

AGENCY FOR INTERNATIONAL DEVELOPMENT  
WASHINGTON, D. C. 20523

**BIBLIOGRAPHIC INPUT SHEET**

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**BATCH 60**

1. SUBJECT CLASSIFICATION	A. PRIMARY Food production and nutrition	AS00-0000-G635
	B. SECONDARY Human nutrition--India	

2. TITLE AND SUBTITLE  
Nutrition intervention: a test of extruded foods in Balwady feeding programs in Tamil Nadu

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4. DOCUMENT DATE 1973	5. NUMBER OF PAGES 70p.	6. ARC NUMBER ARC
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7. REFERENCE ORGANIZATION NAME AND ADDRESS  
Cantor

8. SUPPLEMENTARY NOTES (Sponsoring Organization, Publishers, Availability)  
(In Tamil Nadu Nutrition Project, v.2, Sect.D, pt.3)

9. ABSTRACT

The acceptability of extrusion-cooked foods was tested during a three-month study in Tamil Nadu, India, in 1972, using a Wenger X-25 extruder and twenty-two balwadies to reach 2,170 beneficiaries. These included 600 pregnant or lactating mothers, 700 infants aged six months to two and one-half years, and 870 children aged two and one-half to five years. The study objectives were to test the acceptability, shelf life, handling characteristics, packaging requirements, and operational advantages of extruded food preparations. Two formulations were selected: a bland bite-size bit in ready-to-eat form, and a sweetened powder intended to be reconstituted with water into a porridge. Both products were composed of 70 percent corn grits and 30 percent defatted soya flour, fortified with a vitamin and mineral premix. Both foods were found to be acceptable in the sense that they were not rejected by the test population. Daily consumption was not very different from consumption of CSM in the regular balwady program. However, the sweetened powder was less palatable, and after a time it was being prepared by cooking it in a traditional local preparation. The foods had excellent handling characteristics, the polyethylene packaging was adequate, and the shelf life appeared to be comparable to CSM. The short test program was promising. Further research is needed on operations, preparations, and costs before large-scale programs can soundly be based on extrusion technology.

10. CONTROL NUMBER PN-AAD-778	11. PRICE OF DOCUMENT
12. DESCRIPTORS Acceptability Evaluation Extrusions Feeding	13. PROJECT NUMBER
	14. CONTRACT NUMBER AID/nesa-399 GTS
	15. TYPE OF DOCUMENT

VOLUME II SECTION D

PART III

NUTRITION INTERVENTION:

A TEST OF EXTRUDED FOODS IN BALWADY  
FEEDING PROGRAMS IN TAMIL NADU

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CANTOR/ATAC  
TAMIL NADU NUTRITION PROJECT  
FIELD REPORT

## ACKNOWLEDGMENT

The successful completion of the test of extruded foods was made possible by the kind cooperation extended by the officials at various levels of the Tamil Nadu Government, and CARE Tamil Nadu. We wish to place on record our deeply felt thanks to: Mr. D. K. Oza, Secretary, Social Welfare; Mr. V. Sundaram, Deputy Secretary, Social Welfare; Mrs. Latika D. Padalkar, Director, Women's Welfare; Mrs. Kantha Ekambaram, Deputy Director, Women's Welfare; Mrs. A. Vasanthakumari, Special Officer (child care); and to the following officers of CARE Tamil Nadu: Mr. Jack Soldate, Administrator; Mr. M. Markos, Assistant Administrator; and Mr. G. Ranganathan, Field Officer. We also thank the commissioners of the various Panchayat Unions and their staffs, the Department of School Education and the Rural Development and Local Administration Department for their kind cooperation and help.

NUTRITION INTERVENTION: A TEST OF EXTRUDED FOODS  
IN BALWADY FEEDING PROGRAMS IN TAMIL NADU

COMMENTARY

The testing of extruded foods as a nutrition intervention in the Tamil Nadu Nutrition Project evolved from what was originally planned as both an evaluation of extruder continuous processing of cereals and a test of weaning foods. There are weaning foods available in India; most are costly and cater to the high income market and to some lower class parents representing status foods. Children from the lower economic classes seem to pass directly from breast feeding to adult foods, i. e. the family plate (a). Thus an evaluation of weaning foods was a natural intervention for the Tamil Nadu Nutrition Project. The evaluation of continuous extruder processing represented an alternative to central kitchen development, but had to be curtailed because of time constraints forced by international events. It was therefore decided to examine extruder cooked products for, as noted in the report summary, this production technique is highly versatile with regard to continuous processing of a variety of raw materials as well as the shape and form such products can assume (b).

Preliminary acceptability testing resulted in the selection of two forms of a maize-soy formulation; one a bland, bite-sized piece, the other a sweetened powder - both of which were distributed from several balwadies in one district of Tamil Nadu. The foods were initially given to children enrolled in balwadies, infants below two and a half years of age, and some pregnant and lactating mothers.

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- (a) See Vol. II Section B, Cultural Anthropology and Nutrition, E. Ashkenaz.
- (b) The practicality of continuous extruder production of popular foods is very well illustrated in another report which was a part of the S. M. Cantor Associates program elsewhere in India: RTE Food Processing Plant Andhra Pradesh, J. L. Swanson, Consultant, N.S.L. Singh, Consulting Engineer.

Some results and certain directions derived therefrom are listed below. It should be emphasized that two parts of the report are considered to reflect accurately the test results recorded. These are the admirably qualified summary and the appended anthropologists' observations. Several conclusions drawn in the original draft of the report were modified because they did not appear to reflect collected data properly. Actually, any conclusions have to be viewed as tentative not only because of the short testing time (three months) but also, as noted in the anthropologist's comments, neither the one and a half year olds nor the pregnant and lactating women took any of the food.

The test marks routes for future development. These include:

Proper Marketing - The bite-sized foods may have resembled the indigenous and ubiquitous SEV but were still looked upon by many as raw food that needed cooking. Poor instructions and limited directions on how to moisten the powdered food resulted in too thin a preparation for finger feeding. The fact that the test food replaced CSM, which had been served in the balwadies in the form of an uncooked local preparation posed a very challenging handicap, i. e. poor identification. Further, as noted before, distribution from balwadies may be fine for those enrolled but the products, at least over this short period of testing, probably do not reach the target groups outside the balwady. Finally, it is noted that there are shortcomings in checking the test food in one district (Chingleput) for acceptability and then switching to an entirely different district (North Arcot) for the larger scale program. This technique has been used successfully where sophisticated methodology is available for drawing generalities. Unfortunately, this was not the case here.

Nutrition Education - dovetails with marketing aspects in that the target group apparently could not appreciate that the extruder food was pre-cooked. And again, the aims and objectives of a weaning food bear explanation to the target group as does the necessity for infants and pregnant and lactating mothers to take the proper amount of nutritious foods. Communication was deficient.

Planning - for feeding on a larger than present scale over wider and into less accessible areas should include very serious consideration of the use of extruders or similar equipment. The kind of grain - including low status maize - can be made into a form acceptable in texture and taste to the target groups. This allows use of any grain that happens to be excess at any given time. It also emphasizes the need for formulating acceptable products based on various grains. Secondly, the extruder products are pre-cooked and need, at most, some moistening agent (water) as an aid to eating. Thirdly, large quantities of products can be prepared at any selected geographical point and transported for use or storage at branch distribution points. Extruded products, properly bulk packed, are quite resistant to being pulverized by abrasion and their shelf life with respect to flavor, texture and infestation is greatly advanced over food used in current feeding programs. Nevertheless, it is to be expected that each product would be checked out to meet all aspects of local requirements before large scale manufacturing takes place.

Lastly, there appears to be little doubt as to the superiority of extruder cooking as a mass means of food preparation which can meet mass consumption requirements. Adaptability of extruder cookers to Indian requirements is already underway. The central kitchen concept has definite limitations for scale-up. Fuel economy is rapidly reduced because of heat transfer problems, and the economy of transporting larger and larger quantities of water leaves little choice, and the rapid perishability of cooked food is self evident. One more point about the versatility of extruder foods is most important. Many indigenous and highly acceptable foods are formulated around one cereal - rice, for example. The pre-cooked cereal lends itself to a broadly varied formulation since in most instances it is from 70 to 90% of the entire formulation. Thus many dried pre-mixes, each as a distinctly different dish may be aimed at a separate target group, and are possible to be produced from one extruder cooker which is used only for cereal processing at a central factory site.

In short, extruder processing adapted to Indian technological standards

and operating at acceptable Indian levels of effectiveness may provide what appears to be a convenience food. But such a convenience food makes more effective use of public funds for subsidized feeding programs than central kitchen expansion.

All in all, serious consideration must be given to the results of this rather abbreviated test with a definite plan for continuing and expanding and applying the experimental data.

NUTRITION INTERVENTION:  
A TEST OF EXTRUDED FOODS IN BALWADY  
FEEDING PROGRAMS IN TAMIL NADU

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## INTRODUCTION

### Need for the Study and Objectives

There are a number of large-scale ongoing feeding programs in Tamil Nadu, in both public and private sectors, using conventional cooking methods. These programs cover more than two million pre-school children, school children, and pregnant and lactating mothers. Typical are the Social Welfare Department's balwady feeding programs and the Education Department's mid-day meals scheme. There have been increasing numbers of beneficiaries covered, and quantities of food delivered year after year. There is currently a proposal to open 10,000 more balwadies over a period of three years from 1973-74 financial year.

