Utilizing Palm Kernel Cake with Enzyme Supplementation for Carcass Quality and Broiler Chicken Fattening

Siti Zubaidah[1*], Zuprizal[2], Bambang Ariyadi[3], Chusnul Hanim[2], Aji Praba Baskara[2], Rizka Muizzu Aprilia[1], and Jauharotus Shobahah[1]

[1]Department of Animal Bioscience, Faculty of Food Security, Universitas Negeri Surabaya, Jl. Prof. DR. Moestopo, No, 4 Surabaya, Jawa Timur 60131, Indonesia
[2]Department of Animal Nutrition and Feed Science, Faculty of Animal Science, Universitas Gadjah Mada, Jl. Fauna No. 3 Bulaksumur, Yogyakarta 55281, Indonesia
[3]Department of Animal Production, Faculty of Animal Science, Universitas Gadjah Mada, Jl. Fauna No. 3 Bulaksumur, Yogyakarta 55281, Indonesia

Abstract. The purpose of this study was to evaluate the carcass quality and fatness of broiler chickens that were 35 days old. 1,260 Indian River strain hens were utilized in the investigation. There were six replicates, each with thirty chickens, and seven treatments. T0 : basal feed (control), T1 : T0 with 10% PKC, T2 : T0 with 20% PKC, T3 : T0 with 10% PKC and enzyme one, T4 : T0 with 10% PKC and enzyme one, T5: T0 with 20% PKC and enzyme two, and T6: T0 with 20% PKC and enzyme two were the research treatments. Mannanase 182 g/ton, NSPase 200 g/ton, and protease 130 g/ton make up enzyme one; mannanase 182 g/ton, NSPase 400 g/ton, and protease 260 g/ton make up enzyme two. The hens were housed for 35 days. Carcass quality, which included harvest weight and carcass weight, and fatness, which included abdominal fat and subcutaneous fat, were among the criteria noted. The data were analyzed using Analysis of Variance, followed by Duncan's Multiple Range Test (DMRT). The results showed that the addition of PKC and enzymes increased harvest weight and carcass weight. Treatments T1, T3, and T5 had higher harvest weight and carcass weight compared to treatment P0, reduced abdominal fat, and the addition of PKC and enzymes did not affect subcutaneous fat. This study concluded that the addition of 10% PKC and also 10% PKC with enzymes 1 and 2 could increase body weight and carcass weight, as well as reduce abdominal fat in 35-day-old broiler chickens.
Keywords: abdominal fat, carcass weight, harvest weight, Palm Kernel Cake, subcutaneous fat.

1 Introduction

With 3.17 billion broiler chickens in the world in 2021, there was a significant need for broiler feed [1]. Palm kernel cake is one of the less expensive and more accessible alternative

*Corresponding author: sitizubaidah@unesa.ac.id

feed sources that must be found in order to lower feed expenses. A byproduct of the manufacture of palm kernel oil is palm kernel cake (PKC). With 45%–46% of PKC, or 4.16 million tons, produced in 2022.

PKC has potential as animal feed because it is produced in large quantities and has a high PK concentration. Mannan is one of the anti-nutritional components in poultry feed and is part of Non-Starch Polysaccharides (NSP). Pectin, arabinogalactan, arabinoxylan, and β-glucan are water-soluble fibers, whereas cellulose, galactomannan, xylan, xyloglucan, and lignin have different levels of solubility, size, and structure in water [2]. Mannan in chicken feed affects the immunological response and bacterial growth in the digestive system by increasing feed viscosity in the colon and decreasing nutrient digestibility. The mannan found in PKC cannot be broken down by germs or enzymes found in poultry. One method to enhance the utilization of nutrients in feed containing mannan is to add mannanase to the feed [3].

Broiler hens fed multi-enzymes (Hemicell and Roxazyme G) in feed containing 10% palm kernel meal (PKM) had higher body weight and average daily gain than the control, while feed containing 20% PKM plus multi-enzymes was identical to the control. In comparison to PKM 10% without enzymes in beginning hens, PKM 10% supplemented with enzymes can enhance body weight and average daily gain [4]. Whole chicken flesh that has had its head, feet, neck, and digestive tract removed is called a carcass. Once the chickens were killed and the carcass weight was determined, the boneless breast meat (pectoralis major) was put in labeled plastic bags, sealed, and refrigerated for a full day before being examined for meat quality testing [5]. The weight of the carcass rises as the living weight does, and vice versa. The fatty acid composition and structural characteristics of subcutaneous fat tissue in broiler chickens can be impacted by feed type variations [6]. This study examined the carcass quality and fat deposition of 35-day-old broiler chicks.

