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Review Article

Importance and Scope of Standardization of Drugs in Indian Medicine

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Abstract

Standardization of drugs in Indian medicine is not an easy task as numerous factors influence the bio efficacy and reproducible therapeutic effect. In order to obtain quality oriented herbal products, care should be taken right from the proper identification of plants, season and area of collection and their extraction and purification process and rationalizing the combination in case of polyherbal drugs. This paper reviews the importance and scope of standardization of drugs in Indian medicine.

1. INTRODUCTION

In recent years, there has been great demand for plant derived products in developed countries. These products are increasingly being sought out as medicinal products, nutraceuticals and cosmetics[1]. There are around 6000 herbal manufacturers in India. More than 4000 units are producing Ayurveda medicines. Due to lack of infrastructures, skilled manpower reliable methods and stringent regulatory laws most of these manufacturers produce their product on very tentative basis[2].

In order to have a good coordination between the quality of raw materials, in process materials and the final products, it has become essential to develop reliable, specific and sensitive quality control methods using a combination of classical and modern instrumental method of analysis. Standardization is an essential measurement for ensuring the quality control of the herbal drugs[3]. "Standardization" expression is used to describe all measures, which are taken during the manufacturing process and quality control leading to a reproducible quality. It also encompasses the entire field of study from birth of a plant to its clinical application. It also means adjusting the herbal drug preparation to a defined content of a constituent or a group of substances with known therapeutic activity respectively by adding excipients or by mixing herbal drugs or herbal drug preparations[4]."Evaluation" of a drug means confirmation of its identity and determination of its quality and purity and detection of its nature of adulteration[5].

Standardization of herbal drugs is not an easy task as numerous factors influence the bio efficacy and reproducible therapeutic effect. In order to obtain quality oriented herbal products, care should be taken right from the proper identification of plants, season and area of collection and their extraction and purification process and rationalizing the combination in case of polyherbal drugs[5].

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2. DRUG STANDARDIZATION

The Standardization of crude drug materials includes the following steps:

2.1 Authentication

a) Each and every step has to be authenticated.
b) Stage of collection.
c) Parts of the plant collected.
d) Regional status.
e) Botanical identity like phytomorphology, microscopical and histological analysis (characteristic of cell walls, cell contents, starch grains, calcium oxalate crystals, trichomes, fibers, vessels etc)[6]. Various histological parameter studies are:

1. Leaf constant: Palisade ratio, Vein islet number, Vein termination, Stomatal number, and Stomatal index.
2. Trichomes.
3. Stomata.
4. Quantitative microscopy.
5. Taxonomical identity.
6. Foreign matter.
7. Organoleptic evaluation.
8. Ash values and extractive values.
9. Moisture content determination.
10. Chromatographic and spectroscopic evaluation.
11. Heavy metal determination.
12. Pesticide residue.
13. Microbial contamination.
14. Radioactive contamination.

The herbal formulation in general can be standardize schematically as to formulate the medicament using raw materials collected from different localities and a comparative chemical efficacy of different batches of formulation are to be observed. The preparations with better clinical efficacy are to be selected. After all the routine physical, chemical and pharmacological parameters are to be checked for all the batches to select the final finished product and to validate the whole manufacturing process[6].

The stability parameters for the herbal formulations which include physical, chemical and microbiological parameters are as follow:

2.2 Physical parameters include color, odor, appearance, clarity, viscosity, moisture content, pH, disintegration time, friability, hardness, flow ability, flocculation, sedimentation, settling rate and ash values.

2.3 Chemical parameters include limit tests, chemical tests, chemical assays etc.

2.4 Chromatographic analysis of herbals can be done using TLC, HPLC, HPTLC, GC, UV, GC-MS, fluorimetry etc.

2.5 Microbiological parameters include total viable content, total mold count, total enterobacterial and their count. Limiters can be utilized as a quantitative or semi quantitative tool to ascertain and control the amount of impurities like the reagents used during abstraction of various herbs, impurities coming directly from the manufacturing vessels and from the solvents etc.

