

CHINESE-AMERICAN
JOINT COMMISSION ON RURAL RECONSTRUCTION

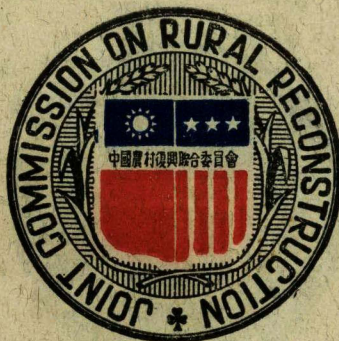
Food & Fertilizer Series: No. 1

YEAST-FEEDING DEMONSTRATION
IN
SELECTED PRIMARY SCHOOLS
TAIPEI AREA, TAIWAN

1953-54

by

Yang, Yueh-heng



Taipei, Taiwan, China

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FOREWORD

This project was undertaken jointly by the Taiwan Provincial Department of Education, the Education Bureau of Taipei Prefecture Government, the Taiwan Sugar Corporation, and the Joint Commission on Rural Reconstruction. The feeding trial was intended to ascertain the acceptability of yeast to students, demonstrate the value of yeast as a food, and publicize yeast produced locally. It was conducted in 14 selected primary and secondary schools near the capital city of Taipei and included some 20,000 students. The feeding trial began on May 15, 1953 and was concluded on January 31, 1954.

This report outlines generally the manner in which the demonstration was conducted and the findings. The project demonstrated the value of food yeast in improving the general health of school age children when consumed in fairly large quantities on a sustained basis.

About 98 percent of the student participants favorably accepted the locally produced yeast, while about 80 percent of the parents interviewed thought that their children's health had been improved and hoped for a continuation of the program. On the basis of these findings the responsible agencies and authorities should consider the extension of yeast feeding to these and other schools on a permanent basis.

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Yeast Feeding Demonstration in Selected Primary Schools in Taipei Area - 1953-54

I. Introduction

1. Yeast as food

Yeast is rich in B vitamins and in protein which usually are deficient in the diets of rice-eating people. The Food and Agriculture Organization of the United Nations has strongly recommended that its member countries, especially those in Asia, explore the possibility of increasing the consumption of yeast in order to make up the deficiency in nutrition due to the practice of over-milling and over-consumption of rice. The FAO Nutrition Committee which met in 1948 at Baguio, Philippines, further suggested that the member countries adopt modern manufacturing methods to produce quality food yeast at low cost and initiate school-feeding programs to introduce yeast to people as a dietary supplement.

Yeast is familiar to the people in Taiwan as a drug for curing indigestion, stomach trouble, and beriberi. "Wakamoto," the trade name of a Japanese-manufactured yeast product, has been popular and for a time was regularly imported. The conception of yeast being a drug and its high selling price in the market, however, have caused people to refrain from consuming it as a daily food supplement.

2. Yeast production and composition in Taiwan

Toward the end of World War II, substantial quantities of Brewer's yeast, a by-product of alcohol manufacturing, was produced in Taiwan. The production of food yeast by Taiwan Sugar Corporation (TSC), a government-owned corporation handling the production and processing of sugar cane and the international marketing of its products, was greatly increased in recent years as shown in the following:

<u>Year</u>	<u>Production (metric ton)</u>
1946	55.67
1947	24.55
1948	26.03
1949	16.15
1950	61.25
1951	84.79
1952	145.61
1953	278.74
1954	723.46*
1955	2,500.00* (projected)

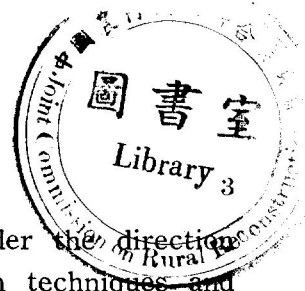
*Including yeast for hog feed

The production of yeast by TSC will be increased further by a project started in FY 1954 with U.S. Government financial assistance. As a result the TSC Hsinying Alcohol Plant will be converted into a yeast plant with a production capacity of 40 metric tons per day.



TSC Hsinying Yeast Plant

The TSC's food yeast production utilizes molasses, an important by-product of sugar manufacturing, as the basic material supplemented with



nitrogen and phosphorus elements. The operation is under the direction and supervision of qualified technicians employing modern techniques and devices. The yeast so produced is comparable in quality with the yeast of the same strain, namely *Torulopsis utilis*, produced in other places.

The following table shows the composition of food yeast produced in Jamaica, Hawaii, and Taiwan:

	Jamaica (1)	Hawaii (1)	Taiwan (2)
Moisture	7.74 %	2.21 %	6.45 %
Crude protein	46.7 %	51.2 %	45.6 %
Crude fat	5.82 %	4.9 %	1.77 %
Crude fiber	6.16 %	(3)	2.34 %
Crude ash	7.66 %	9.28 %	7.84 %
N-free extract	33.6 %	(3)	34.91 %
Vitamins (mg. per 100 gram)			
Thiamin	0.99	0.96	0.866
Riboflavin			
Microbiological	3.98	7.82	(3)
Fluorometric	3.97	7.91	4.75
Biotin	0.34	0.34	(3)
Niacin	40.2	37.9	42.2
Pantothenic acid	5.08	3.07	(3)
Pyridoxine, HCl	4.33	4.21	(3)

(1) *Industrial and Engineering Chemistry*, Vol. 42, No. 9, Page 1830, 1950

(2) Analysed by the Bio-chemistry Department of National Defense Medical Center in June 1953.

