

Application of Geothermal Water for Honey Processing

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ABSTRACT

In the age of renewable energies, geothermal energy is playing a major role in society. It is a kind of energy which is not only used in industrial and commercial based sectors but also for the societal benefits. There are various direct as well as indirect applications of geothermal energy which includes agriculture, aquaculture, balneology etc. Honey processing is a new trend of societal benefits through geothermal energy. This paper includes the various aspects of apiculture including farming, processing and marketing etc. The paper deals with types of bees used in bee keeping projects, the constraints in bee keeping, types of crops used for pollination of bees, honey extraction, types of honey processing, and application and stages involved in honey processing through geothermal water. This paper mainly talks about the water bath method for honey processing in which the geothermal water is used for filtering of honey. The treatment process is performed in two stages the first stage involves the treatment of honey for the period of 24 hours up to a temperature of 50°C. While the second treatment process take place at the temperature of 75°C. In these two stages the complete inactivation of enzymes takes place which leads to the honey purification.

1. INTRODUCTION

Geothermal water is utilized in many ways for direct as well as indirect applications. The annual distribution of geothermal energy includes 34% for fish farming, 28% for bathing and swimming, 15% of individual space heating, 9% for greenhouse heating, 9% for district heating, and the rest is for agricultural drying, Honey Processing, industrial process heating, cooling, and snow melting, Lund and Boyd (2015). Honey Processing is a new trend in direct applications of geothermal water. Where two different temperatures of geothermal water is used for processing bee waxes. The process of bee farming is known as “Apiculture”, which deals with all the aspects of honey bee farming. In this paper a concept is discussed regarding application of low temperature geothermal water for honey processing in Gujarat. Details about exploration and exploitation activities in Gujarat is discussed in Sircar *et al.*, (2015).

2. APICULTURE

Honey Bees have been offering services to the society through ensured pollination in cross-pollinated crops as well as by providing honey and a variety of beehive products like, royal jelly, propolies, bee wax, pollen etc. Honey is not only used as nutrient but also for medicinal purpose. An alternative medical branch is been developed known as “Apitherapy” which uses various types of honey and honey products for medication of several diseases, Molan (2001). Millions of honey bee colonies, mostly, *Apis mellifera*, are maintained all over the world. The world production of honey has been ranging from 14 to 15 lakh metric tonnes per year. There are 15 countries in the world which account for 90% of the world honey production. China is the only Asian country producing nearly 2.5 lakh metric tonnes of honey. India have mainly four native bee species they are (1) *Apis Cerana*, (2) *Apis Dorsata*, (3) *Apis Florare* and (4) *Trigona Irridipennis*, Thomas *et al.*, (2001). At present there are about 30 lakh bee colonies in India, producing about 94500 metric tonnes of honey (2016-17 estimates) including honey from wild honey bees. India is one of the honey exporting countries. The major markets for Indian honey are Germany, USA, UK, Japan, France, Italy, Spain etc. The Apiculture involves various stages which includes farming, processing and marketing. Through the various literature survey it is found that the geothermal water can be utilized for processing of raw honey. Using this concept an apiary is planted in Gujarat where the *Apis Dorsata* type of bees are utilized for honey farming (Figure 1b). Figure 1a gives the glimpse of honeybee boxes used for apiculture at Gujarat, India



Figure1: (a) Honey bee boxes used in apiculture at Gujarat, India (b) Apis Dostra type of bee which is utilized for honey farming

3. POLLINATION

Pollination is the transfer of pollen from anther to stigma of the flower. Bees are attracted by fragrance of the flowers nectar. Nectar is a sweet fluid which is secreted by the nectaries of the flowers; it contains about 30-40% carbohydrate, minerals and vitamins which are the raw material of honey. Apis and non- Apis pollinators play the major role in obtaining potential yield in cross pollinated crops, hybrid seed production and crop under polyhouse condition. Bees only collect boost pollen from anther. Boost pollens are increasing the speed quality viz. seed germination, seed size and chemical composition etc. Apiculture/ Meliponiculture are only one mechanism to harvest the valuable products viz. nectar and pollen which are generally wasted in nature and therefore, without Apiculture/ Meliponiculture, we cannot harvest nectar, pollen and propolies. Table 1 represents the types of crop and their % yield increase in apiculture:

