

Research Article

3-Day Menu Planning for Existing Commercial Disaster Food Supplies Using the Evaluation of Taste and the Blood Sugar Level

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Abstract

In recent years, Japan was hit by great deal of natural disasters such as earthquake and tsunami. During these disasters, food supplies were ordered by the Japanese government for each family. Japanese government encouraged, at least, three days food storage and if it is possible, the duration is extended to one-week. Since the disaster timing is unknown, food supplies for disasters must be able to be stored at normal temperature for a long term (up to 25years). Therefore, food supplies that marketed as long-term preservation is necessary to overcome these situations. This study aimed to design a 3-day menu using commercially available food supplies for disaster situations. Furthermore, we evaluated the taste and evaluated blood sugar level measurement after consuming each meal during the three days. It is necessary for us to offer a meal preventing hyperglycemia after a meal. The hyperglycemia after a meal is to cause obesity,

fatty liver, Alzheimer's dementia. However, the commercial disaster food included a lot of glucose. That is a reason why our blood sugar level is easily up after eating that. The commercial disaster foods that blood sugar level is hard to rise are necessary for us. And the commercial disaster food is expensive (We can purchase the normal retort pouch for approximately 100 Japanese yen, but the disaster edible retort pouch is around 500 Japanese yen.), there is a financial burden, we understood. Low-price commercial disaster foods are necessary for us.

Keyword

Commercial Disaster Food Supplies; Tasting; Blood Sugar Level; One-Week Menu

Introduction

In recent years, Japan was hit by several natural dis-

asters. The Japanese government recommended to its citizen to prepare themselves for disasters by storing 3-day food supplies and other disaster goods if possible.

Before 2016, nutrient labeling showed only the amount of energy, carbohydrate, fat, protein and salt. Therefore, the general people purchasing a commercial food supplies cannot know all the nutrient contents of the items the most available food as a disaster meal contain freeze dry rice. However, there is a shortage in the protein and vitamins among this type of food [1]. We can secure protein with canned food. However, there is a concern regarding salt content in these food supplies which could exceed the required daily amount. We supplemented the vitamins and mineral with supplement. In addition, various side dishes with the retort pouch are prepared, however it lacks nutrient labeling and food allergy information which made it difficult for some people to consume. As a result, when a disaster strikes, the distributed food supplies will be mainly carbohydrates-centered meals that is high in salt which may increase the risk of having high blood sugar and/or pressure level. Therefore, it was necessary to consider the content of the food supplies and the nutrition balance and to make sure it suits all groups. Several nutritional disorders were occurred in the Tohoku district (north area of Japan) after it was attacked by a massive tsunami. Blood sugar level and blood pressure were reported to be increased among the survived victims. Other survivors with hypovitaminosis, food allergies, heart disease patients, kidneys disease patients or diabetic patients were not able to consume the meals provided by the government because these supplies did not have any detailed nutrient labeling [1-6]. After this experience, the Japanese government decided to perform nutrient labeling for the disaster food supplies starting from April, 2016 by a law. The current study aimed to develop a 3-day menu using commercially available disaster food supplies. Then, a taste evaluation for each meal was performed to shed some lights of the participants opinion about the taste, smell and the appearance of this type of food items. We also performed blood sugar level measurement after a meal and for the 3 days. This is because we wanted to offer a delicious meal to many people at the time of the disaster. Even if it is a disaster, we aim at the offer of the universal-food for the people. Using

disaster food for commercially available three days, we thought that it was necessary to check whether nourishment really filled up now.

Material and Methods

The Designed 3-Day Menu

A 3-day menu was designed (1850 kcal) using disaster food supplies available at the Japanese market. (Table-1) represent the first day menu content. We use the water which can store at normal temperature for seven years. The subjects took the water in 2 liters (four plastic bottles of 500 ml) a day. This study used Commercially available disaster food supplies.

The nutrient labeling of the items contained only the total amount of energy, protein, fat, carbohydrate and salt. The food items did not have the information about vitamins, mineral or food allergies. There was less the indication that considered religion to the commercially available disaster food that we used for this study.

Subjects

Ten healthy female volunteers aged between 20 and 24 years old participated in the study. All participants have signed and sealed written consent form. As for the subject, protection of the personal information was kept. The subject had the right to withdraw from this study at any time. Participants were provided with the three meals at the same time (breakfast: 8:30 am, lunch: 12:00 pm, dinner: 17:00 pm) and location. After the meal, blood sugar level was measured using medisafe mini GR-102 (Terumo co.ltd.) and we get the data of average \pm SD mg/dl of the blood sugar level. The measurement carried out consecutively for three days and after each meal.

