Nutrient Content of Banana Peel (*Musa paradisiaca*) Fermented at Different Levels of Palmyra Sugar Liquid Addition

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Abstract. Kepok banana peel is one of the potential feedstuff because of its availability and eases to obtain. However, the fiber content in banana peels was high and resulted in a limitation of its usage. Fermentation can reduce the crude fiber, and the process requires soluble carbohydrates such as palmyra sugar liquid. Therefore, a study were necessary conducted to assess the nutritional changes of fermented kepok banana peels added with different levels of palmyra sugar liquid. A Completely Randomized Design (CRD) consisting of 4 treatments and 5 replications was used in this study. The treatments were P0: kepok banana peel without palmyra sugar liquid, P2: Kepok banana peel using 2% palmyra sugar liquid, P4: fermented kepok banana peel with 4% palmyra sugar liquid, and P6: kepok banana peel fermented with 6% palmyra sugar liquid. The variables observed were dry matter, ash content, crude protein content, crude fat, and crude fiber. The results showed that level of palmyra sugar liquid had no significant effect ($P > 0.05$) on dry matter and crude fat content. However, it had a very significant effect ($P < 0.01$) on the ash, crude protein, and crude fiber content. Level of 6% palmyra sugar liquid was able to produce kepok banana peel silage which is high in crude protein, crude fat, but has lowest crude fiber content. It can be concluded that the usage of palmyra sugar liquid was able to improve the quality of banana peel silage and the addition 6% of palmyra sugar liquid has high value of protein, crude fat, and the lowest value of crude fiber.

Keywords: Banana peel · Nutrient content · Palmyra sugar liquid · Silage

1 Introduction

Kepok banana is a type of banana that is often used in food processing such as banana chips, and fried bananas [1]. Kepok banana peel (BP) contains crude protein, crude fat, calcium, and phosphorus 3.63%, 2.52%, 7.18%, and 2.06%, respectively [2]. Salombre,

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et al. [3] stated that banana peel can be used as an energy source because it has a gross energy of 4692 kcal/kg. However, banana peels contain high crude fiber, limiting their use as feedstuffs, especially for monogastric animals. Crude fibre values in kepok banana peel range from 8,49–18,71 [4–6]. High crude fiber causes poultry to feel full so that it can reduce consumption because crude fiber is voluminous [3].

Reduce crude fiber can be done through fermentation. Reddy and Pierson [7] states that the fermented enhances or creates a unique taste, changes the texture properties, and improves nutritional quality and digestibility. The decrease in crude fiber can be done through the fermentation process, as reported from 18.71 to 11.55 after being fermented with palm sap [8], fermented with EM4 from 12.36 to 10.92% [9], from 18.71 to 12.02% after being fermented for 6 days with 10% goat rumen fluid [10].

Anaerobic fermentation such as silage making is one example of a fermentation process that is often applied to feed processing. Silage is feedstuffs that preserved through the ensilase process, which is the process of preserving feed using spontaneous lactic acid fermentation under anaerobic conditions [11].

One of the efforts to improve the quality of silage is by adding materials containing soluble carbohydrates [12]. Palmyra sugar liquid (PSL) is one of the soluble carbohydrates. It is the result of cooking palm sap in the form of a very thick and sticky liquid with blackish brown color [13]. Utomo et al. [14] reported that the extracts without molasses nitrogen and liquid palm sugar were 85.7% and 86.03%, respectively. Therefore, the present study aimed to determine the level of PSLto nutrients value of kepok banana peels silage.

2 Materials and Methods

2.1 Materials

The experiment was conducted at Politeknik Pertanian Negeri Kupang, East Nusa Tenggara Province, Indonesia. Banana peels were obtained from banana processing around Kupang and palmyra liquid sugar was obtained from traditional market in Kupang.

