Physicochemical characteristics of tuber modified by acetylation method and its application in dry noodle product

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Abstract. Sebaring taro is a source of carbohydrate in the form of starch so it can be used as starch food based on starch like dry noodles. The objective of this study was to study the physical, chemical and functional characteristics of Sebaring Taro starch modified by acetylation method and its effect on the physical, chemical and organoleptic characteristics of dry noodles prepared from the mixture of flour and acetylated starch from Sebaring taro with the addition of sodium tripolyphosphate. The study was conducted in two (2) stages; Phase I is characteristic of tubers, flour and acetylated taro starch, and Phase II is the application of acetylated starch on dry noodles, which is carried out using a Factorial Complete Random Design consisting of two (2) factors. The results showed that acetylated starch from sebaring taro had 11.12% resistant starch content, 7.20% oxalate content, Swelling power 68.40%, but water absorption and oil absorption on acetyl starch was similar to natural starch.

Keywords: *acetylation, characteristics, dried noodles, taro tuber acetylated starch (TTAS), STPP*

1. Introduction

Various agricultural commodities have a good enough feasibility to be developed in Indonesia, one of which is the tubers [1-3]. Tubers are food that has unique flavor and good nutritional content, so it has potential to be developed as an alternative food source [3]. Keladi sebaring is a type of tuber that has great potential as food source of fiber which is good enough but not yet developed [3-5].

Modified starch is a starch whose hydroxyl group has been converted by a chemical reaction (esterification, etherification or oxidation) or by disrupting its original structure [6-9]. Chemical modification can be done by adding a particular chemical or reagent with the purpose of replacing the hydroxyl (OH^-) group on starch [10-12]. For example, in the presence of acetyl group distribution replacing the OH group by acetylation reaction will reduce the strength of the hydrogen bond between

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the starch and cause the starch granules to be more fluid (much water-holding), easily soluble in water, and increase the freeze-thaw stability of starch [12-14].

Acetylation method is a very important method to modify the characteristics of starch because this method can give thickening effect (as thickening agent) in various foods [15-17]. The quality of products produced from acetylated starch is more stable and resistant to retrograde. The physico-chemical properties of acetylated starch are affected by the amount of acetyl group distribution which replaces the hydroxyl (OH-) group in starch [18-20].

Noodle is one of the most popular foods in Asia especially in East Asia and Southeast Asia [21-23]. Noodle is usually made from wheat flour, so the need for wheat for the manufacture of flour is needed very much. But the current condition, the availability of wheat flour is getting less and more expensive. Therefore, in the manufacture of instant noodles the use of wheat flour is substituted with taro starch [24]. The method used in this study uses Factorial RAL which consists of two factors, namely the ratio of starch acetylation: wheat flour (P1 = 0: 100; P2 = 25:75; P3 =50; P4 = 75:25), and concentration sodium tripolipospate (F1 = 0.4%, F2 = 0.5%, F3 = 0.6%).

