INDONESIAN FOOD SCIENCE AND TECHNOLOGY JOURNAL (IFSTJ)

Journal homepage : online-journal.unja.ac.id/ifstj/issue/archive

The Effect of Sterilization Time on the Chemical, Microbiological, and Heavy Metal Characteristics of Canned Paniki Chicken

Hamidin Rasulu[1,*], Janiah Husen[1], Syamsul Bahri[1], Angela Wulansari[1], Nurjanna Albaar[2], Mila Fatmawati[2], Ikrima M. Mustafa[3], Asep Nurhikmat[4], Andi Santi[5], Nancy Kiay[6], Nabel Ahmed A Mansour[7]

[1]*Agricultural Product Technology Study Program, Faculty of Agriculture, Khairun University, Ternate 9717, Indonesia*

[2]*Agribussines Study Program, Faculty of Agriculture, Khairun University, Ternate 9717, Indonesia*

[3]*Management Technology Study Program, Faculty of Economic and Bussinnes, Khairun University, Ternate 9717, Indonesia*

[4]*BPTBA BRIN, Yogyakarta, Indonesia*

[5]*Departement of Aquatic Product Processing and Storage, Pangkep State Polytechnic of Agriculture, Makassar, South Sulawesi, Indonesia*

[6]*Agricultural Product Technology Study Program ,Faculty of Agricultural, Gorontalo University, Gorontalo, Indonesia*

[7]*Faculty of Medical Technology Aljufra University, Libya*

#Corresponding author: E-mail: hamidin@unkhair.ac.id

***Abstract*— The Traditional food is generally less popular with consumers, because apart from tasting different from modern food, traditional food is easily damaged. One of the traditional foods of North Maluku is chicken paniki. This research aims to determine the effect of sterilization time on the chemical, microbiological and metal characteristics of panicle chicken in canned packaging. The research design used linear regression methods and completely randomized planning with 4 treatments and 3 replications. Treatment sterilization time (W) (10, 15, 20, 25 minutes) with observation of 1, 2, and 3 months. Processing canned paniki chicken uses local chicken meat which is cut into cubes, then cleaned, and cooked with local spices, then seaming, exhausting at ±70^{0}C, closing the can, sterilizing at 121^{0}C for 30 minutes. The results of variance analysis showed that different sterilization times had a significant effect on canned paniki chicken on the values of water content, ash content, fat, protein, carbohydrates, total energy, and TBA (2-thiobarbituric acid) values. Meanwhile, the total plate count has no significant effect with the average value during storage for one month, two months and three months, namely 1x10^1 CFU/g in all treatments, still below the maximum limit for the number of bacteria that can be present in the product. In conclusion, the sterilization time for canned paniki chicken has a significant effect on the physicochemical properties and no heavy metal contamination was found and the total plate count in all treatments was still below the maximum limit for bacteria in the product.**

***Keywords*— Traditional Food, Canned Paniki Chicken, Sterilization**

Manuscript received Aug 04, 2024; revised Sept 07, 2024; accepted Dec 28, 2024. Available online December 31, 2024

I. INTRODUCTION

Indonesia has many types of culinary dishes, each associated with unique flavors and distinctiveness related to the raw materials, methods of preparation, and ways of serving and eating, which distinguish them from those of other countries or regions. The taste of traditional food is very specific to each region [1].

Traditional foods often have a short shelf life and can only last for 24 hours at room temperature [2]. The ingredients and ways of serving each traditional food are different, requiring special techniques for packaging and preservation [3]. One effective method to extend the shelf life of traditional foods is preservation technology [4]. Developing advanced preservation methods can extend the shelf life of traditional foods [5]. North Maluku has a variety of typical traditional foods made from local ingredients, one of which is paniki chicken, at first glance paniki chicken looks like Indonesian traditional chicken coconut curry called *gulai* or *opor ayam*. But there are differences between the three chickens. *Gulai ayam* and *opor ayam* are usually seasoned and can be eaten immediately.

Unlike Paniki Chicken, the cooking method and additional ingredients give paniki chicken a distinctive taste.

Paniki chicken contains enough water and oil/fat, resulting in a short shelf life. Damage to foodstuffs with high fat/oil content is caused by the oxidation process. In addition, substandard heating is a major source of food deterioration. One of the efforts to prevent food spoilage with high fat and oil content is to improve processing and packaging techniques [6]. Packaging can prevent physical, chemical and microbiological damage to food [7].

Therefore, to increase shelf life and enhance food safety, innovation with more modern technology is needed, such as canned retort [8]. Processing ready-to-eat raw chicken can be achieved through preservation techniques, specifically using canned packaging [9]. The principle of can retort packaging is the same as canning, where sterilization is carried out to kill spoilage microbes and pathogens using heat at a specific time and temperature [10].

Canning is a food preservation technique that involves hermetically packaging food in containers such as cans, aluminum, or glass [11]. These containers are sealed tightly to prevent the penetration of air and water, thereby avoiding oxidation damage and taste changes [12]. The food undergoes a sterilization process to kill spoilage bacteria and pathogenic bacteria [13].