3. WHO GUIDELINES

The subject of herbal drug standardization is massively wide and deep. The guidelines set by WHO can be summarized as follows:-

- Reference to the identity of the drug. Botanical evaluation-sensory characters, foreign organic matter, microscopical, histological, histochemical evaluation, quantitative measurements etc.
- Reference to the physicochemical character of the drug. Physical and chemical identity, chromatographic fingerprints, ash values, extractive values, moisture content, volatile oil and alkaloidal assays, quantitative estimation protocols etc.
- Reference to the pharmacological parameters, biological activity profiles, bitterness values, hemolytic index, astringency, swelling factor, foaming index etc.
- Toxicity details- pesticide residues, heavy metals, microbial contamination like total viable count, pathogens like *E.coli, Salmonalla, P.aeroginosa, S. aureus, Enterobacteria* etc.
- Microbial contamination.
- Radioactive contamination.

3. MODERN HERBAL AYURVEDIC MONOGRAPHS

In the modern herbal ayurvedic monographs the standardization parameters are discussed in a comprehensive way. According to the modern ayurvedic monograph the quality control protocols include the following:

The synonyms, publication related to the plant, constituents present, analytical methods.

Descriptive evaluation: Description of the drug, phytomorphological, microscopical, organoleptic evaluation, foreign matter etc.

3.1 WHO Guidelines Monograph Titles[7]

- **Botanical**: Sensory evaluation, Foreign matter, Microscopy measurement.
- **Physicochemical TLC**: Ash, Extractable matter, Water content and volatile matter, Volatile oils.
- **Pharmacological**: Bitterness value, Haemolytic activity, Astringency, Sterling index, Foaming index.
- **Toxicological**: Pesticide residue, Arsenic, Metals.
- **Microbial contamination**: Total viable count, Pathogens, Aflatoxins, Radioactive contamination.

4. STANDARDIZATION OF HERBAL PRODUCTS

Commercial production of herbal medicines and their trade are fast growing sector of industry today, due to increasing demand of medicinal plants; the supply line is adversely affected leading to the adulteration and substitution for genuine drugs.

1. Fluorescence quenching: When a plant extract is spotted on a fluorescent silica gel layer and exposed to UV light, it appears as spot on a fluorescent background, thus causing quenching and is directly proportional to concentration of the extract. Silica gel GF plate was used as an adsorbent for fluorescence quenching. Solvents taken- hexane toluene, ether, ethyl acetate, butanol, methanol and water[8].

2. Use of fingerprinting and marker compounds for identification and standardization of botanical drugs: Chemical and chromatographic techniques may be used to aid in identification of an herbal material or extract. Chromatographic technique such as HPLC, TLC, GC and capillary electrophoresis and spectroscopic methods such as IR, NMR, and UV-may also be used for fingerprinting. DNA fingerprinting has been widely used in many species, e.g. DNA fingerprinting of *Panax* species and their adulterants[9]. Marker compounds may be used to help identify herbal materials, set specifications for raw materials, standardize botanical preparations during all aspects of manufacturing processes and obtain stability profiles[10].

3. Densitometric thin layer chromatographic determination of aescin in an herbal medicinal product containing Asculum and Vitis dry extract: A TLC method is developed to analyze the total saponin content, also referred to as the aescin content, in an herbal medicinal product containing two dry extract in capsules. After a purification step using C(18) solid phase extraction, the samples are analyzed on a silica gel HPTLC plate with the upper layer of a mixture of acetic acid/water/butanol(10/40/50v/v/v) as the mobile phase. Spots are visualized by spraying with anisaldehyde reagent and heating the plate for 5-10 min.(100-105oc) and measured at a wavelength of 535 nm[11].

4. Determination of stigmasterol, beta-sitosterol and stigmastanol in oral dosage forms using HPLC with evaporative light scattering detection: - A validated and repeatable HPLC method with online evaporative light scattering was developed for the analysis of two sterols, stegmasterol, beta-sitosterol and a stanol found to be common in many herbal formulations and health care supplements. This method was used to assay commercially available products formulated as oral dosage forms purported to contain African potato and associated sterols and stanol[12].

5. Elemental analysis of herbal preparations for traditional medicines by neutron activation analysis with the kO standardization method: Medicinal herb preparations prescribed for specific treatment purposes were purchased from markets and were analysed by instrumental neutron activation analysis with kO standardization. 500-700 mg of each sample was palletized under a pressure of six tones and irradiated together with monitors for alpha and neutron flux ratio determination for about 6h in a thermal flux of 2.29 x 10(12) n/cm2/s[13].

