[1] Dini Widianingrum*

[2] Rachmat Somanjaya

[3] Sri Umyati

[4] Bambang Kholiq Mutaqin

Effect of Feeding Fermented Catfish Waste in Rations on Performance, Lipid Content, and Lipid Profile of Muscovy Duck Meat

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Abstract: - This study aims to analyze the effect of Fermented Catfish Waste (FCW) on the performance and quality of muscovy duck meat. Experiments were conducted by adding various proportions of FCW in muscovy duck rations and measuring its impact on total ration consumption, daily ration consumption, body weight gain, ration conversion, lipid content and lipid profile of muscovy duck meat. The treatments tested included control (P0) and various levels of FCW, namely 8% (P1), 16% (P2), and 24% (P3). The results showed that the addition of FCW on ration has a significant effect on improving the performance and quality of Muscovy Muscovy meat. The level of FCW administration of 8% resulted in the best performance and meat quality, total ration consumption 7128.00±52.02g, daily ration consumption 101.83±0.74g, body weight gain 1066.80±59.20g, daily body weight gain 15.24±0.85g, ration conversion 6.76 ± 0.37, lipid content 10.39 ± 0.05%, cholesterol 94.58 ± 0.09(mg/dL), triglycerides 32.57 ± 0.08(mg/dL), HDL (High-Density Lipoprotein) 40.59 ± 0.09(mg/dL), and LDL (Low-Density Lipoprotein) 50.63 ± 0.07(mg/dL). In conclusion, the provision of FCW in the diet can improve the quality of muscovy duck meat and provide better health benefits for consumers.

Keywords: fermentation catfish waste; muscovy duck ration; performance; lipid content; lipid profile.

I. INTRODUCTION

Catfish production in Majalengka Regency in 2016 was 240 tons and the waste production was 5.76 tons (Department of Agriculture and Fisheries of Majalengka Regency. 2022). Fish waste is produced from the remaining shredded catfish so that its production increases along with the increasing production of shredded catfish. Catfish waste consists of head, viscera, fins, spines and tail. Fish waste (LIL) generated from the shredded catfish factory is in the form of heads, fins and spines. The production of LIL is 60% of the fish used (Widianingrum et al, 2018).

Fish waste contains 10.79% moisture, 15.70% ash, 45.30% crude protein, 1.41% chitin, 17.49% crude fat, 2.29% calcium and 1.02% phosphorus (Widianingrum et al, 2019). Fish waste has a high enough protein content and its availability is close and easy to obtain so that it can be utilized as a source of animal protein in muscovy duck rations.

Fish waste in fresh conditions generally contains harmful bacteria derived from fish (Dale, 2001). Bacteria contained in the waste include Pseudomonas vulgaris, Pseudomonas mirabilis, and Pseudomonas fluorescens (Yuliantoro et al, 2018). These three bacteria are pathogenic bacteria that can damage proteins by converting amino acids into ammonia, causing catfish waste to rot. Bacteria are so dangerous that their activity must be stopped, among others, by fermentation.

Fermentation is a biological processing method with the help of microorganisms or biostarters. The purpose of fermentation in catfish waste is to prevent spoilage, avoid off-flavor and improve quality (Abun et al, 2022). The success of fermentation is influenced by the management and biostarter used. Commonly used biostarters are Effective Microorganisms (EM4), Aspergillus niger, Rhizopus oligosporus, and Thricoderma viridae.

Aspergillus niger is an aerobic mold, so its growth requires sufficient oxygen. Aspergillus niger is a mesophilic microbe with maximum growth at a temperature of 35°C - 37°C. The degree of acidity for microbial growth is 2 - 8.8 but growth will be better in acidic conditions or low pH. Rhizopus oligosporus is a mold that is widely used in making tempeh, and can be found in nature, because its life is saprophytic. This mold is known as a mold capable of producing lipase enzymes to break down media fats (Yuliantoro et al, 2018).

