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Study of Avocado Seed and Banana Peel Processing as Corn Element Substitution in Japanese Quail (*Coturnix-Coturnix Japonica*) Ration

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ABSTRACT

This study aims to use avocado seeds and banana peels processed into rations to replace the use of corn by utilizing agricultural waste so that it can also reduce feed costs. This research consists of 3 stages of experiments, namely, experiment 1: processing avocado seed flour and banana peel flour to improve its quality. Experiment 2: the results of stage 1 research were carried out direct biological tests to livestock to see digestibility, stage 3 research: application of avocado seed and banana peel-based rations to quail. The results showed that Avocado Seed Processing (ASP) through soaking with 30% Husk Ash Water Filtrate (HAWF) for 48 hours can reduce tannin content in seeds by 42.86%, but crude protein content decreased by 37.53% and increased nitrogen retention by 57.62%. Fermentation of Banana Peel (FBP) using EM4 at a dose of 15mL/100g and fermentation duration of 6 days can reduce 15.54% of crude fiber content and increase crude protein content by 31.12% and increase crude fiber digestibility by 380%. It was concluded that the ration that gave the best response on performance and egg quality was ration C (20% FBP) and F (5% ASP + 15% FBP) so that it could reduce the use of corn by 44%.

Key words: Quail, Avocado Seed, Banana Peel

INTRODUCTION

The poultry sector is one of the livestock sectors that plays an important role in meeting animal protein needs, both poultry as egg producers and as meat producers. The short maintenance time of poultry to produce meat and egg production is one of the reasons poultry farming has the potential to be developed. In addition, the price of protein sources from poultry consisting of meat and eggs is also cheaper and affordable by the purchasing power of the Indonesian people in general, this causes the demand for eggs and poultry meat to increase.

Quail is one of the various types of poultry livestock that is good to continue to be developed because quail is known as a good egg producer and fast sex maturity. Quail have high egg production, reaching 200 to 300 eggs per bird per year with simpler maintenance management (Thomas et al. 2020). In addition, quail growth is faster and relatively does not require a large area for maintenance, so quail is one of the livestock that can provide a source of animal protein, especially quail eggs, for the community at a relatively low price.

In quail farming, farmers are always faced with the problem of increasing feed prices because some feed ingredients are still imported and the availability of feed is limited, while this feed factor is an important factor in the success of quail farming because 60 to 70% of the costs in raising quail include feed costs (Redoy et al. 2017). This encourages farmers to look for alternative feed ingredients or unconventional feed ingredients that are waste or by-products of agriculture or other fields. One of the wastes that can be utilized is avocado seeds and banana peels which can be used as one of the energy source feed ingredients.

Avocado seeds and banana peels have the potential to be used as energy source feed. According to BPS (2018), West Sumatra Province in 2010 produced 29,457 tons of avocado fruit, while banana fruit was 160,516 tons so that the avocado seeds produced were approximately 7,364 tons and 48,154 tons of banana peels, this is because the weight of avocado seeds is 25% of avocado fruit and many banana peels are 30% of banana fruit.

Avocado seeds in poultry can reduce the use of corn and bran. According to Safrida et al. (2021) the metabolic

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energy content of avocado seeds (EM=3570Kcal) is higher than that of corn (EM=3400 Kcal), while the protein content of avocado seeds (10.4%) is also higher than the protein content in corn (8.5%). However, the use of avocado seeds as feed ingredients in quail rations cannot be directly because avocado seeds contain quite high tannins, which are around 1.47% and while poultry can only tolerate tannins 0.5% (Choi et al. 2020), so to reduce tannin levels in avocado seeds, processing is carried out first such as soaking with water or alkaline solutions.

According to Dahyuni (2004) tannin levels in avocado seeds can be reduced through soaking with alkaline solutions such as NaOH. NaOH will bind tannins consisting of polyphenol bonds so that when washing tannins that have been bound by NaOH will be wasted with water. The husk ash substrate can be used as a cheap and easily available NaOH replacement alkaline solution, this is in accordance with the opinion of Jamarun et al. (2021) which explains that husk ash water functions as a base that is cheap and easily obtained in rural areas, it can be used as a substitute for NaOH. Furthermore, Sari et al. (2022) also explained that hydrolysis with husk ash water is more profitable than other types of alkali. The use of processed avocado seeds with NaOH up to 20% does not interfere with quail performance, while above 20% causes quail performance to decline (Dahyuni 2004).

