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23390
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Final Report

Under UNIDO contract # 16001166

for Project FB/URT/05/A06

Supply, installation and commissioning of a multi-function food processor
in the Municipality of Kigoma, Tanzania

Submitted by : Malnutrition Matters

Date: May 11, 2007

NB: Summary / edits from first progress report follow to be included as part of final report.

The objectives of the first stage of the project were to order and ship the VitaGoat food processing system to UNDP/UNIDO in Dar es Salaam, notify UNIDO of the shipment, and to specify requirements for site preparation.

- 1) The VitaGoat equipment was originally ordered from the manufacturer on June 17, 2006. A revised Purchase Order for the equipment was sent on August 21, and was included as Annex 1 of this report.
- 2) The equipment left the manufacturer in Faridabad India on August 25, 2006. The shipment consisted of two crates packed, and with markings, according to instructions in Annex D of the contract. The estimated arrival of the equipment in Dar es Salaam is October 7, 2006. The shipping company issued the Bill of Lading on Sept 5. The Bill of Lading, Invoice and Parts list (the shipping documents) are appended as Annex 2. Please note: the shipments for both Muheza and Kigoma (being the subject of a separate UNIDO contract # 16001166 for Project FB/URT/05/A06) are on the same Bill of Lading since they were consolidated as one shipment. The boxes were marked appropriately (2 boxes for each project), but they are on the one shipment.
- 3) Copies of the shipping documents were sent to M. Latrech and Gillian Ocampo-Goetzlinger of the Procurement Services Unit at UNIDO headquarters in Vienna as well as to Juliet Kabege of UNIDO in Dar Es Salaam immediately upon shipment of the equipment.
- 4) Site preparation requirements, instructions and list of materials were sent to K. Bucyana and G. Ocampo-Goetzlinger of UNIDO in Vienna, and to J. Kabege of UNIDO in Dar es Salaam in June and again to both locations on August 15 2006. Confirmation of receipt of these documents was received by Malnutrition Matters. Preparation of the site, and procurement of required materials and utensils according to these instructions, were the responsibility of UNIDO and/or its partners for this project. A copy of the Site Preparation Guide and the Preparation and Materials Guide were attached in Annex 3 of the first progress report.

Next Phase - following first progress report:

1. The next stage of the project involved confirmation that the VitaGoat food processing system had reached the work site in Kigoma, confirmation that site preparation is complete and confirmation that all required materials and personnel (equipment operators / food personnel) will be available for the training visit by Malnutrition Matters personnel.

2. Technical specialist / Engineer Charles Lauzon of Malnutrition Matters arrived in Dar es Salaam on April 21 and proceeded to Kigoma on April 22 where he was met by William and Celestine. He was given a tour of the site and shown the various components of the UNIDO initiative in Kigoma.
3. Day two began with installation, training, and procedures. Unfortunately the system was slightly damaged in shipping. However this was repaired with local welding. Everything else went smoothly there was help with a carpenter and sheet metal worker on hand. Together they installed the chimney and set up the rest of the equipment. Lauzon then demonstrated the soaking and preparation of Soya beans and instructed the night watchmen to start the soaking at 12am in order that the beans were ready for the next day's training.
4. Day three started training with the instruction of proper soaking techniques, and showed the beans which had been soaked the night before for the day's soya milk production. The rest of the day went as follows:
 - Grinder set-up focusing on important things to note about proper set-up
 - Grinding the Soya beans and starting the fire in the boiler to build pressure
 - Exemplified proper mixing and amounts of water to soya bean ratio
 - Cooked first batch of soya milk using lemon grass, sugar and salt to flavor
 - While first batch was cooking, grind the next batch of the soya mash.
 - Continued the teaching/cooking trying to emphasize the importance of team work and systematic approach to making large amounts of soya milk in one day
 - Made three batches in total (+/- 45 liters) using half of a batch to make soya yogurt from a locally unselective bacteria culture
 - Safety explanation on the boiler
 - Reviewed cooking various products with the VitaGoat and explained how to use the cooker to can various fruits and vegetables
 - Some various supplies were missing the entire time, apparently due to a non-delivery from Dar es Salaam. However there was enough to give an adequate demonstration that, coupled with the training manual should be enough to start their canning operations
 - Weighed out three batches of Soya beans each 2kg dry weight. Again instructed the night guard to soak them late at night for overnight.
 - Removed a thermometer from the cooker because it was damaged as well in the shipping and wasn't giving accurate measurements. Fixed the thermometer that night with super glue. Spare thermometer also in shipment.
5. Day four I began by reviewing the start-up procedure of the boiler and the straining of the beans before the grinding. Explained the health benefits of soya milk and the importance on the focus of sustainability. Lauzon then instructed them that he would be giving much less hands on help and would be assuming more of a supervisor role. The rest of the day went as follows:

- Grinder set-up while quizzing on the important steps to proper set-up
 - Fire and pressure control of the boiler was also reviewed to help them fully understand the system
 - Testing the yogurt that had cultured in the hotel room the night before.
 - Made 2 batches of soymilk and then a batch for the tofu.
 - After lunch made Juice. We used 6 pineapples and a bag of passion fruit
 - Showed how to set-up the bicycle to house the juicer instead of the grinder
 - Juiced all the pineapple and mixed it with the passion fruit and then processed it in the cooker
 - Once they were finished with the juice Lauzon was able to review the canning procedure again, and directed them to weigh out three more batches for the last day of work.
6. On day five staff from the Muheza project arrived and Lauzon resumed training by instructing the Kigoma trainees to start the whole process on their own. While they were working Lauzon did a review with the staff from Muheza and explained to them how to set-up and all the important maintenance and safety features of the various components of the system. Two batches of Soya milk were made with two different flavorings (lemon grass and Vanilla). Once all the training and cleaning was done for the day I opened the floor for discussion answering all the questions they had.
 7. Kigoma participants were able to work with Muheza participants to continue training and organize the set up at Muheza.
 8. Lauzon departed Kigoma at the end of day five. Normally three days of installation and training is provided and sufficient. Local participants and visiting Muheza personnel should have been well-served by five days.

Appendix:

1. Certificate
2. VitaGoat Technical Guide (Separate Doc)
3. Canning Food Preservation Guide (Separate Doc)

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION



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UNIDO/MAL/01/07

Date: 3 May 2007

To: Frank Daller
Malnutrition matters
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E-mail: matters@malnutrition.org

**CERTIFICATE OF DELIVERY, INSTALLATION AND COMMISSIONING OF
VITAGOAT PROCESSING EQUIPMENT IN KIGOMA**

We are acknowledge receipt of two wooden boxes containing VitaGoat equipment which were installed and commissioned to UNIDO Kigoma (Human Security Project) by an expert (Charles Lauzon) from Malnutrition matters of Canada. The VitaGoat equipment were installed on 16th April 2007 and commissioned on 19th April 2007 after training.

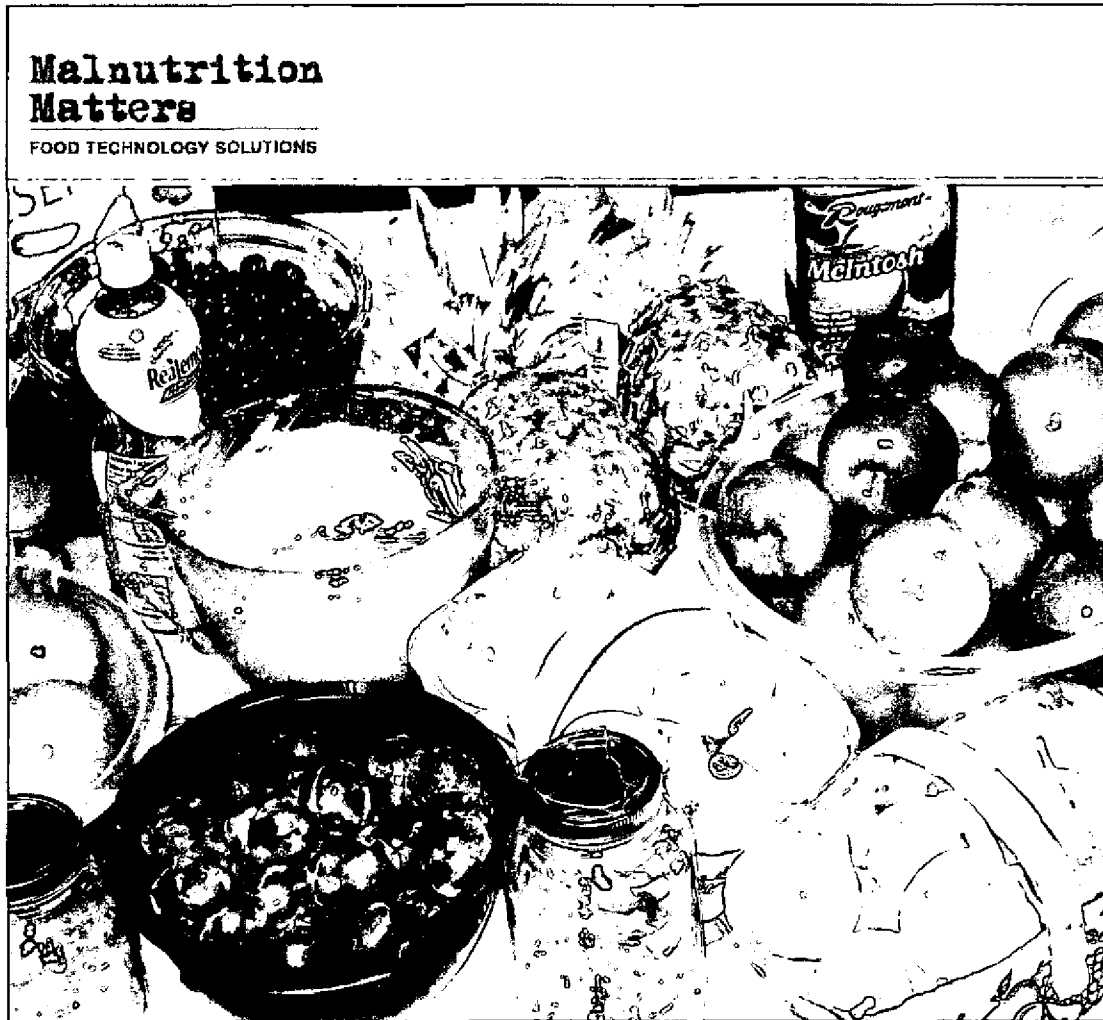
A handwritten signature in black ink, appearing to read 'Celestin Mgoba'.

