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DEVELOPMENT OF HOME-PREPARED WEANING DIETS IN SOUTHWESTERN NIGERIA

by

Robert W. Morgan
Project Coordinator/Weaning Foods
U. S. Department of Agriculture
Office of International Cooperation and development

and

Peter Pellett
Professor of Nutrition
University of Massachusetts

Lagos and Ife, Nigeria
Amherst, Massachusetts and Washington, D.C.
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International Food and Nutrition Program
M.I.T./Room 20A-202
18 Vassar Street
Cambridge, Massachusetts 02139
(Telephone 617-253-3462)

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DEVELOPMENT OF HOME-PREPARED WEANING DIETS IN SOUTHWESTERN NIGERIA

I. INTRODUCTION

Dr. Robert W. Morgan, Washington Coordinator of the HOVIPREP (Home and Village Prepared Weaning Foods) Project and Dr. Peter Pellett, Professor of Nutrition, University of Massachusetts, visited Southwestern Nigeria during October 7-30, 1982, at the invitation of the University of Lagos College of Medicine and the University of Ife Faculty of Health Sciences, to assist in identifying suitable diets for weaning age children which could be prepared from locally available foods, and to plan field tests of new weaning diets in urban and rural Southwestern Nigeria.

To the fullest extent possible, preparation techniques of the new diets would be similar to traditional preparation techniques of traditional weaning foods in that area of coastal West Africa.

In this part of West Africa, spanning 15 or more countries, the weaning food in most prevalent use is a fermented maize pap known locally as "Ogi" which is popular in part because raw Ogi is highly acid in content and can be stored in a pot in the household for a week or possibly considerbly longer without contamination, in this humid tropical climate. When prepared for consumption, a scoop of raw Ogi is mixed with boiling water to yield a cereal-like paste which is fed to the child. Although maize is a good cereal base, the traditional method of preparation renders a cooked Ogi product that is above 90 percent water. An average serving (200 mls.) contains only about 30 calories and about 0.8 g. protein, so that even seven servings a day falls well below meeting the child's nutritional requirements. In response to extensive health and nutrition education efforts in the area, parents occasionally add an egg or cowpeas (a locally available bean in good supply) or other ingredients to the Ogi; but these do not appear to make up for the inherent nutritional deficiencies

in the weaning food. An egg, being costly, may be added only one or two times weekly. Cowpeas prepared in the traditional manner (mashing and cooking) are said to give the young child acute digestive problems, or diarrhea, and are thus avoided.

For many years, health professionals in Nigeria have been frustrated by the lack of a good locally-made weaning food which they can recommend to mothers. In cases of severe malnutrition, they may recommend purchase of one of the more expensive commercial baby foods, and there is no doubt that these manufactured products have saved many lives. Nevertheless, there is a strong felt need in this part of the world for an adequate locally-made food for infants. One of the leading Nigerian pediatricians expressed his frustration as follows: "Many seemingly good weaning foods have been developed in laboratories and research institutes in Nigeria. But as yet, none of these has caught on." Two of the objectives of this present consulting mission were to identify potentially adequate foods, and also to identify mechanisms for promoting these foods so that one or more of them might "catch on."

1. Scope of Work. The University of Lagos assigned a team comprising two biochemists, two pediatricians, and a medical sociologist to work with Drs. Morgan and Pellett. The University of Ife assigned a team comprising a pediatrician, a public health nursing sister, a nutritionist, and two food technologists. Dr. Morgan, a medical sociologist, and Dr. Pellett, a nutritionist, both have considerable prior experience in West Africa and similar ecological areas. Scope of work was as follows:

(1) The joint teams comprising the HOVIPREP consultants and staff members of the University of Ife and the University of Lagos would examine diets in current use for children of weaning age in several areas of Southwestern Nigeria. The teams would take into account the extent to which breast-feeding is continued during this critical weaning period.

(2) The teams would review existing data relevant to child growth patterns and child morbidity/mortality during the weaning period, in Southwestern Nigeria.

(3) The teams would review maternal diets and maternal nutrition with respect to pregnant and lactating women, inasmuch as these factors contribute to birth weights and the ability to breast feed.

(4) The teams would focus their review on mother and child populations assumed to be most at-risk in urban and rural areas of Southwestern Nigeria.

(5) The teams would review current data or seek data on prices, compositions, and availability of milk products and commercially manufactured weaning foods both imported and domestic; and also data on a wide range of food products suitable for forming weaning foods and weaning diets, including cereals, root crops, legumes, sources of animal protein, etc., from the point of view of price, composition, and availability including seasonal availability.

(6) The teams would review data or seek data on weaning practices and related food use beliefs and practices, and other relevant sociocultural data.

(7) Based on the above, the teams would prepare specific weaning diets that meet the nutritional needs of infants at the most economic prices possible.

(8) The teams would develop project plans for field testing the recommended diets in selected communities in urban and rural Southwestern Nigeria, from the point of view of taste, ease of preparation, and general acceptability by families.

(a) In Ife, the field test would be conducted in association with proposed nutritional rehabilitation centers in the Ife area;

(b) In Lagos, the field tests would be conducted using extension workers at primary care centers in the Lagos area.

(9) The teams would discuss ways and means, including the possibility of further technical assistance at appropriate times in order to promote the weaning diets more widely in Nigeria and West Africa, following completion of the field test phase.

(10) Weaning foods identified during this mission and subsequent project activities may include foods prepared at the home and village level, foods centrally-processed, or some combination of these.

2. Persons Interviewed During Consulting Trip.

A. At the University of Lagos

1. Professor Deji Femi-Pearse, Provost, College of Medicine
2. Dr. M. A. Makinde, Department of Biochemistry
3. Dr. T. Olufemi Johnson, Professor of Medicine
4. Dr. J. A. Oyefeso, Department of Medicine
5. Dr. Nike Grange, Department of Pediatrics
6. Professor O. Ransome-Kuti, Director
   Institute of Child Health and Family Care, College of Medicine
7. Dr. O. A. Abosede, ICHFC
8. Dr. Anne Bamishaiye, ICHFC

B. At the University of Ife

1. Professor Michael Akin Bankole, Department of Pediatrics
2. Sister Veronica Aina Agboh
   Department of Community Health and Nutrition
3. Dr. Iferonuwa F. Smith, Community Health and Nutrition

4. Dr. E. O. Ojofeitimi, Community Health and Nutrition
5. Mr. Musa Jinadu, Community Health and Nutrition
6. Professor Oladipo Onayemi, Department of Food Science and Technology
7. Dr. I. A. Adeyemi, Food Science and Technology
8. Professor Akinsola Akiwowo, Department of Sociology
9. Dr. L. A. Adeokun, Department of Demography and Social Statistics
10. Professor A. Adeniyi-Jones (emeritus)
    Department of Community Health and Nutrition

C. At the University of Ibadan

1. Professor A. Omololu, Department of Human Nutrition
2. Mrs. Freya De Cola, Medical Librarian

D. At the International Institute of Tropical Agriculture, Ibadan

1. Dr. E. H. Hartmans, Director General
2. Mrs. Remi Enahoro, Executive Secretary

E. At the U.S. Embassy, Lagos

1. Mr. Chester Norris, Economic Counsellor
2. Mr. Christopher E. Goldthwait, Agricultural Attache
3. Mrs. H. O. Shitta, Economic Section (AID)
4. Mr. Peter E. Osayamwen, Economic Section (AID)

F. At the Federal Ministry of Health, Lagos

1. Dr. Patrick Okungbowa, Head, Federal Nutrition Unit

G. At UNICEF, Lagos

1. Mr. Richard S. Reid, Country Representative

H. At the Ford Foundation, Lagos

1. Ms. Deborah Prindle, Program Officer
2. Mrs. Bilge Reid, Program Officer

I. At the Federal Institute of Industrial Research, Oshodi

1. Dr. A. B. Oniwinde, Acting Director
2. Mrs. Charity C. Edwards, Program Officer

II. THE PROBLEM

1. Introduction and Overview. Nigeria, the most populous country in Africa (estimated range 70-90 million persons) is situated on the West African coast and is included in the group of countries termed Sub-Saharan Africa, where the general food and nutriton situation is amongst those considered to be the most serious in the world.

In general, population growth is high, food production increase is low, and these are associated with high levels of infant mortality and poor life expectancy. Nigeria appears to be no exception to this generality although there are considerable problems in the reliability of available data. Indeed The London Economist in a recent 46-page review on the present state of Nigeria remarked that never before had they published a survey "in which every single number is probably wrong" (January 23, 1982).

Nevertheless, the data that are available appear consistent with a country that despite meeting a great deal of its food needs has widespread food and nutrition problems. The 1982 estimates of the Population Reference Bureau in Washington are given in Table I , showing a current estimated population of about 80 million persons (the last census was conducted in 1963, and many demographers believe the last reasonably accurate census goes back to 1952-53). There are no data on mortality or infant mortality except from isolated sample surveys in the country which suggest that the estimated Infant Mortality Rate figure of 135 may be on the low side.

Sample surveys have also pointed to annual population growth rates in excess of 3 percent for at least the past two decades, and the FAO sets food production increase for the country at probably less than 2 percent per annum, suggesting that Nigeria is among those countries in which food production lags seriously behind the national growth rate. Because of oil, the per capita

TABLE 1 -- Population Estimates for Nigeria

Population (in millions)	82.3
Crude Birth Rate	50
Crude Death Rate	18
Annual rate of national increase (percent)	3.2
Infant Mortality Rate	135
Life Expectancy at Birth (in years)	48
Proportion less than 15 years (percent)	47
Proportion of population in urban centers (percent)	20
Proportion of population engaged in Agriculture (percent)	54
Food production increase per annun (percent)	1.6
GNP 1980 (in U.S. Dollars)	1,080

SOURCES: Population Reference Bureau (1982); FAO (1980).

gross national product (GNP) is somewhat high for an African country, although visual indicators in urban high population density areas as well as in rural villages do not reflect relative wealth. A sample survey in Lagos, for example, showed that the majority of households (about 80 percent) could not afford such simple amenities as a pocket transitor radio or any form of cooking stove (cooking typically is done over wood fires in courtyards or on exterior stairway landings). For Nigeria as a whole, the general health and nutrition picture is that of many developing countries with a relatively low life expectancy, a high infant mortality rate, a large proportion of the population less than 15 years of age, and a high prevalence of low birth weight infants.