(3) Not determined.

II. Yeast Feeding Demonstration

1. Pre-project investigation

Being predominantly considered a drug instead of a food, yeast has a very limited market on Taiwan. TSC has had difficulty in disposing of its

production, although from a nutritional point of view it is much needed by the people. The Provincial Department of Education (PDE) with the assistance of JCRR has in the past three years endeavored to improve the health of school children. Several activities have been undertaken, including the correction of physical defects, eradication of parasites, periodic recording of students' body weight and height, and the training of school nurses. The schools and teachers are generally conscious of the importance of health and nutrition education work and are willing to cooperate in related action programs.

2. The feeding demonstration

The demonstration was carried out under the joint sponsorship of the Taiwan Sugar Corporation, which contributed 9,000 kilograms of yeast and the Provincial Department of Education (with the cooperation of the Education Bureau of Taipei Prefectural Government) which as the Executive Agency was responsible for the implementation of the program. The Joint Commission on Rural Reconstruction gave financial and technical assistance.

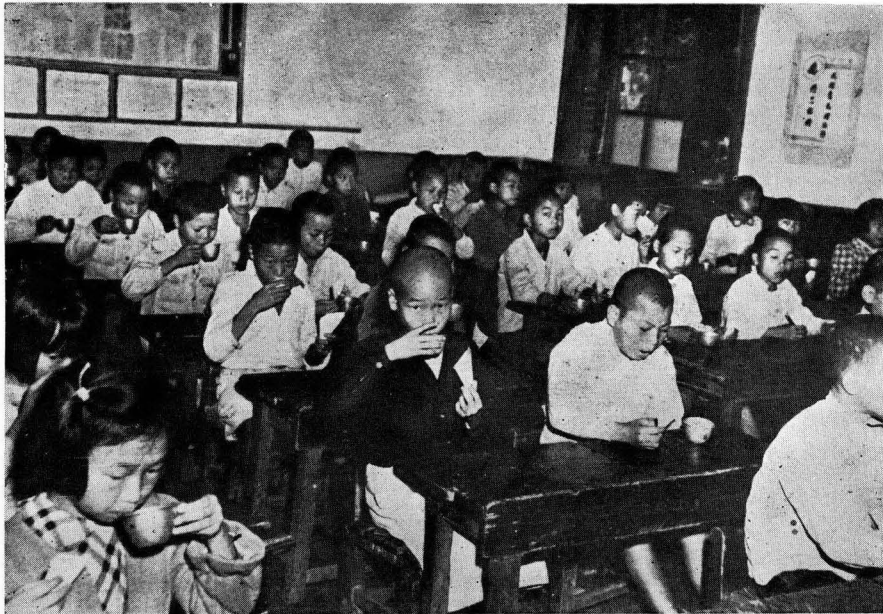
The demonstration was divided into two phases by the intervention of the summer vacation.

a. SELECTION OF SCHOOLS

Schools usually are widely dispersed with different geographical, professional and economic backgrounds. Strictly speaking, no one is identical in background with another. The selection of comparable schools, one to consume yeast and another to be used as a control, with similar, if not identical, environments required much analytical work. Table I (at end of report) shows the geographical, professional and economical backgrounds of the students' families.

b. DISTRIBUTION OF YEAST

Yeast was factory packed in 5-gallon tins and transported from the TSC warehouse directly to the different participating schools on a monthly basis according to their actual requirements. The method of distribution of yeast to the students in Mushan Primary School was most commendable. Yeast of less than 5 grams was given to the students at one time. Yeast of 5

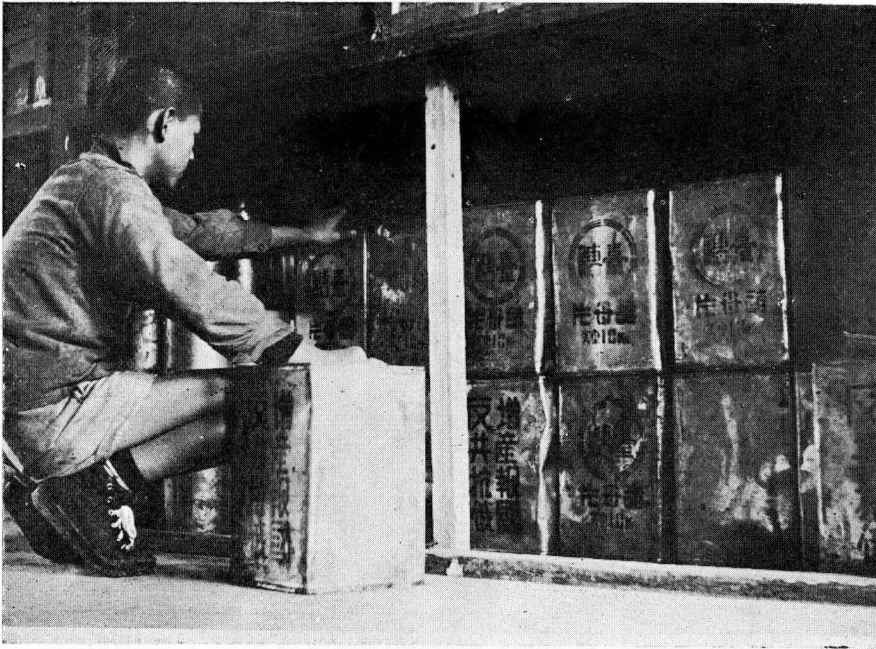


Students Consuming Yeast

grams or more was given to the students in two batches: the first usually after the "morning health check-up" and the second at the first class period after lunch. Before the start of morning classes, the school nurse measured out the yeast according to the actual requirements of the respective classes for the day. Yeast was then brought in small empty tins (used milk powder cans) to the different class rooms. The supervisors gave the containers to the students in the front seat of each row for distribution to the individual students. Each student received the yeast in a piece of clean paper folded in the form of a cone. He consumed it with a cup of boiled water which was provided from tea kettles by the students in the second seats of each row.

