3 MATERIALS AND METHODOLOGY

After selecting a suitable cinnamon type, experimental setup was equipped for carrying out the research. Fixed bed tunnel dryer was used for drying cinnamon at different drying temperatures. Cinnamon bark oil was extracted by hydro distilling the dried sample. Finally the composition analysis was carried out for each cinnamon bark oil sample.

3.1 Materials & Equipments

Cinnamon chips were collected from a cinnamon plantation at Gonapinuwala area in Galle district, southern province of Sri Lanka during the month of August. These cinnamon chips were of the type "mas-katta".

Mettler PM4000 (0-4000 grams) electronic balance was used for weighing the cinnamon chips (Figure 3.1a). Laboratory moisture balance (Citizen-MB 200X) was used to determine the initial moisture content of samples (Figure 3.1b).

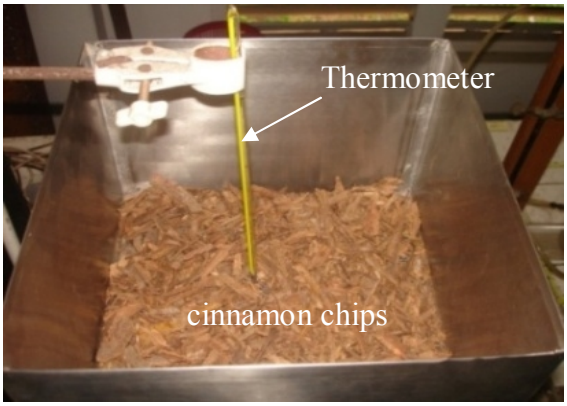
(a) (b)

Figure 3.1: (a) Weighing balance, (b) Moisture balance

Laboratory tunnel dryer fitted with an electrical heater was used to uniformly dry cinnamon chips on a fixed bed (Figure 3.2) of the dimensions 30.5 x 30.5 x 5 cm^3. The dryer was consisted of a centrifugal blower which was used to blow air over an

electrical heater (rating 0.9kW) to the base of the drying chamber. Hot air was blown upwards through a vertical duct which was consisted with an air flow stabilization unit. The drying chamber was fitted at the upper end of the duct. The inlet dry bulb temperature was monitored by a thermostat and a relay was used to control the heater. A thermometer was inserted at inlet to measure the incoming air temperature to the drying chamber (Figure 3.3a) and air flow rate was measured at dryer outlet using an anemometer (TECPEL 712) (Figure 3.3b).

Figure 3.2: Fixed bed dryer with component



(a)

(b)

Figure 3.3: (a) Thermocouple, (b) Anemometer

Inlet air temperature was controlled with an accuracy of ± 1 °C. A constant air flow rate of 0.023 m^3/s (this is the maximum air flow rate of the unit) was maintained throughout the experiment. The oil samples were analysed using gas chromatography mass spectrometer (Agilent, American 7890A/5975C GC-MS system) (Figure 3.4).

Figure 3.4: GC-MS-7890A gas chromatograph equipped with a 5975C plus mass spectrometer (Agilent, American)

3.2 Drying of Cinnamon Chips

A bulk of 30 kg of cinnamon chips of the type “mas katta” was selected for the experiments. Cinnamon chips were kept in sealed poly sack bags to avoid loss of moisture. The sampling method indicated in Figure 3.5 was used to maintain the uniformity between experiments. Cinnamon chips of weight 30 kg was divided into 5 lots containing 6 kg each for air drying at temperatures of ambient, 35 °C, 40 °C, 45 °C and 50 °C. Initial moisture content (M_0) of cinnamon chips (w/w wet basis) was measured using moisture balance for randomly selected 5 samples from each Lot and

average initial moisture content was calculated. Four samples of 500 grams each was randomly selected from Lot 1 for drying at ambient temperature. The first sample was loaded to the drying chamber. The bed dimensions were 30.5 x 30.5 x 5 cm^3. The vanes were fully opened to give maximum air flow rate and the blower was switched on. Temperature readings and the loss of weight of sample were recorded at 10 min time intervals. Drying and weighing were continued until the final moisture content of 24% (w/w dry basis) was achieved for all of four samples.

