

PHARMACOGNOSTICAL AND PHYTOCHEMICAL EVALUATION OF STEM AND LEAVES OF SALVADORA OLEOIDES DECNE

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Abstract

Pharmacognostic study of powdered stem and leaves of *Salvadora oleoides* Decne. was carried out for the authentication of powdered drug. Preliminary phytochemical screening of stem and leaves mainly revealed the presence of saponins, flavonoids, triterpenoids, acidic compounds, phenols, lipids, carbohydrates. Tannins were found to be present only in leaves while coumarins were detected only in stem. Alkaloids, glycosides, anthraquinones and steroids were found to be absent both in the stem and leaves. The pharmacognostic evaluation of both parts showed the visibility of varying colours using hot as well as cold test methods. Moreover, behaviour of the powdered drug was checked through various reagents using U.V light of both short and long wavelengths.

Physicochemical studies such as ash values, extractive values and moisture content of plant parts were carried out to confirm the identity of plant and to assure the quality and purity of the drug. Total ash content of leaves and stem was estimated to be 33.59% and 11.56% respectively. Water soluble ash content of leaves and stem was found to be 12.76% and 4.07% respectively. HCl and HNO₃ insoluble ash content of the leaves was found to be higher as compared to the stem i.e. 5.09% and 5.97% in leaves and 1.69 and 2.3% in stem respectively. Extractive values such as water soluble extractive values, alcohol soluble extractive values, benzene soluble extractive values and chloroform soluble extractive values were also found to be higher in leaves as compared to that of the stem i.e. 20.85%, 17.25%, 5.67% and 3.94% in leaves compared to 19.15%, 8.71%, 3.22% and 3.59% respectively in stem.

INTRODUCTION

Plants have played a promising role with respect to the maintenance and improvement of human health and quality of life over centuries by providing humans with valuable ingredients of medicines, seasonings, beverages, cosmetics, dyes etc. Herbal medicinal system ensures that natural substances present in the plants can play an important role to improve health and cure ailments. At present, most of the research has been focused towards plants all over the world that ensured the great potential of medicinal plants to be employed in various traditional systems. Now days, a great deal of public interest is quite evident with respect to the use of herbal remedies (Arulmozhi et al., 2007). The extraction and development of certain useful drugs and chemotherapeutic agents from the plants as well as use of traditional herbal remedies has resulted in the development of products from natural origin in the developed countries (UNESCO, 1998). The general opinion regarding the plant based products among society and medical community is that these are healthier, safer, and much more reliable than those of synthetic products (Benli et al., 2008). There is need to document the information of the traditional medicines as well as some initiative must be taken to standardize the plant material to be used as medicine (Ozarka, 2005).

Pharmacognostic techniques employed to standardize plant material involves physico-chemical constituents, fluorescence analysis and preliminary photochemical analysis (Anonymous, 1998). Certain phytochemical constituents having variable composition are occurring as secondary metabolites, primarily responsible for the healing properties of medicinal plants (Karthikeyan et al., 2009, Lozoya et al., 1989). The most important of these compounds include alkaloids, terpenoids, steroids, phenols, glycosides and tannins (Abayomi, 1993). Therefore, medicinal plants form a diverse group of economical importance by providing the basic ingredients for indigenous pharmaceuticals (Aiyelaagbe et al., 2001; Augusti et al., 1996).

Salvadora oleoides Decne. is small sized upto 9m tall tree belonging to the family Salvadoraceae (Anonymous, 2010 a). It possesses a short trunk, quite often twisted or bent, up to 2 m in diameter. Leaves are elliptic-lanceolate, coriaceous and somewhat fleshy, dark greenish-yellow when young, gray when mature. Flowers are stalkless, greenish-white, condensed in panicle spikes, often clustered (Orwa et al., 2009). The plant is known with the medicinal properties that possesses anti-diarrhoeal, anti-phlegmatic, anti-septic, carminative, deobstruent, detergent, diuretic, emmenagogue, resolvent and stimulant pharmacological properties (Anonymous, 2010 b). Ethnobotanically, leaf extract is used to prepare an ointment which is used by the locals for healing wounds (Khan, 1996). The fruit possesses a sharp, pungent, acrid and sweet-sour taste with a flavor, appetizer, laxative, carminative, alexipharmic, plays an important role to cure piles, tumors, bronchitis, diseases of the spleen, ascites. The root bark serves as a vesicant (Panhwar and Abro, 2007; Ahmad, 2007). The plant is also used to cure cold, flu and cough (Khan and Qaiser, 2006). Seeds of *S. oleoides* contain a thioglucoside, glucotropaeolin related to mustard oils of Cruciferae (Kjaer, 1963), while myristic, lauric and palmitic acids are found to be present in the seed fat (Khare, 2007).

