

### **Abstract**

The food provided for Japanese Antarctic Expedition of 1957-1962 by Food Committee proved satisfactory in general, in various respects such as nutrition, sanitation, taste, cooking and preparation, and transport. Other various problems such as menu, field ration, kitchen and equipment, cook, drinking water, etc. are mentioned in the report.

After all, in spite of the severe cold state, the wintering personnel, both in the base and in the field trail, was kept healthy without any nutritional disturbance.

## Introduction

In 1956, Food Committee was organized as a section of logistic science in National Committee on Antarctic Research by the Science Council of Japan. And Food Committee (Chairman: Dr. M. HARA) then started to settle several projects for the requests to provide foods and such like.

Various subjects such as (1) nutritive standard, (2) foodstuffs endurable for severe coldness, (3) food composition and names of foods, (4) field ration, (5) menu, (6) taste, (7) kitchen and equipment, (8) preservation, (9) cook, and (10) others, Food Committee attempted to solve concretely.

Total number of 55 persons of wintering teams, extending over five years from 1957 to 1962 except 1958, passed time for scientific reserch in Syowa Base and their health and nutritional condition were kept good during the whole wintering period without any nutritional disturbance.

Daily food-consumption and intake by each personnel were performed favourably as planned, despite difficult circumstances.

### 1. Nutritive standard in the Antarctic area

Table 1. *Nutritive standard*  
(*per man per day*).

Calory	3500
Protein	110 gr
Fat	above 50 gr
NaCl	above 20 gr
Vitamin A	10000 I.U.
" B <sub>1</sub>	5 mg
" B <sub>2</sub>	5 mg
" B <sub>6</sub>	5 mg
" B <sub>12</sub>	1 $\gamma$
Nicotinic acid	30 mg
Folic acid	1.5 mg
Pantothenic acid	1.5 mg
Vitamin D	600 I.U.
" E	3 mg
" K	0.6 mg

The nutritive standard was recommended by Medical Committee of National Committee on Antarctic Research together with Food Committee as Table 1.

To supply vitamins sufficiently other than food, the specially manufactured vitamin-tablets were taken every day by all wintering persons. Under the coldest condition, it necessitates physically more supplies of calory, protein, salts, and vitamins than the above-describe standard, and especially more vitamin C (as to 400mg) and vitamin A needed, so that high vitamin-C-tablet and concentrated cod liver oil were also given in addition.

Table 2. Relation between items of food groups and food forms.  
(kinds of foods in number)

Items	Dehydrated	Canned	Refrigerated	Prepared	Raw
Cereals	21	—	—	—	—
Pulses	13	—	—	—	—
Sugar	2	—	—	—	—
Dairy products	1	2	—	3	—
Eggs	4	—	1	—	—
Meat	10	19	10	—	—
Fish and shell-fishes	13	18	27	9	—
Vegetables	15	11	19	12	5
Fruits	6	11	11	5	6
Fat and oil	—	—	—	7	—
Seasoning	5	—	—	14	—
Fungi	2	4	—	—	—
Sea-weeds	5	—	—	2	—
Tea	10	—	—	—	—
Spice	14	—	—	5	—
Juice	—	—	—	6	—
Cakes	—	—	—	22	—
Alcoholic drinks	—	—	—	5	—
Total	121	65	68	90	11

Table 3. Food composition, per man per day.

Items	Weight gr	Calory	Protein gr	Fat gr
Rice	400	1440	26.8	2.8
Wheat	200	730	17.2	2.2
Other cereals	30	108	3.3	1.7
Soybeans	30	67	7.6	3.6
Other beans and pulses	10	34	2.3	0.2
Sugar	100	387	—	—
Fat and oil	40	320	—	36.0
Dairy products	100	336	28.8	25.0
Eggs	150	244	18.6	17.5
Meat	200	540	28.4	44.0
Fish and shell-fishes	80	104	15.2	4.6
Potatoes	100	70	1.7	0.1
Vegetables and fruits	420	90	5.0	0.4
Salt	25	—	—	—
Total	1875	4470	154.9	138.1

Table 4. Names of foodstuffs and foodgroups.