In addition to avocado seeds, another waste that can also be utilized as poultry feed is banana peels. In terms of composition, banana peels have a gross energy content of 4363Kcal/kg and crude protein of 8.36% and a very high vitamin A content, especially provitamin A, namely beta-carotene, of 45mg/100g dry weight (Nurkholis 2005; Nuriyasa et al. 2022). Beta-carotene acts as an antioxidant. In addition, banana peel also contains carbohydrates, especially extracts without nitrogen at 66.20% (Ziaul and Muneera 2022), so it can be used as an energy source feed ingredient to replace some corn or bran in the ration.

The utilization of banana peels in quail rations cannot be maximized due to its high crude fiber content of 15% (Hidayat et al. 2011), so to reduce the crude fiber content and increase the nutritional value of banana peels can be done by fermentation. Fermentation with EM 4 can reduce the crude fiber content of feed ingredients. The results of research by Mirzah et al. (2007) stated that fermentation of shrimp waste with EM4 at a dose of 20ml/100g substrate fermented for 11 days produced good nutritional value in shrimp waste and among others could reduce crude fiber content.

Santoso et al. (2008) research showed that EM4 is very effective in reducing crude fiber of cassava leaves from 29.74% to 22.04%, EM4 is thought to produce a large amount of crude fiber digesting enzymes such as cellulose and mannase (Rostika et al. 2017). The advantage of *Lactobacillus* in EM4 in digesting crude fiber is because the bacteria do not produce crude fiber in their activity, and so they are more effective in reducing crude fiber. The use of banana peels up to 20% does not affect the growth of broilers, if it reduces body weight (Ziaul and Muneera 2022). The use of avocado seed waste soaked with husk ash water filtrate and banana peel fermented with EM4 in the ration of laying quail can be used as an energy source feed ingredient to reduce the use of corn so as to reduce feed costs which will ultimately increase profits.

MATERIALS AND METHODS

Ethical Approval

The present study was approved by the Animal Ethics Committee of Andalas University, West Sumatera, Indonesia.

Experimental Site

Trial 1: Preparation of Processed Avocado Seed Flour (ASP) and Fermented Banana Peel Flour (FBP)

Tannin Reduction of Avocado Seed with Husk Ash Filtrate

The processing process for avocado seeds is thinly slicing then soaking with: water (A1), soaking with 10% husk ash filtrate (A2), soaking with 20% husk ash filtrate (A3) and soaking with 30% husk ash filtrate (A4), each for 48 hours. After the avocado seeds were soaked, they were dried in the hot sun. After drying, the avocado seeds are ground and made into Processed Avocado Seed Flour (ASP). Avocado seed processed samples were tested for tannin content using the hide powder method and crude protein content using the AOAC (2005) method.

Fermentation of Banana Peel (FBP)

The washed banana peels were cut into small pieces and then subjected to 3 treatments, namely fermentation with EM4 with doses: 0, 15, and 30mL/100g of material with fermentation duration of 0, 6 and 12 days. To see the effect of fermentation, crude fiber and crude protein were tested according to AOAC (2005) procedure**.**

Trial 2: Biological Tests (Nitrogen Retention of ASP and Crude Fiber Digestibility of FBP)

Trial 2 included biological tests on the best trial 1 treatments consisting of N retention for avocado seed and crude fiber digestibility for banana peel. Then the best results of the treatment of Avocado Seed Flour (ASP) and Banana Peel Flour (FBP) were also determined for metabolic energy content. Furthermore, laboratory tests were carried out in the form of proximate tests of the best ASP and FBP which aimed to determine how much nutritional content (water content, crude fat, Ca and P) would be used for ration formulation in trial 3.

The materials used were: the best ASP and FBP samples in trial I, 100 quails aged 4 weeks (50 to be fed AS + ASP and 50 to be fed BP + FBP). The method used was the administration of chromium oxide mixed into the feed as much as 2.83mg/g feed to mark the feces (Scott 1982). Chemical analysis of sample: Nitrogen retention, crude fiber digestibility, metabolic energy, dry matter, crude fat, Ca and P.

Biological Testing of ASP and FBP Diets

Quails were placed in metabolic cages and each cage was occupied by 5 quails and fed with the best treated ASP and FBP and untreated AS and BP of 5 units each mixed with chromic oxide (Cr_2O_3) of 2.83mg/g feed for the purpose of coloring and marking feces (light green feces). Feed was given ad libitum for 24 hours along with drinking water. The feces were collected for 24 hours (until the mark disappeared) and analyzed for crude protein content (ASP and AS) and crude fiber (FBP and BP), in addition to analyzing the energy content of the best ASP and FBP to determine the metabolic energy content. Data analysis: All data were compared between the best treated AS and FBP and untreated AS and FBP by T-test.