In Table 2 the average nutrient intakes in relation to adult requirements are shown. These data are from Food Balance Sheets as published by FAO (1980). The limitations of such an approach are fully realized but these data together with those of Table 3, also derived from Food Balance Sheets, show a diet which on average barely reaches expected energy needs and is also low in its protein concentration. These values have hardly changed since 1960. Animal protein consumption is low (although bush meat, insects and snakes, etc., which are sold in local markets may never reach official statistics) and vegetable materials supply the majority of the calories.

The retinol equivalent appears well above requirement, probably because of the widespread consumption of red palm oil. Riboflavin intake appears low which seems indicative of low milk availability and consumption.

The pattern of food availability is shown in Table 4, where cereals and starchy roots are major sources of both protein and calories with additional protein being supplied by pulses. For the country as a whole, millet

TABLE 2 -- Average Nutrient Availability and Adult Nutrient Requirements, Nigeria, 1977

	Mean intake/day	Mean Requirement Adult Moderately active	
		Male	Female
Kcals	2257	3000	2200
Protein (gms.)	51.5	37.0 [1]	29.0 [1]
Fat (gms)	45.3	-	-
Calcium (mgs.)	445	450	450
Iron [2] (mgs.)	19.3	9	28
Retinol Eq.	1607	750	750
Thiamine (mgs.)	1.52	1.20	0.9
Riboflavin (mgs.)	0.74	1.80	1.30
Niacin (mgs.)	13.6	19.8	14.5
Ascorbic Acid (mgs.)	68	30	30

1. As egg or milk protein. For protein NPU = 70 becomes 52.8g/day for a male and 41.4g for a female.

2. Requirement values cited are for when little animal protein is present in the diet.

SOURCES: FAO (1980); FAO/WHO (1974).

TABLE 3 -- Derived Nutritional Data, Nigeria, 1977

Protein calories as percent total calories (Pcal%)	9.1%
Fat calories as percent total calories (Fcal%)	18.1%
Vegetable product calories as percent total calories	96.2%
Root & Tuber calories as percent total calories	29.1%
Animal protein as percent total protein	15.1%
Cereal protein as percent total protein	51.3%

Calculated from Food Balance Sheet data; FAO (1980).

TABLE 4 -- Food Availability per Head per Day, Nigeria, 1977

	Kcal	Protein (g)	Fat (g)	Retinol Eq. (Micro-gm.)	Retinol Eq. (Micro-gm.)
Grand Total	2257	51.5	45.3	75	1607
Vegetable Products	2172	43.7	40.7	0	1528
Animal Products	85	7.8	4.6	75	79
Grand Total (excl alochol)	2213	51.2	45.3	0	-
Cereals Total	964	26.4	8.3	0	5
Wheat	77	2.2	0.2	0	-
Rice	97	1.9	0.1	0	-
Maize	144	3.8	1.5	0	-
Millet/Sorghum	637	18.3	6.3	0	-
Roots & Tubers	657	7.1	1.5	0	12
Sugar & Honey	58	-	-	-	-
Pulses	76	5.0	0.4	0	.1
Nuts & Oilseeds	61	2.7	4.8	0	-
Vegetables	26	1.3	0.3	0	200
Fruit	62	0.6	0.3	0	38
Meat & Offal	36	3.6	2.3	56	58
Eggs	5	0.4	0.3	8	9
Fish & Seafood	17	2.7	0.6	3	3
Milk	18	1.0	0.5	3	6
Vegetable oils	220	-	24.9	0	1197
Animal oils	8	-	0.9	3	3
Alcholic beverages	44	0.3	0.2	0	-

SOURCE: FAO(1980).

and sorghum are the major cereals though these are much less frequently consumed in the South. Bread consumption is increasing especially in the larger urban areas. Cassava and yams are the major starchy roots consumed in Southern Nigeria and are important calorie sources. Cassava consumption is mainly in the form of "Gari", a dried flour produced after a fermentation stage. Yam is processed in various traditional ways.

Pulses supply some 10 percent of the total protein intake for the country as a whole. Intake is probably higner in the non-sorghum consuming areas of the South. Cowpeas (vigna sp.), simply known as "beans", form the majority of the pulse supply. This is a cultigen of West African origin and is grown widely throughout the continent. A large variety of forms exist of which two forms (vigna unguiculata and vigna sinensis) predominate for seed production. Even within the species, a large number of sizes and seed coat colors exist.

Ongoing research at the International Institute for Tropical Agriculture in Ibadan has produced new varieties and new agronomic techniques (intercropping with maize, "zero till" procedures, rolling injector planting, etc.) where yields have increased several fold. Because some of these new varieties mature in only two months, three crops per year could be produced.

The production potential for cowpeas is important because they are the only readily available high protein source and with high lysine content they complement the low lysine cereal-based diet.

As shown in Table 5, domestic production meets all needs for staple foods except for wheat and rice. Wheat is imported as grain and locally milled into flour and semovita. Both are being increasingly consumed and despite being imported are fully competitive with other staples in price and availability, at least in the Southwest. Packaged U.S. rice is preferred to local rice, though somewhat more expensive in the local market.

TABLE 5 -- Output, Imports and Domestic Food Use for Major Staple Foods in Nigeria

			(Average 1975 - 1977 Thousands Metric Tons)		
	Domestic Output	Imports	Domestic Supply [1]	Domestic Food Use [2]	% Imports [3]
Cereals					
Wheat	20	620	624	445	99
Maize	1320	16	1336	452	1
Millet	2893	37	2963	2017	1
Sorghum	3657	0	3697	2676	0
Rice	543	166	691	459	24
Roots & Tubers					
Sweet Potatoes	197	0	197	157	0
Cassava	10,633	0	10,633	2357	0
Pulses & Oilseeds					
Cowpeas	827	0	825	521	0
Soybeans	68	0	67	48	0
Melon Seed	108	0	108	34	0
Sesame Seed	69	0	66	55	0
Fruit					
Plantain	1900	0	1900	1330	0
Oils					
Palm oil	652	2	642	495	<1

Source: Food Balance Sheet, FAO Rome (1980)

1. Domestic Supply also includes consideration of stocks and exports.
2. Domestic Food use allows for feed, seed and wastage.
3. (Imports ÷ Domestic supply) x 100.
4. Cassava (fresh) and cassava flour (dry) combined.

Thus in summary, the food availability picture shows a diet heavily dependent on cereals and starchy roots and some plantain which is low in protein and also high in bulk. These considerations are important when weaning diets are discussed because weaning is a process of transition from breast milk to receiving an adult diet and traditional weaning diets will tend to be based on the same bulky low protein vegetable foods.

2. Malnutrition and Undernutrition in Nigeria. In West Africa malnutrition has been prevalent for many years. Indeed the first description of kwashiorkor was made in 1933 in the neighboring country of Ghana by Cecily Williams. Morley (1958) observed a high incidence of kwashiorkor in the area of Wesley Guild Hospital in Ilesha in Southwestern Nigeria and several growth studies have revealed severe growth retardation beginning in the first year of life (Morley et al 1968, James 1974, and Omolulu et al 1981). Data from Omolulu et al (1981) are shown in Table 6. This was a transverse longitudinal study performed on 312 infants in a village, also in Southwestern Nigeria. The number of observations and the mean and standard deviation for weight at various ages between birth and 5 years are shown together with new calculations which compare these mean values to the U.S. 50th percentile of weight-for-age. Mean birth weight is low and there is some recovery by 3-4 months but thereafter there is a steady decline until by 10-12 months their weights-for-age are only 74-75% of the U.S. median. These data considered together with their standard deviations reveal a considerable degree of 2nd and 3rd degree malnutrition as indicated by the Gomez scale. Indeed the mean value falls into the Gomez II grouping. The Omolulu et al paper also reports heights. If heights-for-age and heights-for-weights are compared using the mean values (individual values should be used but were not available) these would fall 2-3 standard deviations below the international standards (Waterlow et al 1977), again revealing a considerable degree of stunting and wasting.

TABLE 6 -- Weights for Age (Combined Sexes) Compared to U.S. Median, Osagere Village, Nigeria

Age in Months	Weight	SD	N	%U.S. Median	Age	Weight	SD	N	% U.S. Median
Birth	2.9	0.2	312	87	16	8.3	1.5	310	77
1	3.6	0.8	309	85	17	8.5	1.7	309	77
2	4.5	0.8	310	89	18	9.0	1.7	308	80
3	5.2	0.8	310	90	19	9.1	1.7	308	79
4	5.7	0.7	311	89	20	9.1	1.8	308	78
5	5.8	0.8	310	83	21	9.2	2.1	310	77
6	6.0	0.9	309	80	22	9.5	1.6	308	78
7	6.1	1.0	310	77	23	9.6	1.2	307	78
8	6.4	0.9	312	76	24	10.0	1.7	308	80
9	6.7	1.0	307	76	30	10.7	2.0	272	79
10	6.8	1.2	308	74	36	11.3	2.0	255	78
11	7.0	1.8	312	74	42	12.2	2.0	235	79
12	7.4	1.1	307	75	48	13.1	2.3	230	80
13	7.6	1.5	308	75	60	14.3	2.2	230	79
14	8.0	1.2	312	77	--	--	--	--	--
15	8.2	1.5	309	77	--	--	--	--	--

SOURCE: Omololu et al (1981).

