



FMARD/ WORLD BANK ACCELERATION NUTRITION RESULTS IN NIGERIA (ANRIN)



MANUAL

for

**PROCESSING, PRESERVATION AND
UTILIZATION OF PRODUCE FROM
HOMESTEAD GARDENS- NUTRITIOUS
CROPS AND ANIMAL SOURCE PROTEIN.**

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ACKNOWLEDGEMENT

The manual on Processing, Preservation and Utilization of Produce from Homestead Gardens has come at the right time to complement the other tools being deployed by FMARD / ANRiN to ensure that the beneficiaries of ANRiN and all Nigerian process and consume nutritious foods for improved nutrition. After popular demand from the stakeholders in Gombe, FMARD / ANRiN sought and got No – Objection from the Task Team Lead / World Bank to prepare a manual on Processing outside the 2021 workplan of ANRiN. We appreciate the support by the TTL (Dr. Ritgak Tilley Gyado) and her team in the development and production of the Processing Manual. The manual has been developed and prepared by a team of experts from the World Bank supported Centre for Food Technology and Research (CEFTER) of Benue State University and FMARD with inputs from relevant stakeholders and partners to achieve the set goals and objectives with due cognizance for quality and international standards. It is heart warming to note that the Management of the Federal Ministry of Agriculture and Rural Development, especially the Permanent Secretary (Dr. Ernest A. Umakhihe), provided the necessary environment, coordination and resources to facilitate the preparation of the Manual.

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GENERAL INTRODUCTION AND OBJECTIVES

Accelerating Nutrition Results in Nigeria (ANRiN) is a multi-sectoral Project being sponsored by the World Bank designed to provide cost effective nutrition services to meet dietary requirements of specific segments of the population including children under the age of five, pregnant and lactating mothers, adolescent girls and the aged. It is a known fact that adequate food and optimal nutritional status are the bedrocks for the healthy, secure lives and thus form the basis for development in any nation. To this effect, the Federal Ministry of Agriculture and Rural Development (FMARD / ANRiN) is adopting food-based approach in complementing the services from other sectors towards addressing crisis of malnutrition in Nigeria. FMARD / ANRiN is promoting homestead



garden to produce and consume nutritious crops (bio-fortified, fruits and vegetables) and animal source protein (small ruminant and noiler birds) in the three Local Government Areas of Yemaltu Deba, Balanga and Nafada in Gombe State. The key tool being used to promote homestead garden among the households is the World Bank Standard Generic training manual on the Homestead Garden. The manual is used to teach the rudiments of homestead garden through the Training of Trainers of Master Trainers who subsequently step down the training to the benefiting households.

To engender a full complement of the benefits of producing and consuming nutritious crops and animal source protein, training on Processing, Preservation and Utilization of Produce from Homestead gardens is conducted with a view to entrenching simple skills to process and retain nutrients in the foods at the household level. To this end, the manual on Processing, Preservation and Utilization of Produce from Homestead Gardens is pushing appropriate processing and preservation technologies that are relatively cheap, simple to use and well adapted to the social, cultural and economic conditions in the rural environment.

Processing methods are meant to add value to the products, develop other food types, preserve the products for all-year-round access, reduce post-harvest losses and extend the shelf-life for storage and for use at a later period. Preservation creates unfavourable conditions for the growth or survival of spoilage microorganisms. Several strategies are used to capture the interests of target users of the manual, from highlighting how nutrients

Are critical to health, to practical procedures of processing hygienic food that would conserve the nutritional quality with an extended shelf-life.

This manual focuses on carefully selected varieties of produce from homestead gardens such as Pepper, Tomatoes, Ugu, Carrot, Water Melon, Pawpaw, Orange Fleshed Sweet potatoes (OFSP), and Vit. A Maize.

These nutritious crops (fruit and vegetables) are targeted to provide the essential micro-nutrients (vitamins and minerals) required to maintain healthy living and combat hidden hunger in the society. Animal products are edible parts of a healthy animal (meat, milk, eggs) processed for human consumption or other uses. Proteins which are derived from animal products consumption are very vital to the process of life as they form the principal constituent organs and soft tissues of the human body. Protein is necessary for many vital functions in the body, including growth and development, cellular repair and immune system regulation. A liberal and continuous supply of protein is needed in the food throughout life for growth and repair of body tissues.



The objectives of the Processing and Preservation Manual include:

- Ensuring the produce from the homestead gardens are processed into wholesome, nutritious and appetizing food at economical rates.
- Improving nutritive value and minimizing loss of essential nutrients during processing and preservation.
- Impacting skill for storage and preservation of produce
- Ensuring food safety and preventing food poisoning, contamination or adulteration at household level.
- Responding to the special dietary requirements of children under five years, adolescents and the elderly.
- Sensitizing project participants on the importance of animal proteins in the human diets.
- Introducing proteins, vitamins, minerals and other nutrients that can be derived from goat and poultry rearing.

Optimize the utilization of locally available utensils and equipment for the processing and preservation of crops and animal products.



CHAPTER ONE

1.1.1 An Overview of Nutrition

Every day, several times in a day, one makes food choices that influence the body's health for better or worse. Each day's choices may benefit or harm the health only a little, but when these choices are repeated over years and decades, the rewards or consequences become major. Therefore, wise people think 'nutrition' when making their food choices.

1.1.2 Nutrition

Nutrition is the science that studies the process in which the living organisms take in and make use of food for the production of energy, the functioning of organs and tissues, maintenance of life, growth, reproduction, and elimination of waste products from the body. It includes the relationship between diet, health and disease. Abundance of food does not guarantee good nutrition. Good nutrition involves eating the correct quality, quantity (i.e., adequate), and variety of safe foods to satisfy the body's needs.



1.1.3 Nutrients

When individuals eat foods such as yam, rice, meat, fruits and vegetables, the body can not make use of them in those forms. The food and drink would first be converted into smaller substances which the body can absorb into the blood stream. These substances are called nutrients. **The process of breaking food into smaller substances is called digestion.** Nutrients are needed by the human body for energy, growths, maintenance and repair of body tissues, and regulation of body functions. Food provides the energy for the body's activities such as walking, running, doing housework, breathing, heart beating, digesting of food, etc. There are six broad classes of nutrients, namely; carbohydrates, protein, lipids, water, mineral and vitamins. These are grouped into macronutrients and micronutrients. Macronutrients are the nutrients required by the body in large amounts, including; carbohydrates, protein, water, fats and oil. Micronutrients, on the other hand are those nutrients required by the body in small amounts; minerals and vitamins. **However, all foods contain a mixture of nutrients and except for breastmilk, no single food contains all the nutrients in amounts sufficient to sustain life and promote optimal growth.**



1.1.4 Macronutrients

Carbohydrates, proteins, fats and oil are the only nutrients in foods that provide energy. They are called energy nutrients because of the ability to breakdown and reassemble into a fuel that the body uses to support physical activity and basic functioning. Water is also considered a macronutrient in the sense that the body requires a large quantity of it, but unlike the others, it does not yield energy.

1.1.5 Carbohydrates

Carbohydrates occur in food as sugars and starch, which are the major sources of energy in the diet and as cellulose, the main component of dietary fibre. Good sources of carbohydrates are yam, cassava, rice, potatoes, beans, corn, plantain and others. The only important animal source of carbohydrate is milk, in form of lactose.

Examples of carbohydrates are glucose, fructose and galactose. Glucose is the form of sugar that circulates in the bloodstream. Fructose is the sugar found in fruits and honey and is the sweetest of all the sugars. Glucose is bound to galactose to form the sugar found in the milk. The liver converts fructose and galactose to glucose.



BREAD



CASSAVA



YAM

1.1.6 Importance of Carbohydrates

- i. Carbohydrates are considered the ideal energy source (fuel) for most bodily functions. The brain and other tissues of the central nervous system can only use glucose (sugar) for their energy supply.
- ii. A diet rich in fibre (cellulose) may possibly reduce the risk of colon cancer, obesity, heart diseases, type 2 diabetes and prevent constipation.
- iii. Lactose encourages the growth of favourable intestinal bacteria. It has laxative properties and enhances the absorption of calcium.
- iv. Adequate glycogen storage in the liver enhances normal liver detoxification ability.

1.1.7 Proteins

Proteins are large complex molecules found in the cells of all living things. This nutrient provides the amino acids used to build and repair body tissues such as muscle and bone. They also produce and maintain enzymes, antibodies, hormones, white and red blood cells. Body cells are constantly being worn down and must be replaced. For example, the cells lining the intestine are being replaced every week. Protein can also serve as a source of energy when the body does not get enough carbohydrates and fats for energy. But extra calories of energy from protein not used will be stored as body fats.

Amino acids are the building blocks of all proteins. When one eats food containing protein, the body breaks it down into amino acids and then reassembles these building blocks to make new proteins it needs. The human body needs 20 different amino acids to make proteins. The human body can make 11 of these amino acids, but the other 9 need to come from foods. The 9 amino acids are the ones called essential amino acids.

Both animals and plants are sources of proteins. Food sources of animal protein include beef, milk, fish, poultry, eggs, yoghurt, lamb, goat etc. **All animal proteins provide the 9 essential amino acids in sufficient amount to meet a person's needs. So, they are known as complete proteins and are of high quality.**

Food sources of plant proteins include cereals (wheat, rice corn, millet, etc), legumes (dry beans and peas). Proteins from plant sources are low in essential amino acids. **Combination of these plant foods helps to improve the overall quality of the proteins in such foods. They form complementary proteins.**



1.1.8 Importance of Proteins

- i Building, maintenance, and repair of all body cells.
- ii Important part of the red and white blood cells and help in blood clotting. Red blood cells are being replaced every three months.
- iii Enzymes influence the rate (speed) of chemical reactions in the body; there are specific digestive enzymes that break down food into smaller components that make nutrients available for absorption.
- iv Antibodies fight infections.
- v Hormones serve as messengers that act on some organs to maintain constant conditions within the body; for example, when the pancreas detects that there is a high level of sugar in the blood, it releases a hormone called insulin. Insulin makes sure the excess sugar are removed from the blood and stored away until required.
- vi Protein can serve as a source of energy when the body does not get enough of carbohydrates and fats for energy.

1.1.9 Fats

Fats provide energy in a more concentrated form than carbohydrates. An excess of daily intake of carbohydrates also results in its conversion and storage as fat on the fatty tissue. **Hence, overweight persons should not only avoid an intake of fat but also an excessive daily carbohydrates intake.** The stored fat is mobilized to produce energy but this process of energy liberation is slow.

Liquid fats are called oils, e.g. soybean oil, olive oil, palm oil, groundnut oil, etc. These are mainly of plant origin (vegetable oils). Fats contain essential and non-essential fatty acids. **Essential fatty acids are those that cannot be synthesized by the body and need to be supplied through diet, e.g. linoleic and arachidonic acids.**

Essential fatty acids are the units of fats and are required for growth, reproduction as well as brain function. Fats are classified as saturated (e.g. cheese, whole milk, butter, ice cream, skin and fat of poultry) and unsaturated (e.g. vegetable oils, olive, soybean, groundnut etc, and fish oil, salmon, mackerel, contain omega-3 fatty acids) depending on the chemical structure.



Palm oil and Groundnut oil



Cow Fats (Mai-Shanu)

1.1.10 Importance of Fats

- i. Fat supplies heat. One gramme of fat supplies about nine calories. Tissues, except those of the central nervous system and the brain, can utilize fat as source of energy in the presence of oxygen.
- ii. Subcutaneous fat (fat under the skin) acts as an insulation and helps in retaining body heat.
- iii. Fat provides padding around the vital organs. It holds them in place and helps them to absorb the shock of physical blows.
- iv. Fat is the carrier of the fat-soluble vitamins A, D, E, and K.
- v. The essential fatty acids are needed for the following functions:
 - (a) maintenance and integrity of the cellular membranes
 - (b) regulation of cholesterol metabolism by transporting it between the blood and the body tissues.
 - (c) Act as precursors of an important group of hormone-like compounds prostaglandins.
 - (d) Delay blood clotting time.
- e. Fats have sparing action on vitamin B, that is, if fat consumption is adequate, not much of vitamin B, is needed.
- f. Fat slows down the secretion of hydrochloric acid, muscle contractions and the rate of digestion. A fatty meal stays for a longer time in the stomach and prevents the feeling of hunger. This prevention of hunger is called the 'satiety value' of fats
- g. Fats add flavour to many foods.

1.1.11 Water

Water provides the medium in which most chemical reactions take place in the body. It provides body fluid for nutrient distribution, waste elimination and participates fully in body temperature regulation. Best dietary sources of water are purified water, milk and fruits. For babies from birth to six months of age, breastmilk is the best source of water.



1.1.12 Micronutrients

These are nutrients the body needs in relatively small amount (micro- means 'small') to support normal health and body functions. Vitamins and minerals are micronutrients.

1.1.13 Vitamins

Vitamins are compounds that contain the substance carbon and assist in regulating the processes of the body. For example, vitamins play critical roles in building and maintaining healthy bone, blood, vision and muscle tissue, supporting the immune system to help the body fight illness and disease.

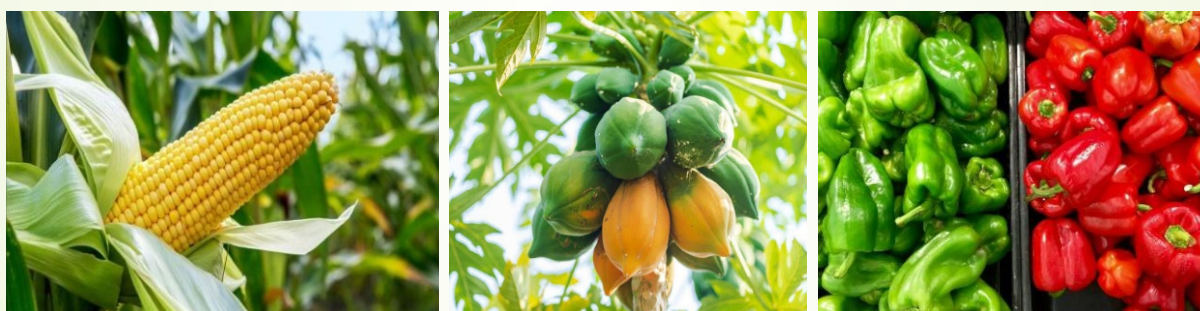
Vitamins do not provide energy but do play an important role in assisting our bodies with releasing and using the energy found in carbohydrates, fats and proteins.

A vitamin's ability to dissolve in water versus fat affects how it is absorbed, transported, stored, and excreted from the body. Thus, they are classified into water soluble and fat soluble.

1.1.14 Two of Vitamins:

Type	Names	Characteristics
Fat soluble	A, D, E, and K	Soluble in fat/oil * Stored in the human body * Toxicity can occur from consuming excess amounts, which accumulate in the body
Water soluble	C, B vitamins (thiamin, riboflavin, niacin, vitamin B6, vitamin B12, pantothenic acid, biotin, and folate.	Soluble in water Not stored to any extent in the human body Excess excreted in urine Toxicity generally only occurs as a result of vitamin supplementation

For the fact that our bodies cannot synthesize most vitamins, we must consume them in our diets. Both water soluble and fat-soluble vitamins are essential for our health and are found in a variety of foods, from animal products, nuts and seeds to fruits and vegetables. Many vitamins break down upon prolonged exposure to heat and/or light



Importance of Vitamins

- i. Vitamin A is required for ability of eye to adjust to change in light. It assists cell differentiation, healthy bone and cognitive (brain) development, and fights against infection.
- ii. Vitamin C acts as an antioxidant in extracellular fluids and lungs, assists in hormones, neurotransmitters, DNA and collagen synthesis. It also enhances immune function.
- iii. Vitamin D regulates blood calcium levels and maintains bone health.
- iv. Vitamin E protects cell membrane and vitamin A from oxidation.
- v. Vitamin K helps in the production of protein that assist in blood coagulation.
- iv. Vitamin B1 and B2 (Thiamin and Riboflavin) required as cofactor in metabolism of carbohydrates and amino acids.

Dietary sources of vitamins include green leafy vegetables, fruits, fish, seafood, meat, milk, egg, fortified cereals, nuts and legumes, orange-fleshed sweet potato.

1.1.16 Minerals

Minerals are solid crystalline substances that do not contain carbon and are not broken-down during digestion. One of the most important properties of minerals is their ability to carry an electrical charge. Like magnets, minerals with opposite electrical charges bond tightly together to form durable compounds, for instance in our bones. The electrical charge of minerals also attracts water, so the minerals inside our cells help them retain the amount of water they need to function.

Major minerals are required in amounts greater than 100mg per day. These include calcium, sodium, potassium, phosphorus, magnesium, Sulphur, and chloride. The total amount of each present in the body is at least 5g (5,000 mg).

Trace minerals are required in amounts less than 100 mg per day. These include selenium, fluoride, iodine, chromium, manganese, iron, zinc and copper. The total amount of any trace mineral in the body is less than 5 mg (or 5,000 mg).



1.1.17 Importance of Minerals:

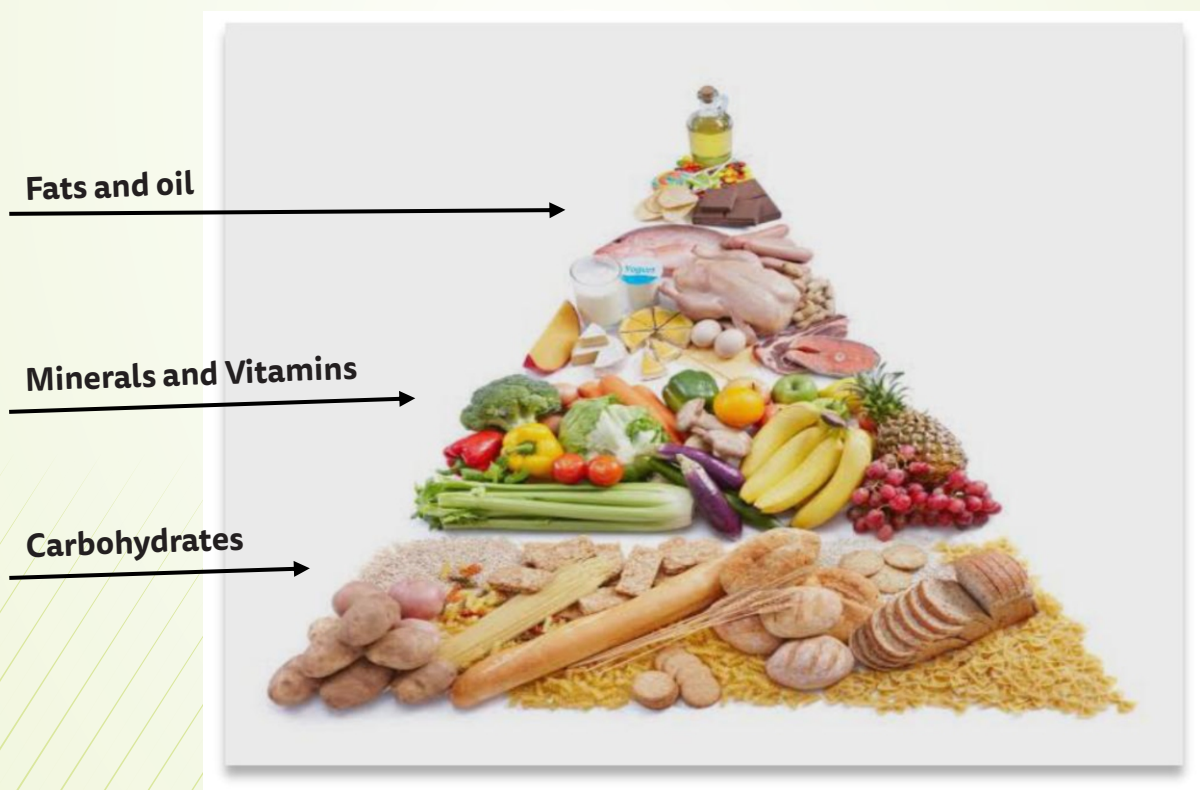
- i. **Essential electrolytes:** Sodium, Potassium, Chloride, and Phosphorus. The interior of body cells contains fluid. These minerals exist in the fluids to form electrolytes. The electrolytes carry electrical current. The electricity is the 'spark' that stimulates nerves to transmit messages and cause muscles to contract or relax. Serious electrolyte disturbance can impair electrical stimulation leading to cardiac arrest.
- ii. **Mineral Power Plants:** Chromium, Manganese, Sulphur, Iodine, and selenium. These minerals help our bodies use the nutrient in foods by assisting their transport into cells, e.g. chromium. Some help enzymes that break down foods to release energy, while others assist the production of hormones that regulate metabolic processes, e.g. iodine in synthesis of thyroid hormones
- iii. **The Blood Fortifiers:** Iron, Zinc, and Copper. Without healthy blood to transport nutrients and oxygen to our cells and to remove cellular waste, we could not survive. The nutrients recognized as playing critical roles in maintaining blood health include vitamin K, iron, zinc and copper. Iron is present in every blood cell. Iron deficiency is the most common nutrient deficiency in the world. It results in iron-deficiency anaemia. Zinc assists the work of approximately 100

different enzymes involved in many different tasks including metabolism, the production of haemoglobin, and the activation of vitamin A in the retina of the eye.

- iv. The Bone Builders:** Calcium, Phosphorus, Magnesium, and Fluoride. Our skeleton is not an inactive collection of bones that simply holds the body together. Bones are living organs that contain several tissues including nerves cartilage and connective tissue, with blood vessels supplying vital nutrients. Bones provide support and attachments for muscular movement, and they protect most vulnerable tissues. Calcium is the most abundant of all the major minerals in the body and 99% of it are in the bones. Phosphorus contributes to the hardness of the bones. It is part of the energy molecule, ATP (adenosine triphosphate). Fluoride combines with calcium and phosphorus to form teeth.

Minerals are widely distributed in foods which include green leafy vegetables, fruits, poultry, fortified cereals, beans, nuts, seeds, mushroom.




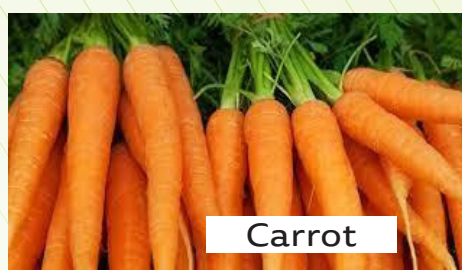





1.1.18 Pyramid of Healthful Diet











1.1.19 SUMMARY

1. Table of Nutrients

S/N	NUTRIENTS	FOOD SOURCES	
1.	Carbohydrate	 <p>Yam</p>  <p>Bread</p>  <p>Maize</p>  <p>Cocoyam</p>	
2.	Protein	 <p>Milk</p>  <p>Egg</p>  <p>Goat</p>  <p>Chicken</p>	
3.	Fat & Oil (Lipids)	 <p>Palm oil</p>  <p>Yoghurt</p>  <p>Vegetable Oil</p>	

4.	Vitamin A	   
5.	Vitamin B	 
6.	Vitamin C	  

7.	Vitamin D	 
8.	Vitamin K	  
9.	Vitamin D	  

1.2. Healthy living is associated with good nutrition and active lifestyle. Healthful diet is key to healthy living. A healthful diet provides the proper combination of energy and nutrients. It has five characteristics: it is adequate, moderate, balanced, varied, and safe.

1.2.1 A Healthful Diet Is Adequate

An adequate diet provides enough of energy, nutrients, and fibre to maintain a person's health. A diet may be inadequate in many areas or only one. For example, many people

do not eat enough vegetables and therefore are not consuming enough of many of the important nutrients found in vegetables, such as fibre-rich carbohydrates, vitamin C, beta- carotene (precursor of vitamin A), and potassium. Other people may eat only plant-based foods. Unless they supplement or use fortified foods, their diets will be inadequate in a single nutrient, vitamin B12.

However, a diet which is adequate for one person may not be adequate for another who is more active.



Meats and Vegetables



Adequately Fed Children

1.2.2 A Healthful Diet Is Moderate

Moderation refers to eating the right amount of foods to maintain a healthy weight to optimize the functioning of our bodies. People who eat too much or too little of certain foods may not be able to reach their health goals. Taking three bottles of soft drink a day may add extra 765 kcal of energy to person's diet. This reduces their food intake thereby cutting out healthful food choices. Consuming soft drinks in moderation keeps more energy available for nourishing foods.



Meat and fish



Vegetable Soup




1.2.3 A Healthful Diet is varied





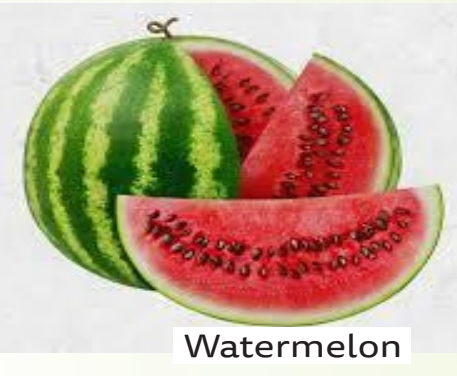



Variety refers to eating a lot of different foods each day. There are different food groups available that are identified with different nutrient classes. By eating new foods on a regular basis, we optimize our chances of consuming the multitude of nutrients our bodies need. This also avoids boredom.














Food groups: Carrot, Orange. Sweet Fleshed Potatoes

2. Table of Food Groups

S/N	NUTRIENTS	FOOD SOURCES
1.	Carbohydrate	 <p>Grains</p>
2.	Roots and Tubers	 <p>Yam</p>  <p>Cassava</p>

3.	Pulses/Legumes	 
4.	Nuts and seeds Seeds	 
5.	Vegetables	 
6.	Fruits	  
7.	Meat and Poultry	 

8.	Fish and Seafood	 <p>Fish</p>  <p>Seafoods</p>
9.	Eggs	 <p>Eggs</p> 
10.	Milk and Milk Products	 <p>Milk</p>   <p>Awara (Cheese)</p>
11.	Oils/Fats	 <p>Vegetable oil</p>  <p>Butter</p>
12.	Sugar, Honey, and Miscellaneous	 <p>Sugar</p>  <p>Honey</p>

1.2.4 A Healthful Diet Is Safe

Hygiene is the absence of disease-causing germs in the food as a result of poor handling or improper cooking, or serving process. Washing of hands, utensils and every container used in serving are key in ensuring food safety.

1.2.5 Aim for a Healthy Weight

Being overweight or obese increases our risk for many chronic diseases, including heart disease, type 2 diabetes, stroke, and some forms of cancer. Evaluating your weight includes calculating your body mass index, which is a ratio of your weight to your height.



Overweight

1.2.6 Be Physically Active Each Day

Engaging in at least 30 minutes of moderate physical activity most days of the week can reduce the risk of chronic diseases. The physical activity includes walking, riding a bike, heavy yard work or housework, and even those that build strength.

1.2.7 Limit Fats, Salt, Sugar

Fat is an important part of a healthful diet, as it provides energy and important nutrients. However, eating a diet high in total fat can lead to overweight and obesity as well as increasing the risk of cancer. **Limit the intake of solid fat such as butter, margarine, 'mai-shanu'. Foods high in sugar promote tooth decay and can contribute significantly to overweight and obesity when taken in excess. Salt contains sodium, a mineral linked to high blood pressure in some people. Eating high amounts of salt leads to loss of calcium from the bones thereby increasing the risk of bone fracture.**

1.2.8 Keep Food Safe to Eat

A healthful diet is one that is safe from food-borne illnesses such as those caused by bacteria, viruses, and other toxins. One of the most important ways to prevent food-borne illness is to wash your hands and kitchen surfaces thoroughly with warm water and detergent before preparing food and after handling raw meats, fish, and eggs.

2 Biofortified Crops

Biofortification is the process of breeding food crops that are rich in micronutrients. This is an agricultural intervention meant to increase the nutritional content of the crop using conventional plant breeding, biotechnology, or mineral fertilization, with the ultimate aim of reducing micronutrient deficiencies.

The most common micronutrient deficiencies include vitamin A, iron, and zinc. In Nigeria, three biofortified crops have been released and they include provitamin A cassava, orange flesh sweet potato (OFSP) and yellow maize (Vit A maize).



Orange Sweet Fleshed Potatoes



Vitamin A Maize

2.1 FOOD SAFETY, QUALITY AND HYGIENE

Traditionally, quality control system is based on the inspection of a product at various points within a process, and rejection of any product that did not meet agreed standard. A more proactive prevention approach to food safety and quality management termed "Quality Assurance" is developed to avert finished product rejection and wastages. Quality assurance requires an effective food monitoring and control system to control resources and ensures the safe, high quality products are consistently manufacture.

2.2 HOW TO DETECT CONTAMINATION AND SAFE GUARDS.

- ▶ Contamination or fresh or processed food can be detected via good manufacturing practices (GMP) using standard operating procedures (SOP)s.
- ▶ These SOPs starts with hnadling, sorting, grading and transportation
- ▶ Similarly, contamination can be detected by subjective and objective sensory evaluation of fresh and processed food products.
- ▶ Contamination can also be ascertained by chemical and microbiological assignment

The above bullet points do no answer how. No safeguards mentioned.

Take for instance, contamination could be detected in OFSP by change in color in a portion of the root, smelling rottened roots, blackish sport on the roots, etc. Contamination could be as a result of the presence of foreign objects in meats, offensive odour, etc. Safeguard could be inform of processing promptly when there are no refrigeration. I guess all resource persons should be involved in the 2.1 and 2.2 of Nutrition Overview in Chapter of our outline. Please submit your input to the secretariat as soon as possible.

3.0. Unit Operations in Food Processing

Food processing is the transformation of agricultural products into food, or of one form of food into other forms. Food processing includes grinding grains to make raw flour, home cooking etc. It contributes greatly to food availability, diversification, reduction of malnutrition and improving food security.

3.1 Common Unit Operations

Harvesting

During the period of growth and maturation changes begin to show in colour, texture and flavour. Harvesting is timed so as to capture the peak qualities in vegetables. Freshly harvested vegetables have the desired plumpness, succulence, crispness attributed to a high degree of turgor. After harvest, the vegetables lose their peak quality quickly depending on post-harvest practice of storing and further processing. Harvested vegetables lose water due to transpiration, respiration and physical drying resulting in loss of weight, and wilting of the leaves. Therefore, cooling of vegetables by cold water spray soon after their harvest slows down the degradative changes in vegetables.

