Journal of Medical and Health Studies
ISSN: 2710-1452
DOI: 10.32996/jmhs
Journal Homepage: www.al-kindipublisher.com/index.php/jmhs

JMHS
AL-KINDI CENTER FOR RESEARCH AND DEVELOPMENT

| RESEARCH ARTICLE

The Role of Cook-Chill and Cook-Freeze Methods as Indicators of Quality of Nutrition Services in Hospital

Hanna Widya Pramandari[1], Made Astawan[2] ✉ and Nurheni Sri Palupi[3]
[123]IPB University, Indonesia
Corresponding Author: Made Astawan, **E-mail**: astawan@apps.ipb.ac.id

| ABSTRACT
An outbreak of COVID-19 cases among food and nutrition department employees at a hospital kitchen occurred because it was difficult to maintain physical spacing between staff. There is a lack of people during self-isolation. However, the kitchen hospital must still operate 24 hours to provide meals. This study aimed to comprehensively evaluate plate waste, and patient satisfaction, associated with cook-serve methods compared to cook-chill and cook-freeze methods. The first stage of this study is to determine nutritionally appropriate, microbiologically safe foods stored after the cook-chill and cook-freeze process and customer preferences through sensory aspects using CATA. The menu that has been chosen is three protein dishes and one vegetable dish. The second stage was an experimental study conducted in a general ward at an Indonesian private hospital. Two hundred ten patients (expected admittance ≥ two days) were served meals from cook-serve, cook-chill, and cook-freeze. Patients' satisfaction and food waste were measured. Intake at mealtimes was assessed through a visible portion size assessment method. Conclusion: The results show no significant difference in satisfaction and food waste in hospitalized patients between cook-serve and cook-c, hill, and cook-freeze methods for protein dishes and a significant difference for vegetable dishes. Cook-chill and cook-freeze potential to be implemented in a hospital kitchen.

| KEYWORDS

Cook-chill, cook-freeze, cook-serve, Covid-19, kitchen hospitals.

| ARTICLE INFORMATION

ACCEPTED: 25 March 2023 **PUBLISHED:** 15 April 2023 **DOI:** 10.32996/jmhs.2023.4.2.12

1. Introduction

WHO declared the incidence of COVID-19 as a world pandemic on March 11, 2020. Health workers who work in hospitals have the highest risk of exposure to the transmission of COVID-19, including food handlers who work in hospital kitchens (Hale, 2021). Keeping a distance between workers in the hospital kitchen is difficult due to the limited kitchen area. A sufficient number of personnel during a pandemic is a challenge that must be faced in carrying out food production activities in hospital kitchens. Hospital food supply systems vary based on food preparation, processing, and delivery methods. The conventional system is a direct preparation and processing system served. The cook-chill method is a food preservation technology in which food is cooked until cooked, cooled quickly within a specific time, stored in the refrigerator, and reheated before serving (El - Ansari 2014). The application of cook-chill technology in hospital food service can be used as an alternative to providing room service for patient attendants. Of course, this will increase the economic value of hospital kitchens (McCray et al., 2018). More information about the feasibility study of the application of cook-chill technology in food service in hospitals in Indonesia made researchers interested in doing this. This research will enable hospital management to analyze the feasibility of cook-chill technology in reforming food production services in hospital kitchens during a pandemic.

1.1 Objective

This study aims to: (1) Identify the sensory characteristics of the cook-chill and cook-freeze method foods produced in a hospital kitchen, (2) Identify the microbiological and chemical characteristics of the cook-chill and cook-freeze method foods produced in the kitchen hospital, (3) Analyze the connection between feeding the cook-chill and cook-freeze methods to patient satisfaction, (4) analyzing the relationship between feeding the cook-chill and cook-freeze methods to patient leftovers.

1.2 Benefit

The results of this study are expected to inform hospital management that the cook-chill and cook-freeze methods can be developed into a method of providing hospital food that can save labor costs.

2. Method

2.1 Time and place

The first phase of the research was carried out in a hospital kitchen and Labkesda DKI Jakarta in May - June 2022. The second research phase was conducted at Siloam Hospital Lippo Village in July - August 2022.

2.2 Tools and materials

The tools used in this research were a blast-chiller and blast-freezer brand Mastercool type D5—convection oven Roller Grill 60L-GN 2/3. The ingredients used in this study were ready-to-eat food produced in a hospital kitchen consisting of chicken rendang, grilled fish in soy sauce, tempeh bacem, and broccoli cream soup.

2.3 Research Stages

2.3.1 Phase 1 research:

The first research stage is product development, menu selection, and recipe development. The menu chosen was rendang chicken, grilled fish cooked in soy sauce, tempeh bacon, and broccoli cream soup, which represented each food category. The experimental design used in this study was randomized entirely with two repetitions with different treatment factors and storage time. Of the two factors above, each treatment was repeated two times.

Type of treatment: P1 = Cook-Chill; P2 = Cook-Freeze

Long storage time for Cook-Chill:
L0 = 0 days
L1 = three days
L2 = six days
L3 = nine days
Long storage time for Cook-Freeze:
L0 = 0 days
L1 = seven days
L2 = 14 days
L3 = 21 days

In this first stage, the analysis was carried out: total microbes, water content, protein content, fat content, carbohydrate content, and total energy. Organoleptic tests include taste, aroma, and color with the CATA method and analysis of the selection of the best treatment combinations. The CATA questionnaire uses ready-to-eat food sensory attributes in Montero's (2021) and Beluso's (2016) studies.

2.3.2 Phase 2 research:

The second stage of the research consisted of selecting research subjects and giving treatment. The minimum subject size in this study was calculated by the formula (Lemeshow, 1997): $\mathbf{n} = \frac{\mathbf{Z} \propto^2 \mathbf{PQ}}{\mathbf{d}^2}$

Information:
n = Number of samples
Zα = reliability coefficient with α = 5%, so Zα = 1.96
P = The proportion of food waste research Djamaluddin et al. (2005) 0.21
Q = 1-P = 0.79
d = Precision level of 1 0%

Based on the formula above, the number of subjects is 65 people; to avoid dropping out, 10% is added to make 70 subjects. After being treated, the leftovers were evaluated using the visual Comstock method and menu satisfaction using the MAT (Meal Assessment Tools) questionnaire. Inclusion criteria for selecting inpatient subjects between July 15 – August 31, 2022, hospitalized for at least two days, treated in general wards and received a normal diet, soft diet, and high-calorie high, protein diet. Subjects were randomly assigned to the conventional method of feeding group, the cook-chill/cook-freeze method.