No recent readily available weight-for-age data could be found in the areas visited. This was partially because in the clinics mothers often carry their own weight records for their children and none are available in the clinics. Nevertheless, although children visiting clinics for inoculation and minor ailments are not necessarily representative of the population as a whole, some cross sectional data on weights-for-age were collected (courtesy Drs. Bankole and Ransome-Kuti) in clinics in Ile-Ife (Modakeke and Enuwa) and in Lagos (Shomolu). These are shown in Table 7.

Undernutrition was prevalent with 42% of the children being below 90% weight-for-age. In Enuwa clinic 23% of the children were in Gomez II and III categories. Non-clinic attendees would be expected to be closer to the status observed by UNICEF (1964,1965), and Omolulu et al (1981) where the majority of the children were below 90% weight-for-age and over half in Gomez II and III categories.

The largest number of observations was made at the Modakeke clinic in Ile-Ife and these weight-for-age data are analyzed further in Table 8 where the percentage deficits are expressed in relation to age. In these children mean weight-for-age does not differ significantly from the U.S. population until after 6 months of age, but then declines in a statistically significant manner.

These data are also shown in Table 9, expressed in a different manner. There it can be seen that the numbers of children defined as malnourished on a weight-for-age criteria (Gomez I-III) increase with age. It is fully realized that weight-for-height and height-for-age criteria should be used whenever possible (Waterlow et al 1977) to distinguish chronic from acute malnutrition; but height data were not available and weight-for-age criteria can be of considerable value in the young child. These data then reveal a

TABLE 7 -- Estimated Malnutrition by Weight for Age (Gomez) Classification in Three Clinics in Southwestern Nigeria

Clinic	No. Weighings	Normal >90%	Gomez I 75-89%	Gomez II 60-74%	Gomez III <60%
Modakeke (Ile-Ife) (<2yrs)	506	62%	30%	7%	1%
Shomolu (Lagos) (<5yrs)	100	50%	39%	7%	4%
Enuwa (Ile-Ife) (<2yrs)	85	48%	29%	12%	11%
Three clinics combined	691	58%	31%	8%	3%

NOTE: Most of the above children were aged 0 - 11 months and analysis elsewhere shows children aged 0 - 5 months are at levels equal to international norms, with a progressive decline in nutritional status thereafter, indicating that Gomez I, II and II levels may be higher in full samples of 0 - 4 year old children.

TABLE 8 -- Weight for Age Levels at Modakeke Clinic, Ile-Ife

Age	Distribution by age and mean percentage of U.S. median	
	No. of weight/age	Mean % of U.S. Std. ± SD
<1 Mo.	49	96.6 ± 11.4
1-3 Mos.	134	98.1 ± 15.2
4-6 Mos.	159	97.2 ± 14.8
7-9 Mos.	120	91.2 ± 14.4 [a]
10-12 Mos.	27	85.6 ± 12.0 [a]
13-18 Mos	17	82.7 ± 13.3 [a]

a. Significantly different from 1-3 Mos. age group ($P < .001$)

NOTE: 506 observations on 224 children (116 males and 108 females) aged between 1 week and 18 months. Maximum of 4 observations on any one child. Compared with U.S. standard 50% percentile.

TABLE 9 -- Distribution by Percentage of U.S. 50th Percentile in Relation to Age (Modakeke Clinic)

Compared with U.S. Standard	<1 Mo.	1-3 Mos.	4-6 Mos.	7-9 Mos.	10-12 Mos	13-18 Mos.
>90%	65.3	73.8	65.4	51.7	37.0	29.4
75-89%	34.7	20.1	28.9	35.8	40.7	58.8
60-74%	0	5.2	5.0	12.5	18.5	5.9
≤ 50%	0	0.7	0.6	0	3.7	5.9

NOTE: Observations in 10-12 and 13-18 month age groups extremely low in Tables 8 and 9, a result of recent clinic policy to see only children in the first year for the most part, older children being referred to a nearby dispensary where we were not able to obtain weights.

considerable degree of malnutrition which becomes significant after 6 months of age, with a probable effect on weaning practices which will be elaborated elsewhere.

3. Maternal Malnutrition. No data could be obtained on the prevalence of maternal malnutrition. That such maternal malnutrion is probably widespread can be deduced from birth weight data and the prevalence of low birthweight infants (LBW). The majority of these in developing countries are described as being small for dates which indicate fetal growth retardation.

Maternal malnutrition, ill health and other deprivations are the most common causes of LBW infants since birth weight is influenced by the mothers' health and nutritional status. Thus the prevalence of LBW infants can be used as an indicator of maternal nutritional status. This is important; however, what is probably more important is that low birth weight is the single most important determinant of the chances of a new born to survive and to experience healthy growth and development.

Increasing attention is now being given to birth weight distribution (WHO 1980) with the frequency of low birth weights being taken as a general indicator of the health status of population groups. In Table 10 some selected data for African countries and for the world are shown. It will be seen that the Nigerian value is at the high end for Africa and is the same as the average for developing countries (The Indian Subcontinent shows a specially high prevalence towards 30%). The average for developed countries is about 7% of which the majority are premature rather than fetal growth retardation. The Nigerian values thus appear typical of developing countries and would indicate poor maternal nutritional status since many studies (Shah 1981) have demonstrated increased birth weights following maternal dietary supplements.

Table 10 --Incidence of Low Birth Weight Infants in Nigeria and in Some Selected Countries in Africa (1979 data)

Country	Live births ($x 10^3$)	LBW (%)	LBW No. ($x 10^3$)
Nigeria	3,730	18	671
Upper Volta	322	21	68
Ivory Coast	370	14	52
Uganda	594	10	59
Kenya	785	17	137
Egypt	1,543	13	208
Tunisia	230	7	17
Zaire	1,288	16	205
Africa Total	21,081	15	3,165
World (Developing)	104,900	18	19,310
World (Developed)	17,400	7	1,290

SOURCE: WHO Division of Family Health (1980).

Table 11-- Birth Weights in Osagere Village, Nigeria

Weight	N	Mean ± SD	Distribution (%)	% U.S. Mean
> 3.6 kg	27	3.7 ± 0.4	9	111
3.0 - 3.59 kg.	68	3.2 ± 0.2	22	96
2.5 - 2.99 kg.	127	2.8 ± 0.3	41	84
2.0 - 2.49 kg.	71	2.3 ± 0.3	23	69
< 2.0 kg	19	1.7 ± 0.3	6	51
	312		100	

SOURCE: Omolulu et al (1981)

The situation in some Nigerian villages is more serious than the average values indicate. A study by Omolulu et al (1981) examined birth weights as part of a 5-year infant growth study in Osagere Village; these values are shown in Table 11 and a 29% prevalence of LBW infants can be seen. It is of interest that Omolulu et al (1981) remark that infants that are born small remain small at least up to 5 years of age. The authors state, "Nutritional intervention should therefore be directed at pregnant mothers in order to improve the birth weights of their children so as to offer these children a better nutritional start in life with a better nutritional potential to become bigger children even under the present unsatisfactory village circumstances."

4. Feeding and Weaning Practices in Southwestern Nigeria. From the Alantic coast on the south to the Sahara on the North, Nigeria spans the principal African vegetation zones, including dense mangrove swamp and rain forest along the southern coastal areas, merging into high forest savanna, low forest and bush savanna, and semi-desert in the north. The area of this report includes mangrove and rain forest merging into high forest savanna. Rainfall in this area ranges from 60 inches per year on the coast to about half this figure in the savanna.

In traditional times, this area was noted for having had no native cereal grain, no milked animals, and few sources of animal protein. Goats were eaten and are eaten today only on ceremonial occasions and usually by adult males. Cattle were and are driven to market in this area from the North (sometimes walking 500 miles), but do not thrive naturally in Southern Nigeria because of the tsetse fly. Snails, snakes, bush meat (including monkey and antelope), bats, locusts and caterpillar are sold in the local market.

Several prominent cereals and legumes were domesticated in the West African savanna, probably 5,000-6,000 years ago, including pearl or bulrush millet, sorghum (known locally as Guinea Corn), Bambara groundnut, and several dozen varieties of cowpeas. Only the latter is native to Southern Nigeria, where it grows in 33 varieties. Millet (in flour and Ogi form) is available in the southern markets, but expensive and little used. Of the two principals cereals used in Southern Nigeria today, maize was imported from the New World and rice from Southeast Asia. Maize is widely grown in Southern Nigeria today and forms the base for the principal weaning food, fermented maize pap or Ogi. Nigerian rice must be "imported" to the South from the Middle Belt or Northern areas, and is much less preferred than imported packaged rice which is widely sold in the Southern markets ("Uncle Ben's" and "Caroline" are two imported favorites).

Of the important tubers, yam and taro (coco yam) were imported from Southeast Asia and cassava from South America. Only Guinea yam is indigenous to the West African savanna. The arrival of the famous Asian food trio--yam, taro, and banana--probably about 1,000 years ago (the precise diffusion route is uncertain) permitted savanna societies to penetrate the rain forest and move southward on the continent.

Other important foods indigenous to or first domesticated in West Africa include okra, egusi, pumpkin and pumpkin seeds, watermelon, sesame, and the oil palm which is a vital source of cooking oil and vitamin A.

Two other important food sources which have come into greatly expanded use in recent decades are chickens (and chicken eggs), and fish. It is not clear to what extent chickens were raised in traditional times, but today they are raised extensively in urban and rural Southwestern Nigeria; some of the garages attached to middle income project houses in the Surulere

area of Lagos being filled with row on row of chickens being grown according to modern mass production methods. Eggs, which were seldom seen 20 years ago, are now peddled door-to-door, in the streets and in offices, usually by young girls carrying egg trays on their heads. Fish of both the salt and fresh water variety, apparently little used in traditional times, are now found in the markets in the fresh, frozen, and dried forms, and stockfish are imported. Nigerian research institutions have also experimented with fish flour for commercial sale.

