NUTRITIONAL BENEFITS OF FISH AND VALUE ADDITION

Module VII of 8

Nutritional Benefits of Fish and Value Addition

Module VII

FOREWORD

The growing demand for fish in Malawi and the Southern African Development Community (SADC) region requires additional efforts by the governments to increase fish production from aquaculture. All Malawi's development policies (Malawi Vision 2063, Malawi Growth and Development Strategy III 2017-2022, National Fisheries and Aquaculture Policy 2016, National Aquaculture Strategic Plan 2021) emphasise the need to promote aquaculture development in order to enhance production from aquaculture to supplement the dwindling capture fisheries production and cannot satisfy the ever increasing demand for fish. The development policies also emphasise the need to pursue sustainable practices and climate smart technologies.

Up until now, there were many reference materials which extensionists from both government and non-governmental organisations have been using to train farmers in aquaculture principles and practice. These manuals, however, were not coherent, often providing conflicting recommendations and were not vetted by the Department of Fisheries under the Ministry of Forestry and Natural Resources as proper training materials for aquaculture. Hence, it is timely that this new aquaculture manual has been developed for use in the aquaculture practice. This manual will become a nationally recognised tool for training in aquaculture practice.
The target users of this aquaculture manual are extensionists from government and non-governmental organisations, fish farmers and trainers of these groups. The manual contains technical information as well as training plans to help the trainers to conduct training in an orderly manner.

The Ministry of Forestry and Natural Resources remains committed to foster the development of aquaculture in the country for nutritional and food security, income generation and job creation.

Yanira Ntupanyama, PhD.
Secretary for Forestry and Natural Resources

PREFACE

This Technical Manual for Trainers on Good Pond Aquaculture Practices has been developed to address the gap that existed when the country did not have a universal, nationally recognised manual as basis for training our extension agents, fish farmers and for use by non-government organisations engaged in the aquaculture sub-sector. This manual will be a reference material for guiding aquaculture practices in Malawi. Accordingly, the manual has been developed to support the implementation of the National Fisheries and Aquaculture Policy 2016 which highlights sustainable aquaculture development as policy priority number 2 and the National Aquaculture Strategy (2021-2029).

There are several challenges that exist in the aquaculture sub-sector that need to be addressed for the benefit of fish farmers and extension workers. The major challenges include: lack of harmonised approaches and information to guide all players in the value chain, inadequate supply and access to inputs i.e. quality fingerlings and feed, unavailability of market structures to aggregate production and measures to increase the resistance of the sector against risks related to climate change.

It is expected that this aquaculture manual will become the necessary tool for all actors along the aquaculture value chain mainly for technical know-how regarding aquaculture production. Where possible, trainers or users may be guided by the aquaculture experts from the Department of Fisheries under the Ministry of Forestry and Natural Resources.

Friday Njaya, PhD.
Director of Fisheries

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The Department also acknowledges the efforts and technical contributions from all the government officers, academicians, technicians and practitioners who took part in the development of this manual. Thanks should also go to the team that finally edited the manual.

Special recognition and gratitude are extended to the GIZ Food and Nutrition Security Program (FNSP) for contributing the chapter on nutritional benefits of fish and all individuals who were involved and contributed in the development of this manual.

INTRODUCTION

Malawi is bestowed with huge water resources with a variety of fish species. This in itself creates and opportunity to exploit its resources for both domestic consumption as well as expanding export markets. Globally, fish demand is increasing because of its health benefits besides being a cheap source of proteins. It's a fact that we all need good food. Good nutrition is a prerequisite to a healthy and productive individual, family and community. This can be achieved through promotion of appropriate food selection, diet diversification, food preparation and feeding practices. The aquaculture sector is crucial in improving food and nutrition security and has an increasingly important role in fighting hunger, as articulated in the 2030 Agenda and the Malawi 2063. Aquaculture production provides an opportunity to enhance household capacities to consume diverse and nutritious foods. Therefore, fish presents a valuable source of nutrients and micronutrients which contribute to diversified and healthy diets. Fish is a cheap source of valuable nutrients for many households in Malawi. Many households often tend often tend to grow high-value products and purchase cheaper ones for family consumption, and fish can easily be purchased by an average household, thereby improving the nutritional security of Malawians. The main challenge is now on how to preserve and process fish in order to maintain its quality.

This module presents the nutritional value of fish, value addition and how it can lead to a more food and nutrition secure state. The module further seeks to provide knowledge on effective ways of processing, developing value added products and utilization of fish and fish products and possible best storage methods. Skills on how to make different fish recipes will be gained.

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Importance of Fish in Human Nutrition

1

Introduction

The Malawi Agriculture Policy promotes food and agriculture based approaches for improving nutrition including production and consumption of diversified foods from all the six food groups. The policy has an emphasis on the foods with high nutritive value of which fish is one of them. To achieve optimal nutrients from fish, there is need to enhance good preserving, processing and storage practices. This chapter is presenting the importance of the consumption of a diverse diet, the various methods of processing/preserving fish and how to prepare different fish products.

Aim

The aim of this module is to improve knowledge and understanding of consuming fish, importance of fish in nutrition and food security and acquire skills in preparation of various meals containing fish.

Objectives

- Participants know
- Importance of eating fish
- How to preserve and process fish

Acquired skills

- Fish preservation and processing methods
- Preparing different fish products

- Acquired attitudes
- A healthy and well-nourished population can be achieved

- Relevance to fish production
- Well preserved and processed fish and fish products for increased acceptance on the market leading to more profits
- Ignite change for nutrition practices at community and household levels as well as build support for an enabling environment for eating farmed fish as a source of nutrition

- Session Overview: This chapter has one session on importance of fish in Human Nutrition, preservation and processing
- Materials: Flip- chart paper, markers, study notes, posters
- Mode of delivery: Lectures, group discussions and practical
- Duration : 60 minutes

Mode of delivery: Lectures, discussions and practical

1.2 Importance of Fish in Human Nutrition

The fisheries and aquaculture sector is crucial for improving food security and human nutrition. As a cheap source of nutrition amongst communities, the demand of fish is increasing despite the decreasing supply from the capture fisheries. Aquaculture is considered as the alternative to meeting the fish deficit as it helps to save fish from the wild. With improved fish farming technologies coupled with improved fish seed, feed and use of crop based feedstuffs and lower fish meal use, will likely increase fish supply thereby influencing people to eat more of the farmed fish. A focus on the nutrient content of farmed fish is important when they have a key role in food based approaches to food security and nutrition. The awareness about fish as an important part of a healthy diet is well known by many, but its accessibility at times is the challenge. Apart from fish providing essential nutrients at affordable price, fish also contributes to the food and nutritional security not only amongst poor and marginalized households. Fish and fish products are a good source of high quality protein which estimated to be approximately 5 - 15% higher than that from plant sources.