But these increases in scale have not been accompanied by technological innovation -- larger pots are being used for traditional modes of preparation. The mid-day meals central kitchen scheme includes the cooking of large quantities of food at a central place in modern hygienic kitchens. There are operational constraints in this approach to central preparation which may limit its applicability to programs covering pre-school children and mothers. In particular, the scheme calls for delivering on a daily basis cooked food which has no shelf life. Accordingly, a rigid delivery schedule must be adhered to.

One of the significant developments of the food processing industry during the mid-twentieth century is cooking by extrusion puffing. This is a process in which cereal grains or other starch-bearing raw food ingredients are cooked and puffed by a continuous process to yield porous bits of ready-to-eat food. The extruders use a continuous compression screw in which the food is heated and compacted to form a plastic mass, which is discharged through a die at the end of the screw. When the product emerges from the die, it instantly expands because of the drop in pressure.

By using different cereal grains, by incorporating various flavoring and coloring ingredients, and by using different shapes and sizes of dies, an enormous variety of products can be produced through an extruder. The addition of a grinder following extrusion allows ready-to-eat foods to be produced in powdered form. Extrusion lends itself to the use of a wide variety of ingredients and flavorings. Consequently, products can be designed to suit any taste and virtually any nutritional specification.

Extruders and ancillary equipment are available as both small and large units, ranging from an annual through-put per 8 hour shift of 600 tonnes to 5,000 tonnes. The complete installation of a 600 ton plant in India is expected to cost about Rs. 12 lakhs and the larger one about Rs. 30 lakhs, including land, buildings, and all necessary accessories.<sup>(a)</sup>

The theoretical advantages of extrusion puffing in cost, in shelf life, and in the varieties of raw materials which could be used and products prepared, prompted this test.

The objective of the project was to test the acceptability of extruder cooked, ready-to-eat, food preparations on a sample of the beneficiaries in the balwady feeding program in Tamil Nadu State. It was also intended to provide data on shelf life, handling characteristics, and packaging requirement of these foods. The extruder used was a Wenger X-25 located in Bareilly, Uttar Pradesh.

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(a) See E. E. Rice, End of Tour Reports.

Phase I Trial - Two types of extruded foods were tested informally among a group of 16 balwady and slum children in the age group of 2-1/2 to 5 years, plus a few adults. The composition of the product was:

70 parts ground corn grits  
30 parts partially defatted soy flour  
0.7 part salt

The products were in both powder and bite-size types. Testing was carried out for two days. The major conclusions drawn from this very ad hoc test were:

Both powder and bite-size types of foods were rated favorably when recipients were asked about color, texture, and mouth feel.

The majority of the children said that the taste was reasonably good. Only one said that the products were definitely not acceptable.

Both the children and their mothers wanted sugar or spices to be added to improve the taste.

Phase II Trial - Based on the experience gained during Phase I, sample quantities of four types of products were prepared. They all had the same composition, but different flavoring:

Bland bite-size bits  
Spiced bite-size bits  
Bland powder  
Sweetened powder

These foods were tried only among balwady-enrolled children, in four balwadies in Chingleput District, for a period of eight days. Each food was consecutively served for two days. Out of the four balwadies selected, two previously had a CSM and oil feeding program, while the other two had no feeding program of any kind. Investigators were posted at each balwady with instructions to serve 40 grams of the food as the first helping and then 20 grams for as many subsequent helpings as each child wished. A structured questionnaire was prepared to be filled out each day by the investigator, partly based on observation of consumption and wastage, partly on the opinions of the recipients.

The following observations were made from the analysis of the questionnaires:

- (a) The highest average quantity consumed per child was about 42 grams for sweetened powder, followed by bland bite-size bits at about 36 grams per child.
- (b) The wastage was highest in the case of bland powder, about 10 grams per child. The lowest wastage was in spiced bite-size bits, but the consumption per child was also the lowest.
- (c) With the help of consumption and wastage figures, the foods were ranked and given scores. The following are the scores which were earned by each product:

Sweetened powder	29 points
Bland bite-size bits	20 points
Spiced bite-size bits	19 points
Bland powder	12 points

The results obtained by this numerical ranking were also confirmed by the oral opinions of the children after having eaten the four types of food.

- (d) Mothers of the children were also asked to offer their opinion about the four types of food. After testing, the greatest number expressed a preference for sweetened powder, followed by bland bite-size bits.
- (e) Similarly, the balasevikas in charge of the balwadies were asked their opinion. Their preference agreed with the children and mothers.

Based on these observations the sweetened powder and bland bite-size bits were chosen for the large-scale trial. The next chapter deals with the organization and methodology of the third and final phase of this test.

## ORGANIZATION AND METHODOLOGY: PHASE III

### Selection of Area

Although the acceptability of extruded foods had been indicated in Phase I and II, consumption was only for a short period of time by a small number of children. It was thought necessary to try these foods on a greater number of beneficiaries, including not only children, but also pregnant and lactating mothers, and pre-balwady age children, and over a longer time.

Arni, Chengam, Tiruppattur, and Vembakkam blocks in North Arcot District were selected for Phase III. Twenty-two balwadies were selected from a total of 123 in the four blocks, taking into consideration accessibility and enrollment. Exhibit I gives the names of the balwadies and the enrollment details in each one. As can be seen from Exhibit I, the program was to cover a total of 2,170 beneficiaries, of which 870 were balwady age children (2-1/2-5 years), 700 were pre-balwady age (6 months - 2-1/2 years -- hereafter called infants) and 600 pregnant and lactating mothers.

As mentioned earlier, two foods - sweetened powder and bland bite-size bits - were selected based on Phase II experience.

The foods were prepared at the only operating extruder plant in India: Soya Products and Research Association, located in Bareilly, Uttar Pradesh. The total food requirements were estimated to be about 15 tonnes - at the rate of 80 grams per beneficiary per day, for 25 feeding days in each of three months. Seven and a half tonnes of each kind of food was produced and shipped to the Education Department's godown at Tiruvalam in North Arcot District. The transportation from Bareilly to Tiruvalam was done by truck, and took about 10 days from the date of dispatch.

The foods were packed in double polyethylene bags. The inner bags containing the food were ordinary polyethylene, while the outer bags were woven polyethylene. The inner bag was tightly tied and the outer bag was stitched. Since the bite-size bits were bulkier than the powder, they were packed at the rate of 11.34 kilograms per bag (25 pounds). The powdered food was packed at the rate of 22.68 kilograms per bag (50 pounds). The foods withstood the trip of more than 2,000 kilometers very well. Torn bags amounted to no more than 1-2%, and loss of product in transit was almost nil. The bite-size bits remained quite crisp even after 10 days travel in open trucks covered with tarpaulin.

The allotments to each block were arranged to be moved from the godown along with the regular CSM, oil, and bulgur wheat shipments. This movement was by truck to the range godowns in every block. The Block Development Officer in turn took delivery of the food from the range godowns and handed it over to the balasevikas in charge of the balwadies selected for the test. They transported the food to their balwadies by bullock carts or passenger buses, or in one block by a tractor pulling a trailer.

The foods retained their freshness well throughout the 2-3 months in which they remained in the balwadies. Since the powdered food was sweet, it attracted ants. The powder also was subject to some infestation by other insects, but it retained its acceptability even after 3-4 months. The bite-size bits did not become infested and suffered no apparent deterioration during the test.

Four investigators were posted at each one of the block headquarters, so that they could visit one balwady every day for collecting data. (a)

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(a) It is to be noted that all the selected balwadies had the CARE (CSM and salad oil) feeding program in operation. The CSM program was temporarily suspended for the duration of the test.

### Data Collection

A structured questionnaire (Appendix I) was designed to elicit information about the balwady in general, the quantum of food consumed and wasted by the regularly enrolled children, and the opinions of the children, mothers, and balasevikas. The four investigators visited one balwady per day by rotation and filled in the questionnaire by observation and enquiry with the cooperation of the balasevikas.

### Training of Balasevikas

In every block headquarters, a training course was organized by our staff for the benefit of the balasevikas. The purpose of the test was explained to them and the method of preparation of the powdered food was demonstrated. (The bite-size bits were fully ready to eat, but the powdered food had to be mixed with water.) Initially, the balasevikas were instructed to mix one part of powder with three parts of water by volume. Since this was found to be too watery the proportion was changed to one to one. This made the food much easier for the children to pick up in their fingers.

The balasevikas were instructed to serve 80 grams of the food to each beneficiary per day. They were supplied with plates, mugs, measuring cups, and pots for mixing the powder with water.

### Duration of the Test

As mentioned earlier, the last phase of test was to run for a period of three months, beginning September 1, 1972. All four investigators worked during the first month. During the second month two of them were retained to collect similar data for comparison purposes from other balwadies having the regular CARE feeding programs. In the third month, the test balwadies were again visited by the investigators, and the same questionnaire was used for additional data collection. This was to determine whether there was any change in quantities consumed and attitudes toward the food during the three-month period.

## RESULTS AND DISCUSSION

### General Details of Balwadies

Out of the 22 balwadies selected for the study, 12 had CARE-constructed buildings (see Table 1). These balwadies had ample space for storage and preparation.

The other 10 balwadies were functioning in donated structures. Without a regular building, the balwady is at the mercy of the local panchayat for storage space. The balwady at S. V. Nagaram in Arni block was located in a structure which was previously a poultry shed. In another balwady, which is functioning in the local panchayat building, cement bags and food bags were stored side by side. Another balwady was operating in the house of the balasevika. In places where there is no separate building for the balwady, the cooking is usually done in the open air.

