

## Fat profile in pork of growing pigs supplemented with virgin coconut oil waste coconut meal pellets

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### Abstract

The quality of pork products is influenced by the composition of meat and fat, which in turn is affected by the feed provided. This study aimed to evaluate the fat profile - specifically fat isolate content, cholesterol, and fatty acid levels (saturated and unsaturated) - in the meat of growing pigs fed with rations containing different levels of Virgin Coconut Oil (VCO) waste coconut meal. A completely randomized design was employed with three treatments: T1 (0% VCO waste), T2 (7.5%), and T3 (15%), each with eight replications. Twenty-four one-month-old pigs were housed in 12 cages (two per cage). Samples were taken from the abdominal and dorsal meat sections. Data were analyzed using the honest significant difference test. Results indicated that increasing VCO waste levels in the diet significantly affected fat isolate content and cholesterol levels in abdominal meat. T1 showed the lowest fat isolate content and cholesterol level, followed by T2 and T3, with significant differences among them ( $P < 0.05$ ). In terms of saturated fatty acids, T1 and T2 were similar but both were significantly different from T3. No significant differences ( $P > 0.05$ ) were found in unsaturated fatty acids across treatments. In dorsal meat, VCO waste inclusion also influenced fat isolate, cholesterol, and fatty acid composition. T1 had significantly lower fat isolate content and unsaturated fatty acids than T2 and T3. Cholesterol levels increased significantly from T1 to T3, though the increase in saturated fatty acids was only significant between T1 and T3. Overall, dietary supplementation with VCO waste coconut meal modified the pork fat profile. It increased abdominal fat isolate content by 44.85%, reduced cholesterol by 1.87%, and enhanced the proportion of unsaturated over saturated fatty acids. Although cholesterol in dorsal meat rose slightly (2.78%), the overall fatty acid profile improved. These findings suggest that VCO waste coconut meal is a viable feed ingredient for improving pork quality through modulation of fat composition.

## 1. Introduction

There is increasing awareness of nutritional needs and selectiveness among consumers for healthy and high-quality food products. This includes a growing demand for safe and nutritious animal products. Consumers tend to prefer fresh, low-fat animal products (Anjalani, 2017). Pork is a type of livestock that has advantages, such as a carcass percentage ranging from 65 to 80% (Lewa *et al.*, 2015) Characteristics that influence the quality of pork include intramuscular fat content (marbling), cooking loss, water retention, and meat pH. The chemical composition of raw pork is 72% water, 20.2% protein, 6.8% fat, and 1% ash (Siagian *et al.*, 2004). United State Department of Agriculture (USDA) (2009) reports that the chemical composition of pork meat includes 60-70%

water, 6-10% fat, and 20-28% protein. The chemical composition of meat is influenced by several factors, including genetic factors (sex, muscle type, and individual animal), environmental factors (nutrition and feed), and physiological factors (pre- and post-slaughter processes).

The quality of pork fat, including its fatty acid profile, is closely linked to the feed provided to livestock during their growth phase. Therefore, formulating an optimal and balanced diet is crucial to achieve a high-quality diet that meets the nutritional needs of livestock. Supplementation is a strategy to enrich and balance the nutrients in animal feed (Maeda *et al.*, 2013). It has been reported that agro-food industries produce a number of agro-industrial residues and by-products (Gaonkar and

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Furtado, 2021) which cause not only a problem in the treatment and final disposal of waste in the world but also significant economic costs (Cotabarren *et al.*, 2019). Coconut residue is one of the by-products obtained from coconut milk extraction (Eadmusik *et al.*, 2022) and is one of the feed ingredients that has a relatively high fat content is VCO waste coconut meal, which has not yet been fully utilized. So far, most coconut waste has been discarded improperly, causing environmental pollution. Utilizing waste as animal feed is a wise effort to mitigate environmental pollution (Panjaitan, 2021). It comprises 40–60% of the initial coconut material, and this spent material contains approximately 25–54% virgin oil and is enriched with significant amounts of protein and dietary fiber (Shakeela *et al.*, 2024).

Using VCO waste coconut meal as a feed ingredient for pigs in the form of compact pellets ensures that all parts of the feed are consumed efficiently. Feed ingredients such as VCO waste have carbohydrates and fatty acids that will influence the fat profile and other components formed in the pigs' bodies. Fat profile analysis, including total fatty acid content, has been extensively studied. However, research on the content of fat isolates, saturated, unsaturated fatty acids, and cholesterol particularly in specific parts such as the abdominal section (pork belly) and dorsal section (back part) of pigs remains limited. Based on this context, this study aims to identify the fat profile (fatty acid profile, fat isolate content, and cholesterol levels) in pork from growing pigs fed with VCO waste coconut meal supplemented pellets.

