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DEVELOPMENT OF A VITAMIN A-RICH WEANING FOOD AND CHILD CEREAL FROM DRIED AND "INSTANTIZED" SWEET POTATO BUDS

FINAL REPORT

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Vitamin A Field Support Project (VITAL)
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o ACRONYMS AND ABBREVIATIONS o

APHIS	Animal Plant Health Inspection Service
CeSSIAM	Center for Studies of Sensory Impairment, Aging and Metabolism
HPLC	High Precision Liquid Chromatography
ICAIT	Central American Research Institute for Industry
ICTA	Institute of Agriculture Science and Technology
IEF	International Eye Foundation
INCOSA	Industrial Food Processing Factory
ISTI	International Science and Technology Institute, inc.
NCBD	National Committee for the Blind and Deaf
NCSU	North Carolina State University
PVO	Private Voluntary Organization
PSI	Pounds per square inch
RE	Retinol equivalent
SPB	Sweet potato buds
USAID	United States Agency for International Development
VITAL	Vitamin A Field Support Project

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I. INTRODUCTION

A. Background

Foods of plant origin constitute an important part of the diet in Guatemala. These foods are the principle and almost exclusive source of carotenoids. Carotenoids are natural, lipid-soluble, biodegradable and easily-oxidized pigments that can be destroyed by the enzymatic action of lipoxigenases and other factors such as light, heat, oxygen, acids, alkalis and metal ions. Carotenoids are found in the tissue of dark green, yellow, and orange plants; with respect to provitamin A activity, carotenes are classified as "active" (beta-, alpha-, and gamma-carotenes). Currently, high precision liquid chromatography (HPLC) is the modern, precise and accurate method of choice for separation and quantification of total vitamin A activity in plant foods.

Guatemala is a poor nation, and one classified by the WHO as having a high probability of manifesting a hypovitaminosis A problem at the public health level. The Center for Studies of Sensory Impairment, Aging and Metabolism (CeSSIAM), and the National Committee for the Blind and Deaf (NCBD) of Guatemala have been involved in issues of basic and applied research and vitamin A interventions in various projects ranging from development and testing of a fortified food (NutriAtol); community level studies of intra-household distribution of foods in rural and urban settings; vitamin A consumption and nutritional status studies in urban and rural poor populations; and a vitamin A strategy for child survival in Alta Verapaz, among other projects. Many of these activities have been undertaken in partnership with the International Eye Foundation of Bethesda, Maryland. Recently, to satisfy some of the objectives of one current project, collaboration with the Department of Food Science of the North Carolina State University (NCSU) was developed.

Throughout this history, the issue of developing strategies for improving vitamin A status through the use of natural or processed foods, and the consumption behavior of populations with access to these foods has dominated. The present work, funded by the Vitamin A Field Support Project (VITAL), a multi-institutional collaboration involving the International Eye Foundation (IEF), the Center for Studies of Sensory Impairment, Aging and Metabolism (CeSSIAM), the Institute of Agricultural Science and Technology (ICTA), a private sector food engineer consultant, and the analytical laboratories of the North Carolina State University, is looking at the preliminary development of a product of dried and "instantized" sweet potato buds as a food-based strategy for vitamin A promotion, especially among young children of poor families.

B. Significance

The significance of the current pilot project (Phase I) and the future of any project of a similar nature are included in the following considerations.

Institutional Interactions:

The project relied on the collaboration between a North American private voluntary organization (IEF), a semi-autonomous Central American agricultural institute (ICTA), a private biomedical research unit, (CeSSIAM) and a North American University (NCSU). The possibilities for further creative ideas from this convergence of professionals are excellent.

Relevance to Health:

Guatemala has yet to resolve its strategy for overcoming the prevalence of inadequate dietary consumption and reduced vitamin A status, especially with measures that will be sustainable and reach the most vulnerable populations. The nutritional eye damage (xerophthalmia) and impaired health (morbidity and mortality) that is currently attributable to hypovitaminosis A in Guatemala, would be expected to be reduced by any effective and widely-accepted intervention.

Relevance to Agriculture:

Sweet potato can be cultivated in a variety of terrains, including those with less than prime soil. Increased demand for sweet potato for production of sweet potato buds may potentially stimulate agricultural production, and contribute to crop diversification.

Relevance to Income Generation:

The industrial production of sweet potato buds, either in small scale cooperatives or larger industrial firms, can potentially generate employment and added value to the commodity of sweet potato.

C. The Participants

The International Eye Foundation (IEF), is a private voluntary organization dedicated to the prevention of blindness in developing countries. In Guatemala, IEF is in partnership with the National Committee for the Blind and Deaf (NCBD) in the implementation of a series of community level interventions. The IEF has developed a capacity to manage its field projects in vitamin A (Guatemala, Honduras, and Malawi) and has established a working partnership with academic and private voluntary institutions in the area of vitamin A.

The Center for Studies of Sensory Impairment, Aging and Metabolism (CeSSIAM) is the research branch for the NCBD, located in the "Dr. Rodolfo Robles V" Eye and Ear Hospital. It has a Task-Force, under the direction of Dr. Jesus Bulux, dedicated to the study of vitamin A biology and its public health consequences for child health and nutritional blindness.

The Institute of Agricultural Science and Technology (ICTA) is a semi-autonomous institution dedicated to improvement of agricultural practices for a variety of crops. The ICTA horticulture division is producing sweet potato and carrot, at cost, for distribution in the IEF's experimental project in Santa Rosa. The sweet potato material used for the dried product in Phase I was the same that is being distributed in a fresh form in Santa Rosa.

Food Chemistry Laboratory of the Department of Food Science of the North Carolina State University, under the direction of Professor Steven Schwartz, has experience in the technology for assaying provitamin A-active carotenoid pigments in plant tissue. It has collaborated with CeSSIAM and the IEF-NCBD in an ongoing study of plants as vitamin A sources.

II. OBJECTIVES [1]

The objectives of the pilot project:

1. To repeat and document the batch-scale preparation of dried sweet potato buds in industrial processing;

2. To test a variety of packaging option with variables in terms of cost of materials, protection from light, protection from humidity, protection from microbial contamination;

3. To analyze the provitamin A carotenoids (alpha-carotene; beta-carotene) and vitamin A content of:

   a) the fresh starting material;
   b) the freshly prepared dried sweet potato buds, and;
   c) the sweet potato buds stored in different packing materials for four months;

4. To determine the acceptability and organoleptic characteristics of gruels and purees based on reconstituted sweet potato buds among:

   a) young children, and,
   b) mothers of young children, and;

5. To determine the variety of culinary possibilities for low income homes that produce acceptable consumption forms.

A flow chart of the activities is found on the next page and results of each component of the project follow thereafter.

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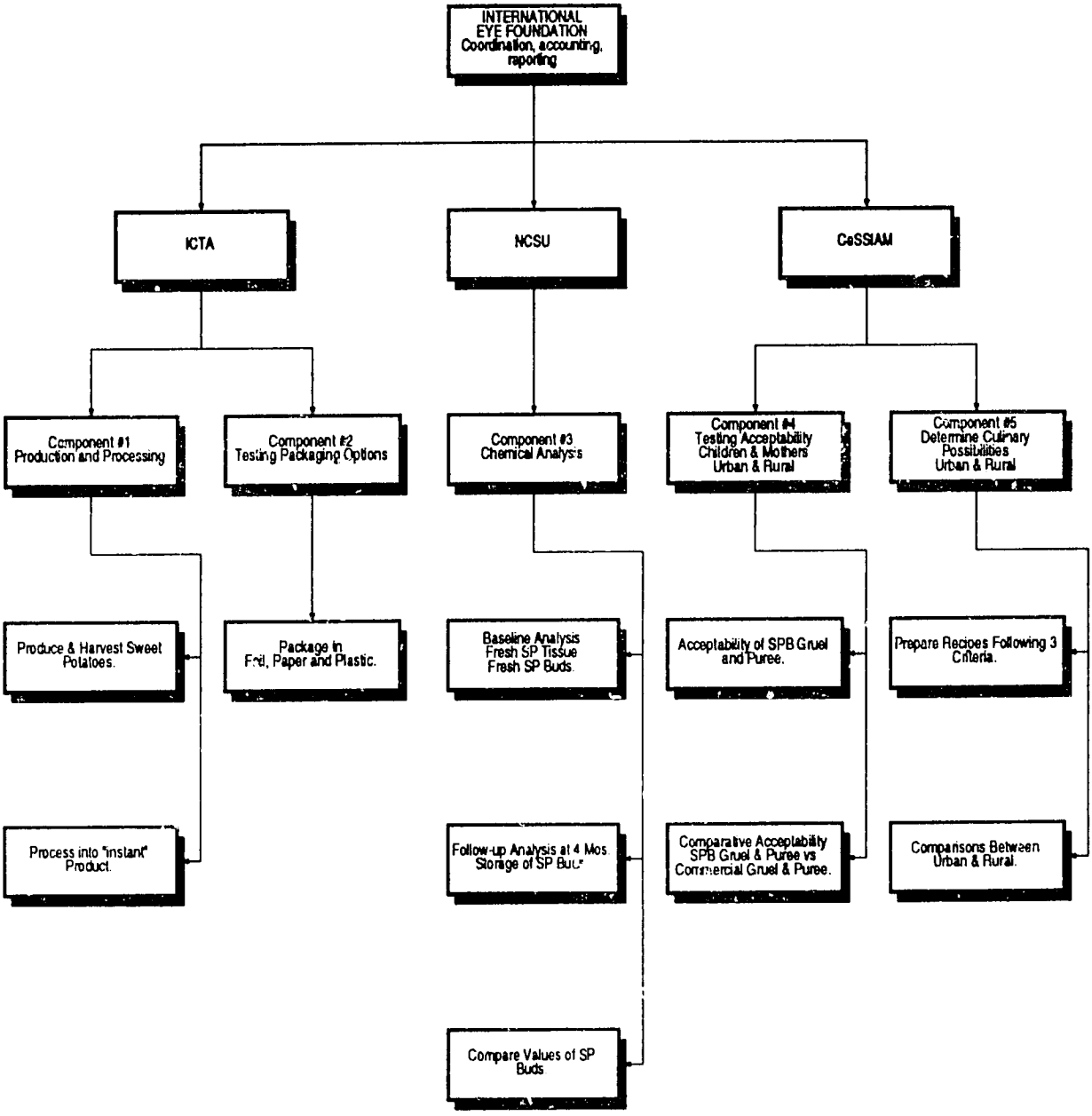
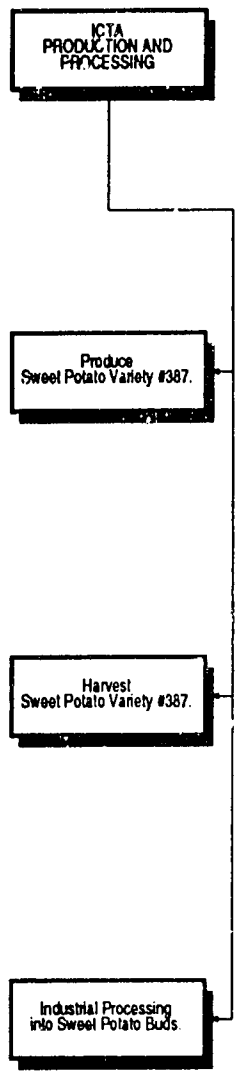
[1] This project has been conceived in two phases. The current pilot project (Phase I) is based on one variety of sweet potato. A second project, (Phase II) recently proposed, would continue the investigation of improved storage studies, sub-studies with micronutrients, and investigation into community distribution strategies.

SWEET POTATO BUDS PROJECT: PHASE I



OBJECTIVE #1


ICTA
PRODUCTION AND
PROCESSING
Produce
Sweet Potato Variety #387.
Harvest
Sweet Potato Variety #387.
Industrial Processing
into Sweet Potato Buds.

III. PROCEDURES

A. Objective #1: Document Industrial Processing

1. Introduction

The first objective was to document the industrial processing of dried sweet potato buds. This involved the production, harvesting, and transport of a sweet potato crop to a factory where the raw sweet potato is processed into the sweet potato buds product.

2. Production

On Friday, February 7, 1992, under the supervision of Ing. Soto and Ing. Esquite, technical staff from the Institute of Agricultural Science and Technology (ICTA), 60 quintales (approximately 6,000 lbs) of sweet potatoes of variety #387 "purple husk and yellow pulp" was harvested. **(See photographs 1 to 3)** These fields are located in San Miguel Duenas, near Antigua Guatemala in the Department of Sacatepequez, on the property of Mr. Nestor Barrientos. Because of their highland location and slower growing, these sweet potato were chosen for definitive processing.

Also, on January 30, 1992, 180 quintales (18,000 lbs) of sweet potatoes of a variety with "purple husk and pale yellow pulp" (variety #387) were harvested on the ICTA lands in La Fragua, Department of Zacapa. **(Photographs 1 to 3)** Since these were harvested a week before they could be processed, they were not considered for definitive use. However, since the bulk processing of raw potatoes to the form of buds requires a minimum of 200 quintales of sweet potato per run, the combined harvests were needed to proceed with the production.

The raw sweet potato from both harvests was packed in 100-weight bags of polypropylene plastic and transported to the processing factory in the Department of Chimaltenango.

3. Industrial Processing

The industrial food processing factory, (INCOSA) of the Malher Co., is situated in the town of El Tejar, Chimaltenango, and is the property of Mr. Carlos Maldondado. With prior authorization of the Chief of Production, Ing. Garcia, the Director of the factory, Ing. Carlos Barrios, and the production boss, Mr. Victor Hugo Arana, processing took place on Saturday, February 8, 1992. **(Photograph 4)** The steps for batch-scale processing follow.

STEPS FOR BATCH SCALE PROCESSING

- A total of 240 quintales (24,000 lbs) of sweet potatoes - 60 quintales from the previous day's harvest and 180 quintales from the prior week - were shipped to the factory. The machinery operates at a minimum capacity of 200 quintales per run. The two varieties of sweet potato were sequenced for separation into two lots.

- The caldrons were preheated beginning at 6 p.m. on February 7, 1992, 12 hours prior to the actual processing. The process began at 6:00 a.m. on Saturday, February 8. The product enters the production line exactly as it arrives from the field, and undergoes a wash procedure in an agitating cylinder with high pressure set at 20 pounds per square inch (psi). This removes the excess soil from the outer husks.

- The next step was the first cooking-cycle, produced by a blast of steam. This was undertaken in a gyrating cast-iron caldron under 80 psi for 45 seconds. This operates with live steam and the purpose of this step is to soften the husk to allow for more efficient peeling.

- The content of the (marmita) is dumped onto a transport belt that carries the softened sweet potatoes to the peeling chamber, which consists of a cylinder surrounded by cylindrical brushes with plastic bristles which rotate around the cylinders. The tubers are peeled by friction, while a stream of water swept away the peelings.

- The sweet potato then fall onto a selection belt, for it is necessary to finish the peeling by hand, as the irregularities of shape do not allow for the brush-peeling to completely remove the husk. A certain amount of edible pulp is lost in the hand-peeling process.

- Once peeled, the product passes into a holding tank which contains water with antioxidant (BHT at a concentration of 0.06%) to prevent oxidation of vulnerable substances such as carotenes. This BHT treatment preserves both the flavor and the color from oxidative alteration. This type of stabilizing process in widely used in industrial food processing, is safe and does not change the organoleptic properties of the products.

- The product next passes on a conveyer belt to a Burched Mill in which they are converted into slices about 1/8 of an inch thick.

- Next, the product passes through a pre-cooking step with the application of a thermal shock wit' ve steam at 90 degrees Celsius an 80 psi pressure for an hour.

- Subsequently, the product passes into a cooling tank, in order to fix the organoleptic properties. A substantial pre-gelatinization of the product (sponging) is seen at this phase due to the natural hydration (70%) along with starch and sugars. These varieties of sweet potato have excellent hygroscopic properties.

- The product undergoes a second cooking in a tank similar to that of the pre-cooking, but with a water-seal to simulate a pressure cooker. The dough is stirred slowly with a screw mixer, which allows for the complete cooking of the sweet potato. The dough passes through a macerating mill to form a semi-solid dough.

- The dough passes on to the drying cylinder, in which a steam drying process is observed, with pressure of 80 psi, in a closed chamber with humidity extractors, which operate on the principles of conduction, convection and radiation.

- A homogeneous fill of sweet potato (on average 6/1000 of an inch in thickness) forms on and adheres to the walls of the rotating cylinder over a period of 10 to 20 seconds. The adherence time is determined by the resistance and the percent humidity of the product. In this case the product had 2% to 3% final water content. The rotation cycle was set at 16 seconds per turn or 3.75 cycles per minute. The purpose of minimizing the drying-time is to avoid the carmelization of free sugars and amino acids (Maillard reaction).

- Following drying, the dry sweet potato flakes are separated from the cylinder wall with a calibrated scraper. Smaller flakes are formed when the large strips are broken up on the helical-spiral transporter.

- Subsequently, the product passes on a final selection conveyer-belt to separate out foreign material such as bits of husk or lumps that are not sufficiently dried.

- Finally, the acceptable product passes through a wire-mesh mill to be ground into small and uniform buds.

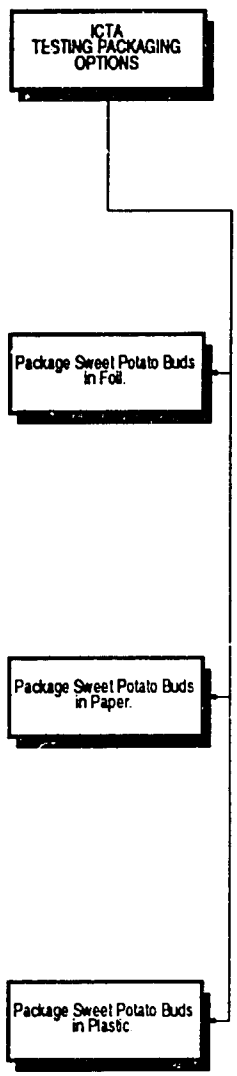
- The final product is allowed to cool for 2 hours.

- After cooling, the product was weighed and packed into black double polyethylene plastic bags for their temporary storage.

- For the yellow variety potato of interest, the original 6,000 lbs yielded 660 lbs of sweet potato buds, for a reduction of 89%. This is a combination of dehusking, dehydration and miscellaneous wastage.

Photograph 5 shows the starting product and the finished product from the sweet potatoes of variety #387 from the two locations - San Miguel Duenas, Chimaltenango (highland) and la Fragua, Zacapa (lowland) - which were produced in the one-day production effort.

OBJECTIVE #2


ICTA
TESTING PACKAGING
OPTIONS
Package Sweet Potato Buds
in Foil.
Package Sweet Potato Buds
in Paper.
Package Sweet Potato Buds
in Plastic

B. Objective #2: Test Packing Options

1. Introduction

The second objective was to test a variety of packaging options with variables in terms of cost of materials, protection from light, protection from humidity, and protection from microbial contamination.

Three alternative packing forms were selected, taking into consideration differences in unit costs of the materials, their availability, and their abilities to preserve the organoleptic properties of the product:

a. co-extruded multifilm of white, translucent plastic;
b. metallized plastic, of shiny aluminum coating;
c. triple-laminated packing with the interior layer of opaque polypropylene, the middle layer of metallized material, and the outer layer of opaque white paper.

2. Packing

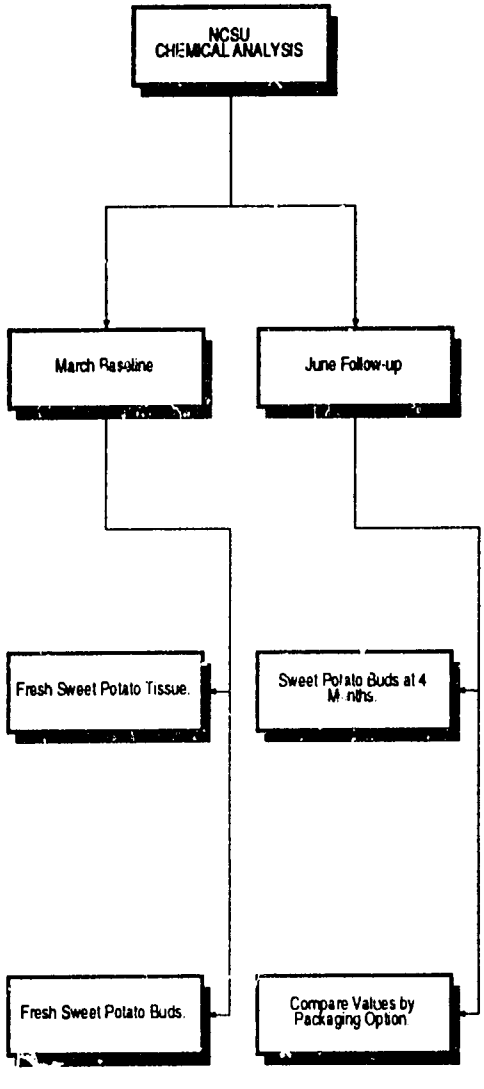
Thirty pounds of processed product from the purple husk and yellow pulp sweet potato was taken for packaging. The packing was done manually on a mechanical packing machine that ordinarily seals cellophane bags. The mechanism both forms and seals the bags. The packing was completed on February 13 at the Tostaduria de Cafe "Monteros" (a coffee packer). One hundred bags of the processed material were packed in different forms, as described as below:

- Triple-laminated packing with the interior layer of opaque polypropylene, the middle layer of metallized material, and the outer layer of opaque white paper. Each bag had 60 g of product. (n = 10)
- Co-extruded multifilm of white, translucent plastic. Each bag contained 110 to 115 g of product. (n = 30)
- Metallized plastic, of shiny aluminum coating. Each bag contained 110 to 115 g of product. (n = 30)
- Yellow plastic bags. Each bag contained 110 to 115 g of product. (n = 30) This was an additional option used to contain the excess product remaining.

3. Shipping

Six separate packages of the processed sweet potato buds in the metallized bags were brought to the U.S. on February 14 and shipped by Federal Express to North Carolina State University, Department of Food Science. (NCSU)

OBJECTIVE #3


NCSU
CHEMICAL ANALYSIS
March Baseline
June Follow-up
Fresh Sweet Potato Tissue.
Sweet Potato Buds at 4 Months.
Fresh Sweet Potato Buds.
Compare Values by Packaging Option

C. Objective #3: Analyze Provitamin A Carotenoids

1. Introduction

The third objective was to a) determine the provitamin A carotenoid (β-carotene) of three sweet potato varieties and of the dry bud product, b) convert the β-carotene values into retinol equivalents (RE), and c) compare the differences.

First step: Collection

On February 12, 1992, approximately 12,000 g of sweet potato (ICTA variety #387, "purple husk and yellow pulp") was harvested from open fields in San Miguel Duenas, Sacatepequez, for processing at the Mahler factory. Not only were six samples of this variety collected for analysis, but tissue was also collected from the "purple husk and pale pulp" sweet potatoes of variety #387 from La Fragua, (4 samples) and tissue from the "brown husk and intense orange pulp" variety sweet potato from La Fragua, (4 samples).

See **Appendix 1** for further details concerning the identity of the specimens, the raw weight, and the weight of the samples. **Photographs 6 and 7** show the process of sectioning and "blanching" of sweet potato tissue.

Second step: Packing and Shipment

The samples were packed in dry ice immediately upon blanching and rapidly cooled. **Photograph 8** illustrates the form in which the samples for analysis were packaged and labeled. On Friday morning, February 14, the samples left Guatemala on a regular flight of Continental Airlines to Houston. Customs and United States Animal, Plant Health Inspection Service (APHIS) inspection procedures were undertaken in Houston International airport, and the samples were delivered to the DHL offices at the airport in the afternoon for one-day shipping and Saturday delivery to Raleigh, North Carolina. Additional dry ice was added. The shipment was received intact on February 15, and transferred to the low-temperature freezers at the NCSU.

Pending notification of safe arrival of intact, well-preserved specimens at NCSU, duplicate samples with numbers; 2, 3, 5, 7, 9, 11, 12, 13, 14 and 16 were preserved in freezers at -4 degrees Celsius in Guatemala in borrowed freezer space at the Central American Research Institute for Industry (ICAIT). These were destroyed when it was confirmed that the frozen samples had arrived in Raleigh.

Photograph 9 illustrates the outer (husk) and inner (pulp) aspects of the special variety of higher-carotene sweet potato which was not processed for instantized product due to its very limited production and availability to date, but its carotene content in the blanched and fresh-frozen a state was assayed. The characteristics are visually compared with variety #387 grown at the same location in La Fragua, Zacapa.

2. Methods

The method of High Precision Liquid Chromatography (HPLC), with the modifications of the methods proposed by the collaborating laboratory in the Department of Food Science and technology of the North Carolina State University, (NCSU) was used on two separate occasions to determine the provitamin A content of a) fresh blanched samples of sweet potato and fresh packaged sweet potato buds at baseline, and b) packaged sweet potato buds at a four month interval. This analysis was performed in the laboratory of food chemist, Dr. Steven Schwartz with participation of Ruth H. Watkins, Ms. Amy Corbet, and Ni Luh Puspitasari in March and August, 1992.

a. March Baseline Analysis [2]

The objective of the analysis was to determine the provitamin A carotenoid, β-carotene, content of three varieties of sweet potato (blanched for 5 minutes) and the provitamin A (β-carotene) content of the dry bud product, convert their β-carotene values into retinol equivalents, (RE) and compare the differences.

In total, seven extractions of the blanched samples and two extractions from two bags of dry buds were preformed.

The β-carotene and RE in the buds was higher (57.5 μg/g and 9.6) than that found in the samples from San Miguel ("purple husk and yellow pulp" variety) (29.1 μg/g and 4.8) and the samples from La Fragua ("purple husk and pale yellow pulp" variety) (12.9 μg/g and 2.1). The pigmented samples from La Fragua ("purple husk and intense orange pulp") had the highest values of all blanched samples (1139.0 μg/g and 189.8 RE). See **Table 1** on the following page and **Appendix 2** for the complete report, March, 1992.

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[2] Watkins, Ruth H. Schwartz, Steven J. "*Analysis of Provitamin A Content in Guatemalan Sweet Potatoes*", Report to the International Eye Foundation, March 1992.

Table 1

Comparison of β-carotene and RE Values
Buds and Blanched Samples on Dry Weight Basis

Samples: Blanched & Buds	*β-carotene µg/g Bud/Blanched *Dry Weight*	*Retinol Equivalent Per Gram *Dry Weight*
Processed Bud Samples	57.5 4.1	9.6 0.7
Blanched SP Tissue #1 San Miguel Duenas "purple husk/yellow pulp"	29.1 12.1	4.8 2.0
Blanched SP Tissue #2 La Fragua "purple husk/pale yellow"	12.9 0.1	2.1 0.0
Blanched SP Tissue #3 La Fragua "brown husk/intense orange"	1139.0 236.5	189.8 39.4

* Mean and Standard Deviation

b. June and July Follow-up Analysis [3]

Samples of processed sweet potato buds were shipped to NCSU in three packaging types for analysis of their provitamin A content. The objective of this analysis was to determine the β-carotene content of processed sweet potato buds in three packing options (foil, paper laminate, and plastic), convert the β-carotene values to retinol equivalents and compare the storage stability of the product over time by packing option. The baseline analysis was performed in March.

In total, four bags of each packing option were extracted in June and two bags of each packing option were extracted in July. The methods for extraction and the HPLC procedure for separation and analysis followed the method previously used in March 1992.

The β-carotene and RE values degraded sharply from March to June. During this three month period the mean loss was approximately 43% (32.9 µg/g and 5.5 RE)

[3] Puspitasari Ni L., Watkins, Ruth H., Schwartz, Steven S., *"Analysis of Provitamin A Content in Stored Guatemalan Sweet Potato Buds"*, Report to the International Eye Foundation, August 1992.

in the foil package, 46% (31.1 μg/g and 5.2 RE) in the paper laminate and 54% (26.4 μg/g 4.4 RE) in the plastic bag options. The foil packaging was significantly better ($p<0.05$) than plastic in the conservation of β-carotene. See **Table 2** on the following page.

Table 2

Comparison of β-carotene and RE Values
Stored Buds by Packaging Option Over Time on Dry Weight Basis

OPTIONS	*MARCH 1992*		*JUNE 1992*	
	*β-carotene μg/g Buds *Dry Weight*	*RE Per Gram *Dry Weight*	*β-carotene μg/g Buds *Dry Weight*	*RE Per Gram *Dry Weight*
#1 Foil	57.5 4.1	9.6 0.7	32.9 3.5	5.5 0.6
#2 Paper	"	"	31.1 1.9	5.2 0.3
#3 Plastic	"	"	26.4 5.4	4.4 0.9
Mean	57.5 4.1	9.6 0.7	30.1 2.7	3.6 1.4

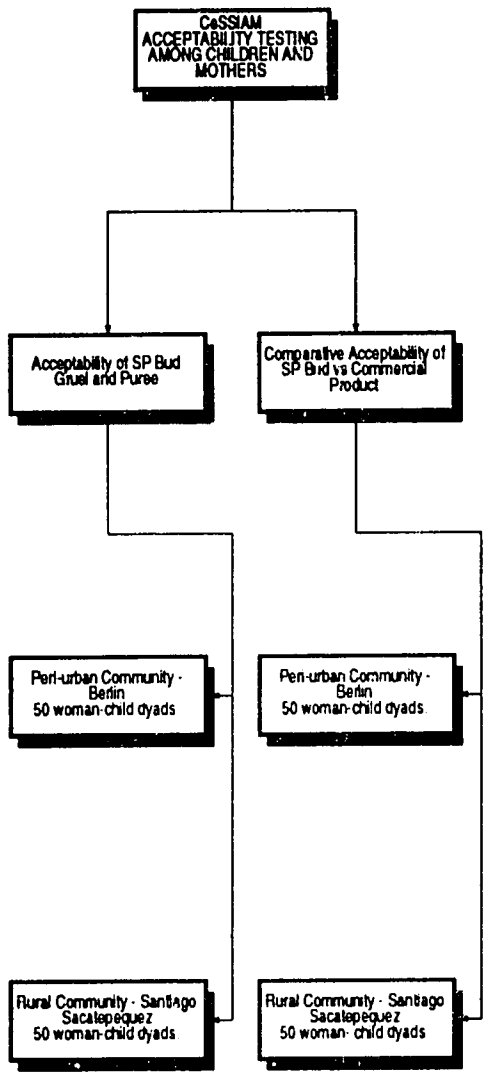
* Mean and Standard Deviation

The degradation was confirmed in a new analysis in July when even more β-carotene was lost: 21.7 μg/g and 3.6 RE; 16.8 μg/g and 2.8 RE; 14.8 μg/g and 2.5 RE; in the foil, paper and plastic packaging options respectively. The loss of β-carotene from March to July for all packaging options combined was 69%.

It was concluded that the decomposition was caused by oxidative deterioration by storing samples in packing materials with air (~20% O_2) and the large surface area of the flake.

It was suggested that the problem of decomposition could be minimized if an inert gas (nitrogen) and foil packaging was used, or if a thicker dried flake, that would expose only the outer surface layer to air, were considered. For the complete reports see **Appendix 3**.

OBJECTIVE #4


CaSSIAM
ACCEPTABILITY TESTING AMONG CHILDREN AND MOTHERS
Acceptability of SP Bud Gruel and Puree
Comparative Acceptability of SP Bird vs Commercial Product
Peri-urban Community - Berlin
50 woman-child dyads
Peri-urban Community - Berlin
50 woman-child dyads
Rural Community - Santiago Sacatepequez
50 woman-child dyads
Rural Community - Santiago Sacatepequez
50 woman- child dyads

D. Objective #4: Determine Acceptability

1. Introduction

The fourth objective was to determine the acceptability and organoleptic characteristics of gruel and puree, based on reconstituted sweet potato buds in the form of gruel and puree among a) young children, and b) mothers of young children.

