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Nutrient Content of Pig Feed Based Local Feed Mixed with Liquid Fermentation Products from Moringa and Azadirachta indica Leaf Extracts

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ABSTRACT: This research aims to determine the nutritional content of rations based on local feed mixed with liquid Moringa leaf extract and fermented Azadirachta indica as pig feed. The research materials used were *Moringa* leaves and *Azadirachta indica* which were extracted and liquid fermented as well as local rations. In this study, an experimental method was used with a completely randomized design consisting of 5 treatments and 4 replications. The treatment in this study was R_0; ration without liquid fermented extract, R_1; ration + 10% liquid fermented extract, R_2; ration + 20% liquid fermented extract, R_3; ration + 30% liquid fermented extract, R_4; ration + 40% liquid fermented extract. The data obtained were analyzed using analysis of variance. Based on the research results, the crude protein content (%) R_0; 13.90±0.40, R_1; 15.02±0.12, R_2; 17.73±0.88, R_3; 19.20±0.29, R_4; 20.22±0.41, crude fiber content (%) R_0; 7.10±0.18, R_1; 6.90±0.27, R_2; 6.85±0.39, R_3; 7.08± 0.17, R_4; 7.04±0.14, non nitrogen free extract content (%) R_0; 48.69±1.88, R_1; 49.42±0.48, R_2; 47.54±0.79, R_3; 46.14±0 .79, R_4; 45.34±0.72, gross energy content (kcal), R0; 3524±45.55, R_1; 3620±26.77, R_2; 3698±19.24, R_3; 3742±10.88, R_4; 3770±31, 28. The results of statistical analysis showed that the treatment had a significant effect of $P<0.05$ on crude protein, non nitrogen free extract, energy content, but had no significant effect of $P>0.05$ on crude fiber content. The conclusion of this research is that the addition of fermented *Moringa* leaf extract and *Azadirachta indica* liquid to local pig rations has an effect on increasing protein and energy content with an average increase in protein content of 3.36% and energy of 107.73 kcal. for each increase, add 250 ml of liquid *Moringa* leaf extract and fermented *Azadirachta indica* to the local ration.

KEYWORDS: *Azadirachta indica*, fermented, liquid, *Moringa* leaf extract, pig feed.

INTRODUCTION

The average level of household income in East Nusa Tenggara (ENT) comes from agriculture and livestock, one of the livestock sub-sectors that supports the household economy and the needs of school children in ENT is pig cultivation because the age to reach selling weight is relatively short, easy in feeding, care and their prolific nature, apart from that, pig farming has become part of the cultural traditions of the people of ENT so that it has become quite popular livestock on the market and is supported by socio-cultural conditions, namely raising pigs is a hereditary custom used in traditional ceremonies.

In the past, pig breeders were fed feed in the form of household waste, restaurant waste, green vegetable waste and fruit waste combined with rice bran and corn. However, in its development, pigs are now predominantly given complete feed in the form of pellets so that In rearing them, feed costs account for 60-70% of the total production costs, so there are also those who use independently formulated feed ingredients made from conventional and non-conventional raw materials to reduce ration costs without paying attention to aspects of nutritional adequacy at each phase of pig growth.

The use of self-formulated feed made from local raw materials has weaknesses, namely its dusty physical properties which can disrupt the respiratory system of pigs when consuming feed and the lack of availability of protein, amino acids, vitamins and minerals as well as the availability of natural antibiotics to improve the immune system needed by livestock. pigs in production at each growth phase. Seeing this problem, a solution is needed to improve the nutritional quality of locally formulated rations and reduce the level of dustiness of the rations by adding nutritious liquids to the rations so that they are served in the form of liquid feed. However, in making this liquid, raw materials are needed that contain nutritional elements that can complement nutritional deficiencies in local rations so that the addition can improve the quality of rations and have an impact on increasing livestock productivity.