In almost all of the balwadies, the feeding commenced at 11:30 a. m. In a few cases, feeding was at 12:00 noon. The duration of feeding varied from 30-65 minutes. Most of the balwadies had a couple of aluminum vessels for mixing the powdered food with water. The bite-size bits could be served from the bag. A few balwadies had aluminum plates and mugs, whereas in the rest the children brought their own every day. To have uniform conditions, we supplied the requisite number of plates and mugs, which were provided only to the regularly enrolled children who ate in the balwady. The other beneficiaries -- infants, and pregnant and lactating mothers -- carried the food home in their own containers.

### Attendance Details

The individual balwady's attendance records for the day on which the balwady was visited in September by our investigators, are presented in Exhibit 2. On the average, for all balwadies in the test, attendance

TABLE 1  
BALWADY BUILDING DETAILS

Block	Number of Balwadies Selected	Number of Balwadies with CARE Buildings
Arni	6	4
Chengam	6	---
Tiruppattur	6	4
Vembakkam	<u>4</u>	<u>4</u>
TOTAL	22	12

Source: Tamil Nadu Study

was 68% of the enrollment (68 out of 100 per day). Of the 68, 24 on the average were balwady children, 21 were infants, and 23 were pregnant and lactating mothers. Arni, Chengam showed lowest participation of about 50% each.

During the month of October, some balwadies providing the regular hot lunch of CSM and oil were visited; attendance details on the days of the visit are presented in Exhibit 3. The average attendance was about 76% of enrollment.

The balwadies feeding extruded foods were again visited in November, and the corresponding attendance details are presented in Exhibit 4. Here again, the attendance averaged about 68%. Arni, Chengam improved to 60%; Vembakkam also increased but Tiruppattur dropped off.

Although there was no difference in the overall average attendance between September and November in the test balwadies, there was variation in individual categories of beneficiaries. The attendance of balwady age children improved from 60% in September to 62% in November. Similarly, infants' attendance improved from 65.5% to 72%. Mothers' attendance, however, declined from 85% to 74%. The attendance of mothers in regular balwadies, where CSM is familiar and highly acceptable, was 70% of enrollment in October.

#### Food Consumption

The average consumption in September of bite-size bits per child is shown in Table 2. Corresponding details for powdered food are presented in Table 3.

TABLE 2

CONSUMPTION OF BITE-SIZE BITS FOOD BY BLOCK:  
SEPTEMBER VERSUS NOVEMBER

Age Group in Months	ARNI				CHENGAM				TIRUPPATTUR.			
	Average Number of Children		Consumption/ Child/Day in grams		Number of Children		Consumption/ Child/Day in grams		Number of Children		Consumption/ Child/Day in grams	
	Sept.	Nov.	Sept.	Nov.	Sept.	Nov.	Sept.	Nov.	Sept.	Nov.	Sept.	Nov.
30 - 35	2	2	37.37	37.00	1	2	70.91	80.00	3	5	64.84	76.53
36 - 41	6	12	40.59	53.10	4	6	71.33	63.33	13	16	69.29	73.03
42 - 47	4	5	44.68	59.26	4	3	73.96	73.33	2	4	79.60	75.00
48 - 53	5	5	54.38	60.00	7	5	74.85	61.00	8	13	70.89	74.13
54 - 59	2	3	60.00	64.12	2	1	73.50	80.00	1	1	76.67	80.00
Above 60	1	1	74.29	75.71	2	7	75.45	57.86	1	1	73.85	77.50
All children	20	28	47.68	56.48	20	24	73.65	64.58	28	40	70.48	74.31
Percentage of Quantity Served (80 grams)			59.60%	70.60%			92.06%	80.73%			88.10%	92.80%

TABLE 2 (continued)

CONSUMPTION OF BITE-SIZE BITS FOOD BY BLOCK  
SEPTEMBER VERSUS NOVEMBER

Age Group in Months	VEMBAKKAM				ALL BLOCKS			
	Average Number of Children		Consumption/ Child/Day in grams		Average Number of Children		Consumption/ Child/Day in grams	
	Sept.	Nov.	Sept.	Nov.	Sept.	Nov.	Sept.	Nov.
30 - 35	2	1	67.80	65.00	2	3	60.41	67.05
36 - 41	8	10	70.75	63.68	8	13	65.74	64.34
42 - 47	5	5	69.14	64.44	4	4	67.69	66.92
48 - 53	6	10	73.21	60.53	7	8	70.51	68.53
54 - 59	2	5	75.65	63.00	2	2	71.53	66.67
Above 60	3	1	73.87	80.00	1	2	74.38	71.09
All children	26	32	71.46	63.00	24	32	68.00	66.52
Percentage of Quantity Served (80 grams)			89.33%	78.75%			85.00%	83.15%

TABLE 3

CONSUMPTION OF POWDERED FOOD BY BLOCK  
SEPTEMBER VERSUS NOVEMBER

Age Group in Months	ARNI				CHENGAM				TIRUPPATTUR			
	Average Number of Children		Consumption/ Child/Day in grams		Average Number of Children		Consumption/ Child/Day in grams		Average Number of Children		Consumption/ Child/Day in grams	
	Sept.	Nov.	Sept.	Nov.	Sept.	Nov.	Sept.	Nov.	Sept.	Nov.	Sept.	Nov.
30 - 35	2	5	52.40	58.33	1	1	66.67	80.00	3	2	49.55	72.50
36 - 41	6	10	43.38	60.59	6	8	54.39	67.39	11	15	48.07	62.00
42 - 47	4	7	45.09	65.68	4	4	60.74	77.38	2	3	55.36	61.00
48 - 53	5	8	51.01	68.78	8	12	57.89	71.69	7	7	55.62	64.31
54 - 59	3	6	56.81	70.71	2	1	62.67	71.11	1	1	55.00	80.00
Above 60	1	2	54.78	77.27	1	3	61.00	76.47	1	2	58.89	78.33
All children	21	38	49.58	65.47	22	29	58.46	71.88	25	28	51.87	64.76
Percentage of Quantity Served (80 grams)			61.98%	81.84%			73.08%	89.85%			64.84%	80.95%

TABLE 3 (continued)

CONSUMPTION OF POWDERED FOOD BY BLOCK  
SEPTEMBER VERSUS NOVEMBER

Age Group in Months	VEMBAKKAM				ALL BLOCKS			
	Average Number of Children		Consumption/ Child/Day in grams		Average Number of Children		Consumption/ Child/Day in grams	
	Sept.	Nov.	Sept.	Nov.	Sept.	Nov.	Sept.	Nov.
30 - 35	2	2	60.00	65.00	2	2	54.11	64.05
36 - 41	7	9	54.72	70.77	7	9	49.11	64.34
42 - 47	4	6	55.69	77.78	4	6	52.84	70.52
48 - 53	6	8	52.87	73.48	6	9	54.16	69.91
54 - 59	2	4	63.20	75.45	2	3	59.50	72.36
Above 60	4	4	70.18	75.45	2	2	66.26	76.67
All children	25	33	58.02	73.47	23	31	53.90	68.61
Percentage of Quantity Served (80 grams)			72.53%	91.84%			67.38%	85.76%

Bite-Size Bits - Although the consumption of bite-size bits varied (from block to block) from 60% to 92%, the average consumption per child among the four blocks was 85% of the 80 grams of food. Another conclusion which can be drawn from Table 2 is that the quantity consumed increased with the increase in age. Children of 30-35 months consumed an average of 60 grams while the children of 60 months consumed about 74 grams (with an interim progressive increase). A detailed analysis of consumption of bite-size bits per balwady is presented in Exhibits 5A, 5B, 5C, and 5D.

Powdered Food - Consumption of the powdered food (Table 3) varied according to block from 62% to 73%. Calculating the average of all four blocks, consumption was 67%. No definite conclusions can be drawn with regard to preference for the powder by particular age groups. Although this food seems to be slightly less favored by children of age 36-47 months, there otherwise seems to be a high degree of consistency in the consumption per balwady, as shown in Exhibits 6A, 6B, 6C, and 6D.

Tables 2 and 3 also present the consumption figures during November for bite-size bits and powdered food, respectively.

Bite-Size Bits - It is significant to note that while the average consumption per child increased in two blocks (from 60% to 71% and from 88% to 93%), consumption in the other two blocks decreased (from 92% to 81% and from 89% to 79%). There was also a 33% increase in participants from September to November.

Powdered Food - Before proceeding to draw fourth conclusions from Table 3, it should be repeated that the powdered preparation was different in November than it was in September. Since it was observed earlier that there was a poor response from the beneficiaries to take powder mixed

only with water, apart from changing the water/powder proportion, by November most of the balasevikas were preparing puttu, which was made from steam-cooked powder with spices and some jaggary added. This regular cooking operation vitiates one purpose of the program - elimination of cooking and local procurement of food.

Possibly because of the new preparation, the consumption of the powdered food improved greatly from September to November: from 67% to 86% for all blocks together. Each block individually also showed improvement. Increase in average participation rate was the same - 33% - as for the groups eating the bite-size bits.

#### Comparison of Regular Program with Extruded Food Program

For the sake of comparison, the consumption of CSM and oil at the balwadies (during October) is presented in Table 4. The ration of CSM and oil is 80 grams and 10 grams, respectively, totaling 90 grams per beneficiary. In the process of cooking, vegetables and spices are added to make uppuma. Table 4 shows that an average of 82% of the food served is consumed, with a range of 77% to 89% for different age groups.

Comparing the consumption of CSM-oil with that of extruded foods, bite-size bit consumption is nearly equal to CSM (85% and 83% consumption of bite-size bits in September and November, respectively, compared to 82% of CSM-oil in October). With regard to powdered food, consumption improved from 67% to 86% over the three months as compared to the 82% consumption of CSM during October.

