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*August 23-24, 2016*
Bandarlampung, Lampung, Indonesia

# UISFS
## THE USR INTERNATIONAL SEMINAR ON FOOD SECURITY

**"Improving Food Security :**
**The Challenges for Enhancing Resilience to Climate Change"**

**Volume II**

**The University of Lampung**
**Indonesian SEARCA Fellow Association**
**Southeast Asian Regional Center for Graduate Study and Research in Agriculture**

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# USR INTERNATIONAL SEMINAR ON FOOD SECURITY

*Improving Food Security : The Challenges for Enhancing Resilience to Climate Change*

**Emersia Hotel and Resort, Bandar Lampung, Lampung, Indonesia**

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**Volume 1**

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2016

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# *Preface*
# *COMMITTEE CHAIR*

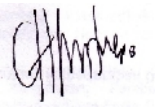
Recently, there are many discussions about food security as a complex issue of sustainable development. One of important topics is will the food needs in the future be met by the current production levels? In addition, the future production faces another sustainable development issues, one of which climate change that affects all four food security dimensions: food availability, food accessibility, food utilization and food systems stability. Improving food security, therefore whilst reconciling demands on the environment conditions which becoming the greatest challenges.

To response that challenges, The University of Lampung collaborated with ISFA (Indonesia SEARCA Fellow Association) and SEAMEO-SEARCA conduct an International Seminar on "Improving Food Security: The Challenges for Enhancing Resilience to Climate Change" in Bandar Lampung, Indonesia on August 23-24, 2016. There are 4 topics are offered as follows: (1.) Food Security and Food Production System, (2.) Food Security, Post Harvest Science and Technology, (3.) Food Security and Socio-Economic Environment Aspect and (4.) Ecological Perspectives on Food Security.

At this seminar, 111 research articles were submitted from 6 countries i.e. Indonesia, Lao, Malaysia, Myamar, Thailand, and Vietnam. The authors are researchers, practitioners included NGO, policy makers, academics as well as industrial professionals. The ultimate aim of this seminar is to deliver state-of-the-art analysis, inspiring visions and innovative methods arising from research in a wide range of disciplines. Through this activity, it is expected that research articles in all aspects related to food security can be documented, rapidly spread, communicated and discussed throughout the countries.

Thank you for your participation and looking forward to having productive discussion among participants.

Sincerely yours,



Christine Wulandari, Ph.D

# *Preface*
# *The Universityof Lampung Rector*

Many Asian countries face serious challenges on their food security due to changing consumption patterns including the demographics, declining of agriculture productivity, degradation of natural resources, rising input costs as well as cost for transportation of supplychains. All of these, need various trends anticipation of short to medium term, and this is clearly becomes efforts focused on mitigating towards the challenges. Together with SEAMEO-SEARCA and Indonesian Searca Fellows Association (ISFA), the University of Lampung (Unila) collaborated to conduct an international seminar with theme in "Improving Food Security: The Challenges for Enhancing Resilience to Climate Change" on 23-24 August 2016 in Emersia Hotel, Bandarlampung. From this international seminar, 111 research articles from six countries in Southeast Asia were compiled and expected to be used as a stepping stone for preparation of development strategies in Indonesia country or other Asian countries resolving the issues of Food Security.

This cooperation among Unila with ISFA and SEARCA in accordance with the Unila statement mission for Unila goals of 2005-2025, one of which Unila is able to build joint effort in many development aspects within various parties, including governments, publics, businesses, non-governmental organizations either national and overseas, with mutual benefit basis in sustainable frame for natural resources conservation in supporting Food Security. The other Unila goals related to the Food Security is the community welfare, in which Unila become the agent of changes and maintain the certainty and justice for the community benefits.

My very sincere appreciation to invited speakers and participants for their great contributions, to all advisory boards SEAMEO-SEARCA and Indonesian Searca Fellows Association (ISFA), reviewers, colleagues and staffs for putting remarkable efforts and their contribution to the organization of this seminar. Finally, I just hope that this seminar is able to inspire and deliver benefits to all participants, in which together we are able contribute to development of Food Security in our countries as well as to global.

We look forward to working with you and getting to know you in years ahead. Thank You.

Your sincerely,

Prof. Dr. Hasriadi Mat Akin

# *Preface*
# *SEARCA DIRECTOR*

**MESSAGE**

The Southeast Asian Regional Center for Graduate Study and Research in Agriculture (SEARCA) is pleased to support the Indonesian SEARCA Fellows Association (ISFA) in organizing this *International Seminar on Improving Food Security: The Challenges for Enhancing Resilience to Climate Change.*

SEARCA's support to this event and many similar others is a testament of our commitment to promote food and nutrition security via the route of Inclusive and Sustainable Agricultural and Rural Development (ISARD). Food and nutrition security continues to be a major problem in the region and in the rest of the world in varying degrees and complexities. This is further exacerbated by the impacts of climate change on agriculture which not only serves as the backbone of the economy but is also key to feeding a growing population that continues to struggle with poverty and hunger.