Sterilization was carried out at a temperature of 121 °C for packaging cans and retort bags [14]. To optimize the sterilization process of canned food, it is necessary to warm up at certain times which the process has two main objectives, namely producing commercially sterile products and cooking food until the cans are ready for consumption [15]. The use of canned packaging in *sambel roa* product uses commercial sterilization temperatures so that *sambel roa* products are safe for consumption and product durability up to 3 years [16]. Characteristics of organoleptic quality of paniki chicken packaged using the canning process [17] In addition, the process of canning wax vegetables with the use of commercial sterilization temperatures can maintain product nutrition and maintain the taste of canned *sayur lilin* food as a superior product for traditional North Maluku food [18]. The length of sterile time affects not only the durability of the product, but also the nature of the product [19].

The sterilization process of canned products with a long enough time will affect the characteristics of the products produced, namely the products will become softer and less desirable by consumers [20]. Therefore, the focus of this research is to study the effect of sterilization time on the chemical, microbiological, and heavy metal characteristics of canned paniki chicken.

II. MATERIAL AND METHODS

A. Material

The raw materials used in processing paniki chicken are local chicken breast and thighs and fresh coconut milk.

B. Methods

1. Processing of Paniki Chicken Products

The processing of paniki chicken products begins by preparing raw materials including 1000 g chicken meat cut into cubes, 500 ml fresh coconut milk, and other additional ingredients that have been ground, such as 50 g shallots, 40 g garlic, 150 g curly chilies, 150 g ground turmeric 10 g, galangal 20 g, lemongrass 25 g, pepper 10 g, salt 25 g, seasoning to taste. Next, cook the chicken for 10-15 minutes, then add the ground additional ingredients, then add the coconut milk and let it boil for 10-15 minutes. Then remove the chicken paniki and let cool.

2. Processing of Canned Paniki Chicken Products

The canned paniki chicken begins by putting 180 g of chicken paniki into a can, then tiring at a minimum temperature of 70°C for ± 25 minutes, then seaming. Followed by the sterilization process using an autoclave at a temperature of 121 °C, lasting 15, 20 and 25 minutes, after completion of sterilization then finishing the product by immersing it in cold air to a temperature of 40 °C, then quarantined for ± 14 days to ensure that the cans do not suffer. damage, then observations were carried out for 1, 2, and 3 months while testing the quality of canned paniki chicken.

C. Statistical Analysis

The design used in this study was a complete randomized design (CRD) treatment factor, namely sterilization time (W) consisting of four levels (10 minutes, 15 minutes, 20 minutes, and 25 minutes). This study had 4 treatments repeated 3 times, so that in total it resulted in 12 treatment combinations, namely 3x3x3 experimental units. The data obtained were analyzed using linear regression methods and fingerprint analysis, with the Complete Random Design (CRD) model. If there is a difference, to determine the difference between treatments, the Least Significant Difference (LSD) is carried out at α 0.05.

D. Analysis Methods

1. Determination of moisture content in canned paniki chicken according to AOAC 930.15 and ash content to AOAC 942.05standard methods. The fat content of samples using paniki chicken which was dried first and then determined gravimetrically using the Soxhlet method was extracted using hexane. And canned paniki chicken protein was determined by extracting the sample with 10 (% w/v) NaOH for 20 minutes at a temperature of 120 ^{0}C. The filtration process was carried out on the supernatant and diluted with distilled water to 100 ml. This extract was used for protein determination (total nitrogen content × 6.25) according to the Kjeldahl method. Meanwhile, carbohydrate analysis (based on differences) (AOAC, 2005).
2. The test using the TBA method for canned paniki chicken was carried out by adding 0.5 g of solution with 10% TCA, vortexing then centrifuging for 10 minutes then taking the supernatant. The supernatant was put into a test tube and TBA was added, vortexed and heated in a water

bath at 100°C for 10 minutes, cooled, and the absorbance at λ 532 nm was read and the percentage of hydroxyl radical inhibition was calculated.

3. Microbiological testing utilizing 3.5 g of PCA (Count Count Agar) media in an Erlenmeyer flask with 200 ml of distilled water to measure the total plate number (ALT) based on SNI 01–2332–3–2006 with a sample of 25 g of canned paniki chicken. Using a magnetic stirrer, PCA is heated for ten minutes or until the solution turns clear. After being placed in a sterile plastic container with 225 milliliters of Butterfield Phosphate (BFP) solution, the canned chicken paniki samples were homogenized. Pour 12–15 ml of PCA into a sterile petri plate after pipetting twice as much of the 1 ml dilution. For a full day, the petri dish was kept in the incubator. A colony counter is used to count the number of colonies that are growing on petri dishes. Between 25 to 250 bacterial colonies were counted in the petri plate.
4. Heavy metal content (SNI 18-13-14 / MU / SMM-SIG (ICP MS). Graded dilution was used to create Pb standard solutions with concentrations of 0.00, 0.30, 0.60, 0.90, 1.20, and 1.50 mg/L from a 100 mg/L Pb standard solution. A spectrophotometer was used to evaluate the absorbance. Atomic Absorption at 283.3 nm in wavelength. Graded dilution was used to create Cu standard solutions with concentrations of 0.00, 0.50, 1.00, 1.50, 2.00, and 2.50 mg/L. The regression equation from the standard calibration curve can be used to determine the concentrations of Pb and Cu metals. Wet digestion samples of canned chicken panicles were identified using an Atomic Absorption Spectrophotometer.