Celestin Martin Mgoba
UNIDO – National Food Processing Consultant
Human Security Project

Cc: Kawira Anne Bucyana
United Nations Industrial Development Organization,
Vienna International Centre
P.O. Box 300, A – 1400,
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23390
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Canning / Food Preservation
With the VitaGoat System



By
Malnutrition Matters

Dec 2006

What is Canning?

The following document refers to a process known as 'canning' but the real objective is "preservation" of the foods, and the containers suggested are glass jars and bottles with certain quality lids for sealing. Cans are not actually recommended as containers for this process. The canning method described here is a method of safely preserving seasonal foods in glass jars or bottles with tight seals that will not leak. The name canning comes from a similar process that is used to preserve foods in tin cans. When operations are properly performed, it is a simple process that utilizes heat to destroy harmful bacteria that can cause spoilage.

Why Can?

Canning is an efficient way of safely preserving seasonal foods; it does not require refrigeration or freezing to maintain freshness or quality of the product once canned. In order to achieve positive results all instructions should be followed with care; there is no room for interpretation of the process. The only change that could be made is to add more time to the hot canning operation.

How Canning Preserves Foods

The high percentage of water in most fresh foods makes them very perishable. They spoil or lose their quality for several reasons:

- growth of undesirable microorganisms-bacteria, molds, and yeasts,
- activity of food enzymes,
- reactions with oxygen,
- moisture loss.



Microorganisms live and multiply quickly on the surfaces of fresh food and on the inside of bruised, insect-damaged, and diseased food. Oxygen and enzymes are present throughout fresh food tissues. Proper canning practices include:

- carefully selecting and washing fresh food.
- peeling some fresh foods.
- hot packing many foods.
- adding acids (lemon juice or vinegar) to some foods.
- using acceptable jars and self-sealing lids.

Collectively, these practices remove oxygen; destroy enzymes; prevent the growth of undesirable bacteria, yeasts, and molds; and help form a high vacuum in jars. Good vacuums form tight seals which keep liquid in and air and microorganisms out.

Canning using the VitaGoat pressure cooker

The canning process can be easily accomplished using the existing VitaGoat cooker by utilizing the high temperature steam from the boiler to boil the water (boiling-water bath canning). As well, the steam from the boiler could be used for "pressure canning" the product in the cooker. This is necessary when

canning many vegetables and milk products (low acid foods) but this method will not be a focus of this report since it generally takes longer to process and has not been adequately tested. The reason that low acid foods must be canned under pressure is that the microorganisms that grow in a low acid environment can only be killed by temperatures greater than 100 C. Low acid foods must be heated to a temperature of 115 C before the spoilage and food poisoning bacteria are killed (botulism bacteria).

Food that has been properly canned will keep indefinitely; but after a year, some chemical changes may occur which could negatively affect the quality of the product. It should be noted that properly canned food has a recommended shelf life of about one year.

Selecting the Correct Processing Time

Generally the longer that you process the food the more likely you will achieve positive results. When canning in boiling water, more processing time is needed for raw-packed foods and for 1 liter jars than is needed for hot-packed foods and 0.5 liters jars. The type of product you plan on canning has a major effect on the style of canning and the process time. This document is focused on water bath canning.

Water bath canning is used with acidic foods, which generally means fruit, although tomatoes can be canned in the water bath as well, as long as a proper amount of acid (ascorbic acid, vinegar, or citric acid) is added.