Thricoderma viridae is a thermophilic mold and strains of Thricoderma viridae. These molds produce sellulase enzymes that can degrade β1-4 glucosidase bonds and can increase protein content and substrates such as palm

[1] Universitas Majalengka, West Java, Indonesia. diniwidianingrum@unma.ac.id
[2] Universitas Majalengka, West Java, Indonesia. rachmatsomanjaya@unma.ac.id
[3] Universitas Majalengka, West Java, Indonesia. sriumyati.28@unma.ac.id
[4] Universitas Padjadjaran PSDKU Pangandaran, West Java, Indonesia. kholiq@unpad.ac.id
* Corresponding Author Email: diniwidianingrum@unma.ac.id

trunks. Besides producing sellulase enzyme, Thricoderma viridae also produces other simple sugars (Sobowale et al, 2007).

The three biostarters are commonly used in fermentation in research. However, the community is not familiar with their existence, so other microorganisms are needed that can be made and are widely available around the community, including local microorganisms (MOL) (Widianingrum et al, 2019). MOL is one of the decomposers that can accelerate and can improve the quality of decomposition of organic matter. Mole can be made from various materials that are widely produced in each region, including guava mole whose quality is equivalent to the usual biostarter (Yuliana, (2011).

Guava is a local fruit widely found in Majalengka Regency. The centers of guava producing areas include Panyingkiran District and Salagedang District. The production of red guava in Majalengka Regency was 5,034.50 tons and the waste was 41.5 tons (Department of Agriculture and Fisheries of Majalengka Regency, 2022). Red guava waste is the residue or rejects from the sale of red guavas with the reason for rejecting due to bruising, overripe, and worms. Red guava waste consists of the flesh and seeds of the fruit.

Red guava contains complete nutrients including energy 49 calories, protein 0.90 grams, fat, 0.30 grams, carbohydrates 12.20 grams, vitamin A 25 SI and vitamin C 87 mg (Utami & Farida, 2022). The high vitamin content is a good source of antioxidants. In addition, red guava also contains eugenol compounds that are good for improving production quality, as a biostarter in the fermentation of catfish waste as a source of animal protein in muscovy duck rations.

Muscovy duck is a meat-producing waterfowl that provides animal protein for the community. The growth of muscovy duck is faster when compared to ducks. The 12-week body weight of ducks is 1517.49 grams (Gushairiyanto et al, 2022) and that of muscovy duck is 1954.43 (Tamzil et al, 2023). Muscovy duck has the potential to be the best meat-producing poultry. The lipid content of muscovy duck meat (3.47%) is lower than that of duck (3.84%) (Damayanti, 2006). The lipid profile of muscovy duck meat is better than that of ducks (Aronal et al, 2012). Muscovy duck is generally kept in the countryside in backyard farms where it is kept in cages at night and grazed in the yard during the day. However, based on data from the Directorate General of Animal Husbandry in 2023, the muscovy duck population decreased in 2018 by 9,024 heads while in 2021 there were 8,202 heads, a significant decrease (Directorate General of Animal Husbandry and Animal Health, Ministry of Agriculture, 2022). 2022). This can be caused by more and more muscovy duck being slaughtered for consumption purposes, so that the supply and demand for muscovy duck is not balanced. If this condition is left unchecked, there will be an muscovy duck glut, so efforts must be made to increase muscovy duck productivity. Muscovy duck productivity is influenced by breeding, feeding and management.

Muscovy duck rations need to be considered properly. Muscovy duck has a habit of eating a lot with a ration consumption of 21.92 + 14.11 kg or 146 grams / day (Widianingrum et al, 2022). When using commercial rations, the production costs are high, so there must be alternative sources of feed ingredients for ration building, including fishery waste and agricultural waste (Marina et al. 2024). The use of feed ingredients from waste, in addition to being low cost, can also help increase muscovy duck productivity and create a healthy, zero waste environment.

Muscovy duck productivity is manifested in high performance and meat quality. The performance of muscovy duck includes ration consumption, body weight gain, and ration conversion. Quality parameters of muscovy duck meat include lipid content and lipid profile (Fatty acid) levels. The main composition of muscovy duck meat is saturated fatty acids, which are fatty acids that do not have double bonds. The intake of saturated fat into the human body in large quantities will increase total blood cholesterol which will increase the incidence of atherosclerosis and will further increase the risk of coronary artery disease (Setiawati et al, 2016). In line with the increasing knowledge about the effect of certain fatty acids on blood fat content, animal fat is not recommended because it contains too much saturated fatty acid (SFA) and too little poly unsaturated fatty acid (PUFA). In addition, the importance of n-3 PUFAs has long been recognized, making n-3s important (Tuminah, 2009).