The predominant ethnic group in Southwestern Nigeria and extending into parts of neighboring Benin and Togo is the large Yoruba tribe numbering perhaps as many as 20 to 30 million persons (as with all other Nigerian statistics, this is an estimate). The Yoruba comprise about 80 percent of the Lagos population and virtually all of the population of the five southwestern Nigerian states, and are one of the largest if not the largest tribal group in Africa (the two other largest African tribal groups, the Hausa and the Ibo, also being located principally in Nigeria). From traditional times the Yoruba have been organized in large territorial groups under powerful paramount chiefs, and have been classified by anthropologists as a patrilineal society. There are, however, strong matrilineal characteristics among the Yoruba. Women in the tribe occupy important managerial and professional roles, and the main section of Lagos and a number of streets are named after women. Trained nurses and midwives, as an example, occupy high status in Yoruba society, and many of the leading Nigerian physicians are female. Among the 13 senior professionals at the Universities of Lagos and Ife who were assigned to work with the HOVIPREP consultant group, twelve were Yoruba and six were women.

(A) Breast Feeding. According to the ethnographic literature, Yoruba women traditionally breast-fed their children for 3 and sometimes 4 years, sexual intercourse being prohibited during this period as is the case in many African societies because of the belief that pregnancy renders the breast-milk poisonous or at least harmful to the suckling infant. Current research indicates that breast-feeding continues for a very long period, perhaps two years for most mothers. In random interviews conducted with about 30 women in Lagos and Ife during this present consulting trip, the average time of breast-feeding was 18.7 months.

The picture is confusing because many mothers also introduce commercial milk powders, sometimes via bottle-feeding, at very early ages, often at 1-3 months of age. The quantitative picture is seldom clarified in the research, so that it is impossible to state whether breast-feeding predominates, but the impression is that breast-feeding is continued very extensively in Southwestern Nigeria and other items in the children's diets are secondary.

Recent research at Ife General Hospital showed that the majority of mothers did not initiate breast-feeding until 10 to 18 hours after delivery, instead giving the children glucose water from feeding-bottles they had brought to the hospital (Ojofeitimi 1981), thus depriving the infants of access to colostrum. Mean frequency of breast-feeding, when this was initiated, was 4.43 +/- 1.46 (SD) times/day while the women were at the maternity centers, and our random interviews indicated frequencies of 4-6 times per day for breast-feeding children generally.

(B) Introduction of Supplementary Foods. As far as can be determined, the traditional fermented maize pap (ogi) is the principal supplementary

food introduced to infants in Southwestern Nigeria, and despite the low nutrient content (about 30 calories per 200 mls. and about 0.8 g. protein), our informants were firm in the belief that this would have to continue to be the base for any weaning diet in the area, and that we would have to focus on reinforcing the ogi in some manner. It was noted that the high acid content resulting from the traditional form of preparation renders raw ogi resistant to contamination and able to be stored many days, unrefrigerated, in containers in households in this humid tropical environment.

During our informal surveys in Lagos and Ife, mothers were asked how many times their children had been fed ogi "yesterday", the range being zero to 5 times in both places, and the mean being 2.25 times per day in both places.

Health education workers in Lagos insisted that mothers were giving their children eggs. According to our survey, 25 percent of children received an egg at least once a week, the mean being 0.2 eggs per week. In Ife, total eggs given children "yesterday" was zero.

A large number of other foods in addition to milks, ogi and eggs were listed as given to children sporadically, including occasional servings of gari (cassava flour), akara or moin-moin (fried and steamed bean cakes), dodo (fried plantain), eba (yam flour), okra and egusi (vegetables), pounded fish and fish flour. The important consideration is how much of these supplementary foods are given how often. Unfortunately research of this nature is extremely difficult in any locality, and the nutritionist normally must rely on impressions. What is clear is that the typical weaning age child in Southwestern Nigeria does not receive consistent feedings 5 to 7 times daily of some calorie-dense mixture that is also adequate in protein.

C. Use of Legumes. The only readily available legume in Southwestern Nigeria is the cowpea. Groundnuts are grown some 500 miles further north and are "imported" to Southern Nigeria where they are sold in the markets, and soy is grown only to a limited extent in widely scattered parts of the country.

Nigeria is the largest cowpea producer in the world, and the potential supply apparently is highly elastic. According to Dr. Erdmann Hartmans, Director General of the International Institute of Tropical Agriculture in Ibadan where special studies of cowpeas have been in progress, new strains being introduced in different sections of Nigeria have a yield up to 5 times greater than present strains and mature in 60 days, so that three crops per year may be possible in good rainfall years. Many housewives grow what are known as "vegetable cowpeas" in their backyards, for home consumption, and there are no statistics on these, so that the supply is greater than official figures report.

Cowpeas are used in two traditional foods in Southwestern Nigeria. Akara is a fried bean cake sold in the markets as a snack food and eaten in homes. Moin-moin is a steamed bean cake, very soft in composition. Beans are also cooked whole or cooked mashed, and served with rice and palm oil or in other similar ways. Pediatricians report that mothers may know the value of cowpeas as a protein food, but usually avoid giving this food to weaning age children because they report that the children get excessive gas, diarrhea and stomach cramps.

Based on the three principal criteria of nutrient value, available supply, and familarity in homes, the consulting team made the decision that maize and cowpeas would form a potentially adequate weaning-food base, and that a part of our efforts should be directed toward identifying

ways of preparing maize-cowpea mixes that would be acceptable to mothers and small children.

D. Commercial Milk Powders and Special Baby Foods. A large variety of these manufactured and imported products are sold in the local markets, ranging from dried whole milk (DWM) to complex and more expensive powdered mixtures containing added vitamins and minerals.

There is no denying that these products are nutritious, help children in crisis situations, and save lives, in an area of the world where no other recognized and consistently used weaning mixtures exist at present. Part of our inquiry focused on possible uses of these mixtures, particularly DWM, in weaning diets. Bread dipped in milk was identified to us as a weaning food sometimes given to children, and we also explored this possibility.

5. Role of the University of Lagos and University of Ife. These two universities had their inception in 1962, the first created by the Federal Government in the rapidly-growing national capital, and the latter by what was then the regional government of Western Nigeria, on a large tract in the Nigerian cocoa belt close to the small town of Ile-Ife where according to Yoruba oral tradition the world began. Both universities are now federal institutions and are among the foremost institutions of learning in Sub-Saharan Africa.

The University of Lagos College of Medicine stands distinct from the university itself in location and administration, being situated in a high density area close to the population center of the city and having a separate governing board and administrative head. The University of Ife stands in an essentially rural and agricultural area, about 200 miles north-east of Lagos. Both medical faculties have strong interests in nutrition,

primary care, and community involvment, and both have been involved in pioneer programs to train new categories of paramedical staffs in the country, one with a focus on urban medicine and one with a focus on rural medicine.

There is no readily available mechanism by which the two universities could collaborate in a weaning foods project, principally because of problems of road and telephone communication, nor was such collaboration intended in the scope of work of this mission. It appears, however, that similar weaning diets will be tried experimentally via similar community action mechanisms at the two universities and that a considerable degree of collaboration will take place.

III. IDENTIFICATION OF SEVERAL POTENTIALLY SUITABLE WEANING DIETS

1. Market Prices of Foods in Lagos and Ife. A brief survey was conducted of prices of staple foods, protein foods, milk products, and special baby foods on sale in two markets in Ile-Ife (Table 12). A similar survey by Dr. Oyefeso in Lagos revealed prices that were in general somewhat lower than those in Ife, and unexpected finding which our colleagues attributed to the fact that most foods in Nigeria are now in the cash crop variety and are brought to the larger cities for sale, tnus forcing down prices to an extent in the cities.

These prices are recorded in Nigerian Naira (N1 = U.S. $1.50) for various weights of products which were then converted into grams of protein per Naira and kilocalories per Naira. A similar exercise had been conducted by the University of Lagos (Table 13) several years ago and similar comparative conclusions can be drawn although inflation has considerably increased the actual prices.

TABLE 12 -- Protein, Calories and Cost of Selected Foods used in Weaning Diets, Ife and Lagos Markets

Food	Unit Weight(g.)	Unit Cost (Naira)	Nutrient Content/100g. Protein	Nutrient Content/100g. Kcal	Nutrient Content/Naira Protein[1]	Nutrient Content/Naira Kcal
(A) Staples						
Rice	1200	1.70	7.0	360	49	2540
Rice(L)	3300	4.50	7.0	360	51	2640
Maize	1000	0.50	9.3	360	186	7200
Maize(L)	3350	2.50	9.3	360	125	4825
Millet	1200	0.80	10.4	340	156	5100
Millet(L)	3600	3.00	10.4	340	125	4080
Gari	1020	0.70	1.1	360	16	5245
Semovita	2000	1.50	11.0	350	146	4670
Wheat Flour	2000	1.20	10.5	350	175	5830
Bread	450	0.30	8.0	250	120	3750
(B) Supplements						
Cowpea	1200	1.20	23.0	340	230	3400
Cowpea(L)	3500	5.00	23.0	340	161	2380
Bean Flour(L)	500	1.75	23.0	340	65	970
Melon Seed	650	1.50	26.0	550	112	2380
Meat	500	2.50	20	140	40	280
Egg	60	0.15	13	160	52	640
Milk, DWM (Nido)	2500	7.50	25.5	500	85	1670
Milk, DWM (Klim)	1800	5.50	25.5	500	83	1640

All prices are for Ile-Ife except where marked (L), = Lagos.