In regard to substituting a type of extruded food for the CSM-oil uppuma, the conclusion is that bite-size bits are more acceptable than the powder, especially since the powder required extra preparation to make it palatable. This should be regarded, however, as a very tentative conclusion in view of the short duration of the test period and the variable source of data used in the comparison.

TABLE 4  
CONSUMPTION OF CSM AND OIL  
BY ENROLLED CHILDREN

Age Group in Months	Average Attendance/ Day/Balwady	Average Quantity/Child/ Day in grams	Average Consumption as Percentage of Quantity Served (90 grams)
30 - 35	1	71.87	79.86%
36 - 41	11	72.55	80.61%
42 - 47	2	69.50	77.22%
48 - 53	10	75.45	83.83%
54 - 60	3	75.00	83.33%
Above 60	1	80.00	88.88%
All children	28	73.78	81.98%

Source: Tamil Nadu Study

### Opinions of Children and Mothers

During the month of September, our investigators asked 10 children and mothers in each balwady for their opinions about the food. They were invited to say whether they liked the food, which one of the two foods they preferred, and suggestions for improvement. Their likes and dislikes have been tabulated in Table 5.

From this table, it is clear that the bite-size bits were the most popular among children as well as mothers. In the case of the powdered food, little to no preference was expressed for this form of the product. A few mothers and children liked both foods equally, and there were some who had no opinion at all.

On the average for the month, 56% of the 933 children asked preferred bite-size bits, while only 16% expressed a preference for the powder. Of the 673 mothers who were asked, 70% preferred bite-size bits, but only 6% preferred the powdered food. Some 17% of the children and 13% of the mothers claimed to enjoy both foods equally; the rest had no opinion.

The mothers also had qualitative statements to offer, which were collected by an anthropologist in a series of in-depth interviews (see Appendix 2). The most important opinions of the mothers found:

- (a) The foods were raw or insufficiently cooked. The mothers suggested that the bite-size bits be fried in oil to attain a golden-brown color, as compared to the naturally white or cream color of the food. They also complained that although the powder looks like CSM, the CSM powder was cooked and served hot, whereas the extruded powder was merely mixed with water and served cold. The mothers did not understand that the foods were already fully cooked.

TABLE 5

OPINIONS OF CHILDREN AND MOTHERS  
REGARDING TEST FOODS

Week of September	CHILDREN									MOTHERS								
	Preferred Powder		Preferred Bite-Size Bits		Liked Both		No Opinion		Total	Preferred Powder		Preferred Bite-Size Bits		Liked Both		No Opinion		Total
	No.	% of Total	No.	% of Total	No.	% of Total	No.	% of Total		No.	% of Total	No.	% of Total	No.	% of Total	No.	% of Total	
1	39	20%	124	63%	29	15%	4	2%	196	24	17%	102	73%	7	5%	7	5%	140
2	28	12%	118	51%	41	18%	43	19%	230	3	2%	95	67%	18	13%	26	18%	142
3	46	20%	132	58%	31	13%	21	9%	230	5	3%	121	72%	5	3%	37	22%	168
4	37	13%	153	55%	59	21%	28	10%	277	6	3%	154	69%	56	25%	7	3%	223
TOTAL	150	16%	527	56%	160	17%	96	11%	933	38	6%	472	70%	86	13%	77	11%	673

- (b) After eating a CSM meal, the mothers said that they felt as if they had had a full meal, whereas they did not achieve this satisfaction with extruded foods: the bite-size bits looked like snacks and the quantity of powder served was not deemed sufficient.
- (c) Being accustomed to CSM feeding for many years, the mothers believed that CSM contributed to the growth of their children; they did not have this confidence in extruded foods. It was difficult for the mothers (most of them illiterate) to understand that the basic ingredients of extruded foods are almost the same as of CSM.
- (d) As mentioned before, the mothers suggested that the powder be prepared in more typical local preparations, such as puttu.

Opinions of Balasevikas

All the balasevikas were requested to offer their opinions about the food. While 17 out of the total 22 preferred bite-size bits, only one balasevika preferred powder; four liked, or disliked, both equally.

Other balasevika's opinions on the advantages and disadvantages were:

- (a) Extruded foods save a lot of their time in distribution as well as in preparation. This avoids cooking which is a tedious process even though an ayah is there to help her.
- (b) They were relieved of the need for procurement of vegetables and fuel.

- (c) Only one balasevika felt that the extruded foods are nutritionally better than CSM. Others felt that CSM is better nutritionally. There is no factual basis for this, but the belief was strongly held all the same.
- (d) Most of the balasevikas felt that the parents and mothers were discouraging the children from consuming the extruded foods, under the impression that the foods are raw and not cooked.

ECONOMIC FEASIBILITY

The Need

We have tried to compare the cost of feeding CSM and oil with the cost of feeding extruded foods in order to work out the economic feasibility of the latter. An examination of economic feasibility is needed because of the fairly large capital costs of an extrusion plant. In the preceding chapters, even though we have demonstrated, at least tentatively, the acceptability of extruded foods, it still remains to be seen whether investments in extrusion plants will be justified.

Capital Cost Structure of the Extrusion Plant<sup>(a)</sup>

There are many companies which manufacture extruders of various sizes under trade names including Anderson, Wenger, and Bonnot. They also manufacture ancillary equipment of various types. Our analysis took two plants of different capacities, one of 600 tonnes output per 8-hour shift per year (Plant A), and another of 5,000 tonnes output per shift per year (Plant B). The cost details are as follows:

	<u>Plant A</u> <u>(Wenger X-25)</u>	<u>Plant B</u> <u>(Wenger X-155)</u>
Land, buildings, installation of utilities, etc.	Rs. 4,07,000	Rs. 18,03,000
Equipment, with all necessary accessories	Rs. 8,06,000	Rs. 12,45,000
Total Capital Cost	<u>Rs. 12,13,000</u>	<u>Rs. 30,48,000</u>

<sup>(a)</sup> From E. E. Rice, End of Tour Report, 1972

At the rate of three shifts per day, the smaller plant could produce about 1,800 tonnes per year, whereas the larger one could produce about 15,000 tonnes per year. But it would be very unrealistic to assume that any plant would work to full capacity. It was assumed that the plant (whether the small or the large one) would work only for two shifts per day, 300 days per year. Based upon this assumption, the fixed and variable costs were worked out and are presented in Table 6.

A plant of 600 tonnes per year per shift capacity is presently operating in India, at Bareilly in Uttar Pradesh. Actual cost details have been collected from that plant. With the help of these figures, costs have been projected for the larger plant, operating under Indian conditions. Of course, economics of scale-up would operate in a larger plant and lower the cost of production per unit of output. If such a large plant could be operated successfully, the cost of production could be decreased to about one-third of the smaller plant's expenses.

For this study, 15 tonnes of food were produced at the plant in Bareilly, for which the following quantities of raw materials were procured locally:

	Number of Kilograms	Price per Kilogram	Cost
Whole corn	11,029	Rs. 0.82	Rs. 9,044
Defatted Soya	4,881	Rs. 1.80	Rs. 8,785
Vitamins and minerals premix	279		Rs. 2,720
Sugar	1,113	Rs. 3.40	Rs. 3,784
Salt	272	Rs. 0.13	<u>Rs. 35</u>
Total Cost			<u><u>Rs. 24,368</u></u>

TABLE 6  
OPERATIONAL COST DETAILS

Cost Items	600 tonnes/shift plant (Rs)	5,000 tonnes/shift plant (Rs)
<b>A. <u>FIXED COSTS</u></b>		
1. 10% as interest on fixed capital	121,245	305,000
2. Depreciation @ 10% on equipment	80,551	125,000
3. Depreciation @ 5% on buildings, fixtures, etc.	19,097	90,000
4. Taxes and Insurance @ 3% on capital cost	<u>36,374</u>	<u>92,000</u>
Total Fixed Costs	257,267	612,000
<b>B. <u>VARIABLE COSTS</u></b>		
1. Labor	90,180	174,000
2. Power @ Rs. 25/-per tonne assuming the plant works for two shifts	30,000	250,000
3. Interest on working capital @ 10%	65,524	466,000
4. Maintenance	<u>327,540</u>	<u>826,000</u>
Total Variable Costs	<u>513,244</u>	<u>1,716,000</u>
Total Costs	<u><u>770,511</u></u>	<u><u>2,328,000</u></u>
Cost of production per ton of extruded foods (excluding the raw material cost)	640	233

Even though the total raw materials input amounts to 17,573 kilograms, the output was 15,000 kilograms, since there is about 15% wastage. Thus the cost of the raw materials needed for producing a kilogram of extruded food would be about Rs. 1.62.

Since our study was conducted in balwadies wherein CSM and oil feeding was going on, it is reasonable to compare the costs of CSM feeding with extruded foods. Also, since balahar is a commodity which has the potential of becoming a substitute for CSM, the estimated cost of balahar feeding is also compared with extruded foods below.

#### Cost of Feeding a Beneficiary

Under the Existing CARE Program - Under the CARE feeding program, a ration of 80 grams of CSM and 10 grams of oil are allowed per balwady beneficiary per day. During the 1971-1972, 610 beneficiaries were delivered a quantity of 14,89,100 kilograms of CSM and 1,79,100 kilograms of oil. The cost of food materials was Rs. 32,09,900 and Rs. 6,88,500, respectively. Apart from this, a sum of Rs. 11,75,000 was incurred for general administration, storage, transport, and miscellaneous expenses. Expenses for vegetables, fuel, spices, and condiments were partially met by the State Government, which provided 3 paise per beneficiary per day; an equivalent amount was programmed to be collected locally in voluntary contributions. Taking all of this into account, the cost of feeding a beneficiary for a day worked out as follows:

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80 grams of CSM @ Rs. 2.13/kg.	17.04 Ps.
10 grams of oil @ Rs. 3.81/kg.	3.81 Ps.
Government contribution/beneficiary/day	3.00 Ps.
Local contribution/beneficiary/day	3.00 Ps.
General administration, transport, storage/ beneficiary/day	<u>4.57 Ps.</u>
Total Cost/Beneficiary/Day	31.42 Ps.

