

Physicochemical characteristics of rotted rice fermented with *Saccharomyces sp* and *Lactobacillus sp* based starters

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Abstract

This study aims to increase the nutritional value of rotten rice as an alternative poultry feed. The experiment was conducted in the Feed Technology laboratory, Faculty of Animal Agriculture, Diponegoro University, Semarang. The experiment was carried out by a 2x3 factorial design. The first factor is the starter used (a *Saccharomyces sp* based starters- yeast of tape and *Lactobacillus sp* based starters- FS-EFV20). The second factor is the starter content (2, 4 and 4% w/w) with five replications. The rotten rice is soaked in hot water (90C for 10 minutes) and then drained to remove any remaining soaking water. Rice is then mixed with the starter according to the treatment, then put into the fermenter, and tightly closed. The filled fermenter was cured for six days (at 25 °C, 85% RH). Analysis of physical and chemical characteristics, in the form of odour, texture, colour, pH, crude fibre, crude protein and ashes were carried out after the time of ripening was completed. The data were analyzed by ANOVA and continued with Duncan's multiple distance test. The results showed that among the starters used, the physical appearance of colour and smell were significantly different ($P<0.05$), but there were no differences in the textures. The concentration of crude protein and crude fibre is interactively affected by the type and the level of the starters ($p<0.05$). The CF increased with the increasing level of commercial yeast for tape starters ($p<0.05$). The CP and CF significantly increase with the level of FS-EFV20 starter ($p<0.05$). The content of ash was not affected by the type of starter, but the use of FS-EFV20 starter tends to increase the concentration of ash in the fermented products. In conclusion, fermentation was a considerable treatment that improved the nutrition values of rotten rice. Moreover, the starter of FS-EFV21 was appropriated starter for the fermentation.

Keywords: Starter, fermentation, physicochemical characteristics, rotten rice

Introduction

Rice is one of the main food ingredients in Indonesia and is always an important topic of discussion every year regarding its availability, price and quality. There are two standards rice quality referred to in trade rice in Indonesia, namely the National Standard Indonesia (SNI) 6128 of 2015 and Regulations The Minister of Agriculture of the Republic of Indonesia Number

31 of 2017 about Rice Quality Class. These two standards emphasizing the existence of quality rice grading premium and medium quality rice. The standards are built with only attention physical properties of rice. The rotten rice is characterized by an incomplete shape, easily crushed, moldy, the presence of lice and the color has changed from yellowish to brownish yellow, and has a musty smell. The quality of rice whose quality does not meet SNI standards before storage, will decrease further after three months of storage [1]. Quality that is not following standards can ultimately affect the safety of rice products, especially after storage. Cases of low quality rice circulating in the market have been widely studied, for example reported by Munarso et al. [2], Based on the analysis of physical quality, the imported rice and the non-subsidized rice from Sumedang was categorized in Premium quality class, non-subsidized rice from Karawang had the quality of Medium class (Permentan 31/2017) or Medium 1 (SNI 6128:2015), while the subsidized rice showed underqualified quality based on the two standards. The damage that occurs to rice is caused by various things, such as too long shelf life, failure in the storage process, and natural disasters (floods). The types of damage that occur to rice in storage are: rotten, mouldy, lice attack so that the quality of rice decreases.

Uly [3] reported that 400 thousand tons of rice stock owned by Bulog has the potential to decrease in quality, originating from domestic procurement for the 2018-2019 period and imports in 2018. As much as 275,811 tons of imported rice in 2018 are still stored in the Bulog warehouse. However, about 106,000 tons of rice from the remaining imports experienced a decline in quality. Perum Bulog plans to dispose of 20,000 tons of degraded rice. On the other hand, the availability and price of energy source feed ingredients for livestock, especially corn, fluctuates due to seasons and markets, thus threatening the sustainability of chicken farming in Indonesia [4]. This opens up opportunities for studies to exploit the potential of damaged rice as a source of feed for poultry.

Animal feedstuff can be obtained by utilizing waste materials, taking into account safety and feasibility factors, such as nutrient content, anti-nutritional compounds or toxins, as well as the presence of pathogenic bacteria and fungi. Fermentation is one of the important methods of food preservation. It is one of the oldest means of food preservation and reduces the risk of food borne diseases and food spoilage [5]. Fermentation is a desirable process and the products that are being prepared by natural fermentation are fermented products [6]. Fermented products are substrates that are invaded or overgrown by edible microorganisms whose enzymes, particularly amylases, proteases; lipases hydrolyze the polysaccharides, proteins and lipids to nontoxic products with flavors, aromas and textures pleasant and attractive to the consumer.

Lactic acid (LA) fermentation of vegetables and fruits is a common practice to maintain and improve the nutritional and sensory features of food commodities Lactic acid fermentation retains all the natural plant ingredients while improving the quality, taste and aroma [7]. LA fermentation enhances the organoleptic and nutritional quality of the fermented fruits and vegetables and retains the nutrients and coloured pigments [8]. The use of

Saccharomyces and non-Saccharomyces yeasts during the fermentation process, demonstrates a new high performance for food and beverage elaboration, which is also capable of producing health-promoting compounds [9]. To these, in this study *Saccharomyces sp* and *Lactobacillus sp.*, was applied to improve the quality performance of rotten rice.

