The Quality of Hydrolized Palm Kernel Meal and Its Efficacy on Laying Hens Aged 21-27 Weeks

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ABSTRACT

Indonesia has a high potential for Palm Kernel Meal (PKM). The use of PKM as animal feed has not been optimal due to several obstacles, one of which is the high non starch polysaccharide (NSP) content. This study aimed to evaluate the quality of PKM that has been given physical, chemical, and biological treatment, and evaluate its use in rations on the production performance and egg quality of laying hens. PKM treatment included filtration, hot water extraction, and the addition of mannanase enzymes. The rations were arranged based on the digested amino acid needs. 60 ISA Brown strain laying hens were used, housed in individual cages. The treatments given were commercial feed and feed containing 10% Hydrolyzed Palm Kernel (PK-H). Feeding trials were carried out for 8 weeks. The design used was a completely randomized design with 5 replications in each treatment. The results showed that the bond structure in PK-H was stretched microscopically. PK-H has improved the quality of its chemical components. The production performance of the two treatments did not show a significant difference. This study concludes that PKM processed by physical, chemical, and biological treatments improved its quality in terms of chemical and microscopic composition. The use of PK-H at a level of 10% in the ration did not reduce the performance of laying hens.

Keywords*: Laying Hens, Mannanase, Palm Kernel Meal Hidrolyzed, Performance, Palm Kernel Meal Quality.*

1. INTRODUCTION

Indonesia is a country with high Palm Kernel Meal (PKM) production. PKM is a by-product of the extraction process or expeller separation of palm kernel oil. Its production ranges from 0.3-0.6 tons/ha plant/year with crude protein content of 14.19-21.66%, fat 9.5-10.5% and crude fiber 12-63%. PKM contains galactomannan, glucomannan, and mannan which are the main structure of NSP (non-starch polysaccharide). Mannan contained in PKM is about 35.2%. The utilization of PKM as animal feed has not been optimal due to several obstacles, including deficiency of the amino acid methionine, tryptophan, cystine and the minerals Zn, Se. NSP is one of the obstacles in poultry [1]. The NSP content in PKM is known to bind water in the lumen thereby increasing the viscosity of the digestive tract digesta thereby reducing its flow rate [2]. The high level of shell contamination in PKM also makes the quality of PKM very varied. Shell contamination in PKM ranges from 10% to 20% depending on the process of separating shells from kernels before extracting palm oil from palm kernels [3]. Poultry is a monogastric animal with very limited ability to hydrolyze or digest NSP because the activity of cellulolytic enzymes in the digestive process is very low. The high potential of PKM must be maximized by processing it to improve its quality.

Improving the quality of PKM can be done by physical, chemical, or biological processes. This study will improve the quality of PKM with a combination of physical, chemical, and biological treatments. Physical processing that will be carried out is screening, chemical processing by extraction with an acid solution, and biological processing using the mananase enzyme. Mananase enzyme is an enzyme for hydrolyzing mannan substrates into manooligosaccharides and small amounts of mannose, glucose and galactose [4]. The use of mannanase enzymes has been known to improve the quality of feed ingredients through several mechanisms, including increasing the viscosity of feed in the digestive tract, releasing D-mannose as an energy source, suppressing the growth of pathogenic bacteria in the intestine, and increasing immunity [5]. Several studies on the use of PKM in rations have been carried out but the results are not consistent. The use of unprocessed PKM at a level of 10% can reduce digestibility as indicated by the increased secretion of endogenous amino acids. Unprocessed PKM can only be used 3%-5% in broiler chickens [6]. Lee et al [7] have carried out the use of PKM which was given the enzyme mannanase at a level of 5% to increase daily egg production (Hen Day Egg Production). This study aimed to evaluate the quality of PKM that has been given physical, chemical, and biological treatment, and evaluate its use in rations on the production performance and egg quality of laying hens.

2. MATERIAL AND METHOD

2.1. Time and Location

This study was conducted from February to April 2021. Proximate analysis was carried out at the PAU Laboratory IPB University. Laying hens are carried out on farms in Semarang Regency.

2.2. Materials

The materials used in this study were 60 laying hens strain ISA Brown aged 19 weeks, drinking water, vitastress, egg stimulant, and disinfectant.

2.3. Feed Processing

Hydrolyzed Palm Kernel Meal (PKH) is PKM that has been given physical, chemical, and biological treatment. Physical treatment was done by screened the PKM in sieve 20 mm. Chemical treatment was carried out by hot water extraction using a weak acid solution. The enzymatic treatment was the use of commercial enzyme Hemicell HT. The enzyme - Mannanase (EC 3.2.1.78) was derived from the bacterium *Paenibacillus lentus* containing 32.89 million units/kg. The used of enzyme is 0.4 kg/ton. PKM is incubated for 12 hours at pH 7 at 40 ^{o}C.

The ration formulations were based on digestible amino acids, macro and micro minerals. The database was inputted from Leeson and Summers [8] book. The standard of the nutrient requirement of the ration is based on the management of Isa Brown layer phase (laying eggs). The treatment ration contains 10% PKM which will be given physical, chemical, and biological treatment. The control ration was a commercial ration.