Although students were advised not to chew the yeast in order to avoid its sticking to the gums and teeth, many failed to follow the instruction. A slight irritation of the gums resulted in a few cases.

Every school without fail stored the allocated yeast in proper places and disposed of it according to the instructions.



Storage of Yeast in School

c. YEAST AS A DIETARY SUPPLEMENT

The protein and B-vitamin requirements of primary school students are comparable to those of the average adult. The inclusion of only 5 grams of yeast in the daily diet offers no appreciable increase in intake. However, if 15 grams per day is consumed, it contributes greatly to the rates of intake, as shown below:

Age group (Ave. wt.)	Daily requirement [*]	5 grams of yeast		15 grams of yeast	
		Amount	% of req.	Amount	% of req.
4-6 years (19 kg)					
Protein	50 gm	2.28 gm	4.56	6.84 gm	13.68
Thiamin	0.8 mg	0.04 mg	5.00	0.13 mg	16.25
Riboflavin	1.2 mg	0.24 mg	20.00	0.71 mg	59.17
Niacin	8.0 mg	2.11 mg	26.38	6.33 mg	79.13
7-9 years (26 kg)					
Protein	60 gm	2.28 gm	3.80	6.84 gm	11.40

Thiamin	1.0 mg	0.04 mg	4.00	0.13 mg	13.00
Riboflavin	1.5 mg	0.24 mg	16.00	9.71 mg	47.33
Niacin	10 mg	2.11 mg	21.10	6.33 mg	63.30
10-12 years (35 kg)					
Protein	70 gm	2.28 gm	3.26	6.84 gm	9.77
Thiamin	1.2 mg	0.04 mg	3.33	0.13 mg	10.83
Riboflavin	1.8 mg	0.24 mg	13.33	0.71 mg	39.44
Niacin	12 mg	2.11 mg	17.58	6.33 mg	52.75

*Using NRC's Recommended Daily Dietary Allowances, revised 1948, as standard

Assuming that the average daily consumption of polished rice by a child of 10 to 12 years is 300 grams and is supplemented by 15 grams of food yeast, the intakes of protein and B vitamins are still below the actual requirements and should be supplemented by other sources. Nevertheless, the yeast greatly boosts the riboflavin and niacin intake levels. The following shows the quantities of protein and B vitamins provided and the percentages of the daily requirements:

Item	300 grams of rice		15 grams of yeast		Total	
	Weight	% of req.	Weight	% of req.	Weight	% of req.
Protein	21.1 gm	28.71	6.84 gm	9.77	26.94 gm	38.49
Thiamin	0.36 mg	30.00	0.13 mg	10.83	0.49 mg	40.83
Riboflavin	0.18 mg	10.00	0.71 mg	39.44	0.89 mg	49.44
Niacin	4.5 mg	37.50	6.33 mg	52.75	10.83 mg	90.25

d. NO STRICT CONTROL IN THE FEEDING DEMONSTRATION

Although the schools and other concerned agencies and individuals were responsible and cooperative, many factors beyond their control greatly affected the experiment. These factors included dietary habits of the students, their general physical conditions, their home living conditions, outbreak of communicable diseases, prevalence of intestinal parasites. Such conditions varied from one area to another or even from one student to another. All

these had a decisive influence on the general health and welfare of the students and influenced their body weights and height measurements. Some deviations in accuracy of weight and height recording were found among schools. The degree of sensitivity and accuracy of weighing scales used, the clothes worn during the check-ups, the weighing time (whether before or after the meal), and other factors varied in some instances from school to school, or from class to class. Therefore, in the strictest sense, the feeding more appropriately should be called a "demonstration", to introduce yeast to the schools, students and their families and to determine its general acceptability and value as a food supplement, rather than an "experiment" conducted under fully controlled conditions.

e. FIRST PHASE DEMONSTRATION

The first phase of the demonstration began on May 1, and ended in the middle of July 1953 due to summer vacation. The daily intake ranged from 1.5 grams to 15 grams per student, as shown in Table II. Records were taken and have been analyzed with the following results:

(1) Out of the 7 primary schools, 5 show favorable effects of yeast on the body weight of the students. The average weight increase of students fed with yeast for the 2½ months' period is 0.26 kilogram more than that of students not fed with yeast.