Material and Methods

The materials used in this study were rotten rice and starter based on *Saccharomyces sp*-Tape Yeast obtained from the local market and starter based on *Lactobacillus sp*- FS-EFV20 from Sulistiyanto [10]. The study was conducted by completely randomized design (CRD) Factorial 2x3, with two starters of *Saccharomyces sp* based and *Lactobacillus sp.*, and three levels of the starter used and replications.

The rotten rice is soaked into the water by 90°C for 10 minutes and then it was drained. The soaked rice is then mixed well with the starter 0, 2, 3, 4 % according to the treatment, then put into the fermenter, and tightly closed, storage for six days (at 25 °C, 85% RH). Analysis of physical and chemical characteristics, in the form of odour, colour, texture, pH, crude fibre, crude protein and ashes were carried out after the time of ripening. The data were analyzed by ANOVA and continued with Duncan's multiple range test [11].

Results and Discussion

The results showed that between the starters used, the physical appearance of smell, colour and pH were significantly different ($P < 0.05$), but there was no difference in texture. Table 1 shows that the odour, colour of rotten rice changed with the fermentation process. There are differences in odour and colour in fermented products using yeast starter and LABs, but both provide a more favourable colour and aroma than rotten rice. The results were in line with several previous studies that fermentation can improve the physical appearance of organoleptic products to be preferred [6,7,8,9]. The texture of fermented products is generally the same, that is, it becomes more brittle. This is possible because during the fermentation process there is a degradation of compounds from complex compounds to simpler compounds so that the structure becomes brittle. This result is in line with Lu et al. [12] and Park et al. [13] that fermentation may thus change the amorphous region of the starch granule as well as the chemical components and thereby modify both physical properties. The pH of the product decreased to become more acidic, this indicates that yeast starter and LABs play an active role in carbohydrate degradation to produce lactic and acetic acid, as well as alcohol, so that the atmosphere becomes acidic [14].

The results of nutritional components (Table 2) show that the Crude Fibre (CF) increased with the level of commercial yeast for tape starters ($p < 0.05$). The Crude protein (CP) and CF significantly increase with the level of FS-EFV20 starter ($p < 0.05$). However, the Ash was not affected by both of starters and the level in the fermentation process. The increase in crude

protein in this study is different from the results of previous studies that natural fermentation can improve the functional properties of rice flour through protein modification on the starch granule surface, therefore improving the in vitro digestibilities of starch and protein [13,15]. The increase in crude fibre content is possible because the carrier used in the starter, especially in the FS-EFV20 starter, the carrier used is a mixture of soybean meal and cassava. The ash content did not change significantly, because the material and the fermentation process did not play a major role in the metabolism of yeast and LAB. The proteins significantly increase after fermentation in both whole and broken grain of rice, but the effect was not significant for CF and Ash [16].

Table 1. Physic-organoleptical performances of fermented rotten rice

Aspects	Levels of yeast based starters (%)				Levels of LABs based starters (%)			
	0	2	3	4	0	2	3	4
Odour	Musty	slightly sourish	Slightly sweet, fresh sourish	sourish	Musty	sour, accented with the smell of garlic	sour, accented with the smell of garlic	sour, accented with the smell of garlic
Colour	dull white, yellowish	yellowish white	yellowish white	yellowish white	dull white, yellowish	white slightly yellowish brown	white yellowish brown	white yellowish brown
Texture	Crumbs	crumbs, a bit soft	crumbs, a bit soft	crumbs, soft	Crum	crumbs, soft	crumbs, soft	crumbs, soft
pH	7.9a	3.9b	3.8b	4b	7.8a	4b	4b	4b

Table 2. Nutrient component of fermented rotten rice

Nut. Component	Levels of yeast based starters (%)				Levels of LABs based starters (%)			
	0	2	3	4	0	2	3	4
Crude protein (%)	6.69a	8.02b	8.29b	8.22b	6.69a	9.04bc	9.07bc	9.11c
Crude fibre (%)	0.63a	1.13b	1.57b	1.78c	0.64a	1.73c	1.95c	2.25d
Ash (%)	0.4a	0.48a	0.49a	0.49a	0.35a	0.59a	0.68a	0.67a

Conclusion

It was concluded that fermentation was a considerable treatment that improved the physicochemical of rotten rice. Moreover, the e starter of FS-EFV20 appropriate for the fermentation of the rotten rice.

Acknolegdment

A Grateful thanks are given to the Faculty of Animal Agriculture Sciences for funding by the contract No: 31/UN7.5.5/PP/2020; Zulfikar T, Amirrudin, Agus Miftah, Evi Suprihatiningsih and Kelik H for supporting laboratory work.

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