2.4. Feeding Trial

The laying hens were placed in individual cages (battery). The equipment was sanitized first with disinfectant. Feed was given every day at 08.00 A.M and 4 P.M. Drinking water was provided ad libitum. Feeding trial was carried out for 8 weeks, the first 2 weeks are adapted feed, containing 50% of treatment feed and 50% of the previously used feed. The weighing of chickens was carried out before the start of the study, before being fed 100% treatment, and at the end of the rearing period. Vita stress is given every time the chicken is weighed. egg stimulant is given for 2 weeks at the age of 22-24 weeks. The study design was a completely randomized design (CRD) with 2 treatments with 5 replications. Each replication consists of 6 laying hens.

3. RESULTS AND DISCUSSIONS

The chemical and amino acid composition and amount of shell contamination of PK-H are presented in Table 1.

Table 1. Chemical composition of PK-H and PKM (% As fed).

Chemical composition (%)	PK-H	PKM
Crude Protein	17.48	17,41
Fat	12.01	12,78
Fiber	12.28	14
ADF	39.22	38,47
NDF	62.49	62,33
Ash	5.69	5,44
Shell Contamination	7.63	15,31
Ca	0.51	0,49
P	0.66	0,63

Description: PK-H: Hydrolyzed Palm Kernel Meal, ADF: Acid Detergent Fiber, NDF: Neutral Detergent Fiber.

The processing has been carried out can improve the chemical quality of PKM, including a decrease in fiber content and an increase in calcium, phosphorus, and crude protein. Shell contamination in PKH also decreased by approximately 50%

Palm kernel hydrolyzed (PK-H) and PKM control were observed using a microscope with a magnification of 500 times to observe the bond structure. The following is a picture of PK-H and PKM.

The Figure 2. shows that the given treatment is effective in breaking down NSP when viewed microscopically. It can be seen in the picture that the structure of the PK-H bond is more expanded/tenuous. Loose structure describes weaker bonds and is easy to hydrolyze. This is caused by the physical, chemical, and biological treatment given to PK-H.

Table 2. Composition of amino acids (%).

Amino acid	PK-H	PKM
Lysine	0.49	0,51
Methionin	0.33	0,32
Cystein	0.22	0,22
Threonin	0.53	0,53
Triptophan	0.13	0,14
Isoleucine	0.59	0,6
Arginine	2.12	2,09
Phenilalanin	0.72	0,73
Histidin	0.31	0,31
Leucine	1.12	1,12
Tyrosin	0.44	0,44
Valine	0.87	0,87
Alanine	0.71	0,7
Aspartat	1.43	1,43
Glucine	3.17	3,17
Glycine	0.80	0,81
Proline	0.60	0,61
Serine	0.73	0,72

Description: PK-H (Hydrolyzed Palm Kernel Meal).

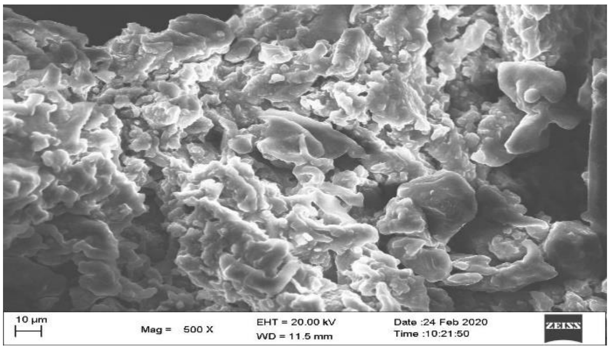

Figure 1. PKH image 500X magnification

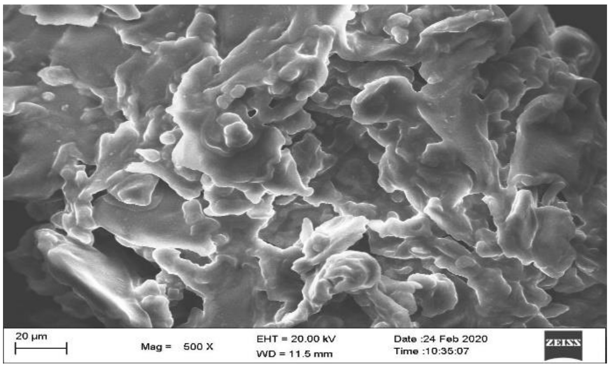

Figure 2. PKH image 500X magnification

3.1. Egg Production

The performance of laying hens aged 21-27 weeks is presented in Table 3.

Table 3. Performance of laying hens aged 21-27 weeks.