Trial 3: Application of Ration to Quail
Experimental Design

At this stage, the best proximate analysis results from trial 1 and 2 were used to develop the ration formula in trial 3. The quail used in this study were 5 weeks old, 240 birds of the Coturnix-coturnix japonica strain. Data were taken after quail egg production had reached 5%.

The research design used was a complete randomized design with 6 treatments and 4 replicates. each replicate consisted of 10 quails. The 6 treatments used were A: 0% ASP + 0% FBP, B: 20% ASP + 0 FBP, C: 0% ASP + 20% FBP, D: 10% ASP + 10% FBP, E: 15% ASP + 5% FBP, F: 5%ASP+ 15% FBP. Each replicate consisted of 10 quails. The experiment lasted for 2.5 months. The treatment ration was formulated with a balanced content of 20% protein and 2800Kcal metabolizable energy (ME) based on (NRC 1994). The composition of feed ingredients, nutrient content (%) and metabolic energy (kcal/kg) of the rations are shown in Table 1 and 2.

Data Collection

Parameters measured were ration consumption (g/head/day), hen day production (%), egg weight (g/grain), egg mass (g/head/day), ration conversion and yolk color. Ration consumption was measured by calculating the amount of ration given minus the amount of ration left over during the study. Daily egg production was calculated by dividing the number of eggs on the day in question by the number of hens alive on the same day multiplied by 100%. Egg weight was calculated by weighing eggs every day during the study, then averaged.

Table 1: Feed ingredients composition (%) in the treatment

Ingredients of feed (%)	Treatment ration					
	A	B	C	D	E	F
Corn	42	21.5	23.5	21.5	21.5	23.5
Rice brand	15	15	13	15	15	13
Soybean meal	20	20	20	20	20	20
Fishmeal	15	15	15	15	15	15
ASP	-	20	-	10	15	5
FBP	-	-	20	10	5	15
Coconut oil	3.5	4	4	4	4	4
Rock flor	4	4	4	4	4	4
Topmix	0.5	0.5	0.5	0.5	0.5	0.5
Total	100	100	100	100	100	100

Egg mass was calculated by averaging the percentage of egg production during the study multiplied by the average egg weight. Ration conversion was calculated by comparing the amount of food consumed with egg mass during the study. Eggs were collected on 3 consecutive days, then the yolk color was compared with the yolk color on a standard yolk fan (Egg Roche Yolk Color Fan).

Table 2: Nutritional content (%) and metabolic energy (kcal/kg) of the treatment ration

Food substances	Treatment ration					
	A	B	C	D	E	F
EM	2844.4	2830.4	2834.0	2817.2	2823.6	2835.9
Crude protein	20.27	20.01	20.33	20.31	20.07	20.26
Crude fiber	4.22	4.75	6.33	5.65	5.19	5.90
Crude Lipid	6.02	7.83	7.32	7.50	7.64	7.42
Ca	2.58	2.56	2.67	2.63	2.59	2.63
P	0.81	0.83	0.86	0.85	0.84	0.85

Statistical Analysis

All data were tested by statistical analysis according to Steel and Torrie (1991), any difference between treatments was tested by Duncan's multiple range (DMR) test (P<0.05).

RESULTS

Effect of Avocado Seed Processing (ASP) and Fermented Banana Peel (FBP)
Tannin Content and Crude Protein in Avocado Seed Processing (ASP)
Trial 1: Avocado Seed Tannin Reduction and Banana Peel Fermentation

The average content of tannins and crude protein in Avocado Seed Processing (ASP) is presented in Table 3. The tannin content ranged from 0.84 to 1.45%, the results of the analysis of variance showed that the percentage of Husk Ash Water Filtrate (HAWF) had a very significant effect (P<0.01) on the tannin content of ASP.

Table 3: Effect of processing on tannin and crude protein content of avocado seed**s**

Parameters (%)	Perlakuan				
	A1	A2	A3	A4	SE
Tanin	1.30^{a}	1.45^{a}	1.24^{a}	0.84^{b}	0.07
Crude protein	7.01^{b}	8.18^{a}	8.29^{a}	6.47^{b}	0.37

Different superscripts in the same column indicate significantly different (P<0.05). SE=Standard Error.