Since the plant is significantly used in traditional medicines and its pharmacognostic study is not previously documented, therefore present study was carried out to identify, characterize and standardize the drug plant parts and their phytochemical screening for the validation of folk claims.

Material and Methods

Plant Material

The first step in standardization of herbal drugs involves the correct identification of plant, microscopic and macroscopic characters. The plant specimens and materials were collected from Mianwali and identified at Quaid-i-Azam University Herbarium, Islamabad. (Fig. 1). Drug was powdered and stored at 25°C in an air tight container. The chemicals used in the experiments were of analytical grade. Fresh material was shade dried, powdered and stored for future use.

Organoleptic Evaluation

The morphological characters such as color, odour, taste and texture of stem and leaves of *Salvadora oleoides* were studied.

Preparation of plant extract

The stem and leaves were washed in tap water, shade dried for 10 days and made into a fine powder using the laboratory mill. 100g of powder was extracted with different organic solvents including water, methanol and ethanol, was allowed to stand for three days. The extract was filtered through Whatman no.1 filter paper to remove all unextractable matter, including cellular materials and other constitutions that are insoluble in the extraction solvent. The entire extract was concentrated to dryness using rotary flash evaporator under reduced pressure.

Macroscopic and Microscopic analysis of Leaf

The macroscopy of leaf was studied according to the method of Brain and Turner (1975), while foliar epidermal anatomy was studied according to modified method of Cotton (1974) and Shultze's method of maceration with improved technique (Subrahmanyam, 1996).

Preliminary Phytochemical Screening

The primary metabolites like carbohydrates and fats were analyzed for their presence as per standard procedures (Kokate, 1986; Harborne, 1998). Similarly, the secondary metabolites like, alkaloids, flavonoids, saponins, terpenoids, phenols, tannins, glycosides, anthraquinones, coumarins, steroids, acidic compounds, resins and phlobatannins were also qualitatively assessed in the leaf and stem extracts of *S. oleoides* (Herbrone, 1973; Trease and Evans, 1989; Sofowara, 1993 and Ngbege et al., 2008). Furthermore, flavonoids (Boham and Kocipai, 1974), saponins (Obadoni and Ochuko, 2001), fats (A.O.A.C, 2000) and phenols (Singleton and Rossi, 1965) were quantitatively analyzed.

Physico-chemical Evaluation and Pharmacognostic Studies

Physico-chemical analysis i.e. percentage of ash values and extractive values were performed according to the methods prescribed (A. O. A. C., 2000; Indian pharmacopeia, 1966 ; WHO guidelines, 1992). Moisture content was estimated according to standard procedure of Sadasivam and Balasubramanian (1987). Fluorescence analysis was carried out according to the method of Madhavan et al. (2009 a); Madhavan et al. (2009 b) and Ansari (2010) with slight modifications.

Results

Organoleptic Evaluation

The color, texture, odour and taste of the plant powder were analyzed and presented in Table 1.

Table 1. Organoleptic evaluation of powdered drug of stem and leaves

Particulars	Plant part	
	Leaf	Stem
Colour	Dull Green	Grayish White
Odour	Characteristic	Characteristic
Taste	Slightly Sweetish	Tasteless
Texture	Leathery	Glabrous

Macroscopy of leaf:

Leaves were simple, opposite, 1.5-7.5cm x 0.4-1.5cm in size, elliptic to lanceolate, apex acute to sub-acute or obtuse, margins entire, coriaceous, dark green when young, grayish at maturity (Fig. 1).

Microscopy of leaf

Ordinary epidermal cells were found to be variously shaped with adaxial cells length 28.44 μ m and breadth 28.75 μ m (Fig. 2) while abaxial cells length was 21.56 μ m with breadth 33.75 μ m (Fig. 3). Stomatal length and breadth was observed to be 13.13 μ m x 5.63 μ m respectively. Guard cells were found to be 23.44 μ m long and 11.88 μ m broad. Unicellular trichomes were scarcely present both on abaxial and adaxial surfaces. Trichomes length was estimated 13 μ m with breadth of 4 μ m (Fig. 4).

