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Analysis of Pork Fatty Acid in Cornet in The Curug Market Using Gas Chromatography

Ade Dwi Widyatari*, Nita Rusdiana, Laode Akbar Rasydy
Department of Pharmacochemistry and science, Faculty of Pharmacy, University Muhammadiyah A.R. Fachruddin, Banten, Indonesia

Abstract

Counterfeiting of food products with non-halal ingredients is starting to become a new problem in Indonesian society, the majority of whom are Muslim. One example of processed meat that is susceptible to the addition of pork components is corned beef. This research aims to determine the content and levels of fatty acids in corned beef. The method used to analyze halal food products is the GC method. The results showed that corned beef 1, 2, and 3 had dominant fatty acids such as myristic acid (1.58), (2.08), and (1.54), palmitic acid (49.91), (48.19) and (48.67), stearic acid (9.27), (10.20) and (7.24), oleic acid (58.89), (49.37) and (59.64), and linoleic acid (12.78), (8.16) and (11.53).

Keywords: analysis; corned beef; lard; GC

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INTRODUCTION

Halal in food products is important for Muslims. Food safety is necessary to keep food safe, hygienic, and of high quality and not conflict with the religion, beliefs, and culture of society.[1] Halal in food products is important for Muslims. Halal is everything that is protected from unclean elements that Muslims cannot consume. One of the halal concepts in Islam, namely consuming food that is lawful, holy, and does not contain the slightest bit of pork content, is a religious order, and the law is obligatory.[2] Events occur nowadays related to current food safety issues, such as the discovery of lard in food and beverage products.[3] In order to improve the taste of processed food products and to keep the price relatively low in the market, lard is used by the public as a food raw material. As a result, many traders mix lard into halal food products.[4]

The increase in meat consumption for the Muslim population will be greatly influenced by halal standards determined by Islamic law. Thus, there needs to be supervision from state-mandated institutions, one of which is the MUI. The non-halal components most commonly found on the market are pork, pork fat, pork gelatin, and pork-based products.[5] One example of processed meat that is susceptible to the addition of pork components is corned beef. In research conducted by Nurfadilah (2022) using the FTIR Spectrophotometry method, the results showed that all samples studied were positive for containing lard, which

* *Corresponding author, e-mail: adexx9@gmail.com*

was indicated in the wave number area 3010-3000cm-1.[6] However, the FTIR method has limitations, namely that it cannot identify the fatty acid component content in the sample with certainty.[8]

The method developed to analyze halal food products containing animal fat, especially pork fat, is GC, as it looks at the fatty acid components. GC can be used to test the purity of certain materials.[3] In research conducted by (Prabawati, 2018) using the GC method, it was found that the content of unsaturated fatty acids such as oleic acid, linoleic acid, and linolenic acid in pork fat was higher than in beef fat.[7] In research conducted by (Hermanto et al., 2010) using the GCMS method, the results demonstrated that the content of saturated fatty acids (SFA) in beef was much greater than in pork fat and chicken fat, while the content of polyunsaturated fatty acids (PUFA) in pork is much larger than beef fat and chicken fat.[8] This research aims to determine the content and levels of fatty acids in corned beef using the GC method.

METHOD

Tools

GC (Shimadzu 2010), sealed weighing bottle, desiccator, 10µL syringe, water bath, Teflon covered tube, analytical balance, micropipette, filter paper, 10mL fat flask, soxhlet apparatus, electric heater, oven, and fat-free cotton.

Materials

Beef, pork, chicken, and corned beef obtained in the Tangerang area, petroleum ether, standard solution, 0.5N NaOH solution in methanol, 20% BF_3 solution, saturated NaCl solution, and nitrogen.

Sample collection method

Sample Selection

In this research, the corned beef sampling technique used a purposive sampling technique based on predetermined inclusion criteria, namely corned beef with a price interval ranging from ten thousand to twenty-five thousand rupiah (Rp. 10,000 – 25,000) per pack, unbranded, not registered with LPPOM MUI or not registered at BPOM.

