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Variation in the Traditional Knowledge of *Curcuma longa* L. in North-Eastern Algeria

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Abstract*—Curcuma longa* L. (*Zingiberaceae*), commonly known as turmeric, has a long history of traditional uses for culinary purposes as a spice and a food colorant. The present study aimed to document the ethnobotanical knowledge about *Curcuma longa*, and to assess the variation in the herbalists' experience in Northeastern Algeria. Data were collected using semi-structured questionnaires and direct interviews with 30 herbalists. Ethnobotanical indices, including the fidelity level (FL%), the relative frequency citation (RFC), and use value (UV) were determined by quantitative methods. Diversity in the level of knowledge was analyzed using univariate, non-parametric, and multivariate statistical methods. Three main categories of uses were recorded for *C. longa*: for food, for medicine, and for cosmetic purposes. As a medicine, turmeric was used for the treatment of gastrointestinal, dermatological, and hepatic diseases. Medicinal and food uses were correlated with both forms of preparation (rhizome and powder). The age group did not influence the use. Multivariate analyses showed a significant variation in traditional knowledge, associated with the use value, origin, quality, and efficacy of the drug. The findings suggested that the geographical origin of *C. longa* affected the use in Algeria.

Keywords*—Curcuma longa*, curcuma indices, ethnobotanical knowledge, variation.

I. Introduction

CURCUMA (*Zingiberaceae*) comprises about 50 species, among them, *Curcuma longa* L. (turmeric) is the most common [1], [2]. It is widely distributed throughout the tropical and subtropical regions of the world [3], [4]. *C. longa* is native to Southeast Asia, and is extensively cultivated in Alleppey, Madras, and Bengal in India. Nowadays, it is also cultivated in many countries worldwide including Pakistan, Thailand, China, Taiwan, Indonesia, Malaysia, Nepal, Japan, Peru, and the Caribbean. Nevertheless, India remains the largest producer of turmeric in the world [4].

Turmeric has a long history in traditional Chinese medicine, as well as Ayurvedic and Kampo medicine for treatment of a wide range of conditions involving topical and internal use. *C. longa* has several common names based on the location, the mode of preparation, and the use [5]. In India, *haridra* and *haldi* remain the most familiar names [6]. Traditionally; *C. longa* has been used for culinary purposes and in the textile industry [7]. It is one of the principal components of curry [8]. In addition, it is used in cosmetics as a hair dye for its golden-yellow color and characteristic odor [9]. Medicinally, turmeric is prescribed for hepatic and gastrointestinal disorders, and for anti-inflammatory diseases [10]. Externally, it is used for inflammation of the oral mucosa, skin allergies, and infected wounds [11]. The dried roots contain the curcuminoids, which are a mixture of three principal metabolites: curcumin, demethoxycurcumin (DMC), and bisdemethoxycurcumin (BDMC) [12]. Curcumin (3-6%) belongs to the group of diaryl hepatanoids, and is the active ingredient of the dietary spice turmeric [13]. In addition, the drug contains (ca. 5%) volatile oil, mainly α- and β-tumerone, zingiberene, and curcumol, and 40% starch [14].

In Algeria, previous ethnobotanical studies have recorded the vernacular names and the uses of plant species with little emphasis on quantitative studies [15]–[17]. The application of quantitative techniques to direct the analysis of interesting plant use contributes substantially to resource conservation and sustainable development [18], [19]. Therefore, the aims of the present work were to investigate the local knowledge, the importance of use of *C. longa* in Algeria, and the factors affecting its utilization in herbal medicine.

II. Materials and Methods

A. Study Area

The research survey was conducted for six months from January to June, 2014, in cities and villages of the three districts: Souk Ahras, Annaba, and El-Tarf located in north-eastern Algeria (Fig. 1). The Annaba region is a coastal town situated in the central part of north eastern Algeria 533 km from Algiers. The El-Tarf region bordering the city of Annaba is located 589 km from Algiers. The area of Souk Ahras is located in the far eastern part of Algeria, near the Tunisian border, and 554 km from Algiers.