## 2. Materials and methods

This research was conducted at the "HANNA" livestock farm in Lelema Village, South Minahasa Regency, located 39.5 km from Manado. The VCO waste coconut meal was collected from the North Minahasa District (30.3 km from Manado).

### 2.1 Preparation of virgin coconut oil waste coconut meal and feed ingredients

The VCO waste coconut meal and other feed ingredients were gathered. They were processed by drying (for wet materials), grinding, and analyzed in the laboratory for proximate: moisture content was determined using AOAC Official Method 934.01, ash content was analyzed following AOAC Official Method 942.05, crude protein was measured using the Kjeldahl method AOAC Official Method 984.13, crude fat was measured using the Soxhlet Extraction method AOAC Official Method 920.39 (AOAC INTERNATIONAL, 2005).

#### 2.1.1 Moisture content by oven drying

A pre-weighed sample was dried in an oven at 105°C until a constant weight is attained. The moisture content was then determined based on the weight loss after the drying process.

#### 2.1.2 Ash content

The sample underwent incineration in a muffle furnace at a controlled temperature range of 550–600°C until complete combustion of all organic matter was achieved, leaving only the mineral residue. This process ensures the removal of volatile and combustible components, facilitating accurate quantification of the inorganic content. The ash percentage was then determined by calculating the ratio of the remaining residue to the initial sample weight, providing insights into the mineral composition of the sample.

#### 2.1.3 Crude protein

The Kjeldahl method is commonly used to determine protein content. The sample was digested using concentrated sulfuric acid (H<sub>2</sub>SO<sub>4</sub>) and a catalyst, converting nitrogen in proteins into ammonium sulfate. After neutralization with NaOH, ammonia was distilled and titrated to calculate nitrogen content, which is then multiplied by a conversion factor (usually 6.25) to estimate crude protein.

#### 2.1.4 Crude fat

The determination was performed using Soxhlet extraction, where the sample is subjected to continuous extraction with a non-polar solvent, such as ether or hexane, to dissolve the fat content effectively. The solvent was evaporated, and the remaining fat residue was weighed to determine the fat content. Crude Fiber The sample was treated with acid (H<sub>2</sub>SO<sub>4</sub>) and alkali (NaOH) to simulate digestion. The remaining indigestible residue, primarily cellulose and lignin, was then filtered, dried, weighed, and ashed. The difference between the dried residue and ash weight gives the crude fiber content. The preparation of rations for the pellet feed consisted of a mix of corn, fish meal, copra meal, rice bran, pig mix, and VCO waste. All ingredients were locally sourced from North Sulawesi.

### 2.2 Sample preparation

The pigs were slaughtered, cleaned, and 1000 g of the parts of pork meat from the dorsal section (back part) and abdominal section (pork belly)—the lower part of the pig's body, specifically from the lower abdomen, around the diaphragm, and under the ribs—were taken for each replication.

## 2.3 Measurement of parameters

### 2.3.1 Determination of fat content in meat using the gravimetric method

A total of 10 g of meat was finely ground until a thick mass was formed. The ground meat was then immersed in 100 mL of n-hexane and was continuously stirred using a magnetic stirrer for five days to ensure efficient extraction. Subsequently, the mixture was filtered, and the n-hexane was evaporated using a rotary evaporator. The resulting extract was concentrated in a water bath until no solvent odor was detected. The extract was placed in a desiccator containing silica gel for 24 hrs, after which the fat/oil content was weighed, and its concentration was determined.

### 2.3.2 Determination of cholesterol content in meat

To prepare a 1000 ppm stock solution, 10 mg of standard cholesterol was precisely weighed and dissolved in a 10 mL volumetric flask to ensure accurate concentration for further analysis. From this solution, 0.375 mL was pipetted, 2 mL of Lieberman-Burchard (LB) reagent was added, and the volume was adjusted to 5 mL using chloroform. The maximum absorbance wavelength was then measured using a spectrophotometer. Subsequently, a series of standard solutions was prepared by pipetting 0.075, 0.150, 0.225, 0.300, and 0.375 mL of the 1000 ppm cholesterol solution into separate volumetric flasks. To each flask, 2 mL of LB reagent was added, followed by dilution to 5 mL with chloroform. The mixtures were incubated in a dark place for 60 mins, and the absorbance of each solution was measured at 625 nm, the previously determined wavelength.

