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Nutritional Value of Modified Banana Tuber Meal (M-BTM) as Duck Feed

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ABSTRACT

Banana tuber meal has good potential as hybrid duck feed, its nutritional content in banana tuber meal needs to be increased through processing technology. The purpose of this study was to determine the nutritional content of banana tuber meal resulting from the rebinding process (cellulose enzyme + Meat Bone Meal), fermentation of inoculum *Saccharomycescerevisiae, Rhizopus oryzae* and the addition of amino acids as feed ingredients for hybrid ducks. The method was in vitro experiment by using a Completely Randomized Design with 5 treatments and 4 replications. The treatments consisted of banana tuber meal (control), T1= Processing of re-binding banana tuber meal, T2= Processing of re-binding banana tuber meal + *Saccharomyces cerevisiae*, T3= Processing of re-binding banana tuber meal + *Rhizopus oryzae*, T4= Processing of banana tuber meal by re-binding meal + amino acids (methionine and lysine). The measured variable was nutrient content (dry matter, ash, crude protein, crude fiber, crude fat, The research variables were nutrient content (dry matter, crude protein, crude fiber, crude fat, calcium, phosphor), NDF, ADF and gross energy. The data were analysed by ANOVA and continued with Duncan's multiple range test. The results showed that the highest dry matter content was at T0 (94.29) and the lowest was T4 (91.18), the highest crude protein was T4 (12.38) and the lowest was T0 (3.65), the highest crude fat was T0 (1.10) and the lowest was T4 (0.54), the highest ether extract was T0 (13.66) and the lowest was T4 (9.14), the highest calcium was T4 (2.46) and the lowest was T0 (0.625), the highest phosphorwas T4 (0.72) and the lowest (0.12), the highest ADF was T0 (32.11) and the lowest was T4 (27.42), the highest NDF was T0 (62.12) and the lowest was T4 (46.28) and the highest gross energy content was T4 (3772.03) and the lowest was T0 (3138.50). In conclusion, the processing of re-binding, fermentation and addition of amino acids resulted in higher crude protein, gross energy, calcium, phosphor and lower dry matter, ash, crude fat, crude fibre, ADF and NDF content.

Keywords: *Nutritional content, Re-binding, NDF, ADF, Gross energy*

1. INTRODUCTION

Feed ingredients are an important factor in business in the livestock sector. Feed is the biggest cost contributor factor with a proportion 60-70% of the total cost of livestock production, especially poultry farming which is growing in Indonesia [1]. The high cost of feed is caused by the influence of the availability of feed ingredients such as maize which is the main energy source for poultry by 70% of the energy needs of poultry metabolism. Based on data from BPS [2], it is reported that the national maize demand in 2018 for independent animal feed raw materials was 4.83 million tons and 8.30 million tons for the feed industry. Reducing the limitations of feed ingredients such as maize in poultry feed formulations by substituting alternative feed ingredients or local feed ingredients is one solution to reduce the need for, dependence on feed ingredients and reduce the high cost of feed.

Utilizing the use of local raw materials for agricultural by-products such as banana tuber meal as feed ingredients is one solution to overcome the availability of corn which is used as feed raw material. Banana plants have a high starch content found in the fruit and banana tuber meal. Banana tuber meal contains 2.38% crude protein, 4.47% crude fibre, 0.87% crude fat, 0.06% calcium, 0.15% phosphor and a gross energy of

3202 Kcal/kg [3]. The use of banana tuber meal as an alternative feed ingredient from agricultural by-products waste has limitations due to the low content of nutrients such as crude protein, gross energy, minerals and high crude fibre content. The low nutritional content of banana tuber meal as raw material for poultry feed needs to be processed to increase the nutritional content of banana tuber meal.

Processing of banana tuber meal by re-binding process, fermentation of using *Saccharomyces cerevisiae*, *Rhizopus sp* and the addition of amino acids (methionine and lysine) is expected to increase the nutritional value of banana tuber. Re-binding is an increase in the nutritional value of banana tuber meal using cellulose and meat bone meal which functions to reduce crude fibre and increase crude protein content. *Saccharomyces cerevisiae* fermentation process can increase protein, carbohydrate content and optimize the role of amino acids to increase nutritional potential. *Saccharomyces cerevisiae* is a single cell protein that contains protease enzymes that can increase nutritional value. *Saccharomyces cerevisiae* also contains complete amino acids. Processing with the addition of *Rhizopus sp* is a mould that produces various enzymes such as amylase, protease and lipase. Fermentation is beneficial for increasing the nutritional value of feed ingredients [4]. The addition of lysine and methionine can balance the amino acid content which functions to modify the protein content that is synthesized and degraded in poultry.

