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Course Code: **HTM204**

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Credit Unit: **2 Units**

HTM204

SPICES, HERBS AND CONDIMENTS

Course Developer/Writer: Dr. Ifeyinwa S. Asogwa
Department of Food Science and Technology,
University of Nigeria, Nsukka

Course Content Editor: Prof. Charles N. Ishiwu.
Nnamdi Azikiwe University, Awka.

Course Development Coordinator: Dr. Esheya Samuel Esheya
Department of Agricultural Economics and Extension,
Faculty of Agricultural Sciences,
National Open University of Nigeria.

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National Open University of Nigeria

National Headquarters

91, Cadastral Zone, Nnamdi Azikiwe Express Way, Jabi, Abuja
Nigeria.

E-mail: centralinfo@nou.edu.ng

URL: www.nou.edu.ng

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INTRODUCTION

The course, SPICES, HERBS AND CONDIMENTS is a core course, which carries two (2) credit units. It is prepared and made available to all degree course students offering Hospitality and Tourism related Programme in the Faculty of Agricultural Sciences**,** Department Economics and Extension at the Nation Open University of Nigeria. This course material is useful in your academic pursuit as well as in your workplace as managers and administrators.

What You will Learn in this Course

This course consists of six modules which are sub-divided into several units. This course guide tells you what the course is all about. What course materials you will be using and also suggests some general guidelines for the amount of time you are likely to spend on each unit of the course in order to complete it on schedule. It also gives you guidance in respect of your Self- Assessment Exercises (SAEs) which will be made available in the assignment file. Please attend those tutorial sessions. The course will introduce you to the application of spices, herbs and condiments.

Course Aim

The main aim of this course is to arm you with adequate information on the concept of spices, herbs and condiments in hospitality and tourism management. This will prepare the student for a future career in hospitality and related disciplines.

Course Objectives

To achieve the aim set out, the course has a set of objectives which are set out as intended learners' outcome under each unit. You should read these objectives before you study the unit. After going through this course, you should be able to discuss:

1 Identification and classification of spices, herbs and Condiments

2 Indigenous and non-indigenous species and condiments

3 Role of spices in food industry and Legislative standards

4 Nutrition composition of spices, herbs and condiments

5 Health benefits of spices, herbs and condiments

6 Collection, Production, packaging and storage of spices, herbs and condiments.

Working through the Course

This course involves that you devote a lot of time to read and study the contents. Each unit contains self-assessment exercises for this course and at certain points in the course you would be required to submit assignments for assessment purposes. At the end of this course, there is a final examination. I would therefore advice that you attend the tutorial sessions where you would have the opportunity of comparing knowledge with your colleagues.

Course Materials

You will be provided with the following materials

· Course guide

· Study units

· References

· Assignments

· Presentation schedule

STUDY UNITS

There are five modules of 14 units in this course, which should be studied carefully.

Assessment

There are two components of assessment for this course:

· The Tutor Marked Assignment (TMA)

· The end of course examination.

Tutor-Marked Assignment

The TMA is the continuous assessment component of your course. It accounts for 30% of the total score. You will be given four TMA's by your facilitator to answer before you can sit for the final examination.

Final Examination and Grading

This examination concludes the assessment for the course. The examination will account for 70% of total score. You will be informed of the time for the examination.

Summary

This course intends to provide you with underlying knowledge of spices, herbs and condiments applications to the study of Hospitality Management and Tourism.

MODULE 1: IDENTIFICATION AND CLASSIFICATION OF SPICES, HERBS AND CONDIMENTS

UNIT 1: MEANING AND CONCEPT OF SPICES

1.1 Introduction

Spices and condiments constitute an important group of horticultural commodities, which, since antiquity, have been considered indispensable in the culinary arts for flavouring foods. Some are used in pharmaceutical, perfumery, cosmetics and several other industries, and others possess colourant, preservative, antioxidant, antiseptic and antibiotic properties. In this unit, the meaning, history and examples of various spices will be discussed.

1.2 Learning Outcomes

By the end of this unit, you will be able to:

- Discuss the concept of spices
- Analyse the origin of spices
- Demonstrate the classes of various spices
- Evaluate spices as an important food ingredient

1.3 Definition, Uses and Opportunities of spices

1.3.1 Meaning of Spices

Spices are natural plant products such as fruit, leaves, seed, root, bark, berry, bud, flower or vegetable substances used to improve the flavour, aroma, taste and colour of food products.

Spices have exhibited numerous health benefits in preventing and treating a wide variety of diseases such as cancer, aging, metabolic, neurological, cardiovascular, and inflammatory diseases. According to the U.S. Food and Drug Administration (FDA), spice is an "aromatic vegetable substance in the whole, broken, or ground form, the significant function of which in food is seasoning rather than nutrition" and from which "no portion of any volatile oil or other flavouring principle has been removed" (Gottardi *et al.*, 2016).

The introduction of spices through the meals has various beneficial effects as well as they can stimulate the secretion of saliva, promote the digestion, prevent from cold and influenza, and reduce nausea and vomiting (Sultana *et al*., 2010). Besides these, spices have been used to change the physical appearance of food. For instance, pepper and turmeric changed the colour, appearance and the taste of food with many health benefits. Ginger, nutmeg and cinnamon improve digestion, considered good for spleen and sore throats.

Self-Assessment Exercise1

1. Define spices.
2. Mention two benefits of adding spices to meals.

1.3.2 General uses of spices

Spices have been used (mostly dried seed, fruit, root, bark, or vegetative material) for rituals, cosmetics and perfumery, their flavouring, colouring and, especially, preservative properties have founded wide applications both in the traditional food preparations and in the food industry. They are also used in beverages, liquors, pharmaceutical, cosmetic and perfumery products. Spices are also seen as food ingredients mainly used to season a food dish during its preparation.

Spices represent a potent tool for the food industry because of their natural properties. Spices possess antioxidant capacity, mainly due to the presence of phenolic compounds.

Spices and its products are used as whole and powder form. Essential oils and oleoresins are widely used in seasoning of foods and imparting aroma, flavour and taste to the food products. These products are also found unique place in cosmetic and pharmaceutical industries. Besides using spices, it is also used as colourant or die in cotton textiles, tobacco industries, bakery products, condiments, meat and fish products. Even now, it ‘s usages in the preparation of Ayurvedic medicines is unbelievable.

1.3.3 Opportunity offered by spices

Spices offer tremendous opportunities that can contribute to national security through agricultural production in sub-tropical Africa.Various needs are met through spice-production, exporting and importing countries of the world such as:

- Creation of jobs and income generation to the nations through local and international trade.
- Spices are important to human health as medicinal products which when utilized over long period of time can help prevent human diseases thus reducing medical costs.
- They are utilized in pharmaceutical, perfume industries, in insect control, food preservation and safety among others.

Therefore, there is a need in Africa especially in the sub-tropics to see to the vast opportunities offered by spices and to tap into it for a better future economically.

1.4 Origin, History, and Top Ten Countries Producing Spices

1.4.1 Origin and history of spices

Spices origin has been known to date back to ancient times in Egypt as recorded in the bible as valuable trade items. The use of spices moved from Egypt through the Middle East and spread to the Mediterranean and Europe. For so many years, the Arab middlemen control the spice trade and spices trade later spread to India, China and Indonesia and in the 17th century to America. Spices could be of indigenous or exotic origin. Indigenous species are those that actually originated in a particular region while exotic are those are imported from other region. Some spices are of temperate plants while some are from the tropical region.

More than 100 varieties of spices are produced throughout the world. Asia is the main leader for the production of spices, particularly of cinnamon, pepper, nutmeg, cloves, and ginger, while Europe grows mainly basil, bay leaves, celery leaves, chives, coriander, dill tips, thyme, and watercress. In America, instead, pepper, nutmeg, ginger, and allspice are mainly produced (Prasad *et al*., 2011; Gottardi *et al*., 2016).

Fig 1: Common spices in Nigeria

1.4.2 Top ten countries producing spices

Spice top ten producing countries as at FAO (2011) report were India, Bangladesh, Turkey, China, Pakistan, Iran, Nepal, Colombia, Ethiopia and Sri Lanka. From time immemorial, India has been known as the 'Land of Spices'. No other country in the world has such a diverse variety of spice crops as India. Indian spices are renowned for their excellent aroma, flavour and pungency, not easily matched by any other country.

Table 3: Spice production by top countries

Country by Ranking	2010 spice production	2011 spice production
India	1,474,900	1,525,000
Bangladesh	128,517	139,775
Turkey	107,000	113,776
China	90,000	95,890
Pakistan	53647	53,620
Iran	18,082	21,307
Nepal	20,360	20905
Colombia	16,998	19,378
Ethiopia	27,122	17,905
Sri Lanka	18,293	8,438
World	1,995,523	2,063,472

Source: FAO (2011)

Self-Assessment Exercise 2

1. List three uses of spices
2. Mention two opportunities offered by spices production.

1.5 Examples, Culinary Benefits and Therapeutic Value Of Spices

1.5.1 Examples and culinary benefits of spices

- **Examples of spices**

Spices are the building blocks of flavour in food applications. Food developers who wish to use these building blocks effectively to create successful products must understand spices completely. Nowadays, food professionals continually search for "new" and unique spice flavourings because of the growing global demand for authentic ethnic and cross-cultural cuisines. Consumers are also seeking natural foods and natural preservatives for healthier lifestyles and natural ways of preventing ailments. So, spices are also being sought for their medicinal value, as antioxidants,

and as antimicrobials The list of spices used worldwide are inexhaustible. They include onions, ginger, garlic, cinnamon, turmeric, cloves, black pepper, coriander, nutmeg among others.

- **Culinary Benefits of Spices**

The fact that spices contain no calorie is of potential interest to many who are calorie conscious. Some of the spices are rich in vitamins and minerals including trace elements. Spices are used traditionally for aroma and as preservatives. Spices are used to mask spoiled meat flavour, improve colour and flavour and of late to improve shelf life of foods. Hot and spicy foods create a niche for healthy foods. Spices, herbs and chillies will be increasingly used to enhance foods that have reduced or no salt or fat, such as snacks, sauces, salad dressings and marinades. Although spices are used primarily to enhance the taste of otherwise bland foods, their beneficial effects stretch far beyond our tongues.

The advantages of spice and their products like powders of spices, spice extracts, tea etc. are they are sterile, free from extraneous materials, soluble in a variety of systems, stable under good storage conditions and represent up to 98 per cent savings in weight and storage space. The independent use of nutritional supplements has increased dramatically over the past several years. Cinnamon for improvement of abnormal glucose and insulin regulation and garlic for hypercholesterolemia are among the more popular nutritional supplements being used by the population at large.

1.5.2 Therapeutic Value of Spices

Herbal medicines are unique and play a vital role in the indigenous system of medicine all over the world and India is no exception wherein a number of medicinal

plants are used as the source of raw drugs in the Indian system of medicine. People today are more concerned about the side effects and the cost effectiveness of drugs and have begun to rely more firmly upon herbs which are comparatively less exploited for their nutritive and medicinal qualities. In traditional medicine, several spices and herbs are believed to possess medicinal properties. Consuming a diet rich in plant foods will provide a milieu of phytochemicals, non nutritive substances in plants that possess health protective benefits. The foods and herbs with the highest anticancer activity include garlic, soybeans, cabbage, ginger, licorice and the umbelliferous vegetables (Balasasirekha, 2014).

Even little spice in our diet could boost our immune system, decrease the risk of cardiovascular diseases and high blood pressure and fight against cancer. Spices which are simply plant-based ingredients used to flavour foods, contain a variety of powerful phytonutrients and phytochemicals. Diabetic patients in increasing numbers are taking dietary supplements and herbs from which they expect additional health benefits. Curcumin, capsaicin, ginger, black pepper, cumin, fenugreek and onion significantly lowered adrenal cholesterol levels in rats which were accompanied by reduced ascorbic acid content in the adrenals of curcumin, capsaicin, fenugreek and onion fed rats. These are indicative of the stimulatory influence of dietary spices on adrenal steroidogenesis.

Self-Assessment Exercise 3

1. Spices can serve as salt replacers in foods. True or false
2. Spices posses health promoting substances called ----------

1.6 Summary

Spices are natural plant products such as fruit, leaves, seed, root, bark, berry, bud, flower or vegetable substances used to improve the flavour, aroma, taste and colour of food products. Spices are utilized in pharmaceutical, perfume industries, in insect control, food preservation and safety. It also creates job opportunities and improves the producing country's economy.

In this unit we have discussed the meaning of spices, examples and origin of spices. You learnt that spices have been utilized since ancient times in cooking and traditional medicine. Spices are majorly used to add good flavour and aroma to food as well as serve as preservatives in cooking and the food industries.

1.7 References/Further Readings

1. UNIDO & FAO (2005) Herbs, Spices and Essential oils, Post-Harvest Operations in Developing Countries. http://www.fao.org/3/a-ad420e.pdf.

2. Fasoyiro, S. (2015). The Value of Spices; Uses, Nutritional and Health Benefits. Institute of Agricultural Research & Training, Obafemi Awolowo University.

3. Gottardi, D., D. Bukvicki, S. Prasad & A. K. Tyagi (2016). Beneficial effects of spices in food preservation and safety. Font. Microbiol., 7

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1.8 Possible Answers to Self-Assessment Exercise(s) within the contents

Self-Assessment Exercise 1

1.Spices are natural plant products such as fruit, leaves, seed, root, bark, berry, bud, flower or vegetable substances used to improve the flavour, aroma, taste and colour of food products.

2a. Spices promote food digestion.

b. It prevents cold and influenza.

Self-Assessment Exercise 2

1a. Spices are used for colouring and flavouring foods

b. It is also used in pharmaceutical industries for drug production.

c. Spices are used in cosmetic and perfumery products.

2.i Creation of jobs to the people

ii. It generates income to the nations through local and international trade.