The determination of acceptability and sensory evaluation of new foods consists, primarily, of rating the appearance and the flavor of the product. The rating of "appearance" is fairly objective and easily measurable. By contrast, determining "flavor" is subjective. This evaluation is performed indirectly by organoleptic tests (flavor, smell, etc.). The first step, begun in early March, was to determine two standard recipes for testing the acceptability of the sweet potato buds in the form of a gruel and puree. Trials in the kitchen resulted in the development of two recipes:

For gruel: 30 g of instant sweet potato buds
240 ml of boiled water
12 g of table sugar

For Puree: 30 g of instant sweet potato buds
120 ml of boiled water
12 g of table sugar

There were two sets of two questionnaires used. The first set was for testing acceptability of the sweet potato gruel and the other was for the sweet potato puree. These two questionnaires included a part for testing acceptability by the mother and a part for her child. The second set of questionnaires included one instrument for comparing acceptability of sweet potato gruel versus a commercial gruel, and the other instrument for comparing the acceptability of sweet potato puree and a commercial puree. The instruments were tested in a pilot study that included ten women and their children aged 1-6 years old. The objective of the pilot test was to refine the questionnaire. The data collection instruments are shown in **Appendix 4**. To determine which were the commercial products to be compared, the following criteria were used: first, that the products were instantaneous, and second that they were suitable for small children.

A Flow Chart for the sequence of activities, to be headed by Licda Lilian de Portocarrero with assistance from Licda Julieta Quan de Serrano, and Dra. carmen Yolanda Lopez, was developed. One hundred pounds of product packaged for daily use was delivered by Ing. Calderon to CeSSIAM.

2. Flow Chart

PILOT PHASE:

DEVELOPMENT OF RECIPES FOR PREPARATION OF A GRUEL AND A CEREAL FROM THE SWEET POTATO BUD PRODUCT

⇓

PILOT PHASE:

PRELIMINARY DEVELOPMENT AND REFINING OF THE ADMINISTRATION OF THE SENSORY TESTING OF THE GRUEL AND THE CEREAL PREPARED FROM SPBs

⇓

SENSORY TESTING:

1) GRUEL AND 2) CEREAL PREPARED FROM SWEET POTATO BUDS IN A STRATIFIED SAMPLE OF CHILDREN AGED 1 TO 6 YEARS IN A PERI-URBAN AREA. A TOTAL OF 50 CHILDREN, 10 PER AGE-INTERVAL, WITH EACH STUDIED ON CONSECUTIVE DAYS WITH EACH SERVING FORM IN A RANDOMIZED A->B OR B>A SEQUENCE. THE PARADIGM IS ACCEPTABILITY TO MOTHER AND CHILD

⇓

COMPARATIVE SENSORY TESTING:

1) SWEET POTATO BUD GRUEL VERSUS COMMERCIAL GRUEL (CEREVITA) AND 2) SWEET POTATO CEREAL VERSUS COMMERCIAL CEREAL (NESTUM) IN A STRATIFIED SAMPLE OF CHILDREN AGED 1 TO 6 YEARS IN PERI-URBAN AREAS. A TOTAL OF 30 CHILDREN, 6 PER AGE-INTERVAL, WITH CEREALS, AND A TOTAL OF 20 CHILDREN, 5 Per AGE-INTERVAL, WITH GRUELS. EACH CHILD WILL BE STUDIED ON CONSECUTIVE DAYS WITH EACH SERVING FORM IN A RANDOMIZED SEQUENCE. THE PARADIGM IS PREFERENCE FOR MOTHER AND PREFERENCE FOR THE CHILD

⇓

SENSORY TESTING

1) GRUEL AND 2) CEREAL PREPARED FROM SWEET POTATO BUDS IN A STRATIFIED SAMPLE OF CHILDREN AGED 1 TO 6 YEARS IN AN INDIGENOUS AREA A TOTAL OF 50 CHILDREN, 10 PER AGE INTERVAL, WITH EACH STUDIED ON CONSECUTIVE DAYS WITH EACH SERVING FORM IN A RANDOMIZED A->B OR B->A SEQUENCE

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COMPARATIVE SENSORY TESTING

1) SWEET POTATO BUD GRUEL VERSUS LOCAL CORN DOUGH GRUEL AND 2) SWEET POTATO CEREAL VERSUS LOCAL OATMEAL MUSH CEREAL IN A STRATIFIED SAMPLE OF CHILDREN AGED 1 TO 6 YEARS IN AN INDIGENOUS AREA. A TOTAL OF 30 CHILDREN, 6 PER AGE-INTERVAL, WITH CEREALS AND A TOTAL OF 20 CHILDREN, 5 PER AGE-INTERVAL, WITH GRUELS. EACH CHILD WILL BE STUDIED ON CONSECUTIVE DAYS WITH EACH SERVING FORM IN A RANDOMIZED SEQUENCE. THE PARADIGM IS PREFERENCE FOR MOTHER AND PREFERENCE FOR THE CHILD

3. Methodology

a. Communities

Two communities were chosen for the study. For the urban area, a marginal peri-urban community named "Berlin" was chosen, where the majority of women were "ladinas". The rural area chosen, Santiago Sacatepequez, is a town located 45 klm from Guatemala City, where the majority of women are indigenous. In Santiago, the town and three "aldeas" (Pacul, Pachali, and Xisholes, were included.

b. Subjects

Two-hundred mothers, or caretakers, with children aged 1-6 years enrolled for the study - 100 in each community. The sample was self-selected based on word-of-mouth through the investigators and community leaders. Each mother or caretaker gave a verbal consent after the nature and purpose of the study was explained. Fifty urban woman-child dyads and fifty woman-child dyads were interviewed for testing the acceptability of gruel and puree. For the comparative acceptability assessment, fifty mothers or caretakers with children, were interviewed in the urban community and fifty woman-child dyads were interviewed in the rural community.

c. Acceptability Assessment

Each mother-child dyad was presented with the gruel and the puree, in random sequence, and the two questionnaires were completed. The interviews were conducted by two nutritionists. When the mother stated that the child was sick, or if the child looked sick, the child was evaluated by a physician who decided whether the child was to be included in the study. If the physician decided that the child should not be in the study, then another mother-child pair was enrolled.

d. Comparative Acceptability Assessment

Each mother-child pair was interviewed using two questionnaires for comparative acceptability of gruel and puree:

- A sweet potato gruel (Gruel A) and a gruel prepared with a commercial 'instant oats' flour (gruel B) were presented to the mother or caretaker and the child. These were presented in randomized sequence.
- The mothers and their children were presented with the sweet potato puree (puree A) and a puree prepared with an instant baby food cereal based on wheat and rice (puree B). Also in randomized sequence.

4. Results

a. Peri-urban Community: "Berlin"

(1) Subjects

Fifty urban woman-child pairs were interviewed for testing acceptability of gruel and puree in the community of Berlin. Mothers or caretakers's ages ranged from 14 to 71 years and had a mean of three children. The number of children per woman ranged from one to nine.

Forty-seven were mothers, one was a grandmother, and two were older sisters of the children. Ninety-two percent of the women worked at their homes, six percent worked out of their houses and one was a student. Of the fifty mothers 13 (26%) were illiterate; 22 (44%) started grammar school but did not finish; 10 (20%) finished grammar school; 3 (6%) started high school; and 2 (4%) were technical assistants. The ages of the 50 children ranged from 12 to 72 months of equally divided between males and females. Eighty-eight percent of these children were, or had been breast-fed.

(2) Acceptability

Of the mothers, 90% found the puree flavor favorable or outstanding, and 10% found it average or poor **(Figure 1)** Eighty-four percent found the gruel favorable and outstanding and 16% found it average, or poor, or did not respond. **(Figure 2)**

Ninety-eight percent liked the color of the puree and 96% liked the color of the gruel. Ninety-four percent of the mothers rated the texture of the puree as good or very good, and 92% rated the gruel the same way. When they were asked about smell, 88% of the women liked the smell of the puree and 94% liked the smell of the gruel. When mothers were asked if they would give the puree and the gruel to their children less than 12 months old, 96% and 98% answered yes for the puree and the gruel respectively.

Another variable of interest was whether mothers would give the puree and the gruel to their sick children. Of the total mothers, 41 (82%) said that they would give the puree and 45 (90%) said that they would give the gruel to children with fever. When asked about giving either the puree or gruel to children with diarrhea, 40 mothers (80%) indicated their willingness to give puree and 32 (64%) the gruel to their child.

In respect to the children tested, 92% accepted the puree and 8% rejected it; and 94% accepted the gruel and 6% rejected it. **(Figures 3 and 4)** The responses by

children to the puree were: 40% smiled, 54% were neutral, and 6% frowned. When the gruel was offered to these children, 30% smiled, 56% were neutral, and 6% frowned. **(Figure 5)**

Perhaps the most important factor in testing the acceptability of foods with children is whether the child requested more gruel or puree when offered a second time. For example, even though the child tried the gruel or puree the first time, only if he or she liked it, would he or she request more. Seventy percent requested more puree and 84% requested more gruel. **(Figure 6 and 7)**

Of the 50 urban mothers or caretakers, 41 tasted both the gruel and puree. With this information, **Figure 8** was constructed, in which 32 (78%) accepted both the gruel and the puree, 5 (12%) accepted the puree but not the gruel, 2 (5%) accepted the gruel but not the puree, and 2 (5%) rejected both. **Figure 9** shows the data for 41 children of which 38 (93%) accepted both, 1 (2%) rejected the gruel and accepted the puree, and 2 (5%) rejected both.

b. Rural Community: Santiago Sacatepequez

(1) Subjects

Fifty woman-child pairs were interviewed in "downtown" Santiago Sacatepequez and the "aldeas" of Pacul, Pachali, and Xisholes. The ages of mothers or caretakers ranged from 15 to 57 years. The number of children per woman ranged from 1 to 11 with a mean of three children. Forty-nine were mothers and one was an older sister to the child. Thirty (60%) were illiterate, 15 (30%) attended at least one year of grammar school, and 5 (10%) finished grammar school.

The age of the children ranged from 12 to 72 months. Twenty-four (48%) were female and 26 (52%) were males. Of these children 96% were currently, or had been breast-fed.

(2) Acceptability

Ninety-two percent of the mothers found the puree flavor favorable or outstanding and 8% found it average, poor, or did not respond. **(Figure 1a)** Ninety-six percent found the gruel favorable or outstanding, and 4% found it average, poor, or did not respond. **(Figure 2a)**

Forty-nine women (98%) liked the color of the puree and 48 (96%) liked the color of the gruel. Forty-eight (96%) rated the texture of the puree good or very good, and 46 (92%) rated the texture of the puree as good or very good, and 46 (92%) rated the texture of the gruel in the same way. When mothers were asked about

the smell, 45 (90%) reported to like the smell of the puree and 48 (96%) liked the smell of the gruel.

When the mothers were asked if they would give the puree and the gruel to children less than 12 months of age, 44 (88%) answered yes for the puree and 37 (74%) for the gruel. Sixty-six percent of the mothers said that they would give the puree to a child with a fever and 64% (32) said they would give the child the gruel. In addition, 36 (72%) of the mothers were willing to give their children puree and 33 (66%) the gruel if their children had diarrhea. In respect to children, 46 (92%) accepted the puree and 4 (8%) rejected it. **(Figure 3a)** Forty eight (96%) accepted the gruel and 2 (4%) rejected it. **(Figure 4a)**

Figure 5a shows the child response to sampling the puree and the gruel. In each, the response was the same: 15 (30%) smiled, 24 (48%) were neutral, 3 (6%) were angry, and 8 (16%) rejected both. Thirty-one (62%) of the children requested more puree and 40 (80%) requested more gruel. **(Figures 6a and 7a)**

All the 50 rural mothers tasted both the gruel and puree. **Figure 8a** shows that 44 (88%) accepted both the gruel and the puree (group AA); 4 (8%) accepted the gruel, but not the puree (group AR); and 2 (4%) rejected the gruel and accepted the puree (group RA). None of the mothers rejected both (group RR).

Figure 9a shows the data for children, 43 (86%) accepted both the gruel and the puree (group AA); 4 (8%) accepted the gruel, but not the puree (group AR); and 3 (6%) rejected the gruel and accepted the puree (group RA). None of the children rejected both (group RR).

c. Comparative Acceptability

(1) Peri-urban Community: Berlin

Women in the peri-urban community of Berlin were asked which of two purees they preferred. Fifty-four percent preferred the SPB puree, 32% preferred the commercial baby puree, and 14% answered positively to both. **(Figure 10)**

Figure 11 shows the same questions, comparing gruel. In this case only 8% of the women preferred the SPB gruel, 76% preferred commercial gruel, and 16% answered that they liked both.

With respect to the children to whom two purees were presented, 38 (76%) accepted the SPB puree and 12 (24%) rejected it. Forty-two children accepted the commercial puree and 8 (16%) rejected the commercial puree. **(Figure 12)**

When the two gruels where presented to children, 44 (88%) accepted the SPB gruel and 41 (82%) accepted the commercial gruel. Six children (12%) rejected the SPB gruel and 9 (18%) rejected the commercial gruel. **(Figure 13)**

Children were next asked which of the two purees they preferred. Not all of the children answered this question, especially the younger ones. Thirteen (26%) preferred the SPB puree, 18 (35%) preferred the commercial puree, 4 (8%) said both, and 15 (30%) did not answer. **(Figure 14)**

Figure 15 represents children's response with respect to the two gruels. Of these children, 12 (24%) preferred the SPB gruel, 16 (32%) preferred the commercial gruel, 6 (12%) preferred both, and 16 (32%) did not answer.

(2) Rural Community: Santiago Sacatepequez

Of the women asked which puree they preferred, 25 (50%) preferred the SPB puree, 7 (14%) preferred the commercial baby puree, 16 (32%) preferred both, and 2 (4%) indicated neither one. **(Figure 10a)** **Figure IIa** shows the same question but comparing the gruel. Only 9 (18%) of the women preferred the SPB gruel, 24 (48%) preferred the commercial gruel based on oatmeal, and 17 (34%) answered that they liked both.

With respect to children presented with two purees, 43 (86%) accepted both and 7 (14%) rejected both. **(Figure 12a)** When children were presented with two gruels, 30 (60%) accepted the SPB gruel and 20 (40%) rejected it. **(Figure 13)** Forty children (80%) accepted the commercial puree and 10 (20%) rejected it. **(Figure 13a)**

When children were asked which of the two purees they preferred, 20 (40%) preferred the SPB puree, 9 (18%) preferred the commercial puree, 1 (2%) preferred both, 2 (4%) preferred neither, and 18 (36%) did not answer. **(Figure 14a)** With respect to gruels, 15 (30%) preferred the SPB gruel, 13 (26%) preferred the commercial gruel, 5 (10%) both, and 17 (34%) did not answer. **(Figure 15a)**

d. Comparative Analysis Urban-Rural

(1) Acceptability

Figure 16 shows no difference in acceptability of mothers from the rural and urban areas. There is a small tendency toward preference of the gruel in the rural area. **(Figure 17)** There is no difference in the acceptability of the puree. **(Figure 18)** The acceptability of the puree and gruel by children had the same tendency. **(Figures 18-19)**

More children in the rural area refused to try both gruel and puree, but the response to sampling was similar in both communities. **(Figure 20-21)** Seventy percent of the urban children requested to consume more puree and 26% of the children in the rural area requested more puree. **(Figure 22)** Eighty-four percent requested more gruel in the urban area and 80% in the rural area. **(Figure 23) Figure 24 and 25** show no difference between communities.

(2) Comparative Acceptability

Figure 26 shows the comparative acceptability of purees by mothers in two communities. The SPB puree was preferred by 50% of the women, both purees were chosen more often by rural mothers. **Figure 27** shows that the commercial gruel was preferred to the SPB gruel and also the rural women chose both more often than the urban women.

When children were asked which of the two purees they preferred, 20 (40%) of the rural children preferred the SPB puree in contrast to 13 (26%) of the urban children that preferred the SPB puree. The high percentage of children that did not answer questions was due to the fact that they were too young to talk. **(Figure 28) Figure 29** shows the comparative acceptability of the gruels. Urban children had a tendency to prefer the commercial gruel and the rural children the SPB gruel.

e. Summary

The acceptability trial was conducted in two different geographic settings: a marginal peri-urban community and a rural indigenous community. Two hundred mothers or caretakers with children 1-6 years old (100 in each community) were recruited for the study. Women were divided into two main groups for testing acceptability of SPB and for comparing acceptability of the SPB versus two instant commercial products.

The majority of mothers (84% to 94%) rated the acceptability of the SPB gruel and puree, (flavor, color, texture, smell) as good or outstanding in both the urban and rural area. The majority of children accepted to try the gruel and puree. Seventy percent requested more puree and 84% requested more gruel in the urban community. Sixty-two percent requested more puree and 80% more gruel in the rural community.

In the comparative acceptability trial, 54% of the mothers preferred the SPB puree and 14% liked both purees in the urban community. Fifty percent preferred the SPB puree and 16% liked both in the rural area. In the comparison with the commercial gruel the results were different -- only 8% of the women preferred the SPB gruel and 16% liked both in the urban community. In the rural area, 18% preferred the SPB gruel and 34% liked both.

f. Conclusions

The SPB gruel and puree were generally well accepted by the mother-child dyads in both communities. The acceptability was greater in the mother than in the child. Mothers were willing to give SPB to their children even when he or she was sick.

There was no difference between acceptability of SPB by mothers in the rural and urban areas. There is a slight tendency toward preferring gruel in the rural area.

In comparing acceptability of SPB versus a commercial puree, both were equally accepted by the mothers in the two communities. However, when the comparison was between SPB and the commercial gruel, the latter was preferred in the two communities. This was especially the case in the peri-urban community. This may be attributed to the fact that the commercial gruel includes cinnamon and vanilla which are common ingredients added to gruels.

ACCEPTABILITY OF SWEET POTATO PUREE BY PERI-URBAN MOTHERS (N = 50)

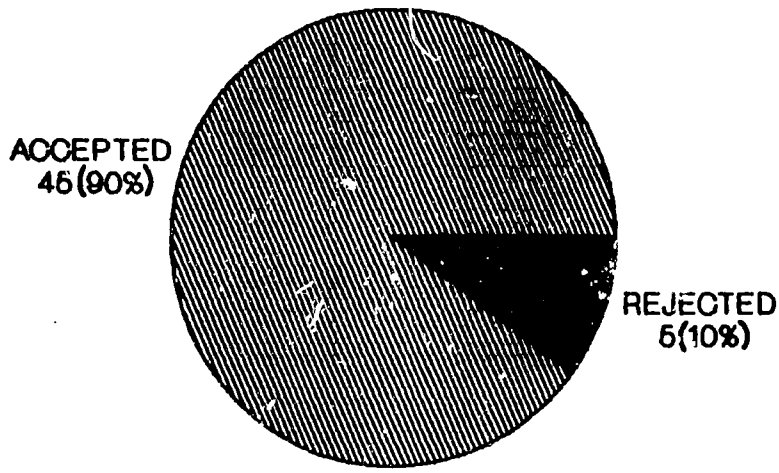


FIGURE 1

ACCEPTABILITY OF SWEET POTATO GRUEL BY PERI-URBAN MOTHERS (N = 50)

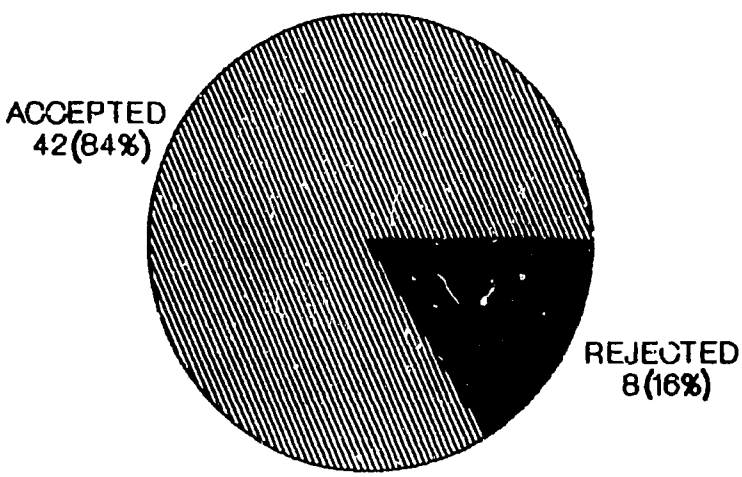


FIGURE 2

ACCEPTABILITY OF SWEET POTATO PUREE BY PERI-URBAN CHILDREN (N = 50)

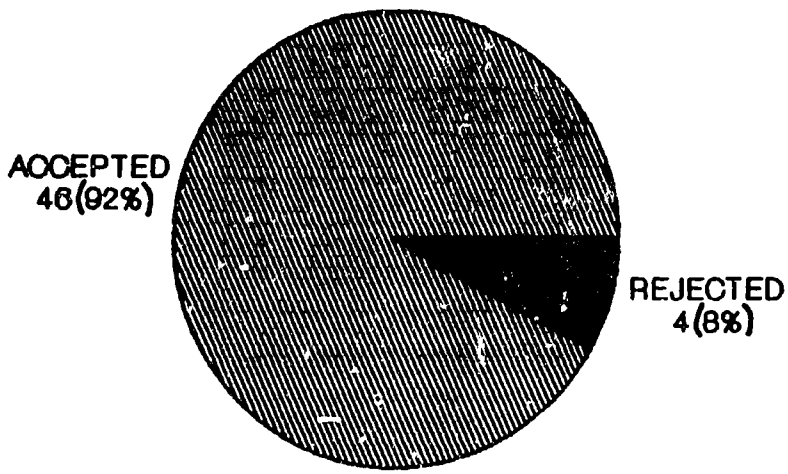


FIGURE 3

ACCEPTABILITY OF SWEET POTATO GRUEL BY PERI-URBAN CHILDREN (N = 50)

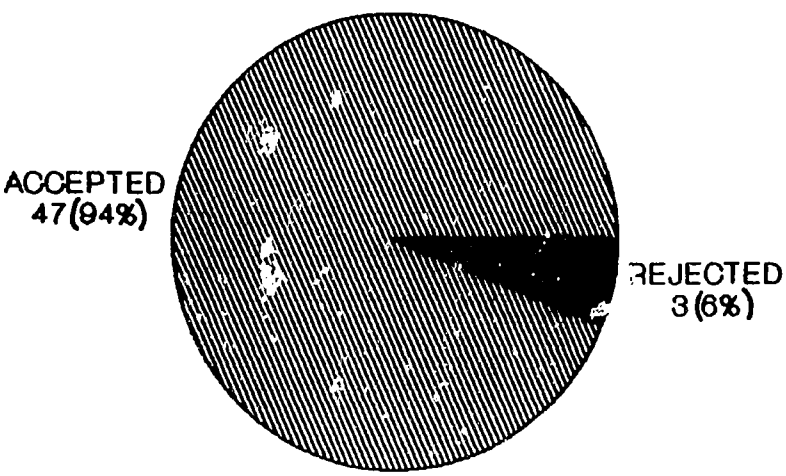


FIGURE 4

RESPONSE TO THE SAMPLING OF SWEET POTATO GRUEL AND PUREE BY PERI-URBAN CHILDREN

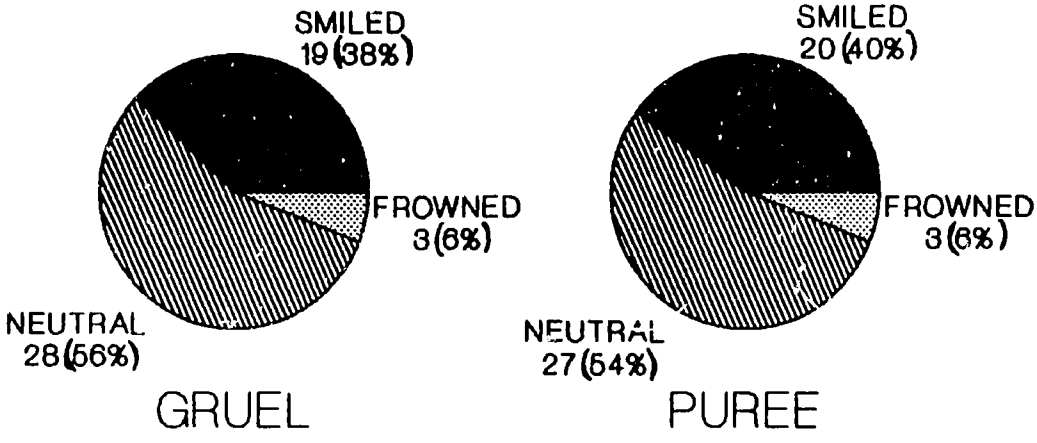


FIGURE 5

PERCENT OF PERI-URBAN CHILDREN WHO ACCEPTED/REJECTED MORE GRUEL AND PUREE WHEN OFFERED

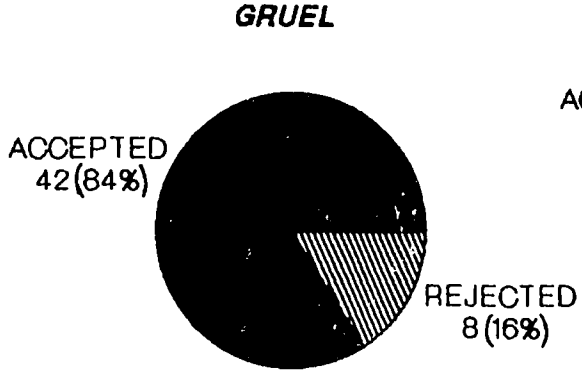


FIGURA 6

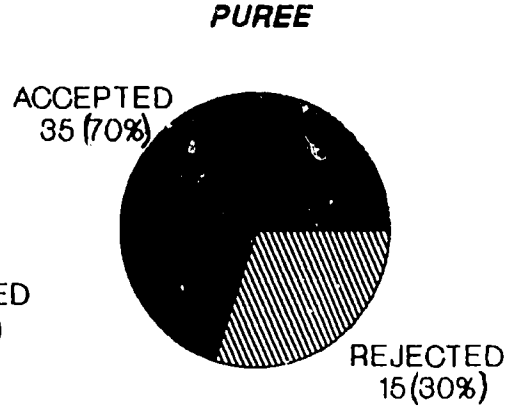


FIGURA 7

ACCEPTABILITY OF SWEET POTATO GRUEL AND PURE BY PERI-URBAN MOTHERS (N = 41)

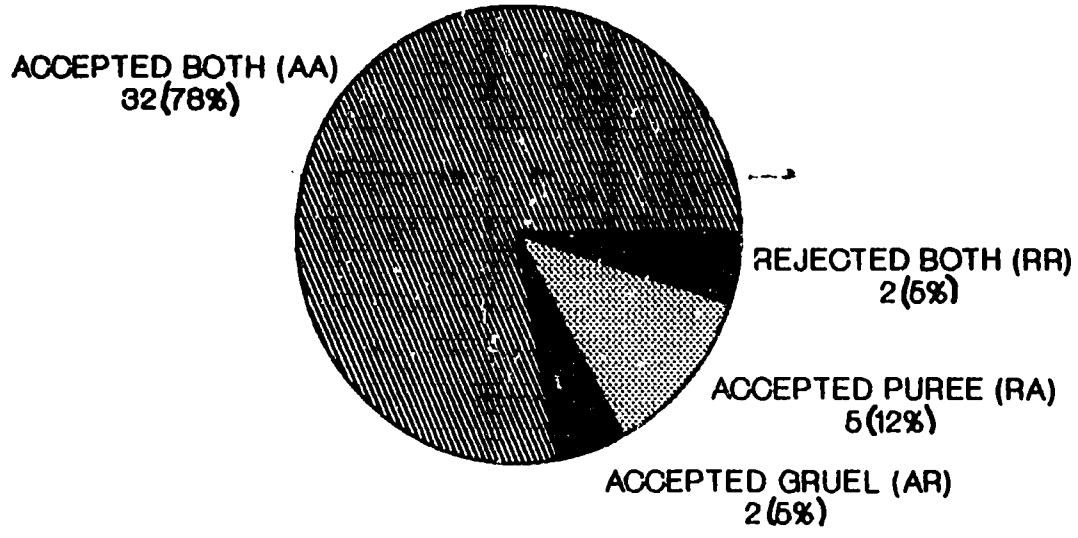


FIGURE 8

ACCEPTABILITY OF SWEET POTATO GRUEL AND PURE BY PERI-URBAN CHILDREN (N = 41)

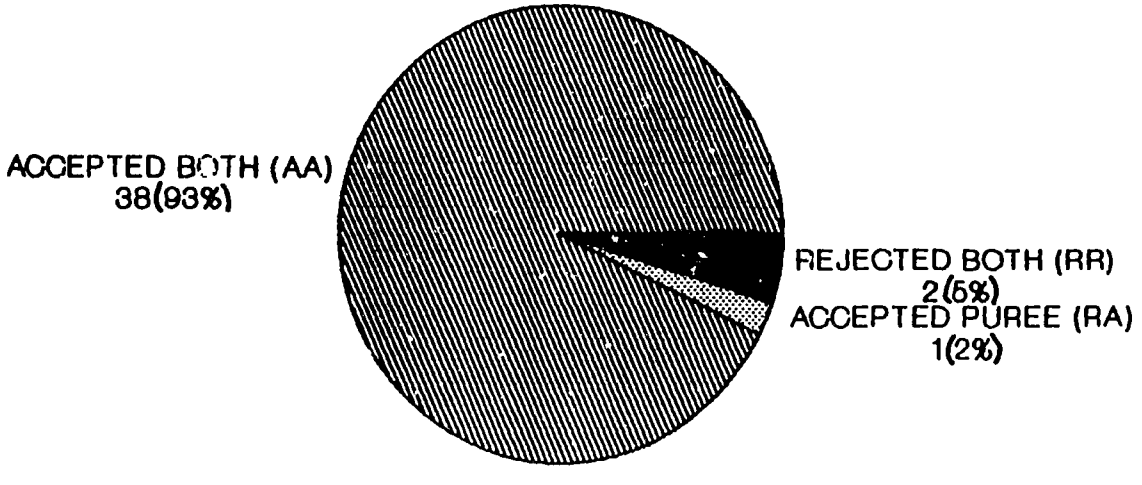


FIGURE 9

COMPARATIVE ACCEPTABILITY OF PUREES BY PERI-URBAN MOTHERS (N = 50)

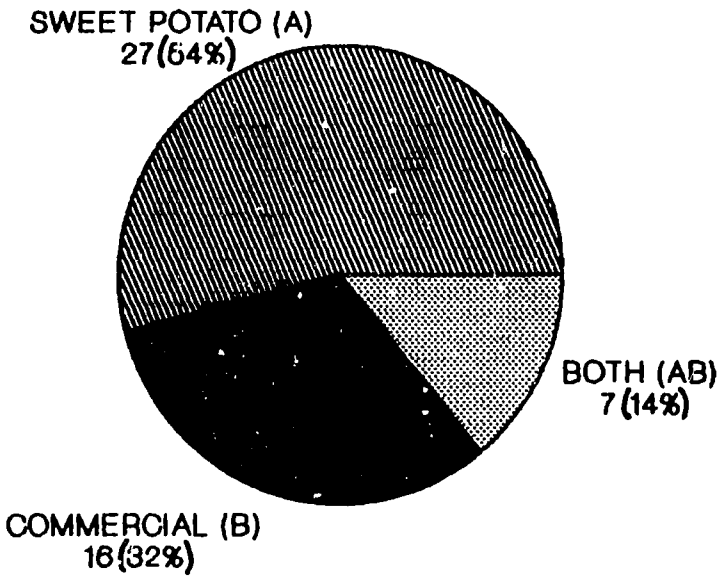


FIGURE 10

COMPARATIVE ACCEPTABILITY OF GRUELS BY PERI-URBAN MOTHERS (N = 50)

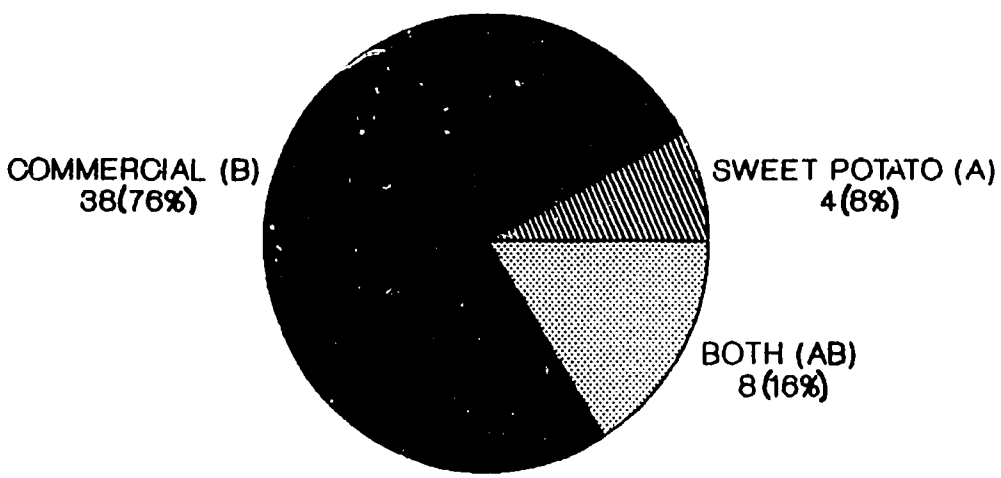


FIGURE 11

COMPARATIVE ACCEPTABILITY OF PUREES BY PERI-URBAN CHILDREN (N = 50)