The crude protein content of ASP with soaking using HAWF is 6.47 to 8.25%. In general, all treatments (A, B, C and D) decreased crude protein (CP) content compared to unprocessed avocado seed flour (CP=10.40%). The results of the analysis of variance showed that the percentage of HAWF gave a very significantly different effect (P<0.01) on the protein content of ASP. The results of further tests using the DMRT test showed that the crude protein content in ASP soaked in HAWF 20% (A3) and 10% (A2) was significantly higher (P<0.01) than ASP soaked with 30% HAWF (A4) and significantly higher than ASP soaked in water (A4).

The crude fiber and crude protein content of fermented Banana Peel (FBP) using EM4 at doses of 0, 15 and 30mL/100gr with a duration of 0, 6 and 12 days can be seen in Table 4 and 5. There was no interaction effect between the dose of EM4 and the duration of fermentation on the crude fiber content of FBP, but the dose of EM4 had a significant effect (P<0.05) on the crude fiber content of FBP. Further test with DMRT showed that the dose of EM4 as much as 15mL/100g of banana peel (B) produced significantly lower crude fiber content (CF=13.51%) (Table 4).

Table 4: Crude fiber content of fermented banana peel

Dose (ml/100g)	Fermentation time (day)			
	0	6	12	Average
	……………………%……………………			
A = 0	14.19	15.32	17.30	15.61[a]
B = 15	12.90	14.47	13.24	13.51[b]
C = 30	14.03	15.22	16.85	15.37[a]
Average	13.67	15.00	15.80	14.83
SE				0.59

Different superscripts in the same column indicate significantly different (P<0.05). SE=Standard Error. CF content before processing = 15.61%.

FBP fermented using EM4 at doses of 0, 15 and 30mL/100g with fermentation duration of 0, 6 and 12 days produced crude protein content of 8.58% - 11.25% as presented in Table 5. There is no interaction effect of EM4 dose with the duration of fermentation on the crude protein content of FBP, but the duration of fermentation has a very significant effect (P<0.01) on the crude protein content of FBP. After further testing using DMRT, it was found that the length of fermentation of 6 days and 12 days produced a very significant (P<0.01) higher crude protein content in TKPF, namely 11.25% and 11.13%.

Table 5: Crude protein content of fermented banana peel

Dose (mL/100g)	Fermentation time (day)			
	0	6	12	Average
	……………………% ……………………			
A = 0	8.38	11.38	12.12	10.63
B = 15	8.95	11.63	10.32	10.30
C = 30	8.40	10.73	10.93	10.02
Average	8.58[a]	11.25[b]	11.13[b]	
SE				0.28

Different superscripts on the same line indicate significantly different (P<0.01). SE=Standard Error. Before processing, crude protein content was 8.58%.

Trial 2: Nitrogen Retention Test, Crude Fiber Digestibility on Best ASP and FBP

The nitrogen retention value of untreated avocado seed flour and processed avocado seed flour (ASP) in this study can be seen in Fig. 1. The average nitrogen retention value in untreated avocado seed flour (control) is 37.49%, this value is lower than the average nitrogen retention in the best TBAO in phase I research (soaked with 30%) which HAWF) reached 59.09%. After conducting a T test, it was found that the value of N retention in ASP was very significantly higher (P <0.01).

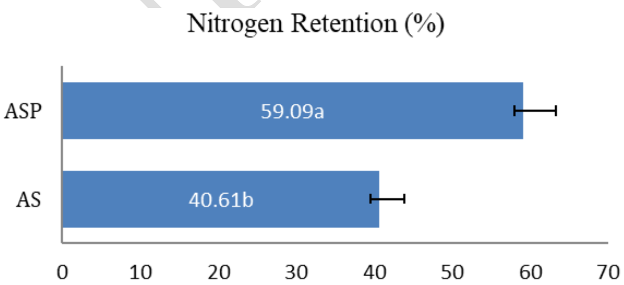

Fig. 1: Nitrogen retention of Avocado Seeds Processing (ASP).

The crude fiber digestibility values of untreated banana peel flour (BP) and fermented banana peel flour (FBP) can be seen in Fig. 2. The best crude fiber digestibility value of FBP in experiment 1 was 25.67%, while that of unfermented banana peel flour (control) was only 5.34%. After T test, it was found that the crude fiber digestibility of fermented banana peel flour (FBP) was significantly higher (P<0.01) than the control.

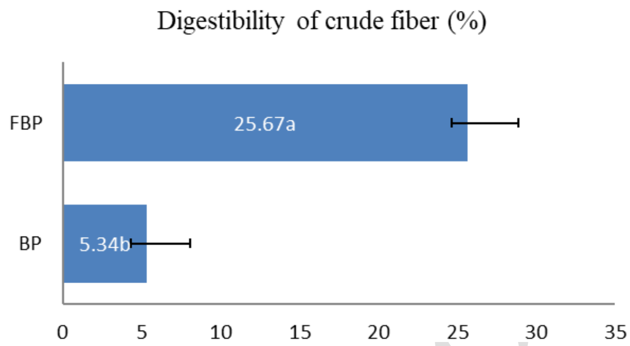

Fig. 2: Crude fiber digestibility of fermentation banana peel (FBP).