3.2 There are a few simple steps that can be taken to cool the produce after harvest;

- ▶ Pick the fruits from the tree early in the morning.
- ▶ Keep the produce in the shade.
- ▶ Spread the fruit out to allow heat to escape (piling the fruit in large heaps does not allow the heat to escape).



Maize



Cassava



Harvesting of Cow

3.3 Cleaning

Foods by the nature of the way they are grown or produced on farms in open environments often require cleaning before use. The cleaning methods are classified into two groups, namely (a) dry cleaning methods which include screening, brushing, aspiration, or winnowing, abrasion and magnetic separation and (b) wet cleaning methods which include soaking, spraying, fluming, floating, ultrasonic cleaning, filtration and settling. The dry-cleaning methods are relatively cheap and convenient as the cleaned surface is dry. However, a major drawback is the spread of dust which can re-contaminate cleaned raw materials. Remedial measures include dust-proofing of equipment and rigorous house-keeping. Wet cleaning has the advantage of removing firmly adherent soils and allowing the use of detergents and sanitizers but has the disadvantage of wet surfaces of foods spoiling more rapidly.



Wet Cleaning of Tomatoes

3.4 Separating or Sorting

The unit operation of separating can involve separating a solid from solid, as in the peeling of potatoes or the shelling of nuts, separating a solid from a liquid, as in many times of filtration, or a liquid from a solid, as in pressing juice from a fruit. It might involve the separation of a liquid from a liquid as in removing oil from water. Separation is based on the differences in physical properties of the food raw materials or products. Sorting methods include weight sorting, size sorting, shape sorting and photometric sorting. Meat cuts, fish fillets, fruits such as apples pears and citrus fruits, vegetables such as potatoes, carrots and onions and eggs are sorted by weight. One of the commonest separating methods is the hand sorting and grading of individual units in vegetables and fruits. **Fruit and vegetables should be sorted to remove objects such as leaves, stones and sticks.** Any immature fruit should be removed and set aside to ripen - some fruit species will ripen after harvest, while others will not. **Diseased, damaged and over-ripe fruits must be sorted out and removed as these can infect the other fruit.**



Sorting of Tomatoes

3.5 Heating

We heat foods for many different reasons. Many foods are heated to destroy microorganisms and preserve the foods, for example, during pasteurization of milk and canning of vegetables. Others are heated to drive off moisture and develop flavours, as during normal cooking to make them more tender and palatable. Some food

ingredients, such as soybean meal, are heated to inactivate natural toxic substances.

3.6 Heating kills bacteria and stops enzyme activity.

There are several methods of heating:

i. Boiling. such as when making jam and sauce. Concentration by boiling (eg jams and sugar confectionery) use higher temperatures (105-120°C) and longer heating times to destroy nearly all the micro-organisms in a food. It also reduces the moisture content of the food.



Boiling of Maize

ii. Blanching. Pieces of vegetable are put in water at above 90°C for several minutes. This kills the bacteria on the surface of the vegetable and stops any enzyme activity.



Blanching of Ugwu

iii. Pasteurization. Pasteurization uses temperatures lower than that of boiling water and so preserves the taste, colour and nutritive value of the product. Pasteurization extends the storage life of bottled fruits and juices, as well as sauces and purees, by several months.



Pasteurization of Milk

At the small-scale, it is best to pasteurize fruit juices, sauces and pickles in their containers after packaging. This is the best method as there is no risk of contamination after the process. The time and temperature needed for pasteurization depends on the size of the container and the acidity of the product

Most foods are sensitive to heat, and prolonged heating causes burned flavours, dark colours, and loss of nutritional value. Microorganisms are more sensitive to rapid heating than are to chemical reactions. Rapid heating can, therefore, destroy microorganisms faster than it causes undesirable chemical reactions. **Hence, it is desirable to heat and cool foods quickly to maintain optimal quality.**

3.7 Drying

In drying the objective is to remove water with minimum damage to the food. It takes food very close to total dryness – in many cases less than 2% or 3% water. Foods are dried to preserve them from spoilage and to reduce the weight and bulk, some foods are dried as convenience items and for their novelty appeal; Methods drying include (a) sun drying, (b) Drying by mechanical driers, and (c) freeze-drying. Sun drying is limited to certain fruits, such as dates, pears and vegetables such as okra, kuka and salted fish and kilishi. They are spread on trays and are turned on their sides during drying. Drying by mechanical driers includes the method of drying (a) by heated air, (b) by direct contact with a heated surface and (c) by the application of energy from radiating microwave. In freeze-drying, the moisture in the food is frozen and then sublimed to vapour, usually by the application of heat under very low-pressure conditions.



Drying Tomatoes



Dried Tomatoes

3.8 Materials Handling

During and after harvest, fruit and vegetables need to be handled carefully to prevent damage to the flesh. Juicy fruits such as berries damage more easily than the harder root vegetables. Bruised and cut fruits are more susceptible to bacterial damage as cuts in the flesh allow bacteria to enter the fruit and spoil the fleshy material.

Materials handling includes such varied operations as hand and mechanical harvesting on the farm, refrigeration of perishable produce, transportation of live sheep and goats, conveying grains to storage barns. Throughout such operations emphasis must be given to maintaining sanitary conditions; minimizing product losses including weight loss of livestock, maintaining raw material quality (e.g. vitamin content and physical appearance), minimizing bacterial and fungal growth, timing transfers of all deliveries so as to minimize hold-ups which can be detrimental to product quality.



Transportation of Tomatoes

3.9 Packaging

Packaging eliminates physical contact between the food and the contaminants. It varies depending on the nature and type of food, the expected shelf life of preserved food, the nature of the function(s) of the package and the visual characteristics of the packaging material. It is to protect food from microbial contamination, physical dirt, insect invasion, light, moisture pick-up, and flavour pick-up. Food is packaged for other purposes, including containment for sale, dispensing, and unitizing into appropriate sizes, and improving the usefulness of the product. Paper, paper cartons, plastics in the form of films, sheets, bags, containers, bottles, glass and metals in the form of foils and cans are used as packaging materials.

Fruit or vegetables should be carefully packed into baskets, trays or crates for transporting to the processing site. The more fragile fruits need to be packed in single layers to prevent crushing those at the bottom. It is advisable to sort fruits and vegetable by size, and package those of similar size together, for optimal use of space and to protect smaller produce from being damaged by larger and heavier produce.



Fruit Drinks

3.10 Fruit Packages

Avoid packaging too many fruits or vegetables in one container, to prevent crushing and bruising of the produce. But avoid packaging too few fruits and vegetables into containers, to prevent the produce from moving around and becoming damaged during transport. Also, packaging too few produce together leads to loss of space and thus increased transport costs.

CHAPTER TWO

PROCESSING, UTILIZATION AND STORAGE OF BIOFORTIFIED CROPS: ORANGE-FLESHED SWEET POTATO (OFSP) AND VITAMIN A MAIZE

1.1 INTRODUCTION:

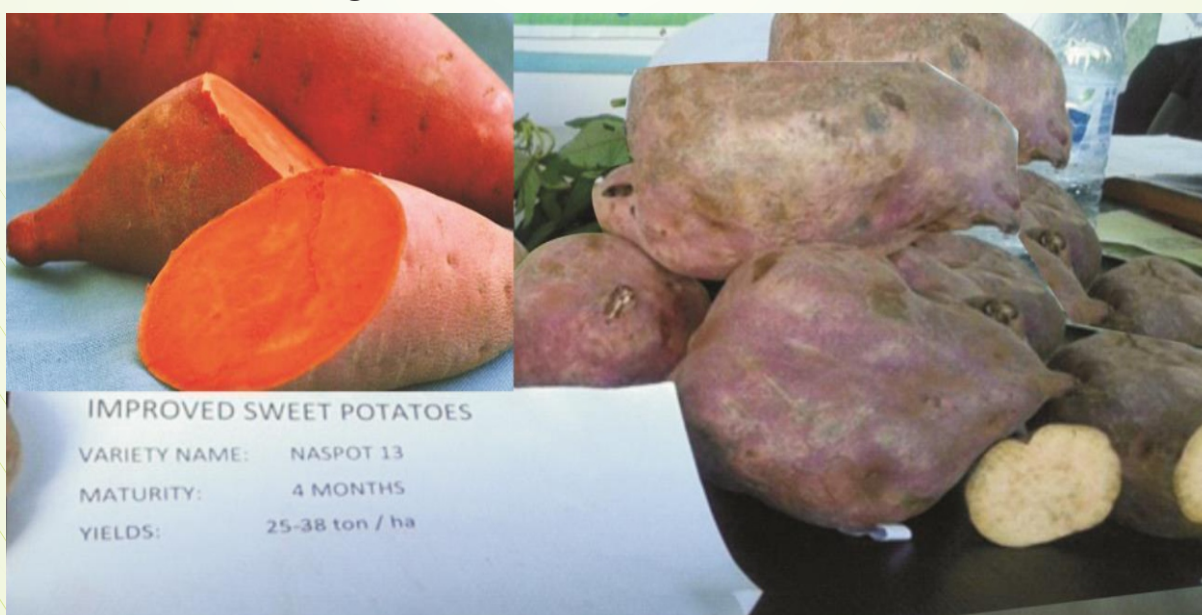
In this module, the Master Trainers will have good knowledge of recipes and food products from Orange-Fleshed Sweet Potato (OFSP) and Vitamin A maize.

The trainees will among others, know:

- ▶ proper handling of the crops to ensure enhanced shelf life during harvesting, preservation, storage and utilization.
- ▶ Food products from Orange-Fleshed Sweet Potato and pro- Vitamin A maize that meet local tastes and food customs in the local communities growing the crops.
- ▶ Different food menu combination for Orange-fleshed sweetpotato and pro-Vitamin A maize;



Orange-Fleshed Sweet Potato - rich in Vitamin A



Orange-Fleshed Sweetpotato (OFSP) -Vitamin A rich Sweetpotato

1.2 NAME OF MAIZE IN SOME NIGERIAN LOCAL LANGUAGES

HAUSA: MASARA

YORUBA: AGBADO

IBO: OKA

IDOMA: IGBANKPA



Maize cob is ready for harvesting to be boiled or roasted for consumption when the silk (hair – like) part of the cob turns to brown.



The appropriate time for harvesting maize in the field is when 80-90 percent of the leaves are dry. This is to ensure that crop is dry enough for storage.



2.1 STEP BY STEP PROCEDURE FOR BOILED OFSP FOR HOUSEHOLD OF FIVE

Ingredients	Measures	Weight (h/ml)
OFSP Root	3 medium size	500
Salt	1/2 teaspoon	3g
Water	1 1/2 milk cup	255



Please note: OFSP cooks fast and does not need much water other it will be too soft

2.2 STEP BY STEP PROCEDURE FOR ROASTED OFSP FOR A HOUSEHOLD OF FIVE

Ingredients
OFSP Root

Measures
3 medium size

Weight (h/ml)
500



2.3 STEP BY STEP PROCEDURE FOR FRIED OFSP FOR A HOUSEHOLD OF FIVE

Ingredients

OFSP Root
Salt
Vegetable Oil

Measures

3 medium size
1/2 teaspoon
for deep frying

Weight (h/ml)

500
3g



2.4 STEP BY STEP PROCEDURE FOR OFSP FRIES/CHIPS FOR A HOUSEHOLD OF FIVE

Ingredients

OFSP Root
Salt
Vegetable Oil

Measures

3 medium size
1/2 teaspoon
for deep frying

Weight (h/ml)

500
3g

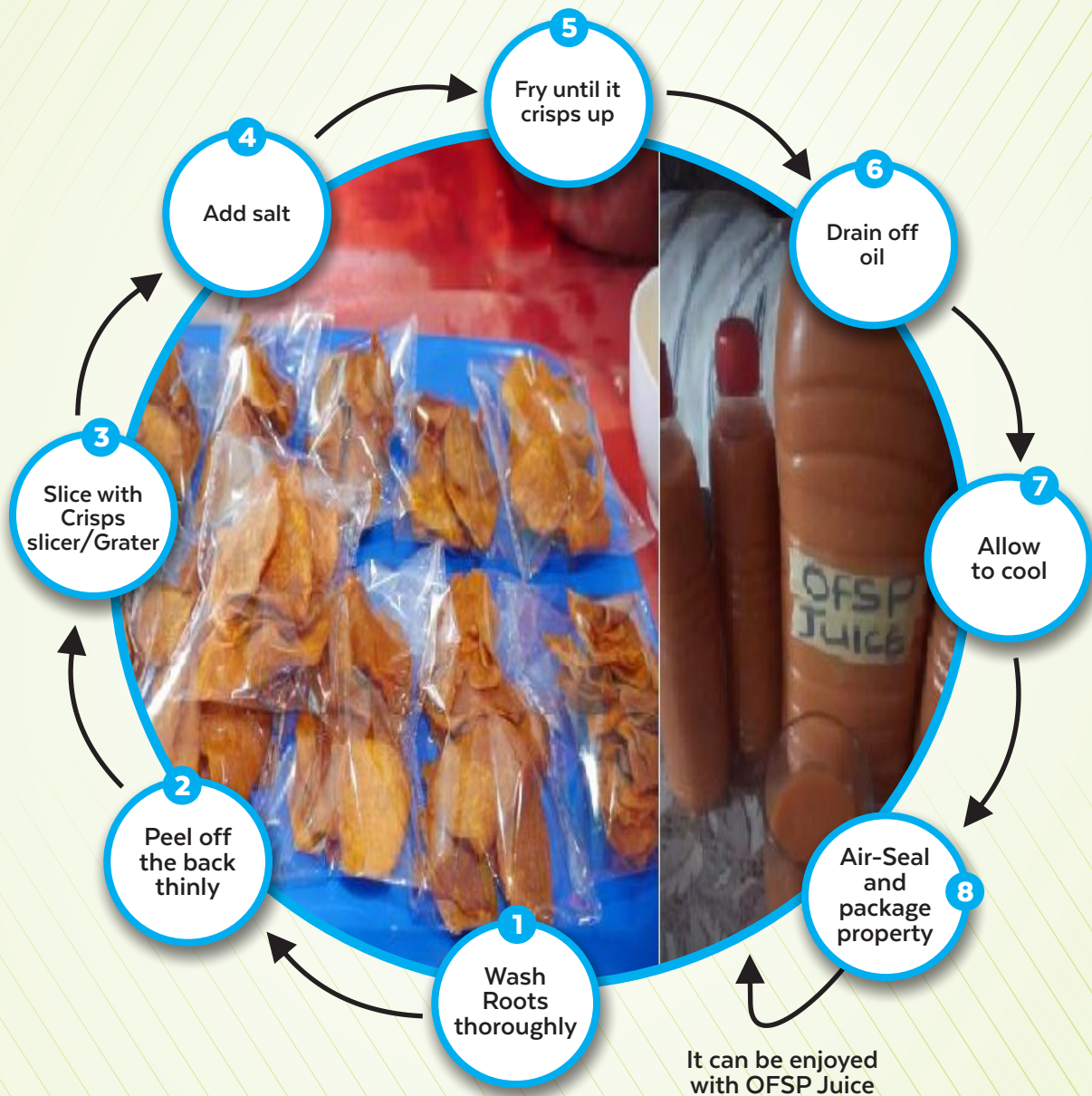


2.5 STEP BY STEP PROCEDURE FOR ROASTED OFSP FOR A HOUSEHOLD OF FIVE

Ingredients
OFSP Root

Measures
3 medium size

Weight (h/ml)
500



Note: If packaging is faulty and air enters, it loses its crispiness.

2.6 MASHED OFSP/PUREE AS COMPOSITE FOR WHEAT FLOUR

Ingredients

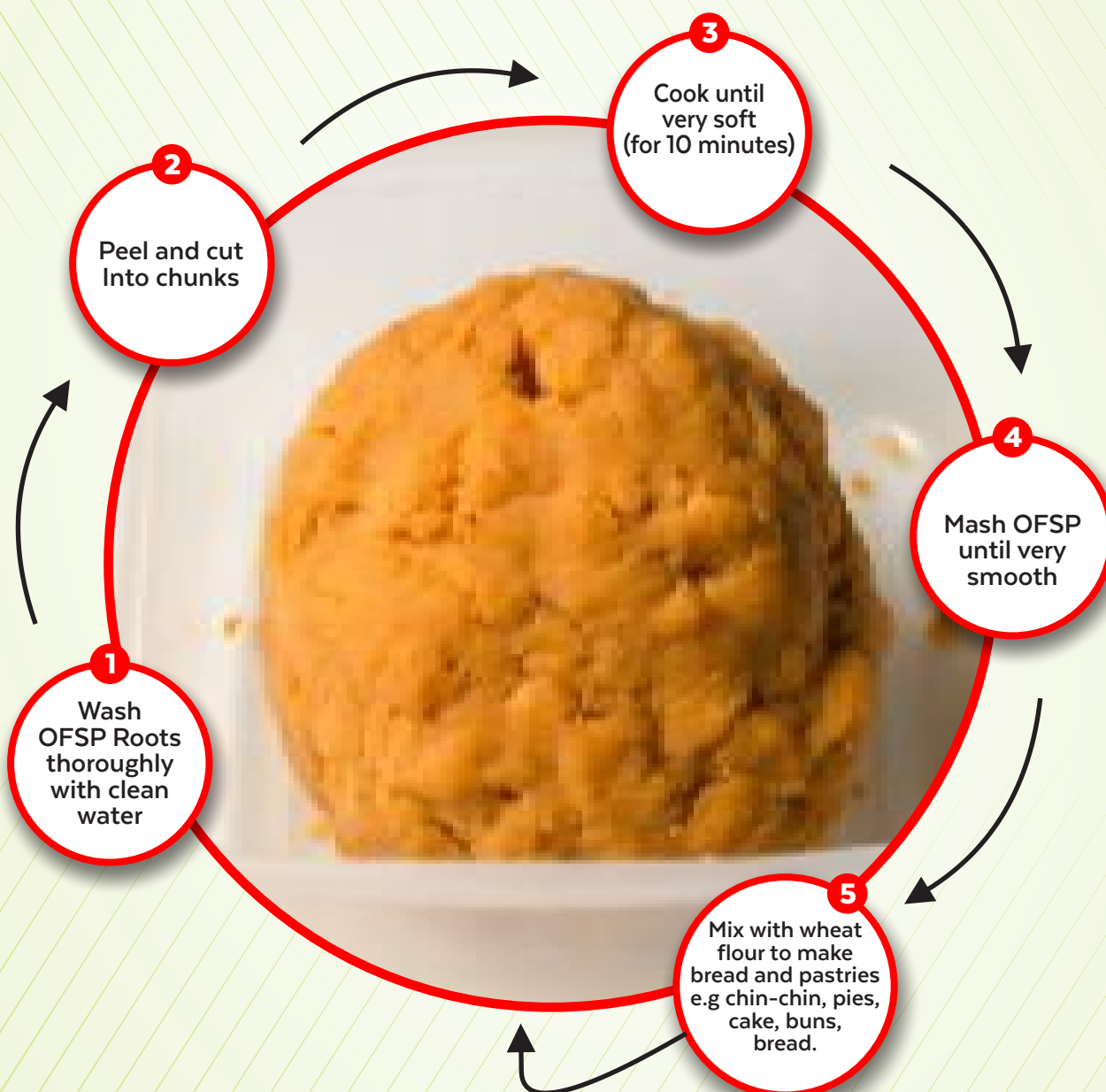
OFSP Root
Water

Measures

3 medium size
1 ½ milk cup

Weight (h/ml)

500
255



Please Note: With mashed OFSP, the pro vitamin A is protected and retained better than using OFSP flour

2.7 STEP BY STEP PROCEDURE FOR OFSP BREAD

Ingredients

Mashed OFSP/Puree

Wheat Flour

Yeast

Sugar

Salt

Lukewarm water or Liquid Milk

Adequate Oil

Measures

1/2 Cup

2 Cups

1 Teaspoon

1 Tablespoon

Small pinch

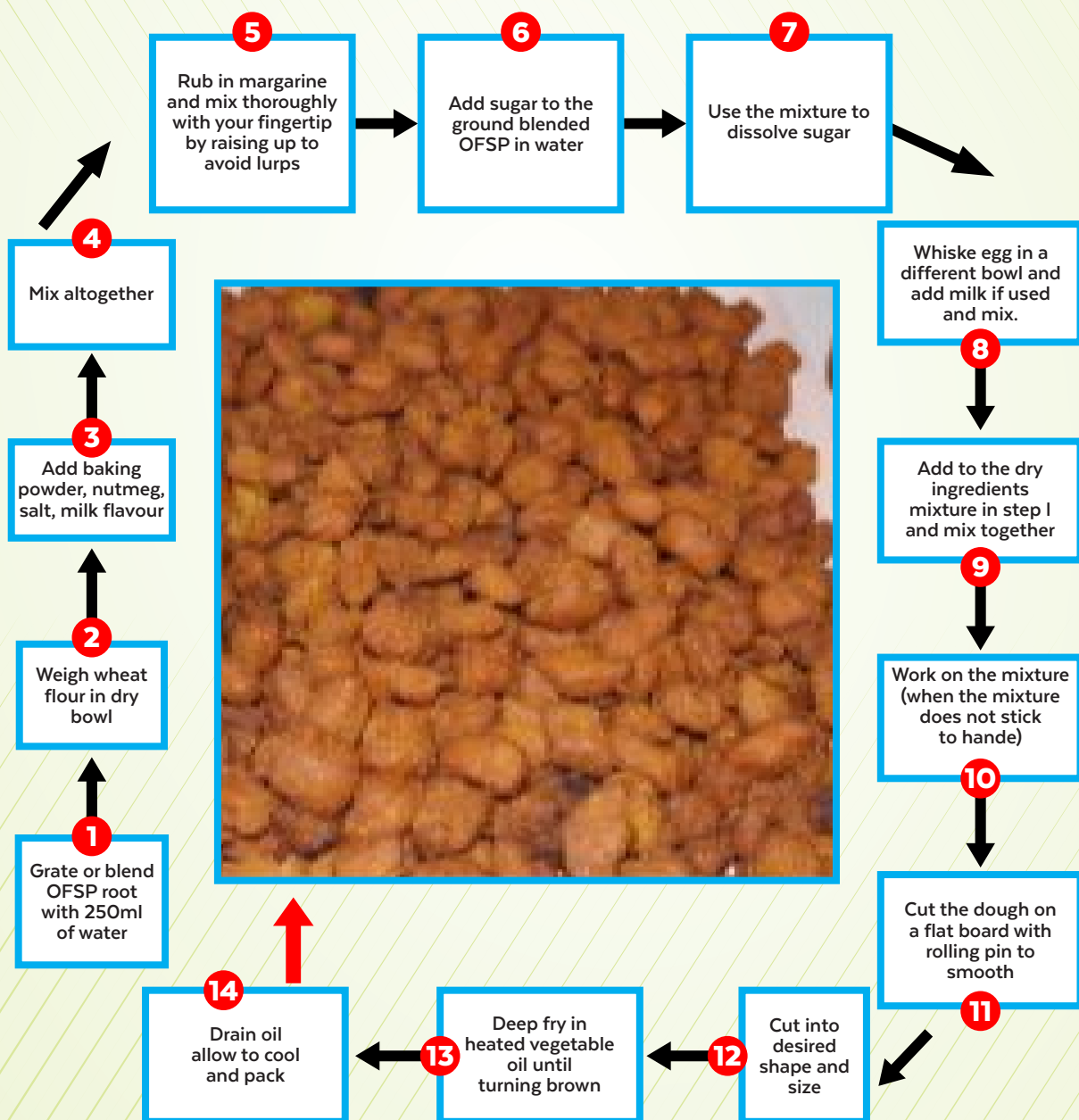
2 Tablespoons



Note: If packaging is faulty and air enters, it loses its crispiness.

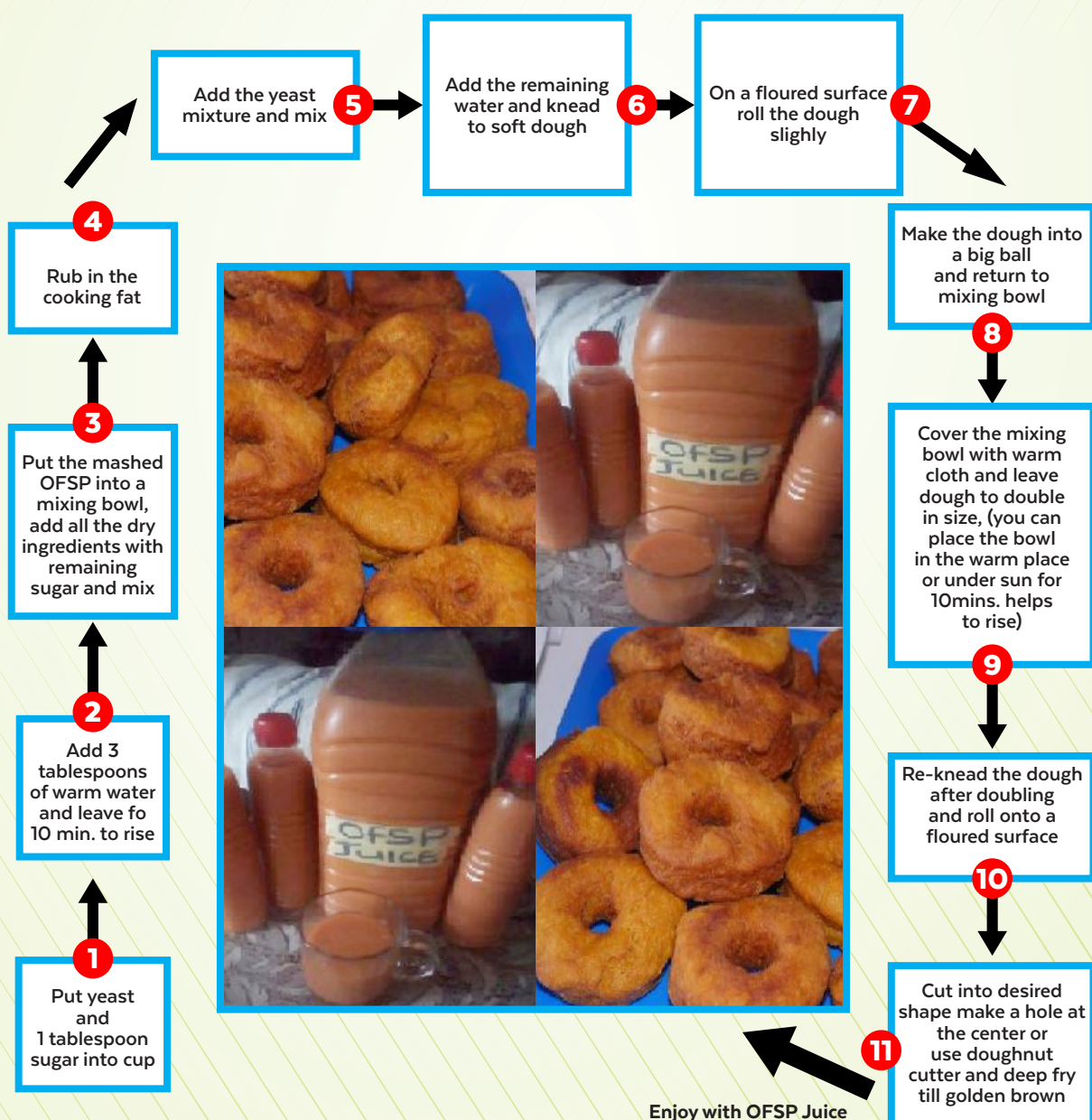
2.8 STEP BY STEP PROCEDURE FOR OFSP CHIN-CHIN

Ingredients	Measures	Weight (g)
OFSP Root	7 big spoon	2200
Wheat Flour	10 milk tins	1000
Margarine	1 ½ milk tins	250
Baking Powder	1 teaspoon full	5
Salt	1 teaspoon	5
Sugar	2 milk tins	290
Egg	1 big size	75
Vegetable Oil	for deep frying	



2.9 STEP BY STEP PROCEDURE FOR OFSP DOUGHNUTS FOR A HOUSEHOLD OF FIVE

Ingredients	Measures	Weight (g)
Mashed OFSP	1 milk cup	165
Wheat Flour	2 milk cups	240
Yeast	1 teaspoon	5
Sugar	½ milk tin	40
Salt	A pinch	
Cooking Fat	2 tablespoons	20
Water, Luke warm	½ milk cup	85
Oil	for deep frying	
Optional		
Egg	1 medium size	60

