

Storage, preparation, and usage of fortified food aid among Guatemalan, Ugandan, and Malawian beneficiaries: A field study report

Jonathan P. Rowe, William C. Brodegard, Oscar A. Pike, Frost M. Steele, and Michael L. Dunn

Abstract

Background. An important consideration in determining the ability of fortified food-aid commodities to meet the nutritional needs of beneficiaries is the manner in which commodities are utilized and prepared and the degree to which micronutrient losses occur during handling and cooking by the beneficiaries.

Objective. A field study was conducted in Uganda, Malawi, and Guatemala to obtain data on storage, preparation, and usage of fortified blended foods provided by the US Agency for International Development.

Methods. Interview and observational data on the use of corn-soy blend, cornmeal, soy-fortified cornmeal, soy-fortified bulgur, and fortified vegetable oil were collected from more than 100 households and two wet-feeding sites (where food is prepared and served by staff on-site) in 32 villages.

Results. Storage practices by beneficiaries appeared to be appropriate, and all commodities observed were free from off-flavors and odors. Cooking water was typically obtained from boreholes or open wells with a pH range of 4.7 to 7.7. Food preparation usually took place in covered areas with the use of an aluminum or clay pot over a wood-fueled fire. Thin or thick porridges were the most common dishes prepared from cereal-based products, with concentration ranges of 10% to 31% (wt/wt) in water. Cooking times for porridges ranged from 5 to 53 minutes, with a mean of 26 minutes. Tortillas and beverages were other preparations commonly observed in Guatemala. Vegetable oil was typically used for pan frying.

Conclusions. Cooking fuel could be saved and nutritional quality probably improved if relief agencies emphasized shorter cooking times. These data can be used to simulate preparation methods in the laboratory for assessment of the nutritional impact of cooking.

Key words: Field study, food aid, Guatemala, Malawi, preparation, Uganda

Introduction

Public Law 480 (PL 480), the Agricultural Trade Development and Assistance Act of 1954, commonly known as the Food for Peace Act, provides legislative authority for international food assistance provided by the United States. The PL 480 program is administered by the US Department of Agriculture (USDA) and the US Agency for International Development (USAID), with a fundamental goal of promoting US foreign policy by enhancing food security in developing countries, including alleviation of hunger, malnutrition, and their causes throughout the world [1]. A large number of private voluntary organizations, as well as the World Food Programme of the United Nations, utilize PL 480 food commodities, donated under Title II of the Act, in their humanitarian aid programming.

Commodities distributed under PL 480 Title II include whole grains and pulses and a variety of processed and blended, cereal-based foods fortified with protein and/or micronutrients for enhanced nutrition. Most of the fortified blended foods are distributed in Africa (> 50%), Asia (20%), and Latin America and the Caribbean (15%) [2].

Humanitarian food aid is typically distributed to vulnerable groups at greatest risk for malnutrition. These foods often constitute a significant proportion of the beneficiaries' total diet. Therefore, it is important to establish that fortified food-aid commodities are being

The authors are affiliated with the Department of Nutrition, Dietetics and Food Science, Brigham Young University, Provo, Utah, USA.

Please direct queries to the corresponding author: Michael L. Dunn, S-221 ESC, Brigham Young University, Provo, UT 84602 USA; e-mail: Michael_dunn@byu.edu.

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utilized appropriately and delivering the maximum nutritional benefit.

An important consideration in determining the ability of fortified food-aid commodities to meet the nutritional needs of beneficiaries is the manner in which the foods are utilized and prepared and the degree to which micronutrient losses occur during handling and cooking by the beneficiaries. An informal preliminary study, using samples collected in the field, indicated that traditional cooking techniques may reduce some micronutrients in food-aid commodities to negligible levels [3]. If this is true, it might be prudent to use more stable, encapsulated vitamins in fortification premixes or to look for other ways to deliver labile micronutrients. More accurate data from a well-designed and controlled study are needed before specific changes in fortification requirements for food aid can be recommended. These data cannot be extrapolated from the general information presently available in the literature, because vitamin stability results are dependent on the specific micronutrient forms used for fortification, as well as the composition of the food matrix and the exact nature of the food-preparation techniques used [4].