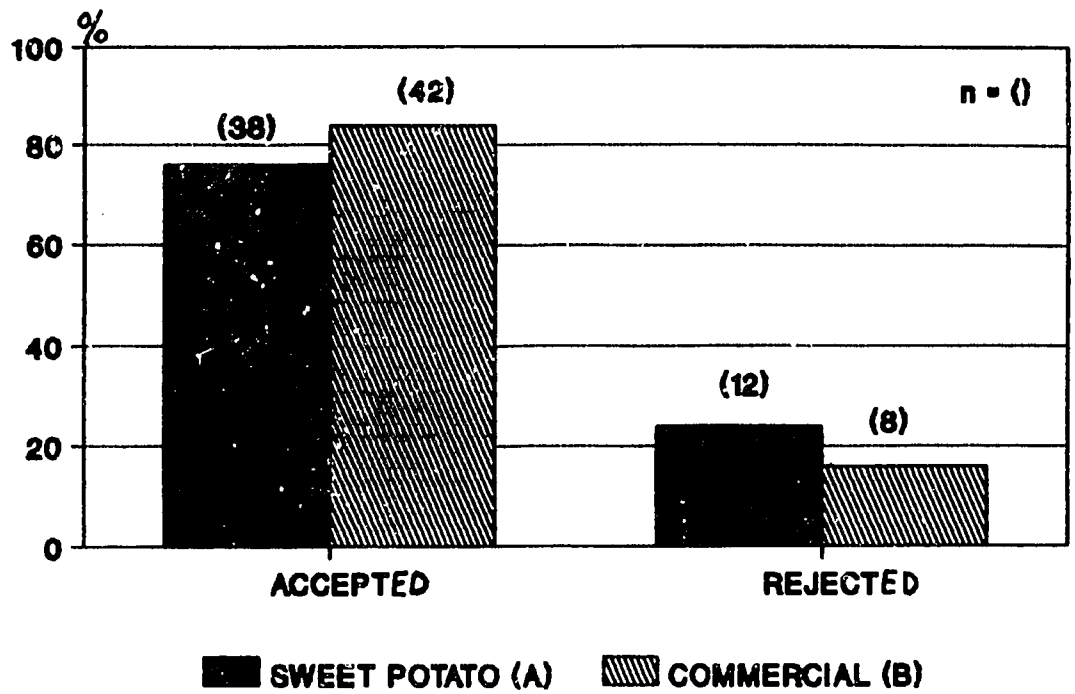


FIGURE 12

COMPARATIVE ACCEPTABILITY OF GRUELS BY PERI-URBAN CHILDREN (N = 50)

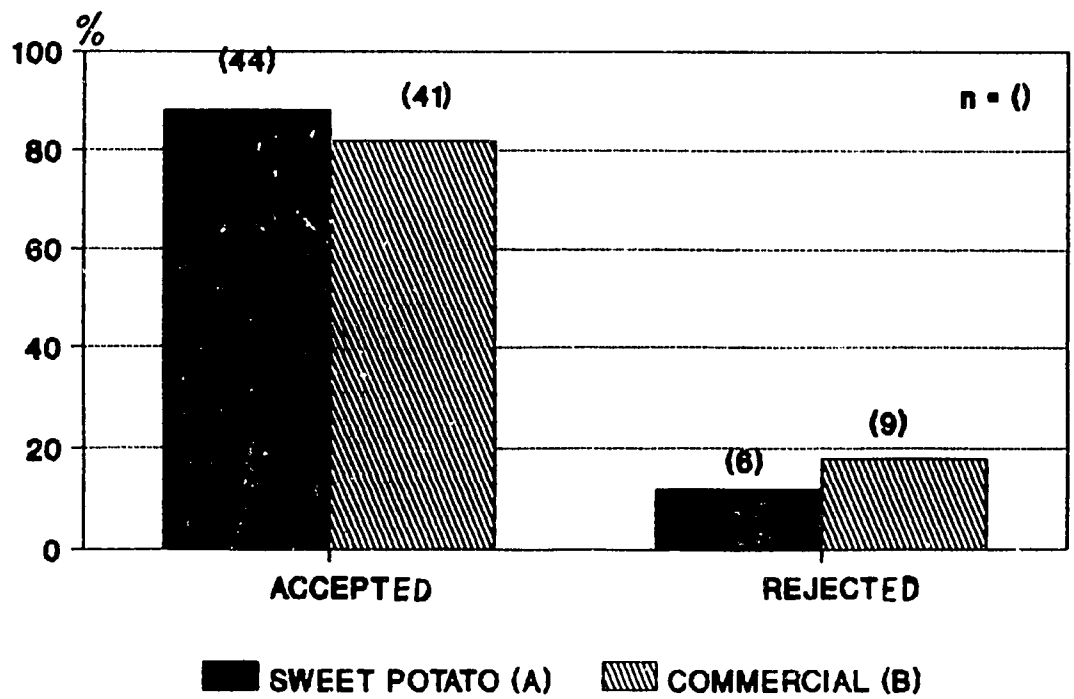


FIGURE 13

COMPARATIVE ACCEPTABILITY OF PUREES BY PERI-URBAN CHILDREN (N = 50)

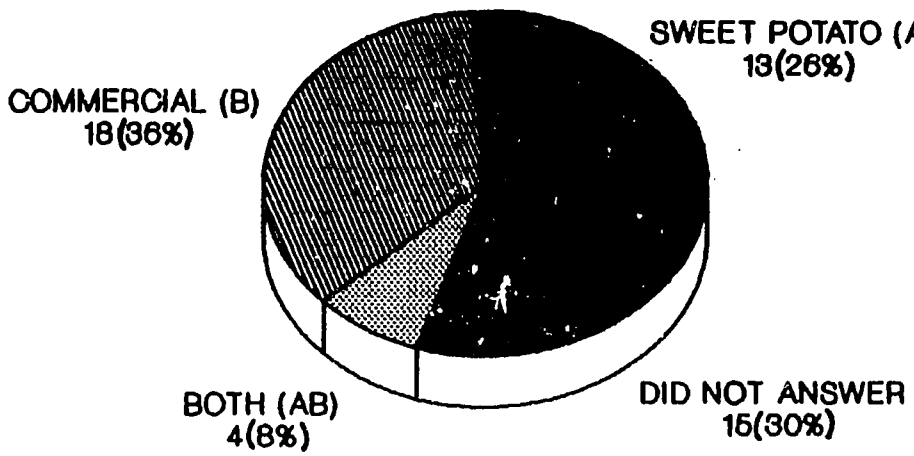


FIGURE 14

COMPARATIVE ACCEPTABILITY OF GRUELS BY PERI-URBAN CHILDREN (N = 50)

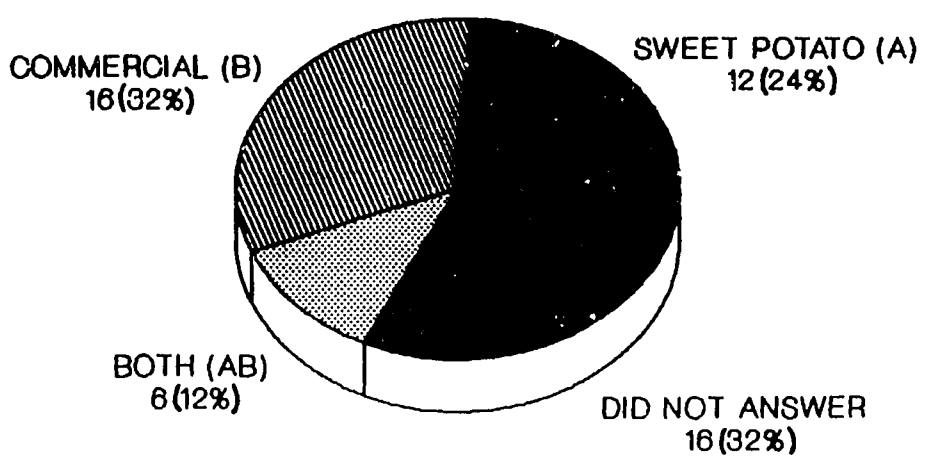


FIGURE 15

ACCEPTABILITY OF SWEET POTATO PUREE BY RURAL MOTHERS (N = 50)

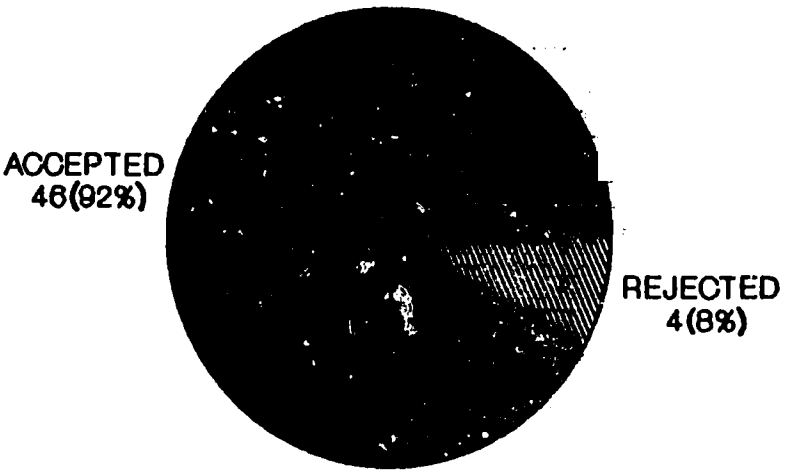


FIGURE 1A

ACCEPTABILITY OF SWEET POTATO GRUEL BY RURAL MOTHERS (N = 50)

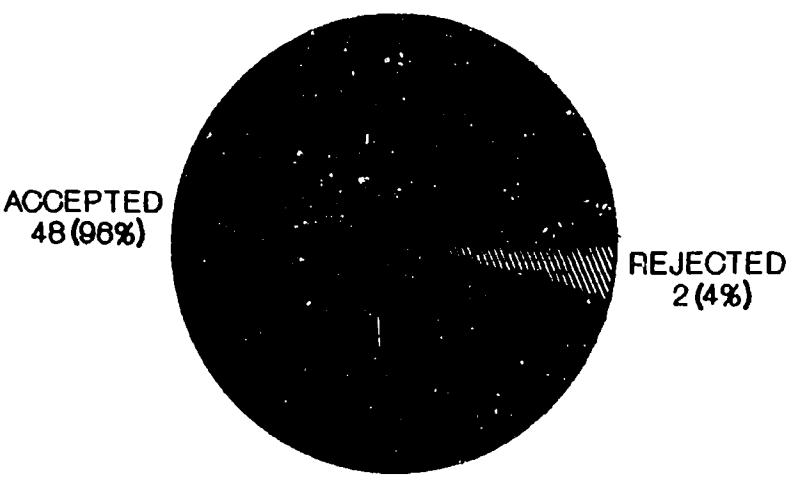


FIGURE 2A

ACCEPTABILITY OF SWEET POTATO PUREE BY RURAL CHILDREN (N = 50)

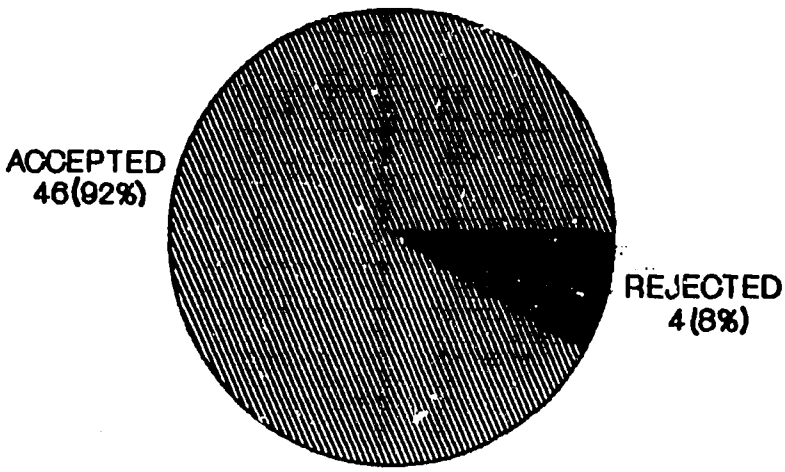


FIGURE 3A

ACCEPTABILITY OF SWEET POTATO GRUEL BY RURAL CHILDREN (N = 50)

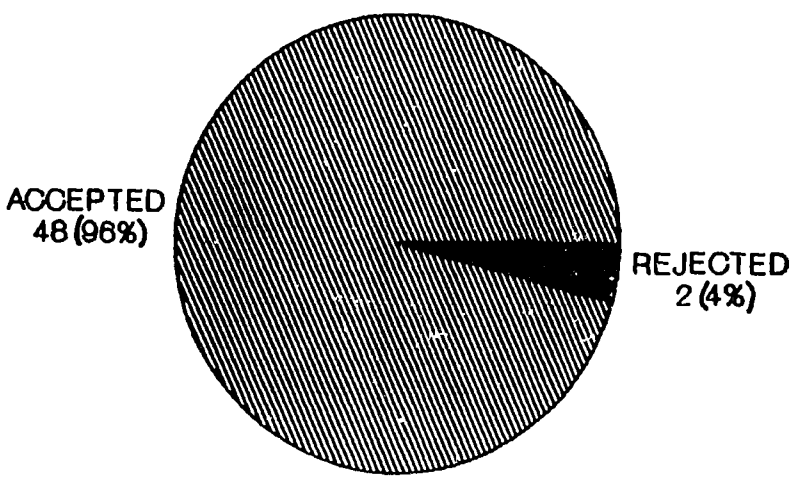


FIGURE 4A

RESPONSE TO THE SAMPLING OF SWEET POTATO GRUEL AND PUREE BY RURAL CHILDREN

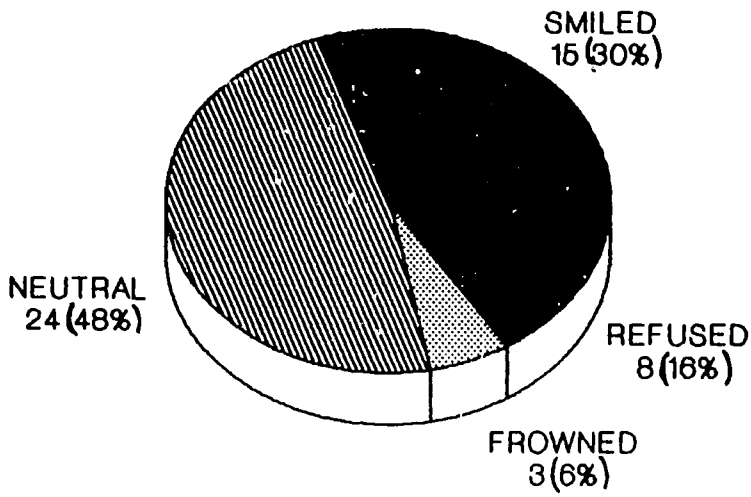


FIGURE 5A

PERCENT OF RURAL CHILDREN WHO ACCEPTED/ REJECTED MORE GRUEL AND PUREE WHEN OFFERED

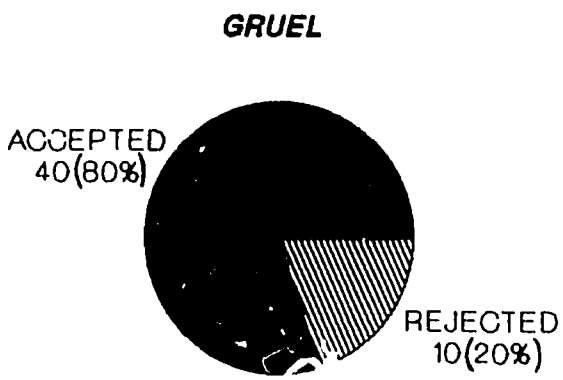


FIGURA 6A

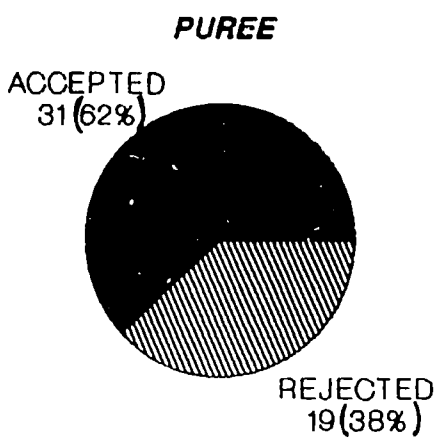


FIGURA 7A

ACCEPTABILITY OF SWEET POTATO GRUEL AND PUREE BY RURAL MOTHERS (N = 50)

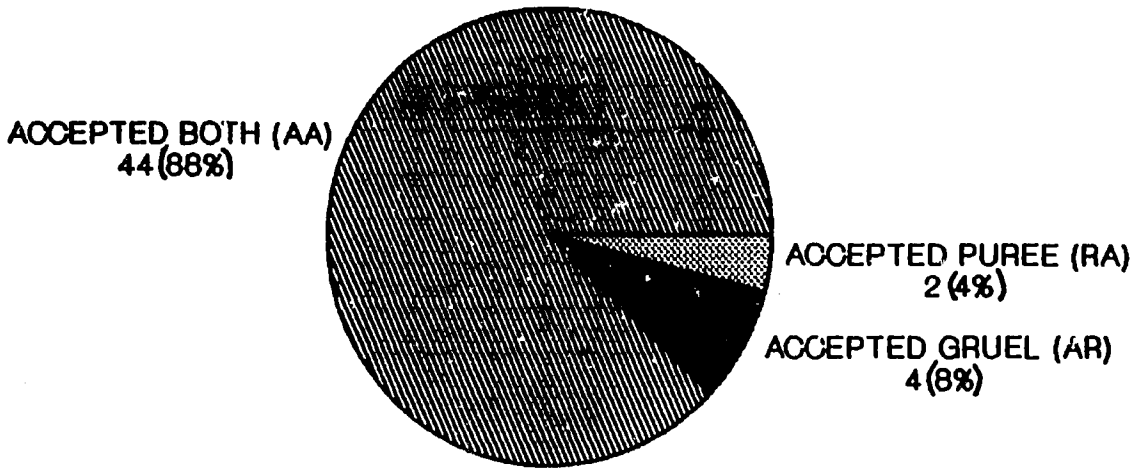


FIGURE 8A

ACCEPTABILITY OF SWEET POTATO GRUEL AND PUREE BY RURAL CHILDREN (N = 50)

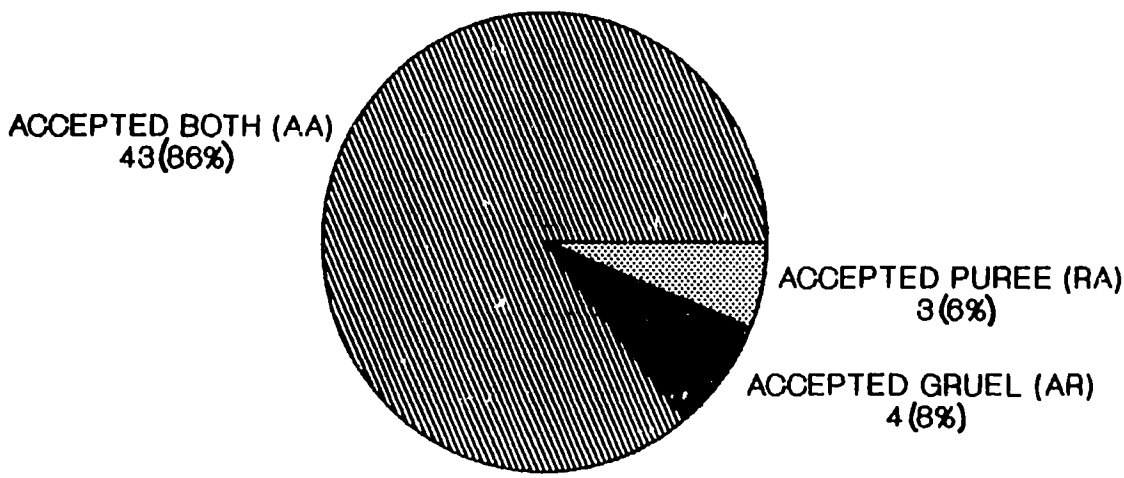


FIGURE 9A

COMPARATIVE ACCEPTABILITY OF PUREES BY RURAL MOTHERS (N = 50)

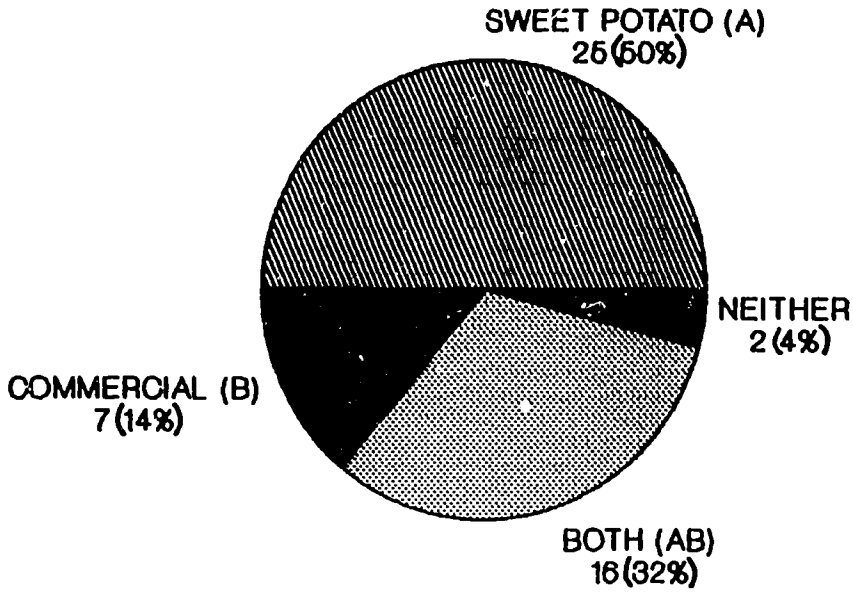


FIGURE 10A

COMPARATIVE ACCEPTABILITY OF GRUELS BY RURAL MOTHERS (N = 50)

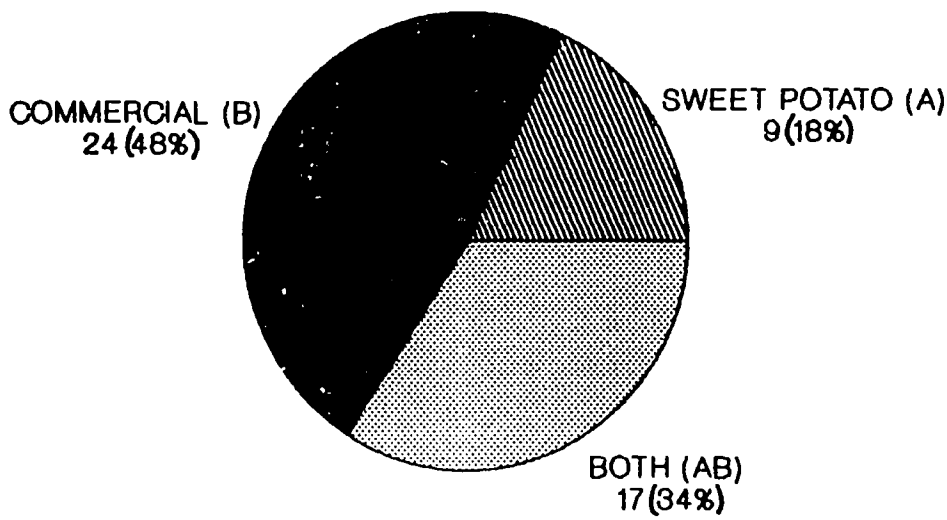


FIGURE 11A

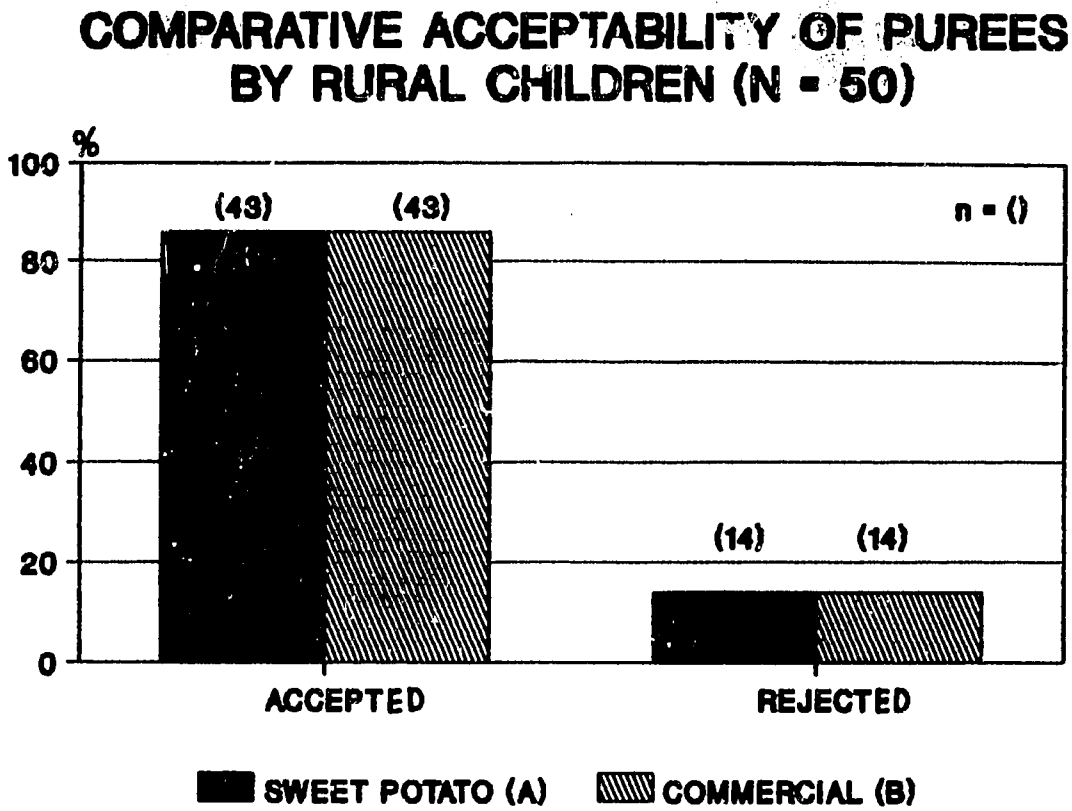


FIGURE 12A

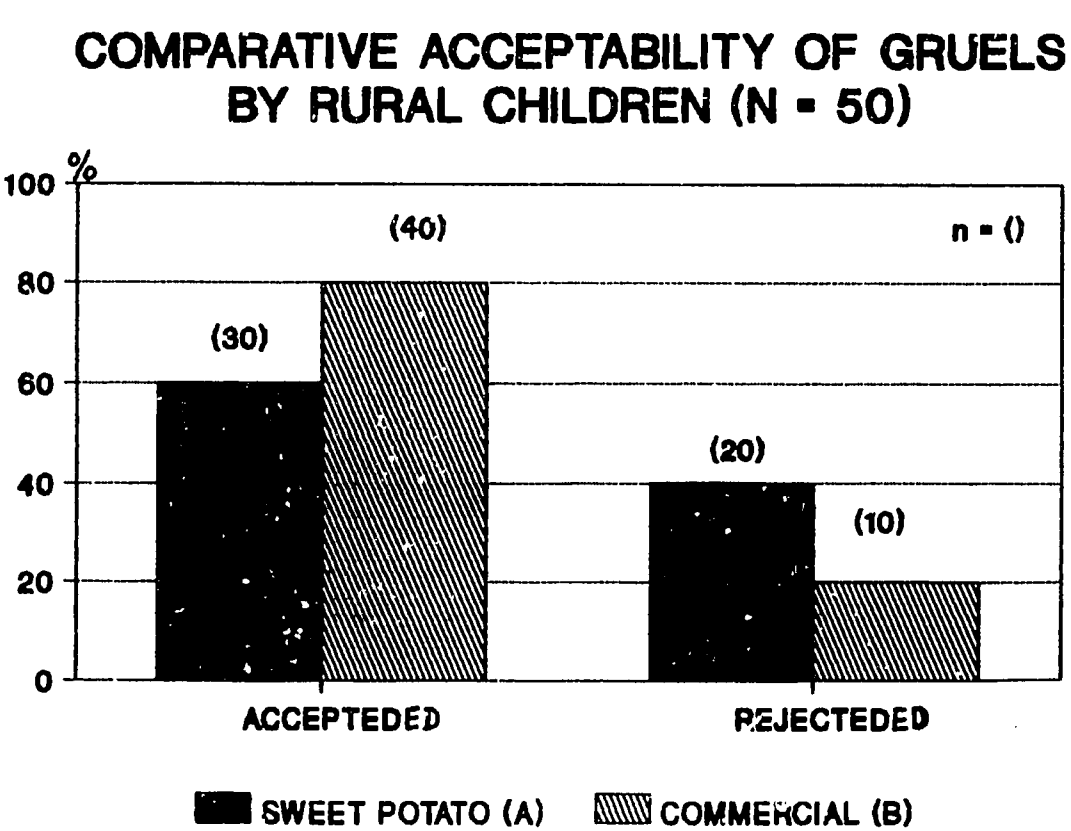


FIGURE 13A

COMPARATIVE ACCEPTABILITY OF PUREES BY RURAL CHILDREN (N = 50)

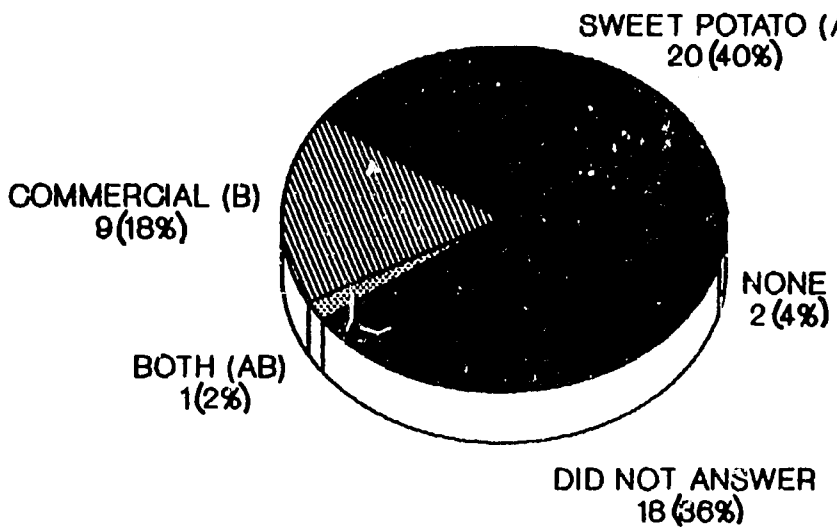


FIGURE 14A

COMPARATIVE ACCEPTABILITY OF GRUELS BY RURAL CHILDREN (N = 50)