The nutrients supplied by CSM and oil are:

	<u>Calories</u>	<u>Protein (grams)</u>
CSM 80 grams	299	16
Oil 10 grams	<u>88</u>	<u>0</u>
Total	<u>387</u>	<u>16</u>

With Balahar - Balahar is now being tried on a very limited scale in Tamil Nadu as an alternative to CSM. Although there have been many formulations of balahar, it now contains wheat flour, groundnut, flour, and bengal gram flour in the respective proportions of 65%, 25%, and 10%. Based on the above formula, the cost of balahar is estimated to be about Rs. 1.50 per kilogram. Compared to the CSM-oil ration, balahar contains only 359 calories and 17.30 grams of protein per 100 grams. If we aim at supplying the same 387 calories provided by CSM and oil, then the quantity of balahar fed should be at least 108 grams.

Since balahar is only semi-processed, it needs cooking like CSM and oil. Thus there is need for money for recurring expenses at the feeding center level. Since the quantity would have to be more, we have proportionately increased the contribution. Similarly, the cost of administration, transport, and storage have been increased prorate.

108 grams of balahar @ Rs. 1.50/kg.	16.20 Ps.
Contribution (government and local) @ Rs. 0.06 per 90 grams/beneficiary/day	7.20 Ps.
Storage, transport, and administration @4.57 Ps. per 90 grams/beneficiary/day	<u>5.48 Ps.</u>
Total Cost/Beneficiary/Day	28.88 Ps.

With Extruded Foods - As stated elsewhere, the raw material cost per kilogram of extruded foods would be Rs. 1.62. The nutrient content of the foods tested were (per 100 grams):

	<u>Calories</u>	<u>Protein (grams)</u>
Bite-size bits	321	21.1
Powdered food	334	18.7

In the preparation of powdered food, bite-size bits are extruded, powdered in a pin mill, and then mixed with crystal sugar. Because of the addition of sugar, the protein content decreases and the calorie content increases.

Thus, if the calorie level of extruded foods is to match that of CSM and oil, 121 grams of bite-size bits or 116 grams of powder would be needed. If both foods are fed alternately (as was done in this test), an average of 119 grams per beneficiary per day would be required. Since these are ready-to-eat foods, preparation costs at the center are eliminated. However, the transport, storage, and administrative costs remain.

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The cost (per beneficiary per day) is worked out below under the two alternatives, Plant A and Plant B:

<u>Per 119 grams</u>	<u>Plant A</u>	<u>Plant B</u>
Raw materials @ Rs. 1.62/kg.	19.28 Ps.	19.28 Ps.
Processing costs:		
@ Rs. 640/tonne - Plant A	7.61 Ps.	
@ Rs. 233/tonne - Plant B		2.73 Ps.
Transport, storage, administration @ Rs. 4.57 Ps. /90 grams	<u>6.04 Ps.</u>	<u>6.04 Ps.</u>
Total Cost	<u>32.93 Ps.</u>	<u>28.05 Ps.</u>

## SUMMARY AND CONCLUSIONS

The objective of this study was to test the acceptability, as well as the shelf life, handling characteristics, packaging requirements, and operational advantages of extruded food preparations. Extrusion cooking or puffing, a technique developed in the United States in the past decade, offers a high degree of versatility both in the raw materials which the extruder is capable of processing, and also in the variety of products which can be produced. Theoretically, an almost unlimited number of formulations of different shapes, sizes, flavors, colors, densities, and mouth feels can be produced by an extruder cooker.

The test was conducted in three phases. The first two trials produced enough information about the acceptability of different products to select two formulations for the final phase: A bland bite-size bit, which was in ready-to-eat form; and a sweetened powder, which was intended to be reconstituted with water into a porridge. Both formulations were composed of 70% corn grits, and 30% defatted soya flour, fortified with a vitamin and mineral premix.

The test was carried out over a 3 month period on approximately 2,200 beneficiaries, using 22 balwadies in North Arcot district as distribution points. Approximately a third of the beneficiaries were pre-school age children regularly enrolled in the balwadies. Another third consisted of infants below the age of 2-1/2 years, and the final group were pregnant and lactating mothers. Both foods were found to be acceptable in the sense that they were not rejected by the test population, and daily consumption, which was measured directly in the case of the balwady enrolled children, was not too far out of line with consumption of CSM in the regular balwady program.

However, the sweetened powder was less palatable to the beneficiaries than the bite-size bits, and after a time, balasevikas started to prepare the powder by cooking it in a traditional local preparation. The cooking at the site, of course, removed one of the key advantages to extruded cooking, which is the ability to deliver a ready-to-eat or nearly ready-to-eat product which does not require extensive preparation at the feeding center, with resulting recurring costs and necessity for supervision.

The foods were found to have excellent handling characteristics. It was anticipated that truck transportation and other transshipments plus moving in and out of godowns would result in significant breakage and powdering of the bite-size bits. This did not take place. The double polyethylene bag packing proved to be adequate to protect the foods. The shelf life of powdered food appeared to be comparable to CSM, while that of the ready-to-eat food was considerably better. The latter was not subject to infestation, and retained its crispness and freshness throughout the test period.

The economic feasibility of an extrusion plant was also examined. The cost of production figures worked out compare favorably with conventional cooking on site preparation of CSM or its Indian equivalent, balahar, in feeding programs. However, it should be emphasized that these figures are extremely tentative, and are estimates based on a combination of foreign experience plus the limited operational history of the single extruder plant now working in India.

The conclusion of this study is that tentatively, keeping in mind the short duration of the test, it appears that acceptable extruder cooked foods can be produced, and can be packed, transported, and handled efficiently under Indian conditions, while demonstrating a shelf life at least as good as that of products presently used in large-scale distribution programs. However, it must be emphasized that this is the first significant testing under relatively controlled conditions of extruded foods in India. Much further research is required, both in operations, preparation, and costs, before large-scale programs can soundly be based on extrusion technology.

APPENDIX 1

TAMIL NADU NUTRITION PROJECT

EXTRUDED FOOD DEMONSTRATION PROJECT  
IN NORTH ARCOT DISTRICT

(To be filled out every day at each Kuzhanthaigal Kappagam (Balwady)  
by CANTOR/ATAC Observer from 1/9/1972 to 30/9/1972)

Date: \_\_\_\_\_

I. GENERAL

1. Name of Kuzhanthaigal Kappagam: \_\_\_\_\_
2. Village: \_\_\_\_\_
3. Panchayat Union: \_\_\_\_\_
4. Balasevika: \_\_\_\_\_
5. Attendance:

	<u>K. K. Children</u>	<u>Outside Children</u>	<u>Mothers:</u>
5.1 Enrollment	_____	_____	_____
5.2 Average attendance (past 3 months)	_____	_____	_____
5.3 Attendance on date:	_____	_____	_____

6. Feeding Arrangements:

- 6.1 Accommodation: CARE Building/others (specify)

APPENDIX 1 (continued)

6.2 Any storage problems?

6.3 Cooking vessels:

6.4 Food serving time: \_\_\_\_\_

6.5 Time taken for feeding: \_\_\_\_\_

APPENDIX 1 (continued)

II. TEST FOOD CONSUMPTION

Sl. No.	Name of Child	Age in Months	Quantity Served (gms.)	Quantity Consumed (gms.)	Quantity Wasted (gms.)	Water Consumption (No. of Mugs)	Rema
1.							
2.							
3.							
4.							
5.							
6.							
7.							
8.							
9.							
.							
.							
.							
.							
40.							

APPENDIX 1 (continued)

III. OPINION OF CHILDREN

(Randomly selecting ten children each day, the Observer should informally call each child separately and obtain the following details)

(Put '✓' mark in the respective column for each child interviewed)

Sl. No.	Regd. No. of Child as in Question II	Like the Food	Dislike the Food	No Opinion	Suggestions for Improvements	Which do you Prefer
1.						Powder/finger
2.						Powder/finger
3.						Powder/finger
4.						Powder/finger
5.						Powder/finger
6.						Powder/finger
7.						Powder/finger
8.						Powder/finger
9.						Powder/finger
10.						Powder/finger

APPENDIX 1 (continued)

IV. OPINION OF MOTHERS

(Randomly select ten mothers who are recipients of this food and interview them for the following details)

Sl. No.	Mothers Name	Age in Years	Like the Food	Dislike the Food	Suggestions for Improvements	Which do you Prefer
1.						Powder/finger
2.						Powder/finger
3.						Powder/finger
4.						Powder/finger
5.						Powder/finger
6.						Powder/finger
7.						Powder/finger
8.						Powder/finger
9.						Powder/finger
10.						Powder/finger

APPENDIX 1 (continued)

V. OPINION OF BALASEVIKAS

1. What do you think about these new foods?

2.1 Which do you recommend? Powder/Finger

2.2 Why?

Signature of Observer: \_\_\_\_\_

Date: \_\_\_\_\_

APPENDIX 2

ANTHROPOLOGIST'S INVESTIGATION

Introduction

Pre-cooked food in two formulations was introduced on September 1, 1972, in 22 balwadies of four blocks in North Arcot District. It replaced CSM in all the 22 balwadies.

At the end of three months, with the program well under way, it was assessed that it was operating well in two blocks - Tiruppattur and Vembakkam - and less well in the other two - Arni and Chengam.