Name of the crop	% yield increase	Required bee colony/ hectare
Mustard	13-222	5
Niger	17	4
Sunflower	21-3400	5
Apple	180-6950	6
Citrus	20-233	5
Grape	23-54	3
Guava	12	3
Litchi	4538-10264	6
Pears	240-6014	6
Coffee	17-39	4

Table 1: Types of crops used for % yield increase in apiculture

4. BEE KEEPING CONSTRAINTS

The major constraints confronting the development of beekeeping are given as: (1) Lack of scientific data and knowledge in selection of honey bee species for cross pollination. (2) Deficiency of quality nucleus stock of bees. (3) Unavailability of infrastructure for production of large volumes of genetically superior bees which are supplied to beekeepers. (4) Advancement in technical knowledge for efficient management of bee colonies for higher honey yield. (5) Poor quality control for production of honey and other beehive products. (6) Needs to be more focused on production of honey and use of other beehive products. (7) Modern laboratories needs to be established for disease prevention, control, analysis and testing of quality of beehive products. (8) Lack of institutional research and support for beekeeping in terms of bank loans etc. (9) The pricing policy for honey and those who are engaged in packing, processing and storing honey needs to be improved. (10) Consumer awareness related to honey and its byproducts needs to be improved. (11) A non- traditional newly introduced industry. (12) Tribals and illiterates from forests and remote rural areas generally practice this industry. (13) It includes the interaction of two living materials- honeybees and living

plants. (14) Flowering of plants and secretion of nectar and production of pollen- sole food of honeybees, is influenced by climatic conditions. (15) The life cycle of honeybee depends on the climatic and floristic conditions, which varies from place to place. (16) De- forestation effects this industry. (17) The quality of honey gets affected due to the use of insecticides, pesticides, weedicides, etc. (18) This industry also gets affected by pollution of water and air. (19) Mono-cropping culture (20) Global warming and unforeseen changes in climatic conditions, Sarswat (2016).

5. PROCESSING METHODS

The processing stages of honey consists following stages (Figure 2) which are:

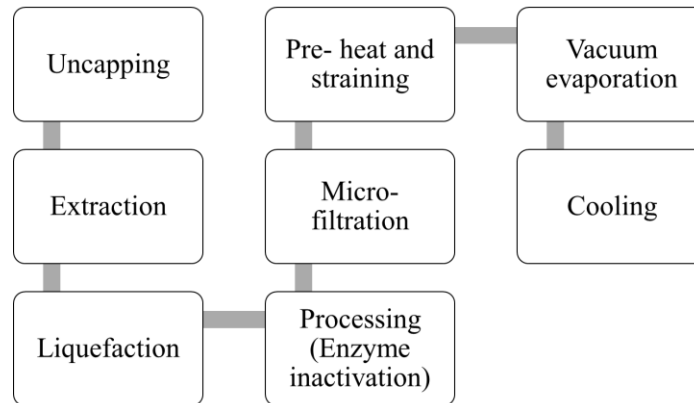


Figure 2. Honey Processing, modified after Kiruja (2001)

5.1 Uncapping

To hold the honey bees, generally we need to close the beehive cells from wax plugs. A heated knife is used to remove this cappings to let the honey flow from the beehive and stored in uncapping tank

5.2 Extractor

After the honey is uncapped the frames are placed in the extractor where the honey is squeezed out. There are mainly two types of extractors radial and centrifugal. Generally the centrifugal type of extractor is used for simple honey extraction. The extractors can be either electrically or manually driven. The size of the extractor varies depending upon the number of frames. The capacity of extractor to hold number of frames varies from 6 to 85 frames. The manual extractors are driven through either a bicycle chain or a hand crank while the electrical ones are motor driven. Figure 3 is a pictorial depiction of honey extractor used in Gujarat.



Figure 3: Centrifugal manually driven (hand crank) 6 frame honey extractor

5.3 Processing

After the honey is removed from the honey comb the raw honey is immediately needed to process. Once the raw honey comes in contact with air it starts crystallizing. To prevent it from crystallizing honey processing is needed immediately, Mburu (2012). There are mainly three methods for processing of honey (1) Simple Straining Methods, (2) Thermal Heating/ Water Bath Method and (3) Bulk Processing Method.