Self-Assessment Exercise 3

1. True
2. Phytochemicals or bioactive substances

UNIT 2 MEANING AND CONCEPT OF HERBS AND CONDIMENTS

2.1 Introduction

2.2 Learning Outcomes

2.3 Concept of herbs and differences between spices and herbs

2.3.1 Concept of herbs

2.1 Introduction

Herbs and spices are plant-derived seasonings used for culinary purposes. The terms ‘herbs’ and ‘spices’ are often used interchangeably, but they have specific definitions in botany. Herbs, spices and condiments contribute to the flavour of foods and food products. They are among the natural compounds that are currently being used as food

preservatives, which contain compounds with marked antioxidant and antimicrobial properties. Condiments are plant products that are used for instant flavouring of food or adjuncts of food.

In this unit the concept of herbs, condiments, differences between spices, herbs and condiments will be discussed.

2.2 Learning Outcomes

By the end of this unit, you will be able to:

- Discuss the concept of herbs
- Analyse the differences between spices, herbs and condiments.
- Demonstrate the culinary uses of herbs
- Evaluate the important of locally fermented condiments

2.3 Concept of Herbs and Differences Between Spices and Herbs

2.3.1 Concept of herbs

Culinary herbs are leaves of a plant used in cooking which comes either in fresh or dried form. Herbs as part of plant possess high quantity of polyphenols. Polyphenols are widely known for their antioxidant properties however they exert other biological effects (anti-inflammatory, anti-cancer and neuro-protective), which may also contribute to their purported benefits, possibly or not, via their antioxidant properties, and they are therefore linked to the maintenance of health via protection against the development of non-communicable diseases (Hollman *et al.*, 2010).

Other properties include anti-microbial, anti-diabetic (Type II), and anti-asthma activities and there is now a growing amount of literature on how polyphenols confer

health benefits via their action on gut microbiota. Examples of herbal spices like rosemary, thyme, marjoram, oregano, chive, parsley, sage, savory, tarragon and basil.

Self-Assessment Exercise 1

1. Culinary herbs are --------- of a plant used in cooking which cooking
    a. fruit
    b. seed
    c. roots
    d. leaves
2. List five examples of herbs.

2.3.2 Differences between spices and herbs

- Spices can be differentiated from herbs as dried part of plants other than leaves.
- Spices have strong flavours while herbs have subtle flavours.
- Herbs store flavour component in their leaves, whereas spices store theirs in seeds, bark, and root.

  Spice may be the bud (clove), bark (cinnamon), root (ginger), aromatic seed (cumin), and flower stigma (saffron) of a plant.
- **Thyme: A typical herb**

Thyme is an aromatic plant and is widely distributed over the Mediterranean area (Europe, Asia and North Africa). Taxonomically, thyme belongs to the family of the Labiatae (Lamiaceae), the genus Thymus (etymologically from the Latin “Thymún” and from the Greek “Thymon”) and to the class of Dicotyledons, native to the countries of the western Mediterranean basin. Thyme is one of the medicinal aromatic

plants found in the Iberian Peninsula, and its essential oil has become one of the most widely used in the food industry. Thyme has been used since ancient times for its health properties, which are associated with its essential oils and chemical components. Its economic importance is associated with its essential oils. In all thyme species and varieties, the main part used commercially is its leaves, with purposes that vary from seasoning to herbalism. Another important use that mainly involves the species Thymus zygis, Thymus mastichina, Thymus corydothymus and some others is the extraction of essential oils through the distillation process.

Figure 2. (a) Thymus zygis subsp. gracilis; (b) Thymus vulgaris; (c) Thymus hyemalis

2.3.3 Thyme as Functional food

- **Thyme as Functional food**

The use of herbs and spices dates back to 5000 B.C. Therefore, they might be considered one of the first functional foods. Experimental evidence supports the health benefits attributed to spices and herbs, for example, cardio-protective and anti-atherogenic potential, digestive stimulant action, antidiabetic effects, antimitogenic properties, cancer-preventive potential and anti-inflammatory properties. Nowadays,

spices are considered by the scientific community to be potential providers of health benefits beyond only food adjuncts for flavour and taste. Although there is not only one definition of functional food, the following definition: “Natural or processed foods that contain known or unknown biologically-active compounds; which, in defined, effective non-toxic amounts, provide a clinically proven and documented health benefit for the prevention, management, or treatment of chronic disease”. Therefore, thyme can be considered a functional food due to the provided benefits other than basic nutrition.

2.3.4 Food uses of Thyme

The use of thyme in food is limited almost entirely to meat products, where it is used for technological purposes, mainly as an antioxidant and preservative. When thyme is added to food, some features may be improved, such as storage conditions, composition, and antimicrobial activity due to its preservative properties. Moreover, the presence of antioxidants and micronutrients in thyme can reduce the bioactivity of the food commodity. The only limiting aspect of thyme addition in some foods is the development of a negative organoleptic effect that sometimes contributes to an unpleasant odor and taste.

2.4 Meaning of condiments, African Fermented Food Condiments and uses of condiments

2.4.1 Meaning of condiments

Condiments are plant products that are used for instant flavouring of food or adjuncts of food. It is mainly added to food immediately before consumption to impart flavour, aroma and zest to food. A condiment is also seen as a spice, sauce, or spice mixture

that is mainly added to different food dishes to contribute a specific flavour, to improve its flavour, or in some nations to supplement the dish.

The food flavouring condiments are prepared either by traditional methods or using high modern technologies. The tradition method is achieved through uncontrolled solid substrate fermentation resulting in extensive hydrolysis of the protein and carbohydrate components. Apart from increasing the shelf life, and a reduction in the anti-nutritional factors fermentation markedly improves the digestibility, nutritive value, and flavours of the raw seeds.

Although fermented food condiments have constituted a significant proportion of the diet of many people, Nigerians have exhibited an ambivalent attitude in terms of consumer tastes and preferences for such foods. The introduction of foreign high technology products especially processed ones because of globalization and liberalization of the economy radically changed the Nigerian food culture into a mixed grill of both foreign and local dishes. Some examples of condiments include Soya sauce, chilly sauce, dawadawa, iru, pickles, mustards, ogiri, ugba, iru, owo, etc.

2.4.2 African Fermented Food Condiments

Fermented foods constitute a significant component of African diets. There are many fermented foods known in Africa and fermented food condiments is one of them. Fermented food flavoring condiments are products usually derived from the fermentative activities of microorganisms on vegetable proteins of legumes or oil seeds origin. They include iru from Africa locust bean, ugba from African oil bean seed and ogiri from melon seeds among others. These fermented food condiments are known to be good sources of proteins and vitamins. The use of fermented vegetable

proteins as seasonings is wide spread in Africa, especially among the rural dwellers. In West Africa, some of the common fermented vegetable condiments include iru or dawadawa from locust bean (*Parkia biglobosa*), ogiri from melon seeds (*Citrullus vulgaris*), daddawa from soybean (*Glycine max*), soumbala from soybean (*Glycine max*), ugba from African oil bean seed (*Pentaclethra macrophylla*) and owoh from cotton seeds (*Gossypium hirsutum*).

a

b

a

b

2.4.3 Uses of Iru/Okpeye/Dadawa:a fermented condiment

Locust beans, commonly referred to as ‘Iru’ by the Yoruba, ‘Ogiri’ by the Igbos, and ‘Dadawa’ by the Hausas. Iru is commonly known for its distinctive, and to most people, unpleasant smell. It is a local seasoning or condiment used in soups and stews.

It is referred to as an African locust bean with the botanical name as ***Parkia biglobosa***. It can be found in a wide range of environments in Africa and it is primarily grown for its pods that contain both a sweet pulp and valuable seeds. The seed is first cooked to remove the seed coat and then fermented. There are two popular types of iru: iru woro and iru Pete. It can be used in making Egusi soup, Ofada stew, Ogbono soup, Efo riro, basically any soup. It is also the secret behind an amazing pot of local rice. Iru can be preserved in any way possible, soaked in water, salted, dried and refrigerated. When its pungent aroma is lost, soaking it in hot water again before use restores it. People preserve it in plantain or banana leaves because it is believed that it gives a unique taste and smell when in use.

Self-Assessment Exercise 2

1. State two differences between spices and herbs

2. Mention five condiments you know

2.5 Nutritional properties, health benefits of fermented condiments and Non fermented condiments

2.5.1 Nutritional properties of condiments

Proximate analyses of most fermented vegetable protein of African origin have shown that these condiments are rich sources of protein, essential amino acids, vitamins and minerals. These components have been found to increase during the fermentation of these condiments (Okechukwu et al., 2012). The substrates for the fermentation of these condiments harbor diverse microorganisms from the environment. These microorganisms transform the chemical constituents of the raw materials during fermentation. The transformation has the following advantages:

i. Enhance nutritive value of the products
ii. Enrich bland diets with improved flavour and texture
iii. Preserve perishable foods
iv. Fortify products with essential amino acids, health promoting bioactive compounds, vitamins and minerals
v. Degrade undesirable compounds and antinutritional factors
vi. Impart antioxidant and antimicrobial properties
Improve digestibility
vii. Stimulate probiotic functions.

2.5.2 Health benefits of iru

Locust bean, like most of the spices, is known to have some health benefits. They include:

- It is used to control diabetes and cholesterol levels.
- It helps to promote good sight and aids digestion
- It is used for treating stroke and hypertension
- It is used for treating stroke and hypertension
- It is used in the management of bacterial infections
- The locust bean contains tannins, which is often recommended for the treatment of diarrhea
- It has a potential benefit for enhancing weight loss.

2.5.3 Non fermented condiments

Mustard is a one of the non-fermented condiments made from the seeds of a mustard plant (white or yellow mustard, Sinapis harta; brown or Indian mustard, Brassica juncea; or black mustard, B. nigra).

The whole, ground, cracked, or bruised mustard seeds are mixed with water, salt, lemon juice, or other liquids, and sometimes other flavourings and spices, to create a paste or sauce ranging in colour from bright yellow to dark brown. Mustard has been used medicinally since the time of the Greek physician Hippocrates (c. 460—375 BC).



The Romans ate the whole seed as a spice during meals, but mustard was not milled for use at table until the eighteenth century. Today, mustard is number one in the world spice trade in terms of volume. That is perhaps a little-known fact, as most people think of spices in terms of nutmeg, mace, cinnamon, ginger and the other tropical spices and condiments. The action of mustard as a condiment is due to three qualities. These are its ability to stimulate appetite and salivation and so hasten the first stage of digestion, its ability to break down indigestible fats and meat fibres, and its ability to stimulate digestive juices to complete the digestive process.

Many people find the taste itself adds to their enjoyment, so aiding good digestion. Mustard contains an essential oil (allyl isothiocyanate) which, when applied to the outside of the body, increases the circulation and so helps the elimination of poisons. Two or three tablespoons of mustard powder can be used in the bath to ease chills, relax tired muscles and promote sleep.

Self-Assessment Exercise 3

1. List five advantages of food fermentation.
2. Mention three health benefits of iru
3. Give two examples of non-fermented condiments

2.6 Summary

Herbs and condiments play important roles our homes due to the good aroma they impact in foods, their nutritional value and health benefits. Herbs are leaves of a plant used in cooking which comes either in fresh or dried form and condiments are seen as a spice, sauce, or spice mixture that is mainly added to different food dishes to contribute a specific flavour, to improve its flavour, or in some nations to supplement the dish.

The differences between spices and herbs, examples of herbs, fermented condiments and non-fermented condiments ant their nutritional values were discussed in this unit. We learnt that condiments preserve perishable foods, fortify products with essential amino acids, health promoting bioactive compounds, vitamins and minerals and also degrade undesirable compounds and antinutritional factors.

2.7 References/Further Readings

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2.8 Possible Answers to Self-Assessment Exercise(s) within the content

Self-Assessment Exercise 1

1. Herbs are leafy parts of plants used in cooking which comes in fresh or dried form.
2. Examples of herbal spices like rosemary, thyme, parsley, sage, and basil.

Self-Assessment Exercise 2

1i Spices have strong flavours while herbs have subtle flavours

ii. Spices store their flavour in seeds, bark, and root whereas herbs store their flavour components in their leaves.

Self-Assessment Exercise 3

1.i Enhance nutritive value of the products

ii Enrich bland diets with improved flavour and texture

iii Preserve perishable foods

iv Fortify products with essential amino acids, health promoting bioactive compounds, vitamins and minerals

v Degrade undesirable compounds and antinutritional factors

2a. It is used to control diabetes and cholesterol levels.

3a. It helps to promote good sight and aids digestion

b. It is used for treating stroke and hypertension.

c. Mustard and soy sauce

UNIT 3 CLASSIFICATION OF SPICES

3.1 Introduction

Spices are classified in various ways. This is necessary for easier identification of the spices. The diverse forms of spices highlight the natures in which the spices exist

during its marketing and usefulness. In this unit the classification, forms of spices, culinary benefits and therapeutic values of spices will be discussed.

3.2 Learning Outcomes

By the end of this unit, you will be able to:

- Discuss the classes of spices
- Analyse the various forms of spices
- Evaluate the preservative effects of spices on food products

3.3 Classification of spices

3.3.1 Classification of spices based on the origin and active principle present

Based on the origin and active principle present, spices are categorised as follows:

A) Pungent spices: These are spices with very strong flavour. They useful in food industries,

pharmaceuticals and cosmetics industries. Such spices include: pepper, ginger, and chillies.

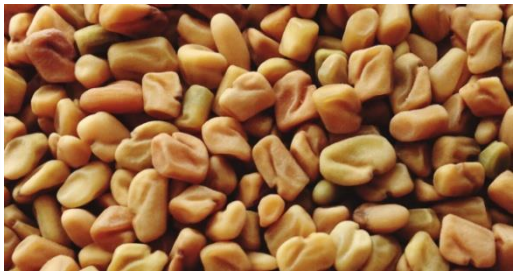
B) Aromatic fruits – cardamom, nutmeg, mace, fenugreek, aniseed, caraway, dill, celery, cumin, coriander, etc.