1.1.1 Health benefits of eating fish

Fish can be considered as a treasure store of nutrients. Fish is a low-fat high quality protein. Fish is filled with omega-3 fatty acids and vitamins such as D and B2 (riboflavin). Fish is rich in calcium and phosphorous and a great source of minerals such as iron, zinc, iodine, magnesium and potassium. Fish is packed with a protein, vitamins, and nutrients that can lower blood pressure and help reduce the risk of heart attack.

Fish as a source of omega-3 fatty acids, it should be known that these essential nutrients keep our heart and brain healthy. Two omega-3 fatty acids found in fish are EPA (eicosapentaenoic acid) and DHA (docosalhexaenoic acid). Our bodies don't produce omega-3 fatty acids so we must get them from the food we eat. We get these fatty acids in the fish we eat.

Fig 1.1 and Fig 1.2 Fish consumption as a good source of proteins

1.2 Nutritional Status in Malawi

Malawi as a Nation is still grappling with developing her capacity, challenged by many factors such as poor nutrition that affects cognitive development, poor health services, especially at community level amongst others. Malnutrition is therefore one of her challenges and has a significant bearing on her children's future development and health with wider implications on socio-economic development. Improving access

to nutritious food, especially in the first 1000 days of life, to improve to improve cognitive development is necessary. Halting intergenerational stunting by prioritizing women's health and nutrition is critical.

In addressing the issues of nutrition, Malawi Growth and Development Strategy (MGDS) III as also outlined in the Malawi 2063, recognizes nutrition as an essential component of the country's human capital and economic growth and development. Aligned with the MGDS III, the Government developed the National Multi-Sector Nutrition Policy 2018-2022 whose goal is to have a well-nourished Malawian population that effectively contributes to the economic growth and prosperity of the country. The Policy amongst other things seeks to improve livelihoods and resilience to promote access to and consumption of diverse diets among young children and pregnant women. This will ensure a good quality of life that is supported by the availability and accessibility of effective and efficient health care services and good nutrition supported by an effective health living educational programme. Fish is therefore one of the cheapest sources of good nutrition that can be easily added in a diet.

Carefully designed social and behavior change interventions can ignite change for nutrition practices at the community and household levels as well as build support for an enabling environment for nutrition. Improving knowledge, attitudes, beliefs, and behaviors related to fish consumption and nutrition, would help to improve nutritional status of the Malawian population, especially nationally vulnerable groups. Inclusion of fish recipes in household meals is one of the interventions that can change nutrition practices amongst many household thereby promoting their nutritional status. Various measures have been put in place to address underweight and other malnutrition related challenges. For example, the establishment of early childhood development centers can help in providing children with various products. As there are feeding programs in these ECDC's, inclusion of fish products in things like porridge would be advised.

1.2.1 Understanding Malawi's nutrition and food security situation

Malawi is a predominantly rural, agricultural country. However, agricultural production and household diets still focus primarily on one food group—staple foods (mostly maize with some rice, cassava and potatoes)—and limited production and consumption of five other food groups (fruits, vegetables, legumes and nuts, animal products, and fats). Poor food diversification is exacerbated by seasonal unavailability and/or lack of understanding about the food diversity that is available naturally. The result is family diets that do not include the recommended six food groups every day of the year. Not all food groups have to be eaten at one meal, but by the end of each day, all food groups should be consumed for a balanced diet.

Over the past decades, Malawi has experienced a decline in the rates of child under nutrition.

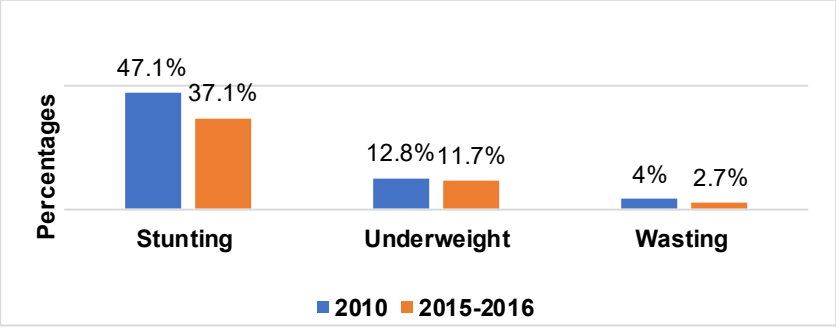

Table 1.1: Trends in the Child Under nutrition (2010-2016)
Source: MDHS (2010 &2015-16)

Malnutrition is still a problem in many countries particularly in Africa. And in Malawi, malnutrition is prevalent with nearly 37% of under-five children being stunted. Stunting is an indication of chronic under nutrition. The underlying causes of under-nutrition include poor child feeding and care practices, inadequate education and lack of knowledge which lead to poor food processing and utilization of high nutritive value foods (MGDS III). Micronutrient deficiencies of vitamin A, iron and iodine are also of public health concern in the Malawi and in the African region. Their consequences include nutritional blindness, poor learning capabilities, poor growth and increased morbidity and mortality rates. Development and agricultural programmes including fisheries and aquaculture which mainstream nutrition issues can go a long way in alleviating the problem of malnutrition in this part of the world as well as in other countries. With so many projects in Malawi aimed at improving nutrient deficiencies, the current status indicate that Vitamin A deficiency has decreased. However, trends for micronutrient deficiencies among vulnerable populations in Malawi are lacking. Current Zinc deficiency is high in all subgroups, ranging from 60% to 66% and Iron deficiency in preschool children is 22% (NSO 2017).

1.2.2 Six food groups and where fish falls

Eating a wide variety of food allows humans to have all the nutrients they need to live healthy and active lives. Malawi has six food groups. Each food group provides similar nutrients, but every food is unique, so eating a variety of foods from each food group helps provide a balanced diet. Fish in the six food groups is in the animal foods which include all foods of animal origin, including meat, eggs, milk products, fish (e.g., matemba, utaka, usipa, kapenta, makakana, chambo), and insects (e.g., bwanoni, ngumbi, mafulufute, mphalabungu). They provide the body with important protein, vitamins, and minerals.

The good thing with the protein content of fish flesh, in contrast to the fat content, is highly constant, independent of seasonal variations caused by the feeding and breeding cycles, and shows only small differences among species.

As we often here the terms food, nutrition and nutrients, let us remember this;

- Food

Food is defined as any substance containing nutrients (such as carbohydrates, proteins, and fats) that can be ingested by a living organism and metabolized into energy and body tissue. In essence, food stimulates growth, helps us to stay alive and produces energy.

- Nutrients

Nutrients are the chemical substances found in food. They are extracted from food as it passes through our digestive system and are used by the body to perform its functions. Nutrients contained in food are needed in the right amounts and combinations for the body to function properly.