5.3.1. Simple Straining Method

It is mainly applied for freshly harvested honey processing. The uncapped honey is allowed to strain through a cotton cloth or net into a dry suitable container. After that the folded straining net or cloth is tie over the mouth of the container. Than allow the liquid honey to settle overnight. The scum needs to be removed from the surface of the honey through spoon before the honey is packed. Figure 4 represents the simple straining method for honey processing.

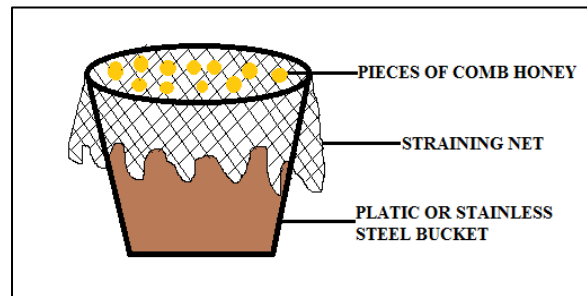


Figure 4: Simple Straining method for honey processing, modified after NAFIS, (2016)

5.3.2. Thermal Heating/ Water Bath Method

One of the best methods for honey purification is through heating under the controlled and low temperature. After extraction, heat treatment reduces the moisture level and destroys all yeast cells present in it. The process of honey extraction cannot be done at higher temperature because the combs will become softer and may breaks. Therefore low temperature is kept for extraction.

At the time of heat treatment of honey, for purifying it, the honey is subjected to double heat treatment. The first heat treatment process is performed for the period of 24 hours. The honey is heated up to a temperature of 50°C so that the crystals formed in honey can melt. Low enthalpy geothermal water is required for the same. This former method is known as standard pasteurization procedure which is widely applied in food industries, National Honey Board (2013). The second treatment process takes place at the temperature of 75°C which is allowed to prevent deterioration of honey quality, Kowalski *et al.*, (2012). Moderate enthalpy geothermal water is used for prevention of deterioration of honey. Gujarat enjoys the availability of both types of geothermal water which is very much congenial for honey processing. The undesirable substances like parts of bees and pollens are removed and after the filtration of such substances the temperature is suddenly cooled up to 50°C. After the second process the wax capping are melted down and collected for sales. In Dholera the water bath method of processing is applied where for the first stage the geothermal water of 45°C is used for pasteurization. While for the second stage the discharged water through heat pump of temperature around 80°C is utilized for the destruction of yeast and enzymes (Figure 5).

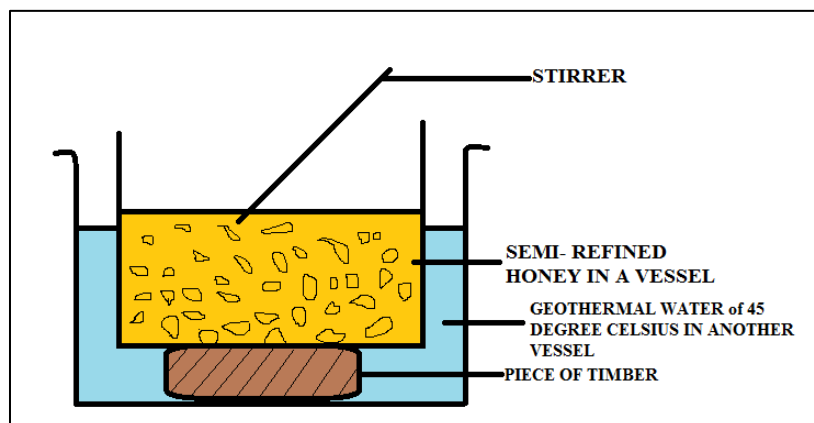


Figure 5: Water Bath method utilizing geothermal water, modified after NAFIS, (2016)

5.3.3. Bulk Processing Method

Large quantity of honey is processed through bulk processing methods (Figure 6). In this method the honey is flow through series of sieves of various sizes. The sieves are arranged in a concentric manner where the coarser mesh is being on the inside while the finest on the outside. The semi refined honey is heated between 45- 50°C temperature in a sump tank which is then flow by gravity through the sieves usually referred as strainers; into a settling tank where it is left there for at least 3 days. The sump tank consist of a hot room a vessel in it consisting of honey. Sump tank will be heated by geothermal water of around 40- 50°C so that the melted honey flows from sump tank to the sieving tank. The scum collected at the top of the strained honey is then removed and the honey is packed.