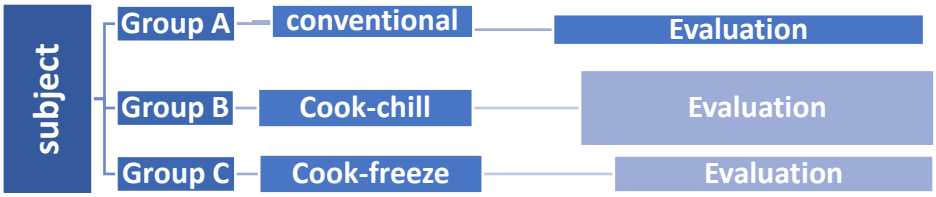

Figure 1 Experimental design randomized posttest only control and comparison group design.

2.4 Analysis Procedure

Cochran's Q test with SPSS for aroma, taste, and texture attributes. The results of patient satisfaction and food waste surveys were processed using Kruskal-Walli's test to determine whether there were significant differences in food waste data and patient satisfaction in each treatment group.

3. Results and Discussion

3.1 Microbiological Analysis

Phase one research to determine the best shelf life of the cook-chill and cook-freeze methods Microbiological analysis was carried out by sending samples to Labkesda DKI Jakarta. Repeated sample tests were carried out twice, according to SNI 7388: 2009 standard concerning the maximum limit of microbial contamination in food.

Table 1: Results of microbiological analysis of chicken rendang menus

Cooking Method	Storage Time	E. Coli (SNI 1S0 7251:2012) <3	Salmonella spp (SNI 2897:2008 point 4.5) Negative	Staphylococcus (AOAC RI 120901) Limit $1x10^3$
Cook-Chill	0	0	negative	$<1.0x10^1$
	3	0	negative	$<1.0x10^1$
	6	0	negative	$<1.0x10^1$
	9	0	negative	$<1.0x10^1$
Cook-Freeze	0	0	negative	$<1.0x10^1$
	7	0	negative	$<1.0x10^1$
	14	0	negative	$<1.0x10^1$
	21	0	negative	$<1.0x10^1$

Table 2: Results of microbiological analysis of tempe-bacem menu

Cooking Method	Storage Time	E. Coli (SNI 1S0 7251:2012) <3	Salmonella spp (SNI 2897:2008 point 4.5) Negative	Staphylococcus (AOAC RI 120901) Limit $1x10^3$
Cook-Chill	0	0	negative	$<1.0x10^1$
	3	0	negative	$<1.0x10^1$
	6	0	negative	$<1.0x10^1$
	9	0	negative	$<1.0x10^1$

Cook-Freeze	**0**	0	negative	$<1.0x10^{1}$
	7	0	negative	$<1.0x10^{1}$
	14	0	negative	$<1.0x10^{1}$
	21	0	negative	$<1.0x10^{1}$

Table 3: Results of microbiological analysis of grilled fish menus

Cooking Method	Storage Time	ALT (ISO 4833-1:2013) Limit $5x10^{5}$	Staphylococcus (AOAC RI 120901) Limit $1x10^{3}$
Cook-Chill	**0**	$<1.0x10^{1}$	$<1.0x10^{1}$
	3	$<1.0x10^{1}$	$<1.0x10^{1}$
	6	$7.7x10^{4}$	$<1.0x10^{1}$
	9	$9.05x10^{4}$	$4.75x10^{2}$
Cook-Freeze	**0**	$3.7x10^{4}$	$<1.0x10^{1}$
	7	$3.1x10^{1}$	$<1.0x10^{1}$
	14	$1.8x10^{3}$	$<1.0x10^{1}$
	21	$1.15x10^{2}$	$<1.0x10^{1}$

Table 4: Results of microbiological analysis of broccoli cream soup

Cooking Method	Storage Time	Enterobacteria (AOAC Performance Tested No. 112101:2021)	Salmonella spp (SNI 2897:2008 point 4.5) Negative	Staphylococcus (AOAC RI 120901) Limit $1x10^{2}$
Cook-Chill	**0**	$<1.0x10^{1}$	negative	$<1.0x10^{1}$
	3	$<1.0x10^{1}$	negative	$<1.0x10^{1}$
	6	$<1.0x10^{1}$	negative	$<1.0x10^{1}$
	9	$<1.0x10^{1}$	negative	$<1.0x10^{1}$
Cook-Freeze	**0**	$<1.0x10^{1}$	negative	$<1.0x10^{1}$
	7	$2.25x10^{1}$	negative	$<1.0x10^{1}$
	14	$<1.0x10^{1}$	negative	$<1.0x10^{1}$
	21	$7.25x10^{1}$	negative	$<1.0x10^{1}$

The results of the microbiological analysis of chicken rendang, based on tempeh and broccoli cream soup, showed that the cook-chill method was still safe to store until the ninth day. The cook-freeze method was still safe to store until the 21st day. According to Thipparedi and Sanchez (2006), the undetectable bacteria was probably due to the role of active compounds in spices which can function as antimicrobials during the cooking and storage process and can eliminate these bacteria. No Salmonella spp. was detected. Furthermore, S. aureus in fast food is closely related to the personal hygiene of workers and the kitchen area.

The maximum amount of ALT in baked fish products based on ISO 4883-1:2013 is $5x10^{5}$ colonies/g, so baked fish products stored using the cook-chill and cook-freeze methods with different storage periods are still suitable for consumption. Seasonings and salt added to the product function as a preservative and can inhibit microbial growth (Soeparno, 2016).

3.2 Proximate Analysis

Phase one research to determine the best shelf life of the cook-chill and cook-freeze methods. Proximate analysis was carried out by sending samples to Labkesda DKI Jakarta, sending test samples without repetition.

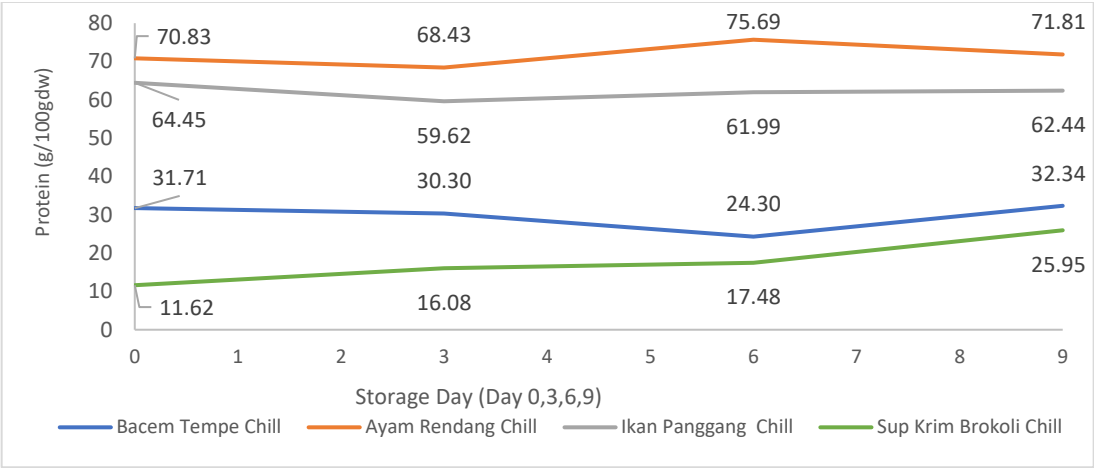

Figure 2: Protein of cook-chill products during storage (g/100 dw)