2.2 Fermentation Process

The fermentation process of banana peel was referred to Chrysostomus et al. [15]. Peels were selected from banana ripe and were marked with yellow color. It was washed with clean water to remove dirt, then drained, sliced ±3 cm, and weighed. The banana peels were mixed with different levels of palmyra sugar liquid 0, 2, 4, and 6%, respectively. The banana peel mixture was added to a plastic jar, compacted, then closed with transparent plastic then covered with a jar lid until tightly and on the outside, the top of the jar is insulated to make it airtight. Banana peel silage was incubated at room temperature for 21 days. On the 21st day, the plastic jars were opened and the fermented banana peels were dried at 60 °C for 48 h to stop the fermentation process. It is then ground and packaged to be sent to the laboratory for analysis of content nutrition.

2.3 Nutrient Contents of Fermented Banana Peels

The proximate compositions were determined according to AOAC [16]. First, the samples were oven dried at 105 °C to assess the moisture content (method 934.01), the Kjeldahl method, which consists of digestion, distillation, and titration (method 990.02) was utilized to assess the crude protein (nitrogen × 6.25) content and extraction in acid and alkali solutions (method 978.10) was used to assess the crude fiber.

2.4 Experimental Design

This study used a completely randomized design with 4 treatments and 5 replications. Banana peels were fermented anaerobically for 21 days with different levels of PSL (0, 2,4, and 6% of fresh weight).

2.5 Statistical Analysis

The results were displayed as average ± SD (standard deviation), and data were analyzed by one-way analysis of variance (ANOVA) programs using the SPSS statistic software SPSS 24 then tested by Duncan multiple range test for mean comparison ($p < 0.05$).

3 Results and Discussion

The effect of using PSL on the nutrient composition of fermented banana peels is presented in Table 1. The results showed that the addition of PSL had no significant effect ($P > 0.05$) on the dry matter of kepok banana peel silage. This was probably caused by the metabolic activity of microorganisms in all the same treatments. In accordance with the opinion of Superanto et al. [17] stated content of dry matter silage was determined by the materials used and the activity of microorganisms during the ensilage process. The results of this study were in line with the research of Koni et al. [18] also found that banana peel fermentation using tape yeast had no effect ($P > 0.05$) on dry matter.

The addition of PSL had a very significant effect ($P < 0.01$) on the ash content of the kepok banana peel silage. The ash content in the treatment without PLS was higher ($P < 0.05$) than in treatments using PSL. This was probably because the silage that uses PSL has a higher growth of microorganisms than without PSL, and it requires a high mineral content and eventually causes the minerals in the substrate was decreased. According to Styawati et al. [19] the decrease in ash content occurred due to a decrease of organic matter in the fermentation process because of the material (substrate) degradation process by microorganisms. The increase in PSL, caused reducing in ash content. This is different from the results of research by Koni et al. [8] on fermentation of kepok banana peels with different levels of palmyra sap, increasing of addition of palm sap, could increase ash content in the banana peel silage.

The addition of PSL had a very significant effect ($p < 0.01$) on the crude protein content of kepok banana peel silage. The protein content of PLS 4% was significantly ($p < 0,05$) lower than the other treatments. This is because PSL as a soluble carbohydrate is a source of food for microorganisms so that microorganisms grow well, and the body

Table 1. Average dry matter, ash, crude protein, crude fat and crude fiber of fermented kepok banana peel with the addition of different levels of PSL

Parameters	Treatments				*p* value
	P0	P2	P4	P6	
Dry matter (%)	14.28 ± 1.02	14.34 ± 0.61	17.04 ± 5.36	15.47 ± 0.27	0,375
Ash (%)	15.07 ± 1.27^{a}	12.84 ± 1.09^{b}	12.13 ± 0.61^{b}	11.39 ± 0.70^{b}	0,001
Crude protein (%)	6.89 ± 0.22^{a}	6.84 ± 0.21^{a}	5.76 ± 0.19^{b}	6.44 ± 0.83^{a}	0,004
Crude fat (%)	12.41 ± 1.00	12.05 ± 0.63	12.31 ± 0.32	12.09 ± 0.87	0,857
Crude fiber (%)	15.14 ± 0.90^{ab}	16.06 ± 1.57^{a}	13.84 ± 0.91^{bc}	12.70 ± 0.67^{c}	0,001