Addressing multi-faceted concerns such as food security and climate change requires collaborative efforts among various stakeholders across the region. That is why SEARCA has developed umbrella programs on food and nutrition security, and climate change adaptation and mitigation which identifies areas for cooperation in research, capacity building, and knowledge management in these two related concerns.

In all these, we are glad to have the cooperation of SEARCA's graduate alumni spread across the region. They have organized themselves into the Regional SEARCA Fellows Association, with at least 8 country chapters including ISFA. The country associations have conducted various knowledge sharing activities such as this International Seminar and plans are also underway for collaborative research projects in the regional alumni organization. By working in synergy, we have seen how the modest contributions of our graduate alumni can make a big difference to agricultural and rural development in the region – truly making them SEARCA's ambassadors in Southeast Asia and beyond.

I congratulate ISFA headed by Dr. Sugeng Prayitno Harianto for organizing this International Seminar which serves as a platform for knowledge sharing on various researches and development activities that contribute to food and nutrition security amidst the detrimental effects of climate change.

Finally, I also thank all our keynote speakers and delegates for their participation in this event and hope to see all of you again in future knowledge sharing events important to the development of the region.

**Gil C. Saguiguit, Jr.**
Director

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

[1]*MARIA ERNA KUSTYAWATI, *AZHARI RANGGA, *SRI SETYANI

(*Dept of Post Harvest Technology, Faculty of Agriculture University of Lampung).
Jl.S.Brojonegoro No.1 Bandar Lampung, Indonesia
([1]Corresponding author, email:maria.erna@fp.unila.ac.id)

## 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.

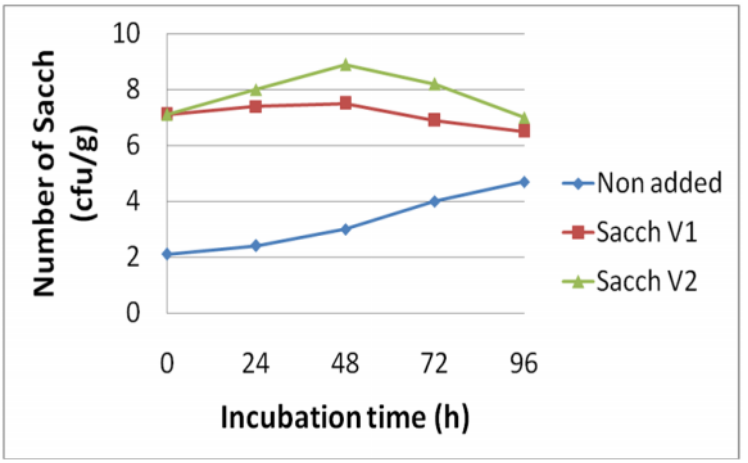



**Fig. 1**. Effect of incubation time on the number of *S.cerevisiae*

*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 30ºC (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).

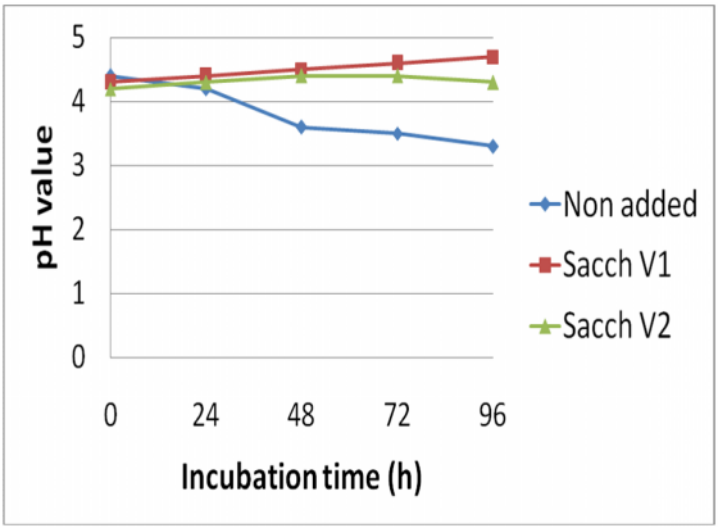



**Fig. 2.** Effect of incubation time on the pH of slurry tapioca starch

*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.