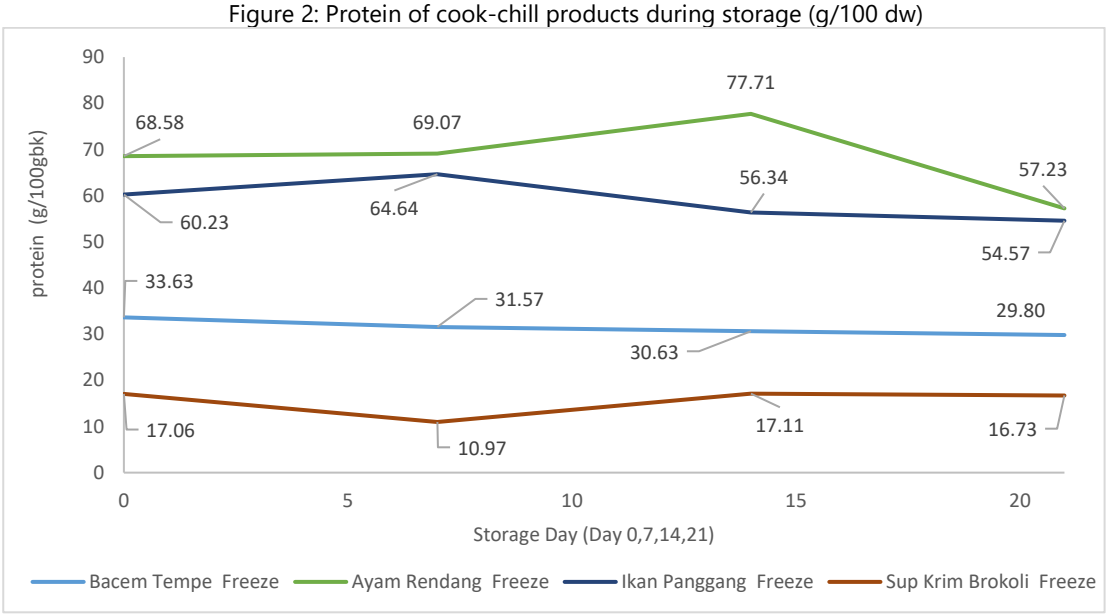

Figure 3: Protein of cook-freeze *products* during storage (g/100 dw)

3.3 Total Proteins

According to Zhang (2021), the formation and recrystallization of ice crystals during the rapid freezing process and long-term frozen storage can destroy some cells and muscle fibers, resulting in changes in protein structure, protein oxidation, and low protein thermal stability. The formation and growth of ice crystals can form non-frozen fluids, which can negatively affect muscle tissue and protein structure. The rapid cooling process is one of the appropriate methods to reduce the effects of damage to protein tissue structures. The rapid cooling process will form ice crystals of small sizes and regular shapes and equally distributed inside and outside the cell (Kaale, 2013).

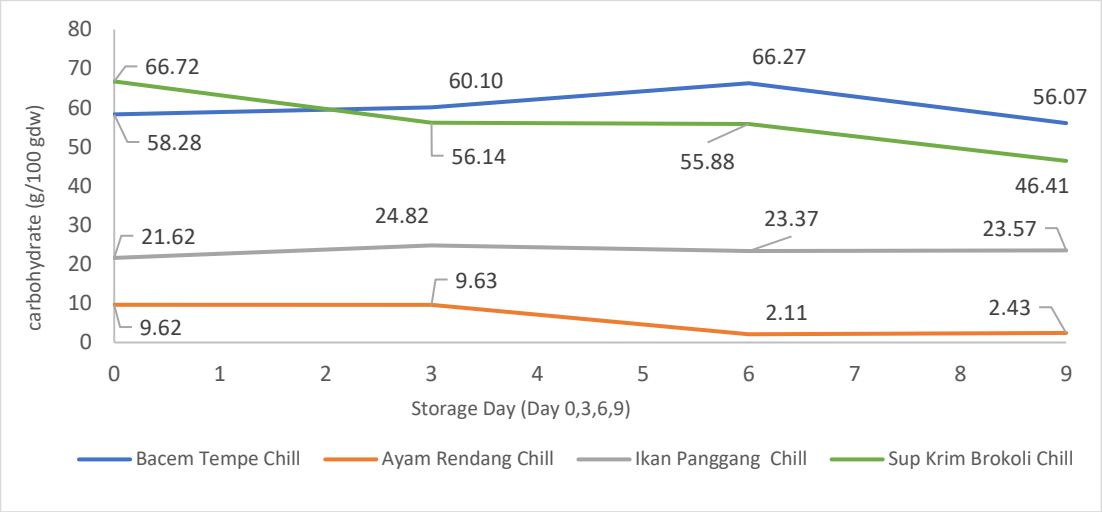

Figure 4: Carbohydrate of cook-chill products during storage (g/100 dw)

