JOURNAL OF NATURAL REMEDIES
DOI: 10.18311/jnr/2021/25708

RESEARCH ARTICLE

Qualitative and Quantitative Ethnobotanical Analysis of *Ricinus communis* L. and *Azadirachta indica A. Juss.* in Sonipat District of Haryana, India

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Abstract

This manuscript contains vital ethnobotanical information and facts about *Ricinus communis* and *Azadirachta indica*, generated through extensive interviews and statistical analysis of data from studied site. Collection and documentation of the information was accomplished by surveying of selected area. The data was analyzed qualitatively and quantitatively, using statistical indices. Number of informants for *Ricinus communis* and *Azadirachta indica* were found to be 85 and 111 respectively. Number of ailments being treated by these plants have been recorded carefully. Quantitative analysis has revealed that seeds of *Ricinus communis* are frequently used to treat arthritis while leaves of *Azadirachta indica* are used for skin disease treatment. Documentation of such ethnobotanical data will help in conservation of studied plants and sustainability of indigenous knowledge which can be instrumental for strengthening health care system.

Keywords: *Azadirachta indica*, Ethnobotanical Study, Quantitative Study, *Ricinus communis*, Statistical Analysis

1. Introduction

Nature being a repository to vast scientific knowledge has always encouraged human efforts to indulge in exploration activities. This exploration act by humans has not only pacified the curiosity and inquisitiveness but has also led to the discovery of many cost effective and affordable solutions for treatment of several ailments. Despite marvelous examples of synthesis of novel compounds by chemists around the world, humans are in no competition to natural synthetic process and its efficiency. Natural products are being utilized by different civilizations in various parts of the world. About 80 percent world population is dependent on crude drugs, plant extracts, and formulations[1,2]. To treat various ailments and diseases, large number of plant based formulations are being used worldwide[3].

Literature study disclosed that *Ricinus communis* and *Azadirachta indica* are widely used medicinal plants which belong to Euphorbiaceae and Meliaceae families respectively[4,5]. Ancient Egyptian tombs have been found to contain castor seeds which date back to 4000BC. Egyptian doctors have mentioned use of castor oil to treat eye irritation in the medical text named "Ebers Payrus"[6]. Castor oil is used to cure severe foot pain, back pain, soreness. Castor oil massage over abdomen in women alleviates menstrual cramps and reduces its irregularity[7].

Azadirachta means azadi-dirakht (free tree) and *indica* implies its Indian origin. This plant is considered to be free tree of India[8,9]. Common names for studied plants are shown in Table 1. On account of high number of therapeutic uses of *Azadirachta indica*, "US National Academy of Sciences" in 1992, said "It is a tree for solving global problems". In old days, people would treat chicken pox using water boiled neem leaves and dried leaves of neem were used for fumigation[9,11]. In view of the above literature, it has become imperative to further investigate and analyze ethnobotanical information about both *Ricinus communis* and *Azadirachta indica*.

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Article Received on: 14.10.2020 Revised on: 17.12.2020 Accepted on: 21.12.2020

Table 1. Common name of plants

Sr. no	Botanical name	Common or Vernacular name
1.	*Ricinus communis*	Arand, Erand, Arandi, Erandi, Erendi, Castor bean, Wonder tree, Bheronta etc[12].
2.	*Azadirachta indica*	Nim, Neem, Nimb, Nimbo, Margosa tree, Azad dakhtul hind etc[13,14].

2. Materials and Methods

2.1 Demographic Profile of the Study Area

The study area included district Sonipat (28.9931°N, 77.0151°E), in the state of Haryana, India. The area is characterized by hot and semi-arid type climate having average temperature of 24.9°C and annual rainfall 653 mm (en.climate-data.org.). Main cultivated crops of the area are wheat, rice, millet, vegetables and legumes. During surveying, it was observed that traditional ways of health treatments are still being used in rural as well as urban areas. Plant products have been found to form the basis of such treatment. Traditional methods of treatment are more frequently used by rural population. The frequency of such uses signify healing potential of studied plants and also establishes the fact that rural areas are endowed with more ethnomedicinal knowledge than urban ones.

