabica*, *Acacia catechu*, *Tabernaemontana divaricata*, *Woodfordia fruticosa*, *Achyranthes bidentata* and *Vitex negundo* are more effective plants for treating dental problems. Valuable ethnomedicinal practices are fast disappearing from rural population. New generation is ignorant of this traditional knowledge. So, measures should be taken to document them and to increase the awareness among youngsters. This study will also be useful for the pharmacologists to isolate the active principles of these plants and incorporate it into the modern healthcare practices for easier and cheaper oral health treatments.

KEYWORDS: Medicinal plants, Traditional knowledge, Oral hygiene, Oral diseases, Parsa district.

INTRODUCTION

The rural people of Nepal rely on plant resources for their domestic and primary health care needs. The ecosystems of Nepal are significantly diversified (Chaudhary, 1998; Subedi, 2004), producing a wide range of unique and valuable medicinal plant resources. The country supports 6653 species of flowering plants, out of which over 701 species have medicinal uses (DPR, 2012). About 80 % of the world's population depends on traditional medicine for their primary healthcare needs since ancient times (WHO, 1993). There is direct relation of ethnomedicine in the conservation of natural resources. Besides, it has relevance in the conservation of genetic resources. The knowledge of ethnobotany is at risk because of lack of written documents and a decrease in the practice of using wild resources (Shrestha, 1985). Modern medicine (allopathy) has limited the use of ethnomedicinal practices to a few groups of people, traditional healers, and ethnic peoples. Therefore, a documentation of useful plants and their ethnomedicinal information is urgently required for the conservation and proper utilization of these plant resources. Plants used for traditional medicine contain a wide range of substances that can be used to treat chronic as well as infectious diseases (Duraipandiyan *et al.*, 2006). The Tharus are one of the major ethnic groups, mostly inhabiting along entire Tarai and inner Tarai region, over the 20 different districts of Nepal. They are recognized as the marginalized indigenous people by the Government of Nepal. They represent 6.6 % (1.7 million) of Nepal's total population (CBS, 2011). Due to global modernization, both natural resources and Tharu culture are depleting at an alarming rate, therefore, there is an urgent need to explore and document this unique and indigenous knowledge before it is lost forever. Some ethnobotanical studies of Tharus have been carried out in Nepal Kumar *et al.*, 2006; Acharya & Acharya, 2009; Gachhadar, 2010; Joshi & Singh, 2010; Singh *et al.*, 2012; Bhattarai & Acharya, 2013; Kumar & Bharati, 2014; Singh, 2017).

Dental caries, tooth decay and pyorrhea are the common dental problems of the mouth in these days. Dental caries is a pathological condition of the teeth resulting in decalcification of the dentine or enamel and disintegration of the remaining organic material, often leading to loss of the teeth. Tooth decay is caused by intra oral factors, such as dental plaque of food and bacteria sticking to teeth, anatomy and position of teeth, dental appliances and restoration and lack of salivary flow and also by extra oral factors, such as high sugar intake, nutritional deficiency, soft foods and bottle feeding, etc. Accumulation of calculus (*tartar*) the scaly yellowish or brownish hard *chalk* like substances that forms at the gums around the teeth is

the most common cause of gingivitis, which is the first stage of pyorrhea. The inflammation of the gum with foul smell is the main symptom of the pyorrhea.

Generally, the fresh tender sticks about 12-15 cm long and 0.5-1.0 cm in diam. are either collected directly from the plants or purchased from local vendors by the people of this district. It is locally known as Datun or datuwan. The stick is crushed at one end by the molar teeth and made in to a brush. Flexible fibers of the crushed end of the stick are used for cleaning the teeth surface and teeth crevices. Unfortunately, these practices are fast vanishing and now exist only among the old people in the rural and interior areas. Therefore, the objective of the present study is to collect, identify and to document such information from rural and tribal areas of the districts before their extinction. Subsequently, to find out new or less known uses for dental care by comparing the collected uses with already published literature. This paper attempts to document an important ethnomedicinal indigenous knowledge for the utilization of medicinal plants to cure oral health problems by an ethnic community dominated by the Tharus in the study area and to collect detailed information on the plant parts utilized, their uses, mode of preparation, and dosage.

