CHAPTER 4

CONCLUSIONS

This work focuses on the physicochemical properties of cross-linked carboxymethyl rice starch (MRS) prepared from dual cross-linking and carboxymethylation reactions. The MRSs were prepared using various amounts of epichlorohydrin (ECH) as cross-linking agent. Two types of organic solvents (methanol and 2-propanol) were employed as a medium to prepare MRS-M and MRS-I, respectively. Based on physicochemical properties, chosen MRSs were studied for the potential use as a tablet disintegrant using aspirin as a model drug. The conclusions can be drawn as follows;

1. MRS can be prepared from native rice starch (RS) *via* dual-reaction with monochloroacetic acid and ECH as a carboxymethylating and cross-linking agents, respectively. The reaction conditions for MRS-M and MRS-I are as presented by Kittipongpatana et al. (2006), and Filbert and Woodbury (1950), respectively, with slight modifications.

2. The degree of substitution (DS) of MRS-M and MRS-I ranged between 0.30 to 0.38 and 0.41 to 0.50, respectively. The modification in 2-propanol medium yielded higher DS products of carboxymethylation than those modified in methanol medium.

3. The MRSs, which were cross-linked with ECH $\geq$ 1 g/ 100g starch, were not soluble but swellable in water.

4. An aqueous solution (1%) of the soluble MRSs yielded pH between 6.8 and 7.6. These MRSs certainly gave the higher percent light transmission (%T) compared to that of native rice starch.

5. Degree of cross-linking (DC) of MRS was between 0-0.89. The DC increased and swelling of MRS decreased when amount of ECH increased.

6. The result of carboxymethylation was marked with IR spectra of MRSs showed the peak at 1600-1700 cm^{-1} which was assigned to carbonyl group.

7. X-ray diffractometry revealed that rice starch showed an A type crystal pattern like other cereal starches. All MRSs presented related pattern of X-ray diffraction to that of the native starch and slight decrease in peak intensities.

8. Scanning electron microscopy (SEM) images exhibited that the granules of each MRS-I was not appeared different from that of RS, except MRS-I-03 which showed some granules with rough surface. SEM images of MRS-M showed the granules of MRSs became rough, grooved and gradually assembled together when amount of ECH increased (1-15 g/ 100g starch).

9. Differential scanning calorimetry (DSC) thermogram of RS showed the onset temperature (T_o) as 70.65±0.22°C while the peak temperature (T_p) and the enthalpy of gelatinization (ΔH) were 74.11±0.08°C and 6.60±0.04 J/g respectively. The DSC thermogram of each MRS showed that the gelatinization peak of MRS become no disappearance.

10. Modified starches displayed improvement in water uptake ability compared with that of RS. The water uptakes were in the order of MRS-I > MRS-M when ECH was used from 0 to 1 g/ 100g starch. However, the water uptakes were in the order of MRS-M > MRS-I when ECH was used from 3 to 15 g/ 100g starch.

11. The range of disintegration time (DT) of silicified microcrystalline cellulose (SMCC) tablets (705.71 mg) containing 2% of MRS-M (9-26 sec) was higher than that of MRS-I (3-5 sec). MRS-I-03 provided the lowest DT (3 sec), which was also lower than that of RS and croscarmellose sodium (CCS) but still higher than that of sodium starch glycolate (SSG).

12. Wetting time (WT) range of SMCC tablets containing various MRS-M (93-150 sec) was higher than that of MRS-I (66-99 sec). The lowest WT was obtained from tablet composing 2% of MRS-I-03, which was also lower than that of RS but until higher than that of CCS and SSG.

13. The DT of aspirin tablets (712.60 mg) containing various MRS-M and MRS-I were in the range of 18-25 and 11-26 sec, respectively. MRS-I-05 gave the lowest DT as only in 11 sec, which was also lower than that of RS, CCS and SSG.

14. The WT of aspirin tablets containing various MRS-M and MRS-I were between 48-82 and 46-56 sec, respectively. The lowest WT was obtained from tablet containing 2% of MRS-I-03, which was also lower than that of RS and CCS but

higher than that of SSG.

15. WT and DT value of the tablet were inversely related with water uptake, the lower WT and DT were found from the tablet containing higher water uptake disintegrant.

16. Water absorption ratio (R) of both SMCC and aspirin tablet decreased when the MRS modified using higher ECH content was employed as a disintegrant. The R value was directly correlated with swelling volume of disintegrant; the disintegrant that displayed higher swelling volume would present the tablets higher R value.

17. MRS-I-03 and MRS-M-04 showed the best potential to be a tablet disintegrant compared with that of RS and their groups; MRS-Is and MRS-Ms, respectively.

18. The higher proportion of MRSs affected the DT and WT of MRS-containing tablets seemed to slight decrease while R value tented to increase.

Suggestions for some subsequent work include;

1. Change SMCC into some other diluents. SMCC is a highly useful excipient because it is multifunctional, requires simple processing (direct compression) and exhibits superior flow and compaction. However, it is one of the hydrophilic diluents. In experiment of DT, tablets disintegrated very fast especially in tablet containing SSG, CCS, MRS-I-03 and MRS-I-05 making it quite difficult to observe during the test.

2. The use of other model drugs to study the potential of the modified starches will increase the understanding of the behavior and properties of modified starches.

3. Use MRSs as other types of pharmaceutical excipient which correspond to their physicochemical properties.