Taste Evaluation

All participants were requested to conduct a taste evaluation for the meals. They added a score to a meal where ten points is the highest scores of evaluations. The evaluation involved the taste, smell, appearance and quantity, Blood sugar level measurement. Blood sugar level were measured using peripheral blood after each meal. The blood sugar status was measured using the level measuring equipment (Medisefe mini)

	The First Day			The Second Day			The Third Day		
	Breakfast	lunch	Dinner	Breakfast	lunch	Dinner	Breakfast	lunch	Dinner
Energy	576 Kcal	191 Kcal	579 Kcal	230 Kcal	200 Kcal	770 Kcal	356 Kcal	175 Kcal	332 Kcal
Protein	7.9g	7.6g	17.3g	12.6g	6.7g	33.9g	8.0g	14.7g	14.7g
lipids	13.5g	0.6g	11.4g	12.8g	0.8g	23.2g	14.0g	6.1g	5.9g
Carbohydrates	105.9g	38.8g	102g	16.1g	41.7g	101.7g	49.6g	15.4g	55.0g
Salt substantial	0.1g	4.95g	2.54g	2.41g	3.68g	1.55g	1.9g	4.0g	2.3g
Total energy	1346 Kcal			1200 Kcal			863 Kcal		
Total protein	32.8g			53.32g			37.4g		
Total lipids	25.5g			36.8g			26.0g		
Total Carbohydrates	246.7g			159.5g			120g		
Total Salt substantial	7.65g			7.64g			7.35g		

Table 1: Nutritive value of the 3-day menu.



Figure 1: First day menu content.

Breakfast: “Bread of the Maple taste” and “Rice cake with black sugar syrup and with soybean powder”; Lunch: “Noodles”; Dinner: “Steamed white rice” and “Hamburger steak”.



Figure 2: Second day menu content.

Breakfast: “Pork miso soup”; Lunch: “Noodles with seaweed”; Dinner: “Rice with five different kinds of vegetables” and “Yellowtail with Japanese radish”.



Figure 3: Third day menu content.

Breakfast: “Bread”; Lunch: “Vegetables, egg and fish boiled with soy source taste”; Dinner: “Egg rice porridge” and “Pork and potato boiled with soy source and sugar”.

made in Terumo Corporation. The measurement time was before a meal, after 15 minutes, 30 minutes, 45 minutes, 60 minutes, 90 minutes and 120 minutes. During the blood sugar level measurement, participants were asked to sit down and relax. All ten subjects ate disaster foods made the same marketing at the same place and location. They also drank the same quantity of water.

Ethical Review Board

This study was conducted with the approval of the Ethical Review Board (Nagoya women's university "hito wo mochiita kennkyuu ni kansuru iinnkai"). The approval number is 27-11.

Results

Nutrition (Requirement of energy intake a day)

The average weight \pm SD of the age of the subject was 53 ± 4 kg (median 54kg, maximum 58kg, minimum 47kg). In the case of 19-29-year-old woman, life activity calculation I, 1850 kcal is necessary for a day.

Tasting Evaluation

Participants have reported that all meals were delicious. All meals scored more than 6 out of 10 (Ten points is the highest score). The meal which got the highest score for taste was “Yellowtail with Japanese radish”, the highest score for smell was “Pork and potato boiled with soy source and sugar”, the highest score for appearance was “Pork and potato boiled with soy source and sugar”, the highest for quantity was “Yellowtail with Japanese radish” and for total balance was “Pork and potato boiled with soy sauce and sugar” (Table 2).

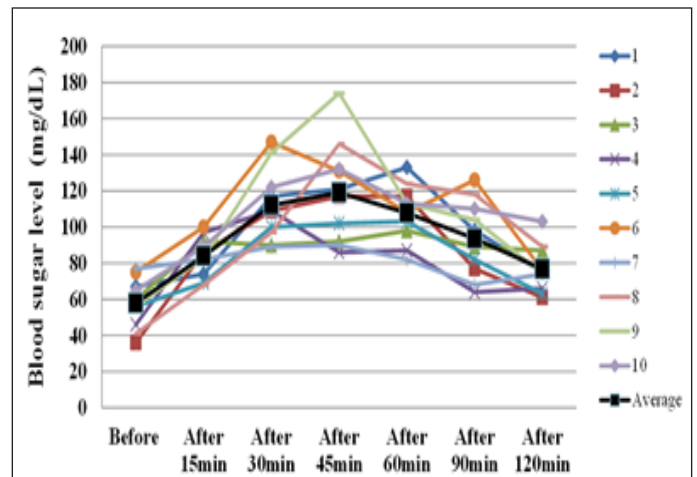


Figure 4: First Day Breakfast (Blood sugar level).

