CNFA sent Ted and Anne-Marie Nordquist to the Soymilk Processing Plant in Mchinji, Malawi in November, 2011 “to improve the quality of soymilk through improved skills and to suggest and demonstrate additional soy foods made from locally grown soybeans”. This soymilk plant is run by the Tayamba Mchinji Boma AIDS Support Group (TMB) and is located about 130 kilometers from Lilongwe, the capital city of Malawi. This area is considered the “Sunbelt of Malawi” where groundnuts (peanuts), sunflowers, corn and soybeans are produced, largely due to the area’s fertile red soils and favorable rain pattern.

Machinery and Proper Storage

Before: the soybeans are <u>incorrectly</u> stored in the production room, rather than a storage unit. Rodents and insects can easily penetrate the bag, moisture from soymilk production will taint the soybeans, and conversely, dust from the soybeans will enter the soymilk process, contaminating the product.

After: The soybeans should be placed in closed plastic containers with a lid that can be securely kept shut. The soybean container should be in a separate room so that only "cleaned and soaked" soybeans are allowed into the production facility.

Cleaning and Sorting Machine

This is a large “electrically driven” cleaning and sorting machine that is not practical at this point in the operation. Since the batches of soybeans to be cleaned and rinsed are only about 3 kg of dry beans, these batches can be cleaned and rinsed by hand. The time and energy that this machine takes to clean and sort the soybeans will only be useful once the soymilk production becomes so large that doing the work by hand is no longer practical.

Steam Boiler

The boiler was designed to run on propane gas, but the members decided to use wood as the heat source. This is cheaper but is very inconsistent heat (if it rains it will not work at all) and smoke from the fire under the steam boiler enters into the production room, making for very unfavorable working conditions.

Recommendation: use propane gas if at all possible and build a roof over the steam boiler to protect its operation on rainy days.

This is a picture of the soymilk processing equipment. It is made up of a “soy cow”, a flash tank and a pressing tank. It is a Prosoya design and produces an “airless” steam injected grind, yielding a very good quality soymilk.

Means of heating water and soymilk. Wood or coal is used. This is the common method of cooking throughout the villages in Malawi.

Method used to cook water to above 95 C. As production increases it will be necessary to use propane gas or electric heating to be efficient .

Cleaning and Soaking the Soybeans

Here 3 kg of dry soybeans are being cleaned and rinsed with fresh water. The water is added to the dry soybeans, stirred vigorously, and then the water is poured off the top until no debris or dirt is seen in the water. Once the water is clear, the soybeans are covered with water that is three times the level of soybeans. Once the soybeans have soaked (here 5-7 hours) they will swell to 2.5 times their original size. All the soybeans should remain covered with water.

Proper hydration of the soybeans

•The soybeans on the left are slightly concave and have a dark yellow center. These soybeans need to be soaked longer.

•The soybeans on the right are flat and the color is even light yellow. These soybeans have been soaked the proper length of time.

•If bubbles appear on the surface of the soaking water, the soybeans have been left to soak too long. The bubbles are gas produced by fermentation of the soaking soybeans.

Once the soybeans are cleaned and soaked properly, just before production the soybeans are to be rinsed again thoroughly so that no “yellow” water remains. The yellow color in the water are sugars that can cause flatulence (or gas in humans) and should be removed.

All of the floating debris including the hulls are removed.

Soy Milk Processing

Processing Soaked Soybeans

1. Rinse, soak, and rinse again 3 kg dry soybeans
2. Add 8 liters of hot water (at least 95 degrees Celsius) to the soaked soybeans
3. Pour the hot water and soaked soybeans into the soy cow hopper (shown here). Close hopper valve.
4. Open steam valve and bring temperature to 101 C. Keep temperature 101-102 C (close steam valve if necessary to maintain temperature)
5. Cook for 7 minutes at this temperature (101-102 C), creating "slurry"
6. Expel cooked slurry into flash tank

This is the hot soymilk slurry (under pressure) being expelled into the flash tank and from the flash tank into a soymilk open container

This shows the hot soy slurry after it has been poured into the pressing tank. The pressing cloth has been sterilized by filling the pressing tank with hot boiling water and immersing the pressing cloth in the hot boiling water.
Then the soy slurry was poured into the pressing tank and the pressing cloth tied.
The pressing tank lid is placed on top and the handle turned to press out the soymilk.

Here the soymilk is shown running through the pressing sack into the soymilk container.