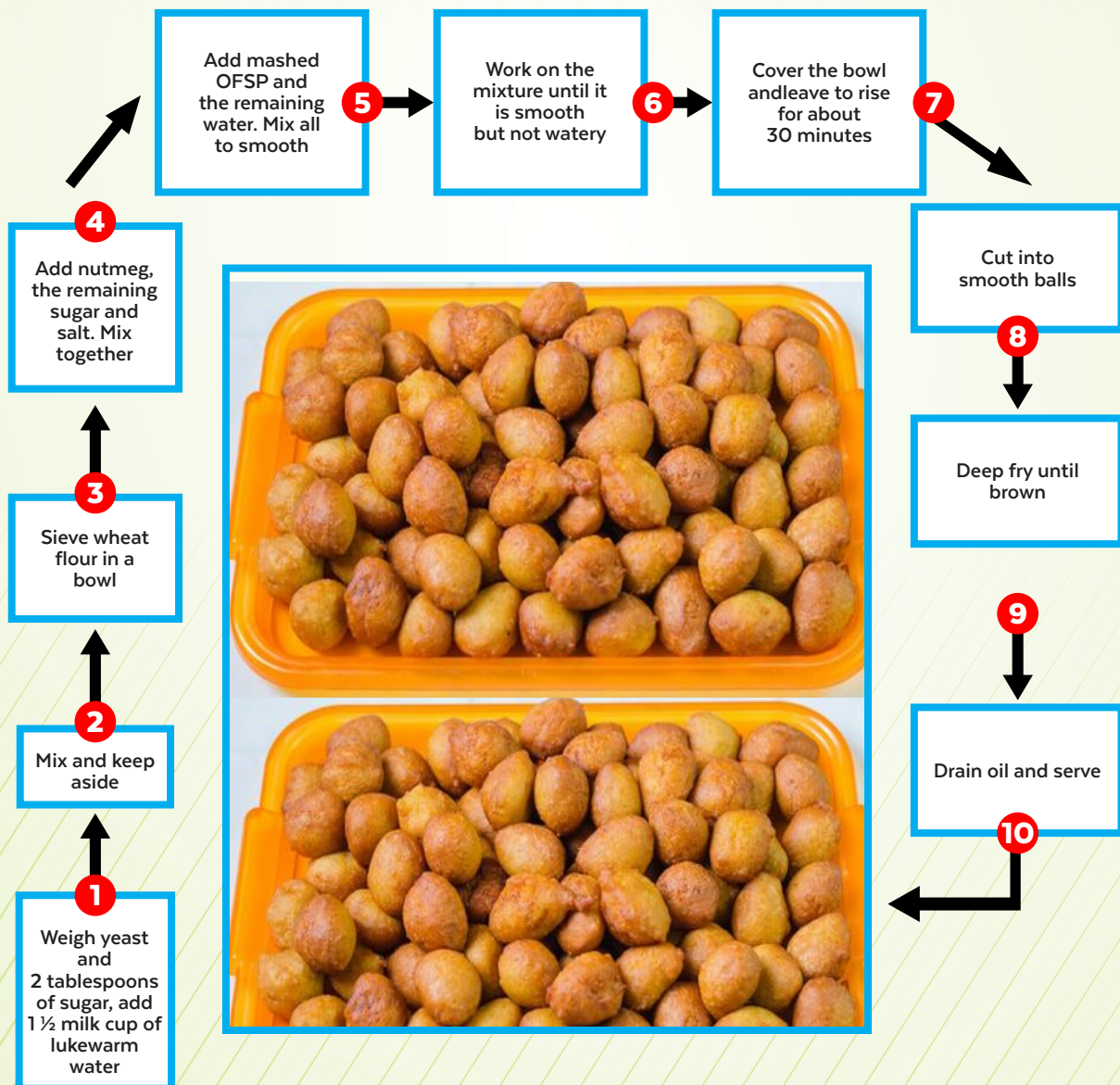


2.10 STEP BY STEP PROCEDURE FOR OFSP DOUGHNUTS FOR A HOUSEHOLD OF FIVE

Ingredients	Measures	Weight (g)
Wheat Flour	12 milk cup	1000
Yeast	1 teaspoon	25
Sugar	1 ½ milk tin	262
OFSP mash	3 milk tins	500
Water	3 milk tins	510
Vegetable Oil	for deep frying	

Optional

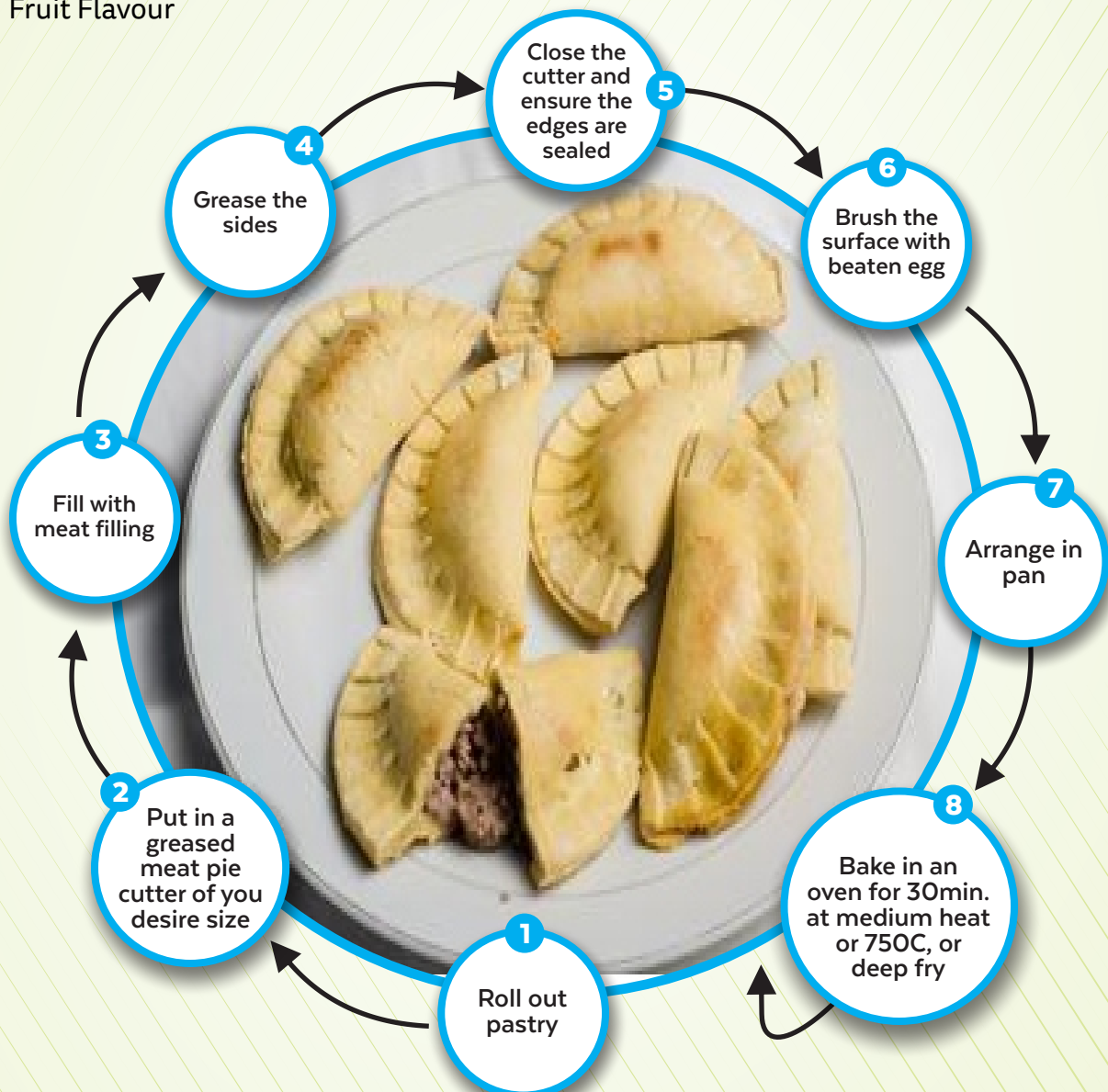
Nutmeg	2 teaspoon	6
Powder milk flavour	3 teaspoon (full)	33



2.11 STEP BY STEP PROCEDURE FOR OFSP MEAT PIE FOR A HOUSEHOLD OF FIVE

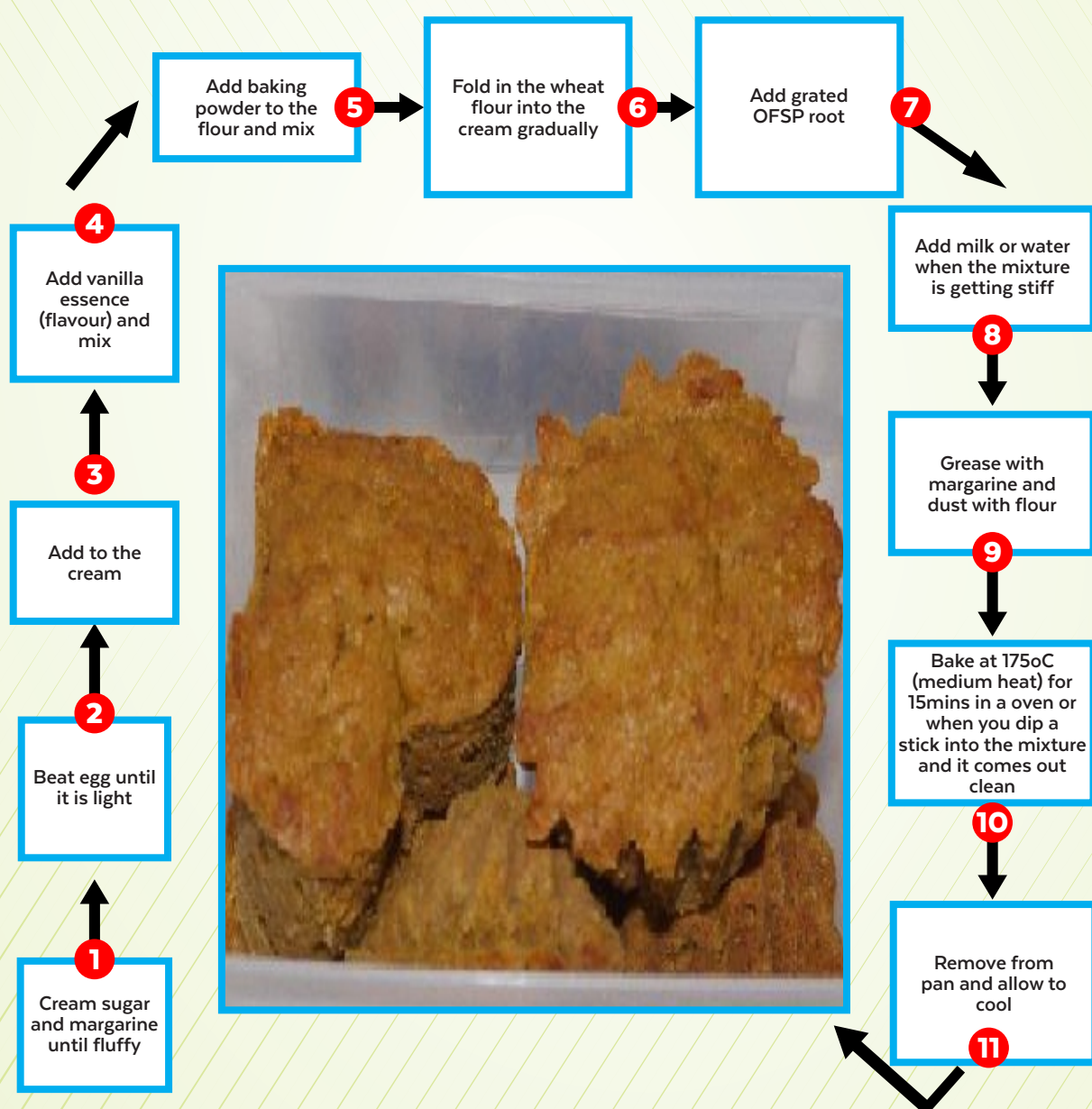
Ingredients

Meat-Pie
OFSP Root
Commercial Flour
Sugar
Margarine
Eggs
Fruit Flavour



2.12 STEP BY STEP PROCEDURE FOR OFSP QUEENS CAKE FOR A HOUSEHOLD OF FIVE

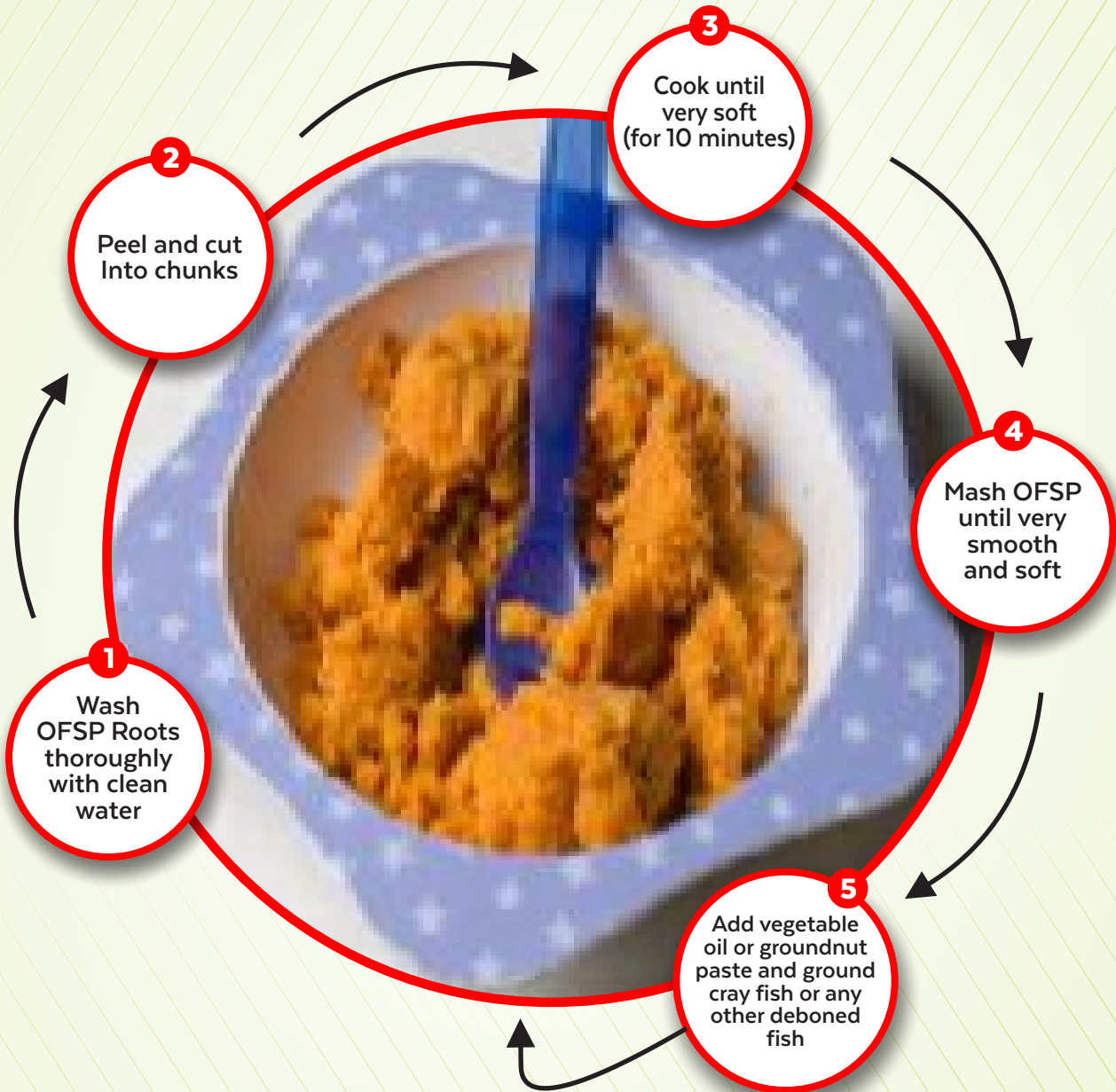
Ingredients	Measures	Weight (g)
OFSP root, grated	2 medium size	300
Wheat Flour	4 milk tins	360
Sugar	1 milk tin	160
Baking Powder	3 teaspoons	15
Vanilla essence	2 teaspoons	6
Egg	2 medium size	120
Optional		
Milk (liquid)	1/2 milk tin	85



Please note: You can also bake in a heated pot lined with smooth sand

2.13 MASHED OFSP AS WEANING/COMPLIMENTARY FOOD

Ingredients	Measures	Weight (h/ml)
OFSP Root	3 medium size	500
Water	1 ½ milk cup	256
Vegetable oil/Groundnut paste crayfish		



2.14 STEP BY STEP PROCEDURE FOR OFSP DOUGHNUTS FOR A HOUSEHOLD OF FIVE

Ingredients

OFSP root peeled & cut into chunks
Palm oil
Pepper
Tomato
Onion
Maggi other seasoning
Salt

Measures

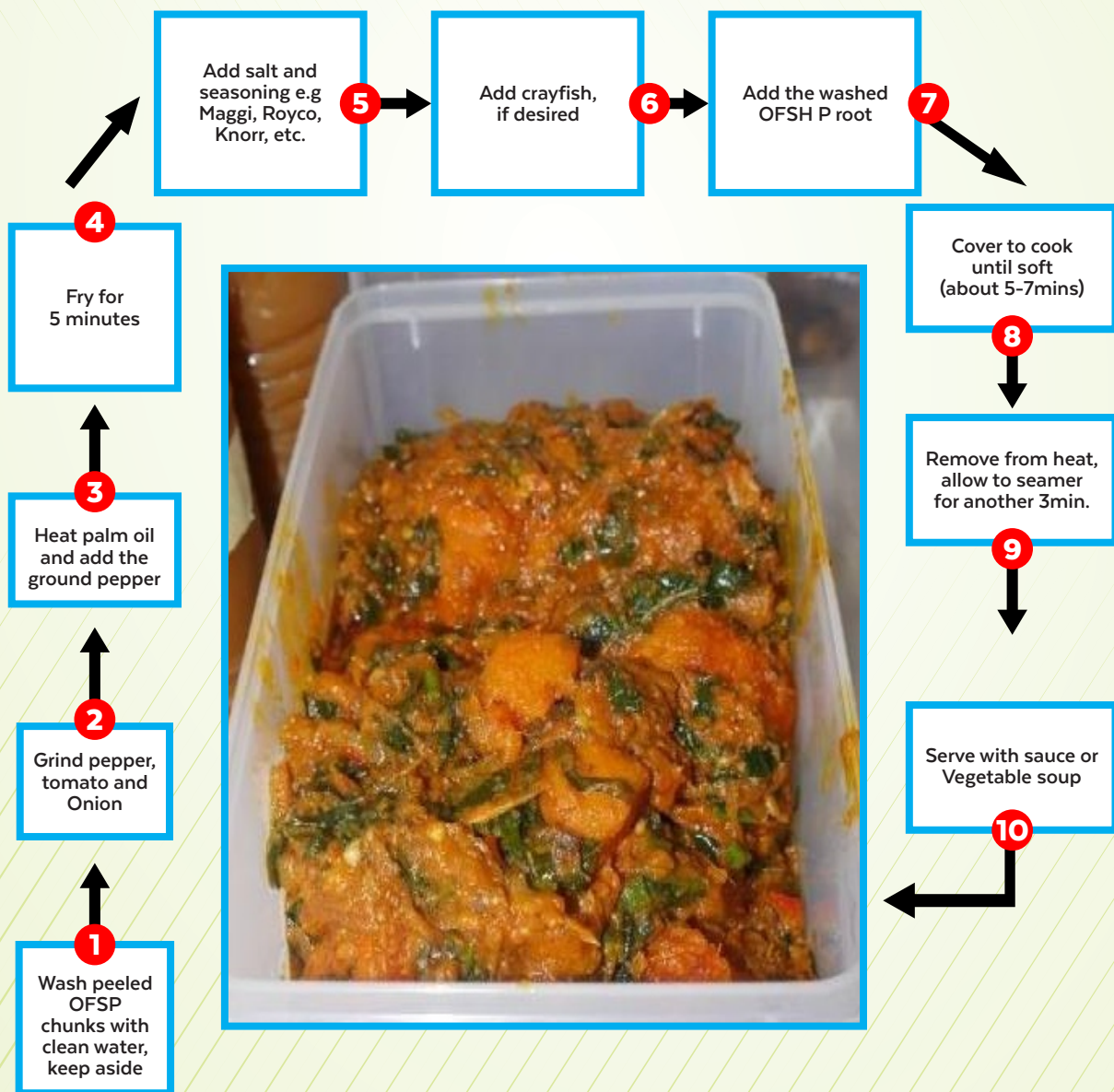
6 medium size
 $\frac{1}{2}$ milk tin
5 medium size
3 medium size
1 small
1 cube
to taste

Weight (g)

1000
78
25
150
25
3

Optional

Crayfish $\frac{1}{2}$ milk cup 26



2.15 STEP BY STEP PROCEDURE FOR GOTE/POTE FOR A HOUSEHOLD OF FIVE

Ingredients

Grits-Sorghum or Maize
Spinach/OFSP leaves
OFSP root
Spring Onions
Pepper
Tomato
Groundnut paste, not smooth
Crayfish, ground
Locust beans
Maggi cube or other seasoning
Water
Salt

Measures

2 milk cups
3 medium bunches
1 medium size
1 small bunch
4 medium
3 medium size
1 milk tin
1 milk tin
1 wrap
2
4 milk tins
to taste
to taste

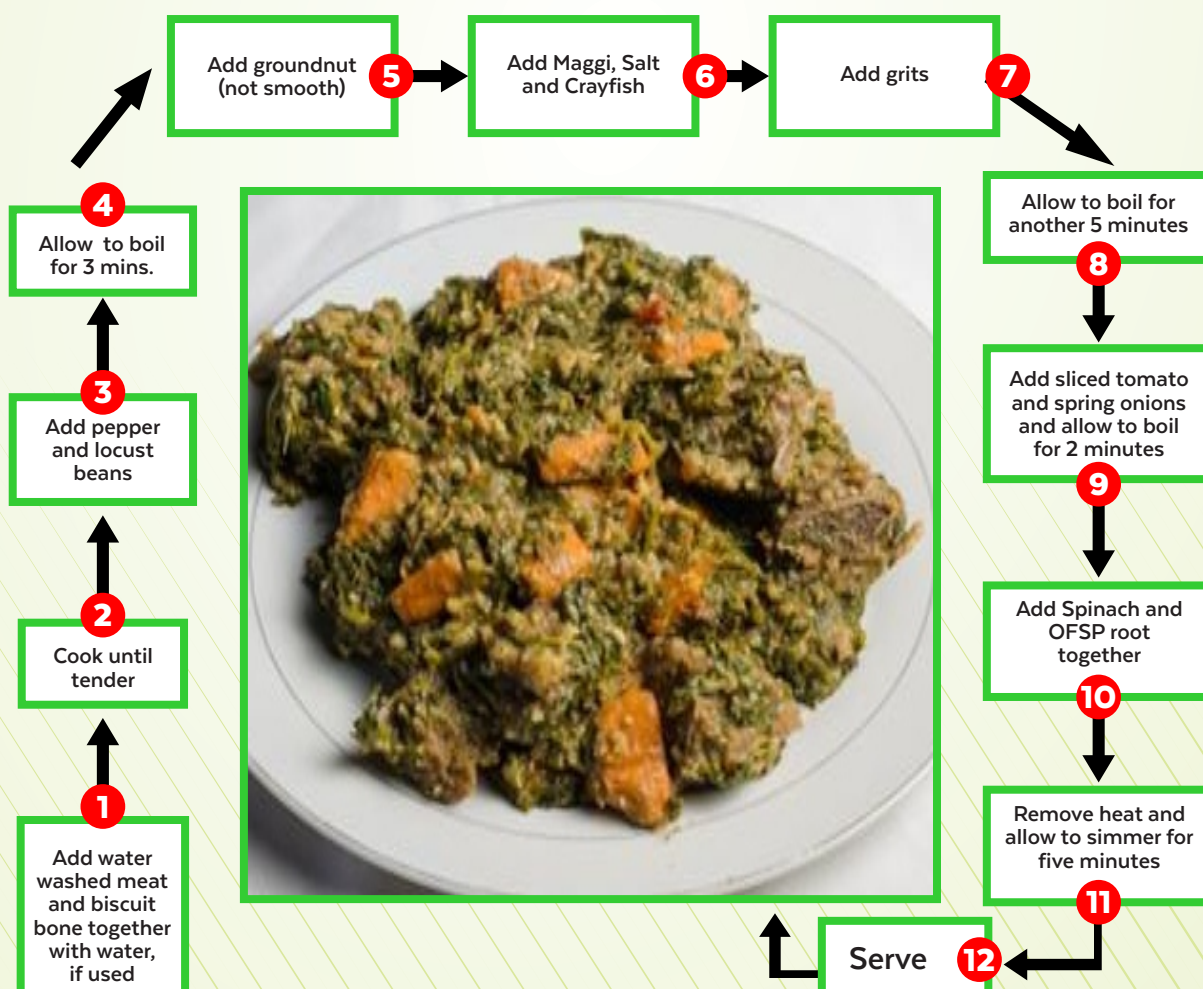
Weight (g)

300
590
170
208
20
150
150
55
22
6
700

Optional

Beef
Biscuit one (soft bone)
Zobo leaves (green)
Curry leaves

to taste
to taste



2.16 STEP BY STEP PROCEDURE FOR 100% OFSP PAP FOR A HOUSEHOLD OF FIVE

Ingredients	Measures	Weight (h/ml)
OFSP Root (not peeled)	10 medium roots	1500
Water for sieving	25Litre keg of water	1000



Preparation of cooked Pap

1. Remove water from the pap or remove pap from refrigerator
2. Mix to smooth paste and thick, add little water but make it is not watery
3. Boil some water
4. Add boiling water mix pap and allow to cook/gel
5. Serve hot with Akara, Moin-Moin or Sugar as desired

2.17 STEP BY STEP PROCEDURE FOR OFSP AKARA FOR A HOUSEHOLD OF FIVE

Ingredients

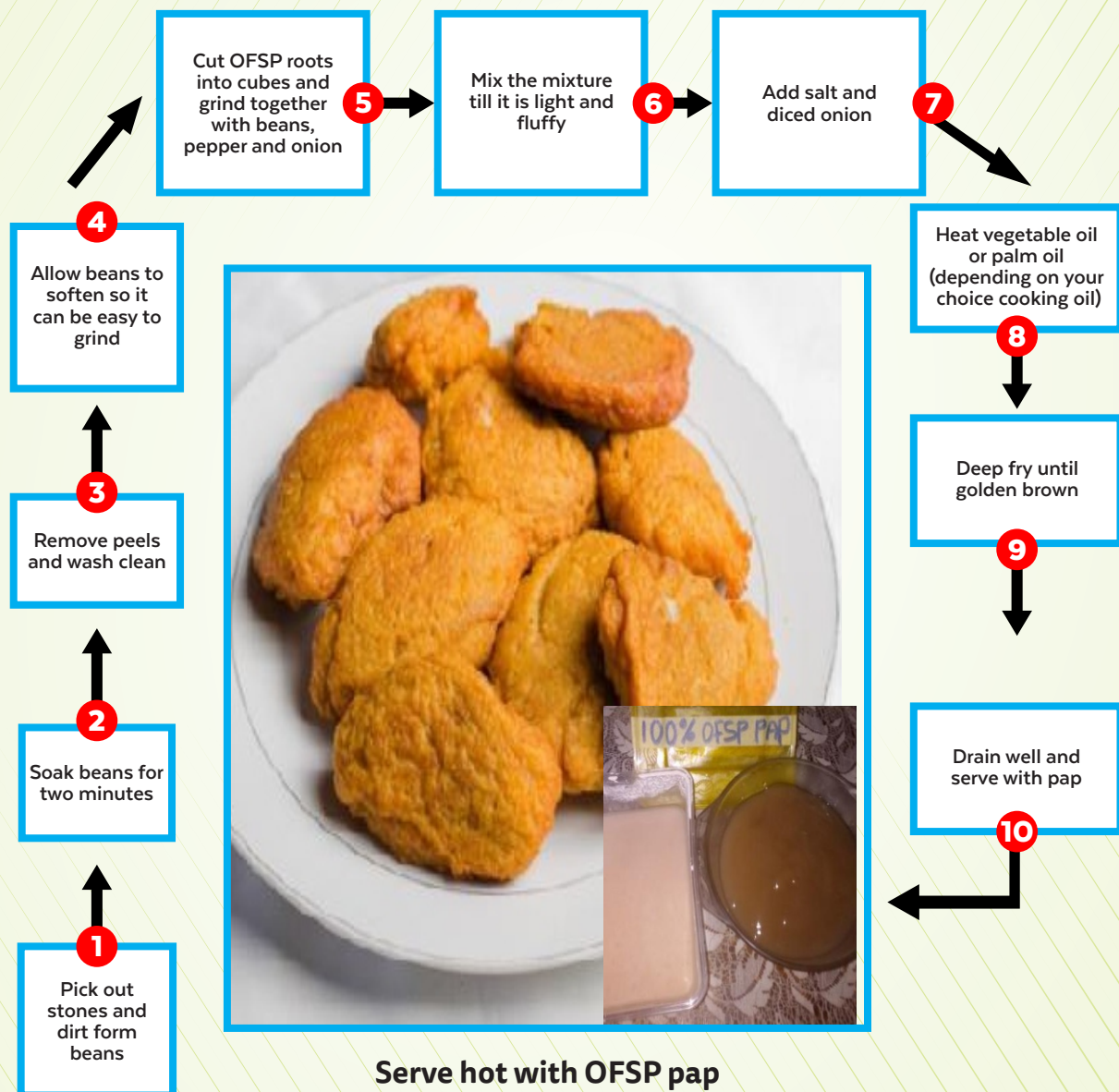
Beans (cowpea) paste
OFSP roots
Onion
Salt
Pepper

Measures

3 milk tin
1 medium size
1 medium size
1 teaspoon

Weight (h/ml)