Note: P0: kepok banana peel without PSL, P2: Kepok banana peel with 2% PSL, P4: fermented kepok banana peel with 4% PSL, and P6: kepok banana peel fermented with 6% PSL. $^{a–c}$ Average ± Standard deviation followed by different letter superscript showed a significant difference ($P < 0.05$).

of microorganisms consists of protein, with the higher the microorganism, the higher the protein content in the substrate.The results of the present study were in line with the study of Sumarsih et al. [20] who reported that using higher levels of molasses can increase the crude protein content of the kepok banana peel. The results of this study found that fermentation without or with PSL can increase the crude protein of banana peels. Al-Sahlany and Al-musafer [21] stated that banana peel protein was 3.70%. The results of this study are in line with the research results of Sumarsih et al. [20] stated that the addition of molasses up to 6% to kepok banana peel silage resulted in crude protein from 5.86% to 6.77%.

The addition of PSL had no significant effect ($P > 0.05$) on the crude fat content of the kepok banana peel silage. This is probably because microorganisms do not use fat as the main energy source so that the fat content in the substrate does not change significantly. This fermentation process can increase the crude fat content of banana peels, according to Duwa et al. [22] that banana peels contain 1.70% crude fat, and Koni [23] kepok banana peels contain 2.52% crude fat. Utomo et al. [14] stated that the crude fat content of silage additives can affect the fat content produced.

The addition of PSL had a very significant effect ($P < 0.01$) on the crude fiber content of the kepok banana peel silage. Using 4% and 6% PLS has lower crode fiber content than 2% PLS and without PLS. The decrease in crude fiber was caused by the activity of microorganisms that produce cellulase enzymes in the fermentation process, with the presence of cellulase enzymes causing a decrease in the crude fiber of kepok banana peel silage. Despal et al. [11] stated that silage is a spontaneous fermentation involving lactic acid bacteria. Lactic acid bacteria according to Yanuarianto et al. [24] is a cellulolytic bacteria that can produce cellulase enzymes that can digest cellulose into glucose. The results of research by Bira et al. [25] found the addition of different types of carbohydrates was able to reduce crude fiber content from 13.07% to 7.82%.

4 Conclusions

References It can be concluded that the addition of palmyra sugar liquid (PSL) has an effect on the ash content, crude protein, and crude fiber, but has no effect on crude fat and dry matter content of kepok banana peel silage. Based on the results addition of 6% PSL can increase protein, and reduce crude fiber in kepok banana peel silage.