III. Result and Discussion

A. Moisture Content

Moisture content is very important for the quality of food products. Free moisture content can cause chemical reactions, enzymatic changes, and the development of microorganisms. This usually occurs at high water content and will affect environmental variables such as pH and temperature. Moisture content also affects product stability and quality [21]. Figure 1 shows the moisture content value with sterilization time for canned paniki chickens.

Figure 1 illustrates how the sterilization time will lower the free water content in food items, as the decline in moisture content in the third month was more pronounced with a sterilization period of 25 minutes.

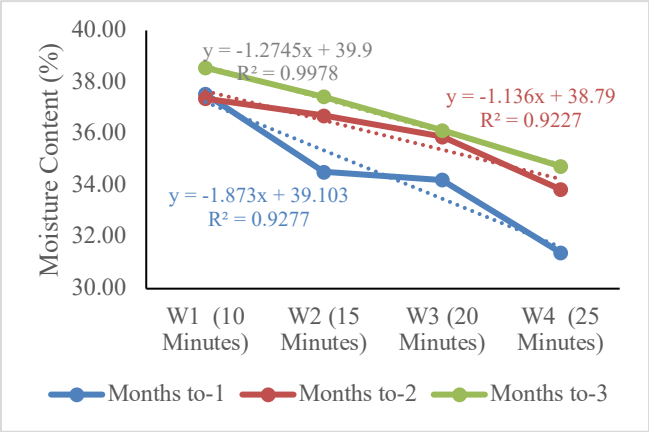

Fig. 1 The average value of moisture content of sterilization time against chickens paniki cans.

According to the resulting moisture content value shown in Figure 1. The decrease in moisture content is greater when the sterilization time is extended. In the first month of storage, the average moisture content ranges from 31.40–37.54%. The lowest value was recorded in W4 treatment for 25 minutes of sterilization with 31.40% and the highest moisture content was recorded in W1 treatment for 10 minutes of sterilization with 37.54%. In the second month, the average moisture content ranged from 33.85 - 37.36%. The lowest value was recorded in W4 treatment for 25 minutes of sterilization with 33.85% and the highest moisture content was recorded in W1 treatment for 10 minutes with 37.36%. In the third month of storage, the moisture content ranged between 33.74 and 38.56%. The W4 treatment had the lowest moisture content at 25 minutes of sterilization, 34.74%, and the W1 treatment had the highest moisture content at 10 minutes of sterilization, 38.56%.

TABLE I
MOISTURE CONTENT OF STERILIZATION TIME OF CANNED PANIKI CHICKENS

Sterilization Time (Minutes)	Moisture content (%)		
	Length of Storage (Months)		
	1	2	3
W1 (10 minutes)	37.54a	37.36b	38.56c
W2 (15 minutes)	34.53b	36.71b	37.43bc
W3 (20 minutes)	34.22b	35.89b	36.13ab
W4 (25 minutes)	31.40a	33.85a	34.74a
LSDα0.05	0.95	0.65	0.58

Remarks: An average number followed by the same notation means no real difference.

The relationship of moisture content during storage is strongly influenced by sterilization time, as shown by the regression results shown in Figure 1. The coefficient of determination of the moisture content is 0.9277 from the regression equation y = -123x+64.32. The coefficient of determination of the water content for two months is 0.9227 from the regression equation

y = -1.136x+38.79, and the coefficient of determination of the water content for three months is 0.9978 from the regression equation y = -1.2745x+39.9.
Fingerprint analysis showed that sterilization time significantly affected the moisture content of canned chickens during storage periods of one month, two months, and three months. LSD test results show that over a one-month storage period, each treatment increases the moisture content. The longer the storage time, the more likely the moisture content increases. This is due to the fact that during the manufacturing process of panicked chicken, binders such as coconut milk that easily absorb water are used. This is because changes in the structure of amylose are caused by temperature and ripening time. When the storage period is complete, the moisture content increases because the hydrolysis process is accelerated by the ambient temperature.
The cooking process using high temperatures, the moisture content in foodstuffs decreases [22]. The type of foodstuff, the temperature used, and the duration of the cooking process determine the rate of decrease or increase in nutritional content [23]. Stated that higher starch temperature and heating duration lead to lower amylose levels due to amylose depolymeration, which results in low molecular weight amylose [24]. Low molecular weight amylose is more prone to retrogradation, which means it reminds amylose and releases water.

