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Research Article

EFFICACY AND SAFETY STUDIES OF *FOENICULUM VULGARE* THROUGH EVALUATION OF TOXICOLOGICAL AND STADARDISATION PARAMETERS

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ABSTRACT

The quality criteria for herbal drugs are based on a clear scientific definition of the raw material. Even though global herbal resources have a great potential as natural drugs and are of great commercial importance, they are very often procured and processed without any scientific evaluation, and launched onto the market without any mandatory safety and toxicology studies. On that basis, an attempt was made on efficacy and safety studies of a well known herbal drug *Foeniculum vulgare* by evaluation of toxicological parameters like heavy metals and pesticide residues. Additional standardisation parameters like, physical constants, ash content, solvent residues to prove identity and purity were also carried out. Results obtained during this experiment revealed that heavy metals and pesticidal residues were variable but found within the prescribed limits. Standardisation parameters were variable in two samples under consideration which may be due to different geographical conditions. Hence, there is an urgent need for mandatory evaluation of these parameters in every crude drug before further processing to ensure safety and efficacy of Indian medicinal plants and better acceptance at International platform.

Key words: *Foeniculum vulgare*, Heavy Metals Analysis, Pesticidal Residues

INTRODUCTION

Natural products, mainly the plant-derived constituents, have long been used as sources of drugs. Natural products are also of great interest in the process of drug discovery, due to their large diversity in nature, permitting the identification of lead molecules of greater interest for the development of new therapeutic agents. Furthermore, a growing world-wide interest in the use of phytopharmaceuticals as complementary or alternative medicine, either to prevent or to ameliorate many diseases, has been noted in recent years. It is believed that about 80% of world's population use plants as their primary source of medicinal agents. [1-5]

Foeniculum vulgare Mill. (fennel) is used as a spice and also as an important ingredient in various folklore medicines throughout the world. Moreover, this plant has been investigated extensively for several medicinal and therapeutic activities and has been reported for possessing carminative, flavouring, antioxidant, antibacterial, antifungal and mosquito repellent properties. [6-8]

Contamination by toxic metals can either be accidental or intentional. Contamination by heavy metals such as mercury, lead, copper, cadmium, and arsenic in herbal remedies can be attributed to many causes, including environmental pollution, and can pose clinically relevant dangers for the health of the user and should therefore be limited.[9-12] The potential intake of the toxic metal can be estimated on the basis of the level of its presence in the product and the recommended or estimated dosage of the product. This potential exposure can then be put into a toxicological perspective by comparison with the so-called Provisional Tolerable Weekly Intake values (PTWI) for toxic metals, which have been established by the Food and Agriculture Organization of the World Health Organization (FAO-WHO). [13-15] Based on this, the present study was conducted on a well known herbal drug fennel to ensure the quality and efficacy by evaluation of toxicological and standardisation parameters.

MATERIALS AND METHODS

Collection and identification of plant material

Two different samples of *Foeniculum vulgare* Mill were collected from Khari Bavali market of New Delhi and collected the information that fennel sample A (thin) is grown in Utter Pradesh and second variety Fennel B (Thick) is grown in Gujarat. The plant material was identified from National Institute of Science Communication and Information Resources (NISCAIR), New Delhi. Voucher specimen and identification certificate ref. no. NISCAIR/RHMD/Consult/-2007-08/966/150 was obtained and kept in the department for future reference.

Standardisation parameters

Cold extraction (maceration) and hot extraction (soxhlation) was carried out for the preparation of pet ether, chloroform, acetone, methanol, hydroalcoholic and aqueous extracts of the two samples of fennel under consideration. Total ash, acid insoluble ash, water soluble ash, loss on drying and total fat analysis was evaluated as per standard methods (IP 1966). The studies were performed in triplicate, mean values were calculated and reported.

Determination of heavy metals by inductive coupled plasma (ICP)

The estimation was carried out using Spectrogenesis (Model 126137) spectrometer which an automatic optical emission spectrometer provides simultaneous measurements. It uses inductively coupled plasma excitation and a semiconductor nebulised and fed into plasma as an aerosol. During the experiment, the high temperature of the plasma (6000-8000K) evaporated the sample. The molecules contained in the sample dissociated into atoms. The atoms were excited and partly ionised. The excited atoms and ions emitted an element specific radiation. Transfer optics fed this radiation into optical system. The intensity was measured using semiconductor detectors (CCD). After processing the measuring signals in the unit, the measured element intensities were evaluated by the smart analyser software. Methods were set up prior to measuring. Calibration functions for each element to be determined and stored in these methods. Concentrations were calculated from the measured intensities, using these methods.

Determination of residual pesticides

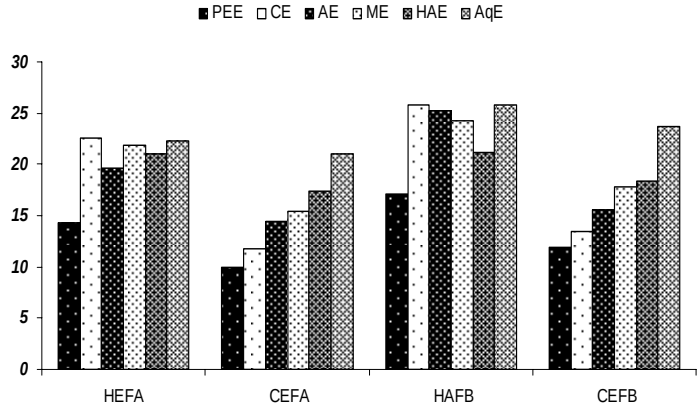
Residual pesticides were analysed by GC-MS. Gas Chromatograph (GC) from Agilent Technologies 7890A performed at inlet temp of 280°C, pressure 17.446 psi, purge flow 50 ml/min, total flow 54.51 ml/min. Column J&W DB-5ms Ultra Inert (p/n 122-532 UI), constant flow mode at a pressure of 14.446 psi with an injection volume of 2 µl. Mass Spectrophotometer (MS) from Agilent 5975C with Triple Axis Detector was performed at 1500° quad temperature and 230°C source temperature. System retention time locked to chlorphyrifos methyl at 13.443 min.