1. No consideration is given to protein quality or digestibility in these calculations.

Table 12 (continued)

TABLE 12-- Protein, Calories and Cost of Selected Foods used in Weaning Diets, Ife and Lagos Markets

Food	Unit Weight(g.)	Unit Cost (Naira)	Nutrient Content/100g.		Nutrient Content/Naira	
			Protein	Kcal	Protein[1]	Kcal
(B) Supplements						
Evaporated Milk (Carnation)	170	0.20	7.0	140	59	1190
Stockfish	48	1.00	63.0	309	30	150
(C) Calorie Sources						
Palm oil	540	0.80	0	900	0	6075
Groundnut oil	540	0.60	0	900	0	8100
Sugar	500	0.50	0	400	0	4000
(D) Baby Milks and Special Foods						
SMA	450	4.00	11.9	450	13	510
S26	450	2.50	12.0	450	22	810
Cow & Gate	500	1.50	14.5	494	48	1650
Cerelac	1000	3.50	11.0	425	31	1210
Farlene	250	3.00 [2]	16.0	330	13	275
Soy-Ogi	450	0.70	20.0	400	128	2570

2. Price as charged in market. Newspaper advertised price for 250g. was ₦1.85.

TABLE 13 -- Comparative Costs of Protein from Protein Foods
(Determined by University of Lagos, Late 1970's Prices)

(A) Milk Products Available for Infants

Product	Weight(g.)	Price (Naira)	Protein/Naira
Casilan	225	1.90	107.5
Dutch Baby	1134	1.80	166.7
Lactogen	450	1.0	88.5
Cow and gate	396	1.10	98.0
Cow and Gate (half cream)	340	1.10	46.3
Complan	450	1.90	73.5
Similac	453	1.35	39.4
Marmex	454	1.35	46.1
Nan	454	1.35	41.8
Eutarmil	454	1.35	40.3
Dino	454	0.80	163.9
Frisolac	450	1.35	48.3
Farm	454	0.80	147.1
Danny Boy	454	0.80	144.9

(B) Cereal Products Available for Infants

Product	Weight(g.)	Price (Naira)	Protein/Naira
Farlene	250	1.25	50
Farex	284	1.06	42.3
Gerber High Protein Cereal	227	0.40	59.6
Cow and Gate Mixed Cereal	284	1.18	157.1

Table 13 (continued)

TABLE 13 -- Comparative Costs of Protein from Protein Foods
(Determined by University of Lagos, Late 1970's Prices)

(C) Protein Foods of Vegetable Origin

Food	Price of 30 g. Protein (Naira)	Protein/Naira
Cowpeas	0.64	468.8
Egusi	2.00	150.0
Rice	2.62	114.5
Ogi Funfun	1.80	166.7

(D) Foods of Animal Origin

Food	Price of 30 g. Protein (Naira)	Protein/Naira
Dried Fish	0.60	500.0
Frozen Fish	0.90	333.3
Liver	3.60	83.3
Beef	3.21	93.5
Egg	4.20	71.4
Shrimps (small dried white)	1.74	172.4
Shrimps (large dried red)	3.48	86.2

Staple foods in markets are mostly sold unpackaged on a volume basis. It was thus necessary to determine the volume sold and convert to weights using weight for volume values for each food. A standard cup was used to measure volume in the market and then a weight conversion was determined in the laboratory. This exercise served to confirm expectations that vegetable staple foods and vegetable protein sources could generally supply large amounts of calories and protein per Naira while animal protein from meat and eggs was much more expensive.

Milk products, especially in the form of dried whole milk (DWM), even though imported, were relatively cheap sources of animal protein. This was in contrast to the special baby milks which were much more expensive.

Dry fish of the stockfish variety is considered a delicacy and was thus quite expensive although some varieties of dried and frozen fish were cheaper than milk according to the University of Lagos data (Table 12).

Special baby foods, whether milk or cereal based, were very expensive and generally compared unfavorably in price with DWM.

The locally produced Soy-Ogi would be a good value for money if it were readily available. This product will be discussed in more detail below.

It should be noted that in the calculations for protein per Naira no consideration was given to protein quality. Certainly cereal products are low in the amino acid lysine, and legume products, for example cowpeas, supply only low levels of sulfur amino acids. Both cereals and cooked legume products may show poor protein digestibility. Thus, were these foods to be consumed alone as the only source of protein, they most certainly would <u>not</u> supply utilizable protein to the extent shown for total protein.

In practice, however, diets are mixtures of foods and complementation occurs. Recommendations will thus be made in a later section for the

appropriate mixing of some of the foods so that the proteins complement each other. For the initial consideration of least expensive mixtures, total protein and total calorie values are sufficient. Animal protein sources including milk are of high protein quality and the baby cereal products are usually mixed with dried milk, again of high protein value.

Prices will of course vary in different areas and different seasons but the major differentials shown between staple foods and special baby food products stay approximately constant. It is recommended that monitoring of prices be conducted in several centers and in different seasons so that least cost recommendations can be made.

2. Centrally-Processed Baby Foods in Nigeria. Two early high protein baby foods were developed in Nigeria--Amama and Arlac. Both were only in production for a year or two in the late 1950's and early 1960's and are no longer available. They both contained more than 40% protein and were designed as diet supplements. Since both were based on groundnuts, the discovery of "Turkey X" disease and subsequent identification of aflotoxin caused severe technical problems for manufacturing the products from which they never recovered. The manufacturing companies--Unigate and Glaxo--are both currently involved in marketing baby foods in Nigeria, but it is unclear whether the products are fully imported, or are manufactured and/or packaged in Nigeria. In a sense this is immaterial since the products are all expensive and are based on European tastes and technology.

Soy-Ogi, developed by the Federal Institute of Industrial Research, Oshodi (FIIRO) was a brave attempt to produce a product which was cheap, of high protein and calorie value yet was based on maize ogi with its traditional acceptable acid fermented taste.

Soy-Ogi production was based on the traditional procedure for corn but involved fortification of the milled corn with cooked soybean followed by a short fermentation stage until acid production was sufficient. The product was then dried using a spray dryer and was then packaged in polyethylene. Two forms of Soy-Ogi were produced--one at 20% protein for child feeding and an adult version with only 12% protein.

Development and testing of Soy-Ogi was completed by the early 1970's and in a Technical Information Bulletin for Industry of FIIRO dated July 1973, it was claimed that the product was ready for commercial exploitation. In 1982 only pilot scale production is still being undertaken and no commercial enterprise appears to be ready to produce Soy-Ogi for the market.

There are some problems with the product which include:

- Rancidity: With 9.5 percent fat and being packaged in polyethylene, rancidity can develop in storage and thus reduce acceptability.
- Protein Level: Current views are that a 12% protein level is adequate as a supplementary food for a young child. Less soy could be used which should reduce the cost.
- Separation: At 20% protein the product after cooking can sometimes separate into layers, which differs from simple ogi and can lower acceptability.
- Soy Availability: Adequate supplies of soybeans may not be available for large scale production. Nevertheless the product is of good nutritional value, low cost, is generally acceptable, and a wide range of developmental work has already been completed. Commercial exploitation of this product should be encouraged preferably at a lower protein level and with improved packaging.

3. Rationale for a Weaning Mix Based on Maize and Cowpeas. Normal recommendations for infant feeding are that supplementary foods should be introduced by the sixth month at latest but breast-feeding should continue for as long as possible. The calorie level of the supplement is most important but high quality protein is also necessary, especially when the volume of breast milk is low. Supplements should also include foods rich in iron to prevent anemia and also in vitamin C (see Table 14).

Ogi, as normally fed alone, has such low caloric density that up to 6 litres a day would be needed to meet a child's daily energy needs. This volume is quite impossible to meet in practice. Thus poor growth and malnutrition frequently ensue.

As indicated earlier, the Federal Institute for Industrial Research developed their product, Soy-Ogi, using soybean to supplement the ogi together with some extra mineral and vitamins. Provided that packaging and rancidity problems can be overcome, increased production of Soy-Ogi could fill a need since its nutritional value is high and the price is well below other special baby foods.

Nevertheless, we do not feel that a local West African baby food should be based on soybean. Soybean is generally unfamiliar in the area, production in Nigeria is presently low, and special cooking techniques are needed.

Cowpea (vigna unguiculata and/or vigna sinensis) is widely cultivated in Africa and is the major legume crop produced in Nigeria, so much so that it is commonly known just as "beans". It is familiar and widely consumed and is the basis of several well known dishes such as Akara and Moin-Moin. Although toxic materials are present in raw cowpeas, traditional cooking and processing procedures normally remove these.

TABLE 14 -- Child Protein and Energy Requirements and theoretical deficits at Various Levels of Breast Feeding

	6 mos	12 mos.	18 mos.	2 yrs.
Mean weight (kgs)	7.4	9.9	11.3	12.5
Requirement				
Protein (g/day)	12.6	13.4	14.0	15.0
Kcal (/day)	815	1020	1150	1250
Intake from Milk (protein and Kcal per day)				
200 ml/day	--	2.4g protein and 135 Kcal		--
400 ml/day	--	4.8 protein	270 Kcal	--
600 ml/day	--	7.2 protein	405 Kcal	--
800 ml/day	--	9.6 protein	540 Kcal	--
1000 ml/day	--	12.0 protein	675 Kcal	--

Daily Deficit, Protein and Calories

Milk intake (ml/day)	6 mos.		12 mos.		18 mos.		2 yrs.	
	Protein	Kcal	Protein	Kcal	Protein	Kcal	Protein	Kcal
0	12.6	815	13.4	1020	14.0	1150	15.0	1250
200	10.2	680	11.0	885	11.6	1015	12.6	1115
400	7.8	545	8.6	750	9.2	880	10.2	980
600	5.4	410	6.2	615	6.8	745	7.8	845
800	3.0	275	3.8	480	4.4	610	5.4	710
1000	0.6	140	1.4	345	2.0	475	3.0	575

Requirement values: FAO/WHO 1973, Protein and Energy Requirements

For all these reasons, cowpea associated with a cereal is recommended as the basis of both home and centrally processed weaning foods for Nigeria.

