

**BIOCHEMICAL INVESTIGATIONS OF FRESH  
MAHUA (*MADHUCA INDICA*) FLOWERS FOR  
NUTRACEUTICALS**

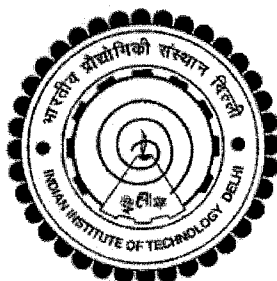
by

**MADHUMITA PATEL**

**Centre for Rural Development and Technology**

Submitted in fulfillment of the requirement of the degree of Doctor of Philosophy

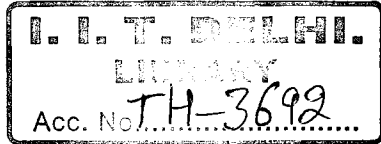
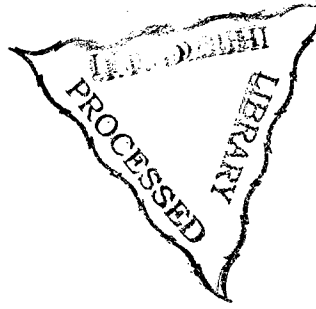
to the



**INDIAN INSTITUTE OF TECHNOLOGY, DELHI  
HAUZ KHAS, NEW DELHI**

**JULY 2008**

Mahua (Sapotaceae) - Nutrient



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PAT-B

*Dedicated to my Beloved Parents*

# CERTIFICATE

This is to certify that the thesis entitled, “ BIOCHEMICAL INVESTIGATIONS OF FRESH MAHUA (*MADHUCA INDICA*) FLOWERS FOR NUTRACEUTICALS” being submitted by Mrs. Madhumita Patel to the Indian Institute of Technology, Delhi for the award of Doctor of Philosophy is a record of bona fide research work carried out by her under my guidance and supervision in conformity with the rules and regulations of Indian Institute of Technology, Delhi.

The research report and 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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(Madhumita Patel)

## **ABSTRACT**

*Unemployment, under employment, and malnutrition are few of the major constraints in the development of rural India, and these problems are even more serious when it comes to the landless section of the society. In rural areas, the landless people either work as labours or collect and sell non-timber forest product (NTFP) to earn their livelihood. Madhuca indica, is a Sapotaceous tree of high economic importance producing two most important NTFPs i.e. mahua flowers and mahua seeds. Madhuca, commonly known as Mahua or Mowarh in North, Mahul in Orissa and Illipi in Southern part of India, is also known as 'Madhuka', 'Madhudruma', 'Madhupuspa', 'Madhusakha' and 'Gudapuspa' in Sanskrit. The name is derived from the Sanskrit word madhu, (meaning honey), due to its exceptionally sugar-rich (66-72 per cent of dry weight) flowers. It is indigenous to the Indian subcontinent and abundantly distributed in the dry deciduous forests of central India (Madhya Pradesh, Orissa, Chattisgarh, Bihar, Jharkhand, and parts of Rajasthan, Gujarat, Andhra Pradesh and Tamil Nadu). Mahua flowers are one of the most important non-timber forest products collected in the country. The flowers are produced during the leanest season of agriculture (March-May), and act as vital source of income and employment generation for the weakest section of the society.*

*During field survey, it was found that the unhygienic collection and processing practice makes these flowers unfit for human consumption. Apart from that, the sweet mahua flavour changes to an unpleasant odour and also develops a bitter aftertaste during sun drying. These factors play a major role for utilization of a substantial quantity of these flowers (more than 80%) in liquor distillery units. This way a highly nutritious and*

*economically available source of nutrition is being underutilized in spite of the alarming malnutrition condition in the rural areas of our country.*

*Present doctoral dissertation is focused on the development of a suitable post harvest processing technology for production of value added mahua products and its detailed biochemical investigations to establish the nutritional and nutraceutical properties of these flowers. Fresh flowers were selected to avoid the undesirable chemical changes during sun drying.*

*Juice was extracted from fresh mahua flower (up to 80 %) and concentrated up to a desired Brix (70 °B). The prepared mahua juice concentrate (MJC) was subjected to detailed biochemical analysis. The nutritional profile was analyzed using instruments like High Performance Liquid Chromatography (HPLC) for sugar profile and vitamins, Atomic Absorption Spectrophotometer (AAS) for mineral like, Ca and Fe and Flame Photometer for Na and K. Analytical results rated the product to be a nutritious liquid sweetener as it contains high quantity of reducing sugars (81.47 % on the basis of % total sugar) with glucose and fructose in 1:1 ratio. Apart from that, an appreciable quantity of vitamins (Vit.A, Vit. B1, Vit. B2, Vit. B3 & Vit.B6) and minerals (Ca, Fe, Na, & K) were also detected. A comparative study of the in vitro antioxidant activity (using DPPH, ABTS and reducing power methods) revealed the superiority of the product over some other liquid sweeteners like honey, apple concentrate and maple syrup taken from market. A 72-hour acute toxicity study and 45 days of sub acute toxicity study of the developed product on albino rats proved the safety of the developed product. Shelf life study revealed the product to be stable at low temperature and high scores of sensory evaluation proved its acceptance as a food supplement. Utilization of the concentrate in*

*confectionery (candy) and bakery products (biscuits, cake, cookies etc.) at different concentration, proved the industrial applicability of the product. The developed nutra-sweetener from mahua has been accepted for filing an Indian patent.*

*Apart from the concentrate, the fleshy corollas were also processed into jam, jelly and sauce and subjected to sensory evaluation and shelf life study. All the developed products were highly acceptable and stable at low temperature. In conclusion present research work successfully proves the multidimensional industrial applicability of mahua flowers especially as a natural, renewable, organic source of raw material for liquid sweetener with antioxidant property.*

*Based on the findings of present research, processing of fresh mahua is strongly recommended to get nutritious food supplements in place of the wasteful liquor.*

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