MATERIALS AND METHODS

Study area

Parsa district lies in between Long. $84^{\circ} 8'$ to $85^{\circ} 27'E$ and Lat. 27° to $27^{\circ} 26'N$ at an elevation of 122 to 925 m above the sea level in Province no. 2, Central Nepal. This study was carried out in the villages; Bagbana (Parsagadhi municipality), Madhuban mathwal (Sakhuwa Prasauni Rural municipality), Gadi, Sonbarsa (Puterwa Sugauli Rural municipality), Sankarsaraiya (Jirabhwani Rural municipality), Nirmal Basti and Subarnapur (Thori Rural municipality) of the district which are situated towards the northern part of the district (Fig. 1). In the study area Tharu community is in highest population.

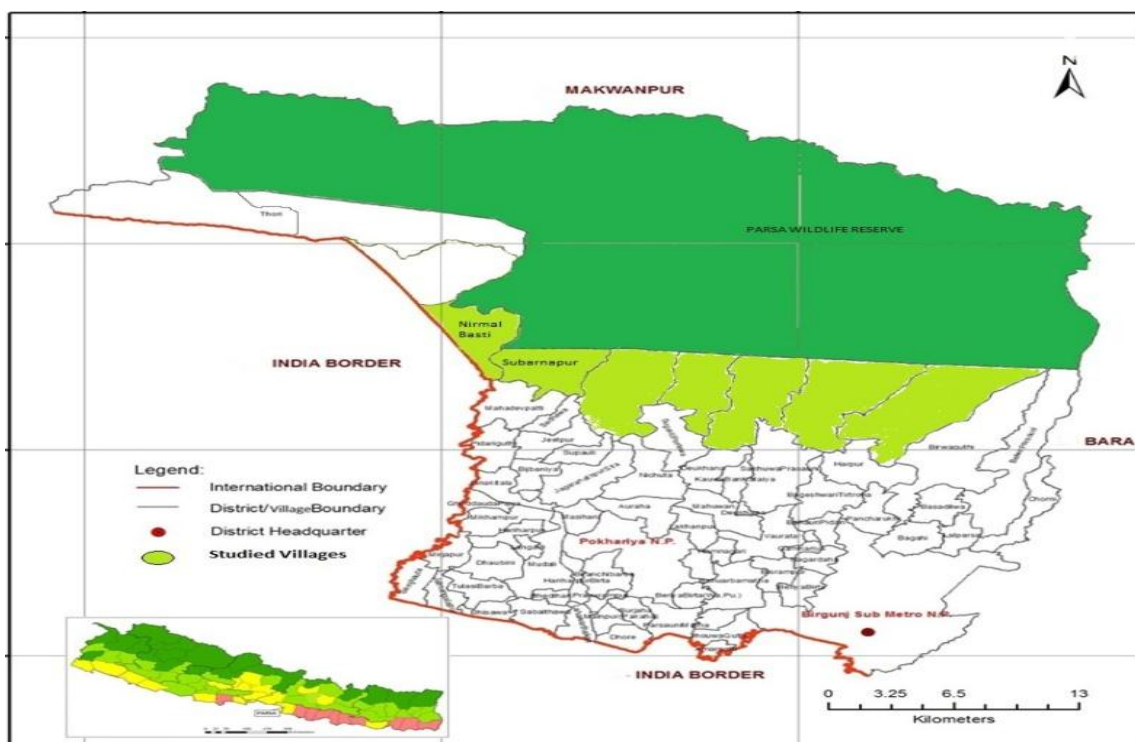


Fig. 1: Location map of the study area.

Data collection, identification of plants, and data analysis

At first field survey was conducted in the study area to identify and enumerate the commonly used plants by the Tharu community for various oral problems by field visit, discussion with local healers, plant sample displaying method, and focus group discussions. Then, the ethnomedicinal data for plant parts used, mode of medicines preparation, application, dosage, etc. were collected using Participatory Rural Appraisal (PRA) (Martin, 1995). During discussion key informants were mainly local healers, Guruwas, and knowledgeable villagers of all studied villages. The study was conducted in three different seasons (spring, rainy, and winter) between the years 2018-2019 in the studied villages of the district. The uses of the plant species were also verified in other villages by cross-checking the information by other respondents. The data were considered valid if at least five informants provided similar uses about the medicinal plants.