2.2 Reasons for the Selection of the Study Site

The area under study is characterized by its remoteness, cultural maintenance, and far-off location from urban areas, lack of modern education and health care facilities and other enabling services. The area having close contact with nature, homogeneity of population, social stratification etc. are other factors that make the area a fit case for ethnobotanical investigations. The livelihood of people mainly revolved around agriculture, livestock and associated activities. The area can be considered as a remote site due to lack of communication and conveyance. The study was carried out in urban and rural model. A field visit of the area was undertaken in January 2019. Ethnomedicinal information was collected in the form of proforma and analyzed statistically. The proforma consisted of following components:

1. Socio-economic profile of informants.
2. Ethno-botanical information of selected plants.
3. Ethnobotanical data in relation to local name, usage of plants in various forms i.e. crude drugs, formulated drugs, method and preparation of formulation, method of application, side effects, precautions and experience of usage of plants as medicines was documented.

2.3 Analysis and Interpretation of the Data

The analysis of data included following steps:

- Firstly, a well-planned format was designed for documentation of ethnobotanical data of studied plants.
- Preliminary survey of urban and rural areas was undertaken and the study areas were selected randomly.
- Urban model consisted of Sonipat and Gohana cities while rural model comprised of four villages: Ahmadpur Majra, Chhatehra, Sikanderpur Majra and Tewari (Teori).
- Informants were classified on the basis of age group, gender and qualification as explained in Table 2.
- Primary data obtained from local informants was translated, compiled, listed and documented in tabular and graphical form.
- Scores were allotted to informants according to various statistical formulae as shown in Table 4. Criteria for scoring pattern is given in Table 3.
- Ailments being treated by plants under study was divided into 19 different disease categories (Table 5) and PCTK scores were calculated.

Table 2. Criteria for interpretation of collected data

Sr.no	Criteria of data collection	
1.	Age group	20 to 50 years
		50 and above
2.	Sex	Male
		Female
3.	Qualification	Illiterate
		Below matriculation
		Above matriculation

Table 3. Assigned grade score for selected attributes

Sr.no	Selected attributes		Assigned grade score
1.	Plant information (PI)	Complete	20
		Incomplete	0
2.	Level of information (LI)	Authentic	20
		Vague	0
3.	Extent of diffusion of knowledge (EDK)	High	20
		Moderate	10
		Low	0

Table 4. Statistical formulae applied for data analysis

Sr.no.	Formulae used	Formulae expansion
1.	Persons Carrying Traditional Knowledge (PCTK) Score (%age)	$\mathbf{PCTK\ (\%) = \frac{Np}{FC} \times 100}$ PCTK is the ratio of number of informants of particular disease (Np) to the total number of informants of particular plant (FC)[15].
2.	Average Score (%age)	$\mathbf{Average\ score\ (\%) = \frac{NG}{N} \times 100}$ Average score is the ratio of number of informants under selected group (NG) divided by total number of informants (N)[16].
3.	Informant Carrying Traditional Knowledge (ICTK) Score (%age)	$\mathbf{ICTK\ (\%) = \frac{Summation\ of\ obtained\ score\ of\ PI, LI\ and\ EDK}{Maximum\ score\ assigned\ for\ (PI + LI + EDK)} \times 100}$ ICTK Score is the ratio of sum of obtained scores (Plant information (PI), Level of information (LI) and extent of diffusion of knowledge (EDK) of individual informant to the total sum of maximum assigned for PI, LI and EDK (Table Number 4) [Formulated in our lab].
4.	Relative Frequency Citation (RFC)	$\mathbf{RFC = \frac{FC}{N}}$ RFC is the ratio of total number of cited reports for medicinal and non-medicinal use of particular plant species to the total number of informants in survey (N)[16].
5.	Reported Uses of Particular Plant Part (RUPP)	Total number of reported uses for particular plant part[16].
6.	Plant Parts Value (PPV)	$\mathbf{PPV = \frac{RUPP}{RU}}$ PPV is the ratio of total number of reported uses for each plant parts and total reported uses for a given plant[16].
7.	Specific Uses (SU)	Total number of specific uses of particular plant parts which is maximally used among the reported uses[17].
8.	Reports of Specific Uses (RSU)	Total number of cited reports for specific uses[16].
9.	Intra specific Use Value (IUV)	$\mathbf{IUV = \frac{RSU}{RUPP}}$ It is the ratio of number of reported specific uses to the total number of reported uses of particular plant part[16].
10.	Overall Use Value (OUV)	$\mathbf{OUV = PPV \times IUV}$ OUV is the overall ranking of uses which is multiple of plant part value and intra specific use value[16].