6. Liquid chromatography UV-determination and liquid chromatography-atmospheric pressure chemical ionization mass spectrometric characterization of sitosterol and stigmasterol in soyabean oil: A narrow bore HPLC-UV method was developed for the analysis of two of the more abundant naturally occurring phytosterols in vegetable oils: sitosterol and stigmasterol. The method enabled detection of the compounds at a concentration of 0.42 µ/ml and quantization at concentration of 0.52 and 0.54 µ/ml for sitosterol and stigmasterol, respectively[14].

7. Simultaneous determination of cinnamaldehyde, eugenol and paeonol in traditional Chinese medicinal preparations by capillary GC-FID: A capillary GC method was established for simultaneous determination of cinnamaldehyde(CNMD), eugenol(EL) and paeonol(PL) in two traditional Chinese herbal medicinal preparations, Weitongding tablet (WTDT) and Guifu Dihuang pill (GDHP). The assays were based on a programmed temperature GC in a 30 m x 0.53 mm capillary column with nitrogen as carrier and FID detector. Good linearity were obtained over ranges of 0.45-0.452 mg/l CNMD, 0.31-0.625 mg/l EL, and 0.30-610 mg/l PL, respectively[15].

8. HPTLC fingerprinting of marketed formulation containing Shankhpushpi: - These are the important Ayurveda formulations used for perinatal care of mother and child health. Standardization of churnas was carried out by organoleptic study, phytochemical analysis; qualitative organic and inorganic analysis, thin layer chromatography, UV- visible spectrophotometer and HPLC fingerprint studies. Qualitative organic analysis of both the churnas revealed the presence of alkaloids, steroids, phenols, tannins, glycosides, resins, saponins and flavonoids[16].

5. EVALUATION OF HERBAL DRUG / PRODUCTS

1. Biological parameter (bioassay): It is well established that the biological potency of the herbal constituents is due to not one but a mixture of bioactive plant constituents and the relative properties of a single bioactive compound can vary from batch to batch while the biological activity remains within the desirable limits. (1) Some of the examples are:

a. Evaluation of adaptogenic activity profile of herbal preparation: Adaptogens help the body to come up with stress and enhance general health and performance. AVM is an herbal formulation. Composition- *Emblica officinalis, Withania somnifera, Asparagus racemosus, Ocimum sanctum, Tribulus terrestris* and *Piper longum.* AVM shows significant antistress, immunomodulatory and anabolic activities in different animal models there by proving a promising adaptogen[17].

b. Evaluation of antioxidant activity of herbal products: A new test method for measuring the antioxidant power of herbal products, based on solid phase spectrophptometry using tetrabenzo-b, f, j, n, l, 5, 9, 13- tetraazacy- clohexadecin- Cu (II) complex immobilized on silica gel is proposed. The method represents an alternative to the mostly used scavenging capacity assays. The method was approved in the analysis of the most popular herbal beverages and drugs Echinacea determined spectrophotometrically[18].

c. Evaluation of microbial contamination reduction on plants through technological process of decoction and spray dry: - The technological process of raw material has many stages, generally, adverse to microbial growth, but its complete elimination depends on the initial and work condition utilized. The aim of this work was to verify the microbial contamination, such as extractive solution (SE) and spray dried extract (PSA) with the purpose of evaluating the decrease of contamination after the decoction and the spray dry. The microbiological analysis of the products was performed by total plate count and MPN coliform[19].

d. Evaluation of nitric oxide scavenging activity of selected medicinal plants used in inflammatory diseases: Four traditional medicinal plants, namely Ventilago madraspatana Gaertn., Rubia cordifolia Linn., Lanatana camara Linn. And Morinda citrifolia Linn. Were selected for a study on the inhibition of nitric oxide (NO), a key mediator in the phenomenon of inflammation, signifying the presence of effective anti-inflammatory constituents therein. Plant samples were extracted with different solvents for evaluation of their inhibitory activity on NO produced in vitro from sodium nitroprusside, and in LPS- activated murine peritoneal macrophages, *ex-vivo*[20].

e. The lipid peroxidation inhibitory activity: The reaction mixture contained mice liver homogenate (0.2 ml, 10% w/v) in 0.15 KCl, KCl (0.1 ml, 150 µm), Tris buffer (0.4 ml, Ph 7.5) and various concentration of test extracts. In vitro lipid peroxidation was initiated by addition of Feso4.7H2O (0.1 ml, 10 µm). The reaction mixture was incubated at 37o for 1 h. After the incubation period, reaction was terminated by addition of thiobarbituric acid (TBA-2 ml, 0.8%) and by heating the contents for 15 min. for development of colored complex. The tubes were then centrifuged at 4000 rpm for 10 min. and cooled. The % inhibition of lipid peroxidation was determined by comparing the results of test compound with those of control not treated with extracts by monitoring the color intensity at 532 nm. Gallic acid was used as a positive control[21].