Items of foodgroup		Name of foods
Cereals		rice**, glutinous rice, alpha-rice*, freeze-dried rice*, wheatflour hard and soft**, dried noodle**, <i>somen</i> , buck-wheat**, <i>tyukasoba</i> **, makaroni**, spaghetti**, <i>fu</i> (dried gluten)**, oatmeal**, cornstarch, cornflake**, glutinous flour**, <i>katakuriko</i> , bread-hardtack*
Pulses		soybeans, green-peas*, peas, <i>azukibean</i> s, <i>uzuramame</i> , <i>azuki-an</i> **, congealed curd**, <i>aburage</i> dried**, <i>harusame</i> **, <i>yuba</i> , <i>tofu</i> powder, kidney-beans*
Sugars		sugar**, honey**
Dairy products		fresh butter**, margarine**, processed cheese**, condensed milk
Eggs		frozen eggs**, powdered eggs**, hen's eggwhite, quail's eggs*
Meat	refrigerated	sirloin-beef**, <i>sukiyaki</i> -beef**, beef fillet**, beef-grinder meat**, veal liver**, pork sirloin**, pork fillet**, chicken mature**, pork loin**
	dehydrated	smoked bacon**, smoked ham**, sausage square**, salami sausage**, canadian bacon**, berlin sausage**, dried meat*
	canned	corned beef**, <i>yamatoni</i> beef**, wiener sausage**, boiled chicken**, smoked ham**, meat ball**, liver paste*, goat meat*
	prepared	pemmican, smoked bacon*, vinegared pork*, stewed beef*, stewed tongue*, stewed oxtail*, stewed beef white*, beefsteak*, oxbowels*, rolled cabbage*, <i>shumai</i> *
Fish and shell-fish	refrigerated	tuna**, yellowfin tuna**, salted salmon**, yellow-tail, jack-mackerel**, common octopus, scabream, prawn**, <i>taisho</i> -prawn**, flounder**, pacific saury**, <i>chikuwa</i> **, vinegar mackerel, cod, <i>kabayaki</i> **, shrimp, pollack roe**, <i>konowata</i> , clam, ligament, salmon roe**, pond smelt**, <i>chawanmushi</i> , carp
	canned	boiled salmon**, king crab**, oiled tuna**, flake seasoned tuna**, oiled sardine**, <i>oden</i> **, anchovy, smoked oiled salmon**, smoked oiled oyster**, smoked oiled shortneck-clam, tomatoed saury**, pike, sea urchin**, <i>kuchitori</i> **, arkshell-seasoned**, spiced saury**, <i>kabayaki</i> **
	dehydrated	dried strips**, herring roe**, squid**, dried cod**, dried larval**, dried shrimp**, earshell dried, dried ligament**, <i>uruka</i>
	prepared	mysis- <i>tsukudani</i> **, pondsmelt- <i>tsukudani</i> **, clam- <i>shigureni</i> **, sweet smelt**
Vegetables and fungi	refrigerated	spinach**, cabbage**, chinese-cabbage**, carrot**, dasheen**, <i>gobo</i> **, immature green peas**, immature kidney beans**, pumpkin**, broadbeans**, immature soybeans**, sweet pepper**, pine agaric**, cauliflower**, brussels sprouts**
	canned	sweet corn**, asparagus**, green peas**, <i>kinpira-gobo</i> **, boiled slimy agaric**, boiled bamboo**, boiled pine agaric**, <i>gomokunomoto</i> **, common mushroom, roasted pine agaric*

Items of foodgroup		Name of foods
	dehydrated	dried onion**, dried onion-powder**, chinese-bamboo-shoot, dried carrot**, dried potato flake**, dried gourd shavings, radish chopped dried, dried royalfern**, <i>shii-take</i> **, sesame seeds*, <i>konnyaku</i> powder**, cabbage**, crystal ginger, carrot powder*
	prepared	<i>takana</i> salted**, salted eggplant, chinese cabbage peppered**, <i>takuan</i> **, <i>misozuke</i> **, melon pickled in <i>sake</i> lees**, salted dried apricot**, scallion soaked in vinegar**, red-coloured common ginger root**, sweet pickles
Fruits	refrigerated	orange**, straw berry** grape**, persimmon**, loquat**, pear**, cherry**, chestnuts**, peach**, banana**, apple, baked apple
	canned	<i>satsuma</i> -orange**, pine-apple**, white peach**, yellow peach**, pear**, cherry, chestnuts**, raisin**, fig**, fruit salad**
	prepared	strawberry jam**, apricot jam**, orange marmalade**, apple jam**, fig jam**
	dehydrated	orange powder, yanzu powder, raisin, plum, apricot, jujube, giant walnut
Fats and oils	vegetable oil**, salad oil**, shortening oil**, lard, margarine**, mayonnaise, peanut butter	
Seasoning and others	dried <i>miso</i> **, <i>miso</i> (sweet, salty, <i>hattyō</i> ), <i>soyū</i> **, vinegar, table salt**, M.S.G. ( <i>ajinomoto</i> ), soup powder**, tomato puree**, <i>furikake</i> **, worcester sauce (conc.), dried yeast**, baking powder**, sodium-bicarbonate**, tomato paste**, tomato-catsup**, natto, dried malt**, gelatin**, citric acid**	
Spice	curry powder**, and other 18 kinds	
Sea-weeds**	undaria, <i>hijiki</i> , dried purple laver, tangle, laver <i>tsukudani</i> , salted tangle, agaragar	
Tea**	<i>sencha</i> , <i>maccha</i> , black tea, instant coffee, tangle tea, raw coffee, cocoa	
Juice**	orange juice and others	
Cake**	cake-mix, icecream-mix and other 21 kinds	
Alcoholic drinks**	concentrated <i>sake</i> , beer, whisky, wine and others	
Cigarettes	peace and other 5 kinds	