Table 5. Different ailments categorized under different disease categories

Sr.no	Disease Category/ Medicinal Uses	Ailments
1.	Arthritis	Joints pain, inflammation in joints and swelling
2.	Cancer	Cancer
3.	Contraceptive	Birth control
4.	Dental problems	Toothache
5.	Diabetes	Diabetes
6.	GI diseases	Acidity, constipation, diarrhea, digestion problem, flatulence, helminthic, hemorrhoids, jaundice, stomach-ache, stomach and intestinal swelling, vomiting
7.	Gynecological disorders	Fallopian tube blockage, leucorrhea, menstrual pain, menstrual irregularity, prolapse of uterus, uterine muscle strengthening, uterus swelling, vaginal infection
8.	Hair problems	Dandruff, hair fall, hair louse
9.	Inflammation	Headache, pain, swelling
10.	Injury	Burn injury, bone fracture, cut, sprain, thorn injury, wound, internal injury
11.	MENE diseases	Oral hygienic maintenance, earache, eyes infection and allergy, mouth ulcer
12.	Muscular problems	Muscular pain
13.	Nervous disorders	Paralysis
14.	Pyrexia	Dengue, viral fever, malaria fever, typhoid
15.	Respiratory diseases	Cold, cough, pneumonia, tuberculosis infection
16.	Skin diseases	Acne, pimples boils and sores, cyst, face freckled, hair furuncle, leucoderma, paronychia, skin allergy, scabies
17.	Sedative uses	Sedative use, to overcome sedative effect
18.	Tonic	Blood purifying effect, cooling effect
19.	Ethno veterinary uses	Hoof infection in cattle's

3. Abbreviations

Total no of informants in survey **(N)**, No of informants of particular plant part **(Ni)**, **P**ersons **C**arrying **T**raditional **K**nowledge **S**core **(PCTK)**, **I**nformant **C**arrying **T**raditional **K**nowledge **S**core **(ICTK)**, **R**elative **F**requency **C**itation **(RFC)**, **R**eported **U**ses of particular plant part (RUPP), **P**lants **P**art **V**alues **(PPV)**, **S**pecific **U**ses **(SU)**, **R**eports of **S**pecific **U**ses **(RSU)**, **I**ntra specific **U**se **V**alue **(IUV)**, **O**verall **U**se **V**alue **(OUV)**, **N**umber of **D**iseases **C**ategories **(NDC)**, **N**o of **p**lant **p**arts **(Npp)**.

4. Results and Discussion

The study revealed that investigated plants were used to treat health problems of human beings and livestock. The distribution of informants as per selected criteria (Table 2) showed that majority of informants who were females, illiterate, and are in 50 years and above age group, carried more traditional knowledge. Rural people shared and possessed more ethnobotanical knowledge than urban ones (Table 7). It could also be interpreted from the present study that rural sites possessed poor public health services and therefore local people are forced to move to cities for major health issues.

Biostatstical methods were employed to analyze ethnomedicinal data (Table 4). Results were prepared, analysed and presented in the form of tables and bar graph (Table 6–12; Figure 1,2). Demographic details of studied rural sites are shown in Table 6. On the basis of ethnomedicinal uses, average scores (Table 8, 9), ICTK (Table 8) and PCTK score (Table 9) were calculated. Application of Score strengths was plotted in the form of bar graph and line graph (Figures 1 and 2). Plant parts were ranked according to frequency of their medicinal use (Table 10 and 11). Detailed analysis of data confirmed that

seeds and leaves in *Ricinus communis* and *Azadirachta indica* were frequently used plant parts respectively. The data was subjected to further analysis and trends in ethnobotanical knowledge were obtained (Table 12).

Table 6. Demographic profile of studied rural area of Sonipat District of Haryana, India

Sr.no	Particulars	Ahmadpur Majra	Chhatehra	Sikanderpur Majra	Tewari (Teori)
1.	Name of head	Naveen Sharma	Bhteri Devi	Suman	Rajesh Kumari
2.	Total population	1,611	2647	3,516	2,906
3.	Male population	877	1409	1,857	1,569
4.	Female population	734	1238	1,659	1,327
5.	Literacy rate	73.17%	74.72 %	71.21%	76.45%
6.	Geographical coordinates Latitude Longitude Altitude	 29°7'58.764"N 76°41'38.8392"E 228 Meters	 29°8'3.84"N 76°42'11.88"E 223 Meters	 29°7'58.764"N 76°41'38.8392"E 228 Meters	 29°8'20.1876"N 76°54'29.2032"E 222 Meters
7.	Health services	Unsatisfactory	Unsatisfactory	Unsatisfactory	Unsatisfactory