- Nutrients are divided into two broad categories: MACRO nutrients and MICRO nutrients.
    - o Macronutrients are required by the body in large amounts; they include carbohydrates, proteins and fat.
    - o Micronutrients are required in relatively smaller amounts by the body; they include vitamins and minerals.

The body needs a mixture of both macro and micro nutrients for it to be healthy and function optimally. We access these nutrients through eating food.

- Nutrition

The term 'nutrition' broadly covers all processes through which we obtain, prepare and eat food. It further describes what different foods are made of (i.e. nutrients) and the processes through which our bodies make

use of the nutrients to enable us to perform daily activities such as work.

- **Adequate nutrition**

Refers to the availability refers to the availability of food in a quantity and quality sufficient to satisfy the dietary needs of individuals, free from adverse substances, combined with regular physical activity.

- **Food Security**

- Is defined as including both physical and economic access to food that meets people's dietary needs and food preferences for a productive and healthy life. Food security has for components: food availability, food access, food utilization and stability of the first three components

Table 1.2: Six Food groups and their roles in nutrition

Food group	Main nutrients	Function
Staples	Carbohydrates	Staples are high in carbohydrates. They are an inexpensive source of energy for growing, working, learning and playing
Vegetables	Vitamins, minerals and fibre,	Vegetables provide nutrients vital for health and maintenance of your body.
Legumes and nuts	Protein, carbohydrate, minerals	Important and inexpensive source of plant protein.
Fruit	Carbohydrates and Vitamins	They protect the body from illnesses and they also provide some energy
Food from animals	Protein, fat	Foods from animals contain high quality proteins and most provide vitamins, minerals, and fat.
Fats and oils	Fat	Fats and oils are an important source of energy in the diet and can provide significant vitamins and minerals. Fats are important for the absorption

1.2.3 Role of fish in food and nutrition security in Malawi

Often referred to as "rich food for poor people," fish provides essential nourishment, especially quality proteins and fats (macronutrients), vitamins and minerals (micronutrients). The contribution of fish to food and nutrition security in Malawi has continued to be of paramount importance, supplying over 70% of the dietary animal protein intake and 40% of the total protein supply (GoM, 2017). Much of the fish is consumed in rural areas thereby contributing significantly to daily nutritional requirements to some of the vulnerable groups such as HIV/AIDS victims, orphans and the poor. Despite the huge reliance on fish for human nutrition in Malawi, the current per capita consumption is also low (11kgs/person/year), and has also not been adequately integrated into national strategies to combat under nutrition.

Though fish can be eaten as a snack, fish contributes to food security as an important accompaniment to rice based diets, maize and cassava based diets, though its consumption there is decreasing due to its scarcity and high costs. Fish supply in Malawi has been declining for a number of reasons while the demand has increased due to the rise in population. Strategies to increase fish supply are being promoted.

1.3 Nutritional Value of Fish

1.3.1 Fish

Fish provide essential macro and micronutrients which are necessary to end malnutrition and reduce the burden of communicable and non-communicable disease around the world. Fish provide a healthy lean protein, crucial fatty acids, including omega-3 polyunsaturated fatty acids, and essential micronutrients, including vitamins A, D, and B and calcium, zinc, iron, and iodine necessary for cognitive development and function, in particular those at risk such as children and women. In many resource-poor settings, they are the most accessible form of animal-source food and greatly enhance the nutritional adequacy of diets based largely on starchy staple crops. Protein from fish is said to be 5-15% more digestible than that from plants, and fish protein improves the digestion of plant protein. Table 2 shows comparison of fish (tilapia) with plant-source foods and other animal-source foods in terms of nutrient content.

Table1.2: The protein content of fish and other foods (per 100 g)

Common name	Protein (g)
Tilapia	20.80
Ground beef	14.30
Chicken breast	14.70
Cow's milk	3.28
Cassava	1.40
Rice	2.69
Kidney beans	8.67
White Corn	9.47

The micronutrients of major public health concern in Malawi are Vitamin A, Iron, Iodine, Selenium and Zinc. Fish has essential micronutrients and poses a high potential in addressing micronutrient deficiencies. Small fish species are rich in micronutrients, in particular, Vitamin A, Calcium, Iron and Zinc, as they are consumed whole including their bones, heads and viscera where most of the aforesaid micronutrients are concentrated. The recommendation is to eat at least two servings of fish per week. A serving is equal to 85gm and fits in the palm of one's hand.

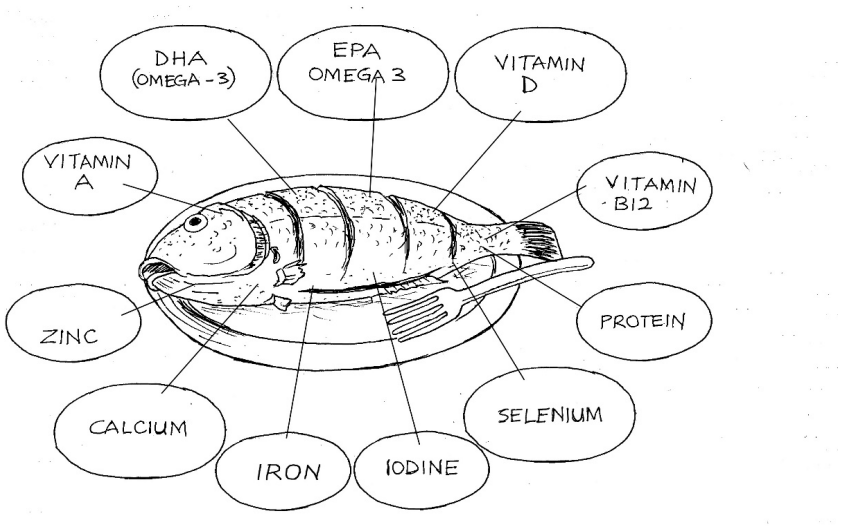

Fig 1.4 Key Nutrients Found in

1.3.2 Fish and some Macronutrients

- Proteins

Proteins are important for growth and development of the body, maintenance and repairing of worn out tissues. They further help in the production of enzymes and hormones required for many body processes. Fish provides easily digested protein of high biological value and this has served as a justification for promoting fisheries and aquaculture activities in several countries. On a fresh weight basis, fish contains a good quantity of protein of about 18 - 20%, and contains all the eight essential amino acids including the sulphur containing lysine, methionine, and cysteine. As most maize based diets lack these compounds, rural households in Malawi dependent on maize greatly benefit by increasing their fish consumption. Fish also complements cassava based diets which are generally low in protein.