C) Aromatic barks – cinnamon and cassia.

D) Phenolic spices containing eugenol – clove and pimento.

E) Coloured spices – paprika, saffron and turmeric.

Nutmeg



Fenugreek

Cinnamon

Cloves

Tumeric

Saffron

Fig. 1 Examples of spices

3.3.2 Basic classification of spices based on the parts used includes:

- Leaves and/or branches of aromatic plants; all or part of the plant can be used. Examples include basil, bay leaf, parsley, rosemary, tarragon and thyme, oregano and chervil.

- Ripened fruits or seeds of plants. Examples include dill, fennel, coriander, fenugreek, berberis, and black pepper.

- Roots or bulbs of certain plants. Examples include garlic, onion, celery and ginger.

Thyme

Bay leaves

Coriander

Onion bulb

Fig 2: Examples of spices and herbs

2.3.3 On the basis of cotyledons and Taste

1. **Dicotyledoneae:** Chilli, paprika, red pepper, sesame, camomile, chicory, tarragon, cubeba, long pepper, pepper, mace, nutmeg, bay leaf, cassia, cinnamon, star-anise, mustard, wasabi, allspice, clove, anise, caraway, celery, chervil, coriander, cumin, dill, fennel, parsley

2. Monocotyledoneae: Garlic, onion, saffron, cardamom, ginger, turmeric, vanilla.

- **On the basis of degree of taste**

a. Hot spices: Capsicum, black and white peppers, ginger, mustard.

b. Mild spices: Paprika, coriander.

c. Aromatic spices: Allspice, cardamom, cassia, cinnamon, clove, cumin, dill, fennel, fenugreek, mace, nutmeg.

Capsicum

Ginger

Mace

Dill

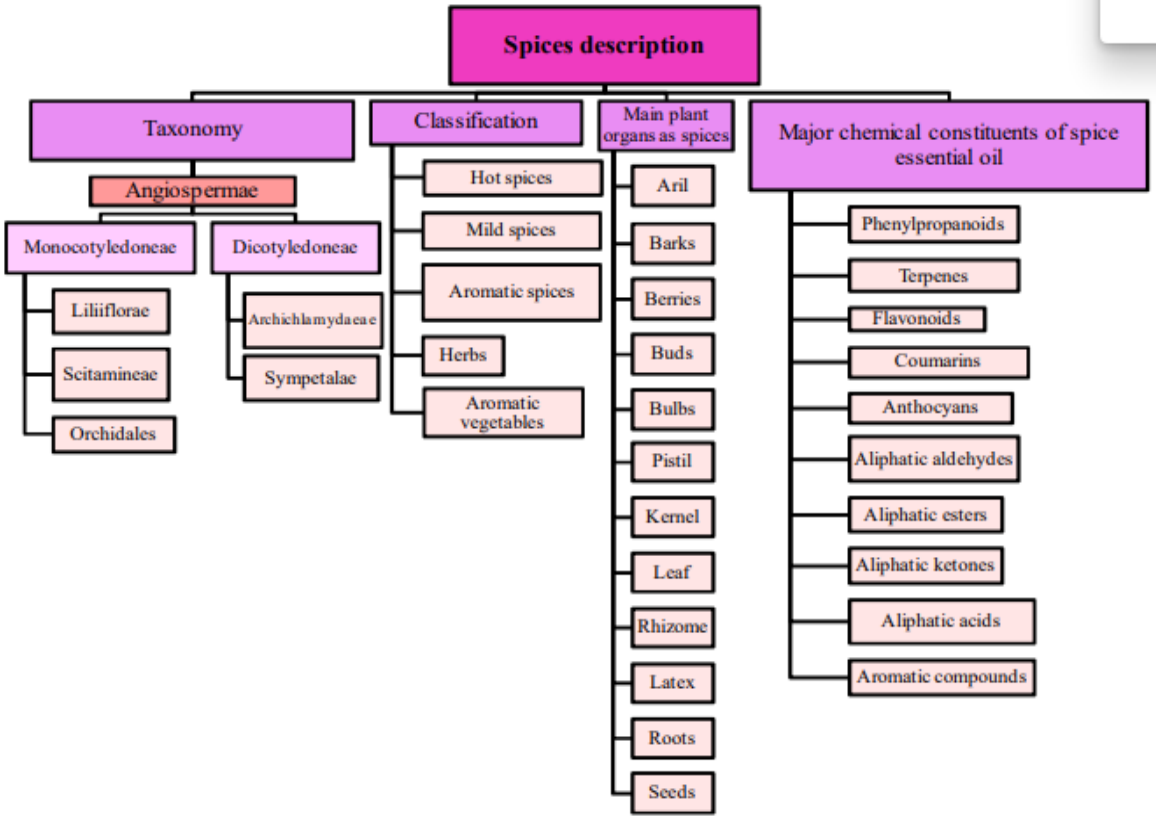


Figure 1: Spices classification (adapted from Peter and Shylaja, 2012, Sajilata and Singhal 2012)

Self-Assessment Exercise 1

1.

1. Classify spices on the basis of degree of taste
2. Classify of spices based on the origin and active principle present

3.4 Forms of spices

3.4.1 Whole and powdered spices

Spices are available in many forms such as: whole spices, dried spices, ground spices etc.

- **Whole Spices**

  Examples include cardamom, black pepper, clove, turmeric, ginger, cinnamon, and cassia. Consumers and chefs frequently use fresh spices to give a fresh taste to foods. The “fresh” taste consumers seek from spices comes initially from their aroma. This aroma is due to the volatile component of the spice. It can be lost during harvesting, storing, processing, or handling. For some spices, the fresh forms have different flavour profiles than the dried forms, examples being ginger, galangal, cilantro, or basil. Fresh ginger has more pungency than dried ginger because of higher levels of pungent-producing gingerol which, during storage, degrades to the milder shogoals that are found in larger amounts in dried ginger. Flavour is intact in a whole spice and is more slowly released than with the ground spice, especially when subjected to preparation techniques such as frying or roasting, during which time the whole spice slightly cracks open.

- **Powdered or ground spices**

Spices are often used in their dried forms because they are not subject to seasonal availability, are easier to process, have longer shelf life, and have lower cost. These dried forms are most frequently used for processed products or for wholesale usage. Dried spices come whole, finely or coarsely ground, cracked, and as various-sized particulates. Spices are ground by milling them to various-sized particulates.

This grinding also generates rapid air movement and heat that dissipate some of the volatile oils and even change some natural flavour notes through oxidation.

Also, most dried spices retain a higher overall flavour concentration than fresh spices. For example, one pound of dried garlic has an equivalent flavour of five pounds of fresh garlic.

3.4.2 Concentrates, Oils and Oleoresins

- **Concentrates**

Flavour is a combination of taste, aroma, and texture. The sensations of sweet, piney, sour, bitter, spicy, sulfury, earthy, and pungent are derived from an overall combination of aroma (due to volatile components) and taste (mainly due to non-volatile components) in a spice. Crunchiness, smoothness, or chewiness, adds to a spice's overall flavor perception. Spice extractives, which are highly concentrated forms of spices, contain the volatile and non-volatile oils that give each spice its characteristic flavour. Example is tamarind concentrate.

- **Oils and Oleoresins**

Essential oils, such as oil of basil, oil of caraway, or oil of black pepper, are produced by grinding, chopping, or crushing the leaf, seed, stem, root, or bark; then cold expressing, dry distilling, or extracting through distillation (using water, steam, or steam and water) and recovering the distillate oil with a solvent. Sometimes the oil is distilled from a whole spice, such as the leaf or flower, or from a broken spice. Depending upon the method of extraction, the nature of the volatiles can differ with the same type of spice.

Self-Assessment Exercise 2

1. List the four forms of spices
2. Essential oils are produced by ------- and ---------

3.5 Preservative properties of spices

3.5.1 Overview of the preservative power of spices

Spices play a key role in food safety by acting as antimicrobial agents in foods. The antimicrobial properties of different spices have been recognized which depends on type, composition, concentration, microbial species and storage condition. Various spices have been known for their preservative properties. This role of spices in ensuring food safety cannot be overemphasized. The preservative property of spices is reported to be due to their volatile oils and oleoresins. Essential oils of thyme and oregano are effective fumigants against fungi attacking stored grains. Essential oils of nutmegs, ginger, cloves were effective against insects infesting maize in storage.). Gould (1989) linked the activities of various essential oils with impairment of a variety of enzyme systems including those involved in energy production and structural component synthesis.

- **Turmeric effect on prolongs the shelf life in food**

Turmeric (haldi), a rhizome of Curcuma longa, is a flavourful yellow-orange spice. Its plant is 3 feet in height and has lance-shaped leaves and spikes of yellow flowers that grow in a fleshy rhizome or in underground stem. An orange pulp contained inside the

rhizome constitutes the source of turmeric medicinal powder. The most active component of turmeric is curcumin, which makes up to 2–5% of the spice.

Turmeric has been shown to inhibit the growth of numerous microorganisms including bacteria, viruses, and fungi. For instance, turmeric was shown to inhibit the growth of *Helicobacter pylori*, which is associated with the development of gastric and colon cancers.

Turmeric extract has also shown activity against food-borne pathogens. The bactericidal activities of turmeric against Escherichia coli BL-21 strain were reported by another study (Sathishkumar *et al*., 2010).

Turmeric exhibits antifungal activity against numerous strains of fungus. This spice can also inhibit the production of aflatoxin.

3.5.2 Other herbal extracts and their effect in food preservation

Ginger, onion and garlic are traditional edible and medicinal plants. They are regularly used as seasonings to enhance the sensory quality of foods.

Blends of aqueous extracts of ginger, onion and garlic had synergistic effect while at high concentration of composite solution adverse effect on odour and overall acceptance was observed. diluted solution of the composite extract could therefore be a natural promising preservative for stewed-pork considering the comprehensive effects of antioxidation, anti-bacteria and sensory quality, which could extend the shelf life for about 5–6 days.

Self-Assessment Exercise 3

1. Enumerate the five factors on which the antimicrobial properties of spices depend
2. The preservative property of spices is reported to be due to their ------- and ------

1.6 Summary

Classification of spices based on the origin and active principle present includes pungent spices such spices include: pepper, ginger, and chillies. Aromatic fruits like cardamom, nutmeg, mace, fenugreek, aniseed, caraway, dill, celery, cumin, coriander. Aromatic barks for example cinnamon and cassia. Phenolic spices containing eugenol such as clove and pimento. And coloured spices – paprika, saffron and turmeric.

In this unit we have discussed the various classes of spices, forms of spices and the preservative power of some spices. You learnt that spices inhibit the growth of numerous microorganisms including bacteria, viruses, and fungi.

1.7 Glossary

- Antioxidant: a substance that inhibits oxidation or damaging effect in a living organism and prevent the deterioration of stored food products.
- Antimicrobial agent: a substance that is active against microbes
- Antiseptic: a substance preventing the growth of disease-causing organisms
- Artherosclerosis: a disease of the arteries characterized by the deposition of fatty material on their inner walls.

3.8 References/Further Readings

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2. Sathishkumar M., Sneha K. & Yun Y.S., (2010). Immobilization of silver nanoparticles synthesized using Curcuma longa tuber powder and extract on cotton cloth for bactericidal activity. Bioresour. Technol., 101:7958–7965.

3. Yumin, C.A.A., Weigang, G.U., Jinjie Z., Yin Chu, Xingqian Y.E., Yaqin H.U., & Jianchu Chen (2013). Effects of chitosan, aqueous extract of ginger, onion and garlic on quality and shelf life of stewed-pork during refrigerated storage, Food Chemistry 141:1655–1660

3.6 Possible Answers to Self-Assessment Exercise(s) within the content

Self-Assessment Exercise 1

1a. Hot spices

b. Mild spices

c. Aromatic spices

2a. Pungent spices

b. Aromatic fruits

c. Aromatic barks

d. Phenolic spices

e. Coloured spices

Self-Assessment Exercise 2

1a. Whole spices

b. Powdered or ground spices

c. Concentrates

d. Oils and Oleoresins

2. Grinding and chopping

Self-Assessment Exercise 3

1a. Type

b. Composition,

c. Concentration,

d. Microbial species

e. Storage condition

2. volatile oils and oleoresins

MODULE 1: IDENTIFICATION AND CLASSIFICATION OF SPICES, HERBS AND CONDIMENTS

UNIT 1: INDIGENOUS AND NON-INDIGENOUS SPICES

1.1 Introduction

Spices have consistently been recognized as a part of the culinary ethos. In the culinary industry, it has been a history from its beginning that the flavouring and colouring have been used to preserve food and used for medical purposes. The use of spices as food flavour is now a significant course globally. Spices do not only cover the colour of food, aroma, and flavour; it also used for the duration of chronic illness to help human beings for the maintenance of their health and beauty.

In this unit, the meaning, examples and uses of both indigenous and non-indigenous spices will be discussed.

1.2 Learning Outcomes

By the end of this unit, you will be able to:

- Discuss the concept of indigenous spices
- Analyse the uses of non-indigenous spices
- Demonstrate the benefits of indigenous and non-indigenous spices
- Evaluate spices as an important food ingredient

1.3 Meaning and examples of indigenous spices

1.3.1 Meaning of indigenous spices

Indigenous spices refer to native spices common in a given region. They are cultivated and used locally within the locality where it is found. Nigerians and Africans at large are known for their cultural diversity in every aspect. Especially in food, Africans take pride rather broad cooking skills since the days of our forefathers. Local spices were more commonly used. Most of the Nigerian spices grow in the wild. The bulk of the spices identified in Nigeria are found in the Southern rainforest zone of the country, while others such as garlic and ginger are found predominantly in the dry Northern zone. Local spices are still used among us today only that, there's now limited knowledge concerning their uses and their nature.