Source: Census 2011 of India

Table 7. ICTK score and different attributes of information

Sr.no.	Assigned ICTK scores (%)	Attributes of information
1.	16.6	Incomplete, vague information with moderate level of diffusion
2.	33.3	Complete but vague information with low level of diffusion
3.	50	Incomplete and authentic information with moderate level of diffusion Complete, vague with moderate level of diffusion
4.	66.6	Complete and authentic information but no diffusion
5.	83.3	Complete, authentic information with moderate level of diffusion
6.	100	Complete, authentic information with high level of diffusion

Table 8. ICTK and average score percentage of informants of entire district

Sr.no.	ICTK score percentage of informants	Average score percentage of informants			
		Ricinus communis		*Azadirachta indica*	
		Urban	Rural	Urban	Rural
1.	16.6	0	3.52	1.80	5.40
2.	33.3	0	0	0.90	0
3.	50	0	1.17	0	7.20
4.	66.6	22.35	16.47	28.82	16.21
5.	83.3	9.41	45.88	6.30	29.73
6.	100	0	2.35	0	3.60

Table 9. PCTK score percentage of entire district

Sr.no.	Disease Categories/ Medicinal use	PCTK Score percentage	
		Ricinus communis	*Azadirachta indica*
1.	Arthritis	68.23	1.80
2.	Cancer	1.17	0
3.	Contraceptive	1.17	0
4.	Dental problems	1.17	36.03
5.	Diabetes	1.17	16.21
6.	GI diseases	40	10.81
7.	Gynecological disorders	3.52	0.90
8.	Hair problems	1.17	18.91
9.	Inflammation	37.64	0
10.	Injury	35.29	18.01
11.	MENE diseases	0	35.13
12.	Muscular problems	9.41	0
13.	Nervous disorders	1.17	0
14.	Pyrexia	0	45.04
15.	Respiratory diseases	2.35	0.90
16.	Skin diseases	25.9	34.23
17.	Sedative uses	2.35	0
18.	Tonic	0	18.91
19.	Ethno veterinary uses	1.17	0

Table 10. Quantitative analysis of ethnobotanical data of entire district with reference to *Ricinus communis*

Sr.no	Plant part	Ni	RFC	RUPP	PPV	SU	RSU	IUV	OUV
1.	Seeds	33	1.22	14	0.52	To treat arthritis	38	2.71	1.40
2.	Leaves	63	2.33	2	0.07	To treat arthritis	2	1	0.07
3.	Stem	3	0.11	12	0.44	To treat respiratory disorders	13	1.08	0.47
4.	Roots	3	0.11	2	0.07	To treat arthritis	2	1	0.07

(N=85 and RU= 27)

Table 11. . Quantitative analysis of ethnobotanical data of entire district with reference to *Azadirachta indica*

Sr.no	Plant part	Ni	RFC	RUPP	PPV	SU	RSU	IUV	OUV
1.	Fruits	13	0.52	4	0.16	To get rid of human head louse	10	2.5	0.4
2.	Seeds	18	0.72	7	0.28	To treat diabetes	13	1.85	0.5
3.	Leaves	79	3.16	9	0.36	To treat skin allergy	30	3.33	1.2
4.	Bark	15	0.6	2	0.08	To treat burns	14	7	0.6
5.	Stem	41	1.64	2	0.08	To treat toothache	41	20.5	1.6
6.	Roots	3	0.12	1	0.04	To treat burns	3	3	0.1
7.	Liquid exudate	2	0.08	2	0.08	To treat pyrexia	2	1	0.08

(N=111 and RU= 25)

Table 12. Trends of ethnobotanical knowledge of entire district with reference to *Ricinus communis* and *Azadirachta indica*

Sr.no	Trends of ethnobotanical knowledge	Group name
1.	Rural > Urban	Rural Urban models
2.	Ahmadpur Majra>Chhatehra>Sikanderpur Majra>Tewari	Rural model
3.	50 years and above > 20-49 year (Except Sikanderpur Majra)	Age group
4.	Female > Male (Except Ahmadpur Majra)	Sex group
5.	Illiterate > Below matric > Matric and above matric	Rural qualification group
6.	Matric and above matric > Illiterate >Below matric	Urban qualification group