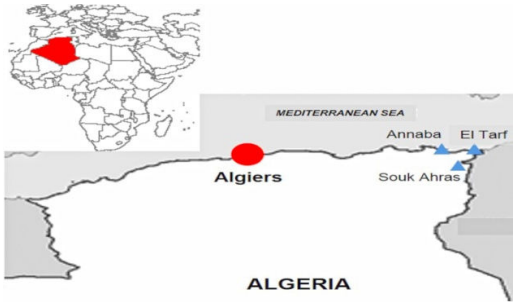

Fig. 1 Geographical locations of the study areas

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B. Data Collection

The survey was conducted using a structured questionnaire in personal interviews with the herbalists. The informants demonstrated the methods of preparation of *C. longa*. Thirty male herbalists were interviewed between the ages of 25 to 60 years. Ethnobotanical data, including the local plant name, the part used, and the methods of preparation and administration were analyzed.

The voucher specimen of the rhizome of turmeric was identified by Dr. Mohamed Loutfy Ashour, Department of Pharmacognosy, Faculty of Pharmacy, Ain Shams University, Egypt.

C. Data Analysis

1. Ethnobotanical Indices

The following indices were calculated as numerical representatives for quantitative ethnobotany to emphasize the importance of the traditional knowledge of turmeric in North-Eastern Algeria.

The Fidelity level (FL) was adopted [20]. This index shows the importance of species, and is given by the frequency of citation divided by the total number of informants, without considering the use categories, as the following:

$$FL = (\frac{S}{N}) * 100$$

where S is the number of positive respondents to the use of *C. longa* for a given category and N: is the total number of respondents.

The Use Value (UV) assesses the relative importance of *C. longa*. This index was proposed by Phillips and Gentry [21], [22]. Data were first arranged by categories of use. SUV_{ik} was taken as the specific ethnobotanical use for the category of use (k) according to the respondent (i). SUV_{ik} values were calculated as:

$$SUVik = \sum Riki$$

where R_{ikj} is the rank attributed to the specific use (j) within the category of use (k) by the respondent (i). The Use Value (UV_k) of the species for each category of use is calculated using the following formula:

$$UVk = \sum SUVik/N$$

where N is the number of respondents.

The Overall Use Value (OUV) for each group of herbalists was determined based on the following formula [23].

$$OUV = \sum UVk$$

where UV_k is the estimated Use Value of *C. longa* in the particular use category.

2. Statistical Analysis

All statistical tests presented in this study were analyzed using SPSS Statistics 17.0 (Statistical Package for Social Sciences, SPSS Inc., Chicago, IL, USA, 2008).

The means of UV for each age group were statistically compared using the one-way ANOVA test followed by Dunn's post-hoc test. The differences between the means were considered significant for the values of $p<0.05$.

Multivariate tests were used to determine the complex relationship among variables [19]. Six key informants were analyzed, including the Use Value, the origin, the quality, the efficacy, the dosage of the drug, the marketing and the best product of *C. longa* in North-Eastern Algeria. These tests included:

- Correspondence. Analyses examined the relationships between herbalists and the associations between variables in two dimensions. Additionally, similar informants were identified from their positions, with the respect of the axes, and the underlying factors in the noticed pattern. Finally, the observed patterns were explained, based on key informants of the research participants.
- Cluster Analysis was used to examine the grouping of herbalist perceptions. This analysis generated a dendrogram, which illustrates how closely the herbalists are related to each other based on the six key informants for which they are cited.

III. Results and Discussion

A. Local Ethnobotanical Knowledge

1. The Local Name and the Origin of *Curcuma longa*

Turmeric is found in Algerian markets under different local names. The most widely used name of *C. longa* in Algeria is "*Kourkoum*" written in Arabic as "الكركم", and the rhizome is called "*El-Jidr El-Asfar*" meaning yellow root. Based on the results, *C. longa* is familiar to 96.67% of the herbalists sampled. In addition, India represents the main geographical source of turmeric in the market with a 93.1% of the samples, followed by China and Malaysia with 6.9% for both and Indonesia (3.4%).

2. The Form of Use and the Method of Administration

Commercially, the entire rhizome was the most frequently used plant part, in addition to its powdered form (as a spice). Turmeric powder, known as "*Seffa*" in Arabic, was administered orally as an ingested powder according to 66.7% of the respondents. However, the aqueous decoction was recommended by 55.6% of the herbalists. Maceration of turmeric was prescribed topically by 22.2% of the herbalists. The turmeric infusion was not reported as being used.

The results showed that turmeric is popular as a spice, and constitutes an integral part of the traditional medical prescriptions in north-eastern Algeria. *C. longa* is mixed with other spices, and used in different preparations cooked with vegetables and rice. Turmeric is one of the most widely used spices in Algerian cooking. It is an important constituent spice in the "*Rass El Hanout*" spice [24].