Sample Drying Based on SNI 01-2891-1992

Initially, 5-10 grams of chicken, pork, beef, and corned beef samples were weighed and placed in a closed weighing bottle whose weight was known. It was then dried in an oven at 105°C for 3 hours, then cooled in a desiccator and weighed.[9]

Water Content Based on AOAC (2005) 930.15

First, the previous sample of 2 grams was weighed, placed in a solder container whose weight had been identified, then dried in the oven at 135°C for 2 hours, then cooled in a desiccator and weighed.[10]

Standard of fat extraction of pork, beef, chicken, and corned beef fat samples using the soxhlet method

7-10 grams of water-free sample was weighed accurately, put in a paper sleeve lined with cotton, then covered with cotton, then put in the soxhlet device that has been connected to a fat flask filled with stones. Water was boiled and weighed. It was then extracted with petroleum ether solvent for ± 6 hours. The petroleum ether was distilled, and the fat extract was dried in a drying oven at 105°C, then cooled and weighed.

Hydrolysis and Esterification AOAC (2012) 969.33

20 – 30 mg of fat extract was weighed and then put into a tube covered with Teflon. 1

mL of 0.5 N NaOH was added in methanol, boosted with nitrogen, then heated in a water bath for 20 minutes, and 2 mL of 20% BF_3 was added, re-heated for 20 minutes, and cooled. Furthermore, 2 mL of saturated NaCl and 1 mL of isooctane were added and shaken well to form two phases. The liquid phase was separated, and then the organic phase was injected into gas chromatography.[12]

Detector Analysis with the Gas Chromatography

Hydrolyzed and esterified fat samples were analyzed using GC Shimadzu 2010, with a Cyanopropyl methyl sil column (capillary column), injector temperature 220°C, detector temperature 240°C, with N_2 flow rate 30 mL/minute, He flow rate 30 mL and a flow rate of H_2 40 mL/minute. The data obtained from GC was in the form of a chromatogram consisting of fatty acids in the form of methyl esters along with the area. The content of fatty acid methyl esters and the area of chicken, pork, beef, and corned beef samples 1, 2, and 3 were processed using a chemometric analysis program with Minitab 16 software and Microsoft Excel.

RESULTS AND DISCUSSION

Fat Extraction

The method to extract fat in this study was the Soxhlet method as it can produce high fat extraction. In the process of dissolving substances, the selection of learning was based on the principle "like dissolves like". Basically, non-polar solvents will easily dissolve in non-polar solvents.[11] The solvent used in this fat extraction was petroleum ether. Petroleum ether was light carbon, which was relatively cheaper, inert, less dangerous to fire and explosion risks, and prefers non-polar fat.[13] Fat extract levels can be seen in **Table 1**.

Table 1. Fat Extract Content

Sample Code	Sample Weight (g)	Fat Level (% w/w)
Corned 1	5.0438	6.63
Corned 2	5.2962	4.10
Corned 3	5.0417	8.63
Chicken Meat	4.1279	12.83
Pork	8.2826	42.39
Beef	4.7085	13.88

It can be seen that the highest extract levels are found in chicken, pork, and beef as these chicken, pork, and beef are pure meat, while the corned beef sample is a processed food that contains only a small amount of fat. It aligns with Nurfadillah's research (2022) that the sample of corned beef from foodstuffs only contained a little fat. The size of this fat extract depends on the amount of fat contained in the corned beef sample.[6]

Analysis of Fatty Acids with Gas Chromatography

GC analysis was carried out to determine the composition of each fatty acid from chicken, pork, beef, and corned beef samples 1,2,3. The GC fatty acid chromatogram profile can be seen as follows:

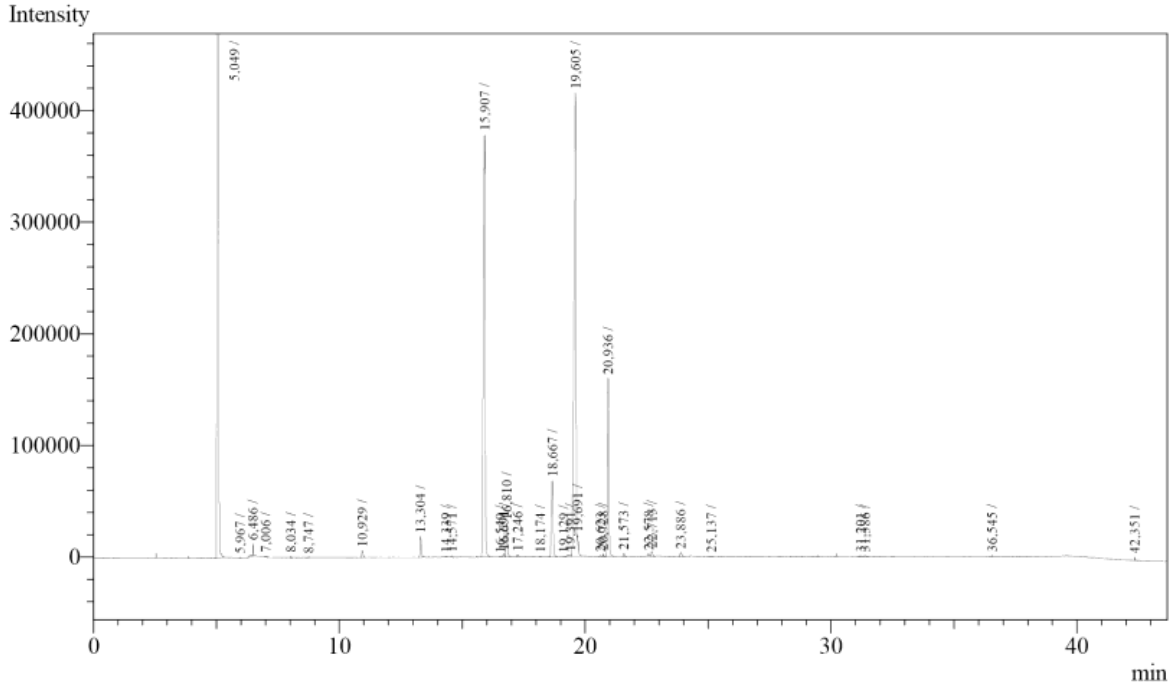

Figure 1. Corned 1

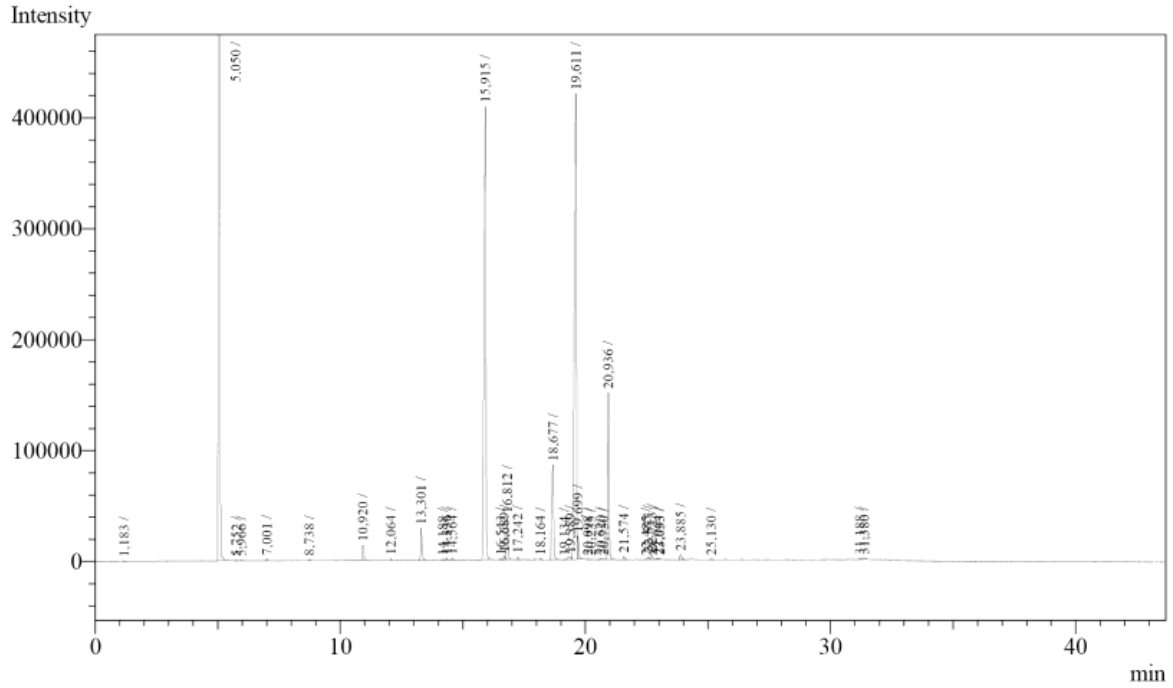

Figure 2. Corned 2

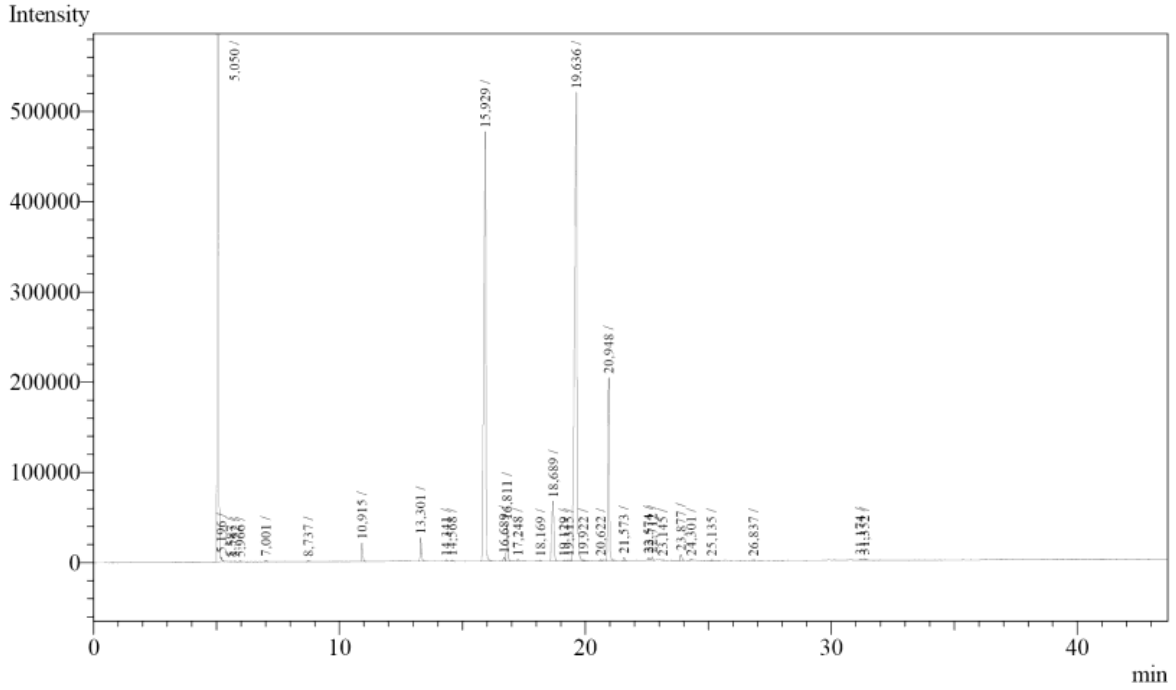

Figure 3. Corned 3

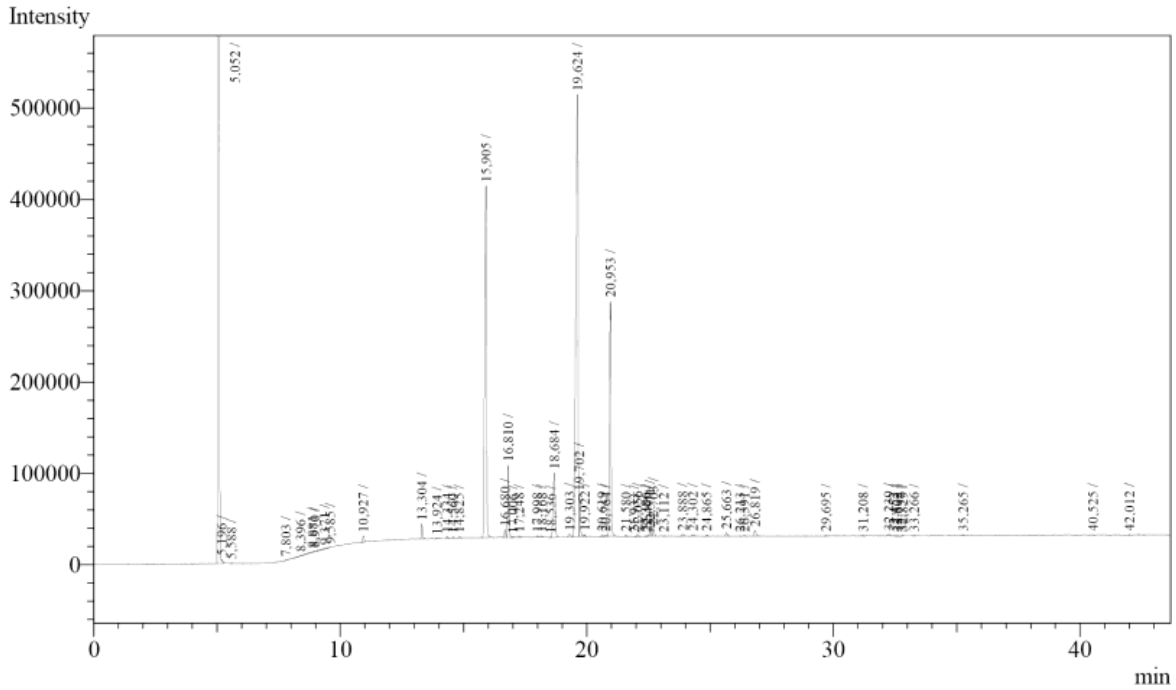

Figure 4. Chicken Meat