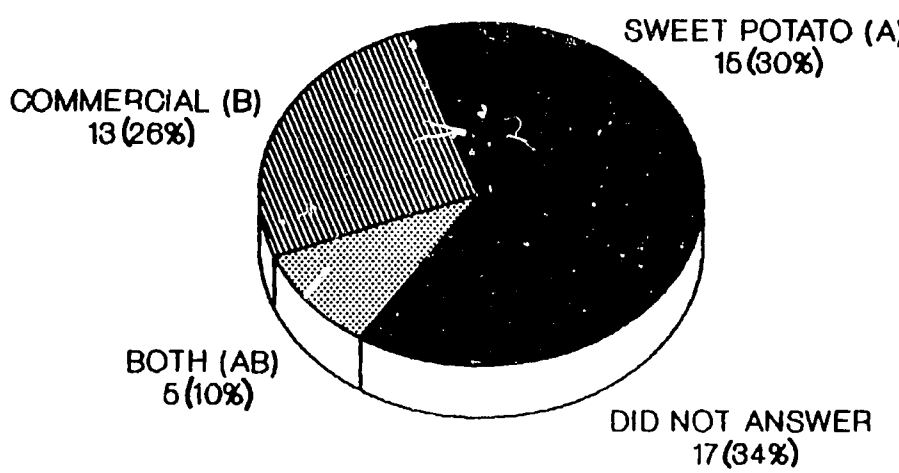


FIGURE 15A

ACCEPTABILITY OF SWEET POTATO PUREE BY PERI-URBAN AND RURAL MOTHERS

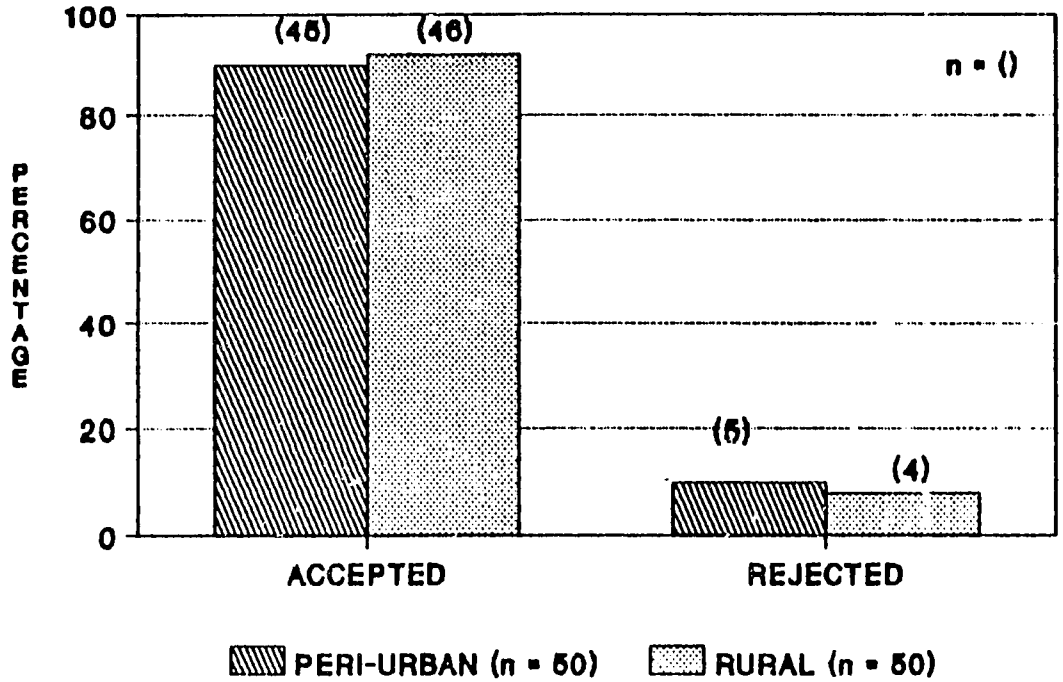


FIGURE 16

ACCEPTABILITY OF SWEET POTATO GRUEL BY PERI-URBAN AND RURAL MOTHERS

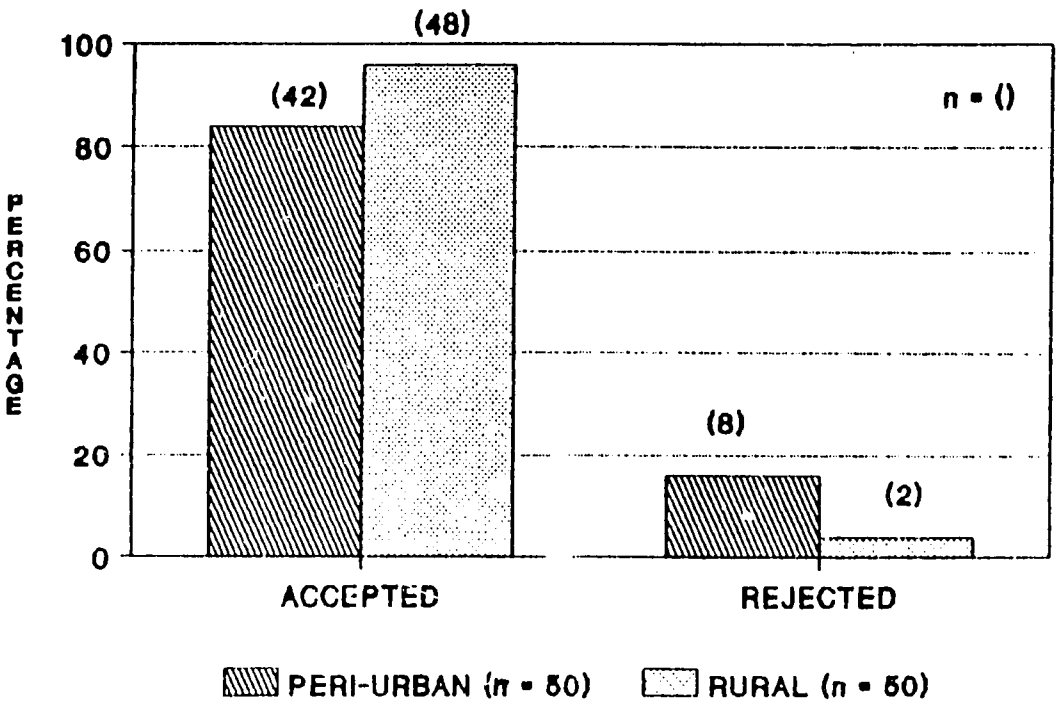


FIGURE 17

ACCEPTABILITY OF SWEET POTATO PUREE BY PERI-URBAN AND RURAL CHILDREN

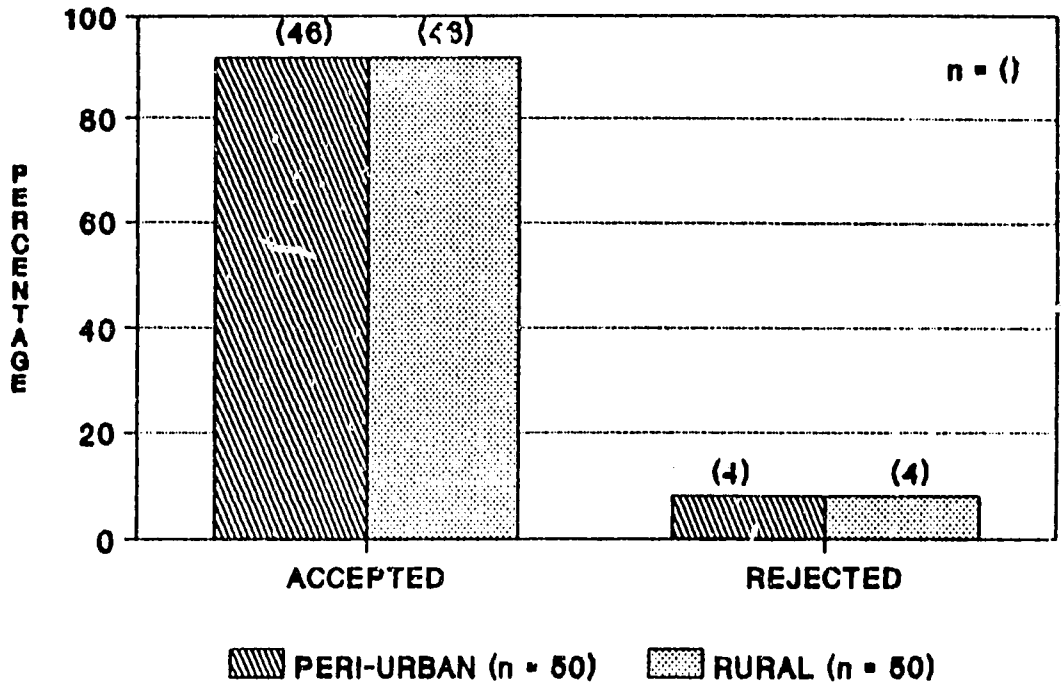


FIGURE 18

ACCEPTABILITY OF SWEET POTATO GRUEL BY PERI-URBAN AND RURAL CHILDREN

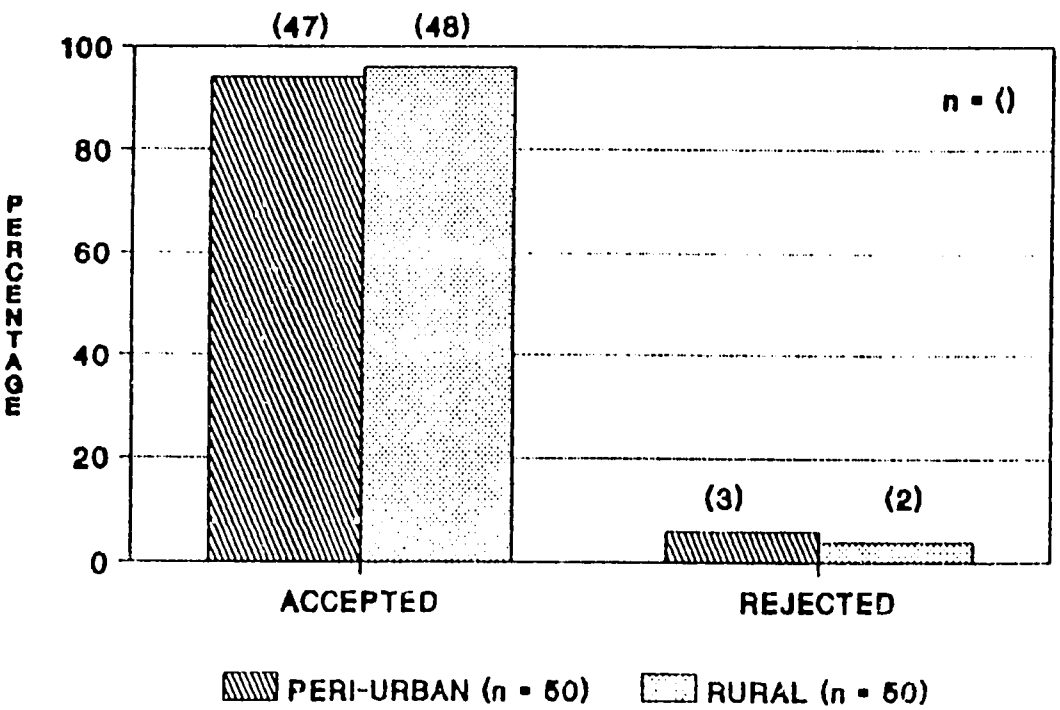


FIGURE 19

RESPONSE TO THE TEST OF SWEET POTATO PUREE BY PERI-URBAN AND RURAL CHILDREN

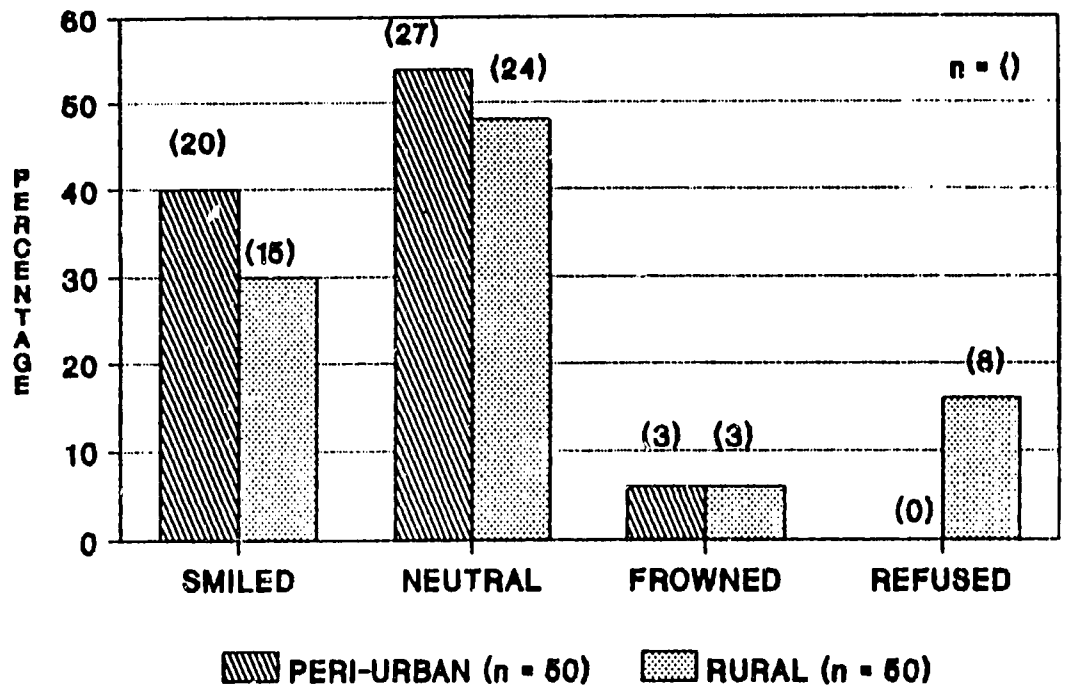


FIGURE 20

RESPONSE TO THE TEST OF SWEET POTATO GRUEL BY PERI-URBAN AND RURAL CHILDREN

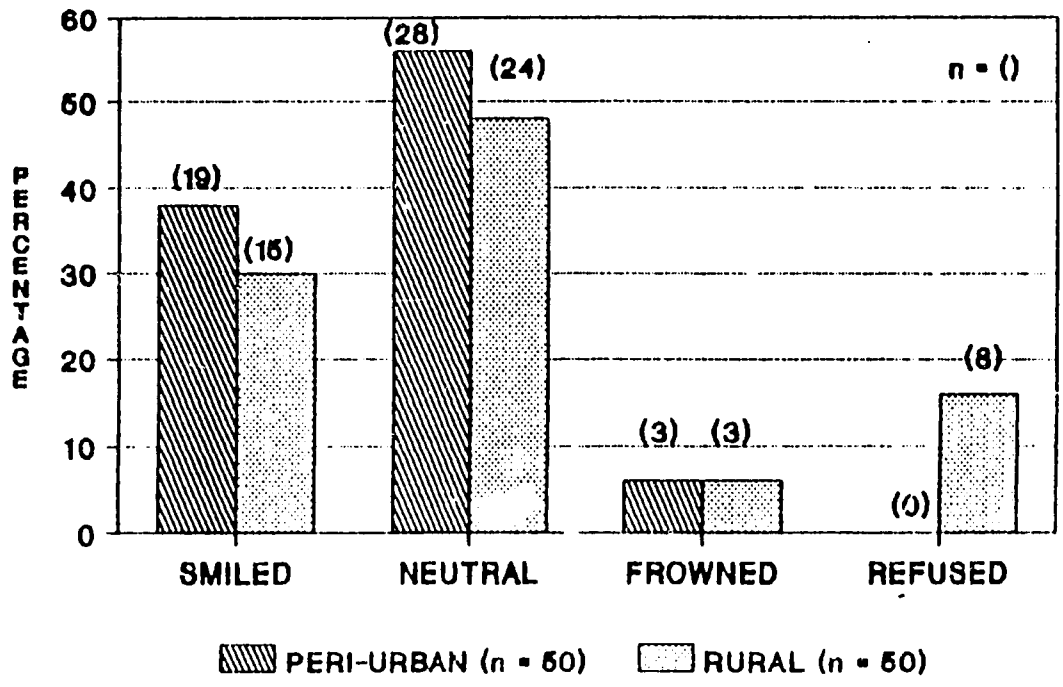


FIGURE 21

PERCENT OF PERI-URBAN AND RURAL CHILDREN WHO ACCEPTED/REJECTED MORE PUREE WHEN OFFERED

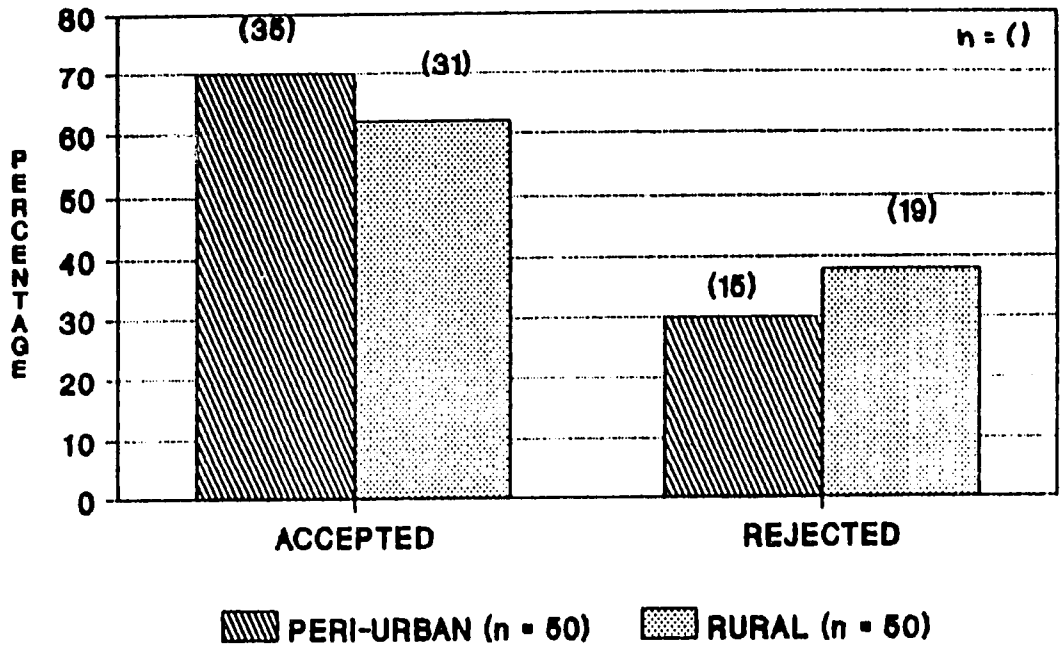


FIGURE 22

PERCENT OF PERI-URBAN AND RURAL CHILDREN WHO ACCEPTED/REJECTED MORE GRUEL WHEN OFFERED

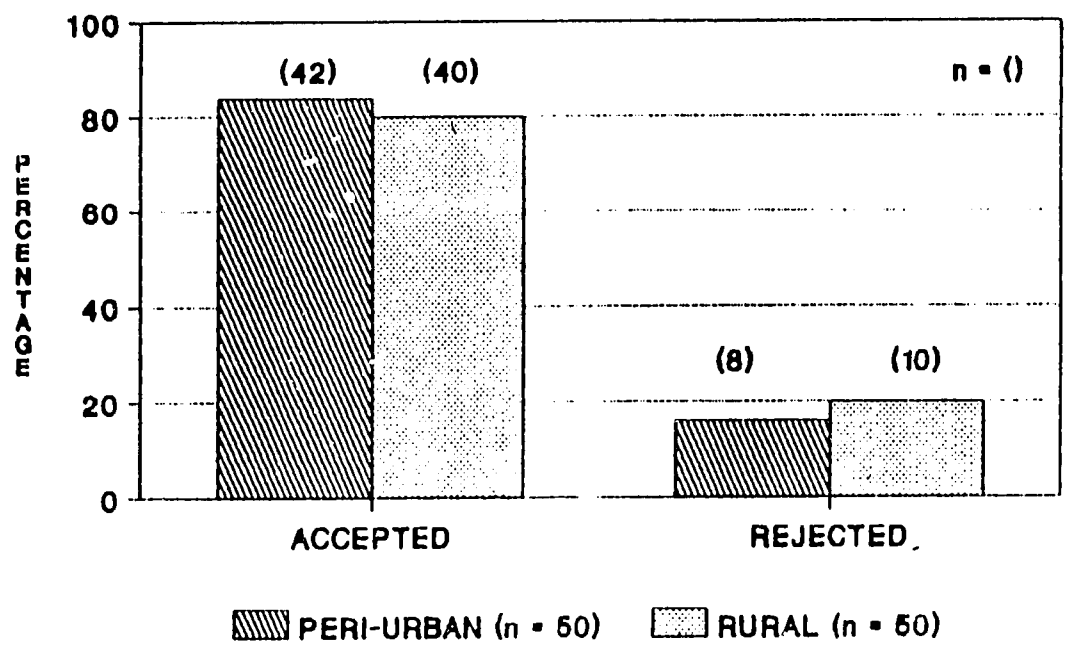


FIGURE 23

ACCEPTABILITY OF SWEET POTATO GRUEL AND PURRE BY MOTHERS IN DIFFERENTS AREAS
A = ACCEPTED R = REJECTED

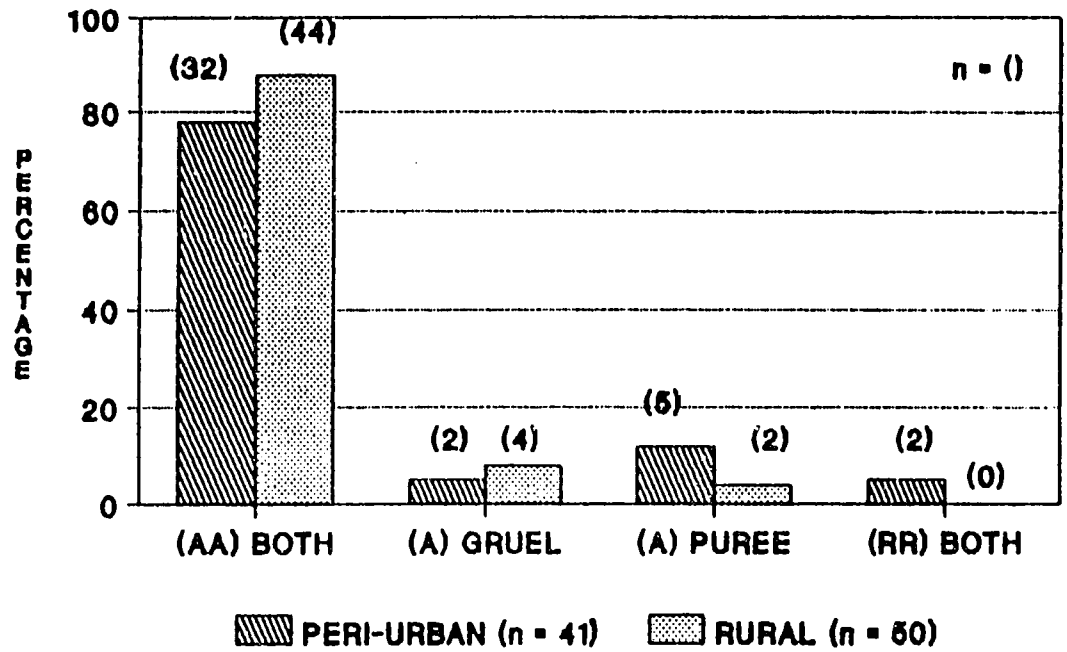


FIGURE 24

ACCEPTABILITY OF SWEET POTATO GRUEL AND PURRE BY CHILDREN IN DIFFERENTS AREAS
A = ACCEPTED R = REJECTED

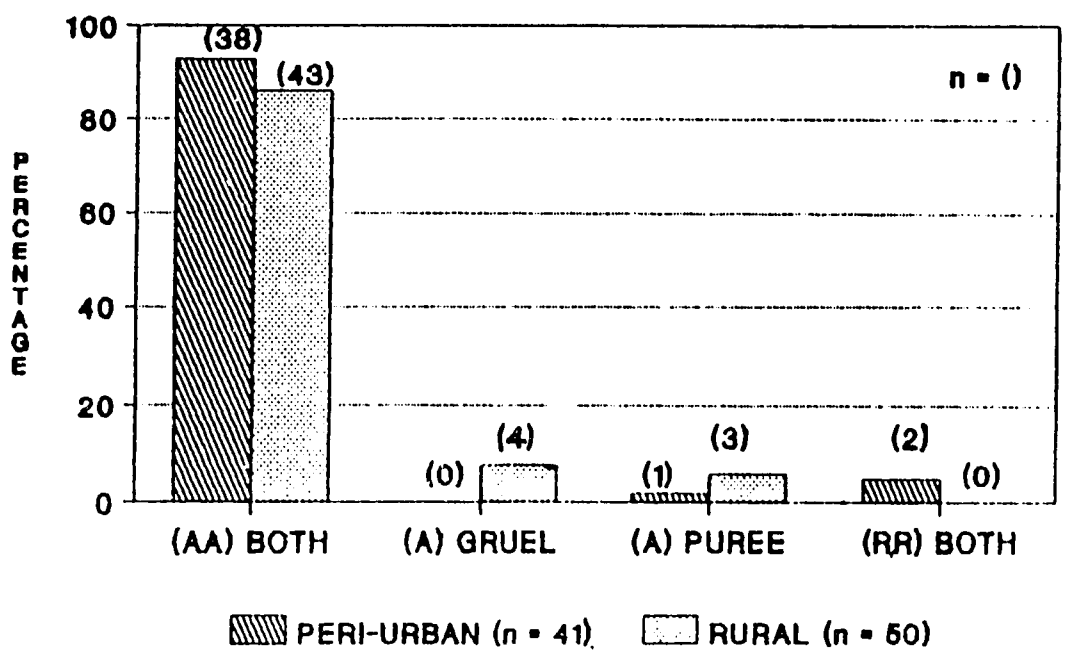


FIGURE 25

COMPARATIVE ACCEPTABILITY OF THE PUREES BY MOTHERS IN DIFFERENTS AREAS

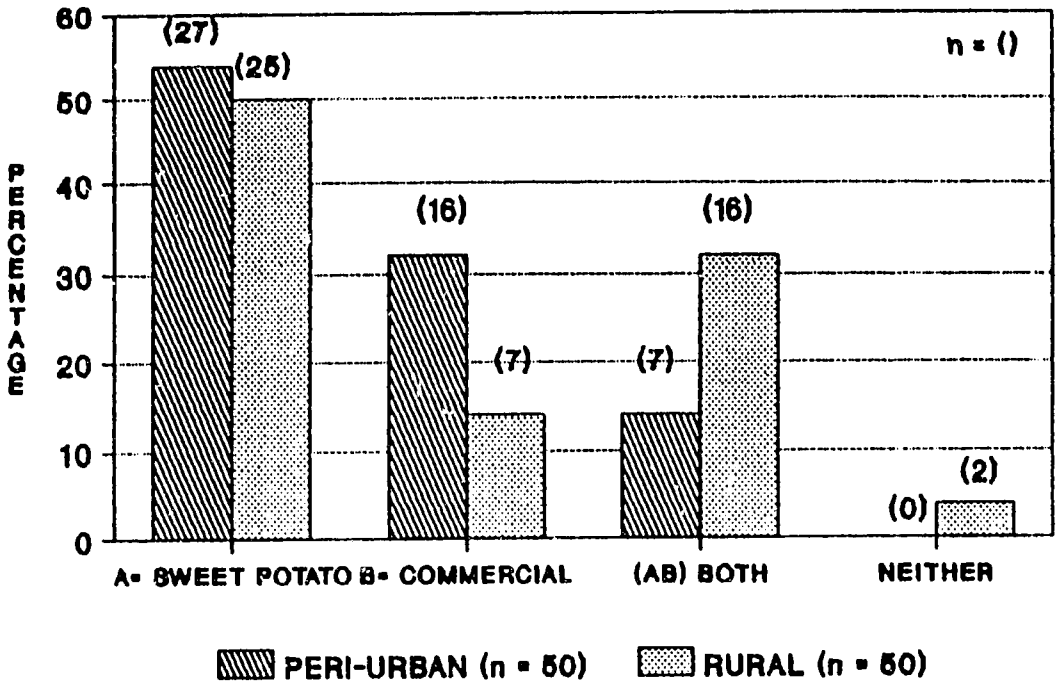


FIGURE 26

COMPARATIVE ACCEPTABILITY OF THE GRUELS BY MOTHERS IN DIFFERENTS AREAS

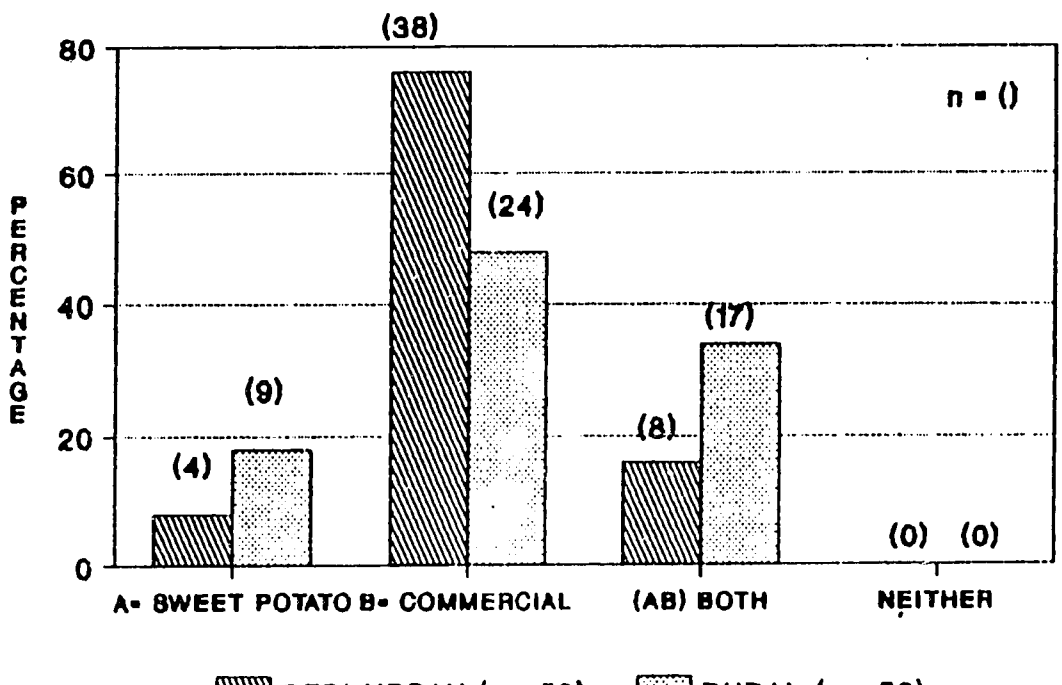


FIGURE 27

COMPARATIVE ACCEPTABILITY OF THE PUREES BY CHILDREN IN DIFFERENTS AREAS

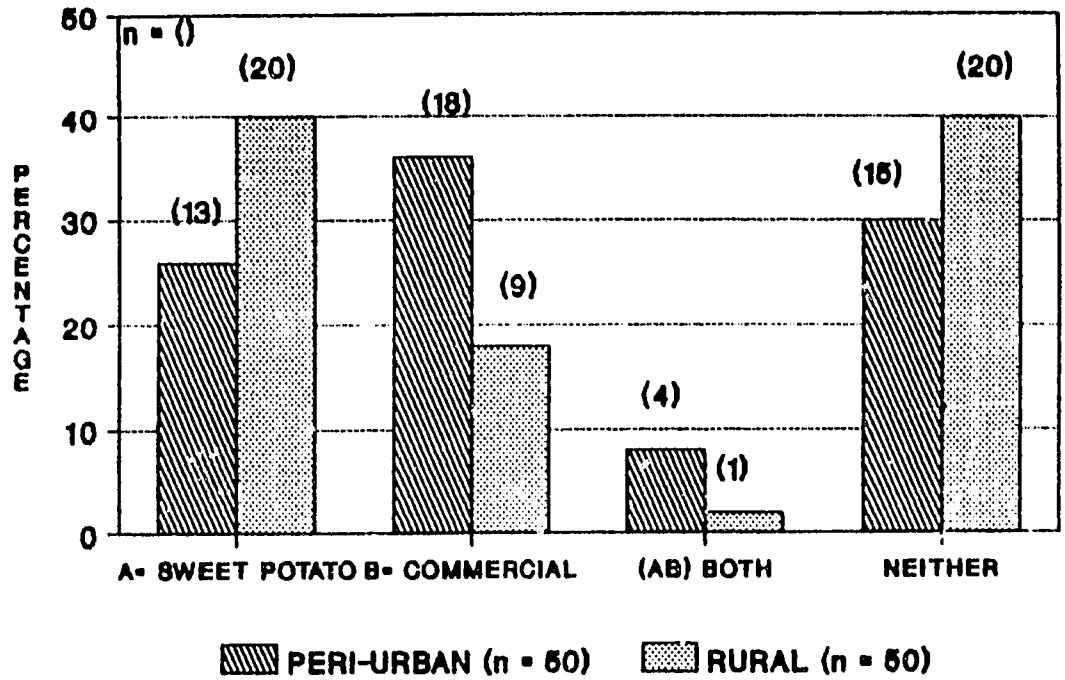


FIGURE 28

COMPARATIVE ACCEPTABILITY OF THE GRUELS BY CHILDREN IN DIFFERENTS AREAS

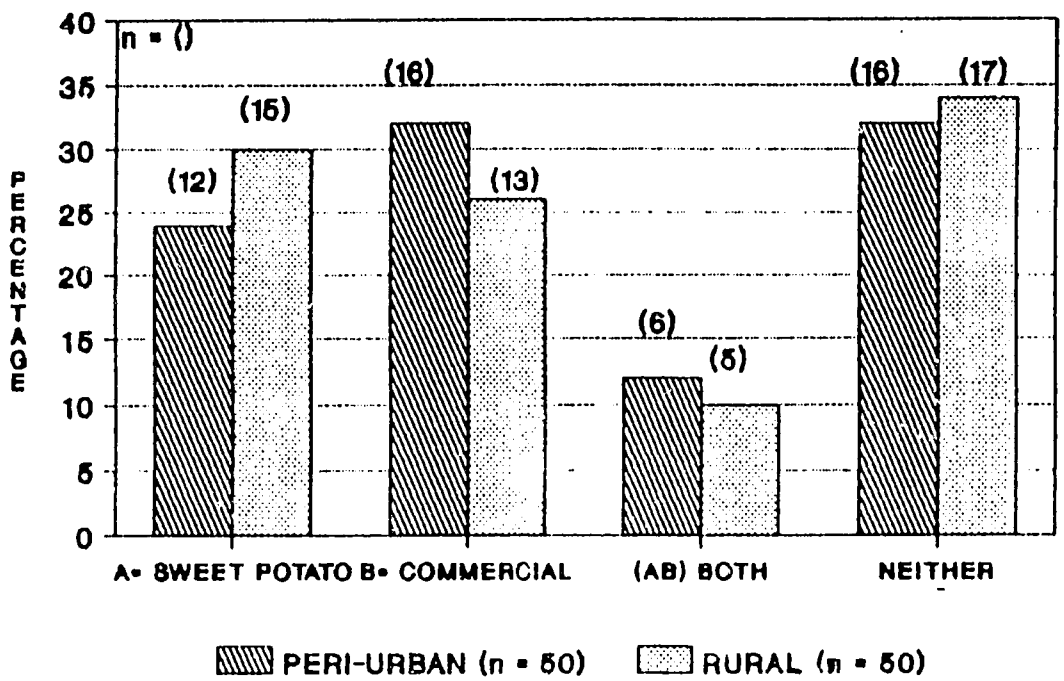
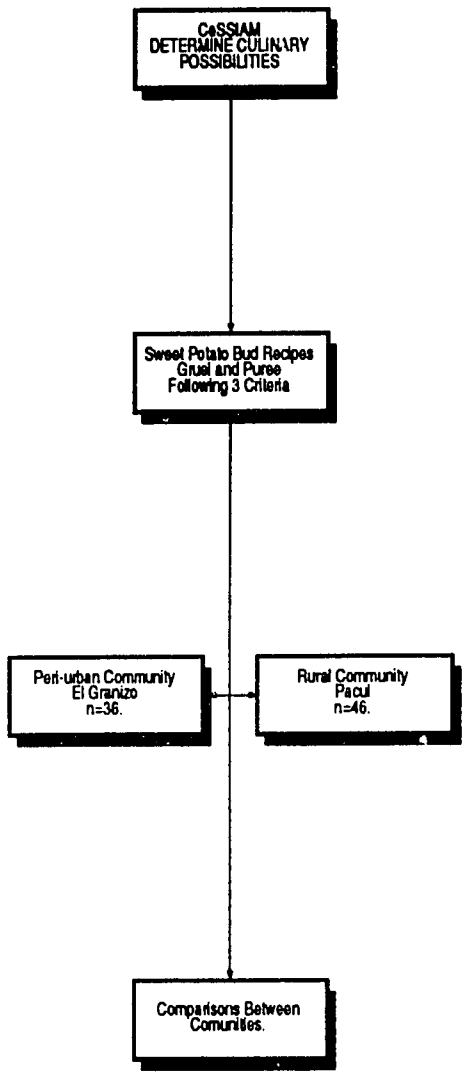


FIGURE 29

OBJECTIVE #5


CoSSIAM
DETERMINE CULINARY
POSSIBILITIES
Sweet Potato Bud Recipes
Gruel and Puree
Following 3 Criteria
Peri-urban Community
El Granizo
n=36.
Rural Community
Pacul
n=46.
Comparisons Between
Comunities.

