Proceeding

International Conference

Food for a Quality Life

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SEAFAST CENTER

Southeast Asian Food & Agricultural Science & Technology (SEAFAST) Center
Bogor Agricultural University
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FOOD FOR A QUALITY LIFE

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Jakarta International Expo, Kemayoran
Jakarta - Indonesia

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PREFACE

Food is essential for life.
Good quality of food is essential for good quality of life.

Quality is a simple word with a complex meaning. Often, quality is defined as fitness for purpose. Firstly, quality very much depending on the characteristics of the product. However, quality of the same product/process/service might also be different for different user. International Organization for Standardization (ISO 9000:2000) has defined quality as “the totality of features and characteristics of a product, process or service that bear on its ability to satisfy stated or implied needs”.

What about quality of life? Quality of life is even more complex, subjective and multidimensional, encompassing a totality features of life. First of all, food is essential for life. Food gives us the energy and nutrients to grow and develop, be healthy, active, and productive. That’s why a good quality of food is essential for good quality of life.

We, SEAFAST Center, Bogor Agricultural University (IPB), in partnership with Indonesian Association of Food Technologists (IAFT/PATPI) and Department of Food Science and Technology, Bogor Agricultural University (IPB) recognize the important role of food for a quality of life. With that in minds, we have organized the conference of FOOD for a QUALITY LIFE, as a means of bringing together many Scientists and stakeholders to take on issues and challenges in the food area; such as food security, safety, quality, nutrition, and their connection with health, and ultimately with a quality of life.

The conference, organized in conjunction with Food Ingredient Asia 2014, has attracted more than 200 participants; highlighting new, emerging and re-emerging issues of food quality, safety and nutrition. Scientists and stakeholders from throughout the regions have shared perspectives, address challenges and discuss strategies and collaborative programs to enhance the continuing global efforts to ensure food for a quality life.

All of those discussions are recorded and presented in this report or proceeding.

We deeply grateful to the committee, panelists, speakers and member of editorial team for the time and effort that each of them expended on
generation of leaders, through innovative and challenging competitions such as *Developing and Exhibiting Prototype Products* and *Graduate Students Research Paper Competition*. We see this valuable gathering of stakeholders as one key event in developing the growth of the region's food ecosystem future, where emerging challenges and opportunities require cooperation and mutual collaboration to keep driving progress in the region's economy and welfare.

We sincerely hope that this International Conference may be beneficial to all participating attendees for the respective interests, work, business and field of expertise. We also hope that progress and development in this region and globally may have been contributed or even initiated by this gathering. We certainly wish you a good and enjoyable time during this conference.

Thank you.

**Puspo Edi Giriwono**

*Chair of International Conference 2014*
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In order to develop a Food Technology in Indonesia, in 1967 in Bogor, it was formed an organization named IAFT (PATPI), acronym for the Indonesian Association of Food Technologists (Perhimpunan Ahli Teknologi Pangan Indonesia). This association is a professional organization that gather experts/professionals in the field of food technology, as well as other areas that is closely related to the food field. IAFT members come from universities, research centers, government agencies or private sector and food industry.

PATPI is the only professional organization in the food field that represents Indonesia in the IUFoST (International Union of Food Science and Technology). In addition, IAFT is also a member of FiFSTA (The Federation of Institute of Food Science and Technology in the ASEAN) and the recognition of IAFT as Allied Organization No. 27 by the IFT (The Institute of Food Technologists), USA.

PATPI engaged in the field of food technology including the application of basic sciences such as chemistry, physics, and microbiology as well as the principles of engineering, economics, and management on all food supply chain, start from the harvest to consumption. Food supply chain covers the aspects of raw materials handling, processing, preservation, packaging, storage, distribution, quality control, safety, acceptability, a new food product development, as well as aspects of nutrition and public health.


Indigenous Probiotic Culture in Yogurt Added with Purple Sweet Potato Extract: Study on Microbiological and Physicochemical Properties

