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**CENTRO NACIONAL DE TECNOLOGIA AGROPECUARIA Y FORESTAL
"ENRIQUE ALVAREZ CORDOVA"
LABORATORIO DE TECNOLOGIA DE ALIMENTOS**

FINAL REPORT

USE OF CTI GRINDERS FOR SORGHUM FLOUR PRODUCTION AND UTILIZATION

CENTA-INTSORMIL-USAID

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SUMMARY

The use of sorghum for human consumption to add value to the crop and increase its profitability, especially for small and medium producers, has contributed to food security and nutrition in El Salvador. CENTA is promoting the cultivation of sorghum as an alternative to food production in rural and urban areas. Since 2010 when wheat prices lower again, sorghum was no more an alternative to replace wheat in certain types of food, but is being used in more stable markets, as people allergic to gluten, people with diabetes and to correct nutritional deficiencies such as iron deficiency anemia because of its nutritional properties. The aim of this study was to contribute to the development of agribusiness in sorghum through the transfer of technology in processing and grain quality, grinding equipment for dry milling for micro-enterprises, producers etc.. And development of new food products using sorghum as a main ingredient.

Among the relevant results of the project, we can cite a number of 1062 trained producers, the development of at least 13 new food products, including fortified beverages, snacks, biscuits, ethnic beverages etc, which are already being marketed, the adoption of sorghum in nutrition programs to correct nutritional deficiencies and the acquisition and purchase of more than 15 artisan grinders distributed in rural and urban communities in the country, which are being used for different income generation activities .

INTRODUCTION

Economic and nutritional opportunities of sorghum are limited by available equipment options for processing and also by the good supply of grain quality. The large-scale commercial operations result in products of high price and poor families can not afford the costs of these products. The corn mills (mills for wet grinding), have also been used to grind sorghum, but require twice as many processing steps and to produce flour suitable for food processing.

Since 2007, Compatible Technology International (CTI) has been working with CENTA INTSORMIL to develop the use of small mills for grinding sorghum and to promote this technology in different technology transfer activities. These mills can be produced locally; have a good capacity (25 to 30 pounds per hour) and can achieved the desired particle size for food processing. Employers who attend the workshops and who are interested in acquiring mills can buy one from a local dealer or manufacture the mills themselves, using pieces of the original mills CTI. Food Laboratory technicians can provide help on the type of mill (wood, metal, aluminum) drawings, materials and type of engine you have to adapt to the CTI grinders.

The use of these mills is considered important to encourage small food industry and add value to the cultivation of sorghum in the country, also contributes to improving food security and nutrition in vulnerable communities. There are already several small rural communities and urban mills using CTI technology. It has distributed a number of approximately 15 mills nationwide which are being used in various income generating activities.

BACKGROUND AND LITERATURE REVIEW.

Traditionally sorghum has been used as a substitute for corn to make tortillas and other products after cooking with lime and grind in wet form. The milling was performed using mills popularly "corn" or mill used especially for wet milling of corn.

Dry milling offers many advantages to store and market products of sorghum, but the grinding technique is not as popular. People interested in using sorghum flour are struggling to find who perform milling, or where to get a suitable mill to obtain flour of good quality.

With the disc mills NGO Compatible Technology International (CTI), which were introduced to the country in the year 2010, demonstrated the potential to transform sorghum flour with a simple and good quality characteristics (Taylor, 2010.) These mills are manufactured in the U.S., but can be made at home or use parts of them, such as disks, which have special slots and a special sharp, which makes dry grinding. This would eliminate or reduce the need for complete and allow mills to import the adequacy of existing grinders for grinding sorghum flour of good quality at lower cost. In El Salvador, and we have a manufacturer and distributor of CTI mills, which are already available to the public. In Africa these mills are in popular use in the communities especially for grinding sorghum (Rooney & Miller, 2007)

GENERAL OBJECTIVE

Promotes SORGHUM agribusiness through the use of low-cost mills designed for Compatible Technology International (CTI) for the production of flour in an small-scale food production.

SPECIFICS OBJECTIVES

- Promote the use of low-cost mills, designed by CTI for processing grain sorghum flour for the food industry.
- Train farmers and other processors in the production of sorghum flour and its use for food and drinks.
- Crop adding value of sorghum and increase profitability

METHODOLOGY:

The project was conducted by the Food Laboratory since 2010. The total running time was two years. The activities include at least 20 annual workshops to demonstrate and promote the use of low-cost CTI mills for the production of sorghum flour on a small scale and its use as a main ingredient or mixed with other grains.

In the theoretical and practical workshops covered the following topics: Grain quality for food production (humidity, pericarp color, glume color, hardness, density, nutrient composition, varieties (improved vs. native), production of flour, use mills (manufacturing, assembly and use and development of sorghum-based products.

There were also other promotional activities such as lectures, development of new products made from sorghum or mixed with other flours, producing a wide range of functional foods, including foods including gluten free, diabetic food, nutritious food, whole grain and others to expand the range of alternative products for local and foreign markets. Besides several mills were distributed in rural communities nationwide.

RESULTS

Some of the performed activities are:

1. Training in production and use of sorghum flour. Have been trained since 2010 to date a total of 1162 people in a total of 51 workshops (Table 1)



Figure 1. Trainees in workshops on production and processing of sorghum flour given in the Laboratory of Food Technology.

