

SCIENTIFIC ANALYSIS OF SELECT MEDICINAL PLANTS FROM AN *AYURVEDIC* PERSPECTIVE

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by

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CERTIFICATE

This is to certify that the thesis entitled '**Scientific Analysis of Select Medicinal Plants from an Ayurvedic Perspective**' being submitted Ganesh Prabhu V to the Indian Institute of Technology Delhi for the award of Doctor of Philosophy is a record of original bonafide research work carried out by him. He has worked under our supervision and guidance in conformity with the rules and regulations of the Indian Institute of Technology Delhi. He has fulfilled the requirements for the submission of this thesis, which to our knowledge has reached the requisite standard. The research report and the results presented in this thesis have not been submitted, in part or in full, to any other university or institute for the award of any degree or diploma.

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ABSTRACT

Modern medicine is evidence based and practices the use of discrete, well-defined chemical entities for the treatment of diseases. Ayurveda, the time-tested medical practice of India is based on usage of a diversity of botanical resources. It has in-depth understanding of the therapeutic properties of plants, which are in tune with the theory and parameters of Ayurveda. The treatment method in Ayurveda aims to remove the disease causing factors and the restoration of the equilibrium of bodily functions and tissues (doshas and dhatus) in a way which is compatible, conducive and nourishing to patients without weakening them. Ayurveda classifies doshas in to three major systems: Vata, Pitta and Kapha popularly known as tridosha, deals with the systems of regulatory function, each with a particular area of responsibility. The fundamental aim of ayurvedic therapy is to restore the balance between these three systems.

The entire materia medica of Ayurveda is classified according to rasa (literally called taste). Rasa is a major parameter in ayurvedic pharmacology. Nearly 8,000 plant parts such as roots, leaves, fruits, flowers, seeds, etc. have been categorized in Ayurveda according to the six rasa. A medicinal plant may contain –a single rasa or a combination of rasa.

*In this research, five medicinal plants viz. Atibalā (*Abutilon indicum* Linn), Kūsmānda (*Benincasa hispida* Thunb), Tāla (*Borassus flabellifer* Linn), Jivanti (*Leptadenia reticulata* Retz., Wt. & Arn.), and Balā (*Sida cordifolia* Linn), classified under the same taste category (madhura rasa / sweet) have been selected. The Present work focused on identification of fingerprints responsible for sweet taste. Identification of chemical compounds responsible for the sweet taste was carried out by classical analytical methods like total sugar, non-reducing sugar, and reducing sugar. Identification by modern analytical techniques like HPLC,*

electronic tongue, Nuclear Magnetic Spectroscopy, Fourier Transform Infrared spectroscopy and AAS were carried out.

The sugar content of the samples were found appreciable amount. Taste identification of the samples by electronic tongue by comparing with standard taste compounds like cellobiose, galactose, glucose, mannose, sucrose, xylose, NaCl, caffeine, urea and citric acid explained the taste pattern of the samples. Principle component analysis of the sensor data shows that all the five plants are clustered together with identical taste. Further data analysis by SIMCA modelling and PLS regression, the taste of the medicinal plants revealed as sweet.

In the proton NMR study, the presence of sugar compounds was observed for all samples. The data analysis by multivariate analysis revealed that all the samples are grouped together on the basis of taste. It shows the similar taste pattern exist between the plants. A PCA score plot shows that all five plants grouped near the sweet standards, glucose and sucrose. It shows the similarity of the taste exist between glucose standard and samples. Cluster analyses of the NMR data were conducted to determine the clustering pattern among the samples.

A comprehensive compilation of the data analysis shows that medicinal plants of present study could be grouped under single taste category as sweet. These findings indicate that prima facie there is correspondence between taste determination of medicinal plants using modern analytical tools and the traditional classification of Ayurveda. Physico-chemical and spectroscopic metabolomics of medicinal plants give support to identify and categorize according to the biochemical constituents. The presence of significant amount of sugar compounds in all the plants was confirmed by HPLC analysis. Taste profiling by electronic tongue also confirmed the sweetness present in all the plants taken in this study. The

spectroscopic analysis shows the presence of carbohydrates viz. glucose, sucrose, fructose, galactose and mannitol. All the tests have demonstrated that the selected medicinal plants not only contain compounds related to sweetness but also grouped under one category. Detailed analytical studies undertaken in this research have contributed to greater understanding of metabolites responsible for the sweet taste. This study of correspondence of taste of medicinal plants and the traditional classification of medicinal plants in Ayurveda may lead to many studies in future that would validate the ayurvedic concept of rasa based classification of medicinal plants.

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