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ABSTRACT

This study was aimed to determine the effect of indigenous probiotic lactic acid bacteria on quality of yogurt added with purple sweet potato extract in terms of microbiological, physical (pH, viscosity and chromatic colors), and chemical (content of titratable acid, moisture, ash, reducing sugar, soluble protein, and fat) properties. Single direction completely randomized design was used as experimental design with 4 treatments of various indigenous probiotic bacteria and purple sweet potato extract (10% v/v). Y0 was control sample of commercial culture, contained mixture of Streptococcus thermophillus FNCC 0040 (St) and Lactobacillus bulgaricus FNCC 0041 (Lb) in the ratio of 1:1; Y1 was mixture of commercial culture and indigenous probiotic Lactobacillus plantarum Dad13 with ratio of St : Lb : Dad13 1:1:0.5; Y2 was mixture of commercial culture and indigenous probiotic Lactobacillus plantarum Mut7 with St : Lb : Mut7 1:1:0.5; Y3 was mixture of commercial culture and indigenous probiotic Lactobacillus acidophilus SNP–2 with ratio of St : Lb : SNP–2 1:1:0.5, each treatment was repeated three times. Yogurt made using Y1 was the most preferable, with viable cell count of 10⁹ CFU/ml after 2 weeks storage, pH of 3.78, viscosity of 519.667 cP, chromatic color of 18.559, moisture content t of 85.266%, lactic acid content t of 1.273%, 0.8041% ash content, reducing sugar of 3.3278%, soluble protein content t of 1.478% and fat content of 0.08%.

Keywords: indigenous, physicochemical, probiotic, purple sweet potato extract, yogurt
INTRODUCTION

With the increasing awareness of importance of healthy food, food demand has been recently shifted. Food with good nutritional composition, appealing taste and flavor, as well as health functional has attracted more consumer interest. Among functional food, a benefit expected is the ability to maintain intestinal microbiota balance which plays an important role for human health. Such balance is achieved from diet containing prebiotic, probiotic or their combination known as synbiotic.

Several lactic acid bacteria (LAB) have been widely known as probiotic, such as Lactobacillus acidophilus, L. reuteri, L. casei and Bifidobacterium, are natural intestinal microflora. Parvez et al. (2006) mentioned that probiotics able to enhance immune system, reduce lactose intolerance, prevent hypertension, and has prevention as well as therapeutic effect for diarrhea. Codex requirement for minimum living cell number in fermented milk is $10^7$ CFU/g (Anonymous, 2008), to anticipate cell number decrease while passing through intestinal extreme condition (Shah, 2000).

Lourens-Hattingh and Viljoen (2001) noted that lactic acid bacteria contained in commercial yogurt of Streptococcus thermophilus and Lactobacillus bulgaricus was insufficient for intestinal tract protection, thus other probiotic is needed. Several indigenous LAB with probiotic property had been success fully isolated such as Lactobacillus plantarum Dad 13 from fermented buffalo milk (buttermilk), Lactobacillus plantarum Mut 7 from Indonesian fermented cassava (gatot) and Lactobacillus acidophilus SNP-2 from faecal of baby whom only consume breast milk (Rahayu, 1996).

The combination of prebiotic-probiotic was able to enhance microflora survival for better health benefits (Anonymous, 1989). Oligosaccharides of purple sweet potato (2.165% oligosaccharide content) which mostly consist of indigestible carbohydrate of rafinose and stachyose were able to increase beneficial bacteria (Lactobacillus sp and Bifidobacterium) in intestinal tract, indicated by increasing cell viability in the intestinal tract (Wardani, 2003). Previous research has successfully use indigenous culture Lactobacillus plantarum to prepare yogurt supplemented with purple sweet potato with acidity of 11.956 N, moisture content of 85.54% and total solid of 13.593% (Tari et al., 2012). However, the physicochemical and microbiological properties of yogurt were not evaluated. Thus a research on use of purple sweet potato as prebiotic source combined with Lactobacillus plantarum Dad 13, Lactobacillus plantarum Mut 7, and Lactobacillus acidophilus SNP-2 as indigenous probiotic need to be conducted.

Present study is also expected to enhance utilization of local agriculture product and to develop food product diversity in form of yogurt
supplemented with purple extract using *Lactobacillus* sp as indigenous starter, with better physicochemical and well-accepted organoleptic properties. This study was aimed to determine the effect of indigenous probiotic lactic acid bacteria on quality of yogurt with addition of purple sweet potato extract in terms of microbiological, physical (pH, viscosity and chromatic colors), and chemical (content of titratable acid, moisture, ash, reducing sugar, soluble protein, and fat) properties.

**MATERIALS AND METHODS**

Materials used in this research were purple sweet potato (*Ipomoea batatas* L) from local market in Sukoharjo and yogurt starter culture: *Streptococcus thermophilus* FNCC 0040, *Lactobacillus bulgaricus* FNCC 0041, and indigenous lactic acid bacteria: *Lactobacillus plantarum* Dad13, *Lactobacillus plantarum* Mut7 and *Lactobacillus acidophilus* SNP-2, obtained from Food and Nutrition laboratory of Inter-university Center UGM Yogyakarta. Other materials were skim milk, alcohol 70%, spiritus, and distilled water obtained from Biology, Chemical, and Microbiology Laboratory of Agriculture Department of Universitas Veteran Bangun Nusantara. Research diagram was presented in Figure 1 below.