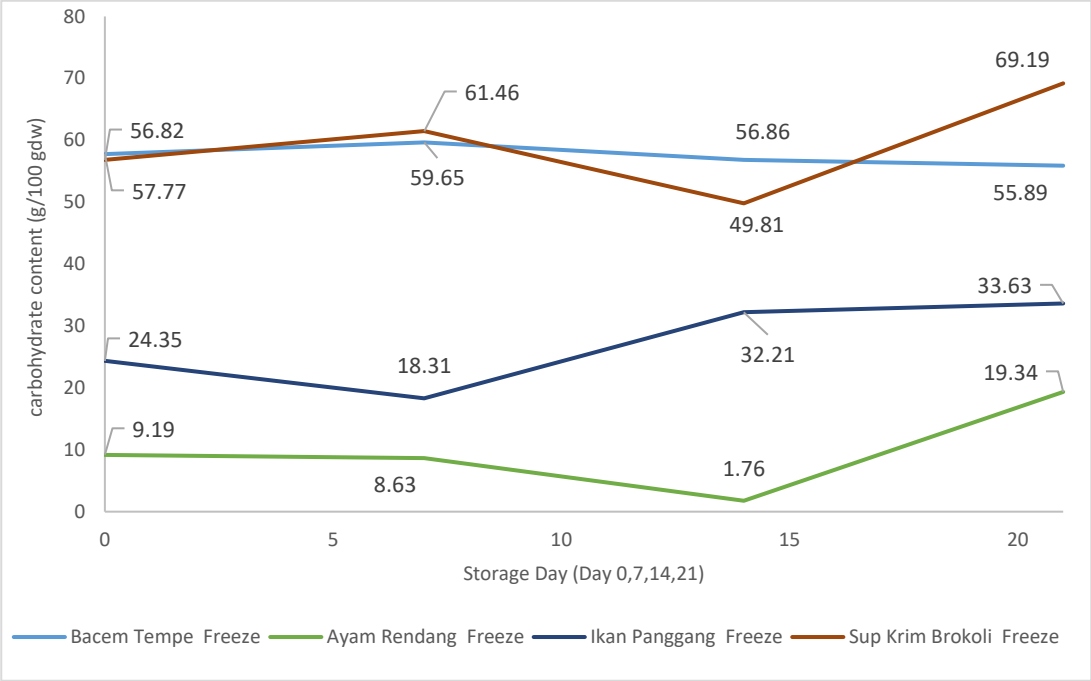

Figure 5: Carbohydrate content of cook-freeze products during storage (g/100 gdw)

3.4 Total Carbs

The effect of the roasting process on carbohydrates is generally related to the occurrence of hydrolysis. Baking will cause starch gelatinization, which will increase its digestibility. The role of simple and complex carbohydrates in the Maillard reaction can reduce the availability of carbohydrates in baked food products (Dandago, 2009).

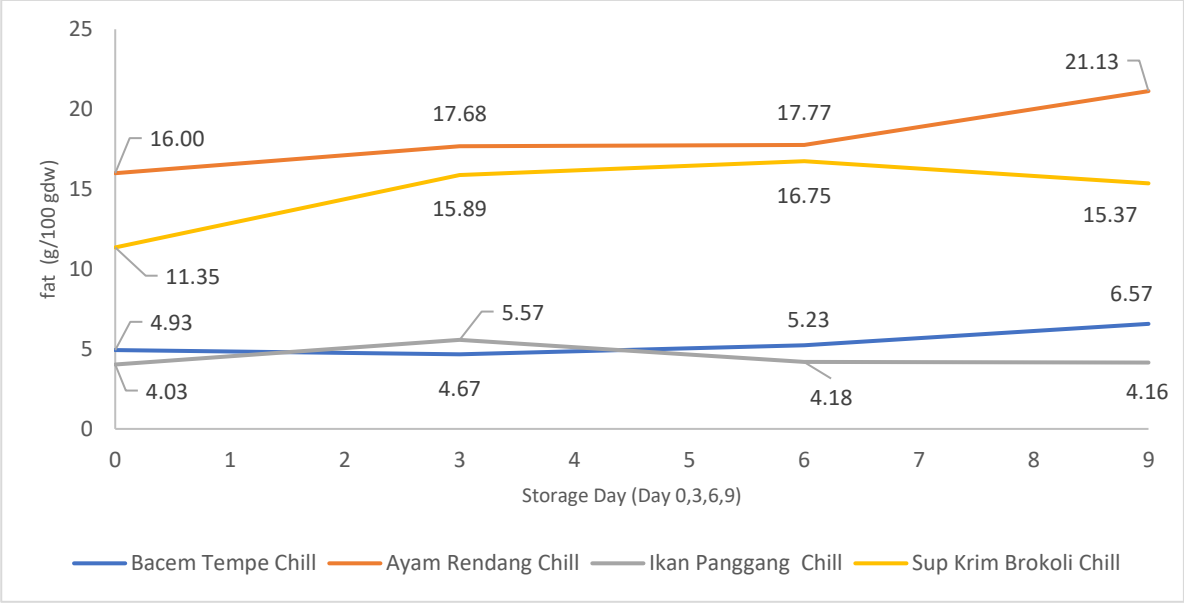

Figure 6: Fat of cook-chill products during storage (g/100 g dw)

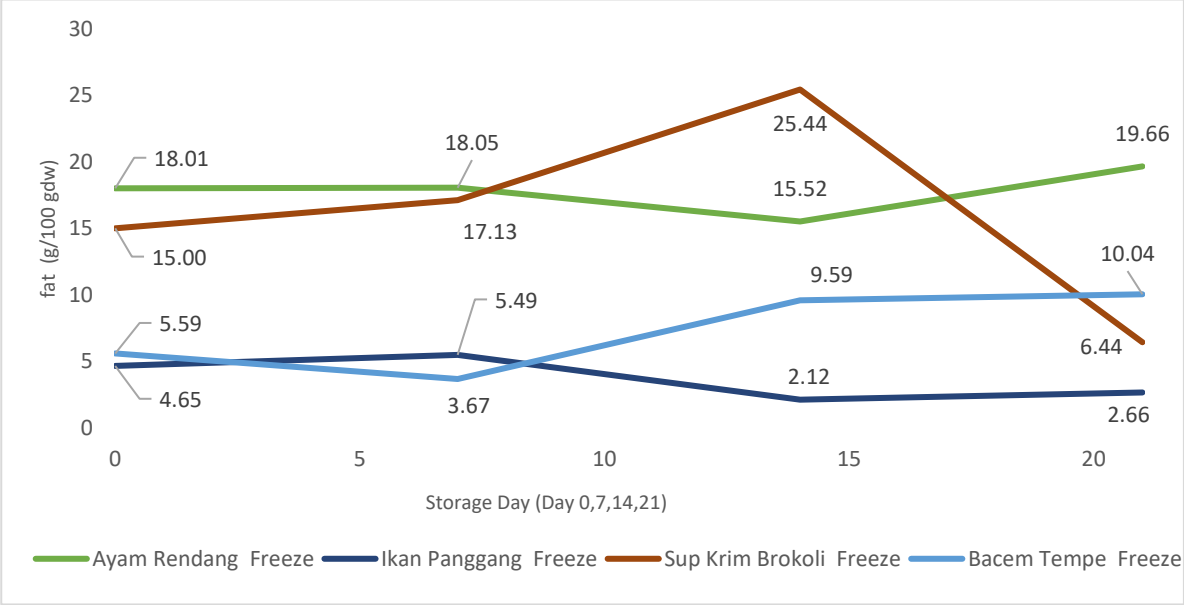

Figure 7: Fat content of cook-freeze products during storage (g/100 g dw)

3.5 Total Fat

In the food processing process, there will be damage to the fat contained in it. The degree of damage varies depending on the temperature and duration of the process. The higher the temperature used, the more fat damage will be more intense. Essential fatty acids isomerize when heated in an alkaline solution and are sensitive to light, temperature, and oxygen (Dandago, 2009).