Ingredients for making liquids that can be used are Moringa leaves and *Azadirachta indica* as a source of protein, amino acids, vitamins, minerals and natural antioxidants. Based on the results obtained by [1] that there are 18 types of essential amino acids

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including threonine 9403.09 ppm, lysine 11694.16 ppm, leucine 18087.41 ppm, isoleucine 9321.59 ppm, phenylalanine 17236.01 ppm, valine 11183.48 ppm, methionine 5684.68 ppm, tryptophan 2577.82 ppm while non-essential amino acids include histidine 9965.39 ppm, proline 10068.07 ppm, tyrosine 8641.63 ppm, aspartic acid 16585.76 ppm, glycine 13027.13 ppm, arginine 13123.94 ppm, alanine 14474.52 ppm, glutamic acid 30106.87 ppm, serine 10055.98 ppm, cysteine 470.37 ppm. It is further stated that glutamic acid is the amino acid with the highest concentration while the lowest is cysteine. The composition of amino acids can determine the properties and activity of the proteins contained in a substance. [2] added that Moringa leaves also contain alkaloids, phenol hydroquinone, flavonoids, steroids, tannins and saponins so that Moringa leaves have the potential to act as antioxidants.

Moringa leaves also act as a hepatoprotector, and Moringa contains antioxidants so it is good for diseases related to digestion [3] . Moringa leaves have antioxidant and total phenolic content, for the IC value of the ethyl acetate fraction is 117.19 ppm, chloroform-methanol is 189.09 ppm, chloroform is 286.75 ppm and methanol is 111.7 ppm [4]. Apart from that, Moringa leaves also contain minerals, as found by [1] that there are 13 essential minerals contained in M. oleivera leaves with varying concentration distributions, selenium and chrome are the highest minerals with concentrations of 1097.84 ppm and 919.99 ppm. Potassium and magnesium are the lowest minerals in concentration with a concentration distribution of 68.83 ppm and 60.84 ppm.

Meanwhile, *Azadirachta indica* leaves contain bioactive compounds including sitosterol, hyperoside, nimbolide, quercetin, quercitrin, routine, azadirachtin, and nimbine [5]. Azadirachta indica leaf extract has activity as an antioxidant [6]. Antioxidants are compounds that can delay or slow down the speed of oxidation of oxidized materials [7]. Antioxidants can inhibit lipid oxidation through competitive oxygen binding, inhibit the initiation stage, block the propagation stage by destroying or binding free radicals, inhibit catalysts or stabilize hydrogen peroxide, apart from being antioxidants, Azadirachta indica leaves are also anti-bacterial. According to [8] Azadirachta indica contains bioactive compounds of alkaloids, steroids, flavonoids, saponins and tannins. These compounds can inhibit the growth of salmonella and E. coli bacteria.

To optimize the use of these materials, they need to be extracted first with the aim of separating nutritional compounds, vitamins, minerals and antioxidants from the mixed compounds and to increase their effectiveness, fermentation is carried out in liquid form. so that the combination and use of liquid fermented Moringa leaf extract and Azadirachta indica leaves as a mixture of local rations can increase the nutritional content of local rations. Therefore, this research aims to determine the content of crude protein, crude fiber, extra ingredients without nitrogen and energy in local feed-based rations mixed with liquid Moringa leaf extract and liquid fermented Azadirachta indica as pig feed.

RESEARCH MATERIALS AND METHODS

This research was conducted in June-August 2023, in the laboratory of reproductive biology and animal health, Faculty of Animal Husbandry, Maritime Affairs and Fisheries, Nusa Cendana University. In this research, ingredients were used in the form of Moringa leaves and Azadirachta indica which were extracted, palm sugar, the yeast Saccharomieses cerevisiae and several local rations which were formulated into ration as presented in Table 1.

Table 1. Composition of ingredients for ration based on local feed

Ingredients	Presentase (%)	Price /Kg	Price/composition (Rp)
Rice bran	30	4.500	1.575
Ground corn	20	6.000	1.200
Fish flour	5	10.000	500
Soybean husk flour	20	3.000	600
Banana hump flour	15	1.500	150
Coconut cake	7,5	3.000	225
Salt	2	5.000	100
Premix	0,5	68.000	340
Total	100		4.690

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In this study, an experimental method was used with a completely randomized design consisting of 5 treatments and 4 replications. The treatments in this study were:

R0: ration without liquid fermented extract,
R1: ration + 500 ml of fermented extract liquid,
R2: ration + 750 ml of fermented liquid extract,
R3: ration + 1000 ml of fermented extract liquid,
R4: ration + 1250 ml of fermented liquid extract.