1.3.2 Example of indigenous spices: African black pepper and African nutmeg

There various examples of indigenous spices. They include African black pepper, garlic, ginger, onions, among others.

- **African Black Pepper (*Piper guineense*):** African black pepper is known as 'uziza' in Igbo South East, and 'iyeree' in Yoruba south Western Nigeria. The plant is also known as Ashanti pepper, Benin pepper, Guinea pepper, and false cubeb in other parts of Africa. The plant is used for culinary, medicinal, cosmetics, and insecticidal purposes.
- *P. guineense* parts are widely used in South East Nigeria for its nutritional and medicinal properties. The plant is used as a spice for its pungent and flavourful characteristic for soup preparation for post-parturient women. In the South Eastern parts of Nigeria, the seeds are prescribed for women after childbirth to enhance uterine contraction enabling expulsion of the placenta and other remains from the womb.

African black pepper

1.3.3 African nutmeg

Monodora myristica. Commonly known as African nutmeg, *M. myristica* is a perennial plant of the Annanacea family found in the forests of West Africa. The nut obtained after the seeds are cracked is a popular condiment used as a spicing agent in both African and continental cuisines in Nigeria. African nutmeg are aromatic and are used as a condiment in food providing flavour resembling that of nutmeg (*Myristica fragrans*) when ground to powder.

African nutmegs are tropically distributed and it is very common in the south east and south-south regions of Nigeria. Its local names are; Jamaica nutmeg, African nutmeg, Calabash nutmeg, Airama, *Ehuru* or *Ehiri* in lgbo language in the Eastern part of Nigeria.

African nutmeg

Self assessment Exercise 1

1. The common name for *Piper guineense* is ----------
2. The scientific name for African nutmeg is ----------

1.4 Alligator Pepper and *Tetrapleura tetraptera*

1.4.1 Alligator pepper

Aframomum melegueta K. Schum belongs to the ginger family (Zingiberaceae) and is colloquially called grains of paradise or alligator pepper. It is variously known locally as *ose oji* in Igbo, ataare in Yoruba, and *cittáá* in Hausa of Nigeria. The plant produces trumpet-shaped, purple-colored flowers which develop into 5 to 7 long pods with each containing as many as 300 reddish-brown seeds.

In the Igbo culture of Eastern Nigeria, alligator pepper is chewed alongside kola nut where the hot spicy taste of the former attenuates the astringent taste of the latter. The seeds are also used in preparing yam pottage for new mothers to enhance appetite and reduce the risk of puerperal infections in most parts of Southern Nigeria

The seed of *A. melegueta* is used in different African cultures as a spice, medicine, or for other preternatural roles. In folk medicine, the seeds are employed as a local remedy for stomach ache, snakebite, diarrhea, cardiovascular diseases, diabetes, and inflammation.

Alligator pepper

1.4.2 *Tetrapleura tetraptera*

Tetrapleura tetraptera Schumach and Thonn Taub (Mimosaceae), Yoruba name *aridan, oshogisha* or *uhiokirihio in Igbo* is a single-stemmed deciduous plant that grows on the fringe of the West and Central African rainforest zone.

The fruit has four winged pods and appears green when tender but shiny, glabrous, dark-purple-brown when mature and ripened. The fruit consists of a fleshy pulp with small, brownish-black seeds and possesses a characteristically pungent aromatic odor, which contributes to its insect-repellent property.

Two of the fruit's wings are woody, whereas the other two are filled with soft, oily, and aromatic sugary pulp. The seeds, which rattle in the pods, are small, black, hard, flat, about 8-mm long, embedded in the body of the pod, which does not split open.

The economic and medicinal significance of *T. tetraptera* are numerous. The fruits have been widely used in Nigeria for manufacturing of seasoning spices, pomades and soaps due to its pleasant aroma characteristics while it is used in Ghana as a vitamin source. An infusion of the whole fruit is usually used by convalescents for bathing in order to be relieved from feverish conditions. The infusion is also used to relieve constipation and as an emetic. The plant has many other traditional medicinal uses such as in the management of convulsions, leprosy, inflammation and rheumatic pains.

Tetrapleura tetraptera

Self-Assessment Exercise 1

1. An indigenous spice that is usually chewed alongside kola nut is -------
2. ---------- indigenous spice is used in fold medicine for the management of convulsions, leprosy, inflammation and rheumatic pains.

1.5 Non-indigenous spices: uses and health benefits

1.5.1 Non-indigenous spices refer to spices not commonly cultivated in Nigeria. They are as follows cinnamon, clove, Coriander, Cumin, Fenugreek, fennel, among others.

- **Cinnamon**

Cinnamon or sweet wood or true cinnamon (Dalchini or dorchini) or Ceylon cinnamon had been prized for many centuries in the Orient and is one of the earliest known tree spices in India. Cinnamon is famous for its bark and leaves which are strongly aromatic. The bark has a sweet and agreeable taste. The bark, either as small pieces or powder, is extensively used as spice or condiment. It is aromatic, astringent, stimulant and carminative. It possesses the property of checking nausea and acts as an anti-emetic. The powdered bark of cinnamon in water is applied to alleviate headaches and neuralgia. Cinnamon is often combined with ginger to stimulate circulation and digestion.

Powdered cinnamon is a constituent in chocolate preparation in Spain. It is also used for flavouring cakes and sweets, candy, gum, curry powders, incenses, dentifrices and perfumes. The leaf oil is used in the manufacture of some cheaper types of perfumes, soaps, toothpastes, hair oils and face creams. It is used commercially as an agent for

flavouring liquor, and also in the synthesis of vanillin. In the flavouring industry, it is used as a modifier. The cinnamon buds are as good for flavouring and spicing like the bark itself. Cinnamon wood provides a soft timber for use as a low-grade board wood.

The root bark also yields 3% oil, which differs from both the stem-bark and leaf oil. It is a colourless liquid with a camphoraceous odour.

1.5.2 Nutmeg

Nutmeg (*Myristica fragrans*) is an evergreen tree belonging to family Myristicaceae, a family of flowering plants indigenous to Asia, Africa, Pacific islands, and America. Nutmeg contains fats (30-40%) and essential oils (10%). The distinctive aroma of nutmeg is due to presence of essential oil which contains terpenes. A variety of value-added products can be made from nutmeg especially in spicy and sweet dishes like custard, pies, spice cakes, cookies, soups, sauces, cheese, vegetables and egg dishes.

In general, nutmeg completely dried kernels can also use directly in the cooking even they are either milled or grated just before being added in the cooking (in last minutes).

Nutmeg is also used in many cosmetic products like shampoos, soaps, shaving creams, perfumes etc. It is also used in making balms and syrups for medicinal purposes.

1.5.3 Coriander

Coriander of commerce is the dried fruit of *Coriandrum satiuum L*., an aromatic spice crop. It is a very old flavouring substance and its usage both for its leaves, stems as

well as fruits has been mentioned in Egyptian, Herbrew and Roman literature as early as 5000 BC. The essential oil content of the seeds is about 0.1-0.7%.

All parts of the plant are indispensable food adjuncts in cookery. The young plants are used as a spice in the preparation of chutneys, sausages, curries and soups for flavouring. The dried fruits are an important ingredient of curry powder, sausages and pickling spices.

In food industries, coriander is one of the important ingredients in the manufacture of bakery products, imitation flavours, pork, meat, fish and salads, soda and syrup, gelatine, dessert, candy, preserves, chocolates and liquors. The essential oil of coriander seeds is a valuable ingredient in perfumery industries. Coriander is also used as a carminative and flavouring agent and to correct the griping qualities of other medicines.

1.5.4 Clove

Clove's scientific name (*Syzygium aromaticum* Merrill and Perry) and belong to the family Myrtaceae. Clove is one of the most ancient and valuable spices of the Orient, known as far back as the 1st century sc. Clove is valued as a spice and for its essential oil. The volatile oil obtained from the clove bud contains mainly eugenol- (80-90%) and caryophyllene (4-8%). The major use of cloves is for domestic culinary purposes:

- As a spice to flavour both sweet and savoury dishes and in the preparation of pickles and sauces. Cloves, both whole and ground, are used in baked goods, cakes, confectionery, chocolates, puddings, desserts, sweets, syrups, preserves, etc.
- Clove is used for flavouring curries, gravies, ketchup and spice mixtures. The inferior culls are used for the production of clove oil, which is used as a

flavourant for all kinds of food products, in soap preparation, perfumery and the synthetic preparation of vanillin.

- Owing to the antiseptic property of eugenol, clove oil is invariably an ingredient in chewing gums, toothpastes and mouthwashes. In dentistry, eugenol is used in combination with zinc oxide for the temporary filling of cavities. It is also used for flavouring of `Kretek' cigarettes in Indonesia. It is reported to aid in digestion and is also used as an antispasmodic and counter irritant.

Self-Assessment Exercise 3

1. Nutmeg belongs to family a) Anacardiaceae b) Mysitiaceae c) Lauraceae d) Leguminaceae

2. The active principle of the clove is a) Capcicin b) Allicin c) eugenol d) Linolool

1.7 Summary

Spices are natural plant products such as fruit, leaves, seed, root, bark, berry, bud, flower or vegetable substances used to improve the flavour, aroma, taste and colour of food products. Spices are utilized in pharmaceutical, perfume industries, in insect control, food preservation and safety. It also creates job opportunities and improves the producing country's economy.

In this unit we have discussed the meaning of spices, examples and origin of spices. You learnt that spices have been utilized since ancient times in cooking and traditional medicine. Spices are majorly used to add good flavour and aroma to food as well as serve as preservatives in cooking and the food industries.

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1.9 Possible Answers to Self-Assessment Exercise(s) within the content

Self-Assessment Exercise 1

1. African black pepper
2. *Monodora myristica*

Self-Assessment Exercise 2

1. Alligator pepper
2. *Tetrapleura tetraptera*

Self-Assessment Exercise 3

1 – B

2 - C

UNIT 2: INDIGENOUS CONDIMENTS

2.3 Introduction

Condiments are plant products that are used for instant flavouring of food or adjuncts of food. It is mainly added to food immediately before consumption to impart flavour, aroma and zest to food. A condiment is also seen as a spice, sauce, or spice mixture

that is mainly added to different food dishes to contribute a specific flavour, to improve its flavour, or in some nations to supplement the dish. In this unit, we will discuss the concept of indigenous condiments, examples, uses and their health benefits.

2.2 Learning Outcomes

By the end of this unit, you will be able to:

- Discuss the concept of indigenous condiments
- Demonstrate the health benefits of indigenous condiments
- Evaluate condiments as an important food ingredient

2.3 The concept of indigenous condiments and their examples

2.3.1 Indigenous condiments

Traditional fermented condiments (dawadawa, iru, ogiri) based on vegetable proteins, are consumed by different ethnic groups in Nigeria. It has been the pride of culinary traditions for centuries. It is evident that these products have played a major role in the food habits of communities in the rural regions serving not only as a nutritious non-meat proteins substitute but also as condiments and flavouring agents in soups. These condiments are being increasingly marketed throughout the country and beyond in informal ways.

The food flavouring condiments are prepared either by traditional methods or using high modern technologies. The tradition method is achieved through uncontrolled solid substrate fermentation resulting in extensive hydrolysis of the protein and

carbohydrate components. Apart from increasing the shelf life, and a reduction in the anti-nutritional factors, fermentation markedly improves the digestibility, nutritive value, and flavours of the raw seeds.

Although fermented food condiments have constituted a significant proportion of the diet of many people, Nigerians have exhibited an ambivalent attitude in terms of consumer tastes and preferences for such foods. The introduction of foreign high technology products especially processed ones because of globalization and liberalization of the economy radically changed the Nigerian food culture into a mixed grill of both foreign and local dishes.

2.3.2 Examples of indigenous condiments

Some examples of indigenous condiments include chilly sauce, ugba, dawadawa, iru ogiri etc.

Ogiri

Ogiri is a product of the fermentation of boiled melon seeds (*Cucumeropsis manii*), fluted pumpkin (*Telferia occidentale*) or castor oil seed (*Ricinus communis*). It is a food flavouring condiment used in sauces and stews that serve as accompaniment to starchy root and vegetable diets. It is also added to other preparations as seasoning e.g., in boiled meat and staple foods such as ikokore – a Nigerian local pottage.

It is consumed in the Eastern, South-Western and Middle belt regions of Nigeria. The melon seed contain a seed coat (testa/hull) which forms its outer covering and it is derived from the integument tissue, originally surrounding the ovule. The seed coat in the mature melon seed is a transparent and very thin layer. It is a multifunctional

organ that plays an important role in embryo nutrition during seed development and in protection against detrimental agents from the environment afterwards.

2.3.3 Processing steps

The traditional preparation of ogiri from melon seeds is by the method of uncontrolled solid-state fermentation, Achi, (2005) and it involves boiling the raw seeds after which they are dehulled, and then boiled again to soften seeds for fermentation. The softened seeds are wrapped in leaves, kept in sacks and incubated near the earthen pot for a period of three to five days or longer after which the mash is dried and milled to a smooth paste, the *ogiri*.

The dehulling process is the separation of the seed coat of the melon seeds from the cotyledons, and it requires an abrasive action. This abrasive removal of the testa/hulls is carried out manually and because of its tedious nature when done with the hands, the locals have resorted to dehulling the boiled seeds with the aid of the bare feet as this is easier and faster; thus, dehulling is always done manually and with the aid of the feet. However, this method of dehulling may introduce a myriad of organisms into the seeds prior to fermentation (some of which could be pathogenic and/or spoilage).

Self-Assessment Exercise 1

1. Fermentation improves the digestibility, nutritive value, and ----- of the raw seeds.
2. The traditional preparation of ogiri from melon seeds is by the method of ----------state fermentation.