E. Objective #5: Determine Culinary Possibilities

1. Introduction

The objective of this component was to determine the variety of culinary possibilities in low income households (urban and rural) by motivating mothers to develop recipes with sweet potato buds and draw comparisons.

The sweet potato buds, reconstituted in the forms of a gruel and puree (breakfast cereal), in the foregoing section, followed a specific recipe formulated by the project nutritionists. These were used in a standardized fashion to address the questions of Objective #4. However, they represent the narrowest range of possibilities for preparation. Thus, it was considered important to see how individual mothers in different households would prepare the dried sweet potato buds into forms of gruel and puree if left on their own without specific guidance.

2. Methods

In order to determine the culinary possibilities for sweet potato buds, a study was conducted with 36 urban and 46 rural indigenous women in two communities. The first community, El Granizo, was selected to represent an urban community, and the aldea of Pacul, an indigenous community located 45 klm from Guatemala City, was chosen to represent a rural community.

In both communities leaders were contacted to inform them of the purpose of the study and to request assistance in organizing the participation of mothers. In each community mothers were enrolled into three groups each with instructions to prepare sweet potato buds using the following criteria:

a) prepare SPBs following their own criteria and bring a portion of the recipe the following day;
b) prepare SPBs in the form of an "atol" (gruel) and a puree following instructions provide to them and to bring a sample of their recipe the following day, and;
c) prepare creative recipes and bring a sample of the recipe the following day.

Each mother was provided with one pound of the sweet potato bud product the day they were enrolled. The following day each mother was interviewed regarding the ingredients and preparation of their recipe(s). In addition to the questions related to preparation, mothers were asked if they liked the product; if they thought it easy to prepare; if it was easy to combine with other ingredients; if it was practical for creation of new recipes; and with whom they tried their own recipe.

3. Results

a. Urban Community - El Granizo

A total of 36 mothers participated in the development of recipes for sweet potato buds: 4 in Group I; 13 in Group II, and; 19 in Group III.

In addition to the 27 different "atol" recipes and 11 different "puree" recipes reported, other recipes were created including pancakes, sweet and salty patty cakes, soup, jelly, sweets and deserts. Some mothers reported adding sweet potato buds to soups, in their child's baby bottle milk, and in baby cereal. In total 57 recipes or uses were found. **Table 1** outlines the distribution of recipes by groups.

Table 1
Recipes From Urban Community Distributed by Group

URBAN	Group I	Group II	Group III	Total
Number	4	13	19	36
GRUEL	4	14	9	27
PUREE	1	8	2	11
PANCAKE	1	1	2	4
PATTIE CAKE	-	2	2	4
PUDDING	-	-	4	4
DESERT	-	-	2	2
JELLY	-	1	-	1
SOUP	-	-	1	1
RELLENITO	-	-	1	1
PUDDING PINEAPPLE	-	-	1	1
SPB PINEAPPLE	-	-	1	1

The set of tables included in **Appendix 5** contain the data regarding amounts and type of ingredients used in the preparation of different recipes.

Questions related to the acceptability of the product for the creation of recipes were asked after the women had presented their recipe samples. In El Granizo, 100% of the women who used SPB thought the product was good, 100% reported it to be easy to prepare, 97% thought that is was easy to combine with other ingredients, and 100% reported that SPBs was a practical product for the creation of recipes. In response to the question with whom they tried their new recipes, 92% reported that they tried it themselves, 67% gave it to their children, 44% gave it to their husbands, and 50% gave it to someone else in the house (parent, relative, sibling, or neighbor or friend). See **Table 2.**

Table 2

Acceptability of SPB for Recipes (Urban n=36)

What do you think of this product?	*n*	*%*
GOOD	36	100.0
REGULAR	0	0.0
BAD	0	0.0
NO ANSWER	0	0.0
Is it easy to prepare?		
YES	36	100.0
NO	0	0.0
NO ANSWER	1	0.0
Is it easy to mix?		
YES	35	97.2
NO	1	2.8
NO ANSWER	0	0.0
Is it easily used in other recipes?		
YES	36	100.0
NO	0	0.0
NO ANSWER	0	0.0
Who tried your recipe?		
HERSELF	33	91.7
CHILDREN	24	66.7
HUSBAND	16	44.4
SOMEONE ELSE	18	50.0
NO ANSWER	1	2.8

b. Rural Community - Pacul

A total of 46 women participated in the development of new recipes for sweet potato buds: 14 in Group I; 18 in Group II, and; 14 in Group III. Groups I and III were enrolled separately, but in the same day, while Group II was enrolled the day following the first two groups.

A total of 32 different "atol" recipes and 17 different gruel recipes were created. In addition 4 pattie cake, 3 soup, 2 dessert, and 1 rellenito recipes were reported by participating mothers. In total 59 different recipes or uses were found. **Table 3** outlines the distribution of recipes generated by this group.

Table 3
Recipes From Rural Community Distributed by Group

RURAL	*Group I*	*Group II*	*Group III*	*Totals*
Number	14	18	14	46
GRUEL	9	16	7	32
PUREE	2	15	-	17
PATTIE CAKE	-	-	4	4
SOUP	-	1	2	3
DESSERT	-	-	2	2
RELLENITO	-	-	1	1

The set of tables included in **Appendix 6** contain the data regarding amounts and type of ingredients used in the preparation of different recipes.

Questions related to the acceptability of the product for the creation of recipes were asked after the women had presented a sample of their recipes. In Pacul, 93% of the women who used SPB thought the product was good, 98% reported it to be easy to prepare, 91% thought that is was easy to combine with other ingredients, and 89% reported that SPBs was a practical product for the creation of recipes. In response to the question with whom they tried their new recipes, 96% reported that they tried it themselves, 76% gave it to their children, 67% gave it to their husbands, 44% to someone else in the house (parent, relative, sibling, or neighbor or friend). **(Table 4)**

Table 4
Acceptability of SPB for Recipes (Rural n=46)

What do you think of this product?	*n*	%
GOOD	43	3.5
REGULAR	2	4.3
BAD	0	0.0
NO ANSWER	1	2.2
Is it easy to prepare?		
YES	45	97.8
NO	0	0.0
NO ANSWER	1	2.2
Is it easy to mix?		
YES	42	91.3
NO	2	4.3
NO ANSWER	1	2.2
Is it easily used in other recipes?		
YES	41	89.1
NO	3	6.5
NO ANSWER	2	4.3
Who tried your recipe?		
HERSELF	44	95.6
CHILDREN	35	76.1
HUSBAND	31	67.4
SOMEONE ELSE	20	43.5
NO ANSWER	2	4.3

c. Comparisons Between Urban and Rural Recipes

A total of eleven different recipes were created by 36 women from the urban community, while only six different recipes were prepared by 46 women in the rural setting. Gruel, puree, pattie cake, soup, dessert, and "rellenito" were common recipes in both communities. Pancake, pudding, jelly, and SPB with pineapple were recipes prepared only in the urban community. Of the recipes common for both communities, there were seven sweet puree recipes and four salty recipes created by women in the urban community. In the rural setting, there were 31 sweet puree recipes and only one salty recipe. The other common recipe between groups were sweet pattie cakes. Besides soup recipes, all of the others were sweet.

Comparing the different gruel recipes prepared in the two communities, a median of five ingredients were used by the women from the urban community, while a median of four ingredients were used to prepare gruel in the rural community. Twenty-seven out of 36 women prepared gruel in the urban setting and 32 out of 46 in the rural community. Details of the ingredients used are shown in **Figure 1.** As shown, milk (67% vs 16%), bits of salt (41% vs 9%) and vanilla (11% vs 0%) are most commonly used by urban women. Sugar and cinnamon are slightly higher in the rural setting (93% vs 100% and 82% vs 84%). Also the rural community tended to add more ingredients to thicken the recipes such as polenta, oatmeal, starch, incaparina, or St. Vincent flour.

Figure 2 shows the ingredients used to prepare puree. Eleven out 36 women and 17 out of 46 rural women made puree from SPB. Ingredients most commonly added to puree in urban settings were milk (54% vs 24%), salt (54% vs 12%), margarine (45% vs 12%), onion (18% vs 6%), and bouillon (27% vs 0%). Rural women tended to prepare more sweet purees utilizing many different kinds of fruits such as apple, peach, plum, pear, pineapple, and banana. In contrast, urban area women tended to add only raisins. But the tendency of both groups was to use five as the median number of ingredients to add in the preparation of either sweet or salty purees.

In each group four women prepared pattie cake using a median of six ingredients. **Figure 3** shows the different ingredients utilized in the preparation of these recipes. Eggs (75% vs 25%), cinnamon (50% vs 25%), margarine (50% vs 0%), and flour (25% vs 0%) were most frequently used by urban women, while oil (100% vs 75%) was the most common ingredient used to fry the pattie cakes in the rural community.

Figure 4 summarizes all of the ingredients used by women of both groups for the soup recipes. There was only one soup recipe in the urban setting compared to three in the rural community. The ingredient most commonly used by both groups was tomato (100%).

For desert, there were two recipes in each group. Milk was used in the two rural recipes but not in the urban ones. However, the urban recipes contained a wider variety of ingredients overall. **(Figure 5)**

Rellenito was also prepared by one woman from each community (the figure with the ingredient is not shown) but both recipes are summarized in the appendix of recipes reported for each community.

Figure 1

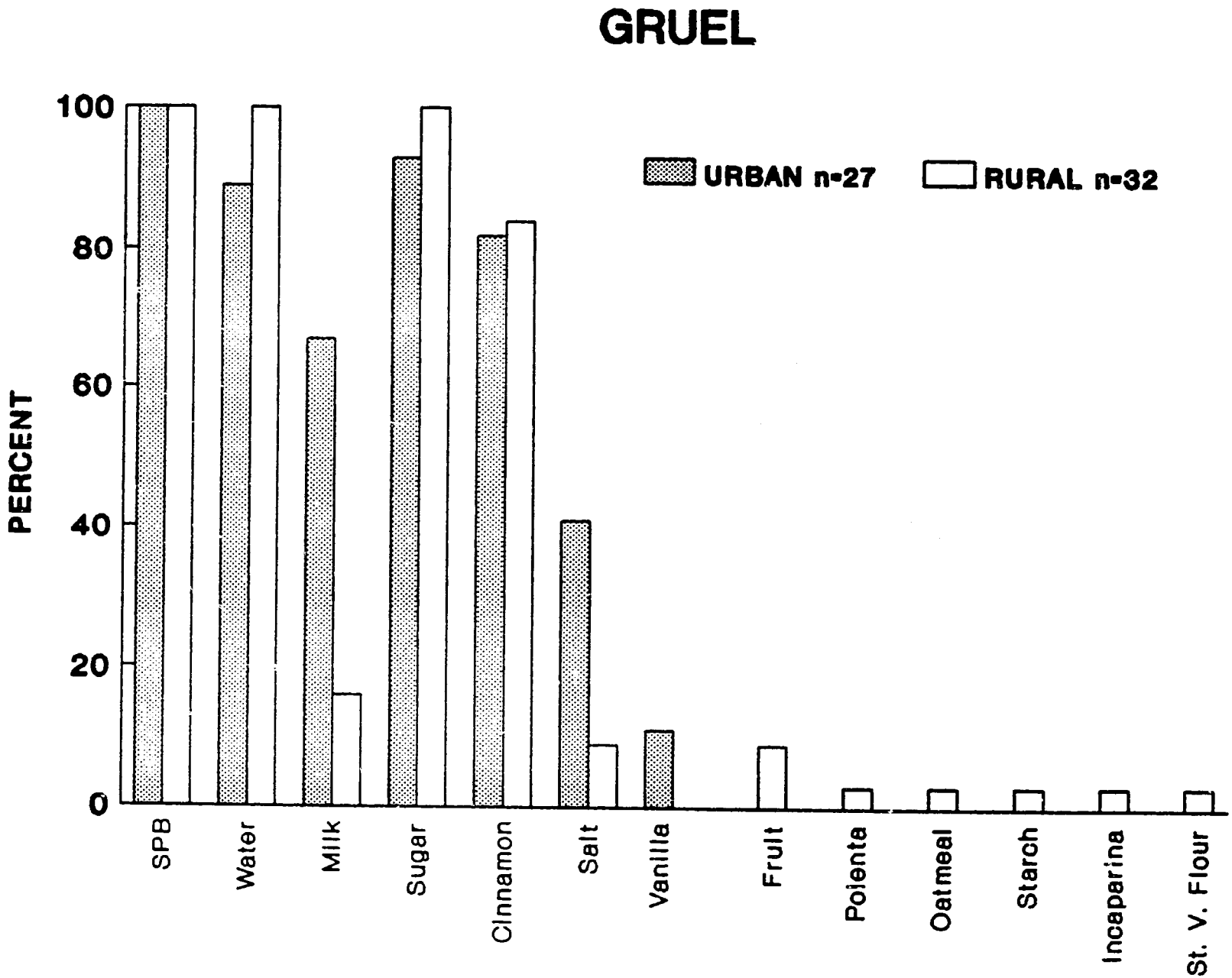

GRUEL
URBAN n=27
RURAL n=32
PERCENT
100
80
60
40
20
0
SPB
Water
Milk
Sugar
Cinnamon
Salt
Vanilla
Fruit
Polenta
Oatmeal
Starch
Incaparina
St. V. Flour

Figure 2

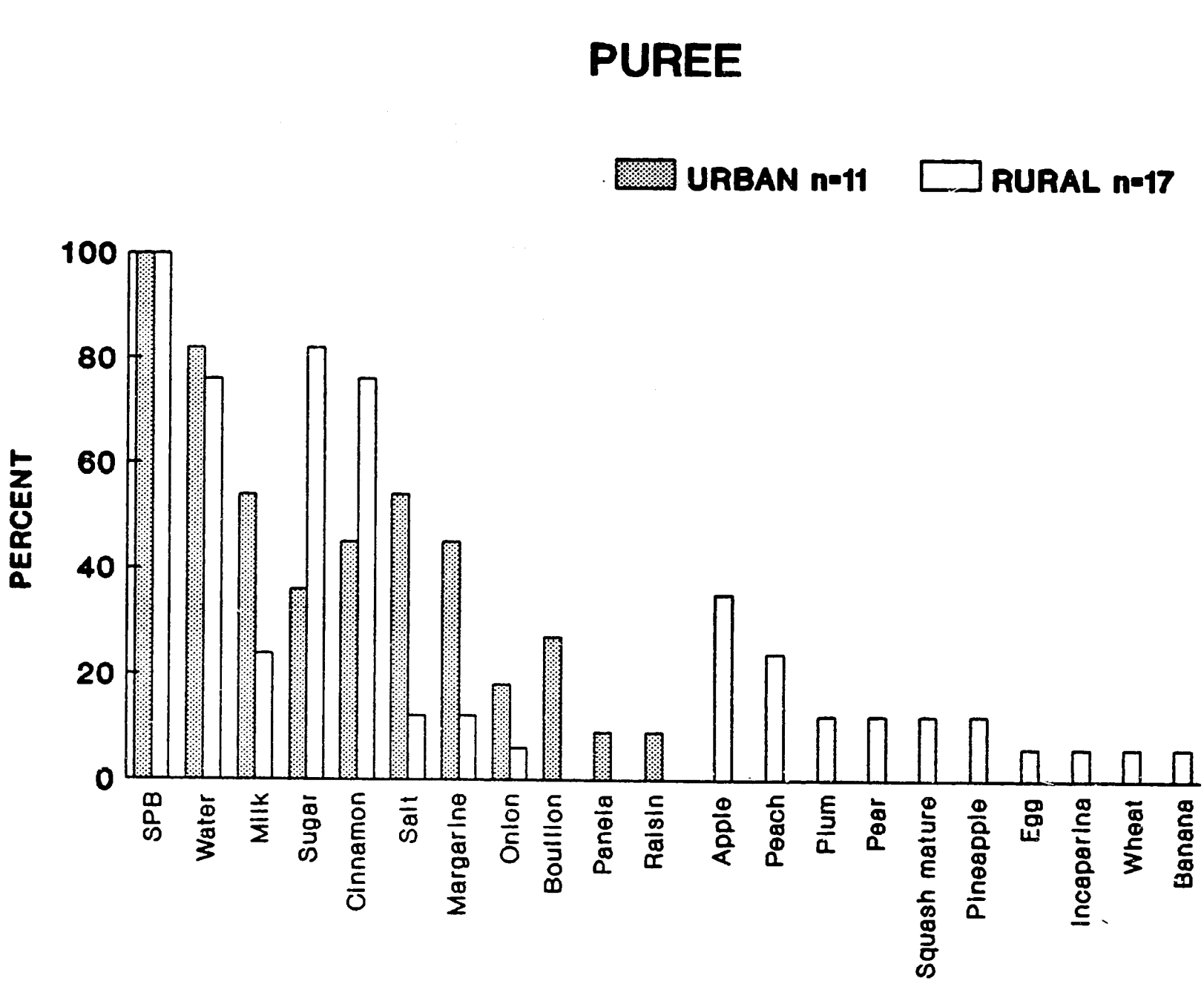

PUREE
URBAN n=11
RURAL n=17
PERCENT
100
80
60
40
20
0
SPB
Water
Milk
Sugar
Cinnamon
Salt
Margarine
Onion
Bouillon
Panela
Raisin
Apple
Peach
Plum
Pear
Squash mature
Pineapple
Egg
Inceparina
Wheat
Banana

Figure 3

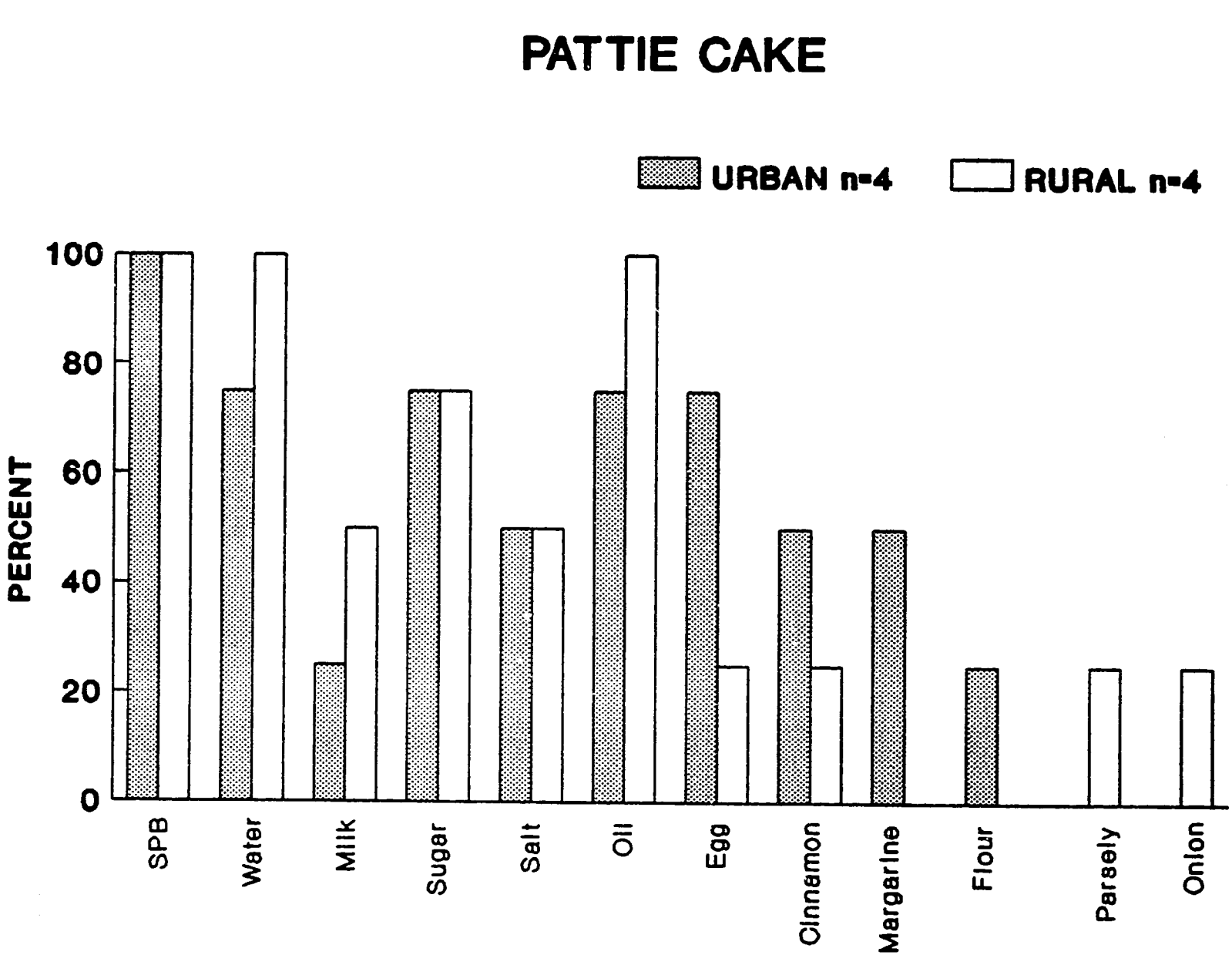

PATTIE CAKE
URBAN n=4
RURAL n=4
PERCENT
100
80
60
40
20
0
SPB
Water
Milk
Sugar
Salt
Oil
Egg
Cinnamon
Margarine
Flour
Parsely
Onion

Figure 4

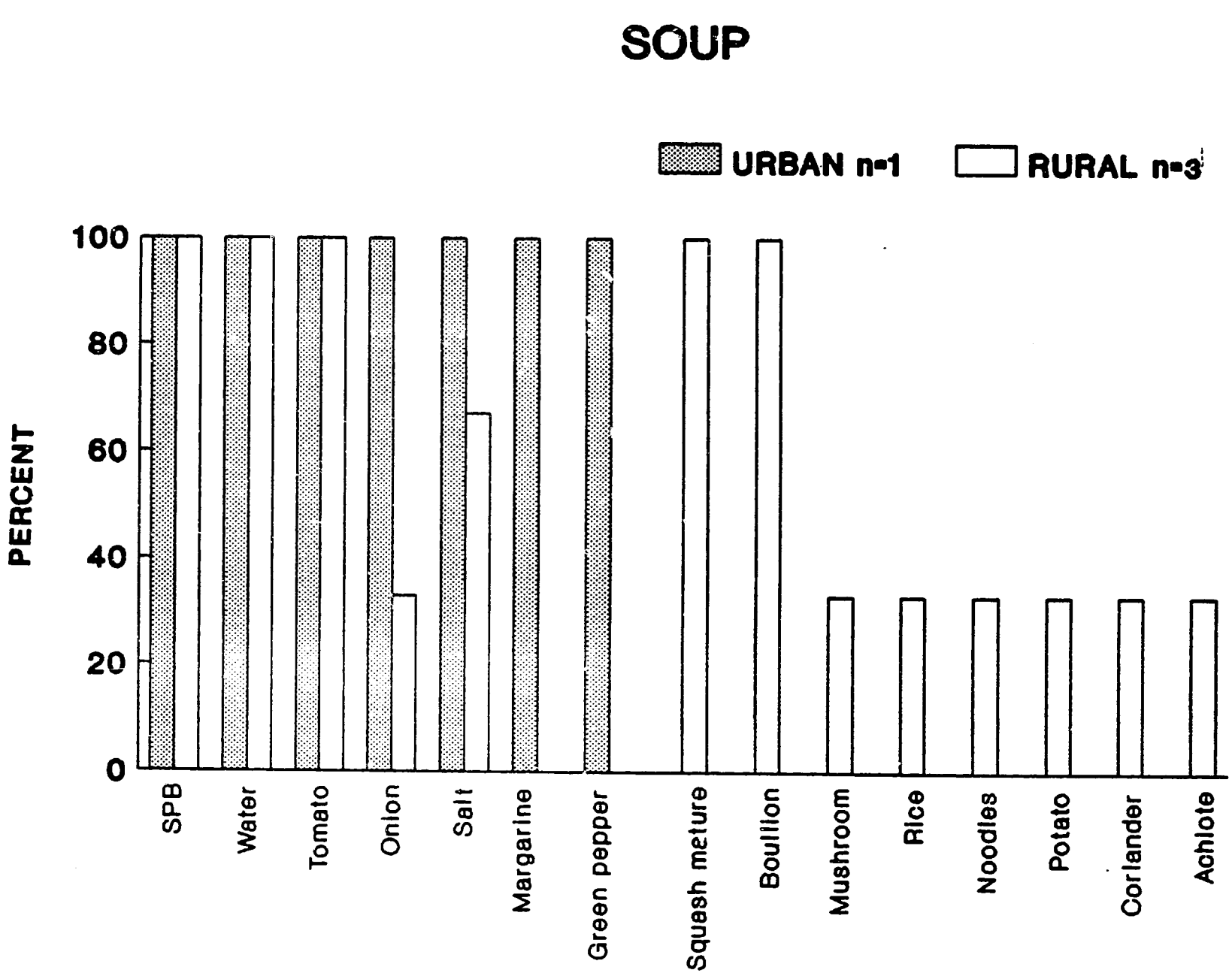
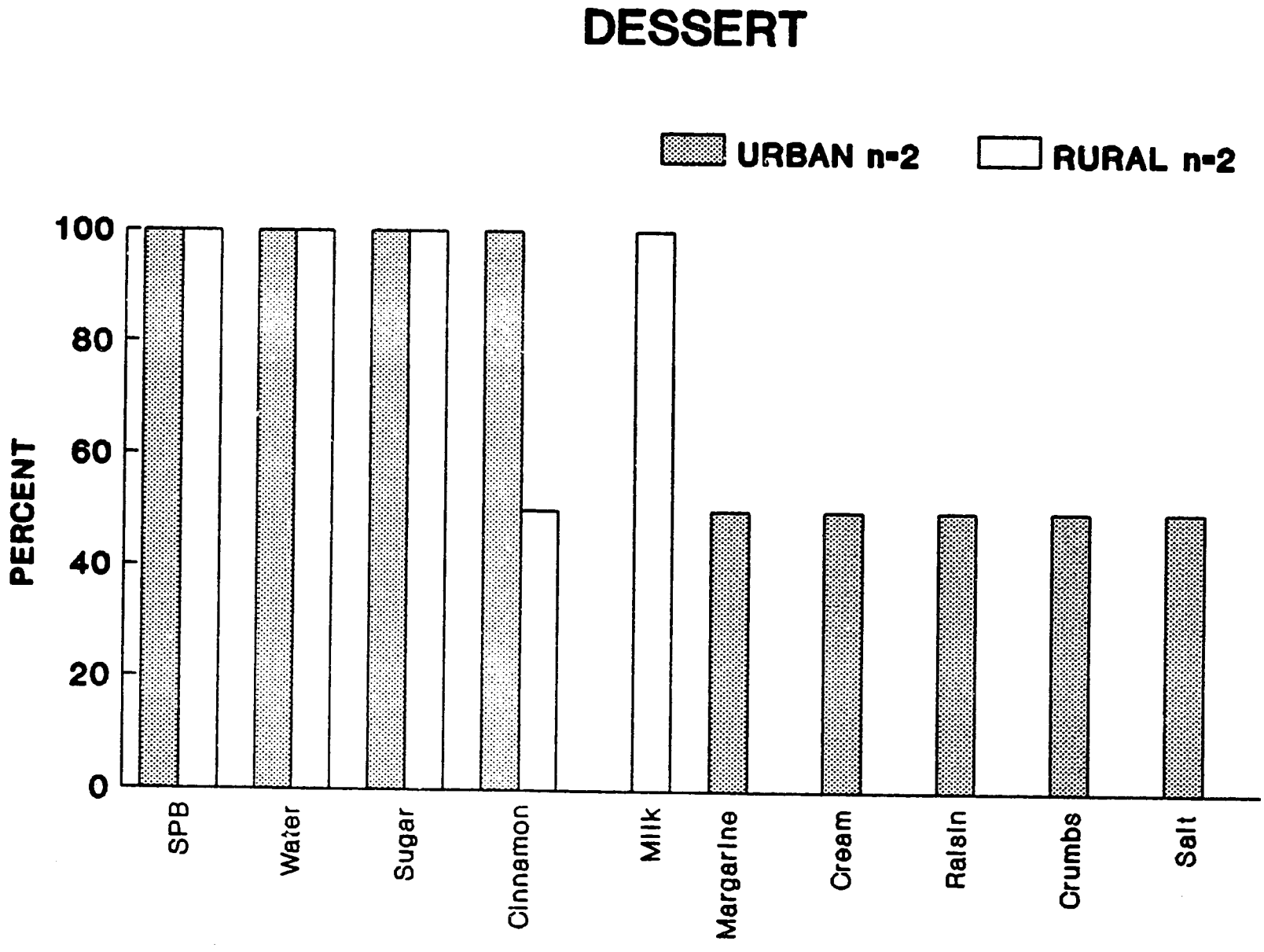
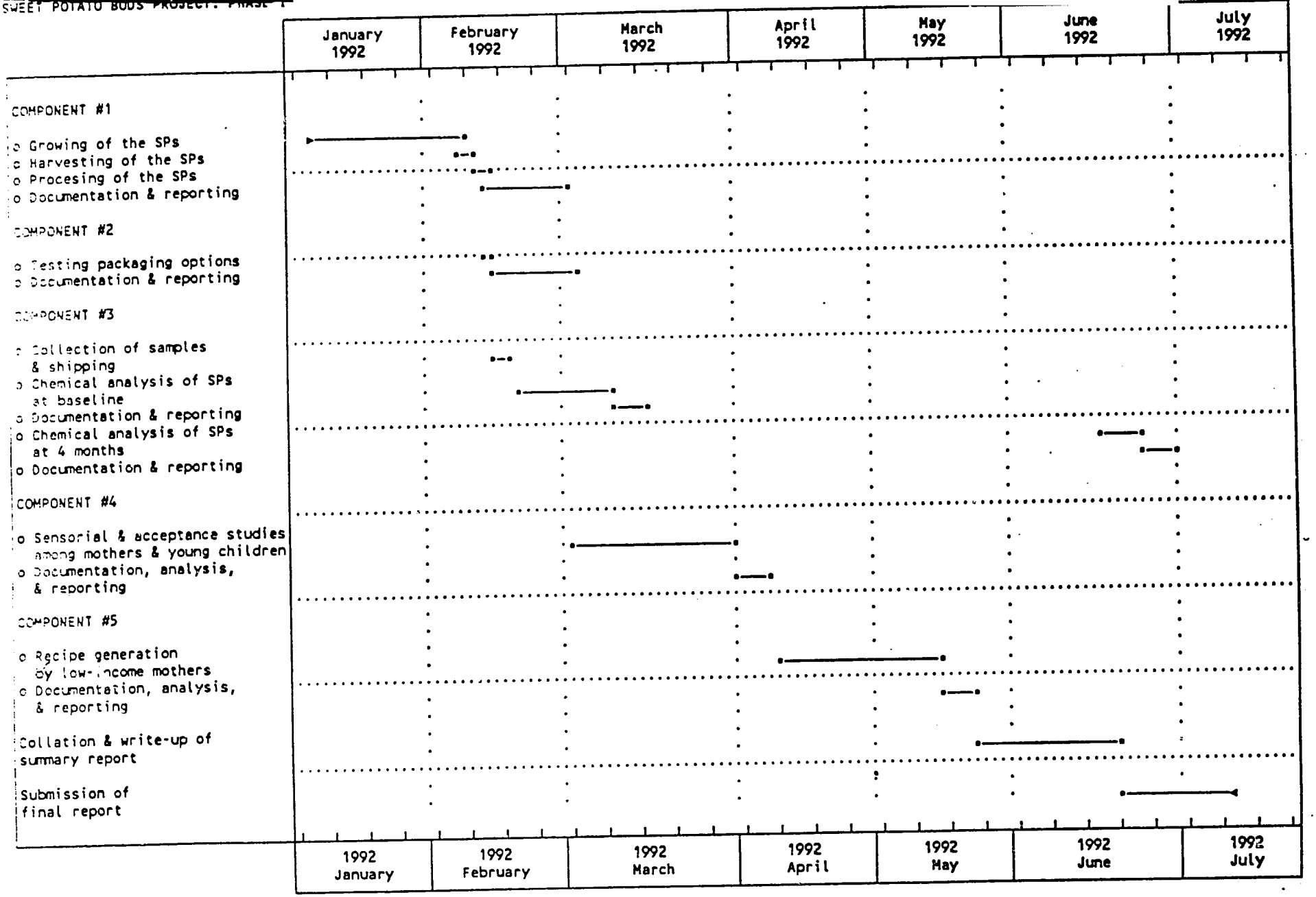

SOUP
URBAN n=1
RURAL n=3
PERCENT
100
80
60
40
20
0
SPB
Water
Tomato
Onion
Salt
Margarine
Green pepper
Squash meture
Boullion
Mushroom
Rice
Noodles
Potato
Corlander
Achiote

Figure 5


DESSERT
URBAN n=2
RURAL n=2
PERCENT
100
80
60
40
20
0
SPB
Water
Sugar
Cinnamon
Milk
Margarine
Cream
Raisin
Crumbs
Salt

SWEET POTATO BUDS PROJECT: PHASE I



IV. SCHEDULE OF ACTIVITIES COMPLETED

The schedule of activities completed, by project component, is found on the following page. Except for the reporting, the project remained on schedule.

