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Fuzzy logic and modern analytical tool coupling in comprehensive evaluation of traditional and complementary medicine.

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Traditional medicines (TM) and complementary and alternative medicines (CAM) are attracting more and more attention within the context of health care provision and health sector reforms. W.H.O is promoting its inclusion in health policies because of its positive features, which include diversity and flexibility; accessibility and affordability in many parts of the world; broad acceptance among many populations in developing countries; comparatively low cost and growing economic importance.

With out critical assessment of what should be integrated and what should not, we risk developing a health care system that costs more, is less safe and fails to address the management of chronic disease in publicly responsible manner (1). The priority areas of research according to the committee on Science and Technology to the house of Lords, include

- Effects of each individual therapy: efficacy, safety and cost effectiveness.
- Research into mechanisms of action of individual therapies including patterns of response to treatment.
- Research into TM/CAM genre itself, including social research into motivation of patients seeking TM/CAM and usage patterns of TM/CAM
- Research into new strategies which are sensitive to the TM/CAM paradigm
- Research into efficacy of diagnostic methods used
- Research into implementation and effects of TM/CAM in specific health care settings (2).

In the present scenario the quality control of herbal medicines mainly concentrate on use of modern analytical tools include droplet counter current chromatography (DCCC), preparative thin layer chromatography (PTLC), centrifugal thin layer chromatography (CTLC), overpressure layer chromatography (OPLC), gel filtration, vacuum liquid chromatography (VLC), preparative high performance liquid chromatography (PHPLC), etc. The parameters studied usually like total ash value, Acid insoluble ash. Alcohol soluble ash, assay for total alkaloids, glycosides, total volatile oils etc. Can these parameters alone decide the fate of TM/CAM medicines practiced for many decades?

Ayurveda (in India), Kampo (in Japan) etc and in almost all the countries have their own traditional system of medicine have been used successively for centuries. For example in Ayurveda the treatise Charaka samhita dates to 7th century B.C.

The classification of medicinal plants found in Charaka samhita can be grouped under 3 main categories

- Naama-Roopa jnaana (Identification, Pharmacognosy)
- Guna Karma Jnaana (Pharmacology)
- Proyoga jnaana(Application, Pharmaceutics, and Pharmacodynamics)

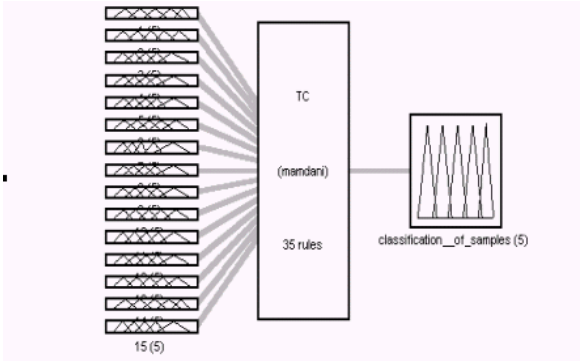
For example the pharmacological aspects are explained on the basis rasa (taste), guna (properties) and Karma (action) (7). Most of the standards in TM/CAM are expressed in linguistic terms and the knowledge is passed to students by teacher by experiential learning. Do these methods have no significance in the standardization of TM/CAM medicines?

Traditional knowledge has to be studied and understood with reference to its foundation. Use of intelligent techniques like fuzzy logic and neural logic can be effectively used to scientifically present explanation given by experts in traditional system in scientific terms. The characteristics of fuzzy logic which is put to use it in the present context of standardization is as follows i) Fuzzy systems are suitable for uncertain or approximate reasoning, especially for the system with a mathematical model that is difficult to derive, ii) Fuzzy logic allows decision making with estimated values under incomplete or uncertain information. Fuzzy logic has been applied to many different types of problems since introduced by Zadeh in 1965. Unlike Boolean logic, fuzzy logic is suited

to evaluating subjective situations. For agriculture, the subjectivity of fuzzy logic is particularly appealing (3-5). Field conditions – weather, the position and intensity of the sun and dust, just to name a few – and crop conditions – size, shape, weed and pest pressure – combine to create a difficult situation for conventional evaluation methods. For example, given a pile of fruit, we can separate apples and oranges. If we are looking at an apple X, our description might include red, a hint of green and a mostly round shape. If we look at an apple Y, the description might include green, smooth and oblong. An orange might have an orange color, a rough texture and round shape as descriptors. While we can verbally describe apples and oranges, it's much more difficult to create a mathematical description of an apple or orange that will apply for all situations. The variability common in agriculture makes fuzzy logic appealing. In classification of TM medicine fuzzy logic modern analytical tool coupling can be successively used.

The %w/w of phytoconstiutents and also linguistic variables can be given as input and different rules are made to connect these variables to get a known output. Mamdani and sugeno fuzzy rule based systems can be used in classification. For example in figure- I mamdani fuzzy rule based system is used where fifteen inputs are connected with a set of thirty five rules to classify the samples into five varieties.

Figure- I A model fuzzy inference system editor.



This will result in increased recording and preservation of indigenous knowledge of herbal pharmaceuticals including development of digital libraries. With development of sophisticated H.P.L.C equipment where fractionation is done automatically if there is arrangement where information regarding the status of the herbal drug is indicated it helps in authentication of the plant and also identification of it from adulterants and substitutes. Through fuzzy logic this can be achieved and we can get a comprehensive evaluation of TM/CAM medicine both with regards to active constituents and also clinical evaluation.

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