This study aims to determine the effect of re-binding processing, fermentation of *Saccharomyces cerevisiae*, *Rhizopus sp* and amino acids in banana tuber as local feed ingredients for ducks, where re-binding processing, fermentation of using Saccharomyces cerevisiae, *Rhizopus sp* and amino acids can increase the value of nutritional content, ADF, NDF and gross energy of banana tuber meal as alternative feed ingredients for hybrid ducks.

2. MATERIALS AND METHOD

2.1. Materials

This research was conducted in March-April 2021 the Laboratory of Nutrition and Animal Feed Laboratory, Faculty of Animal Science, Universities Brawijaya Malang. Banana tuber, meat bone meal, methionine and lysine, cellulose enzymes, *Saccharomyces cerevisiae, and Rhizopus sp.* research materials used according to proximate analysis procedures, 1 liter tube, and plastic zip analytical balance.

2.2. Method

This experiment used a completely randomized design with 5 treatments and 4 replications with details:

T_0: Modified banana tuber meal (M-BTM) (control)

T_1: Modified banana tuber meal (M-BTM)

T_2: Modified banana tuber meal (M-BTM) + *Sacharomyces cerevisiae*

T_3: Modified banana tuber meal (M-BTM) with re-binding processing + *Rhizopus sp*

T_4: Modified banana tuber meal (M-BTM) with re-binding + amino acid (methionine and lysine)

Table 1. Nutrient composition

Ingredients (%)	Treatment				
	T0	T1	T2	T3	T4
Rice bran	60	60	60	60	60
Concentrate	20	20	20	20	20
Maize	20	15	10	5	0
BTM-M	0	5	10	15	20
Total	100	100	100	100	100
Composition.					
GE (Kcal/kg)**	3846	3854	3863.7	3890.9	3880.8
CP (%)*	17.19	17.54	17.89	18.32	18.59
CF (%)**	2.23	2.77	3.31	3.91	4.39
Fat (%)*	7.03	7.21	7.38	7.59	7.73

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** Laboratory Analysis of the Center for Food and Nutrition Studies, Gajah Mada University, Yogyakarta (2020)

2.3. Data Collection and Measurement

The banana tuber meal is chopped/thinly sliced, milled to get a small particle size of the tuber meal. The procedure for re-binding the banana tuber meal that has become meal then flush with warm water at a temperature of ±30-35 °C, then added (T_1) cellulose enzyme 0.3% and Meat Bone Meal 11.63% put into a plastic bag and incubated in a semi-aerobic for 48 hours. The re-binding banana tuber meal was then added with inoculum (T_2) *Sacharomyces cerevisiae* 0.3% and (T3) *Rhizopus sp* 0.3 was incubated for 48 hours aerobically according to the modified Adli [5] *Rhizopus sp* 0.3 was incubated for 48 hours aerobe as recommend by [5] modified. Furthermore, (T_4) banana tuber meal resulting from re-binding was added 0.2% methionine and 0.3% lysine. according to Method from Sjofjan [8]. The data of parameters were identification using SAS University online Ed 64-red hat [9, 10].

3. RESULTS AND DISCUSSION

Processed banana tuber meal inrease (p <0.01) on the dry matter content. The highest dry matter content was found in the control treatment (T_0) 94.29 and the lowest was in the treatment of banana tuber meal processing with re-binding and amino acid processing (T_4) 91.18. The decrease in dry matter content in each processing was caused by changes in the dry matter content by the substrate where organic matter was decomposed by microorganisms found in each processing inoculum such as cellulose enzymes, Saccharomyces cerevisiae and Rhizopus sp. Processing of banana tuber meal with several processing processes causes a decrease in the amount of dry matter due to energy requirements by microbes in the inoculum that change the substrate, especially carbohydrates that produce energy in the form of heat, CO2, and H2O. Based on the research of Sjofjan [7] which states that the amount of dry matter on the fermentation substrate will decrease its content due to the use of organic nutrients by microbes, the release of CO2, and energy in the form of heat that evaporates with water. particles, thereby reducing dry matter in a material. Sjofjan [6] inoculum that changes the substrate, especially carbohydrates that produce energy in the form of heat, CO_2, and H_2O.

Crude fibre is a carbohydrate group consisting of cellulose, hemicellulose and lignin. The effect of several types of banana tuber meal processing (p<0.01) decrease the crude fiber content. The crude fibre content of banana tuber meal in this study was highest in treatment T_0 13.66% and the lowest in treatment T_4 9.14%. The decrease in crude fibre content is thought to be due to the process of added cellulose enzymes, *Saccharomyces cerevisiae* and *Rhizopus sp* which causes a decrease in crude fibre content caused by fermentation which can break complex fibre bondsinto simple ones. Kupai [3] stated That cellulase is an enzyme that hydrolyses cellulose into cellobiose (disaccharide), then further hydrolysed by the enzyme cellulose produce glucose. In addition, the yeast *Saccharomyces cerevisiae* is thought to also produce cellulose enzymes that convert crude fibre into glucose, therefore the use of *Saccharomyces cerevisiae* in fermentation can reduce fibre content. The cellulase enzymes are extracellular enzymes produced in cellulolytic microbial cells and then removed from the cells into the digestive system to digest cellulose [14].