2. Evaluation of marketed polyherbal antidiabetic formulatios using biomarker charantin: Charantin is one of the phytoconstituents present in *Momordica charantia*. It is well known to possess antihyperglycaemia, anticholesterol, immunosuppressive, antiulcerogenic, antispermatogenic and androgenic activities. HPTLC method is fast, precise, sensitive and reproducible with good recoveries for standardization of polyherbal formulations. The recovery values of charantin were found to be about 98.89%[2].

3. *In vivo* and *in vitro* evaluation of hair growth potential of Shoe flower: The leaves and flowers of Hibiscus *rosa-sinensis* are used as promoters of hair growth and as an aid in healing of ulcers. Petroleum ether extract of leaves and flowers of the plant was evaluated for the potential growth *in vivo* and *in vitro* methods. *In vivo*, 1% extract of leaves and flowers in liquid was applied topically over the shaved skin of albino rats and monitored and assessed for 30 days. The length of hair and different cyclic phases of hair follicles, like anagen and telogen phases were determined at different time periods. *In vitro*, the hair follicles from albino rat neonates were isolated and cultured in DMEM supplemented with 0.01 mg/ml petroleum ether extract of leaves and flowers. It is concluded that the leaf extract, when compared to flower extract, exhibits more potency on hair growth[22].

4. Clinical evaluation to assess the safety and efficacy of coded herbal medicine "Dysmo-off" versus allopathic medicine "Diclofenac sodium" for the treatment of primary dysmenorrhoea: The clinical study on primary dysmenorrhoea to comparatively examine the coded herbal drug formulation "Dysmo-off" with authentic allopathic medicine "Diclofenac sodium". A random controlled clinical trial was conducted. These evaluations were based on verbal rating scale so as to ascertain the rate of analgesic effects on dysmenorrhoeic pain. The patients were randomly allocated with the ratio of 1:2 for controlled treatment with (NSAIDS) (n=40) received Diclofenac sodium tablets twice daily for 4 days (50 mg one day prior to and three days after the menstruation), and test treatment with Dysmo-off (n=80) received powdered Dysmo-off twice daily for 4 days (5 g one day prior to and three days after the menstruation). Treatment lasted for 4 consecutive menstrual cycles. Haemoglobin, ESR and ultrasound were measured at baseline during study. All subjects were clinically studied[23].

5. Thermographic evaluation: In the present study, the authors used thermography to evaluate the effects of herbal formulations based on "Sho" scientifically. In the cases that were suitable for Keishibukuryogan, the so called Keishibukuryogan Sho, a significant skin temperature rise was observed in the upper half of the body after the intake of Keishibukuryogan. In a case that was suitable for Hochuekkito, a marked elevation of skin temperature spread through the upper trunk. It suggested that thermography is useful for an objective evaluation of Sho in Kampo medicines, and for identification of the action site of the herbal formulation[24].

6. Biochemical evaluation: Most of the herbal drugs are a mixture of a number of ingredients. Their cumulative effect increases the efficacy of the drug in curing the diseases. Muthu Marunthu is an herbal formulation comprising of eight various plant ingredients, and has been claimed to possess anticancer effect. It was observed that the growth rate in rats was normal and there was no change in blood parameters such as glucose, urea, proteins, cholesterol and also in the activities of pathophysiological enzymes such as lactate dehydrogenase (LDH), gluconate oxaloacetate transaminase (GOT), glutamate pyruvate transaminase (GPT), alkaline and acid phosphatase after Muthu Marunthu administration. The tumor weight was found to be reduced in methylcholanthrene induced fibrosarcoma rats after Muthu Marunthu treatment[25].

7. Evaluation of Kutaj-Ghanavati for alkaloidal principles: Kutaj-Ghanavati is a reputed Ayurvedic preparation used in dysentery and diarrhea. It contains water extract of Kurchi bark and fine powder of aconite roots. It was evaluated quantitatively and qualitatively employing TLC and titrimetric method. In TLC study no interference of Kurchi and Aconite alkaloids with one another in their respective solvent systems. The formulation was found to contain all alkaloids of Kurchi and Aconite[26].