The purpose of this study was to obtain observational and interview data regarding the preparation and use of fortified blended foods by making site visits to the homes of food-aid beneficiaries in key distribution areas. Data from this field study could subsequently be used to perform a simulation in which typical preparation procedures could be carefully controlled in the laboratory, allowing the effect on micronutrient stability in fortified food-aid commodities to be accurately determined.

Methods

Field site visits

The field study was carried out during July and August 2005 in the distribution areas of cooperating private voluntary organizations in Guatemala, Uganda, and Malawi. Data were collected from more than 100 households and two wet-feeding sites (where food is prepared and served by staff on-site) in 32 different villages spread across different regions of the three countries evaluated. The field study sites were selected on the basis of the type of programming, the amount and type of commodities distributed, travel logistics, and the ease of cooperation with internal aid organizations within each country.

Local collaborating agencies assisted in the field study by arranging site visits to the homes of beneficiaries, providing interpreters, and introducing researchers to village leaders and beneficiaries. With this assistance, the field scientists were able to collect key storage,

preparation, and usage data for five of the fortified foods commonly distributed by USAID: corn-soy blend, cornmeal, soy-fortified cornmeal, soy-fortified bulgur, and fortified vegetable oil.

Eight villages were visited in central Guatemala. Visits were made to four villages in the province of Baja Verapaz and four mountain villages in the province of Quiché. Storage and distribution centers in Rabinal, San Martín, Chubaj, and Guatemala City were also visited. Households participating in Maternal and Child Health programs were exclusively visited in the Guatemala field study because of the increased risk of malnutrition in this vulnerable group, and because beneficiaries were more likely to be in their homes during site visits. Data were obtained on corn-soy blend, soy-fortified bulgur, and vegetable oil.

Site visits in Uganda were carried out in nine villages in the southern districts of Mbarara and Ntungamo and five villages in Nakasongola. Additional visits were made to observe wet-feeding programs at a World Food Programme refugee camp in Kiryandongo and a World Food Programme orphanage in the city of Kampala. The households visited in Uganda were participating in HIV/AIDS, Food for Work, Maternal and Child Health, and Vulnerable Households programs. Data were obtained on corn-soy blend, soy-fortified cornmeal, and vegetable oil.

In Malawi data were collected in three villages in Dedza District, two in Mchinji District, and three in Thyolo District. The households visited were participating in Food for Work, Chronically Ill, and Orphan Household programs. Data were obtained on corn-soy blend, cornmeal, and vegetable oil.

Data collected during site visits included household demographics, sources of water used for food preparation, quality of the food aid when it was received, home storage practices, food utilization and preparation practices, and personal opinions regarding acceptability of food aid to beneficiaries.

Data were collected by beneficiary interviews as well as objective and subjective measurements made as commodities were prepared at meal times. Objective measurements included storage temperature and water activity of commodities, pH of water used for cooking, and specific data on cooking times and temperatures and food mass and volume. Ethical approval of the study was obtained from the institutional review board of Brigham Young University. Data were gathered after oral informed consent had been obtained from the participating beneficiary, with number coding used to protect the beneficiary's identity.

Equipment for collecting field data included a portable electronic balance (Ohaus, LS200), a portable water activity meter (Decagon), a pH meter (Oakton pHTestr1), a digital infrared/contact thermometer (Oakton 35625-40), and graduated cylinders for measuring volume.

TABLE 1. Household demographics

Country	No. of households	Household size (mean \pm SD)	Children/ household (mean \pm SD)	Households with infants < 2 yr (%)	Households with pregnant or nursing mothers (%)
Uganda	21	5.5 \pm 2.5	3.3 \pm 1.5	28.6	14.3
Malawi	41	6.0 \pm 2.3	3.8 \pm 2.3	19.5	24.4
Guatemala	35	6.3 \pm 3.0	2.6 \pm 1.8	25.0	25.0
Total	97	6.0 \pm 2.6	3.3 \pm 1.9	23.5	22.5

Results and discussion

Food-aid programming at visited sites

Food-aid programming can be broadly categorized as developmental, transitional, or emergency-focused. Individual projects within a program area, such as Maternal and Child Health, Food for Work, General Relief, School Feeding, etc., have specific objectives or beneficiary targets. Most of the common project types were included in the field study. Beneficiaries assisted by private voluntary organizations participating in the field study were part of Food for Work and Maternal and Child Health projects in Guatemala; Food for Work, Chronically Ill, and Orphan Household projects in Malawi; and Maternal and Child Health, Food for Work, HIV/AIDS, and Vulnerable Household projects in Uganda. Refugee and orphanage wet-feeding programs conducted by the World Food Programme were visited in Uganda.