3.6 Sensory Test

The FGD (Focus Group Discussion) stage was conducted to determine the ideal sensory attributes of ready-to-eat food products. This stage involved five expert panelists from the hospital catering team Sunshine Food Group (SFG). The results of the attribute consensus are used in taking ready-to-eat food sensory data. The panelists used in the sensory test were the nutrition team panelists and nursing students working in the hospital. The panelists used in the CATA sensory test were consumer panelists of 40 people, with a ratio of 65% male and 35% female. The age of the panelists ranged from 20 to 50 years.

Correspondence analysis (CA) or correspondence analysis analyzes the relationship pattern between products and attributes. Correspondence analysis is obtained by standard correspondence analysis on the indicator matrix, which is coded as a binary variable, the number 1 if the sample attribute is considered available by the panelists, and the number 0 if the attribute is not available in the sample. Correspondence analysis also represents the ideal product according to the panelists in the biplot map (Meyners et al., 2013).

Table 5 Cochran's Q analysis between chicken rendang menu samples

Attribute	*p-value*	Sampel							
		RACC0	RACC3	RACC6	RACC9	RACF0	RACF7	RACF14	RACF21
Colour									
Bright	<0,0001	1,000b	1,000b	1,000b	1,000b	1,000b	1,000b	1,000b	0,500a
Pale	<0,0001	0,025a	0,025a	0,000a	0,000a	0,000a	0,000a	0,000a	0,550b
Aroma									
Rancidity	0,051	0,000[a]	0,000a	0,000a	0,000a	0,000a	0,000a	0,050a	0,000a
Spice	1,000	1,000a	1,000a	1,000a	1,000a	1,000a	1,000a	1,000a	1,000a
Sour	1,000	0,000a	0,000a	0,000a	0,000a	0,000a	0,000a	0,000a	0,000a
Typical Rendang	1,000	1,000a	1,000a	1,000a	1,000a	1,000a	1,000a	1,000a	1,000a
Taste									
Salty	1,000	1,000a	1,000a	1,000a	1,000a	1,000a	1,000a	1,000a	1,000a
Spice	1,000	1,000a	1,000a	1,000a	1,000a	1,000a	1,000a	1,000a	1,000a
Rancidity	0,051	0,000a	0,000a	0,000a	0,000a	0,000a	0,000a	0,050a	0,000a
Bitter	0,428	0,000a	0,000a	0,000a	0,000a	0,000a	0,000a	0,000a	0,025a
Texture									
Soft	<0,0001	1,000b	1,000b	1,000b	1,000b	0,500a	1,000b	1,000b	1,000b
Fatty	0,539	1,000a	1,000a	1,000a	1,000a	0,975a	0,975a	1,000a	1,000a

The results of the Cochran's Q test on the chicken rendang menu showed that all sensory attributes were significantly different for each sample at a significance level of 5%, except for the aroma of spices (p=1,000), sour aroma (p=1,000), salty taste (p=1,000), and the taste of spices (p=1,000).

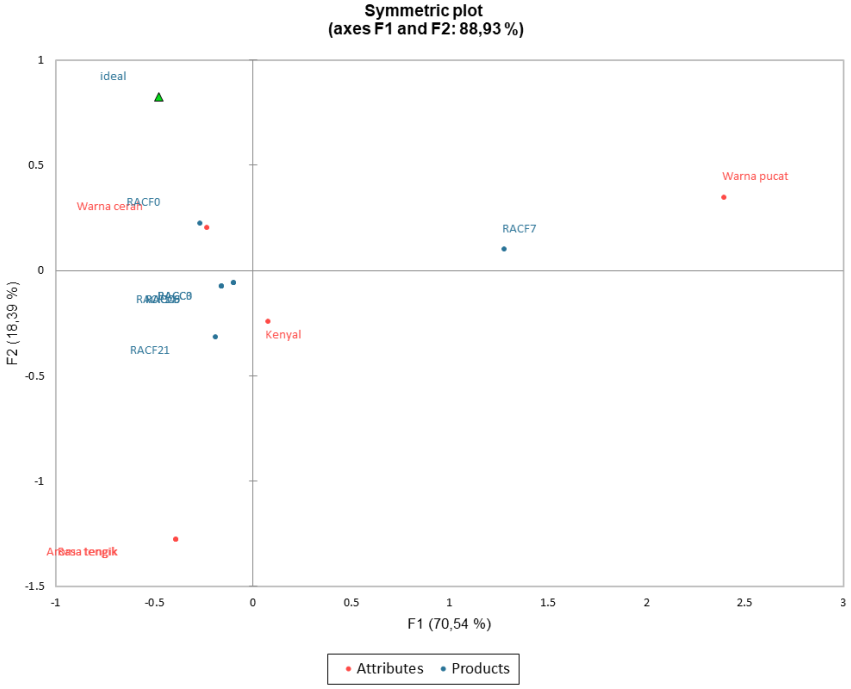

Figure 8: Biplot graph of the chicken rendang menu

Figure 8 shows the distribution of the attributes of the chicken rendang menu according to the overall panelists. The sample closest to the ideal attribute is cook-freeze chicken rendang H-0.

Table 6 Cochran's Q analysis between the bacem tempe menu samples

Attribute	*p-value*	Sampel							
		BTCC0	BTCC3	BTCC6	BTCC9	BTCF0	BTCF7	BTCF14	BTCF21
Colour									
Bright	<0,0001	1,000b	1,000b	1,000b	1,000b	1,000b	0,500 a	1,000b	1,000b
Pale	5521	0,000a	0,050 a	0,100a	0,200a	0,125a	0,600 b	0,150a	0,025a
Aroma									
Rancidity	<0,0001	0,000a	0,000a	0,000a	0,000a	0,000a	0,500b	0,050a	0,000a
Spice	1,000	1,000a	1,000a	1,000a	1,000a	1,000a	1,000a	1,000a	1,000a
Sour	0,428	0,000a	0,000a	0,000a	0,000a	0,000a	0,000a	0,000a	0,025a
Typical Bacem	1,000	1,000a	1,000a	1,000a	1,000a	1,000a	1,000a	1,000a	1,000a
Taste									
Salty	1,000	1,000a	1,000a	1,000a	1,000a	1,000a	1,000a	1,000a	1,000a
Spice	1,000	1,000a	1,000a	1,000a	1,000a	1,000a	1,000a	1,000a	1,000a
Rancidity	0,025	0,000a	0,000a	0,025a	0,025a	0,000a	0,025a	0,075a	0,125a
Bitter	0,681	0,000a	0,075a	0,025a	0,050a	0,075a	0,075 a	0,025a	0,050a
Texture									
Soft	<0,0001	1,000b	1,000b	1,000b	1,000b	0,500 a	1,000b	1,000b	1,000b

The results of the Cochran's Q test on the bacon tempe menu showed that all sensory attributes were significantly different for each sample at a significance level of 5%, except for the aroma of spices (p=1,000), the distinctive aroma of bacon (p=1,000), the salty taste (p=1,000), the taste of spices (p=1,000).