Fig 1: *Salvadora oleoides* Decne.

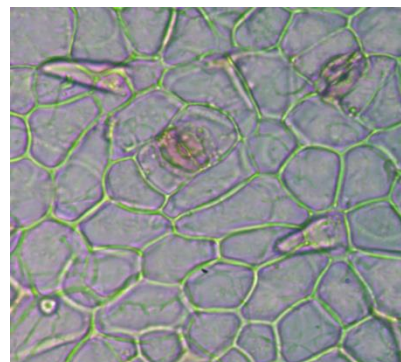
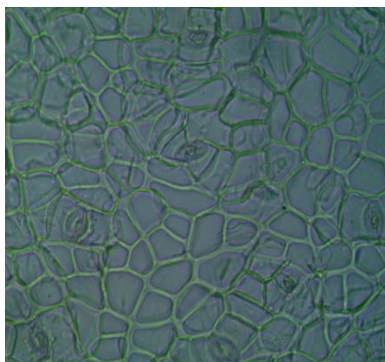
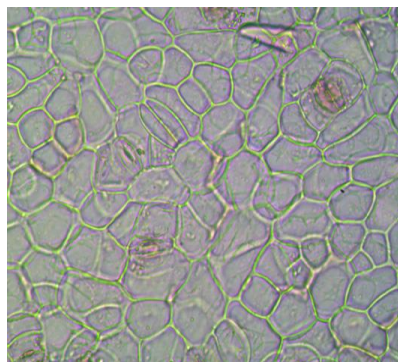


Fig 2. Adaxial Leaf Epidermis

Fig 3. Abaxial Leaf Epidermis

Fig 4. Trichomes features

Physico-chemical Evaluation and Pharmacognostic Studies

Physico-chemical parameters including extractive values, moisture content and ash content (i.e. water soluble ash content, acid insoluble ash content) of stem and leaves of *Salvadora oleoides* are presented in Table 2 and 3, while pharmacognostic evaluation of stem and leaves of *Salvadora oleoides* has been tabulated in Table 4. Behaviour of powdered drug of stem and leaves towards various reagents is evident from Fig. 5 and 6.

Table 2. Ash content of the stem and leaves of *S. oleoides*

	Percentage (%)	
	Stem	Leaf
Total Ash Content	11.56	33.59
Water Soluble Ash	4.07	12.76
HCl Insoluble Ash	1.69	5.09
HNO ₃ Insoluble Ash	2.3	5.97
Moisture Content	6.46	8.9

Table 3. Extractive values of the stem and leaves of *S. oleoides*

Solvent Used	Percentage (%)	
	Stem	Leaf
Distilled Water	19.15	20.85
Methanol	8.715	17.25
Ethanol	14.16	14.54
Chloroform	3.59	3.94
Benzene	3.22	5.67



Fig. 5. Colour analysis of powdered drug of stem using various solvents



Fig. 6. Colour analysis of powdered drug of leaves using various solvents

Preliminary Phytochemical Screening

Preliminary phytochemical screening of alcoholic extract of stem and leaves of *S. oleoides* showed significant results as shown in Table 5, while quantitative determination of saponins, fats and flavonoids have been presented in Table 6.

Table 4. Preliminary phytochemical screening of powder and alcoholic extract of stem and leaves of *Salvadora oleoides* Decne.

Sr. No.	Test Performed	Part Used	Alcoholic Extract	Using Powder
1.	Test for Tannins	Stem	-	-
		Leaf	+	+
2.	Test for Saponins	Stem	+	+
		Leaf	+	+
3.	Test for Flavonoids	Stem	+	+
		Leaf	+	+
4.	Test for Triterpenoids	Stem	+	+
		Leaf	+	+
5.	Test for Alkaloids	Stem	-	-
		Leaf	-	-
6.	Test for Cardiac Glycosides	Stem	-	-
		Leaf	-	-
7.	Test for Coumarins	Stem	+	+
		Leaf	-	-
8.	Test for Acidic Compounds	Stem	+	+
		Leaf	+	+
9.	Test for Anthraquinones	Stem	-	-

