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Quality Of Nata Fruticans On Various Concentration *Monascus Purpureus* As Natural Dye

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Abstract – *Monascus purpureus* is a mold species capable of producing secondary metabolites, such as pigments used as natural colourants in foods, such as nata *fruticans*. Using natural colourants on nata is an alternative to replacing synthetic colours in food. This study aims to know the effect of colour produced and the best concentration of *M. purpureus* on nata fruticans. This research method includes making data fruticans sheet using water fruit of *Nypa fruticans*, making spores suspension of *M.purpureus*, and fermenting nata fruticans by using *Monascus* spores suspension with various concentrations of 10%, 20%, and 30%. *Monascus-nata fruticans* complex was dried and extracted by methanol to determine the colour intensity of *M.purpureus* pigment production and absorbed by *Monascus-nata fruticans* complex. The 30% concentration of *M. purpureus was the best concentration* based on colour, texture, aroma, and colour intensity

Keywords – Colourant; Monascus-Nata Fruticans Complex; Pigment; Quality; Spore.

I. INTRODUCTION

Nata is one of the functional food products which mainly consists of cellulose which is helpful in the digestive process [1]. Nata can be produced from various substrate sources, one of which is *Nypa fruticans* Wurmb. [2] Nipah is a palm plant that grows on the coast and river mouths with an area of ± 700,000 ha of nipa palm plantations spread across several provinces in Indonesia, including Jambi Province [3]. The parts often used and processed as food products from the nipa plant are the sap and fruit. Nipa sap is known to have a relatively high sugar content ranging from 10-11.2% per liter [4]. In addition, Nipah fruit also has a relatively high sugar content ranging from 27.22 to 100 g Nipah fruit [5].

Nata products are usually served as a liquid given the fruit aroma essence and are added as a dye in the food [6]. Generally, synthetic dyes can harm health if used continuously and is capable of causing allergies, harm to humans, and even cause liver disorders and cancer [7]. This condition can be used as a benchmark for developing food additives, especially dyes that are natural and safe as food additives and health.

Natural dyes can come from various sources, one of which is microorganisms; *M. purpureus* can be used as an alternative source of natural dyes in food [8]. *M. purpureus* produces stable, non-toxic, and safe pigments to be used as food additives as a dye [9]. These fungi can produce pigments through a fermentation process with the types of pigments produced, such as yellow,

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red, and orange. The colouring of nata de coco using *M.purpureus* in media of rice extract and tofu dregs showed that nata could perfectly absorb the colour pigments of *M. purpureus* and did not change the taste of the nata [10]. However, various concentration of *M. purpureus* in nata also affects the formation and absorption of colour in nata [11]. Information on *M. purpureus* as a natural dye is still limited. This study aims to determine and observe the quality of nata fruticans at various concentrations of *M.purpureus* as a natural dye.

II. Research Methods

2.1. Collection of sample

Samples of Nipah fruits juice were obtained from Kuala Tungkal, West Tanjung Jabung, Jambi, Indonesia. The sampling was done by purposive sampling. The Nipah fruits juice sample was placed into a sterile plastic bag and stored in a cool box containing ice gel for transport to the Biotechnology and Engineering Laboratory, Faculty of Mathematics and Natural Science, Jambi University to be prepared for treatment.

2.2. Acetobacter xylinum starter

300 mL of coconut water, 1.36 g of ZA, 5.45 mL of 25% vinegar and 54.5 g of sugar. The solution is boiled and put into an incubation bottle of 300 mL. The bottle were closed, then cooled for 6 hours. Inoculation in 27.2 mL of *Acetobacter xylinum* mother liquor. The bottle mouth were covered with paper and incubated at 28-30 ℃ for 7 days [3]. The starter is ready to use after a layer of nata formed on the surface of the media.

2.3. Suspension of Monascus purpureus

M. purpureus suspension was prepared by scraping the entire surface of 7-day-old fungal hyphae given 10 mL of sterile distilled water and put into a sterile Erlenmeyer filtered with sterile gauze. Then pipetted, 1 mL of spore suspension and dripped into a hemocytometer to calculate the spore density [12]. The spore density is 2.7×10^6 cfu/mL.

2.4. Nata sheets production

Fruit juices of Nipah using to produce nata sheets. Added the ingredients of starter solution; 340 mL of Nipah fruit juice, 1.54 g of ZA, 6.18 mL of 25% vinegar, and 61.8 g of sugar. The solution was stirred and boiled, then put into a fermentation tray of 340 mL. The tray is then covered with newsprint and cooled for 4 hours. The 30.9 mL of nata starter was added into the solution and incubated at 28–30ºC for 9 - 11 days. The nata sheets were ready to be harvested [3].