The plants were identified based on related flora (Stainton, 1988; Bista *et al.*, 2001), website (www.efloras.org, accessed on 3/15/2019), and verified by cross-checking with the authentic voucher specimens at the National Herbarium and Plant Laboratory, Godavari, Lalitpur, Nepal. The nomenclature and classification of plants were followed according to the website (www.theplantlist.org, accessed on 4/25/2019).

The collected data were analyzed using Microsoft Excel 2007 program for parts used, mode of preparation of medicines, plants belonging to various families and life forms of plants. To compare the efficacy of a particular plant for treating oral problems; frequency of citation was calculated using the fidelity level (FL) formula according to Friedman *et al.* (1986).

$$\text{Frequency of citation} = \frac{\text{No. of informants who cited the species}}{\text{Total No. of informants interviewed}} \times 100 \quad (1)$$

Toothache and dental caries are common oral health problems in this area. So, Preference analysis was conducted taking five important plants used to treat these problems according to Amatya (1996). In this exercise ten participants were selected randomly among total key participants to identify the best preferred medicinal plants for the treatment of toothache and dental caries.

$$\text{Preference index} = \frac{\text{Preference level} \times \text{No. of respondents}}{\text{Total No. of respondents}} \quad (2)$$

RESULTS AND DISCUSSION

A total of 33 plant species, belonging to 20 families, and 29 genera used by the Tharu community as ethnomedicine for the treatment of various oral health problems was documented from the study area, detailing their family, tharu name, family, habit, plant part(s) used, ailments treated, mode of application of medicines and frequency of citation (%) (Table 1).

Table 1: Medicinal plants with their names, family, habit, parts used, mode of preparation and citation %.

S.N.	Scientific name	Tharu/Local name	Family/Habit	Parts used	Ailments treated	Mode of application of medicines	Citation %
1	<i>Abrus precatorius</i> L	Tairi	Fabaceae/C	Leaves	Aphthous stomatitis	Juice of the tender leaves is swallowed by chewing them.	
2	<i>Acacia arabica</i> Willd.	Babur	Mimosaceae/ T	Leaves, Bark	Bleeding gums	Powder of stem bark is used to cure bleeding gum.	60
					Aphthous stomatitis	Decoction of the tender leaves is used as gargle or mouth wash.	45
3	<i>Acacia catechu</i> Willd	Khair	Mimosaceae/ T	Bark	Tooth ache	A piece of bark is placed in the cavity of aching tooth.	40
4	<i>Agave Americana</i> L.	Tari	Agavaceae/ S	Latex	Toothache	Latex found exuding from the leaves or at	24

						the base of stem is used to cure toothache.	
5	<i>Achyranthes aspera</i> L	Chirchira	Amaranthaceae/ H	Stem or root	Pyorrhea.	Stem and root is used as tooth brush to cure pyorrhea.	70
6	<i>Achyranthes bidentata</i> Blume.	Lal Chirchira	Amaranthaceae/ H	Twigs	Toothache	Young branch and twig are used as tooth brush to get relief from toothache.	70
7	<i>Aloe vera</i> L.	Ghiukumari	Liliaceae/ H	Leaves	Toothache	The gel is used to cure dental pain.	30
8	<i>Areca catechu</i> L	Supari	Palmae/ T	Bark	Toothache	piece of bark is placed in the cavity of aching tooth	25
9	<i>Annona squamosa</i> L.	Sarifa	Annonaceae/T	Leaves	Toothache	Decoction of green leaves is gargled for toothache.	36
10	<i>Calotropis gigantea</i> (L.) R. Br.	Akwan	Asclepiadaceae/ H	Latex	Aphthous stomatitis	Latex is mixed with honey and applied.	35
					Tooth ache	Latex is inserted into the carious tooth.	45
11	<i>Cassia alata</i> L.	Dad pat	Caesalpiniaceae,/ S	Leaves, flowers	Aphthous stomatitis	Decoction of leaves and flowers is used as mouth wash.	26
12	<i>Ficus benghalensis</i> L.	Bar	Moraceae/ T	Leaves	Gum swelling	Dry Leaf powder is applied against gum swelling.	40
13	<i>Ficus racemosa</i> L.	Gular	Moraceae/ T	Latex	Gum swelling	Latex is applied against gum swellings.	45
14	<i>Ficus religiosa</i> L.	Pipal	Moraceae/ T	Bark	Bad breath	Decoction of stem bark is used as mouth wash to remove the foul smell of breathing.	40
15	<i>Indigofera Pulchella</i> L.	Chimnati	Fabaceae/ S	Leaves	Mouth ulcer	Young leaves are chewed for the treatment of mouth ulcer.	55
16	<i>Lawsonia inermis</i> L.	Mehadi	Lythraceae/ S	Leaves	Mouth ulcers	Decoction of leaves is used as gargle.	30
17	<i>Mangifera indica</i> L.	Aam	Anacardiaceae/ T	Leaves	Sensitivity of teeth	Tender leaves are chewed	30
18	<i>Melia azedarach</i> L.	Bakaino	Meliaceae/ T	Twigs	Gingivitis	Tender stem and branches are used as tooth brush.	45
19	<i>Mimosa pudica</i> L.	Lajawanti	Fabaceae/ H	Root	Toothache	Decoction of root is used with water to gargle to reduce toothache.	40
20	<i>Moringa oleifera</i> Lam.	Sohijan	Moringaceae/ S	Root bark	Dental caries	Fresh juice of the root bark is applied	35