Little research has been done to reduce the SFA content of muscovy duck meat. Efforts to increase omega-3 content in muscovy duck meat are by providing additional feed that does not interfere with digestion and contains omega-3, including fermented fish waste. Based on this description, it is very important to conduct research on the Effect of Feeding Fermented Catfish Waste in Rations on Performance, Lipid Content, and Lipid Profile of Muscovy duck Meat.

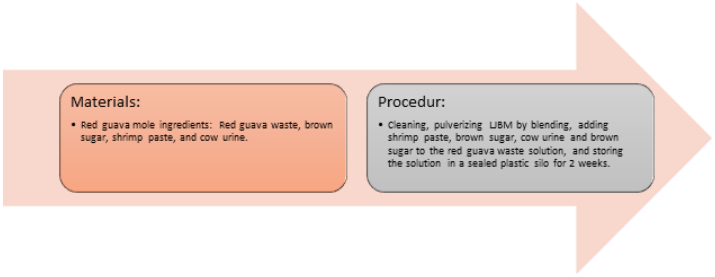
II. RESEARCH METHODS

This study used an experimental design with a randomized complete block design (RCBD) approach to assess the effect of fermented catfish waste meal (FCW) on muscovy duck performance and meat quality. The research subjects consisted of uniformly aged male muscovy ducks divided into several treatment groups. Each treatment group received rations with different doses of FCW, namely control (no FCW), 8% FCW, 16% FCW, and 24% FCW (Montgomery, 2017).

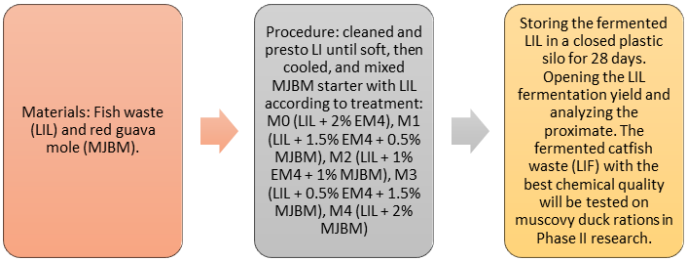
The rations were prepared by adding fermented catfish waste meal at various concentrations according to the treatments and fed to the muscovy ducks during the study period (Muniasamy, et al. 2024). Performance parameters observed included ration consumption (KR), body weight gain (PBB), and ration conversion efficiency (FCR). Ration consumption was measured daily by recording the remaining ration and calculating the total consumption during the study, while body weight gain was measured weekly by weighing the muscovy ducks. Ration conversion efficiency was calculated by dividing total ration consumption by body weight gain.

Research procedure:

1. *Preparation of Red Guava MOL (RGM):*



2. *Fermentation of Catfish Waste:*



3. *Research flow chart:*

Meat quality assessment, lipid content and lipid profile of muscovy duck meat were analyzed. Meat samples were taken from several treatment units at the end of the research period and analyzed for total lipid, cholesterol,

triglyceride, HDL (High-Density Lipoprotein), and LDL (Low-Density Lipoprotein) levels using chromatographic and spectrophotometric techniques (Wahyuni, et al. 2021). Data obtained from the measurement of meat performance and quality were statistically analyzed using the analysis of variance (ANOVA) test to determine differences between treatments. The results of the analysis were compared with the control to assess the effect of FCW addition on each parameter observed. Conclusions and recommendations were drawn based on the results of the analysis to provide guidance on the use of FCW in muscovy duck rations.isis muscovy duck meat quality: lipid content and lipid profile levels.

III. Results And Discussion

Effect of Fermented Catfish Waste Flour on Muscovy duck Performance

The results showed that the addition of fermented catfish waste meal (FCW) in the diet had a significant effect on muscovy duck performance, as measured by total ration consumption (KR), daily ration consumption, body weight gain (PBB), and ration conversion (FCR). Treatment with FCW gave better results than the control (P0), especially in the P1 treatment with the highest FCW content (8%).