2 Materials and methods

2.1 Ethical clearance

The UGM Faculty of Veterinary Medicine issued ethical clearance number 048/EC-FKH/Eks./2022.

2.2 Materials

Closed housing was used in the study. For a total of 1,260 chickens, this study included seven treatments and six repetitions. Two hens were randomly selected from each cage at the conclusion of the rearing period in order to collect data on harvest weight, carcass weight, abdominal fat, and subcutaneous fat. Seven feed treatments were employed in this study: P0 was basal feed (control), T1 was 10% PKC, T2 with 20% PKC, T3 with 10% PKC and enzyme one, T4 with 10% PKC and enzyme one, T5 20% PKC and enzyme two, and T6 with 20% PKC and enzyme two. Enzyme one was composed of protease 130 g/ton, mannanase 182 g/ton and NSPase 200 g/ton, and enzyme two was composed of protease 260 g/ton, mannanase 182 g/ton, and NSPase 400 g/ton.

At the of maintenance of the 35-day rearing period, the chickens were weighed to determine their harvest weight. The body weight of broiler chickens after their blood, feathers, neck, head, legs from the knee down (shank), and internal organs, aside from the kidneys and lungs, were removed was used to determine the sample carcass weight. The proportion of abdominal and subcutaneous fat was calculated by comparing the weight of abdominal and subcutaneous fat produced with the slaughter weight of broiler chickens.

2.3 Desain experiment

This study used analysis of variance (ANOVA) and, if there were differences between treatments, Duncan's multiple range test (DMRT) [7]. The linear model for a completely randomized design with a single-factor design is:

$$\mathbf{Y}ij = \mu + \tau i + \epsilon ij \quad (1)$$

where : where: Yij = observation in the design, and i = 1,2,...,p and j = 1,2,...,n , μ = overall mean, τi = treatment effect for the-i , εij = experimental error for the-i and the-j replicate.

2.4 Observed parameter

The parameters observed included carcass data from 35-day-old broiler chickens, consisting of harvest weight and carcass weight, as well as fat content, consisting of subcutaneous fat and abdominal fat.

3 Results and discussion

3.1. Carcass Quality

Table 1 showed the impact of PKC supplementation with enzyme supplementation on harvest weight and carcass weight.

Table 1. Quality of 35-day-old broiler carcasses fed PKC supplemented with enzymes (g/bird)

Variable (g/birds)	Treatment								
	T0	T1	T2	T3	T4	T5	T6	SEM	P-Value
Harvest weight	1805.67^{c}	2176.67^{a}	1922.00^{b}	2252.00^{a}	1959.48^{b}	2183.00^{a}	1913.33^{b}	27.59	<0.001
Carcass weight	1189.96^{d}	1462.96^{a,b}	1370.46^{b,c}	1559.52^{a}	1294.63^{c,d}	1575.83^{a}	1204.42^{d}	26.79	<0.001

^{abc} Significant differences (P<0.05) were indicated by different superscripts on the same line. T0: basal feed (control); T1: 10% PKC; T2: 20% PKC; T3: 10% PKC and enzyme one; T4: 10% PKC and enzyme one; T5: 20% PKC and enzyme two; and T6: 20% PKC and enzyme two.

3.1.1. Harvest weight

The findings shown that the harvest weight and carcass weight of 35-day-old broiler chickens increased when PKC supplemented with enzymes (P<0.05). The harvest weight of treatments T1, T3, and T5 was greater than that of the control group, T2, T4, and T6. Harvest weight could rise by 20.04% with 10% PKC (T1) and by 24.70% with 10% PKC plus enzyme one (T3), and the harvest weight could be increased by 20.90% (T5) by adding enzyme two, 6.05% (T2) by adding 20% PKC, 7.85% (T4) by adding 20% PKC with enzyme one, and 5.63% (P6) by adding enzyme 2 in comparison to the control (T0). When 10% PKC was added together with enzyme supplementation, the carcass weight increased by 23.70% (T3) and 24.49% (T5) in comparison to the control (T0) (Table 1).