360
140g
75g
5g

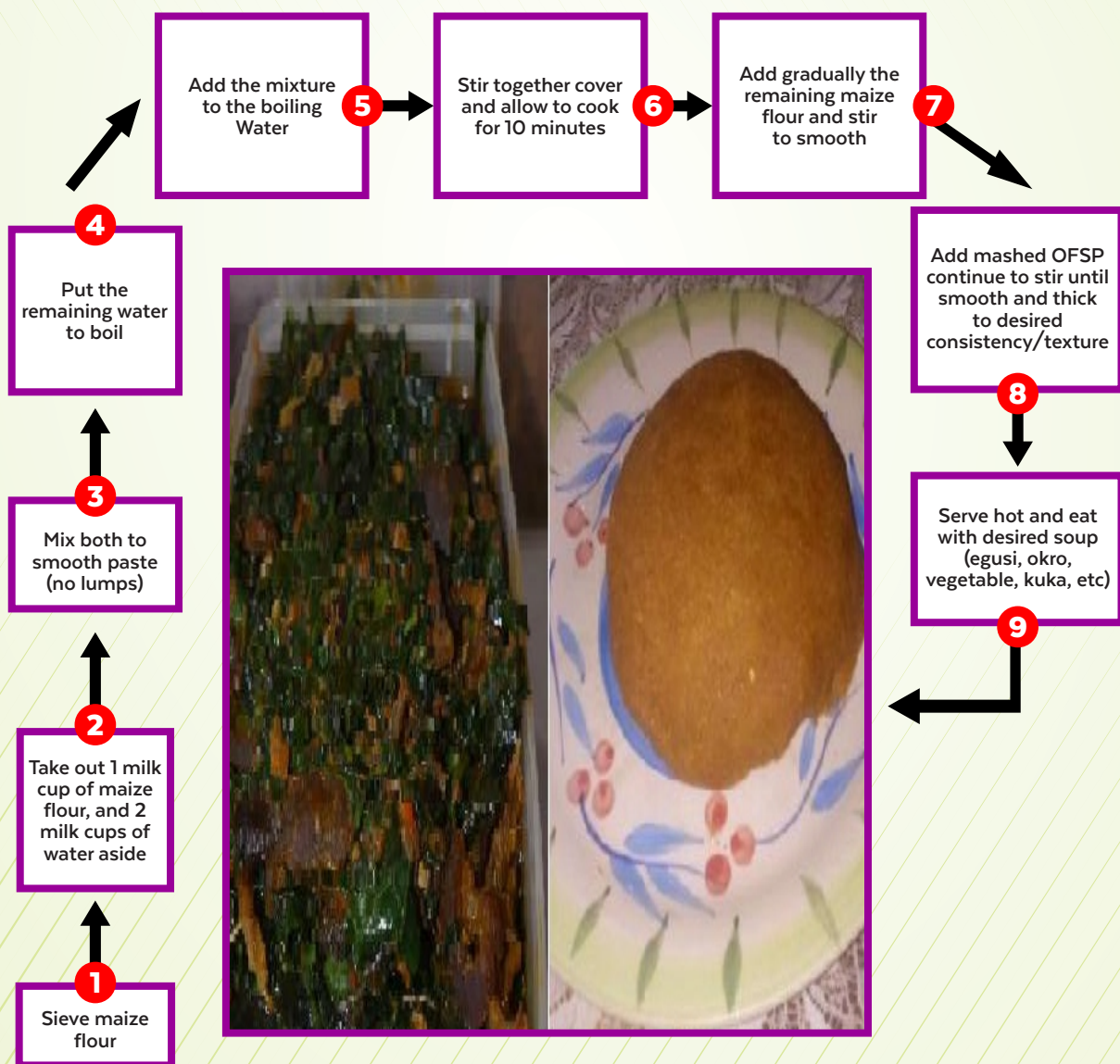


2.19 STEP BY STEP PROCEDURE FOR OFSP SWALLOW FOR A HOUSEHOLD OF FIVE

OFSP Swallow

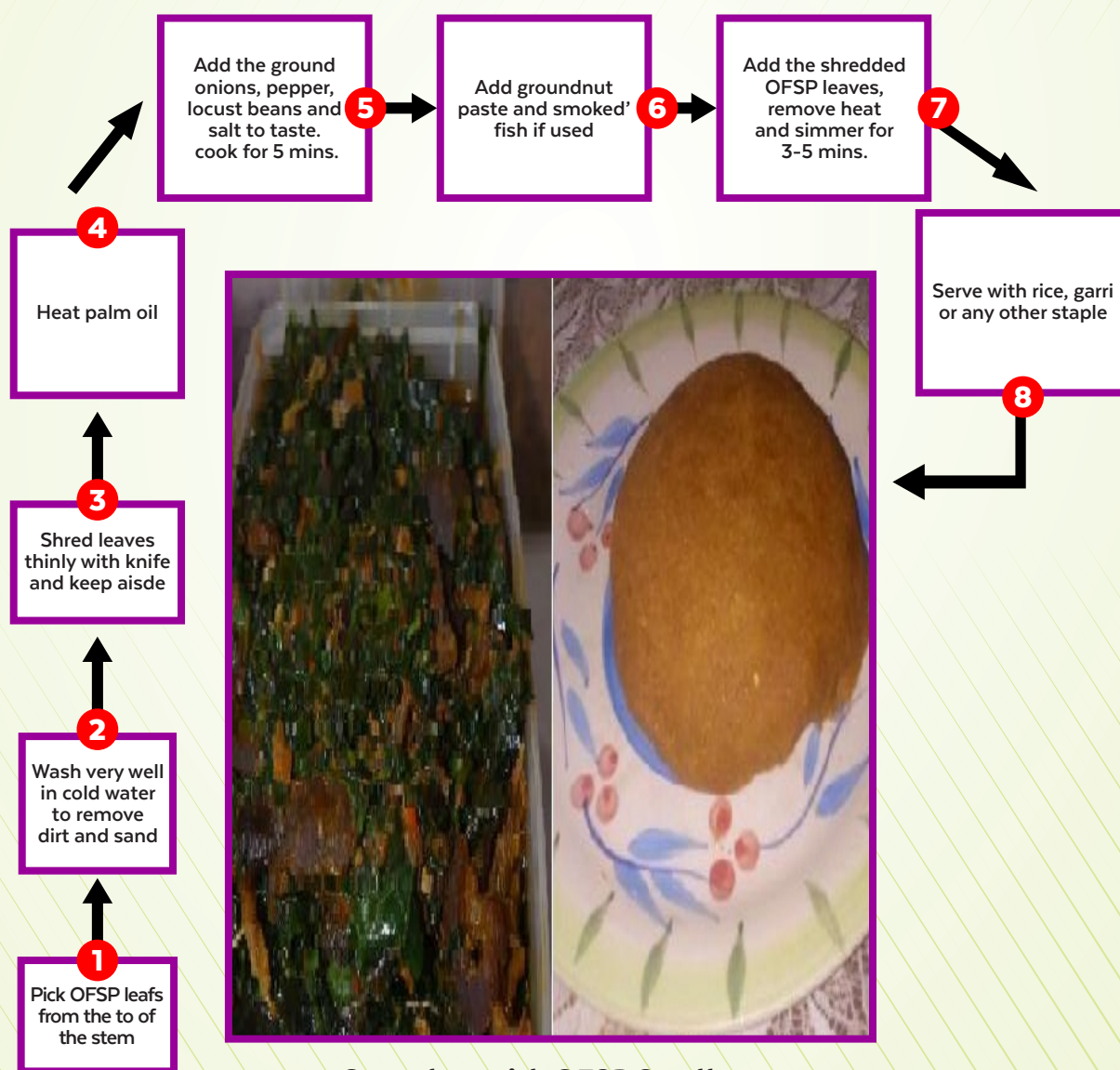
OFSP mash can be used to enrich some of Nigerian swallows like Tuwo, Amala, Garri, Wheat, Semolina and Pounded Yam.

Ingredients	Measures	Weight (g)
Maize flour	1 milk cup	165
OFSP, mashed	3 milk cups	360
Water	8 milk cups	1400ml



STEP BY STEP PROCEDURE FOR OFSP LEAF VEGETABLE SOUP FOR A HOUSEHOLD OF FIVE

Ingredients	Measures	Weight (g)
Fresh OFSP leafs	3 bunches	510
Palm oil	1 milk tin	156
Pepper	5 medium size	15
Salt	To Taste	
Locust beans	1 wrap	25
Optional		
Smoked fish	1 medium	150
Cow skin, diced	½ milk ti	40
Groundnut paste	to taste	



Serve hot with OFSP Swallow

2.20 STEP BY STEP PROCEDURE FOR OFSP JUICE

OFSP JUICE

Ingredients

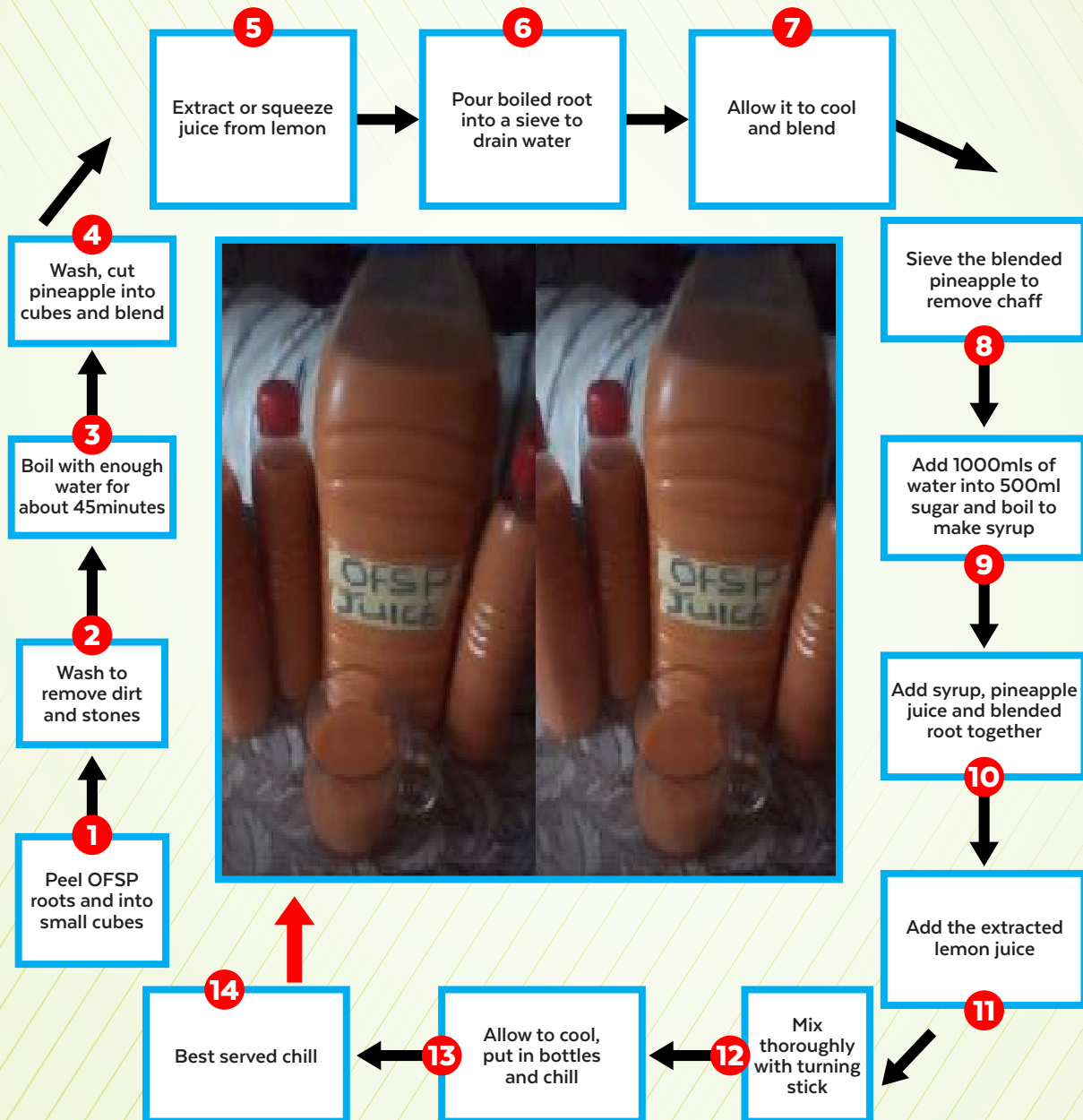
OFSP root
Pineapple
Lemon Fruit
Sugar
Water

Measures

10 big roots
1 big size
1 piece
3 milk tins
15litre keg

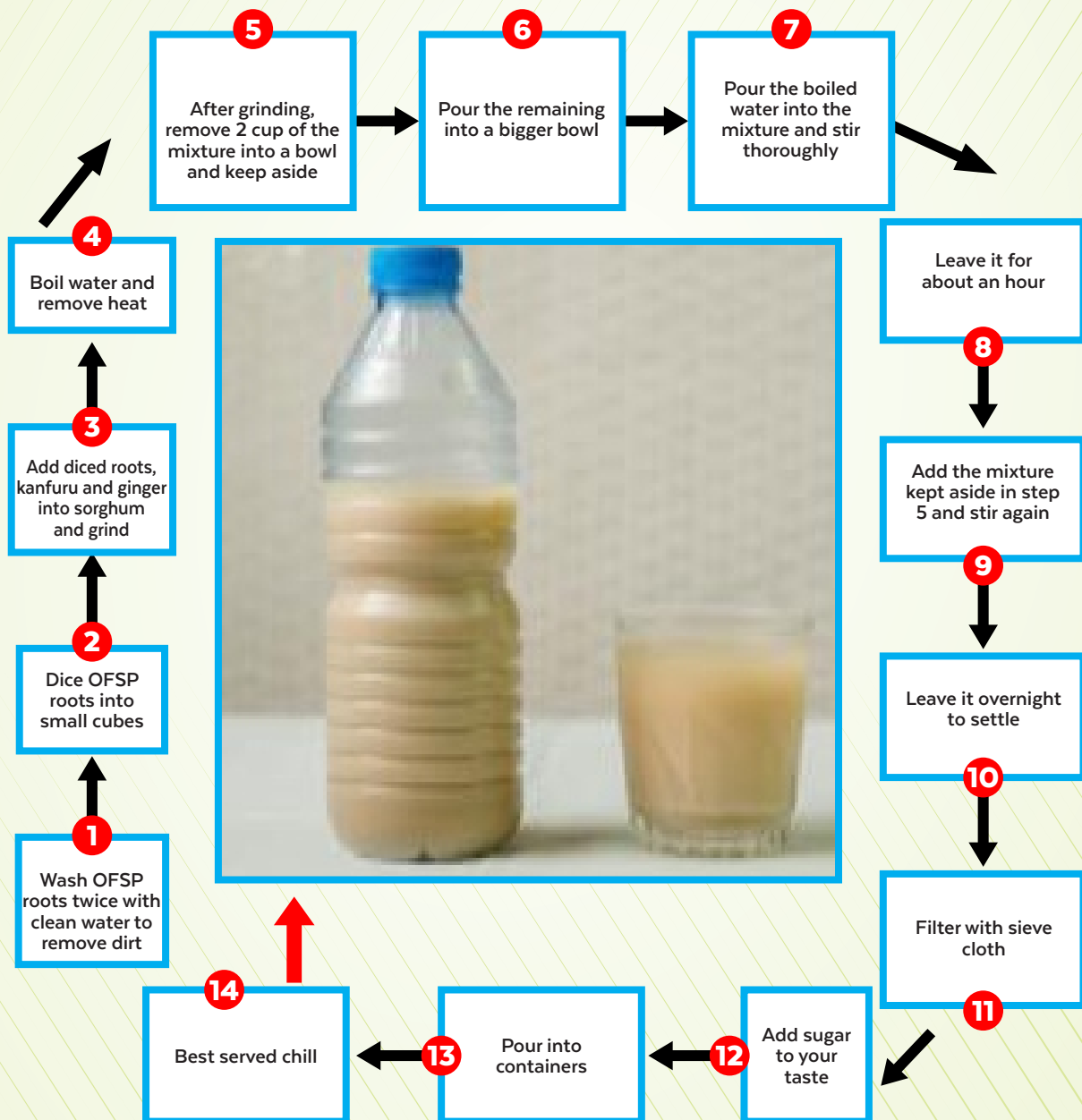
Weight (g)

4000
2700
25
500
15000



2.21 STEP BY STEP PROCEDURE FOR OFSP KUNU

Ingredients	Measures	Weight (g)
Sorghum Dawa	12 milk tin (1 ½ mudu)	2000
OFSP root	6 big roots	1800
Kanfuru	1 piece	22
Ginger	2 medium size	48
Water	2 (5L) keg	10000



CHAPTER THREE

PROCESSING, UTILIZATION AND STORAGE OF TOMATO FRUITS AND VEGETABLES

1.0 Introduction of Tomato Fruit

The tomato is known as a power house of nutrition. It contains a multitude of vitamins and minerals that act to support health.

Tomato can be classified as perishable food crop with high moisture content (50-90%) As a result of the above, there is need to processed tomato into various products such as tomato puree, tomato ketchup and paste and jam.

1.1 List of Menu (Products and By-Products)

Tomato Products

Ready to use tomato paste
Ready to use tomato ketchup
Ready to use tomato puree
Ready to use tomato jam
Dried tomato

Tomato by-products

Tomato seeds
Tomato skin/peels
Tomato pomace

1.2 Processing step-wise:

1.2.1 Step by step processing of Tomato paste for household of six (6)

Materials and equipment;

Matured ripe tomato fruit (10kg)
Lemon juice
Sodium benzoate (0.3kg)
Salt (2.5%)
Weighing scale
Water bath
Pulper/Blender
pH meter
Cooking pots
Knives
Themometer
Refractometer
Sieves





Ingredients

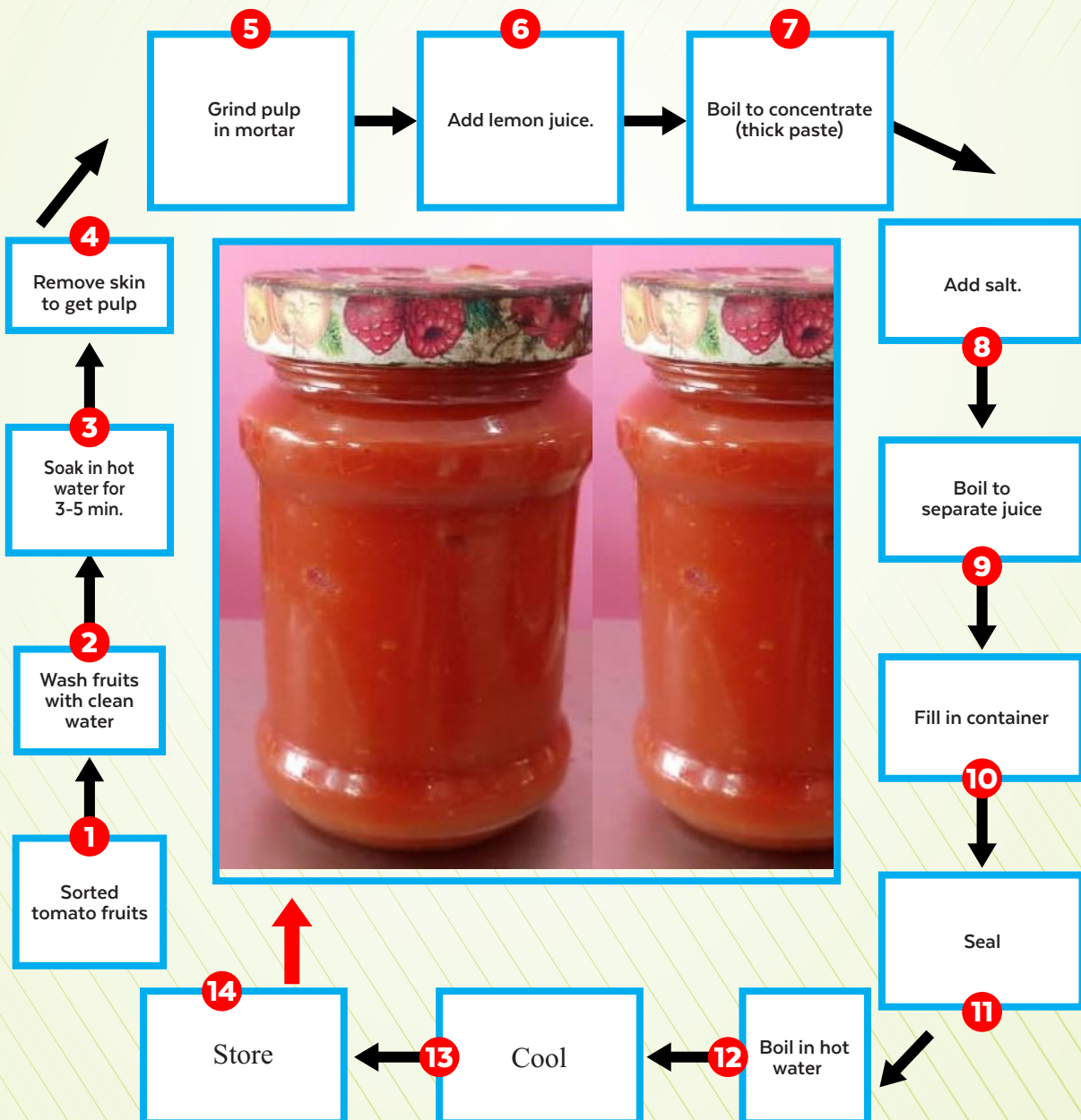
Tomato fruit
Clean water
Lemon juice
Salt

Measures

56 medium size fruit
3 litres
2 tea spoon
1 tea spoon

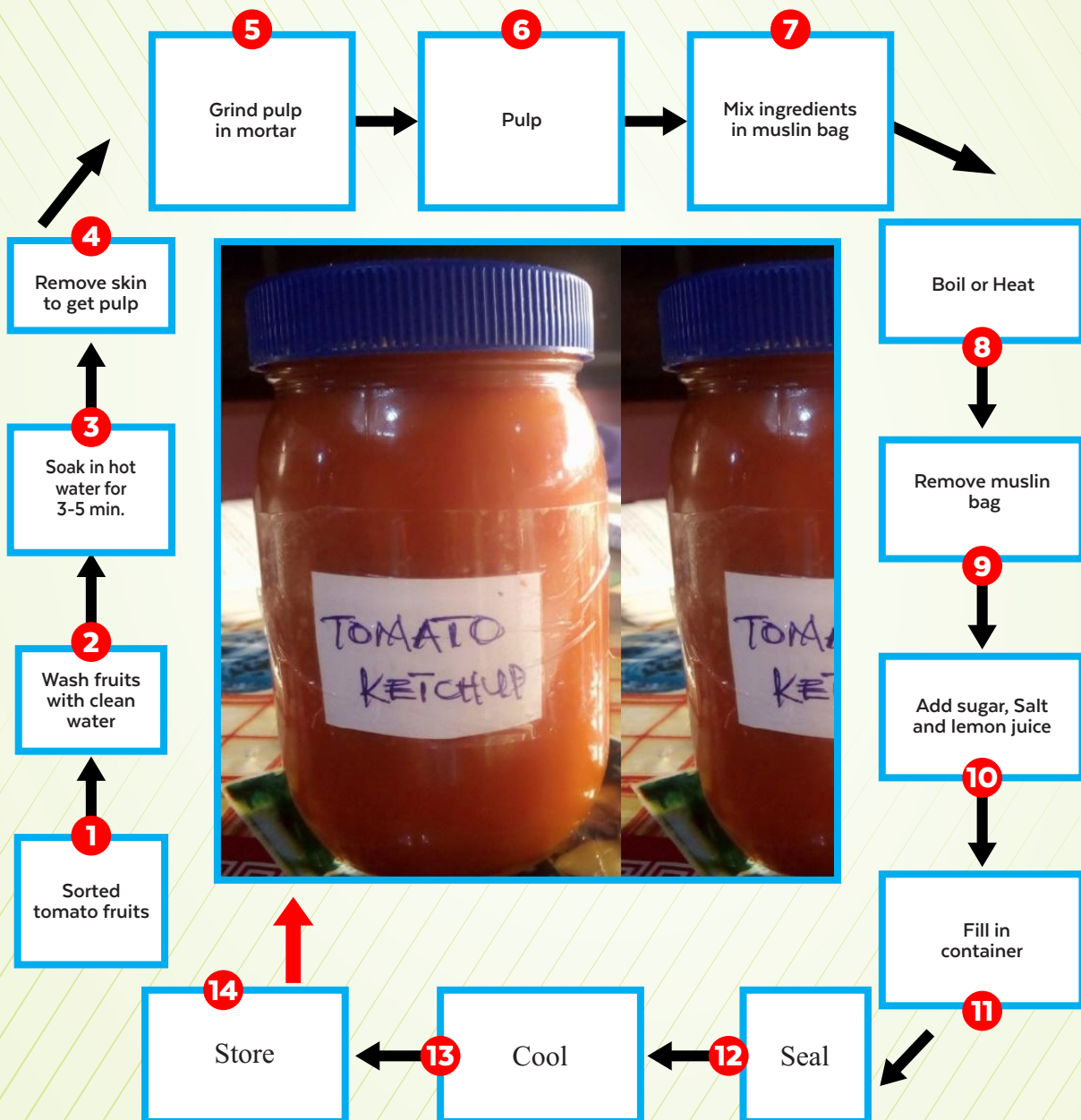
Weight (g or mL)

2500g
3000mL
9mL
6g



1.2.2 Step by step processing of Tomato ketchup

Ingredients	Measures	Weight (g or mL)
Tomato fruit	56 medium size fruit	2500g
Sugar	½ cup	100g
Lemon juice	2 tea spoon	9mL
Salt	¼ cup	41.25 g
Ginger	1 medium size sliced pieces	3g



1.2.3 Step by step processing of Tomato puree

Ingredients

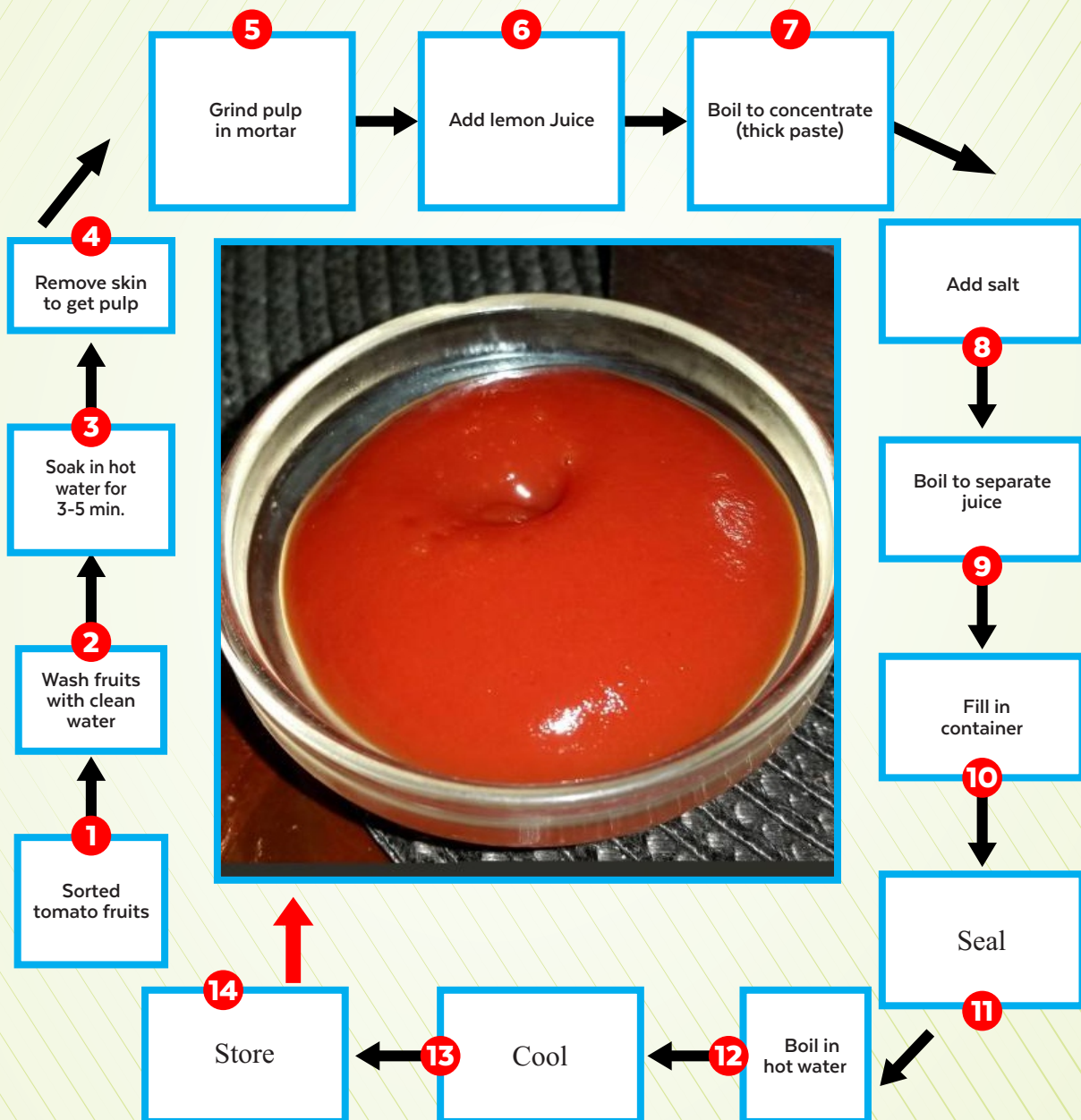
Tomato fruit
Clean water
Lemon juice
Salt

Measures

56 medium size fruit
3 litres
2 tea spoon
1 tea spoon

Weight (g or mL)

2500g
3000mL
9mL
6g



1.2.4 Step by step processing of Tomato jam using standard operation procedures (SOPs)

Ingredients

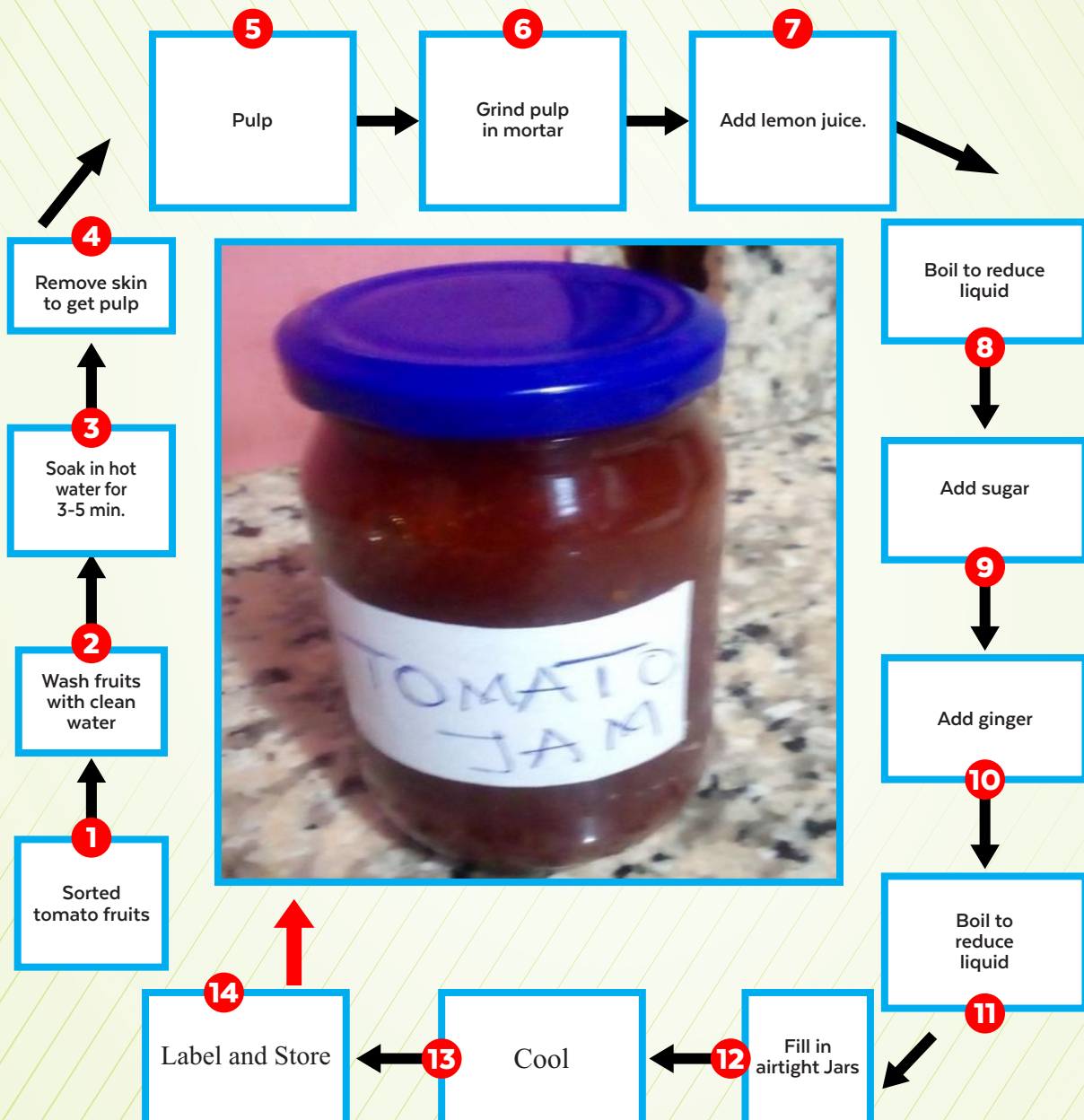
Tomato fruit
Sugar
Lemon juice
Ginger

Measures

56 medium size fruit
7 cups
2 tea spoon
1 medium size sliced pieces

Weight (g or mL)