VI. APPENDIX

1. Identity of Sweat Potato Specimens
2. March Baseline Analysis
3. August Follow-up Analysis
4. Acceptability Questionnaires
5. Recipes - Urban
6. Recipes - Rural
7. Photographs

APPENDIX

1. Identity of Sweet Potato Specimens
2. March Baseline Analysis
3. \ugust Follow-up Analysis
4. Acceptability Questionnaires
5. Recipes - Urban
6. Recipes - Rural
7. Photographs

APPENDIX I

DETAILS OF THE SWEET POTATO SAMPLES SENT TO THE DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY OF THE NORTH CAROLINA STATE UNIVERSITY FOR LABORATORY DETERMINATION OF VITAMIN A ACTIVITY

Six Samples of Sweet Potato of Variety 387 with Purple Husk and Yellow Pulp from San Miguel Dueñas, Sacatepequez

Sample #	Raw Weight (g)	Weight post 5-min Blanching (g)
1	100	103
4	100	102
6	100	100
8	100	102
10	100	100
15	100	100

Six Samples of Sweet Potato of Variety with Brown Husk and Intense Orange Pulp from ICTA, la Fragua, Zacapa

Sample #	Raw Weight (g)	Weight post 5-min Blanching (g)
18	100	102
19	100	102
22	100	100
24	100	102

Six Samples of Sweet Potato of Variety 387 with Purple Husk and Intense Orange Pulp from ICTA, la Fragua, Zacapa

Sample #	Raw Weight (g)	Weight post 5-min Blanching (g)
25	100	100
26	100	102
27	100	102
28	100	104

APPENDIX #2
MARCH BASELINE ANALYSIS
REPORT

Analysis of Provitamin A Content in Guatemalan Sweet Potatoes

Report to International Eye Foundation
Bethesda, MD

And

Dr. Noel Solomons
CeSSIAM

March 1992

Prepared by:
Ruth H. Watkins and Steven J. Schwartz
North Carolina State University

Introduction:

Samples from CeSSIAM of three varieties of sweet potatoes and one variety of sweet potato buds were analyzed to determine the provitamin A content. The only significant provitamin A compound in sweet potatoes is β-carotene. The goals were to find the β-carotene content of these samples, convert β-carotene values into retinol equivalents and to compare the differences between the three sweet potato varieties. Likewise, the provitamin A value of the bud product was determined and will be used to evaluate the storage stability of β-carotene in the bud.

Experimental:

The fresh sweet potatoes were harvested and blanched (less than 24 hours from harvest) for 5 minutes. One-hundred grams each of 14 samples were quick frozen on dry ice and shipped to this lab for analysis. The samples contained three varieties: 4 "pale", 4 "pigmented" and 6 "less pale" samples. The samples were separated visually upon arrival into their respective classes. The samples numbered 4 and 6 were not of the same "less pale" color as the other four samples in this variety but were labeled as "less pale" because they were slightly darker than the "pale" variety. Samples were combined into extraction pairs of like variety. In total, seven blanched sample extractions were performed. The buds arrived in six bags and two extractions from each bag were performed.

The extraction procedure for the blanched tissue followed that of the previously reported method. The method for extracting the buds was altered to include more water to make the initial puree. Thirty grams of buds were added to 130 mL of water and blended to make a puree from which the 10 grams for extraction was taken.

The HPLC and moisture analysis procedures followed the previous procedure.

Results and Discussion:

The provitamin A carotenoid, β-carotene, is found in abundance in sweet potatoes. The predominant form of β-carotene in the blanched and bud samples was the all-trans-form. However, during the thermal process for producing buds, significant quantities of the cis isomers were formed. This conformational change can be seen in the differences noted in the enclosed chromatogram. This isomeric change does not affect the calculation for provitamin A activity. But, studies have shown that isomerization of the all-trans to the cis isomers reduces the biological availability of β-carotene as a precursor to vitamin A (Zechmeister, 1949 and Sweeny and Marsh, 1971).

The concentration of β-carotene and RE (retinol equivalent) value of the sweet potato and bud samples are shown in table 1. The comparison of the RE in blanched samples versus the processed buds is on a dry weight basis. The percent remaining moisture in the processed buds was very low and outside the range of measurement with the current method. Therefore, it was assumed that the moisture content was 0% in the buds. The total RE in the buds was higher than that found in the pale samples (improved variety intense orange color produced by ICTA in La Fragua, Zacapa) and slightly higher than the less pale samples (variety purple peel and yellow pulp from San Miguel Duenas, Sacatepequez, Antigua). The pigmented samples (387 variety produced by ICTA in La Fragua, Zacapa) had the highest RE of all the samples.

The standard deviation between samples of the same variety was highest for the less pale samples. This was due, in part, to the inclusion of samples 6 and 4. This pair of sweet potatoes more closely resembled the pale variety than the less pale variety. The lowest standard deviation was between the the two samples of the pale variety. The standard deviation was acceptable for the buds and showed little variation between the six sample bags. The pigmented samples also had a high standard deviation. Previous work also showed high variability between samples. This variation

may be due to may factors including: experimental error, crop location, climate (rainfall), and between plant differences.

In summary, the pigmented variety of sweet potato had the highest provitamin A content and the RE was higher in this variety than in the typical American variety (44.3 RE as compared to 8.8 RE (Adams, 1975)). The other two varieties and the bud had lower RE values. Raw data and calculation procedures can be found in the Appendix.

References

Adams, C.A. 1975. "Nutritive Value of American Foods". Ag. Handbook No. 456. US Printing Office, Washington, DC.

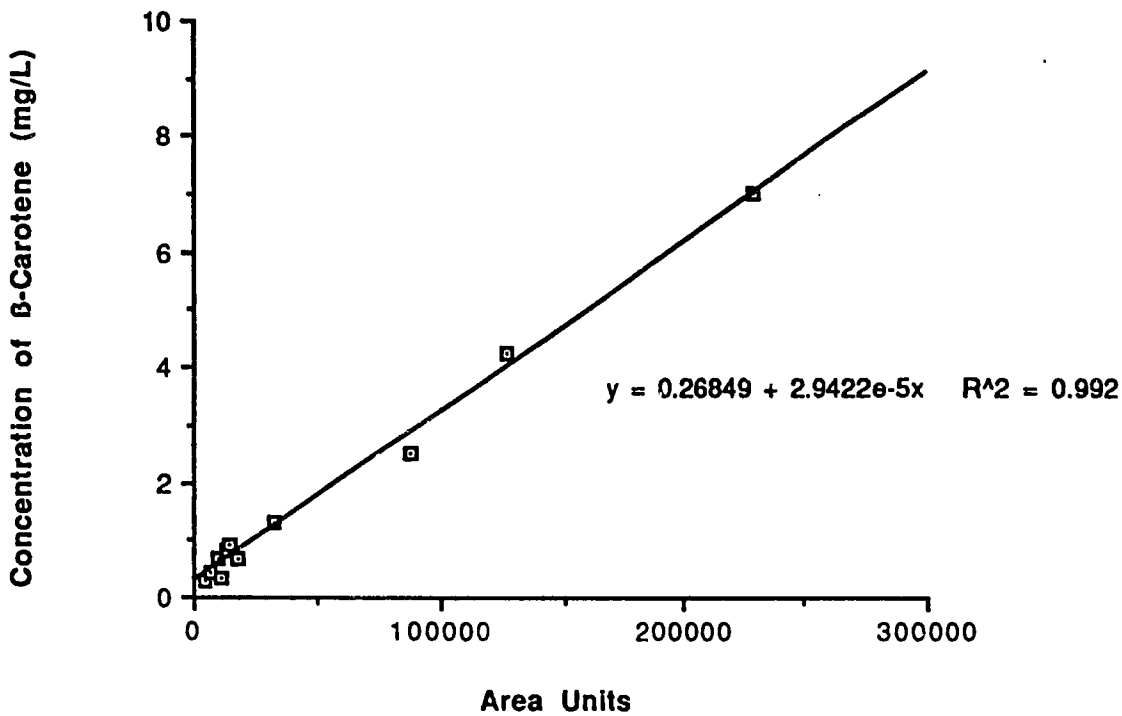
Sweeny, J.P. and Marsh, A.C. 1971. Effect of Processing on Provitamin A in Vegetables. J. A. Diet. Assoc. 59:238-243.

Zechmeister, L. 1949. Stereoisomeric Provitamins A. Vitamin. Horm. 7:57-81.

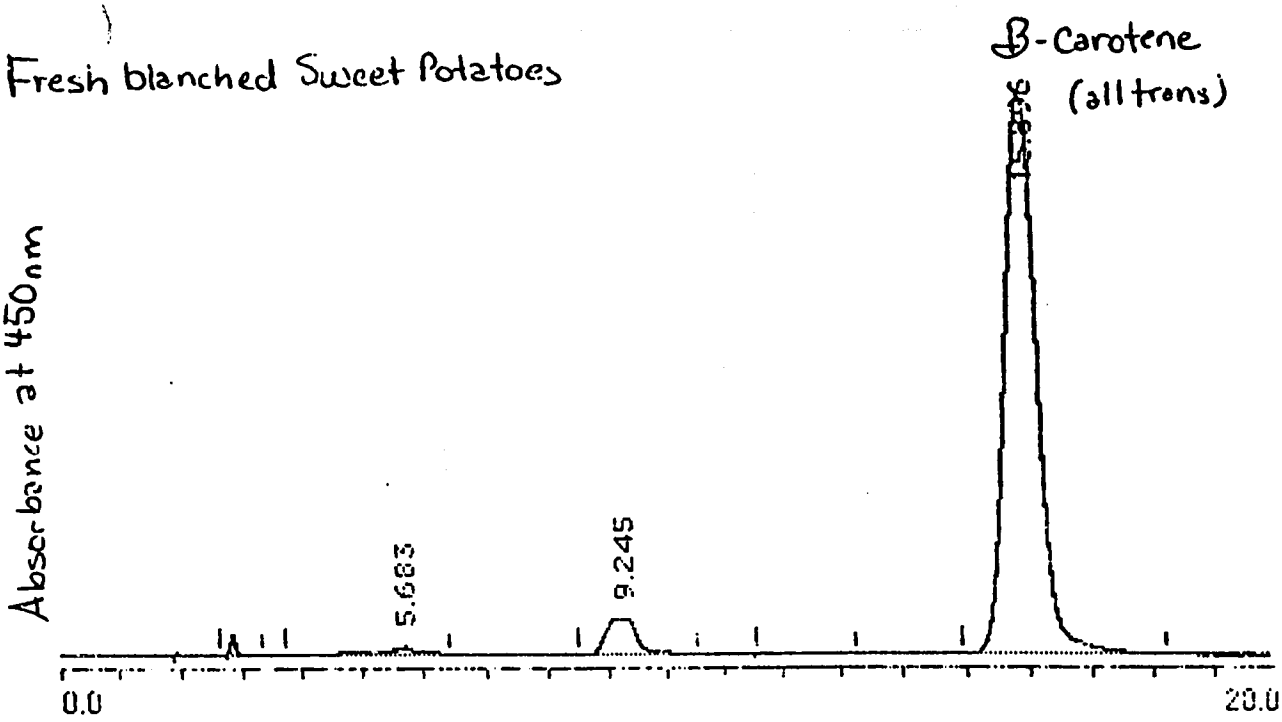
Appendix

1- Concentration curve for β-carotene versus absorbance units
2- Sample calculations for conversion of absorbance unit to RE
3- Table for moisture content of blanched sweet potato samples
4- Table for β-carotene and RE values for blanched sweet potatoes
5- Table for moisture content of bud samples
6- Table for β-carotene and RE value of bud samples

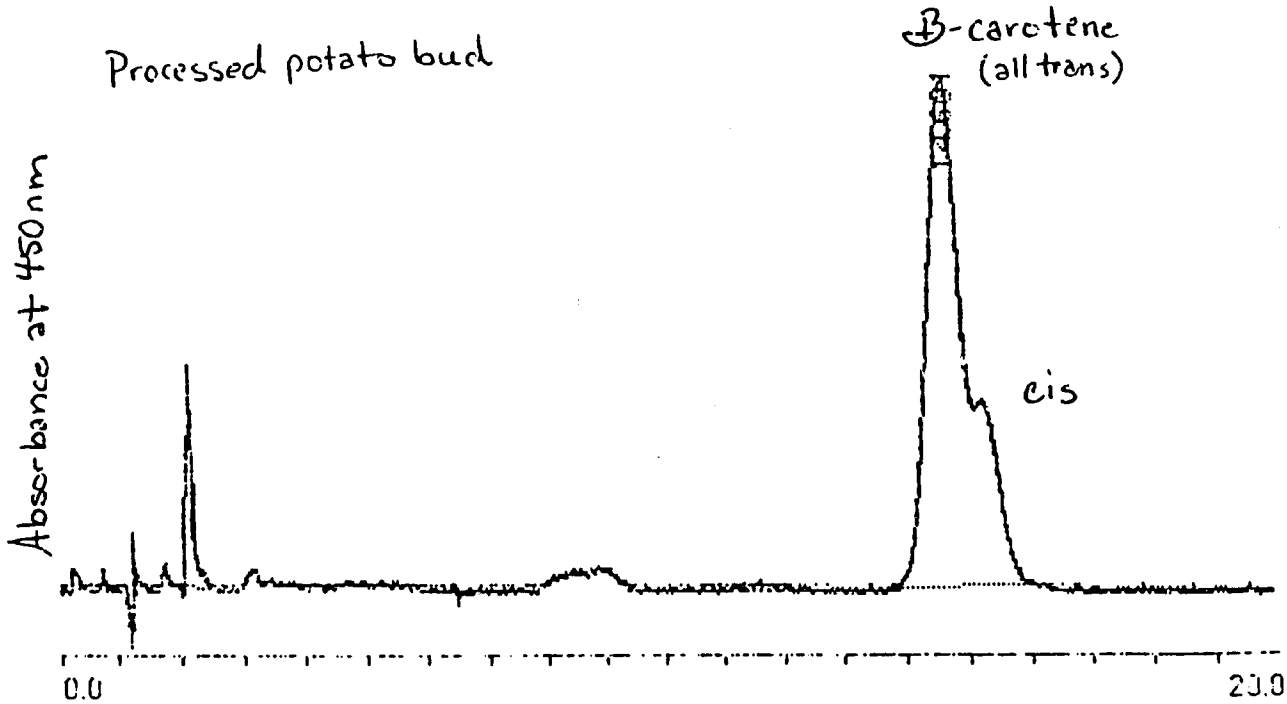
Standard Curve of ß-Carotene Concentration



Fresh blanched Sweet Potatoes



Processed potato bud



Conversion of β-Carotene to Retinol Equivalents:

Sample calculation: y= concentration of ß-carotene (mg/L)

x= area units from the dynamax integration

$y=2.6849*10^{-1} + 2.9244*10^{-5}$ (x)

mg/L to µg/g sample used 50 mL total sample extraction volume.

1 Retinol Equivalent= 6 µg β-carotene

Moisture Calculations for Blanched Sweet Potatoes

Guatemala # San Miguel	Blanched wt. grams	Original Wt. grams	During blanch H20 + grams	Avg added grams	Wet wt. grams	Dry wt. grams	% solids from puree	Avg Wet wt. grams
1	103.0	100.0	3.0	1.5	9.9	1.3	13.4	9.9
15	100.0	100.0	0.0	1.5	9.9	1.4	14.0	
8	102.0	100.0	2.0	1.0	9.9	1.6	16.1	10.5
10	100.0	100.0	0.0	1.0	11.0	1.7	15.2	
6	100.0	100.0	0.0	1.0	9.4	1.4	14.8	9.5
4	102.0	100.0	2.0	1.0	9.6	1.5	15.7	
Improved								
18	102.0	100.0	2.0	2.0	10.2	1.6	16.2	9.6
19	102.0	100.0	2.0	2.0	9.1	1.8	19.3	
20	100.0	100.0	0.0	1.0	9.5	1.4	15.0	9.8
24	102.0	100.0	2.0	1.0	10.2	1.7	16.7	
Variety 387								
28	104.0	100.0	4.0	3.0	10.0	1.0	9.6	9.8
27	102.0	100.0	2.0	3.0	9.5	0.8	8.2	
26	102.0	100.0	2.0	1.0	9.2	1.4	15.8	8.3
25	100.0	100.0	0.0	1.0	7.4	1.0	13.6	

Note: The sweet potato samples were combined into pairs for preparation of puree and extraction. For example, 1 and 15 were combined and so forth.

Moisture Calculations

Guatemala # San Miguel	Avg Dry wt. grams	1/2=wet tissue grams	Minus H2O added from blanch	% solid of tissue	Wet Wt (g) for extraction	Wet Adjusted for Blanch gain (g)	Dry extraction weight grams
1	1.4	4.9	4.9	27.8	5.0	4.9	1.4
15							
8	1.6	5.2	5.2	31.6	5.0	5.0	1.6
10							
6	1.4	4.7	4.7	30.8	5.0	5.0	1.5
4							
Improved							
18	1.7	4.8	4.7	36.0	5.0	4.9	1.8
19							
20	1.6	4.9	4.9	32.1	5.0	5.0	1.6
24							
Variety 387							
28	0.9	4.9	4.8	18.4	5.0	4.9	0.9
27							
26	1.2	4.1	4.1	30.0	5.0	5.0	1.5
25							

ß-carotene Concentration in Blanched Sweet Potatoes

Sample # San Miguel	Wet Adjusted for Blanch gain (g)	Dry extraction weight grams	Absorbance units (sucessive duplicates)	Average Abs. units	ß-carotene mg/L (wet)
1	4.9	1.4	26235	26495.0	1.048
15			26755		
8	5.0	1.6	26271	26631.5	1.052
10			26992		
6	5.0	1.5	6845	6831.5	0.469
4			6818		
Improved					
18	4.9	1.8	6319	6234.5	0.452
19			6150		
20	5.0	1.6	4826	4886.5	0.412
24			4947		
Variety 387					
28	4.9	0.9	777392	781826.0	23.271
27			786260		
26	5.0	1.5	959112	970670.5	28.828
25			982229		

ß-carotene Concentration in Blanched Sweet Potatoes

Sample # San Miguel	ß-carotene µg per Gram of wet tissue	ß-carotene µg/g (dry)	Retinol Equivalents Per Gram of Wet tissue	Retinol Equivalents Per Gram of Dry tissue
1	10.640	38.227	1.773	6.371
15				
8	10.627	33.586	1.771	5.598
10				
6	4.742	15.399	0.790	2.567
4				
	Average 8.670 Standard Deviation 3.401	Average 29.071 Standard Deviation 12.065	Average 1.445 Standard Deviation 0.567	Average 4.845 Standard Deviation 2.011
Improved				
18	4.611	12.806	0.769	2.134
19				
20	4.164	12.965	0.694	2.161
24				
	Average 4.388 Standard Deviation 0.316	Average 12.885 Standard Deviation 0.113	Average 0.732 Standard Deviation 0.053	Average 2.148 Standard Deviation 0.019
Variety 387				
28	239.911	1306.206	39.985	217.701
27				
26	291.187	971.803	48.531	161.967
25				
	Average 265.549 Standard Deviation 36.258	Average 1139.005 Standard Deviation 236.459	Average 44.258 Standard Deviation 6.043	Average 189.834 Standard Deviation 39.410

Moisture Calculations for Buds

Bud bag #	reconstit. grams	added H2O mL	extraction grams	Grams of Buds in extraction	Buds for %H2O grams	water added mL	Wet weight grams
1	30.0	130.0	10.0	1.9	9.0	30.0	10.3
1	30.0	130.0	10.0	1.9	9.0	30.0	10.1
2	30.0	130.0	10.0	1.9	9.0	30.0	9.4
2	30.0	130.0	10.0	1.9	9.0	30.0	10.0
3	30.0	130.0	10.0	1.9	9.0	30.0	9.5
3	30.0	130.0	10.0	1.9	9.0	30.0	10.3
4	30.0	130.0	10.0	1.9	9.0	30.0	10.1
4	30.0	130.0	10.0	1.9	9.0	30.0	10.5
5	30.0	130.0	10.0	1.9	9.0	30.0	10.6
5	30.0	130.0	10.0	1.9	9.0	30.0	10.9
6	30.0	130.0	10.0	1.9	9.0	30.0	9.6
6	30.0	130.0	10.0	1.9	9.0	30.0	10.4

% wet weight of the flake	Avg wet wt grams	Dry weight grams	Avg dry wt grams	% solids	% moisture	Avg % moisture	dry weight of extraction sample
2.4	2.4	2.5	2.4	100.0	0.0	0.0	1.9
2.3		2.4					
2.2	2.2	2.2	2.3	100.0	0.0	0.0	1.9
2.3		2.4					
2.2	2.3	2.3	2.4	100.0	0.0	0.0	1.9
2.4		2.5					
2.3	2.4	2.4	2.5	100.0	0.0	0.0	1.9
2.4		2.5					
2.4	2.5	2.5	2.6	100.0	0.0	0.0	1.9
2.5		2.6					
2.2	2.3	2.3	2.3	100.0	0.0	0.0	1.9
2.4		2.3					

Concentration of ß-carotene in Sweet Potato Buds

Bag #	Flake wt. for extraction (g)	Absorbance units sucessive duplicates	Average Abs. units	ß-carotene mg/L	ß-carotene µg/g bud	Retinol Equivalent Per Gram of Bud
1	1.9	65648.0	66353.0	2.221	59.219	9.870
1	1.9	67058.0				
1	1.9	60242.0	61500.0	2.078	55.412	9.235
1	1.9	62758.0				
2	1.9	63165.0	63725.0	2.143	57.158	9.526
2	1.9	64285.0				
2	1.9	60621.0	60395.5	2.045	54.545	9.091
2	1.9	60170.0				
3	1.9	66085.0	65963.0	2.209	58.913	9.819
3	1.9	65841.0				
3	1.9	67836.0	67950.0	2.268	60.472	10.079
3	1.9	68064.0				
4	1.9	70273.0	70904.0	2.355	62.790	10.465
4	1.9	71535.0				
4	1.9	69845.0	69672.5	2.318	61.824	10.304
4	1.9	69500.0				
5	1.9	55434.0	55235.0	1.894	50.496	8.416
5	1.9	55036.0				
6	1.9	64530.0	64359.0	2.162	57.655	9.609
6	1.9	64188.0				
6	1.9	68945.0	34472.5	1.283	34.206	10.148
6	1.9	68014.0				
					Average 55.699 Standard Deviation 7.935	Average 9.688 Standard Deviation 0.601

APPENDIX #3
AUGUST FOLLOW-UP ANALYSIS
REPORT

Analysis of Provitamin A Content in Stored Guatemalan Sweet Potato Buds

Report to International Eye Foundation
Bethesda, MD

And

Dr. Noel Solomons
CeSSIAM

August 1992

Prepared by:
Ni Luh Puspitasari, Ruth H. Watkins and Steven J. Schwartz
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Raleigh, NC 27695

Comparison of RE Values Between Processed and Blanched Samples

Bud Sample Number	ß-carotene µg/g Bud	Retinol Equivalent Per Gram of Bud
1	59.2	9.9
1	55.4	9.2
2	57.2	9.5
2	54.5	9.1
3	58.9	9.8
3	60.5	10.1
4	62.8	10.5
4	61.8	10.3
5	50.5	8.4
5	50.5	8.4
6	57.7	9.6
6	60.9	10.1
Average	57.5	9.6
Stnd. Dev.	4.1	0.7

Blanched Sample Number	ß-carotene µg/g Blanched Dry Weight	Retinol Equivalent Per Gram Dry Wt.	ß-carotene µg/g Blanched Wet Weight	Retinol Equivalent Per Gram Wet Wt.
1 and 15	38.2	6.4	10.6	1.8
8 and 10	33.6	5.6	10.6	1.8
6 and 4	15.4	2.6	4.7	0.8
Average	29.1	4.8	8.7	1.4
Stnd. Dev.	12.1	2.0	3.4	0.6
18 and 19	12.8	2.1	4.6	0.8
20 and 24	13.0	2.2	4.2	0.7
Average	12.9	2.1	4.4	0.7
Stnd. Dev.	0.1	0.0	0.3	0.1
27 and 28	1306.2	217.7	239.9	40.0
25 and 26	971.8	162.0	291.2	48.5
Average	1139.0	189.8	265.5	44.3
Stnd. Dev.	236.5	39.4	36.3	6.0

Introduction:
Samples from CeSSIAM of sweet potato buds in three packaging types were analyzed to determine the provitamin A content. The only significant provitamin A compound in sweet potatoes is β-carotene. The goals were to find the β-carotene content of these samples, convert β-carotene values into retinol equivalents and to compare the storage stability of the bud product in the different package types. Sweet potato buds were previously analyzed in March 1992. This report includes further analytical data for samples analyzed in June and July, 1992

Experimental:
The buds arrived in three bag types: foil, paper laminate, and plastic. Four bags of each type were extracted in June. Also, two bags of each type were extracted in July.

The method for extracting the buds was as previously reported in March, 1992. Thirty grams of buds were added to 130 mL of water and blended to make a puree from which the 10 grams for extraction was taken. The samples that were extracted in July were lower in β-carotene concentration. Therefore, 20 grams of the puree from these samples was used for extraction in order to obtain detectable levels of β-carotene for HPLC analysis..

The HPLC procedure for separation and analysis followed the method previously stated (March, 1992).

Results and Discussion:
A summary listing the average concentrations of β-carotene and RE (retinol equivalent) values of the sweet potato bud samples on a dry weight basis are shown in Table 1. The March or initial value of ß-carotene is included on this Table for comparison. The data shows that extensive degradation of the ß-carotene has occurred. The loss between the foil packaged samples in March and the foil packaged samples in June (3 months of storage) was approximately 43 percent.

The losses over three months of storage in the paper laminate and plastic bags were even greater (46 and 54%, respectively). Between the three packaging types, the foil package appeared to be a slightly better barrier than the plastic laminate and the plastic laminate appeared slightly better than the plastic bag. However, the only significant difference ($p < 0.05$ level) between the package types was that the foil significantly retained more ß-carotene than samples stored in plastic bags.

Because the degradation was extensive, further extractions were conducted in July to confirm the deterioration of the provitamin A compound. The data shows that deterioration of ß-carotene has continued. This data is listed in the appendix along with the complete quantitative data for individual analysis of the samples conducted in June. Because of equipment modifications, it was necessary to prepare a new standard curve to measure the concentrations of ß-carotene in samples analyzed in July. This new curve is also illustrated in the appendix.

In conclusion, the sweet potato buds showed a marked loss of provitamin A over a relatively short storage time of three months at room temperature. Even the foil pouched samples lost almost half of their original ß-carotene content. Since carotenoids are susceptible to oxidation, the most reasonable explanation for the decomposition is oxidative deterioration caused by storing samples in packaging materials with air (~20% O_2). Oxidation is also enhanced by exposing a large surface area of the flaked sweet potato bud to air containing oxygen. The fact that the buds are dried to a thin flake in order to rehydrate easily accelerates oxidation by removing protective barriers.

The problem could be minimized or possibly eliminated by storing samples in an inert environment such as packaging with nitrogen. Foil packaging materials are most suitable for this purpose since they provide an excellent barrier to gas exchange and exclude light. Paper and plastic films generally permit permeation of gases

through the package. Alternatively, a thicker dried flake could be considered for production of the bud product. This product might minimize loss of β-carotene during storage by exposing only the outer surface layer of the dried bud to air, thereby limiting degradation to surface β-carotene.