**Note** \* : food used for reserve diet only.

\*\* : food used for both base diet and reserve diet.

no mark : food used for base diet only.

## 2. Foodstuffs endurable for severe coldness

The contents of the selected foodstuffs to be endurable for severe coldness, consisted of dehydrated, canned, refrigerated, manufactured or prepared foods and a few of raw material.

The beverages were also adopted in as concentrated form as possible, because transportation by ship, plane and car forced these provision's volume into a definite limited capacity, so that the bulk of water which was contained in foods and beverages should be diminished as much as possible.

The relation in figures between the item of food group, food form and number of kinds of food is shown in Table 2.

The prepared or manufactured food contains cooked or half-cooked products with which one can make dishes speedily or instantly.

The foods used in expedition every year, amounted to 300~500 kinds, and it was feared that Japanese expedition party brought too many varieties of foods to Antarctica, but in practice the menu plan allowed for many joyful dishes and prevented from becoming monotonous in diet.

## 3. Food composition and names of foods

The selected foods were divided into four parts for the purpose of settling of diet.

- (a) base diet... foods for the wintering team in the base and at the trail camp (BD).
- (b) reserve diet... foods for reserve to be used against emergencies (RD).
- (c) ship's diet... foods in the transport-ship.
- (d) ship's reserve diet... foods for reserve of transport-ship.

To satisfy the above nutritive standard, food composition was planned and is indicated in Table 3.

The whole names of foods are shown in Table 4.

## 4. Field ration

In field parties, three or four men occupied a tent, and two or three men rode in a vehicle. A set of ration to be eaten in the vehicles en route consisted of ryebiscuit, frozen bread, dried fruits, dried meat and sweets etc. and three days' ration in a set of three packages for two men, were packed in a box (A, B).

The foods as breakfast and supper (both to be cooked in tent) were prepared for a set and also in ration box (C, D and S). These different boxes might be furnished by turns every four days. In field ration, instant-type food such as alpha-rice was used conveniently within a short time, because of the light equipment, fuel limitation and cooking by handy process.

Each box contained enough food for 12 man-days (4 men for 3 days or 3 men for 4 days) and in weight did not exceed 0.5 kg per man per day.

Against emergency, Box E containing sugar and 'zamppa' was prepared.

Zamppa is Tibetan instant baked flour which was popular on the Himalayan Expeditions.

Details of ration are shown in Table 5.

Table 5. Food contents of boxes in field ration weight (gr) per one meal.

Box	Item	gr	Item	gr
A and B box	ryebiscuit	37	cheese	15
	<i>senbei</i>	33	chocolate	10
	peanut	5	bean sweets	17
	mixed nuts	13	rock sugar	10
	<i>arare</i> cracker	11	chewing gum	7
	honey	3	orange milk	15
	raisin	10	mixed juice	
	salami sausage	16	frozen bread	
	dried meat	27	total	239
C box	alpha-rice	200	dried onion	4
	corn flake	40	powdered potato	4
	sugar	80	sea-weeds	5
	powdered milk	40	<i>miso</i>	20
	dried cabbage	4	dried <i>naruto</i>	7
	dried spinach	1	<i>mochi</i>	13
			total	418
D box  To be used in the tent combined with C and S.	MSG ( <i>Ajinomoto</i> )	4	ovaltine	13
	salt	10	seasoned sea-weeds	3
	soy	10	wheat flour	20
	instant soup	8	pickled radish	25
	catchup	4	baking powder	1
	mustard		sweets/fruits	75
	butter	60	(cigarette)	19
	black tea	8	(roll paper)	10
	green tea	10	nescafe	8
			total	289
S box  To be used in the tent combined with C and D.	frozen beef	100	powdered egg	100 (4 days)
	bacon	100 (2 days)	canned beef	40 (4 days)
	frozen pork	100	corned beef	30 (4 days)
	ham	100 (2 days)	icecream powder	
	frozen chicken	100	frozen noodles	
	canned crab	40 (4 days)	chicken fat	
			total	200
E box (for emergency)	sugar	18 kg	zamppa	15 kg