B. Ethnobotanical Indices and Use Categories

1. The Fidelity Level (FL)

C. longa was used by the local herbalists for many purposes in three main categories, namely, medicine, food, and cosmetic. The powdered form had a higher level for each use. However, the higher FL values were observed for its use as a food (93.33%) and medicine (90.00%). Similar values were noticed for the rhizome form for same uses with 53.33 and 53.33%, respectively. The values of cosmetic uses were also estimated (powder FL=23.33%, rhizome FL=16.66%).

2. Traditional Preparations

The uses of turmeric in primary health care mentioned by the herbalists are listed in Table I. Most of these cited uses are related to the treatment of skin, respiratory, and liver problems. Eczema and skin lightening were the most common topical uses in cosmetics and skin disorders. In addition, jaundice and gastritis are the principal gastrointestinal tract diseases treated, while influenza is the main respiratory ailment improved by turmeric.

TABLE I
TRADITIONAL USES OF *C. LONGA* IN NORTH-EASTERN ALGERIA

Parts and Preparation	Treated disease
One glass of milk boiled with two teaspoons turmeric powder.	Cold and influenza affection
Apply externally a mixture of turmeric powder with ginger powder in milk	Rheumatism
Turmeric powder in «*Maa Ouard*» Rose water for external application.	Enhance skin
Maceration of the rhizome in water for 24 h administrated internally.	Flatulence
External application of turmeric powder with gelatinous substance of «*El Hendi*» *Opuntica ficus indica,* in honey.	Eczema
One teaspoon of turmeric powder with ½ teaspoon of cumin powder and one teaspoon of black coffee in honey. This preparation is administrated internally *per os*, for three months.	Improve immunity
Make a mixture with turmeric powder, chicory, and rosemary in honey, administrated internally.	Liver diseases
One glass of hot water (approx. 200 ml) with one teaspoon of turmeric powder is given three times/day.	Gastritis
A decoction of turmeric rhizome taken orally daily (approx. 400 ml).	Jaundice
Fifty g of turmeric powder with ½ glass of honey is administrated *per os*, two teaspoons daily.	Jaundice
Turmeric powder mixed with chicken liver.	As food for patients suffering from jaundice

3. The Use Value (UV)

The use value (UV) of turmeric for each ailment was calculated. This value indicated the degree of knowledge of the herbalists. The UV values showed that *C. longa* is used mainly in the treatment of gastrointestinal (UV=0.46), hepatitis (UV=0.46), and dermatological ailments (UV=0.43). The results showed lower values for use in the treatment of respiratory problems (0.06), immunity (0.06), and cancer (0.03). The powder was more frequently cited than the rhizome.

The use of turmeric in Algeria is based on its traditional uses in Asia (in both Ayurvedic and Chinese Medicine). Mainly, it is used to support liver functions and to treat jaundice [25]–[28]. Additionally, turmeric has been used to treat inflammation, dyspepsia, peptic ulcer, infections, mycoses, wounds, and skin disorders [29]–[31]. Scientific evidence has confirmed the topical use of *C. longa* in herbal medicine for wound healing [32]. The importance of turmeric in the diet has been related to the Ayurvedic hypothesis [33], [34].

C. Pattern Variation in Traditional Knowledge of Curcuma longa in North-Eastern Algeria

1. Category Use Variation According to the Class Age

The UV for each use category of *C. longa* ranged from 0.23 to 0.96 (Table II), and the overall use value (OUV) was 2.12. Medicine and food were the most used categories in north-eastern Algeria. The results showed that the herbalists' group age of (30-40) had the highest OUV value by category use (1.13). In addition, they possess more information about the use of *C. longa*.

Statistical analysis between means (ANOVA) of UV showed no significant differences between the categories of use. This result indicated the homogenous utilization of *C. longa* between the three age groups of herbalists. The findings revealed that the age group did not influence the local knowledge.