A calibration curve was then plotted, correlating cholesterol concentration with absorbance, and the linear equation ( $y = ax + b$ ) along with the R-value was determined. For sample preparation, weigh 1.00 g of meat, soak it in 25 mL of n-hexane, and stir using a magnetic stirrer for 3–5 days. After this period, filter the mixture, rinse with n-hexane, and evaporate the solvent using a rotary evaporator. The extract was further concentrated in a water bath until no solvent odor remains. The residue was then placed in a desiccator containing silica gel for 24 hrs. After drying, 100 mg of the fat/oil extract was weighed, followed by the addition of 2 mL of LB reagent. The mixture was then diluted to a final volume of 5 mL using chloroform. After drying, 100 mg of the fat/oil extract was weighed, followed by the addition of 2 mL of LB reagent. The mixture was then diluted to a final volume of 5 mL using chloroform. The solution was incubated for 5 mins, after which its absorbance was measured. The cholesterol concentration of the sample was then determined using the equation  $y$

$= ax + b$ . The test was performed three times to ensure the accuracy.

### 2.3.3 Determination of saturated/unsaturated fatty acids in meat samples using gas chromatography

The hydrolysis process is a crucial step in the analysis of fatty acids in meat. In this procedure, a 5 g sample was accurately weighed and placed in a large test tube to facilitate further chemical reactions. Approximately 10 ml of concentrated HCl was added and heated in a water bath at 80°C until boiling for 3 hrs. Once cooled, the mixture was added with 10 mL of diethyl ether and petroleum ether (1:1) for extraction. The upper oil layer was then collected and evaporated in a water bath with nitrogen gas assistance. For the methylation process, 0.5 mL of the extracted oil was taken and transferred to a small, sealed test tube. Then, 1.5 mL of sodium methanolate solution was added, the tube was sealed and heated at 60°C for 5–10 mins with occasional shaking. After cooling, 2 mL of boron trifluoride methanoate was added and the mixture was heated again at 60°C for another 5–10 mins. Once cooled, the solution was added with 1 mL of heptane and 1 mL of saturated NaCl, and the upper layer was collected. Finally, the sample was transferred to a GC vial, and 1  $\mu$ L was injected into the gas chromatograph (GC, Agilent Technologies 7890B) for analysis.

## 2.4 Data analysis

Isolated fat, cholesterol, saturated, and unsaturated fatty acids values were shown as the mean and analyzed statistically with analysis of variance (ANOVA). A completely randomized design of 3 treatments and 8 replications was performed. Differences between treatments were identified using the Honestly Significant Difference (HSD) Test. The experimental treatments included three types of pellets supplemented with different levels of VCO waste coconut meal: T1 = 0%; T2 = 7.5%; T3 = 15% in the total ration. The quality of the pelleted feed was formulated based on the nutritional requirements of growing pigs. The experimental subjects were 24 one-month-old pigs placed in 12 cages, each containing 2 piglets.

## 3. Results and discussion

### 3.1 Effect of treatment on fat isolates in the abdominal (pork belly) section of pigs

The data in Table 1 showed that the fat isolate content (%) in the stomach area of the pigs ranges from 12.51% to 23.05% a 44.85% increase in fat isolate content. This indicates that as the proportion of VCO waste coconut meal increases in the feed, the amount of fat stored in the pig's body tissues increases, especially in

the intramuscular and subcutaneous fat. Statistically, the increasing proportion of VCO waste in the diet affects the increase in fat isolate content and cholesterol levels in the pig's meat. Data from Table 2 showed that the fat isolated in pig meat refer to the proportion of fat found in the pork. Pigs serve as an excellent model for nutrigenomic studies, particularly lipid metabolism, because fat deposition and fatty acid composition in pig tissues reflect the composition of fatty acids in the diet consumed (Finalli *et al.*, 2022).

Table 1. Composition of treatment rations and nutrient content.