- Fats

The fat content of fish varies depending on the species as well as the season but, in general, fish have less fat than red meats. The fat content ranges from 0.2% to 25%. However, fats from fatty fish species contain the polyunsaturated fatty acids (PUFAs) namely EPA (eicosapentaenoic acid) and DHA (docosahexaenoic acid) (omega 3 fatty acids) which are essential for proper growth of children and are not associated with the occurrence of cardiovascular diseases such as coronary heart disease. In pregnant women, the presence of PUFAs in their diets has been associated with proper brain development among unborn babies. In other studies, omega 3 fatty acids have also been associated with reduced risk of preterm delivery and low birth weight. The fat also contributes to energy supplies and assists in the proper absorption of fat soluble vitamins namely A, D, E, and K.

1.3.3 Fish and Micronutrients

- Vitamins

Fish is a rich source of vitamins, particularly vitamins A and D from fatty species, as well as thiamin, riboflavin and niacin (vitamins B1, B2 and B3). Vitamin A from fish is more readily available to the body than from plant foods. Vitamin A is required for normal vision and for bone growth. Fatty fish contains more vitamin A than lean species. Studies have shown that mortality is reduced for children under five with a good vitamin A status. As sun drying destroys most of the available vitamin A better processing methods are required to preserve this vitamin.

Vitamin D present in fish liver and oils is crucial for bone growth since it is essential for the absorption and metabolism of calcium. Thiamin, niacin and riboflavin are important for energy metabolism. If eaten fresh, fish also contains a little vitamin C which is important for proper healing of wounds, normal health of body tissues and aids in the absorption of iron in the human body.

- Minerals

The minerals present in fish include iron, calcium, zinc, iodine (from marine fish), phosphorus, selenium and fluorine. These minerals are highly 'bioavailable' meaning that they are easily absorbed by the body. Iron is important in the synthesis of hemoglobin in red blood cells which is important for transporting oxygen to all parts of the body. Iron deficiency is associated with anemia, impaired brain function and in infants is associated with poor learning ability and poor behavior. Due to its role in the immune system, its deficiency may also be associated with increased risk of infection.

Calcium is required for strong bones (formation and mineralization) and for the normal functioning of muscles and the nervous system. It is also important in the blood clotting process. Vitamin D is required for its proper

absorption. The intake of calcium, phosphorus and fluorine is higher when small fish are eaten with their bones rather than when the fish bones are discarded. Deficiency of calcium may be associated with rickets in young children and osteomalacia (softening of bones) in adults and older people. Fluorine is also important for strong bones and teeth.

Zinc is required for most body processes as it occurs together with proteins in essential enzymes required for metabolism. Zinc plays an important role in growth and development as well in the proper functioning of the immune system and for a healthy skin. Zinc deficiency is associated with poor growth, skin problems and loss of hair among other problems.

Iodine, present in seafood, is important for hormones that regulate body metabolism and in children it is required for growth and normal mental development. A deficiency of iodine may lead to goiter (enlarged thyroid gland) and mental retardation in children.

It is evident that fish contribute more to people's diets than just the high quality protein they are so well known for. Fish should therefore be an integral component of the diet, preventing malnutrition by making these macro and micro nutrients readily available to the body.

Table Key Nutrients in fish

Nutrient	Importance
Long chain omega-3 fats	- These fatty acids are essential for optimal brain development
Iodine	- Fish is in practice the only natural source of this crucial nutrient. - Iodine serves several purposes like adding thyroid function. - It is also essential for neurodevelopment
Vitamin D	- Another nutrient crucial for mental development, this vitamin also regulates the immune systems function - It is essential for bone health
Iron	- During pregnancy, iron intake is crucial so that the mother an produce additional blood for herself and the baby
Calcium, Zinc, other minerals	- Diets without dairy products often lack calcium, and zinc deficiency slows a child's development

1.3.4 Fish and Our Health

- **Lactating mothers**

Eating fish whilst breast feeding is necessary for the health of the child and increasing fish consumption during breastfeed makes your child to grow up healthier. Fish have a wide range of important vitamins and nutrients like EPA, DHA, and vitamin D. fish are so rich in iodine, magnesium, iron and copper, all of which play a huge rile in the development of a child. Therefore, adding fish to a meal of a locating mother makes her baby to grow healthier.

- **Children and eating fish products**

Fish is soft, easy to cook and more easily digested than meat so even young children can be fed fish, contributing to improved nutrient intake. Fish can also be used as complementary foods especially in paste or powder form. These products can be used to enrich the maize and cassava based porridges that are normally consumed by young children in rural communities, especially in Africa. However, the challenge is to develop acceptable fishery products to use as complementary foods for young children as similar attempts failed in

the 1980s and 1990s. Older children can consume fish without any problems and if well-cooked they can benefit tremendously from the small fish that are such an excellent source of calcium and fluorine elements crucial for the development of strong bones and teeth in the young.

- Fish and HIV/AIDS

The World Health Authority estimates that people living with HIV survive up to eight years longer if they have a good, varied diet. Not only is overall health improved, but the efficacy of antiretroviral drugs appears to be enhanced. Fish can contribute significantly to the nutritional regime of those living with HIV particularly in terms of the high quality protein and micronutrients that fish provide in a readily accessible form.

Summary

Fish can be considered as a treasure store of nutrients. Fish is a low-fat high quality protein. Fish is a rich source of vitamins, particularly vitamins A and D from fatty species, as well as thiamin, riboflavin and niacin (vitamins B1, B2 and B3). Vitamin A from fish is more readily available to the body than from plant foods. The minerals present in fish include iron, calcium, zinc, iodine (from marine fish), phosphorus, selenium and fluorine. Calcium which is in fish is required for strong bones (formation and mineralization) and for the normal functioning of muscles and the nervous system. It is also important in the blood clotting process. Vitamin D is required for its proper absorption. Deficiency of calcium may be associated with rickets in young children and osteomalacia (softening of bones) in adults and older people. Zinc is required for most body processes plays an important role in growth and development as well in the proper functioning of the immune system and for a healthy skin. Iodine, present is important for hormones that regulate body metabolism and in children it is required for growth and normal mental development.

It is a good idea for women to consume fish when they are breast feeding. This is good not only time but also the health of the child. Fish aids in early child development amongst others. Fish plays a good role in improving malnutrition and even health of the sick and the aged. It is evident that fish contribute more to people's diets than just the high quality protein they are so well known for. Fish should therefore be an integral component of the diet, preventing malnutrition by making these macro and micro nutrients readily available to the body.

Fish Preservation and Processing

2

Introduction

The main purpose of preservation and packaging is to prolong the shelf life of the product. Spoilage of fish takes place mainly for three reasons: microbial activity, enzymatic action and chemical reactions. Therefore, preservation methods are directed towards stopping these actions or minimizing them to safe levels. On the other hand, the main reason of value addition is to make the products more attractive to customers by improving the appearance and/ or their quality so that they are willing to pay premium prices. The major preservation and value addition methods have been described in this chapter. This includes some of the preserved and value added fish products that can be made for people's consumption. Importance of proper packaging, storage and transportation of fish has been described.

