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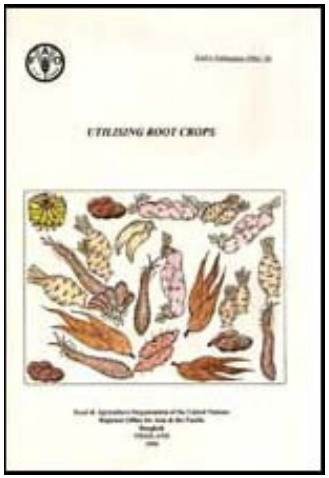

Utilising root crops

Contents (89 p.) Dynamic version

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This publication is the joint effort of all technical officers under FAO Regional Programme Project TCP/RAS/2254 " Promotion of Increased Utilisation of Local Root Crops" based in Solomon Islands, Tonga and Vanuatu.

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Foreword

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Root crops (cassava, sweet potato, taro and yam) are the main staple food in the Pacific countries of Solomon Islands, Tonga and Vanuatu. Root crop production in these countries is mainly centred on small plots of land where the crops are grown primarily for home consumption. The crops are harvested only when needed and very little processing is carried out. A few commercial farms do exist and are centred close to urban markets.

As each country faces an increase in its urban population and an increase in the production of export orientated cash crops, the production of local, staple crops have been affected. This has led to a greater dependency on the importation of staple commodities such as rice and convenience foods such as wheat flour bread and snack foods.

Due to the perishability of root crops, the difficulty of transporting the crops within the country and the lack of developed market outlets, only an estimated 10% of the total root crop production of the Solomon Islands and Vanuatu are marketed locally. In Tonga, locally marketed root crops amount to about 10 - 20% total national production. The prices of root crops traded on the local market are therefore relatively higher than the price of imported staple food commodities.

The above situation is creating an increased dependency on overseas markets to supply the basic food consumption needs of each country. National food security can thus be jeopardised and balance of payments can become a serious problem for the exchequer.

Lack of knowledge in the area of food processing in the Pacific Islands hinders the development in preservation, value adding or increasing the convenience of locally grown commodities for the local market. On the other hand, products such as jam, sauces, bread, biscuits, noodles, cakes and even fruit juice could be made locally. Such processing activities and enterprises could generate additional employment and income opportunities at both

household and commercial levels.

As an initial step, FAO provided technical assistance through the project "The Promotion of Increased Utilisation of Local Root Crops" [TCP/RAS/2254]. The project supported Government efforts in each of the three countries, to develop basic facilities and providing training in food processing. Training activities for promoting and developing root crop products were initiated.

This publication is a collection of the products and recipes developed by the above project. The recipes are primarily designed for use at the household level or as a basic product formula upon which to expand production at the small scale, industrial level. The processing equipment purchased or fabricated locally by the project are illustrated and the names of equipment suppliers listed.

It is hoped that this book can assist small producers and entrepreneurs, especially women, increase their income and raise their living standards as they put the information into practice.

A.Z.M . Obaidullah Khan
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Section 1: General information

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Weights, measures and oven temperatures:

The recipes presented in this publication have been adapted for use by rural, village households, where it is acknowledged that equipment such as weighing scales may not be available. The use of common kitchenware items such as teaspoons, dessertspoons and coffee mugs have been used as measuring . If the reader intends to use the recipes as a basic formulae for producing the products at the small scale, industrial level then the use of weighing scales and graduated (volume) measuring jugs are strongly recommended.

Similarly, it is appreciated that most rural, village households do not have access to modern gas cookers with pre - calibrated temperature dials. Cooking temperatures stated in the following recipes are general indicators of the oven temperature required to cook the product. Where readers have access to more modern cookers or small scale industrial ovens, then pre calibrated temperature settings should be used. The use of an accurate probe type thermometer is recommended for checking cooking temperatures at the small scale industrial level [see section on quality control for more information].

Exact weight, volume and temperature equivalents to the measures and descriptions used in the recipes presented in this book are listed below.

Volumes:

Comodity	**Measure**	**Exact volume equivalent**
Water	1 mug	250 mls
	1 tablespoon	20 mls
Vanilla essence	1 teaspoon	5 mls
Cooking oil	1 mug	260 mls
Milk, fresh	1 mug (full)	250 mls
Lemon or lime juice	1 tablespoon	20 mls
	1 teaspoon	5 mls

Weights:

Commodity	Measure	Exact volume equivalent
Root Crop Flour:		
Cassava flour	1 mug	145 grams
	1 tablespoon	20 grams
Sweet potato flour	1 mug	100 grams
	1 tablespoon	15 grams
Taro flour	1 mug	140 grams
	1 tablespoon	20 grams
Yam flour	1 mug	130 grams
	1 tablespoon	15 grams
Root Crops Fresh:		
Average weight grated pulped	1 tablespoon	40 grams
	1 tablespoon	60 grams
Root crop, cooked and mashed:		
Average weight	1 mug	315 grams
Cassava	1 mug	280 grams
	1 tablespoon	35 grams
	1 teaspoon	10 grams

Sweet potato	1 mug	160 grams
	1 tablespoon	20 grams
	1 teaspoon	5 grams
Taro	1 mug	80 grams
	1 tablespoon	35 grams
	1 teaspoon	10 grams
Yarn	1 mug	120 grams
	1 tablespoon	15 grams
	1 teaspoon	4 grams
Baking powder	1 teaspoon	31/2 grams
Bicarbonate of soda	1 teaspoon	31/2 grams
Sugar	1 mug	160 grams
	1 tablespoon	20 grams
Milk powder	1 tablespoon	10 grams
Margarine	1 tablespoon	60 grams
	1 dessertspoon	30 grams
Ngali nuts, ground	1 mug	150 grams
Honey	1 tablespoon (level)	40 grams
Grated coconut	1 mug	80 grams
	1 tablespoon	10 grams
Salt	1 teaspoon	4 grams

Onion, finery chopped	1 tablespoon	35 grams
Wheat flour	1 mug	115 grams
Dried yeast	1 tablespoon	20 grams

The following conversion factors can also be used when tablespoons cannot be purchased locally:

1 tablespoon = 2 dessertspoons or 4 teaspoons = 20 mls
1 dessertspoon = 2 teaspoons = 10 mls
1 teaspoon = 5 mls
1 cup = 16 tablespoons = 250 mls

Oven temperatures:

RECIPE DESCRIPTION	**TEMPERATURE**		**GAS MARK**
	F	**C**	
VERY COOL	275	140	1
COOL	300 - 325	150 - 160	2
MODERATELY HOT	350 - 375	180 - 190	3
HOT	400 - 425	200 - 220	4
VERY HOT	450 - 475	230 - 250	5

Recipe preparation terms and definitions:

Beat: to stir very hard
Cream: to beat ingredients into a creamy, smooth consistency using a fork.
Fold: to mix ingredients together in gently
Batter: a mixture of flour, eggs and milk

Processing techniques and equipment:

The processing techniques described in this publication are defined below. The equipment used or developed by the project for carrying out each operation are described and illustrated. Where items of equipment were purchased from overseas manufacturers, the suppliers name and address is given in Annex 1.

Drying

DRYING: remove water or moisture from a product.

Drying food material in the sun is the oldest form of food preservation. The sun's energy is used to evaporate most of the moisture from the food. The simplest way of drying food material is to spread thin layers of the materials on a piece of matting in an open, sunny space. However, if the food material is unprotected, then there is a chance of it becoming contaminated by dirt, insects, rain and animals walking over it.

Solar driers:

The two types of solar driers illustrated below are not only designed to keep the food material clean during the drying operation but also reduce the time required to dry the material.

The solar drying cabinet is made from 2.5 cm thick wood, which is painted black all over. The black surface absorbs heat from the sun and helps to raise the temperature of the air inside the cabinet to facilitate a faster rate of drying the product. The frame of the lid is a made of thin, lightweight wood (also painted black) which supports a

sheet of clear plastic. The clear plastic cover allows the suns energy to enter the cabinet and heat the air inside. The base and upper edges of the cabinet are perforated with 1 cm diameter holes at intervals of 1- cm. The holes allow air to circulate freely throughout the chamber of the cabinet and remove the water which is being evaporated from the food material. The food material is placed on a series of wooden framed trays within the cabinet. The frames of the trays are made of a lightweight wood which support fine mesh material (such as mosquito netting;). The trays sit on 2.5 cm square pieces of wooden rods so that they do not touch the based of the cabinet. This again facilitates the free movement of air around the product and a faster rate of drying.

