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Waiting time, temperature, storage conditions, and total plate count of inpatients food at Universitas Gadjah Mada Academic Hospital

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ABSTRACT

Background: The food presentation is the final step of hospital food service. In the process of serving food, there is a waiting time or also called holding time that is the distance between the food that has been processed until the time it has been presented to patients in the inpatient room.

Objective: This study aims to obtain waiting time, temperature, storage condition, and total plate count of UGM academic hospital patient meals.

Design: The research that took place during September-October 2017 is an observational study. The cooked meals were observed in temperature and the samples of total plate count were measured in 3 waiting time i.e. waiting time of 2 hours, 4 hours and 6 hours.

Results: The temperature and humidity of the Nutrition Department rooms and inpatients rooms are not in accordance with food safety standards. Changes in food temperature dropped dramatically after 2 hours of waiting time, especially in open food conditions. The total plate count was increasing in 2 hours, 4 hours and peak 6 hours after processing. Safe waiting time considered to the total plate count for rice, pepes fish, bacem tempeh is <6 hours; for tomato seasoning eggs, vegetable with coconut milk is <4 hours and for beef teriyaki is <2 hours. The total plate count under closed storage conditions is higher than open storage conditions.

Conclusions: The safe waiting time for the whole food is <4 hours. It is necessary to apply HACCP, GMP, and SSOP to control the extrinsic factors causing food unsafe.

KEYWORDS: total plate count, waiting time, patient meals, food safety.

1. Introduction

Nutrition services in hospitals are services provided and adjusted to the patient's condition based on clinical condition, nutritional status, and metabolic status of the body[1]. Food and beverage sanitation is a major factor that must be considered because it is related to food safety given to the clients/hospital patients. Thus, good quality food is one of the important components in the chain of hospital patients healing. WHO in 1993 reported that about 70% of cases of diarrhea in developing countries were caused by contaminated food[2].

Centers for Disease Control and Prevention (CDC) in 1994 reported 14 factors causing food poisoning, namely cold temperature, serving time, contaminated place/equipment, consumer hygiene, and other factors[3]. The food management requires food quality control to define *Good Manufacturing Practices* (GMP), *Sanitation Standard Operating Procedures* (SSOP), and *Hazard Analysis Critical Control Point* (HACCP)[4].

Controlling the proliferation of food bacteria is one of the hazard prevention approaches in HACCP. Time and temperature are critical parameters in assessing bacterial growth rate. Food serving is the final series of food delivery trips at the hospital, where food serving has the highest risk of contamination. In the process of serving food there is waiting time or also called holding time, which is the time between food that has been processed at the Nutrition Installation until it is served to patients in the inpatient rooms[5].

The cooked food must be served to the patients on time, because the temperature of the food will be changed if it is served too late. In practice, food that has been cooked in a Nutrition Installation requires stages of preparation, storage condition, and distribution before being served to patients in the inpatient ward. Because of the condition of the disease, not all patients immediately consume the food that has been served. Some patients also consume the food directly after it is served but not directly consume it all so that the food is left open. These things can cause a longer patient waiting time for food.

The Nutrition Installation of UGM Academic Hospital has a Standard Operating Procedure (SPO) that regulates the distribution schedule and withdrawal schedule of food equipment or patient food leftovers. But the SPO was compiled based on a survey of patients regarding the food distribution time preferences, there is no scientific basis regarding the waiting time and the safe condition for food storage at a room temperature condition. According to the background of the problem, it can be formulated that the problem that will be discussed in this study is "How long is the safe food waiting time for patients and how is the right food storage condition at the room temperature condition?"

2. Research Methods

The research which took place during September-October 2017 was an observational study to obtain an overview of waiting time, temperature, storage condition, and the total plate count of inpatients food at UGM Academic Hospital. The temperature of cooked food was observed and the sample of the total plate count was taken in three different waiting times, waiting time of 2 hours, 4 hours, and 6 hours. During the waiting time, food is conditioned according to the realization of the food delivery sequence; is stored after cooking, is placed in the patient's eating utensils, and distributed to the inpatients rooms.