		Leaf	-	-
10.	Test for Phenols	Stem	+	+
		Leaf	+	+
11.	Test for Steroids	Stem	-	-
		Leaf	-	-
12.	Test for Carbohydrates	Stem	+	+
		Leaf	+	+
13.	Test for Reducing Sugars	Stem	+	+
		Leaf	+	+
14.	Test for Resins	Stem	-	-
		Leaf	-	-
15.	Test for Pholabatannins	Stem	-	-
		Leaf	-	-
16.	Test for Lipids/Fats	Stem	+	+
		Leaf	+	+

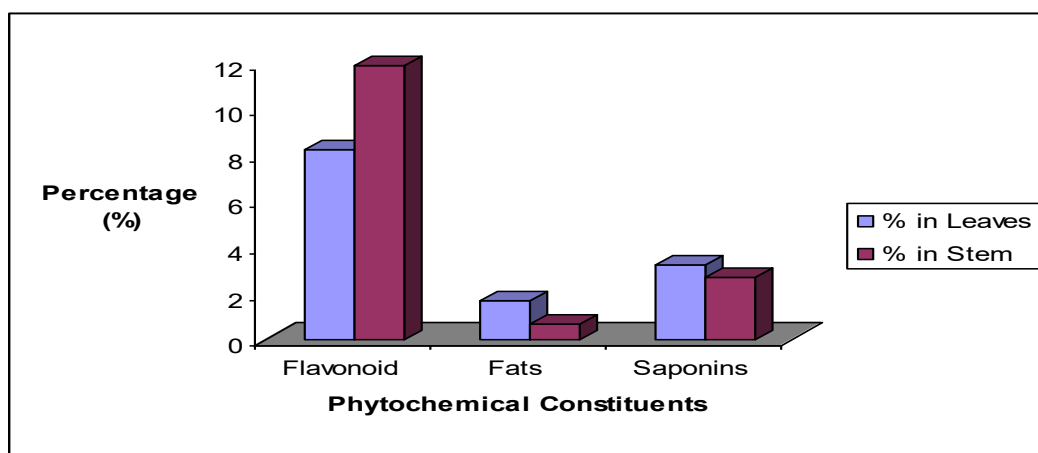


Fig 7. Quantitative determination phytochemicals of stem and leaves of *S. oleoides* Decne.

Discussion

All the results obtained from present study have been presented in the respective tables. The powdered drug of stem and leaf of *Salvadora oleoides* were subjected to physico-chemical and phytochemical screening which were found to be very promising.

Physico-chemical parameters are usually helpful in prevention of adulteration and in authentication of the crude drug. Ash values of a drug give an idea of earthy matter or inorganic composition present along with the drug which clearly depicts that ash value is indicative of impurities being present in the drug (Table 2). The ash content of a particular plant remains constant for that species, therefore serves an important parameter for the purpose of evaluation of any drug. Water-soluble ash is a good indicator of either previous extraction of the water-soluble salts in the drug or incorrect preparation. Acid insoluble ash value on the other hand indicates contamination with silicious material e.g., earth and sand. Moisture content is one of the important factors affecting the bacterial and fungal growth, which ultimately causes spoilage. Therefore, moisture content is an important parameter in controlling the quality of crude drug. Moreover, the percentage of active chemical constituents in crude drugs is given in terms of air dried drugs. Hence the moisture content of a drug should be determined. Extractive values are primarily useful for the determination of exhausted or adulterated drugs and these may provide the basis to identify the quality and purity of the drug. Standardization of extraction procedures contributes significantly to the final quality of the herbal drug (Handa et al., 2008). The pharmacognostic parameter may play its part to detect the authenticity of the medicinal plants. The basic purpose to carry out pharmacognostic and diagnostic characters is to standardize methods for the quality control and assurance in order to provide a baseline to commercialize plant constituents for herbal products (Anwar, 2006).

Phytochemical screening of alcoholic extract of stem and leaves of *S. oleoides* showed significant results as shown in Table 5. Preliminary phytochemical screening of stem and leaves of *Salvadora oleoides* mainly revealed the presence of saponins, flavonoids, triterpenoids, acidic compounds, phenols, lipids, carbohydrates and reducing sugars. Tannins were present only in leaves while coumarins were found to be present only in stem. Alkaloids, glycosides, anthraquinones, steroids,