Amount of Acid for Tomatoes

- Add 2 tablespoons (30mL) of bottled lemon juice or 1/2 teaspoon (2.5mL) of citric acid per 0.5 liters of tomatoes.
- For 0.5 liters, use 1 tablespoon(15mL) of bottled lemon juice or 1/4 teaspoon (1.25mL) of citric acid.

- Instead of the lemon juice or citric acid, vinegar can be used, but it will cause a more noticeable flavor change. Add 4 tablespoons(60mL) of vinegar per liter or 2 tablespoons(30mL) of vinegar per 0.5 liters.
- If you don't like the acid taste, dilute the product with water; rinse the tomatoes and add some sugar to each jar before canning or to the product before eating.

If raw foods are being canned, a certain amount of very **HOT** sugar water or juice should be added to fill in any voids which could hold air around the product.

To destroy microorganisms in acid foods processed in a boiling-water canner, you must:

- Process jars for the correct number of minutes in boiling water.
- Slowly cool the jars at room temperature.

The food may spoil if you fail to add process time for lower boiling-water temperatures at altitudes above 305 m, or if you process for fewer minutes than specified, or force-cool jars in cold water.

The reason that altitude adjustments are necessary is that at a higher altitude water boils at a lower temperature, not allowing the product in the cans to reach the required temperature. By adding some extra time to the canning process you can account for the difference in altitude.

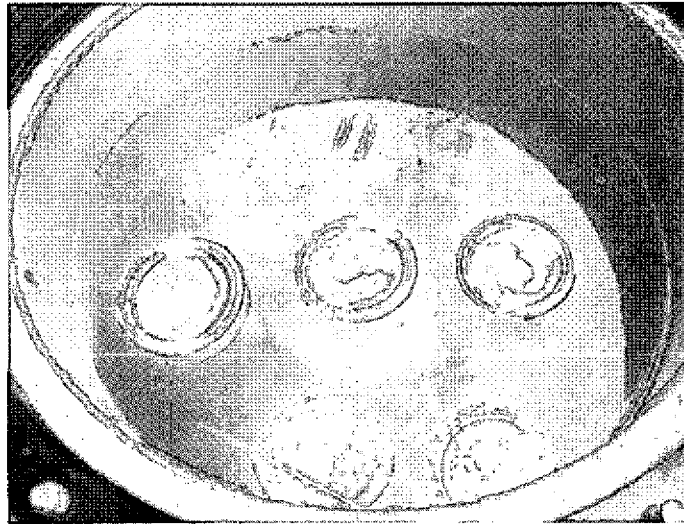
Steps for using the VitaGoat for water bath canning.

Once you have processed the product that you intend to can, you should keep the product in a warm place to minimize the cooling before it has been

canned; hot product will be more successful and longer lasting once canned. It is important to be aware of the number of cans necessary to complete your canning operation successfully without waste. To start, sterilize all the cans or jars and tops that will be used for the canning activities. The easiest way to sterilize the can/jars/tops is to place them all (or as many as possible) in the VitaGoat cooker. Add a small amount of water (enough to cover the bottom rack) loosely place the cooker lid without any screws and open the steam inlet valve to the cooker. The HOT steam will quickly heat the water to boiling and sterilize all the jars/cans/tops, but to be sure, it would be advised to do this for approximately 10 minutes. Once the cans/jars/tops are sterilized they should be placed up-side-down on a **clean** towel and kept covered with a clean cloth or plastic until they are about to be used.

Now fill the cooker about one third full of water and heat the water close to boiling with the steam from the boiler. At the same time pour the product into your jars, but remember that there must be a reasonable amount of space between the product and the top of the jar (headspace), 1.5 to 3 cm should suffice. With a set of tongs dip a sterilized top into the boiling water for a few seconds to ensure cleanliness. Having washed your hands thoroughly or using sterile latex gloves, inspect the top of the jar and the lid to make sure that there are no nicks or scratches that could possibly affect the seal of the jar. Place the tops on the jars and screw the tops shut to about finger tight (if canning one liter jars the maximum number of jars is seven per product run plus another seven 0.5 L jars placed on the second row) turn off the steam to the cooker and set the jars into the water ensuring that the water covers the top of the jars by more than an inch. Put the cooker top on, bolting every second screw. Start the steam and wait for the temperature to rise to around 100C (if it doesn't reach exactly 100C but stops rising it is sufficient). Once the temperature has stabilized, start timing; the average length of time to can fruits in a water bath is about 30min, but if you are canning raw fruit you must add 5 to 10 minutes to the process.

A special, dedicated, steam-injected cooker is available at low cost, which could do about double of the volume of the VitaGoat cooker either working in parallel with the VitaGoat cooker or separately.



When the time is done, there are a few options.