Household demographics of field-study beneficiaries

Information on household demographics was obtained by interviews with the primary caregivers in the households. Data on household size, number of children per household, and percentage of households with infants and pregnant or nursing mothers are shown in **table 1**. Household size was defined as the number of persons in the household consuming the fortified food, as reported by the primary caregiver, and varied widely from 2 to 14. The number of children in a household varied from zero to 11. Guatemala, where only households participating in Maternal and Child Health programs were visited, had the highest percentage of households with pregnant or nursing mothers, and Uganda had the lowest. Uganda had the highest percentage of households with infants under 2 years of age.

Data obtained from the survey as well as from private voluntary organizations cooperating in the field study indicate that an average household size of five persons is typically used to calculate caloric requirements when planning general rations. For supplementary

rations, many private voluntary organizations increase the ration of the targeted beneficiaries to account for intra-household sharing. The data in **table 1** indicate that the estimate of household size by private voluntary organizations is relatively accurate.

Household eating patterns and contribution of food aid to the diet

Information on the number of meals eaten per day, typical approximate meal times, and the contribution of food aid to the overall diet was obtained from the primary caregivers of the households in Uganda and Malawi. Questions to elicit this information were added to the questionnaire after the Guatemala study was complete.

The number of meals per day was never less than two and was as high as five in some households. The average number was 3.3 \pm 0.7 in Uganda ($n = 21$) and 2.6 \pm 0.7 in Malawi ($n = 41$). Typical starting times for meals were 8 a.m., 1 p.m., and 7 p.m. Food was always eaten on the day it was prepared, and no food was stored for more than a few hours after it had been cooked. Sharing of food among household members was very common; generally the food ration was distributed among all of the members of the household.

Data on the percentage of the total daily diet derived from food aid are shown in **table 2**. Just under half of households in Uganda and all households in Malawi reported that at least 75% of their daily diet was derived from food aid. The lower use of food aid in Uganda may be partly due to the fact that in that country one-third of beneficiaries reported selling food aid or trading it

TABLE 2. Proportion of total daily diet derived from fortified food-aid commodities

Country	No. of households	% of households		
		< 50% of diet	≥ 50 < 75% of diet	$\geq 75%$ of diet
Uganda	21	14.3	38.1	47.6
Malawi	41	0.0	0.0	100.0
Total	62	4.8	12.9	82.3

for other goods, whereas none in Malawi reported selling or trading food aid. The accuracy of these data is questionable, since all private voluntary organizations reported that beneficiaries were instructed not to sell or trade food aid for other goods, and the presence of representatives of private voluntary organizations at some sites may have hindered free expression on this question.

Although the questionnaire differed slightly in Guatemala, the field scientists were able to determine that a ration designed to last for 4 weeks was typically consumed by Guatemalan beneficiaries within 2 weeks in some cases, and almost always within 3 weeks. During the last week of the month, the contribution of food aid to total dietary intake in Guatemala was negligible. Trading was also found to be uncommon among the households visited in Guatemala, most likely because all of the beneficiaries visited were part of the Maternal and Child Health program. Discussions with Guatemalan private voluntary organizations indicated that Food for Work program beneficiaries were known to have an increased level of trading.

Water sources utilized for food preparation

As is the case in many areas of the world, the availability of clean water is an important issue in Uganda, Malawi, and Guatemala. In all of these countries, the main sources of water, as reported by beneficiaries, were boreholes or open wells (**table 3**). Other minor sources, reported only in Uganda, included municipal, river, and spring water. The mean water pH was 6.7 ± 0.6 ; pH ranged from a rather acidic 4.7 in one sample, reportedly drawn from a well, to a slightly alkaline high of 7.7.