Experimental ration composition	Treatment		
	T1	T2	T3
Feed ingredients			
Concentrate	30.00	30.00	30.00
Corn	30.00	30.00	30.00
Fish meal	12.00	12.00	12.00
VCO dregs	0.00	7.50	15.00
Rice bran	17.00	15.00	11.00
Coconut meal	10.00	4.50	1.00
Pig mix	1.00	1.00	1.00
Total	100.00	100.00	100.00
Nutrient composition*			
Nutrient	T1	T2	T3
Crude protein	17.95	17.27	16.84
Crude fiber	6.99	6.48	5.96
Crude fat	7.55	8.70	10.02
Calcium	1.21	1.20	1.19
Phosphorus	1.10	1.11	1.11
ME (kcal/kg)	3019.94	3093.16	3174.69

\*Composition derived from reference concentrate products and laboratory analyses (Bagau, 2024).

Table 2. Average fat isolate, cholesterol, saturated fatty acids and unsaturated fatty acids in the abdominal section (pork belly) of pigs.

Variable	Treatment		
	T1	T2	T3
Fat isolate (%)	12.51 <sup>a</sup>	17.78 <sup>b</sup>	23.05 <sup>c</sup>
Cholesterol (mg/dL)	66.66 <sup>a</sup>	66.03 <sup>b</sup>	65.41 <sup>c</sup>
Saturated fatty acids (%)	14.10 <sup>a</sup>	14.16 <sup>a</sup>	15.74 <sup>b</sup>
Unsaturated fatty acids (%)	92.44 <sup>a</sup>	84.44 <sup>b</sup>	84.26 <sup>b</sup>

Values with different superscripts are statistically significantly different ( $P < 0.05$ ). T1: 0% VCO waste in the total ration, T2: 7.5% VCO waste in the total ration, T3: 15% VCO waste in the total ration.

This is likely due to the fat and energy content in the coconut meal, which has 42.58% fat and 6008 kcal/kg of gross energy. Additionally, VCO waste coconut meal is rich in saturated fatty acids (such as lauric acid, about 41.14% of total fatty acids, according to Novariant and Tulalo (2007), which can be absorbed and utilized by the pig's body to form fat. This process increases fat storage in the body, which is reflected in the increased fat isolate

content. The inclusion of VCO or coconut meal in pig feed can enhance lipid metabolism and promote fat accumulation in the body. In general, lauric acid (C12:0) found in VCO is known to increase body fat content because it is quickly absorbed and used by the body for fat synthesis. The use of VCO waste coconut meal as a feed ingredient can increase intramuscular fat accumulation in pig meat, which may enhance marbling (meat quality) and possibly provide positive effects on the taste and texture of the meat.

### 3.2 Effect of treatment on fat isolates the dorsal section (back part) of pigs

Data from Table 3 shows that the fat isolate content in the back part of the pig ranges from 14.33% to 25.38% a 47.26% increase in fat isolate content. This indicates that as the proportion of VCO waste coconut meal increases in the feed, the amount of fat stored in the pig's body tissues, especially in the back area, which is rich in subcutaneous fat, also increases. VCO waste coconut meal contains saturated fatty acids, particularly lauric acid (C12:0), which can be rapidly absorbed and used by the body to form fat. The addition of VCO waste coconut meal to pig feed tends to increase fat formation in pig body tissues. Several studies have shown that lauric acid can increase fat accumulation in the body through a rapid metabolic process. For example, research showed that providing coconut oil (which is also rich in lauric acid) to livestock increased body fat levels, particularly in subcutaneous adipose tissue (Rolinec *et al.*, 2024).

Table 3. Average fat isolate, cholesterol, saturated fatty acids and unsaturated fatty acids in the dorsal section (back part) of pigs.

Variable	Treatment		
	T1	T2	T3
Fat isolate (%)	14.33 <sup>a</sup>	19.86 <sup>b</sup>	25.38 <sup>c</sup>
Cholesterol (mg/dL)	57.34 <sup>a</sup>	58.16 <sup>b</sup>	58.98 <sup>c</sup>
Saturated fatty acids (%)	24.93 <sup>a</sup>	25.30 <sup>ab</sup>	25.60 <sup>b</sup>
Unsaturated fatty acids (%)	75.05	74.64	74.41

Values with different superscripts are statistically significantly different ( $P < 0.05$ ). T1: 0% VCO waste in the total ration, T2: 7.5% VCO waste in the total ration, T3: 15% VCO waste in the total ration.