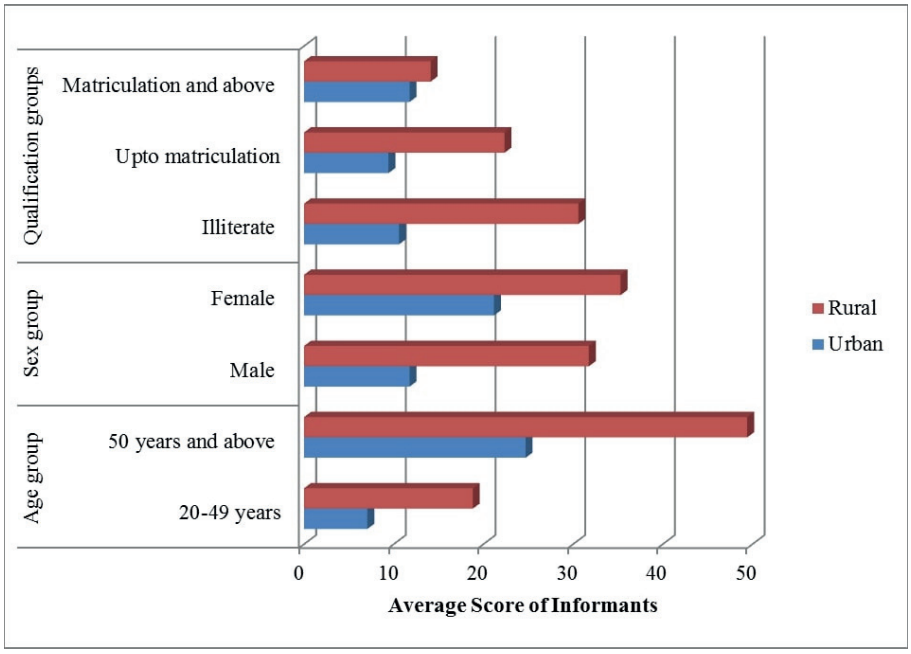

Figure 1. Average score of informants for selected groups *(Ricinus communis)*.

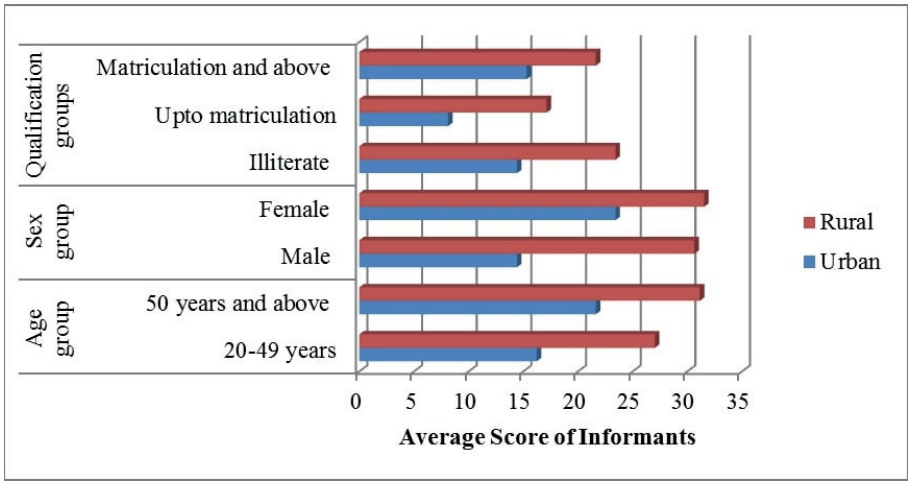

Figure 2. Average score of informants for selected groups *(Azadirachta indica)*.

5. Conclusion

From the study undertaken it was established that studied plants have enormous medicinal value. Out of 400 interviewers, 210 shared traditional information regarding studied plants. This study was focused on ethnobotanical knowledge of urban and rural areas of Sonipat, India. Rural and urban surveyed sites differed quietly, in possession of such knowledge. Rural areas were found to be the main repositories of traditional knowledge. As per PCTK score strength, *Ricinus communis* is widely used to treat arthritis (68.23%) and *Azadirachta indica* is used to treat different types of fever such as malarial, viral etc. (45.04%). *Ricinus communis* plant is best known for its anti-arthritic, anti-inflammatory, treating internal injury, skin diseases, curing boils and sores and toxic effects while *Azadirachta indica* is used for its anti-pyretic, anti-inflammatory, curing infection and for maintenance of oral hygiene conditions.

Ethnomedicinal knowledge percentages for *Ricinus communis* among various groups is calculated to be 68.23 % for rural, 74.11 % for 50 years & above age, 67.05 % for female and 41.17 % for illiterate informants whereas in case of *Azadirachta indica*, the percentage is 62.16 % for rural, 56.76 % for 50 years & above age , 54.95 % for female, 39.94 % for those qualified up to matriculation.