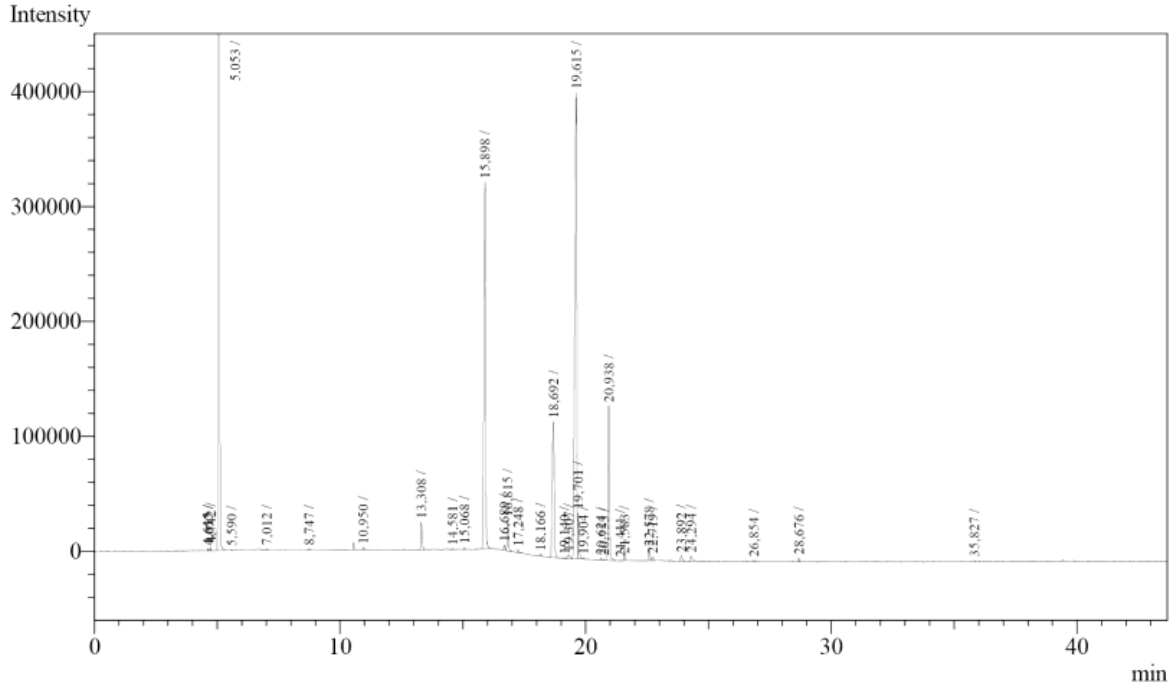

Figure 5. Pork

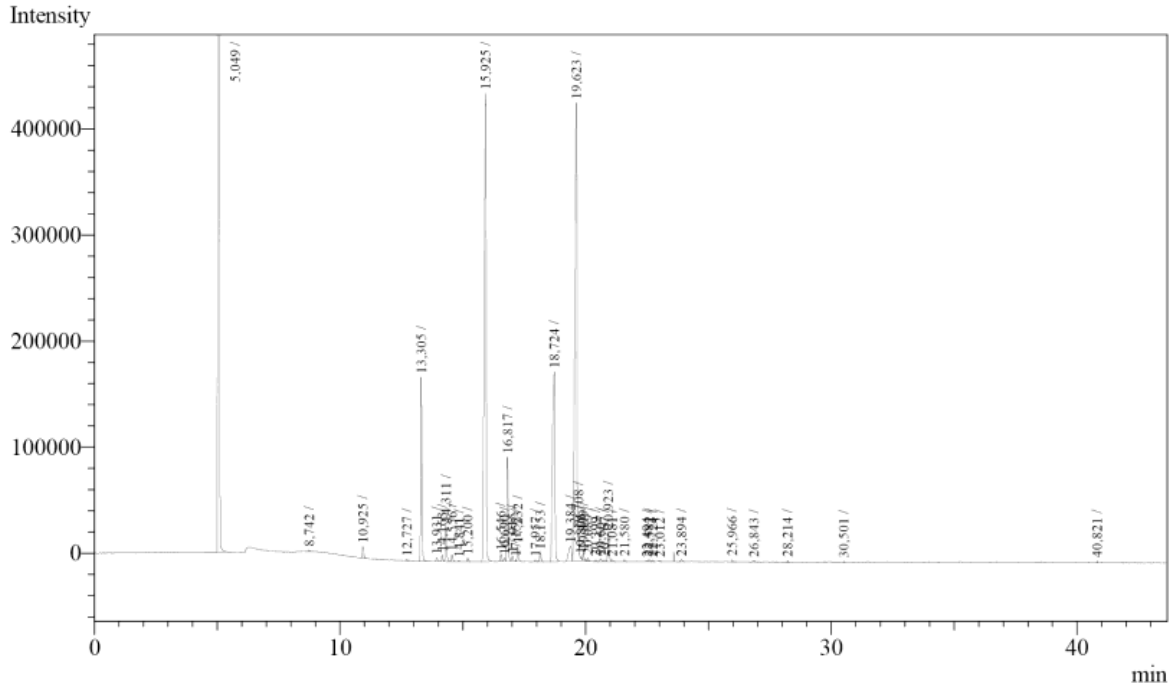

Figure 6. Beef

Based on the chromatograms of the three corned beef samples (Figures 1, 2, and 3), the peaks are similar. Based on the chromatograms of the three animal samples (Figures 4, 5, and 6), there are differences in peaks. It does not align with research conducted by Prabawati (2018) that the peaks of fatty acid chromatograms are relatively the same in beef fat and pork fat. Chromatogram peaks are compared based on retention time with standards to obtain information about the type of composition in the sample.[14] The fatty acid profile was then

interpreted, and the type of fatty acid was based on standard fatty acid references. A comparison of the percentage of fatty acid levels can be seen in **Table 2**.