The lid of the pressing tank has been attached and the soymilk is being pressed through the cloth with the help of the hand press.

Once the soymilk is pressed (separating it from the “okara,” soybean pulp) it needs to be heated to above 95 C before being filled into bottles

Here is a member using the hand held refractometer . A drop of soymilk is placed on the window prism and then looked at like a telescope into the sunlight. There is a scale of 0-30. When looking through the refractometer there will be a “shadow” at the bottom of the scale. Where the “line of the shadow” crosses the scale the number at that point tells you the total soy solids of the soymilk. The goal is about a minimum of 6 total solids.

The hot (>95C) soymilk is filled in the sterilized bottles and then the caps are applied. Once the sealed bottles and caps are in place, the bottles are placed in ice water to get the temperature down to 4C.

To sterilize the bottles and caps, the bottles and caps are placed in a container and boiling water (>95C) is poured into the bottles and container with caps

Sealing the bottles

The bottles are hot, so placing them on the table and using a cloth to insulate the hands from the bottles is important.

The bottles should be filled almost to the top to eliminate the “head space” between the soymilk and the cap. Bacteria, yeast and mold will begin to grow in this space first.

Once the soymilk has been cooled from 95C down to 4C in ice water, the bottles of soymilk can be placed in the refrigerator. However, the temperature of this refrigerator was 15 C. For any effective shelf life the temperature of the refrigerator needs to be at 4C.

Tofu Processing

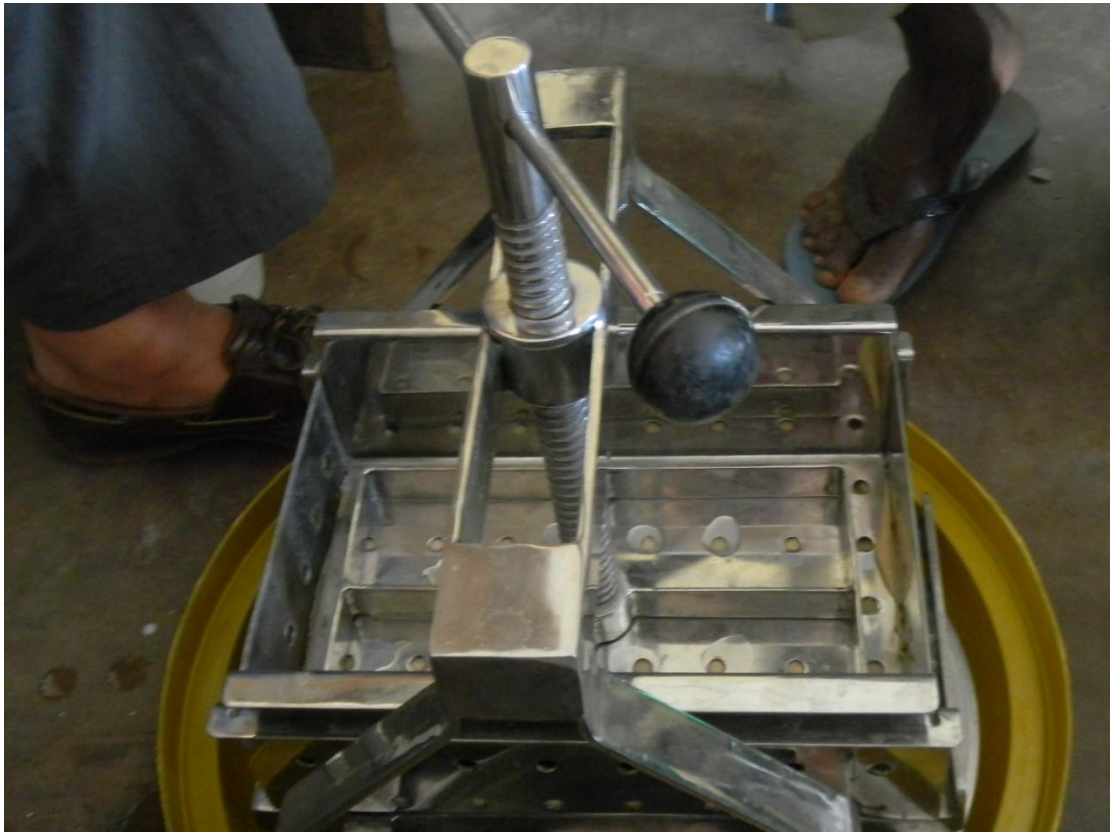
1. Follow the steps for processing soymilk through the heating process.
2. Once the milk is heated to 95 C, add 50 grams of CaSO4 (calcium sulfate) or MgCL2 (magnesium chloride) to 500 ml of hot (95C) water to 10 liters of hot soymilk.
3. Separately stir the soymilk and coagulant vigorously. The coagulant is poured into the soymilk and stirred vigorously for 30 seconds. Then use the spoon to slow down the motion of the soymilk and bring it to a stand still.
4. Cover the soymilk and let stand 5 minutes. Remove the cover and slowly move the spoon in the soymilk.
5. You should see yellow liquid appearing. Very slowly continue to move the spoon throughout the soymilk until there is only curds and yellow whey.