**Figure 1. Research Diagram**
Starter Preparation

Six tubes of sterile 5 ml MRS broth were prepared; each tube was inoculated with slant culture of *Lactobacillus bulgaricus* FNCC 0041, *Streptococcus thermophilus* FNCC 0040, *L. plantarum* Dad13, *L. plantarum* Mut7 and *L. acidophilus* SNP-2 and incubated for 24 hours inoculation at 37°C.

Preparation of Purple Sweet Potato Extract

Preparation was conducted based on previous research by Tari (2011). Sweet potatoes were diced (5x5 cm), blanched at 100°C for 2 minutes, grounded using fruit juicer, squeezed and filtered. After storage for 24 hours at 4°C, filtrate was separated to be used in yogurt preparation.

Preparation of Purple Sweet Potato Yogurt

Fresh milk, skim milk (5% b/v), and extract (10% v/v) were mixed and pasteurized at 72°C for 15 minutes. After cooling to 40-45°C, 5% (v/v) culture of *Streptococcus thermophilus* and *Lactobacillus bulgaricus* as well as indigenous probiotics at ratio of 1:1:0.5 were aseptically inoculated and homogenized. Inoculated milk-extract was put into sterile bottles before 17 hours incubation at 40°C to obtain purple sweet potato yogurt.

Experimental Design

Single direction completely randomized designed was applied with 4 treatments, as follows:

- Y0 = commercial culture St and Lb (control);
- Y1 = commercial culture + indigenous probiotic Dad13, with ratio of St : Lb : Dad13 1:1:1.05;
- Y2 = commercial culture + probiotic Mut7 with ratio of St : Lb : Mut7 1:1:0.5;
- Y3 = commercial culture + probiotic SNP-2 with ratio of St : Lb : SNP-2 1:1:0.5.

Experiment Parameters

Analyses were done on:

- Physical properties consisted of pH using pH meter, viscosity using viscometer, and color intensity using photoelectric Hunter colorimeter.
- Chemical properties consisted of moisture content using thermogravimetric method, lactic acid content using titration method, ash content using dry method, reducing sugar content using Nelson Somogyi method, soluble protein content using Folin-Lowry method, and fat content using Majonier method (Sudarmadji et al., 1997).
Statistical Analysis

Data obtained were then statistically analyzed using One-way Anova test (Ostle, 1974).

RESULTS AND DISCUSSION

Microbiological Properties

Microbiological analysis was carried out to measure viable cells of probiotic culture in purple sweet potato yogurt during 2 weeks storage (Figure 2). Figure 2 showed that LAB number at initial stage (week 0) was 10^5 CFU/ml for all samples. After a week, LAB number in control (Y0), Y1 and Y2 remained at about 10^5 CFU/ml, while in sample Y3 decreased by 1 log cycle to 8.7x10^8 CFU/ml. After 2 weeks, the LAB number in Y0 and Y1 remained at about 10^6 CFU/ml, while in Y2 and Y3 decreased by 1 log cycle to 8.5x10^8 and 7.9x10^8 CFU/ml, respectively. These results indicated that the culture Y1 had highest survival showed by highest viability.

![Viability of LAB Yogurt](image)

**Figure 2.** Cell viability of lactic acid bacteria in yogurt with addition of purple sweet potato extract after 2 weeks storage.

Physical Properties

pH

Analysis of pH was carried out to measure acidity rate. The pH of purple sweet potato yogurt is presented in Figure 3.
Results showed that average pH from all treatments were ranging from 3.78 to 4.09, which fall within pH of fermented dairy products. Wood (1982) mentioned that pH of fermented milk product ranged from 3.7 to 4.6. Mital and Steinkraus (1974) mentioned that L. acidophilus and L. plantarum able to digest verbascose, raffinose and stachyose of purple sweet potato as carbon source. This sugar contained in purple sweet potato were verbascose, raffinose and stachyose (Patte and Young, 1982). Figure 2 also shows that indigenous probiotic culture in sample Y1 and Y2 (L. plantarum Dad 13 and L. plantarum Mut 7) effectively utilized raffinose and stachyose as carbon source due to their ability to produce α-galactosidase which hydrolize stachyose and raffinose into glucose and galactose and further metabolized into pyruvic acid then lactic acid. Lactic acid was easily dissociated into CH₃CHOHCOO⁻ and H⁺, where the latter is yogurt acidity indicator.