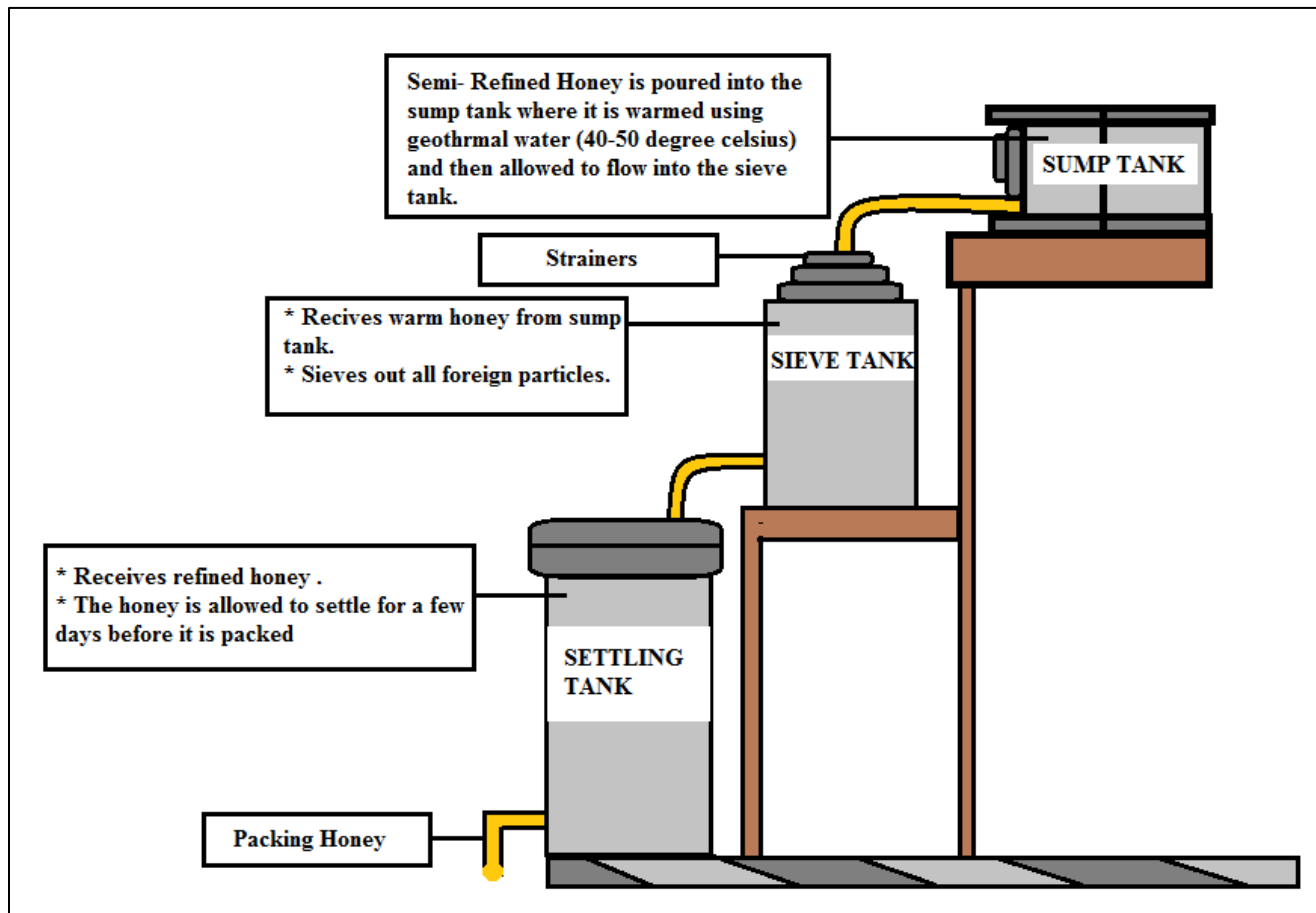


Figure 6: Bulk Processing Method, modified after NAFIS, (2016)

6. CONCLUSION

Geothermal energy can be used to improve livelihoods of the local communities in India. The paper talks about one of such utilization of geothermal water. Honey processing through geothermal water is a new trend. Geothermal water is utilized to process honey through various methods like thermal heating/ water bath method and bulk processing methods. This paper also elaborates about the pre stages of processing like uncapping and extraction of the honey from beehives. The major constraints and the types of flowers or vegetation required for apiculture is also discussed.

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