The inpatients rooms used were the inpatients rooms at Gatotkaca 4 which was permitted by the patients through *informed consent*. In these 3 waiting times, the physical environment characteristics of the room were also measured. The patients' diet that is sampled includes: 1)Rice, 2)Vegetable Curry with Coconut Milk, 3)Vegetable Curry without Coconut Milk, 4)Beef, 5)Egg, 6)Fish, 7)Tempeh, and 8)Steamed Chicken Rice. The weight of each sample is taken 100 g for each waiting time. The data obtained was analyzed using univariate analysis.

3. Result

3.1. Characteristics of physical environment data collection location

In this study, the environmental factors measured were room temperature and room humidity according to the sequence of the process and patient meals distribution at waiting times of 2 hours, 4 hours and 6 hours.

Based on Permenkes No. 1204 / Menkes / SK / X / 2004 concerning Hospital Environmental Health Requirements, the processing room temperature standard ranges from 22-30^{o}C with humidity of 35-60%[6]. Meanwhile, the standard temperature of the treatment room is 22-24^{o}C with humidity of 45-60%. The results of physical environment measurements can be seen in Table 1.

Table 1 shows that the temperature of food processing room in the nutritional installation still met the standard, while the humidity was higher than the requirements. In the treatment room, the temperature tended to exceed the required limits of 24oC same as the humidity of the treatment room.

Environmental humidity or RH (*Relative Humidity*) is important for the activity of water (aw), food ingredients, and the growth of microorganisms on the surface of the food ingredients[7].

TABLE 1. Results of Physical Environment Measurements

Type of Sample	Waiting Time	Data Collection Location	Physical Environment	
			Room Temperature	Room Humidity
Rice Baby food	2 hours	Nutrition Installation Processing Room	28 C	70%
	4 hours	Gatotkaca 4 Room 407	28 C	67%
	6 hours	Gatotkaca 4 Room 407	26 C	70%
Vegetable Curry with Coconut milk Vegetable Curry without Coconut Milk	2 hours	Nutrition Installation Processing Room	28 C	76%
	4 hours	Gatotkaca 4 Room 408	27 C	58 %
	6 hours	Gatotkaca 4 Room 408	26 C	56 %
Meat Egg	2 hours	Nutrition Installation Processing Room	28 C	72 %
	4 hours	Gatotkaca 4 Room 408	28 C	56 %
	6 hours	Gatotkaca 4 Room 408	27 C	60 %
Fish Tempeh	2 hours	Gatotkaca 4 Room 408	27 C	62%
	4 hours	Gatotkaca 4 Room 408	29 C	70%
	6 hours	Gatotkaca 4 Room 408	27 C	72%

3.2. Changes in food temperature

The results of observations of changes in food temperature at the waiting time of 2 hours, 4 hours, and 6 hours can be seen in Table2. Food temperatures begin to enter the danger zone after waiting time of 4 hours and 6 hours or when food begins to be distributed in patient care rooms. A danger zone is an optimal temperature range for bacterial growth at 10-60^{o}C[8]. Based on the table and graph above, it can also be concluded that staple food in opened condition experience temperature decrease more than those stored in closed condition.

3.3. Total food germ figures

The Total Number of Germs or Total Plate Number shows the number of microbes in a product. The Total Number of Germs is useful to show the quality, the shelf life/half life of food, the contamination and the hygienic status during the production process (SNI, 2009)[9]. Based on SNI 7388-2009, the maximum limit of the total diet food Plate Number specifically for health needs in the form of ready-to-eat food is $1x10^2$ cfu/g. The total Number of Food Germs based on Storage Condition and Waiting Time illustrated in Table 3.

