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WORD COUNT 2000
TIME SUBMITTED 03-SEP-2020 10:11AM
PAPER ID 62772742

THE ROLE OF *Saccharomyces cerevisiae* AS MODIFICATION AGENT ON THE CASSAVA STARCH

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ABSTRACT

Saccharomyces cerevisiae is group of yeast in food categorized in GRAS. It possesses several of extracellular and intracellular of enzymes beneficial to the tapioca modification. Tapioca has low characteristic of pasting properties that its use in food production was narrow. Modified tapioca could be defined as change of its physical, biochemical, or microbiological properties for the better purpose. The introduction of yeast *Saccharomyces cerevisiae* in to the cassava starch suspension was investigated in order to evaluate its potential in modifying pasting and physicochemical properties of the starch. *Saccharomyces cerevisiae* at the various concentrations was inoculated into cassava starch suspension and incubated at room temperature (30^{o}C) in facultative aerobic condition for 24, 48, 60 and 72h. The growth of *Saccharomyces cerevisiae* was monitored; the pH and starch granules were evaluated. The result showed that there was sign of erosion to the structure of cassava starch granules of the inoculated starch and of which could result in the change of its pasting properties. However, the growth of *Saccharomyces cerevisiae* was not in high counts which indicated non-optimally growth. It could have been lacking of growth factor, nutrition, or the presence of another microbe as competitor. Thus, the investigation on the present of lactic acid bacteria involved in the fermentation of the cassava starch suspension was needed.

Key words: *modification, S.cerevisiae, tapioca, pasting properties*

INTRODUCTION

Cassava is considered as low quality of raw substances in protein, minerals, and vitamin contents. This drawback characteristic of cassava affected its low price as raw

fresh materials. Processing cassava to produce dried cassava chips, tapioca, ethanol, liquid sugar, sorbitol, monosodium glutamate, and modified cassava flour have been done by some researches. Several researchers have focused on fermenting cassava with additional nutrients for improving the quality of cassava flour (Uboh and Akindahu, 2005). However, a challenged method to improve its properties has been attracting most scientists. One of the techniques was modification of physical, chemical, and pasting characteristic of tapioca starch by fermentation with the use of starter culture. Fermenting cassava with addition of with mixed cultures *Lactobacilus plantarus, Saccharomyces cerevisiae,and Rhizopus oryzae* produced the cassava flour having protein increased and reduced starct content (Gunawan *et al*., 2013). However, the production of tapioca starch with the fermentation by the use of *Saccharomyces and Lactobacillus plantarum* has been neglected.

Saccharomyces cerevisiae has been associated with human beings for more than 6000 years, due to its use in food production, baking, wine and beer making. Potable and industrial ethanol production constitutes the majority of use of *S. cerevisiae* in biotechnological applications. However, baker's yeast also plays an important role as a model organism in the field of biochemistry, genetics and molecular biology. Baker's yeast can also be used as host organism for novel production of some industrially relevant chemicals. *Saccharomyces cerevisiae* has a very important role as a starter in the fermentation of various foods and beverages known as brewer's yeast, distillers yeast, and baker's yeast, and has been studied by several researchers (Kurtzman and Fell, 1998). In Indonesia, the use of yeast to produce traditional foods and fermented foods has not been so entrenched in comparison to fungi such as *Mucor spp, Rhizopus spp, Penicillium spp and Aspergillus spp*, or the use of lactic acid bacteria *Lactobacillus casei, L lactis, A.xylinum, A aceti,* due to lack of knowledge in the utilization and engineering yeast as a starter or as an agent in the fermentation process. Yeast has amylolytic properties in starch degradation that is capable for producing the enzyme amylase. Amylolytic yeast may have potential use in the food products as they contribute to the desired flavor (Romano *et al.,* 2002). The role of amylolytic yeast in producing ethanol and yeast biomass from starch, as well as for producing beverages and foods with low carbohydrates have much to do, for example in fermented rice, production of amylase in fermentation of sticky rice, and cassava tape (Ardhana and Fleet, 1989; Fleet, 2001). Yeast great potential and is still very

necessary, especially in food diversification through a fermentation process to produce a new type of food or modification of existing products with better nutritional value, as well as aroma and texture adapted to the people's will. Baker's yeast has a great potential as a catalysts in organic chemistry owing to ease of handling, broad substrate acceptability and production of enzymes belonging to different *classes*. *S. cerevisiae* may be used in dry and pressed form, as raw yeast or lyophilized biomass and is capable of catalyzing many reactions in water or in organic media.This study was conducted to monitor the growth of *S.cerevisiae* co-inoculated during fermentation to produce modified tapioca starch, and to investigate the structure change of starch granule.