**Viscosity**

Viscosity was reflecting frictional force of liquid. The viscosity of yogurt fermented with different starter cultures and with addition of sweet potatoes is presented in Figure 4.
Figure 4. Viscosity of probiotic yogurt prepared using indigenous culture and with addition of purple sweet potato extract

Figure 4 shows that yogurt Y3 fermented using indigenous culture of *L. acidophilus* –SNP2 was the least viscous with the viscosity of 476.267 cP which is the lowest among all samples. This was related to lactose transformation by lactic acid bacteria to release lactic acid contributing to pH decrease and promoting protein denaturation. Whereas sample Y3 had higher pH of i.e. 4.09, indicating lower amount of lactic acid implicating lower denaturation. Thus yogurt became less viscous as compared to others.

**Chromatic Color**

Color is considered as important physical (objective) and organoleptic (subjective) food properties. Chroma (C*) value is indicating color intensity of food or agriculture product. In this research, the value was calculated as $C^* = \sqrt{a^2 + b^2}$. Red color was denoted as $a^+$ and green as $a^-$, while blue and yellow were denoted as $b^+$ and $b^-$, respectively. The measurement was conducted using photoelectric instrument known as Hunter Colorimeter. Results were then analyzed using DMRT (Duncan's Multiple Range Test) as seen in Figure 5 below.
Figure 5. Chromatic color of probiotic yogurt fermented using indigenous culture and with addition of purple sweet potato extract

As seen in Figure 5, yogurt made from control culture (Y0) without indigenous probiotic had lowest chromatic color of 17.995 among all samples. This was due to the presence of anthocyanin, natural pigment of purple sweet potato. Astawan and Kasih (2008) mentioned that color intensity of anthocyanin was pH dependent. Red color intensity was stronger near pH 1 and decreased near pH 4. On the other hand, yogurt acidity was increased with the increase of lactose fragmentation by LAB into lactic acid. Higher content of lactic acid decreased pH. Sample Y0 had lowest pH among all samples indicated higher level of lactic acid, thus chromatic color detected from Y0 yogurt was lower as compared to other samples (Y1, Y2 and Y3).

Chemical Properties

Lactic Acid Content

Titratable acid was also indicated lactic acid content as a result of lactose as main sugar in milk. L. bulgaricus, S. thermophilus and probiotic able to consume lactose as carbon source for their growth. Titratable acidity and statistic analysis result of purple sweet potato yogurt prepared using indigenous probiotic culture was presented in Figure 6 below.

Figure 6 showed that lactic acid produced by samples Y0, Y1, Y2 and Y3 ranging from 0.937 to 1.237%, which is still in the range for yogurt standard quality based on Indonesian National Standard (SNI) 2981-2009 of 0.5 – 2%. Sample Y1 prepared using starter culture of L bulgaricus, S.thermophilus and L.plantarum Dad 13 contained the highest lactic acid of 1.273%. Above data
was closely related to the pH as described above with the pH of sample Y1 was the lowest \( (3.78) \). The pH was representing ion \( H^+ \) produced from lactic acid dissociation into \( H^+ \) and \( CH_3COO^- \). Lower pH correlate with the increase of \( H^+ \). Thus titratable acid of Y1 was the highest among all samples.

![Bar Chart]

**Figure 6.** Titratable acid content of probiotic yogurt fermented using indigenous culture and with addition of purple sweet potato extract

**Moisture Content**

Water is the largest part of yogurt, given 87.5% moisture content of milk as yogurt raw material. Figure 7 showed that indigenous culture significantly affected moisture content of purple sweet potato yogurt which ranging from 85.157\% to 85.549\%. Beside protein denaturation due to lactic acid addition of purple sweet potato extract increased total solid, resulting lower yogurt moisture content as compare to milk as raw material. Highest moisture content was obtained by sample Y3, prepared using starter culture of *S. thermophilus*, *L bugharicus* and *L. acidophilus SNP-2* in the ratio of 1:1:0.5. Shah and Jelen (1990) noted that growth rate of *L. acidophilus* was slower as compare to *S. thermophilus* and *L bugharicus* which probably due to the low rate of \( \beta \)-galactosidase production, as well as the presence of extra polysaccharide, and decelerating milk protein coagulation by lactic acid thus increased moisture content.
Ash Content