The solar tent works on the same principle as the solar drying cabinet but is lighter in weight, cheaper to make and easier to carry from place to place. The tent frame is made from bamboo or 2.5 cm square pieces of wood, secured in an A frame arrangement. The clear plastic sheet is secured over the A frame. The material to be dried is placed on a "table" made out of a bamboo frame and fine mesh. The table is placed on a sheet of black plastic and covered by the tent frame.

When using solar driers, they should be placed in a sunny location. In addition, they should be placed on concrete or any surface which is not wet and which will not retain moisture (i.e. grassy areas or muddy areas are not suitable surfaces to put solar driers on). The driers should be slightly raised off the ground. A clearance space of at least 1 10 cm is recommended to allow the air to circulate freely. The clear plastic surface of the drier should be kept dry and clean. It is best to allow the solar drier to warm up in the sun before putting the material to be dried inside. Material being dried by this method should be put out in the sun as in the early morning to make full use of the sun.

Solar driers are cheap to use and simple to make. However, the disadvantages are that the drying of food material is entirely dependent on the weather. It often takes more than one day to thoroughly dry the food material and the food may spoil if the weather changes during the drying process. For commercial operations, depending on the weather for drying is not a reliable operation.

Hot air driers:

Hot air driers which use gas to heat up the air is another means of drying food quickly and relatively cheaply. The hot air drying cabinet illustrated below is relatively simple in design and does not involve the use of electric fans to distribute the hot air over the material being dried. Two gas burners situated at the bottom of each metal tube, quickly heats up the surrounding air. The hot air rises and enters the drying cabinet chamber. It hits the deflector plate at the top of the metal tube, is dissipated within the chamber cabinet and passes over the food material, spread out on the stacked trays. As the air escapes out of the chimney' on the top of the cabinet, it carries with it the moisture which has evaporated from the food material. With hot air driers, food can be dried within a 4 - 6 hours. The temperature of the air inside the drying cabinet should be monitored as air temperatures can become too hot causing the food material to burn rather than dry. A digital thermometer and rod type probe (see quality control section for details of this type of instrument) is ideal for monitoring air temperatures during the drying process. Air temperatures should not exceed 50 - 55C.

The hot air drying cabinet illustrated below, is made out of wood and metal. The main frame of the cabinet is 5cm square wood with 2cm thick wooden side panels. Ideally all the wood used should have been pre - treated to prevent the risk of fire. The sliding doors are made of 1.25cm thick plywood. The chimney pieces, deflector plates and tubes leading from the gas burners are made of 1 mm thick galvanised sheet steel. The screws used to secure the metal pieces onto the wooden frame are made of brass to prevent rusting over time. The trays are made of a thin wooden frame with metal mesh centre. The trays slide into the cabinet along rails made of wooden rods. The cabinet should be brushed with linseed oil from time to time to counteract the effects of over drying and cracking.

Dimensions of drying tray frames

Solar tent

Hot air driers

Filtering

FILTERING: pass material slowly through a device which permits fluid to pass through but retains solid particles. Equipment used: fine piece of muslin cloth or pillowcases. The fabric used should be fine enough to allow the liquid to pass through but retain the coarser material or pulp.

Filtering
Filtering (cont.)

Grating

GRATING: Grating is the action of rubbing the vegetable or fruit against a rough surface (a grater) to produce small pieces of the food material.

The food material can be grated using manually operated or mechanised graters.

Manually operated graters have been designed for general purpose use or for use with specific commodities such as coconuts. The manually operated graters illustrated below can either be purchased from stores or made at home.

The wooden framed, manually operated, general purpose grater illustrated below is made from wood and galvanised sheet steel. The frame is made of 2.5 cm square cut pieces of wood. The perforated surface is made from a curved piece of galvanised sheet steel which is screwed onto the wooden frame. Ideally the sheet of steel should be screwed onto the wooden frame using brass screws to avoid rusting. The holes in the steel are made by punching the surface with a strong 2 - 3 inch nail. The holes should be made by punching the nail though from the underside of the piece of metal. This ensures that the rough edges, against which the vegetable is to be rubbed,

are on the outside surface. These graters can be made in any size required. They should however be thoroughly dried after cleaning to stop them rusting.

Coconut graters are readily available on the local market. Mechanised graters are useful for commercial operations only. The supplier of the mechanised grater illustrated below is given in Annex 1.

Manually operated general purposed graters.
Manually operated general purposed graters (cont.)

Coconut graters

Mechanised graters

Grinding

GRINDING: crushing material into powder form.

Mechanised / manual grinding using mills

Peeling

PEELING: removing the skin of the vegetable or fruit. Equipment used:

Pressing

PRESSING: Pressing describes the action of pushing or squeezing material to exude liquid.

Pressing can be carried out by hand or by using a press. The two presses illustrated below are made out of galvanised sheet steel.

The drum press is suitable for making gari. The cotton bag containing the cassava pulp is placed inside the perforated drum. The second drum is lowered down and screwed in place as tightly as possible. This step is equivalent to placing weighted material on top of the bag of cassava pulp. As the cassava de - waters over a few days, the screws are tightened further to maintain pressure on the pulp. The water runs out of the press through the perforations in the outer drum and is collected in the bucket underneath the stand.

The dimensions of the two drums are:

- Outer perforated drum:	External diameter and height of 40 cm. The holes are 1/2cm diameter and spaced 21/2 cm apart from the bottom of the drum to a height of 1 5 cm up the drum
- Inner non - perforated drum:	External diameter of 30 cm and height of 50 cm.

The drum supports are threaded pieces of mild steel.

The drum support stand is also made of galvanised steel, standing 0.6 m off the floor and with a surrounding lip of 0.1 m. On three sides of the table there are screws which tighten against the side of the perforated drum, to secure it onto the table.

The screw press is of a very similar design and suitable for use in pressing out the water from root crop pulp to

collect the starch. The outer drum dimensions are the same as for the drum press. Instead of the inner drum, there is a metal or wooden plate attached to a centre screw piece. As the screw torque is turned the wooden or metal plate presses against the pulp in the cotton bag and presses out the water. The screw torque is fixed onto the drum by a metal bracket. The support stand is of the same dimensions as that supporting the drum press.

Drum press

Screw press

Sieving

Sieving: separation of coarse material from finer material.

Slicing

Slicing: cut vegetable or fruit into a thin, flat pieces.

Mechanised slicing machines.

Syphoning

Syphoning: drawing liquid from one container to another.

Locally fabricated "drum" oven.

The oil drum oven illustrated below mainly consists of a used, but non - rusted empty oil drum. One end of the oil drum is altered to form the door of the oven. Three quarters of the end plate is cut out and re - connected to the uncut end piece by means of three hinges. Four metal runners are fixed to the entire length of the inner drum wall. Two racks are then made out of stiff mesh and placed along the runners. These form the shelving upon which the baking tins and trays will be placed.

The central oven drum needs to be supported on a metal frame, its uppermost surface covered with a metal outer casing and a chimney piece put in place. The metal support frame is made from pre - formed galvanised steel rods - approximately 2.5 cm square. Where the metal support frame runs up the side of the central oven drum, there should be a one inch space. The frame and the centre drum should be joined together with metal brackets, still retaining the one inch gap. The metal cover over the central drum oven is made out of a same sized, used but non - rusted oil drum. Both end pieces are cut from this oil drum and the main body cut along its entire length. This cover is secured to the support frame and central oven drum using metal brackets. A one inch gap is left between the central oven drum and the outer cover. At the rear end of the drum, a 10cm diameter hole is cut out of the metal covering. A 1.5m long piece of galvanised steel pipe is welded onto this cover.at an angle of 20 to the upper surface of the covering surface.