phlobatannins and resins were absent both in the stem and leaves. Quantitative determination of saponins, fats and flavonoids also yielded significant results. Majority of phytochemicals have been known to bear valuable therapeutic activities such as insecticidal (Kambu et al., 1982), antibacterial, antifungal (Lemos et al., 1990), anticonstipative (Ferdous et al., 1992), spasmolytic (Sontos et al., 1998), antiplasmodial (Benoitvical et al., 2001) and antioxidant (Vardar-unlu et al., 2003) activities etc. The plants thus find their medicinal value due to respective phytochemical constituents they contains. Pharmacological activities have been reported about saponins such as antibiotic, antifungal, antiviral, hepatoprotective, anti-inflammatory and anti-ulcer (Oakenfull, 1986; Zhang, 2001). Tannins are basically used to heal inflammation, leucorrhoea, gonorrhoea, burn, piles, diarrhea and as antidote in the treatment of alkaloidal poisoning (Buzzini et al., 2008). Phenols are very wide spread in nature. They range from simple structures having a simple aromatic ring to highly complex polymeric structures and often exist in glycosidic forms (Williamson and Manach, 2005). Tannins, phenolics, saponins, alkaloids and flavonoids have been linked or suggested to be involved with antibacterial and anti-viral activity while tannins and flavonoids are thought to be responsible for antidiarrheal activity (Enzo, 2007). Flavonoids are one of the most widely distributed natural products in plants. Investigations of the mode of action indicate that tannins and flavonoids increase colonic water and electrolyte reabsorption and other phytochemicals act by inhibiting intestinal mobility, while some components have been shown to inhibit particular enteropathogens (Enzo, 2007). Therapeutically terpenoids exert wide spectrum of activities such as antiseptic, stimulant, diuretic, anthelmintic, analgesic and counter-irritant (Gokhale et al., 2003). Coumarins, phenolic substances made of fused benzene and alpha-pyrone rings, have long been recognized to possess anti-inflammatory, antioxidant, anti-allergic, hepatoprotective, antithrombotic, antiviral, and anticarcinogenic activities. Alkaloids are considered to be associated with medicinal uses for centuries and one of their common biological properties is their cytotoxicity (Nobori et al., 1994), and their absence in this plant might prove helpful to lower the risk of poisoning by the plant. Thus, the pharmacological activities of this plant.

References

- A.O.A.C. 2000. Methods of Analysis by Association of Official Analytical Chemists. Washington D.C., USA.
- Abayomi, S. 1993. Historical review of traditional medicine in Africa. Spectrum Book Ltd. Ibadan, p: 9-25.
- Ahmad, F. 2007. GIS, GPS and remote sensing application to investigate agricultural potential in Cholistan. Sociedade & Natureza Uberlandia, 19: 55-64.
- Aiyelaagbe, O. 2001. Antibacterial activity of *Jatropha multifida* roots. J. Fit. 72(5): 544-546.
- Anonymous. 1998. Macroscopic and microscopic Examination: Quality Control methods for medicinal plant materials, WHO, Geneva.
- Anonymous. 2010 b. <http://www.druginfosys.com/herbal/Herb.aspx?Code=739&name=Salvadora%20oleoides%20Decne.&type=2>
- Anonymous. 2010 a. <http://worldagroforestrycentre.org/SEA/Products/AFDbases/AF/asp/SpeciesInfo.asp?SpID=17991>.
- Ansari, S.H. 2010. Essentials of Pharmacognosy, 4th ed; Birla Publications: Delhi.
- Anwar, M. 2006. The pharmacognostic and pharmacological studies on medicinal valued herbal drugs, *Erythrina variegata* var *orientalis*, *Matricaria chamomilla*, *Psoralea corylifolia* and *Chenopodium album*. Ph.D Thesis, Department of Pharmacognosy, University of Karachi, Pakistan.
- Arulmozhi, S., P.M. Mazumder, P. Ashok, S.L. Narayanan. 2007. Pharmacological activities of *Alstonia scholaris* linn. (Apocynaceae) - A Review. Pharma. Rev. 1(1): 163-170.
- Augusti, K.T. 1996. Therapeutic values of onion and garlic. Indian J. Exp. Biol. 34(3): 634-640.
- Benli M., U. Bingol, F. Geven, K. Guney and N. Yigit. 2008. An investigation on to antimicrobial activity of some endemic plant species from Turkey. Afr. J. Biotechnol. 7 (1): 001-005.
- Benoitvical, F., A. Valentin, M. Mallic and J.M. Bassierc. 2001. Antiplasmodial activity of *Colchosperrum planchonii* and *C. tinctorium* tubercle essential oils. J. Essent. Oil Res., 13: 65-67.