The proportion of households reporting that they boiled water before consumption to lower the risk of microbial contamination varied from country to country, despite the fact that private voluntary organization and government representatives emphasized this practice in all areas visited. Only 50.0% of Ugandan households and 19.5% of Malawian households reported boiling their water. The lack of compliance is most likely due to the scarcity of firewood, the main source of fuel. In Guatemala, firewood is more plentiful, and all of the homes visited reported that they boiled their water.

USAID Title II fortified food-aid commodities distributed

Commodity distribution data evaluated in the field study focused on US PL 480 Title II in-kind fortified blended foods, and did not cover all commodities utilized by the private voluntary organizations and the World Food Programme. Most World Food Programme field offices procure a significant proportion of their fortified blended foods from local and regional suppliers, who may follow different manufacturing specifications [5].

Fortified blended food commodities available for evaluation in the field study included corn-soy blend, vegetable oil, soy-fortified cornmeal, soy-fortified bulgur, and cornmeal. The availability of these particular commodities corresponds well with data from the USDA Food Aid Report indicating that corn-soy blend, vegetable oil, and cornmeal were the most commonly used fortified blended foods in all Title II Programs in fiscal year 2004 [6].

Title II USAID fortified food-aid commodities distributed by participating private voluntary organizations and World Food Programme agencies in Africa include corn-soy blend, cornmeal, soy-fortified cornmeal, soy-fortified bulgur, and fortified vegetable oil. Guatemalan private voluntary organizations distributed corn-soy blend, soy-fortified bulgur, and fortified vegetable oil. All commodities other than vegetable oil were dry, ground meals of relatively small particle size that had been fortified with vitamins and minerals. The dry products were packaged by USAID suppliers in woven polymer bags (soy-fortified bulgur) or three-layered kraft-paper bags with plastic linings (corn-soy blend, cornmeal, and soy-fortified cornmeal). Vegetable oil was refined, bleached, deodorized vegetable oil (typically soybean oil) to which vitamin A had been added. Vegetable oil was packaged in steel canisters.

Household storage practices and quality of food-aid commodities received

Fortified commodities in Uganda and Malawi were typically stored in the original USAID packaging in a dark room. The storage areas in Guatemala were similar to those in Africa, with a few exceptions. The majority of the recipients in Guatemala stored dry commodities in

TABLE 3. Water sources

Country	No. of households	% of households				
		Borehole	Municipal	River	Spring	Well
Uganda	21	42.9	14.3	4.8	4.8	33.3
Malawi	41	34.1	0.0	0.0	0.0	65.9
Guatemala	35	0.0	0.0	0.0	0.0	100.0
Total	97	23.5	3.1	1.0	1.0	71.4

sealed plastic bags inside metal or ceramic containers. Vegetable oil in Africa was almost always stored in the original USAID metal canisters, whereas Guatemalan recipients transferred the oil into their own plastic bottles (typically recycled PETE beverage bottles) at distribution sites.

The mean temperature of the household food-storage sites was $25.3 \pm 2.5^\circ\text{C}$ in Uganda in July, $21.0 \pm 1.9^\circ\text{C}$ in Malawi in August, and $23.1 \pm 3.2^\circ\text{C}$ in Guatemala in July.

The water activity of fortified dry-meal products in household storage ranged from 0.43 in Uganda to 0.68 in Guatemala, with an overall mean of 0.58 ± 0.5 ($n = 54$). Data on water activity were collected during the dry season in Uganda and Malawi and during the wet season in Guatemala.

Visual evaluation of commodities by field scientists revealed occasional signs of insect infestation in dry products, but these were relatively few. In all other cases, commodity quality was good, with typical appearance and aroma. No off odors or visual signs of spoilage were apparent.

Commodity use and preparation

Key to assessing the suitability of current fortified blended foods and making recommendations on product reformulations is an understanding of how they are utilized and prepared in the field. The beneficiaries were asked questions about acceptability of the commodities, types of food typically prepared, and the sources of recipes. Observations were made of the actual cooking times and temperatures and other key preparation variables.

Ninety-eight percent of Guatemalan beneficiaries followed recipes learned from the private voluntary organization, and the remaining 2% used traditional recipes. Most Ugandan beneficiaries also reported using primarily recipes from the private voluntary organization. In Malawi nearly all beneficiaries reported using traditional recipes.