The use of fermented extract liquid in the treatment is based on 1 kg of ration.

Procedure for making extract and fermentation liquid

Preparation of extract

The moringa and Azadirachta indica leaves used are dark green. Before using, the Moringa and Azadirachta indica leaves are air-dried for one day, then blended until smooth. A total of 100 grams of leaf flour consisting of 80 grams of moringa leaves and 20 grams of Azadirachta indica leaves was extracted using the maceration method using water as a solvent, to which ethanol and methanol were added. The ratio between moringa and Azadirachta indica leaf flour and solvent is 1: 3. Then the solution is macerated for 48 hours using a shaker bath. After 48 hours the sample was filtered and the filtrate obtained was collected in an Erlenmeyer. The filtrate that has been obtained is then evavored using a rotary evavorator at a temperature of 40^{o}C until a concentrated extract is obtained.

Liquid fermentation

In liquid media fermentation, a concentrated solution of extraction results, distilled water and palm sugar are used. A total of 200ml of the extract solution was mixed with 1 liter of liquid to which 10 grams of yeast and 20ml of palm sugar were added and dissolved in 1 liter of distilled water. After mixing, the liquid was put into an Erlenmeyer with a capacity of 500 ml and covered, then put into a water bath and fermented for 7 days at 30^{o}C. After 7 days the solution is removed from the water bath and ready to be used as a mixture for pig rations.

Parameters and Data analysis

The parameters examined in this research were the content of crude protein, crude fiber, extra materials without nitrogen and energy, which were analyzed proximately. The data obtained from proximate analysis were then analyzed statistically according to a completely randomized design, and continued with the DUNCAN test using SPSS 21 software.

RESULTS AND DISCUSSION

Increasing livestock productivity is very dependent on the quantity and quality of feed provided, local rations have nutritional value below the standards that have been determined for each phase of pig growth, in general local rations have low protein and high crude fiber because they are composed of rice bran and corn is the main ingredient and is an energy source, while the low protein content is due to the lack of availability of protein source raw materials and if available, the price is relatively high so that its use will increase the cost of rations which has an impact on low income from livestock sales. The following is the average content of crude protein, crude fiber, non nitrogen free extratct (NNFE) and energy of local rations mixed with extra liquid from Moringa leaves and Azadirachta indica fermented at different levels, presented in Table 2.

Table 2. Average content of crude protein, crude fiber, NNFE and energy of local rations mixed with extra liquid from fermented Moringa leaves and Azadirachta indica .

Parameter	Treatment					P-Value
	R_0	R_1	R_2	R_3	R_4	
Crude Protein (%)	13,90±0,40	15,02±0,12	17,73±0,88	19,20±0,29	20,22±0,41	0.02*
Crude Fiber (%)	7,10±0,18	6,90±0,27	6,85±0,39	7,08±0,17	7,04±0,14	0.55ns
NNFE (%)	48,69±1,88	49,42±0,48	47,54±0,79	46,14±0,79	45,34±0,72	0.03*

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Energy (kcal)	3524±45,55	3620±26,77	3698±19,24	3742±10,88	3770±31,28	0.03*

Note : ** significantly effect, P<.0.05, ^{ns} : no significantly effect, R_0: ration without liquid fermented extract, R_1: ration + 500 ml of fermented extract liquid, R_2: ration + 750 ml of fermented liquid extract, R_3: ration + 1000 ml of fermented extract liquid, R_4: ration + 1250 ml of fermented liquid extract.

Based on the table above, it can be seen that the average crude protein and energy content of local rations increased along with the higher level of extra liquid addition of fermented Moringa leaves and Azadirachta indica but there was a decrease in the NNFE content, while the crude fiber content did not increase or decrease compared to control ration without treatment.