The main structure of the oven is now completed. The main structure should now be placed on a level, concrete surface. Once in place the front sides and back of the oven should be built up with a number of clay bricks. These bricks can be easily made from heavy, clay soil and some sand. A number of wooden moulds of dimensions 18 x 10 x 30cm should be made. Into these mould the clay and sand mixture is compacted. The moulds are then removed and the bricks allowed to dry slowly and thoroughly in the sun. It is probably necessary to experiment a little with the clay and sand mixture to get, bricks which do not crumble or break when handled. Once ready, the bricks can be used to build the support wall around the entire metal structure, leaving at the base of oven door end for the

fuel chamber. The bricks are fixed together using more of the clay and sand mixture used to fabricate the bricks. The upper surface of the metal cover also needs to be smothered with clay and sand mixture. The small gap between the front of the centre oven and the metal cover should be filled with clay and sand mixture to stop heat escaping. The clay and sand layer on top of the oven will help insulate it and improve cooking temperatures. The only other remaining feature which needs to be built is the fuel chamber door. This is constructed of a piece of sheet metal to which a metal handle is attached. This is then fixed to the clay and sand brick wall using metal runners. The fuel chamber door should slide up and down rather than open outwards. An up / down sliding feature facilitates better control over the rate of wood burning in the chamber and consequently control over cooking temperatures.

Before using the oven for baking, a small fire should be made in the fuel chamber and kept alight for as long as possible. Ideally a 24 hour period is best. This process allows the clay bricks to dry out slowly and "cures" the oven prior to its use. It prevents major cracks and break up of the clay wall during its use. Should any minor cracks appear in the clay walls then they should be filled up with more of the clay and sand mix.

Locally fabricated "drum" oven.
Locally fabricated "drum" oven. (cont.)

Cooking utensils.

Cooking utensils 1.
Cooking utensils 2.
Cooking utensils 3.
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Cooking utensils 6.

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Quality control procedures and equipment.

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The quality of a product is dependent on a number of factors. These factors include the quality of ingredients used to make the product, cooking time and / or temperature used during processing, the cleanliness of processing premises, processing equipment and the standards of hygiene practiced by persons making the product.

Utilising poor quality ingredients will produce a poor quality end product. It is important to adopt practices of checking the quality of raw materials and ingredients used for making end products. For example, oil used for frying chips should be fresh or if it has been used for frying before, it should not be dark brown in colour nor have a strong smell. The flesh of cassava tubers used for making flour should not be blue / black in colour otherwise the final product will also have a blue / black colour. The quality of water used in processing premises (including water used for washing equipment and utensils) should be clean and safe.

For products preserved by the use of heat to kill the spoilage and pathogenic micro - organisms, it is essential that both the time and temperature used for processing are adequate to kill the spoilage micro - organisms. It is not enough to just heat the product to very high temperatures since too high a temperature will change the taste and nutritional content of the food. Cooking temperatures can be monitored with the use of thermometers. For foods use, common, glass bulb, mercury thermometers should not be used incase they crack and the mercury contaminates the food product. For commercial operations, digital probe type thermometers are available. These thermometers are easy to use and have different types of probes for monitoring temperatures ovens, refrigerators and the product itself (rod type probe) or for monitoring the temperature of oil used for deep frying chips (high

temperature resistant wires). Manufacturers of these thermometers provide comprehensive instructions on how to use these instruments.

For products preserved by the use of preservative agents, the strength of the preservative has to be strong enough to suppress the growth or destroy the spoilage micro - organisms in the product. In jam making, sugar prevents the growth of micro - organisms. The sugar dissolved in the product, reduces the amount of water available for spoilage micro - organisms to grow. When making jam commercially, it is important to check that each batch of jam contains enough sugar to prevent the growth of spoilage micro - organisms. Refractometers (illustrated on page 37) are used for checking the sugar content of each batch of jam. The instrument is able to determine the percentage of sugar dissolved in the jam. Full instructions on the use of such an instrument are provided by the manufacturers. Should such an instrument be purchased then the assistance of a food technologist or trained laboratory technician should be sought to' make sure it is being used correctly.

Adopting goods standards of cleanliness of processing premises, processing equipment / utensils and standards of hygiene practiced by persons making the product are important for the quality and safety of the final product.

The interior and exterior of processing premises (whether the kitchen of a domestic house or a purpose built processing building) should be in a good state of repair. Holes in window screening, gaps under doorways, open spaces in the roof provide insect and vermin with easy entry points. All rubbish and waste material should be kept well away from food processing premises to discourage the congregation of flies and other insects. Proper disposal of rubbish also important for maintaining the cleanliness of areas surrounding food processing premises.

Internally all working areas and surfaces should be regularly cleaned with sanitising agents (mild bleach, disinfectants or if available steam). It is useful to draw up a schedule for cleaning areas that are not used every day (such as store rooms, ceiling areas, ceiling fans and areas behind processing equipment). The advice of a qualified food technologist should be sought concerning the most suitable chemicals and cleaning agents for cleaning equipment and work surfaces which are to be in direct contact with food materials. Processing equipment and cooking utensils should be thoroughly cleaned after use and stored in a clean environment. As

many metal items of equipment and kitchen utensils sold in local shops are not made from stainless steel, they should be thoroughly dried after cleaning and regularly inspected for signs of rust. If using oil to lubricate mechanical items of equipment, then ensure they do not come into contact with the food materials and ingredients during processing operations.

People involved in both cleaning and processing operations should keep themselves clean and tidy. Outdoor clothing and shoes should be changed before entering the food processing premises. Clean aprons should be used and long hair tied up to prevent contaminating the food product with hair. This helps maintain a clean working environment within the kitchen or processing premises. It is extremely important to wash the hands (with soap) and thoroughly dried (using clean towels) before handling any food material. Hands should be re - washed every time the processor leaves the processing area to visit the toilet, answer the telephone or be called away for any other reason.

When products are produced for sale outside the home, samples of each batch of product made should be retained and visually inspected over a period of time. Should any signs of deterioration be found (such as mould development on the surface of jam, increase in moisture content of stored flour), then corrective measures need to be taken. The advice of a qualified food technologist should be sought to solve the problem.

Processed products should be stored in suitable conditions (ice - cream obviously needs to be kept in a freezer). It is fine to keep chips in sealed plastic bags in a store room provided that both the packaging material keeps out moisture and that the store room is clean, dry, cool and free from insect or rodent infestation. Note that a " store " could even refer to a cupboard used in a domestic kitchen. Even a cupboard must be kept clean and dry when used for storing food.

Digital thermometer & probes.

Refractometer

Packaging materials and product labelling.

A good quality product should also be packaged and presented well. Packaging materials protect processed products during storage.

Packaging materials used should be strong enough to withstand the type of handling the product will be exposed to and act as a barrier against moisture, oxygen and unwanted matter entering the product. The type of packaging material chosen should however be relatively inexpensive and where possible purchased locally. The package must also be sealed well in order to prevent oxygen, moisture and other unwanted material from entering the product and reducing the storage life of the product.

When using glass jars for preserving root crops as jam the following issues should be noted. Only glass jars which are intact should be used. Glass jars should be inspected for cracks. Jars with cracks (no matter how fine), especially around the neck of the jar, should be discarded. Cracks along the neck of the jars prevent a good air tight seal forming when the lid is screwed on. All jars and lids should be sterilised prior to use [see jam recipe for details of how to sterilise the jars].

There are many forms of plastic packaging materials. Different types of plastic are suited to different packaging requirements - that is some are moisture proof or do not allow gases to enter the product (or both). The most commonly used plastic films are; polyethylene (polythene) and polyvinyl chloride (PVC). Polythene is milky white in colour and slightly greasy to touch. It is highly permeable to oxygen and carbon dioxide and slightly absorbs oils, grease and organic liquid vapours. The advantages of polythene are that it has a low permeability to water at normal temperatures and is low in cost. PVC is the strongest and most barrier proof plastic of those mentioned above. It is a transparent, strong plastic. If using PVC for food use, then it should have been made using non - toxic plasticisers or be lead free unplasticised PVC. Cellulose film is also widely used in food packaging but it is very permeable to water vapour and is not very strong. and cannot be subjected to heat sealing. Cellulose film is usually used for wrapping rather than packaging foods.

In order to seal plastic bags, heat needs to be applied. Sealing plastic bags with an elastic band does not provide an adequate seal to keep out moisture. There are specially designed plastic bag sealers available on the market. A sketch of a typical model is illustrated on page 39. Plastic bags can be heat sealed using a wax candle and hacksaw blade. However, this method is not recommended for use on a commercial scale operation but could be used to seal plastic bags at the household level.