						to the cavity of tooth	
21	<i>Phyllanthus emblica</i> L.	Aaura	Euphorbiaceae/ T	Twigs	Teeth cleaning	Tender twigs are used as tooth-brush for mouth and teeth cleaning.	25
22	<i>Piper betle</i> L.	Pan	Piperaceae/ C	Leaves	Bad breath	Leaves are chewed along with other ingredients which are used for betel quid.	60
23	<i>Psidium guajava</i> L.	Runni	Myrtaceae/ T	Leaves	Swollen gums, mouth ulcers	Decoction of leaves is applied locally.	45
24	<i>Pterocarpus marsupium</i> Roxb.	Vijaysal	Fabaceae/ T	Latex	Pyorrhea	Latex is applied on gums in pyorrhea.	40
25	<i>Ricinus communis</i> L.	Aandi	Euphorbiaceae/ S	Seed	Pyorrhea	Powder of seeds is smoked like cigarettes to kill worms in the teeth.	20
26	<i>Rosa alba</i> L.	Gulab	Rosaceae/ S	Leaves	Toothache	Leaf juice relieves toothache and strengthens gums.	25
					Teeth cleaning	Tender leaves are used for cleaning teeth.	25
27	<i>Streblus asper</i> Lour.	Kaksi	Moraceae/ T	Leaves	Dental caries	Twigs are used to clean teeth and also to prevent dental caries.	50
28	<i>Syzygium cumini</i> L.	Jamun	Myrtaceae/ T	Leaves	Mouth blister	Extract of young leaves mixed with water is gargled to cure blister	35
29	<i>Tabernaemontana divaricata</i> L.	Takkar	Apocynaceae/ S	Root, latex	Toothache	Infusion of the root is used as an antipyretic.	45
					Dental caries	The latex is applied on a cotton pellet, to teeth in dental caries	50
30	<i>Tamarindus indica</i> L,	Imali	Caesalpiniaceae/ T	Fruit	Aphthous, stomatitis, sore throats	Gargle of tamarind water is used.	30
31	<i>Terminalia chebula</i> Retz.	Harro	Combretaceae/ T	Bark	All dental problems	Gargle of bark decoction is used.	65
32	<i>Vitex negundo</i> L.	Simali	Verbenaceae/ S	Twigs, Leaves	Bad breath	Stem branches are used as toothbrush to make strong teeth and to prevent foul smell from mouth.	65
					Gingivitis	Paste of Leaves is applied gently for the treatment of tooth and gum diseases	40

33	<i>Woodfordia fruticosa</i> (L.) Kurtz.	Dhayaro	Lythraceae/ S	Leaves, fruits	All dental problems	Decoction made from equal amount of leaves and fruits are used to gargle to get relief from all dental problems.	50
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Among them, 8 spp. were cultivated, and 25 spp. were harvested from the wild. It showed that people of the study area depend on the natural resources to fulfill their primary healthcare needs. *Annona squamosa*, *Areca catechu*, *Mangifera indica*, *Phyllanthus emblica*, *Piper betle*, *Psidium guajava*, *Rosa alba* and *Syzygium cumini* are cultivated in their field or house, but also used for medicinal purposes.