In all three countries, all but a few households used wood fires to prepare commodity-based meals. Food preparation typically took place in covered areas, away

from direct sunlight. All African households used aluminum pots for cooking, and the majority of Guatemalan households used aluminum or ceramic pots.

Seasonings and other additives were used commonly in Guatemala but only occasionally in Africa. Guatemalan recipes often included cinnamon, herbs, or bananas. In Africa sugar, vegetable oil, and occasionally tomatoes and onions were added to the meals. One reason for the infrequent use of vegetables in Africa was the timing of the field study, which corresponded to the dry season when gardens were not in production.

The dishes most commonly prepared from the commodities, as reported from interviews, are shown in **table 4**. Because of cultural preferences, soy-fortified bulgur was not distributed in Africa. To avoid competition with the native corn market, cornmeal and soy-fortified cornmeal were not distributed in Guatemala. Both soy-fortified bulgur and soy-fortified cornmeal were distributed in only limited areas.

In Uganda and Malawi, the most common preparation made from corn-soy blend was a thin, drinkable porridge; the next most common was a very thick, spoonable mush called “bread” in Uganda and “nsima” in Malawi. The nsima or bread is made in a two-stage process, with about one-third of the cereal meal added at the beginning and the remainder added later in the cooking process. In both Guatemala and Uganda, the dish most commonly prepared from corn-soy blend was a drinkable porridge, which was of much thinner consistency in Guatemala. The second most common use of corn-soy blend in Guatemala was as dough for tortillas.

Cornmeal was exclusively used to prepare the traditional bread or nsima products in Uganda and Malawi, whereas soy-fortified cornmeal was used in a similar fashion to corn-soy blend, with thin porridge predominating.

The most common method of preparing soy-fortified bulgur in Guatemala was steeping the dry meal overnight in a large amount of water at room temperature. The meal absorbs water and swells approximately three times in volume. The steeping water is then drained and typically discarded, and the swollen soy-fortified bulgur is combined with vegetables or seasoned and

TABLE 4. Primary uses of dry-meal food-aid commodities

Product	% of households			
	Corn-soy blend ($n = 63$)	Soy-fortified bulgur ($n = 12$)	Soy-fortified cornmeal ($n = 7$)	Cornmeal ($n = 41$)
Thin porridge	76.2	—	85.7	—
Thick mush	3.2	—	14.3	100.0
Tortilla	11.1	—	—	—
Beverage	—	41.7	—	—
Steeped	—	50.0	—	—
Other	9.5	8.3	—	—

used as a filling in tortillas or empanadas. In a few households, the steep water was used as a beverage and the soy-fortified bulgur was fed to animals. Another preparation method involves grinding the soy-fortified bulgur and dry roasting it in a frying pan. The toasted soy-fortified bulgur meal is then mixed with water to make a thin beverage.

Of the 81 households in the three countries using USAID vegetable oil, 69.1% reported frying as the sole use. The percentage of households reporting frying as the sole use of oil ranged from 90.9% in Malawi ($N = 22$) to 54.3% in Guatemala ($n = 35$), where oil was also commonly used as an ingredient in other products. Some beneficiaries, for example, reported adding a few spoonfuls of the fortified oil to porridge on the basis of instruction received from their benefactor private voluntary organization, whereas other households administered several spoonfuls of oil neat as a tonic for persons in poor health.

A summary of specific preparation variables, including formulation and cooking times and temperatures, is shown in **table 5** for the principal products prepared from each USAID commodity. These data were collected by direct measurement in households visited during meal preparation times.

Information on the method of steeping soy-fortified bulgur was obtained exclusively from interviews, since the bulgur had already been steeped at the time of the visit. All households used approximately the same ratio

of 0.25 kg of bulgur to 1.5 L of water.

Despite the widespread use of corn-soy blend and soy-fortified cornmeal for making thin porridge, the cooking methods varied from household to household. As previously noted, private voluntary organizations instruct beneficiaries about the importance of boiling water and/or porridge products to eliminate pathogens. As a result, beneficiaries would always bring the porridge to at least a low boil. This is reflected in the relatively small standard deviation of the maximum temperature during cooking. Perhaps most notable, however, were the large standard deviations in boiling and cooking times. These differences can most likely be attributed to instructions from private voluntary organizations. In one area, for example, all beneficiaries cooked the porridge for at least 30 to 45 minutes because the distributing private voluntary organization understood government boiling recommendations to mean boiling food, not just water, for 30 to 45 minutes.