After packaging it is important to clearly label the packages. Products must be clearly labelled with all necessary information. Appropriate Government authorities should be approached concerning information which has to be presented on product labels by law. There may also be legal requirements regarding the designs of labels used. This type of information is usually available from either the Ministry of Health, Ministry of Trade and Commerce or Ministry of Agriculture. Whether labelling products for domestic or commercial use, labels should always state basic information such as the name of the product and date of manufacture. For commercial operations, the name of the manufacturer, gross or net weights of product per unit (that is weight of chips in one bag, weight of jam in one jar) and a list of the ingredients used in making the product should also be presented. Labels can be hand written as long as the information is written in very clear print and permanent ink is used. The use of adhesive labels on the outside of the package is advised. Placing labels inside a clear, plastic bag is not advised.

Electric bag sealer

Electric bag sealer

Candle and hacksaw blade method of sealing plastic bags

To seal plastic bags using this method you will require a wax candle, hacksaw blade or flat piece of thin metal and matches.

Light the candle. Fold the edge of the plastic bag over the teeth of the hack-saw blade. Lightly pass the folded edge of plastic through the candle flame. Remove the hacksaw blade and check that the seam is well sealed.

Candle and hacksaw blade method of sealing plastic bags.

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Section 2: Root crop flour and recipes utilising root crop flour

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Root crop flour

Materials:

Fresh root crop tubers (cassava, sweet potato, taro or yam)
Clean water

Equipment:

Sharp knives
Buckets
Slicer (manual or mechanised)
Drier (solar or hot air drier)
Grinder (manual or mechanised)
Sieves
Bag sealer

Preparation:

a) Wash, peel and re - wash the tubers. Place the peeled tubers in a bucket of clean water until ready to slice.

b) Slice the tubers to a thickness of 2 - 3 mm.

c) Place the tuber slices in a single layer, on drying trays. Place the drying trays in the sun or in a hot air drier as soon as possible. Continue drying the tuber slices until they snap cleanly and crisply.

d) Allow the tuber slices to cool. The dry tuber slices can be stored in sealed plastic bags or sacks, in a dry, well ventilated storage space until ready for grinding.

e) Grind the dried tuber slices into flour when required. During the grinding operation the flour should be sieved to remove the coarse particles. The coarse particles can be re - ground. Grinding and sieving operations should be repeated until the flour resembles very fine powder.

f) The flour should be stored in clean, dry, airtight containers, sealed plastic bags or sacks until required. The flour should then be stored in a clean, cool, dry place. it is important to label the containers of flour with the name of the product and the date that it was made.

Pancakes

Ingredients:

2 mugs root crop flour
1 teaspoon baking powder
2 1/2 tablespoons sugar
2 eggs (beaten)
2 full mugs milk
oil for frying

Utensils:

Mixing bowl
Wooden spoon
Teaspoon
Tablespoon
Fork
Jug
Coffee mug
Glass
Shallow frying pan
Spatula
Stove

Preparation:

a) Mix all ingredients together to make a batter.

b) Transfer the batter into a jug.

c) Cover the base of the shallow frying pan with a thin layer of oil.

d) Fry the batter a little at a time. Shake the frying pan to spread the batter evenly over the base of the pan (the pancakes should be flat, round and about 3 - 4 mm thick).

e) Cook each pancake for about 10 - 15 minutes - turning the pancake over once to cook both sides.

Biscuits

Ingredients:

2 mugs root crop flour
4 1/2 tablespoons sugar
2 round tablespoons margarine
1 egg
Flavouring:
1 mug ground ngali nuts or
1 level tablespoon honey or
10 tablespoons grated coconut

Utensils:

Coffee mug
Tablespoon
Fork
Glass
Mixing bowl
Rolling pin (or empty glass bottle)
Baking tray
Stove

Preparation:

a) Cream the margarine and sugar together to form a smooth paste.
b) Beat the egg and add to the margarine / sugar mixture.
c) Add the flour and flavouring (nuts, honey or coconut), a little bit at a time, to the biscuit mixture. Mix well.
d) Knead the mixture into a stiff cough. Continue to knead for 10 minutes.
e) Roll out the dough until about 1/2 thick.

f) Cut out circular shapes using an upturned glass.
g) Place the dough circles on a lightly oiled baking tray.
h) Bake in a moderately hot oven (180C) for 20 - 25 minutes or until golden brown on the outside.

Baki cakes

Ingredients:

- 1 1/2 mugs root crop flour
- 1/2 teaspoon salt
- 2 1/2 dessertspoons margarine or oil
- 1 egg
- 1/2 mug water

Utensils:

- Coffee mug
- Teaspoon
- Fork
- Glass
- Mixing bowl
- Rolling pin
- Spatula
- Shallow frying pan
- Stove

Preparation:

a) Beat the egg.
b) Add salt, flour, fat and mix well.
c) Add enough water to the mixture to form a dough.
d) Divide the dough into small balls of even size and roll out flat.
e) Put a thin layer of oil in the frying pan. Fry each cake until golden in colour. Turn each cake over once during the cooking process.

Sweet potato buns

Ingredients:

- **3 mugs boiled, mashed sweet potato**
- **1 mug milk**
- **2 mugs sweet potato flour**
- **1 1/2 teaspoons baking powder**
- **1 teaspoon lemon juice**
- **1/2 teaspoon salt**
- **oil for frying**

Utensils:

- **Sharp knife**
- **Saucepan**
- **Sieve**
- **Potato masher**
- **Coffee mug**
- **Mixing bowl**
- **Teaspoon**

- Wooden spoon
- Baking tray
- Oven

Preparation:

a) Heat the water in a saucepan.
b) Wash, peel and slice 4 medium sized sweet potato tubers. Place sliced tubers in the hot water and cook until soft.
c) Drain off water. Place cooked tubers in a mixing bowl and mash.
d) Measure out 3 mugs of mashed sweet potato and place in a mixing bowl.
e) Add milk, flour, baking powder, salt and lemon juice. Mix into a firm dough.
f) Shape dough into egg sized pieces. Place on a greased baking tray.
g) Bake in a hot oven (200C) until cooked.

Roti

Ingredients:

- 2 mugs root crop flour
- Water
- Cooking oil
- Pinch of salt

Utensils:

- Coffee mug
- Mixing bowl

- **Wooden spoon**
- **Rolling pin (or empty glass bottle)**
- **Shallow frying pan**
- **Spatula**
- **Stove**

Preparation:

a) Mix salt and flour
b) Add enough water to make a thick dough.
c) Divide the dough into 4 balls
d) Pat each ball into a circular shape on a clean chopping board. The circular shape is known as roti.
e) Place a thin layer of oil in the frying pan.
f) Transfer a roti to the frying pan and cook over a medium flame. Turn the roti over once during cooking adding a little extra oil if the frying pan becomes dry. Fry until the roti is golden brown.

Taro cakes

Ingredients:

- **41/2 mugs cooked, mashed taro**
- **1 tablespoon sugar**
- **6 mugs cooking oil**
- **2 tablespoons cassava flour**
- **2 egg whites**

Utensils:

- **Sharp knife**
- **Tablespoon**
- **2 coffee mugs**
- **Potato masher**
- **Mixing bowl**
- **Sieve**
- **Deep frying pan**

Preparation:

a) Wash, peel and boil taro tubers until cooked.
b) Drain the tubers from the water and mash.
c) Measure out 41/2 mugs mashed taro
d) Add sugar, egg whites, 4 tablespoons oil and the cassava flour. Mix well.
e) Make small balls with the dough.
f) Pour the remainder of the oil into a deep frying pan and heat.
g) When the oil is hot, deep fry the balls until they turn brown in colour.

Taro muffins

Ingredients:

- **2 mugs root crop flour**
- **1/2 teaspoons baking powder**
- **2 teaspoons sugar**
- **1 mug cooked, mashed taro**
- **1 tablespoon margarine**
- **2 eggs**

- 1 1/4 mugs milk

Utensils:

- Sharp knife
- Saucepan
- Potato masher
- Wooden spoon
- Tablespoon
- Teaspoon
- Coffee mug
- Mixing bowl
- Bread tin
- Oven

Preparation:

a) Peel, wash and boil the taro until cooked.
b) Drain, mash and measure out 1 mug mashed tarot
c) Mix all the dry ingredients together.
d) Mix all the wet ingredients together.
e) Mix both the wet and dry ingredients together. Stir lightly.
f) Pour into a greased loaf tin.
g) Brush the top of the loaf with milk
h) Bake in a hot oven (220C) until golden brown. Cooking time is approximately 20 minutes.