2. Materials and methods

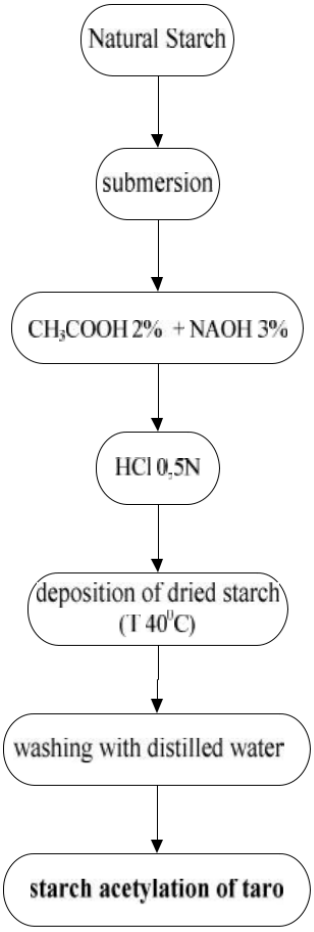

Figure 1. Starch modification scheme with the acetylation method

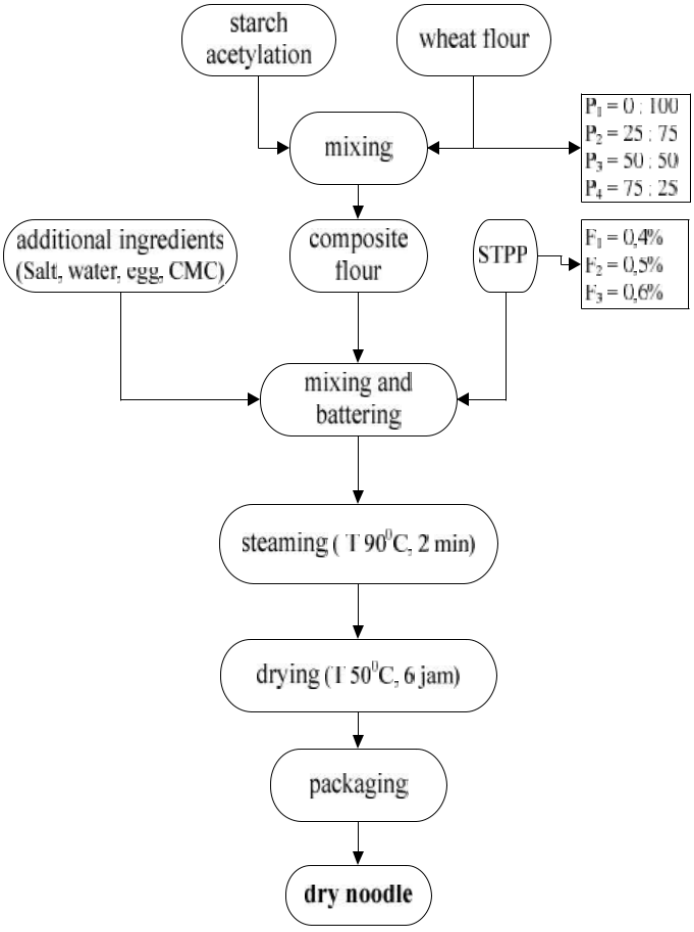

Figure 2. Dry noodle making scheme

Materials used were tuber taro, wheat flour, salt, cooking oil, garlic, soy sauce, CMC, STPP, eggs, sodium metabisulfite. The research consisted of two phases: the preliminary research and the major research. Preliminary research in the form of observations of the characteristics of the tuber, taro flour and NTS and its starch which were performed in three (3) replicates.

The method performed in the major research was using a random used design (RAL), which consists of two factors, namely: Factor I. Ratio of TTAS with wheat flour (%) consisting of four levels, namely: P1 = 0: 100; P2 = 25:75; P3 = 50: 50; P4 = 75: 25 and Factor II. STPP concentration (F) consisted of three levels, namely: F1 = 0.4%; F2 = 0.5%; F3 = 0.6%.

The process of making dried noodles

TTAS was mixed with wheat flour and STPP in accordance with a predetermined proportion. The mixture was mixed with salt (1%), water (35%) of the total weight of flour, 1 egg (40g), and CMC (2g). The mixture was then stirred up into dough, rolled, and printed using noodle maker. The noodle was boiled at a temperature of 90^0C for 2 minutes, and then dried in an oven at 50^0C for 22 hours, packed in sealed plastic containers.

3. Results and discussion

Characteristics of physical, chemical, functional taro flour, NTS and TTAS, we can seen on Table 1.

Table 1. Characteristics of physical, chemical, functional flour, starch and sebaring acetylation starch

Parameter	Flour Taro	Tuber Starch	Acetylation Starch
Amylose content (%)	13,02±0,10	20,50±0,12	22,77±0,05
Resistant Starch (%)	-	4,79±0,14	11,12±0,09
Oxalate Content (mg/ 100g)	34,19±0,31	17,33±0,07	7,20±0,33
Swelling Power (g/g)	-	38,44±0,34	68,40±0,35

Table 1 shows that acetylated modified tuber roots have different physical, chemical and functional characteristics with their natural starches. Acetylated starch from sebaring taro starch has 11,12% resistant starch content higher than the starch content resistant to natural starch which only 4.79%. Breaking branch bonds will increase amylose levels, so the resistant starch will also be higher. The higher the amylose content of the starch the higher the starch content is resistant. Amylose rich starch granules have greater crystallizing ability due to intensive hydrogen bonding [25].

Acetylation starch oxalate levels were lower (7.2 mg) than natural starch (17.3mg). Decreased oxalate levels occur because of the reaction between NaCl and CaC_2O_4. NaCl dissolved in water decomposes into Na^+ and Cl^- ions. The Na^+ ion attracts negatively charged ions and Cl^- ions attract positively charged ions. While CaC_2O_4 in water decomposes into Ca_2^+ and $C_2O_4^{2-}$ ions. Na^+ binds $C_2O_4^{2-}$ ions - forms $Na_2C_2O_4$. The Cl^- binding Ca_2^+ ion forms a water-soluble $CaCl_2^-$ white precipitate [26].

Amylose content on acetylation starch was 22.77% higher than natural starch (20.50%). An increase in the number of amylose occurs due to the breaking of the branches of amylopectin in the bonds Î± 1-6 glucoside. This means that the chain of amylopectin branches will decrease and the increase of straight chain amylose as a result of the breaking of the branches of amylopectin [27].

Swelling power in acetylation starch was 68.40g / g higher than natural starch (38.4g / g). The increase of swelling power in acetylated starch is caused by the substitution of acetyl group which replaces the hydroxyl group so that the hydrogen bond becomes weak and finally cause the starch ganula structure

becomes less tightly. Water absorbed in each starch granule will make starch granules expand and coincide so as to increase the value of its swelling power [28].