Aim

The aim of this module is to improve participants' knowledge and understanding on the importance of fish preservation, processing, packaging and good storage. The chapter further seeks to enhance participants' skills in proper fish preservation, processing and packaging skills so as to maintain the quality of the fish products.

Objectives

- Participants know
- Importance of fish preservation and processing
- Types of preservation and processing methods
- Importance of good packaging and storage
- Impacts of transportation on fish and fish products

Acquired skills

- Basic ways of fish preservation and processing

- Acquired attitudes
- Good fish preservation and processing maintains the quality of fish and fish products
- Packaging of fish and fish products

- Relevance to fish production
- Good preservation and processing of fish and fish products will lead to increased consumption of fish thereby creating a market for farmed fish whilst improving the national status of the Malawian population
- Increased incomes and benefits from farmed fish

- Session Overview: The chapter looks at preservation, processing, packaging, storage and transportation of fish and fish products.

- Materials: Flip- chart paper, markers, study notes, posters – images of fish preservation, processing, packaging
- Mode of delivery: Lectures, group discussions and practical
- Duration: 90 minutes

2.1 Different processing and curing methods

2.1.1 Fish processing and curing

Fish processing refers to a series of actions applied by fish processors and other actors of the value chain to preserve their fish products from the time fish is caught until it reaches to the consumer. Processing if done well can produce good quality products that can fetch a high price in the market and also can be stored for longer. Good quality products can also sell quickly because consumers prefer them.
As fish can spoil more rapidly than many other foods, post-harvest handling, processing, preservation require particular care to maintain its quality and nutritional attributes and avoid waste and losses. There are a wide range of actions used by the fish farmers and fish processors to preserve and add value to their fish products. These techniques aim at preventing fish from spoilage, damages or destruction due to enzymes and bacteria action.

Benefits of Fish Processing

- Coverts raw food into edible, usable and palatable form
- Helps in preservation and storage of perishable and semi-perishable products
- Helps in avoiding glut in the market and reduces post-harvest losses and the produce available off-season
- Generates employment to those doing the processing
- Development of ready to consume convenient products which saves time for cooking
- Helps in improving palatability and organoleptic quality of the produce by value addition and helps in inhibiting anti-nutritional factors
- Helps in easing marketing and distribution tasks
- Enables transportation of delicate perishable food products over long distances

2.1.2 Processing and Preservation

· Removing off-flavor

Off-flavor is one of the problems of tilapia farming, especially in ponds when they are growing in green water systems. Tilapia absorbs the smell of the surrounding environment and their flesh can develop a muddy flavor or an earthy or metallic flavor. Removing of off-flavor in fish should be considered as part of processing. Purging of fish for 5–14 days in clear/fresh water before sale is recommended. Addition of common salt (10 ppt) or sodium thiosulfate helps destroy the organisms that produce off-flavors. Alternatively, fish can be harvested when the off-flavor organisms die off at low temperatures or, when preparing fish for consumption, soaking in 80% NaCl solution and/or smoking can reduce the off-flavor. In order to avoid off-flavor, excessive organic matter should not be allowed to accumulate and anoxic conditions at the pond bottom should be prevented. When preparing ponds, bottom mud with excessive organic matter should be removed and allowed to dry in the sun.

· Fresh fish and fish products

Fresh fish spoil very quickly and better methods to preserve must be followed. The first obvious way of avoiding spoilage and loss of quality is to keep harvested fish alive until consumption. Handling of live fish for trade and consumption is a common fish-handling practice amongst many people. For live fish handling for market, fish are first conditioned in a container of holding pond with clean water, whilst the weak and dead are removed. Some fish can be put in holding basins equipped with oxygen control, water filtering and circulation and temperature control. Icing of fresh fish is another correct storage and transportation method for fish. Fish have to be cleaned in fresh water before icing is done. Grading of the fish before they are iced and packed should be done.

2.1.3 Benefits of Smoked and Dried fish

Good quality smoked and dried fish can be kept for 2 to 3 months. Salted and dried fish can keep for longer if it is stored well. During storage and when selling fish, it is important to keep the fish safe and protect it from sources of contamination and things which can affect quality. Smoked and dried fish should be kept in a proper store which has good air flow, is cool, and protected from rain, insects, rats and other animals. The fish should be kept so that it does not absorb moisture causing mould growth and a risk of bacterial spoilage. The sacks or containers of fish should be easily got to and kept on pallets to keep them off the floor. It is good to sell first the fish which have been in the store the longest. Don't use pesticides (or any other chemicals) on processed fish or on any surfaces with which it come in contact with fish;

Table 2.1: Different Methods of processing/preserving fish in Malawi

Method	Example
Solar Fish Drying Tents Solar tent dryers are being promoted to reduce post-harvest losses while increasing economic gains and reducing the use of forest resources. Solar tent dryers are used for drying small fish such as Utaka, Usipa, Matemba and Ndunduma Solar driers are efficient in achieving higher drying temperatures and reduced humidity. They also increase drying rates, producing lower moisture content in the final product and highly improved quality.	 **Fig 1.2** Source: Lifuwu, Salima
Open- Sun Dried (Nsomba Zouma) Sun drying is a popular way of processing small fish such as Utaka, Usipa, Matemba and small Mcheni. The fish need to be put on the reed made of drying racks and then need to be turned once or twice a day to dry evenly. This process takes 3-4 days.	 **Fig 2.2** Source: Senga Bay, Salima
Boiled- Dried Fish (Nsomba Zofwafwaza) This type of processing is only used to process Usipa. First, the fish will be boiled in water and then placed on the rack to dry under the sun. This process takes less time (2-3 days) than sun drying and the taste is different from the sun-dried fish.	 **Fig 2.3** Source: Lifuwu, Salima
Smoked Fish (Nsomba Zowamba) Smoking is a process of preserving larger fish such as Chambo, Kampango, and Mlamba. Smaller fish may also be smoked. Fish is dried in the sun for about half a day and then put in an oven. Big fish species like Kampango, Chambo and Mlamba are opened, gutted and in some cases cut into sizeable chunks before drying. This process can be completed in a day.	 **Fig 2.4** Source: Senga Bay, Salima