Sweet potato biscuits

Ingredients:

- **3 mugs root crop flour**
- **2 teaspoons baking powder**
- **1 teaspoon salt**
- **2 mugs mashed sweet potato**
- **6 level tablespoons sugar**
- **1 tablespoon margarine**

Utensils:

- **Sharp knife**
- **Saucepan**
- **Potato masher**
- **Wooden spoon**
- **Coffee mug**
- **Mixing bowl**
- **Glass**
- **Teaspoon**
- **Rolling pin (or empty glass bottle)**
- **Baking tray**
- **Oven**

Preparation:

a) Wash, peel and boil the sweet potato tubers until cooked.
b) Drain the cooked tubers and mash.
c) Measure out 2 mugs of mashed potato.

d) Sieve the flour, salt and baking powder together.
e) Mix the mashed potato, sugar and margarine together.
f) Add flour to the potato mixture. Mix thoroughly.
g) Roll the dough out on a lightly floured surface until '/," thick.
h) Cut out shapes with an upturned glass.
i) Place on a well oiled baking tray.
j) Bake in a moderately hot oven (180C) for 12 - 15 minutes until golden brown.

Steamed cassava snacks

Ingredients:

- **2 mugs cassava flour**
- **1/2 mugs hot water**
- **Pinch of salt**
- **Grated coconut**
- **Honey**

Utensils:

- **Coconut grater**
- **2 medium sized bowls**
- **Sieve**
- **Teaspoon**
- **Coffee mug**
- **Large saucepan**

Preparation:

a) Mix together cassava flour, water and salt.
b) Knead the mixture until a smooth dough is formed.
c) Divide the dough into 12 balls
d) Mix grated the grated coconut and honey together and divide into 12 portions.
e) Use the thumb to make a hole in the centre of each ball of dough. Fill each hole with the coconut / honey mixture. Smooth the dough back over the filling [see illustration on page 51].
f) Steam the dough balls for 20 - 30 minutes.
g) Serve hot.

Spicy cassava cake

Ingredients:

- **3 mugs cassava flour**
- **11 1/2 level tablespoons sugar**
- **1/2 teaspoon nutmeg**
- **1 large coconut, grated**
- **1 1/2 mugs milk rind of half an orange**
- **2 rounded tablespoons margarine**
- **1/2 teaspoon mixed spice**
- **1/2 teaspoon salt**
- **1 teaspoon vanilla essence**
- **2 eggs**

Utensils:

- Coffee mug
- Glass
- Teaspoon
- Fork
- Mixing bowl
- Wooden spoon
- Coconut grater
- Grater
- Saucepan
- Bread tin
- Oven

Preparation

a) Mix all the dry ingredients together.
b) Add melted margarine and mix well.
c) Add eggs, vanilla essence and milk.
d) Beat the mixture well.
e) Put into a well greased bread tin.
f) Bake in a moderately hot oven (180 - 190C) for 1 1/2 hours.

Fritters

Ingredients:

- 1 mug boiled yam, mashed
- 1 egg yolk
- 1/4 mug milk

- 1/4 mug root crop flour
- 1 teaspoon baking powder
- 1/2 teaspoon salt

Utensils:

- Sharp knife
- Saucepan
- Potato masher
- Coffee mug
- Glass
- Fork
- Teaspoon
- Mixing bowl
- Deep frying pan

Preparation:

a) Wash, peel and chop the tubers into small pieces. Place in a saucepan of water and boil until cooked.
b) Drain off the water and mash.
c) Combine with all other ingredients
d) Fold in 1 stiffly beaten egg.
e) Half fill the deep fat frying pan with oil.
f) Drop spoonfuls of the mixture into deep frying pan and cook until golden brown (cooking time approximately 8 - 10 minutes).

Chocolate sweet potato pie

Ingredients:

For the pastry:

- **1/2 mug root crop flour**
- **1/2 teaspoon salt**
- **1/2 teaspoon baking powder**
- **1 tablespoon margarine**
- **6 - 7 tablespoons cold water**

For the filling:

- **1 mug cooked mashed potato, sieved**
- **2 mugs milk**
- **2 eggs**
- **3/4 mug brown sugar**
- **1/2 teaspoon cinnamon**
- **1/4 teaspoon salt**
- **1 tablespoon lemon juice**
- **8 small squares chocolate**
- **1 teaspoon margarine**
- **2 tablespoons boiling water**

Utensils:

- **Coffee mug**
- **Teaspoon**
- **Tablespoon**
- **Fork**

- Glass
- Mixing bowl
- Wooden spoon
- Rolling pin (or empty glass bottle)
- Sieve
- Shallow pudding bowl
- Sharp knife
- Saucepan
- Oven
- Stove

Preparation:

a) Make the pastry by mixing the flour, salt and baking powder together.

b) Add the margarine and rub into the flour using the fingertips. Mix until the flour mixture looks like breadcrumbs.

c) Add cold water a little at a time and mix well. Continue to add a little bit of water at a time until the flour mixture forms a smooth dough.

d) Roll the dough out until it is large enough to line the inside of a shallow pudding basin [see illustration on page 56 & 57]

e) Wash, peel, boil and mash the sweet potato.

f) Press the sweet potato through a sieve.

g) Mix the sieved sweet potato with the milk, sugar and well beaten eggs.

h) Stir in the cinnamon, salt, lemon juice.

i) Pour the filling mixture into the pastry lined shallow pudding bowl.

j) Cook the pie in a hot oven (230C) for 10 minutes then reduce to a medium heat (160C) and cook for a further 15 minutes until the filling puffs up a little and the blade of an inserted knife comes out clean.

k) Melt the chocolate. with the butter in a saucepan. Remove from the heat and add I or 2 tablespoons of boiling water. Beat the mixture until smooth and pour over the warm pie and chill well before serving.

Lining a pudding basin with pastry
Lining a pudding basin with pastry (cont.)

Honeybread

Ingredients:

- **1 full mug, cassava flour**
- **3 level tablespoons honey**
- **60 drops vanilla essence**
- **1 egg**
- **1 level teaspoon bicarbonate of soda**
- **1 mug water**
- **2 tablespoons sugar**
- **Juice from two lemons**

Utensils:

- **Metal basin**

- Sieve
- Coffee mug
- Teaspoon
- Tablespoon
- Wooden spoon
- Glass
- Fork
- Wok
- Bread tin
- Stove
- Oven

Preparation:

a) Mix the sugar, lemon juice in l/3 mug water. Heat over a medium hot flame until the sugar dissolves. Boil for 5 minutes. Stir continuously whilst heating. Allow to cool.

b) Heat some water in the wok.

c) Mix the honey and sugar mixture together. Boil for 3 minutes until the honey has blended well with the sugar mixture.

d) Place a basin containing the honey and sugar mixture in the wok of hot water. Gradually add the sifted flour and stir to mix well.

e) Add the vanilla essence, egg, bicarbonate of soda and the remaining water.

f) Pour the mixture into a bread tin.

g) Bake in a hot oven (210C) for 30 minutes.

Cassava snacks

Ingredients:

- **3 mugs cassava flour**
- **3 1/2 mugs root crop starch**
- **6 rounded tablespoons margarine**
- **1/2 teaspoon salt**
- **1 teaspoon bicarbonate of soda**
- **3 tablespoons milk powder**
- **1/2 teaspoon tartaric acid**
- **1/4 mug water**
- **5 eggs**
- **3 - 4 cloves of garlic**

Utensils:

- **Sharp knife**
- **Metal basin**
- **Sieve**
- **Coffee mug**
- **Tablespoon**
- **Teaspoon**
- **Wooden spoon**
- **Glass**
- **Fork**

- Rolling pin (or empty glass bottle)
- Baking trays
- Chopping board
- Stove
- Oven

Preparation:

a) Sieve all dry ingredients together and mix well.
b) Beat the margarine until smooth.
c) Beat the eggs well.
d) Peel and finely chop the garlic cloves.
e) Mix the eggs with the margarine. Add finely chopped garlic
f) Add all the dry ingredients to the margarine and egg, a little at a time. Knead into a dough and allow to rest for a few minutes.
g) Knead the dough for 5 minutes before rolling out to 3/4" thickness.
h) Cut the dough into round circles using an upturned glass.
i) Bake in a cool oven (150 - 160C) for 25 minutes.