2500g
1200g
9mL
3g

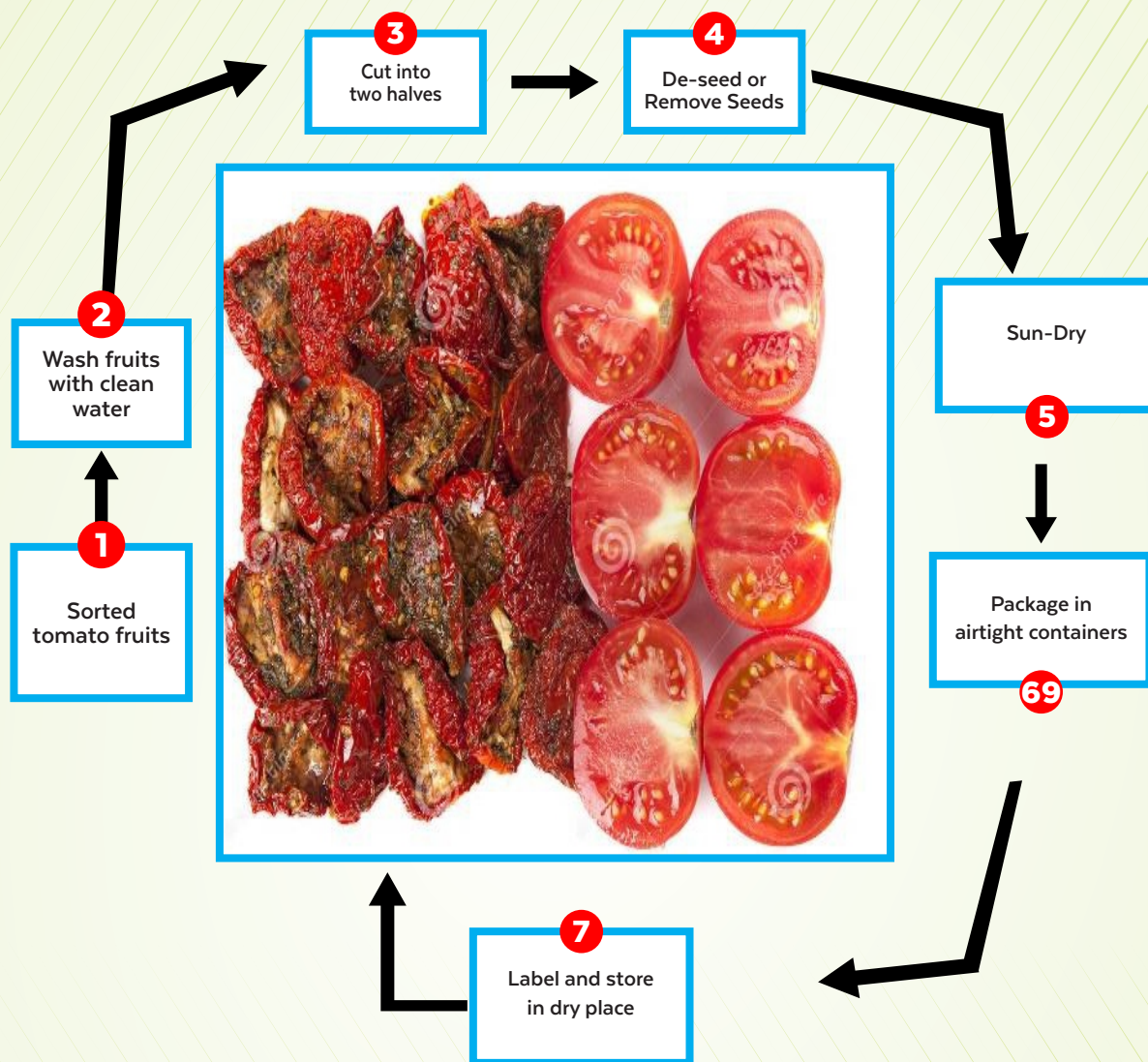


1.2.5 Step by step processing of dry tomato

Ingredients
Tomato fruit

Measures
56 medium size fruit

Weight (g or mL)
2500g



1.3 Utilization of tomato fruit vegetable by-products such as seeds oil production:

1.3.1 Tomato seed utilization

Tomato seeds are edible and rich in bioactive compounds and minerals

Dried tomato seed are utilized in bread fortification with significant effect on anti-oxidant activity, nutritional and sensory profile.

Tomato seed are utilized in corn and soybean meal and is healthy diet for chicks
Tomato seed is also utilization in quality oil production

1.3.2 Utilization of tomato fruits skin/peel

Tomato skin is the by-product of tomato processing which is reported to contain high amount of lycopene as compared to other parts. Tomato skin powder is utilized in the formulation of ketchup, dry fermented sausages and in beef hamburgers. The use of dried tomato skin powder in refined oils for carotenoids solubilization for oil quality improvement



Tomato peels/skin

1.3.3 Utilization of tomato pomace in pigments

Colors are usually added to foods to improve their appearance by imparting a color to otherwise colorless. Plant colors presents an alternative to synthetic colors, thus pigments from tomatoes can be utilized in food applications with accompany advantages.

Carotenes from tomato pomace are utilized as pigments in margarine. Other reported applications of tomato pigments in food include addition to rice, sweet potato chips and ice cream

1.3.4 Nutrients supplements and comminuted vegetarian sausages production.

Tomato skin or peel is utilized in meat products such as sausage and hamburger
Tomato peel can be used in sausage production as a colorant



Sausage

2.0 Storage of Tomato

2.1 Fresh Produce

Refrigeration

Pot-in-pot cooler
Tin-in pot cooler
Wall-in-wall cooler
Metal-in-wall cooler

Evaporative cooling

Vegetable basket



2.2 Processed products

Pet bottles under ambient temperature
Refrigeration

3.0 Packaging and Packaging Materials

3.1 Packaging materials for fresh produce

Polyethylene bags
Trays and shallow crates
Wooden box
Ventilated plastic crate
Perforated fiberboard carton
Slatted wooden crates



Pet bottle for tomato products



Polythene bags



Plastic containers



Slated wooden containers



Perforated cartons

Menu combination

3.2 Tomato paste

Fried tomato sauce on dishes like boiled beans, rice and stew



Jollof rice with tomato puree



Tomato jam served with slices of bread as breakfast food



Tomato ketchup served with Irish potato chips



3.3 Key messages to the household

Tomato contains vitamin A to prevent blindness

Processing of tomato products will help prevent post-harvest losses

Tomato fruits can be stored in evaporative coolers in absence of refrigerator

HOUSEHOLD

PIXEL ALIGNED



4.0 PROCESSING OF PAWPAW AND WATER MELON FRUITS

4.1. PROCESSING OF PAWPAW

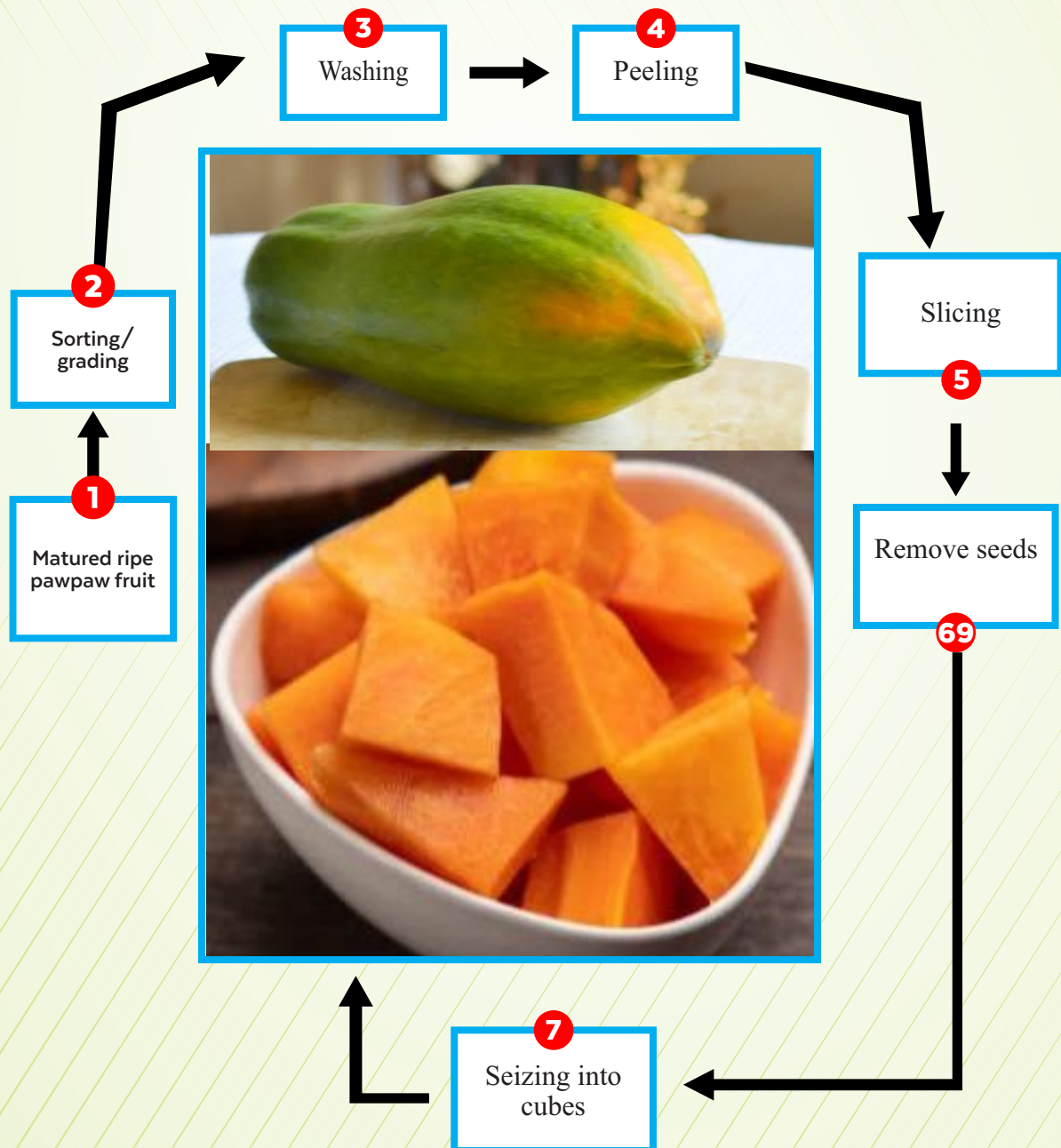
- ▶ pawpaw cubes
- ▶ pawpaw juice
- ▶ Jam/jellies production

4.1.1 Step by step procedure for processing pawpaw cubes for a family of seven (7) persons

Ingredients
Ripe Pawpaw

Measures
2 Big size

Weight
3kg



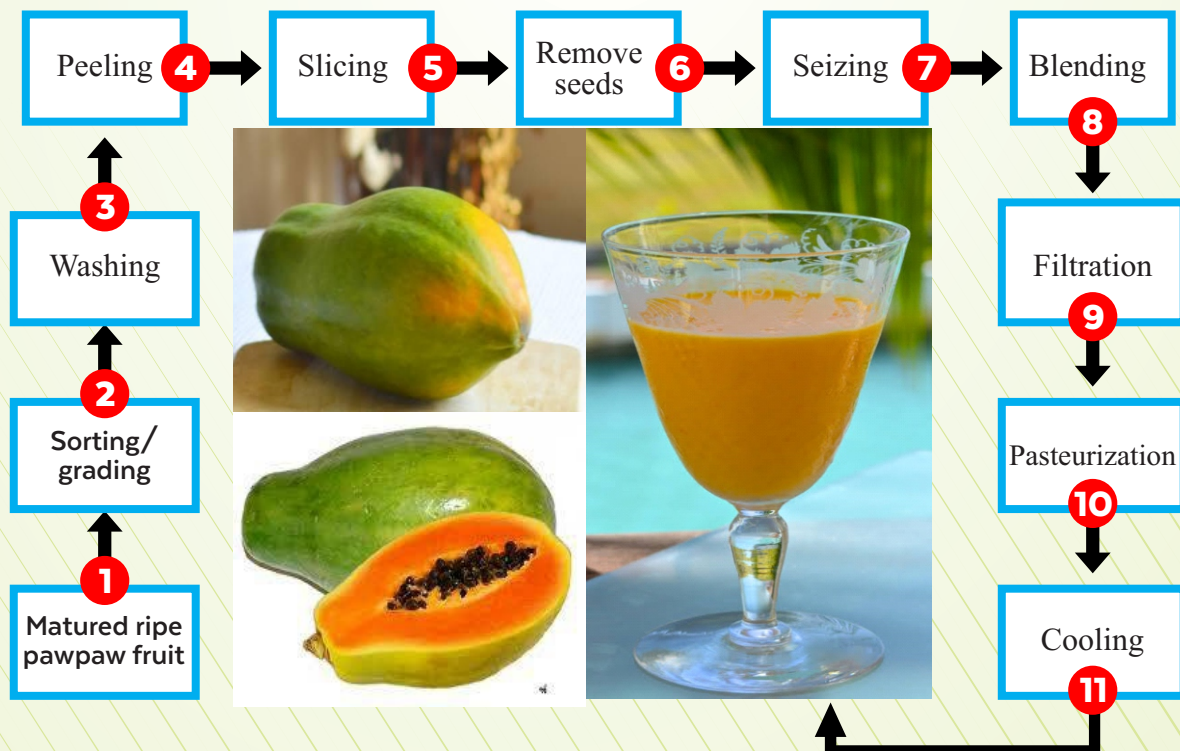
Menu combination:

Pawpaw cubes as dessert or Appetizer with rice and stew, pounded yam and vegetable soup or jollof rice



4.1.2 Step by step procedure for processing pawpaw fruit juice/squash for a family of seven (7) persons

Ingredients	Measure	Weight
Pawpaw fruit	4big size	6kg
Water	1ltr	1 kg
Sugar	1milkcup	100 g



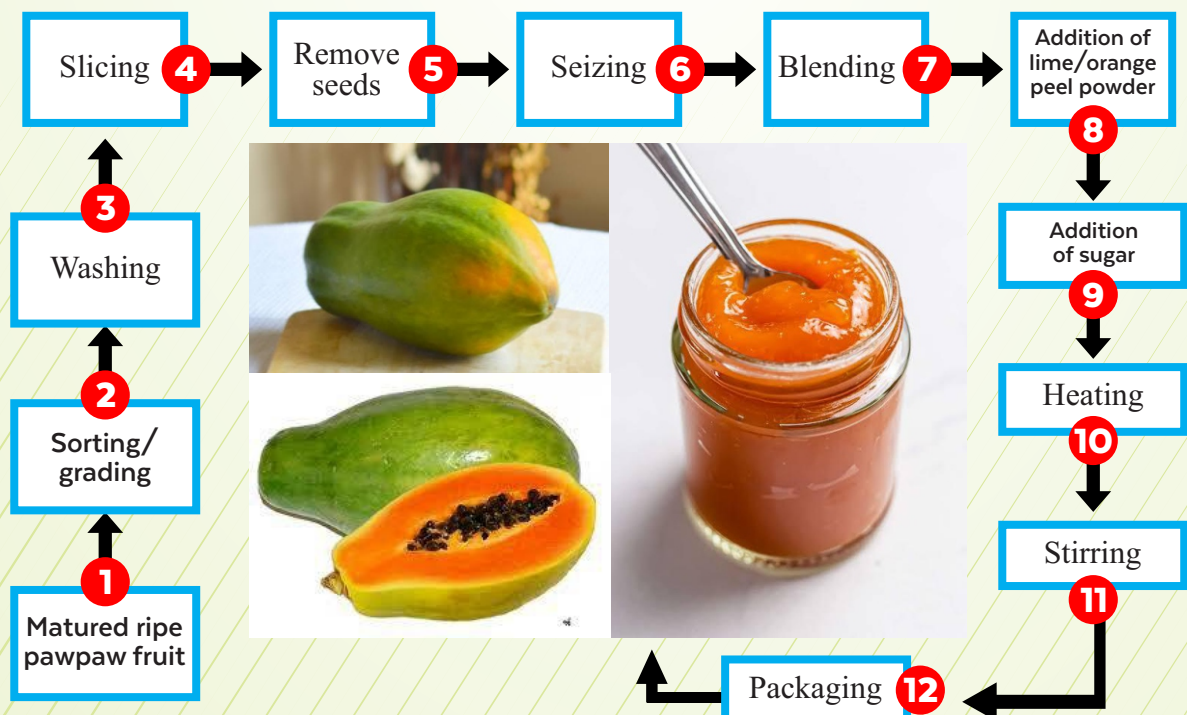
Menu combination:

Pawpaw juice with rice and stew,
pottage yam, pounded yam.



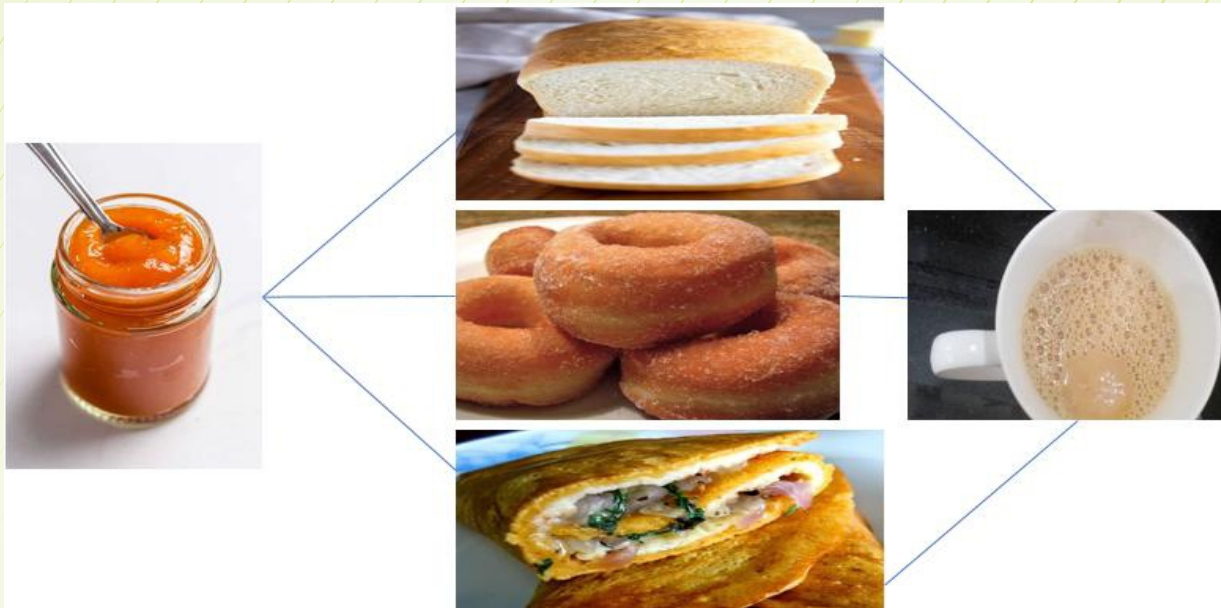
4.1.3 Step by step procedure for processing pawpaw fruit jam for a family of seven (7) persons

Ingredients	Measure	Weight
Pawpaw fruit	4 big size	6 kg
Sugar	10 spoon	85 g
Lime juice	5 big size	20 ml
Orange peel powder	2 teaspoon	8.4 g



Menu combination:

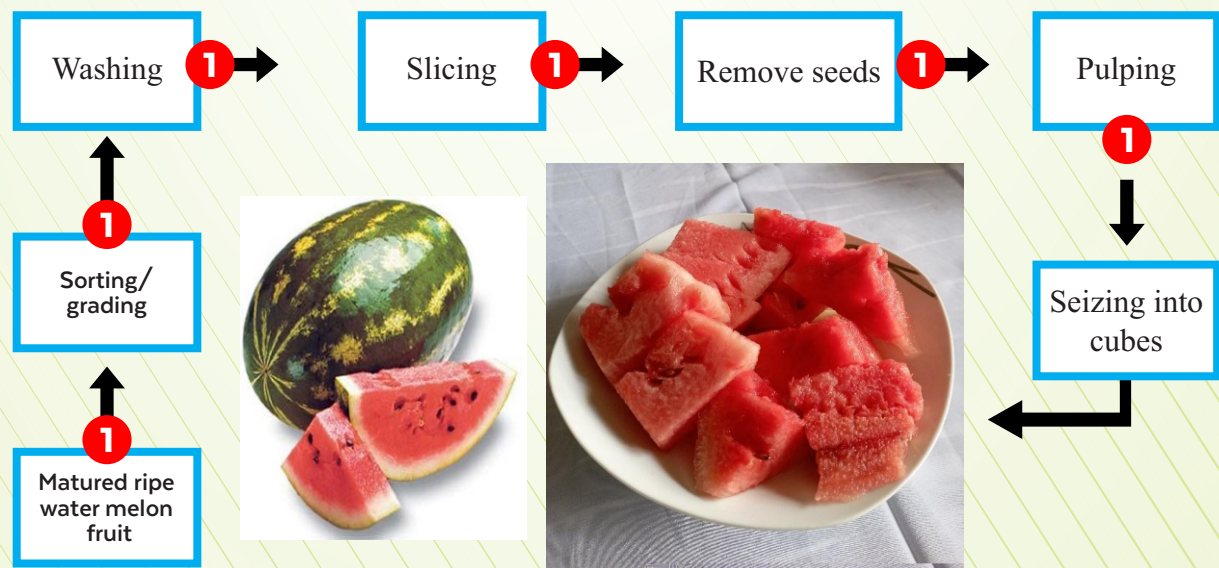
Pawpaw jam with bread, doughnut, omelet, cup of tea or coffee, etc.

**4.1.4 Processing of watermelon fruits**

- ▶ Watermelon cubes
- ▶ Juice from watermelon fruit
- ▶ Jam/jellies production

Step by step procedure for processing of watermelon cubes for a family of seven (7) persons

Ingredients	Measures	Weight
Ripe Watermelon fruit	1 Big size	3kg



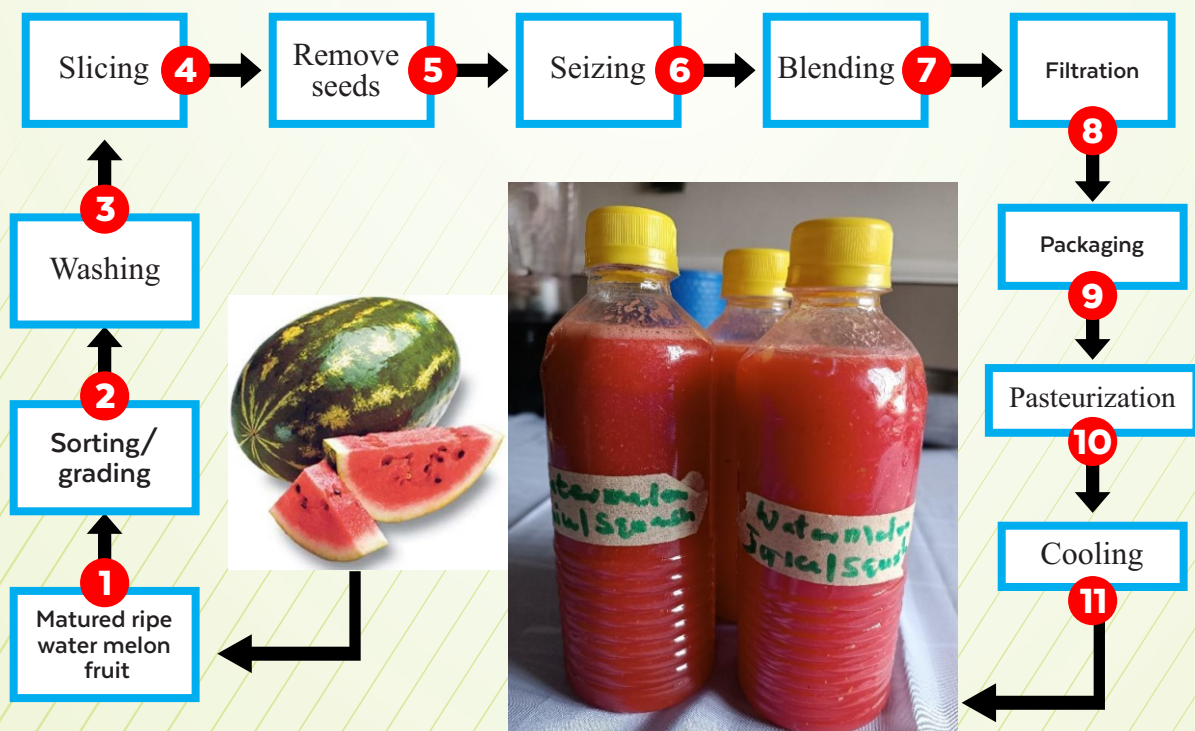
Menu combination:

Water melon cubes as dessert or appetizer with spaghetti or pounded yam and egusi soup, or moimoi



4.1.5 Step by step Procedure of processing water melon fruit juice/squash for a family of seven (7) persons

Ingredients	Measure	Weight
Ripe watermelon fruit	2big size	6kg
Water	500 ml	500g
Sugar	1milkcup	100g



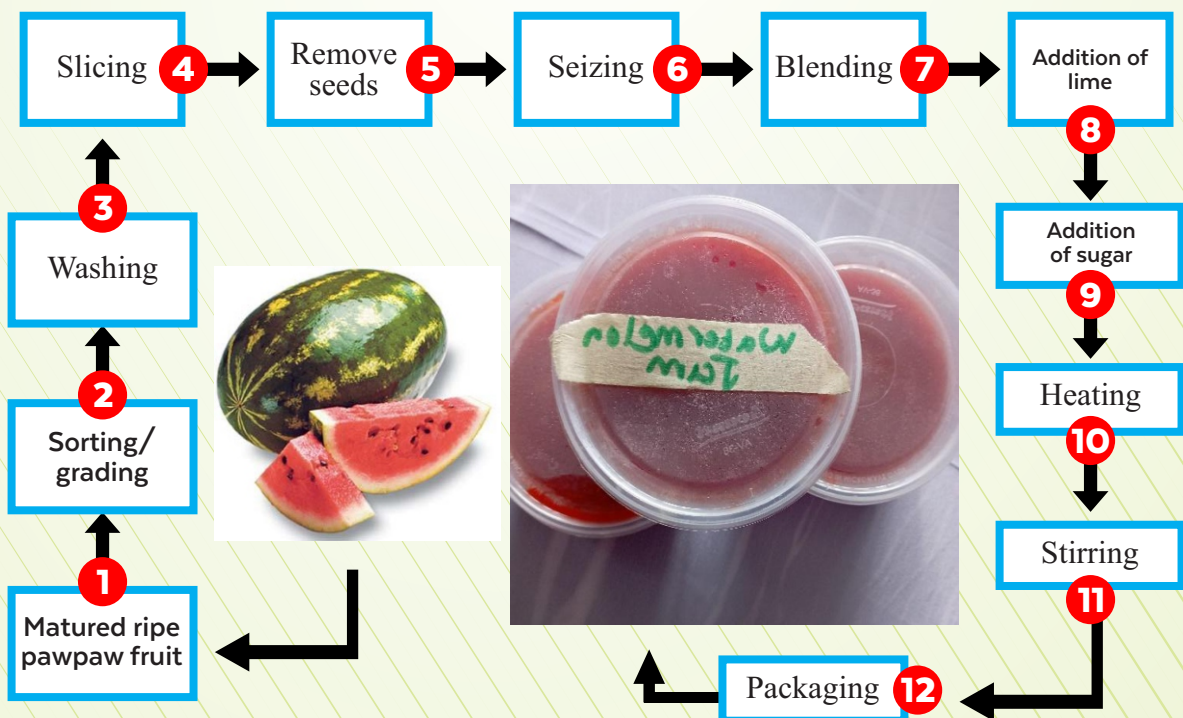
Menu combination:

Water melon juice with beans and plantain, or akara, or boiled yam with vegetable sauce



4.1.6 Step by step procedure for production of water melon fruit jam for a family of seven (7) persons

Ingredients	Measure	Weight
Watermelon fruit	2 big size	6 kg
Sugar	10 spoon	85 g
Lime juice	8 big size	45 ml
Orange peel powder	2 teaspoon	8.4 g



Menu combination:

Water melon jam with pan cake, puff puff, cake slices and cup of tea or coffee, etc.