E: 576Kcal; P: 7.9g; F: 13.5; C: 105.9g; NaCl: 0.96g; Sugar: 73.5%.

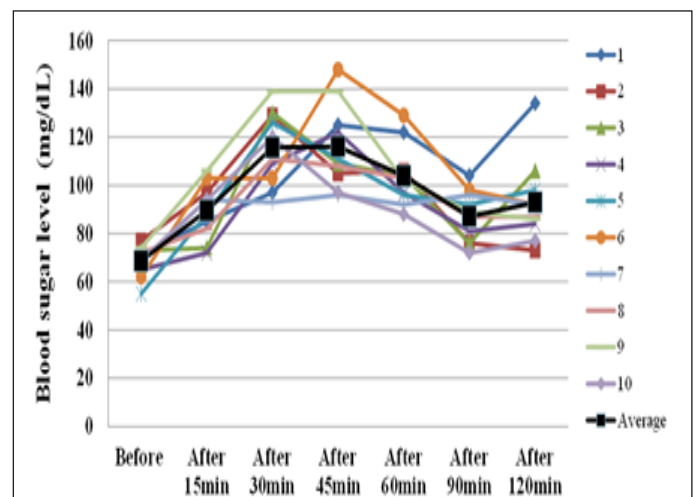


Figure 5: First day Lunch (Blood sugar level).

E: 191Kcal; P: 7.6g; F: 0.6; C: 38.8g; NaCl: 5.14g; Sugar: 81.3%.

Menu		Taste	Smell	Appearance	Quantity	Total Balance	
First day	Breakfast	Bread of the Maple taste	82±1.1	7.6±1.7	8.0±1.2	8.2±1.1	7.9±0.9
	Breakfast	Rice cake with black sugar syrup and with soybean powder	8.9±1.4	7.9±1.1	8.1±1.3	8.4±1.0	8.5±1.1
	Lunch	Noodles	7.9±0.7	7.9±0.6	7.3±0.9	8.1±1.4	8.1±0.7
	Dinner	Steamed white rice	7.6±0.8	7.1±0.9	8.2±1.5	8.4±1.3	7.8±0.9
	Dinner	Hamburger steak	8.9±1.0	9.0±1.2	8.8±1.0	8.7±1.6	9.0±0.9
Second day	Breakfast	Pork miso soup	8.4±1.0	8.3±0.9	8.3±1.3	8.3±0.9	8.2±0.8
	Lunch	Noodles with seaweed	8.2±0.6	7.7±0.7	7.8±0.9	7.5±0.7	8.3±0.7
	Dinner	Rice with five different kinds of vegetables	8.7±0.7	7.7±1.6	8.9±0.9	8.9±1.0	8.8±0.6
	Dinner	Yellowtail with Japanese radish	9.4±1.1	8.7±0.9	8.7±0.7	9.2±0.8	8.0±0.7
Third day	Breakfast	Bread	7.7±1.2	7.1±1.2	7.6±1.6	6.3±1.7	7.3±1.4
	Lunch	Vegetables, egg and fish boiled with soy source taste	8.4±1.0	8.4±0.7	8.6±0.7	7.5±1.6	8.4±0.7
	Dinner	Egg rice porridge	6.8±0.8	6.5±0.8	7.5±1.1	7.9±1.2	7.3±1.1
	Dinner	Pork and potato boiled with soy source and sugar	9.3±0.7	9.0±0.7	9.0±0.8	8.0±0.8	9.1±0.7

Table 2: Tasting evolution of three days menu (perfect score is ten points).