Based on the table 3, it can be seen that the Total Number of Germs of rice, fish pepes, bacem tempeh, and steamed chicken rice still meets the quality standard up to 6 hours after being cooked. At first glance there is no visible increase in the number of germs from hour to hour because the method of calculating the number of germs used states the total number of germs <10 cfu/g for the result that is close to zero.

Meanwhile, vegetable curry with coconut milk and vegetable curry without coconut milk no longer meet the quality standard in the 4 hours waiting time. This applies to both closed and non-closed samples. Samples that have the highest total number of bacteria are vegetable curry with coconut milk (*Lodeh*) in closed storage condition at waiting time of 6 hours.

TABLE 2. Changes in Food Temperature based on Storage Conditions and Waiting Times

Type of Sample	Storage Condition	Temperature (°C)			
		Finished processing	2 Hours Waiting Time	4 Hours Waiting Time	6 Hours Waiting Time
Rice	Closed	97,5	72,5	37,0	30,7
	Opened	97,5	72,5	35,4	25,5
Vegetable Curry with Coconut Milk (Lodeh Curry)	Closed	98,4	72,8	34,4	27,2
	Opened	98,4	72,8	26,0	24,5
Vegetable without Coconut Curry (Soup)	Closed	98,6	66,0	33,8	26,8
	Opened	98,6	66,0	26,8	23,7
Pepes Fish	Closed	99,0	34,5	28,0	27,5
	Opened	99,0	34,5	26,1	26,4
Beef Teriyaki	Closed	91,5	35,0	26,2	24,5
	Opened	91,5	35,0	22,9	21,5
Tomato Seasoned Egg	Closed	93,9	31,8	26,7	24,3
	Opened	93,9	31,8	22,7	21,7
Bacem Tempeh	Closed	93,0	34,5	28,9	27,7
	Opened	93,0	34,5	26,2	25,8
Steamed Chicken Rice	Closed	92,5	51,6	29,8	26,2
	Opened	92,5	51,6	29,4	25,5

TABLE 3. Total Number of Food Germs based on Storage Condition and Waiting Time.

Type of Sample	Storage Condition	Total Number of Germs		
		2 Hours Waiting Time	4 Hours Waiting Time	6 Hours Waiting Time
Rice	Closed	<10	<10	<10
	Opened	<10	<10	<10
Vegetable Curry with Coconut Milk (Lodeh Curry)	Closed	5×10^1	$1{,}0 \times 10^4$	$1{,}3 \times 10^5$
	Opened	5×10^1	$1{,}1 \times 10^4$	$1{,}5 \times 10^4$
Vegetable Curry without Coconut Milk (Soup)	Closed	4×10^1	$2{,}6 \times 10^4$	$6{,}5 \times 10^4$
	Opened	4×10^1	$6{,}8 \times 10^4$	$8{,}0 \times 10^4$
Pepes Fish	Closed	<10	<10	<10
	Opened	<10	<10	<10
Beef Teriyaki	Closed	$7{,}4 \times 10^2$	$7{,}9 \times 10^4$	$7{,}6 \times 10^4$
	Opened	$5{,}5 \times 10^2$	$7{,}9 \times 10^2$	$1{,}3 \times 10^3$
Tomato Seasoned Egg	Closed	$9{,}0 \times 10^1$	$4{,}3 \times 10^2$	$7{,}6 \times 10^2$
	Opened	$9{,}0 \times 10^1$	$1{,}1 \times 10^2$	5×10^2
Bacem Tempeh	Closed	<10	<10	<10
	Opened	<10	<10	<10
Steamed Chicken Rice	Closed	<10	<10	<10
	Opened	<10	<10	<10

4. Discussion

4.1. Characteristics of physical environment data collection location

From table 2 the results of the study show that the processing room temperature of Nutrition Installation remained constant during the study period of 28°C, while the humidity of the food processing room was in the range of 62% to 76%. Patient treatment temperature was in the range 26-29°C, while the humidity of the room was in the range of 56% - 76%. The room temperature of food production still meets the requirements. However, the humidity of the processing room is not stable.

