CHAPTER V

DISCUSSION

It was found that dehydration of lime juice by spray-dryer could not be done without drying aids both for unconcentrated and concentrated lime juice by vacuum evaporation since lime juice contains pectin which are capable of forming gels with sugar and acid under suitable conditions (6).Efforts were made to look for a suitable carrier to be used as a drying aid. Table 5 shows that drying aids such as glucose,sucrose and dextrin did facilitate dehydration.Additional investigations showed that dextrin was the most suitable because it was soluble and tasteless.When glucose or sucrose was used they gave sweetness to the powder product which may be unsuitable for some purposes.Other drying aids which may cause insoluble problem after reconstitution could not be used either.However the products obtained from Table 5 developed caking phenomenon rapidly and it could be noticed that there was severe flavor loss in the outlet air probably due to the high inlet air temperature used in the experiment.The method for concentration of lime juice before drying also had an important effect on the flavor loss of lime juice.Freeze concentration was preferred to vacuum evaporation because of the much better flavor retention in the lime juice concentrate.

The experimental results shown in table 6 was obtained with lower inlet air temperature.It demonstrates that lime juice with high solid content could not be spray-dried.Dextrin must be used as drying aid at approximately twice the solid content.of the lime juice.The product with the highest dextrin content still caked within a short period.It may be due to low inlet air temperature.Experimental results shown in Table 7 obtained with the ratio of dextrin to solid content of juice less than 1.0,conform with those shown in Table 6 that lime juice with high solid content could not be spray-dried.Concentration of lime juice at 10°Brix was therefore considered appropriate and adopted for all subsequent spray drying experiments.The 10°Brix lime juice concentrate with dextrin added at 20 , 25 and 30% were spray dried at 200 , 250 and 300°C. and the physical and chemical properties of lime powder obtained are shown in Table 8 , 9 ,and 10, respectively.Higher inlet air temperatures were used in the above experiments because the results from Table 5 and 6 indicated that lime powder obtained with inlet air temperature at 180°C. or less was too moist and consequently caked easily upon storage.Table 8 shows that the higher the dextrin content the better would be the ascorbic acid retention and the color in the lime powder.Table 9 and 10 give the same results.In addition,when inlet air temperature increased, moisture content of the lime powder would decrease accordingly.At the same time darker color products would be obtained: Fig 3 ,4 show the effects of dextrin and inlet air temperature on the color of lime powder.Lime powder packed in polyethylene bag could be stored at room temperature for 150, 182 and 270 days respectively as shown in Table 9 .Shelf life of the spray-dried product was limited primarily by caking and browning discolorator.Table 11, 12, and 13 show the results of organoleptic test.Powder spray-dried at low temperature i.e. 200°C. appeared to give the best organoleptic result with respect to color, odor and flavor.The results of 2^3 factorial experiment are presented in Table 14 and Table 15. According to the results shown in Table 14,experimental run number 3 gave the best lime powder for it contained more ascorbic acid content, lower moisture content, higher organoleptic test score and percent recovery than all the other samples.Table 15 shows effects of variables on physical and chemical properties of lime powder using significant value and sign.Positive sign means that when variable is increased, quality factor will increase while negative sign indicates that increase of variables will lower the quality factor.It was shown that the higher the juice concentration, the higher the moisture content was observed in the products.Dextrin also had a significant effect on moisture and ascorbic acid content of lime powder.Inlet air temperature had a profound effect on optical density;the higher the temperature, the higher the degree of optical density.Two-factor interaction of juice concentration and percent dextrin affected moisture content and optical density.Color and flavor of powder were also affected by two factor interaction of juice concentration and inlet air temperature. Three factor interaction also had an important effect on moisture and ascorbic acid content. Table 15 also shows that product could not be obtained without dextrin.

For storage studies, Table 16 shows that the moisture content of powder packed in aluminium foil was less than that packed in polyethylene bag. Different packaging had no effect on other quality attributes except moisture content. The vacuum-packed and ordinary air-packed lime powder samples showed no difference in physical and chemical properties indicating that spray-dried lime powder may not require vacuum-packing when aluminium foil is used.

Fig 5 shows the color of lime powder packed in polyethylene bag after 9-months storage at room temperature. The powder obtained with 20%, 25% and 30% dextrin turned dark brown, brown and slightly brown respectively. However all three samples became completely caked due to moisture pick-up during the storage test. Non-enzymatic browning reactions are either due to Strecker degradation of amino acid compounds or due to deterioration of ascorbic acid (36). Hydrolysis of sucrose can also occur leading to non-enzymatic browning (57). The data in Table 16 showed that ascorbic acid disappeared completely after only six weeks indicating that browning reaction in lime powder was probably due to degradation of ascorbic acid.