Ash content was minor part of yogurt. As shown in Figure 8, ash content which ranged from 0.7895% to 0.8242% of purple sweet potato yogurt was significantly affected by the use of indigenous culture, and they are still in the range of ash content for yogurt standard quality based on Indonesian National Standard (SNI) 2981-2009. Highest ash content of 0.8242% observed in sample Y3 prepared using commercial culture and indigenous probiotic Lactobacillus acidophilus SNP-2. Ash content represented yogurt mineral level as important nutrition for human and essential for lactic acid bacteria (LAB) survival in human intestinal tract.
Reducing Sugar

Reducing sugar was the easiest substrate to be utilized as energy source, thus higher rate of culture growth implicated in reducing sugar utilization, both for cell growth and lactic acid production, resulted in decreased reducing sugar. Figure 9 shows that probiotic culture significantly affected the reducing sugar utilization as energy source. Highest reducing sugar was observed in sample Y3 of 4.268%, followed by Y2 and Y1 of 3.924% and 3.328%, respectively, and lowest value is observed in control sample (Y0) of 3.079%. Lowest utilization of reducing sugar indicated by Y3.

![Reducing sugar content graph](image)

Purple sweet potato yogurt prepared using indigenous probiotic culture

Note: Different notation letter means significant different

Figure 9. Reducing sugar of probiotic yogurt fermented using indigenous culture and with addition of purple sweet potato extract

The low rate of reducing sugar utilization by *Lactobacillus acidophilus* SNP-2 was probably due to the low β-galactosidase and polysaccharide presence on outer membrane. (Shah and Jelen, 1990), This was also presumably caused by low cell viability of sample Y3 after 2 weeks storage, the lowest among all samples. At initial stage of storage, cell number of sample Y3 was 1 log cycle decreased into 8.7×10⁸ CFU/ml. After 2 weeks, control (Y0) and Y1 were still about 10⁹ CFU/ml, while cell number of Y2 and Y3 generally 1 log cycle decreased into 8.5×10⁸ and 7.9×10⁸ CFU/ml, respectively, resulting highest reducing sugar content of sample Y3.

Soluble Protein Content

Soluble protein is available protein in food system. During milk fermentation by LAB, milk protein was partly decomposed into various monoepptide and amino acids. Meanwhile, lactic acid produced from fermentation also induce protein coagulation, thus protein became easier to
be digested by intestinal enzymes. These factors contribute to the increase of yogurt protein bioavailability twice than fresh milk (Anonymous, 1989).

![Graph showing protein soluble content](image)

Note: Different notation letter means significant different

**Figure 10.** Soluble protein of probiotic yogurt fermented using indigenous culture and with addition of purple sweet potato extract

Figure 10 showed that indigenous probiotic significantly affected soluble protein content of purple sweet potato yogurt, ranging from 1.145% to 1.478%. The highest content of soluble protein of 1.478% was observed in sample Y1 prepared using starter culture of *S. thermophilus*, *L. bulgaricus* and *L. plantarum Dad 13* with ratio of 1:1:0.5, with the lactic acid bacteria number of $10^6$CFU/ml range after 2 weeks storage. Whereas LAB number of sample Y2 and Y3 generally 1 log cycle decreased into $8.5 \times 10^8$ and $7.9 \times 10^8$ CFU/ml, respectively. It was assumed that efficient utilization of energy source by Y1 starter, accelerated protein decomposition resulted in highest soluble protein.

**Fat Content**

Fat is essential nutrition served as energy source, contribute to flavor and texture improvement, as well as source of vitamin A, D, E, and K (Winarno, 2002). Result showed that fat content was significantly affected by indigenous culture utilization, ranged from 0.08% to 0.186% (Figure 11). Based on yogurt quality requirements by SNI 2981-2009, purple sweet potato yogurts obtained in this research were classified as non-fat yogurt, given fat content below 0.5%.
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Yogurt prepared using starter culture Y1 consisting of Streptococcus thermophilus, Lactobacillus bulgaricus and Lactobacillus plantarum dad 13 with the ratio of 1:1:0.5 and with addition of purple sweet potato extract was the most preferable. The yogurt contained viable LAB after 2 weeks storage 10⁶ cfu/ml, pH of 3.78, viscosity of 5.1987 cp, chromatic color value of 18.559, titratable acid of 1.2733%, moisture content of 85.2664%, ash content of 0.8041%, reducing sugar of 3.3278%, soluble protein of 1.4782%, and fat content of 0.08%.

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