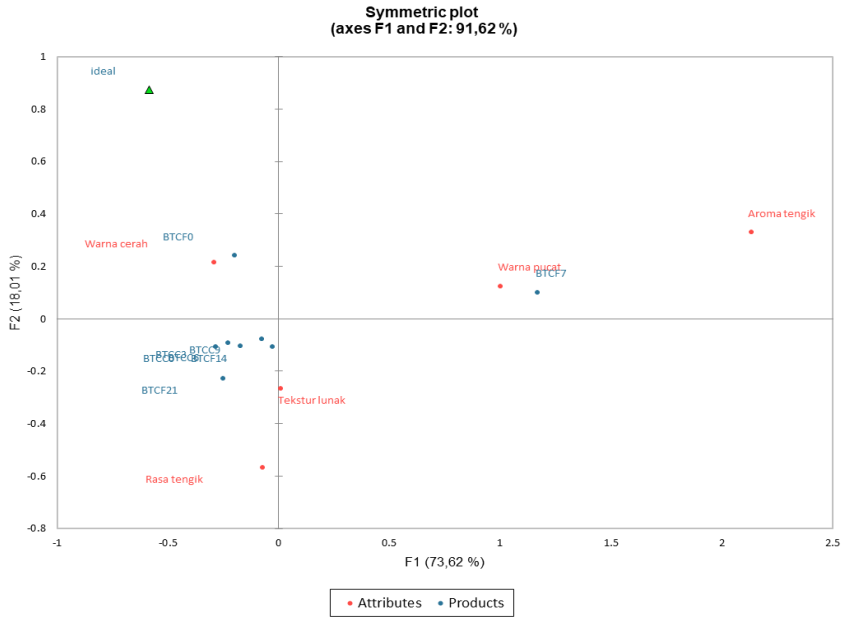

Figure 9: Biplot graph of the bacem tempe menu

Figure 9 shows the distribution of the attributes of the chicken rendang menu according to the overall panelists. The sample closest to the ideal attribute is based on tempe cook-freeze H-0.

Table 7 Cochran's Q analysis between grilled fish menu samples

Attribute	*p-value*	Sampel							
		IPCC0	IPCC3	IPCC6	IPCC9	IPCF0	IPCF7	IPCF14	IPCF21
Colour									
Bright	0,084	1,000a	1,000a	0,975a	0,925a	0,875a	0,925a	0,975a	0,975a
Pale	0,003	0,000a	0,000a	0,050a	0,150a	0,175a	0,200b	0,225a	0,100a
Aroma									
Rancidity	0,539	0,000a	0,000a	0,000a	0,000a	0,000a	0,025a	0,025a	0,000a
Spice	0,170	1,000a	1,000a	1,000a	0,950a	1,000a	0,975a	1,000a	1,000a
Sour	0,428	0,000a	0,000a	0,000a	0,000a	0,000a	0,000a	0,025a	0,000a
Typical Grill F	0,332	0,975a	0,975a	0,975a	0,925a	0,950a	1,000a	1,000a	1,000a
Taste									
Salty	0,166	0,950a	0,975a	0,925a	0,950a	0,850a	0,925a	0,875a	1,000a
Spice	0,026	1,000a	0,900a	0,925a	0,950a	0,825a	0,850a	0,925a	1,000a
Rancidity	1,000	0,000a	0,000a	0,000a	0,000a	0,000a	0,000a	0,000a	0,000a
Bitter	0,001	0,000a	0,000a	0,000a	0,125b	0,025a	0,000a	0,000a	0,025ab
Texture									
Soft	1,000	1,000a	1,000a	1,000a	1,000a	1,000a	1,000a	1,000a	1,000a
Fatty	1,000	1,000a	1,000a	1,000a	1,000a	1,000a	1,000a	1,000a	1,000a

The results of the Cochran's Q test on the grilled fish menu showed that all sensory attributes were significantly different for each sample at a significance level of 5%, except for rancid taste (p=1,000), soft texture (p=1,000), and fatty texture (p=1,000).

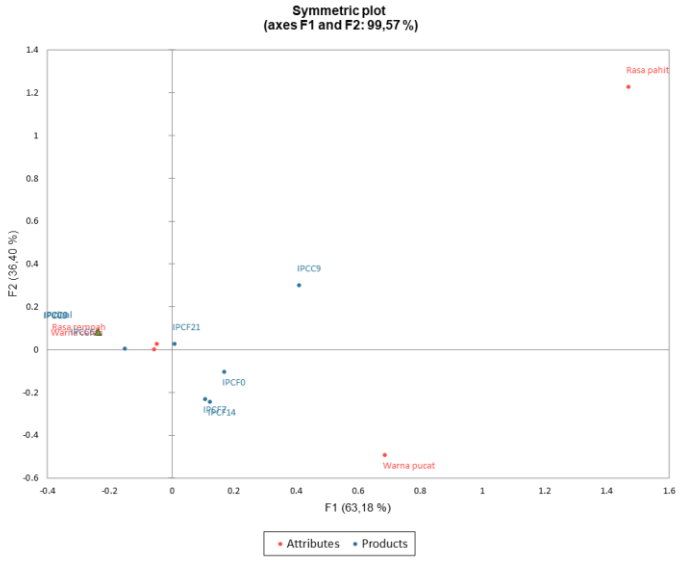

Figure 10: Biplot graph of grilled fish menu

Figure 10 shows the distribution of grilled fish menu attributes according to the overall panelists. The sample closest to the ideal attribute is based on tempe cook-chill H-3.