As earlier planned, I was to research into consumer reaction to the pre-cooked foods: was the reception favorable; how did it compare between the two types -- finger and powder; how did both compare with CSM; did pre-cooked food fit in differently from the CSM with the child's feeding patterns.

I decided to visit two balwadies in Arni block as this might enable me to locate reasons for the poorer results in Arni and Chengam blocks. The two balwadies which we (my assistant and I) visited are at Irumbedu and Sevoor; both balwadies are located in CARE buildings.

We talked to a number of balwady children and interviewed their mothers at length in their homes. In addition, we interviewed the mothers of the non-balwady child beneficiaries of less than 2-1/2 years, as well as the pregnant and lactating mothers receiving the food.

Number of Women Interviewed

Name of the Balwady	Mothers of Balwady	Mothers of non-Balwady	Pregnant Women	Lactating Women	Total
Irumbedu	23	18	6	12	59
Sevoor	<u>20</u>	<u>19</u>	<u>---</u>	<u>15</u>	<u>54</u>
Total	43	37	6	27	113

Observations

In both balwadies, there were certain general observations we made which, I imagine, apply as much to the regular CSM program as to pre-cooked food. They are:

- (a) The balwady children obviously consider the food the chief attraction for attending. Many appear only late in the morning and very few children return for the afternoon session. With 25-30 children attending in the morning, there are frequently only 7-10 in the afternoon.
- (b) Food means for outside beneficiaries - non-balwady children, and pregnant and lactating women - is in most cases collected by young girls of 6-12 years - older sisters or daughters of the recipients. An occasional grandmother and a sprinkling of women with babies of less than three months also turn up to collect the food. This is the busy season in the fields so very few working women can afford the time to, or think it worth their while, to come and collect the balwady food. In a dull season, the balasevikas said, many more women come.

My impression is that only working women or their family members come to collect food at the balwady. By and large, no women whose status (economic or social) precludes her from working is interested in the balwady food. This does not apply to the same extent to children eating in the balwady - they come from different castes and economic groups; it is the outside beneficiaries who more consistently are from the lower socioeconomic levels. Taking food home is more easily labelled as charity, but a child eating in the balwady is a more acceptable idea, made so perhaps by the parallel of the longer standing mid-day meals scheme.

- (c) Food meant for non-balwady child beneficiaries is not fed to children below 1-1/2 years. Many of the registered outside beneficiaries who should be below 2-1/2, looked about the same age as the balwady children. Where the beneficiary is an infant, the mother asked in a reasonable tone, "How can I feed it to him? He is too small."
  
- (d) Any food taken home tends to be shared by all the children in the house, occasionally by the mother, but rarely by adult men.

### Comparisons

#### A. Murukku versus Puttu

The bite-size bit is popularly known as "murukku" and the sweetened powder as "puttu." In its more liquid form, as initially served, the powder was called "kanji."

Mothers in Irumbedu generally preferred murukku, but quite often it was not treated as pre-cooked food. After being carried home by an outside beneficiary, it might be fried in oil along with chillies before being eaten. The complaint was that it had a raw appearance - the normal murukku is a darker brown. The puttu was less popular than the bits. But in both villages, the powder as kanji was definitely and strongly disliked. The mothers invariably stated that kanji gave the children loose motions. This may be partly due to the fact that the powder was first introduced as kanji and any new food is likely to cause stomach upsets for small children. Also many of the outside beneficiaries collect the food and fold it into their sarees or dresses. It is not possible to do this with kanji and this may have contributed to their dislike of it.

In Sevoor village, however, powder as puttu was preferred to murukku. Mothers had no knowledge or experience of frying murukku and eating it. Very early in the experiment one child in the balwady got "serengu" - sores all over his body. This was immediately attributed to the murukku and might have substantially contributed to its unpopularity. There were four or five cases of children being withdrawn from the balwady and many more cases where the balasevika had been asked not to feed any food to these children in school. The majority of these cases were from relatively well-to-do families.

B. CSM, Murukku and Puttu

CSM is commonly known as "uppuma" or "manja uppuma" - yellow uppuma. Opinion was almost unanimous in preferring uppuma to murukku and puttu. Why was uppuma preferred?

1. "No stomach upsets", they would say. What about in the beginning? Didn't the children have loose motions, etc. ? "Yes", the mothers would agree, "but they have gotten used to it; it had become a habit." This would lead one to expect the same with the murukku and puttu. Actually, dislike was not too vehement in its expression and the balasevikas substantiated this; there are less complaints now than at the start of the program.

2. The other major reason why uppuma was preferred is that it is a hot, stomach-filling meal. Murukku and puttu were considered just snacks (especially murukku), which is aptly termed as a "potlam" - a packet to be casually munched in idle time. It is possible, though difficult to establish, that because of this murukku is shared by more people than the uppuma is - murukku is more divisible.

Mothers were hesitant as to whether the child was hungry again immediately after eating murukku or puttu. But they were very definite that after uppuma the child did not want to be fed again for some hours. This was especially felt by working mothers. They return from the fields at 4:30 or 5:00 and are now more often met by children clamoring for food than when uppuma was served.

Interviewing working mothers here furthered the impression I had formed in Mannivakkam (see the Feeding Pattern of a Pre-school Child): the working mother is frighteningly disinterested in how much and how often the child eats. Often a mother, asked at 5:00 or 6:00 p. m. what or when her child had last eaten, would reply, "How should I know? Ask the child." Unless the child is particularly weak or ill, the mother is unconcerned with the feeding pattern. It is only when the child has an upset stomach or some other ailment that the mother takes stock of the situation; and since diet is believed to be the cause of so many illnesses, she easily picks on the newest addition to the child's food as being the cause of the illness. The connection between a set quantity of uppuma or murukku or puttu and the good health of the child is only nebulously comprehended in the far reaches of the mother's mind. She will not feed only the younger child, the other children must get their share. Why should the child in her womb be more favored than her other children?

3. Flavor was another factor in favor of uppuma; the chillies in it made it more palatable. The puttu very seldom called forth strong reaction one way or the other; perhaps it is too indefinite in character. The murukku stirred more active opinions, both for and against.

We asked the many mothers as to how they would like the pre-cooked food served. A woman would only choose from the three known forms: puttu, murukku, and uppuma. When we tried to draw out suggestions for alternate forms, it only brought forth a puzzled or disinterested reaction. When we suggested "bread?", "iddli?", "biscuits?", reaction was more spirited and many said, "How can we tell till we try it? Why not give it to us and then we'll say?"

### Conclusions

If the target group is to get maximum benefit from the program, then as far as the balwady child is concerned, consideration might be given to feeding earlier in the morning, so that the child will be hungrier and ready for a meal when it gets home in the afternoon. On the other hand, two or even three feedings a day, say at 9:30, noon, and 3:00, would get more nutrition into the child, and might well have the effect of increasing the number of hours the children actually spend at the balwadies. The morning and afternoon feedings could be snacks, the noon lunch a hot meal.

The puttu and, especially, the murukku, being considered merely as snacks, are more likely to generate a meal at home.

As for outside beneficiaries, the category of pregnant and lactating mothers is so only in name; most of the food really goes to the children in the house.

No non-balwady child beneficiary of less than 1 or 1-1/2 years is fed from the food obtained from the balwady. Even the balasevika is vague as to who is expected to eat the food assigned to a child below one year. The food is conceptualized as family food: Government has chosen, for some reason, to benefit families with very small children; and the small child is not considered the recipient of the food but only the necessary qualification for receiving such food.

It might be worth trying out three or four types of pre-cooked food, the recipient daily having the choice of all the alternatives. Over a period of three or four months, definite preferences are likely to be established which would help guide future programming.

IRUMBEDU

Investigated:

21 - Balwady Children  
 27 - Non-balwady Children  
 18 - Pregnant and Lactating Mothers

	Balwady Children	Non-balwady Children	Pregnant and Lactating Mothers	Totals
<b>1. <u>Caste</u></b>				
Harijan	---	2	---	2
Mudaliar	6	2	3	11
Gounder	6	8	6	20
Ediyar	4	---	4	8
Others	5	5	5	10
Total	21	17	18	56
<b>2. <u>Number of Children in Household</u></b>				
1	1	4	3	8
2	5	2	4	11
3	6	6	5	17*
4	7	4	3	14
5	2	1	2	5
Total	21	17	17*	55
<b>3. <u>Mothers/Womens working status</u></b>				
Not working	3	2	2	7
Agricultural labor	17	15	16	48*
Total	20 *	17	18	55

\*One child has no mother.

	Balwady Children	Non-balwady Children	Pregnant and Lactating Mothers	Total
<b>4. <u>Who Collects</u></b>				
Self	Not	2	5 ]	7
Mother	appli-	6	---	6
Sibling/Child	cable	7	12	19
Others		2	1	3
Total		17	18	35
<b>5. <u>No. of People in the Household who Share the Stuff</u></b>				
Children 1	4	2	2	8
2	5	5	6	16
3	3	6	3	12
4/5	9	3	5	17
Everyone in Household	---	1	2	3
No one	---	---	---	---
Total	21	17	18	56
<b>6. <u>Preferences</u></b>				
<u>Singly:</u>				
Uppuma	9	4	11	24
Murukku	1	3	2	6
Puttu	1	3	---	4
<u>In combination:</u>				
Uppuma+Puttu	2	---	1	3
Puttu+Murukku	---	1	---	1
Murukku+Uppuma	1	4	2	7
All 3	5	2	1	8
No opinion	1	---	---	1
All 3 useless	1	---	1	2
Total	21	17	18	56

	Balwady Children	Non-balwady Children	Pregnant and Lactating Mothers	Total
<b>7. <u>Illnesses are</u></b>				
<b><u>Caused by:</u></b>				
Uppuma	1	3	1	5
Puttu	4	9	5	18*
Murukku	4	3	5	12
Total	9	15	11	35
<b>8. <u>Meal After:</u></b>				
<b><u>Uppuma:</u></b>				
Now	7	2	5	14
A little later	1	5	2	8
Much later	11	8	8	27
<b><u>Puttu:</u></b>				
Now	15	11	15	41
A little later	1	1	---	2
Much later	1	1	2	4
<b><u>Murukku:</u></b>				
Now	15	14	15	44
A little later	1	1	---	2
Much later	1	---	2	3
<b>9. <u>Murukku Eaten:</u></b>				
As is	1	5	1	7
Fried	5	5	9	19
Either	10	4	5	19
Don't eat	5	3	3	11
Total	21	17	18	56

\*For the children, mothers gave opinions.