- You can drain the water bath water from the down spout into a bucket and then remove all the cans by hand..(caution jars are still very hot)
- Or if you have canning tongs you can grab the jars right out of the water eliminating the need to refill the cooker with the warm water once you are finished.

When the cans are out of the water they should be placed on a wood surface to avoid thermal shock. If the jars are cooled too quickly it could result in cracking of the jars or improper processing leading to early spoilage. Let the cans cool down on their own at room temperature.

This process is highly repeatable and can be continued as long as the boiler has a sufficient supply of fire and water to produce steam. In controlled tests we have been able to can approximately 10-15 liters of product every hour. Given that the VitaGoat can create processed food at up to 30 liters per hour, it is apparent that it takes about three times the amount of time to can the food than to produce it.

Maintaining Color and Flavor in Canned Food

To maintain good natural color and flavor in stored canned food, you must:

- Remove oxygen from food tissues and jars,
- Quickly destroy the food enzymes,
- Obtain high jar vacuums and airtight jar seals.

Follow these guidelines to ensure that your canned foods retain optimum colors and flavors during processing and storage:

- Use only high-quality foods which are at the proper maturity and are free of diseases and bruises.
- Use the hot-pack method, especially with acid foods to be processed in boiling water.
- Don't unnecessarily expose prepared foods to air. Can them as soon as possible.
- While preparing a canner load of jars, keep peeled, halved, quartered, sliced, or diced apples, apricots, nectarines, peaches, and pears in a solution of 3 grams (3,000 milligrams) ascorbic acid to 4 liters of cold water. This procedure is also useful in preventing stem-end discoloration in cherries and grapes. You can get ascorbic acid in several forms:

Pure powdered form—seasonally available among canners' supplies in supermarkets or pharmacies. One level teaspoon of pure powder weighs about 3 grams. Use 1 teaspoon (15 ml) per 4 liters of water as a treatment solution.

Vitamin C tablets—economical and available year-round in many stores. Buy 500-milligram tablets; crush and dissolve six tablets per 4 liters of water as a treatment solution.

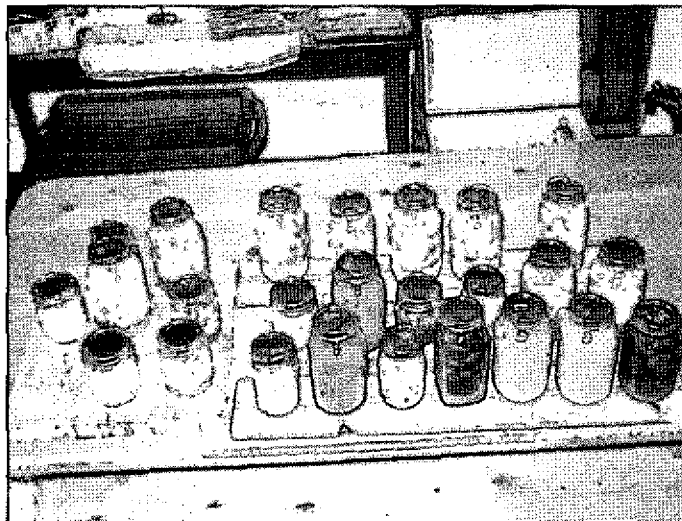
Commercially prepared mixes of ascorbic and citric acid—seasonally available among canners' supplies in supermarkets. Sometimes citric acid

powder is sold in supermarkets, but it is less effective in controlling discoloration. If you choose to use these products, follow the manufacturer's directions.

- Add the prescribed amount of citric acid to the bulk food being prepared.
- Fill hot foods into jars and adjust headspace.
- Tighten lids securely, but if you are especially strong, not as tightly as possible.
- Process and cool jars.
- Store the jars in a relatively cool, dark place, preferably between 10° and 21° C

Cooling Jars

When you remove hot jars from a canner, do not retighten their jar lids. Retightening of hot lids may cut through the gasket and cause seal failures. Cool the jars at room temperature for 12 to 24 hours. Jars may be cooled on racks or towels. Air is exhausted during processing and food shrinks. If a jar loses excessive liquid during processing, do not open it to add more liquid. Check for sealed lids as described below.



Testing Jar Seals

After cooling jars for 12 to 24 hours, it is possible to test the seals with one of the following options:

Option 1. Press the middle of the lid with a finger or thumb. If the lid springs up when you release your finger, the lid is unsealed.

Option 2. Tap the lid with the bottom of a teaspoon. If it makes a dull sound, the lid is not sealed. If food is in contact with the underside of the lid, it will also cause a dull sound. If the jar is sealed correctly, it will make a ringing, high-pitched sound.

Option 3. Hold the jar at eye level and look across the lid. The lid should be concave (curved down slightly in the center). If center of the lid is either flat or bulging, it may not be sealed.