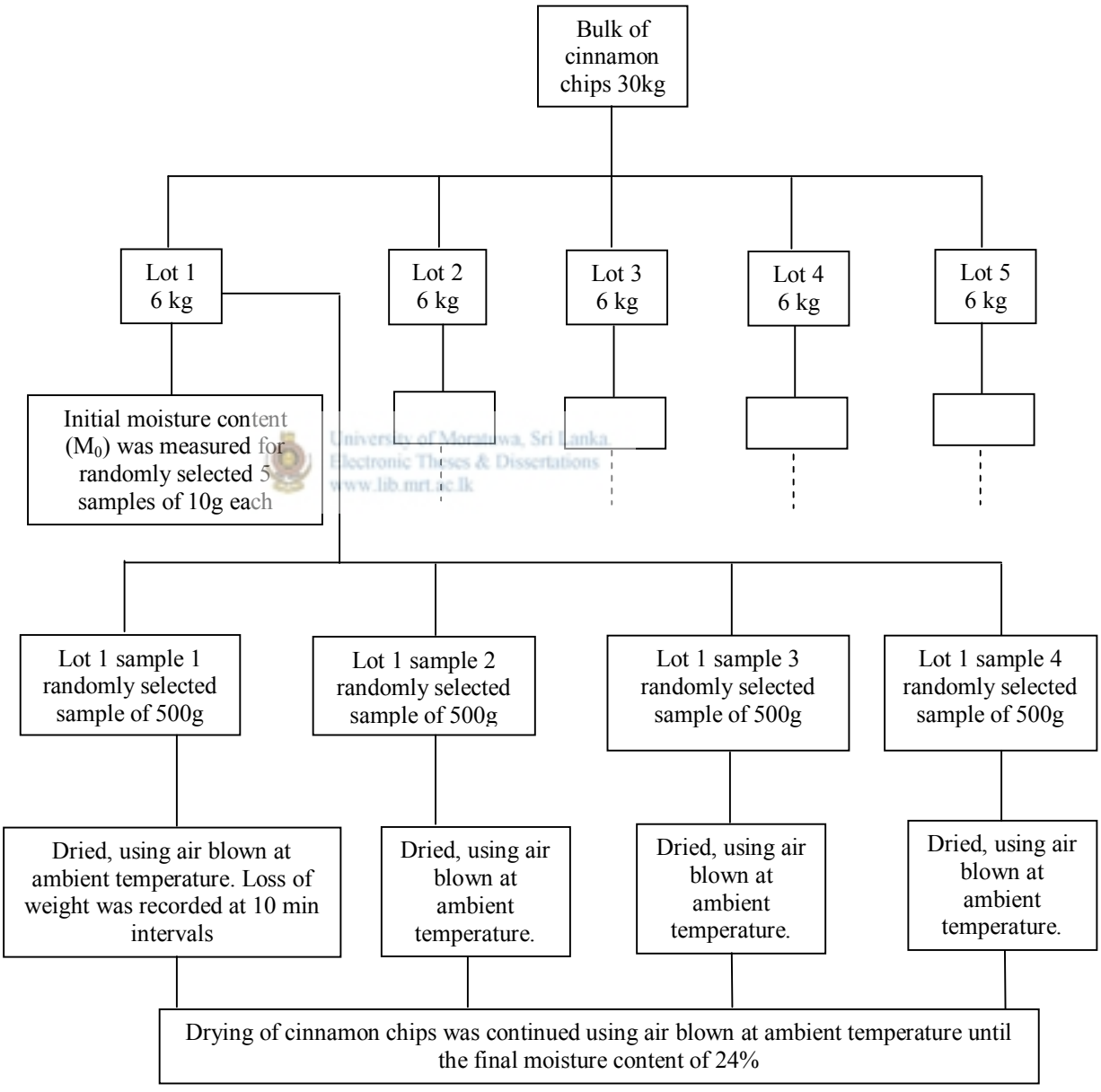


Figure 3.5: Cinnamon chips sampling method

The final moisture content of 24 % was selected based on the average moisture content of cinnamon chips available in the market. The moisture content (on dry basis) at any instant was calculated using the equations given in section 4.1. Frequent mixing of cinnamon chips was done to achieve uniform drying. Dried samples were packed in poly sack bags and stored in a dry place before hydro distilled.

