CHAPTER 6

EXTRACTION OF PHYTOCHEMICALS FROM SELECTED PLANTS

6.1 INTRODUCTION

In this chapter two aspects are discussed. One of the aspects is the validation of the design for performance of the novel pyrolyser. Stem parts of two plants namely Ziziphus jujuba and Dodonaea viscosa are extracted using this novel pyrolyser. The second aspect is the extraction from the parts of the three plants Moringa oleifera, Cedrus deodara and Celastrus paniculatus using solvent extraction technique.

6.2 VALIDATION OF DESIGN BY EXTRACTION OF Z.jujuba USING PYROLYSER

The extraction was carried out using the designed pyrolyser for validating the principle of design. The stem of Z.jujuba were broken into pieces of length approximately 15-20 cm and dried under sun to reduce the moisture content. The dried plant material was weighed and sixteen kilograms loaded inside the main chamber of the pyrolyser. The chamber was kept airtight by tightening the bolts and closing the outlet valve.

Since slow pyrolysis technique is worked out in the heating rate of $< 50^\circ C/minute$, the heat inside the chamber was increased from room temperature in steps of $50^\circ C$ with the help of the temperature controller and time taken for each step was noted down. At temperatures just about $100^\circ C$, steam around the corners of the lid was observed indicating the removal of moisture. As the
temperature inside the chamber was raised further, the woody parts broke down to release tarry vapors and gaseous matter. At a temperature of 290°C, a high dense cloud of smoke and vapors escaped out around the lid of the chamber. The dilute condensed vapors were collected around 375°C. The viscosity and the color of the condensates were observed to increase with the increase in temperature. The residual contents were removed by heating above 600°C and after 160 minutes the process was observed to have ended. The condensates collected in the flask was found to be an immiscible mixture of the less viscous light brown watery part and a thick dark brown viscous part. The weight loss was ten kilograms as the char remain weighed six kilograms. The biomass conversion gave a yield of 300 ml of pyrolysis oil. The main chamber was cleaned with hot water to prepare it for the next pyrolysis run. The process was repeated 3 times to establish repeatability. The temperature plotted with time showing the various phases of heating curve is shown in Figure 6.1.

**Figure 6.1 Heating curve of the pyrolysis of Z. jujuba**

- A – Moisture Removal
- B – Thin Vapour near lid
- C – Dense Vapour and Smoke
- D – First low viscous condensate
- E – Dark Viscous Oil
- F – End of extraction
The important stages (1 to 6) during the pyrolysis process are shown in Figure 6.2.

Figure 6.2 Stages of pyrolysis process of Z.jujuba
1) Loading of stem 2) Experimental setup for pyrolysis 3) Appearance of vapors around the corners of the lid 4) Appearance of vapor through the bottom valve 5) Concentrated oil collected 6) Char remains of the stem

6.3 VALIDATION OF DESIGN BY EXTRACTION OF D.viscosa USING PYROLYSER

Fifteen kilograms of sun-dried stem pieces of Dodonaea viscosa were weighed and loaded inside the main chamber of the pyrolyser, its opening was closed, and the temperature was increased in steps of 50°C. As the biomass was heated, the initial stage involved the removal of moisture. Outlet valve was opened at regular intervals to check for the presence of the extracts. At a temperature of 280°C, a highly dense cloud vapour escaped around the lid of the chamber, indicating the breakdown of the stem bark. The first instance of extract appearance was at 370°C, and this substance was collected in a glass flask. As the experiment proceeded, a dark viscous extract was collected at 440°C. Further heating to 600°C drove away all the residual
contents. The temperature was then reduced and maintained at 550°C for 30 minutes. The volatiles appeared to stop after 130 minutes (Figure 6.3). A separation of two distinct fractions of the extract occurred, with one viscous oily substance and the other in a less oily brownish aqueous phase.

The experimental setup was allowed to cool for 24 hours, and the charred charcoal remains were taken out and weighed. The weight loss was 10.2 kg, as the char remains weighed 4.8 kg. The biomass conversion yielded 500ml of pyrolysis oil. The main chamber was cleaned with hot water, and the process was repeated three times to establish reproducibility.

![Diagram of Heating Curve of pyrolysis of D. viscosa](image)

**Figure 6.3 Heating curve of the pyrolysis of D. viscose**

### 6.4 SOLVENT EXTRACTION PROCESS OF M.oleifera, C.deodara, C.paniculatus

The relevant part of plants namely leaves of M.oleifera, heartwood of C.deodara and seed of C.paniculatus were initially sorted for good and degraded material. Only good material were selected. Then the selected
material were cleaned of trash and other foreign particles. This was done using sieves to remove sand and other foreign matter and then sizing was done manually. They were later dried in shade in the temperature range 35-40°C and the moisture content is reduced to around 10%. The dried parts were then ground to smaller particles. Active substances responsible for the medicinal properties were extracted by solvent extraction method using ethanol and water (hydroalcohol) in the ratio 7:3 at room temperature. The extraction was carried out under controlled atmospheric conditions for 24 hours and the extract was condensed under vacuum in a rotary vacuum evaporator (Figure 6.4) to a viscous liquid.

![Rotary vacuum evaporator used in this research work](image)

**Figure 6.4 Rotary vacuum evaporator used in this research work**

The concentrated extract was later filtered using a Watman filter paper no.1 and the filtrate was dried and ground. The process flow is given in Figure 6.5.
Active components from parts of selected plants were successfully extracted and the plant extracts were made ready to be coated on medical bandages.

Figure 6.5 Flow chart of procedure followed for dry extracts

6.5 CONCLUSION