(2) The number of students and the increase and decrease of body weight of both the yeast feeding and the control groups are as follows:

Month	Group	No. of students	Increase in weight		No change in weight		Decrease in weight	
			No. of students	%	No. of students	%	No. of students	%
May	Yeast	9,273	5,918	63.82	314	3.39	3,041	32.79
	Control	9,029	4,789	53.04	391	4.33	3,840	42.63
June	Yeast	9,274	4,048	43.65	168	1.81	5,058	54.54
	Control	9,028	2,687	29.76	458	5.07	5,883	65.16
July (half month)	Yeast	9,276	4,715	50.83	708	7.63	3,853	41.54
	Control	9,028	3,662	40.56	1,051	11.64	4,315	47.80

The difference in percentage of weight increase between the feeding and control groups, although amounting to only 10 percent, is statistically significant. However, the result cannot be considered as conclusive due to the following reasons: (1) The record of body weight has not been accurately taken by some schools; (2) It has not been possible to select two identical schools for purposes of comparison because different localities have different environments; (3) The general rice shortage during the first half period of the demonstration has affected the basic food supply in some poorer areas, such as Kungliao and Shuangchi in Taipei prefecture; (4) The daily intake of yeast of 5 grams per person as a source of protein is not sufficient for the purpose; (5) Besides B vitamins and protein, calcium may be another limiting factor of children's growth; and (6) The presence of intestinal parasites in the students may reduce the effectiveness of yeast.

f. SECOND PHASE DEMONSTRATION

The second phase demonstration was started on September 1, 1953 and ended on January 31, 1954 when the fall term was finished, lasting a total of 5 months.

(1) The outstanding features of the demonstration were:

(a) *The introduction of different rates of daily yeast intake to one school:* Because of the delay in reporting the actual number of students attending the fall term by the various schools, the yeast intake rate of the first phase demonstration was followed for the first one and half months. Beginning October 16, 1953, different daily intake quantities were introduced in one school so that a comparison among the students receiving different amounts might be made among the classes of the same school. It was thought that students in the same school would have a more or less similar environment. See Table III for details.

(b) *The introduction of yeast-bone meal tablets:* As the daily calcium intake of children on Taiwan is usually low as the result of the low consumption of dairy products, the deficiency in calcium was also considered as one of the possible factors limiting the children's growth. A cheap source of calcium is from bone meal which contains about 37 percent of calcium (as CaO). Therefore, the TSC was requested to supply 2 tons of calcium-yeast,

1 ton of yeast mixed with 10 percent of bone meal and 1 ton of yeast mixed with 20 percent of bone meal. The mixing of bone meal in the yeast tablets was also expected to remove the gum-sticking effect of pure yeast tablets. The calcium-yeast was supplied in mid-November and regularly fed to some groups of students from December 1, 1953.

(c) *The eradication of intestinal parasites:* It was generally felt that the presence of intestinal parasites in some students would have an adverse effect on the effectiveness of yeast. In late November, 1953 the eradication work was carried out in some schools in order to compare "parasite-eradicated" and "non-parasite-eradicated" groups. Santonin ($\frac{1}{4}$ grain)/calamel ($\frac{1}{4}$ grain) tablets were given in the following doses:

<u>Age (years)</u>	<u>Dosage</u>
6- 7	$\frac{1}{2}$ tablet two times in three days
8-10	$\frac{2}{3}$ tablet two times in three days
11-12	1 tablet two times in three days

(d) *Clinical examination of selected groups of participating students:* At the end of the yeast feeding demonstration, a clinical examination team, consisting of 3 medical doctors, 1 technician, and 1 supervisor, was sent to



Checking weight of Students

different schools to conduct physical examinations of the participating students. The items of examination included the general health condition, body height, body weight, and chest measurements, hemoglobin test, the development of bones and teeth, and tests for vitamins B₁, B₂, and niacin deficiencies. About 5,000 students were examined.

(2) The results of the second phase demonstration are as follows:

(a) *Yeast group vs control group:* The following comparison shows the results at two schools being located in the same general area and having students with comparable backgrounds. See Table IV for details.

Group	Daily yeast intake	School	No. of student	Period	Body weight				
					Total increase	Monthly average	Increase	No change	Decrease
Yeast	2 gm	San-kwang	1,748	5 months	1.49 kg	0.30 kg	52.10 %	37.75 %	10.15 %
Control	0	San-chung	2,378	5 months	1.22 kg	0.24 kg	47.37 %	39.60 %	13.03 %

(b) *Groups with different yeast intakes in the same school:*

School	Yeast intake (gm)	No. of students	Period (months)	Body weight		
				Total increase (kg)	Monthly average (kg)	Percentage showing increase
Panchiao	3	890	5	1.20	0.240	52.49
	5	612	5	1.59	0.318	56.29
	7	67	5	1.94	0.388	56.52
	10	135	5	1.51	0.302	70.96
	15	125	5	1.75	0.350	76.87
Mushan	3	498	4	1.03	0.258	71.12
	5	58	2	0.52	0.260	86.09
	7	94	5	1.85	0.370	65.11
	10	58	1	0.63	0.630	82.76
	15	104	5	1.55	0.310	71.98
Kungliao	3	472	5	1.07	0.214	61.82
	5	76	4	0.81	0.203	61.78
	10	993	4	1.01	0.250	65.68
	15	94	4	1.39	0.348	55.59

The groups with a shorter feeding period showed a comparatively higher increase than those with a longer feeding period, which indicates that the effect of yeast consumption during the first month or two was more pronounced than that of the subsequent months. For details see Table V.