TABLE II
THE OVERALL USE VALUE OF *C. LONGA* ACCORDING TO THE AGE GROUP

Category use				
Age Class	Medicine	Cosmetic	Food	OUV
(20-30)	0.10	0.00	0.13	0.23
(30-40)	0.50	0.13	0.50	1.13
(40-60)	0.33	0.10	0.33	0.76
OUV	0.93	0.23	0.96	2.12
M.	0.31	0.08	0.33	
SD.	0.20	0.07	0.19	
P	0.368	0.314	0.436	

OUV: Overall Use Value, *p*: level of significance, M.: Mean; SD.: Standard Deviation

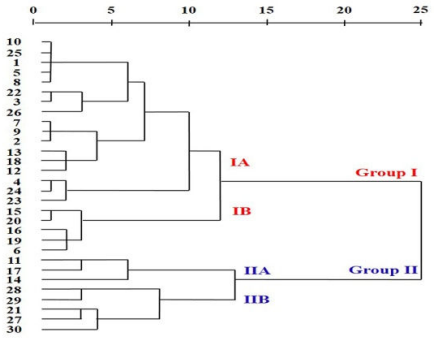

Fig. 2 Dendrogram obtained from the cluster analysis of thirty observations of traditional knowledge in north-eastern Algeria

2. Multivariate Analysis

The variability or the homogeneity was investigated by multivariate tests. The thirty observations were submitted to hierarchical clustering analysis to distinguish clusters. The

dendrogram suggested the existence of two principal clusters (I and II), based on their differences in the selected criteria.

Fig. 2 represents the dendrogram which exhibited a clear separation of respondents at the fifteen cluster levels.

Group I included twenty-two informants, and could be divided into two sub-groups (IA, IB). Group II involved eight informants, with two sub-groups (IIA, IIB). The factors responsible for such similarity were explored for their relationship to the ethnobotanical observations. Then, the responses of thirty herbalists for six variables were recorded using principal component analysis. The two axes explained 73.9% of the observed variation. The X axis and the Y axis accounted for 39.1 and 34.8% of the variations, respectively.

The coefficients represent the correlation with the two axes. The efficacy and the UV were positively linked on the first factor (0.680, 0.631), but weakly related to the second factor (0.236, 0.308). In contrast, it was observed that the origin and the quality showed a positive link on the Y axis and loaded weakly on the X axis (0.660, 0.628) *vs* (0.457, 0.317). Additionally, the other two parameters: commercialization and dosage showed a weak correlation on both the X and Y axes. The values of the correlation coefficients were (0.009, 0.200) and (0.250, 0.060), respectively. The projection matrix is plotted in Fig. 3 in two-dimensional space, and depicted the position of the respondents underlying analyzed parameters. Two groups (I and II) could be distinguished based on the origin of the best drug. Indeed, it was observed that all of the herbalists in the first group mentioned India. Other sources such as China, Indonesia, and Malaysia were included in group II. Subgroups IA and IB could be distinguished by the use value (UV), which is moderately higher in subgroup IA than in subgroup IB. Subgroups IIA (30-27-29-28) and IIB (14-17-11-21) could be differentiated according to the efficacy of the drug. Herbalists of sub-group IIA indicated that *C. longa* was an effective drug. In contrast, this parameter was absent in subgroup IIB.

Regarding the dose of *C. longa* used, herbalists of group II were in agreement for use without a specific dosage. Participants (GII) suggested that this factor did not affect the knowledge use of *C. longa* in Algeria. In contrast, this observation varied in the first group.

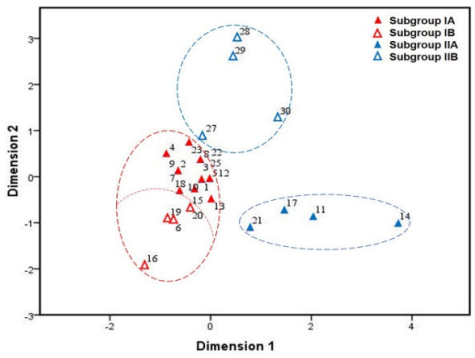

Fig. 3 Principal component analysis of thirty respondents in north-eastern Algeria

It is worth indicating that most of the herbalists in the Annaba and El Tarf areas were included in Group I (IA and IB) in addition to the sub-group IIA. However, all of the herbalists in the subgroup IIB are located in the Souk Ahras area, which also included those in the sub-group IA. According to the present study, there is no correlation between geographical factors and the traditional use of *Curcuma longa* in north-eastern Algeria.

IV. Conclusions

This study highlights the importance of the use of *Curcuma longa* in Algeria and the perceptions of herbalists to those uses. The local knowledge of *C. longa* in Algeria depends mainly on the traditional uses of turmeric in Ayruvedic herbal medicine. The variability of use is based on the origin and the quality of turmeric in Algeria.