This is how the curds and whey appear as the spoon is moved slowly through the soymilk.

Take a strainer and force it down into the curds and whey. Using a cup, extract the whey from the center of the strainer.

Removing the whey with a cup

Pour the curds (tofu) into the pressing box. The pressing cloth was first sterilized by cooking it in hot water before this step.



Fold the cloth into the pressing box and begin turning the handle to press out the whey. Turn “very slowly” over time to extract as much whey as possible.

When all of the whey has been pressed from the tofu, remove the tofu from the pressing box and separate it from the pressing cloth in water (water earlier sterilized by cooking it first).

Here is finished tofu cut into blocks. Two recipes are:

1. Cut tofu into small cubes. Add salt to corn flour and roll the tofu cubes in the salted flour. Deep fry in cooking oil and serve

2. Tofu Balls – mix 1/3 tofu with 1/3 vegetables and 1/3 okara (soy pulp). Add spices to taste and some corn flour to make a dough.

3. Deep fry these tofu balls and sell the same day.

4. From beginning to end about 300 tofu balls in one hour.

Adding spices to tofu and okara

Shredding Vegetables

Here carrots, onions, paprika, kale, spinach and tomatoes are broken into small pieces to be added to the tofu and okara.

Here a member is rolling his recipe of tofu, okara, vegetables and spices into a “winning” deep fried soyfood we call tofu balls.

Another member producing tofu balls

The men are determined to participate head to head with the women.

The tofu balls were deep fried in cooking oil.

Adding sugar, vanilla and a pinch of salt to flavor the soymilk greatly improved the taste.

- Soy solids >6
- Sugar 6-7%
- Vanilla 1-2%
- Salt 0.5%

After formulating original and vanilla soymilks using some sugar, salt and vanilla flavor, we passed around the soymilk for all to try. This one seemed to really like it and we all agreed on the formula for the future!

The two winners of the tofu ball contest the first day were Gabriel and Daniel.

The winner of the second day of competition for the best tasting tofu balls was Annie Beatrice.

The second prize on the last day of competition went to Agatha.

The third prize for the best tasting tofu balls on the final day of competition was Lawrence. He does not appear happy here, but Lawrence was constantly encouraging the members and joking with them all day long. He donated spices, vegetables and his compressor (from his chicken egg incubator) the last few days to help us continue the training despite power outages that occurred daily.

Lawrence donated the use of this compressor for the last several days of our training. Without it we would have been unable to continue since the power was lost on a daily basis, once for 24 hours.

Each day we reviewed together what we had learned, answering any questions. We also decided on what we wanted to do the following day. This was important so the members could agree on the next days activity and what time we would begin in the morning. Most days started at 7:00 and finished around 16:30.

Each day we would go over the next days lesson. Here we talk about the steps for making tofu.

Pearson (our interpreter) would translate everything into the local language “chichewa” and write each step on paper we taped to the wall. Every day and every exercise was recorded on the wall including formulations for soymilk, tofu balls, making tofu and yogurt.

The members took extensive notes and asked questions when they did not understand. Many offered suggestions that helped to plan the following days activities. Attention levels were very high!

In the bottom right hand of this picture are soybeans being sold at market. We paid about 230 kwacha per kg which is about $1.09.kg or $0.50/lb. Most corn, rice and legumes were sold in bulk. These soybeans were local. Nearly all transport was done by bicycle in and around the village.

Here is a picture of the market where we purchased the soybeans. This is a typical scene throughout Mchinji.

All of the farm land around Mchinji is farmed without any mechanization. All work is done by hand and they rely on rain to provide necessary water.