RESULTS

Results obtained from standardisation parameters are depicted in Figure 1-3 which are self explanatory. Heavy metals estimation results are presented in Table 1 which reveals that the observed quantities of lead, cadmium, arsenic and mercury were found within the prescribed limits. Residual pesticides results are presented in table 2. As per WHO recommendations, the pesticidal residues should not be more than 1 % of the total intake of material by the patient which includes food and water also.[16] In that way, the observed quantities of Dichloro Diphenyl Trichloroethane as 0.29 ppm (0.000029 %) in Fennel A, γ-Benzene hexachloride as 0.62 ppm (0.000062 %) in fennel B, Malathion as 0.88 ppm (0.000088 %) and 0.34 ppm (0.000034 %) in Fennel A and Fennel B respectively can be considered as quite low and safe.

DISCUSSION

Medicinal plants have played a key role in world health. They are distributed worldwide, but most abundant in tropical countries. It is estimated that about 25% of all modern medicines are directly or indirectly derived from higher plants. India has a rich traditional culture of using herbal drugs however; quality control and safety issues become the major concern when it comes to the acceptability of traditional Indian drugs at the International scenario. [2]



HEFA= Hot extraction of Fennel A, CEFA= Cold extraction of Fennel A, HEFB= Hot extraction of Fennel B, CEFB= Cold extraction of Fennel B. PEE= pet ether extract, CE=Chloroform extract, AE= Acetone extract, ME= Metahnolic extract, HAE= Hydro-alcoholic extract, AqE= Aqueous extract.

Fig. 1: Comparative extractive values of two samples of *Foeniculum vulgare.*

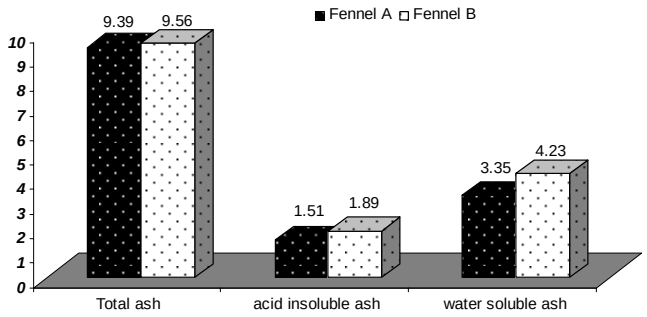


Fig. 2: Comparative ash values of two samples of *Foeniculum vulgare*

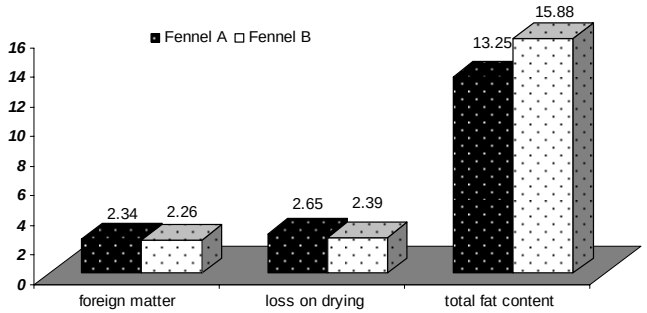


Fig. 3: Comparative foreign matter, loss on drying and total fat contents of two samples of *Foeniculum vulgare*

Table 1: Heavy metals analysis of two samples of *Foeniculum vulgare*

Parameter	Observation		Detectable limit	Requirement
	Fennel A	Fennel B		
Lead	2.65 ppm	0.93 ppm	0.1 ppm	Not more than 10 ppm
Cadmium	Not Detectable	Not Detectable	0.5 ppm	Not more than 0.3 ppm
Arsenic	0.59 ppm	0.51 ppm	0.1 ppm	Not more than 10 ppm
Mercury	Not Detectable	Not Detectable	0.5 ppm	Not more than 1 ppm

Table 2: Residual pesticides analysis of two samples of *Foeniculum vulgare*

Parameter	Observation		Detectable limit	Requirement
	Fennel A	**Fennel B**		
Dichloro Diphenyl Trichloroethane	0.29 ppm	Below detection limit	0.02 ppm	
2,4 Dichloro phenoxyacetic acid	Below detection limit	Below detection limit	0.01 ppm	
γ-Benzene hexachloride	Below detection limit	0.62 ppm	0.05 ppm	
Malathion	0.88 ppm	0.34 ppm	0.04 ppm	*

* The toxicological evaluation of pesticidal residues in medicinal plant material is based on the likely intake of the material by the patients. In general, the intake of residues from medicinal plant material should account for no more than 1 % total intake from all sources, including food and drinking water [16]

The quality of a plant product is determined by the prevailing conditions during growth which includes seed selection, growth conditions, use of fertilizers, harvesting, drying and storage hence, they are capable of variation. Apart from these criteria, factors such as the method of extraction, contamination with microorganisms, heavy metals, and pesticides can alter the quality, safety, and efficacy of herbal drugs. The variations observed during the present study may be due to one or more of these conditions. Thus, using cultivated plants under controlled conditions instead of those collected from the wild can minimize most of these factors and any step towards pollution prevention and bioresource management can definitely help for better growth and increased therapeutic potential of these drugs.

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