4.2 UTILIZATION OF BY-PRODUCTS FROM PAWPAW AND WATERMELON

4.2.1 Utilization of by-products for water melon



Watermelon seed bar



Watermelon seed sauce



Toasted watermelon seed

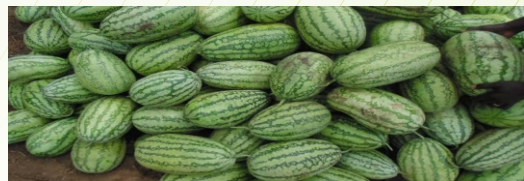
4.3 STORAGE OF PAWPAW AND WATERMELON

4.3.1 Fresh produce

- ▶ Fruits in the topics are seasonal and large quantities of them are wasted due to poor post-harvest handling and inability to preserve them.



- #### 4.3.2
- Fruits such as watermelon are preserved by cold atmosphere storage, chilling and use of active packaging materials.



4.3.3 Processed products

- ▶ Processed juice or drink from fruits are usually stored under refrigeration or ambient condition
- ▶ Processed jams and jellies are also stored under ambient or refrigerated temperature conditions

4.4 PACKAGING AND PACKAGING MATERIALS

Common Packaging material for Packaging of pawpaw and watermelon fruits products are,

- ▶ Pet bottles
- ▶ Plastic containers

5.0 EQUIPMENT USED FOR PROCESSING OF PAWPAW AND WATERMELON FRUITS

Common equipment used for processing of pawpaw and watermelon fruits are,

- ▶ Stainless steel knives
- ▶ Pot of boiling and pasteurization
- ▶ Manual Blender
- ▶ Packaging materials such as pet bottles
- ▶ Muslin clothe/sieve for filtration
- ▶ Stainless basins for washing
- ▶ Stove of gas or busen burner for heat source

6.0 MENU COMBINATION

- ▶ Pawpaw/watermelon pulp cubes as desert or appetizer for 3 course meal
- ▶ Pawpaw/watermelon juice with rice and stew, jollof rice, pounded yam, etc.
- ▶ Pawpaw/watermelon jam with bread doughnut, omelet, cup of tea or coffee, etc
- ▶ Watermelon seed bar as snacks with chilled juice or drinks
- ▶ watermelon seed sauce with pounded yam, white rice.

7.0 KEY MESSAGE TO THE HOUSEHOLDS

- ▶ Embrace hygienic practices in preparation of foods
- ▶ Avoid use of rusted utensils
- ▶ Ensure good raw materials such as fresh and wholesome fruits
- ▶ Ensure us of clean and potable water i.e boil water from well and stream sources before use
- ▶ Package to avoid contamination after processing
Store in a cool and clean place.

CHAPTER FOUR

PROCESSING, UTILIZATION AND STORAGE OF ANIMAL PROTEIN SOURCES

1.0 Animal slaughtering

Slaughtering of animal is the process of killing animals intended for human consumption.

1.1 Pre-slaughter process for goats

Select healthy goats including:

- ▶ Old goats or the ones that are no longer productive due to a decrease in the litter size and number of parturitions
- ▶ Excess mature males in the herd can be selected for slaughter to reduce the adverse effect of inbreeding depression.
- ▶ Poor mothering ability resulting in lower number of kids weaned per litter
- ▶ Deformed goats as a result of injury sustained which affects riding for male or ability to carry pregnancy to term in the doe (not diseased or sick animals)

1.2 Notes and instructions:

- ▶ Meat of healthy freshly slaughtered animals must be sterile. Poor lairage, slaughtering and post slaughtering process lead to contamination of the carcass.
- ▶ Avoid contamination by the animal itself, tools and equipment used in slaughter, the workmen and the dirty conditions of the slaughterhouse environment
- ▶ Wash off dirt, body discharges and excreta before bleeding the animals
- ▶ Animals should not be slaughtered on the floor to reduce the incidences of carcass contamination. Hoisting during killing, skinning, evisceration, washing and inspection is recommended.
- ▶ Separate dressing operations from offal cleaning.
- ▶ Animals should not be fed for at least 12 hours to slaughter
- ▶ Water must be given the animal ad libitum (unlimited)
- ▶ Feeding animals before slaughter makes evisceration difficult and carcass contamination leading to poor quality meat

1.3 Religious Slaughter (Islamic Slaughter (Halal)/Jewish (Kosher))

Religious slaughter requires the animal to be in a state of consciousness at the time it is killed. This is characteristic of Jewish (Kosher) and orthodox Islamic (or Halal) slaughters. Halal slaughter stipulates that the name of Allah (God) should be mentioned at the initiation of the operation, and blood must flow out completely from the animal.

1.4 Humane Slaughter

The humane slaughtering method requires that the animal is stunned and rendered in a complete state of unconsciousness prior to killing. The animals are stunned to Z

unconsciousness, feeling no pain. This is done either by mechanical, electrical or chemical means in a process called stunning. Stunning also renders the animals motionless thus eliminating excitement and possible cruelty.

Unless disallowed by rituals and established traditions, the humane method and associated techniques of slaughter are recommended for use as they allow for safer, more economic and hygienic operations and a desirable quality product.

1.5 Post slaughter operations: These include: Skinning (vertical skinning or horizontal skinning – see figures 1- 4)

- ▶ Scalding: place the animal on a sturdy plastic pallet or concrete slab;
- ▶ infuse the bled carcass with air through a cut made at the hind leg;
- ▶ pour boiling water to remove the hair with sharp knife or razor blade;
- ▶ wash and rinse the carcass; and remove the head.
- ▶ Shankling is then done before evisceration.

1.6 Singeing with fire: This involves the use of fire to burn the hair on the body of the bled animal. The body together with the head and feet is singed with fire and hair is scraped off. The body is then scrubbed with a sponge and water to remove residual char and hair. After this, it is close-shaved, rewashed and eviscerated.

Evisceration; the removal of the intestine and other soft tissues to produce the carcass.

Fig 1. Killing of animal on the ground



Fig 2. Killing of animal in vertical position



Fig 3. Dressing of the animal body vertical



Fig 4. Dressing of animal body horizontal



1.7 Poultry Dressing Process

- **Bleeding:** Procedures earlier highlighted for selection and of resting animals to be slaughtered should be adopted in birds bleeding. Birds must be bled thoroughly to enhance adequate keeping quality.
- **Defeathering and Dressing:** Dressing of poultry carcasses ensures that all hair, feathers, dirt, scurf, etc., must be completely removed and the carcass thoroughly washed.
- **Removal of head, feet and oil glands**
- **Evisceration:**

All viscera including the oesophagus, crop, cloaca, lungs, trachea, kidneys and reproductive organs, should be removed from the carcass before the final wash, and shall be handled as inedible material.

1.8 Key Message to the Households

- a. The participants should know the kind of animal to select for slaughtering (healthy), how to slaughter animals, dress and make primal cuts for processing into stable products for storage and preservation
- b. know the various methods of dressing animal carcass hygienically to increase the shelf life and reduce contamination.

1.9 Cleaning: This involves Hygiene and precautionary measures of the slaughter and dressing process, utensils, personnel, environment and clothing.

- Use clean and sharp knife and rinsed the knife in hot water to prevent the transmission of bacteria into the animal tissues. Singeing and scraping of the animal body must be carefully done to avoid splits in the skin by fire action
- ▶ Clean hot water should be used in rinsing carcass after sponging and washing before evisceration.
 - ▶ During evisceration, care should be exercised not to puncture the intestines.
 - ▶ Stomachs and intestines should not be opened while carcass dressing is in operation to prevent the spillage of the visceral contents and contaminating the meat.
 - ▶ carcasses should be washed with clean potable water under pressure if possible. Personnel hygiene as well as equipment is very important in preventing contamination of meat.
 - ▶ Sick personnel with boils and sores and other conditions must be barred from the premises all must be routinely examined for their health condition.
 - ▶ All apparels used for the slaughtering, boots, long water proof aprons should be washed and dried before next use.
 - ▶ **Cleaning of the slaughtered animal must be done in clean environment**
 - ▶ The liquid effluents should be spread out on the ground at some distance from

the slaughter plant for quick drying as they empty on a slope from deep concrete drains away from the plant.

- ▶ Straw bedding should be placed on the ground initially to absorb the liquid and re-layered at each time of disposal.

The site should be constantly maintained to ward off vermin.

1.10 Heating: Heating dries off the free water, thereby reducing the water activity and increasing shelf life. The high glow temperatures of the hardwood chips fire for smoking are as high as 620-1160°C. leading to an all-smoking temperature of about 200°C.

1.11 Cooling: Fresh animal carcasses are rapidly chilled to 4°C to reduce the internal body temperature animal at slaughter. Addition of ice blocks to fermented sour milk (nono) will cool the products and the consumption time can be extended from 12 hours to 24 hours before spoilage.

1.12 Drying: Drying of the processed beef and poultry meat should be done hygienically under the sun covered with muslin clothe to prevent contamination by flies and other insects perching on it.

1.13 Fermentation: Inoculated fresh milk for the production of nono is allowed to ferment for 12 -24 hours at room temperature depending on weather condition. During fermentation, some of the lactose is converted to the lactic acid.

1.14 Material handling:

Raw meat and milk should be held at lower temperature to maintain its integrity and prevent the proliferation and growth of spoilage and pathogenic microorganisms. In the absence of cold chain access, processing should commence immediately.

1.15 Salting: Salting of animal products while processing imparts flavour, creates an unfavourable environment for growth of spoilage microorganisms and acts as preservative agents.

1.16 Smoking: Smoking of meat is a food preservation method which involves the exposure of meat directly to wood smoke. Smoke produces typical flavor and distinctive color and hardens the surface of the product. Smoke produced by the slow combustion of sawdust derived from hard woods inhibits microbial growth, retard fat oxidation and import flavor to cured meat. (We need good picture of smoking meat pls)

1.17 Dry smoking involves smoking the animal products until the moisture level is reduced to ensure that it keeps for long period and does not require refrigeration of heating again. Example of this is Kilishi).

1.18 Wet smoking involves smoking meat to impart flavour and lightly dry. Such products can keep for 1-2 days without refrigeration e.g. suya or tsire.

1.19 Freezing: Freezing delays spoilage and keeps foods safe by preventing microorganisms from growing and by slowing down enzyme activity that causes food spoilage. Effective freezing of meat is at temperature $<18^{\circ}\text{C}$.

1.20 Curing: Curing is the addition of salt, salt petre, sodium nitrite, sugar, phosphate, methionine etc., to meat in order to impart unique properties like color, flavor texture to meat and meat products with the end products having lower water activity which prevent microorganisms proliferation.

1.21 Boiling: Boiling of meat in processing makes it tender, and with additions of other ingredients imparts flavour in stew.

1.22 Roasting: Roasting of meat through the use of dry heat by burning logs or charcoal by a high smoking temperature of up to 200°C , leads to dryness of meat with reduction in water activity with ultimate beneficial effect on meat preservation.

Goat meat cuts



Fig 5. Burnt Goat Carcass.

Source: shutterstock.com

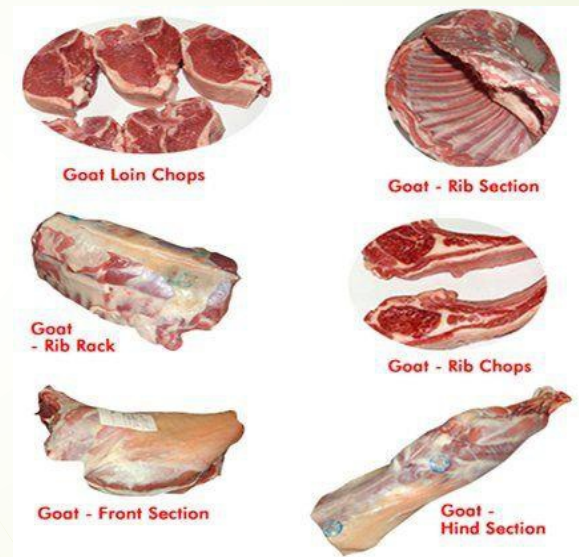


Fig 6. Goat Primal Cuts. Source

Source: Amery meat market

Fig 7. Poultry cuts Source: instructables.com



2.0 Processing, Utilization and Storage of Animal Protein Sources**2.1 list of products derived from goat and poultry**

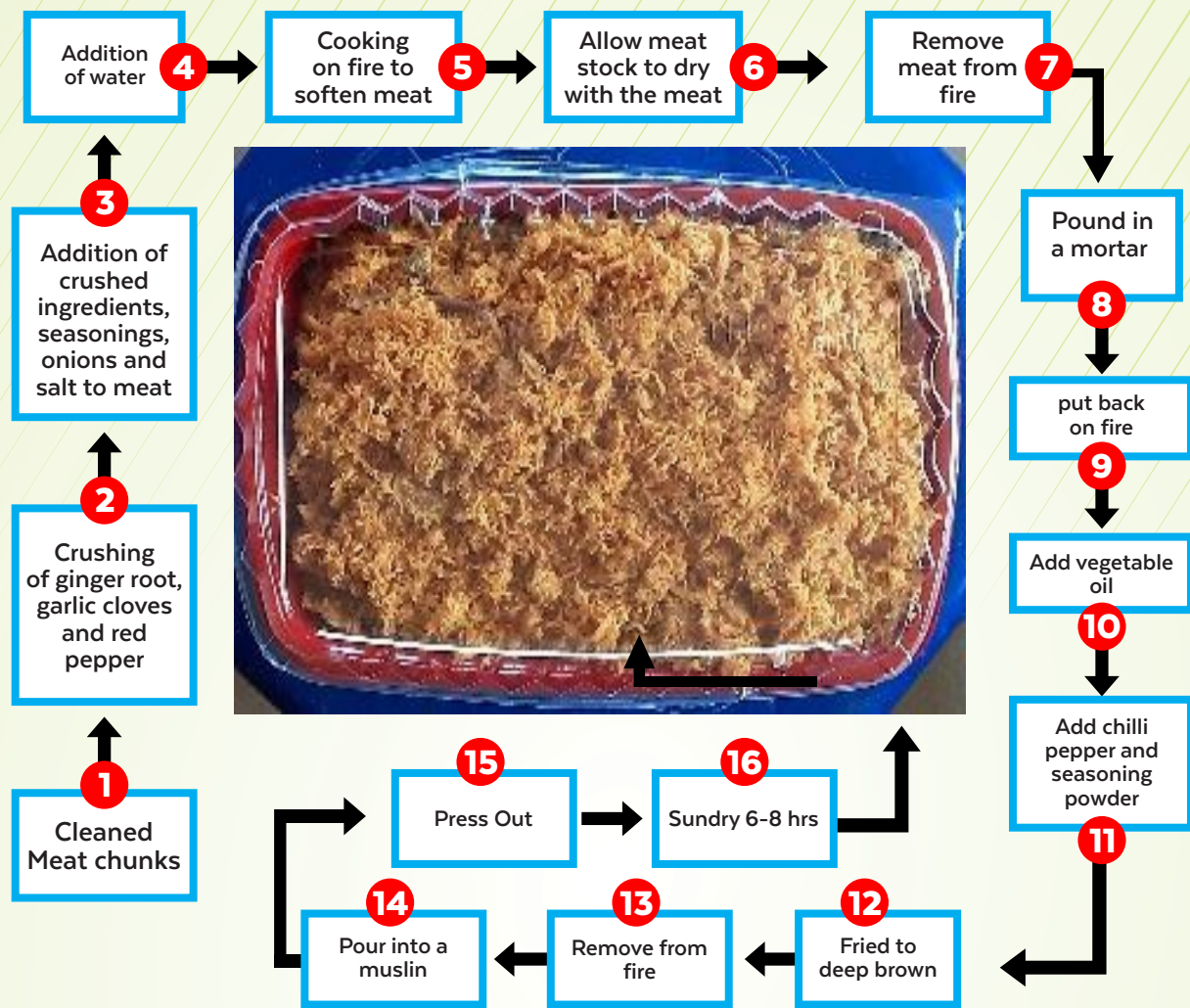
- o Meat
- o Milk
- o Egg
- o skin
- o hydrolysed feather meal
- o Bone meal
- o Hooves and horns
- o Meat meal
- o Egg shell

2.2 Processing of products from goat and poultry

Dambu Nama
 Dambu Kaza
 Meat Suya/Tsire
 Chicken Suya
 Smoked Meat/Smoke dried meat
 Smoked Chicken/Smoke dried chicken
 Nono – Milk (local yoghurt)
 Wara - Local Cheese (fresh)
 Wara – Local Cheese (fried)
 Meat balls
 Chicken balls
 Boiled Meat
 Boiled Chicken
 Fried Meat
 Fried Chicken
 Boiled eggs
 Fried Eggs

1.2.1 Step by Step Procedure for Preparation of Dambun Nama (shredded Meat/Floss)

Ingredients	Measure	Weight (g/ml)
Meat	8 medium size	500
Ginger root/(powder)	1 teaspoon	5
Garlic Cloves of garlic	4 cloves	5
Vegetable oil	2 cups	300
Seasoning powder	2 teaspoonfuls	10
Seasoning cubes	2 cubes	
Onions	1 big	120
Red pepper	½ handful	
Ground cayenne pepper	3 teaspoon	15
Salt	½ teaspoon	
Water		1000



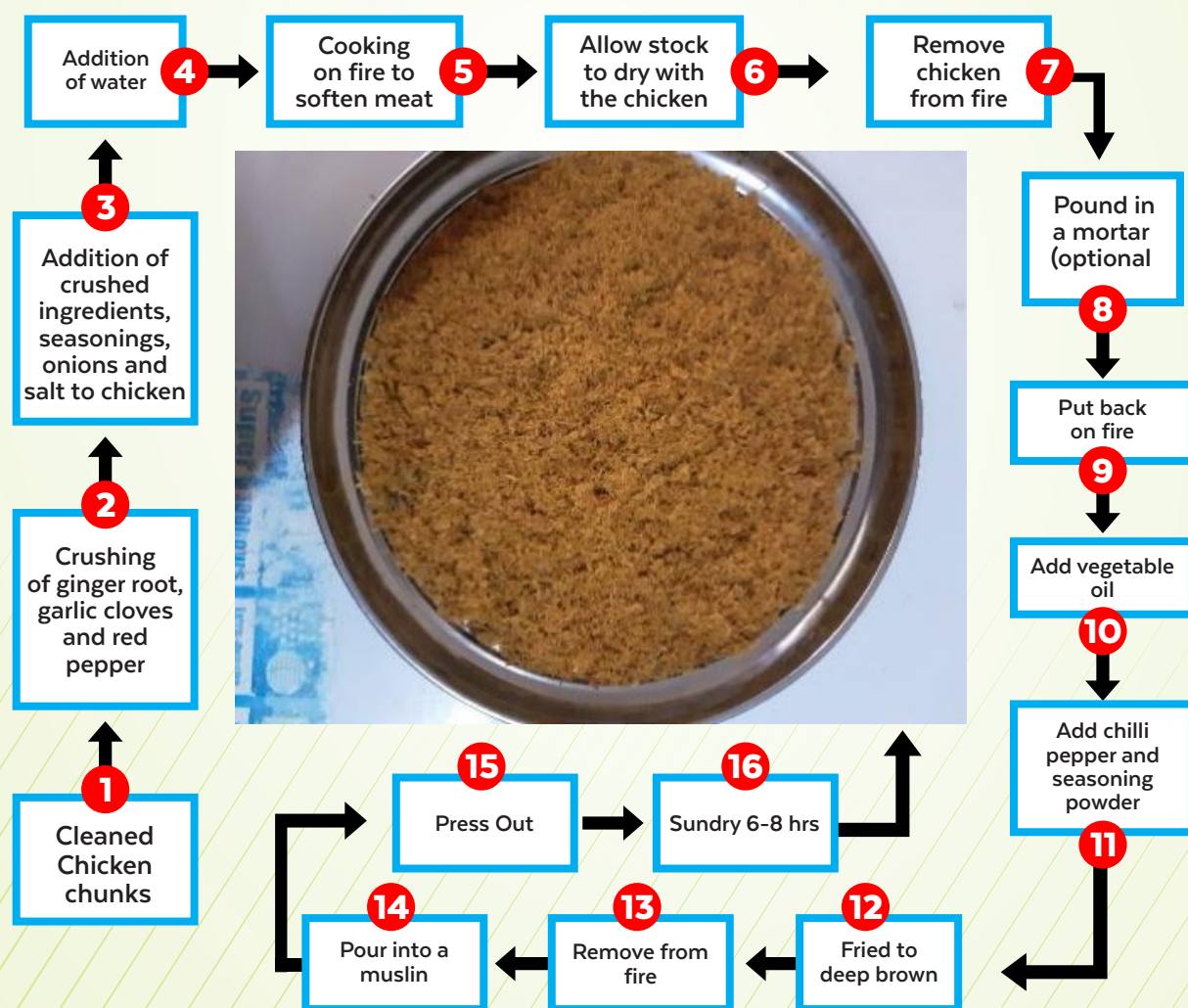
Note: Can be stored for 3-4 months

Utilization and Menu Combination

Dambu Nama can be used to make stew, added in jollof rice, yam pottage, OFSP vegetable soup.

2.2.2 Step by Step Procedure for Preparation of Dambun Kaza ((shredded Chicken/Floss)

Ingredients	Measure	Weight (g/ml)
Chicken	4 medium size	500
Ginger root/(powder)	1 teaspoon	5
Garlic Cloves of garlic	4 cloves	5
Vegetable oil	2 cups	300
Seasoning powder	2 teaspoonfuls	10
Seasoning cubes	2 cubes	
Onions	1 big	120
Red pepper	½ handful	
Ground cayenne pepper	3 teaspoon	15
Salt	½ teaspoon	3
Water	1 cup	150



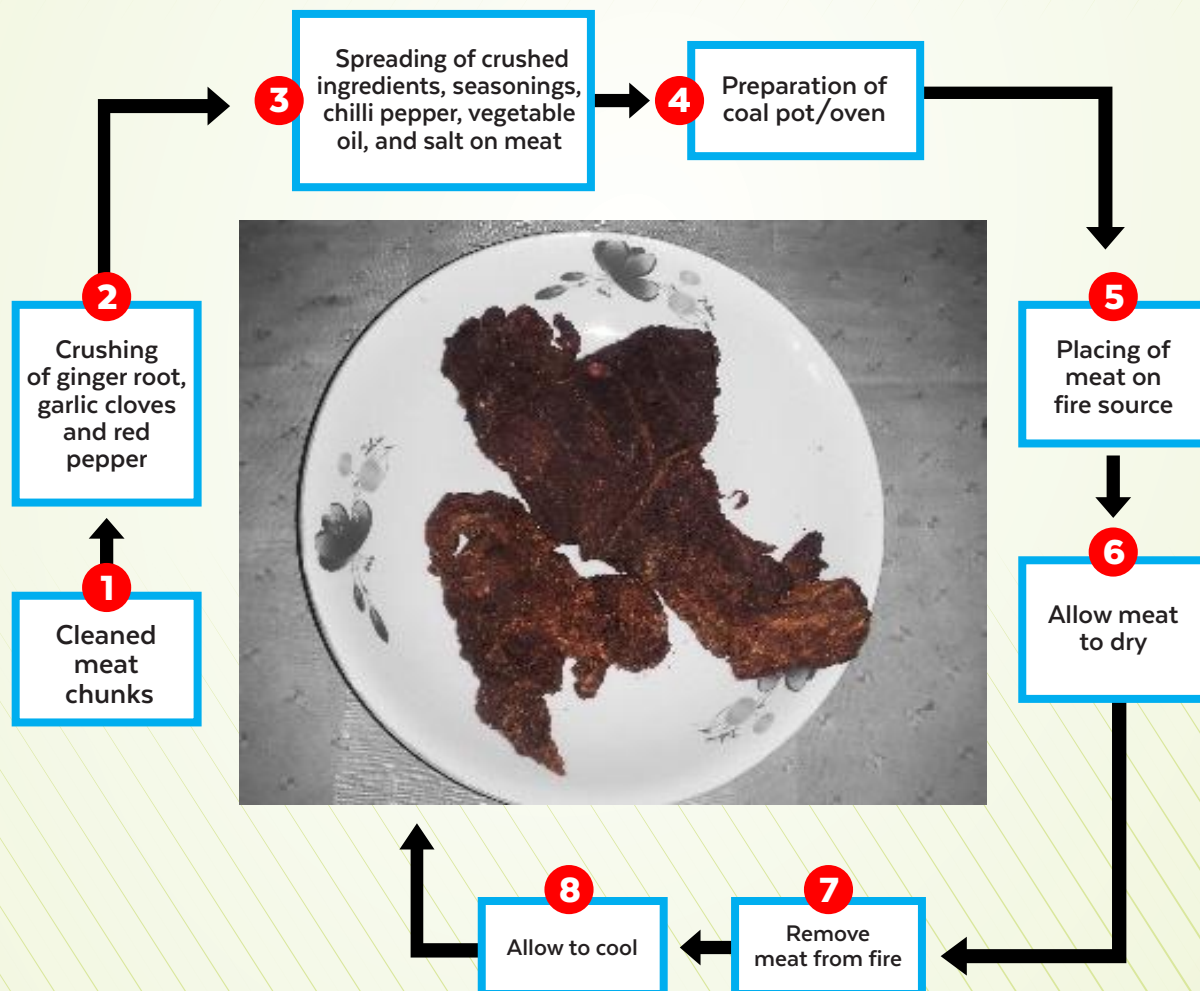
Note: Can be stored for 3-4 months

Utilization and Menu Combination

Dambu Kaza can be used to make stew, added in jollof rice, yam pottage, OFSP soup.

2.2.3 Step by Step Procedure for Production of Meat Suya/Tsire

Ingredients	Measure	Weight (g/ml)
Meat	8 medium size cut	500
Ginger root/(powder)	1 teaspoon	5
Garlic Cloves of garlic	4 cloves	5
Vegetable oil	small	10
Seasoning powder	2 teaspoonfuls	10
Seasoning cubes	2 cubes	
Ground cayenne pepper	3 teaspoon	15
Salt	½ teaspoon	3
Suya Powder	3 teaspoon	15

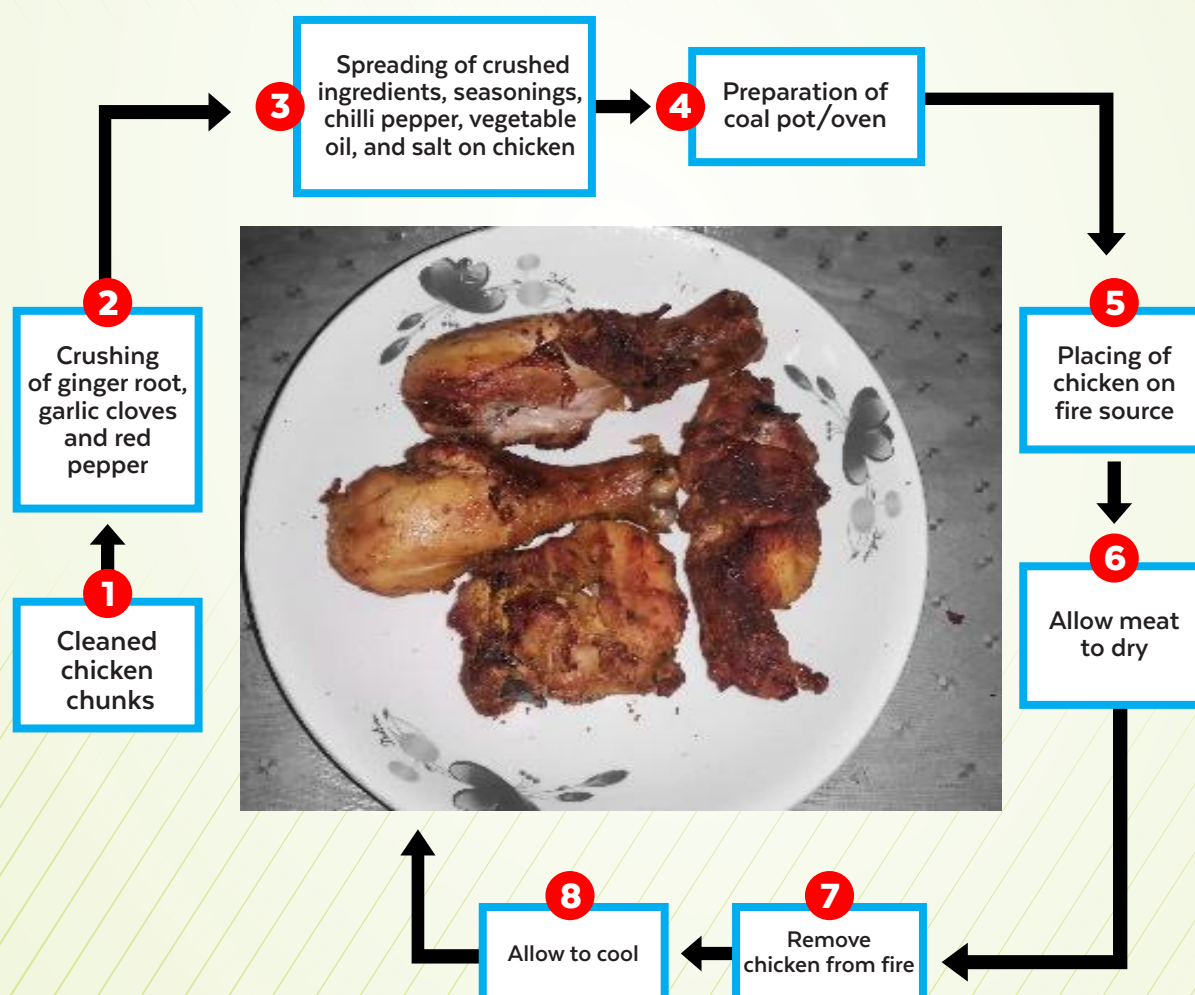


Utilization and Menu Combination

Meat Suya/Tsire can be served with masa, onion and sprinkled suya powder, used to make stew, eaten with OFSP bread

2.2.4 Step by Step Procedure for Production of Chicken Suya/Tsire

Ingredients	Measure	Weight (g/ml)
Chicken	4 medium size	500
Ginger root/(powder)	1 teaspoon	5
Garlic Cloves of garlic	4 cloves	5
Vegetable oil	small	10
Seasoning powder	2 teaspoon	10
Seasoning cubes	2 cubes	
Ground cayenne pepper	3 teaspoon	15
Salt	½ teaspoon	3
Suya Powder	3 teaspoon	15