Trial 3: Ration Application to Quail

The average consumption, daily egg production, egg weight, egg mass ration conversion and yolk color index in this study can be seen in Table 6. Ration consumption of quail fed ASP and FBP ranged from 14.08-21.65g/head/day. The results of the analysis of variance showed that the use of ASP and FBP in the ration gave a very significant difference (P<0.01) to the consumption of quail rations.

Daily egg production (Table 6) of quails consuming ration B was significantly lower than the others due to its very low consumption and high tannin content in the ration, while quails consuming rations D and E had daily egg production that was not significantly different even though the consumption of D was significantly higher (P<0.05) than E due to the higher tannin content in D. The daily egg production of quails consuming rations D and E was not significantly different. The average daily egg production of quail ranged from 5.02% to 51.16%, the results of the analysis of variance showed that the use of ASP and FBP in the ration produced very significant differences (P <0.01) on daily egg production of quail.

From the results of this study, quail egg weight ranged from 8.15grams to 9.35grams. The use of ASP and FBP in quail rations gave a very significantly different effect (P<0.01) on quail egg weight. Quail consuming rations C and F had a significantly higher egg weight compared to A (control) while the egg weight of B, D and E were not significantly different from A (control).

The average egg mass produced in the study was 0.42 to 4.16g/day. Analysis of variance showed that there was a very significant difference (P<0.01) in the effect of the use of ASP and FBP on quail egg mass. Quail consuming rations C and F had egg masses that were not significantly different from A (control), while quail consuming rations B, D and E had egg masses that were significantly lower than A (control). In Table 6 it can also be seen that the egg mass in quails consuming rations B, D and E is very significantly lower (P<0.01) than A (dick), this is due to egg weight and daily egg production which is also significantly lower than A. Likewise, quail consuming

Table 6: Average consumption, daily egg production, egg weight, egg period, ration conversion and yolk color index during the study

Parameters	Treatments						SE
	A	B	C	D	E	F	
Ration consumption (g/head/day)	21.44^{a}	14.08^{c}	21.20^{ab}	19.90^{b}	15.45^{c}	21.65^{a}	0.46
Egg production (%)	51.16^{a}	5.02^{d}	43.04^{ab}	22.38^{c}	9.69^{d}	37.59^{b}	3.32
Egg weight (g/grain)	8.15^{b}	8.38^{b}	9.35^{a}	8.62^{b}	8.27^{b}	9.29^{a}	0.22
Egg mass (g/head/hr)	4.16^{a}	0.42^{c}	4.02^{a}	1.93^{b}	0.79^{c}	3.49^{a}	0.27
Ration conversion	5.32^{a}	35.51^{c}	5.66^{a}	10.76^{a}	23.50^{b}	6.30^{a}	3.16
Yolk color	5.50^{b}	7.50^{a}	7.25^{a}	7.50^{a}	7.84^{a}	8.17^{a}	0.40

Different superscripts on the same line indicate significantly (P<0.05) different and significantly different (P<0.01). SE=Standard Error.

ration D had an egg mass that was very significantly (P<0.01) lower than A, C, and F but very significantly higher than B and E, this was also due to the daily egg production produced in D which was also very significantly lower (P<0.01) than A, C and F and very significantly higher than B and E.

The higher the yolk score value, the better because the yolk color is more yellow. The results of the analysis of variance showed that the use of ASP and FBP in quail rations produced very significant differences (P<0.01) on the yolk color index. After further testing with DMRT, it was found that the yellow color index in B, C, D, E and F was significantly higher than A (control).

DISCUSSION

Trial 1: Effect of Avocado Seed Processing (ASP) and Fermented Banana Peel (FBP)

Tannin content and crude protein in Avocado Seed Processing (ASP)

Avocado seed waste soaked with 30% HAWF can reduce tannin levels in ASP by 42.86%. The low tannin content (0.84%) in ASP soaked with 30% HAWSF is due to a stronger pH value compared to 10 and 20% HAWSF, where at 30% HAWSF the pH value reaches 10.6 which is close to the pH of strong bases such as NaOH which has a pH value of 11.