MATERIAL AND METHODS

Materials

White cassava tubers (Manihot utilisima var Kasetsart) were obtained from the Institute for Agricultural Research and Technology (BPTP) Bandar Lampung, pure culture of *Saccharomyces cerevisiae* was purchased from the culture collection of Gadjah Mada University, broth Malt Extract broth (Difco,USA), Malt Extract Agar (Difco), saline (0.85 % NaCl), oxytetracycline and chloramphenicol, and reagents for chemical analysis were obtained from Sigma Chemicals Company (St.Louis, MO).

Tapioca starch fermentation

The fermentation process was carried out by submerged fermentation method. Briefly, 100 mL of extracted cassava slurry was placed into a 500 mL flask. To the flask was added 150 mL distilled water containing V1% and V2% of *S.cerevisiae*. The flask was covered by cotton to create an anaerobic condition. The mixture was fermented at room temperature (30±2^{o}C) for different time (24, 48, 72, and 96, hours). After wards, solid and liquid phases were separated immediately by vacuum filtration. The solid phase was dried in oven blower at 50^{o}C to get the moisture content of 12-14% and designated as modified tapioca starch.

pH analysis

The pH of filtrate obatained from the fermentation was determined by the pH meter.

Microbiological analysis

One mL of sample was taken from the flask and serially diluted to 10^{-4} with sterile distilled water into the test tubes. One mL of diluted sample was spread plated into petridishes with designated media, then was incubated at 29±2^{o}C for 24-48h.

RESULT AND DISCUSSION

Microbial growth

Submerged fermentation of co-culturing *S. cerevisiae* without any additional nutrients was applied in this study. Microbial growth is defined as microbial population which is increasing of the quantity cellular and structure of organisms. The growth pattern of *S. cereviseae* on cassava fermentation is shown in Figure 1. Four phases were detected, such as adaptation phase (lag phase), growth phase (exponential phase), static phase (stationary phase), and mortality phase (death phase). The growth rate of *S. cereviseae* V2 was significantly faster than those of *S. cereviseae* V1. *S. cereviseae* growth has entered to stationary phase at fermentation time of 24 h. Moreover, the period of stationary phase both of *S. cereviseae* growth were achieved at about 48 h. It was found that addition of nutrient to the tapioca startch fermentation significantly affected the growth of *S. cerevisiae*. No other study was found regarding the microbial growth of *S. cereviseae* on tapioca starch submerged fermentation. The increase of yeast count in the control sample without addition of *S.cerevisiae* could be due to the growth of wild yeasts or yeast contaminants which was presence during fermentation.

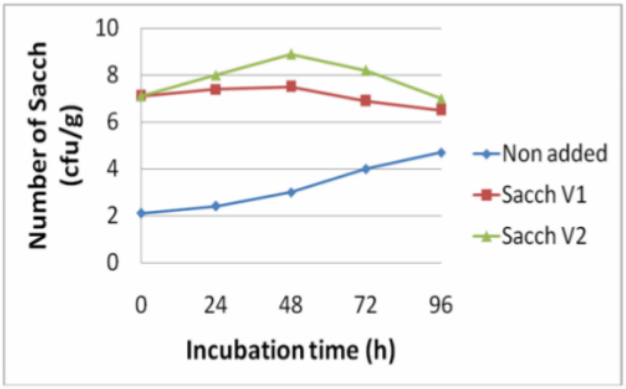


Fig. 1. Effect of incubation time on the number of *S.cerevisiae*

pH change

pH is one of the most important factors for maximizing growth of microorganisms, which was also found to be true for fermentation temperature. When co-inoculation *S. cereviseae*, on cassava fermentation without pH control, the pH profile decreased with time could have been as a result of more latic acid production and accumulation. On the other hand, it was noted that pH of addition with *S. cereviseae* (V1% and V2%) slightly increased from 4.1 to 4.9 (at *S.cerevisiae* V1) and to 4.4 (*S.cerevisiae* V2) within fermentation temperature studied at 30°C (Figure 2). The addition of nutrient slightly increased the pH of the substrate due to the degradation of nutrient by *S.cerevisiae* and the cell biomass containing nitrogenous source. These results agree with previous works that the optimum pH levels for addition of *S. cerevisae* were from 3.5 to 6.0 and temperature levels were from 20 to 40°C (Manikandan and Viruthagri, 2010; Polyorach *et al*., 2013).