Freezing This process of preservation locks up the water in the body of the fish as ice thus preventing bacterial growth. Freezing and thawing fish several times causes the growth of pathogens. Therefore, the cold chain should not be interrupted. This is done by putting fish in a freezer or in a box with blocks of ice.	 **Fig 2.5** Source: SANA Cash & Carry. Lilongwe
Frying Fish is deep fried in fat. Deep frying is a cooking method in which food is submerged in hot fat. The use of fresh (unused) oil as opposed to old/used/unhealthy fat/oil should be encouraged to avoid negative health effects arising from the use of old/used/unhealthy oil/fat.	 **Fig 2.6** Source : Monkey bay, Mangochi
Salting Salting is a way of drying the flesh of the fish by drawing out moisture from the flesh of the fish with the aid of salt thus preventing bacterial growth. Salting is done by rubbing dry salt on the fish or dipping in salty water. Fish is then sun dried or smoked.	 **Fig 2.7** Source: SANA Cash & Carry. Lilongwe
Roast Dried Fish First is put on the dry rack to dry for a few hours, and then roasted on a steel pan. The fish is sun dried for the rest of the day. This process can be completed in 1-2 days	 **Fig 2.8** Source : Monkey bay, Mangochi
Pan roasting, smoking, para boiling on Chitofu 3 in 1 This is a technology which has 3 fish processing methods under one roof. This technology has been tried and tested on fish pan roasting, para boiling, frying and smoking. The technology uses very few firewood and reduces drudgery	

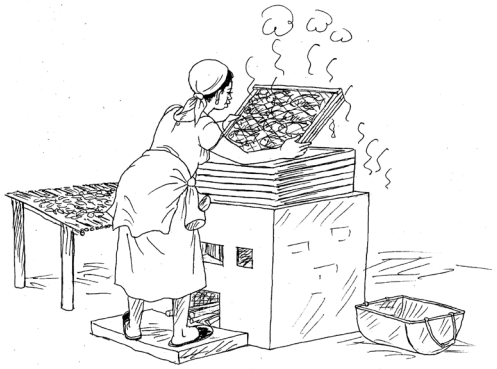

Fig 2.11 Fish smoking on a Chitofu 3 in 1

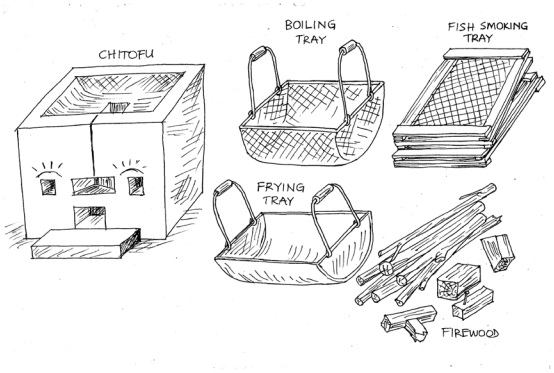

Fig 2.12 Accosries of a Chitofu 3 in 1

2.1.4 Fish Taboos & Other Reluctances on Fish Consumption

In Malawi, various rites and traditions are common including food taboos. The implication of such cultural or religious beliefs and practices on adequate nutrition of mostly women and children can be significant. Below are some of the examples of food taboos associated with fish consumption in Malawi:

Table 2.2: Food Taboos Associated with Fish Consumption

Taboo	Perceived consequences	Fact/ Truth
Eating of roasted fish by pregnant women	The baby will be born with rash or sores on the face	Fish contains important nutrients for required for the baby's development and growth. Except where it is clinically proven that one is allergic to certain species of fish, consumption of fish in pregnant women should be encouraged
Eating of catfish by pregnant women	The baby will be born with a slippery head or with a skin rash	
Eating of fish without scales	Un clean food – Religious beliefs & Association with	Diversifying diets through adding fish provides a variety of nutrients. Consumption of other types of fish should be promoted to these groups.

2.2 Packaging, Storage and Transportation of fish

2.2.1 Packaging

Proper packaging which includes materials and methods can affect fish losses. During processing and packaging, these things must be avoided

- Processing of already spoiled/poor-quality fish
- Processing fish under unhygienic conditions, allowing blowfly infestation
- Inadequate control of heat intensity during smoking leads to over-smoking of fish and possible burning
- Drying fish unsupervised, on ground, rocks or bitter herbs

- Breakage or damage owing to inadequate packaging method and materials

When packaging fish and fish products, we should not package fish and fish products which have these qualities;

- Damage to the stomach area ("belly burst");
- Damage to the fish;
- Insect infestation damage;
- Discoloration;
- Presence of moulds or decay;
- Bad smell;
- Breakage and physical damage.

2.2.2 Storage

Poor handling and storage of fish can lead to losses in fish and this loss is both in quality, quantity and the monetary vale of the harvested fish. When storing fish, we should remember that the first-in, first-out rule is always applied although the general trend in many small-scale fish markets where the most recently arrived fish is the first to be sold and fish already in storage is left and can suffer quality deterioration, which will affect its eventual selling price. In such situations, good business practices and good storage practices can help to ensure good-quality fish.

- **Several factors tend to influence the rate of spoilage of fresh fish:**

Time between death and final use or consumption: Even if fish are chilled using ice, they will gradually spoil over time; processed fish quality also deteriorates over time.

Temperature abuse: High ambient temperatures, such as 20 °C, create favourable conditions for fish spoilage. Low temperatures, such as 5 °C and below, slow the action of bacteria and the rate of spoilage, helping to reduce losses.

Handling practices: Poor handling practices lead to sustained and increased microbial contamination, hastening the spoilage rate of fish. Such practices include: using equipment, fish boxes and baskets; not washing fish; washing fish in dirty water; placing fish on dirty surfaces; and physically damaging fish by throwing or standing on them.

Besides spoilage, post-harvest fish losses are caused by:

- Poor processing techniques damaging fish;
- Animal predation and insect infestation;
- Inadequate packaging and storage practices leading to damage of the end product;

Post-harvest fish losses are a major concern and occur in most fish distribution chains. Not only do losses constitute lost income to fish farmers, processors and traders but they also contribute to food insecurity – a loss of fish means less fish available for the consumer.

2.3 Transportation

Fish transport refers to a system or means of conveying fishery products from landing site and to the fish markets or established fish processing centres/areas. Transport can be done by means of vehicles of all

kinds: cars, trucks, boats/canoes, motorcycle, bicycle or by foot.

Before taking your fish to the market, careful considerations must be made on the mode of transport to be used. Mode of transport to be used will depend on

- Distance to the market
- Volume of the fish products
- Time to be at the market

We have to remember that during fish distribution, delays owing to breakdown of transport vehicles and inaccessibility of production areas leads to quality and physical damage to fish. This in the end effects on the prices to be offered on our fish by customers. Fish should not be stacked with other objects as they will deformed them and make the not look attractive on the market. If we are selling live fish, with should ensure to have enough oxygen to be sued along the way.