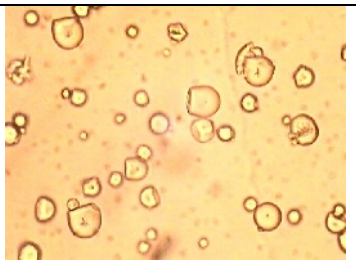
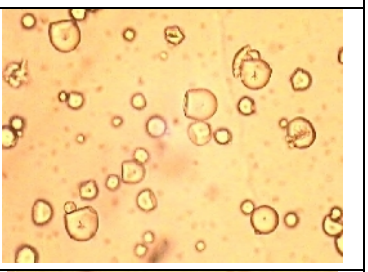
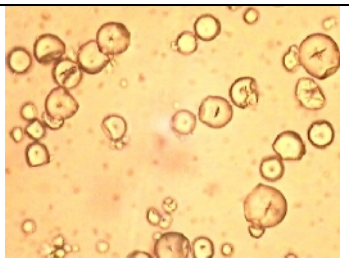
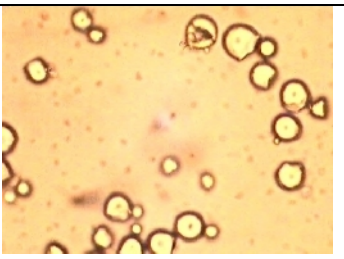
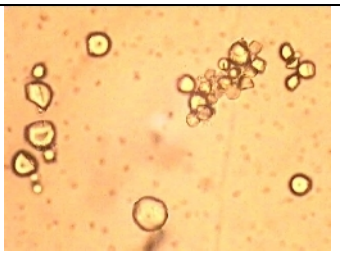
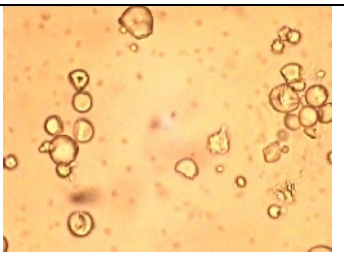
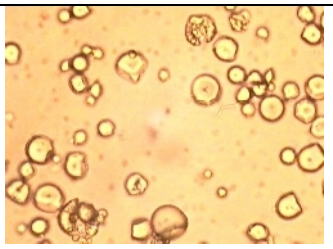
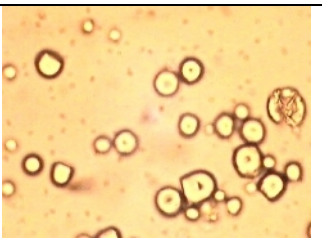
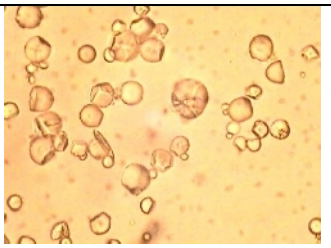
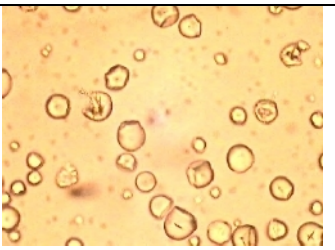
| Fermentation time | *S.cerevisiae* co-inoculated | Without co-inoculated |
|---|---|---|
| 0 h |  |  |
| 24h |  |  |
| 48h |  |  |
| 72h |  |  |
| 96h |  |  |

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

[1]*MARIA ERNA KUSTYAWATI, *AZHARI RANGGA, *SRI SETYANI

(*Dept of Post Harvest Technology, Faculty of Agriculture University of Lampung).
Jl.S.Brojonegoro No.1 Bandar Lampung, Indonesia
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## 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.

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## 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.

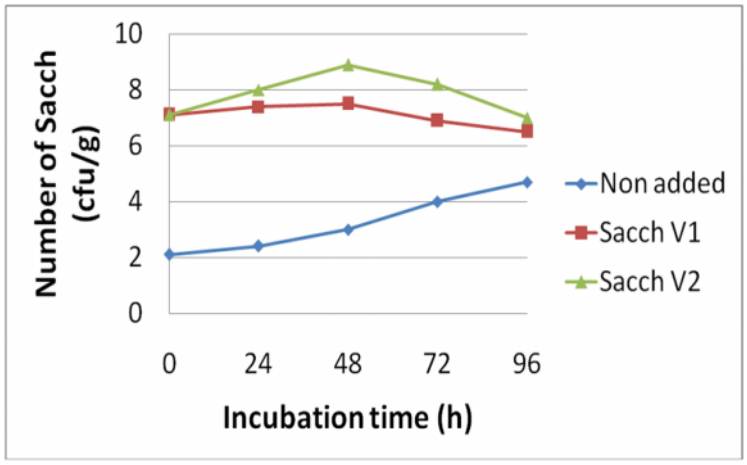



**Fig. 1**. Effect of incubation time on the number of *S.cerevisiae*

*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 30ºC (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).