### 3.3 Effect of treatment on cholesterol in the abdominal section (pork belly) of pigs

Cholesterol in pig meat is greatly influenced by the type of fat present in the feed, as saturated fats have the potential to increase cholesterol levels in the pig's body. T1 showed the highest cholesterol levels (66.66 mg/dL). T2 showed a slight decrease in cholesterol levels to 66.03 mg/dL. T3 showed a further reduction to 65.41

mg/dL a 1.87% decrease. The addition of VCO waste coconut meal, which contains saturated fatty acids, does not always lead to a drastic increase in cholesterol levels in pig blood. The reduction in cholesterol levels in T2 and T3 can be explained by several factors. The fatty acid composition in VCO, particularly lauric acid, tends to have a more complex effect on lipid metabolism. Coconut is classified as saturated fat. However, not all saturated fats act the same way in the body.

The length of their fatty acid chain, whether medium-chain or long-chain, affects how they are metabolized, resulting in different health effects. The medium-chain fatty acids predominant in coconut are absorbed differently and have been linked to various health benefits, including improvements in cognitive function and a more favorable lipid profile compared to long-chain fatty acids. Thus, coconuts provide a healthful source of saturated fats and should not be equated with foods containing longer-chain saturated fats (Hewlings, 2020). Some studies suggest that lauric acid may influence cholesterol levels differently than other saturated fatty acids, such as palmitic acid or stearic acid. Cholesterol Metabolism: While saturated fats in the feed have the potential to increase blood cholesterol, VCO waste coconut meal also contains other bioactive compounds (such as polyphenols) that can function as antioxidants and help regulate lipid metabolism. The reduction in cholesterol levels with increasing proportions of VCO waste coconut meal (from T1 to T3) may also be influenced by changes in the fatty acid composition of the feed or the pig's meat, as well as potential metabolic adaptation within the pig's body to the feeding pattern.

#### 3.4 Effect of treatment on cholesterol in the dorsal section (back part) of pigs

Cholesterol in pig meat is an important component that is influenced by the fats present in the feed. Cholesterol is a compound found in cell membranes and is highly influenced by the fat composition in the feed. Cholesterol is a byproduct of fat metabolism in the body. The increase in fat levels in the pig's body (with the inclusion of VCO waste coconut meal) is often associated with an increase in cholesterol levels, although this effect is not always linear. VCO waste coconut meal contains saturated fatty acids (primarily lauric acid), which can increase cholesterol levels, but the effect may be more complex.

Lauric acid in VCO is known to have a more moderate effect on cholesterol compared to other saturated fatty acids, such as palmitic acid (C16:0). Research by Yudha and Tasminatun (2016) showed that lauric acid is more likely to increase HDL (good

cholesterol) rather than LDL (bad cholesterol), which could contribute to a better lipid balance in the body. While there is an increase in cholesterol levels in T2 and T3, this increase is relatively small, and the differences between the treatments may not be large enough to have a significant health impact on the pigs. However, it suggests that the addition of VCO waste coconut meal can cause changes in the lipid profile of the pig's body, including an increase of 2.78% in the dorsal pork meat. Research by Hanczakowska (2017), indicated that lauric acid in VCO can function to increase HDL cholesterol and reduce LDL cholesterol, which could have protective effects on heart health in pigs and even in humans if applied to human diets.

#### 3.5 Effect of treatment on saturated fatty acids in the abdominal section (pork belly) of pigs

The fatty acid profile of pork reveals that the fat in the abdominal section tends to contain a higher proportion of unsaturated fatty acids than that in the abdominal section. In the abdominal section, there was a more significant increase in the content of saturated fatty acids, with a more noticeable rise between treatments (from 14.10% in T1 to 15.74% in T3). There was a more significant increase in the content of saturated fatty acids, with a more noticeable rise between treatments. Research results comparison of fatty acid profiles of three adipose tissues in pigs found that abdominal subcutaneous adipose had the largest proportion of monounsaturated fatty acids and the lowest saturated fatty acids (Qianming *et al.*, 2018). Further test results showed that T1 had the same effect as T2 but was lower than T3, thus increasing the use of VCO waste coconut pulp increased the amount of saturated fatty acids in the abdominal meat of pigs. This is supported by the opinion (Purnomo *et al.*, 2023), that coconut products that still contain oil are included in food sources of saturated fat. About 90% of the fatty acids in it are saturated.

#### 3.6 Effect of treatment on saturated fatty acids in the dorsal section (back part) of pigs

The data in Table 2 showed that the average content of saturated fatty acids in the dorsal section of pigs ranges from 24.93% to 25.61%. The saturated fatty acid content in this study was lower than the results of the study by Sriyani *et al.* (2017) which obtained the general characteristics of fatty acids in Balinese pork and landrace pork, namely the saturated fatty acid content (SFA) of Balinese pork 28.79% and the saturated fatty acid content of landrace pork (SFA) 29.26%. The research results of Qianming *et al.* (2018) showed that dorsal subcutaneous adipose tissue (DSA) contains saturated fatty acids in a lower proportion compared to the proportion of unsaturated fatty acids.