8. Organoleptic evaluation: Organoleptic evaluation of food products plays an important role in judging the censoring acceptability or rejection of food items in the market. Effect of various treatments (blanching, pricking, and lye treatment), sugar concentration (50%, 60%, 70%) and storage on the color scores; flavor scores; texture scores of intermediate moisture apricots. The overall acceptability of the products was significantly higher in 70% sugar syrup but these scores decreased as the storage period advanced[27].

The subject of herbal drug standardization is massively wide and deep. There is so much to know and so much seemingly contradictory theories on the subject of herbal medicines and its relationship with human physiology and mental function.

For the purpose of research work on standardization of herbal formulations, a profound knowledge of the important herbs found in India and widely used in Ayurvedic formulation is of utmost importance[6].

Even when the chemical composition of a plant extract is known, the pharmacologically active moiety may not be. Environment, climate, and growth conditions influence composition, as does the specific part of the plant and its maturity. Monographs detailing standardization of active ingredients would improve the marketplace. Even if an herbal product is standardized to, for

example, 4% of a constituent, the remaining 96% of ingredients is not standardized and may affect the product's solubility, bioavailability, stability, efficacy and toxicity. Just as controlled trials are necessary to establish safety and efficacy, manufacturing standards are required to ensure product quality[28].

6. CONCLUSIONS

Now a day's newer and advanced methods are available for the standardization of herbal drugs like fluorescence quenching, combination of chromatographic and spectrophotometric methods, biological assays, use of biomarkers in fingerprinting etc. Bioassay can play an important role in the standardization of herbal drugs and can also become an important quality control method as well as for proper stability testing of the product[4]. India can emerge as the major country and play the lead role in the production of standardized, therapeutically effective ayurvedic formulation. India needs to explore the medicinally important plants. This can be achieved only if the herbal products are evaluated and analyzed using sophisticated modern techniques of standardization such as UV- visible, TLC, HPLC, HPTLC, GC-MS, spectrofluorimetric and other methods[6]. Standardisation of herbal formulation is essential in order to assess the quality of drugs, based on the concentration of their active principles.