- Boham, B.A. and A.C. Kocipai. 1974. Flavonoids and condensed tannins from leaves of Hawaiian *vaccinium vaticulatum* and *V. calycinium*. *Pacific Sci.* 48: 458-463.
- Brain, K. R. and T. D. Turner. 1975. *The practical evaluation of phytopharmaceuticals*, Wright-Scientific, Bristol. 4-9.
- Buzzini, P., P. Arapitsas, M. Goretti, E. Brand, B. Turchetti, P. Pinelli, F. Leri and A. Romani. 2008. Antimicrobial and antiviral activity of hydrolysable tannins *Mini. Rev. Med. Chem.*, 8: 1179-1178.
- Clark, J. 1960. Preparation of leaf epidermis for topographic study. *Stain Technol.*, 35: 35-39.
- Cotton, R. 1974. Cytotaxonomy of the genus *Vulpia*. (unpublished) Ph.D. Thesis, Univ. Manchester, USA.
- Enzo, A.P. 2007. Traditional plants and herbal remedies used in the treatment of diarrheal disease: Mode of action, quality, efficacy and safety considerations. In: Ahmad I, Aqil F, Owais M, editors. *Modern Phytomedicine Turning Medicinal Plants in to Drugs*. WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim, pp. 248-260.
- Ferdous, A.J., S.M. Islam, M. Ahsan, C.M. Hassan and Z.V. Ahmad. 1992. In vitro antibacterial activity of the volatile oil of *Nigella sativa* seeds against multiple drug-resistant isolates of *Shigella* spp. and isolates of *Vibrio cholerae* and *Escherichia coli*: *Phytother. Res.*, 6: 137-140.
- Gokhale, S.G., C.K. Kokate and A.P. Purohit. 2003. *A text Book of Pharmacognosy*, Nirali Prakashan, Pune.
- Handa, S. S., S.P. S. Khanuja, G. Longo, D.D. Rakesh. 2008. *Extraction technologies for medicinal and aromatic plants*. International Centre for Science and High Technology Trieste.
- Harborne, J.B. 1998. *Methods of extraction and isolation*, In: *phytochemical methods*, Chapman and Hall, London. 60-66.
- Herborn, J.B. 1998. *Phytochemical Methods: A guide to modern techniques of plant analysis*, 2nd Edition Hall, New York, p: 5-11.
- Indian Pharmacopoeia. 1996. Government of India, Ministry of health and human welfare, New Delhi (India): Controller of publications; 2: A53-A54.

- Kambu, K., D. Phenzu, N. C. Coune, J. N. Wauter and L. Angenot. 1982. Plants Medicine ET Phytotherapie, p. 34.
- Karthikeyan A., V. Shanthi and A. Nagasathaya. 2009. Preliminary phytochemical and antibacterial screening of crude extract of the leaf of *Adhatoda vasica* L. Int. J. Green Pharm. 3: 78-80.
- Khan, A.U. 1996. Appraisal of ethno-ecological incentives to promote conservation of *Salvadora oleoides* Decne: The case for creating a resource area. Biological Conservation, 75: 187-190.
- Khan, M.A. and M. Qaiser. 2006. Halophytes of Pakistan: Characteristics, distribution and potential economic usages. Sabkha Ecosystems. M.A. Khan, G.S. Kust, H.-J. Barth and B. Böer (eds.). Vol: II: 129-153.
- Khare, C.P. 2007. Indian medicinal plants: An illustrated dictionary. Springer Science+Business Media, LLC., 233 Spring Street, New York, NY 10013, USA, p. 574.
- Kjaer, A. 1963. The distribution of sulphur compounds. In: Chemical plant Taxonomy (ed. T. Swain). Academic Press, London, p: 453.
- Kokate, C.K. 1986. Practical Pharmacognosy. New Delhi (India): Vallabh Prakashan.
- Lemos, T.L.G, F.J.A. Matos, J.W. Alencar, A.A. Crareiro, A.M. Clark and J.D. Chesnary. 1990. Antimicrobial activity of essential oils of Brazilian plants: Phytopther. Res., 4: 82-84.
- Lozoya M. and X. Lozoya. 1989. Pharmacological properties in vitro of various extracts of *Mimosa pudica* Linn. Tepescohuite Arch Invest Mex. pp. 87-93.
- Madhavan, V., H. Basnett, M.R. Gurudeva and S.N. Yoganarsimhan. 2009 a. Pharmacognostical Evaluation of *Droseraburmannii* Vahl (Droseraceae). Indian J. Traditional Knowledge. 8(3): 326-333.
- Madhavan, V., Pravinkumar, P. Zamabad, M.R. Gurudeva and S.N. Yoganarsimhan. 2009 b. Pharmacognostical Evaluation of root bark of *Streblus asper* Lour. Indian Journal of Traditional Knowledge. 8(2), 176-180.
- Ngbege, J., R.A. Yarkuba and D.A. Njam, 2008. Phytochemical screening for active compounds in *Conarium schweinfurthii* (Atile) leaves from Jos North, Plateau State Nigeria. Res. J. Bio. Sci., 3(9): 1070-1078.