The higher the pH value, the stronger the alkaline strength so that the bound in tannins are also stronger, this caused the tannin content in avocado seed flour to be lower. HAWF 30% which functions as an alkali such as NaOH will bind phenol from the polyphenol bond so that this bound phenol will be wasted with the husk ash filtrate water. In accordance with the opinion of Atanu et al. (2020) that the use of alkaline solutions such as NaOH aims to bind tannin compounds consisting of polyphenol bonds so that the bound tannins will be wasted with water.

The decrease in crude protein content by 37.53% in ASP soaked in 30% HAWF (A4) because the resulting filtrate is classified as a strong base with a pH of 10.6 so that the weakly acidic protein in avocado seeds reacts with HAWF which includes a strong base to form salt. The salt formed is easily soluble in water, when washing avocado seeds some of the protein will be wasted with water (leaching).

In addition, at high pH the avocado seed protein undergoes a change in charge which causes a decrease in the attraction between protein molecules so that the molecules are more easily decomposed and the protein dissolved in the husk ash water filtrate increases, this will reduce the crude protein content of ASP because the protein is wasted not only the protein dissolved in the husk ash water filtrate but also the protein that forms salt with the filtrate. According to Lošdorfer (2017), the effect of pH is based on the difference in charge of the amino acids that make up the protein, which affects the attraction between protein molecules.

Effect of Fermentation on Crude Fiber and Crude Protein Content of Fermented Banana Peel (FBP)

The decrease in crude fiber content at a dose of 15mL/100g (B) was 15.54% because at this dose the microbes that digest crude fiber work optimally. One type of microorganism contained in EM4 is bacteria (*Streptomyces* sp) that produce cellulase enzyme. Cellulase enzyme can degrade the crude fiber found in banana peel. During fermentation, the lignocellulose bonds in banana peels are broken because the lignolytic microbes in EM4 help break down the lignocellulose bonds so that cellulose and lignin can be released from these bonds by the lignase enzyme. This causes a decrease in crude fiber content in banana peels fermented with EM4 in treatment B.

This research is also in line with the research of Kumar et al. (2020) which stated that microbial starters such as EM4 reduce the cell wall content (NDF) of rice straw because during fermentation there is a breaking of the lignocellulosic bonds of rice straw. Lignolytic microbes in EM4 help break down lignocellulose bonds so that cellulose and lignin can be released from these bonds by the lignase enzyme.

The crude protein content in FBP fermented for 6 days and 12 days increased by 31.12 and 29.72%. The high crude protein content in FBP fermented with EM4 for 6 days and 12 days is due to the microbes in EM4 that continue to grow and develop as the fermentation time increases, then the microbes will increase the crude protein content of banana peels because microbes are single cell proteins that increase the crude protein content in FBP. Protein levels in fermentation can increase due to an increase in decomposing microbes that die because they cannot survive in an acidic atmosphere (Sharma 2020). Furthermore, Bhatia (2013) also explained that microbes are single cell proteins so that they can indirectly increase crude protein content.

Trial 2: Nitrogen Retention on Best ASP and Crude Fiber Digestibility on Best FBP

Nitrogen Retention Value of ASP

Nitrogen retention is the amount of nitrogen consumed and can be retained by the body of livestock to be used in the metabolic process so that the greater the nitrogen retention value of a feed ingredient, the better it is for the metabolic process of quail. The nitrogen retention value of the best ASP increased by 57.62% compared to avocado seeds without processing. Nitrogen retention of ASP is higher even though the crude protein content is lower because the tannin content is lower so that the protein bound to the tannin that forms a complex compound is also reduced, this causes the digestibility of ASP protein in quail to increase so that less nitrogen is released through feces and urine. Reduced nitrogen excreted by quail with feces and urine can increase the nitrogen retention value. The level of nitrogen retention depends on the metabolic energy of the ration, protein consumption, protein digestibility coefficient, protein quality, and the balance of amino acids in the ration (Wahyu, 1997).

Conversely, in unprocessed avocado seeds (control) although the protein content is higher than processed avocado seed flour due to the high content of tannins that bind to proteins in avocado seeds so that protein digestibility is reduced which causes the nitrogen retention value to drop. Tannins can suppress nitrogen retention and result in decreased digestibility of amino acids (Calislar 2017). Furthermore, Hassan et al. (2020) stated that tannins are polyphenolic compounds that have the ability to precipitate proteins, namely by forming insoluble complexes that can reduce protein digestibility.

Crude Fiber Digestibility Value of Fermentation banana peel

Fermentation of banana peel with EM4 is able to increase the fiber digestibility of banana peel flour almost five times than without fermentation. This is because during fermentation the enzymes produced by microbes in EM4 can break lignocellulose bonds in banana peel and cellulose is then degraded by cellulase enzymes while lignase will break down lignin.