Summary

Fish of good quality fetches good prices on the market as it is easily accepted by customers. Well processed fish well therefore lead to increased incomes for the fish farmer or processor. Fish processing refers to a series of actions applied by fish processors and other actors of the value chain to preserve their fish products from the time fish is caught until it reaches to the consumer. Some of the processing methods include icing, smoking and sun drying. Use of energy saving technologies like the chitofu 3 in 1 is encouraged. The technology is not only cheap but it is one of the sustainable ways of using our natural resources as it uses less fuel wood as compared to the conversional fish processing methods.

Packaging methods and materials are key to maintaining the quality of our fish and fish products. Fish which is in poor quality must not be packaged. Good storage facilities must be used so as not to affect the quality of the fish. First in and first out principle has to be followed when storing and selling our fish.

Processing if done well can produce good quality products that can fetch a high price in the market and also can be stored for longer. Good quality products can also sell quickly because consumers prefer them.

Transporting methods of our fish and fish products to the market has to be carefully considered. We have to remember that during fish distribution, delays owing to breakdown of transport vehicles and inaccessibility of production areas leads to quality and physical damage to fish. This in the end effects on the prices to be offered on our fish by customers. Fish should not be stacked with other objects as they will deformed them and make the not look attractive on the market. If we are selling live fish, with should ensure to have enough oxygen to be sued along the way.

Preparing fish and Product development

3

Introduction

To improve he nutritional status of the population of Malawi, especially nutritionally-vulnerable groups, there must be a focus of improving knowledge, attitudes, beliefs and behaviors related to nutrition. Households and household members need to adjust their dietary habits and optimize their nutrition- related practices. Specific targeted nutritional interventions targeting pregnant women, lactating mothers, children and other vulnerable groups would help in safeguarding them from under-nutrition. Preparing and processing of different fish products is therefore necessary in this regard. People will need to know how to make different fish based products basing on available recipes and those that can be developed. This chapter is therefore taking us through preparing and developing different fish products.

Aim

The aim of this chapter is to improve participants' knowledge and understanding on the different recipes that can be made from fish and improve their skills on how to make a selected fish products.

Objectives

- Participants know
- How to make prepare different fish recipes

- Acquired skills
- Making different recipes a number of fish species

- Acquired attitudes
- Good fish preservation and processing maintains the quality of fish and fish products
- Packaging of fish and fish products

- Relevance to fish production
- Promote recipes using fish for improving nutrition of targeted groups.

- Session Overview: The chapter looks at Preparing fish and Product development Materials: Flip-chart paper, markers, study notes, posters, masking tapes, 6 food group charts posters compiled recipes/recipe books, locally available foods and ingredients, cooking utensils, storage materials
- Mode of delivery: Lectures, group discussions and practical
- Duration: 90 minutes

3.1 Tilapia, Catfish Usipa and Matemba Recipes

3.1.1 Barbecued Chambo

Ingredients

Whole fish gutted
Salt and pepper
Butter
Garlic, crushed (optional)
Chopped lemon grass (optional)
Tinfoil

Method

- With a sharp knife, make several slits across the skin of the fish
- Rub garlic into the skin
- Place on tinfoil large enough to wrap fish completely
- Dab on butter and sprinkle with salt, pepper and lemon grass if used
- Wrap up in the foil and put on barbeque fire for about ½ hr.
- Take the fish out of the foil and put the fish back onto the fire to char the skin completely.
- May be served with rice, Nsima or chips.

3.1.2 Boiled Chambo

Ingredients

4 Chambo fillets
2 tablespoon oil
4 tomatoes chopped
Royco (to taste)
1 cup water
1 small green capsicum, finely sliced (optional)
1 onion sliced
1 table spoon tomato paste
Salt (to taste)

Method

- Slice Chambo fillets (skin on) into 10 cm portions
- Heat the oil on medium in a large pot.
- Fry the onion until soft.
- Add the tomatoes, tomato paste and cup of water and stir.
- Turn down the heat and simmer for about 10 minutes until slightly reduced and saucy.
- Add the green capsicum, stir and cook for three minutes.
- Season with salt and Royco to taste.
- Add the fish pieces to the pan and simmer for five minutes or until the fish is cooked through

Fig 3.1 Fish should always be part of our diet

3.1.3 Fried Chambo

Ingredients

4 medium sized Chambo	2-4 cloves garlic
1 tablespoon fresh ginger	1 cup lemon juice
1 tablespoon black pepper	Salt to taste
2 cups oil	

Method

a) Gut fish remove scales and wash thoroughly.
b) Crush and mince garlic, chop ginger and mix with lemon juice, pepper and salt.
c) Coat the fish with mixture and store in the refrigerator to marinate for 30 minutes.
d) In a heavy based skillet (standard or non-stick) heat oil for about 5 minutes until hot, but not smoking.
e) When oil is ready, remove fish from marinade, allow fish to drip off excess liquid to avoid oil splattering
f) Add fish and fry until golden and crispy on the outside or about 3-4 minutes on each side

3.1.4 Mlamba (catfish) cutlets

Ingredients

1 catfish	1 egg beaten
Cooking oil	Breadcrumbs or flour
Salt	

Method

- Remove the head and guts from the catfish
- Pour hot water over the body and scrape the skin with a knife to remove any slime
- Cut across the body into 2.5cm (1) slices
- Beat the egg with a pinch of salt
- Dip catfish slices into the egg, then breadcrumb or flour
- Fry it in hot oil until brown on both sides.

3.1.5 Mlamba Pie

Ingredients

1 catfish	1 cup peas
2 tomatoes chopped	500g potatoes or sweet potato
3-4 green onion chopped	2 cups fish stock
Water	1 table spoon oil
Salt	

Method

a) Clean and gut the catfish and remove head
b) Remove fins and cut into chunks
c) Heat oil in frying pan and fry onions until soft
d) Add the tomatoes and cook a little
e) Peel and slice the potatoes and boil in salted water for 5 minutes or until half cooked
f) Grease a casserole dish and place a layer of potatoes on the bottom
g) Cover with chunks of catfish

h] Pour over the peas and tomato mixture and finish with a layer of potatoes
i] Sprinkle salt over (according to your taste), then pour on water or fish stock
j] Bake in a moderate oven at 177 degree Celsius for ½ hour or until well cooked

3.1.6 Dried catfish balls in gravy

Ingredients

2 good sized dried fish
4 heaped table spoon Ufa/ flour
2 green onions finely chopped
Water
2 tomatoes chopped
2 eggs
1 table spoon curry powder (optional)

Method

a] Cook the fish and tomatoes until tender
b] Strain return the liquid to the pan and bring to the boil
c] Remove the flesh from the fish and set aside
d] Break the eggs into a bowl and beat a little
e] Add the ufa/flour, onion, fish and salt
f] Mix well, adding enough water to make a firm dough and form into balls
g] Carefully place the balls in the simmering liquid and cook 10-15 minutes until done