Table 1. Average ß-carotene Concentration in Stored Sweet Potato Buds (Summary data for June analyses & overall average for March analyses)

Bud Sample Type / Number	ß-carotene µg/g Bud	Retinol Equivalent Per Gram of Bud
Foil 1	36.555	6.093
Foil 2	35.162	5.860
Foil 3	29.452	4.909
Foil 4	30.587	5.098
Average	32.939	5.490
Standard Deviation	3.450	0.575
Paper Laminate 1	33.609	5.602
Paper Laminate 2	31.626	5.271
Paper Laminate 3	29.938	4.990
Paper Laminate 4	29.366	4.894
Average	31.135	5.189
Standard Deviation	1.908	0.318
Plastic 1	27.713	4.619
Plastic 2	27.339	4.556
Plastic 3	31.740	5.290
Plastic 4	18.916	3.153
Average	26.427	4.405
Standard Deviation	5.389	0.898
March Buds Average	57.489	9.582
Standard Deviation	4.082	0.680

Appendix

1- Concentration curve for β-carotene versus absorbance units for July samples
2- Sample calculations for conversion of absorbance units to RE for July samples
3- Table for β-carotene concentration and RE value of bud samples in June and July

ß-Carotene Concentration in Sweet Potato Buds (June, 1992)

Bag #	Flake wt. for extraction (g)	Absorbance units sucessive duplicates	Average Abs. units	* ß-carotene mg/L	** ß-carotene µg/g bud	Retinol Equivalent Per Gram of Bud
Foil 1a	1.9	38291	37466.500	1.371	36.555	6.093
Foil 1b	1.9	36642				
Foil 2a	1.9	36264	35690.000	1.319	35.132	5.860
Foil 2b	1.9	35116				
Foil 3a	1.9	28717	28413.000	1.104	29.452	4.909
Foil 3b	1.9	28109				
Foil 4a	1.9	29880	29859.500	1.147	30.587	5.098
Foil 4b	1.9	29839				
Paper 1a	1.9	33192	33711.500	1.260	33.609	5.602
Paper 1b	1.9	34231				
Paper 2a	1.9	31297	31184.000	1.186	31.626	5.271
Paper 2b	1.9	31071				
Paper 3a	1.9	28746	29032.000	1.123	29.938	4.990
Paper 3b	1.9	29318				
Paper 4a	1.9	28737	28303.000	1.101	29.366	4.894
Paper 4b	1.9	27869				
Plastic 1a	1.9	26229	26196.000	1.039	27.713	4.619
Plastic 1b	1.9	26163				
Plastic 2a	1.9	25265	25719.000	1.025	27.339	4.556
Plastic 2b	1.9	26173				
Plastic 3a	1.9	32135	31329.500	1.190	31.740	5.290
Plastic 3b	1.9	30524				
Plastic 4a	1.9	29967	14983.500	0.709	18.916	3.153
Plastic 4b	1.9	29843				

Note: * mg of ß-carotene per liter of extracted solution.
**µg of ß-carotene per gram of bud.

ß-carotene Concentration in Sweet Potato Buds (July, 1992)

Bag #	Flake wt. for extraction (g)	Absorbance units sucessive duplicates	Average Abs. units	* ß-carotene mg/L	** ß-carotene µg/g bud	Retinol Equivalent Per Gram of Bud
Foil a	1.9	18821	19829.500	0.824	21.681	3.614
Foil b	1.9	20838				
Paper a	1.9	14547	14427.500	0.639	16.811	2.802
Paper b	1.9	14308				
Plastic a	1.9	11246	12156.500	0.561	14.763	2.461
Plastic b	1.9	13067				

Conversion of β-Carotene to Retinol Equivalents:

Sample calculation: y= concentration of ß-carotene (mg/L)

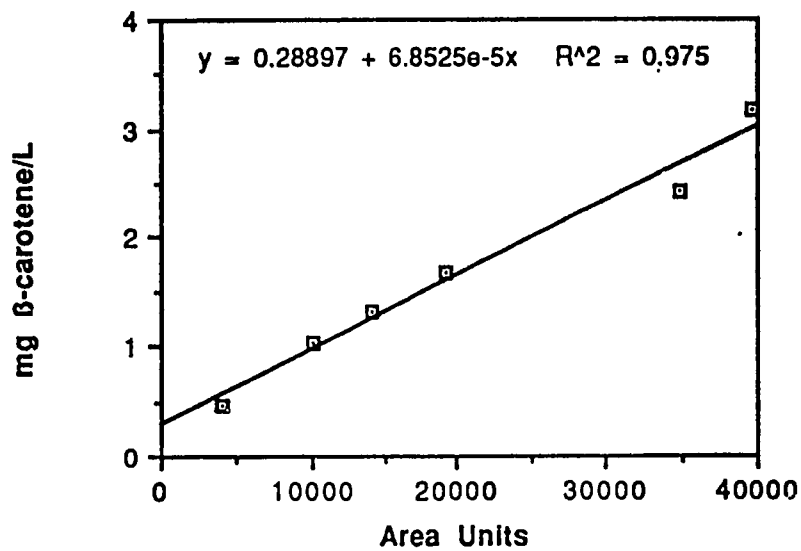
x= area units from the dynamax integration

$y=2.8897*10^{-1} + 6.8525*10^{-5}$ (x)

mg/L to µg/g sample used 50 mL total sample extraction volume.

1 Retinol Equivalent= 6 µg β-carotene

ß-Carotene Standard Curve for July Data



APPENDIX #4
ACCEPTABILITY QUESTIONNAIRES

QUESTIONNAIRE FOR THE SENSORIAL TESTING OF SWEET POTATO BUD PREPARATIONS FOR YOUNG CHILDREN (GRUEL, PAP)

code:_____ Place: _____
Date:_____ Interviewer:_____

TEST OF ACCEPTABILITY OF SWEET POTATO BUDS IN FORM OF CEREAL
(VERSION FOR ADULT)

Name of the mother or caretaker:_____
Schooling:_____ Occupation:_____ No of Children: ____
Place of Family Residence_____

1, Have you consumed food in the last two hours? Yes:_ No:_

2. Are you currently hungry? Yes:__ No:__
If yes, how hungry? Slightly:__ Moderately:__ Very:__

3. How would you rate the visual aspects of this cereal?
Poor:__ Average:___ Good:___ Outstanding:___
Comments:_____
_____

4. How would you rate the color of the cereal?
Poor:__ Average:___ Good:___ Outstanding:___
Comments:_____
_____

5. How would you rate the flavor of the cereal?
Poor:__ Average:___ Good:___ Outstanding:___
Comments:_____
_____

6. How would you rate the texture (consistency) of the cereal?
Poor:__ Average:___ Good:___ Outstanding:___
Comments:_____
_____

7. How would you rate the smell of the cereal?
Poor:__ Average:___ Good:___ Outstanding:___
Comments:_____
_____

8. Would you serve this product to a baby less than 12 mo old?
Yes: __ No: __

9. Would you serve this product to a child between 1 and 6 years? Yes:__ No:__

10. At what age in a child's life do you think this cereal should be begun in a child's diet?_____
Why this age? _____
_____

11. Would you serve this cereal to a child who was sick with
a fever? Yes:__ No__ diarrhea? Yes:__ No__
a cold? Yes:__ No__

12. Will you let your child who is with you try this right now? Yes:__ No:__

13. If not, Why?_____
_____

Code:_____ Place: _____
Date:_____ Interviewer:_____

TEST OF ACCEPTABILITY OF SWEET POTATO BUDS IN FORM OF CEREAL
(VERSION FOR CHILD)

Name of the mother or caretaker:_____.
Place of Family Residence_____
Date of Birth:_____ Age in Months:____ Sex:____
Was the Child Breastfed? Yes:__ No:__ How long? ___ mo

STANDARDIZED OBSERVATION FOR CHILDREN

1. Child rejected the offering; Yes:__ No:__

2. Child accepted the offering: Yes:__ No:__

3. Child's response to sampling: Smile:__ Neutral:__
   Frown:__

4. Child requests to consume more cereal when offered
   Yes:__ No:__

QUESTIONING FOR CHILDREN AGED 36 TO 72 MONTHS OF AGE

1, Have you consumed food in the last two hours? Yes:_No:_

2. Are you currently hungry? Yes:__ No:__
   If yes, how hungry? Slightly:__ Moderately:__ Very:__

3. How would you rate the visual aspects of this cereal?
   Poor:__ Average:___ Good:___ Outstanding:___
   Comments:_____
   _____

4. How would you rate the color of the cereal?
   Poor:__ Average:___ Good:___ Outstanding:___
   Comments:_____
   _____

5. How would you rate the flavor of the cereal?
   Poor:__ Average:___ Good:___ Outstanding:___
   Comments:_____
   _____

6. How would you rate the texture (consistency) of the cereal?
   Poor:__ Average:___ Good:___ Outstanding:___
   Comments:_____
   _____

7. How would you rate the smell of the cereal?
   Poor:__ Average:___ Good:___ Outstanding:___
   Comments:_____
   _____

(CONTINUED)

code:_____ Place: _____
Date:_____ Interviewer:_____

TEST OF ACCEPTABILITY OF SWEET POTATO BUDS IN FORM OF GRUEL
(VERSION FOR ADULT)

Name of the mother or caretaker:_____
Schooling:_____ Occupation:_____ No of Children: ____
Place of Family Residence_____

1, Have you consumed food in the last two hours? Yes:_No:_

2. Are you currently hungry? Yes:__ No:__
If yes, how hungry? Slightly:__ Moderately:__ Very:__

3. How would you rate the visual aspects of this gruel?
Poor:__ Average:___ Good:___ Outstanding:___
Comments:_____
_____

4. How would you rate the color of the gruel?
Poor:__ Average:___ Good:___ Outstanding:___
Comments:_____
_____

5. How would you rate the flavor of the gruel?
Poor:__ Average:___ Good:___ Outstanding:___
Comments:_____
_____

6. How would you rate the texture (consistency) of the gruel?
Poor:__ Average:___ Good:___ Outstanding:___
Comments:_____
_____

7. How would you rate the smell of the gruel?
Poor:__ Average:___ Good:___ Outstanding:___
Comments:_____
_____

8 Would you serve this product to a baby less than 12 mo?
Yes: __ No: __

9. Would you serve this product to a child between 1 and 6 years? Yes:__ No:__

10. At what age in a child's life do you think you this gruel should be begun in a child's diet?_____
Why this age? _____
_____

11. Would you serve this gruel to a child who was sick with a fever? Yes:__ No__ diarrhea? Yes:__ No__ a cold? Yes:__ No__

12. Will you let your child who is with you try this right now? Yes:__ No:__

13. If not, Why not?_____
_____

code:_____ Place: _____
Date:_____ Interviewer:_____

TEST OF ACCEPTABILITY OF SWEET POTATO BUDS IN FORM OF GRUEL (VERSION FOR CHILD)

Name of the mother or caretaker:_____
Place of Family Residence_____
Date of Birth:_____ Age in Months:____ Sex:____
Was the Child Breastfed? Yes:__ No:__ How long? ___ mo

STANDARDIZED OBSERVATION FOR CHILDREN

1. Child rejected the offering of gruel: Yes:__ No:__

2. Child accepted the offering of gruel: Yes:__ No:__

3. Child's response to sampling: Smile:__ Neutral:__
   Frown:__

4. Child requests to consume more gruel when offered
   Yes:__ No:__

QUESTIONING FOR CHILDREN AGED 36 TO 72 MONTHS OF AGE

1, Have you consumed food in the last two hours? Yes:_No:_

2. Are you currently hungry? Yes:__ No:__
   If yes, how hungry? Slightly:__ Moderately:__ Very:__

3. How would you rate the visual aspects of this gruel?
   Poor:__ Average:___ Good:___ Outstanding:___
   Comments:_____
   _____

4. How would you rate the color of the gruel?
   Poor:__ Average:___ Good:___ Outstanding:___
   Comments:_____
   _____

5. How would you rate the flavor of the gruel?
   Poor:__ Average:___ Good:___ Outstanding:___
   Comments:_____
   _____

6. How would you rate the texture (consistency) of the greul?
   Poor:__ Average:___ Good:___ Outstanding:___
   Comments:_____
   _____

7. How would you rate the smell of the gruel?
   Poor:__ Average:___ Good:___ Outstanding:___
   Comments:_____
   _____

(CONTINUED)

Code: _____ Place: _____
Date: _____ Interviewer: _____

RECORD OF RECENT DIETARY INTAKE BY SUBJECTS INTERVIEWED IN SENSORY TESTS

Name of the Subject _____
Monther/Caretaker ( ) Child ( )

PENULTIMATE MEAL

Date: _____ Time: _____ Type of Meal: Br Lu Su Sn

Code:	Foods:	Units	Total	Gm

ULTIMATE MEAL

Date: _____ Time: _____ Type of Meal: Br Lu Su Sn

code:	Foods:	Units	Total	Gm

Br = breakfast
Lu = lunch
Su = supper
Sn = snack

GRUEL SUMMARY:

Twenty seven women made gruel recipes from sweet potato buds (SPB). The amount of SPB used ranged from 6.0 to 227.0 g. Other ingredients included water (88.9%), milk (70.4%), sugar (92.6%), cinnamon (77.8%), vanilla (11.1%), a few women used a bit of salt. Cooking time ranged from 3.0 to 30.0 min. Five women used SPB in an instantized form.

G R U E L

Ingredients		Quantity
Sweet potato	(g)	65
Water	(ml)	200
Milk	(ml)	500
Sugar	(g)	80
Cinnamon	(u)	1
Salt		bit
Vanilla	(drop)	5
Cooking time	(min)	15
Number of servings		6

G R U E L

Ingredients		Quantity
Sweet potato	(g)	70
Water	(ml)	1000
Milk	(ml)	500
Sugar	(g)	94
Cinnamon	(u)	2
Salt		bit
Vanilla	(drop)	5
Cooking time	(min)	10
Number of servings		4

G R U E L

Ingredients		Quantity
Sweet potato	(g)	30
Water	(ml)	150
Milk	(ml)	290
Sugar	(g)	18
Cinnamon	(u)	bit
Salt		bit
Cooking time	(min)	6
Number of servings		1

G R U E L

Ingredients		Quantity
Sweet potato	(g)	25
Water	(ml)	1000
Milk	(ml)	40
Sugar	(g)	80
Cinnamon	(u)	1
Salt		bit
Cooking time	(min)	15
Number of servings		3

G R U E L

Ingredients		Quantity
Sweet potato	(g)	30*
Water	(ml)	600
Milk	(g)	16
Sugar	(g)	10
Cinnamon	(u)	3
Salt		bit
Cooking time	(min)	8
	*	instantized
Number of servings		3

G R U E L

Ingredients		Quantity
Sweet potato	(g)	40
Water	(ml)	1000
Milk	(ml)	48
Sugar	(g)	160
Cinnamon	(u)	2
Salt		bit
Cooking time	(min)	instant
Number of servings		4

G R U E L

Ingredients		Quantity
Sweet potato	(g)	80
Water	(ml)	400
Milk	(ml)	500
Sugar	(g)	74
Cinnamon	(u)	2
Salt		bit
Cooking time	(min)	10
Number of servings		6

G R U E L

Ingredients		Quantity
Sweet potato	(g)	75
Water	(ml)	870
Sugar	(g)	100
Cinnamon	(u)	3
Salt		bit
Cooking time	(min)	15
Number of servings		2

G R U E L

Ingredients		Quantity
Sweet potato	(g)	50
Water	(ml)	1000
Sugar	(g)	100
Cinnamon	(u)	1
Salt		bit
Cooking time	(min)	5
Number of servings		4

G R U E L

Ingredients		Quantity
Sweet potato	(g)	53
Water	(ml)	1070
Milk	(g)	24
Sugar	(g)	60
Vanilla	(drop)	10
Cooking time	(min)	30
Number of servings		4

G R U E L

Ingredients		Quantity
Sweet potato	(g)	60
Water	(ml)	800
Milk	(ml)	100
Sugar	(g)	100
Cinnamon	(g)	5
Cooking time	(min)	30
Number of servings		4

G R U E L

Ingredients		Quantity
Sweet potato	(g)	106
Water	(ml)	600
Milk	(g)	20
Sugar	(g)	60
Cinnamon	(u)	2
Cooking time	(min)	15
Number of servings		7

G R U E L

Ingredients		Quantity
Sweet potato	(g)	106
Water	(ml)	1000
Milk	(ml)	290
Sugar	(g)	186
Cinnamon	(u)	5
Cooking time	(min)	10
Number of servings		6

G R U E L

Ingredients		Quantity
Sweet potato	(g)	50
Water	(ml)	580
Milk	(ml)	500
Sugar	(g)	80
Cinnamon	(u)	2
Cooking time	(min)	10
Number of servings		2

G R U E L

Ingredients		Quantity
Sweet potato	(g)	10*
Water	(ml)	90
Milk	(ml)	500
Sugar	(g)	40
Cinnamon	(u)	1
Cooking time	(min)	15
	*	instantized
Number of servings		1

G R U E L

Ingredients		Quantity
Sweet potato	(g)	20
Water	(ml)	500
Milk	(g)	24
Sugar	(g)	80
Salt		bit
Cooking time	(min)	3
Number of servings		6

G R U E L

Ingredients		Quantity
Sweet potato	(g)	50
Water	(ml)	1000
Milk	(g)	24
Sugar	(g)	60
Cinnamon	(u)	5
Cooking time	(min)	8
Number of servings		15

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G R U E L

Ingredients		Quantity
Sweet potato	(g)	53
Water	(ml)	1160
Milk	(ml)	500
Sugar	(g)	60
Cinnamon	(u)	1
Cooking time	(min)	10
Number of servings		3

G R U E L

Ingredients		Quantity
Sweet potato	(g)	159
Water	(ml)	1600
Sugar	(g)	120
Cinnamon	(u)	1
Cooking time	(min)	15
Number of servings		6

G R U E L

Ingredients		Quantity
Sweet potato	(g)	15
Milk	(ml)	100
Sugar	(g)	12
Cinnamon	(u)	1
Cooking time	(min)	10
Number of servings		2

G R U E L

Ingredients		Quantity
Sweet potato	(g)	6
Water	(ml)	290
Sugar	(g)	20
Cinnamon	(u)	1
Cooking time	(min)	5
Number of servings		1

G R U E L

Ingredients		Quantity
Sweet potato	(g)	30
Water	(ml)	400
Cinnamon	(u)	1
Salt		bit
Cooking time	(min)	10
Number of servings		1

G R U E L

Ingredients		Quantity
Sweet potato	(g)	227
Water	(ml)	1000
Sugar	(g)	100
Cinnamon	(g)	3
Cooking time	(min)	10
Number of servings		8

G R U E L

Ingredients		Quantity
Sweet potato	(g)	30
Milk	(ml)	400
Cinnamon	(u)	1
Cooking time	(min)	10
Number of servings		5

G R U E L

Ingredients		Quantity
Sweet potato	(g)	15
Milk	(ml)	150
Sugar	(g)	12
Cooking time	(min)	instant
Number of servings		2

G R U E L

Ingredients		Quantity
Sweet potato	(g)	10
Water	(ml)	290
Sugar	(g)	10
Cooking time	(min)	instant
Number of servings		10

G R U E L

Ingredients		Quantity
Sweet potato	(g)	106
Water	(ml)	1000
Sugar	(g)	227
Cooking time	(min)	30
Number of servings		6

PUREE SUMMARY:

Eleven women prepared puree using SPB. The amount of SPB used ranged from 12.0 to 159.0 g. Other ingredients included were: water (81.8%), milk (54.5%), sugar (36.4%), cinnamon (45.4%), margarine (45.4%), unrefined brown sugar (panela) (9.1%). Five women prepared salty puree recipes adding a bit of salt, bouillon and onion. Cooking time ranged from 5.0 to 25.0 min. Three women used SPB in the instantized form.

PUREE		
Ingredients		Quantity
Sweet potato	(g)	65
Water	(ml)	200
Sugar	(g)	60
Cinnamon	(u)	1
Salt		bit
Raisins	(u)	20
Cooking time	(min)	12
Number of servings		4

PUREE		
Ingredients		Quantity
Sweet potato	(g)	30
Water	(ml)	500
Milk	(ml)	16
Salt		bit
Margarine	(g)	60
Bouillon	(g)	6
Cooking time	(min)	20
Number of servings		1

PUREE

Ingredients		Quantity
Sweet potato	(g)	12
Water	(ml)	150
Milk	(g)	8
Salt		bit
Margarine	(g)	10
Onion	(g)	10
Cooking time	(min)	5
Number of servings		not reported

PUREE

Ingredients		Quantity
Sweet potato	(g)	40
Water	(ml)	200
Salt		bit
Margarine	(g)	60
Bouillon	(g)	24
Onion	(g)	19
Cooking time	(min)	5
Number of servings		1

PUREE

Ingredients		Quantity
Sweet potato	(g)	159
Water	(ml)	100
Milk	(ml)	500
Cinnamon	(g)	2
Salt		bit
Cooking time	(min)	25
Number of servings		6

PUREE		
Ingredients		Quantity
Sweet potato	(g)	50
Water	(ml)	290
Sugar	(g)	30
Cinnamon	(u)	5
Salt		bit
Cooking time	(min)	15
Number of servings		2

PUREE		
Ingredients		Quantity
Sweet potato	(g)	25*
Milk	(ml)	100
Sugar	(g)	6
Cinnamon	(u)	1
Cooking time	(min)	5
*		instantized
Number of servings		1

PUREE		
Ingredients		Quantity
Sweet potato	(g)	53
Water	(ml)	400
Margarine	(g)	60
Bouillon	(g)	24
Cooking time	(min)	25
Number of servings		6

PUREE		
Ingredients		Quantity
Sweet potato	(g)	30
Water	(ml)	200
Cinnamon	(u)	1
Unrefined brown sugar (panela)	(g)	60
Cooking time	(min)	instantized
Number of servings		1

PUREE		
Ingredients		Quantity
Sweet potato	(g)	20
Water	(ml)	27
Milk	(g)	20
Sugar	(g)	12
Cooking time	(min)	instantized
Number of servings		1

PUREE		
Ingredients		Quantity
Sweet potato	(g)	25
Milk	(ml)	300
Margarine	(g)	6
Cooking time	(min)	5
Number of servings		3

PANCAKES SUMMARY:

Four women prepared pancakes using SPB. The amount of SPB used ranged from 15.0 to 106.0 g. Other ingredients included were: water (50.0%), milk (100%), sugar (50.0%), margarine (100%), egg (75.0%), oil (50.0%), baking powder (25.0%), flour (25.0%), fruit (25.0%). Cooking time ranged from 15.0 to 35.0 min.

PANCAKES

Ingredients		Quantity
Sweet potato	(g)	not reported
Water	(ml)	730
Milk	(g)	32
Cinnamon		bit
Salt		bit
Margarine	(g)	30
Egg	(g)	47
Oil		bit
Baking powder		bit
Flour	(g)	60
Cooking time	(min)	35
Number of servings		10

PANCAKES

Ingredients		Quantity
Sweet potato	(g)	40
Water	(ml)	150
Milk	(g)	24
Salt		bit
Margarine	(g)	6
Egg	(g)	47
Oil	(ml)	2
Baking powder	(g)	3
Cooking time	(min)	15
Number of servings		4

PANCAKES		
Ingredients		Quantity
Sweet potato	(g)	106
Milk	(ml)	500
Sugar	(g)	60
Margarine	(g)	47
Oil	(ml)	56
Baking powder		bit
Fruit	(g)	86
Cooking time	(min)	30
Number of servings		7

PANCAKES		
Ingredients		Quantity
Sweet potato	(g)	15
Milk	(ml)	27
Sugar	(g)	20
Margarine	(g)	30
Egg	(g)	47
Cooking time	(min)	15
Number of servings		unreport

PATTIE CAKE SUMMARY

Four women prepared pattie cakes using SPB. The amount of SPB ranged from 50.0 to75.0 g. Other ingredients added were: water (75.0%), milk (25.0%), sugar (75.0%), cinnamon (75.0%), margarine (25.0%), egg (75.0%), oil (75.0%). Only one woman prepared salty pattie cakes adding a pinch of salt and bouillon. Cooking time ranged from 30.0 to 35.0 min.

PATTIE CAKE		
Ingredients		Quantity
Sweet potato	(g)	75
Water	(ml)	100
Milk	(ml)	100
Sugar	(g)	60
Cinnamon	(g)	5
Margarine		bit
Egg	(g)	47
Cooking time	(min)	35
No. of servings		6

PATTIE CAKE		
Ingredients		Quantity
Sweet potato	(g)	53
Water	(ml)	100
Sugar	(g)	20
Cinnamon	(g)	1
Egg	(g)	47
Oil	(ml)	18
Salt		bit
Cooking time	(min)	35
No. of portions		6

PATTIE CAKE		
Ingredients		Quantity
Sweet potato	(g)	50
Water	(ml)	27
Salt		bit
Margarine	(g)	47
Oil	(ml)	2
Flour		bit
Cooking time	(min)	35
No. of servings		6

PATTIE CAKE		
Ingredients		Quantity
Sweet potato	(g)	53
Sugar	(g)	12
Cinnamon	(g)	1
Egg	(g)	47
Oil	(ml)	9
Cooking time	(min)	30
No. of portions		5

PUDDING SUMMARY

Four women prepared pudding with SPB. The amount of SPB ranged from 35.0 to 106 g. Other ingredients added were: water (50%), milk (100%), sugar(75%), cinnamon (100%), egg (25%), fruit (25%), raisins (25%); cooking ranged from 5 to 30 min.

PUDDING RECIPE		
Ingredients		Quantity
Sweet potato	(g)	53
Water	(ml)	200
Milk	(ml)	500
Sugar	(g)	94
Cinnamon	(u)	2
Egg	(g)	47
Fruit	(g)	105
Corn starch	(g)	45
Cooking time	(min)	15
Number of servings		1

PUDDING RECIPE		
Ingredients		Quantity
Sweet potato	(g)	106
Milk	(ml)	580
Sugar	(g)	94
Cinnamon	(u)	5
Salt		bit
Raisins	(u)	15
Cooking time	(min)	5
Number of servings		6

PUDDING RECIPE

Ingredients		Quantity
Sweet potato	(g)	35
Water	(ml)	290
Milk	(ml)	500
Cinnamon	(u)	2
Salt		bit
Cooking time	(min)	15
Number of servings		not reported

PUDDING RECIPE 4

Ingredients		Quantity
Sweet potato	(g)	106
Milk	(ml)	500
Sugar	(g)	186
Cinnamon	(u)	1
Salt		bit
Cooking time	(min)	30
Number of servings		8

DESSERT SUMMARY:

Two women prepared dessert using SPB. The amounts of SPB used ranged from 53 to 454 g. Other ingredients included were: water (100%), sugar (50%), cinnamon (100%), margarine (50%), cream (50%), raisins (50%), crumbs (sweet) (50%). Cooking time was 30 min.

DESSERT 1

Ingredients		Quantity
Sweet potato	(g)	454
Water	(ml)	1450
Sugar	(g)	385
Cinnamon	(u)	5
Margarine	(g)	180
Cream	(g)	290
Raisins	(g)	60
Crumbs (sweet)	(g)	48
Salt		bit
Cooking time	(min)	30
Number of servings		9

DESSERT 2

Ingredients		Quantity
Sweet potato	(g)	53
Water	(ml)	200
Sugar	(g)	not reported
Cinnamon	(u)	1
Cooking time	(min)	not reported
Number of servings		7

JELLY SUMMARY:

One woman made jelly from SPB. The amount of SPB used was 20 g. Other ingredients included were: water (100%), sugar (100%), cinnamon (100%), fruit (100%). Cooking time was 30 min.

JELLY		
Ingredients		Quantity
Sweet potato	(g)	106
Water	(ml)	580
Sugar	(g)	280
Cinnamon	(g)	2
Fruit	(spoon)	3
Cooking time	(min)	30
Number of servings		3

SWEET POTATO BUDS WITH PINEAPPLE SUMMARY:

One woman made SPB with pineapple. The amount of SPB used was 454 g. Other ingredients included were: water (100%), sugar (100%), fruit (100%). Cooking time was 20 min.

SWEET POTATO W/PINEAPPLE

Ingredients		Quantity
Sweet potato	(g)	454
Water	(ml)	500
Sugar	(g)	466
Fruit	(g)	580
Cooking time	(min)	20
Number of servings		20

PUDDING WITH PINEAPPLE SUMMARY:

One woman made pudding with pineapple from SPB. The amount of SPB used was 50 g. Other ingredients included were: water (100%), milk (100%), sugar (100%), cinnamon (100%), fruit (100%). Cooking time was 15 min.

PUDDING W/PINEAPPLE		
Ingredients		Quantity
Sweet potato	(g)	50
Water	(ml)	150
Milk	(ml)	500
Sugar	(g)	227
Cinnamon	(g)	2
Fruit	(g)	500
Cooking time	(min)	15
Number of servings		8

SOUP SUMMARY:

One woman made soup recipe from SPB. The amount of SPB used was 20 g. Other ingredients included were: water (100%), margarine (100%), tomato (100%), green pepper (100%), onion (100%), salt (100%). Cooking time was 15 min for the ingredients and SPB added in an instantized form.

SOUP		
Ingredients		Quantity
Sweet potato	(g)	20*
Water	(ml)	100
Salt		bit
Margarine	(g)	30
Tomato	(g)	164
Green pepper	(g)	2
Onion	(g)	19
Cooking time	(min)	15
		instantized
Number of servings		4

"RELLENITOS"* SUMMARY:

One woman made "rellenitos" recipe from SPB. The amount of SPB used was 112 g. Other ingredients included were: water (100%), sugar (100%), cinnamon (100%), oil (100%), strained black beans (100%), flour (100%). Cooking time was 40 min.

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* "Rellenitos" have the shape of a croquet, outside made of SPB and other ingredients, inside filled with black beans.

RELLENITOS

Ingredients		Quantity
Sweet potato	(g)	112
Water	(ml)	200
Sugar	(g)	20
Cinnamon	(u)	6
Oil	(ml)	2
Strained black beans	(g)	48
Flour		bit
Cooking time	(min)	40
Number of servings		6

"RELLENITOS"* SUMMARY:

One woman made "rellenitos" recipe from SPB. The amount of SPB used was 112 g. Other ingredients included were: water (100%), sugar (100%), cinnamon (100%), oil (100%), strained black beans (100%), flour (100%). Cooking time was 40 min.

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* "Rellenitos" have the shape of a croquet, outside made of SPB and other ingredients, inside filled with black beans.

RELLENITOS

Ingredients		Quantity
Sweet potato	(g)	112
Water	(ml)	200
Sugar	(g)	20
Cinnamon	(u)	6
Oil	(ml)	2
Strained black beans	(g)	48
Flour		bit
Cooking time	(min)	40
Number of servings		6

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GRUEL SUMMARY (RURAL):

Thirty two women made gruel recipes from sweet potato buds (SPB). The amount of SPB used ranged from 10.0 to 227.0 g. Other ingredients included water (97%), milk (12%), sugar (100%), cinnamon (84%), oatmeal (3%), starch (3%), apple (6%), banana (3%), incaparina (3%), St. Vincent flour (3%), polenta (3%), salt (9%). Cooking time ranged from 2 to 50 min. Seven women used SPB in an instantized form.