4. New Weaning Foods Prepared by Consulting Team. Three new approaches to the blending of maize and cowpeas were developed by the consulting group in Lagos, and some nine mixtures were produced and given preliminary inspection during our mission in Nigeria.

The first two approaches were developed by Dr. Oyefeso of the Department of Medicine and the third by Dr. Makinde of the Department of Biochemistry, both members of the Lagos Consulting Team.

The "groundrules" established by the Lagos Consulting Team were as follows:

(A) All ingredients and food preparation and serving utensils would be purchased by team members in local markets;

(B) Preparation and serving techniques would resemble as closely as possible traditional methods;

(C) An approximate 3-to-1 mix of maize and cowpeas would be used;

(D) After initial processing of ingredients (for example, partial fermentation of the ingredients or pre-cooking of the ingredients), the final preparation stage, still using locally-purchased traditional untensils, and initial tasting of the new foods would take place at a demonstration session in the office of the Provost (administrative head of the College of Medicine).

As it happened, a member of the U.S. Embassy staff was present at the demonstration in the Provost's office, and a second demonstration was held the following day at the U.S. Embassy.

All of the rules were followed with one exception, --an electric kettle was used in the two demonstrations in lieu of wood fires, on the conference tables of the Provost and the Embassy.

5. Description of the Three Food Preparation Techniques.

Drs. Oyefeso and Makinde have a strong interest in weaning foods. The former completed an extensive study of cowpeas in West Africa and their processing and digestibility for infants.[1/] The latter has done similar research on fortified Ogi and worked with FIIRO in the development of Soy-Ogi. The three preparation methods which they developed (the first two by Dr. Oyefeso and the third by Dr. Makinde) are as follows:

(1) Addition of cooked and seived cowpea into the Ogi by direct mixing by the mother before feeding. This may not be widely applicable because of the time involved in preparation of the cowpea and some prejudice which may exist on the use of beans in children's diets.

Demonstration and education may overcome some of the prejudice but availability of a precooked bean flour, from which the testa has been removed, at a competitive price, would be helpful especially for the working mother who can no longer afford the time for preparation.

At present a bean flour, which still contains much of the testa and is not cooked, is available but the price of this product is 3-4 times that of the original beans. A price differential such as this is too large but local production of a precooked bean product at a more reasonable price may be possible.

(2) Preparation at village level of precooked cereal and legume flours which can be mixed in appropriate proportions either by the mother or by the vendor.

The procedure involves soaking (some fermentation) and cooking of the cereal grain (millet, rice or maize) and the legume (cowpea), and removal of the testa from the cowpea (a toasting and winnowing followed by boiling may also be used) and some of the hull fiber from the cereal. This is followed by drying and grinding. The drying stage may be the most

1/ Jacob Adetola Oyefeso, Studies on the Effect of Traditional Culinary Methods on the Digestibility of Local Cowpea (Vigna unguiculata) Protein, PH.D. Thesis, University of Lagos College of Medicine, 1980. A copy of this Thesis is

difficult at the village level but open pan heating can be used and sun drying may also be suitable in some circumstances.

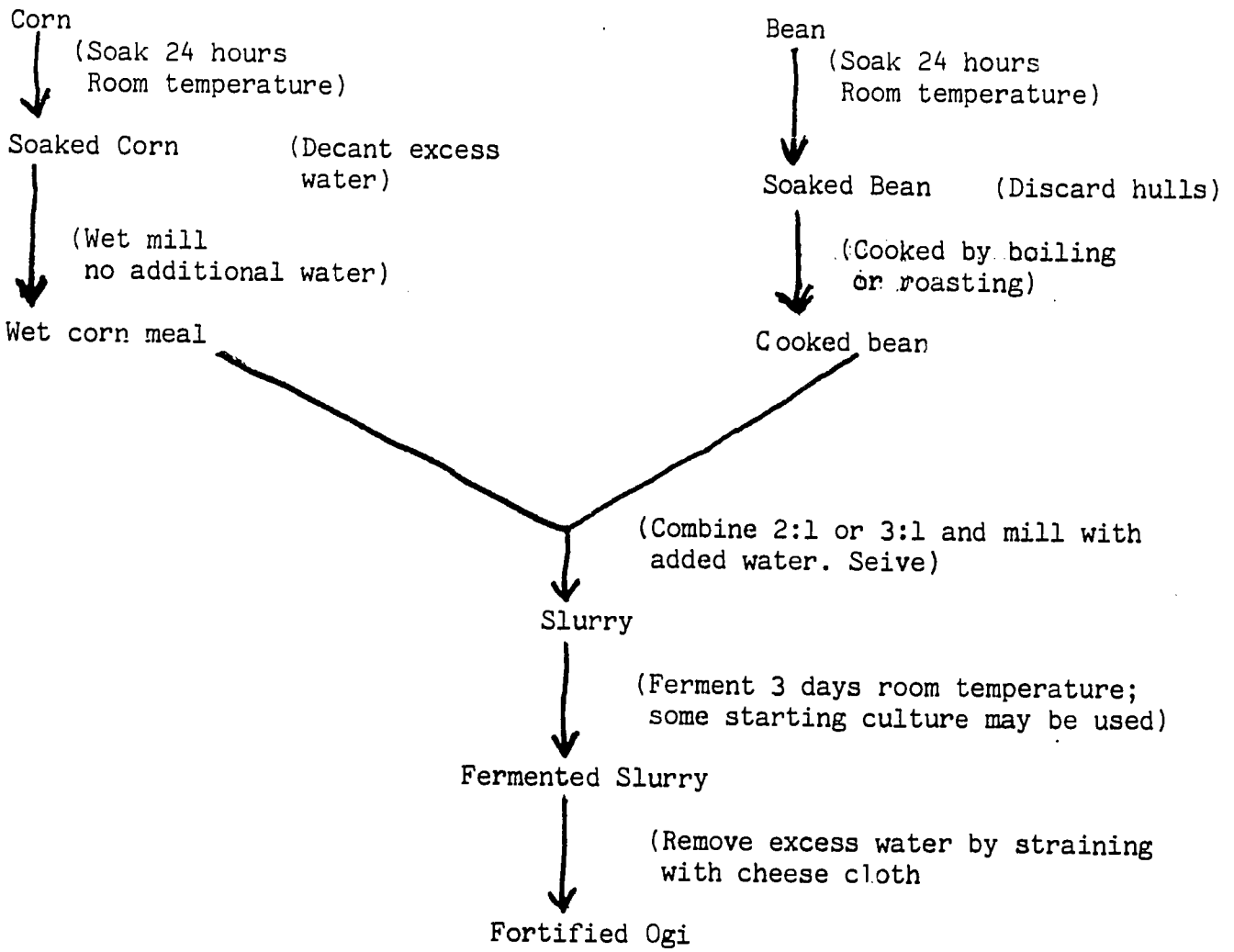
Mixtures of cereal and legume (3 to 4:1) do not need further cooking and gel readily with hot water to form a mixture suitable for baby feeding. Individual cereals can be used in any combination provided that the ratio of cereals to legume approximates 3 to 1, but some incorporation of millet is recommended because of its better protein value and higher iron content. A further advantage of millet may be the partial malting which can occur in the soaking--fermentation stage which can reduce the hot paste viscosity and improve caloric density (Desikachar 1980).

A procedure such as that described may also be suitable for central-processing and if fortified with minerals and vitamins and with perhaps a small amount of dried milk, could seriously challenge the Cerelac and Farlene market with the great advantage that it would be based upon locally available foods and should readily adapt to local tastes. The cost of production and packaging must however be kept low.

(3) Preparation at the village level of Ogi fortified with cowpea. This approach should interfere least with tradition since the product, although fortified, differs very little in appearance and in preparation by the mother from traditional Ogi.

The procedure is outlined in Figure 1. It will be seen that the main fermentation takes place after the combination of the corn meal with the cooked bean and that the product is a wet cake similar to Ogi. Two procedures are possible for the cooking of the dehulled beans--boiling or roasting. Which is the more suitable has yet to be ascertained. It was recognized however that the roasting procedure produces a desirable flavor. The wet-cake bean Ogi would be prepared by the mother in a similar manner to Ogi in that it would be either gelled by boiling water or mixed with cold water and cooked.

Figure 1. Outline of Procedure for Making Fortified Ogi



Procedure devised by M. Makinde, Department of Biochemistry, University of Lagos.

6. First Demonstrations of the New Weaning Foods. In the two demonstration sessions at the College of Medicine and U.S. Embassy, Dr. Oyefeso first prepared several mixtures using pre-cooked and partially fermented maize, millet, rice, and cowpea flours. Each was stored in large air-tight bottle containers bought inexpensively in the local market. The legume flour was mixed with each of the cereal flours separately and with the three cereal flours combined, in boiling water.

No bean taste was detected in mixtures approximating three parts cereal to one part legume. The appearance of the mixtures was like that of white flour, which is culturally a positive feature in this society. The taste of all mixtures was pronounced as very good by the dozen persons present (all of whom were parents or had been parents of small children) without the addition of sugar. The taste was improved by the addition of a small amount of sugar, but sugar was not essential.

Dr. Makinde then heated and served several fermented maize-cowpea mixtures. These were wrapped in banana leaves as is traditional Ogi. Foreigners often find the heavily-fermented taste of Ogi to be too strong; this affect was softened and (to a foreigner, at least) the flavor seemed to be improved in the maize-cowpea mixture. One of the mixtures had no detectable bean taste, and this was pronouced by all present to be the best-tasting of all the flour and fermentation mixtures. The same enthusiastic reception was accorded several of the flour mixtures, and the latter fermented maize-cowpea mixture, by the group at the U.S. Embassy the following afternoon.