2.4 African oil bean seed condiment

2.4.1 African oil bean seed (Ugba)

African oil bean seed (*Pentaclethra macrophylla*) is one of the many tropical under-utilized crops that are recently attracting worldwide attention because of its high nutrient potential. The Igbo's in the Eastern Nigeria use the name 'Ugba' for the fermented African oil bean seed. It is a traditional food condiment generally produced by (local) fermentation in homes as a small family business.

African oil bean seed is a cheap source of protein and minerals for feeding pregnant and lactating mothers, malnourished children and animals.

The African oil bean seeds are subjected to heat treatment by boiling for several hours, dehulling, slicing and subsequent wrapping in fresh leaves where the fermentation will then take place.

2.4.2 Production methods

The 'Ugba' is prepared locally by boiling the African oil bean seed for several hours after which the water is drained. The cooked seed is dehulled, and sliced. The sliced 'Ugba' is cooked again for some hours and the water is drained. At this point the 'Ugba' is soaked in water for hours, washed several times after which the water is drained thoroughly using a basket. Another basket is lined with fresh leaves and the 'Ugba' poured inside it, well covered and is allowed to ferment for about three days or more.

Self-Assessment Exercise 2

1. African oil bean seed is a cheap source of -------- and ------- for feeding pregnant and lactating mothers, malnourished children and animals.
2. The 'Ugba' is prepared locally by first boiling the African oil bean seed for several hours. True or False

2.5 *Prosopis africana* Condiment

2.5.1 Overview of *Prosopis africana*

Prosopis africana also known as *African mesquite* or iron tree is the only species of Prosopis that is indigenous to tropical Africa. It is one of the plants used to stimulate wound healing in traditional medicine of south-eastern Nigeria. It is a tree with a very hard wood and easily distinguishable by its dark rough bark, pale drooping foliage with small pointed leaflets and sausage-shaped fruit.

In Nigeria, *P.africana* is variously called *Okpei* (Igbo), *Ayan* (Yoruba), *Okpeghe* (Idoma and Tiv), and *Kiriya or Kiriaya* (Hausa).

2.6 Summary

Indigenous condiments are locally processed condiments which are added to food to add zest to it. The food flavouring condiments are prepared either by traditional methods or using high modern technologies.

The tradition method is achieved through uncontrolled solid substrate fermentation resulting in extensive hydrolysis of the protein and carbohydrate components. Some examples of indigenous condiments are iru, ogiri, okpei (okpeghe) among others. In this unit, you learnt that fermentation of condiments increases the shelf life, assists in

the reduction of anti-nutritional factors, improves the digestibility, nutritive value, and flavours of the raw seeds.

2.8 References/Further Readings

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2.9 Possible Answers to Self-Assessment Exercise(s) within the content

Self-Assessment Exercise 1

1. Flavours
2. Uncontrolled solid

Self-Assessment Exercise 2

1. Protein and minerals
2. True

UNIT 3: NON-INDIGENOUS CONDIMENTS

3.1 Introduction

The indigenous condiments were discussed in the previous unit as the locally processed and consumed condiments that add to flour, appearance and nutritive value

of foods. The non-indigenous condiments, examples, health benefits and uses will be analysed in this unit.

3.2 Learning Outcomes

By the end of this unit, you will be able to:

- Discuss the concept of non-indigenous condiments
- Analyse the uses of common non-indigenous condiments
- Evaluate condiments as an important food ingredient

3.3 Non indigenous condiments: Ketchup and soy sauce

3.3.1 Ketchup

- The use of ketchup began as a Chinese fish sauce called ke-tsiap and was originally tomato free. The name was gradually changed to ketchup, and in Britain other ingredients instead of fish were added.
- The sauce was more similar to soy sauce or Worcester sauce than to the tomato ketchup. During the 19th century, ketchup was prepared from oysters, mussels, mushrooms, walnuts, lemons, celery, and even fruits, such as plums and peaches.
- Usually, components were either boiled down into a syrup-like consistency or left to sit in salt for extended periods of time. Both of these processes led to a highly concentrated end product: a salty, spicy flavor bomb.
- Tomatoes were included in ketchup around 1700, and modern ketchup contains tomatoes, onions, vinegar, sugar, and spices.

3.3.2. Soy sauce

Soy sauce is available in many varieties worldwide, including chemically produced soy sauce, and fermented or naturally brewed soy sauce (NBSS).

Soy sauce is also called jiangyou in Chinese, shoyu in Japanese, and soya sauce in British Englishis the most consumed seasoning in East and Southeast Asian cuisine and is still gaining considerable popularity in Western countries.

Its distinct flavour is characterized by a strong umami, salty, and caramel-like character which enhances the overall savory taste and aroma of many kinds of dishes. Soy sauce is used for a wide variety of both cooked (hot and cold) and uncooked foods, such as sushi, sashimi, stir fried noodles, and any type of fish, meat, and/or vegetable stews.

In ancient China, about 2200 years ago, soy sauce was developed as a way to preserve food due to its salt content and also to enhance the flavour of the modest, vegetarian Buddhist diet since salt at that moment was an expensive commodity.

Nowadays, soy sauce is used as a food product rather than a food preservative. In fact, its production methods have been developed into advanced technologies, and the flavour quality and consistency have improved markedly.

Soy sauce is made using essentially five basic raw ingredients: soybeans/soybean flakes (as the main protein source), wheat/wheat flour (as the main carbohydrate source), salt, water, and *Aspergillus oryzae/Aspergillus sojae*, salt-tolerant yeast and lactic acid bacteria.

Nonetheless, existing fermentation processes are remarkably diverse and complex, making soy sauce a widely varied product with strong local/ cultural heritage. Like balsamic vinegar, soy sauce can be found worldwide, from the cheapest hydrolyzed forms to the most expensive premium, aged brands.

Fermented soy sauce itself comes in many forms, namely, sweet, salty, light and dark. They differ in their colour, viscosity, sweetness and umami flavour.

- Light soy sauce is light and thin and is the type which has the characteristic of saltiness and umami in a complex combination. It is obtained from pressing the fermented soybeans the first time. It is also called superior soy sauce.
- Dark sauce is darker and less salty, produced by fermenting the pressed soybean residue (after extracting the light soy sauce) with more brine.

Various additives determine the composition of the other varieties. For instance, sweet soy sauce has added palm sugar and is heated after fermentation. Salty soy sauce has added salt.

Importance of sauces in food preparation:

1. Enhances flavour.

2. Some sauces help in digestion, example mint sauce and apple sauce with roast pork.

3. It gives moistness to the food; white sauce adds creaminess to firm and dry food.

4. Adds colour to food, hollandaise sauce served on vegetables adds colour.

5. Served as an accompaniment, sometimes gives a contrast taste to another food, example cranberry sauce with roast pork.

6. Sometimes gives name to the dish, example Madeira wine when added to brown sauce, it is called sauce Madeira.

7. Enhances nutritional value of the dish.

8. Dresses and compliments food that need some additional quality and makes the food more palatable, example Chaufroid sauce is used to coat various food items, and gives a god appearance.

9. Gives tartness and contrasts or balances a bland food, example Devil sauce served with eggs give appealing tartness.

Fig 1: Ketchup and soy sauce

Self-Assessment Exercise 1

1. Original ketchup contained tomatoes. True or false
2. Fermented soy sauce itself comes in many forms. Name them.

3.4 Mayonnaise and Hollandaise Sauce

3.4.1 Mayonnaise

Mayonnaise is a basic cold sauce. It is used as a salad dressing and as an accompaniment. It has a wide variety of uses, particularly in hors d'oeuvres and

salads. It is a rich sauce, as it is thickened with egg yolk and has a high percentage of fat.

Basic recipe of Mayonnaise: 1 litre.

Ingredients	Quantity
Egg yolks	8
Salad or olive oil	1 lit.
French mustard	¼ tsp.
Vinegar	25 ml.
Lemon	1
Seasoning	to taste

Method of preparation:

1. Place egg yolks, vinegar, seasoning in clean bowl and whisk well.

2. Add oil slowly, a little at a time, whisking continuously, until all the oil is incorporated.

3. Finish the sauce by adding the juice of lemon and warm water.

4. This is done to ensure coherence of the sauce of the sauce and to prevent its turning or curdling.

5. Mayonnaise is suitable for serving with cold fish, meat and hors d'oeuvre

3.4.2 Hollandaise Sauce

Hollandaise Sauce

Hollandaise Sauce is a warm yellow and rich sauce. It contains a high percentage of fat and egg yolks. It is an emulsion of butter, lemon juice and egg yolks. Hollandaise is served over grilled or baked fish, vegetables and egg. It is an accompaniment to cauliflower, asparagus, broccoli, salmon, and trout.

Recipe for Hollandaise sauce: **500 gm.**

Ingredients	Quantity
Butter	500 gm.
Egg yolks	5
Crushed peppercorns	8
Vinegar	30 ml
Lemon juice	2

Method of preparation:

1. Melt butter in a pan and keep aside.

2. Place crushed peppercorns and vinegar in a pan and reduce completely.

3. Add one table spoon of water and cool.

4. Add egg yolks and whisk

5. Place the pan in a double boiler and whisk the egg yolks till a sabayon is formed (thickens). Then gradually add the melted butter until it is blended and forms a smooth sauce. Add lemon juice.

6. Strain through a fine strainer and correct seasoning. Store at 30-37-C, if necessary.

Self-Assessment Exercise 2

1. ----- is used as a salad dressing and as an accompaniment.
2. -------- is a warm yellow and rich sauce.
3. Hollandaise is served over ----------, -------- and ----------

3.5 Bouillons, Fish Sauce and Thickening agents

3.5.1 Bouillons

Bouillons and consommes are thin, clear liquids ´ obtained either (1) by cooking of suitable proteinrich substances or their extracts and/or hydrolysates with water, with or without the addition of seasonings and/or flavoring substances, edible fats, sodium chloride (salt), spices and their natural extracts or distillates or other foodstuffs to improve their taste, or (2) by reconstitution of an equivalent mixture of dehydrated ingredients according to the directions for use.

The forms of presentation may be as ready to-use bouillons and consommes to be consumed ´ with or without heating; condensed and concentrated bouillons or consommes presented as liquid, semi liquid, or paste-like products, which, after the addition of water according to the directions for use, yield regular bouillons or consommes; and ´ dehydrated bouillons and consommes, which are ´ dry products that, after reconstitution with water according to the directions for use with or without heating yield the regular hydrated product. Examples of bouillons sold in Nigeria are Knorr and Maggi cubes.

Bouillon cubes

3.5.2 Fish Sauce

Fish sauce is a translucent, not turbid, liquid product with a salty taste and fish flavor obtained from fermentation of a mixture of fish and salt.

The product is prepared by mixing fish (sound and wholesome fish or parts of fish in a condition fit to be sold fresh for human consumption) with salt and is fermented in covered containers or tanks.

Generally, the fermentation process takes not less than 6 months. Subsequent extractions may follow by adding brine to further the fermentation process, in order to extract the remaining protein, fish flavor, and odor.

Other ingredients may also be added to assist the fermentation process

3.5.3.Thickening agents or Liaisons

These are used to thicken sauces some of them are:

Roux: is fat and flour mixture, which are cooked together. It is cooked to various degrees, namely white, blond or brown. Equal quantities of flour, butter and margarine are taken to prepare the different coloured roux. The colour acquired depends upon the degree of cooking of the flour, and the colour of the sauce depends upon the liquid and roux used.

While preparing sauce, boiling liquid should never be added to a hot roux, as it may become lumpy, a cold liquid to a hot roux, or a hot liquid to a cold roux may be added to get a smooth texture. Starch: Arrowroot, corn flour, fecule (potato starch), tapioca is used to thicken the sauce. A paste should be made of cold liquid and starch, and then stirred into boiling liquid and allowed to boil, till the starch is cooked. It gelatinizes at 93-C (200-F).

Starch contains no gluten and gives clear sauce and thickens more as it cools.

Buerre Manie or Manie Butter: chiefly used for fish sauces. Equal quantities of flour and butter are kneaded together, and very little quantity is added at a time to boiling liquid and stirred well to form a smooth consistency.

Yolks of egg and Cream: It is a liaison, added as a finishing agent at the end of cooking. The product is never boiled, when the liaison is added, or it would curdle. The liaison is added to thicken delicate cream or volute soups. Yolks of eggs are used to prepare mayonnaise by emulsifying it with oil.

Blood: It is usually used for game cooking. It thickens the sauce and gives a particular flavour, example preparation of Jugged Hare.

Self-Assessment Exercise 3

1. Fish sauce is made from short time fermentation of fish parts. True or False
2. List five sauce thickening agents or Liaisons.

3.6 Summary

Mustard, dill, soy sauce, mayonnaise etc are examples of non-indigenous condiments. Dill is known as a garden plant in ancient literature and the use of fruits as condiment was known since biblical times. Dill is of value for both its leaves and seeds. Mayonnaise is a basic cold sauce while hollandaise is a warm yellow and rich sauce. Finishing techniques which is a means of adding value to sauces were also discussed in this unit. Such techniques include reduction, straining, deglazing, seasoning among others.

3.7 Glossary

- Indigenous: native to or naturally occurring in a place

3.8 References/Further Readings

1. Farooqui, A.A. and Sreeramulu, B.S. 2001 cultivation of Medicinal and Aromatic plants, University Press India Limited, Hyderabad, India. PP 433-43.

2. Kumar, K., Abdulkhadar, Rangaswamy, P and Irrwlappom, 2010, I, Introduction to spices, Plantation crops, Medicinal and Aromatic plants. Oxford and IBH Publishing Co., New Delhi.