*List of box*

	A, B	C	D	S	E	Total
1) Use	lunch	breakfast and supper			emergency	—
2) Content	18 (man-meal)	12 (man-days)	16 (man-days)		—	—
3) Weight (approxim.)	4.5 kg	5.0~6.5 kg	3.6~4.7 kg	6.0 kg	—	
4) Number of case	40	25 and 25	25 and 25	25	2	167
5) Total weight	180	288	208	150	23	859

*Nutritive value of box (per one meal)*

	A, B	C	D	S	E	Total
Weight	239 gr	418 gr	239 gr	200 gr		1146 gr
Calory	842	1810	881	764		4297
Protein	27.4 gr	46.7 gr	25.3 gr	53.5 gr		152.9 gr
Fat	29.0 gr	4.6 gr	55.3 gr	50.9 gr		144.8 gr

Packing of field ration: As packing material, a thin polyethylene sack was found to be superior to cellophane or thick polyethylene. It was found useful to insert a polyethylene sheet between pieces from frozen meat or fish in the ration package, so that this kept pieces from sticking to each other and prevented trouble in the cooking process.

Menu of field ration:

Typical daily menu

Breakfast: potage soup with bacon or ham, cornflakes, coffee.

In vehicle: bread, biscuit, *sembei*, chocolate, cheese and sweets.

Supper: boiled rice, *misoshiru*, beef/pork/chicken/fish, in turn 4 days, *takuan*, green tea.

Night: ovaltine or black tea.

Some canned meat, fish and vegetable were included to be used in dishes for variety and menu for flexibility, and as Japanese like European and Chinese dishes they were included as well as Japanese essential dishes, and all trail groups enjoyed in field camp steak, fried sweet-sour pork and *sukiyaki* like as at Syowa Base.

## 5. Menu

An example of menu used in March, 1961 is shown in an opposite page:



Breakfast		Lunch		Dinner	
<i>miso</i> soup		roast pork		<i>miso</i> soup	
<i>miso</i>	7 gr	roast	200 gr	spinach	20 gr
<i>wakame</i>	3 "	cabbage	20 "	eggs	30 "
potato	20 "	tomato spaghetti		<i>tempura</i>	
bean curd	3 "	spaghetti	30 "	shrimp	50 "
<i>asakusanori</i>	5 "	onion	10 "	squid	20 "
salmon roe	40 "	butter	10 "	conger eel	30 "
boiled rice or bread	180 "	sauce	5 "	radish	15 "
		<i>shiitake</i>	3 "	pickled chinese cabbage	50 "
		crab-salad		orange	150 "
		crab	30 "	boiled rice or bread	180 "
		onion	10 "		
		mayonnaise	10 "		
		pineapple	50 "		
		boiled rice or bread	180 "		
Nutritive value :					
	Calory	3744			
	Protein	105.0 gr			
	Fat	115.2 gr			

## 6. Taste

The matter which most concerns the daily feeder might be "chacun à son goût", but in the majority of wintering persons, their own physical demand leads naturally to keeping their appetite good, regardless of individual taste for food.

Japanese taste always their own diet, but at times we take various dishes, such as European-style or Chinese-style dishes.

Referring to the information from the reports of previous expeditions, each person required bulky foods containing high calory with fatty foods from March to May of almost every year. In this period active work was continued by each person.

From July to August, their activity dropped and food-intake reduced markedly to about 2500 Cal with low fat.

From October to November, though labour was active again, they liked light and plain tasted diet of high calory with low fatty food. A similar practice was observed repeatedly every year.

All of them take green vegetables every day.