(c) *Calcium-yeast (bone meal as source of calcium) vs pure yeast:*

School	Yeast intake (gm)	Bonemeal content (%)	No. of students	Period (months)	Body weight	
					Total increase (kg)	Monthly average (kg)
Sanhsia	5	10	112	2	0.85	0.425
	5	20	112	2	0.60	0.300
	10	20	104	2	0.60	0.300
	15	10	215	2	1.06	0.503
	5	0	328	2	0.84	0.420
	10	0	211	2	1.01	0.501
	15	0	272	2	0.58	0.290
Panchiao	3	20	615	2	0.53	0.265
	5	10	65	2	0.63	0.315
	5	20	131	2	0.44	0.220
	10	10	111	2	0.80	0.400
	3	0	1,055	2	0.49	0.245
	5	0	1,033	2	0.72	0.360
	10	0	265	2	0.59	0.295
Chichow	5	10	1,092	2	0.89	0.445
	5	20	1,000	2	0.37	0.185
	5	0	985	2	0.75	0.375

The calcium-yeast feeding experiment lasted for only 2 months from December 1, 1953 to January 1, 1954. The record reveals that an admixture of 90 percent yeast and 10 percent bone meal had a good effect on the weight increase of the students while a mixture containing 20 percent of bone meal had an adverse effect. The reason for this unexpected result was

not ascertained.

(d) *Effect of parasite eradication on students' body weight:*

	Chichow	Sanhsia	Total or average
No. of students participating in the eradication	742	719	1,461
No. of students discharging parasites*	409	365	774
Percentage discharging parasites	55.12%	50.76%	52.98%
Average weight of participants before eradication (kg)	22.99	23.17	23.07
Average weight of participants 1 month after eradication (kg)	23.44	24.14	23.79
Increase within 1 month (kg)	0.45	0.97	0.72

*Representing adult worms, of which, about two-thirds were ascaris, found and reported by the students' families and class supervisors. Actual number must be higher if strict observation and examination were made.

The big increase of 0.72 kgs in body weight within one month after the eradication of parasites shows that the presence of intestinal parasites is one of the factors retarding the normal growth of school-age children. The difference in increase between the Chichow student (0.45 kg) and Sanhsia student (0.97 kg) may be explained by the fact that people of Chichow, being closer to Taipei City, are more susceptible to attack by parasites through the consumption of vegetables fertilized with raw night soil from Taipei City, while people of Sanhsia, being a remote township, are less exposed. In both cases, the rate of increase was reduced for the following months.

(e) *Clinical examination on symptoms of nutritional deficiencies.* A total of 4,493 students of both yeast and control groups were examined shortly before end of the second phase demonstration, with the following findings (For details see Table VI):

Group	School	Location	No. of students	% showing vitamin deficiencies		
				Vitamin B ₁	Vitamin B ₂	Niacin
Yeast	Kungliao	Rural-mountainous	606	3.96	24.75	1.16
Control	Shuangchi	Rural-mountainous	810	5.68	32.09	0.36
Yeast	Mushan	Rural	1,263	4.99	31.35	3.01
Yeast	Chichow	Rural-urban	1,465	12.97	28.55	2.87
Control	Chungho	Rural-urban	349	26.07	26.11	5.73

The physicians of the examination team were selected from general hospitals and were not highly specialized in clinical nutrition examination. Their judgment of deficiency symptoms might not coincide with others' findings. For example, the riboflavin deficiency of the students under examination was about 30 percent, while some nutritionists have reported it as high as 70 percent among the children of the primary schools in Taiwan. Nevertheless, the data are adequate for comparison.

(f) *Reaction of students and their families:* The reaction of students to the yeast feeding was carefully observed by both the school officials concerned and the project supervisors during the progress of the demonstration. Reports were received at the beginning that some students felt more thirsty while others felt nauseated. Some students complained that yeast caused a slight dizziness. Some students, mostly girls, with a high daily yeast intake were afraid that the yeast might not be properly digested and become harmful to their health. Nevertheless, the feeding continued and such complaints gradually were reduced, due partially to the formation of habit and partially to publicity and educational work. The students in the control group even complained against the unfair treatment of the project executor for not allocating yeast to them, and the students given small amounts of yeast were envious of their schoolmates who received 10 or 15 grams. About 98 percent of the students said that they liked yeast; many described the taste as being similar to that of parched peanut kernels.

Near the end of the demonstration, the responsible officials of Education Bureau of Taipei Prefectural Government interviewed individually several parents of the yeast feeding students. Thirty-two families in the vicinity of Panchiao were visited and a blank sheet of paper was distributed to each family, asking their comments. The points volunteered are tabulated as follows:

Item	No. of families reported	% of total interviewed
Students' health improved	25	78
Students' appetite improved	21	66
Students rising earlier	1	3
More resistance to colds	2	6
No apparent effect observed	2	6
Program to be continued	26	81

The favorable reaction from the students' families lends support to an expansion of the yeast feeding program in the future.

III. Recommendations

1. The production of yeast by TSC should be expanded and made efficient so that the price could be substantially reduced. Yeast would then be more acceptable to the people as a regular dietary supplement.

2. Research should be conducted and immediate action taken to prepare yeast in the form of food instead of as drugs so that people may consume it in large quantities instead of only a few "tablets." Research should also be done on introducing additives to enhance the taste and flavor so that the yeast can be used as a soup ingredient. For reducing the cost in packing, some material other than tin should be considered.

3. If the price is acceptable, yeast should be used to "fortify" or enrich wheat flour and sweet potato powder.

4. Research should be made to increase the B-vitamin, especially thiamin and riboflavin, and methionine contents of yeast. Deficiencies in thiamin and riboflavin are very salient among most rice-eating people.

