Optimization Analysis of the Experimental Parameters on the Extraction Process of Propolis

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Abstract—This research uses propolis as the raw material. To study the microwave-assisted extraction technique in combination with a shearing mechanism that is adopted to increase the rate of contact between the solvent and extractive. The shearing mechanism is applied to accelerate the fracturing of the botanic cell walls on plant fiber. And, the integrated circulation system ensures the operating temperature controlled.

Index Terms—microwave, extraction, propolis

I. INTRODUCTION

Microwave-assisted extraction (MAE) is a new extraction process method [1]. It uses microwave energy to heat a solvent which contacts the extract. The extract within the base material then attaches to the solvent. This method is characterized by rapid and uniform heating of the extract and solvent, and involves an extraction time of about 15-30 minutes [2]. These quantities are about 10 times smaller than volumes used by traditional extraction techniques, and significantly reduce extraction costs. In addition the microwave-assisted method is also used in environmental analysis [3], dry samples [4], microwave leaching [5] and other fields.

Microwave energy is an electromagnetic radiation with wavelengths between 1mm to 1m and frequencies in the range of 300 MHz to 300 GHz. This range is most used as the frequency for communications, in particular the radar, cell phones, television and satellite applications, therefore the Federal Communications Commission agreement states that two frequencies of 0.915 and 2.45GHz are specifically used for microwave heating in order to avoid interference with communications [6]. Microwaves can be used to heat water molecules. When microwaves stimulate molecules they promote molecular rotation and create kinetic energy which in turn releases heat or other forms of energy. As different materials have different dielectric constants, dielectric loss factors, heat and water contents, and different reflection and absorption characteristics in terms of subjection to microwave they can be selectively manipulated through microwave heating. These differential characteristics allow selective heating of the target material while allowing other components to be used as coolant during material processing.

The traditional MAE uses microwave heating methods. Specifically this involves electromagnetic energy transmission by radiation. This method allows the heat to be applied directly to the solution or the materials without having to be transferred from the container. This significantly shortens the time required to complete the extraction process. To put it simply, microwave energy heats the solvent directly which is already in direct contact with the sample base material. However, high temperatures can easily degrade the active ingredients during this process. This is compensated for by the addition of a temperature control module that can accurately maintain the specified necessary temperature.

Propolis is a substance produced by bees. It is made from elements of specific plant buds or bark juice which are mixed with bee secretions, pollen and beeswax. It has a gun like consistency and can be used to inhibit the reproduction of micro-organisms and the maintenance of an aseptic cellular state [7]. In addition, propolis contains many other natural ingredients: including gum (resin), wax, essential aromatic oils, pollen, various other substances and organic debris. Propolis does not dissolve in water, but is easily soluble in ethanol solution. Burdock [8] found that the main ingredient within the class of Propolis Flavonoids, have the ability to target and destroy cancer cells as well as strengthen the immune system.

Flavonoids are the largest single substance in a propolis sample. They make up between of 30-40% of propolis. Flavonoids including flavones, flavonols, flavanones and flavanons are the main components in propolis and it is these