Chapter VIII

CONCLUSIONS AND RECOMMENDATIONS

8.1 Conclusions

The experimental results may be concluded as follows:

1. The precision of the experimental data was found to be rather high. The results were consistent with the mass conservation law.

2. The evaporation/concentration ratio calculated from the concentration of product and feed was very agreeable to that calculated from the flow rates of feed and product. The ratio was found to have a maximum of 2.9 within a feed range about 0.26-0.31 liter/min. However the values obtained here were still too low to yield a highly concentrated fruit-juice.

3. The Seban-Shimazaki's correlation equation which is for convective heat transfer with turbulent flow in a closed conduit, was found to be well applicable to the flow of hot water in the present experiments.

4. The theoretically derived equation of the proposed model:

$$(\Gamma_o^{4/3} - \Gamma_L^{4/3}) = 0.925\left(\frac{T_s - T_v}{\lambda}\right)\left(\rho^2 k^3 g \frac{\cos\theta}{\mu}\right)^{1/3}$$

was found to be agreed reasonable well by the experimental results. Some deviation from the equation was expected to be caused by the cumulative effects of experimental errors and the assumptions used in deriving the equation.

5. The concentrate juice obtained had undesirable odor and taste,with acceptable color and appearance. The vitamin C content was unable to be detected. The keepability was good if some preservatives were added. Storage at refrigerated temperature resulted better color than that at room temperatures.

8.2 Recommendations

The study of inclined-film evaporator should be further attended. According to the present experiments, however unfavorable results obtained,it does show some points of view which are listed as follows:

1. The inclined evaporator should be constructed to provide the one that correspond with the change of viscosity as the concentration changed. This was to keep the regular layer of thin film which implied effective surface for evaporation.

2. The initial concentration of the feed should be increased by adding some sugar and citric acid to help to keep the volatiles as suggested by Lowe and King(1974). This might increase the boiling temperature,the proper initial concentration must be tried.

3. The evaporator should provide an opening for convenient and better cleaning,and it must be tightly closed for accommodating vacuum.

4. There should be an attached unit for separating or fractionating the volatiles from water condensate,and the use of waste such as peel,pulp,should be investigated.

5. All the valves used for controlling the flow rate should be glove valves in order to provide a better flow regulation.

6. The economic view points must be taken in consideration. In this study,this point was regardless due to time limitation and unsufficient data, However, it is the most important factor within the scope of application.

7. More sensitive and precise equipments should be installed where it is needed ,for example, a thermocouple to measure the plate temperature and the boiling temperature, a device to measure the film thickness, a device to produce regular thin film,etc.

8. The variation of fluid properties i.e., density, ρ; thermal conductivity,k; and viscosity, μ; during the evaporation should be taken into account in deriving the theoretical equation for the process. This would be very difficult and the numerical method with the assistance of a computer must be used.

9. In order to obtain concentrate juice with high nutritional value and high acceptibility , the further process 'cut back' should be performed.