The effect of processing banana tuber meal dcrease (p <0.01) on ether extract content. Processing of banana tuber meal value at treatment T_0 of 1.10% and decreased ether extract value in each treatment with the lowest ether extract content at treatment T4 0.054%. The decrease in ether extract in processed banana tuber meal is thought to be due to processing with the addition of cellulose. *Saccharomyces cerevisiae* and *Rhizopus sp* which can degrade the fat content in banana tuber meal. *Saccharomyces cerevisiae* was able to degrade ether extract as indicated by the low ether extract content in the treatment T3 because it was used to meet energy needs for yeast growth. *Rhizopus sp* is only able to produce enzymes such as proteases, lipases and amylase. The activity of lipase enzymes that work in the breakdown of fat from the substrate so that the content of organic matter during fermentation decreases. The decrease in ADF content occurs when the content level is given 5% (R5) due to changes in the cell wall during the fermentation process into simpler components that is hemicellulose and cellulose [11].

Tabel 2. Nutritional Content of Banana Tuber Meal

	Treatments				
	T0	T1	T2	T3	T4
DM%	94.29^{A}	93.79^{B}	92.25^{C}	91.21^{D}	91.18^{E}
CP%	3.65^{A}	10.10^{B}	10.85^{C}	11.48^{D}	12.38^{E}
CF%	13.66^{E}	12.60^{D}	11.63^{C}	10.81^{B}	9.14^{A}
EE%	1.10^{C}	0.55^{B}	0.54^{B}	0.54^{AB}	0.054^{A}
Ca%	0.69^{A}	1.97^{B}	2.10^{C}	2.16^{C}	2.46^{D}
P%	0.12^{A}	0.62^{B}	0.72^{C}	0.72^{C}	0.72^{C}
GE	3138^{A}	3458^{B}	3431^{B}	3709^{C}	3772^{D}
NDF%	62.12^{D}	60.73^{D}	60.44^{C}	47.63^{B}	46.28^{A}
ADF%	32.11^{D}	30.66^{C}	29.31^{B}	27.61^{A}	27.42^{A}

Description: Superscript uppercase letters (A-D) on the same line have a very real impact (P<0,01).

DM% - Dry matter; CP% - Crude Protein; CF% - Crude Fiber; EE% - Ether extract; Ca% - Calcium; P%, Phosphor; GE-Kcal/kg - Gross energy; NDF% - Neutral Detergent Fiber); ADF% - Acid Detergent Fiber)

The results of statistical analysis showed that the processed banana tuber meal showed increase (p <0.01) on crude protein. The lowest crude protein content was in the control treatment (T_0) 3.65% and the highest in the treatment (T_4) 12.38%. The increase in crude protein value was due to the re-binding treatment (addition of meat bone meal) on the banana tuber meal as a protein source to increase the value of the crude protein content. The increase in crude protein value is also thought to be caused by a process of changing the substrate either physically or chemically at aerobic or anaerobic conditions by the activity of enzymes produced by microbes with the aim of increasing nutritional value. This is in accordance with the statement of Malianti [13] that the increase is thought to be caused by the growth and development of the number of microbial cells which increase the protein content of the substrate because the crude protein comes from the protein of microorganism.

NDF (Neutral Detergent Fiber) consists of hemicellulose, cellulose, lignin and protein bound to the cell wall which is easily soluble in neutral detergent while ADF is a substance consisting of lignin, cellulose which is easily soluble in acidic detergent [15]. Processing of banana tuber meal had decrease NDF (p <0.01). Highest NDF (Neutral Detergent Fiber) content in treatment T_0 62.12% and the lowest at treatment T_4 62.12%. The decrease in NDF content is thought to be due to changes in the cellulose component due to the fermentation process that digests the cell walls of the banana tuber meal. The research by Sembiring [12] that the NDF content of banana tuber meal fermented using *S. cerevisiae* 42.98 decreased compared to banana weevil without treatment at 57.41 g/100 g neutral detergent fiber (NDF). Usman [16] stated that the value of NDF from the processing of fermented corn straw decreased in each treatment. The decrease in NDF content can occur during the fermentation process due to the presence of microbes that can digest cell wall components. Processing of banana tuber meal had decrease (p <0.01). Highest ADF (Acid Detergent Fiber) content at treatment T_0 32.11% and the lowest at treatment T_4 27.42%.

4. CONCLUSION

In conclusion, the processing of re-binding, fermentation and addition of amino acids resulted in higher crude protein, gross energy, calcium, phosphor and lower dry matter, ash, crude fat, crude fibre, ADF and NDF content.

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