3.1.7 Usipa with groundnut flour

Ingredients

2 cups of Usipa
2 Carrots (optional)
3 spoons of cooking oil
1 large onion
1 cup of water
1 Cup groundnuts
Salt (to taste)
1 Chili Pepper (optional)
2 large tomatoes
2 garlic cloves (optional)

Method

a] Roast then peel a cup of groundnuts. Crush or grind the groundnuts into a powder.
b] Add some hot water and mix to make a paste
c] Chop onion and garlic and dice the Carrots
d] Fry the onions and garlic in oil until brown and tender
e] Add the tomatoes and carrots
f] Add the groundnut paste and water.
g] Make sure to mix regularly to prevent stickiness
h] Season with salt, pepper and chilli
i] Add your fish and let it simmer for 20 minutes

3.1.8 Smoked Matemba in Groundnut Sauce

Ingredients

100g smoked matemba
4 tablespoon of groundnut paste
3 spoons of cooking oil
2 carrots
1 chilli peeper
2 large tomatoes
1 large onion
2 garlic cloves
Salt and pepper

Method

a) Chop onion and garlic and dice the carrots
b) Fry the onions and garlic in oil until brown
c) Add the tomatoes and carrots
d) Add the groundnuts paste and water
e) Make sure to mix regularly to prevent sticking
f) Make sure to mix regularly to prevent stickiness
g) Season with salt, pepper and chilli
h) Add your fish and let it simmer for 20 minutes

3.1.9 Smoked Matemba in Coconut Milk

Ingredients

100g smoked matemba
3 spoons of cooking oil
1 ground coconut
2 large tomatoes
1 large onion
2 garlic cloves
Salt

Method

a) Boil water and place in a long jug
b) Dip in the fish and let the leftovers settle at the bottom
c) Do not drain the water, carefully scoop out fish in sieve. Let them drain
d) Heat all in a pan and add the chopped onions
e) Follow this with crushed garlic and salt
f) Cook for about 3 – 5 minutes in low heat while stirring
g) Add chopped tomatoes and ground coconut
h) Let the mixture cook in the same low heat until ready
i) Mix in the matemba and the other ingredients
j) Cover and let it cook in low heat for 10 minutes
k) Serve with nsima, potatoes, cassava or rice

3.1.10 Smoked Matemba Porridge

Ingredients
100g smoked matemba
2 spoons of sorghum flour
2 spoons of maize flour
2 spoons of millet seeds
3 spoons of cooking oil
4 spoons of sugar or honey
1 lemon
5 cups of water
2 spoons of soya flour (optional)
2 spoons of margarine or butter

Method
a) Mix flour in a bowl, add ½ a cup of water and mix well
b) Bring 4 cups of water to boil in a pot
c) Add the flour mixture, constantly stirring, bring to boil
d) Lower the heat and let in simmer for 15 minutes
e) Add in some lemon, sugar/honey, and a spoon of butter or margarine
f) Remove from the heat and serve with toasted bread or chapatti

3.1.11 Grain, fish and vegetable porridge (baby porridge)

Note
You can use any small dried usipa such as bonya, usipa ofutsa (para boiled) and matemba

Method
a) Mix whole maize flour with fish powder and add water to make a paste
b) Bring the pot containing fish/whole maize flour paste on fire and stir continuously until it starts boiling
c) Once the mixture starts boiling, reduce the heat and cook on low heat for 20-30 minutes
d) Stir from time to time to make sure that the food does not stick at the bottom of the pot
e) Add cooking oil and pounded amaranthus leaves, mix well and cook for 2-3 minutes
f) Add mashed boiled pumpkins and simmer for 2-3 minutes
g) Add iodized salt
h) Serve it to the child while it is warm.

Yield: Approximately 1¾ cups
Nutritional information per yield (values are from actual nutrient analysis of porridge sample): 312kcal energy, 8.97g proteins, 10.69g fat, 44.90g carbohydrates, 16.19mg iron, 8.92mg zinc, 0.007mg vitamin C and 29µg vitamin A.

3.1.12 Fish flour

This is a good source of protein and calcium. This flour can be stored in a closed container in a cool dry place for up to a month.

Ingredients
Small fish- Usipa or matemba

Method
a) Lightly roast the dried fish for 3-4 minutes before pounding and drying in a winnower in direct sun (Light roasting of dried fish helps to reduce the fishy smell, makes the pounding easier and the porridge acceptable). Parboiled fish such as usipa can just be further dried in the sun and pounded without roasting.
b) Let the roasted fish cool for some time
c) Pound the fish into powder
d) Keep the flour in a clean tight closed container in a dry place

Recommended usage:
Use the fish flour to enrich porridge made from the different types of flours. Alternatively mix 1 part of fish to 4 parts of maize before milling.

3.1.13 Green Banana with Dried Usipa (for 6 People)

Ingredients
5 green bananas
2 cups Usipa
2 tomatoes
2 onions
1 medium green pepper (optional)
Salt (to taste)
Lime

Method
a) Wash Usipa in hot water
b) Wash, peel and cut green bananas
c) Place Usipa, bananas, tomatoes, onions, and green pepper in alternate layers. Beginning with the fish
d) Add a little lime and boil until cooked
e) Serve hot

Recommended usage:
This can be eaten as a meal on its own or with rice, cassava, nsima, or orange fleshed sweet potatoes.

3.1.14 Fish-Sorghum Porridge (for 6 people)

Ingredients
- 1.5 cup dried small fish powder
- 6 cup sorghum meal
- 1.5 cup pounded groundnut
- 3 cup sweet potato flour
- Sugar to taste

Method

a) In a bowl, mix the sorghum meal, pounded groundnut, sweet potato flour and dried fish powder.
b) Mix 12 cups of water with the porridge mix and make a smooth paste.
c) Boil 36 cups of water in a pot.
d) Add the paste to the boiling water and mix until smooth.
e) Cook for 15 minutes and add sugar to taste.
f) Serve in a clean bowl.

Recommended usage

- For children aged 6–23 months, the porridge can be prepared as a meal.
- For pregnant and lactating women, as well as other members of the household, it can be consumed for breakfast or as a snack between meals.

Summary

Improving knowledge, attitudes, beliefs and behaviors related to nutrition will help in improving the nutritional status of the Malawian population. Households and household members need to adjust their dietary habits and optimize their nutrition- related practices. Specific targeted nutritional interventions targeting pregnant women, lactating mothers, children and other vulnerable groups would help in safeguarding them from under-nutrition. Preparing and processing of different fish products is therefore necessary in this regard. People will need to know how to make different fish based products basing on available recipes and those that can be developed. Fish flour can be added to a number of products thereby improving nutrition of many that might be eating such products.

NUTRITIONAL BENEFITS OF FISH AND VALUE ADDITION

Module VII of 8