Crude protein content

The results of statistical analysis showed that the treatment had a significant effect of P<0.05 on increasing the crude protein content of local rations. This is due to the use of Moringa leaves which contain quite high levels of protein and amino acids when extracted because they have been separated from other substances. According to [9] the protein content of dried Moringa leaves reaches 28.44%, fat 2.74%; carbohydrates 57.01%; 12.63% fiber and quite high calcium content of 1600-2200mg compared to fresh form so more is provided in extract form. Apart from that, the extraction results through the fermentation process can help reduce anti-nutrients in Moringa leaves so that their use in liquid form ensures even distribution of protein throughout the ration which has an impact on increasing the protein content of the ration. According to [10] the fermentation process can reduce the antinutrient levels in Moringa leaf flour. This occurs because after experiencing changes in the cell wall polysaccharides as a result of the influence of enzymatic hydrolysis in the fermentation process, it produces sufficient protein available [11].

Meanwhile, the use of extra Azadirachta indica leaves in this liquid, namely as a natural toxin binder, will reduce and suppress the proliferation of bacteria and microbes which can damage the physical and nutritional quality of local rations which are usually contaminated by pathogenic bacteria and microbes which can disrupt livestock digestion. According to [12] Azadirachta indica leaf extract has antioxidant activity. Natural which functions to inhibit lipid oxidation which causes rancidity. Apart from being an antioxidant, Azadirachta indica leaf extract is also an anti-bacterial. According to [13] Azadirachta indica leaf extract contains polyphenol compounds which have antibacterial power which can fight large amounts of pathogenic bacteria. The antibacterials contained in Azadirachta indica leaf extract can be used as a natural antibacterial [14].

Based on the results of Duncan's further tests, it showed that there was a significant difference of P<0.05 between treatments R_0-R_1 and R_3-R_4, and there was a very significant difference of P<0.01 between treatment R0 and treatments R_2, R_3, R_4, and treatment R_2 and R_3, R_4 on the crude protein content of local rations. This was due to the higher level of addition of liquid fermented Moringa leaf extract and Azadirachta indica in the local ration, causing differences in the protein content of the ration in each treatment. This also shows that every addition of 250 ml of liquid fermented moringa leaf and Azadirachta indica extracts in 1 kg of local ration can increase the crude protein content by an average of 3.36%. So according to [15] Moringa leaves can function as a potential source of additional protein as a feed ingredient.

Crude Fiber Content

The results of statistical analysis showed that the treatment had an insignificant effect of P>0.05 on the crude fiber content of local rations. This shows that the addition of extra liquid from fermented Moringa leaves and Azadirachta indica did not make a difference in the crude fiber content of the diet when compared to the control diet without treatment. This is because the crude fiber content in Moringa and Azadirachta indica leaves is relatively low and when extracted in liquid form the crude fiber content will decrease because the extraction results have undergone filtration and first before being evavored it forms a concentrated extract so that when added to local breeders' rations, did not have an effect on reducing the crude fiber content of local rations. According to [16] The cytoplasm will be dissolved in the organic solvent and compound extraction will be complete.

This is also because the extract of Moringa and Azadirachta indica leaves has gone through a liquid fermentation process using yeast which is capable of producing cellulase enzymes which function to break down the fiber content and components of Moringa and Azadirachta indica leaves which can reduce the fiber content and are more easily digested by livestock that consume them, so that The extra fermented liquid added to the local ration made no difference compared to the control ration without extra fermented liquid. According to [17] in the fermentation process the ability of microbes to degrade crude fiber is due to the secretion of several enzymes.

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Microbes that can produce cellulase enzymes will break down cellulose into cellobiose [18]. The decrease in crude fiber content of Moringa and Azadirachta indica leaf extracts during the fermentation process is due to the presence of enzymes that can break down cellulose into glucose with the help of bacteria that can produce cellulase enzymes so that they can reduce crude fiber levels during the fermentation process. [19] added that the cellulase enzyme is a complex enzyme that works in stages to break down cellulose into glucose, then the glucose will be used as a source of carbon and energy.