Following the demonstration, the Provost made the following administrative decisions:

(A) Several of the mixtures would be field and laboratory tested (via methods described below) and as soon as practicable would be prepared in the hospital kitchen and introduced on pediatric wards;

(B) A project involving medical sociologists and extension workers in the Institute of Child Health and Family Care would be set up to further test and promote the new diets on a pilot basis;

(C) A room would be set up on the hospital compound as a nutritional rehabilitation center for children discharged from pediatric wards, at which mothers would be instructed in the use of the new foods (following appropriate field and laboratory testing).

(D) He would explore the possibility of commercial preparation of one of the cereal-cowpea flour mixtures for sale as a weaning food, with a part of the proceeds going to further research and development of weaning foods.

The Lagos Consulting Team agreed that appropriate field and laboratory testing should precede large-scale introduction of any of the new weaning mixtures.

7. Approximate Nutrient Content of the Demonstrated Foods. One can predict with relative confidence that nutritent content of foods prepared by the first method (combination of dry cereal and legume flours). It is more difficult to estimate the nutrient content of the other two types of mixtures (partial fermentation and fuller fermentation of the ingredients) without laboratory testing because of the variable water content of the final products.

Approximate protein and calorie values per 100 g. of different dry flour mixtures are given in Tables 15 and 16, together with amino acid scores. For mixtures 3-9 these protein values are very satisfactory because of high limiting amino acid scores, comparing favorably with the nutrient levels of commercial baby foods (mixtures 7-9 probably have too much bean to be acceptable).

Regarding the addition of bean to Ogi, it must be recognized that in order to increase the protein content to acceptable levels the proportion of bean to maize will be greater than the usually acceptable proportions of 1:3 for maximum protein quality. This is inevitable because of the extremely low level of protein in Ogi. It also must be recognized that the calorie level can never be increased to acceptable levels by bean alone without bean quantities being far too high. Thus sugar or oil (preferably red palm oil to increase Beta-carotene levels, but groundnut oil could also be used) must be added to bring calorie levels to those needed.

Nutrient values for 20 g. of the dry flour combinations mixed in different quantities of water are estimated in Table 17, and compare well with human milk over most of this range. Calorie values of the mixtures except at highest dilution exceed cow's milk if a spoon of ordinary sugar is added to each serving.

Unfortunately the mixes made according to method three (fermentation of the maize cowpea mixture together for three days, see Figure 1) which most closely resembles the preparing of traditional Ogi, are the most difficult

TABLE 15 -- Estimated Protein Values of Maize-Cowpea Mixtures

Number of Mixture	Proportions		Per 100 g.		Amino Acid Score[1]			
	Maize	Cowpea	Protein(g)	Kcal	SAA	Lysine	Threonine	Tryptophan
1	100	0	9.5	350	136	(49)	90	73
2	90	10	11.0	349	137	(65)	89	79
3	80	20	12.5	349	138	(77)	89	84
4	75	25	13.3	348	139	(82)	89	86
5	70	30	14.0	346	140	(87)	(89)	(87)
6	60	40	15.5	346	141	94	(89)	(90)
7	50	50	17.0	345	141	101	(89)	92
8	33	66	19.4	343	142	109	(88)	96
9	0	100	24.5	340	199	120	(88)	100

1. Score for the limiting amino acid bracketed. Comparison is made with the new FAO/WHO 1983 provisional pattern.

NOTE: Mixtures 3-9 have both adequate protein quantity and quality. Mixtures 7-9 probably have too much bean to be acceptable.

TABLE 16 -- Estimated Protein Values of Some Mixtures of Maize, Millet, Rice, and Cowpea (Dry Flours)

Number of Mixture	Proportions				Per 100 g.		LAA
	Maize	Millet	Rice	Cowpea	Protein[1]	Kcal	Value[2]
1	33	33	-	33	14.4	343	90
2	33	-	33	33	13.8	350	87
3	--	33	33	33	13.8	347	89
4	22	22	22	33	13.8	347	89

1. All mixtures are of adequate protein value.

2. Limiting Amino Acid (LAA) in each case is Threonine. LAA determined using FAO/WHO 1983 pattern.

TABLE 17 -- Protein and Calorie Density of Maize-Cowpea Mixtures in Water, With and Without Sugar Added (Estimated Values)

Water Added to 20g. Maize-Cowpea Mixture[1]	Per 100 mls. Mixture		
	Protein (g.)	Kcal	Kcal[2]
50 mls.	3.8	100	157
75 mls.	2.8	74	116
100 mls.	2.3	58	92
150 mls.	1.6	47	65
Cow's Milk	3.8	80	-
Human Milk	1.1	70	-

1. 75:25 mixture taken. This is of adequate protein quality. Similar values would occur for mixtures numbered 3-6 in Table 15 and for all four in Table 16, with those in Table 16 being slightly superior.

2. With 10 g. sugar added.

Table 18 -- Protein and Calorie Density of Ogi (Fermented Maize Pap) With Four Levels of Cowpea (Estimated Values)

FOOD	Per 100 mls. Mixture		
	Protein (g.)	Kcal	Kcal[1]
Ogi (10 g. Paste/100 Mls. Water)[2]	0.4	14	54
Ogi + 5 g. Cooked Cowpea (75:25 ratio)	0.7	19	59
Ogi + 10 g. Cooked Cowpea (60:40)	1.0	23	63
Ogi + 15 g. Cooked Cowpea (50:50)	1.3	27	67
Ogi + 20 g. Cooked Cowpea (45:55)	1.6	31	71

1. With 10 g. sugar added (5 g. oil would have approximately the same effect).

2. Moisture content of Ogi paste probably varies between 50-70 percent (60 percent assumed in table). Moisture content of cooked cowpea probably 70-80 percent (75 percent assumed). Cooked cowpea with testa removed in paste form.

to evaluate in advance of actual laboratory testing, because of the high water content of the final product. An attempt is made in Table 18 based on different cereal-legume ratios, estimates being given of the protein-calorie content of 10 g. of fermented maize paste in 100 mls. water supplemented with various levels of cooked beans. The ratio used in the two demonstration sessions in Lagos was 50:50 on a dry basis and the taste was pronounced by all participants as very agreeable, with no unpleasant bean flavor. Therefore, any lower level of bean would be acceptable in terms of taste.

A 3:2 mixture deriving from 10 g. Ogi and 10 g. cooked legume would yield an estimated 1.0 g. protein and 23 Kcal. per 100 ml. If a child receives about 1,000 mls. per day (about five feedings) this would provide about 10 g. protein and about 230 Kcal. The addition of one spoon (10 g.) of sugar per 100 mls. (i.e. about 2 spoons per serving) would increase the latter value to about 630 Kcal. In combination with mother's milk, this should produce a weaning diet of satisfactory nutrient value.

The example for a child aged 12 months and weighing 10 kg. is given in Table 19. According to FAO/WHO standards, the daily nutrient requirements for this child are 13.4 g. protein and 1,020 Kcal. Assuming the mother is able to produce 600 mls. of breast milk per day, then the nutrient value for the child is 7.2 g. protein and 405 Kcal (see Table 19). Total intake for the child from the two sources becomes 17.2 g. protein and 1,035 Kcal, which now exceeds daily requirement.

It should be emphasized that several further steps are needed in Nigeria before specific weaning recipes with specific nutritient content can be identified:

(A) Selected mixtures based on ingredients used in the two demonstration sessions must be given preliminary field testing for acceptability to mothers and children with respect to taste, ease of preparation, shelf

TABLE 19 -- Diet of Fermented Maize-Cowpea Mix Plus Mother's Milk: Estimated Nutrient Values Compared with Daily Requirements, for Child Weighing 10 kg. (Aged About 12 Months)

FOOD	QUANTITY	PROTEIN	KCAL	KCAL[1]
Maize-Cowpea Paste Mixed at 3:2 Ratio (DWB)[2]	10g. Ogi + 10g. Cooked Bean Mixed in 100 Mls. Water	1.0 g.	23	63
Maize-Cowpea Paste Mixed at 3:2 Ratio (DWB)[2]	Mixture Per 1,000 Mls. (5 Feedings/Day)	10.0 g.	230	630
Mother's Milk	600 Mls./Day[3]	7.2 g.	405	---
Total, Two Food Sources Combined	1,600 Mls./Day	17.2 g.	635	1,035
Daily Requirement, Child Weighing 10 Kg.[4]	----------	13.4 g.	1,020	-------

1. One spoonful (10g.) sugar added per 100 mls. water.

2. DWB = Dry Weight Basis

3. See Table 14. Cameron and Hofvander state that a fully lactating woman can be expected to produce about 850 mls./day, so that this estimate is conservative.

4. Requirement values from FAO/WHO, see Table 14.

life in typical homes, and general satisfaction to the family;

(B) Mixtures found acceptable in preliminary field tests must then be tested in the laboratory for nutrient content and demonstrated weight gain in animals;

(C) Accepted mixtures must then be given wider definitive testing in the field, in larger samples. A methodology proposed by the University of Ife Faculty of Health Sciences is described in Section IV below.

8. Weaning Foods Based on Other Combinations. Approaches other than maize-cowpea mixes are possible and some of these were examined during the consulting trip. The majority of these involve the fortification of a cereal product with another protein high in lysine. As is the case throughout most of the Third World, animal protein sources (meat, eggs, chicken) are expensive but are sometimes available. Dried or frozen fish is less expensive and can sometimes supplement cereals economically.

An important factor that should be recognized is the increase in bread consumption in Nigeria during the past two decades, in both towns and villages. Bread, being one of the first convenience foods, is well suited for infant feeding particularly when given in combination with milk, and also where possible with sugar. Since it is pre-cooked, bread softened with hot water to which dried whole milk and some sugar are added can be of high nutritional value and low volume, and probably would be well accepted by most small children.