SEVOOR

Investigated:

20 - Balwady Children  
 17 - Outside Children  
 15 - Pregnant and Lactating Mothers

	Balwady Children	Non-balwady Children	Pregnant and Lactating Mothers	Total
<b>1. <u>Caste</u></b>				
Harijan	2	2	9	13
Mudaliar	3	5	2	10
Gounders	10	7	2	19
Others	5	3	2	10
Total	20	17	15	52
<b>2. <u>Number of Children in Household</u></b>				
1	---	---	2	2
2	6	4	4	14
3	5	7	6	18
4	6	2	1	9
5	3	2	2	7
6	---	2	---	2
Total	20	17	15	52
<b>3. <u>Mothers/Womens working status</u></b>				
Not working	5	3	3	11
Weaving at home	4	4	1	9
Agricultural labor	11	10	11	32
Total	20	17	15	52

**SIDNEY M. CANTOR ASSOCIATES INCORPORATED**

	Balwady Children	Non-balwady Children	Pregnant and Lactating Mothers	Total
<b>4. <u>Who Collects</u></b>				
Self	Not	12	6	18
Mother	appli-	3	---	3
Sibling/Child	cable	2	8	10
Others		---	1	1
Total		17	15	32
<b>5. <u>No. of People in the Household who Share the Stuff</u></b>				
Children 1	7	4	---	11
2	3	8	4	15
3	2	1	4	7
4/5	4	4	3	11
Everyone in Household	2	---	2	4
No one	2	---	2	4
Total	20	17	15	52
<b>6. <u>Preferences</u></b>				
<u>Singly:</u>				
Uppuma	6	9	11	26
Murukku	1	1	---	2
Puttu	1	---	2	3
<u>In combination:</u>				
Uppuma+Puttu	3	2	1	6
Puttu-Murukku	2	---	---	2
Murukku+Uppuma	3	---	---	3
All 3	3	3	1	7
No opinion	---	---	---	---
All 3 useless	1	2	---	3
Total	20	17	15	52

**SIDNEY M. CANTOR ASSOCIATES INCORPORATED**

	Balwady Children	Non-balwady Children	Pregnant and Lactating Mothers	Total
<b>7. <u>Illnesses are</u></b>				
<b><u>Caused by:</u></b>				
Uppuma	5	1	---	6*
Puttu	8	6	---	14
Murukku	8	7	---	15
<b>Total</b>	<b>21</b>	<b>14</b>	<b>---</b>	<b>25</b>
<b>8. <u>Meal After:</u></b>				
<b><u>Uppuma:</u></b>				
Now	6	4	5	15
A little later	4	2	1	7
Much later	5	9	7	21
<b><u>Puttu:</u></b>				
Now	10	10	8	28
A little later	1	3	---	4
Much later	2	---	---	2
<b><u>Murukku:</u></b>				
Now	11	11	8	30
A little later	1	2	---	3
Much later	1	---	---	1
<b>9. <u>Murukku Eaten:</u></b>				
As is	11	13	7	31
Fried	2	---	1	3
Didn't eat	7	4	7	18
<b>Total</b>	<b>20</b>	<b>17</b>	<b>15</b>	<b>52</b>

\*For the children, mothers gave opinions.

## EXHIBIT 1

NAMES OF BALWADIES SELECTED AND  
ENROLLMENT DETAILS

Name of Panchayat Union	Name of Balwady	Enrollment			Total
		Balwady Children	Other Children	Mothers	
Arni	Irumbedu	40	40	40	120
	Ariyappadi	40	40	40	120
	Sevoor	40	40	40	120
	S. V. Nagaram	40	40	40	120
	Agrapalayam	40	40	40	120
	Nathapakkam	40	40	40	120
Chengam	Pachal	40	--	--	40
	Manmalai	30	--	--	30
	Arattawadi	40	--	--	40
	Pudupet	40	40	--	80
	Sorapanandal	40	20	--	60
	Melpallipet	40	40	--	80
Tiruppattur	Achamagalam	40	40	40	120
	Perumapet	40	40	40	120
	Irunapet	40	--	--	40
	Kursilapet	40	40	40	120
	Agraharam	40	40	40	120
	Pudupet	40	40	40	120
Vembakkam	Vembakkam	40	40	40	120
	Asanammappet	40	40	40	120
	Thenkalani	40	40	40	120
	Perungathur	40	40	40	120
Grand Total		870	700	600	2,170
Average per Balwady		40	32	27	99

EXHIBIT 2

AVERAGE ATTENDANCE IN THE SELECTED  
BALWADIES DURING SEPTEMBER, 1972

Name of Panchayat Union	Name of Balwady	Enrollment			Total
		Balwady Children	Other Children	Mothers	
Arni	Irumbedu	19	16	14	49
	Ariyappadi	18	5	14	37
	Sevoor	24	26	6	56
	S. V. Nagaram	22	16	13	51
	Agrapalayam	27	28	27	82
	Nathapakkam	18	32	20	70
Chengam	Paclal	25	--	--	25
	Manmalai	15	--	--	15
	Arattawadi	26	--	--	26
	Pudupet	23	19	--	42
	Sorapanandal	25	9	--	34
	Melpallipet	13	6	--	19
Tiruppattur	Achamangalam	20	12	21	53
	Perumapet	32	27	30	89
	Irunapet	35	--	--	35
	Kursilapet	27	26	20	73
	Agraharam	24	13	18	55
	Pudupet	31	30	24	85
Vembakkam	Vembakkam	27	23	28	78
	Asanammamet	21	21	21	63
	Thenkalani	25	23	21	69
	Perungattur	34	31	30	95
Average per Balwady		24	21	23	68
Average attendance as percentage of enrollment		60%	65.5%	85%	68

EXHIBIT 3

ATTENDANCE DETAILS OF CARE FEEDING BALWADIES

Sl. No.	Name of Balwady	Enrollment				Average Attendance/Day			
		Balwady Children	Other Children	Mothers	Total	Balwady Children	Others Children	Mothers	Total
1.	Sondakuppam	40	40	40	120	38	30	34	102
2.	Yelagiri Hills	40	--	--	40	14	--	--	14
3.	Kadirampatti	40	40	40	120	25	31	34	90
4.	Pachal	40	40	40	120	27	4	28	59
5.	Andiappanur	40	40	40	120	25	22	19	66
6.	Selandampalli	40	40	40	120	36	22	36	94
7.	Jolarpettai	40	40	40	120	22	27	17	66
8.	Chinnakallupalli	40	--	--	40	30	--	--	30
9.	Chinnaponneri	40	40	40	120	35	26	30	91
10.	Overall average per Balwady	40	31	31	102	27	23	28	78
11.	Average attendance as percentage of enrollment	--	--	--	---	68%	73%	90%	76%

## EXHIBIT 4

AVERAGE ATTENDANCE IN THE SELECTED  
BALWADIES DURING NOVEMBER, 1972

Name of Panchayat Union	Name of Balwady	Average Attendance			
		Balwady Children	Other Children	Mothers	Total
Arni	Irumbedu	33	35	28	96
	Ariyappadi	22	26	18	66
	Sevoor	24	22	10	56
	S. V. Nagaram	28	20	18	66
	Agrapalayam	23	27	20	70
	Nathapakkam	28	31	24	83
Chengam	Pachal	29	--	--	29
	Manmalai	25	--	--	25
	Arathawadi	22	--	--	22
	Pudupet	18	26	--	44
	Sorapanandal	24	10	--	34
	Melpallipet	28	26	--	54
Tiruppattur	Achamangalam	20	21	26	67
	Perumapet	19	15	20	54
	Irunapet	31	--	--	31
	Kursilapet	28	22	26	76
	Agraharam	21	17	19	57
	Pudupet	26	16	19	61
Vembakkam	Vembakkam	33	37	30	90
	Asanammampet	31	34	32	97
	Thenkalani	29	31	20	80
	Perungathur	35	29	36	100
Average per Balwady		40	32	27	68
Average attendance as percentage of enrollment		62%	72%	74%	68%

## EXHIBIT 5A

CONSUMPTION OF BITE-SIZE BITS FOOD IN ARNI  
BLOCK BY BALWADY, SEPTEMBER, 1972

Age Group in Months	Irumbedu (2) <sup>(a)</sup>		Ariyappadi (1)		Sevoor (1)		S. V. Nagaram (0)		Agrapalayam (2)		Nethapakkam (2)		Average Consumption/ Child/Day for All Balwadies
	Total # of Children	Total Food Con- sumed in grams	Total # of Children	Total Food Con- sumed in grams	Total # of Children	Total Food Con- sumed in grams	Total # of Children	Total Food Con- sumed in grams	Total # of Children	Total Food Con- sumed in grams	Total # of Children	Total Food Con- sumed in grams	
30 - 35	5	190	1	20	1	20	---	---	12	480	0	0	37.37
36 - 41	15	670	4	240	3	170	---	---	24	730	5	260	40.59
42 - 47	10	355	5	290	5	240	---	---	8	280	3	220	44.68
48 - 53	1	40	5	260	4	180	---	---	11	460	19	1235	54.38
54 - 59	0	0	2	160	4	250	---	---	7	330	3	220	60.00
Above 60	0	0	0	0	1	70	---	---	0	0	6	450	74.29
All Children	31	1255	17	970	18	930	---	---	62	2280	36	2385	47.68

(a) Figures in parentheses are number of days observations were taken.