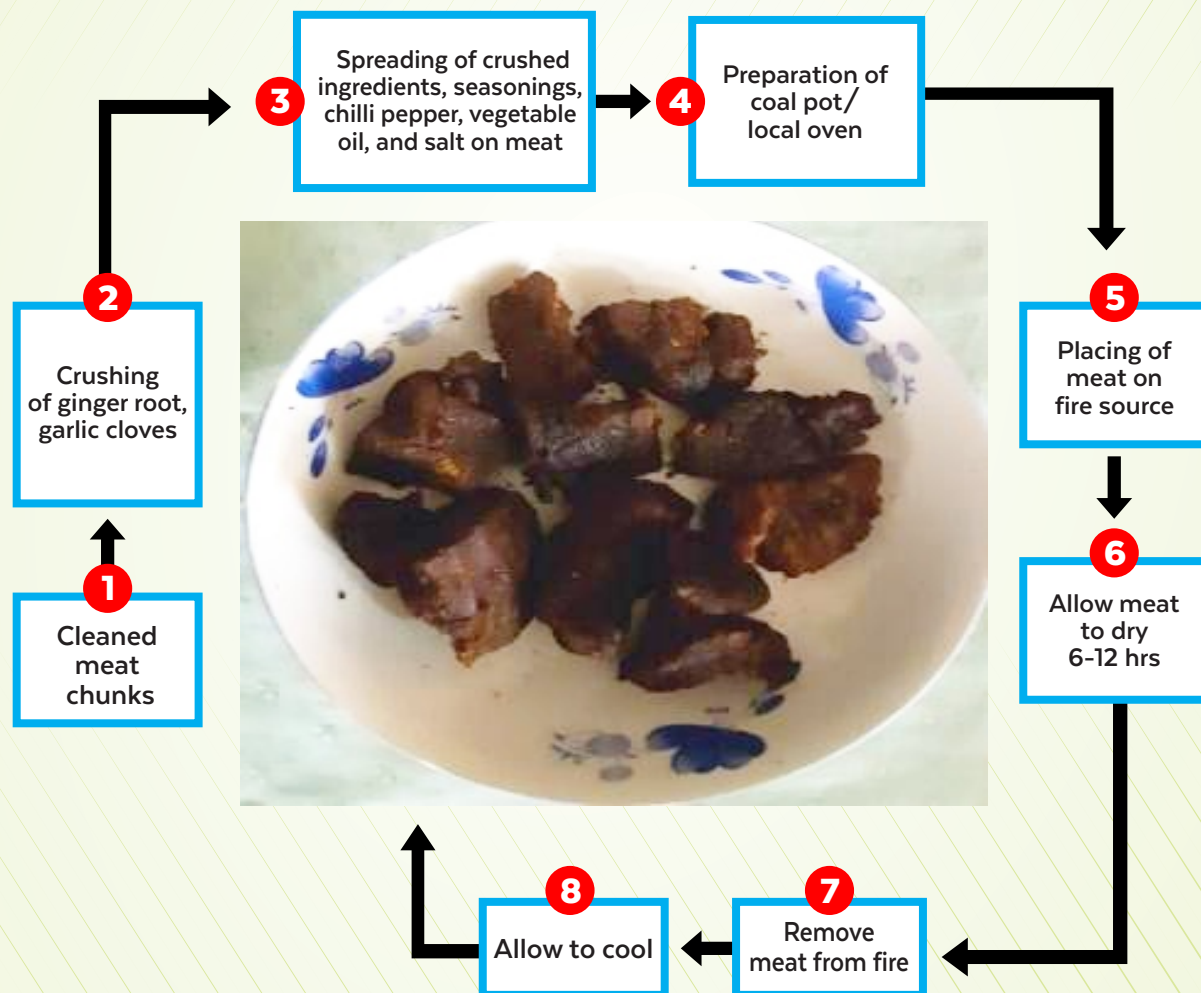


Utilization and Menu Combination

Chicken Suya/Tsire can be served with masa, onion and sprinkled suya powder, used to make stew, eaten with OFSP bread

2.2.5 Step by Step Procedure for Preparation of Smoked Meat/Smoke Dried Meat

Ingredients	Measures	Weight (Gram)
Meat	8 medium size	500
Ginger root/(powder)	1 teaspoon	5
Garlic Cloves of garlic	4 cloves	5
Vegetable oil	small	10
Seasoning powder	2 teaspoonful	10
Seasoning cubes	2 cubes	
Ground cayenne pepper	3 teaspoon	15
Salt	½ teaspoon	3

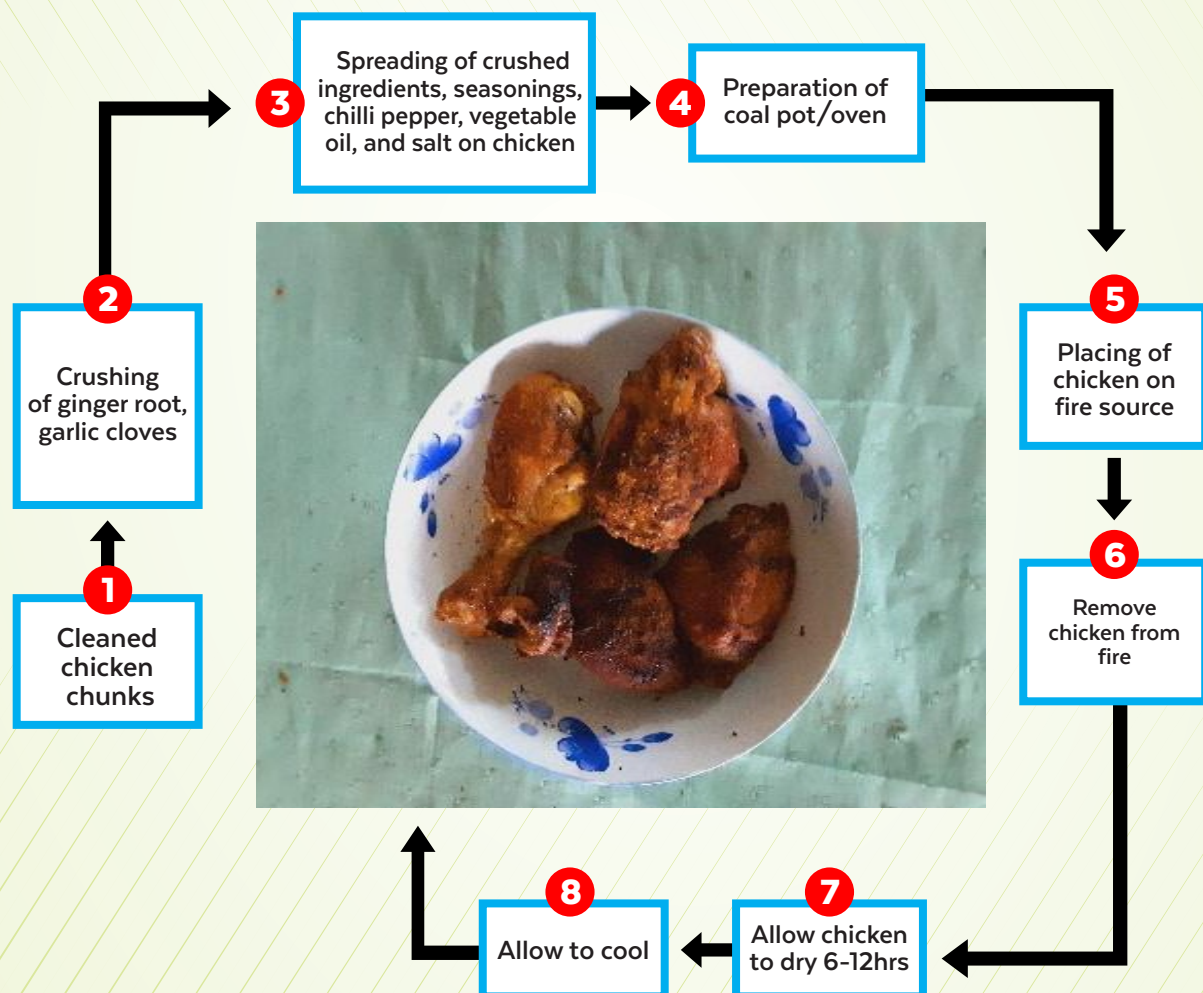


Utilization and Menu Combination

Smoke dried meat can be used to make stew, added in jollof rice, yam/OFSP pottage.

2.2.6 Step by Step Procedure for Preparation of Smoked Chicken/Smoke Dried Chicken

Ingredients	Measures	Weight (Gram)
Chicken	4 medium size	500
Ginger root/ (powder)	1 teaspoon	5
Garlic Cloves of garlic	4 cloves	5
Vegetable oil	small	10
Seasoning powder	2 teaspoonfuls	10
Seasoning cubes	2 cubes	
Ground cayenne pepper	3 teaspoon	15
Salt	½ teaspoon	3

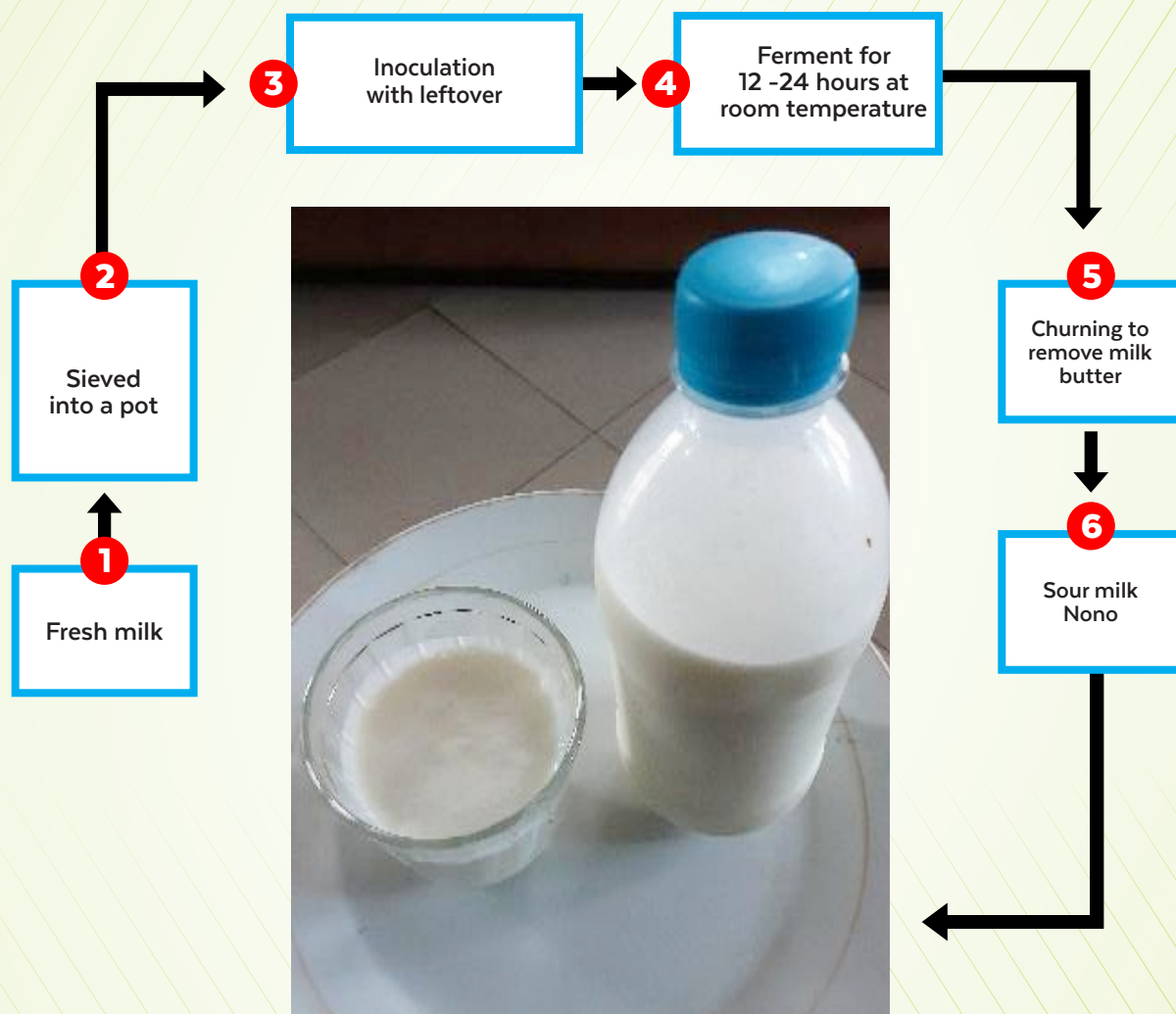


Utilization and Menu Combination

Smoke dried Chicken can be used to make stew, added in jollof rice, yam/OFSP pottage

2.2.7 Step by Step Procedure for Preparation of Fresh Milk into Nono (sour milk)

Ingredients	Measure	Weight (ml)
Fresh Milk	¼ keg	1000
Leftover milk (starter)	1 cup	150
Sugar as required		

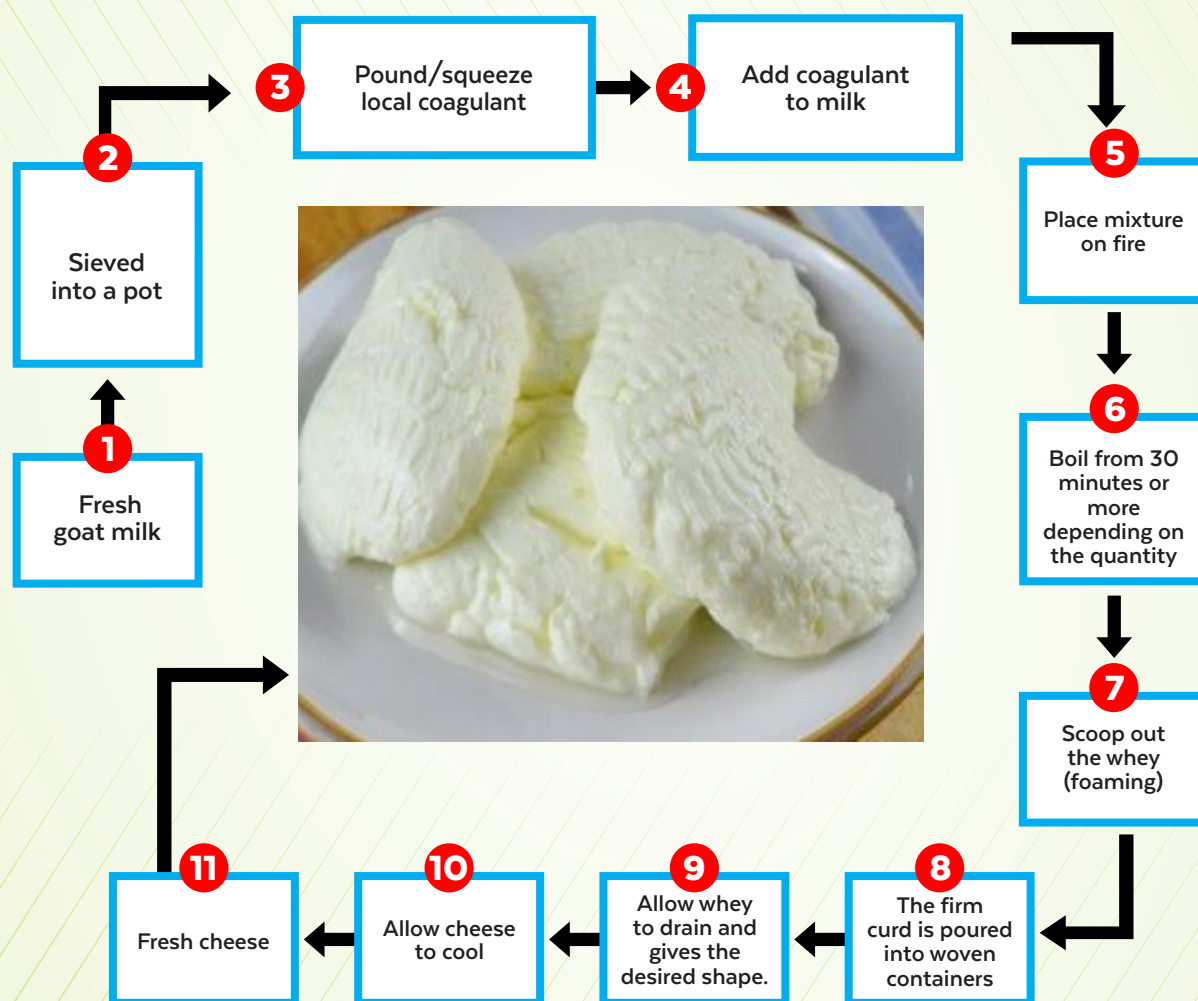


Utilization and Menu Combination

The nono is usually taken with sugar, and fura which is made up of millet flour compressed in balls. The cooked fura is crumbled in a bowl of nono (now called fura da nono). The sour milk can also be taken by young children in maize pap.

2.2.8 Step by Step Procedure for Preparation of Fresh Milk into Wara - Local Cheese (Fresh)

Ingredients	Measures	Weight (ml)
Fresh milk	½ keg	2000
Salt	to taste	
Local coagulant <i>Calotropis procera</i> (bombom plant)		
Samia or lime juice		



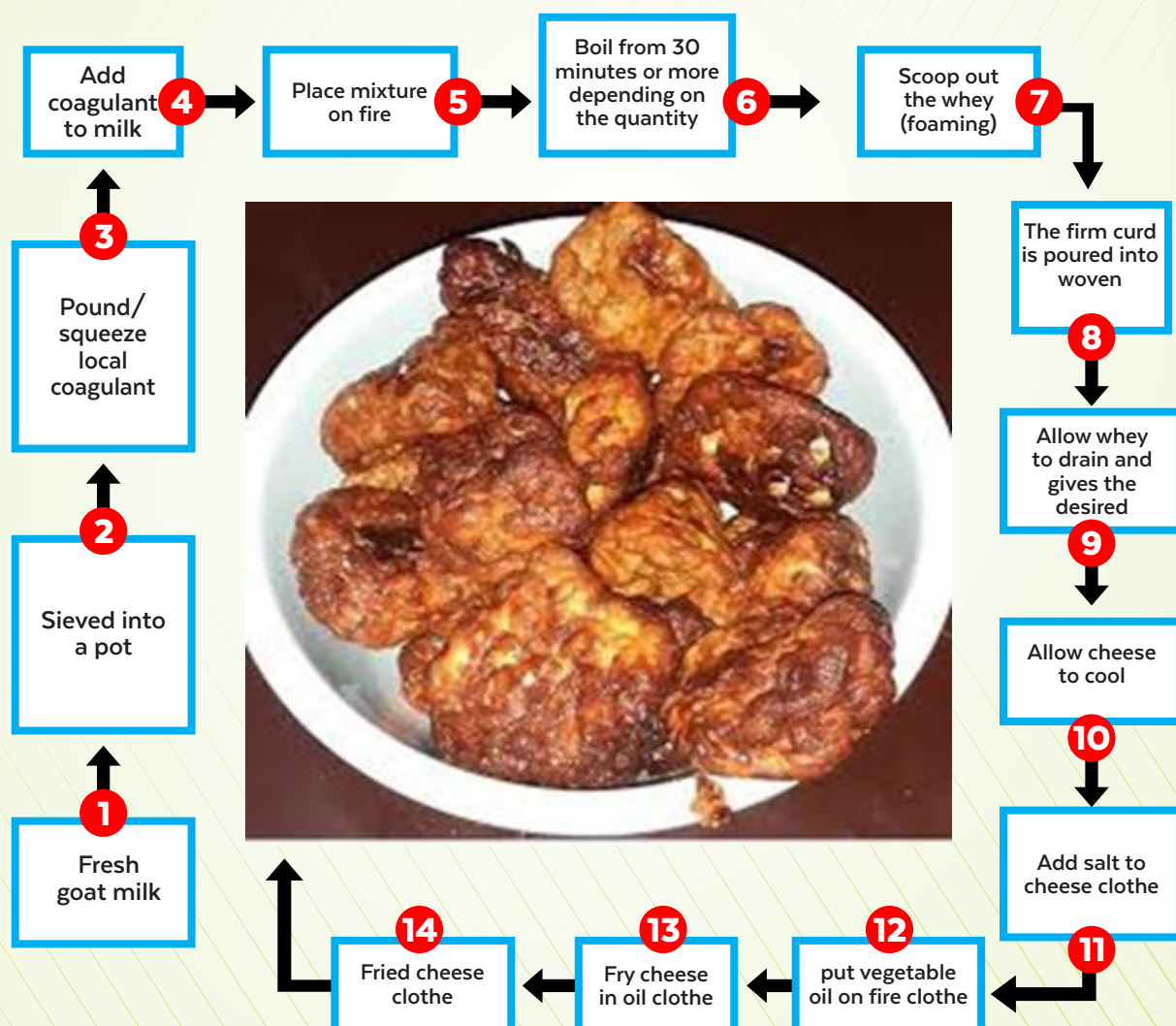
Note: The cheese can be left in whey at room temperature for 2 – 3 days before consumption.

Utilization and Menu Combination

The cheese can be consumed immediately with or without salt. It can be used to make stew, can be added to make OFSP vegetable soup.

2.2.9 Step by Step Procedure for Preparation of Fresh Milk into Wara - Local Cheese (Fried)

Ingredients	Measures	Weight (ml)
Fresh milk	½ keg	2000
Salt	to taste	
Vegetable oil	Deep fry	
Local coagulant <i>Calotropis procera</i> (bombom plant)		
Samia or lime juice		



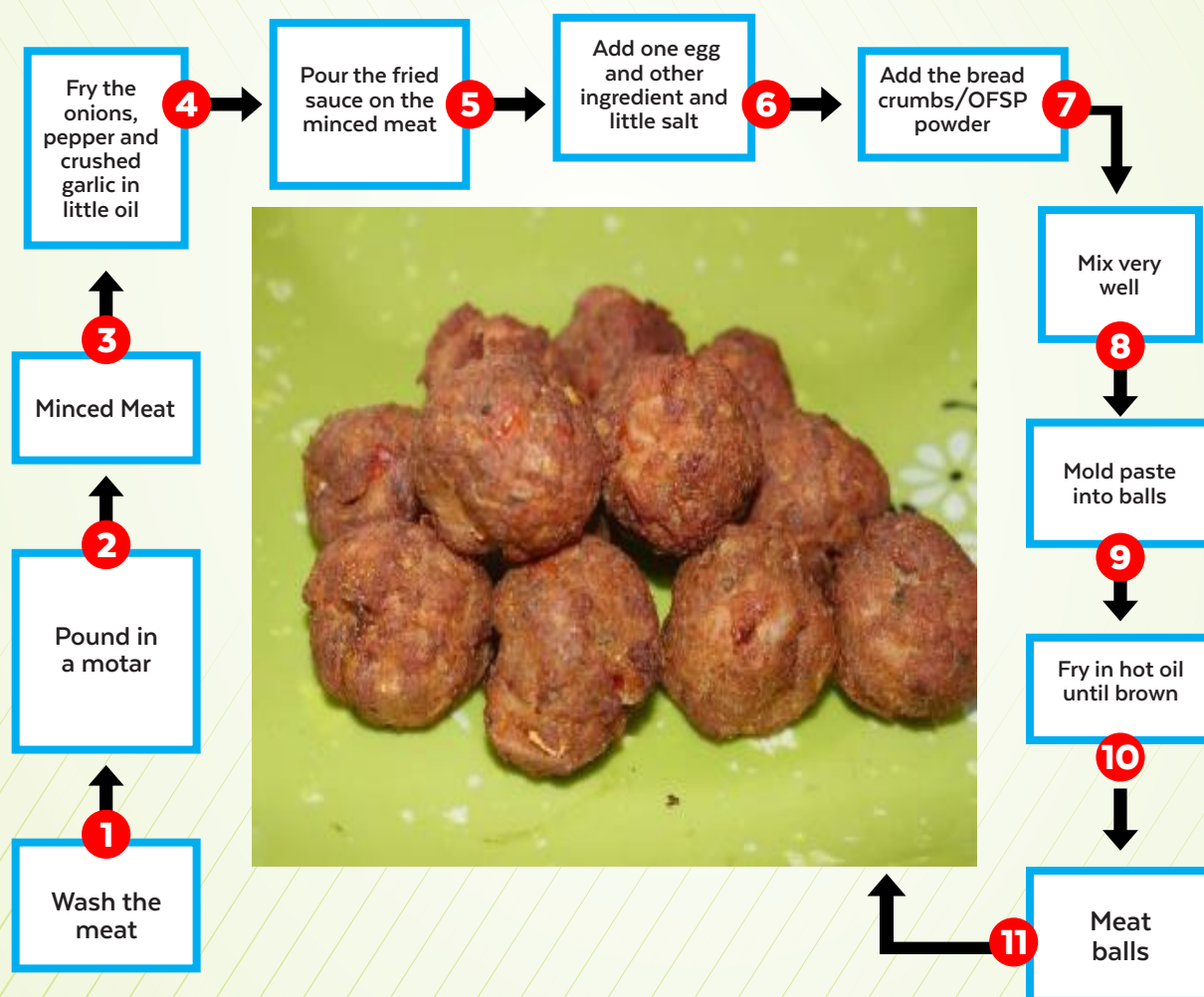
Note: Fried cheese can be stored for at least 6-8 days.

Utilization and Menu Combination

The cheese can be consumed immediately. It can be used to make stew, can be added to make OFSP vegetable soup.

2.2.10 Step by Step Procedure for Preparation of Meat Balls

Ingredients	Measures	Weight (g/ml)
Meat	8 medium size	500
Ginger root/(powder)	1 teaspoon	5
Garlic Cloves of garlic	4 cloves	5
Vegetable oil	1 bottle	750ml
Seasoning powder	2 teaspoonfuls	10
Seasoning cubes	2 cubes	
Salt	½ teaspoon	3
Onions	small size	75
Red pepper	5pcs	
Eggs	1 medium	55
OFSP powder/bread crumbs	2 table spoon	20g

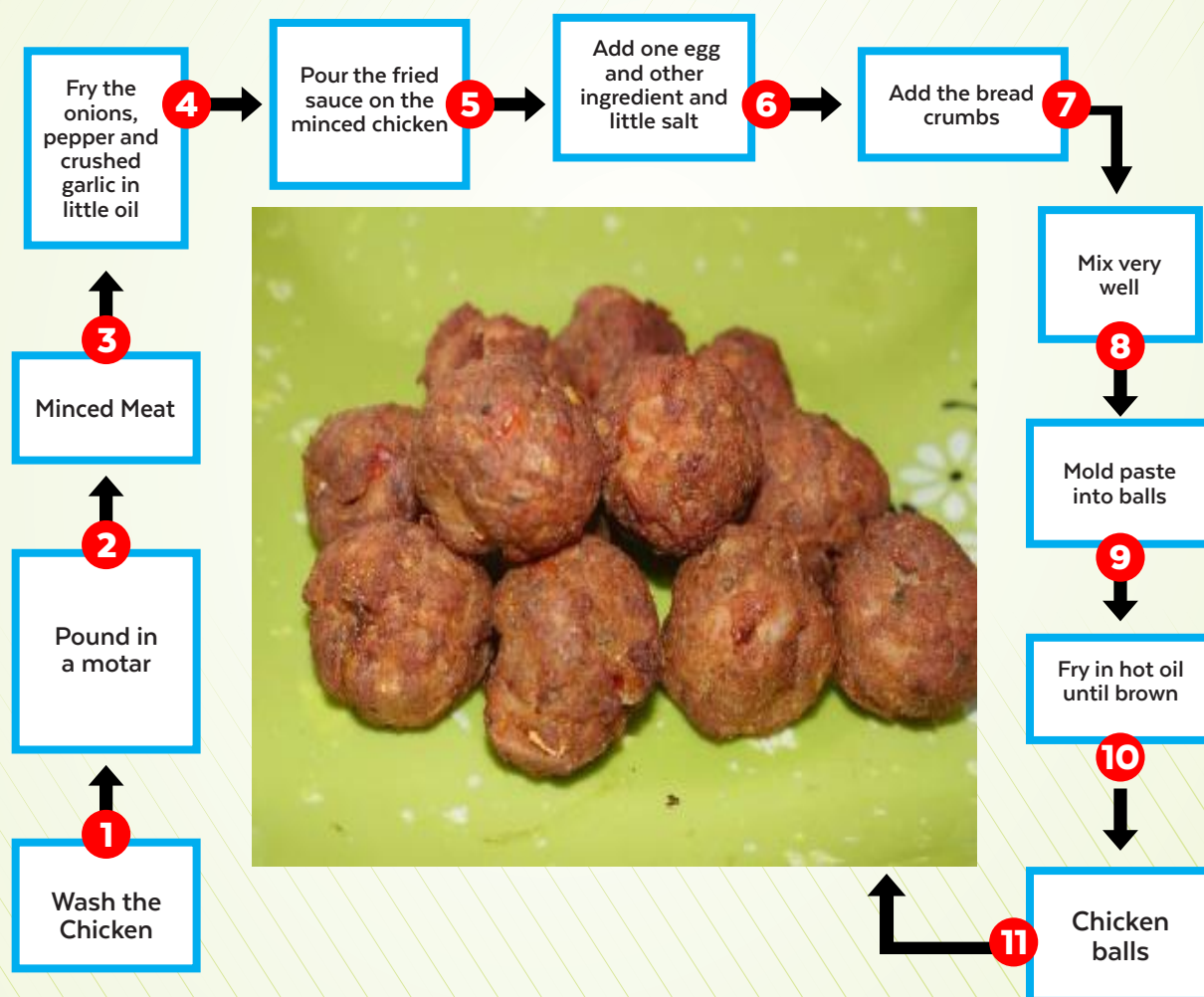


Utilization and Menu Combination

Chicken balls can be consumed immediately by using to eat bread, make stew, can be added to make OFSP vegetable soup. Make moin moin, jollof rice, OFSP pottage etc