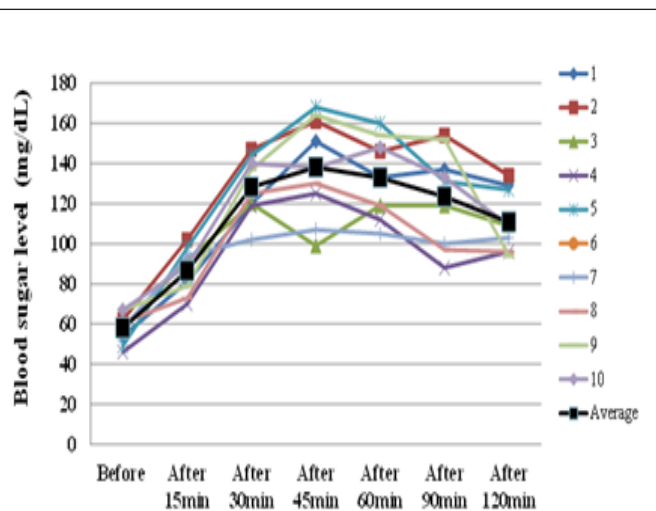


Figure 6: First day Dinner (Blood sugar level).

E: 579Kcal; P: 17.3g; F: 11.4; C: 102g; NaCl: 2.49g; Sugar: 70.5%.

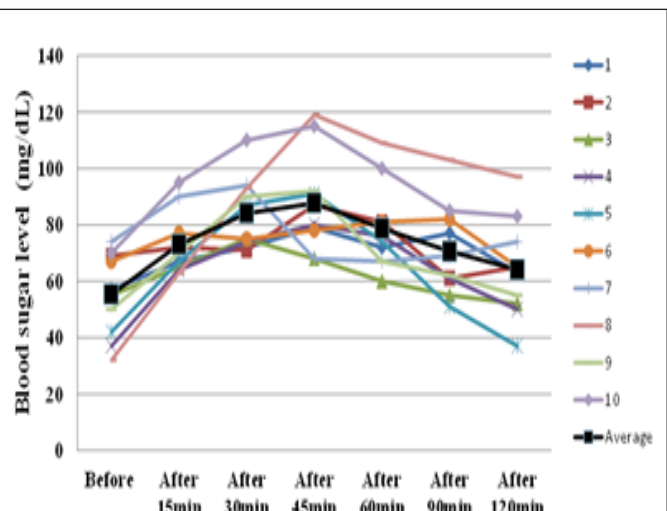


Figure 7: Second day Breakfast (Blood sugar level).

E: 230Kcal; P: 12.6g; F: 12.8g; C: 16.1g; NaCl: 2.41g; Sugar: 28%.

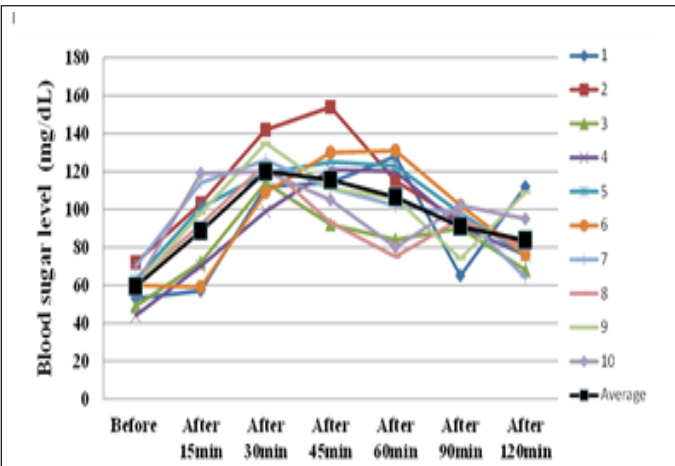


Figure 8: Second day Lunch (Blood sugar level).

E: 200Kcal; P: 6.7g; F: 0.8g; C: 41.7g; NaCl: 3.68g; Sugar: 83.4%.

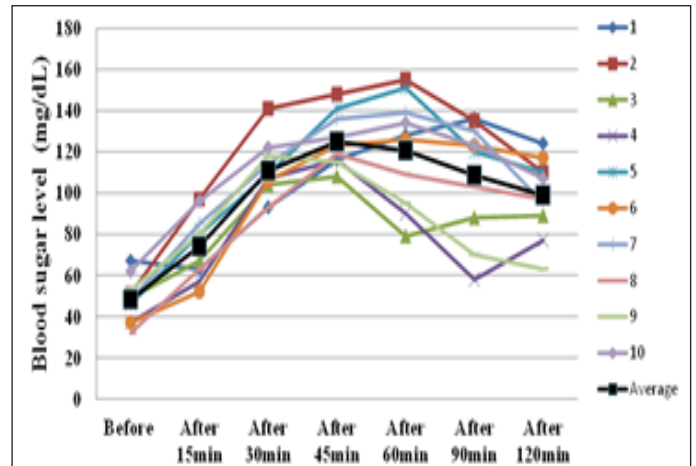


Figure 9: Second day Dinner (Blood sugar level).