It can also be concluded from the study that storehouse of ethnobotanical information of studied plants are under threat due to lack of knowledge transmission and its inadequate usage from native sites. Such vital knowledge is disappearing because the young who are in contact with outside world have adopted an attitude that traditional ways are irrelevant and illegitimate. However, it is worth mentioning here that before any ethnomedicinal formulation is fully put to use and commercialized, it needs to be thoroughly investigated in terms of its chemical composition and concentration of different constituents. Clinical trials are required to ascertain the physiological effects of different components of formulation and to arrive at the exact dosage.

6. Acknowledgement

I wish to express my deepest gratitude to my mentor and supervisor Dr. Neelu Sood for her expert advice and professional help during the completion of this study. I sincerely thank and am indebted to my husband, Mr. Rupinder Kumar for extending financial aid and for the constant encouragement on this work. He has been a constant help to conduct field surveys, required for successful completion of this manuscript. I am also grateful to Dr. B. D. Vashistha who guided me during the course of this study. My workmate Anju Kumari has been a genuine help. I also thank my family, friends and my teachers for their continuous support to bring about this research work to a successful end.

7. References

1. Verma S, Singh S. Current and future status of herbal medicines. Vet World. 2008; 1:347–50. https://doi.org/10.5455/vetworld.2008.347-350
2. Poonam K, Singh GS. Ethnobotanical study of medicinal plants used by the Taungya community in Terai arc landscape, India. J Ethnopharmacol. 2009; 123(1):167–76. https://doi.org/10.1016/j.jep.2009.02.037. PMid:19429357
3. Oladeji O. The characteristics and roles of medicinal plants: some important medicinal plants in Nigeria. Nat Prod Ind J. 2016; 12(3):1–8.
4. Maithani A, Parcha V, Pant G, Dhulia I, Kumar D. *Azadirachta indica* (Neem) leaf: A review J Pharm Res. 2011. p. 1824-7.
5. Bolaji ZS, Andrew GK, Benson OA. Castor oil plant (*Ricinus communis L.*): Botany, ecology and uses. Int J Sci Res. 2014; 3(5):1333–41.
6. Tamimi FAA, Hegazi AEM. A case of castor bean poisoning. Sultan Qaboos Univ Med J. 2008; 8(1):83–7.
7. Marwat SK, Rehman FU, Khan EA, Baloch MS, Sadiq M, Ullah I, et al. *Ricinus communis*: ethnomedicinal uses and pharmacological activities. Pak J Pharma Sci. 2017; 30(5):1815–27.
8. Sharma P, Tomar L, Bachwani M, Bansal V. Review on neem (*Azadirachta indica*): Thousand problems one solution. Int Res J Pharm. 2011; 2(12):97-102.
9. Tiwari, Verma AK, Chakraborty S, Dhama K, Singh SV. Neem (*Azadirachta indica*) and its potential for safeguarding health of animals and humans: A review. J Biol Sci. 2014; 14(2):110–23. https://doi.org/10.3923/jbs.2014.110.123
10. Gupta A, Verma UP, Lal N, Ojha SK. Evolution and exploration of *Azadirachta indica* in dentistry: An update. Br J Med Med Res. 2017; 21(8):1–15. https://doi.org/10.9734/BJMMR/2017/33538
11. Bhowmik D, Chiranjib, Yadav J, Tripathi KK, Kumar KPS. Herbal remedies of *Azadirachta indica* and its medicinal application. J Chem Pharm Res. 2010; 2(1) :62–72.
12. Rana M, Dhamija H, Prashar B, Sharma S. *Ricinus communis L.* - A review. Int J Pharmtech Res. 2012; 4 (4):1706–11.

13. Biswas K, Chattopadhyay I, Banerjee RK, Bandyopa dhyay U. Biological activities and medicinal properties of neem (*Azadirachta indica*). Curr Sci. 2002; 82:133 6–45.
14. Hashmat I, Azad H, Ahmed A. Neem (*Azadirachta indica A. Juss*) - A nature's drugstore: an overview. Int Res J Biol Sci. 2012; 1(6):76–9.
15. Kaur J, Rani S, Singh G, Sood N. 2015. Intensity and depth of traditional knowledge of two medicinally important plants Thevetia peruviana and Calotropis procera presently conserved in rural areas of Haryana. J Med Plants Stud. 2015; 3(6):24–32.
16. Hoffman B, Gallaher T. Importance indices in ethnobotany. Ethnobot Res Appl. 2007; 5:201–8. https://doi.org/10.17348/era.5.0.201-218