For temperatures above ambient, the loading of cinnamon chips was done after the blowing air reached the required set temperature for drying. All the other experimental procedures were carried out as similar to ambient temperature (Lot 1) for air drying at temperatures of 35 °C (Lot 2), 40 °C (Lot 3), 45 °C (Lot 4) and 50 °C (Lot 5).

3.3 Extraction of Cinnamon Bark Oil

The volatile organic compounds of cinnamon bark were obtained by traditional hydro-distillation (HD) method using cinnamon oil extraction apparatus as shown in Figure 3.6. The four replicate samples dried at a particular temperature were mixed together to achieve uniformity before the hydro distillation process.

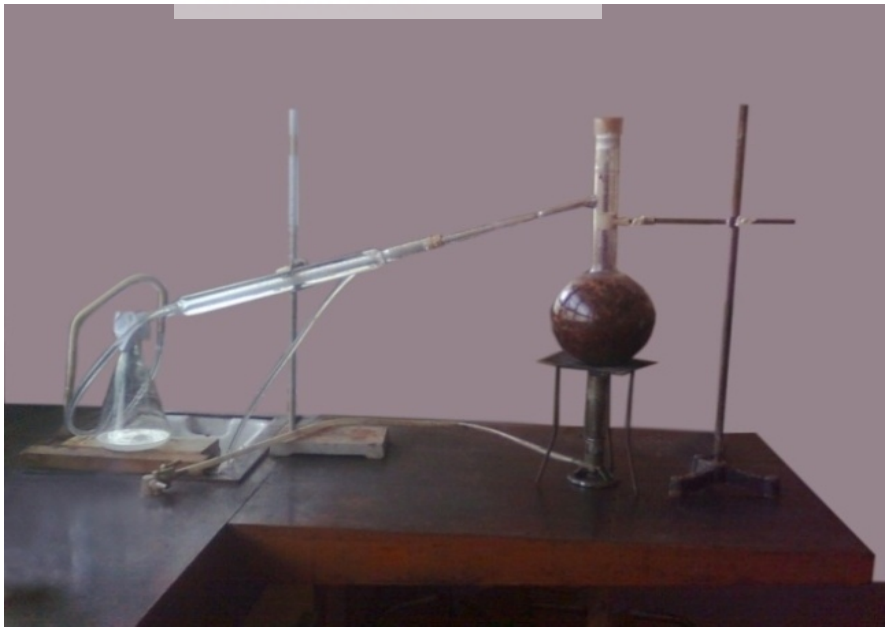


Figure 3.6: Cinnamon oil extraction apparatus

Four samples of 250 grams each were randomly selected. Each sample of dried cinnamon bark was distilled using 850 ml of water for about 90 min. Cinnamon bark oil was separated from water in the distillate using a separating funnel (Figure 3.7) and the separated sample was stored in a dark place until the GC analysis was carried out. As in the case of drying, four replicate experiments were performed for hydro distillation of cinnamon chips dried at a particular temperature.

Figure 3.7: Cinnamon oil separation apparatus

3.4 Identification of Volatile Organic Compounds

The oil samples were analysed using GC-MS and a 5% phenyl / 95% dimethyl polysiloxane capillary column (30 m × 0.5 mm i.d., film thickness 0.25µm) was used for the separation. The injector temperature was 25 °C, and the oscillatory temperature was 100 °C. A 2µl of extract was injected in split mode (split ratio of 1:100) to the column. The initial temperature was kept at 70 °C for 2 min, and the temperature was gradually increased to 270 °C at a rate of 5 °C/min. Mass detector conditions were as follows: FID mode; source temperature, 250 °C; scanning rate 100 scan/min; quadropole temperature, 150 °C.