Fiber fractions have been partially broken down by microbes contained in EM4 so that in the digestive process in the quail's body more crude fiber is digested and absorbed, which in turn will increase the digestibility of crude fiber in FBP. According to Dilaga et al. (2022) during the fermentation process there is a breaking of lignocellulose bonds in rice straw.

In quail, a high value of crude fiber digestibility is very important in the metabolic process because the digestive process of quail does not produce enzymes that are able to degrade crude fiber, this can be seen with the low value of crude fiber digestibility in banana peel flour without fermentation (control) because the fiber fractions contained in banana peels cannot be broken down in the digestive process. The high crude fiber content in feed is an antinutritional factor for monogastric animals, which cannot efficiently assimilate fiber because of the lack of specific endogenous enzymes (Písaříková and Zralý 2009).

Trial 3: Ration treatment to livestock

The results of trial 1 showed that avocado seed meal soaked with 30% HAWF produced the lowest tannin content and banana peel flour fermented using EM4 at a dose of 15mL/100grams with a fermentation duration of 6 days produced the lowest crude fiber content and higher crude protein. The best ASP and FBP need to be tested biologically in the field by using them in the ration composition of laying quail.

Effect of ASP and FBP on quail ration consumption.

The consumption of treatments C and F were not significantly different from the control (A), this is because the control ration (A) and rations containing 20% FBP (C) and 15% FBP (F) have the same level of palatability so that the ration consumption is also not significantly different. FBP which has a pleasant smell and aroma is favored by quail, so the reduction in the use of corn substituted with FBP 20 and 15% in the ration has no effect on quail ration consumption. According to Canogullari (2016) that consumption is not only influenced by the energy content and food substances of the ration, the health of the livestock, but also by the smell and shape of the ration.

Ration consumption of B, D and E was significantly lower than A (control) due to the presence of tannins in ASP which caused a bitter and astringent taste, thus reducing the level of palatability which had an effect on reducing quail ration consumption. In accordance with the opinion of Hassan et al. (2020) which states that the bitter and astringent taste caused by the presence of tannins can cause low chicken consumption.

Effect of ASP and FBP in Rations on daily egg production (hen day) of Quail.

Daily egg production in quails consuming rations B, D, E and F was significantly different from A (control). The low egg production of B, D, E and F was due to low consumption and the presence of tannin in the ration. Low consumption causes the nutrients consumed to produce are not fulfilled, thus reducing egg production.

Daily egg production in A (control) was significantly higher than F although consumption between A and F was not significantly different, it is suspected that there are alkaloids or other compounds in ASP besides tannins that can reduce quail production, one of which is thought to be the high content of triterpenoids. The results of research by Setyawan et al (2021) showed that tannins, triterpenoids were also found in avocado seeds. Tannin can reduce feed intake, nutrient digestibility, and chicken development performance so high quantities of tannins have been demonstrated to have antinutritional effects in monogastric animals (Kumar et al. 2022).

Effect of ASP and FBP in Ration on Quail Egg Weight

The higher egg weight in treatments C and F is because at a good consumption level TKPF can slow down sexual maturity so that the age of first laying quail is longer which will result in greater egg weight. According to Revelation (1997) young chickens whose sex maturity is slowed down produce larger eggs than chickens whose sex maturity is not slowed down.

Quails consuming rations C and F reached sexual maturity at 52 and 54 days of age, this age of sexual maturity was slower than ration A (control) which reached sexual maturity at 45 days. Jaya (2012) reported that quails that are slowed to sexually mature at the age of 50-55 days are more profitable because they have a larger egg size, longer production peak, longer production life and decreased mortality.

FBP can slow down the sex maturity of quail because FBP has high crude fiber. The nature of fibrous food is bulky so there is a tendency for transit time in the digestive organs to be very short, resulting in a decrease in nutrient absorption (including fat and its components such as cholesterol). As a result of the inhibition of cholesterol absorption, the ovaries are inhibited in synthesizing the hormone estrogen, thus inhibiting the formation of egg follicles which ultimately slows down the age of sexual maturity. One of the roles of cholesterol is as a precursor of several steroid hormones such as estrogen and testosterone (Craig et al. 2018).

In treatments B, D and E, very low consumption will cause low protein consumption so that the egg weight is not significantly different from A (control), low protein consumption will result in low yolk weight and egg albumen. According to Shim et al. (2013) that the weight of the yolk and the size of the egg is also influenced by protein consumption, if protein consumption is low, it will form yolk and low egg weight.