Fabaceae and Moraceae were the most prominent family (4spp.), followed by Mimosaceae (2spp.), Euphorbiaceae (2 spp.), Amaranthaceae (2 spp.), Myrtaceae (2spp.), Caesalpiniaceae (2 spp.), Lythraceae (2 spp.) and others (13 spp) Fig. 2.. Other researchers have also reported that Fabaceae was the dominant family in their study area (Bhattarai & Acharya, 2013; Kumar *et al.*, 2013).

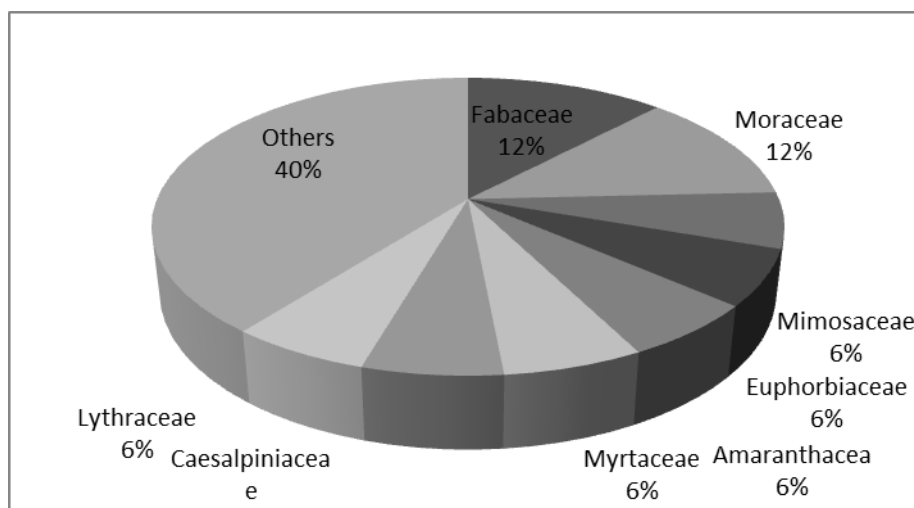


Fig. 2. Family wise analysis of documented medicinal plants.

Out of total documented plant species, the majority were trees (50%), followed by shrubs (31 %), herbs (15 %), & climbers (4 %) (Fig.3). Several researchers (Singh *et al.*, 2012; Bhattarai & Acharya, 2013; Kumar & Bharati, 2014 & Ambu *et al.*, 2020) have reported that the most widely used form of plants for medicinal purposes was herbs, but the result of this study showed that trees are most commonly used for oral health treatment.

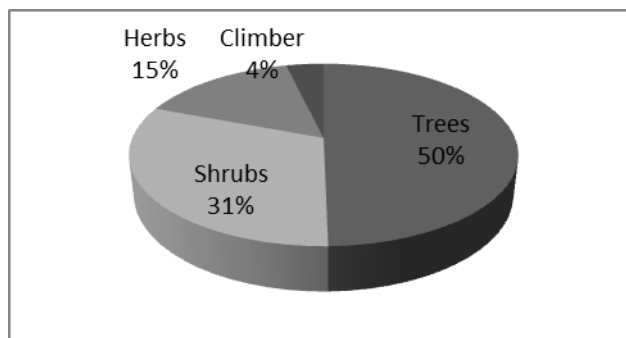


Fig. 3. Life forms of documented medicinal plants.

The Tharu people use different parts of the plant for the treatment of oral health. Leaves were the most frequently used parts (39 %), followed by barks (16 %), latex (13 %), Twig (11%), root (8%), fruits (5 %) and others (stem, flower & seeds; 8 %), (Fig. 4). According to other researchers, the most frequently used plant parts were leaves (Kumar & Bharati, 2014; Poudel & Singh, 2016). Leaves may contain more active compounds and comparatively it is easy for phytochemical and pharmacological studies comparison to other parts (Faruque *et al.* 2018). Usually they use young leaves than mature leaves to prepare medicines.