Cassava bread

Ingredients:

- 4 mugs cassava flour
- 2 1/2 mugs water
- 1 heaped tablespoon sugar
- 3 eggs
- 1 1/2 teaspoons salt

- 1/4 mug oil
- 1 1/2 tablespoons dried yeast

Utensils:

- Coffee mug
- Tablespoon
- Teaspoon
- Saucepan
- Piece of cloth
- Mixing bowl
- Wooden spoon
- Bread tin
- Oven

Preparation:

a) Mix l/2 mug cassava flour with the water. Boil for 4 minutes and allow to cool slightly.
b) Mix the yeast with the dry flour. Gradually mix with the warm water. Knead the dough well.
c) Add the remaining ingredients and knead thoroughly for 10 minutes.
d) Place in a well greased bread tin, cover with a clean cloth. Place in a warm area until the dough has risen to double its original size.
e) Bake in a hot oven (200C) for 50 minutes
f) Allow to cool before slicing.

Banana bread

Ingredients:

- 1 1/2 mug composite flour (1/2 mug root crop flour + 1 mug wheat flour)
- 2 rounded tablespoons margarine
- 3/4 mug sugar
- 2 eggs
- 2 ripe bananas
- 1/4 teaspoon salt
- 1/2 teaspoon sodium bicarbonate
- Oil for greasing the bread tin

Utensils:

- Coffee mug
- Tablespoon
- Teaspoon
- Mixing bowl
- Glass
- Wooden spoon
- Fork
- Bread tin

Preparation:

a) Mix the margarine and sugar together.
b) Beat the eggs well and gradually add to the margarine / sugar mixture.
c) Mash the bananas and add to the margarine / egg / sugar mixture.
d) Gradually add the flour, salt and bicarbonate of soda to the mixture.
e) Pour into a greased bread tin and bake in a cool oven (160C) for at least 1 hour.
f) Check that the loaf is cooked by inserting the blade of a clean knife into the dough. If the knife comes

out clean then it is cooked. If the loaf is not quite ready continue to bake until the blade of the inserted knife comes out cleanly.
g) Allow the loaf to cool before removing from the tin.

Vanilla buns

Ingredients:

- **3/4 mug composite flour (1/4 mug root crop flour + 1/2 mug wheat flour)**
- **1 rounded tablespoon margarine**
- **6 tablespoons sugar**
- **1/4 teaspoon baking powder**
- **2 eggs**
- **1/4 teaspoon vanilla essence**

Utensils:

- **Coffee mug**
- **Tablespoon**
- **Teaspoon**
- **Mixing bowl**
- **Fork**
- **Glass**
- **Sieve**
- **Wooden spoon**

Preparation:

a) Cream the margarine and sugar together until light and fluffy.
b) Beat the eggs well and gradually add to the margarine and sugar mixture. Continue to beat well.
c) Sieve the flour and baking powder together. fold in the creamed margarine, sugar and egg mixture using a little warm water. Add the vanilla essence.
d) Half fill paper cones with mixture.
e) Bake in a hot oven (220C) for 15 .- 20 minutes or until the buns are firm to touch.

Mixed flour bread

Ingredients:

- **3 mugs composite flour (1 mug root crop flour + 2 mugs wheat flour)**
- **2 level tablespoons dried yeast**
- **3/4 tablespoon sugar**
- **1/4 tablespoon margarine**
- **1/4 teaspoon salt**
- **1 3/4 mugs water**
- **Oil for greasing the bread tin**

Utensils:

- **Coffee mug**
- **Tablespoon**
- **Teaspoon**
- **Mixing bowl**
- **Wooden spoon**
- **Bread tin**
- **Piece of cloth**

Preparation:

a) Dissolve salt and sugar in water
b) Mix the flour and yeast in the salt / sugar solution. Knead to form a soft, smooth dough.
c) Knead the margarine into the dough.
d) Mould the dough into a greased bread tin.
e) Put the bread tin in a warm place covered by a clean, damp cloth. Leave to rest until the dough has risen to double its original size.
f) Lightly spray some water on the surface of the dough.
g) Bake in a hot oven (200C) for 30 minutes.

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Section 3: Root crop starch and recipes utilising root crop starch

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Root crop starch
Caramel dessert
Savoury griddle cakes
Iced dessert (ice-cream)

Root crop starch

Ingredients:

- **Fresh root crop tubers (cassava, sweet potato, taro or yam)**
- **Clean water**

Equipment:

- **Sharp knives**
- **Buckets**
- **Grater (manual or mechanised)**
- **Fine mesh cloth**
- **Press (optional)**
- **Plastic tubing**
- **Drying tray**
- **Drier**
- **Grinder**

Preparation:

a) Wash, peel and re - wash the tubers. Place the peeled tubers in a bucket of clean water until ready to grate.

b) Grate the peeled tubers into a fine pulp. Place the pulp in a clean bucket. Cover the pulp with plenty of clean water. Stir the pulp and allow to stand for 10 minutes.

c) Filter the pulp through a clean piece of cotton cloth and keep the water in a separate bucket. Squeeze out as much water from the pulp as possible (a press can be used for this operation).

d) Place the pulp in a clean, empty bucket and cover with more clean water. Stir the pulp thoroughly and

allow to stand for a further 10 minutes. Filter the pulp as described in (c) above. Add the filtered water to the bucket containing the filtered water collected from the first pulp washing operation.

e) Repeat step (d) until the water used for washing the pulp remains clear.

f) Discard the pulp (or dry and use as animal fodder).

g) Leave the filtered water to stand overnight in the bucket.

h) Carefully syphon off the filtered water from the bucket using a piece of clean, plastic tubing. Discard the water.

i) A layer of starch will appear at the bottom of the bucket. Carefully rinse the surface of the starch with clean water. Discard the rinsing water. Cover the starch with more clean water and allow to settle for 1 - 3 hours.

j) Syphon off the top layer of water.

k) Scrape out the starch from the bottom of the bucket. Place on a drying tray lined with a piece of clean plastic and sun dry. If using a drying cabinet, place the starch on a clean metal sheet.

l) Break up the starch at frequent intervals throughout the drying process so that the starch dries thoroughly.

m) Continue to dry the starch until it resembles a fine white powder.

n) Grind the starch and package in clean, dry, air tight containers, sealed plastic bags or sacks until required. Store in a clean, dry and well ventilated place.

Caramel dessert

Ingredients:

- 4 mugs milk
- 5 tablespoons sugar
- 3 eggs
- 6 - 7 level tablespoons starch

Utensils:

- 2 medium sized saucepans
- 2 wooden spoons
- Glass
- Fork
- Large bread tin
- Refrigerator
- Stove

Preparation:

PLACE THE BREAD TIN IN THE FREEZER BEFORE STARTING THE RECIPE.

a) Heat the milk in a saucepan, stirring continuously to prevent the milk from burning on the bottom of the saucepan.

b) Mix the sugar with a little water. Heat in a separate saucepan until all the sugar has dissolved and the mixture is like syrup. Stir the mixture continuously whilst heating to prevent the bottom from burning.

c) Add a little hot milk to the sugar syrup. Gradually add the remainder of the milk and mix until all the sugar syrup has dissolved.

d) Mix the starch with enough cold water to form a smooth paste.

e) Add the starch paste to the sugar and milk mixture. Stir continuously to prevent any lumps forming.

f) Beat the eggs together in a glass. Remove the saucepan from the stove and add the beaten eggs. Mix well.

g) Heat the mixture for 4 -5 minutes.

h) Pour the mixture into a pre - cooled bread tin.

i) Place the dessert in a refrigerator for at least three hours before eating.

Savoury griddle cakes

Ingredients:

- **3/4 mug grated root crop tubers**
- **1 small onion**
- **1 1/2 tablespoon root crop starch**
- **1 egg pinch of salt**
- **vegetable oil for cooking**

Utensils:

- **Sharp knife**

- Grater
- Coffee mug
- Tablespoon
- Glass
- Fork
- Mixing bowl
- Shallow frying pan

Preparation:

a) Wash, peel and grate the root crop tubers as finely as possible.
b) Peel and finely chop the onion.
c) Beat the egg
d) Add onion, starch, salt and beaten egg to the grated root crop.
e) Mix well to give a dropping consistency.
f) Thinly coat the frying pan with oil. Heat over a low flame, dropping spoonfuls into the frying pan thinly coated with oil.
g) Fry each cake for 10 minutes, turning them over once during cooking.