The ANOVA results revealed significant differences between the treatments involving VCO waste coconut meal. Post-hoc testing showed that T1 was statistically similar to T2 but significantly lower than T3, whereas T2 and T3 did not differ significantly. The fatty acid profile in pork indicates that the fat in the dorsal section predominantly contains saturated fatty acids. This suggests that subcutaneous fat in the dorsal region may absorb more saturated fatty acids from the diet, particularly the lauric acid present in VCO waste coconut meal. According to Luthfiah (2016), the fatty acids contained in coconut waste from coconut milk production are the most dominant ones, namely lauric acid (C12:0) of 19.59%. Dorsal fat in pigs often contains higher amounts of saturated fatty acids, particularly palmitic acid (C16:0) and stearic acid (C18:0), which are more easily stored in body regions with a greater propensity for fat accumulation. Pigs are an excellent model for the study of nutrigenomics, particularly lipid metabolism, because the deposition and composition of fatty acids in their tissues reflect the composition of fatty acids in their diet (Rolinec *et al.*, 2024). This increase reflects the higher levels of saturated fat that result from the inclusion of VCO waste coconut meal in the diet.

### 3.7 Effect of treatment on unsaturated fatty acids in the abdominal section (pork belly) of pigs

The data in Table 2 showed that the unsaturated fatty acid content in the abdominal section (pork belly slightly decreased from 84,26% (T3) to 92,44% (T1). Qianming *et al.* (2018) research results comparison of fatty acid profiles of three adipose tissues in pigs found that the abdominal subcutaneous adipose had the largest proportion of monounsaturated fatty acids. Leading to compositional differences between dorsal and abdominal fat (Popova *et al.*, 2015), unsaturated fatty acids, such as oleic acid, often originate from vegetable oils, which may be present in the VCO waste coconut meal or other feed ingredients. The reduction in unsaturated fatty acid levels in T3 may be attributed to the increased proportion of lauric acid in the diet, which is more saturated and leads to changes in the overall fat composition in the pigs' bodies. In this case, the increase in saturated fat tends to reduce the proportion of unsaturated fat formed.

### 3.8 Effect of treatment on unsaturated fatty acids in the dorsal section (back part) of pigs

The data in Table 2 showed that the unsaturated fatty acid content in the dorsal section slightly decreased from 75.05% (T1) to 74.41% (T3). While there was a slight decrease, the difference was not significant. Franco *et al.* (2006) studied the differences in fatty acid profiles as a function of fat storage location in carcasses, unsaturated fatty acids showed a significantly higher percentage in

subcutaneous and intramuscular back fat ( $68.11 \pm 1.49\%$ ), but this study was higher, ranging between 74.41-75.05%. Subcutaneous fat in the dorsal section, primarily located on the upper body of pigs, tends to contain higher levels of unsaturated fatty acids such as oleic acid (C18:1) and linoleic acid (C18:2). Oleic acid (C18:1), the primary unsaturated fatty acid in diets based on vegetable oils, continues to play an important role in fat formation in the dorsal section, despite the small decline in higher treatment groups. This is linked to the absorption of fats from feeds that contain vegetable oils, which are rich in unsaturated fatty acids. Oleic acid is a key unsaturated fatty acid in pork and plays a critical role in marbling (intramuscular fat), which is frequently observed in the dorsal section of pigs.

## 4. Conclusion

Based on the results and discussion, this study showed that dietary supplementation with VCO waste coconut meal significantly altered the fat profile of pigs. Increasing the level of use resulted in a 44.85% increase in fat isolate content and a 1.87% decrease in cholesterol levels in the abdominal pork meat, accompanied by higher unsaturated fatty acid content compared to saturated fatty acids. While cholesterol levels increased slightly in the dorsal pork meat (2.78%), the overall impact of VCO waste supplementation was an improved fatty acid profile, potentially leading to improved pork quality for human consumption. These findings suggest that VCO waste coconut meal can be effectively used as a feed ingredient to modulate pork fat composition. Further studies are needed to investigate the long-term effects of this supplementation on pig health and meat quality characteristics beyond the fat profile.

## Conflict of interest

The authors declare no conflict of interest.

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