Tomato and Mango Products made with the VitaGoat Cooker

Mango Production

The VitaGoat can take whole mango fruit and transform it into a "puree". This is referred to as "mango puree" and it does not have any other ingredients added to it. A variety of foods can be made from the puree afterwards including:

- a) *Nectar*: This is mango puree with some water and sugar added to it
- b) *Juice*: This is clarified puree with water (and possibly sugar) added to it
- c) *Jam*: This is thickened puree with sugar and pectin added
- d) *Jelly*: This is juice with a gelatinizing agent added to it, along with sugar
- e) Mango "*leather*" - strips of dried mango puree

Note that in large-scale commercial operations, other ingredients are often added to these products to enhance their mouthfeel, colour or shelf-life. For example, food grade additives such as ascorbic acid, food colouring or thickeners may be used in mango beverages.

The following instructions and recipes will only focus on the "healthier" mango products, namely beverages (nectar and juice). It is possible to produce jams, jellies and fruit leathers from the puree, but these are not as nutritious as the beverages and they require extra processing such as evaporation or drying, which is beyond the scope of what the VitaGoat can accomplish, although it is possible to make these foods with inexpensive auxiliary equipment.

Note that the production volumes for each "batch" of mango products can be up to 15 liters at a time.

Making mango nectar

- 1- Wash, peel and pit ripe mangos, and then mash with the cycle-grinder.
- 2- Add 1-2 cups (250-500ml) of water to the VitaGoat vessel for every 1 liter of mango fruit for an "average" density nectar. Most commercial nectars have a higher water content than this, so it may be appropriate to add more water at this stage, depending on the desired consistency of the finished product.
- 3- Add sugar as desired. The usual sugar quantity is between 10-12% of the total nectar volume.
- 4- Add steam at the same time. Bring to approx. 90C and cook for 5 minutes.
- 5- Drain mango nectar from VitaGoat and use immediately, add to soymilk or soy yogurt for making blends or put into glass jars for further sterilization.

For sterilization into glass bottles or jars:

- 6- Pour hot nectar into glass jars, leaving at least a 6 mm headspace between the lid and the nectar. Jar sizes can be 1/2 liter or 1 liter sizes for example. Note that the temperature difference between the jar and the product must never be more than 45C. This is eliminated by placing the jars in hot water and removing them just before filling.
- 7- Adjust lids as instructed in the canning guide
- 8- Process in a boiling water canner for 20 minutes
- 9- Remove bottles and let cool on racks for 24 hours at room temperature
- 10- Store under cool conditions of possible (but not refrigerated)

Making mango juice

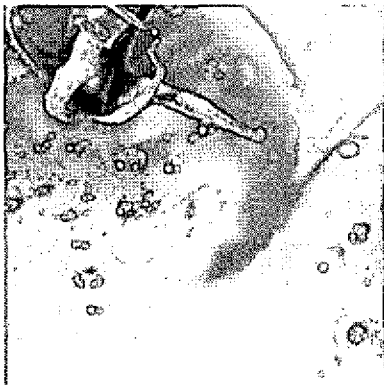
Mango juice is clarified nectar. The taste of the juice will be less "fruity" but will have a smoother mouthfeel. To make mango juice:

- 1- Wash, peel and pit ripe mangos
- 2- Process with the cycle grinder / fruit mill and place in the cooker.
- 3- Add 125-250 ml of water for every 1 liter of mango fruit. If thinner juice is desired, add more water.
- 4- Add steam and bring to approx. 90C and cook for 5 minutes.
- 5- Drain product from grinder/cooker and filter through the manual press
- 6- Squeeze out any juice from pulp
- 7- Add sugar in desired quantity (usually from 10-12 % of total juice volume) to the juice and mix well.
- 8- Cool juice immediately if for consumption that day

For sterilization into glass bottles or jars:

- 9- Pour hot juice into glass jars, leaving at least a 6 mm headspace between the lid and the nectar. Jar sizes can be 1/2 liter or 1 liter sizes for example.
- 10- Adjust lids as instructed in the canning guide
- 11- Process in boiling water canner for 10 minutes for jar volumes up to 1 liter or 15 minutes for up to 2 liters.
- 12- Remove bottles and let cool on racks for 24 hours
- 13- Store under cool conditions if possible (but not refrigerated)

Tomato Production



One tomato product that would seem to be clearly popular would be a tomato sauce that could be made when tomatoes are in season, and preserved for later use when tomatoes are off-season.

Commercial brands of tomato sauces rarely only have tomatoes in them however, with some additional ingredients being salt, sugar, oil,

ascorbic acid and a preservative (often sodium benzoate). Added to this is the fact that tomato sauces vary in composition and thickness depending on local tastes and preferences, as well as with the variety of tomato used.