Cuadro 1. Trained People 2010-2012

TRAININGS	2010	2011	2012
Sorghum processing and use of CTI grinders	24	15	2
	Trainees per year		
TRAINEES	2010	2011	2012
	692	224	210

2. Technical assistance to nationals and foreigners. Among the foreigners were trained two technicians from University Marta Abreu de las Villas, Cuba and two technicians from INTA, Nicaragua in the use of sorghum for food and milling equipment utilization.

3. Have been developed a total of 13 products using only sorghum meal or combined with other flours. Among the developed products are snacks, soups, noodles, fortified beverages, ethnic beverages and bakery products



Figure 2. New sorghum based products developed by the Food Laboratory

4. Sorghum Programs Food and Nutritional Security (SAN)

The team has worked on various nutrition programs, using sorghum to correct problems of nutritional deficiencies in the population. Collaborated with the Foundation for the relief of children "FIRMC" and Community Development Association (ADESCO) "Las Delicias", an organization dedicated to improving

the health of children through supplementary feeding programs. Mothers of children diagnosed with iron deficiency anemia, were trained in manufacture of sorghum products that were included in the diet of children and they were monitored in anthropometric data to verify improvements in their health. Sorghum corrected the problems of anemia in 72% of children subject to supplementary feeding plan.



Figure 3. Children belonging to the supplementary feeding program of the FIRMC, El Salvador.

5. Promotional and outreach activities.

Were performed a number of promotional speeches with 6 different actors, to promote the nutritional content of sorghum grain and the products developed. Participation in exhibitions of the National Bureau of Bakers of El Salvador (MENAPAES) and First Food and Nutrition Fair organized by the CENTA'S Food Lab, as well as other institutional activities. There were 6 promotional and motivational speeches to members of MENAPAES.



Figure 4. Activities of promotion and extension of the use of sorghum for food production.

6. Distribution of CTI mills. In the country have distributed a total of 15 mills, which have been donated and others as follows:

- Cooperativa San Jerónimo, Zamorano/Fomilenio.
- Clínica FIRMC, Las Delicias, San Juan Opico
- Universidad Marta Abreu, Cuba. .
- PREMODER La Laguna, Chalatenango.
- San Rafael Cedros, Cabañas. Panadería Rural
- ASCOPARSAL, Asociación de panaderos Artesanales
- Concepción Batres, Usulután.
- Cooperativa las Bromas Atiquizaya. Panadería Rural.
- MENAPAES , Cojutepeque.



Figure 5. Personal of rural microenterprises and urban areas receiving CTI grinders

6. ADOPTION OF MILLS CTI

A monitoring survey to verify the adoption of technology by a group of people selected randomly from a sample of 200 trainees in the production and use sorghum flour.

The study was conducted with sample of 100 people, from bakeries and farmers' associations, including 42 men and 58 women, ages 31 to 42 years, with an average household members of 3. The survey was designed by master's student Jael Jaen, Kansas State University. The questions developed and their respective percentages of frequencies, are summarized in Table

Table 2. Frequency Data for Monitoring Survey on Production and Use of Sorghum Flour.

Survey Data	Frequency	Frequency
	SI (%)	NO (%)
Do you belong to a cooperative	57.3	42.7
Did you buy Sorghum flour	59.5	40.5
Did you produce Sorghum flour?	13.5	86.5
Are you interested in the use of Sorghum for food	83.8	16.2
Do you produce bakery products	55.4	44.6
Do you produce ethnics beverages	17.3	82.7
Were you trained by CENTA	67.6	32.4
After training did you started using sorghum	52.7	47.3
Advantages of their use (flour Price)	55.2	44.8
Advantages of their use (flavor)	74.3	25.7
Disadvantages (grain price)	87.9	12.1
Disadvantages (Cultural aspects)	77.0	23.0



Figure 6. Filling out Personal survey data for monitoring technology adoption

CONCLUSIONS:

- The technology transfer was successfully performed, since the majority of respondents knew the use of sorghum through CENTA and a total of 83% of respondents are interested in continuing to use sorghum as food.
- Most producers buy flour to cooperatives, they do not produce because they lack their own or local equipments.
- Increased use of the flour is for making pastries, to a lesser extent French bread and ethnic drinks
- Among the advantages of using sorghum in food, price was mentioned, but mostly used for providing the taste and quality.
- Among the disadvantages shown for the use of sorghum are grain acquisition and the cultural aspect, which relates the consumption of crop sorghum for animal feed.

EXPECTATIONS:

- Due to the fall in the price of wheat flour, the substitution of wheat flour, sorghum, is not a viable option in the country, look for more stable and specialized markets, such as gluten-free products, nutraceutical products or healthy grains, school feeding and so on.
- Offering alternatives such as sorghum products for school feeding programs, like fortified beverages QPM maize and sorghum, biscuits, snacks and other products that can replace existing bought internationally. COTSAN / CONASAN
- Promote sorghum for food and nutritional security projects (SAN) within the PAF, such as household workshops, field schools ECAS and other agricultural outreach
- Continue technology transference from CENTA to other Central American countries like Nicaragua, Guatemala and Honduras.

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