Table 1. Muscovy duck performance at various levels of catfish waste fermentation

Variable	Treatment			
	0% FCW	8% FCW	16% FCW	24% FCW
Total Ration Consumption (g)	8648.8±276.16**b**	7128.00±52.02**a**	7317.80±43.74**a**	7393.20±16.24**a**
Daily Ration Consumption (g)	123.55±3.95**b**	101.83±0.74**a**	104.54±0.62**a**	105.62±0.23**a**
Body Weight Gain (g)	1061.6±129.82	1066.80±59.20	1035.00±126.12	893.40±45.51
Daily Body Weight Gain (g)	15.17±1.85	15.24±0.85	14.79±1.80	12.76±0.65
Feed Conversion	8.50±0.81	6.76±0.37	7.43±0.75	8.36±0.43

Notes: Different letters on the same line indicate significant differences ($p<0.05$)

Total ration consumption (TRC) in muscovy duck showed different variations among the different treatments. In the treatment with 0% fermented catfish waste (FCW) (P0), the total ration consumption was highest at 8648.8±276.16 g, while the lowest ration consumption was found at 8% (P1) at 7128.00±52.02 g. This variation shows that FCW in the ration does not always increase consumption consistently (Nworgu, et al. 2014). This variation shows that the inclusion of FCW in the diet does not always increase consumption consistently (Nworgu, et al. 2014). However, in general, P0-treated muscovy ducks showed higher ration consumption than the other treatments. The increase in ration consumption in some units suggests that the addition of FCW may have increased muscovy duck appetite, which could be attributed to the nutrient content of FCW which may be more attractive or more nutritious to muscovy duck (Sola-Ozores, et al. 2019).

Body weight gain (BWG) showed varying results depending on the level of FCW used. Treatment P1 with 8% FCW showed the highest PBB with a value of 1066.80 ± 59.20 g. This indicates that at certain levels, the addition of FCW can increase body weight gain (Akinmoladun, et al. 2017). Although the ration consumption in the P1 treatment was not always the highest, the efficiency of ration utilization for body weight gain appeared better than the control treatment (P0) and other treatments. These results suggest that FCW at 8% may provide an optimal balance between nutrition and ration utilization efficiency, resulting in better body weight gain (Akinmoladun, et al. 2017). In contrast, the lowest PBB was found in P3 with a value of 893.40±45.51 g, indicating that there were fluctuations in the results even though the same treatment was applied, which may be due to individual variations or environmental conditions that were not fully controlled.

The feed conversion ration (FCR) measures the efficiency of converting rations into body weight, and the best (lowest) value was found in treatment P1 with a value of 6.76±0.37. This indicates that the muscovy ducks in this treatment were more efficient in converting ration consumption into body weight. In contrast, the highest FCR value was found in the P0 treatment with a value of 8.50±0.81, indicating that the muscovy ducks in this treatment required more ration to achieve the same body weight gain. The decrease in FCR in the P1 treatment indicated that the addition of FCW at this level improved ration conversion efficiency, which could be attributed to better feed quality or the positive effect of FCW on muscovy duck metabolism.

Lipid Content and Lipid Profile of Muscovy duck Meat

The use of fermented catfish waste meal (FCW) in the diet showed a clear impact on the lipid content and lipid profile of muscovy duck meat. This study assessed how variations in FCW concentration affected the lipid composition of muscovy duck meat, focusing on total lipid, cholesterol, triglyceride, HDL, and LDL levels.

Tabel 2. Fat content and lipid profile of muscovy duck meat at different levels of catfish waste fermentation

Variable	Treatment			
	0% FCW	8% FCW	16% FCW	24% FCW
Lipid Content (%)	13.42±0.05**c**	10.39±0.05**a**	13.69±0.12**b**	15.66±0.06**d**
Cholesterol (mg/dL)	120.51±0.11**c**	94.58±0.09**a**	110.55±0.08**b**	130.48±0.09**d**
Triglyceride (mg/dL)	48.52±0.09**c**	32.57±0.08**a**	44.66±0.09**b**	50.69±0.07**d**
High Density Lipoprotein (mg/dL)	46.64±0.25**c**	40.59±0.09**a**	44.65±0.06**b**	48.66±0.18**d**
Low Density Lipoprotein (mg/dL)	40.62±0.06**a**	50.63±0.07**b**	40.76±0.09**a**	40.73±0.06**a**