2.2.11 Step by Step Procedure for Preparation of Chicken Balls

Ingredients	Measures	Weight (g/ml)
Chicken	8 medium size	500
Ginger root/(powder)	1 teaspoon	5
Garlic Cloves of garlic	4 cloves	5
Vegetable oil	1 bottle	750ml
Seasoning powder	2 teaspoonfuls	10
Seasoning cubes	2 cubes	
Salt	½ teaspoon	3
Onions	small size	75
Red pepper	5pcs	
Eggs	1 medium	55
OFSP powder/bread crumbs	2 table spoon	20g

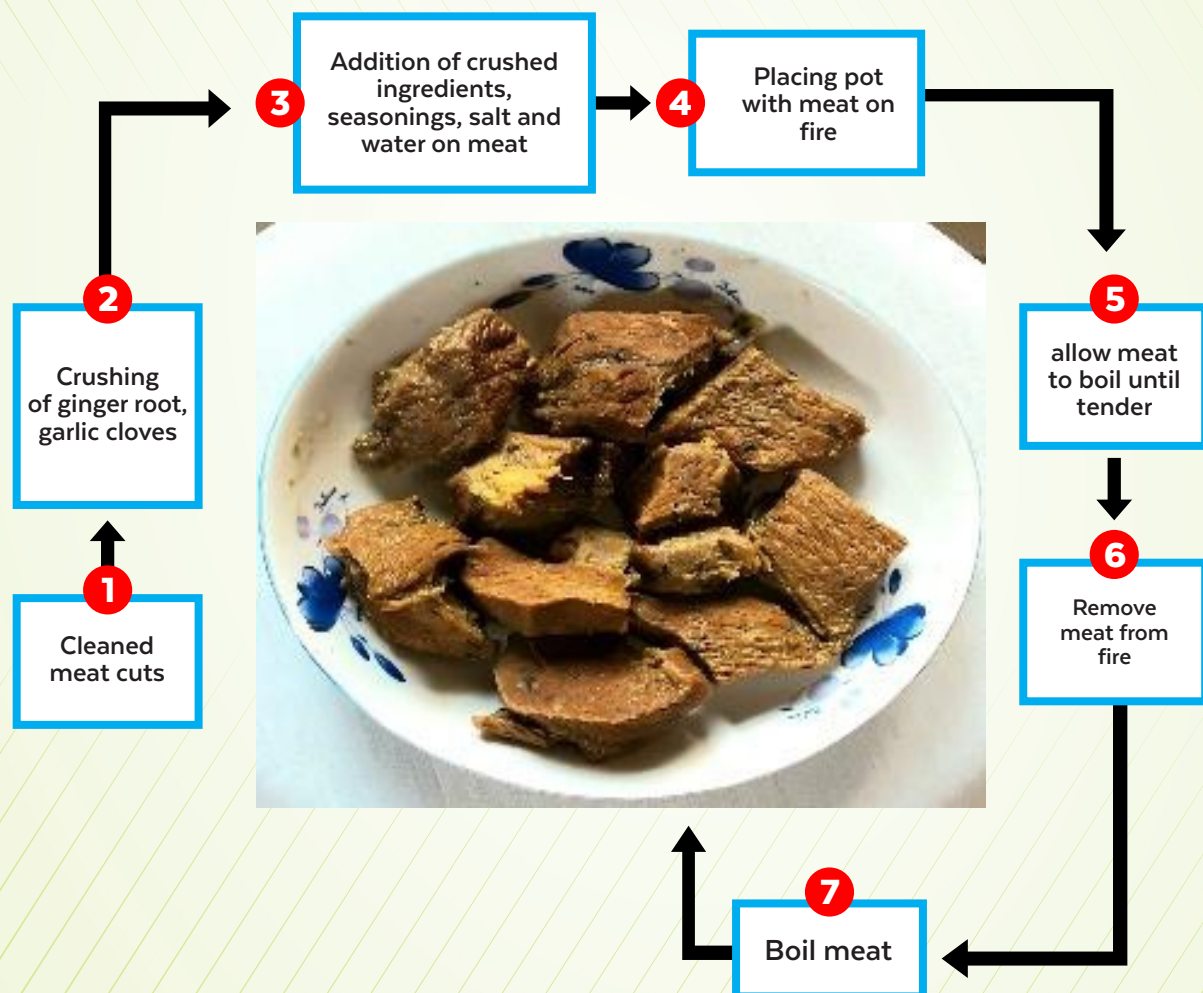


Utilization and Menu Combination

Chicken balls can be consumed immediately by using to eat bread, make stew, can be added to make OFSP vegetable soup. Make moin moin, jollof rice, OFSP pottage etc

1.2.12 Step by Step Procedure for Preparation of Smoked Chicken/Smoke Dried Chicken

Ingredients	Measures	Weight (Gram)
Chicken	4 medium size	500
Ginger root/ (powder)	1 teaspoon	5
Garlic Cloves of garlic	4 cloves	5
Vegetable oil	small	10
Seasoning powder	2 teaspoonfuls	10
Seasoning cubes	2 cubes	
Ground cayenne pepper	3 teaspoon	15
Salt	½ teaspoon	3

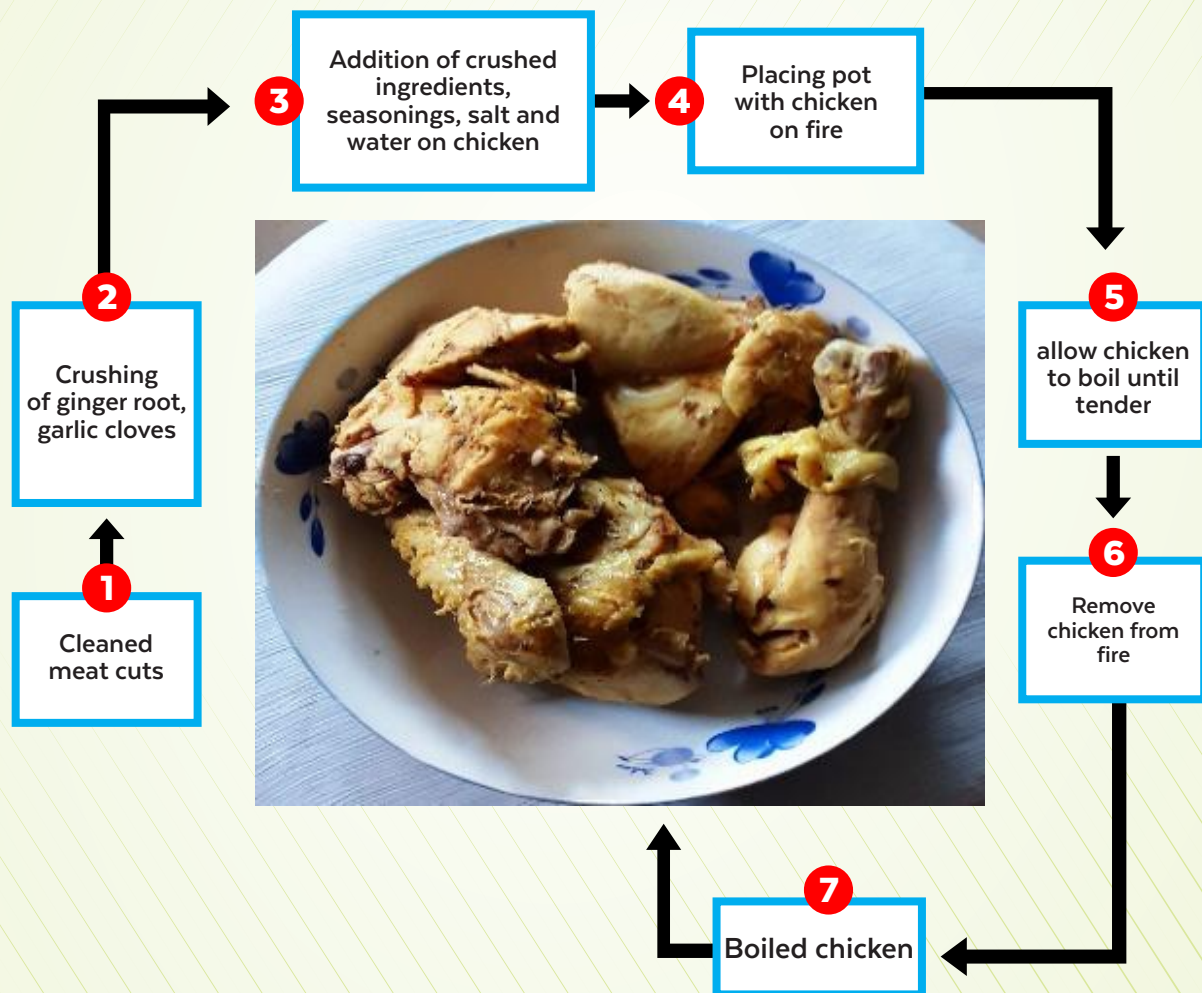


Utilization and Menu Combination

Seasoned boiled meat can be used to make stew, added to OFSP pottage, OFSP vegetable, pepper soup.

2.2.13 Step by Step Procedure for Preparation of Boiled Chicken

Ingredients	Measures	Weight (g/ml)
Chicken	4 medium size	500
Ginger root/(powder)	1 teaspoon	5
Garlic Cloves of garlic	4 cloves	5
Seasoning powder	2 teaspoonfuls	10
Seasoning cubes	2 cubes	
Salt	½ teaspoon	3
Onions	small size	75

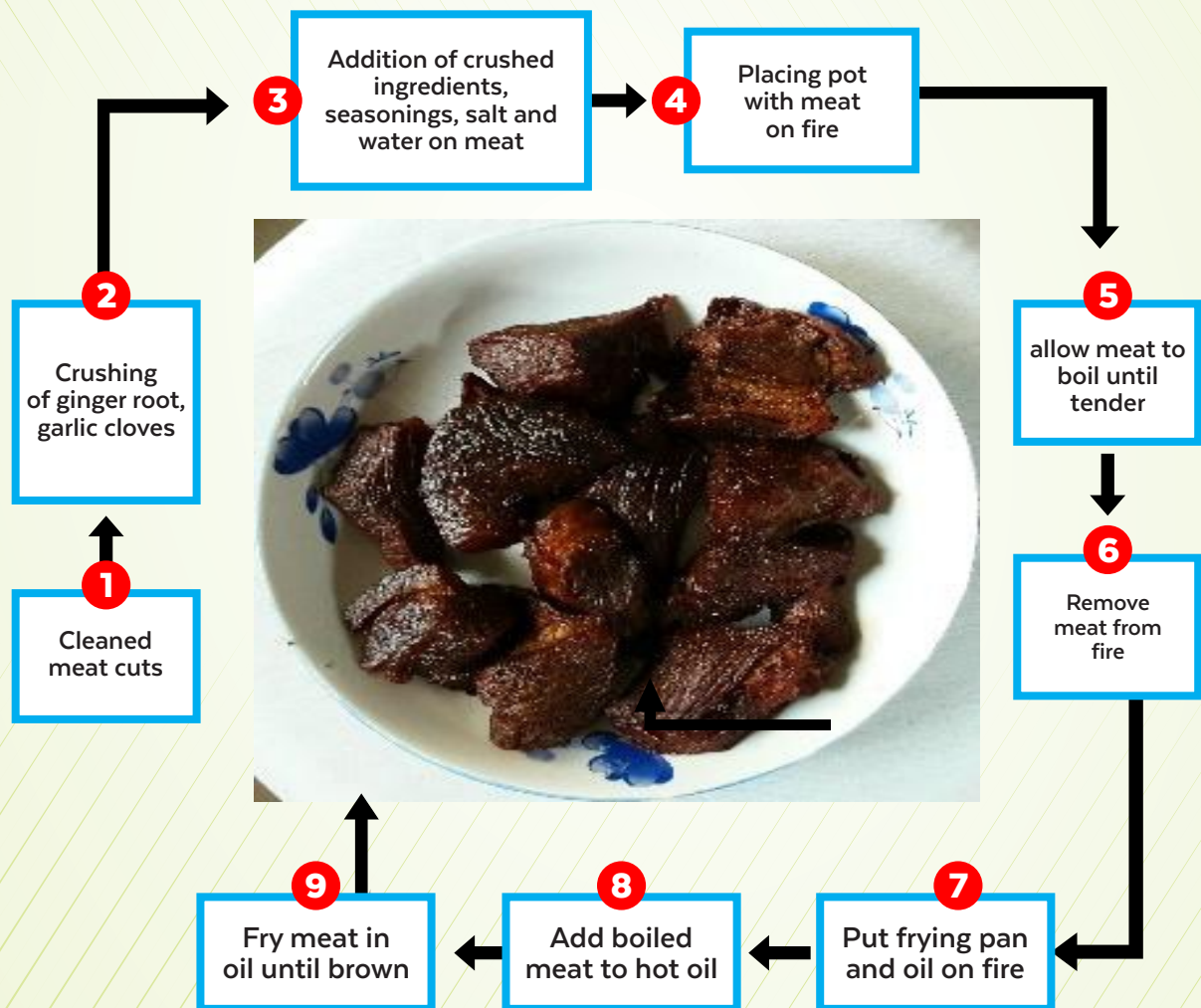


Utilization and Menu Combination

Seasoned boiled meat can be used to make stew, added to OFSP pottage, OFSP vegetable, peppersoup.

2.2.14 Step by Step Procedure for Preparation of Fried Meat

Ingredients	Measures	Weight (g/ml)
Meat	8 medium size	500
Ginger root/(powder)	1 teaspoon	5
Garlic Cloves of garlic	4 cloves	5
Seasoning powder	2 teaspoonfuls	10
Seasoning cubes	2 cubes	
Salt	½ teaspoon	3
Onion	small size	75
Vegetable oil	deep fry	

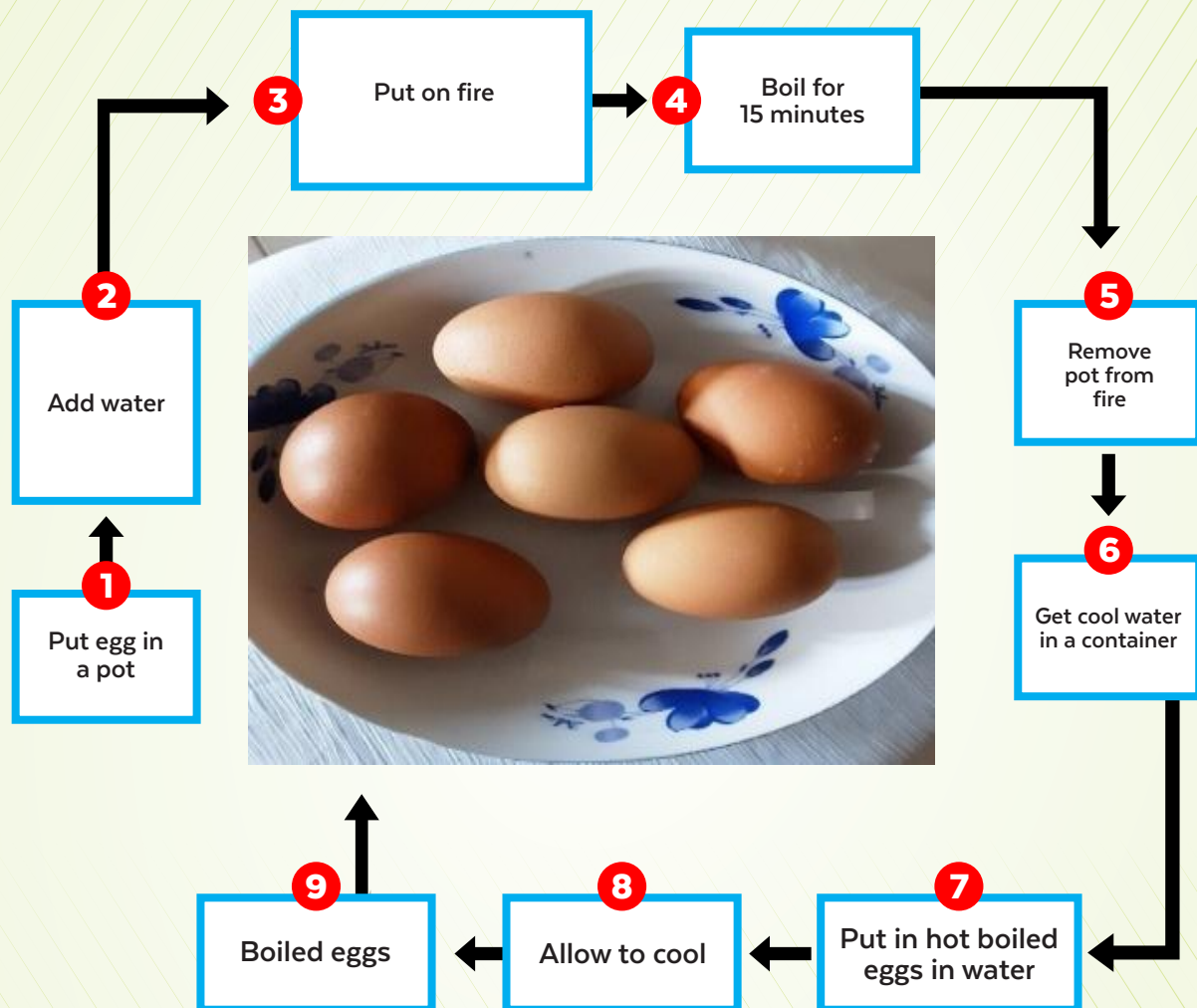


Utilization and Menu Combination

Fried meat can be eaten, used to make stew, added to OFSP pottage, OFSP vegetable, pepper soup.

2.2.16 Step by Step Procedure for Preparation of Boiled Eggs

Ingredients	Measures	Weight (g/ml)
Eggs	4 medium	220
Water		

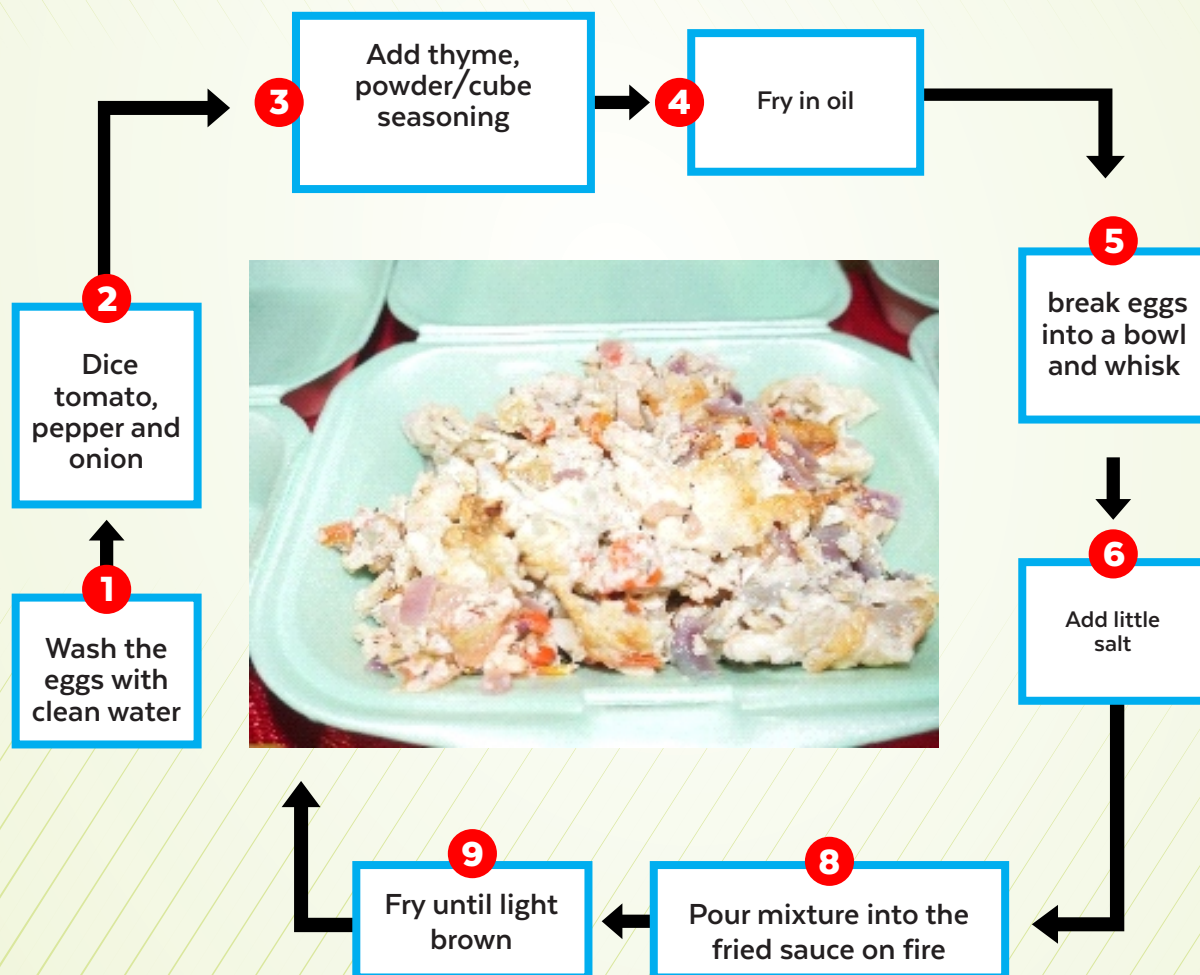


Utilization and Menu Combination

Boiled eggs can be used to cook stew, combined with rice, OFSP bread, OFSP pottage, boiled OFSP root.

1.2.17 Step by Step Procedure for Preparation of Fried Eggs

Ingredients	Measures	Weight (g/ml)
Eggs	4 medium	220
Ginger (powder)	½ teaspoon	3
Vegetable oil	½ cup	75
Seasoning powder	½ teaspoon	3
Seasoning cube	½ cube	
Tomatoes	1 medium	
Onions	1 small	75
Red pepper	3 nos	
Vegetable oil	½ cup	75



Utilization and Menu Combination

Fried eggs can be used to eat OFSP bread, OFSP pottage, boiled OFSP root.

3.0 Storage of Animal Products

3.1 Raw Products

3.1 Eggs:

Freshly laid eggs can be cleaned, put in a clean straw-based basket and kept in an aerated place at room temperature for at least a month. The integrity of the stored eggs would be intact.

Fresh eggs can also be dipped in oil for preservation and kept in well ventilated room. Eggs can be stored for 2 – 3 months with this method

3.2 Chevon and Poultry Meat:

Raw meat can only be kept in a freezer to maintain its integrity and to prevent the proliferation of spoilage microorganisms. In a local environment, fresh meat should be processed for preservation as earlier discussed to extend the shelf life.

3.3 Milk:

Milk has high water content and requires cold chain storage which may be difficult to maintain in the rural setting. However, ice blocks could be used to preserve milk for use for few hours.

Processed products

Storage of processed products requires that the moisture level must be considerable reduced to inhibit the growth of spoilage and pathogenic microorganisms.

Eggs: Processed eggs (fried or boiled) must be consumed within few hours of preparation and can only be stored by refrigerating.

Meat Products:

Meat from animal that have been properly processed for storage by employing food preservation principles through addition of salt, dehydration as well as selecting for possible desirable microflora through curing to impart desirable colour, can be stored for specified periods based on the processing techniques and reduction of moisture content.

Milk:

Liquid processed milk (nono) shelf life can be extended for storage by refrigeration for a few days before consumption. Local cheese (wara) can be stored fresh for 2-3 days in whey, while frying it can extend its shelf life for 6 – 8 days. Sundried local cheese (wara) can store for one month with repeated sundrying as required.

3.4 Equipment

Medium size cooking pots, sieve, frying pan, bowls, serving spoons, turning spoons, pestle and mortar, muslin cloth, knives, charcoal pot, local oven.

Fig 8. Sieves



Fig 9. Frying pans



Fig 10. Cooking Pots



Source: Akinfolarin 2022

Fig 11. Bowls



Fig 12. Serving/Frying spoons



Fig 13. Knives



Source: Akinfolarin 2022

Fig 14. Turning spoons



Fig 15. Muslin clothes



Fig 16. Mortar and pestle



Source: Akinfolarin 2022

Fig 17. Charcoal pot



Source: Akinfolarin 2022

Local oven/kiln

Fig 18. Local rectangular burning box



Source: scialert.net

Fig 19. Half cut aluminium drum Oven



Source: Adams 1998

Fig 20. Circular Red Clay Oven



Source. scialert.net

3.5 Packaging and Packaging materials

Meat processed for storage are packed in packaging materials that will protect the integrity of the products, protect it from cross contamination, deterioration or damages in the course transportation, storage or sales. The best packaging material for processed meat for preservation and storage is paper and paper board, cling film and aluminum foil.

4.0 Key message to the households

- i. Households should note the measurement of ingredients to maintain quality and avoid wastage.
- ii. Store processed animal products at the local environment to be used at a later date, while maintaining integrity, safe to eat and improve their animal protein consumption.
- iii. All ingredients must be prepared and measured before embarking in food processing.

REFERENCES

Eke, M. O. (2019). Orange Peel Value Chain-Process Technologies and investment opportunities. A Paper Presented at Raw Material Research and Development Council, Abuja on the 28th November, 2019: Unpublished

Fellow. P. (2000). Food Processing Technology: Principles and Practice, 2nd Edition, CRC Press; Woodhead Publishing Limited, P52-60

Herschdoerfer, S.M (1986). Quality control in the food industry; volume 2, 2nd Edition, Academic press: pp24-26.

Ibrahim, S. Inelo E. D. and Eke M. O. (2021). Physico-chemical, Alveograph and Anti-nutritional Properties of Breads Formulated from Wheat and Pawpaw (*Carica papaya*) seed Flour Blends. Asian Food Science Journal 20(3): 72-85, 2021: Article no. AFSJ.66246, ISSN: 2581-7752

Isreal, O. A.; Eke, M. O. and Edah, J. (2020). Physicochemical, Microbiological and Sensory Quality of Juice Mix Produced from Watermelon Fruit Pulp and Baobab Fruit Pulp Powder. Croatian Journal of Food Science and Technology 12(1) 48-55

Laboratory manual on food technology, nutrition and dietetics for schools and industries (2011). Produced and edited by: the department of food technology, kaduna polytechnic, Kaduna.

Olaitan, N. I; Eke, M. O and Agudu, S. S. (2017). Effect of Watermelon (*Citrullus lantus*) Rind Flour Supplementation on the Quality of Wheat Based Cookies. The International Journal of Engineering and Science (IJES) 6 (12). ISSN(e): 2319-1813 ISSN(P): 2319- 1805. . India.

Ihekoronye A.I and Uzomah A (2011). Manual on small food processing. Springfield publishers.

Adewumi F.A and Atinoke (2010). Processing techniques of tomato jam, tomato puree and tomato paste. Paper presented at NAERLS/NSPRI/NIHORT national workshop on tomato processing, preservation, storage and marketing held at the Nigerian stored products and research institute, NSPRI Ilorin 9th -13th August 2010

Calvo, M.M., Garcia M.L and Selgas M.D (2008). Dry fermented sausages enriched with lycopene from tomato peel. Meat science., 80:167-172

Adams, B. O (1998). Storage Stability of Non-Comminuted Smoke Dried Salted Rabbit Meat. MSc Thesis University of Ibadan, Unpublished Thesis

Alonge, D. O. (1984). Smoke Preservation of Meats in Nigeria. Quality and Public Health. Ph.D Thesis University of Ibadan

Ajayi, O. O., Balogun O. B., Oriowo-Olaleye, M., and M. O. Faturoti (2018). Microbial Analysis and Proximate Composition of Boiled and Fried Local Cheese (Wara). International Journal of Scientific Research Publication, Vol 8, Issue 12, December, 2018.

Belewu, M. A., Belewu, K. Y., and O. C. Nkwunwo (2005). Effect of Biological and Chemical Preservatives on the Shelf life of West African Soft Cheese. *African Journal of Biotechnology*, Vol 4 (10), Pp 1076 – 1079, October 2005

Codex Alimentarius Commission, Committee on Food Hygiene (1991). Draft principles and application of Hazard Analysis and Critical Control Point (HACCP) system. *Alinorm 93/13*, Appendix VI. Food and Agriculture Organization/World Health Organization, Rome

Dauda, A. O. (2017). Comparative Study of the Nutritional and Microbial Safety of Fried “Wara” (Local cheese), Widely Hawked in Ilorin and Ogbomosho Towns in Nigeria. *Annals of Food Science and Technology*.

Egwin E., Amanabo M., Yahaya A. and M. Bello (2013). Nigerian Indigenous Fermented Food: Processes and Prospects. *Animal products (milk, meat, nono, cheese, kilishi)*

Ethiopia Sheep and Goat Productivity Improvement Program (2009). Technical Bulletin No. 22, Proper Slaughtering and Flaying of Sheep and Goat pg 1 – 5.

F.O.A. George., A. O. Ogbolu., O.J. Olaoye., S. O. Obasa., A. A. Idowu and D. O. Odulate (2015). Fish Processing Technologies in Nigeria: A case of Ibeju-Lekki Area, Lagos State. *ScienceAlert; scialert.net*

FAO (2010). A dairy Goat Production Handbook for Farmers. Farm Africa Technologies and Practices for Small Agricultural Producers (TECA) Food and Agriculture Organization of the United Nations.

Food Safety for Canadian Regulation (2019). Poultry Dressing Procedures and Preparation of Edible Parts. Government of Canada, www.inspection.gc.ca

G. Pollot and R. T. Wilson (2009). Sheep and Goats for Diverse Products and Profits. FAO Diversification Booklet 9. Rural Infrastructure of Agro-Industrial Division, Food and Agriculture Organization of the United Nations Rome (2009).

Ikeme, A. I. (1990). Meat Science and Technology. A comprehensive Approach. African Fep. Publisher Ltd. Onitsha, Nigeria

Institute of Medicine, Food and Nutrition Board. Dietary Reference Intakes for Thiamin, Riboflavin, Niacin, Vitamin B6, Folate, Vitamin B12, Pantothenic Acid, Biotin, and Choline. National Academy Press, Washington, DC, 1998

O Zannu, D. J. Agossou and. I Koca (2018). Traditional Dairy Production in the Republic of Benin (Wagashi and Degue). *Global Scientific Journals*, vol 6, issue 9. Sept 2018

St. John A. C (1985). Manual for the Slaughter of Small Ruminants in Developing Countries 10. Food and Agriculture Organization of the United Nations Consultant.



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