G R U E L

Ingredients		Quantity
Sweet potato	(g)	20
Water	(ml)	600
Milk	(ml)	100
Sugar	(g)	80
Cinnamon	(u)	1
Banana	(g)	43
Cooking time	(min)	30
Number of servings		6

G R U E L

Ingredients		Quantity
Sweet potato	(g)	227
Water	(ml)	2900
Milk	(g)	24
Sugar	(g)	100
Cinnamon	(u)	1
Salt		bit
Cooking time	(min)	25
Number of servings		10

G R U E L

Ingredients		Quantity
Sweet potato	(g)	70
Water	(ml)	2400
Sugar	(g)	186
Cinnamon	(u)	1
Polenta	(g)	186
Salt		bit
Cooking time	(min)	30
Number of servings		10

G R U E L

Ingredients		Quantity
Sweet potato	(g)	25*
Water	(ml)	1000
Sugar	(g)	100
Cinnamon	(u)	2
Oatmeal	(g)	30
Cooking time	(min)	10
	*	instantized
Number of servings		5

G R U E L

Ingredients		Quantity
Sweet potato	(g)	200
Water	(ml)	1400
Sugar	(g)	60
Cinnamon	(u)	2
Salt		bit
Cooking time	(min)	30
Number of servings		6

G R U E L

Ingredients		Quantity
Sweet potato	(g)	48
Water	(ml)	1200
Sugar	(g)	151
Cinnamon	(u)	2
Starch	(g)	16
Cooking time	(min)	20
Number of servings		6

G R U E L

Ingredients		Quantity
Sweet potato	(g)	53
Water	(ml)	1200
Sugar	(g)	80
Cinnamon	(u)	1
Apple	(g)	340
Cooking time	(min)	25
Number of servings		6

G R U E L

Ingredients		Quantity
Sweet potato	(g)	53
Water	(ml)	500
Sugar	(g)	100
Cinnamon	(u)	1
Incaparina	(g)	30
Cooking time	(min)	25
Number of servings		5

G R U E L

Ingredients		Quantity
Sweet potato	(g)	35
Water	(ml)	800
Sugar	(g)	70
Cinnamon	(u)	1
Apple	(g)	170
Cooking time	(min)	50
Number of servings		3

G R U E L

Ingredients		Quantity
Sweet potato	(g)	50
Water	(ml)	1000
Sugar	(g)	52
Cinnamon	(u)	1
St. Vincente flour	(g)	38
Cooking time	(min)	25
Number of servings		5

G R U E L

Ingredients		Quantity
Sweet potato	(g)	35
Water	(ml)	1450
Sugar	(g)	227
Cinnamon	(u)	1
Cooking time	(min)	15
Number of servings		5

G R U E L

Ingredients		Quantity
Sweet potato	(g)	20
Water	(ml)	1000
Milk	(g)	16
Sugar	(g)	120
Cooking time	(min)	instant
Number of servings		4

G R U E L

Ingredients		Quantity
Sweet potato	(g)	106
Milk	(ml)	400
Sugar	(g)	40
Cinnamon	(u)	1
Cooking time	(min)	2
Number of servings		2

G R U E L

Ingredients		Quantity
Sweet potato	(g)	60
Water	(ml)	1440
Sugar	(g)	100
Cinnamon	(u)	1
Cooking time	(min)	20
Number of servings		6

G R U E L

Ingredients		Quantity
Sweet potato	(g)	40
Water	(ml)	870
Sugar	(g)	100
Cinnamon	(u)	1
Cooking time	(min)	20
Number of servings		4

G R U E L

Ingredients		Quantity
Sweet potato	(g)	40
Water	(ml)	600
Sugar	(g)	120
Cinnamon	(u)	1
Cooking time	(min)	20
Number of servings		3

G R U E L

Ingredients		Quantity
Sweet potato	(g)	88
Water	(ml)	1000
Sugar	(g)	100
Cinnamon	(u)	1
Cooking time	(min)	20
Number of servings		5

G R U E L

Ingredients		Quantity
Sweet potato	(g)	30
Water	(ml)	1000
Sugar	(g)	80
Cinnamon	(u)	1
Cooking time	(min)	instant
Number of servings		5

G R U E L

Ingredients		Quantity
Sweet potato	(g)	25
Water	(ml)	600
Sugar	(g)	60
Cinnamon	(u)	2
Cooking time	(min)	instant
Number of servings		3

G R U E L

Ingredients		Quantity
Sweet potato	(g)	30
Water	(ml)	600
Sugar	(g)	80
Cinnamon	(u)	1
Cooking time	(min)	20
Number of servings		3

G R U E L

Ingredients		Quantity
Sweet potato	(g)	25
Water	(ml)	800
Sugar	(g)	60
Cinnamon	(u)	2
Cooking time	(min)	10
Number of servings		5

G R U E L

Ingredients		Quantity
Sweet potato	(g)	30
Water	(ml)	1000
Sugar	(g)	94
Cinnamon	(g)	15
Cooking time	(min)	50
Number of servings		3

G R U E L

Ingredients		Quantity
Sweet potato	(g)	25
Water	(ml)	720
Sugar	(g)	100
Cinnamon	(u)	1
Cooking time	(min)	20
Number of servings		4

G R U E L

Ingredients		Quantity
Sweet potato	(g)	60
Water	(ml)	360
Sugar	(g)	60
Cinnamon	(u)	4
Cooking time	(min)	20
Number of servings		2

G R U E L

Ingredients		Quantity
Sweet potato	(g)	212
Water	(ml)	5000
Sugar	(g)	372
Cinnamon	(g)	30
Cooking time	(min)	10
Number of servings		10

G R U E L

Ingredients		Quantity
Sweet potato	(g)	10
Water	(ml)	200
Sugar	(g)	20
Cinnamon	(u)	1
Cooking time	(min)	instant
Number of servings		1

G R U E L

Ingredients		Quantity
Sweet potato	(g)	20
Water	(ml)	480
Sugar	(g)	40
Cinnamon	(u)	1
Cooking time	(min)	5
Number of servings		2

G R U E L

Ingredients		Quantity
Sweet potato	(g)	30
Water	(ml)	120
Sugar	(g)	20
Cooking time	(min)	instant
Number of servings		1

G R U E L

Ingredients		Quantity
Sweet potato	(g)	30
Water	(ml)	580
Sugar	(g)	80
Cooking time	(min)	instant
Number of servings		4

G R U E L

Ingredients		Quantity
Sweet potato	(g)	not reported
Water	(ml)	1600
Sugar	(g)	120
Cinnamon	(u)	1
Cooking time	(min)	20
Number of servings		6

G R U E L	
Ingredients	**Quantity**
Sweet potato (g)	35
Water (ml)	290
Sugar (g)	40
Cooking time (min)	instant
Number of servings	1

G R U E L	
Ingredients	**Quantity**
Sweet potato (g)	150
Water (ml)	1440
Sugar (g)	160
Cooking time (min)	20
Number of servings	6

PUREE SUMMARY (RURAL):

Seventeen women prepared puree using SPB. The amount of SPB used ranged from 15.0 to 106.0 g. Other ingredients included were: water (76%), milk (24%), sugar (82%), cinnamon (76%), margarine (12%), salt (12%), apple (35%), pineapple (12%), plum (12%), peach (24%), pear (12%), egg (9%), banana (9%), incaparina (9%), mature squash (12%), onion (9%), wheat flour (9%). Cooking time ranged from 5.0 to 90.0 min. Six women used SPB in the instantized form.

PUREE		
Ingredients		Quantity
Sweet potato	(g)	35
Water	(ml)	1000
Milk	(g)	24
Sugar	(g)	140
Cinnamon	(u)	1
Salt		bit
Egg	(g)	47
Margarine	(g)	60
Cooking time	(min)	30
Number of servings		unreported

PUREE		
Ingredients		Quantity
Sweet potato	(g)	40*
Water	(ml)	400
Sugar	(g)	160
Apple	(g)	170
Plum	(g)	116
Peach	(g)	138
Pear	(g)	162
Cooking time	(min)	unreported
	*	instantized
Number of servings		unreported

PUREE

Ingredients		Quantity
Sweet potato	(g)	35*
Water	(ml)	500
Milk	(ml)	100
Mature squash	(g)	227
Sugar	(g)	80
Cinnamon	(u)	1
Cooking time	(min)	unreported
	*	instantized
Number of servings		6

PUREE

Ingredients		Quantity
Sweet potato	(g)	30
Water	(ml)	150
Sugar	(g)	80
Cinnamon	(u)	2
Apple	(g)	170
Plum	(g)	116
Cooking time	(min)	40
Number of servings		1

PUREE

Ingredients		Quantity
Sweet potato	(g)	15*
Water	(ml)	not reported
Sugar	(g)	80
Apple	(g)	85
Peach	(g)	138
Pear	(g)	162
Cooking time	(min)	25
	*	instantized
Number of servings		4

PUREE	
Ingredients	**Quantity**
Sweet potato (g)	70*
Sugar (g)	454
Cinnamon (g)	10
Apple (g)	1816
Pineapple (g)	303
Cooking time (min)	15
*	instantized
Number of servings	22

PUREE	
Ingredients	**Quantity**
Sweet potato (g)	15
Milk (g)	32
Water (ml)	200
Sugar (g)	60
Cinnamon (u)	1
Cooking time (min)	15
Number of servings	3

PUREE	
Ingredients	Quantity
Sweet potato (g)	20*
Water (ml)	600
Sugar (g)	60
Incaparina (g)	45
Cinnamon (u)	1
Cooking time (min)	15
*	instantized
Number of servings	7

PUREE

Ingredients		Quantity
Sweet potato	(g)	30
Water	(ml)	600
Sugar	(g)	80
Cinnamon	(u)	2
Apple	(g)	170
Cooking time	(min)	40
Number of servings		8

PUREE

Ingredients		Quantity
Sweet potato	(g)	108
Water	(ml)	500
Sugar	(g)	160
Cinnamon	(u)	1
Apple	(g)	681
Cooking time	(min)	30
Number of servings		6

PUREE

Ingredients		Quantity
Sweet potato	(g)	20
Milk	(ml)	200
Salt		bit
Margarine	(g)	30
Onion	(g)	19
Cooking time	(min)	45
Number of servings		4

PUREE

Ingredients		Quantity
Sweet potato	(g)	40
Water	(ml)	1600
Sugar	(g)	454
Cinnamon	(u)	2
Peach	(g)	1656
Cooking time	(min)	90
Number of servings		6

PUREE

Ingredients		Quantity
Sweet potato	(g)	30
Water	(ml)	200
Sugar	(g)	80
Cinnamon	(u)	1
Mature squash	(g)	114
Cooking time	(min)	20
Number of servings		4

PUREE

Ingredients		Quantity
Sweet potato	(g)	30
Water	(ml)	125
Sugar	(g)	36
Cinnamon	(u)	1
Wheat	(g)	30
Cooking time	(min)	5
Number of servings		4

PUREE

Ingredients		Quantity
Sweet potato	(g)	20
Water	(ml)	200
Cinnamon	(u)	1
Banana	(g)	430
Cooking time	(min)	5
Number of servings		8

PUREE

Ingredients		Quantity
Sweet potato	(g)	25
Sugar	(g)	454
Cinnamon	(u)	1
Peach	(g)	1656
Cooking time	(min)	40
Number of servings		9

PUREE

Ingredients		Quantity
Sweet potato	(g)	35
Pineapple	(g)	101
Cooking time	(min)	instant
Number of servings		1

PATTIE CAKE SUMMARY (RURAL):

Four women prepared pattie cakes using SPB. The amount of SPB ranged from 5.0 to 53.0 g. Other ingredients added were: water (100%), milk (50%), sugar (75%), cinnamon (25%), salt (50%), egg (25%), oil (100%), parsely (25%), onion (25%). Cooking time ranged from 10 to 40 min.

PATTIE CAKE		
Ingredients		Quantity
Sweet potato	(g)	50
Water	(ml)	290
Milk	(g)	24
Sugar	(g)	20
Salt		bit
Oil	(ml)	18
Cooking time	(min)	30
No. of servings		4

PATTIE CAKE		
Ingredients		Quantity
Sweet potato	(g)	53
Water	(ml)	67
Sugar	(g)	6
Cinnamon	(u)	1
Egg	(g)	94
Oil	(ml)	45
Cooking time	(min)	40
No. of portions		13

PATTIE CAKE

Ingredients		Quantity
Sweet potato	(g)	5
Water	(ml)	27
Salt		bit
Oil	(ml)	45
Parsely	(g)	15
Onion	(g)	19
Cooking time	(min)	10
No. of servings		2

PATTIE CAKE

Ingredients		Quantity
Sweet potato	(g)	50
Water	(ml)	150
Milk	(g)	8
Sugar	(g)	20
Oil	(ml)	27
Cooking time	(min)	10
No. of portions		7

SOUP SUMMARY (RURAL):

Three women made soup recipe from SPB. The amount of SPB used ranged from 25 to 227 g. Other ingredients included were: water (100%), boullion (100%), tomato (100%), salt (67%), noodles (33%), inmature squash (100%), potato (33%), coriander (33%), achiote (33%), mushroom (33%), onion (33%), rice (33%). Cooking time ranged from 10 to 20 min. One woman added SPB in an instantized form.

SOUP	
Ingredients	Quantity
Sweet potato (g)	unreported
Water (ml)	200
Tomato (g)	82
Inmature squash (g)	147
Boullion (g)	90
Onion (g)	38
Mushroom (g)	120
Rice (g)	120
Salt	bit
Cooking time (min)	20
Number of servings	3

SOUP	
Ingredients	Quantity
Sweet potato (g)	35
Water (ml)	1000
Salt	bit
Tomato (g)	41
Noodles (g)	120
Inmature squash (g)	74
Boullion (g)	45
Cooking time (min)	20
Number of servings	5

SOUP

Ingredients		Quantity
Sweet potato	(g)	227*
Water	(ml)	500
Tomato	(g)	41
Inmature squash	(g)	147
Boullion	(g)	45
Potato	(g)	227
Coriander	(g)	bit
Achiote	(g)	bit
Cooking time	(min)	10
	*	instantized
Number of servings		4

DESSERT SUMMARY (RURAL):

Two women prepared dessert using SPB. The amounts of SPB used ranged from 100 to 454 g. Other ingredients included were: water (100%), milk (100%), sugar (100%), cinnamon (50%). Cooking time ranged from 10 to 40 min.

DESSERT		
Ingredients		Quantity
Sweet potato	(g)	454
Water	(ml)	200
Milk	(ml)	1000
Sugar	(g)	186
Cinnamon	(u)	1
Cooking time	(min)	10
Number of servings		10

DESSERT		
Ingredients		Quantity
Sweet potato	(g)	100
Water	(ml)	1740
Milk	(g)	16
Sugar	(g)	80
Cooking time	(min)	40
Number of servings		6

"RELLENITOS"* SUMMARY:

One woman made "rellenitos" recipe from SPB. The amount of SPB used was 5 g. Other ingredients included were: water (100%), sugar (100%), oil (100%), polenta (100%). Cooking time was 10 min.

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* "Rellenitos" have the shape of a croquet, outside made of SPB and other ingredients, inside filled.

RELLENITOS

Ingredients		Quantity
Sweet potato	(g)	5
Water	(ml)	27
Sugar	(g)	10
Oil	(ml)	45
Polenta	(g)	30
Cooking time	(min)	10
Number of servings		2

Photograph Legend

Photograph 1: A view of the sweet potato fields on the hillside overlooking the village of San Miguel Duenas near Antigua. This is a highland location. The volcano "Agua" is seen to the southwest in the background.

Photograph 2: A scene from the harvest of variety 387 sweet potatoes from San Miguel Duenas.

Photograph 3: Variety #387 sweet potatoes in situ.

Photograph 4: A view of the balance scale used to weigh-in sweet potatoes on their arrival, and after processing to finished product, at the processing factory (Mahler Sus.) in El Tejar, Chimaltenango.

Photograph 5: On the left is sweet potato (variety #387) from San Miguel Duenas, show with sections of fresh product beside the dried instantized "buds." Note the deeper yellow color to both pulp and product. On the right is the fresh sweet potato (variety #387) with both intact tissue and the instantized 'buds" from La Fragua, Zacapa. Note the paler hue of both pulp and product of the lowland-grown sweet potato.

Photograph 6: Shown are pieces of sweet potato of the variety #387 cut and weighed to exactly 100 g slices prior to the stabilization procedure.

Photograph 7: The 100 g slabs of sweet potato tissue sit in a wire colander over live steam for the 5-min stabilization (blanching) procedure as shown. This procedure improves the yield of carotene in analysis by altering the matrix to increase the ease of extraction and destroys the tissue lipoxigenase enzymes which would oxidize the pigments even with --70 degree Celsius frozen storage.

Photograph 8: The samples of sweet potato tissue weighed prior to blanching and post-blanching are shown in the labeled and sealed, plastic bags immediately prior to freezing on dry ice for their next-day shipment to the analytical laboratory at North Carolina State University.

Photograph 9: The varieties of sweet potato which have been sent for quantitative analysis for provitamin A activity are shown. The tuber with the purple husk and yellow pulp (variety #387) is on the left and the tuber with brown husk deep orange (high-carotenoid content) pulp. Both were grown in the low-land site at La Fragua, Zacapa.

Photograph 10: Acceptability test of gruel in the peri-urban community of "Berlin".

Photograph 11: Acceptability test of puree in the peri-urban community of "Berlin".

Photograph 12: Comparative Acceptability in the peri-urban community of Berlin.

Photograph 13: Acceptability test of sweet potato puree in rural community, Santiago, Sacatepequez.

Photograph 14: Acceptability test of sweet potato gruel in the rural community, Santiago, Sacatepequez.

Photograph 15: Comparative Acceptability of two gruels, one prepared with sweet potato buds and the other with a baby-food commercial cereal in the rural community, Santiago, Sacatepequez.

Photograph 16: Comparative Acceptability of two purees, one prepared with sweet potato buds and the other with a commercial cereal in the rural community, Santiago, Sacatepequez.

Photograph 17: Gruel and Puree prepared with SPB, sample from a household of "El Granizo", a marginal peri-urban community.

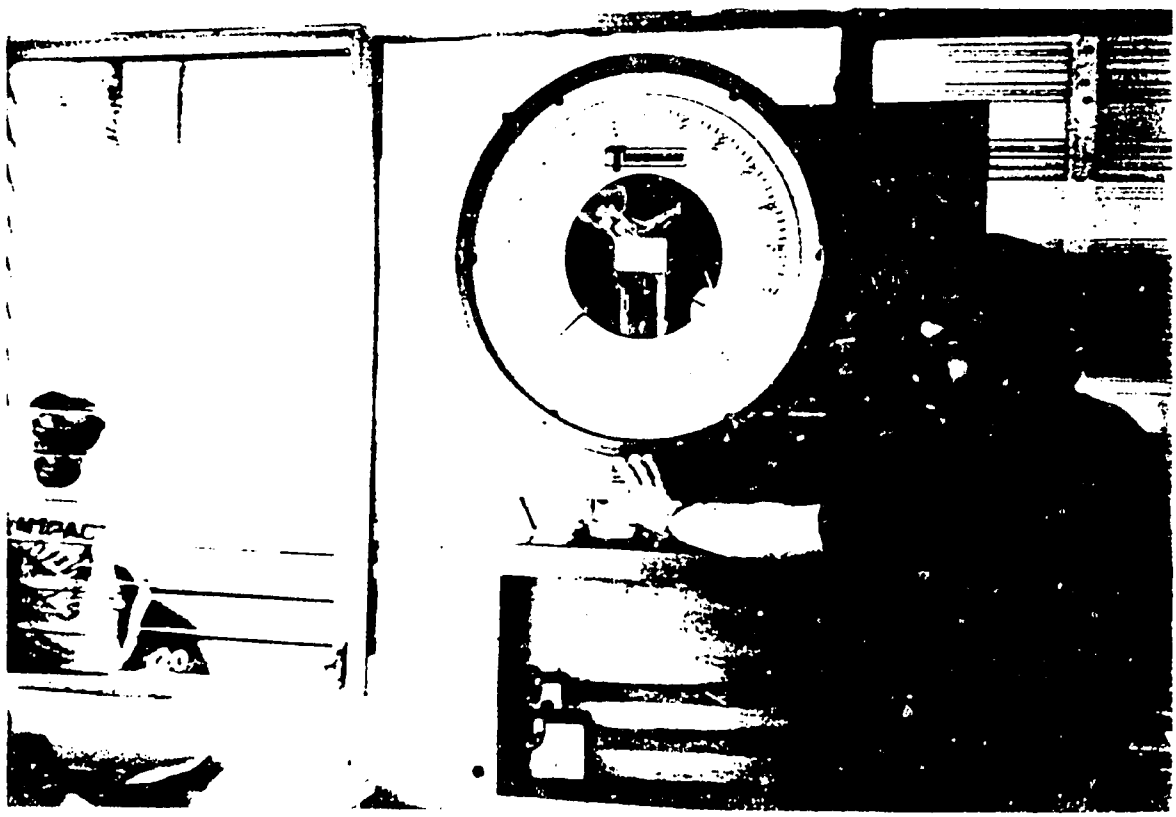
Photograph 18: Sample of "Rellenito" prepared with SPB, from a household of "El Granizo".

Photograph 19: A nutritionist from the team of CeSSIAM interviewing ladies from the indigenous rural community of "Pacul", during the recipe trial.

Photograph 20: Sample of pattie cakes prepared with SPB, from a household of "Pacul".

FIGURE 1:

FIGURE 3:



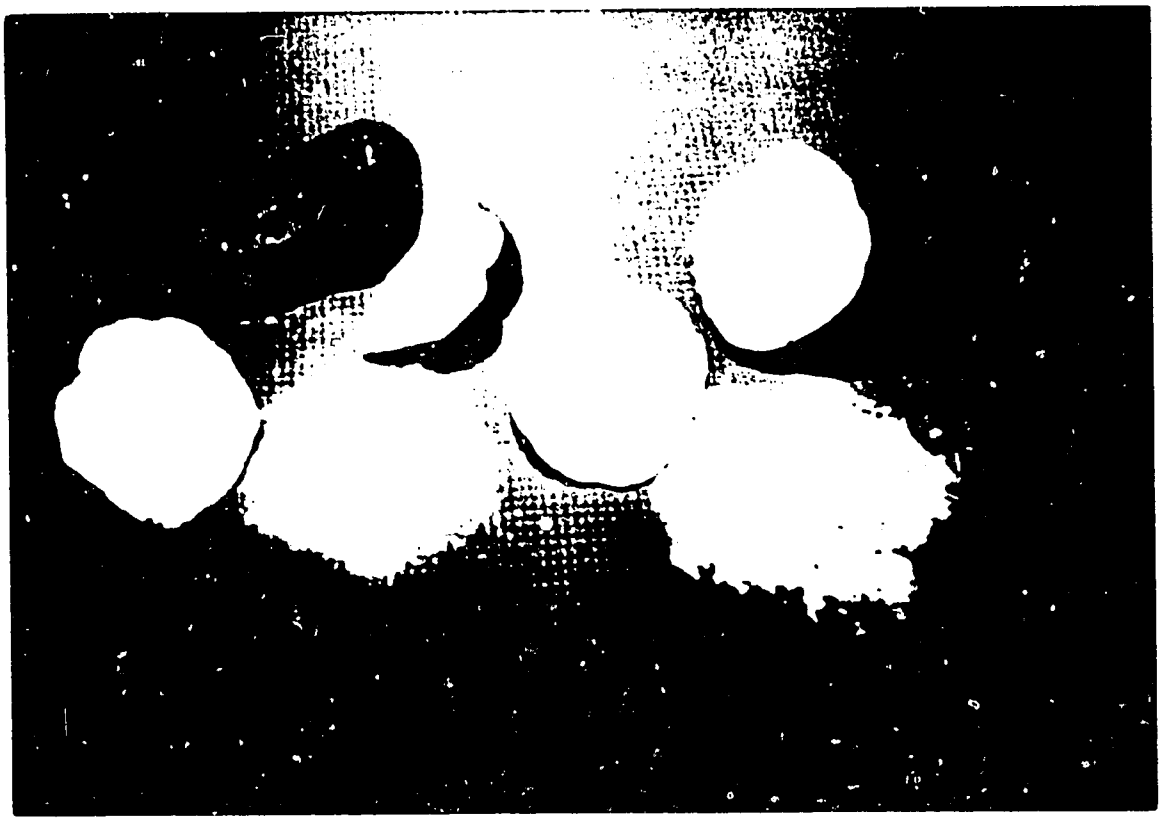


FIGURE 5:

FIGURE 7:

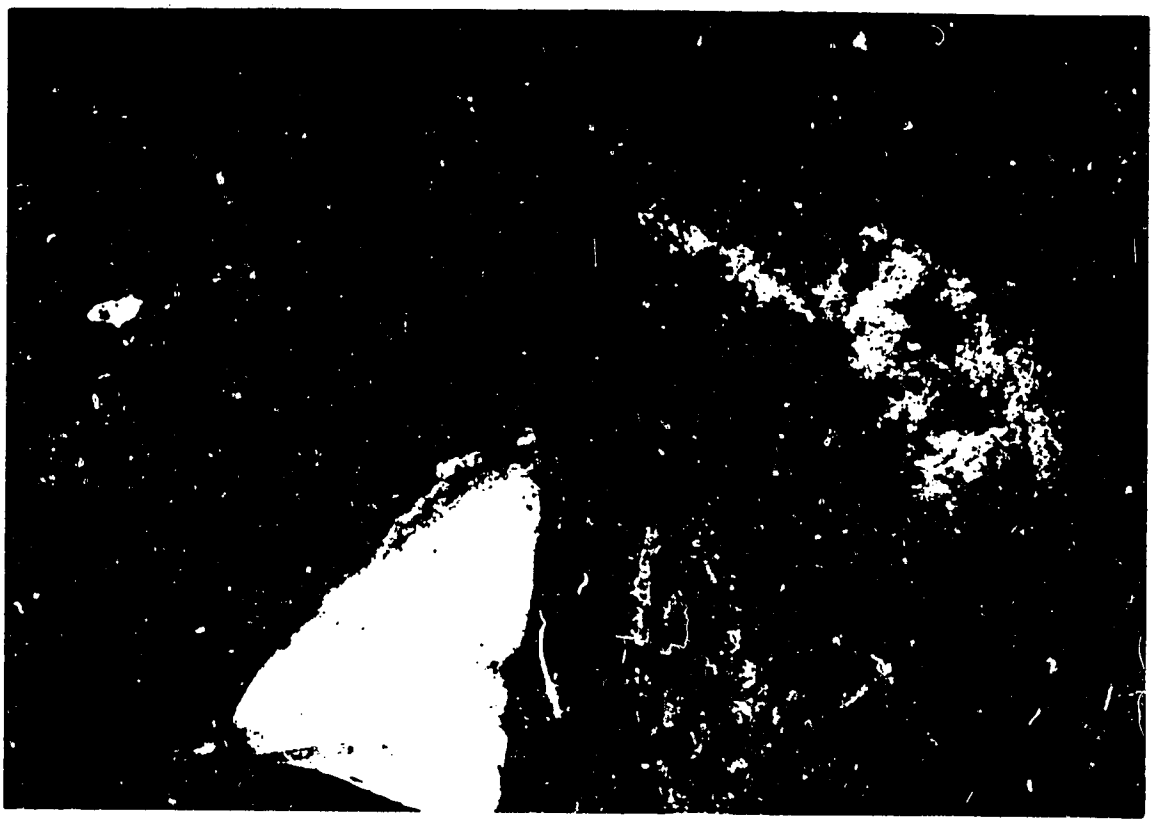


FIGURE 9:

FIGURE 10

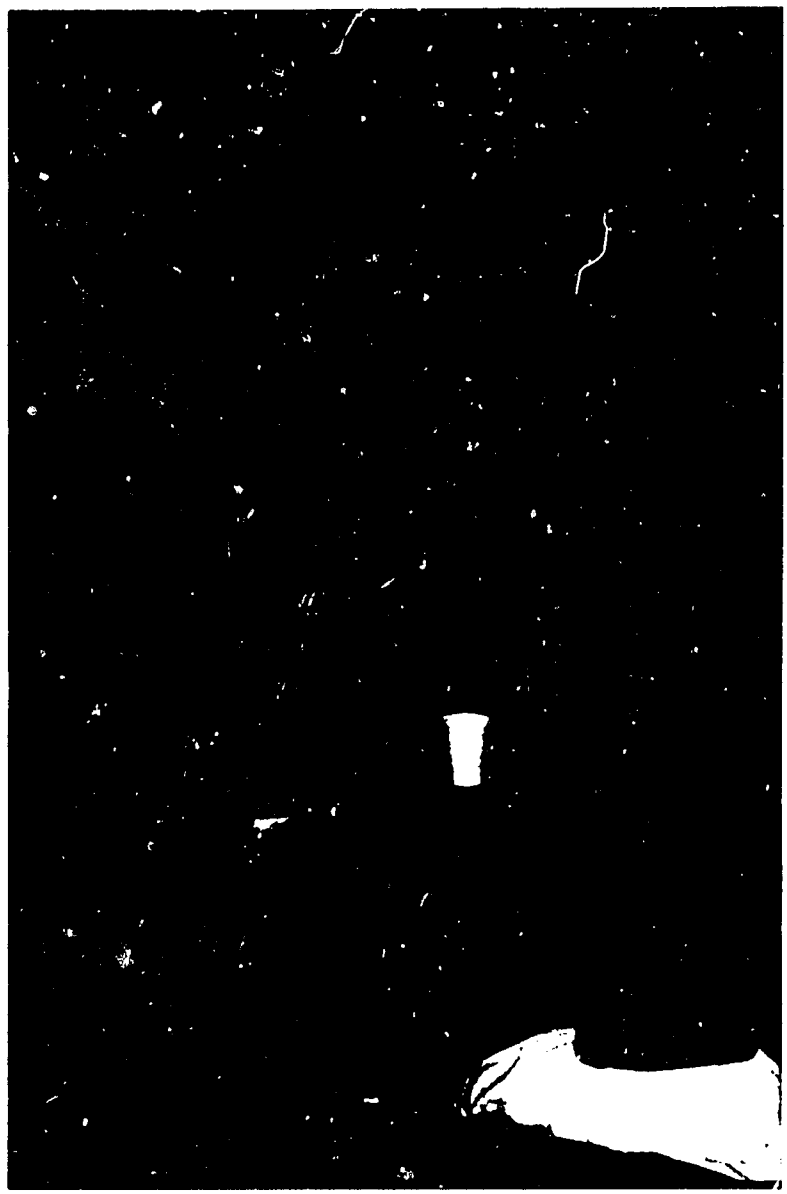


FIGURE 11

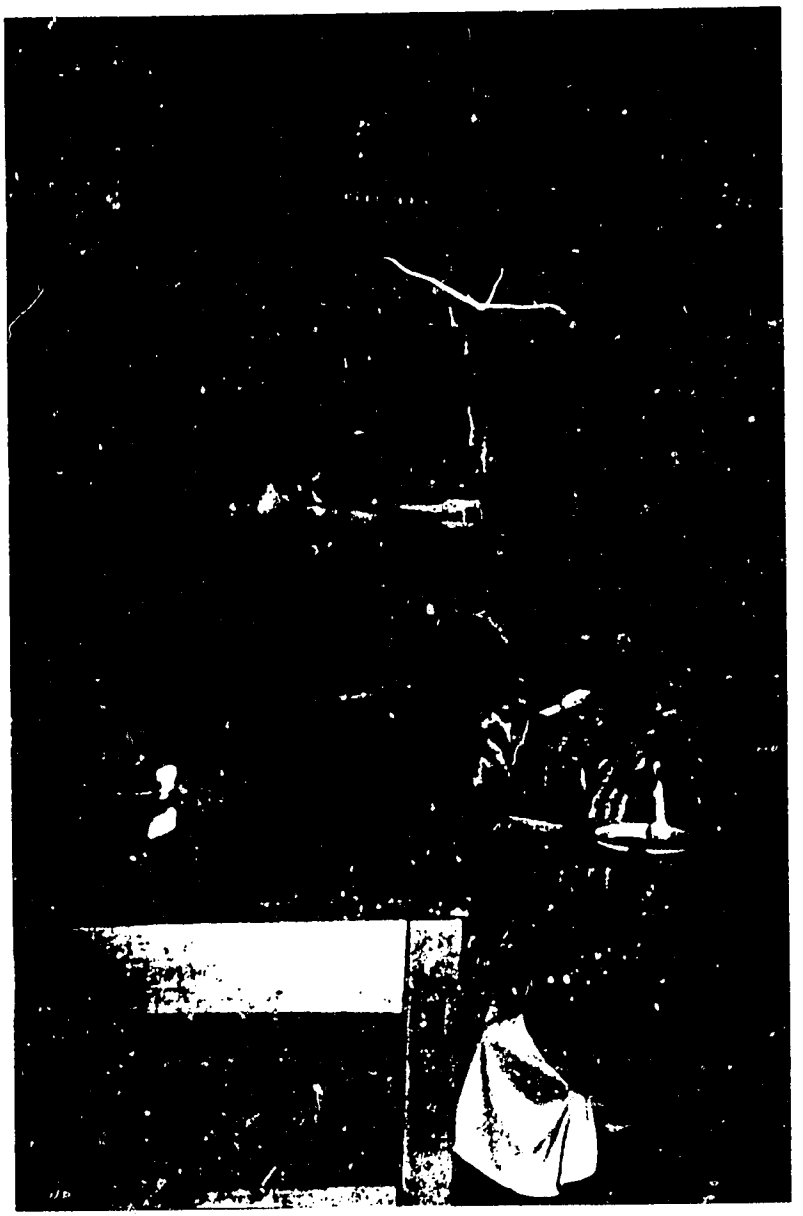


FIGURE 12

FIGURE 13

FIGURE 14

FIGURE 15

FIGURE 16

FIGURE 17

FIGURE 18

FIGURE 19

FIGURE 20