Iced dessert (ice-cream)

Ingredients:

- 2 teaspoons root crop starch
- 4 tablespoons cooked, mashed sweet potato or taro
- pinch of salt
- 3/4 mug sugar
- 2 teaspoons cocoa powder

- 1 mug milk
- 1 egg
- 1 tablespoon lime juice
- 1/4 mug cold water

Utensils:

- Coffee mug
- Bowl
- Saucepan
- Sieve
- Fork
- Small bread tin or plastic container
- 2 glasses
- Teaspoon
- Tablespoon
- Sharp knife
- Wooden spoon
- Stove

Preparation:

a) Wash, peel and boil the root crop tubers.
b) Mix the sugar, starch, salt and cocoa powder together in a bowl.
c) Slowly stir in the milk.
d) Place the bowl over a saucepan of boiling water and stir until the mixture has thickened.
e) Separate the egg yolk from the egg white.
f) Beat the egg yolk well. Add a little of the hot milk mixture to the beaten egg yolk.

g) Mix the egg yolk with the remainder of the milk mixture.
h) Place the bowl back over the saucepan of hot water. Continue to stir for 4 - 5 minutes.
i) Remove the bowl from the saucepan of hot water and allow the contents to cool.
j) Mix the cold water together with the mashed root crop and lime juice. Press the mixture through a sieve.
k) Combine the root crop mixture with the milk mixture and place in the bread tin or plastic container.
l) Freeze the mixture for one hour.
m) Take the mixture out of the container and beat well.
n) Return the mixture to the loaf tin or plastic container and continue to freeze until hard.

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Section 4: Gari and recipes utilising gari

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Gari

Ingredients:

- Cassava
- Water

Utensils:

- Sharp knife
- Grater (manually operated or mechanised)
- Bucket
- Cotton or linen bag / sack
- Weights (heavy stones) or drum press
- Plastic sheet
- Thick bottomed, shallow frying pan (or wok)
- Wooden spoon
- Fine mesh sieve
- Stove
- Plastic bags
- Heat sealer (or candle)

Preparation:

a) Wash, peel and finely grate the cassava tubers into pulp.

b) Place the cassava pulp in a linen or cotton cloth bag.

c) Tie the bag firmly and place a heavy weight on top of the bag or place in a drum press and screw down the bolts firmly. Leave it in the sun for three to four days. If using the drum press keep tightening the bolts every day.

d) Open the bag to check if the pulp is dry and not sticky. If not dry then spread out to dry in the sun for

an hour or two.

e) When dry remove from the bag and rub through the sieve.

f) Place small batches of the fine pulp in a shallow pan over a low heat until the particles become light and free flowing. The gari should be very light cream in colour.

g) Sieve the gari to remove coarse fibre pieces.

h) Pack the gari in air tight containers or sealed plastic bags / sacks. Store in a cool, dry place.

Gari porridge

Ingredients:

- **4 heaped tablespoons gari**
- **1 2/3 mug milk**
- **1 tablespoon sugar**

Utensils:

- **Tablespoon**
- **Coffee mug**
- **Saucepan**
- **Wooden spoon**
- **Stove**

Preparation:

a) Mix the gari with the milk.
b) Heat slowly over a low flame (do not boil). Stir the mixture continuously.
c) Add sugar to taste
d) Serve hot

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Section 5: Recipes utilising fresh root crops

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Sweet potato jam

Ingredients:

- 14 medium sized sweet potato tubers
- 8 1/2 mugs brown sugar
- Juice from 9 limes
- 1 1/2 teaspoons peeled, finely chopped, fresh ginger

Utensils:

- Sharp knife
- Teaspoon
- Wooden spoon
- 2 large saucepans
- Mixing bowl
- Potato masher
- Sieve
- Stove
- Jam jars

Preparation:

a) Wash, peel and chop the sweet potato tubers into small chunks.
b) Boil the potato chunks until soft.
c) Drain off the water and mash the potato tubers.

d) Press the mashed potato through a sieve to form a puree.
e) Place the puree in a saucepan and add the brown sugar.
f) Slowly heat the mixture (stirring continuously) until all the sugar has dissolved.
g) Add the lime juice and mix well.
h) Add the fresh ginger and mix well.
i) Boil the mixture until it is very hot, stirring all the time.
j) Transfer the hot mixture into sterilised jam jars.
k) Half close the lids of the jam jars and place in a saucepan of boiling water. The water in the saucepan should come half way up the side of the jam jar).
l) Place a lid on the saucepan and boil the contents for 30 minutes.
m) Carefully remove the jars from the boiling water and close the lids very tightly.
n) Invert the jam jars and make sure that the jam touches the inside surface of the lid. After 1 - 2 minutes return jam jars to upright position.
o) Wipe the outside of the jam jars with a clean cloth.
p) Allow the jars to cool before labelling with the name of the product and date of manufacture.

Cassava drops

Ingredients:

- **2 mugs pulped, fresh cassava**
- **1/2 teaspoon salt**
- **Pinch of pepper**
- **1/2 teaspoon curry powder**

Utensils:

- **Sharp knife**

- Very fine grater
- Teaspoon
- Mixing bowl
- Wooden spoon
- Deep frying pan

Preparation:

a) Wash, peel and finely grate the fresh cassava
b) Add salt, pepper and curry powder
c) Form small balls with the pulp mixture.
d) Half fill the frying pan half way with oil and heat.
e) Fry the balls in hot oil until golden brown.
f) If required, sprinkle with extra salt or curry powder before serving.

Sweet potato mash

Ingredients:

- 7 - 8 medium sized sweet potato tubers
- 1/2 tablespoon margarine
- 2 eggs
- 1/2 mug orange juice
- Brown sugar
- Cinnamon

Utensils:

- Coffee mug
- Sharp knife
- Fork
- Glass
- Mixing bowl
- Potato masher (or use a wooden spoon)
- Wooden spoon
- Saucepan
- Oven proof dish
- Stove
- Oven

Preparation:

a) Wash, peel, chop, boil and mash the sweet potato tubers.
b) Press the mashed potatoes through a sieve.
c) Add butter, egg and orange juice. Mix well.
d) Place in an oven proof dish. Sprinkle with brown sugar and cinnamon.
e) Bake in a moderately hot oven (180 - 190C) for 30 minutes or until the top has turned brown.

Vakalavalava

Ingredients:

- 2 mugs grated, fresh cassava
- 1 mug grated coconut
- 1 tablespoon margarine
- 2 tablespoon sugar oil

Utensils:

- **Sharp knife**
- **Grater**
- **Coffee mug**
- **Tablespoon**
- **Mixing bowl**
- **Bread tin**
- **Oven**

Preparation:

a) Grate the cassava and the coconut.
b) Mix the cassava, coconut and sugar. Add butter and mix well
c) Lightly grease the bread tin.
d) Place the mixture in the bread tin. Bake in a moderately hot oven (180C) for 1 hour.
e) Remove from the dish and cut into slices.
f) Serve hot or cold.

Savoury balls

Ingredients:

- **2 mugs pulped cassava**
- **1 finely chopped onion**
- **1/2 teaspoon chopped garlic**
- **1/2 teaspoon salt**
- **1 egg oil for frying**

Utensils:

- **Sharp knife**
- **Grater**
- **Coffee mug**
- **Teaspoon**
- **Glass**
- **Fork**
- **Mixing bowl**
- **Deep frying pan**

Preparation:

a) Peel and chop the onion and garlic.
b) Mix the grated cassava, onion, garlic and salt.
c) Lightly beat the egg and add to the cassava mixture. Mix together until smooth.
d) Make small balls with the mixture.
e) Use a quarter of a mug of oil to fry some of the balls. Use the remainder of the oil to top up the oil level whilst frying the rest of the balls.

Sweet potato cake

Ingredients:

- **3 mugs cooked, mashed sweet potato**
- **1 mug boiling milk**
- **2 drops vanilla essence**
- **3 eggs**

- 2 level tablespoons sugar

Utensils:

- Coffee mug
- 2 glasses
- Fork
- Tablespoon
- Wooden spoon
- Saucepan
- Mixing bowl
- Bread tin

Preparation:

a) Wash, peel, chop, cook and mash the sweet potato.
b) Boil the milk in a saucepan.
c) Add the boiling milk and vanilla essence to the mashed potato.
d) Beat the egg yolks together with the sugar and add to the potato mixture.
e) Add the butter and mix well.
f) Fold in stiffly beaten egg whites.
g) Place the mixture in a bread tin and bake in a hot oven (200C) for about 1 hour.