B. Ash Content

Ash is the residual organic matter produced from the combustion of organic matter. Ash content is closely related to the mineral content in food, purity, and food hygiene. Most foodstuffs consist of 96% organic matter and water, with inorganic minerals remaining [25].
Figure 2. indicates that the longer the sterilization time, the greater the decrease in ash content. In the first month of storage, the average ash content values ranged from 1.22–1.61%, with W4 having the lowest value at 25 minutes of sterilization with 1.22%, and W1 having the highest value at 10 minutes of sterilization with 1.61%. In the second month, the average ash content value ranges from 1.51–1.70%. In the third month of storage, ash content ranged between 1.56 and 1.78%, with the lowest ash content in W4 treatment at 25 minutes sterilization time at 1.51% and the highest ash content in W1 treatment at 10 minutes sterilization time at 1.78%. The longer sterilization time resulted in lower ash content compared to other methods. This is because high temperatures and sterilization durations can break mineral bonds in the product.
The relationship of ash content during storage is strongly influenced by sterilization time, as shown by the regression results shown in **Figure 2**. The coefficient of determination for ash content for one month is 0.9924 from the regression equation y = -0.128x+1.73. For two months, the coefficient of determination is 0.9512 from the regression equation y = -0.0645x+1.7475. For three months, the coefficient of determination is 0.7714 from the regression equation y = -0.063x+1.85.

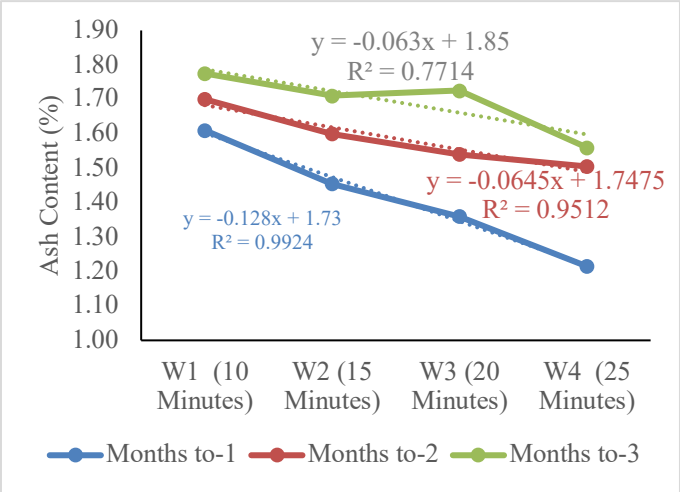

Fig. 2 Average Ash Content Value of Sterilization Time of Canned Paniki Chickens

TABLE 2
ASH CONTENT OF STERILIZATION TIME OF CANNED PANIKI CHICKENS

Sterilization Time (Minutes)	Ash (%)		
	Length of Storage (Months)		
	1	2	3
W1 (10 minutes)	1.61c	1.70b	1.78b
W2 (15 minutes)	1.46b	1.60b	1.71b
W3 (20 minutes)	1.36b	1.54a	1.73b
W4 (25 minutes)	1.22a	1.51a	1.56a
LSDα0.05	0.4	0.4	0.4

Remarks: Average numbers followed by the same notation mean no real difference.

According to the LSD test results, **Table 2** shows that sterilization time affects the ash content of canned paniki chickens for one month, two months, and three months of storage. The steaming or evaporation process causes an increase in ash content, which causes concentration of materials left behind, one of which is minerals [26]. However, it is different in the W4 treatment, with a sterilization time of 25 minutes, which results in the longest reduction in ash content. This can be caused by the breakdown of the chemical bonds of some minerals that paniki chickens have. It is also caused by water, which can increase ash content.

C. Fat Content

Fat content is an undissolved nonpolar ester consisting of fatty acids and glycerol [27]. All foods, both animal and vegetable, contain fat [28]. **Figure 3**. Indicates the value of fat content with sterilization time for canned paniki chickens.

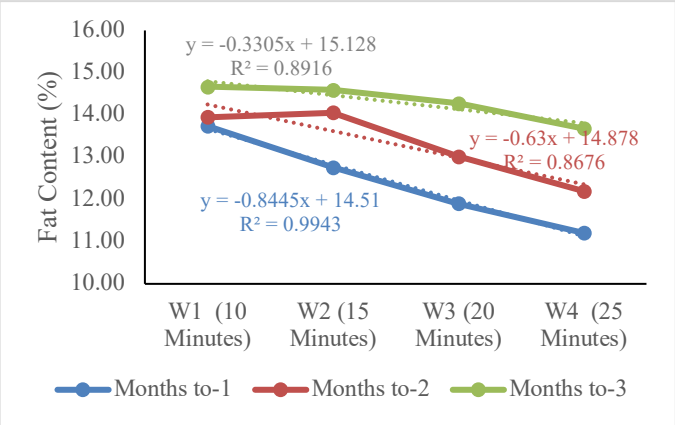

Fig. 3 The average value of fat content sterilization time for canned paniki chickens

Figure 3. shows that the decrease in fat content is greater with longer sterilization times. In the first month of storage, the average fat content ranges between 11.21 and 13.74%. The W4 treatment had the lowest fat content at 25 minutes sterilization time, with 11.21%, and the W1 treatment had the highest fat content at 10 minutes sterilization time, with 13.74%. In the second month, there was a variation between 12.20 to 14.05%. The lowest value for W4 treatment at 25 minutes sterilization time was 12.20%, and the highest value for W2 treatment at 15 minutes sterilization time was 14.05%. In the third month, there was a variation between 13.67 to 14.67%. The lowest value for W4 treatment at 25 minutes sterilization time was 13.68 percent, and the highest value for W2 treatment at 15 minutes sterilization time with a value of 14.59 %. After the processing process, there will usually be fat damage to the material. The degree of damage varies depending on the duration of the sterilization process. According to [29], tissue fluid loss during the cooking process is the main cause of decreased fat content in chicken meat that has been steamed or boiled. Heating will make fat removal easier and speed up the movement of fat molecules into large ones.