In addition, tomato sauces usually have less water than the whole crushed tomatoes since they have been boiled in a saucepan, usually until about 1/3 of the water has boiled off. This makes for a thicker product that will not make the sauce too watery. In the case of the VitaGoat however, tomatoes are cooked through the *addition* of water in the form of steam, so a more (and not less) watery tomato product will result from processing with the system. Tomato pastes are even thicker than sauces and can usually only be made in large commercial operations through the vacuum evaporation of tomato juice in order to highly concentrate it. This clearly makes tomato pastes impossible to make with the VitaGoat (it is also not possible to make tomato paste at home). Finally and similarly, tomato ketchup is made either by blending tomato paste with vinegar, sugar and spices or by boiling off a large amount of water from the tomatoes. For these reasons, the only tomato products that can be made with the VitaGoat are crushed tomatoes, full-water tomato sauce and tomato juice.

Thickening the tomato sauce

It is possible to obtain a thicker tomato sauce with the VitaGoat using two methods:

- a) Use partially dried or fully dried tomatoes, grind/mash and cook with water in the cooker
- b) Add a thickener to the tomato sauce after processing.

In testing for the proper formulation of tomato sauces, Malnutrition Matters had the following results:

- a) It is possible to obtain a "thick" tomato sauce by using partially dried tomatoes instead of full-water tomatoes. We dried tomatoes in an oven at 65C for 16 hours and reduced the moisture content by 60%. These tomatoes were then ground and put with water to the cooker and steamed for 10 minutes.
- b) If fresh tomatoes are cooked in the VitaGoat, the resulting product is very watery (like tomato juice) and would have to be boiled in an open pot on a stove to obtain sauce with the right consistency
- c) Another test was made by adding thickeners to the watery tomato sauce produced in the VitaGoat after it was made and stirring them in. The results were as follows:

Tomatoes were blended with cornmeal, tapioca flour, ripe and green plantain, cassava (yucca) and okara. All tests used 750 g tomatoes with 125 mL water processed until smooth in a food processor. The starch additive in the indicated amount was either added to the processor to grind if appropriate or added before cooking as shown in the table below. Mixture was heated to boiling to achieve thickening, if any. Approximately 15 mL of liquid was separated from the thickened sauce and cooled to room temperature, in order to measure the pH. Consistency of the sauce at room temperature was rated informally after cooling on a scale of 1-10 with 10 being very thick and 1 being with no noticeable thickening.

Results

Starch	Amount	Consistency	pH	Comments
yellow cornmeal	125 mL	10	4.5	Too thick
yellow cornmeal	50 mL	5	4.4	Good consistency
tapioca flour	50 mL	5	4.1	smooth, clear gel
peeled cassava	200 g	9	4.5	too thick, white specks of cassava present in puree
green plantain	135 g	6	4.5	white specks of plantain present; thickens considerable as it cools
ripe plantain	145 g	8	4.7	very thick, 'burped' as it cooked, specks present
soya okara	230 g	1	4.6	no thickening occurred

From this, we can see that acceptable results were obtained by adding cornmeal, cassava or plantain to the tomato sauce after it was processed.

VitaGoat tomato products

There are thus four main types of tomato products that can be made with the VitaGoat

- 1- Tomatoes that are ground very quickly and boiled afterwards using traditional methods to make sauces. The essentially speeds up the conversion of raw tomatoes in a "puree".
- 2- Tomato sauce can be made by using partially or fully dried tomatoes and grinding and cooking them with water in the cooker.
- 3- Tomato sauce can also be made by adding thickeners (cornmeal, cassava or plantain) to the sauce after it is made although the product will not be "pure" tomato sauce.

- 4- Tomato juice can be made by grinding and cooking raw tomatoes (with or without tomato skins and seeds)

Note that tomato "blends" can also be made, for example by cooking them with vegetables, spices and soya products like okara and tofu to make soups or adding some soymilk to the tomato puree to make a cream of tomato soup. This report will focus only on the relatively "pure" tomato products.

Tomato skins and seeds

Tomato juice and sauce can be made using whole tomatoes, skins and seeds included. It is possible to remove the skins and seeds however if desired. To remove skins, place tomatoes in boiling water for 2 minutes, then place in cold water. The skins will come off easily. To remove seeds, cut tomato in half and squeeze out seeds. Tomato seeds however are relatively high in oil and add energy to the tomato mixture. In addition, research indicates that oil in a meal increases the absorption of Vitamin A.

Note that the production volumes for each "batch" of tomato products can be up to 15 liters at a time.