2.5. Fermentation of Monascus-nata complex

The fermentation media consisted of 5% rice extract. Rice flour is made by washing rice, then drying it in an oven at 60 ℃ for a day, and then mashing it. The rice powder is boiled with water at 100 ℃ for 30 minutes and filtered [10]. The fermentation media neutralized by adding 1M NaOH until the pH was neutral. Put fermentation media into an Erlenmeyer of 100 mL. Inoculated with a starter concentration of 10%, 20%, and 30% (v/v) [11]. Fermentation lasts for 16 days with an aerator.

2.6. Pigment extraction

Dry sheets *of* Monascus-nata fruticans complex are mashed with a mortar, and 10 mL of methanol is added. The mixture is stirred and put into a test tube for 24 hours, centrifuged at 4000 rpm for 30 minutes. The supernatant was filtered, and colour intensity was measured by UV-VIS Spectrophotometer wavelengths of 400, 470, and 500 nm [12].

2.7. Hedonic test

After 16 days fermentation, the hedonic test observed. The parameters of hedonic test is colour, texture and aroma. The hedonic test giving assessment score by panelists with certain criteria[10].

2.8. Data Analysis

The data in this study were colour intensity and hedonic data of Monascus-nata fruticans complex. The data was analyzed in a ANAVA test and descriptive qualitative method.

III. Result And Discussion

3.1. Colour intensity of Monascus-nata fruticans complex

Result of the *Monascus-nata fruticans complex* colour intensity at three wavelengths show different intensity (Table 1).

TABLE I. THE AVERAGE OF COLOUR INTENSITY MONASCUS-NATA FRUTICANS COMPLEX.

Concentration (%)	Wavelengths		
	Yellow (400 nm)	Orange (470 nm)	Red (500 nm)
Ponceau 4R (Control)	0,32	0,92	1,44
10%	0,28	0,24	0,35
20%	0,13	0,17	0,19
30%	0,59	0,36	0,60

The variation concentration of *M.purpureus* starter shows high absorbance in red intensity with values of 0.35, 0.19, and 0.60. This proved that the red pigment is the dominant colour produced by *M. purpureus.* The red pigment produced by *M. purpureus* is the optimum colour that dominates changes in liquid culture media. It relatively shows a high absorption value compared to yellow and orange pigments [13]. Low absorbance in 10% and 20% concentration are due to the optimization of yellow and orange pigment production, which is only stable in the early stages of the fermentation process. This is related to the growth rate of *M. purpureus* in producing pigments. The formation of *M. purpureus* pigment begins at the end of the log phase on days 4-5 [14] followed by a discolouration from yellow and continues to change to orange, then increases towards reddish colour on day 10 to day 14 fermentation [15].

In 20% concentration, the colour intensity has decreased, affected by instability in pigment production during the fermentation process caused defect pigment. Aeration is one factor affecting the decrease in colour intensity at 20% concentration during the fermentation process. The aerator was used as a reactor to supply oxygen during fermentation. During the fermentation, the oxygen supplied was not spread on the surface of the media. It affected the metabolic process of pigment production in *M. purpureus* and the level of stability of pigment absorbed by nata. According to Timotius [16] that agitation processes in liquid media also affect the quality of growth and formation of *M. purpureus* pigment. Using aerators to supply oxygen is unsuitable for fermentation in liquid media. It will trigger a hard bump between media particles and the mycelia of fungi and can impact lower pigment production [17]. The ANAVA test showed no significant effect on the colour intensity of yellow, orange and red colours produced ($p > 0,05$)

3.2. Hedonic Test On Monascus-nata fruticans complex

The hedonic test was conducted with the method of giving a score by panellists with criteria. Various concentrations of *M. purpureus* given to nata fruticans affect the quality of the colour, texture and aroma parameters (Table 2).

TABLE II. THE AVERAGE OF HEDONIC TEST ON MONASCUS-NATA FRUTICANS COMPLEX.

Concentration (%)	Parameters					
	Colour		Aroma		Texture	
	Score	Category	Score	Category	Score	Category
Ponceau 4R	3,67	Like	3,10	Neutral	3,27	Chewy
10%	3,39	Like	3,07	Neutral	3,37	Chewy
20%	2,70	Neutral	3,00	Neutral	3,11	Chewy
30%	3,47	Like	3,00	Neutral	3,24	Chewy

3.2.1. Colour

Colour is one of the main characteristics in nata that affects the appearance of physical quality properties in nata. The P4R as an artificial dye showed good results in colouring nata, and the scoring of 30 panellists supported it liked the colour formed on nata fruticans. Artificial dyes have a considerable effect on the colour changes in nata. The colour pigments contained in the dye can be perfectly absorbed and bound to the cellulose network in nata during the fermentation process [18].