The medicinal and economic importance of turmeric in Algeria necessitates the presence of new strategies to enhance its use. That focused on knowledge exchange with herbalists from Asian countries (mainly, India and China).

Additionally, Algerian quality control standards for different spices are required to check the authenticity and to assure the efficacy of turmeric.

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References

[1] K. Kubitzki, H. Huber, "Flowering plants, Monocotyledons: Alismatanae and Commelinanae (except Gramineae)", Springer-Verlag, New York, 1998, pp. 484.
[2] D.J. Mabberley, "Mabberley's plant-book : a portable dictionary of plants, their classification and uses," 3rd ed., Cambridge University Press, Cambridge, UK; 2008, pp. 239.
[3] C.C. Araujo, L.L. Leon, "Biological activities of *Curcuma longa* L.," *Mem. Inst. Oswaldo. Cruz,* vol. 96, no. 5, pp. 723–728, Jul. 2001.
[4] P.N. Ravindran, K. Nirmal Babu, K. Sivaraman, "Turmeric: the genus *Curcuma*, " CRC Press, Boca Raton, FL, 2007, pp. 130.
[5] U. Quattrocchi, "CRC world dictionary of medicinal and poisonous plants: common names, scientific names, eponyms, synonyms, and etymology, " CRC, Boca Raton, 2012, pp. 252.
[6] Indian Pharmacopoeia Commission, "Indian pharmacopoeia," 6th ed. vol. 3, Indian Pharmacopoeia Commission, Ghaziabad; 2010, pp. 2507–2508.
[7] K.G. Ramawat, "Herbal drugs: ethnomedicine to modern medicine," Springer, Berlin, 2009, pp. 255.
[8] I.A. Khan, E.A. Abourashed, "Leung's encyclopedia of common natural ingredients: used in food, drugs, and cosmetics," 3rd ed., John Wiley & Sons, Inc., Hoboken, N.J; 2010, pp. 603–605.
[9] V.S. Govindarajan, "Turmeric - chemistry, technology, and quality," *Crit. Rev. Food. Sci. Nutr.,* vol. 12, no. 3, pp: 199–301, Jun. 1980.
[10] H.P. Ammon, M.A. Wahl, "Pharmacology of *Curcuma longa,*" *Planta Med.,* vol. 57, no. 1, pp: 1–7, Feb. 1991.
[11] T. Fleming, PDR for herbal medicines, 2nd ed., Medical Economics Co., Montvale, NJ; 2000, pp. 775–777.
[12] S. Prasad, S.C. Gupta, A.K. Tyagi, B.B. Aggarwal, "Curcumin, a component of golden spice: From bedside to bench and back," *Biotechnol. Adv*., vol. 32, pp. 1053–1064, Apr. 2014.
[13] S.C. Gupta, S. Patchva, W. Koh, B.B. Aggarwal, "Discovery of curcumin, a component of golden spice, and its miraculous biological