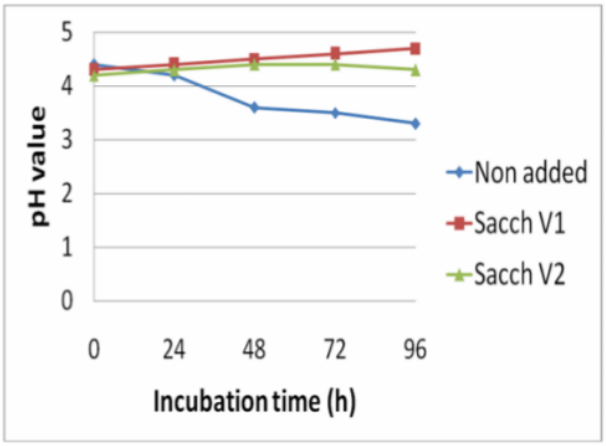


Fig. 2. Effect of incubation time on the pH of slurry tapioca starch

The change of granule

Figure 3 showed the granules of the native tapioca starch and tapioca starch fermented with *S.cerevisiae*. Hillum and lamellae of granules were noted in the native tapioca starch; whereas, there was signed of corrosion in the lamellae, and hillum was disrupted in the fermented tapioca starch. This was an indication of changes in the pasting properties of fermented tapioca starch. The reasons beyond this process could have been the enzymatic activity of *S.cerevisiae* that hydrolyzed carbon backbone chain of the oligosaccharide in the starch. This study was agree with the research done by Kustyawati *et al*. (2013). No other study was found regarding the effect of fermenting tapioca starch with *S. cereviseae* on the granules.

The findings of the present study was that (1) the growth of *S. cerevisiae* was not in high counts which indicated non-optimally growth, (2) Granule erosion was significantly noted, (3) The investigation on the present of lactic acid bacteria involved in the fermentation of the cassava starch suspension was needed.

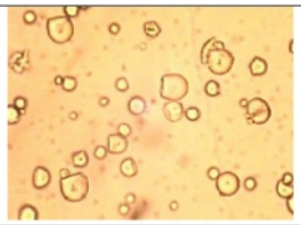
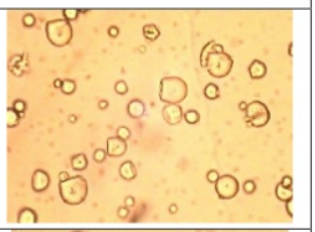
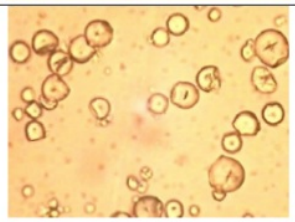
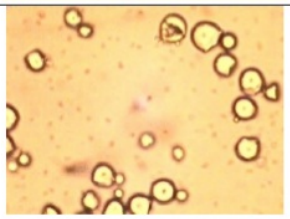
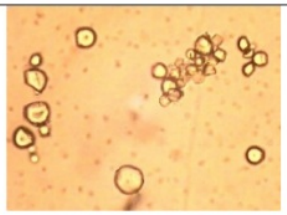
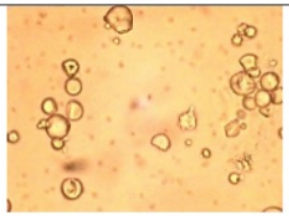
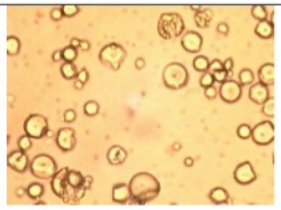
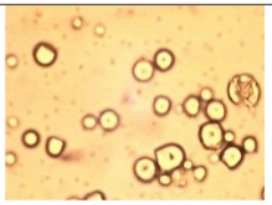
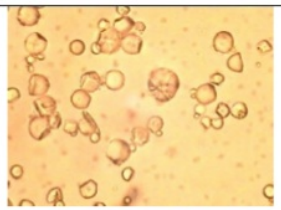
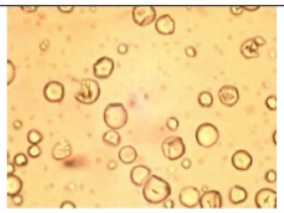
Fermentation time	*S.cerevisiae* co-inoculated	Without co-inoculated
0 h		
24h		
48h		
72h		
96h		

Figure 3. Effect of fermentation by the use of S.cerevisiae on the microscopic study of tapioca starch granule

ACKNOWLEDGMENT

This work was supported by a grant provided by the Institute of Research and Public Services (LPPM) University of Lampung, Indonesia, through the Grant Application (*Hibah Terapan*) 2016 with the project number of 418/UN/8/LPPM/2016.

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