Commodity acceptability

Overall, all commodities were received and accepted very favorably by beneficiaries. Differences in perceptions of nutritional benefit were noted from country to country, which were probably attributable to educational programs of private voluntary organizations associated with distribution.

TABLE 5. Preparation variables for specific products

Product	Ingredients	No. of observations	Variable	Mean	SD	Min	Max
Thin porridge	Corn-soy blend or soy-fortified cornmeal	28	Concentration of dry ingredients (% wt/wt)	14.3	3.8	10.5	26.3
			Water temperature at addition (°C)	66.5	16.0	36.0	94.0
			Maximum temperature during cooking (°C)	94.4	2.6	88.0	97.0
			Boiling time (min)	23.8	12.6	4.0	46.0
			Total cooking time (min)	26.4	12.2	5.0	53.0
Thick mush	Corn-soy blend, cornmeal, or soy-fortified cornmeal	35	Concentration of dry ingredients (% wt/wt)	23.8	3.7	19.2	31.3
			Water temperature at addition (°C)	73.2	8.3	50.0	87.0
			Maximum temperature during cooking (°C)	94.9	2.3	89.0	98.0
			Time to addition of 2nd portion of dry ingredients (min)	8.7	3.5	3.5	14.0
			Total cooking time (min)	12.7	4.2	5.0	20.0
Various products	Vegetable oil for frying	6	Maximum temperature during cooking (°C)	193.6	60.6	127.0	280.0
			Total cooking time (min)	5.1	2.8	2.0	9.0

The beneficiaries reported liking corn-soy blend for its nutritional value and its sensory qualities, although the order of emphasis varied markedly from country to country. In Uganda 65% of beneficiaries reported that the nutritional aspect of corn-soy blend was what they liked most, whereas in Malawi 74% indicated that the sensory properties were most important. Guatemalans also reported very favorable acceptability of corn-soy blend based on sensory properties. Dislikes associated with corn-soy blend were very infrequently mentioned and were typically associated with general appearance, smell, or taste.

Cornmeal, which is a common and widely used staple in both Uganda and Malawi, was liked predominantly for its sensory rather than its nutritional qualities, especially in Malawi (88%). The beneficiaries appeared to understand that cornmeal was not as highly fortified as corn-soy blend. When asked about dislikes associated with cornmeal, none of the Ugandan beneficiaries offered any concerns, whereas nearly 30% of the Malawian beneficiaries disliked the taste of the cornmeal, possibly due to varietal differences in corn. Other reasons for dislike included color, texture, and excessive time needed to cook.

Soy-fortified bulgur, soy-fortified cornmeal, and vegetable oil were all well liked, and no negative comments related to these products were recorded.

Conclusions

The data from this field study suggest that USAID food-aid commodities are generally well accepted by beneficiaries. All commodities observed in beneficiary homes were in good condition and free from off flavors and odors. Storage practices appeared to be appropriate and adequate. Products prepared by beneficiaries from the cereal-based foods were primarily porridge and thick mush; Guatemalan beneficiaries tended toward greater recipe diversity, primarily because of

their greater access to fresh garden produce. A very wide range of cooking times was observed for porridges. The average cooking time was much longer than necessary, given the fact that most recommended cooking times for these products are between 5 and 10 minutes [7–9].

Household sizes in this study are generally larger than those used by private voluntary organizations to determine the amount of food aid allocated to households. Furthermore, the food-aid supplement typically constitutes a much larger proportion of the total diet than intended. Consequently, the food is almost always exhausted before supplies are replenished each month.

Another major concern is the actual nutrient delivery achieved after preparation of fortified commodities by the beneficiaries. The unexpectedly long cooking times used by many of the beneficiaries could have a detrimental effect on vitamin stability. Data from this study on product preparation have been used in a laboratory simulation to evaluate the effect of typical cooking methods used by beneficiaries on vitamin stability in common USAID fortified blended foods. These studies will provide information on the nutritional adequacy of fortified humanitarian food-aid commodities as consumed, so that appropriate recommendations can be made in cases where improvements are needed.

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