activities," *Clin. Exp. Pharmacol. Physiol.,* vol. 39, no. 3, pp: 283–299, Mar. 2012.
[14] N.G. Bisset, M. Wichtl, "Herbal drugs and phytopharmaceuticals. A handbook for practice on a scientific basis with reference to German Commision E Monograph," 2 ed., CRC Press, Boca Raton, 2001, pp. 173–175.
[15] V. Hammiche, K. Maiza, "Traditional medicine in Central Sahara: pharmacopoeia of Tassili N'ajjer," *J. Ethnopharmacol.,* vol. 105, no. 3, pp: 358–367, Jan. 2006.
[16] A. Bouzabata, "Traditional treatment of high blood pressure and diabetes in Souk Ahras District," *J. Pharmacogn. Phytother.,* vol. 5, no. 1, pp: 12–20, 2013.
[17] R. Azzi, R. Djaziri, F. Lahfa, F.Z. Sekkal, H. Benmehdi, N. Belkacem, "Ethnopharmacological survey of medicinal plants used in the traditional treatment of diabetes mellitus in the North Western and South Western Algeria," *J. Med. Plants Res.,* vol. 6, no. 10, pp: 2041–2050, Mar. 2012.
[18] B. Hoffman, T. Gallaher, "Importance indices in ethnobotany," *Ethnobotany R. & A.*, vol. 5, pp: 201–218, 2007.
[19] M. Höft, S. Barik, A. Lykke, "Quantitative ethnobotany. Applications of multivariate and statistical analyses in ethnobotany," *PPI Working Paper.*, vol. 6, pp: 1–49, Jun. 1999.
[20] J. Friedman, Z. Yaniv, A. Dafni, D. Palewitch, "A preliminary classification of the healing potential of medicinal plants, based on a rational analysis of an ethnopharmacological field survey among Bedouins in the Negev desert, Israel," *J. Ethnopharmacol.* vol. 16, no. 2-3, pp: 275–287, 1986.
[21] O. Phillips, A.H. Gentry, "The useful plants of Tambopata, Peru: I. Statistical hypotheses tests with a new quantitative technique," *Econ. Bot.,* vol. 47, no. 1, pp: 15–32, Jan-Mar. 1993a.
[22] O. Phillips, A.H. Gentry, "The useful plants of Tambopata, Peru: II. Additional hypothesis testing in quantitative ethnobotany," *Econ. Bot.,* vol. 47, no. 1, pp: 33–43, Jan-Mar. 1993b.
[23] A. Gomez-Beloz, "Plant use knowledge of the Winikina Warao: the case for questionnaires in ethnobotany," *Econ. Bot.,* vol. 56, no. 3, pp: 231–241, Fall. 2002.
[24] F. Baba Aissa, "Encyclopédie des plantes utiles. Flore d'Algérie et de Maghreb. Substances végétales d'Afrique d'Orient er d'Occident," EDAS, Alger, 2000, pp. 337.
[25] S.C. Gupta, B. Sung, J.H. Kim, S. Prasad, S. Li, B.B. Aggarwal, "Multitargeting by turmeric, the golden spice: From kitchen to clinic," *Mol. Nutr. Food Res.,* vol. 57, no.: 9, pp: 1510–1528, Sept. 2013.
[26] A.S. Negi, J.K. Kumar, S. Luqman, K. Shanker, M.M. Gupta, S.P. Khanuja, "Recent advances in plant hepatoprotectives: a chemical and biological profile of some important leads," *Med. Res. Rev.,* vol. 28, no. 5, pp: 746–772, 2008.
[27] S.M. Salama, M.A. Abdulla, A.S. AlRashdi, S. Ismail, S.S. Alkiyumi, S. Golbabapour, "Hepatoprotective effect of ethanolic extract of *Curcuma longa* on thioacetamide induced liver cirrhosis in rats," BMC *Complement. Altern. Med.,* vol. 13, no. 56, pp: 1–17, Mar. 2013.
[28] A.G. Singh, A. Kumar, D.D. Tewari, "An ethnobotanical survey of medicinal plants used in Terai forest of western Nepal," *J. Ethnobiol. Ethnomed*., vol. 8, no. 19, pp: 1–14, May. 2012.
[29] G. Calapai, M. Miroddi, P.L. Minciullo, A.P. Caputi, S. Gangemi, R.J. Schmidt, "Contact dermatitis as an adverse reaction to some topically used European herbal medicinal products - part 1: *Achillea millefolium-Curcuma longa*," *Contact Dermatitis*, vol. 71, no. 1, pp: 1–12, 2014.
[30] C.P. Khare, C.K. Katiyar, "The modern Ayurveda: milestones beyond the classical age," Taylor & Francis, Boca Raton, FL; 2012, pp. 165.
[31] C.P. Khare, "Indian medicinal plants an illustrated dictionary," Springer-Verlag, Berlin, Germany; 2007, pp.187–188.
[32] M. Ayyanar, S. Ignacimuthu, "Herbal medicines for wound healing among tribal people in Southern India: Ethnobotanical and Scientific evidences," *Int. J. App. Res. Nat. Prod.,* vol. 2, no. 3, pp: 29–42, Sep. 2009.
[33] D. Eigner, D. Scholz, "*Ferula asa-foetida* and *Curcuma longa* in traditional medical treatment and diet in Nepal," *J. Ethnopharmacol.,* vol. 67, no. 1, pp: 1–6, Oct. 1999.
[34] K.C. Velayudhan, N. Dikshit, M. Abdul Nizar, "Ethnobotany of turmeric (*Curcuma longa* L.)," *Indian J. Tradit. Know.,* vol. 11, no. 4, pp: 607–614, Oct. 2012.