CHAPTER V

DISCUSSION

The overall study of extracting agar red seaweeds from various sources in southern Thailand has been quite satisfactory. The variables that are of main interest in this research work are pH of extracting solvent, time of extraction, ratio of solvent to seaweed used and the effect of alkali pretreatment of seaweed before extraction.

The first part of the study involved the determination of some components of red seaweed from three sources in southern Thailand, such as moisture content, ash;fiber and protein content.

The result of moisture content in seaweed, after sun drying, from Ranong, Songkla and Suratthanee can be seen respectively in Table 4-1, Table 4-2 and Table 4-3. The moisture content of seaweeds from these three provinces were all below 20%. This finding is similar to that of Tseng (26) who reported that after the seaweed was gathered, washed with fresh water and then spread to dry by sundrying for 3-4 days, the moisture content would have dropped to less than 20%. A seaweed such as this would have a storage life of approximately 5 years (6).

The result of chemical analysis of seaweed is shown in Table 4-4. It shows that protein content of the red seaweed

(Rhodophyceae),genus Gracilaria gathered from Ranong, Surathanee and Gracilaria confervoides from Songkla (3) are 4.38, 7.5 and 6.9 respectively. The above protein figures are considered very low in comparison with other seaweeds which have been used as a staples item of diet such as Porphyratenera which contain 25-30% protein (5). This is the reason that Porphyra has been used as food for direct human consumption. However, it is evident from the data that Gracilaria is not suitable for use as food directly, but it could probably be used as a raw material in agar production (6).

The second part of the study involved the determination of the optimum conditions for extracting agar from red seaweed from southern Thailand in order to obtain maximum agar yield and best quality. The first variable considered was the effect of pH of extracting solvent used, the result is presented in Table 4-5, which shows that the optimum pH of extracting water that gave maximal agar yield was 5.5, using acid sodium phosphate buffer as a pH controller. This supported the report by Tslendy and Sargent (7) who found that the pH of the extracting solution was of very considerable importance, but the effect varied for the different species. Thus the yield from Gelidium cartilagineum and Pterocladia species was maximal around pH 6-8 and fell off with increasing alkalinity. In case of Endocladia muricata, the reverse held true, the maximum

yield being secured at pH 12 (5).

In regard to the effect of time of extraction on agar yield, the experimental result is given in Table 4-6. The optimum time of extraction which gave maximum agar yields appears to be 2.0 hrs. This result indicated that extracting for 0.5 hr was still not enough to break the cell wall of seaweed, so the agar which occurs as a structural carbohydrate in the cell walls of seaweed, can not dissolve freely in the extracting solvent. Difficulty was encountered in filtering and the filtered liquor was too weak to gel. On the other hand, longer extracting time gave much lower agar yield. This was due to the fact that the extracting solution was very viscous because of loss of water during extraction.

The experimental result concerning the effect of amount of solvent used on agar yield indicates that the optimum ratio of seaweed to solvent used is in the range of 1:25 to 1:35 as shown in Table 4-7. Too much solvent yielded weak liquor that was unable to gel. On the opposite, if solvent used was less than optimum it gave a very viscous solution and difficult to filter subsequently.

Considering the experiment on the effect of alkali pretreatment of seaweed before extraction, it was found that the alkali pretreatment of seaweed before extraction slightly affected on agar yields as shown in Table 4-8 and Table 4-9. But the major effect of alkali pretreatment was upon some

properties of extracted agar which it will be discussed later.

The maximum agar yield of 26 wt % (dry basis) was obtained from extracting the seaweed from Ranong. The other results show that the seaweed from Songkla and Suratthanee contained 20-23 wt % and 18-21 wt %, respectively, as shown in Table 4-9, Table 4-10 and Table 4-11. This experimental result shows only small difference of agar yield extracted from three provinces in southern Thailand; Ranong, Songkla and Suratthanee. The agar yield of this seaweeds in sufficiently high for potential use as a raw material to produce agar to supply demand in our country. Chapman (5) reported that the total agar content of North Carolina Gracilaria lied between 55 and 65% on a dry weight basis, but only 25-35% could be obtained in the laboratory. It is there fore very probable that using efficient commercial equipment, much higher agar yield would be obtained from these seaweeds in southern Thailand.

The result of alkali pretreatment on some properties of agar extracted from seaweed from Ranong is shown in Table 4-12, alkali pretreatment of seaweed before extraction seems to increase the gel strength of the agar obtained. This alkali pretreatment probably caused the conversion of the algal polysaccharide from low to high setting power (23). This correlated well with Haas and Russel Wells in 1929 (27) who found that the mucilagineous substance from contain weeds acquired marked gelling ability when subjected to the action of alcoholic potash.

Chapman (5) also reported that Yanagawa has been studied the effect of sodium hydroxide on such mucilages and found that among 30 species of weeds tested Gracilaria verrucosa,G.gigas and Pterocladia tennis were notably high in gel strength.

The experimental result concerning the determination of some properties of agar extracted from red seaweed from three provinces in southern Thailand is shown in Table 4-13. In this consideration, the commercial powder that sold in the market is selected to use as a reference for property testing of the extracted agar. The result shows that the quality of extracted agar that obtained from extracting red seaweed from southern Thailand is resonably good in comparison with the agar commercially. Some properties are almost the same except that the gel strength of the extracted agar is lower than that of the commerical agar. The moisture content of extracted agar from Ranong, Songkla and Suratthanee were 17.3%, 15.9% and 18.1%, respectively, while the commercial powder agar had 17.2% moisture content. The moisture content of the extracted agar is well below the level of 20% for optimal commercial storage. Clingman (28) stated that since the principal components in agar that are the primary sources of spoilage is the carbohydrate or galactose, higher water will accelerate deterioration of agar either by microorganisms or chemical reaction such as browning reaction.

In case of the clarity of agar, the % transmittance of

1.5% agar solution was measured against the solution blank at the wavelength of 520 mμ using Spectrophotometer (Bausch & Lomb, Inc.,Spectronic 20). The result of % transmittance of extracted agar, after bleaching with 1% activated carbon, from seaweed from southern Thailand is quite satisfactory when compared with commercial agar as shown in Table 4-13. This experimental result also shows that the alkali pretreatment of seaweed before extraction gave slightly higher in % transmittance as shown in Table 4-12. Because of the treatment of the seaweed with 1% sodium hydroxide at 90°C for 2 hrs caused partial bleaching of the seaweed and thus gave light-coloured seaweed prior to extraction. The clarity of extracted agar is also dependent upon many factors, such as method of washing the seaweed after gathering, method of drying, etc (3). The seaweed used in this experiment was dried by sun drying. As a resent the seaweed will have been partially bleached by solar radiation. So the intensity of sunlight, thickness of spreadingseaweeds, length of drying and with daily inversion of the layers are of interested.

The latter result concerning the dissolution and gelation properties of agar is also shown in Table 4-13. The extracted agar is soluble in hot water (90°- 100°C) with the rate of dissolution, 1.5% agar solution, of 3.5 min from Ranong, 4.5 min and 5.0 min for agar extracted from Songkla ans Surat-thanee respectively. Rate of dissolution of extracted agar is

slower than rate of dissolution of commercial power agar, since the extracted agar might be contained of more impurities and method of preparing in laboratory is not likely with commercial equipment. Gelation temperature of 1.5% extracted agar solution is in the range of 37° to 41°C and gel melting temperature is about 74° - 79°C.