- Nobori, T., K. Miurak, D.J. Wu, L.A. Takabayashik, D.A. Carson. 1994. Deletion of the cyclin-dependent kinase-4 inhibitor gene in multiple human cancers. *Nature*, 368 (6473): 753-756.
- Oakenfull, D.G. 1986. Aggregation of bile acids and saponins in aqueous solution, *Austr. J. Chem.*, 39 1671-1683.
- Obdoni, B.O. and P.O. Ochuko P.O. 2001. Phytochemical studies and comparative efficacy of the crude extracts of some Homostatic plants in Edo and Delta States of Nigeria. *Global J. Pure Appl. Sci.* 8 b:203-208.
- Orwa, C., A. Mutua, R. Kindt, R. Jamnadass and A. Simons. 2009. World Agroforestry Centre ICRAF. Agroforestry database: A tree species reference and selection guide version 4.0 Nairobi, Kenya.
- Ozarka, K.R. 2005. Studies on anti-inflammatory effects of two herbs *Cissus quadrangularis* Linn, and *Valeriana wallichii* DC using mouse model. Ph.D. Thesis, university of Mumbai, Mumbai.
- Panhwar, A.Q. and H. Abro. 2007. Ethnobotanical studies of Mahal Kohistan (Khirthar National Park). *Pak. J. Bot.*, 39(7): 2301-2315.
- Sadasivam, S., Balasubramanian. 1987. Practical Manual in Biochemistry, Tamilnadu agricultural university, Coimbatore. Pp. 17.
- Singleton, V.L. and J.A. Rossi. 1965. Colorimetry of total phenolics with phosphomolybdic-phosphotungstic acid reagents. *Am. J. Enol. Vitic.* 16: 144-158.
- Sofowara, A. 1993. Medicinal plants and Traditional medicine in Africa. Spectrum Books Ltd, Ibadan, Nigeria. p. 289.
- Sontos, F.A., V.S.N. Rao and E.R. Silveria. 1998. Investigations on the antinociceptive effect of *Psidium guajava* leaf essential oil and its major constituents. *Phytother. Res.*, 12: 24-27.
- Subrahmanyam, N.S. 1996. Laboratory Manual of Plant Taxonomy, Vikas Publishing house pvt., Ltd., New Delhi, p: 153-6.
- Trease, G.E. and W.C. Evans. 1989. Trease and Evans' Mexican medicinal plants. *J. Ethnopharmacol., Pharmacognosy*, 13th Edn. Baillière Tindall, London.

- UNESCO. 1998. FIT/504-RAF48. Terminal report. Promotion of ethnobotany and the sustainable use of plant resources in Africa, Paris . pp. 60-61.
- Vardar-unlu, G., F. Cadan and A. Sokmen. 2003. Deferera, Polissiou, M. Sokmen, M. Donmez, E and tap bektas J. Agric. Food. Chem., pp. 51-63.
- WHO/ PHARM/ 92.559/ rev.1., Quality control methods for medicinal plant materials, Organisation Mondiale De La Sante, Geneva. 9: 22-34.
- Williamson, G. and C. Manach. 2005. Bioavailability and bioefficacy of polyphenols in humans. II. Review of 93 intervention studies. Am. J. Clin. Nutr., 81(1): 243-55.
- Zhang, Y.W., D.Q. Due, L. Zhang, Y.J. Chen and X.S. Yao. 2001. Effects of Ginsenosides from Panax ginseng on cell-to-cell communication function mediated by gap junctions, Plants Med., 67: 417-422.