E: 770Kcal; P: 33.9g; F: 23.3g; C: 101.7g; NaCl: 1.55g; Sugar: 52.8%.

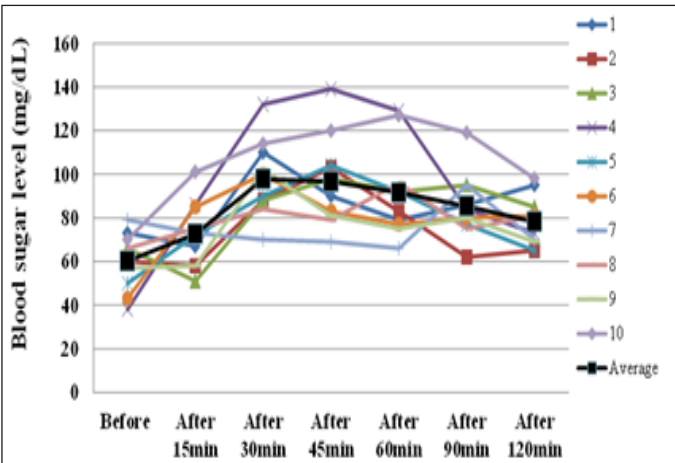


Figure 10: Third day Breakfast (Blood sugar level).

E: 356Kcal; P: 8g; F: 14g; C: 101.7g; NaCl: 49.6g; Sugar: 55.7%.

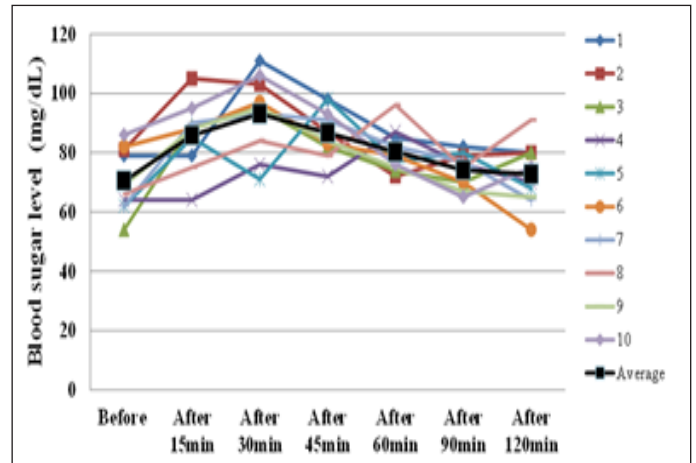


Figure 11: Third day Lunch (Blood sugar level).

E: 175Kcal; P: 14.7g; F: 6.1g; C: 15.4g; NaCl: 4.12g; Sugar: 35.2%.

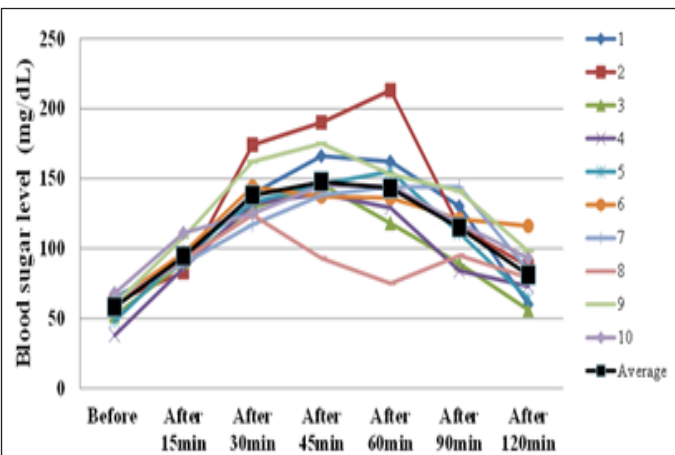


Figure 12: Third day Dinner (Blood sugar level).

E: 332Kcal; P: 14.7g; F: 5.9g; C: 55g; NaCl: 2.38g; Sugar: 66.3%.