5. Calcium-yeast should be widely produced for general consumption. The source of calcium may be common bone meal. If the required fineness and complete sterilization of bone meal could not be ensured, either calcium gluconate or ordinary limestone may be considered.

6. The yeast school feeding program should be continued and expanded. The daily yeast intakes for different age groups are suggested as follows:

6-8 years (roughly corresponding to grades 1 and 2)	: 5 grams
9-10 years (roughly corresponding to grades 3 and 4)	: 7 grams
11-12 years (roughly corresponding to grades 5 and 6)	: 10 grams
13 years and up (middle school students)	: 15 grams

The mixing of some 10 percent of bone meal or other calcium source in yeast for school children is recommended. This amount of calcium in yeast will supply about 40 percent of the minimum daily requirement.

7. Introduction of yeast to protein-deficient groups, notably the aborigines, the salt and mine workers, and farmers using sweet potatoes as their staple food, should be encouraged. The concerned agencies should work out practical plans to implement such programs.

Table I. Family Backgrounds of the Students Participating in the Yeast Feeding Demonstration in Various Primary School of Taipei Prefecture

Group	School	No. of students			Geographical background (%)					Professional background (%)							Economic background (%)			
		Boys	Girls	Total	Town	Country	Plain	Mountainous	Farmer	Merchant	Labor	Gov't. employee	Fisher men	Mining worker	Others	Rich	Well-to-do	Common	Poor	Very poor
I.	Panchiao (yeast)	1,700	1,500	3,200	63.00	37.00	100	0	21.00	22.00	18.00	20.00	0	1.00	18.00	2.00	16.00	67.00	12.00	3.00
	Shulin (control)	900	800	1,700	47.00	53.00	100	0	47.00	16.00	9.00	11.00	0	0	17.00	2.00	16.00	60.00	16.00	6.00
II.	Sanhsia (yeast)	900	800	1,700	47.01	52.99	100	0	41.90	22.40	12.10	8.52	0	1.27	13.81	4.22	13.93	62.40	13.50	5.95
	Yingko (control)	1,000	900	1,900	58.53	41.47	100	0	28.74	17.78	13.16	4.77	0.05	2.68	32.82	1.99	11.17	65.65	13.48	7.71
III.	Sankwang (yeast)	900	800	1,700	65.00	35.00	100	0	8.00	31.00	27.00	11.00	0	0	23.00	4.00	42.00	42.00	6.00	6.00
	Sanchung (control)	1,400	1,100	2,500	64.80	35.20	100	0	18.00	30.00	22.50	9.00	0.30	0.10	20.10	2.00	13.00	43.00	32.00	10.00
IV.	Chichow (yeast)	800	700	1,500	0	100	100	0	32.17	20.37	14.92	16.12	0.25	0.25	15.92	3.74	13.83	65.94	11.54	4.95
	Chungho (control)	1,000	800	1,800	7.30	92.70	100	0	40.00	13.30	17.50	7.60	0.50	4.00	17.10	2.00	9.70	76.30	9.00	3.00
V.	Mushan (yeast)	700	500	1,200	65.00	35.00	100	0	50.00	10.00	17.50	0.50	0	0	22.00	2.30	19.10	50.00	23.00	5.60
	Shenkeng (control)	400	300	700	42.18	57.82	100	0	75.40	9.92	5.40	2.75	0	3.60	2.93	2.12	10.40	61.00	23.99	2.49
VI.	Kungliao (yeast)	400	200	600	0	100	100	0	35.00	10.00	15.00	8.00	23.00	5.00	4.00	5.00	5.00	10.00	35.00	45.00
	Shuangchi (control)	600	400	1,000	0	100	100	0	41.00	17.00	10.00	8.00	1.00	12.00	11.00	2.28	12.88	64.53	16.45	3.86
VII.	Fushan (yeast)	50	50	100	0	100	0	100	55.00	0	45.00	0	0	0	0	0	0	0	26.00	74.00
	Shinhsien (control)	36	41	77	0	100	0	100	28.70	6.49	50.14	6.42	1.24	0	7.01	0	1.46	29.96	38.99	29.59

Table II. Quantity of Yeast Allocation to Different Primary Schools in Taipei Prefecture
First Phase Demonstration (May 1 - July 15, 1953)