2.9 Possible Answers to Self-Assessment Exercise(s) within the content

Self-Assessment Exercise 1

1. False
2. sweet, salty, light and dark

Self-Assessment Exercise 2

1. Mayonnaise
2. Hollandaise Sauce
3. Grilled or baked fish, vegetables and egg

Self-Assessment Exercise 3

1. **False**
2. **i** Roux

   ii Starch

   iii Buerre Manie or Manie

   iv Butter Yolks of egg

   v Cream

MODULE 3: ROLE OF SPICES IN FOOD INDUSTRY AND LEGISLATIVE STANDARDS

UNIT 1: USES OF SPICES IN THE FOOD INDUSTRY

1.1 Introduction

Spices are common food condiments, which have been used as flavoring, seasoning, and coloring agents and as preservatives all over the world since earliest times, particularly in India, China, and many other southeastern Asian countries . Spices can be derived from bark, buds, flowers, fruits, leaves, rhizomes, roots, seeds, stigmas and stem or the intact plant tops of plant. Herb is used as a subset of spice and refers to dried leaves of aromatic plants.

In this unit, you will learn the uses of spices in the food industries. the uses of spices include as namely as flavoring agent, preservative and coloring agents. Spices and their extracts possess preservative and natural antioxidant properties, spice extracts are popular and certain of them have antibacterial, antifungal and antiviral activities.

1.2 Learning Outcomes

By the end of this unit, you shall be able to

1. Discuss the sensory roles of herbs and spices in the food industry
2. Discuss the antimicrobial function of herbs and spices in the food industry
3. Discuss the nutritional role of herbs and spices in the food industry

1.3. Sensory Roles

Major uses of **spice** and **herbs** in food and beverages include: Sensory roles such as (a) flavoring; (b) coloring; (c) aroma enhancing, antifungal, antibacterial, antioxidant and nutritional roles

1.3.1 Spices as flavouring agents

Flavoring food is one of the most common uses for spices, almost each spice is related to a specific flavor and they are basic for culinary proposes around the world. Every spice or flavoring contains predominating chemical components that create these sensual qualities. A spice's chemical compounds can contribute mild to strong flavors. The balance of these chemical compounds gives a spice its characteristic flavor profile.

Depending on the region, different spices are used for flavoring foods bringing a distinguish flavor to each food style that even gives culinary identity. For example, Mexico is known for the use of flavors from cinnamon, vanilla, dried chilies and cocoa. In Nigeria, spices such as ginger, cloves and nutmegs are used to add unique flavours to foods and drinks such as cakes, bread, kunu, Zobo drink etc.

Flavors given by spices are due to the certain families of chemicals, such as phenylpropanoids, monoterpenes and other phenol compounds. Some important chemical compounds for the flavoring potential of spices are eugenol, apiol, sufranol, vanillin, piperine, beta caryophyllene, alfa pinene, carvacol, thymol, sabinene, cinnamaldehyde and gingerol

1.3.2 Natural colours

People whose diets are largely colourless starches, such as rice or maize, use peppers to add colour to their bland, achromatic diets. Paprika, paprika oleoresin, red pepper oleoresin, and dried chilli may all serve as a source of red colour in various processed products. Some spices, such as saffron, paprika, turmeric, parsley, and annatto provide color as well as flavor to foods and beverages. Spices can meet consumer's demands for "natural" colorings.

The components responsible for the coloring in spices are oil soluble or water soluble. Some typical coloring components in spices are crocin in saffron, carotenoids in paprika, capsanthin in chile pepper, bixin in annatto, or curcumin in turmeric. The overall coloring given by a spice is sometimes a combined effect of two or more of its coloring components.

Self Assessment Exercise 1

1. The oldest use of spice is for ----------
2. Apart being used as flavouring agents, another sensory use of spices is to add --------- to diets

1.4 Antimicrobial Activity of some spices

Food preservation is a main concern nowadays and most of the existing preservatives are based on synthetic chemicals. The application of some spices as preservatives in food has been evaluated in order to determine its efficiency since spices are natural sources and offer an opportunity to replace synthetic preservatives in food, such as nitrates, which have been claimed to possess negative effect on human health

1.4.1 Cumin

Cumin (*Cuminum cyminum*) is a spice traditionally used as an antiseptic agent and it has powerful antimicrobial activity in different kinds of bacteria, pathogenic and non-pathogenic fungi for humans. The cumin essential oil contains cuminaldehyde, βpinene, p-cymene and γ-terpinene as major chemical compounds. The main

compound of the cumin essential oil is cuminaldehyde which provides the antimicrobial properties. The alcoholic extract of cumin has been proven to present a significant inhibition of microorganisms, such as *Bacillus subtilis*, *Escherichia coli* and *Saccharomyces cerevisiae* with an outstanding antimicrobial activity for species such as *A.tumefaciens, B. subtilis, Bacillus licheniformis, Pseudomonas oleovorans, Trichophyton rubrum, S. cerevisiae and Saccharomyces pombe*.

The antifungal propierties of cumin oil have been proven in recent studies, whole cumin oil inhibit *Aspergillus flavus* and *Aspergillus niger* by over 90% when aldehyde fraction of the oil containing the antimicrobial chemical compound cuminaldehyde was tested.

1.4.2 Cloves

Clove as preservative Clove (*Eugenia caryophyllata*) is a common spice used around the world for culinary proposes but it also poses different properties that make cloves a potential preservative. Clove essential oil main compounds are eugenol and beta caryophyllene, both compounds have antibacterial activity against *Escherichia coli, Listeria monocytogenes, Salmonella enterica, Campylobacter jejuni and Staphylococcus aureus*. The clove essential oil has a high concentration of eugenol of around 88.58% and it has been proved to have diverse antimicrobial activity. Sensitivity of different bacterial strains to clove essential oil have been tested and the highest level of sensitivity was observed against five strains of Staphylococcus epidermidis with an inhibition zone greater than 16 mm. Clove also has fungicidal activity and their chemical compounds, such as carvacrol and eugenol are known to

possess fungicidal characteristics against *Candida albicans* and *Trichophyton mentagrophytes.*

1.4.3 Ginger

Ginger (*Zingiber officinale*) is a commonly used spice that contains polyphenolic compounds, among them the 6-gingerol and its derivatives, these chemical compounds made ginger a potent antioxidant. Ginger CO2 extracts have been proven to contain high polyphenol content and found to have a enhanced efficiency as an antioxidant preservative at an earlier stage of fat oxidation. Ginger has been shown to inhibit the multiplication of colon bacteria and other microorganisms, such as *Escherichia coli*, Proteus sp, Staphylococci, Streptococci and Salmonella. Ginger also has antifungal activity against some species, such as Aspergillus. The phenolic compounds in ginger are denaturing agents that avoid microbial growth by changing the cell permeability leading to rupture of bacterial cells. Most of the phenolic compounds are metal chelators and attach to active sites of metabolic enzymes reducing enzyme activities and bacterial metabolism and reproduction.

1.4.4. Cinammon

Cinnamon (*Cinnamomum verum*) is considered as a preservative because it is an effective antimicrobial and antibacterial which can inhibit bacterial growth, especially gram positive bacteria. Cinnamon oil is composed of different chemicals, amongst them the most important are cynammyldehyde, cynammyl alcohol and eugenol. Antimicrobial capacity of cinnamon has been tested against *Staphylococus aureu*s proving its capacity to inhibit *S.aureus* growth with an optimum inhibiting effort of

0.09% this result is mainly attributed to the chemical compound in cinnamon called cynammyldehyde. Cynammyldehyde inhibition to bacterial growth can be caused by inhibition of the synthesis of cell walls, inhibition of the cell membrane function, inhibition of protein synthesis or inhibition of the synthesis of nucleic acids.

Self Assessment Exercise 2

1. ---------- spice contains high amount of an antimicrobial compound called eugenol

a. clove

b. cinnamon

c. ginger

d. garlic

2. Cynammyldehyde is a compound found in ----------

a. clove

b. cumin

c. ginger

d. cinnamon

1.5 Antioxidant Properties and Nutritional Functions

1.5.1 Antioxidant Properties

Antioxidants are added to foods to preserve the lipid components from quality deterioration. Synthetic antioxidants like butylated hydroxy anisole (BHA), butylated hydroxy toluene (BHT), propyl gallate (PG) and tert-butyl hydroquinone (TBHQ) are the ones commonly used. Due to the suspected action of these compounds as promoters of carcinogenesis, there is growing demand for natural antioxidants. Antioxidants also play a role in defence mechanisms of the body against cardiovascular diseases, cancer, arthritis, asthma and diabetes. Many herbs and spices are known as excellent sources of natural antioxidants, and consumption of fresh herbs in the diet may therefore contribute to the daily antioxidant intake

Antioxidants are useful in health and lowering the risk for cancer, hypertension. and heart disease. The naturally occurring antioxidants of therapeutic plants such as polyphenols (phenolic diterpenes, diphenolic diterpenes) and flavonoids show a high capability to donate hydrogen from phenolic hydroxyl groups, thereby forming stable free radicals. Spices and herbs are an excellent source of phenolic compounds (favonoids, phenolic acid and alcohols, stilbenes, tocopherols, tocotrienols), ascorbic acid and carotenoids which have been reported to exhibit good antioxidant activity

Spices like kesum (Polygonum minus), ginger (*Zingiber offcinale*) and turmeric (*Curcuma longa*) extract (without solvent) have good antioxidant activity. A significant and linear relationship existed between the antioxidant activity and phenolic content of kesum, ginger and turmeric, thus indicating that phenolic compounds are major contributors to antioxidant activity. also, use of spices such as

pepper, cardamom and turmeric prevents or retards significantly the oxidative degradation, and thereby contributing substantially to the preservation of food items.

The antioxidant effect of ginger is comparable to BHT, which is a chemical antioxidant used to minimize oxidative rancidity.

1.5.2 Nutritional Effects

Herbs and spices are also good sources of important nutrients in foods. Black cumin seeds contains noticeable quantities of carbohydrates, proteins and fats. In addition, potassium, calcium, phosphorous and magnesium were major minerals, even as considerable quantities of sodium, iron, manganese, zinc and copper are also present. Black cumin seeds contain 6.46 %, 22.80 %, 31.16 %, 6.03 % and 4.20 % of moisture, proteins, fat, fiber, ash contents, respectively, while nitrogen free extract was found to be 29.36 %. Mineral composition showed that potassium is leading (808.00 mg/100g) subsequently calcium (570 mg/100g), phosphorous (543 mg/100g) and magnesium (265 mg/100g), respectively. Furthermore, significant quantities of sodium, iron, manganese, zinc and copper were found in the native variety of black cumin seeds

Oregano found to be rich in crude fibre (17.43%), total phenol content (87.80 GAE/100g DW) and antioxidant activity (84.80%) which supports its use as a functional food. Peppers are high in vitamin A (red peppers only), vitamin E, and potassium. One hundred grams of fresh red chilli pepper has 240 mg of vitamin C (fi ve times higher than an orange), 11 000 IU of vitamin A, and 0.7 mg of vitamin E. Vitamin C is sensitive to heat and drying, but vitamin A is very stable, and paprika and dried chilli both contain relatively high amounts of this important nutrient

Self Assessment Exercise 3

1. The component of spices that plays a major role in the antioxidant function of spices is ---------
   a. protein
   b. water
   c. polyphenols
   d. polyfurans
2. Chilli pepper contains higher amount of ---------- than oranges
   a. Vitamin A
   b. vitamin B
   c. vitamin C
   d. vitamin D

1.6 Summary

The pleasant flavour and pungency of spices make them essential in the preparation of palatable dishes. Spices and herbs are also very concern both in the industry and in scientific research because of their strong antioxidant, antifungal and antibacterial properties, which exceed many currently, used as natural preservatives. These properties are due to a lot of substances, including some vitamins, favonoids, terpenoids, carotenoids, phenols, minerals, etc. Essential oils and/or their components are becoming progressively more popular as natural antimicrobial agents to be used for a wide variety of purposes, including food preservation.

1.7 References/Further Readings

1. Peter, K.V. (2012) Ed. *Handbook of herbs and spices*. Second edition (Vol.1). Woodhead Publishing Limited

2. Peter, K.V. (2012) Ed. *Handbook of herbs and spices*. Second edition (Vol.2). Woodhead Publishing Limited

1.8 Possible Answers to Self Assessment Exercises

Self Assessment Exercise 1

1. Flavouring
2. Colour

Self Assessment Exercise 2

1. A- Clove

2. D- Cinnamon

Self Assessment Exercise 3

1. C- Polyphenols
2. C- Vitamin C

UNIT 2: LEGISLATIVE STANDARDS OF HERBS AND SPICES

2.1 Introduction

2.2 Learning Outcomes

2.3 Definitions and Food Regulatory Bodies

2.3.1 Definitions of food laws and food standards

2.3.2 Food regulatory agencies - NAFDAC

2.3.3. Codex Alimentarius Commission

2.4 Codex Standard for Chilli Pepper

2.4.1 Definition of produce and minimum quality requirements for fresh chilli pepper

`2.4.2 Quality classification and packaging

2.4.3 Standard for contaminants

2.5. CODEX Standard for fresh Garlic

2.5.1 Definition and minimum quality requirements

2.5.3. Contaminants and Hygiene

2.5.2 Classification and packaging

2.5.3. Contaminants and Hygiene

2.6. Summary

2.7 Glossary

2.8 References/Further Readings

2.9 Possible Answers to Self-Assessment Exercise(s)

2.1 Introduction

Spices, herbs, and flavorings have been traded internationally for thousands of years, but until recently, most food was produced, sold, and consumed locally. However, over the last century, the amount of food traded internationally has grown exponentially.

Public concerns about food safety issues have increased the amount of regulatory oversight on foods as well as spices, herbs, and flavors in the past century. Every country needs laws to encourage the production of safe and wholesome foods, and to prohibit the sale of foods that are unsafe or fraudulent.

In this unit, we shall discuss the food standard and regulations for spices and herbs, using typical spices as case studies.