The blood sugar level of the breakfast of the second day reached the highest level after 45 minutes of meal. The mean \pm SD of the highest blood sugar level was 87.7 ± 17.5 (Figure 7). The blood sugar level of the lunch of the second day reached the highest level after 30 minutes of meal. The mean \pm SD of the highest blood sugar level was 120 ± 12.6 (Figure 8). The blood sugar level of the dinner of the second day reached the highest level after 45 minutes of meal. The mean \pm SD of the highest blood sugar level was 124.9 ± 12.9 (Figure 9).

The blood sugar level of the breakfast of the Third day reached the highest level after 30 minutes of meal. The mean \pm SD of the highest blood sugar level was 97.8 ± 17.7 (Figure 10). The blood sugar level of the lunch of

the Third day reached the highest level after 30 minutes of meal. The mean \pm SD of the highest blood sugar level was 93.1 ± 12.8 (Figure 11). The blood sugar level of the dinner of the Third day reached the highest level after 45 minutes of meal. The mean \pm SD of the highest blood sugar level was 147.5 ± 26.2 (Figure 12).

Price of the commercial disaster foods

The price of 3 day commercially available disaster supplies of food was checked and recorded. The first day menu price was 3214 yen (Japanese Yen + Tax: Approximately 27US\$). The second day menu price was 2624 yen (Japanese Yen + Tax: Approximately

22US\$). The third day menu price was 2418 yen (Japanese Yen + Tax: Approximately 21US\$). The bread was the price of approximately 1.6 times than rice. In addition, the bread and the noodles were about the same prices. The commercially available disaster food is able to preserve at room temperature for three years. The commercially available general meal (It is shielded by a pack) can be preserve at normal temperature between six months and one year. The prices of commercially available general meal are clarified in table 3. The price of steamed rice (It is shielded by a pack) is about 160 yen. The price of side dish (It is shielded by a pack) is about 300 yen.

Menu		Price Japanese Yen + Tax	US Dollars	
First day	Breakfast	Bread of the Maple taste	648	5.4
	Breakfast	Rice cake with black sugar syrup and with soybean powder	432	3.6
	Lunch	Noodles	648	5.4
	Dinner	Steamed white rice	378	3.2
	Dinner	Hamburger steak	460	3.9
		Water (500ml 4 Bottles)	648	5.4
	Total Price		3214	26.8
Second day	Breakfast	Pork miso soup	410	3.5
	Lunch	Noodles with seaweed	648	5.4
	Dinner	Rice with five different kinds of vegetables	486	4.1
	Dinner	Yellowtail with Japanese radish	432	3.6
		Water (500ml 4 Bottles)	648	5.4
	Total Price		2624	21.9
Third day	Breakfast	Bread	648	5.4
	Lunch	Vegetables, egg and fish boiled with soy source taste	410	3.5
	Dinner	Egg rice porridge	302	2.6
	Dinner	Pork and poteto boiled with soy source and sugar	410	3.5
		Water (500ml 4 Bottles)	648	5.4
	Total Price		2418	20.2

Table 3: Price evolution of the three-day menu (Japanese Yen with Tax and US dollars).

Discussion

Ten female subjects have consumed commercially available disaster foods items for three days. Blood sugar level was evaluated after each meal for all participants. Then, a taste evaluation was conducted for each meal to evaluate the taste, smell and the appearance of food items. Each tasting result of ten subjects was a high evaluation. The commercially available disaster food was reported to be delicious. It was revealed that blood sugar level rose when subjects ate glucide-rich disasters foods. However, the best blood sugar level of ten measured subjects was less than 160mb/dl on the average. At a disaster, it is necessary for the diabetic in particular to check nutrient labeling. When diabetic eat glucide-rich disasters foods, we need to regulate carbohydrate quantity. In addition, as for the marketing product, a big difference leaves in nutritive value by a combination. It is necessary for us to think about a combination of improved disaster food. Since there is a limited type of disaster food supplies, it is recommended to increase the variety so it could suit all taste and health conditions. In addition, an effort to lower the price will be necessary in future because the commercially available disaster food is expensive. It is necessary to prepare for a sudden disaster by taking in disaster foods in daily-life. There is the indication of the allergy substance in food (e.g. eggs, milk, wheat, prawns, crab, peanut etc..) which the government recommends in Japan. Also, in Japan, encourage indication of allergen is an abalone, a cuttlefish, salmon roe, an orange, kiwi fruit, beef, a walnut, a salmon, mackerel, a soybean, chicken, a banana, pork, a matsutake mushroom, a peach, a yam, an apple and gelatin. The commercially available disaster food that we checked in the current study, displayed soybean, pork, chicken, beef, gelatin, milk, wheat, egg and mackerel only. It is necessary to check food indication of the commercially available disaster food in the case of patients with the food allergy, too. At first, when designing a meal for disaster situations, the groups at risk (infants and the elderly or patients) should be considered. However, the lack of the meal designed for group at risk was reported at the time of a disaster abroad [2,6]. The future disaster food supplies must aim at the universal or international-food which everyone can consume. In