School No.	Name of school	Allocation							Quantity			Total monthly requirement (gm)
		No. of students	Daily in-take each student (gm)	Daily requirement of students (gm)	Monthly requirement of students (gm)	No. of teachers	Daily in-take each teacher (gm)	Daily requirement of teachers (gm)	Monthly requirement of teachers (gm)			
1709A	Sanhsia	1,711	1.5	2,566.5	69,295.5	36	5.0	180.0	4,860.0	74,155.5		
1782A	Sankwang	1,262	2.0	2,524.0	68,148.0	25	5.0	125.0	3,375.0	71,523.0		
1752A	Kungliao	686	3.0	2,058.0	55,566.0	18	5.0	90.0	2,430.0	57,996.0		
1701A	Panchiao	2,966	3.0	8,898.0	240,246.0	71	5.0	355.0	9,585.0	249,831.0		
1716A	Chichow	1,396	5.0	6,980.0	188,460.0	27	5.0	135.0	3,645.0	192,105.0		
1789A	Wulai	217	5.0	1,085.0	29,295.0	12	5.0	60.0	1,620.0	30,915.0		
1770A	Musan	762	2.0	1,524.0	41,148.0	30	5.0	150.0	4,050.0	131,868.0		
"	"	180	7.0	1,260.0	34,020.0							
"	"	120	10.0	1,200.0	32,400.0							
"	"	50	15.0	750.0	20,250.0							
Sub-total:	7 schools	9,350			778,828.5	219			29,565.0	808,393.5		
1769A	Shen keng					15	5.0	75.0	2,025.0			
1715A	Chung ho					32	5.0	160.0	4,320.0			
1748A	Shuang chi					25	5.0	125.0	3,375.0			
1704A	Shu lin					31	5.0	155.0	4,185.0			
1707A	Ying ko					39	5.0	195.0	5,265.0			
1780A	San chung					45	5.0	225.0	6,075.0			
1791A	Shin hsien					5	5.0	25.0	675.0			
Sub-total:	7 schools					192			25,920.0	25,920.0		
Total:	14 schools	9,350			778,828.5	411			55,485.0	834,313.5		

No student participating

Table III. Quantity of Yeast Allocation to Different Primary Schools in Taipei Prefecture
Second Phase Demonstration (September 1, 1953—January 31, 1954)

School No.	Name of school	No. of students	Daily intake each student (gm)	daily requirement of students (gm)	monthly requirement of students (gm)	No. of teachers	Daily intake each teacher (gm)	daily requirement of teachers (gm)	monthly requirement of teachers (gm)	Total monthly requirement (gm)
1709 A	Sanhsia	1,022 279 163 213	1.5 5.0 10.0 15.0	1,533 1,395 1,630 3,195	41,391 37,665 44,010 86,265	37	10	370	9,990	219,321
1752 A	Kungliao	426 79 90 91	3.0 5.0 10.0 15.0	1,278 395 900 1,365	34,506 10,665 24,300 36,855	20	10	210	5,880	112,206
1701 A	Panchiao	936 800 808 120 240 180	1.5 3.0 5.0 7.0 10.0 15.0	1,404 2,400 4,040 840 2,400 2,700	37,908 64,800 109,080 22,680 67,200 72,900	73	10	730	19,710	394,278
1770 A	Mushan	588 478 110 110	1.5 3.0 7.0 15.0	882 1,434 770 1,650	23,814 38,718 20,790 44,550	32	10	320	8,640	136,512
1782 A	Sankwang	1,758	2.0	3,516	94,932	32	10	320	8,640	103,572
1716 A	Chichow	1,554	5.0	7,770	209,790	30	10	300	8,100	217,890
1790 A	Fushan	27	5.0	235	6,345	4	10	40	1,080	7,425
	Sub-total:	10,992		1,129,164		228		62,040		1,191,204
1707 A	Yingko					40	10	400	10,800	10,800
1708 A	Shuangchi					25	10	250	6,750	6,750
1704 A	Shulin					33	10	330	8,910	8,910
1769 A	Shenkeng					17	10	170	4,590	4,590
1780 A	Sanchung					46	10	460	12,420	12,420
1715 A	Chungho					36	10	360	9,720	9,720
1791 A	Hsinhsien					5	10	50	1,350	1,350
1789 A	Wulai					13	10	130	3,510	3,510
	Sub-total:					215		58,050		58,050
	Total:	10,992		1,129,164		443		120,090		1,249,254

No student participating

Table IV. Body Weight Difference in 5 Months Between Yeast Consuming Students
(2 gm/day) and Control Students

School	Month	No. of Students	Yeast daily intake (gm)	No. of students showing Change of body weight				Increase over previous month (kg)		
				Increase	%	No change	%		Decrease	%
Sankwang	September	1,740	2	607	34.88	923	53.05	210	12.07	+ 0.18
Sanchung	September	2,358	0	709	30.07	1,397	59.24	252	10.69	+ 0.10
Sankwang	October	1,758	2	749	42.61	717	40.78	292	16.61	+ 0.11
Sanchung	October	2,351	0	1,118	47.55	937	39.86	296	12.59	+ 0.28
Sankwang	November	1,760	2	932	52.96	675	38.35	153	8.69	+ 0.35
Sanchung	November	2,426	0	985	40.60	1,107	45.63	334	13.77	+ 0.22
Sankwang	December	1,748	2	1,285	73.51	375	21.45	88	5.04	+ 0.51
Sanchung	December	2,430	0	1,230	50.62	827	34.03	373	15.35	+ 0.22
Sankwang	January	1,735	2	981	56.54	610	35.16	144	8.30	+ 0.34
Sanchung	January	2,325	0	1,590	68.39	441	18.97	294	12.64	+ 0.40
Average										
Sankwang	Sept.-Jan.	1,748	2	911	52.10	660	37.75	177	10.15	+ 0.30
Sanchung	Sept.-Jan.	2,378	0	1,126	47.37	942	39.60	310	13.03	+ 0.24

Table V. Change of Body Weight Among Student Groups
with Different Yeast Intakes in the Same Schools