As is shown in Table 20, bread can also be cheap. This table gives the comparative costs of obtaining 200 Kcal or 10 g. protein from mixtures of corn and beans, semovita and milk as well as for special baby foods. The relatively inexpensive nature of dried whole milk should be noted and although this product is imported, it should not be precluded from use as a protein supplement.

TABLE 20 -- Comparative Costs for Obtaining Equivalent Units of Protein and Calories from Various Foods and Baby Food Mixtures

FOOD	Cost in Nigerian Naira (₦1 =U.S. $1.50)[1] Per 200 Kcal	Per 10 g. Protein
Rice : Beans (3:1)	0.08	0.10
Maize : Beans (4:1)	0.05	0.07
(3:1)	0.06	0.08
Bread : DWM[2] (4:1)	0.07	0.09
Semovita : DWM[2]	0.05	0.06
Cerelac	0.16	0.32
Farlene	0.73	0.75
S.M.A.	0.40	0.75
Nido (DWM)	0.12	0.12
Soy-Ogi	0.08	0.08
Sugar	0.05	----

1. Ingredient costs only are calculated.

2. DWM = Dried Whole Milk

In Table 21 the protein values of some mixtures are shown. Many are at the low end of the generally recommended levels for protein in weaning foods but all are far superior in protein value to plain Ogi and all would provide adequate growth when used to supplement breast feeding.

While the mixtures can improve protein and calorie value, the child also has need for minerals and vitamins. Additional supplementation with dark green leafy vegetables and other sources of iron and vitamin C must be recommended.

IV. PROPOSALS FOR FIELD TESTING THE NEW WEANING DIETS

Whereas the University of Lagos College of Medicine staff developed the new weaning mixes which were tested during this consulting mission, the University of Ife staff worked out a procedure for field testing and promoting the new mixtures.

The former government general hospital outside of Ife Town is now used by the university as a teaching hospital. Here, children with severe malnutrition are kept on the pediatric ward for about two weeks, but then must be discharged as a matter of policy, to make way for other serious cases. The only organized nutritional rehabilitation service in the area is a once-weekly session at an MCH outpatient clinic in the town, conducted by an epidemiologist on the Faculty of Health Sciences staff who examines children and counsels mothers. The university staff recognized that severely malnourished children discharged after only two weeks are at very great risk and that a once-weekly nutritional rehabilitation service is entirely inadequate.

During the consulting mission, we discussed several alternatives to address this problem, including an in-patient service where mothers and children would reside for a time after the child is discharged from the hospital, and a day-care center somewhere in the town to which children would be brought daily. The latter seemed more practicable from the point of view of staffing

TABLE 21 -- Protein Value of Selected Mixtures

Food	Weight(g.)	Sugar(g.)	Protein(g.)	Kcal	LAA	PCal%[2]	U.P.(g.)
Maize : Cowpea (3:1)	60/20	20	10.3	370	0.81	11.1	8.3
Maize : Cowpea (4:1)	65/15	20	9.7	370	0.75	10.5	7.3
Semovita : DWM (4:1)	65/15	20	10.5	380	0.70	11.0	7.4
Bread : DWM (4:1)	75/15	20	9.8	340	0.72	11.5	7.1
Rice : Cowpea (3:1)	60/20	20	9.1	360	0.94	10.1	8.6
Millet : Cowpea (4:1)	65/15	20	9.7	370	0.83	10.5	8.0

1. LAA = Limiting Amino Acid Score

2. PCal % = Protein Calories as Percent of Total Calories

3. U.P. = Ulitizable protein = Protein(g.) times LAA Score

costs and also because mothers would be unwilling to live away from home for the weeks or months required to rehabilitate the child. Presumably mothers would be better able to attend a day-care center on a regular basis with the option of sometimes sending the child in the company of another family member or friend.

1. Objectives of the Day-Care Center. Professor Bankole, who would be project director of the Ife component, outlined the objectives of such a day-care center as follows:

(1) To provide a place where severely malnourished children can be monitored daily over a long time period, by a trained nutritional rehabilitation worker, and the child's diet also monitored at least for daytime feedings;

(2) To provide a place where the mothers of these children can interact with the rehabilitation worker over a long time period. Mothers would be instructed in the following:

(a) Identification of the problem (i.e. the child's diet is inadequate and has produced the illness; proper diet over an extended time period is the correct treatment);

(b) Identification of proper foods and recipes to correct the problem;

(c) Instruction in preparation and feeding of the new diets, including buying or securing of the foods locally by the mother;

(d) Monitoring of the child's progress over several months, via scales or armbands, which show the child's growth to be adequate or not adequate;

(e) Instruction in diagnosing malnutrition in other children in her household and community, via scales or armbands (it would be feasible

to issue sufficient armbands to every mother coming into the center, for her to give out to other mothers in her community);

(f) Instruction in referring cases believed to be at risk from her community to the center.

(g) Instruction in how to teach other mothers to monitor for malnutrition and to prepare and use proper weaning diets.

Mothers thus become extension workers for the center, and the influence of the center as a preventive as well as curative service has the potential for extending broadly in the area being served.

2. Staffing of the Center. Professor Bankole proposed that a full-time person with the title "Center Manager" be employed and that this person might be a retired nurse or midwife on pension, who might be interested in serving in this job at a modest salary. Such a person would be adequate for this job, the most important qualifications being an interest in mothers and children and a responsible professional attitude.

The Consulting Team then considered additional staffing, and it was decided that several mothers, -- possibly three mothers, -- whose children were rehabilitated at the Center, might be employed on salary to assist the Center Manager and to monitor the outreach program by the other mothers.

Professor Bankole would serve without salary as Project Director, and Sister Agboh would serve without salary as Assistant Director.

3. Other Recurrent Costs. For several reasons, the team felt that it was imperative that for a period of up to three months for any specific child, the mother receive a small cash allowance to assist in the purchase of foods for the daytime feedings at the Center. Reasons for this are as follows:

(1) Medical care is given free of charge in Oyo State, and food given in the Center would be considered as part of the treatment;

(2) Until the malnourished child had been at the Center long enough for the mother to see improvement and to be convinced that the new diets were helping (perhaps as long as three months), mothers might be reluctant to spend their own money on these new foods. A small cash allowance would solve this problem, at least for the daytime feedings (probably three feedings per day). It would be up to the Center Manager to see that appropriate foods were brought with the money.

4. Fixed Costs Required to Set Up the Center. Space for a day-care center is available at the larger MCH clinic in Ife Town. Equipment required would include:

(a) Cooking and food serving utensils and food storage facilities;

(b) Scales and armbands;

(c) Toys for the children;

(d) Tables, chairs, benches, etc.

If the project develops well in Ife Town, a second rural site was proposed for an extension of the project, at a dispensary some 15 miles outside of the town which serves the village of Alapata and about 20 satellite villages, the total population served being about 20,000. Sister Agboh would act as liaison between the two project centers and would require a travel allowance.

5. Proposed Budget for One Year. Professor Bankole drew up a proposed budget for one year to establish the center in Ife Town, of Naira 16,820 (U.S. $25,230) as follows. A similar budget was adopted by the University of Lagos consulting group.

Recurrent Costs

	Salaries:	
1.	Project Director	0
2.	Principal Investigator	0
3.	Center Manager (175 x 12)	₦ 2,100
4.	Three Mothers (120 x 12 x 3)	4,320
	S/T	6,420
	Travel Allowance:	
5.	(Principal Investigator) (50 x 12)	600
	Food Allowances:	
6.	3 meals/day for 20 children (1x20 x 365)	7,300
	Total Recurrent Costs/Annum	₦14,320

Initial Fixed Costs

1.	Cooking, Feeding, Storage, etc. (purchase of equipment)	1,000
2.	Scales and Armbands	1,500
	Total Initial Fixed Costs	₦ 2,500
	Total Budget	₦16,820

6. Potential Funding Sources Explored. Both university teams are aware that assistance under the HOVIPREP Project is limited to short-term technical assistance of the type provided during this consulting visit. The teams have explored sources of funding, including sources within Nigeria, and it should be noted that the largest part of the costs of the proposed weaning foods project activities can be borne by existing resources at the two universities, on a long-term basis.

It seems likely that the nutritional rehabilitation activity proposed will provide an excellent base for testing the new weaning diets. The University of Lagos also adopted this approach and the Provost agreed to explore the possibility of setting up a similar center on the grounds of Lagos University Teaching Hospital.

The Institute of Child Health and Family Care, a part of the University of Lagos College of Medicine, also provides a base for broader testing of the new diets via an urban MCH clinic and extension staff, and a proposed rural clinic outside Lagos.

V. LONG-RANGE PROMOTION OF NEW WEANING DIETS, IN NIGERIA AND INTERNATIONALLY

The following long-range project goals were identified during the consulting visit:

(A) Establishment of several nutritional rehabilitation centers in Lagos and Ife, which in addition to serving as referral centers for children at risk from health facilities and the community at large, would also serve as training centers for mothers as outreach workers in the community;

(B) Definitive testing of one or more weaning diets, including mixtures of maize and cowpeas prepared in the manner of traditional Ogi, mixtures of dry flours prepared from cereals plus cowpea, and possibly also the use of bread

mixed with whole dry milk and sugar as a weaning food;

(C) Promotion of these diets in homes via mothers trained as community extension workers;

(D) Introduction of new weaning diets on hospital pediatric wards;

(E) Development of the rehabilitation centers as training centers for nutrition workers from other sections of Nigeria, to promote new diets and better weaning practices;

(F) Assessment of the potential for offering training programs on an international basis, for nutrition workers from other countries in West Africa using similar traditional weaning foods and having similar weaning practices.

It was agreed in principle that the university teams in Lagos and Ife would request further technical assistance at an appropriate later date for the further development of these project activities, including appropriate methods for project evaluation and the development of larger national and international training components.

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