Characteristics of dry noodle quality

The observation result of dry noodle cooking loss due to the proportion of wheat flour and modified starch taro with concentration of STPP ranged from 7,15-12,35%.

Figure 3 shows that the more acetylated starch addition and the higher the concentration of STPP the cooking loss increases. This is because the starch is not good enough in binding to existing solids. The high cooking loss is caused by less optimum of starch matrix gelatinized in binding starch is not gelatinised [29].

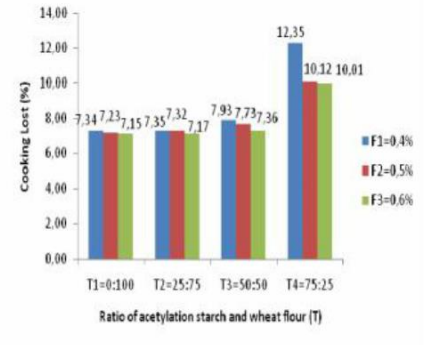

Figure 3. The effect of interaction of starch acetylation ratio and wheat flour with STTP concentration on cooking lost of dried noodles

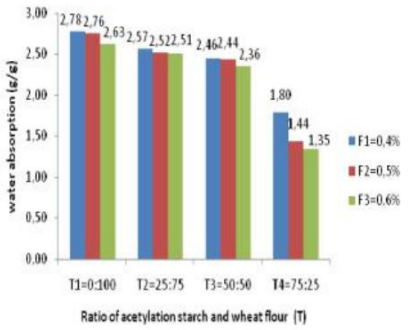

Figure 4. The effect of interaction of starch acetylation ratio and wheat flour with STTP concentration on the water absorption capacity of dried noodles

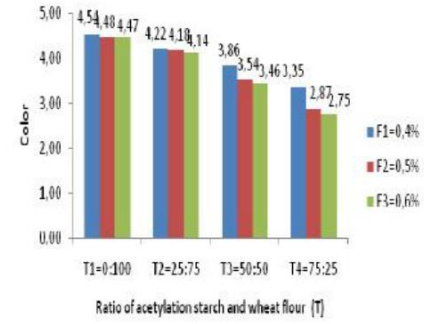

Figure 5. The effect of interaction of starch acetylation ratio and wheat flour with STTP concentration on dry noodle color

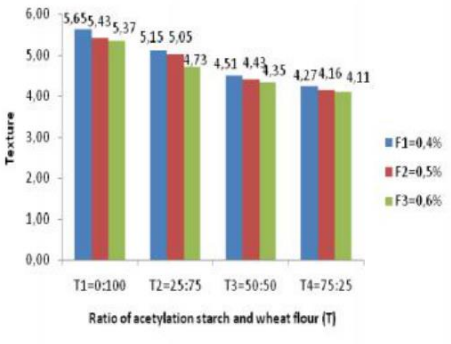

Figure 6. The effect of interaction of starch acetylation ratio and wheat flour with STTP concentration on dry noodle texture

The result of observation on dry noodle fiber content due to the proportion of wheat flour and modified starch of taro with the concentration of STPP ranged from 1.35 to 2.78%

Figure 4 shows that the more acetylated starch addition and the higher the concentration of STPP the water absorption decreases. The lower the water absorption value, the noodles will absorb less water and the noodle will not expand.[30].

The average value of panelist preferences to dry mature noodle color due to the treatment of wheat flour and modified taro starch proportions with concentration of STPP ranged from 2.75 to 4.54. Figure 5 shows that the more acetylated starch addition and the higher the concentration of STPP the noodles will decrease. This is due to the non-enzymatic browning of Maillard's reaction so that the dry ripe noodle results in browning which causes the panelist's favored level to decrease [31].

The average value of panelist preferences to dry mature color due to the treatment of the proportion of wheat flour and modified starch taro with concentration of STPP ranged from 4.11 to 5.65.

Figure 6 shows that the more acetylated starch addition and the higher the concentration of STPP the noodle texture will decrease. This is because the more acetylation starch the texture is very difficult to be formed into dough so that the texture decreases [32]. This is because starch acetylation does not contain gluten. Gluten has elastic and plastic properties, which will produce noodles not easily broken[33]. The addition of STPP concentration does not affect dry noodle products.

4. Conclusion

Acetylated starch can change the physical, chemical and functional properties of taro flour. This change can be seen with the increasing characteristics of taro starch such as swelling power, resistant starch, and amylose. On the other hand, acetylated starch may lower the oxalate content of the taro starch. Acetylated starch from taro can be used as an ingredient for the substitution of wheat flour in the manufacture of dry noodles. The best dried noodles were obtained at acetylated starch and wheat flour ratio (25:75) with 0.4% STPP concentration.

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