The temperature of the treatment room exceeds the standard temperature limit while the humidity level of the treatment room is not stable, the humidity level of some treatment rooms is still quite high. According to Permenkes No. 1204 / Menkes / SK / X / 2004 concerning Hospital Environmental Health Requirements, the processing room temperature standard ranges from 22-30°C with humidity of 35-60%. Meanwhile, the standard temperature of the treatment room is 22-24°C with humidity of 45-60%.

Physical environment, especially temperature and humidity greatly affect the quality of cooked food both during storage in the production room and after being distributed to the patient care rooms. Temperature plays an important role in managing the course of metabolic reactions for all living things, especially for bacteria. Ambient temperature that is higher than the temperature that can be tolerated will cause denaturation of proteins and other essential cell components so that cells will die. Likewise, if the ambient temperature is below the tolerance limit, the cytoplasmic membrane will not be liquid so that the transportation of nutrients will be hampered and the process of cell life will stop. Thus temperature has an important role on the quality of food stored because if it is at temperature that is in accordance with the conditions of bacterial growth, it will accelerate the rate of bacterial growth which results in the process of damage of stored food[10].

Environmental humidity (relative humidity, RH) is important for foodstuffs and growth of microorganisms on the surface of foodstuffs. A storage space that has a low RH will cause unpackaged food experience dryness on the surface and changes in the value of water activity. If dry food product is brought into a humid environment (high RH) it will absorb moisture so that the surface can be overgrown with fungus. The same thing will happen if the food that has been cooled is brought to a warmer environment. This will cause water condensation on the surface. This process is important to be concerned for the packaging of perishable products, because the packaging space is usually warmer than the cooling chamber, so it will form a thin layer of condensation. This will cause an increase in water activity which in turn can facilitate the growth of microorganisms[11].

4.2. Changes in food temperature

Changes in food temperature occur both in staple foods, vegetables, animal side dishes, vegetable side dishes and steamed chicken rice. The most drastic changes occur when the waiting time is above 2 hours. So it can be concluded that the longer the food waiting time, the lower the temperature of cooked food. The temperature drop that needs to be watched out is the *danger zone* temperature. The danger zone temperature is the critical temperature in food stored at 5–60°C[12].

Different foods reach the danger zone temperature at different waiting time. In the staple food, vegetable curry with coconut milk, vegetable curry without coconut milk and steamed chicken rice entered the danger zone area while waiting > 4 hours. Whereas for animal and vegetable side dishes have entered the critical temperature danger zone at waiting time of > 2 hours.

Among the changes in all food products temperature, products that are stored in open condition more quickly experience a decrease in temperature compared to products in closed condition.

Monitoring of waiting time and food temperature are very important to be concerned

with controlling the rate of bacterial development[5]. The food which is safe to consume as follows:

- Freshly cooked food, because the temperature is> 60°C.
- Waiting time is less than 4 hours (the food temperature can be ignored).
- Foods that are getting closer to the danger area have shorter waiting time.
- Food stored at cold temperatures must be reheated before serving (reheating).

According to the *Food Standards of Australia New Zealand* (2012), to maintain the quality of food in the shelf life of food (after food processing) needs to be conditioned at an optimal temperature to maintain its quality[10]. The expected temperature is in the areas outside the danger zone, namely in cold storage (temperature <5°C) and in hot storage (temperature> 60°C). The method of storing products is different for each type of food. The choice of temperature is adjusted to the type of food. Cooked food products in the form of staple foods, animal side dishes, vegetable side dishes, vegetables and steamed chicken rice should be stored in a hot condition that is> 60°C. Meanwhile, fruit products such as juice are stored in cold condition, <5°C.

4.3. Total number of food germ

From the results of the examination of the total number of germs on all cooked food products (staple foods, animal side dishes, vegetable side dishes, vegetables and steamed chicken rice), it was found that there was an increase in bacterial activity at different temperature for different types of food.