Table 2 Comparison of the percentage of fatty acid levels of the test results

Fatty Acid	Fatty Acid Content in % (w/w)					
	Corned 1	Corned 2	Corned 3	Chicken Meat	Pork	Beef
Caprylic acid, C8:0	0.1	0.12	0.11	Ttd	0.14	0.09
Myristic Acid, C14:0	1.58	2.08	1.54	0.77	1.86	9.74
Myristoleic Acid, C14:1	0.12	0.20	0.10	0.14	Ttd	2.30
Pentadecanoic Acid, C15:0	0.12	0.18	0.10	0.08	0.06	0.47
Palmitic Acid, C16:0	49.91	48.19	48.67	28.58	34.25	43.29
Palmitoleic Acid, C16:1	0.27	0.28	0.29	4.33	2.43	0.21
Heptadecanoic Acid, C17:0	0.22	0.27	0.14	0.11	0.24	0.02
Cis-10-Heptadecanoic Acid, C17:1	0.07	Ttd	0.06	0.10	0.12	0.59
Stearic Acid, C18:0	9.27	10.20	7.24	0.03	15.92	22.27
Elaidic Acid, C18:1n9t	0.04	0.07	0.07	0.25	0.09	Ttd
Oleic Acid, C18:1n9c	58.89	49.37	59.64	41.74	49.88	44.57
Linoleic Acid, C18:2n6c	12.78	8.16	11.53	12.34	0.07	1.50
Linolenic Acid, C18:3n3	0.48	0.33	0.32	0.51	0.32	0.12

Based on the six samples analyzed, it was seen that the palmitic acid content in beef was the highest (43.29) compared to pork (34.25) and chicken (28.58). It aligns with research conducted by (Hermanto et al., 2010) that long-chain saturated fatty acids in beef fat are much greater than in chicken and pork. Palmitic acid in corned beef samples is 1,2 and 3, respectively, namely (49.91), (48.19), and (48.67). It indicated that the palmitic acid content of the corned beef sample resembles that of beef. Meanwhile, the stearic acid in beef was the highest (22.27) compared to chicken (0.03) and pork (15.92). In corned beef samples 1,2,3, the stearic acid content was (9.27), (10.20), and (7.24), respectively. It shows that the stearic acid level in the corned beef sample resembles that of pork. The myristic acid content in beef is the highest (9.74) compared to pork (1.86) and chicken (0.77). The myristic acid of each corned beef sample is 1,2 and 3, namely (1.58), (2.08), and (1.54). It indicated that the myristic acid level of the corned beef sample resembles pork. The oleic acid content in pork (49.88) is higher than in beef (44.57) and chicken (41.74). It aligns with research conducted by (Prabawati, 2018) that the content of the unsaturated fatty acid oleic acid in pork is higher than in beef. Meanwhile, in corned beef samples 1, 2, and 3, the oleic acid content respectively is (58.89), (49.37), and (59.64), indicating that the oleic acid level in the corned beef sample resembles that of pork. The linoleic acid content in chicken is the highest (12.34) compared to pork (0.07) and beef (1.50). In corned beef samples 1,2, and 3, the linoleic acid content was (12.78), (8.16), and (11.53), respectively. This shows that the corned beef samples have almost the same linoleic acid levels as chicken meat. Based on the results of GC analysis, the saturated fatty acid (SFA) content of beef is greater

than that of chicken and pork, while the content of monounsaturated fatty acids (MUFA) and polyunsaturated fatty acids (PUFA) in chicken and pork is higher than beef. Analysis of the three corned beef samples above has almost the same fatty acid content as pork.

Analysis with Principal Component Analysis (PCA)

The fatty acid groupings from corned beef samples 1, 2, 3, chicken, pork, and beef were then analyzed using principal component analysis (PCA). In PCA, a new variable is created, which is a linear combination of the original variables. This new variable is called the principal component.[15,16] The variable area was chosen as it was directly proportional to the concentration of fatty acids in the sample. As a result of the large and varied amount of fatty acid data, the number of variables used in this study was 13 (% area of 13 fatty acids) in order to minimize errors.[17]