Chips

Ingredients:

- Fresh root crop tubers

- Oil for frying
- Salt

Utensils:

- Sharp knife
- Slicer
- Bowl
- Sieve
- Deep frying pan

Preparation:

a) Wash, peel and thinly slice the root crop tubers.

b) Place tuber slices in a bowl of cold-water.

c) Wash slices for a few minutes.

d) Drain off excess water using a sieve.

e) Half fill a deep frying pan with oil and heat.

f) Test that the oil is hot enough for frying the chips by placing one or two slices in the oil. If the chips burn within a minute or two of cooking then reduce the heat. If the chips take longer than 4 -5 minutes to cook then increase the heat slightly.

g) Place small batches of tuber slices in the oil to cook. Remove when golden brown or yellow and crispy in texture.

h) Place the chips in a sieve and shake to remove excess oil.

i) When cool sprinkle the chips with oil.

French fries

Ingredients:

- **Fresh root crop tubers**
- **Oil for frying**
- **Salt**

Utensils:

- **Sharp knife**
- **Bowl**
- **Sieve**
- **Deep frying pan**

Preparation:

a) Wash, peel and cut the tubers into chunks of about 0.25" thick.

b) Place the tuber chunks in a bowl of cold water.

c) Wash the chunks for a few minutes.

d) Drain off excess water using a sieve.

e) Half fill a deep frying pan with oil and heat.

f) Test that the oil is hot enough for frying the french fries by placing some chunks in the oil. If the french fries burn within a five to ten minutes of frying then reduce the heat. If the chunks take longer than 15 - 20 minutes to cook then increase the heat slightly.

g) Place small batches of chunks in the oil to cook. Remove when golden brown or yellow with a crispy outer layer.

h) Place the french fries in a sieve and shake to remove excess oil.

i) Eat whilst still hot, sprinkled with salt if required.

Sweet potato souffl

Ingredients:

- **3 mugs cooked, mashed sweet potato**
- **2 1/2 tablespoons butter**
- **1 tablespoon milk**
- **2 tablespoons finely chopped onion.**
- **1/2 teaspoon cinnamon Salt & pepper**
- **3 eggs**

Utensils:

- **Coffee mug**
- **Tablespoon**
- **Teaspoon**

- Fork
- Sharp knife
- Wooden spoon
- Saucepan
- 2 glasses
- Metal bowl
- Baking tray
- Stove
- Oven

Utensils:

a) Wash, peel and cook the sweet potatoes.
b) Mash the potatoes with a wooden spoon until smooth. Measure out 3 mugs.
c) Add 2 tablespoons melted butter, milk, onion, cinnamon, salt and pepper to the mashed potato. Mix well.
d) Separate the eggs and beat the egg whites until stiff.
e) Beat the egg yolks.
f) Fold the egg yolks into the potato mixture, then add the egg whites.
g) Put into a metal bowl. Place the metal bowl on a baking tray half filled with water.
h) Spread 1/2 tablespoon butter on top of the souffle.
i) Bake in a cool (160C) for 1 hour.

Taro fish cakes

Ingredients:

- Cooked flesh of one medium sized, tuna fish

- 2 1/4 mugs cooked, mashed taro
- 2 eggs
- 1/2 teaspoon salt
- 1/2 teaspoon pepper
- Flour for dusting
- Breadcrumbs

Utensils:

- Sharp knife
- Fork
- Teaspoon
- Wooden spoon
- Coffee mug
- 2 glasses
- Mixing bowl
- Shallow frying pan or oven and baking tray
- Stove

Preparation:

a) Wash, peel, boil and mash the taro using the back of a wooden spoon or a potato masher.
b) Measure out 2 1/4 mugs of mashed tarot
c) Beat in 2 egg yolks, salt and pepper.
d) Add the tuna and mix well
e) Form into flat cakes.
f) Dust each cake with flour, brush with egg white and coat with crisp breadcrumbs.
g) Fry in oil for 15 minutes or on a greased baking tray in a moderately hot oven (180 - 190C) for 25

minutes.

Sweet potato pudding

Ingredients:

- **2 mugs cooked, mashed sweet potato**
- **4 1/2 tablespoons sugar**
- **1/2 tablespoon margarine**
- **1 egg**
- **1/4 mug milk**
- **1/2 teaspoon salt**
- **20 drops vanilla essence**

Utensils:

- **Metal basin**
- **Bread tin**
- **Saucepan**
- **Potato masher**
- **Wooden spoon**
- **Measuring cup**
- **Teaspoon**
- **Oven**

Preparation:

a) Wash, peel, cook and mash the sweet potato. Weigh out 2 mugs of mashed potato.

b) Mix the mashed potato with 2/3 sugar, milk, egg and margarine
c) Add the vanilla essence and mix well.
d) Add 2 - 3 drops of water to the remaining sugar. Place in a saucepan and heat over a medium flame until the sugar browns and thickens.
e) Pour the sugar syrup into the bread tin. Spreading it evenly over the base of the bread tin.
f) Add the potato mixture on top of the sugar syrup.
g) Bake in a moderately hot oven (180C) for 45 minutes.

Spicy sweet potato cake

Ingredients:

- **12 1/2 tablespoons peeled sweet potato (uncooked)**
- **1 tablespoon margarine**
- **3 1/2 tablespoons sugar**
- **2 1/2 tablespoons wheat flour**
- **1/2 teaspoon nutmeg**
- **Small piece of peeled, finely chopped ginger**
- **1 mug grated coconut**
- **3 tablespoons raisins**
- **Pinch of salt**
- **5 drops vanilla essence**
- **Oil for greasing the bread tin**

Utensils:

- **Tablespoon**
- **Coffee mug**

- Teaspoon
- Grater
- Sharp knife or vegetable knife
- Sieve
- Mixing bowl
- Wooden spoon
- Fork
- Coconut grater
- Bread tin
- Oven

Preparation:

a) Grate the peeled sweet potato tubers.
b) Cream together the margarine and sugar. Add to the grated sweet potato.
c) Sieve the flour with the nutmeg and salt.
d) Add the finely chopped ginger.
e) Mix the flour with the margarine mixture.
f) Squeeze the milk from the grated coconut and add to the cake mixture.
g) Add raisins and vanilla essence
h) Pour the mixture into a greased bread tin and bake in a moderately hot oven (190C) for 1 hour.

Sweet potato bread

Ingredients:

- 6 1/2 mugs plain wheat flour
- 1 tablespoon finely shredded sweet potato (uncooked)

- 4 tablespoons sugar
- 2 1/2 teaspoons salt
- 1 teaspoon dried yeast
- 1 1/2 mugs water

Utensils:

- Plastic bowl
- Grater
- Teaspoon
- Bread tin
- Piece of cloth
- Oven

Preparation:

a) Mix all the dry ingredients together.
b) Boil the water and gradually add to the dry ingredients to form a dough. Knead the dough well.
c) Blend in the finely grated sweet potato.
d) Put the dough into the bread tin.
e) Cover the dough with a damp piece of cloth and leave in a warm, dry place for 2 hours.
f) Bake in a cool oven (160C) 45 minutes.

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Annex 1: Manufacturers and suppliers processing equipment

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Thermometers, refractometers and analytical sieves:

Salmond Smith Biolab Limited,
Private Mail Bag 36900,
Northcote,
Auckland 9,
NEW ZEALAND.
Tel: (9)418 3039
Fax: (9) 418 0729

Manual vegetable slicers:

Quality Cafe & Club Equipment,
P.O.Box 209,
Potts Point, NSW,
AUSTRALIA.
Tel:(61)2331 4124
Fax: (61) 2 360 2397

Electric vegetable slicers and graters:

CeCoCo,
Ibaraki,
Osaka

JAPAN.
Tel: 0726 (22) 244 - 3
Telex: J 65910 CECOCO

Mechanised / manually operated grinding mills:

C. S. Bell Company,
P.O.Box 291,
Tiffin,
Ohio 44883,
UNITED STATES
Tel: 419 448 0791
Fax: 419 448 1203

Plastic bag sealers:

Fastair Services Limited,
P.O.Box 54,
Lutwyche QLD 4030,
AUSTRALIA.
Tel: (61) 7 357 7600
Fax: (61) 7 857 6133

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