TABLE 3
FAT CONTENT OF STERILIZATION TIME OF CANNED PANIKI CHICKENS

Sterilization Time (Minutes)	Fat (%)		
	Length of Storage (Months)		
	1	2	3
W1 (10 minutes)	13.74b	13.95b	14.67b
W2 (15 minutes)	12.76a	14.05b	14.59b
W3 (20 minutes)	11.90a	13.02a	14.27a
W4 (25 minutes)	11.21a	12.20a	13.68a
LSDα0.05	0.66	0.43	0.31

Remarks: Average numbers followed by the same notation mean no real difference.

The relationship of fat content during storage is significantly affected by sterilization time, as shown by the regression results presented in **Figure 3**. In one month, fat content has a coefficient of determination with a value of R2 = 0.9943 from the regression equation, y = -0.8445x + 14.51. In two months, the coefficient of determination was 0.676 of the regression equation, y = -0.63x+14.878. In three months, the coefficient of determination was 0.8915 from the regression equation, y = -0.3305x+15.128.

According to the LSD test results, fingerprint analysis showed that sterilization time actually affected the fat content of canned paniki chicken for one month, two months, and three months of storage. Results showed that the longer the storage time, the higher the fat content in each treatment, and the longer the storage time tended to result in an increase in fat content. This is due to the process of making panicked chicken with binders such as coconut milk and coconut oil. During the storage process, the moisture content of the material, the storage temperature, and the humidity of the room change, and the longer the storage, the fat content increases, and the fat breakdown is accelerated by the material's contact with air, light, and temperature. When rancidity and an increase in microbes appear, damage begins to occur [30].

D. Protein Content

The body needs protein as fuel, builder, and regulator. Polymers of amino acids bound to peptide bonds are called proteins. Protein molecules consist of elements C, H, O, and N, which have no fats or carbohydrates. **Figure 4** shows the value of protein content with sterilization time for canned paniki chickens.

According to **Figure 4**, a decrease in protein levels is positively correlated with sterilization duration. In the first month of storage, the average protein content ranges between 20.80 and 23.65%. W4 treatment at 25 minutes sterilization time had the lowest protein content of 20.80% and W1 treatment at 10 minutes sterilization time had the highest protein content of 23.65%. In the second month, the average protein content ranged between 22.22 and 23.61%. W4 treatment at 25 minutes sterilization time had the lowest protein content of 22.22% and W1 treatment at 10 minutes sterilization time had 23.61% content. In the third month of storage, protein values ranged between 23.00 and 24.55%. The lowest protein content was found in the W4 treatment for 25 minutes of sterilization with 44%, and the highest protein content was found in the W1 treatment for 10 minutes of sterilization with 24.55%. This is due to protein hydrolysis during the sterilization process, which results in a decrease in the nutritional content of protein [31].

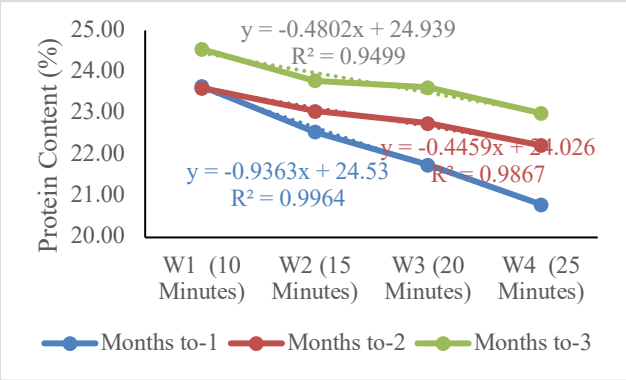

Fig. 4 Average Value of Protein Content Sterilization Time of Canned Paniki Chicken

TABLE 4
PROTEIN CONTENT OF STERILIZATION TIME OF CANNED PANIKI CHICKENS

Sterilization Time (Minutes)	Protein (%)		
	Length of Storage (Months)		
	1	2	3
W1 (10 minutes)	23.65d	23.61c	24.55b
W2 (15 minutes)	22.55c	23.05bc	23.79b
W3 (20 minutes)	21.76b	22.76b	23.62a
W4 (25 minutes)	20.80a	22.22a	23.00a
LSDα0.05	0.17	0.22	0.31

Description: The average number followed by the same notation means no real difference

The relationship of protein levels during storage is strongly influenced by sterilization time, as shown by the regression results presented in **Figure 4**. For one month, there is a coefficient of determination for protein levels, with the value R2 = 0.9964 from the regression equation y = -0.9363x+24.53. For two months, there is a coefficient of determination with the value R2 = 0.9867 from the regression equation y = -0.4459x+24.026, and for three months, there is a coefficient of determination with the value R2 = 0.9499 from the regression equation y = -0.4802x+24.939.
Fingerprint analysis showed that sterilization time actually affected the protein levels of canned paniki chickens for one month, two months, and three months of storage. The results of the LSD test showed that the longer the storage time, the higher the protein content in each treatment. During storage, the fixated (absorbed) compounds are hydrolyzed into the fiber network measured as proteins.

