# Effects of Acetic Anhydride toward Degree of Substitution on Acetylation Method of Sago Starch (*Metroxylon sp*) from Papua

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## INTRODUCTION

Sago contains carbohydrates that are stored in the starch form. Starch is generally formed from two molecules of glucose polymer, namely amylose and amylopectin, which its composition varies for each type of starch [1]. The weakness of starch can be overcome through a modification of the functional properties of starch to expand sago starch. Chemical modification of starches can enlarge the range of certain starch physical properties of the parent starch [2] and enhance their use in a number of applications found in industrial processes and food manufacture. Chemical modification of starch can be performed by various methods such as acetylation.

Generally, native starch has a low Degree of Substitution (DS) because of their limited degree or reaction on the granule surface. Increasing DS can be obtained by modification of native starch through acetylation reaction using few catalysts such as pyridine and NaOH. Several researchers have reported the effects of acetylation on many sort of starch sources such potato, corn, pea and cassava [3-5]. There are few studies about the effects of acetylation of starches with a wide range of amylose contents. We have carried out some work on effects of acetic anhydride concentration toward DS value of native and modified sago starch from Papua.

## METHOD

### A. *Acetylation with acetic anhydride*

In this study, sago starch was modified by acetic anhydride with various concentrations. Sago starch was acetylated according to the method described by [6] with few modifications. Sago starch was pre-gelatynitated by mixing 500 g sago starch into 550 mL De-ionized water and stirring at 70 °C for 20 min. Subsequently, it was precipitated by adding ethanol of 96% and washing with acetone. Starches of 25 g were added into acetic anhydride and pyridine with rasio of ½:1 and 1:1. The mixture were reacted at 50 °C for 1 h, cooled, precipitated by ethanol, filtered and dried at 50 °C. The acetylated starches were denoted as AS-0.5 and AS-1.

### B. *Characterization*

Fourier transform infrared spectra (4,000-500 $cm^{-1}$, resolution 4 $cm^{-1}$) of native starch and modification starch were recorded with a Shimadzu FTIR spectrometer.

The percentage of acetyl groups (Ac %) and the degree of substitution (DS) of acetylated starches were determined by the titration method described by [6].

## RESULT AND DISCUSSION

Acetylation of starches is an important substitution method that has been applied to starches that impart the thickening needed in food application. Acetylated starches with low degree of substitution (DS) are widely used in food industries. Therefore in this study, sago starch was modified by acetylation method with various concentration of acetic anhydrate to obtain acetylated starch with low degree of substitution (DS).

### A. *FTIR analysis*

FTIR spectroscopy analysis was used to monitor changes in the structure of the starches promoted by acetylation by analyzing the frequency and intensity of the peaks. Fig. 1 shows FTIR spectra of the native and acetylated starches. The native starch presented strong peaks in the 3000-3600 $cm^{-1}$ and 2950 $cm^{-1}$ regions, which correspond to OH and CH stretching, respectively; peak at 1650 and 1420 $cm^{-1}$ correspond to OH and CH bending [7].

Acetylated starches had strong absorption band at 1735-1740 $cm^{-1}$ which attribute to C=O stretching of acetyl group, band at 1368 $cm^{-1}$ which attribute to C-H in acetyl group and band at 1234 $cm^{-1}$ which attribute to C-O stretching of acetyl group with evidence of acetylation [8]. The 1740 $cm^{-1}$ peak increased as amount of acetic anhydrate increased from 50 g to 100 g. on the other hand, since the intensity of the hydroxyl group peak at 3000-3600 $cm^{-1}$ decreased, it has been suggested that the hydroxyl groups in the starch molecules were converted into acetyl groups.

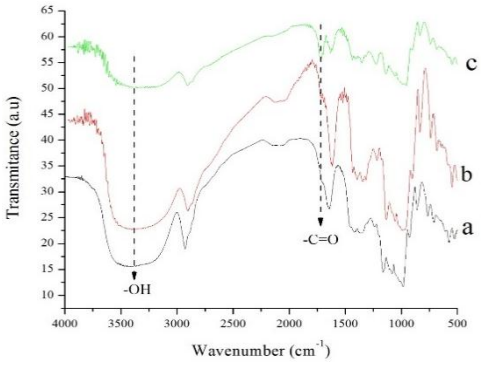


**Figure 1.** FTIR spectra of (a) native starch, (b) AS-0.5 and (c) AS-1

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### *B. Percentage of Acetyl Groups (Ac%) and Degree of Substitution (DS)*

Table 1 shows the effect of acetylation with different concentration of acetic anhydride on percentage of acetyl groups (Ac%) and Degree of Substitution (DS) of acetylated starches. *Ac%* and DS of starches increased significantly with increasing acetic anhydride. The acetylated starches showed DS ranging between 0.08 and 0.11. Acetylated starches with low DS are used in food industry as agents of texture, consistency and stability in food and currently being studied in the development in biodegradable packaging and pharmaceutical applications. Starches with medium DS may be applied as substitutes for thermoplastic cellulose acetates [9].

**Table 1.** Acetyl percentage and degree of substitution contents of acetylation treated starches

| Acetylation starches | Acetyl (%) | Degree of substitution |
|---|---|---|
| Native | - | - |
| AS-0.5 | 2.15 | 0.08 |
| AS-1 | 2.85 | 0.11 |

## CONCLUSION

In conclusion, the introduction of acetyl groups was confirmed by FTIR spectroscopy with the present of carbonyl groups. Different concentration of acetic anhydride in the acetylation reaction promoted *Ac%* and DS changes in starches. The acetylated starch with highest concentration (100 g) of acetic anhydride showed the highest acetyl content and the degree of substitution (2.85 and 0.11 %). Acetylated starch with 50 g of acetic anhydride can be applied in food industry because it had low acetyl content and degree of substitution (2.15 and 0.08 %).

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