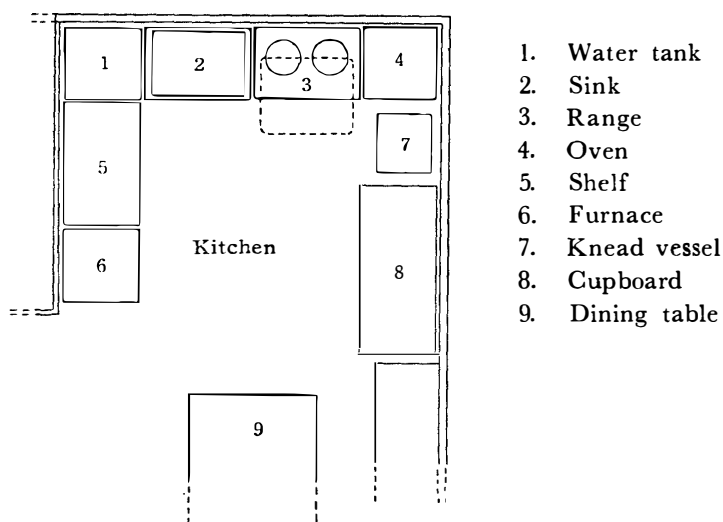
But with the approach of the end of the wintering period, the most serious matter in the diet was shortage of greens, so the refrigerated-dehydrated green vegetables of stock or greens obtained by quick-cultivation method at the base, might be useful for solving this suffering and request.

### 7. Kitchen and equipment

The site of the whole building with four huts covers about 328 sq.m in Syowa Base.

The kitchen is in the main hut and has a space of about 7 sq.m.

The equipment in the kitchen, i.e. a furnace, oven, range, sink, water tank, knead-vessel, shelf of table-ware, cupboard, etc. are put in the kitchen room. The dining tables are also placed near the kitchen. Sitting around the tables the wintering personnel passed joyful time of meal almost every day.



*Fig. 1. Kitchen and equipment.*

### 8. Preservation

To preserve raw material, dehydrated, refrigerated, and canned foods, there were used various kinds of refrigerators at the base. The raw material and such foods as vegetable, fruit, cheese, evaporated milk, cooked food, etc. should be stored all right in icebox or refrigerator of 5°C temperature, even for a whole year storage, if temperature management be kept well.

To keep refrigerated food securely, the refrigerator of -18°C temperature was necessary, and dehydrated and canned foods were kept safe in shelf or passage at room-temperature.

To avoid freezing of food or to keep temperature of cooked diet near room-temperature (13—20°C), special room-temperature-apparatus is needed.

The canned foods stored for several years in the base were found to be safe of these 80% after inspection.

### 9. Cook

At the beginning of the expedition, Food Committee received applications of

cook, and 2 men were selected. Before their departure for Antarctica, the selected cooks made efforts for training on cookery.

In isolated base, every cook endeavored to make ingenious use of food material of limited stock and they were solicitous about the nutritive condition and sanitation of the personnel.

Every week, cook furnishes diet for 6 days except Sunday and on Sunday a person on duty from wintering team takes his place in turn and serves as one-day-cook.

### 10. Others

The drinking water was gotten from paddle, iceberg or laid snow. The chemical nature of the water was found by examination to be as follows :

Water of	100 ml + 1 ml - H <sub>2</sub> SO <sub>4</sub> 0.001MKMnO <sub>4</sub>	Na-concn. mEq/l	K-concn. mEq/l	Ca-concn. γ/ml
Iceberg	1.62	0.113	0.011	0.22
Laid snow	2.02	1.343	0.02	0.42
Paddle	8.90	3.2	0.05	1.66

## SUMMARY

Food Committee provided food and beverages to fulfil nutritive standard recommended for Japanese Antarctic Research Expedition party. The selected foods were considered to fit transport, preservation, preparation, etc. and the greater part of them were dehydrated, refrigerated, canned, and a small part of raw material.

Kinds of foods amount to about 300—500, but being many varieties allowed on menu plan for many joyful dishes and prevented to be monotonous.

All likes to eat greens and meat every day, and more greens requested. High fatty food tasted well in spring and low fatty food in autumn.

To keep provisions securely, proper facilities were necessary, at least three types of preservative apparatus were needed.

Field ration must be considered especially (1) to be contained sufficiently nutritive and (2) being easy to make dishes, and (3) being compressed volume convenient to carry.

Being calculated food-intake in the base indicated about 3500 Cal and more than 180 gr of protein as Food Committee planned.

In base and in field trail, all persons 55 in number were in good health during wintering periods of 1957-1962 without any nutritional trouble.

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*(Manuscript received December 24, 1963)*



*Kitchen*



*Kitchen*



*Meal time (1958)*



*Water from paddle*