REFERENCES

1. Sagar Bhanu P.S., Zafar R., Panwar R., "Herbal drug standardization", *The Indian Pharmacist*, vol. 4(35), May 2005, 2005, pp.19-22.
2. Patel P.M., Patel N.M., Goyal R.K., "Evaluation of marketed polyherbal antidiabetic formulations uses biomarker charantin", *The Pharma Review*, vol.4 (22), June 2006, pp.113.
3. Patel P.M., Patel N.M., Goyal R.K., "Quality control of herbal products", *The Indian Pharmacist*, vol.5(45), March 2006, pp.26-30.
4. Bhutani K.K., "Herbal medicines an enigma and challenge to science and directions for new initiatives**",** *Indian Journal of Natural Products,* vol.19 (1), March 2003, pp.3-8.
5. Kokate C.K., Purohit A.P**.,** Gokhale S.B., "Analytical pharmacognosy", *Pharmacognosy,* 30th edition, Feb. 2005, pp.1,99.
6. Shrikumar S., Maheshwari U., Sughanti A., Ravi T.K., "WHO guidelines for herbal drug standardization", 2006.
7. Ansari S.H., "Standardization of crude drugs", *Essentials of Pharmacognosy*, Ist edition, 2005-06, pp.14, 581.
8. Gokhale S.B., Surana S.J., "Fluorescence quenching as a tool for identification and quality control of crude drugs", *Planta indica*, vol 2 (3), July 2006, pp.47.
9. Shaw P.C., Pui-Hat Butt P., "Authentication of Panax species and their adulterants by random primed polymerase chain reaction", *Planta Medica*, vol. 61, 1995, pp.466-469.
10. Lazarowych N.J., Pekos P., "Use of fingerprinting and marker compounds for identification and standardization of botanical drugs: Strategies for applying pharmaceutical HPLC analysis to herbal products", *Drug Information Journal*, Vol.32, 1998, pp.497-512.
11. Apers S., Naessens T., Pieters L., Vlietinck A., "Densitometric thin-layer chromatographic determination of aescin in an herbal medicinal product containing Aesculus and Vitis dry extract", *Jr. of Chromatographic Analysis*, vol.1112(1-2), April 2006, pp.165-170.
12. Nair V.D., Kanfer I., Hoogmartens J., "Determination of stigmasterol, beta-sitosterol and stigmastanol in oral dosage forms using HPLC with evaporative light scattering detection", *Journal of pharmaceutical and biomedical analysis*, vol. 41(3), June 2006, pp. 731-737.
13. Sarmani S.B., Abugassa I., Hamzah A., Yahya M.D., "Elemental analysis of herbal preparations for traditional medicines by neutron activation analysis with the kO standardization method", *Biological trace element research*, 1999, pp. 365-376.
14. Careri M., Elviri L., Mangia A., "Liquid chromatography-UV determination and liquid chromatography-atmospheric pressure chemical ionization mass spectrometric characterization of sitosterol and stigmasterol in soyabean oil", *Jr. of Chromatographic Analysis*, vol. 935(1-2), Nov.2001, pp.249-257.
15. Yu B.S., Lai S.G., Tan QL, "Simultaneous determination of cinnamaldehyde, eugenol and paeonol in traditional Chinese medicinal preparations by capillary GC-FID", *Chemical and pharmaceutical bulletin*, vol. 54(1), Jan 2006, pp. 114-116.
16. Santosh M.K., Shaila D., Sanjeeva Rao I., "Standardization study of dadimastaka and pushyannga churnas", *Asian Jr. of Chemistry*, vol. 16(34), 2004, pp. 1735-1741.
17. Azamathulla Shaik, Hule Amolkumar, "Evaluation of adaptogenic activity profile of herbal preparation", *Indian Jr. of Experimental Biology*, vol. 44, July 2006, pp.574-579.
18. Zaporozhets O.A., Lipkovska N.A., "A new test method for the evaluation of total antioxidant activity of herbal products", *Jr. of Agricultural and Food Chemistry*, vol. 52(1), 2004, pp.21-25.
19. De Souza T.P., Zulian Lionzo M.I., "Evaluation of microbial contamination reduction on plants through technological process of decoction and spray dry", *Brazilian Jr. of Pharmacognosy,* vol. 16(1), 2006, pp.94-98.
20. Basu S., Hazra B., "Evaluation of nitric oxide scavenging activity of selected medicinal plants used in inflammatory diseases", *Phytotherapy research*, vol. 20(10), 2006, pp. 896-900.
21. Shinde A.D., Bhise S.B., "Evaluation of wound healing activity of herbal drug combination of *Tridax Procumbens, Azadirachta indica, Curcuma longa* and *Apis mellifera*", *Indian Drugs*, vol. 41(6), June 2004, pp.376-378.
22. Adhiraj N., Ravikumar T., Shanmugasundaram N., "In vivo and in vitro evaluation of hair growth potential of Shoe flower", *Jr. of ethanopharmacology*, vol. 88(2-3), 2003, pp. 235-239.
23. Nazar H., Usmanghani K., "Clinical evaluation toi assess the safety and efficacy of coded herbal medicine "Dysmo-off" versus allopathic medicine "Diclofenac sodium" for the treatment of primary dysmenorrhoea", *Jr. Herb Pharmacotherapy*, vol. 6(1), 2006, pp.21-39.
24. Inokawa M., Iguchi K., Kohda H., "Thermographic evaluation of the efficacy of Kampo medicine", *Hiroshima Jr. Med Sci*., vol. 55(1), March 2006, pp.1-8.
25. Palani V., Senthilkumaran R.K., "Biochemical evaluation in antitumour effect of Muthu Marunthu on experimental fibrosarcoma in rats", *Jr. of Ethanopharmacology*, vol. 65(3), 1999, pp.257-265.
26. Bhavasar G.C., Pundarikakshudu K., "Evaluation of Kutaj-Ghanvati for alkaloidal principles", *Indian Jr. Natural Products*, vol. 20(1), 2003, pp.33.
27. Sharma H.R., Verma P., "Organoleptic and chemical evaluation of osmotically processed Apricot wholes and halves", *Natural Product Radiance*, vol.5 (3), Sep-Oct 2006, pp.350-356.
28. Boullata I.J., Nace M.A., "Safety issue with herbal medicine", *Pharmacotherapy*, vol. 20(3), 2000, pp.257-269.