CHAPTER 9

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Beekeeping industry has been firmly established in western countries since over a century. Only one species of honeybees *Apis mellifera* exist in western countries, which has been domesticated. Very voluminous work has been reported abroad on honeys and beeswaxes of *A. mellifera*. Beekeeping industry has been introduced in India only recently and very little or negligible work has been reported on Indian honeys and beeswaxes.

In India there exist four different types of honeybees namely *Apis cerana indica*, *Apis dorsata*, *Apis florea* and *Trigona* sp. When more than one species of the same genus exist together in animal kingdom the species evolve behavioural differences, particularly foraging behaviour differences for existence. This fact coupled with diversity of flowering plants in India will have to be duly reckoned with, while attempting to know the composition of honeybee products. Thus the investigations on bee products touches the boundaries of the other disciplines of science like botany, palynology, entomology etc. without which the investigations may be incomplete atleast from the applied aspect of it. Attempts have, therefore, been made to collect basic data on Indian honeys and beeswaxes from different species of Indian honeybees.
from different parts of the country and bring out their peculiarities. Colonies of Indian honeybees have, therefore, been maintained for making observations on them and to collect pure samples of honey and beeswaxes.

As nectar forms a raw material of honey, initially concentration and composition of nectars of the seven nectario-ferrous plants of Mahabaleshwar are studied. The sugar concentration of Whayati and Jambul nectar is generally high. In Silver oak nectar, it is as high as ripe honey. All nectars principally contain glucose, fructose and sucrose. All the major nectar yielding plants of Mahabaleshwar flower in succession which enables production of as many as nine unifloral honeys, i.e. the honeys gathered by the bees from a single plant source. Peculiarities of the flowering rhythm of pleiocelial plants of Mahabaleshwar is reported.

Over 200 honey samples, gathered by different kinds of Indian honeybees, have been collected from different parts of the country and analysed for about 15 different physico-chemical constants. The apiary honey samples are conspicuous by higher moisture content, higher acidity and lower levulose content when compared to A. mellifera honeys. The honey produced from west and east coastal humid regions show higher moisture content than the less humid central and northern
regions of India. The diastase enzyme value of Indian honeys is very low and invertase enzyme value almost same when compared with *A. mellifera* honey. Genuine honeys do not contain hydroxy-methyl-furfural (HMF). HMF is a decomposition product mainly of fructose. Honeys that are heated beyond reasonable limit or stored at higher temperatures or adulterated with commercial glucose contain high HMF values. The composition of Indian honeys is congenial for the development of HMF. Higher ambient temperatures also accelerate formation of HMF in Indian honeys. It is found that formation of HMF at higher temperature particularly above 30°C, shoots up sharply. The European specifications for diastase value and HMF content cannot be applied to Indian honeys.

The unifloral honeys of Mahabaleshwar show some peculiarities. The colour varies widely from light yellow to dark amber. Honeys like Whayati, Burambli with low levulose to dextrose ratio granulate quickly while Jambul honey with high L/D ratio does not granulate at all. Karvi honey is characterised by abnormally high non-reducing sugar and protein content and its thixotropic property like Heather honey of Scotland. Pisa honey is also characterised by its high protein and ash content and dark amber colour. Paper chromatographic analysis indicates that Pisa honey contains maximum number of aminoacids and Karvi maximum number of sugars. Because of the
special colour, taste and flavour these honeys enjoy consumers' preferences.

The microscopical analysis of honey samples indicates that there are about 45 major nectar yielding plants in India. The maximum number of pollen grains per gram of apiary honey is 37000, while in squeezed honeys the number is more than 0.13 million pollen grains per gram of honey. The gross chemical composition of both hand collected pollen and bee-collected pollen shows wide range of variation. So far as honey fermenting yeasts are concerned, there are about 27 species of yeast belonging to 5 different genera in Indian honeys. A method to distinguish apiary honey from squeezed honey based on pollen count has been suggested.

Beeswax is a product of honeybees. 90 samples of Indian beeswaxes from different parts of the country are analysed for 11 different physico-chemical characteristics. Statistical analysis indicates that in Apis waxes, only the melting points vary significantly. Trigona wax is altogether different from Indian Apis waxes. All the Indian waxes are conspicuous by low acid value compared to A. mellifera wax.

A modified method of adsorption chromatography is worked out to obtain the fractionation and isolation of beeswax
components. All the Indian Apis beeswaxes show presence of
same components, but in different proportions. Analysis of
beeswax using modified method supported by dry ascending
column chromatography, argentation chromatography, acetylation
and IR spectroscopy, show that wax is mainly made up of esters
of free acids, hydroxy acids with alcohols and diols and
esters containing free hydroxy group. The other components are
hydrocarbons (12 percent) and acids (2 percent). Unsatura-
ration is present in hydrocarbons only.

For extraction and processing of bee products various
equipments are designed. These include honey processing unit,
moisture reduction unit, honey testing kit, solar wax extractor
and comb foundation mill.

Beekeeping is a recently introduced industry in India.
The observations made, investigations carried out and the data
collected here will help not only in laying purity specifications
and in quality control of the Indian honeys and beeswaxes, but
also lead to a qualitative improvement in the beekeeping
industry in India.