D. *Carbohydrate Content*
Carbohydrates are inorganic compounds composed of carbon, hydrogen, and oxygen. Carbohydrates function to determine food characteristics such as taste, color, and texture [32]. **Figure 5**. Indicates the value of carbohydrates with sterilization time for canned paniki chickens.

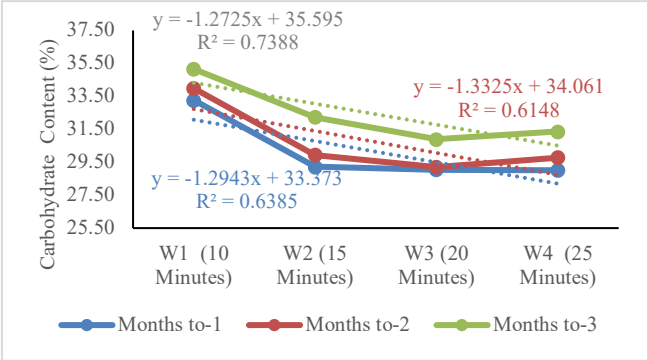

Fig. 5 Average Value of Carbohydrate Content Sterilization Time Against Canned Paniki Chickens

Figure 5. showed that a greater decrease in carbohydrates was related to sterilization duration. In the first month of storage, the average carbohydrate values ranged between 29.01 and 33.27%. The lowest carbohydrate value was found in W4 treatment for 25 minutes of sterilization with a value of 29.01%, and the highest carbohydrate value was found in W1 treatment for 10 minutes of sterilization with a value of 33.27%. In the second month, the average carbohydrate values ranged between 29.79 and 33.99%. The lowest carbohydrate value was found in W4 treatment for 25 minutes of sterilization with a value of 29.79 and the highest carbohydrate was found in W1 for 10 minutes with a value of 33.99%. In the third month of storage, carbohydrate values ranged between 31.36 and 35.16%. The W4 treatment had the lowest carbohydrate value during 25 minutes of sterilization, with 31.36%, and the W1 treatment had the highest carbohydrate value during 10 minutes of sterilization, with 35.16%.

TABLE 5
CHARBOHIDRAT CONTENT OF STERILIZATION TIME OF CANNED PANIKI CHICKENS

Sterilization Time (Minutes)	Carbohydrate (%)		
	Length of Storage (Months)		
	1	2	3
W1 (10 minutes)	33.27b	33.99c	35.16c
W2 (15 minutes)	29.21a	29.94b	32.24b
W3 (20 minutes)	29.05a	29.20a	30.90a
W4 (25 minutes)	29.01a	29.79b	31.36a
LSDα0.05	0.71	0.42	0.43

Remarks: An average number followed by the same notation means no real difference.

The carbohydrate content relationship during storage is significantly affected by sterilization time, as shown by the regression results presented in **Figure 5**. For one month, protein levels have a coefficient of determination with a value of R2 = 0.6385 from the regression equation y = -01.2943x+33.373. For two months, carbohydrate levels had a coefficient of determination with a value of R2 = 0.6148 from the regression equation y = -1.3325x+34.061. For three months, carbohydrate

levels had a coefficient of determination with a value of R2 = 0.7388 from the regression equation y = -1.2725x+35.595.
Fingerprint analysis showed that sterilization time affected canned chicken carbohydrates for one month, two months, and three months of storage, as shown in the LSD test results in **Table 5**. The amount of proportion of the content of the value of water, ash, protein and fat affects the amount of carbohydrates; state that by reducing water content, food will contain more nutrients such as carbohydrates, proteins, and minerals, but vitamins and coloring agents will be lost.

E. Total Energy

Figure 6. shows the total energy value with sterilization time against canned panicked chickens. This value is calculated from the total fat, protein, and carbohydrates, as well as carbohydrates and dietary fiber available.

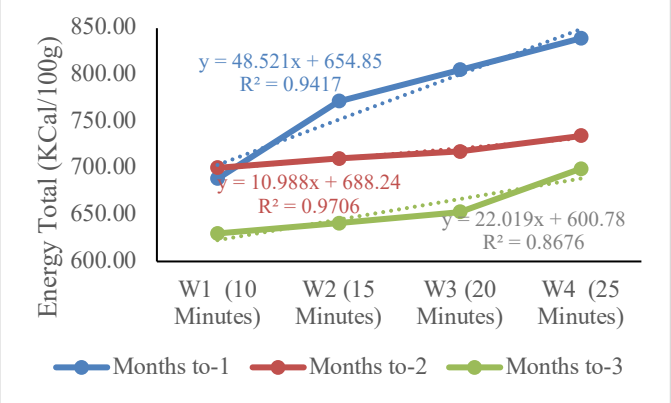

Fig. 6 Average Energy Total Value of Sterilization Time Against Canned Paniki Chickens