References

1. Handayani S, Harahap AE, Saleh E.: Kandungan fraksi serat silase kulit pisang kepok (Musa Paradisiaca) dengan penambahan level dedak dan lama pemeraman yang berbeda. J Peternak 15:1–8 (2018).
2. Koni TNI, Foenay TAY. Effect of tapioca level and ensilage length on tannin and mineral content of kepok banana peels silage. J Ilmu Ternak;20:87–94 (2020).
3. Salombre VJ, Najoan M, Sompie FN, Imbar MR. Utilization Of Ensilage Kepok Banana Peels Replacing Part Of Corn In The Diet On Carcasses And Viscera Indices Of Broiler. J Zootek;38:27–36 (2018).
4. Koni TNI, Bale-Therik J, Kale PR. Utilizing of fermented banana peels by rhyzopus oligosporus in ration on growth of broiler. J Vet;14:365–70 (2013).
5. Fitroh BA, Wihandoyo W, Supadmo S. The use 3 of banana peel meal (Musa paradisiaca) as substitution of corn in the diets on performance and carcass production of hybrid ducks. Bull Anim Sci;42:222–31 (2018).
6. Diarra SS. Peel meals as feed ingredients in poultry diets: Chemical composition, dietary recommendations and prospects. J Anim Physiol Anim Nutr (Berl);102:1284–95 (2018).
7. Reddy NR, Pierson MD. Reduction in antinutritional and toxic components in plant foods by fermentation. Food Res Int;27:281–90 (1994).
8. Koni TNI, Foenay TAY, Sabuna C, Rohyati E. The Nutritional Value of Fermented Banana Peels using Different Levels of Palm Sap. J Ilm Peternak Terpadu;9:62–71 (2021).
9. Putra GY, Sudarwati H, Mashudi M. Effect of Addition Banana Peel (Musa paradisiaca L.) Fermentation in A Complete Feed on The Nutrient Contents and Digestibility by in Vitro Gassa. J Nutr Ternak Trop;2:42–52 (2019).
10. Sa'o TM, Foenay TAY, Koni TNI. Nutritive Content Of Banana Peel Flour (Musa Paradisiaca) Fermented By Goat Rumen Fluid. J Ilmu Peternak Terap;4:78–83 (2021).
11. Despal, Permana IG, Safarina SN, Tatra AJ. Addition of Water Soluble Carbohydrate Sources Prior to Ensilage for Ramie Leaves Silage Qualities Improvement. Media Peternak;34:69–76 (2011).
12. Utomo R, Budhi SPS, Astuti IF. The Effect Of Cassava Pomace Level As Additive On Quality Of Rumen Content Silage. Bul Peternak;37:173–80 (2013).
13. Naiola E. Amylolitic microbes of nira and laru from Timor Island, East Nusa Tenggara. Biodiversitas;9:165–8 (2008).
14. Utomo R, Noviandi CT, Astuti A, Umami N, Kale-Lado LJMC, Pratama AB, et al. Pengaruh penggunaan aditif pada kualitas silase hijauan Sorghum vulgare. Simp. Nas. Penelit. dan Pengemb. Peternak. Trop., Yogyakarta: Fakultas Peternakan Universitas Gadjah Mada; p. 63–9 (2016).
15. Chrysostomus HY, Koni TNI, Foenay TAY. The effect of various additives on crude fiber and mineral content of kepok banana peels silage. J Trop Anim Vet Sci;10:91–7 (2020).
16. AOAC (Association of Official Analytical Chemists). Official Methods of Analysis of the Association of Official Analytical Chemists. 18th ed. Washington, DC.: Association of Official Analytical Chemist; (2005).

17. Superianto S, Harahap AE, Ali A. Nutrition Value of Cabbage Vegetable Waste Silage with Rice Bran Addition and Different Duration of Fermentation. J Sain Peternak Indonesia;13:172–81 (2018).
18. Koni TNI, Foenay TAY, Asrul. The nutrient value of banana peel fermented by tape yeast as poultry feedstuff. Indones J Anim Sci;29:211–7 (2019).
19. Styawati NE, Muhtarudin, Liman. Pengaruh Lama Fermentasi Trametes Sp. Terhadap Kadar Bahan Kering, Kadar Abu, Dan Kadar Serat Kasar Daun Nenas Varietas Smooth cayene. J Ilm Peternak Terpadu;2:19–24 (2014).
20. Sumarsih S, Sutrisno C., Sulistiyanto. Kajian Penambahan Tetes Sebagai Aditif Terhadap Kualitas Organoleptik dan Nutrisi Silase Kulit Pisang. Semin. Nas. Kebangkitan Peternak., vol. 1, Semarang: p. 208–11 (2009).
21. Al-sahlany STG, Al-musafer AMS. Effect of substitution percentage of banana peels flour in chemical composition , rheological characteristics of wheat flour and the viability of yeast during dough time. J Saudi Soc Agric Sci;1:4–8 (2018).
22. Duwa H, Saleh B, Lamido M, Saidu A. Growth , haematological and serum biochemical indices of broiler chickens fed banana peel meal as replacement for maize in the semi-arid zone of Nigeria. Online J Anim Feed Res;4:121–6 (2014).
23. Koni TNI. Effect of fermented banana peel on broiler carcass. Indones J Anim Veterinery Sci;18:153–7 (2013).
24. Yanuarianto O, Amin M, Hasan SD, Dilaga SH, Subudy. Nutrition Composition and Digestibility of Corn Straw Silage Added Leucaena and Molasses Fermented at Different Times. J Ilmu Dan Teknol Peternak Indones;5:70–7 (2020).
25. Bira GF, Tahuk PK, Kia KW, Hartun SK, Nitsae F. Characteristics of Silage Chromolaena odorata With the Addition of Different Types Dissolved Carbohydrates. J Sain Peternak Indones;15:367–74 (2020).