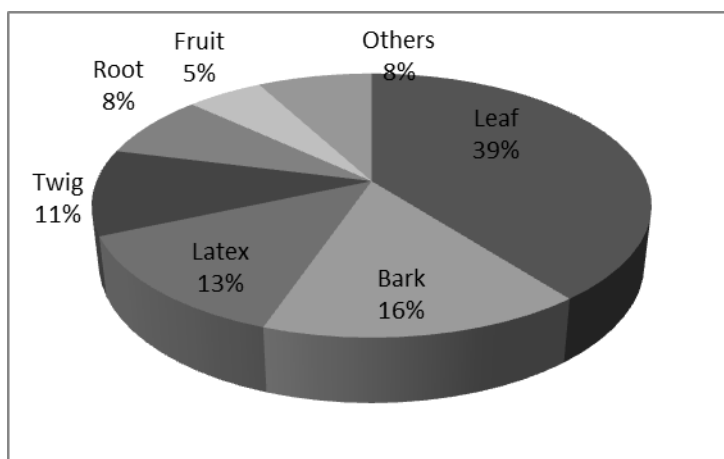


Fig. 4. Percentage of plant parts used in documented medicinal plants.

Mode of drug preparation

The Tharu community uses different methods of medicines preparation such as decoction, juice, powder, infusion etc. for the treatment of oral health. The most frequently used mode of medicine preparation was decoction (27 %), followed by juice (13%), latex (13%), twig (13 %), powder (5%), bark (5 %) and others (24 %) (Fig. 5). Other category of mode of drug usage represented the, toothbrush, young leaves, infusion, gel, paste and smoke.

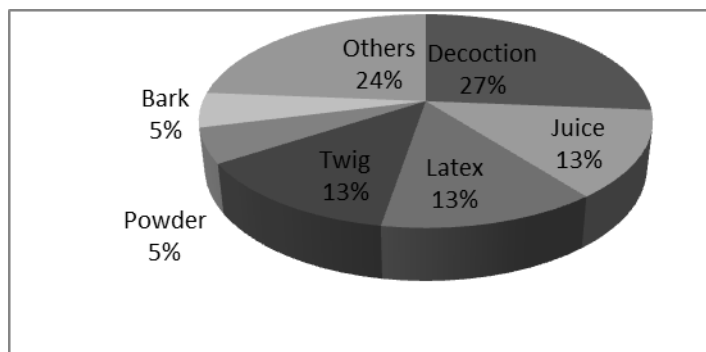


Fig. 5. Mode of medicines preparation.

Decoction is prepared by boiling the plant material with water. The juice is a natural fluid, which is extracted from a plant or its parts by crushing and squeezing. Most of the Tharus use decoction and juice as a method of drug preparation which is easier to prepare and more efficient than others. This method of drug preparation has been reported previously; Islam *et al.* (2014) & Jadid *et al.* (2020) also reported that decoction is the highest mode of medicine preparation in their study. Similarly, Singh *et al.*, 2012; Kumar & Bharati, 2014; Rai & Singh, 2015; Poudel & Singh, 2016; Singh, 2017; Ambu *et al.*, 2020 reported that juice is the highest mode of medicine preparation in their study.

Preference analysis

As toothache and dental caries are common oral health problems in the study area. The preference analysis results showed that the preference index of *Achyranthes aspera* is highest for treating toothache (Table 2), while *Terminalia chebula* got highest position for treating dental caries (Table 3). The result of citation percentage % analysis also supports this result.

Table 2: Preference analysis of the plants used for toothache.

Plant	Number of respondents per preference level			Preference	
species	1	2	3	index	Rating
<i>Achyranthes aspera</i>	5	4	0	1.3	I
<i>Terminalia chebula</i>	5	4	1	1.6	II
<i>Acacia arabica</i>	3	5	2	1.9	III
<i>Calotropis gigantea</i>	4	2	4	2	IV
<i>Acacia catechu</i>	4	3	3	2.3	V

Table 3: Preference analysis of the plants used for dental caries.