According to **Figure 6**, an increase in total energy is associated with a longer sterilization time. In the first month of storage, the average total energy value ranged between 688.59 and 839.12 KCal/100g. The W1 treatment has the lowest total energy value, which is 688.59 KCal/100g, and the W4 treatment has the highest total energy value, which is 839.12 KCal/100g. In the second month, the average total energy value ranged between 700.31 and 734.46 KCal/100g. During 10 minutes of sterilization, the W1 treatment had the lowest total energy value, 700.31 KCal/g. The W4 treatment had the highest total energy value, 734.46 KCal/g, during 25 minutes of sterilization. In the third month of storage, the total energy value ranged between 630.01 and 699.39 KCal/g. The W1 treatment had the lowest energy value, 630.01 KCal/g, for 10 minutes of sterilization, and the W4 treatment had the highest energy value, 699.39 KCal/g, for 25 minutes of sterilization. Sterilization increases carbohydrate, ash, and total energy content, but water, protein, and fat content tends to decrease with time. It is associated with three components of the chicken paniki menu: carbohydrates, fats and proteins.
The large concentration of proteins, fats, and carbohydrates affects the calorific value based on rough calculations, and the longer the sterilization time, the more water comes out of the material, resulting in an increase in the concentration of other components [33]. Since water accounts for most of the weight of food without adding energy, an increase in the amount of water in the food can lead to a decrease in energy content [34].

TABLE 6
ENERGY TOTAL OF STERILIZATION TIME OF CANNED PANIKI CHICKENS

Sterilization Time (Minutes)	Energy Total (KCal/100g)		
	Length of Storage (Months)		
	1	2	3
W1 (10 minutes)	688.59a	700.31a	630.01a
W2 (15 minutes)	771.64b	710.33a	640.95a
W3 (20 minutes)	805.27bc	717.74a	652.98b
W4 (25 minutes)	839.12c	734.46b	699.39c
LSDα0.05	12.35	7.42	6.04

Remarks: An average number followed by the same notation means no real difference.

The sterilization time exerts a major influence on the total energy relationship during storage, as shown by the regression results shown in **Figure 6**. The coefficient of determination for the amount of energy for one month is 0.9417 from the regression equation y = 48.521x+654.85. The coefficient of determination for two months is 0.9706 from the regression equation y = 10.988x+688.24, and for three months, the coefficient of determination is 0.8676 from the regression equation y = -22.019x+600.78.
Fingerprint analysis shows that sterilization time affects the total energy of canned chickens for one month, two months, and three months of storage, as shown in the LSD test results in **Table 6**.

F. Thiobarbituric Acid (TBA)

One of the common parameters used to measure the level of rancidity of food products is the amount of TBA (2-thiobarbituric acid). This tension is caused by the oxidation of unsaturated fatty acids in the oil by air oxygen. **Figure 7**. indicates the value of TBA with sterilization time for canned paniki chickens.
According to **Figure 7**, the longer the sterilization time, the higher the TBA value. The average TBA value in the first month of storage ranged from 0.12-0.21%, with W4 treatment having a value of 0.12% at 25 minutes and W1 treatment having the highest value, 0.21% at 10 minutes sterilization time. In the second month of storage, the TBA value ranges from 0.14-0.25%. The W3 treatment had the lowest TBA value of 0.14% at 20 minutes sterilization time, and the W1 treatment had the highest TBA value of 0.25% at 10 minutes sterilization time. In the third month of storage, the TBA value ranges from 0.19-0.40%. The W4 treatment had the lowest TBA value of 0.19% at 25 minutes sterilization time, and the W1 treatment had the highest TBA value of 0.40% at 10 minutes sterilization time. It is suspected that the longer the sterilization time can inhibit the increase in malonaldeid levels produced. The product can be bound well if the TBA content is below 3 mg malonaldehyde/*kg* sample.

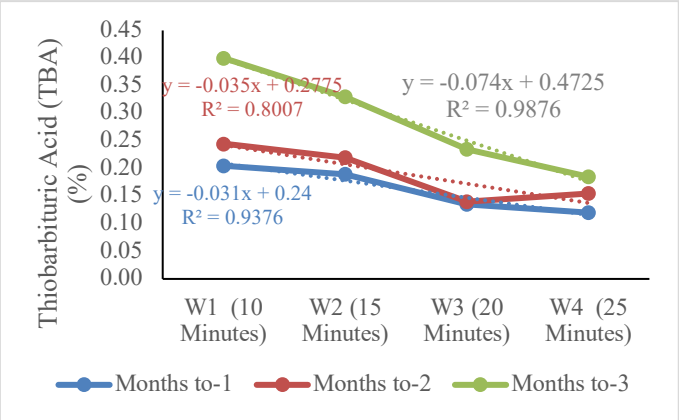

Fig. 7 The average value of TBA sterilization time against chickens paniki cans.

So it can be concluded that paniki chickens with sterilization time treatment of 10-25 minutes are still accepted by consumers. This shows that the increase in TBA number is due to rancidity that occurs due to changes in fat composition, then oxidizes to produce peroxides, ketones, and aldehydes. This shows that can packaging is the most effective packaging as a product protector against the ingress of air, gases, and microbes and is caused by changes in porosity or damage (deformation) of cans due to high temperatures and too short a time (which means also high pressure) given during the sterilization process, so that the vacuum level is reduced, and provides a buffer for the oxidation process during storage.