Some types of food such as rice, pepes fish, bacem tempeh and steamed chicken rice increased the total number of germs after waiting time> 6 hours. Meanwhile, on beef teriyaki products, tomato seasoned eggs, vegetable curry with coconut milk, and vegetable curry without coconut milk have increased the number of germs at shorter waiting time, which is> 2 hours.

In addition to the type of food ingredients, the type of food processing affects food durability in the shelf life of food (food waiting time). Processing affects acidity (pH), water activity (AW) and *Equilibrium humidity* (EH)[13]. Unexpected bacterial activity is when the number of bacteria exceeds the recommended safe amount, ie the total plate count (ALT) reaches $1x10^2$ cfu/g[9].

Rice, pepes fish, bacem tempeh and steamed chicken rice are still safe to consume until the waiting time is 6 hours. Tomato seasoned eggs, vegetable curry with and without coconut milk are safe to consume until the waiting time is less than 4 hours. However, beef teriyaki is safe to consume until the waiting time is less than 2 hours.

At 2 hours after cooking, the bacterial value in beef teriyaki has exceeded the recommended threshold. High bacterial counts can be caused by not achieving safe internal temperatures. The USDA recommends that the internal temperature achieved in heating using an oven on red meat and poultry be 163°C[14].In this study, the internal temperature of meat was not measured. The considered temperature is a minimum processing temperature of 900°C so that pathogenic germs die.

Some food products such as coconut milk, beef teriyaki and tomato seasoning eggs that are stored in a closed condition have a higher total number of germs than the food products that are stored in an open condition. The environmental conditions and the types of food products stored are very influential in increasing the total number of germs. The food storage containers or containers must be separate for each type of prepared food. Food must have a lid that can close completely but it still has ventilation which can release water vapor. Meanwhile, when using bento, water vapor is difficult to get out because there is no ventilation. Food vapors enter the food because it will cause re-contamination.

In terms of nutritional value, meats and eggs are foods that are rich in nutrients. Foods that are rich in nutrients will be more easily damaged and pose greater food safety risks compared to the ingredients with lower nutritional contents

because the food ingredients can be used for bacterial development. Food is an organic material which is a source of nutrients for microorganisms. Food grouping based on level of resilience:
- Highly perishable foods (fruit, meat, eggs, milk)
- Semi-perishable foods (Potatoes, whole grains)
- Stable / Nonperishable foods: Sugar, flour, rice

Meat is one of the foods with the highest AW, which is 0.99-1.00[15]. AW level of 0.99 is the most optimum AW for breeding the majority of food pathogenic bacteria (*Campylobacter spp., Enterohemorrhagic Escherichia coli, Salmonella spp*[16].

The high amount of microbial of some food stuffs in a short waiting time can be caused due to no implementation yet for food control system until the food is cooked. Food can experience a fairly rapid increase in the number of bacteria before processing or during processing. In some countries, food control systems are carried out by conducting inspections to control extrinsic factors[17].

The number of bacteria is influenced by environmental factors that can actually be controlled. This shows that the application of the Hazard Analysis and Critical Control Point (HACCP) system is important to be applied to guarantee the product produced. HACCP can control potential food hazards from raw materials until the products in consumers[18]. Besides HACCP, the operation of food requires controlling food quality, including establishing *Good Manufacturing Practices* (GMP) and *Sanitation Standard Operating Procedures* (SSOP)[4].

5. Conclusion

Based on the description above, several conclusions can be drawn: 1) The description of the physical environment (temperature and humidity of the room) during the operation of the patient's food is not fully in accordance with the standards. 2) The most drastic changes in food temperature occur when waiting time is more than 2 hours. 3) The total number of germs in the patient's food after the waiting time of 2 hours, 4 hours, and 6 hours has increased dramatically especially after the 4 hours waiting time. 4) The total number of germs in the patient's food based on differences in storage conditions after waiting time of 2 hours, 4 hours, and 6 hours is more in closed conditions especially for eggs, meat and vegetables. 5) Waiting time and safe storage conditions are less than 4 hours.