School	Month	Yeast intake (gm.)	No. of students	Increase in weight		Average increase over previous month (kg)	
				No. of students	Percentage		
Panchiao	Sept. 1953	3	1,286	452	35.15	0.08	
		5	658	219	33.54	0.13	
		7	178	58	32.58	0.02	
		10	187	115	60.85	0.25	
		15	66	41	62.12	0.25	
	Oct. 1953	3	1,163	624	55.20	0.36	
		5	661	397	60.06	0.34	
		7	178	71	39.89	0.77	
		10	188	103	54.79	0.34	
		15	129	82	65.57	0.34	
	Nov. 1953	3	946	598	63.31	0.27	
		5	723	469	64.87	0.40	
		7	119	94	78.99	0.38	
		10	314	244	77.71	0.33	
		15	129	108	83.72	0.60	
	Dec. 1953	3	531	322	60.64	0.22	
		5	519	339	65.32	0.34	
		7	119	88	73.95	0.50	
		10	133	93	69.92	0.20	
		15	126	103	81.75	0.27	
Jan. 1954	3	524	340	64.89	0.27		
	5	514	307	59.73	0.38		
	7	119	92	77.31	0.27		
	10	132	122	92.42	0.39		
	15	125	108	86.40	0.29		
Total:	Sept. 1953- Jan. 1954	3	4,450	2,336	52.49	5 months average: 0.23 0.32 0.39 0.31 0.36	
		5	3,075	1,731	56.29		
		7	713	403	56.52		
		10	954	677	70.96		
		15	575	442	76.87		
Mushan	Sept. 1953	5	115	99	86.09	0.52	
		7	46	31	67.39	0.27	
		10	58	48	82.76	0.63	
		15	60	46	76.67	0.43	
	Oct. 1953	3	499	294	58.92	0.11	
		7	106	61	57.55	0.14	
		15	118	79	66.95	0.13	
	Nov. 1953	3	496	410	82.66	0.38	
		7	106	81	76.42	0.40	
		15	116	94	81.03	0.26	
	Dec. 1953	3	498	371	74.50	0.26	
		7	106	82	77.36	0.49	
		15	115	75	65.22	0.39	
	Jan. 1954	3	498	341	68.47	0.28	
		7	106	51	48.11	0.55	
		15	112	81	72.32	0.34	
	Total:	Sept. 1953- Jan. 1954	3	1,991	1,416	71.12	5 months average: 0.26 0.52 0.38 0.63 0.30
			5	115	99	86.09	
			7	470	306	65.11	
			10	58	48	82.76	
15			521	375	71.98		
Kungliao	Sept. 1953	3	663	338	50.90	0.23	
		5	409	271	66.26	0.30	
		10	94	61	64.89	0.15	
		15	94	62	65.96	0.26	
	Nov. 1953	3	408	308	75.49	0.39	
		5	77	61	79.22	0.43	
		10	93	79	84.95	0.60	
		15	94	83	88.30	0.69	
	Dec. 1953	3	407	279	68.55	0.29	
		5	77	47	61.04	0.26	
		10	93	57	61.29	0.18	
		15	94	47	50.00	0.06	
	Jan. 1954	3	402	219	54.48	0.16	
		5	76	22	28.95	0.20	
		10	93	48	51.61	0.08	
		15	94	17	18.09	0.38	
	Total:	Sept. 1953- Jan. 1954	3	2,289	1,415	61.82	5 months average: 0.27 0.30 0.25 0.35
			5	306	186	60.78	
			10	373	245	65.68	
			15	376	209	55.59	

Table VI. Summary of the Clinical Examination Results on Primary School Students Participating in Yeast Feeding Demonstration

Name of school	No. of students examined	Vitamin B ₁ deficiency						Vitamin B ₃ deficiency						Niacin deficiency					
		Knee jerk		Edema of lower limbs		Angular stomatitis		Glossitis		Fissures on lip or tongue		Pigmentation of skin		Desquamation of skin		Astrophy of local mucosa		Total	
		Sluggish	Ab-sence	Marked	Moder-ate	Mild	Total	Marked	Moder-ate	Marked	Moder-ate	Marked	Moder-ate	Marked	Moder-ate	Marked	Moder-ate		
Kungliao (yeast)	{ 606 %	11		1	12	24	9	111	8		22	150	2			5			7
		1.81		0.17	1.98	3.96	1.48	18.32	1.32		3.63	24.75	0.33			0.83			1.16
Shuangchi (control)	{ 810 %	28			18	46	7	209	3		41	260					2		3
		3.46			2.22	5.68	0.86	25.80	0.37		5.06	32.09	0.12			0.24			0.36
Mushan (yeast)	{ 1,263 %	53	1	1	8	63	32	337	14		13	396				10			38
		4.20	0.08	0.08	0.63	4.99	2.53	26.68	1.11		1.03	31.35	1.90			0.79			3.01
Chichow (yeast)	{ 1,465 %	155	8	1	16	180	14	370	13	1	20	418	23		1	14			42
		10.58	0.55	0.07	1.10	12.30	0.96	25.26	0.89	0.07	1.37	28.55	1.57		0.07	0.96			2.87
Chungho (control)	{ 349 %	58	6	4	23	91	2	105	10		9	126				5			20
		16.62	1.72	1.15	6.59	26.08	0.57	30.09	2.87		2.58	36.11	3.44			1.43			5.73
Total	{ 4,493 %	305	15	7	77	404	64	1,132	48	1	105	1,350	61	2	3	34			110
		6.79	0.33	0.16	1.71	8.99	1.42	25.20	1.07	0.02	2.34	30.05	1.36	0.04	0.07	0.76			2.45

行政院農委會圖書室



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