Table 8 Cochran's Q analysis between a sample menu of cream of broccoli soup

Attribute	*p-value*	Sampel							
		BKCC0	BKCC3	BKCC6	BKCC9	BKCF0	BKCF7	BKCF14	BKCF21
Colour									
Bright	1,000	1,000a	1,000a	1,000a	1,000a	1,000a	1,000a	1,000a	1,000a
Pale	0,035	0,000a	0,000a	0,000a	0,025a	0,100a	0,100a	0,125a	0,050a
Aroma									
Rancidity	0,539	0,000a	0,000a	0,000a	0,025a	0,000a	0,025a	0,000a	0,000a
Spice	<0,0001	1,000b	1,000b	1,000b	0,500a	1,000b	1,000b	1,000b	1,000b
Sour	1,000	0,000a	0,000a	0,000a	0,000a	0,000a	0,000a	0,000a	0,000a
Typical Cream So	<0.0001	0,500a	1,000b	1,000b	1,000b	1,000b	0,500a	1,000b	1,000b
Taste									
Salty	<0,0001	1,000b	1,000b	0,500a	1,000b	0,500a	1,000b	0,500a	1,000b
Spice	<0,0001	1,000c	0,500b	1,000c	1,000c	0,000a	0,500b	1,000c	1,000c
Rancidity	0,170	0,000a	0,025a	0,050a	0,000a	0,000a	0,000a	0,000a	0,000a
Creamy	<0,0001	0,500b	0,500b	1,000c	0,000a	1,000c	0,500b	0,500a	0,000a
Texture									
Thickness	<0,0001	0,500b	1,000c	0,000a	1,000c	0,000a	1,000c	0,000a	1,000c
Fatty	<0,0001	1,000b	1,000b	0,500a	1,000b	1,000b	0,500a	1,000b	1,000b

The results of Cochran's Q test on the menu of cream of broccoli soup showed that all sensory attributes were significantly different for each sample at the 5% significance level, except for bright color (p=1,000) and sour aroma (p=1,000).

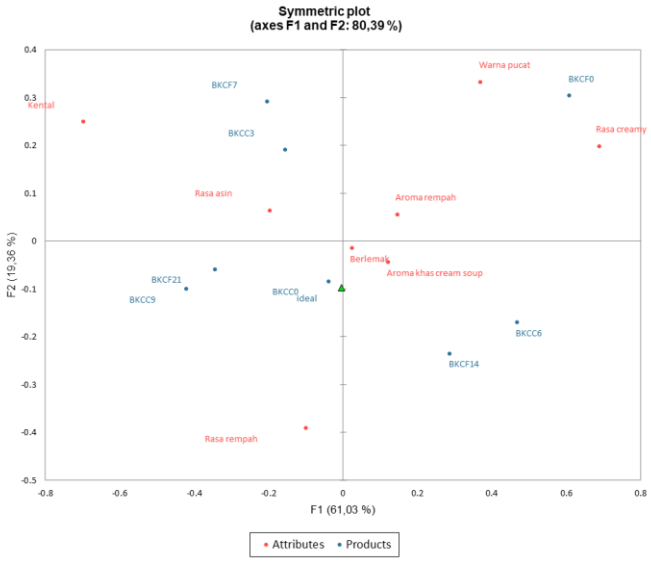

Figure 11: Biplot graph of cream broccoli soup menu

Figure 11 shows the distribution of menu attributes of cream of broccoli soup according to the overall panelists. The sample closest to the ideal attribute is based on tempe cook-chill H-0.

3.7 Selection of storage period

Based on the results of microbiological analysis, proximate analysis, and sensory tests, the following is the selection of the shelf life of ready-to-eat food that will enter the study's second phase.

Table 9 Selection of shelf life of ready-to-eat food

Menu	Method	Microbiological Analysis	Proximate Analysis	Near-Ideal Sample (CATA)	Conclusion
Rendang Chicken	**Cook-Chill**	The H-9 meets standards	The H-9 meets standards	Cook-freeze chicken rendang H-0	Preferred H-9 shelf life
	Cook-Freeze	The H-21 complies with the standard	The H-21 complies with the standard		The shelf life of H-14 was chosen, related to storage capacity and research time limitations.
Bacem Tempe	**Cook-Chill**	The H-9 meets standards	The H-9 meets standards	Bacem tempe cook-freeze H-0	Preferred H-9 shelf life
	Cook-Freeze	The H-21 complies with the standard	The H-21 complies with the standard		The shelf life of H-14 was chosen, related to storage capacity and research time limitations.
Grilled fish	**Cook-Chill**	The H-9 meets standards	The H-9 meets standards	Cook-chill grilled fish H-3	The H-3 shelf life was chosen, related to the differences in texture during the H-6 shelf life.
	Cook-Freeze	The H-21 complies with the standard	The H-21 complies with the standard		The H-7 shelf life was chosen, related to the change in texture during the H-14 shelf life.
Cream of Broccoli Soup	**Cook-Chill**	The H-9 meets standards	The H-9 meets standards	Cook-chill Cream Broccoli Soup H-0	Preferred H-9 shelf life
	Cook-Freeze	The H-21 complies with the standard	The H-21 complies with the standard		The shelf life of H-14 was chosen, related to storage capacity and research time limitations.

3.8 Phase two research

3.8.1 Patient Satisfaction Level

According to the inclusion criteria, the research subjects in this study were adult patients treated in classes 1-3 from July 15 – August 31, 2022. The research subjects were patients who received a normal diet, soft diet, and high-calorie high protein diet.

Table 10 Distribution of research subjects based on gender and age.

Characteristics	n	%
Man	41	20
Woman	169	80
Total	210	100

The distribution based on gender was that there were more female subjects than male subjects, namely 80%. The youngest age of the research subject was 23 years old, and the oldest was 55 years old. According to Naglaael (2017), improving the quality of service and food in hospitals is more likely to increase the overall level of satisfaction, which can reduce the patient's length of stay and save costs.

Table 11 Mean and standard deviation of food waste and patient satisfaction in each treatment

		N	Means	std. Deviation	std. Error	Minimum	Maximum
Chicken Rendang	conventional	70	.0893	.14139	.01690	.00	.50
	Cook Chill	70	.1143	.15160	.01812	.00	.50
	Cook Freeze	70	.0893	.14139	.01690	.00	.50
	Total	210	.0976	.14466	.00998	.00	.50
Bacem Tempe	conventional	70	.1000	.14371	.01718	.00	.50
	Cook Chill	70	.1286	.15194	.01816	.00	.50
	Cook Freeze	70	.1143	.15160	.01812	.00	.50
	Total	210	.1143	.14887	.01027	.00	.50
Grilled fish	conventional	70	.1036	.14429	.01725	.00	.50
	Cook Chill	70	.1464	.15634	.01869	.00	.50
	Cook Freeze	70	.1321	.15766	.01884	.00	.50
	Total	210	.1274	.15320	.01057	.00	.50
Cream Soup Broccoli	conventional	70	.1036	.14429	.01725	.00	.50
	Cook Chill	70	.1821	.17509	.02093	.00	.50
	Cook Freeze	70	.2000	.18843	.02252	.00	.50
	Total	210	.1619	.17458	.01205	.00	.50
FeedbackScore	conventional	70	32.5000	1.80779	.21607	28.00	35.00
	Cook Chill	70	32.1429	2.13518	.25520	27.00	35.00
	Cook Freeze	70	32.3714	1.52440	.18220	27.00	35.00
	Total	210	32.3381	1.83662	.12674	27.00	35.00