Making Tomato Sauce with dried tomatoes

- 1- Wash tomatoes
- 2- Dry tomatoes in sun until half the water has evaporated or use dried tomatoes.
- 3- Grind in fruit mill on cycle grinder. Add 250 ml of water per 1 liter of dried tomatoes and place in cooker. Add salt for taste if desired.
- 4- Add steam and bring to approx. 90C and cook for 5 minutes.
- 5- Empty product from cooker and use immediately or for further sterilization.

For sterilization into glass bottles or jars:

- 6- Add lemon juice or citric acid in correct quantity to jars before filling. Pour hot sauce into glass jars, leaving at least a 6 mm headspace between the lid and the nectar. Jar sizes can be 1/2 liter or 1 liter sizes for example.
- 7- Adjust lids as instructed in the canning guide
- 8- Process in boiling water canner for 35 minutes for 500 ml jars and 45 minutes for 1 liter jars.
- 9- Remove bottles and let cool on racks for 24 hours
- 10- Store under cool conditions if possible (but not refrigerated)

Making Tomato Sauce with raw tomatoes and thickener

Same process as above but use raw tomatoes to make a thinner sauce and add a thickener (cornmeal, cassava, plantain) as needed to obtain the desired consistency (note that tomato sauce becomes thicker as it cools down).

If sterilizing in bottles, measure the pH (acidity) of the tomato sauce and make sure that it is 4.5 or lower. If higher than 4.5, add sufficient amounts of lemon juice or citric acid to adjust the pH.

Making Tomato Juice

- 1- Wash tomatoes, remove stems and cut in quarters
- 2- Process tomatoes in fruit mill on cycle grinder.
- 3- Add mashed tomatoes to cooker. If tomatoes have a coarse texture, add some water.
- 4- Turn on grinder and add steam at the same time
- 5- Bring to approx. 90C and cook for 5 minutes.
- 6- Empty product from cooker into filter press and squeeze out the tomato juice.
- 7- Add salt to the juice for flavour if desired and mix
- 8- Cool and serve or use to make tomato soup (add soymilk to make cream of tomato soup)

For sterilization into glass bottles or jars:

- 9- Pour juice in cooker and heat to boiling in the cooker then stop steam.
- 10- Add lemon juice or citric acid in correct quantity to jars before filling. Pour hot juice into glass jars, leaving at least a 6 mm headspace between the lid and the nectar. Jar sizes can be 1/2 liter or 1 liter sizes for example.
- 11- Adjust lids as instructed in the canning guide
- 12- Process in boiling water canner for 35 minutes for 500 ml jars and 40 minutes for 1 liter jars.
- 13- Remove bottles and let cool on racks for 24 hours
- 14- Store under cool conditions if possible (but not refrigerated)

Other Fruit and Guidelines for Canning

Recommended Process Times for Acid Foods in Boiling Water Bath

	Style of Pack	Jar Size		<i>Process Time at Altitudes of</i>		
				0- 305 m	306 - 915 m	916 - 2750 m
Apple Butter	Hot	0.25 L	5 min	10 min	10 min	
		or 0.5 L 1 L		10 min	15 min	15 min
Apple Juice	Hot	0.5 L or 1 L		5 min	10 min	10 min
		1.9 L		10 min	15 min	15 min
Apples, sliced	Hot	0.5 L or 1 L		20 min	25 min	30 min
Applesauce	Hot	0.5 L		15 min	20 min	20 min
		1 L		20 min	25 min	30 min
Spiced Apple Rings	Hot	0.25 L or 0.5 L		10 min	15 min	15 min
Berries, whole	Hot	0.5 L or 1 L		15 min	20 min	20 min
	Raw	0.5 L 1 L		15 min 20 min	20 min 25 min	20 min 30 min
Berry, Syrup	Hot	0.25 L or 0.5 L		10 min	15 min	15 min
Cherries, whole, sour or sweet	Hot	0.5 L		15 min	20 min	20 min
		1 L		20 min	25 min	30 min
	Raw	0.5 L or 1 L		25 min	30 min	35 min

Fruit Purees	Hot	0.5 L or 1 L	15 min	20 min	20 min
Peaches, Apricots & Nectarines--	Hot	0.5 L 1 L	20 min 25 min	25 min 30 min	30 min 35 min
halved or sliced	Raw	0.5 L 1 L	25 min 30 min	30 min 35 min	35 min 40 min
Pears, halved	Hot	0.5 L 1 L	20 min 25 min	25 min 30 min	30 min 35 min
Plums - halved or sliced	Hot Raw	0.5 L 1 L	20 min 25 min	25 min 30 min	30 min 35 min
Rhubarb, stewed	Hot	0.5 L or 1 L	15 min	20 min	20 min
Zucchini Pineapple	Hot	0.25 L or 0.5 L	15 min	20 min	20 min