Parameter	P1	P2
Hen day average (%)	62.95±8.63	68.45±7.74
Egg weight (g)	56.42±1.46	57.11±3.28
Consumption (g/hen/day)	105.35±1.48	105.05±0.89
Total consumption (g)	17528.78±438.87	17506.54±341.18
Total eggs produced (g)	5925.82±698.35	6384.41±540.87
Body Weight (19 weeks old) (g)	1473.32±19.9	1482.25±25.05
Body Weight (21 weeks old) (g)	1634.9±52.74	1601.15±90.86
Final weight (g)	1794.05±142.6	1765±141.8
Weight gain (g)	159.15±119.69	163.85±85.27
FCR	3.01±0.32	2.78±0.2

Description: FCR: Feed Conversion Ratio, P1: Control (Commericial feed), P2: Feed containing PK-H

The average daily egg production of chickens with control and PK-H treatments were 62.95% ± 8.63 and 68.45% ± 7.74. Daily egg production was not affected by the treatments. This shows that the use of PKM at the level of 10% in the ration of laying hens for 6 weeks has not shown a decrease in egg production. In contrast Zanu et al [9] reported that use PKM in layer more than 10% for 8 weeks showed a decrease in egg production. Perez et al [10] also stated that the use of PKM began to show a downward trend in egg production at levels above 10% and significantly at the level of 50%. PKM contains anti-nutrients in the form of high NSP, phytic acid, unbalanced nutrition.

Physical processing is carried out to reduce shell contamination in PKM. The shell content in PKM ranges from 16%-29.6%. The shell on the PKM has a hard and sharp texture that can interfere with feed making machines in feed mills and can cause injury to the walls of the digestive tract of livestock. The main content in the shell is fiber, so it cannot be digested properly by monogastric animals. Therefore, physical processing namely screening was carried out to separate the shell and PKM. The screening process in PKM is proven to reduce fiber content. PKM that has been filtered at a filter size of 2 mm can reduce the percentage of shell contamination to 7.32%-12.52% [3]. Mannnase enzymes can increase nutrient absorption by releasing nutrients trapped in the cell wall matrix. Reduces digesta viscosity caused by NSP which has the property of absorbing water [11]. The use of the enzyme mannanase in study can improve the quality of the ration. The use of mannanase enzymes produced by microorganisms has several advantages, including a fast, inexpensive production process, and does not pollute the environment [12]. Several mechanisms of the mannanase enzyme in influencing chicken performance are: the high digesta viscosity caused by Β mannan can be reduced, providing an energy source in the form of D-mannose resulting from the hydrolysis of Β-mannan, suppressing the development of pathogenic bacteria in the digestive tract, increasing immunity, and releasing nutrients trapped [5]. Manan hydrolysis using enzymes can increase mannose by 30% [13]. So that 70% of the MOS released.

3.2. Egg Weight

The eggs weight produced by chickens with control treatment and PK-H treatment were 56.42 ± 1.46 and 57.11 ± 3.28 g. The eggs weight was not affected by the treatments. The use of PKM in laying hens rations does not affect egg weight [10]. The use of PKM at the level of 12% and 28% with mannanase did not significantly affect performance production of layer [14]. Lower egg weight was found when the layer was given 28% without mannanase addition. Factors that affect egg weight are chicken age, genetics, feed quality, chicken size, and production stage [15]. Leeson and Summers [8] stated that it was strongly influenced by methionine and total sulphur amino acids in the diet.

3.3. Feed Consumption

The feeding trial of control treatment and PK-H treatment did not affect the feed consumption of laying hens (105.35±1.48 Vs 105.05±0.89 g/hen/day). The use of PKM in the ration can affect the color of the ration. Although having a darker color, the reaction did not reduce the daily feed intake. [10] reported that the use of PKM at levels 0, 10%, 20%, 30%, 40% and 50% did not affect the feed intake. Diarra et al [16] and Koçer et al [7] stated that the use of PKM without using enzymes or using 8 types of enzymes also did not affect the daily consumption of chickens.

3.4. Weight Gain

During 6 weeks of study, the control treatment and PK-H treatment did not affect the weight gain of laying hens (159.15 ± 119.69 and 163.85 ± 85.27 g). The body weight gain of laying hens is not a factor that must be achieved as high as possible [3].

3.5. Feed Conversion Ratio

The control treatment and PK-H treatment did not affect the Feed Conversion Ratio (FCR) obtained from the study (3.01±0.32 and 2.78±0.2). The higher the FCR value, the lower the ability of chickens to convert feed into eggs [17]. According to Sundu et al [18] 81% of carbohydrates contained in PKM are in the form of NSP which consists of 78% linear mannan, 12% cellulose, 3% glucuronoxylan, and 3% arabinoxylan.

This study uses PKM at a level of 10% making the contribution of the Β mannan content of PKM by 3.5%.The content of β-mannan in soybean meal is 1.3% of dry matter and in corn, it is 0.08% [5]. Soybean and cornmeal used in the study were 18.85% and maize 50.91%. The contribution of Β-manan from soybean meal and corn was 0.025% and 0.047%, respectively. The amount of mannan in the ration as much as 3.572% can interfere with the performance of chickens if the PKM used is not processed. According to Sathitkowitchai et al [13] Β-mannan, 2-4% reduces growth and reduces efficiency by 20%-30%.

4. CONCLUSIONS

The quality of PKH is much better than PKM in terms of nutrient content and PKH cell wall images under an electron microscope. The use of PK-H at a level of 10% in the ration did not reduce the production performance of laying hens.

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