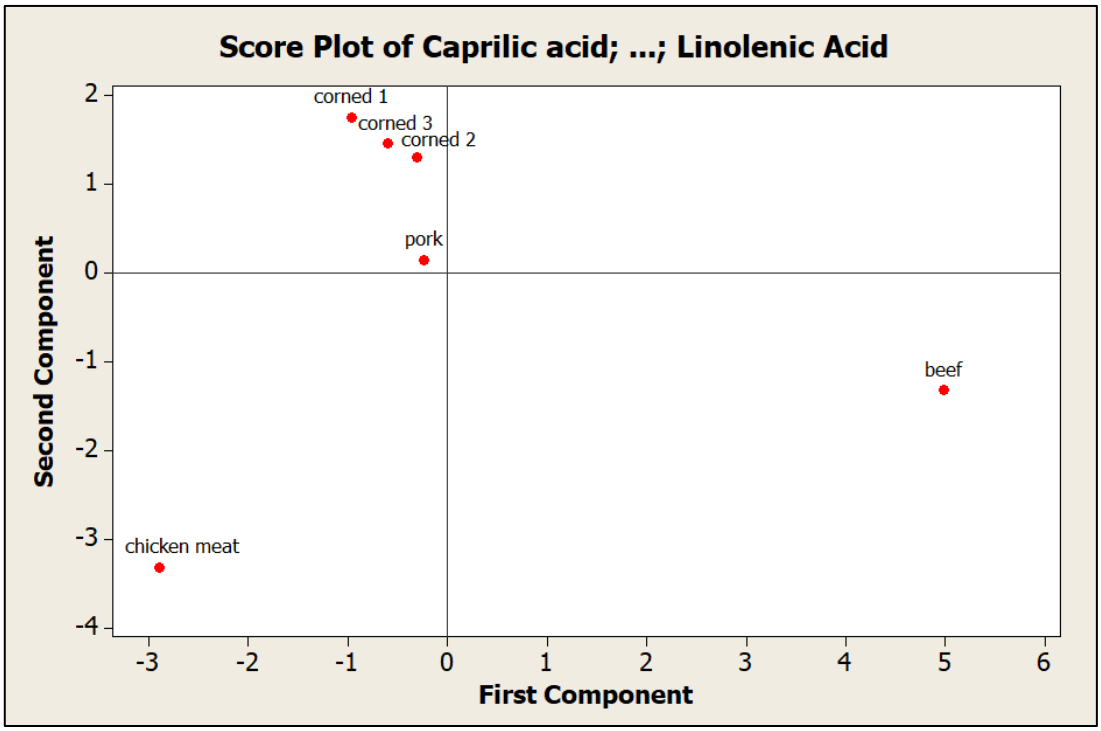

Figure 7. The results of the analysis of plot scores for chicken, pork, beef, and corned beef 1, 2, and 3

Based on the resulting score plot in Figure 7, it can be seen that the corned beef samples 1,2,3, and pork are in the upper left quadrant, while chicken meat is in the lower left quadrant and beef is in the lower right. It indicates that the analysis of Fatty acids provides results in the form of samples divided into 4 quadrants. Based on the score plot, sample points that have the greatest contribution or influence can be seen by looking at the distance between the sample points. The farther is from the origin (0,0), the greater its contribution to the PCA process. [18,19] Based on the results of the PCA score plot in Figure 7, it can be seen that corned beef samples 1, 2, 3, and pork are located in the same quadrant. The closer the distance between the points is, the closer the relationship between the samples being analyzed will be.[20] Therefore, qualitative analysis using PCA, corned beef samples 1, 2, and 3 have almost the same fatty acid content as pork.

CONCLUSION

Based on the analysis results, it is known that all tested corned beef samples showed almost the same fatty acid content as pork. as corned beef samples 1, 2, and 3 were located in the same quadrant. The dominant fatty acids in corned samples were myristic acid, palmitic acid, stearic acid, oleic acid, and linoleic acid. The percentage of fatty acids contained in corned beef samples varied. The oleic acid contained in the corned beef samples had the highest concentration. Corned 1 contained dominant fatty acids such as myristic acid (1.58), palmitic acid (49.91), stearic acid (9.27), oleic acid (58.89), and linoleic acid (12.78). Corned 2 contained dominant fatty acids such as myristic acid (2.08), palmitic acid (48.19), stearic acid (10.20), oleic acid (49.37), and linoleic acid (8.16). Meanwhile, corned 3 contained dominant fatty acids such as myristic acid (1.54), palmitic acid (48.67), stearic acid (7.24), oleic acid (59.64), and linoleic acid (11.54).

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