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REFERENCES

1. Kemenkes RI. 2013. Pedoman Pelayanan Gizi Rumah Sakit. Jakarta : Kemenkes RI.
2. Ruby P. Pucket. 2004. Food Services Manual for Health Care Institutions. 3rd Edition. USA: American Hospital Association.
3. Center for Disease Control and Prevention. 2001. Notice to Readers: on going Investigation of Anthrax. Florida: MMWR Morb Mortal Wkly Rep.
4. Hiasinta Purnawijayanti. 2001. Sanitasi Higiene dan Keselamatan Kerja dalam Pengolahan Makanan. Yogyakarta: Kanisius.
5. Atiq Yunita, Indah Wulandari, Aranta Galuh Fridintya. 2014. Gambaran Waktu Tunggu, Suhu dan Total Bakteri Makanan Cair di RSUP Dr.Kariadi Semarang. Jurnal Med Hosp 2014; Vol 2 (2): 110-114
6. Menteri Kesehatan RI. 2004. Keputusan Menteri Kesehatan Republik Indonesia Nomor 1204/Menkes/SK/X/2004 tentang Persyaratan Kesehatan Lingkungan Rumah Sakit.
7. Doddy Yudhabuntara. 2003. Pengendalian Mikroorganisme dalam Bahan Makanan Asal Hewan. Bogor: Direktorat Jenderal Bina Produksi Peternakan Departemen Pertanian.
8. Jimmy Tomam Azari. 2013. Studi Komparatif Pencucian Alat Makan dengan Perendaman dan Air mengalir terhadap jumlah kuman pada alat makan di warung makan buam Gonilan. Skripsi: Program Studi Kesehatan Masyarakat FIK UMS

9. Badan Standardisasi Nasional. 2009. SNI 7388:2009 tentang Batas Maksimum Cemaran Mikroba dalam Pangan.
10. Food Standards Australia New Zealand. 2013. Annual Report of Food Standards Australia New Zealand. https://www.foodstandards.gov.au/publications/annualreport201213/Documents/FSANZ-AnnualReport_WEB-2012-13.pdf
11. Sandulachi, Elisaveta. 2012. Water Activity Concept And Its Role In Food Preservation. Technical University of Moldova.
12. Messing, L. 2015. Keeping Foods Out of the Temperature Danger Zone. Michigan State University. https://www.canr.msu.edu/uploads/resources/pdfs/keeping_foods_out_of_the_temperature_danger_zone.pdf
13. Prihatini, Rini Indriani. 2008. Analisa Kecukupan Panas pada Proses Pasteurisasi Santan. Bogor: Institut Pertanian Bogor.
14. USDA. 2011. How Temperatures Affect Food. https://www.fsis.usda.gov/shared/PDF/How
15. IFT/FDA. 2003. Evaluation and Definition of Potentially Hazardous Foods. Comprehensive Reviews in Food Science and Food Safety. Vol. 2 https://www.fda.gov/files/food/published/Evaluation-and-Definition-of-Potentially-Hazardous-Foods.pdf
16. ICMSF. 1996. Microorganisms in Foods 5-Microbiological specifications of food pathogens. Blackie Academic & Professional, London.
17. Schweihofer, J.P., Reau, B.J. 2012. Opportunities in Meat Marketing: Meat Inspection. Michigan State University. Extension Bulletin E3114. https://www.canr.msu.edu/uploads/resources/pdfs/meat_inspection_bulletin.pdf
18. Hanekom S., Vermeulen E., Oldervage Theron W., et al. (2010): Food safety risk factors in a hospital food service unit serving low microbial diet to immunocompromised patients. AJAND. 10 (9): 4000 4015.