This is because feed with 10% PKC has a lower crude fiber content than feed with 20% PKC. PKC crude fiber is in the form of mannan, which is part of NSP. This non-starch polysaccharide increases the viscosity of the digestive tract digesta. The more NSP there is, the more viscous the digesta becomes, so that digestive enzymes cannot hydrolyze the substrate in the digesta [8]. The quantity of nutrients that can be absorbed by the small intestine is low due to low nutrient digestibility, and adding 20% PKC reduces agricultural output. Because enzymes can hydrolyze mannan in PKC into manno-oligosaccharides, lowering the viscosity of the digestive tract digesta and improving nutrient digestibility, adding enzymes can enhance harvest weight.

3.1.2. Carcass weight

PKC and enzymes can raise carcass weight in comparison to the control group (P<0.05). Table 1 showed the impact of combining PKC with enzymes on carcass weight. There was no change in carcass weight when 10% and 20% PKC were added. Additionally, the addition of enzymes had no effect on carcass weight; however, when 10% PKC and enzymes were added, carcass weight rose relative to the control. Enzymes combined with 20% PKC reduced the weight of the carcass. According to [9], adding 0.8% PKME resulted in a higher carcass weight than the control. Genetics, sex, age, body weight, and dietary ingredients all have an impact on the carcass weight of broiler chickens. The carcass weight increases with the living weight and vice versa. According to [10], ROS 508 strain chickens had the best carcasses when compared to Cobb slow, Cobb fast, Ross 308, Hybro Plus, and Avian 48 strains. The harvest weight in this trial was fed with the addition of 10% PKC and enzyme 1, ranging from 2,183 g to 2,252 g. Broiler chicken carcasses are significantly impacted by age, sex, and breed.

3.2. Fattening

In 35-day-old broiler chickens, PKC plus enzyme treatment decreased abdominal fat (P<0.05) but had no effect on subcutaneous fat levels (P>0.05) (Table 2). Abdominal fat levels could be lowered by 23% by adding 10% PKC or PKC and enzymes, particularly when PKC and enzymes are combined. Subcutaneous fat levels remained unchanged after PKC and enzymes were added. [11] stated that in broiler chickens, fat deposition lowers feed efficiency, decreases meat yield, and affects meat quality. PKC supplemented with enzymes in feed contains beneficial nutrients, galactomannan was a polysaccharide consisting of manose and galactose chains that are beneficial to health because they contain fiber and polysaccharides, and also play a role in triggering the growth of intestinal bacteria that aid digestion.

Table 2. Fat content of 35-day-old broiler chickens fed PKC supplemented with enzymes (%)

Variabel (%)	Treatment							SEM	P-Value
	T0	T1	T2	T3	T4	T5	T6		
Abdominal fat	1.25^{a}	0.98^{b}	0.96^{b}	0.94^{b}	1.05^{b}	0.94^{b}	0.99^{b}	0.260	0.01
Subcutaneous fat	0.11	0.11	0.10	0.10	0.12	0.12	0.13	0.026	0.76

^{abc} Different superscripts on the same line indicate significant differences (P<0.05). T0 : basal feed (control), T1 : T0 with 10% PKC, T2 : T0 with 20% PKC, T3 : T0 with 10% PKC and enzyme one, T4 : T0 with 10% PKC and enzyme one, T5: T0 with 20% PKC and enzyme two, and T6: T0 with 20% PKC and enzyme two.

The proportion of subcutaneous fat in 35-day-old broiler hens was unaffected by the addition of PKC, however it could reduce abdominal fat in comparison to the control. The proportion of abdominal fat may decrease with the addition of PKC and enzymes. This was consistent with a study [12] that found PKC fermentation with enzymes could lower abdominal fat in broiler chicks and increase feed efficiency and conversion. Broiler chicken meat fed a diet with 0.8% palm kernel meal extract (PKME) could reduce abdominal fat by 15% when compared to the control group. PKC's quality as poultry feed may be enhanced via fermentation technology and the addition of enzymes. Feeding PKC and enzymes had no effect on the percentage of subcutaneous fat. The health of the digestive system and the development performance of chickens may benefit from the addition of lauric acid to broiler chicken feed [13]. Fatty acids formed in the liver are converted into triglycerides and sent to adipose tissue, especially abdominal fat, for storage. If fatty acid synthesis in the liver decreases, the amount of triglycerides sent to adipose tissue also decreases. As a result, fat accumulation in the abdominal decreases [14].