2.2 Learning Outcomes

by the end of this unit, you will be able to

1. Discuss the local and international regulatory bodies
2. Analyze the CODEX standard for fresh chilli pepper
3. Analyze the CODEX standard for fresh ginger

2.3 Definitions and Food Regulatory Bodies

2.3.1 Definitions of food laws and food standards

Food laws

In all countries, food is governed by a complexity of laws and regulations, which set out the government's requirements to be met by food chain operators to ensure food safety and quality. The term "food law" applies to legislation which regulates the production, trade and handling of food and hence covers the regulation of food control, food safety, quality and relevant aspects of food trade across the entire food chain, from the provision for animal feed to the consumer. Food law govern the food production, processing, distribution, marketing, and consumption. There are international, federal, state, and local food laws. Food laws typically govern the use of pesticide, food additives, nutrition labeling, tariffs on agricultural imports, and restaurant cleanliness. They also govern topics like packaging, distribution, adulteration, and fraud in the food industry. In every country, standards are an important part of the regulation of food production and food trade.

Food standards

Food standard is a set of criteria that a food must meet if it is to be suitable for human consumption, such as source, composition, appearance, freshness, permissible additives, and maximum bacterial content. In every country, standards are an important part of the regulation of food production and food trade. These food standards are often set in accordance with the Codex Alimentarius Commission. Standards of identity define what a given food product is and the ingredients that must be used in manufacturing it.

2.3.2 Food regulatory agencies - NAFDAC

A wide range of government agencies impact food law at the federal, state, and local levels. The states usually have task forces, food policy councils, and agencies that address food policy issues. States continue to introduce new food laws or amend existing laws.

National Agency For Food And Drug Administration And Control (NAFDAC)

NAFDAC is Nigeria's food safety authority and is responsible for the regulation and control of food product manufacturing, importation, exportation, advertisement, sale and distribution in Nigeria. It defines food as any "article manufactured, processed, packaged, sold or advertised for use as food or drink for human consumption, chewing gum and any other ingredient which may be mixed with food for any purpose whatsoever."

Under the provisions of the law and the accompanying guidelines, no food item may be imported, manufactured, advertised, sold or distributed in Nigeria unless it has been registered by NAFDAC. Its scope is to regulate, protect and promote public health by ensuring the wholesomeness, quality, safety, and efficacy (as applicable) of food, packaged water, drugs, cosmetics, medical devices, chemicals and detergents (referred to as regulated products) consumed in Nigeria.

NAFDAC operates at the Federal and State levels along with the state government agencies. At the local government level, there are primary healthcare agencies responsible for street food vending, catering establishments and traditional markets.

2.3.3. Codex Alimentarius Commission

The Codex Alimentarius Commission (CAC) is an international food standards body established jointly by the Food and Agriculture organization (FAO) and the World Health Organization (WHO)in May 1963 with the objective of protecting consumer's health and ensuring fair practices in food trade. Nigeria is a member of CAC therefore her food standards concerning spices are in conformity with Codex standards. Codex Alimentarius is a collection of internationally adopted food standards and related texts presented in a uniform manner. These food standards and related texts aim at protecting consumers' health and ensuring fair practices in the food trade.

The Co d e x Al i m e n t a r i u s (CODEX) international food standards, guidelines and codes of practice contribute to the safety, quality and fairness of this international food trade. Consumers can trust the safety and quality of the food products they buy and importers can trust that the food they ordered will be in accordance with their specifications.

The Codex Committee on Spicess and Culinary Herbs (CCSCH) was established by codex alimenatrius commission to elaborate worldwide standards for spices and culinary herbs in their dried and dehydrated state in whole, ground, and cracked or crushed form.

Self Assessment Exercise 1

1. Legislation which regulates the production, trade and handling of food is called ----------
   a. food standard
   b. food regulator
   c. food law
   d. food control
2. The body responsible for food regulation and control in Nigeria is ----------

2.4 Codex Standard for Chilli Pepper

2.4.1 Definition of produce and minimum quality requirements for fresh chilli pepper

Definition of produce: This Standard applies to commercial varieties of chilli peppers1 grown from Capsicum spp., of the Solanaceae family, to be supplied fresh to the consumer, after preparation and packaging. Chilli peppers for industrial processing are excluded.

Minimum quality requirements: In all classes, subject to the special provisions for each class and the tolerances allowed, the chilli peppers must be:

- whole, the stalk (stem) may be missing, provided that the break is clean and the adjacent skin is not damaged;
- sound, produce affected by rotting or deterioration such as to make it unfit for consumption is excluded;
- firm;

- clean, practically free of any visible foreign matter;
- practically free of pests and damage caused by them affecting the general appearance of the produce;
- free of abnormal external moisture excluding condensation following removal from cold storage;
- free of any foreign smell and/or taste;
- free of damage caused by low and/or high temperatures.

`2.4.2 Quality classification and packaging

Chilli peppers are classified in three classes defined below:

- "**Extra" Class:** Chilli peppers in this class must be of superior quality. They must be characteristic of the variety. They must be free of defects, with the exception of very slight superficial defects affecting an area of up to 0.5% of the produce surface, provided these do not affect the general appearance of the produce, the quality, the keeping quality and presentation in the package.
- **Class I:** Chilli peppers in this class must be of good quality. They must be characteristic of the variety. Slight defects, however, may be allowed, affecting an area of up to 2.0% of the product surface, provided these do not affect the general appearance of the produce, the quality, the keeping quality and presentation in the package
- **Class II:** This class includes chilli peppers which do not qualify for inclusion in the higher classes, but satisfy the minimum requirements specified in Section above. Defects, however, may be allowed, affecting an area of up to

3.0% of the product surface, provided the chilli peppers retain their essential characteristics as regards the quality, the keeping quality and presentation.

Packaging: Chilli peppers must be packed in such a way as to protect the produce properly. The materials used inside the package must be new, clean, and of a quality such as to avoid causing any external or internal damage to the produce. The use of materials, particularly of paper or stamps bearing trade specifications is allowed, provided the printing or labelling has been done with non-toxic ink or glue. Chilli peppers shall be packed in each container in compliance with the Recommended International Code of Practice for Packaging and Transport of Fresh Fruits and Vegetables (CAC/RCP 44-1995).

2.4.3 Standard for contaminants

The produce covered by this Standard shall comply with the maximum levels of the Codex General Standard for Contaminants and Toxins in Food and Feed (CODEX STAN 193-1995). this standard stipulates that the maximum level of aflatoxin in foods is 15 µg/kg and the maximum level for lead is 0.2 mg/kg. Standards for other contaminants are also stipulated.

The produce covered by this Standard shall comply with the maximum residue limits for pesticides established by the Codex Alimentarius Commission. The table below shows the maximum residure limits for some pesticides for spices, fruits and berries.

Table 1: Minimum requirement level for aflatoxin for spices, fruits and berries

Pesticide	MRL	Year of Adoption
Aldicarb	0.07 mg/kg	2011
Bifenthrin	0.03 mg/kg	2011
Carbaryl	0.8 mg/kg	2011
Carbendazim	0.1 mg/kg	2011
Carbosulfan	0.07 mg/kg	2011
Chlorpyrifos	1 mg/kg	2005
Chlorpyrifos-Methyl	0.3 mg/kg	2005
Cyfluthrin/beta-cyfluthrin	0.03 mg/kg	2011
Cyhalothrin (includes lambda-cyhalothrin)	0.03 mg/kg	2016
Cypermethrins (including alpha- and zeta- cypermethrin)	0.5 mg/kg	2011

Pesticide	MRL	Year of Adoption
Deltamethrin	0.03 mg/kg	2011
Diazinon	0.1 mg/kg	2005
Dicofol	0.1 mg/kg	2005

Self Assessment Exercise 2

1. The minimum quality requirement for fresh chilli include all of the following except ----------
    a. they must clean and practically free of any visible foreign matter;
    b. practically free of pests and damage caused by them affecting the general appearance of the produce
    c. free of abnormal external moisture including condensation following removal from cold storage;
    d. free of any foreign smell and/or taste;
2. The maximum level of aflatoxin allowed in fresh chilli pepper is ----------
    a. 25 µg/kg
    b. 5 µg/kg
    c. 20 µg/kg
    d. 15 µg/kg

2.5.CODEX Standard for fresh Garlic

2.5.1 Definition and minimum quality requirements

Definition of produce: This Standard applies to the rhizome of commercial varieties of ginger grown from *Zingiber officinale* Roscoe, of the Zingiberaceae family, to be supplied fresh to the consumer, after preparation and packaging. Ginger for industrial processing is excluded.

Minimum quality requirements: In all classes, subject to the special provisions for each class and the tolerances allowed, the ginger must be:

- whole;

- sound, produce affected by rotting or deterioration such as to make it unfit for consumption is excluded;
- clean, practically free of any visible foreign matter;
- practically free of damage caused by pests affecting the general appearance of the produce; - free of abnormal external moisture, and properly dried if washed, excluding condensation following removal from cold storage;
- free of any foreign smell and/or taste;
- firm;
- free of abrasions, provided light abrasions which have been dried properly are not regarded as a defect;
- sufficiently dry for the intended use; skin, stems and cuts due to harvesting must be fully dried.

The development and condition of the ginger must be such as to enable it: - to withstand transport and handling; and - to arrive in satisfactory condition at the place of destination.

2.5.2 Classification and packaging

Ginger is classified in three classes defined below:

- “Extra” Class Ginger in this class must be of superior quality. It must be characteristic of the variety and/or commercial type. The roots must be cleaned, well shaped and free of defects, with the exception of very slight superficial defects, provided these do not affect the general appearance of the produce, the quality, the keeping quality and presentation in the package.

- Class I Ginger in this class must be of good quality. It must be characteristic of the variety and/or commercial type. The roots must be firm, without evidence of shrivelling or dehydration and without evidence of sprouting. The following slight defects, however, may be allowed, provided these do not affect the general appearance of the produce, the quality, the keeping quality and presentation in the package: Slight skin defects due to rubbing provided they are healed and dry and the total surface area affected not exceeding 10%.
- Class II This class includes ginger which does not qualify for inclusion in the higher classes, but satisfy the minimum requirements specified above. The roots should be reasonably firm. The following defects, however, may be allowed, provided the ginger retains their essential characteristics as regards the quality, the keeping quality and presentation:
  - skin defects due to rubbing, provided they are healed and dry and the total surface area affected not exceeding 15%;
  - early signs of sprouting (not more than 10% by weight by unit of presentation); -
  - slight markings caused by pests;
  - healed suberized cracks, provided they are completely dry;
  - - slight traces of soil; - bruises.

2.5.3. Contaminants and Hygiene

.**Contaminants**: The produce covered by this Standard shall comply with the maximum levels of the Codex General Standard for Contaminants and Toxins in Food and Feed (CODEX STAN 193-1995). See above

The produce covered by this Standard shall comply with the maximum residue limits for pesticides established by the Codex Alimentarius Commission. See above

Hygiene: It is recommended that the produce covered by the provisions of this Standard be prepared and handled in accordance with the appropriate sections of the Recommended International Code of Practice – General Principles of Food Hygiene (CAC/RCP 1-1969), Code of Hygienic Practice for Fresh Fruits and Vegetables (CAC/RCP 53-2003), and other relevant Codex texts such as Codes of Hygienic Practice and Codes of Practice.

The produce should comply with any microbiological criteria established in accordance with the Principles for the Establishment and Application of Microbiological Criteria for Foods (CAC/GL 21-1997). A microbiological criterion should be appropriate to protect the health of the consumer and where appropriate, also ensure fair practices in food trade. A microbiological criterion should be practical and feasible and established only when necessary.

Self Assessment Exercise 3

1. Answer true or false. Any ginger tuber that has any trace of sprouting should be rejected according to Codex standard.
2. The most important reason for setting up a microbiological criteria for spices is to
    a. ensure adequate nutrition
    b. protect health of consumers
    c. advertise the food
    d. classify the food

2.6. Summary

Food legislation for spices is very important as to promote food safety and ensure health of the consumers. food legistlation can at national, state or local levels. Food standard is a set of criteria that a food must meet if it is to be suitable for human consumption, such as source, composition, appearance, freshness, permissible additives, and maximum bacterial content. A wide range of government agencies impact on food laws at the federal, state, and local levels.

The major food regulatory body in Nigeria is NAFDAC. On the international level Codex Alimenatrius formulated food standards for member states. Other governmental and non governmental bodies are also involved in food legislations and control like the ministries of health and agriculture, the local government areas, research institutes etc.

2.7 Glossary

GAE: Gallic acid equivalent. it is used in a situation that gallic acid is used as standard for measurement of phenolic content

Suberization of cells: Suberization of cells at the wound area, a process that heals the wound with a layer of phenolic and aliphatic compound. It is an important anti-infection defense mechanism of the wounded tuber.

Rancidity: Rancidity is the decomposition of oils, fats and other lipids by oxidation or hydrolysis, or both resulting in off flavour and off odour.

1.7 References/Further Readings

1. https://www.fao.org/fao-who-codexalimentarius.

2. PCurtis, P.A. ed. (2005). *Guide to Food Laws and Regulations*. Oxford, UK: Blackwell Publishing,

1.8 Possible Answers to Self-Assessment Exercise(s)

Self Assessment Exercise 1

1. C- Food law
2. NAFDAC

Self Assessment Exercise 2

1. C- free of abnormal external moisture including condensation following removal from cold storage
2. D- 15 µg/kg

Self Assessment Exercise 3

1. False
2. B – Protect consumer health

MODULE 4: NUTRITIONAL COMPOSITION OF SPICES, HERBS AND CONDIMENTS

UNIT 1: NUTRITIONAL COMPOSITION OF SOME SPICES

1.1 Introduction

Spices have consistently been recognized as a part of the culinary ethos. In the culinary industry, it has been a history from its beginning that the flavouring and colouring have been used to preserve food and used for medical purposes. The use of spices as food

flavour is now a significant course globally.