Notes: Different letters on the same line indicate significant differences ($p<0.05$)

The use of fermented catfish waste (FCW) in the ration affects the lipid content of muscovy duck meat. The treatment with 24% FCW (R3) produced the highest lipid content of 15.66%. This indicates that the higher the proportion of FCW in the ration, the more lipid accumulation in the muscovy duck meat tissue. The addition of FCW can be attributed to the high content of essential fatty acids in the flour, such as unsaturated fatty acids, which contribute to increased lipid content in the meat.

The use of FCW in the diet also affected the lipid profile of muscovy duck meat. The highest lipid content was found in the P3 treatment with 24% FCW, with a value of 15.66±0.06%. This indicates that the addition of FCW at higher levels tends to increase the lipid content of muscovy duck meat. Unsaturated fatty acids in FCW, such as omega-3 fatty acids, can increase lipid accumulation in body tissues. In contrast, the lowest lipid content was found in the P1 treatment with a value of 10.39±0.05%, indicating that lower levels of FCW did not significantly increase lipid content.

The use of FCW also affected the lipid profile of the muscovy duck meat, which can be seen from the changes in cholesterol, triglycerides, HDL, and LDL. A decrease in total cholesterol levels in muscovy duck meat occurred as the level of FCW increased. The P1 treatment showed the lowest cholesterol level at 94.58±0.09 mg/dL and the highest at P3 at 130.48±0.09 mg/dL, when compared to the control treatment (P0) which had higher cholesterol levels. This cholesterol reduction is important because high cholesterol levels can be risky for heart health, including increasing the risk of cardiovascular disease. This reduction in cholesterol levels suggests that FCW can contribute to the improvement of the lipid profile of muscovy duck meat. Triglyceride levels in muscovy duck meat also decreased with increasing levels of FCW. The P1 treatment showed the lowest triglyceride level at 32.57±0.08 and the highest at P3 at 50.69±0.07 mg/dL. This decrease in triglyceride levels indicates an improvement in a healthier lipid profile, which can reduce the risk of heart disease and other metabolic disorders. Lower triglycerides are often associated with a good diet and potentially greater health benefits.

The lipid profile showed a decrease in cholesterol and triglyceride levels in the P1 treatment with 8% FCW, with values of 94.58±0.09 mg/dL and 32.57±0.08 mg/dL triglycerides. This decrease indicates a positive effect on the lipid profile, potentially reducing the risk of heart disease and cardiovascular health problems. In contrast, the P3 treatment showed the highest cholesterol levels with values of 130.48±0.09 mg/dL and triglycerides 48.66±0.18 mg/dL, which may be related to an increase in total lipid levels.

The increase in HDL (High-Density Lipoprotein) levels in the P3 treatment, with a value of 48.66±0.18 mg/dL, indicates an improvement in the lipid profile. HDL helps in the transportation of cholesterol from the blood to the liver, which is beneficial for heart health. In contrast, LDL (Low-Density Lipoprotein) levels tended to be stable among the treatments, with a value of 40.73±0.06 mg/dL. The decrease in LDL levels in treatments P0 (control) and P2 indicates that the addition of FCW does not always reduce LDL levels, which may be influenced by other factors in the diet or muscovy duck metabolism.

The use of FCW in the diet has an impact on the efficiency of ration utilization, body weight gain, and meat quality of the muscovy duck. The increase in total lipid levels, decrease in cholesterol and triglycerides, and increase in HDL indicate that FCW can be used as an effective additive in the ration to improve muscovy duck meat quality and provide better health benefits for consumers.

HDL, or good cholesterol, levels increased significantly in the P3 treatment, with a value of 48.66±0.18 mg/dL. HDL has an important role in reducing the risk of heart disease as it helps transport cholesterol from the blood back to the liver for processing and elimination from the body. This increase in HDL levels suggests that FCW can help improve the lipid profile of muscovy duck meat by increasing good cholesterol, which is beneficial for cardiovascular health. LDL, or bad cholesterol, levels decreased with increasing levels of FCW. The P3 treatment showed the lowest LDL levels at 40.73±0.06 mg/dL. Lowering LDL levels is important because high LDL can lead

to plaque buildup in the arteries, which risks causing atherosclerosis and heart disease. By lowering LDL levels, FCW can play a role in improving the lipid profile of muscovy duck meat.