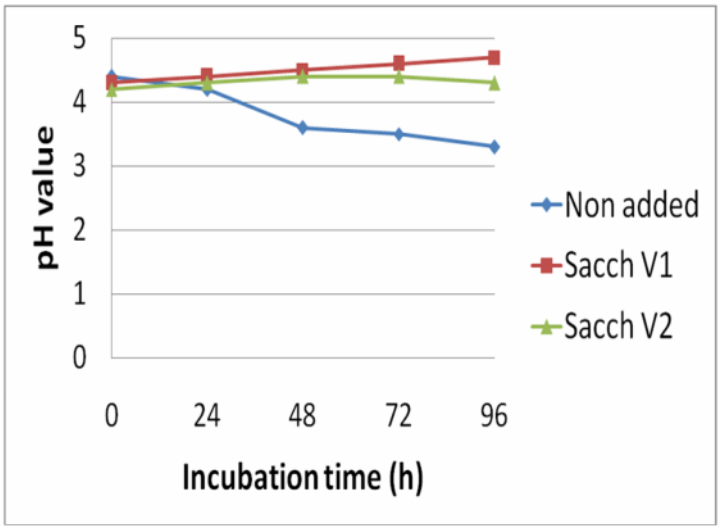



**Fig. 2.** Effect of incubation time on the pH of slurry tapioca starch

*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.

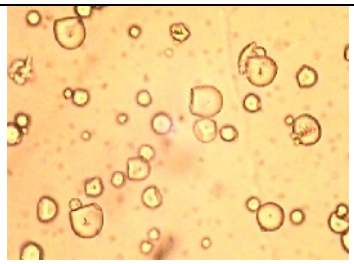
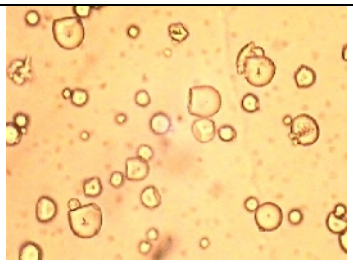
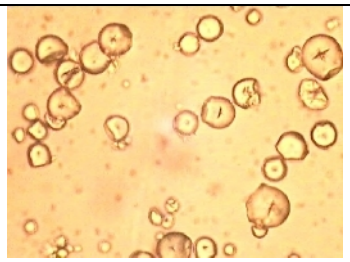
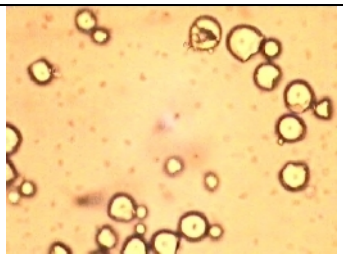
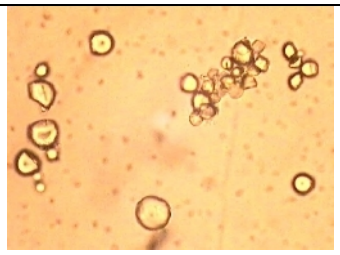
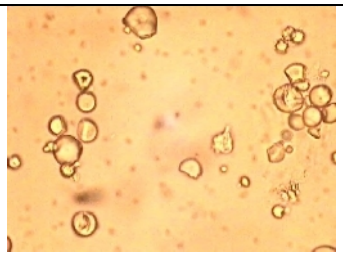
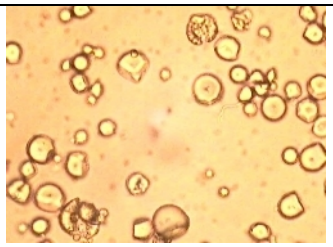
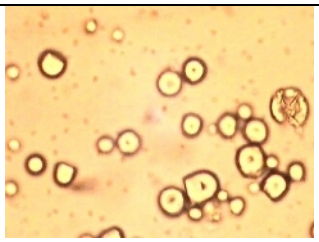
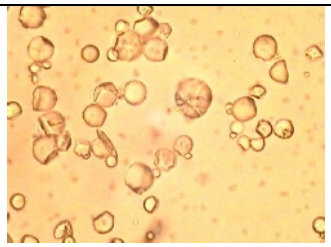
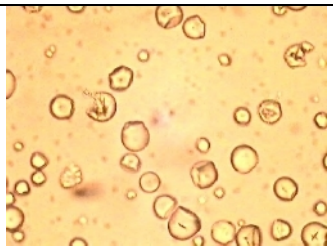
| Fermentation time | *S.cerevisiae* co-inoculated | Without co-inoculated |
|---|---|---|
| 0 h |  |  |
| 24h |  |  |
| 48h |  |  |
| 72h |  |  |
| 96h |  |  |

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

**ACKNOWLEDGMENT**

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