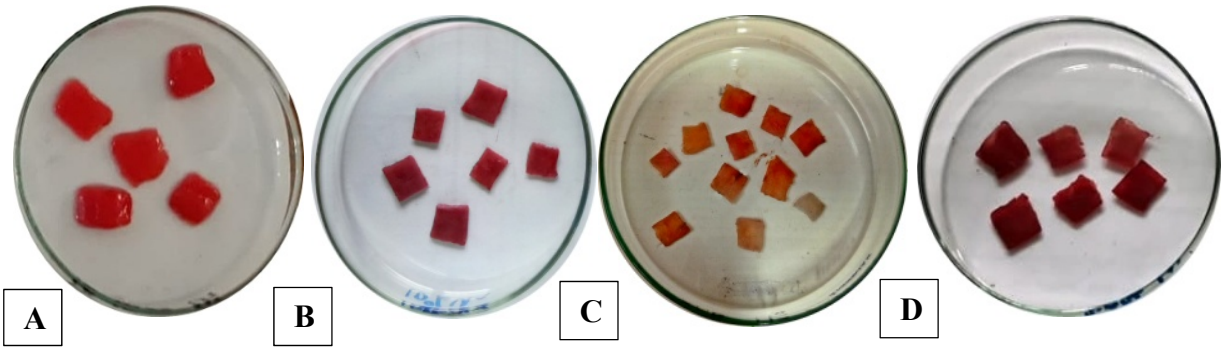

Fig 1. Colours of Monascus-nata fruticans complex

Notes: A. P4R B. 10% C. 20% and D. 30%

The colour changes of *the Monascus-nata fruticans complex* were examined and compared *to Monascus* pigment and artificial pigment (P4R) dyed nata pieces. Using 10% concentration formed reddish colour, 20% concentration formed an orange colour and 30% concentration formed dark red colour (Fig 1.). These results showed that colour change in nata was dyed by the extracellular pigments in the mycelium of *M. purpureus*, the mycelium able to extend, fill and grow along the cellulose capillary network in nata pieces. During the fermentation, nata pieces were coloured by the secretions of extracellular pigment of *M. purpureus* trapped in the capillary network in nata. Mycelium plays a significant contributor to the change in the colour of nata. [19]. Based on the hedonic test, using a 30 % starter was the best concentration that was mostly liked (Table 2) by the panellists between 10% and 20% concentration of *M.purpureus* starter.

3.2.2. Aroma

Aroma is one of the essential aspects that affect the physical quality of nata. The results of the hedonic test by the 30 panellists on the aroma parameters of *the Monascus-nata fruticans complex* are shown in Table 2. The highest value is 3,10 in the control treatment using artificial pigment dye (P4R). However, from the average value in the treatment, the value did not show a significant difference between the P4R control treatment and the treatment of *M. purpureus* concentration. The average value of this aroma parameter is 3, with the description in the neutral category.

The characteristics of the aroma in nata, according to SNI 01-4317-1996 [20], are normal and odourless, but the aroma in *Monascus-nata fruticans complex* is little odour. During the fermentation, acetic acid bacteria produce the acid as a product metabolism cell that impacts the odour formed in nata pieces [21]. In addition, the aroma produced in nata is distinctive and slightly sour at harvest and will disappear during washing, soaking and boiling [22]. Based on the result of the hedonic test, the aroma is still acceptable to the panellists according to SNI 01-4317-1996, with the characteristics of nata being normal and odourless.

3.2.3. Texture

The production of Monascus-nata fruticans complex using various concentrations showed that all the treatments gave the same result on texture is chewy, and the panellist gave the same scoring on the texture of nata. Using various concentrations of M. purpureus on the Monascus-nata fruticans complex did not significantly affect the texture of the nata. In addition, the high water content in the nata can affect the consistency of the texture of the nata. The content of sugar as a carbon source can affect the metabolism processes of Acetobacter xylinum in forming cellulose tissue in nata that affect the texture forming it able to be soft and hard [23].

IV. CONCLUSION

The research concluded that giving various concentrations of M. purpureus affects the colour quality of the Monascus-nata fruticans complex. The concentration of 30% M.purpureus was the best treatment, with a colour intensity that formed red. The highest colour intensity relates to the hedonic test (3.47) with the category liked.

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