4 Conclusion

This study found that PKC 10% and PKC 10% with enzymes one (130 g/ton of protease, 200 g/ton NSPase, and 182 g/ton mannanase) and two (260 g/ton protease, 400 g/ton NSPase, and 182 g/ton mannanase) could improve the carcass quality of 35-day-old broiler chickens and reduce abdominal fat, making them ideal for human consumption.

We are appreciative of the Palm Oil Fund Management Agency's (Badan Pengelola Dana Perkebunan Kelapa Sawit, Indonesia) support for this work.

References

1. Livestock and Animal Health Statistic. (2021). Directorate General of Animal Husbandry and Animal Health, Ministry of Agriculture, Republic of Indonesia. 1644549920.Buku_Statistik_2021.pdf (pertanian.go.id). Accesed on 27 Desember 2022.
2. Gomez-Osorio, L. M., Nielsen, J. U., Martens, H. J., & Wimmer, R. (2022). Upgrading the nutritional value of PKC using a Bacillus subtilis derived monocomponent β-mannanase. Molecules, 27(2), 563.
3. Shastak, Y., Ader, P., Feuerstein, D., Ruehle, R., & Matuschek, M. (2019). ß-mannan and mannanase in poultry nutrition. Worlds Poultry Science Journal, 71(1), 161 –174.
4. Koranteng, A. A. A., Gbogbo, K. A., Adjei-Mensah, B., Bouassi, T., Ainia, C. T. F., Glago, J., & Kokou, T. (2022). Impact of palm kernel cake with or without multi-blend enzyme on the growth performance and carcass traits of Sasso broilers. International Journal of Veterinary Science and Medicine, 10(1), 80 – 89.
5. Aristides, L. G. A., Venancio, E, J., Alfieri, A. A., Otonel, R. A. A., Frank, W. J., & Oba, A. (2018). Carcass characteristics and meat quality of broilers fed with different levels of Saccharomyces cerevisiae fermentation product. Poultry Science, 97(9), 3337–3342
6. Paszkiewicz, W., Muszynski, S., Kwiecien, M., Zhyla, M., Swiatkiewicz, S., Arczewska-Wlosek, A., & Tomazewska, E. (2020). Effect of soybean meal substitution

by raw chickpea seeds on thermal properties and fatty acid composition of subcutaneous fat tissue of broiler chickens. Animals, 10(3), 533.

7. Moore, K., Mowers, R., Harbur, M. L., Merrick, L., Mahama, A. A., & Suza, W. (2023). Chapter 8: The Analysis of Variance (ANOVA). Iowa State University.
8. Habte-Tsion, H.M., & Kumar, V. (2018). Nonstarch polysaccharide enzymes—general aspects. Enzymes in Human and Animal Nutrition, 183 – 209.
9. Krismianto, L., Yunianto, V. D., Suthama, N., & Agritio. (2023). Effect of adding palm kernel meal extract to rations using microparticle protein sources on fatty meat and carcass weight of broiler chicken. Bantara Journal of Animal Science, 5, 37 – 47.
10. Hassan, F., Atallah, S., & Reda, R. (2021). Comparison of performance, meat quality, and profitability of Cobb, Hubbard, and Ross broiler strainsVergleich von Leistung, Fleischqualität und Rentabilität zwischen Cobb-, Hubbard- und Ross-Broilern. European Poultry Science, 85: 1 – 13.
11. Wang, M., Marcelline, S. P., Liu, S. Y., & Selle, P. H. (2025). Fat deposition and growth performance in broiler chickens are diversely influenced by maize or wheat following dietary cruderotein reductions plausibly involving insulin. Journal Animal Science Biotechnology, 24(16): 179.
12. Pasaribu, T. (2018). Efforts to improve the quality of palm kernel cake through fermentation technology and enzyme addition for poultry. Indonesian Bulletin of Animal and Veterinary Sciences. WARTAZOA, 28(3), 119 - 128
13. Zeitz, J. O., Fenhoff, J., Kluge, H., Stangl, G. I., & Eder, K. (2015). Effect of dietary fats rich in lauric and myristic acid on performance, intestinal morphology, gut microbe, and meat quality in broilers. Poultry Science, 92(10), 2404 – 2413.
14. Bezerra, M. A., & Cohen, D. E. (2019). Triglyceride metabolism in the liver. Comprehensive Physiology, 8(1), 1–8.