TABLE 7
TBA CONTENT OF STERILIZATION TIME OF CANNED PANIKI CHICKENS

Sterilization Time (Minutes)	TBA (%)		
	Length of Storage (Months)		
	1	2	3
W1 (10 minutes)	0.21b	0.25c	0.40b
W2 (15 minutes)	0.19b	0.22bc	0.33b
W3 (20 minutes)	0.14a	0.14a	0.24a
W4 (25 minutes)	0.12a	0.16ab	0.19a
LSDα0.05	0.01	0.02	0.03

Remarks: An average number followed by the same notation means no real difference.

The TBA relationship that occurs during storage is strongly influenced by sterilization time, as shown by the regression results presented in **Figure 7**. The one-month TBA value has a coefficient of determination with the value R2 = 0.9376 from the regression equation y = -0.031x+0.24. The two-month TBA value has a coefficient of determination with the value of R2 = -0.8007 from the regression equation y = -0.035x+0.2775, and the three-month TBA value has a coefficient of determination with the value of R2 = 0.9876 from the regression equation y = -0.074x+0.4725.

Fingerprint analysis showed that sterilization time had a significant impact on the TBA of canned panicked chickens during storage of one month, two months, and three months, as shown in the LSD test results in **Table 7**. TBA testing is performed to measure the amount of aldehydes produced as a byproduct of fat degradation or fatty hydro peroxide due to hydrolysis reactions affected by the high moisture content of the material. This suggests that the increase in the amount of TBA is due to changes in fat composition, which then undergo oxidation, which produces peroxides, ketones, and aldehydes. The maximum limit of TBA is around 0.5 mg malonaldehyde/Kg. However, according to SNI 01-2352-1991, the TBA value of the product that is still good is 0.22-0.28 mg malonaldehyde/Kg. This value is still below the maximum limit, so canned panicked chickens do not experience rancidity. This shows that canned packaging is the best way to protect products from air, gases, and bacteria.

G. Total Plate Count (TPC)

The Total Plate Count (TPC) principle is used to calculate colony growth of mesophilic aerobic bacteria after the sample is implanted on a solid media plate. The total plate count is a number that indicates the number of colonies of mesophilic aerobic bacteria per gram or milliliter of a test sample.
Sterilization of canned panicked chickens shows good results because TPC is maintained for ten, twenty, and twenty-five minutes. As a result, the TPC value remains at the same 1x101 value for three months of storage. **Table 8**. Shows the value of the total plate number for three months of storage of canned panicked chickens.

TABLE 8
TOTAL PLATE COUNT (TPC) OF STERILIZATION TIME OF CANNED PANIKI CHICKENS

Sterilization Duration (Minutes)	Total Plate Count (TPC) (CFU/g)		
	Length of Storage (Months)		
	1	2	3
W1 (10 minutes)	1x101	1x101	1x101
W2 (15 minutes)	1x101	1x101	1x101
W3 (20 minutes)	1x101	1x101	1x101
W4 (25 minutes)	1x101	1x101	1x101

H. Heavy Metals Contamination

The results of metal contamination analysis on canned chicken products did not show Hg, Cd, As, Sn, and Pb contamination. This may be because the concentration of Hg, Cd, As, Sn, and Pb contamination is so small that the tool cannot identify them. Thus, from the point of view of contamination levels, the entire sample of panicked chicken is safe for consumption. This is due to the fact that different sterilization processes do not change how foodstuffs interact with cans. **Table 9**. shows the results of metal contamination analysis.

TABLE 9
METAL CONTAMINATION OF STERILIZATION TIME OF CANNED PANIKI CHICKENS

Duration of Storage (months)	Treatment	Heavy Metals				
		Merkuri (Hg) (mg/kg)	Kadmium (Cd) (mg/kg)	Arsen (As) (mg/kg)	Tin (Sn) (mg/kg)	Timbal (Pb) (mg/kg)
1	W1	ND	ND	ND	ND	ND
	W2	ND	ND	ND	ND	ND
	W3	ND	ND	ND	ND	ND
	W4	ND	ND	ND	ND	ND
2	W1	ND	ND	ND	ND	ND
	W2	ND	ND	ND	ND	ND
	W3	ND	ND	ND	ND	ND
	W4	ND	ND	ND	ND	ND
3	W1	ND	ND	ND	ND	ND
	W2	ND	ND	ND	ND	ND
	W3	ND	ND	ND	ND	ND
	W4	ND	ND	ND	ND	ND

Remarks: *ND (Not Detected)*

IV. CONCLUSION

In conclusion, the sterilization time used for canned paniki chicken has a significant effect on the physicochemical characteristics. as well as no heavy metal contamination was found in the product, and the total plate count of $1x10^1$ CFU / g in all treatments is still below the maximum limit regulation standard for bacteria in the product.

ACKNOWLEDGMENT

We would like to express our gratitude to the PDP *Kedaireka* Matching Fund 2023 funding program of the Ministry of Education and Culture, Technology and Higher Education which has helped complete this research through testing canned chicken products, as well as the BLU Production House of Khairun University which has facilitated food canning.

CONFLICT OF INTEREST

The authors declare no conflicts of interest or personal relationships with other people or organizations that can inappropriately influence this work.

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