EXHIBIT 5B

CONSUMPTION OF BITE-SIZE BITS FOOD IN CHENGAM  
BLOCK BY BALWADY, SEPTEMBER, 1972

Age Group in Months	Pachal (3) <sup>(a)</sup>		Mammalai (3)		Arattawadi (2)		Pudupet (1)		Sorapamandal (3)		Melpallipet (2)		Average Consumption/ Child/Day for All Balwadies
	Total # of Children	Total Food Con- sumed in grams	Total # of Children	Total Food Con- sumed in grams	Total # of Children	Total Food Con- sumed in grams	Total # of Children	Total Food Con- sumed in grams	Total # of Children	Total Food Con- sumed in grams	Total # of Children	Total Food Con- sumed in grams	
30 - 35	0	0	6	460	0	0	4	300	0	0	1	20	70.91
36 - 41	5	370	9	670	8	590	9	690	18	1300	11	660	71.33
42 - 47	16	1230	4	290	10	720	10	800	13	880	0	0	73.95
48 - 53	41	3010	6	440	18	1370	0	0	25	1900	9	690	74.85
54 - 59	0	0	7	520	6	400	0	0	14	1090	3	195	73.50
Above 60	0	0	13	980	3	200	0	0	6	480	0	0	75.45
All Children	62	4610	45	3360	45	3280	23	1790	76	5650	24	1565	73.65

(a) Figures in parenthesis are number of days observations were taken.

## EXHIBIT 5C

CONSUMPTION OF BITE-SIZE BITS FOOD IN TIRUPPATTUR  
BLOCK BY BALWADY. SEPTEMBER, 1972

Age Group in Months	Achamangalam (1) <sup>(a)</sup>		Perumapet (2)		Irunapet (2)		Kursilapet (2)		Agraharam (2)		Pudupet (2)		Average Consumption/ Child/Day for All Balwadies
	Total # of Children	Total Food Con- sumed in grams	Total # of Children	Total Food Con- sumed in grams	Total # of Children	Total Food Con- sumed in grams	Total # of Children	Total Food Con- sumed in grams	Total # of Children	Total Food Con- sumed in grams	Total # of Children	Total Food Con- sumed in grams	
30 - 35	0	0	6	440	3	180	11	850	9	440	2	100	64.84
36 - 41	10	605	28	2070	22	1708	30	2355	22	1620	32	1620	69.29
42 - 47	3	235	15	1195	2	160	0	0	5	400	0	0	79.00
48 - 53	7	470	9	720	27	1890	14	1070	16	1195	17	1035	70.89
54 - 59	0	0	2	160	0	0	0	0	4	300	0	0	76.67
Above 60	1	80	0	0	0	0	2	160	0	0	10	720	73.85
All Children	21	1390	60	4585	54	3938	57	4435	56	3955	61	3475	70.48

(a) Figures in parentheses are number of days observations were taken.

EXHIBIT 5D

CONSUMPTION OF BITE-SIZE BITS FOOD IN VEMBAKKAM  
BLOCK BY BALWADY, SEPTEMBER, 1972

Age group in Months	Vembakkam (3) <sup>(a)</sup>		Asanammamet (3)		Thenkalani (3)		Perungattur (2)		Average Consumption/ Child/Day for All Balwadies
	Total # of Children	Total Food Con- sumed in grams	Total # of Children	Total Food Con- sumed in grams	Total # of Children	Total Food Con- sumed in grams	Total # of Children	Total Food Con- sumed in grams	
30 - 35	15	995	5	315	5	385	0	0	67.80
36 - 41	26	1785	30	3060	23	1690	8	620	70.75
42 - 47	26	1815	7	480	17	1195	18	520	69.14
48 - 53	17	1310	21	1475	18	1320	11	800	73.21
54 - 59	4	315	2	160	7	490	10	775	75.65
Above 60	0	0	0	0	0	0	31	2290	73.87
All Children	88	6220	65	4490	70	5080	68	5005	71.46

(a) Figures in parentheses are number of days observations were taken.

EXHIBIT 6A

CONSUMPTION OF POWDERED FOOD IN ARNI  
BLOCK BY BALWADY, SEPTEMBER, 1972

Age Group in Months	Irumbedu (2) <sup>(a)</sup>		Ariyappadi (3)		Sevoor (3)		S. V. Nagaram (4)		Agrapalayam (2)		Nethapakkam (2)		Average Consumption/ Child/Day for All Balwadies
	Total # of Children	Total Food Con- sumed in grams	Total # of Children	Total Food Con- sumed in grams	Total # of Children	Total Food Con- sumed in grams	Total # of Children	Total Food Con- sumed in grams	Total # of Children	Total Food Con- sumed in grams	Total # of Children	Total Food Con- sumed in grams	
30 - 35	9	390	3	220	3	130	2	80	7	410	1	80	52.48
36 - 41	21	445	18	935	12	660	26	1290	15	680	7	285	43.38
42 - 47	14	440	16	815	9	565	11	460	7	255	1	80	45.83
48 - 53	0	0	12	560	24	1065	22	1220	8	510	13	675	51.01
54 - 59	0	0	2	100	20	1410	14	560	4	170	7	430	56.81
Above 60	0	0	0	0	3	220	14	870	0	0	6	400	64.70
All Children	44	1275	51	2630	71	4050	89	4480	41	2025	35	1950	49.58

(a) Figures in parentheses are the number of days observations were taken.

EXHIBIT 6B

CONSUMPTION OF POWDERED FOOD IN CHENGAM  
BLOCK BY BALWADY. SEPTEMBER, 1972

Age Group in Months	(a) Pachal (1)		Nanmalai (0)		Arattawadi (2)		Pudupet (1)		Sorapanandal (1)		Melpallipet (2)		Average Consumption/ Child/Day for All Balwadies
	Total # of Children	Total Food Con- sumed in grams											
30 - 35	1	80	---	---	0	0	5	320	0	0	0	0	66.67
36 - 41	6	320	---	---	11	400	9	720	6	250	9	540	54.39
42 - 47	7	390	---	---	12	670	5	400	3	180	0	0	60.74
48 - 53	20	1060	---	---	16	930	0	0	11	660	10	650	57.89
54 - 59	0	0	---	---	9	510	0	0	3	190	3	240	62.67
Above 60	0	0	---	---	4	140	0	0	2	160	4	310	61.00
All Children	34	1850	---	---	52	2650	19	1440	25	1440	26	1740	58.46

(a) Figures in parentheses are the number of days observations were taken.

EXHIBIT 6C

CONSUMPTION OF POWDERED FOOD IN TIRUPPATTUR  
BLOCK BY BALWADY, SEPTEMBER, 1972

Age Group in Months	Achamangalam (3) <sup>(a)</sup>		Perumpapet (2)		Irunapet (2)		Kursilapet (2)		Agraharam (2)		Purupet (2)		Average Consumption/ Child/Day for All Balwadies
	Total # of Children	Total Food Con- sumed in grams	Total # of Children	Total Food Con- sumed in grams	Total # of Children	Total Food Con- sumed in grams	Total # of Children	Total Food Con- sumed in grams	Total # of Children	Total Food Con- sumed in grams	Total # of Children	Total Food Con- sumed in grams	
30 - 35	0	0	7	400	6	375	15	760	4	70	1	30	49.55
36 - 41	25	1595	23	1140	24	1250	20	1090	17	240	28	1270	48.97
42 - 47	7	370	15	2	2	160	0	0	4	40	0	0	55.36
48 - 53	22	1315	6	425	28	1900	14	725	9	70	18	960	55.62
54 - 59	0	0	2	155	0	0	0	0	1	10	0	0	55.00
Above 60	1	150	0	0	0	0	2	160	2	70	12	670	58.89
All Children	56	3440	53	3100	60	3685	51	2735	37	500	59	2930	51.87

(a) Figures in parentheses are the number of days observations were taken.

EXHIBIT 6D

CONSUMPTION OF POWDERED FOOD IN VEMBAKKAM  
BLOCK BY BALWADY, SEPTEMBER, 1972

Age Group in Month	Vembakkam (2) <sup>(a)</sup>		Asanammappet (3)		Thenkalani (3)		Perungattur (4)		Average Consumption/ Child/Day for All Balwadies
	Total # of Children	Total Food Con- sumed in grams	Total # of Children	Total Food Con- sumed in grams	Total # of Children	Total Food Con- sumed in grams	Total # of Children	Total Food Con- sumed in grams	
30 - 35	10	625	5	290	5	285	0	0	60.00
36 - 41	17	950	33	1305	24	1555	14	1005	54.72
42 - 47	24	1475	4	110	12	685	18	960	55.69
48 - 53	15	750	17	520	21	1165	29	1900	52.87
54 - 59	2	120	1	0	5	320	17	1140	63.20
Above 60	0	0	0	0	0	0	56	3930	70.18
All Children	68	3920	60	2225	67	4010	134	8935	58.02

(a) Figures in paraentheses are the number of days observations were taken.