addition, as for the support supplies, the food which we could not eat arrived often [7]. Development of the disaster food supplies that can easily consumed without preparation will be necessary in future. It is necessary to make the disaster food menu which includes nutrient labeling, allergic indication and that can be prepared without the need of other supplies like water. It is also necessary to consider the nutrient balance too when preparing this type of food items. In the current study, the amount of energy of the meal was calculated based on the age and gender of the participants., It is recommended to consume between 1750-2000 kcal per day per person for the Japanese meal intake standard. However, each three kinds of disaster food supplies for one day that was used in this study did not fulfil the required amount. Therefore, we recommend added supplementary diet such as; cookie, a biscuit, a cracker, yokan or chocolate. It might be necessary to add an extra meal some cases to reach the recommended amount. There are many people thinking that the appearance of the disaster food is not attractive. However, because of this seasoning evaluation, the commercially available disaster food was delicious enough in addition, as for the disaster food, a rise in blood sugar level after a meal was a concern because of the rich content of carbohydrates. The low glycemic index food items which are not elevate blood sugar after a meal is necessary to protect form diabetes. Because there was much glucose, as for the commercially available disaster food, hyperglycosemia after a meal was worried about. However, from these findings, we understood that the hyperglycosemia did not happen if it was this dietary formula. We want to recommend that we take the solution dietary fiber with a meal to suppress the rise in blood sugar level after a meal in future. We want to think about adding the material which holds down a rise in blood sugar level to a drink. Because we do not know when the disaster will occur, it is necessary to be prepared for such event. Disaster food supplies must always be ready in everyday life before the expiration date. Not only in the case of emergency but also in daily life, disaster food should help in maintaining health. These results of research help a patient (diabetes or Alzheimer's disease) as well as a general population. The commercially available disaster food contains high amount of carbohydrates, but since blood sugar level

did not raised after a meal, it should not be a concern. Of course, it will be necessary in future to come up with a combination and ingredients of a meal that have less impact on blood sugar level. Difference in sugar sensitivity greatly influences blood sugar level. However, we can watch a change of the overall blood sugar level by showing it with the mean of ten people. The blood sugar level can play the peak after a meal in 45 minutes from 30 minutes. As for the peak value in the average of the blood sugar level, there was not the thing more than 160 mg/dl in this study. In this study, menu was revealed that the disaster food was very expensive. The expense of this menu was 23 dollars = 3,000 yen per three meals a day. The expense of the retort pouch which is not disaster food is 12 dollars = 1,500 yen per three meals a day. We think that it is difficult to hold disaster food in large quantities economically. However, it is necessary to prepare for an emergency by using rolling stock law (we incorporate disaster food as some everyday life). It is necessary for a combination of commercially available disaster food and education about the rolling stock law to be performed for general people widely [8,9]. An effort to make use of having learned in from northeastern great earthquake disaster and Kumamoto earthquake is necessary [10]. We will hope that cheaper disaster food is marketed in future.

The Japanese Government requested from its citizens to prepare and store 3-day supplies of disaster food. The Japanese Government recommended also to store one-week disaster food supplies if it is applicable. However, there is no clear recommendation about the nutrient contents of the food items that need to prepared for disasters which is very important in maintain good health during disaster situations. Moreover, Government recommendation was made regarding the water supplies storage or preparation for such events. Available food supplies lack also allergic information and have no consideration for religion believes (e.g. Halal, vegetarian etc.) We think that the menu making at the time of the disaster for one week is more necessary. According to a menu with the nutritional consideration at the time of the disaster by the administrative dietitian will be necessary in future. We gather up these findings and make a brochure for a general person and distribute it and want to enlighten storage of the disaster food to be helpful in the case of an emergency.

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