The addition of FCW in the ration showed a positive impact on muscovy duck meat quality. With increased total lipid levels, decreased cholesterol and triglycerides, as well as increased HDL levels and decreased LDL levels, the resulting muscovy duck meat offers better health benefits to consumers. This study shows that the use of FCW in rations can be an effective strategy to improve the quality of muscovy duck meat, making it healthier and more beneficial to human health.

IV. Discussion

The use of fermented catfish waste in muscovy duck rations showed good potential in improving performance, especially in PBB and ration conversion. However, the increase in lipid and cholesterol levels in muscovy duck meat needs to be a concern, especially in the treatment with high FCW content (P3). The P1 treatment with 8% FCW proved to give the best results in terms of ration conversion efficiency and healthier meat lipid quality (lower cholesterol and triglycerides). Providing large amounts of FCW, such as in the P3 treatment, has the potential to increase lipid and cholesterol levels, which can affect the health quality of muscovy duck meat. Overall, the use of FCW as an alternative protein source in muscovy duck rations gave positive results, with treatment P1 (8% FCW) being the most efficient and optimal in improving performance without significant negative effects on meat quality. That the use of FCW in rations can be an effective strategy to improve the quality of muscovy duck meat, making it healthier and more beneficial to human health.

The use of fermented catfish waste (FCW) in muscovy duck rations significantly affected the lipid content and lipid profile of muscovy duck meat. The increase in total lipid content in muscovy duck meat, especially in the treatment with 24% FCW (P3), can be explained by the high essential fatty acid content in FCW. Catfish waste contains unsaturated fatty acids, including omega-3 fatty acids, which contribute to lipid accumulation in muscovy duck body tissues. Unsaturated fatty acids, particularly omega-3, are known to have health benefits, such as reducing the risk of heart disease and inflammation.

The lipid profile of muscovy duck meat was significantly improved with lower cholesterol and triglyceride levels in treatments with increased FCW levels. This decrease in cholesterol and triglycerides indicates a positive effect on cardiovascular health, as low levels are associated with a reduced risk of heart disease. Increased levels of High-Density Lipoprotein (HDL) and decreased levels of Low-Density Lipoprotein (LDL) in the R3 treatment indicate an improvement in the lipid profile. HDL helps transport cholesterol from the blood to the liver, while low LDL reduces the risk of plaque buildup in the arteries, which can lead to atherosclerosis (Krauss, et al. 2018).

Biologically, the decrease in cholesterol and triglycerides and increase in HDL can be attributed to the antioxidant and anti-inflammatory effects of the unsaturated fatty acids in FCW. The omega-3 fatty acids in FCW can modulate lipid metabolism and increase the activity of enzymes involved in lipid breakdown, thereby improving the overall lipid profile. These results indicate that FCW can be used as an effective additive in rations to improve the quality of muskrat meat. By reducing cholesterol and triglyceride levels and increasing HDL, muscovy meat from the P3 treatment offers better health benefits for consumers, reducing the risk of heart disease and improving the overall lipid profile. Therefore, FCW is a value-added feed option in muscovy production, providing benefits both in terms of meat quality and health benefits (Pertiwi, 2024).

V. Conclusion

Based on the research results, it can be concluded that fermented catfish waste (FCW) in the ration has a significant effect on improving the performance and quality of Muscovy Muscovy meat. The level of FCW administration of 8% resulted in the best performance and meat quality, total ration consumption 7128.00±52.02g, daily ration consumption 101.83±0.74g, body weight gain 1066.80±59.20g, daily body weight gain 15.24±0.85g, ration conversion 6.76 ± 0.37, lipid content 10.39 ± 0.05%, cholesterol 94.58 ± 0.09, triglycerides 32.57 ± 0.08, HDL 40.59 ± 0.09, and LDL 50.63 ± 0.07.

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