Effect of ASP and FBP in Ration on Quail Egg Mass

The fact that treatments C and F did not differ from A (control) was influenced by egg production and egg weight. In quail that consumed ration C had the same egg production as A (control), while in treatment F although the egg production was lower than A (control) but because the egg weight was higher than A which ultimately resulted in egg mass that was not significantly different from A (control). Egg mass is highly dependent on egg weight and daily egg production because egg mass is obtained from the multiplication of egg weight with daily egg production. According to Shim et al. (2013), egg mass is closely related to egg weight and egg production produced.

Effect of Using ASP and FBP in Ration-on-Ration Conversion of Quail

The lower the ration conversion rate, the more efficient the amount of feed consumed in producing eggs. Ration conversion is obtained from the quotient of the amount of feed consumed with egg mass. The average ration conversion value as shown in Table 6 is 5.32-35.51.

Quail that consumed rations C, D and F ration conversion was not significantly different from A (control), this is due to ration consumption and egg mass resulting in the same ration conversion. In treatment D, although the ration conversion was not significantly different from A (control), the conversion rate tended to be higher because the egg mass was very significantly lower than A. The ration conversion of B and E was very significantly higher than A (control) because the egg mass was very significantly lower, resulting in a large conversion rate.

The ration conversion rate in B is very significantly greater ($P < 0.01$) which reached 35.51 due to very low daily egg production which is only 5% so that the egg mass is also very small, although the ration consumption of B is very significantly lower but because the production is very small resulting in a very large ration conversion rate. According to Rasyaf (1995) ration conversion is the ratio between the amount of ration consumed compared to the amount of egg production in a certain unit of time.

From this study, it can be seen that the use of ASP at the level of 15% (E) and 20% (B) in quail rations is inefficient, this is indicated by the very large conversion rate. The use of FBP up to the level of 20% (C) in the quail ration is efficient because it produces conversion rates that are not significantly different from the control ration.

Effect of ASP and FBP in Ration on Quail Yolk Color

The high yolk color index in rations containing ASP and FBP (A, B, C, D, E and F) is due to the high content of vitamin A or carotene in ASP which reaches 27.2IU/g and the content of β-carotene in FBP which is 45mg/100g. This can increase the amount of carotene pigments in the yolk thus increasing the yolk color index in quail eggs. This can increase the amount of carotene pigment in the egg yolk, thus increasing the yellow color index in quail eggs. According to Kljak et al. (2021), egg yolk color is closely related to the vitamin A content in the ration, the higher the vitamin A consumed, the carotene pigment and egg yolk color will also increase.

The high content of β-carotene in FBP also causes an increase in the yolk color index. According to Hausman & Sandman (2000), β carotene is an unstable carotenoid compound because it is easily oxidized into xanthophyll. Xanthophyll is used to ensure the desired color pigmentation in the yolk (Alay and Karadas 2016). Xanthophyll cannot be synthesized in the chicken body but is obtained from a ration consisting of feed ingredients containing xanthophyll.

The higher the yolk index value, the more favorable it is to consumers. From the results of this study, the yolk color index value of quail fed the treatment rations (B, C, D, E and F) ranged from 7.3 to 8.2, this value was higher than the yolk color index value of quail fed the control ration (A) which was only 5.8. The yolk color index value of eggs fed with ASP and FBP in the diet was higher than the yolk index value of quail eggs in general. From the results of previous research conducted by Sestilawati (2011), the yolk color index only ranged from 5.78 to 6.42. The results of phase III of this study showed that the use of 20% ASP (ration C) or 5%ASP + 15% (ration F) in the ration of laying quail can reduce the use of corn by 44% with better performance and egg quality.

Conclusion

Processing avocado seeds through soaking with 30% husk ash water filtrate (HAWF) for 48 hours can reduce tannin content in seeds by 42.86%, but crude protein content decreased by 37.53% and increased nitrogen retention by 57.62%. Fermentation of banana peel using EM4 at a dose of 15 ml/100 g and fermentation duration of 6 days can reduce 15.54% of crude fiber content and increase crude protein content by 31.12% and increase crude fiber digestibility by 380%. The rations that gave the best response on performance and egg quality were rations C (20% FBP) and F (5%ASP + 15%FBP), which could reduce the use of corn by 44%.

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Author's Contribution

Ade Djulardi was in charge to supervise the experiment and writing the original script. Hera Dwi Triani and Ahadiyah Yuniza conducted the experiment, analyzed the data and finalize manuscript.

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