Plant	Number of respondents per preference level			Preference	
species	1	2	3	index	Rating
<i>Terminalia chebula</i>	5	4	0	1.3	I
<i>Tabernaemontana divaricata</i>	5	4	1	1.6	II
<i>Woodfordia fruticosa</i>	3	5	2	1.9	III
<i>Streblus asper</i>	4	2	4	2	IV
<i>Moringa oleifera</i>	4	3	3	2.3	V

In past many researchers have reported about use of plants for oral health viz.: Dharmi, 2008 (2 plants out of 73 plants); Joshi, 2008 (4 plants out of 73 plants); Burlakoti, 2008 (1 plant out of 64 plants); Singh *et al.*, 2012 (12 plants out of 66 plants); Ambu *et al.* 2020 (3 plants out of 116 plants) and Jadid *et.al.* (1 plant out of 30 plants). This study reported 33 plants used for the treatment of various oral health problems from the study area.

CONCLUSION

The present ethnomedicinal investigation revealed that the Tharu people of Parsa district have great faith in their traditional system of medicine and still depend upon natural plant resources to cure their various ailments. Oral diseases are one of the most important problems in public health and are on the rise in developing countries. Most of the oral diseases are caused due to bacterial infections. The antibacterial activity of medicinal plants are due to the presence of potential bioactive compounds which help to reduce bacterial growth in the oral cavity and thus prevent formation of plaque, dental caries and ulcers. Out of 33 plants few plants viz. *Achyranthes aspera*, *Terminalia chebula*, *Acacia Arabica*, *Acacia catechu*, *Tabernaemontana divaricata*, *Woodfordia fruticosa*, *Achyranthes bidentata* and *Vitex negundo* are more effective plants for treating dental problems. Use of indigenous plants in oral health and hygiene has a long history in different parts of the world.

Simultaneously, it was observed that new generation is almost ignorant or least interested in the traditional method of healing. Therefore, it was felt that documentation of plant related indigenous knowledge throughout tribal area needs to be completed along with creation of awareness among the youngsters, so that rapid loss of this valuable knowledge about plant resources can be checked to a certain extent. The data collected on dental protective plants needs to be systematically screened for verification of tribal claims and for antimicrobial properties. The present study also suggests for research and development of natural

antibacterial compounds that are safe for the oral pathogens. The active principles of these plants should be incorporated into modern healthcare practices for easier and cheaper oral health treatments.

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REFERENCES

1. Acharya, R., & Acharya, K. P. (2009). Ethnobotanical study of medicinal plants used by the Tharu community of Parroha VDC Rupandeshi district, Nepal. *Scientific World*, 7(7): 80-84.
2. Ambu, G., Chaudhary, R. P., Mariotti, M., & Cornara, L. (2020). Traditional Uses of Medicinal Plants by Ethnic People in the Kavrepalanchok District, Central Nepal. *Plants*, 9: 759. <https://doi.org/10.3390/plants9060759>
3. Bhattarai, K. R., & Acharya, S. K. (2013). Documentation of ethnobotanical knowledge of Tharu people on the utilization of plant resources in Gadariya and Phulwari VDCs of Kailali district, west Nepal. *Bulletin of the Department of Plant Resources*, 37: 41-50.
4. Burlakoti, C., & Kunwar, R. M. (2008). Folk Herbal Medicines of Mahakali Waterheds Area, Nepal, In P.K. Jha, S.B. Karmacharya, M.K. Chhetri, C.B. Thapa & B.B. Shrestha (eds.), *Medicinal plants in Nepal: An Anthology of Contemporary Research* (pp, 187-193). Kathmandu, Nepal: ECOS.
5. CBS, (2011). *Statistical Year Book of Nepal*. Central Bureau of Statistics, HMG Nepal National Planning Commission Secretariat, Kathmandu, Nepal.
6. Chaudhary, R. P. (1998). *Biodiversity in Nepal: Status and Conservation*. Bangkok, Thailand: Craftsman Press.
7. DPR, (2012). *Plants of Nepal- fact sheet*. Ministry of Forest and Soil Conservation, Kathmandu, Nepal: Department of Plants Resource.
8. Dhami, N. (2008). Ethnomedicinal uses of plants in the western Terai of Nepal: A case study of Dekhatbhuli VDC of Kanchanpur district. In P.K. Jha, S.B. Karmacharya, M.K. Chhetri, C.B. Thapa & B.B. Shrestha (Eds.), *Medicinal plants in Nepal: An Anthology of Contemporary Research* (pp.164-176). Kathmandu, Nepal: ECOS.