Table 12 Data normality test results on food waste and patient satisfaction with the *Shapiro-Wilk method*

	Kolmogorov-Smirnov [a]			*Shapiro-Wilk*		
	Statistics	*df*	*Sig.*	*Statistics*	*df*	*Sig.*
Chicken Rendang	.407	210	.000	.654	210	.000
Bacem Tempe	.374	210	.000	.693	210	.000
Grilled fish	.350	210	.000	.717	210	.000
Cream Soup Broccoli	.304	210	.000	.762	210	.000
FeedbackScore	.274	210	.000	.886	210	.000

a. Lilliefors Significance Correction

Based on data from table 7, it is known that the measurement results are not generally distributed because all data groups produce a *p-value <0.05,* so the hypothesis test is carried out using a non-parametric statistical method, namely the Kruskal-Walli's test.

Table 13 Results of the Kruskal-Walli's test on food waste

	ChickenRendang	Bacem Tempe	Grilled fish	Cream SoupBroccoli
Kruskal-Wallis H	1,511	1,420	2,981	11,585
df	2	2	2	2
Symp. Sig.	.470	.492	.225	003
hypothesis	H0 accepted _	H0 accepted _	H0 accepted _	H_0 is rejected

a. Kruskal Wallis test
b. Grouping Variables: Experiments

The hypothesis of the comparison test is as follows:

H_0: There is no significant difference in average leftovers from the data in each group. H_0 is accepted if the p-value is > 0.05. There was no significant difference in the average leftovers in the conventional, cook-chill, and cook-freeze treatment of chicken rendang, tempeh bacem, and grilled fish. On the cream of broccoli soup menu, there is a significant difference in average leftover food between conventional, cook-chill, and cook-freeze treatments.

Table 14 Kruskal-Walli's test results on patient satisfaction.

	FeedbackScore
Kruskal-Wallis H	.744
df	2
Symp. Sig.	.689
hypothesis	H0 accepted _

a. Kruskal Wallis test
b. Grouping Variables: Experiments

The test results in table 14 show no significant average difference in patient satisfaction data in the conventional, cook-chill, and cook-freeze treatments.

4. Conclusions and Suggestions

4.1 Conclusion

In the first stage of research: microbiological analysis showed that the cook-chill and cook-freeze processing methods were relatively safe to be applied in food production in hospital kitchens, with a shelf life of up to 9 days for the cook-chill method and a shelf life of up to 21 days for cook-freeze method Proximate analysis showed that the cook-chill and cook-freeze processing methods did not show a decrease in the nutritional value of the food.

In the second stage of research: there is no difference in leftovers in serving food with the cook-chill and cook-freeze methods compared to the conventional method in the menu of chicken rendang, bacem tempe, and grilled fish (p-value > 0.05). There were differences in leftovers in food preparation using the cook-chill and cook-freeze methods compared to the conventional method in the broccoli cream soup menu (p-value <0.05). There is no difference in patient satisfaction with the conventional menu treatment, cook-chill, and cook-freeze (p-value > 0.05).

4.2 Suggestion

This research can be continued by calculating labor costs and raw material costs to assess the efficiency of applying the cook-chill and cook-freeze methods in food production in hospital kitchens.

Funding: This research received no external funding.
Conflicts of Interest: The authors declare no conflict of interest.
Publisher's Note: All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers.

References

[1] Comstock E, St P, Mackiernan Y. (1981). They measure individual plate waste in school lunches: visual estimation and children's ratings vs. actual weighing of plate waste. *J Am Diet Assoc*. 79(3):290-296.

[2] Djamaluddin M, Edi P, dan Ira P. (2005). Analisis Zat Gizi dan Biaya Sisa Makanan Pada Pasien dengan Makanan Biasa di RS Dr. Sardjito Yogyakarta. *Jurnal Gizi Klinik Indonesia*. 1(3): 108-112.

[3] Hale M, Dayot A. (2020). An outbreak investigation of COVID-19 in hospital food service workers. *American Journal of Infection Control*. 000:19–20. doi: 10.1016/j.ajic.2020.08.011.

[4] Kaale LD, Eikevik TM, Bardal T, Kjorsvik E, Nordtvedt TS. (2013). The cooling rate effect on the ice crystal growth in air-packed salmon fillets during super chilling and superchilled storage. *International Journal of Refrigeration*. 36(1):110-119.

[5] Lemeshow S, David WHJr. (1997). Besar Sampel dalam Penelitian Kesehatan (terjemahan). Yogyakarta (ID): Gajahmada University Press.

[6] McCray S, Maunder K, Krikowa R, MacKanzie-Shalders K. (2018). Room service improves nutritional intake and increases patient satisfaction while decreasing food waste and cost. *Journal of the Academy of Nutrition and Dietetics*. 118(2):284–293. doi: 10.1016/j.jand.2017.05.014.

[7] Meyners M, Castura JC, Carr BT. (2013). Existing and new approaches for the analysis of CATA data. Food Quality and Preference. 30: 309-319

[8] Montero ML, Garrido D, Gallardo K, Tang J, Ross CF. (2021). Consumer Acceptance of a Ready-to-Eat Meal during Storage as Evaluated with a Home-Use Test. *Foods* 10, 1623. https://doi.org/10.3390/foods10071623.

[9] Naglaa A El-Sherbiny, Eman HI, Mahmoud MH. (2017). Patients' satisfaction with delivered food services in Fayoum Hospital. *EC Nutrition*. 9(2):94-104.

[10] Olsen NV, Menichelli E, Sorheim O. (2012). Likelihood of buying healthy convenience food: An at-home testing procedure for ready-to-heat meals. *Food Quality and Preference*. 24:171–178.

[11] Soeparno. (2016). Ilmu dan Teknologi Daging. Edisi ke-2. Yogyakarta (ID). UGM Press.

[12] Thippareddi H, Sanchez M. (2006). *Thermal Processing of Meat Products.* New Technologies and Quality Issues. Taylor and Group CRC Press. New York (US): pp. 156–192.

[13] Zhang C, Li Y, Xia X, Sun Q, Sun F, Kong B. (2021). Changes in protein oxidation, structure, and thermal stability of chicken breast subjected to ultrasound-assisted immersion freezing during frozen storage. *Food Chemistry*: 398:133874