Non Nitrogen Free Extract (NNFE) content

The results of statistical analysis showed that the treatment had a significant effect of $P<0.05$ on the NNFE content of local rations. This is due to the addition of extra liquid from Moringa leaves and fermented Azadirachta indica which is increasingly high in local rations, causing an increase in the organic matter content of the ration, which is followed by an increase in protein content, thus reducing the carbohydrate content which has an impact on decreasing the NNFE content of the ration. According to [20], the NNFE content of a feed ingredient is very dependent on other components, such as organic matter, crude protein, crude fat and crude fiber. [21] added that NNFE is part of carbohydrates, NNFE contains carbohydrates, sugar and starch, as an energy source.

Based on the results of Duncan's further tests, it showed that the R_0-R_1, R_1-R_2, R_2-R_3, and R_3-R_4 treatments showed an insignificant difference of $P>0.05$. This was due to the use of extra liquid from fermented Moringa leaves and Azadirachta indica leaves which were the source materials. protein so that it can increase the protein content but does not have an impact on the extra ingredients without nitrogen. Meanwhile, the R_0-R_2, R_0-R_3, R_0-R_4, R_1-R_3, R_1-R_4, and R_2-R_4 treatments showed a significant difference of $P<0.05$ in reducing the NNFE content of local rations. The cause of the decrease in NNFE content is because carbohydrates utilize the properties of bacteria that grow during liquid fermentation of Moringa and Azadirachta indica leaf extracts. In other words, the microbial cell mass translates the levels of extract material without nitrogen in Moringa and Azadirachta indica leaves into protein which is characterized by an increase in protein content which has an impact on reducing carbohydrates as one of the NNFE components so that when added to local rations, it will further reduce the NNFE content. Local rations. According to [22] stated that the decreasing levels of extract materials without nitrogen were due to the focus on the use of sugar as an energy source for fermentation microbes. [23] added that the fermentation process relatively reduces the levels of hemicellulose, cellulose and lignin as components that make up NNFE. This decrease is caused by the production of relevant enzymes by microorganisms, such as non-starch polysaccharide degrading enzymes.

Energy Content

The results of statistical analysis showed that the treatment had a significant effect of $P<0.05$ on increasing the energy content of local rations. This is because the addition of Moringa leaf extract and fermented Azadirachta indica leaves is able to increase the organic matter content of the ration, even though there is a decrease in carbohydrates, it can be replaced by the high protein content of the ration produced along with increasing levels of liquid addition of Moringa leaf extract and fermented Azadirachta indica leaves. According to [24] that the increase in amino acid protein in a product indicates that carbohydrate utilization is proportional to protein production.

Based on Duncan's further tests, it showed that there was a significant difference of $P<0.05$ between treatments R_0 and R_1, R_2, R_3, R_4, treatments R_1 and R_2, R_3, R_4, and treatments R_2 and R_4. This was due to an increase in the level of addition of fermented Moringa leaf extract and Azadirachta indica liquid, thus providing a difference in increasing the energy content of the ration between treatments. This was also followed by an increase in the content of organic matter and crude protein, although carbohydrates and BETN decreased. The use of ingredients that have high protein will be more beneficial if combined with ingredients that have high energy content.

Meanwhile, between treatments R_2-R_3 and R_3-R_4 there was no significant difference $P>0.05$ between treatments. This is because the crude fiber, carbohydrate and NNFE content is not much different between the treatments, even though Moringa leaf extract and fermented Azadirachta indica have been added, causing the energy content of the resulting rations to be not much different. However, it can still be used by pigs to increase their productivity. This also shows that each increase in the addition of 250 ml of liquid fermented moringa leaf and Azadirachta indica extracts in 1 kg of local ration can increase the energy content of the ration by an average of 107.73 kcal. According to [25] that carbohydrates are a carbon source that functions as an energy producer. [26] added that pigs are able to use the energy in the liquid feed they consume which comes from carbohydrates, fats and proteins.

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CONCLUSION

The conclusion of this research is that the addition of fermented Moringa leaf extract and Azadirachta indica liquid to local pig rations has an effect on increasing protein and energy content with an average increase in protein content of 3.36% and energy of 107.73 kcal. for each increase, add 250 ml of liquid Moringa leaf extract and Azadirachta indica fermented to the local ration.

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