9. Duraipandiyan, V., Ayyanar, M., & Ignacimuthu, S. (2006). Antimicrobial activity of some ethnomedicinal plants used by the Paliyar tribe from Tamil Nadu, India. *BMC Complementary and Alternative Medicine*, 6: 35-41.
10. Gachhadar, P. (2010). Indigenous knowledge and practices on medicinal plants among the Tharu community in Eastern Nepal. <https://www.semanticscholar.org/paper/28fbf7123da826a1605baffe27f23a0f0f948b19>
11. Faruque, M.O, Uddin, S.B, Barlow, J.W, Hu, S., Dong, S., Cai, Q., Li. X, & Hu, X. (2018). Quantitative ethnobotany of medicinal plants used by indigenous communities in the Bandarban District of Bangladesh. *Frontiers in Pharmacology*, 9, 40. <https://doi.org/10.3389/fphar.2018.00040>
12. Islam, M. K., Saha, S., Mahmud, I., Mohamad, K., Awang, K., & Jamal Uddin, S. (2014). An ethnobotanical study of medicinal plants used by tribal and native people of Madhupur forest area, Bangladesh. *Journal of Ethnopharmacology*, 151: 921-930.
13. Jadid, N., Kurniawan, E., Himayani, C.E.S., Andriyani, Prasetyowati, I., Purwani, K.I., et al. (2020) An ethnobotanical study of medicinal plants used by the Tengger tribe in Ngadisari village, Indonesia.
14. *PLoS ONE*, 15(7): e0235886. <https://doi.org/10.1371/journal.pone.0235886>.
15. Joshi, N. R., & Singh, V. (2010). Non-timber forest products (NTFP's) used by the Tharu tribe of Kanchanpur District of Far-Western Nepal. *New York Science Journal*, 3(11): 111-119.
16. Joshi, K.R. (2008). Ethnomedicinal use of plants: A case study of Sharmouli VDC, Darchula District, Nepal, In P.K. Jha, S.B. Karmacharya, M.K. Chhetri, C.B. Thapa & B.B. Shrestha (Eds.), *Medicinal plants in Nepal: An Anthology of Contemporary Research* (pp.164-176). Kathmandu, Nepal: ECOS.
17. Kumar, A., Tewari, D.D. & Tewari, J.P. (2006). Ethnomedicinal knowledge among the Tharu tribe of Devipatan division. *Indian Journal of Tradition Knowledge*, 5(3): 310-313.
18. Kumar, R., & Bharati, K. A. (2014). Ethnomedicines of Tharu Tribes of Dudhwa National Park, India. *Ethnobotany Research & Applications*, 12: 01-13.
19. Martin, G. J. (1995). *Ethnobotany: A methods manual*. London, UK: Chapman and Halls.
20. Poudel, M., & Singh, N. B. (2016). Medical ethnobiology and indigenous knowledge system found in the Darai ethnic group of Chitwan, Nepal. *Journal of Institute of Science and Technology*, 21(1): 103-111.

21. Rai, R., & Singh, N. B. (2015). Medico-ethnobiology in Rai community: A case study from Baikunthe Village Development Committee, Bhojpur, Eastern Nepal. *Journal of Institute of Science and Technology*, 20(1): 127-132.
22. Singh, A. G., Kumar, A., & Tewari, D. D. (2012). An ethnobotanical survey of medicinal plants used in the Terai forest of western Nepal. *Journal of Ethnobiology and Ethnomedicine*, 8: 19. <https://doi.org/10.1186/1746-4269-8-19>
23. Singh, S. (2017). Ethnomedicines used by Kochila Tharu tribes living near the Bara district of Nepal. *World Journal of Pharmaceutical Research*, 6(14): 1267-1283. <https://doi: 10.20959/wjpr201714-13732>
24. Shrestha, P. (1985). Contribution to the ethnobotany of the Palpa area. *Contributions to Nepalese studies: Journal of the Institute of Nepal and Asian Studies, Tribhuvan University*, 12(2): 63-74.
25. Subedi, B. P. (2004). *Linking plant-based enterprises and local communities to biodiversity conservation in Nepal Himalaya* (Ph. D. thesis). Kumaun University, Nainital, India.
26. WHO. (1993). *Guidelines on conservation of medicinal plants*. Gland, Switzerland: IUCN, WHO and WWF.