Spices from seeds are rich sources of fat protein and carbohydrates. Spices play a key role in nutrition as good sources of micro and macronutrients. Ogunka-Nnoka and Mepha (2008) conducted research on the proximate analysis of some Nigerian spices. These were shown to be fairly rich in nutrients. Many spices have rich sources of calcium, phosphorus, magnesium and micronutrients such as zinc.

Spices do not only cover the colour of food, aroma, and flavour; it also used for the duration of chronic illness to help human beings for the maintenance of their health and beauty. Spices contain some chemical and bioactive molecules such as sulphur mixing, tannins, vitamins etc. Spices like rosemary, cinnamon, and oregano, have an excellent percentage of antioxidants. In this unit, the nutrition composition of certain spices will be discussed.

1.2 Learning Outcomes

By the end of this unit, you will be able to

1. Discuss the chemical composition of at least two spices
2. Analyse the bioactive molecules in spices

3. Demonstrate the chemical contents of spices
4. Evaluate the proximate, mineral and vitamin content of spices

1.3 Nutritional compositions of Ginger and Cinnamon

1.3.1 Ginger

Ginger is used extensively in food, beverage, and confectionery industries in products such as marmalade, pickles, chutney, ginger wine, liquors, and other bakery products. The chemical components of the ginger vary considerably, depending on the location of cultivation and postharvest treatments. Ginger contains polyphenol compounds such as gingerol and its derivatives such as zingiberene, bisabolene, camphene, geraniol, linalool, borneol and oleoresin (a combination of volatile oils and resin) that accounts for its characteristic aroma and therapeutic properties. Dry ginger contains essential oil 1-3%, oleoresin 5-10%, starch 50-55 % and moisture 7-12 % with small quantities of protein, fibre, fats and ash. The ginger rhizome contains several interesting bioactive constituents and has health-promoting properties.

Table 2: Quantitative Composition of Phytochemicals

Phytochemical constituent (mg/100g)	Value
Flavonoids	1.34 ±0.05
Saponins	2.12 +0.04
Steroids	6.78±0.04
Glycosides	3.14 ±0.03
Resins	4.13 ±0.03
Tannins	5.46+0.06

Table 3: The Proximate Composition of Ginger

Components	Value (%)
Moisture	10.90 ± 0.003
Ash	8.25 ± 0.004
Fat	1.85 ± 0.004
Proteins	4.86 ± 0.007
Fibre	11.72 ± 0.007
Carbohydrate	62.43 ± 0.002

Table 4: Mineral Composition of the Sample (mg/100g)

Mineral components	Concentration (mg/100g)
Zinc	5.17 ± 0.05
Iron	8.37 ± 0.04
Phosphorus	595.66±0.04
Calcium	878.86±0.03
Magnesium	1.92±0.04
Potassium	0.72±0.06

1.3.2 Cinnamon

Cinnamon spice is obtained from the bark of the cinnamon tree. Harvesting for bark is made after the second or third year of planting, and the subsequent harvest is made between 12 and 18 months after the previous harvest. The branches harvested this way are processed by scraping off the outer bark, then beating the branch evenly with a hammer to loosen the inner bark. The outer bark of the tree is thick and brownish. The inner bark is more useful than the outer one.

Table 1: Proximate Composition of the Cinnamon

Nutrient	% Composition
Moisture	5.1
Ash	2.4
Crude Protein	3.5
Crude Fat	4.0
Crude Fiber	33.0
Nitrogen Free Extract	52.0
Energy	258 Kcal/100g

Table 2: Mineral Composition of the Cinnamon

Minerals	Amount in "mg/g"
Iron	7.0
Zinc	2.6
Calcium	83.8
Chromium	0.4
Manganese	20.1
Magnesium	85.5
Potassium	134.7
Sodium	0.0
Phosphorus	42.4

Self-Assessment Exercise 1

1. How many percent of protein does ginger contain?
2. How many percent crude fibre does cinnamon have?

1.4 Nutrition compositions of Nutmeg and turmeric

1.4.1 Nutmeg

Though Nutmeg is used sparingly in dishes still its impact health in many ways with high nutritive contents like vitamins, minerals and organic compounds related essential oils. According to the USDA National Nutrient Database, these beneficial components include dietary fiber, manganese, thiamine, vitamin B6, folate, magnesium and copper.

Nutrient Value - Nutmeg (each 100 g)

Nutrient	Value
Water (g)	6.23
Energy	525.00
Energy (kJ)	2196.00
Protein (g)	5.84
Total lipid (fat)(g)	36.31
Ash(g)	2.34
Carbohydrate (g)	49.29
Fiber, total dietary (g)	20.80
Sugars, total including NLEA (g)	2.99
Calcium, Ca (mg)	189.00
Iron,Fe [mg]	3.04
Magnesium, Mg [mg]	183.00
Phosphorus, P [mg]	213.00
Potassium, K [mg]	350.00
Sodium, Na [mg]	16.00
Zinc, Zn [mg]	2.15
Copper, Cu [mg]	1.03
Copper, Cu [mg]	1.03
Manganese, Mn [mg]	2.90
Selenium, Se [µg]	1.60
Vitamin C, total ascorbic acid [mg]	3.00

Thiamine [mg]	0.35
Riboflavin [mg]	0.06
Niacin [mg]	1.30
Vitamin B-6 [mg]	0.16
Folate, total [µg]	76.00
Folate, food [µg]	76.00
Folate, DFE [µg]	76.00
Choline, total [mg]	8.80
Vitamin A, RAE [µg]	5.00
Carotene, beta [µg]	28.00
Cryptoxanthin, beta [µg]	66.00
Vitamin A, IU [IU]	102.00
Fatty acids, total saturated [g]	25.94
Fatty acids, total monounsaturated [g]	3.22
Fatty acids, total polyunsaturated [g]	0.35
Phytosterol (mg)	62.0

1.4.2 Turmeric

The spice turmeric is a botanical that is used widely in the Middle East and Asia, not only to impart a distinctive flavour to foods, but also purportedly to provide health benefits as a component of traditional medicines. Recently, it has been added to

nutraceuticals, beverages, and processed foods. Turmeric is obtained from the rhizome of Curcuma longa L. (Zingiberaceae family).

Proximate composition of turmeric plant

Parameter	Composition (%)
Moisture	8.92±0.02
Dry matter	91.00±0.01
Ash content	2.85±0.02
Crude fibre	4.60±0.01
Crude protein	9.40±0.02
Fat	6.85±0.00
Carbohydrate	76.38±0.01

Mineral and vitamin composition of turmeric

Parameter	Composition (%)
Riboflavin	0.59±0.02
Thiamine	0.16±0.00
Niacin	2.30±0.00
Calcium	0.21±0.01
Phosphorus	0.63±0.02
Potassium	0.46±0.03
Iron	0.045±0.02

Self-Assessment Exercise 2

1. Dry matter content of turmeric is how many percent?

2. Riboflavin content of turmeric is 0.59±0.02%. True or false?

1.5 The nutrition composition of Clove

1.5.1 Clove

Spices are used frequently in most homes and restaurants. They are used as an aromatic and stimulating addition to medicines and to snuff, ground to powder, they may be taken as a stimulant or stomachic or to relieve constipation, thus most times ameliorate food and health problems. Several of these plants' parts are use in various concoctions in folk medicine. An example of these spices is the clove or lavanga (Syzygium aromaticum). Cloves are the aromatic dried flowers buds of a tree in the family Myrtaceace-the Myrtle family. Cloves are natives to Indonesia and Mollucca Island and are used as a spice in cuisines all over the world.

Table 1: Proximate composition of *Syzygium aromaticum* seed

Constituents	Concentration (g/100g DW)
Moisture	23.35 ± 0.02
Ash	9.10 ± 0.05
Crude Fibre	10.65 ± 0.03
Crude Fat	18.90 ± 0.04
Crude protein	7.00 ± 0.01
Carbohydrate	30.95 ± 0.17

Values are mean of triplicate determination ± standard deviation of mean

Table 2: Mineral content of *Syzygium aromaticum* seed

Minerals	Concentration(mg/kg)
Ca	782.54 ± 0.62
Mg	1259. 86 ± 10.65
Na	2.56 ± 0.01
K	2.69 ± 0.02
Fe	710 ± 12.45

1.5.2 Garlic

Garlic (*Allium sativum L*.) is the most economically important species of the Allium genus and an important vegetable crop throughout the world. Garlic is considered a rich source of volatile compounds, which are responsible for the distinct flavour and the bioactive properties of dry bulbs. There is also a high content of non-volatile compounds with well-known medicinal and therapeutic properties, such as amides, nitrogen oxides, phenolic compounds, especially flavonoids, proteins, saponins and sapogenins, as well as antioxidants, minerals (especially P, K and Se) and vitamins (especially vitamin C and vitamins of B complex). According to Koch and Lawson 2018, dry garlic bulbs mainly consist of water (62–68%) and carbohydrates (26–30%), while proteins are detected in relatively less amounts (1.5–2.1%). Moreover, protein contents of 4–6% are also very common in various cultivars, considering the high dry matter content of the bulbs, while ash content ranges between 0.6% and 1.0%, and energy content is around 140 kcal 100 g–1 f.w.

Self-Assessment Exercise 3

1. Garlic is considered a rich source of volatile compounds, which are responsible for the distinct flavour and the ---------- properties of dry bulbs.
2. ---------, -------- and ---------- are the non-volatile contents found in garlic bulbs.

1.6 Summary

Spices contain high nutritive contents like vitamins, minerals and organic compounds related essential oils. There is also presence of abundance content of non-volatile compounds with well-known medicinal and therapeutic properties, such as amides, nitrogen oxides, phenolic compounds, especially flavonoids, proteins, saponins and sapogenins, as well as antioxidants, minerals (especially P, K and Se) and vitamins (especially vitamin C and vitamins of B complex). These available compounds in spices are referred to as their chemical components.

1.7 References/Further Readings

1. Imoru, A., Onibi, G. E. and Osho, I. B. (2018). Nutritional and Biochemical Compositions of Turmeric (Curcuma longa Linn) Rhizome powder – A Promising Animal Feed Additive. International Journal of Scientific & Engineering Research Volume 9, Issue 1, January-2018.
2. https://fdc.nal.usda.gov/fdcapp.html#/food-details/171326/nutrients.

3. Ogunka-Nnoka, C.U and Mepha, H.D (2008). Proximate composition and anti-nutrient contents of some common spices in Nigeria. Food Science Journal 2:62-67.

1.9 Possible Answers to Self-Assessment Exercise(s) within the content

Self-Assessment Exercise 1

1. 4.86±0.07%
2. 33.0%

Self-Assessment Exercise 2

1. 91.00±0.01%
2. True

Self-Assessment Exercise 3

1. Bioactive
2. Amides, nitrogen oxides, and phenolic compounds

UNIT TWO: NUTRITION COMPOSITIONS OF COMMON HERBS

2.1 Introduction

Culinary herbs are those plants whose fresh or dried leaves are used in cooking. Herbs and spices are naturally low or free of calories, fat, saturated fat, sugars and sodium,

they are a perfect way to increase the flavour of foods without additional calories. In fact, using herbs and spices can help reduce the negative nutrients in consumers' diets.

One of the benefits of culinary herbs is primarily due to their antioxidant properties. Free radicals are generated in the body as a result of metabolic reactions. Free radicals cause damage in living system resulting in oxidative stress. Free radical scavengers (antioxidants) which are in culinary herbs have potentials to prevent, decay or ameliorate many of human chronic and ageing diseases such as cancer, diabetes, heart disease, stroke, malaria and rheumatoid arthritis. Culinary herbs are as important today as they were in ancient times for enhancing the flavour and taste of our foods as well as serving as a source of dietary medicine. The chemical compositions of herbs will be discussed in this unit.

2.2 Learning Outcomes

By the end of this unit, you will be able to

1. Discuss the chemical composition of at least two herbs
2. Analyse the bioactive molecules in herbs
3. Evaluate the proximate, mineral and vitamin content of herbs

2.3 Chemical compositions of bay and curry leaves

2.3.1 Bay leaves

The chemical composition of bay (L.nobilis) leaves showed in Table 1. The findings indicated that moisture content of leaves is 4.95% which is similar to those values obtained by Tainter *et al*., (1993), Protein content (7.62%) of leaves, the crude oil of

leaves was 8.57%.and the ash content, 3.63%, the crude fibre content was 24.40%, while total carbohydrates of sample investigated is 50.83 %.

Table 1: Proximate composition of bay leaves

Parameter Sample	Bay leaves studied
Moisture	4.95
Protein	7.62
Ash	3.63
Oil	8.57
Crude fiber	24.40
Carbohydrate	50.83

Table (2) minerals and vitamins in bay leaves (mg\100g)

Element	Mg / 100g
Calcium	377
Phosphorus	112
Potassium	550
Iron	45
Copper	0.36
Magnesium	112
Manganese	7.313
Zinc	2.90
Riboflavin	0.90
Ascorbic acid	45.33

2.3.2 Curry leaves

Murraya koenigii (M. koenigii) (L) Spreng belonging to family Rutaceae and commonly known as “curry leaves” called “The Ultimate Cure” for multifarious diseases. The fresh leaves are reported to have a high nutritional value and are extremely rich in antioxidant vitamins, minerals, carbazole alkaloids, polyphenols, tannins and saponins.

These leaves find ample use as a flavouring agent in foods.

Proximate composition of curry leaf powder

Test parameter (mg/100g)	Values
Moisture	5.86
Total ash	9.68
Crude fibre	5.22
Total fat	2.43
Total protein	3.81
Total carbohydrate	60.24

Vitamin content of curry leaf powder

Parameters (mg/100gm)	Va lues
B-Carotene (IU/100gm)	100989.18 IU
Vitamin C	0.1
Vitamin E	0.05
Vitamin B_1	0.5
Vitamin B_2	0.5

Vitamin B_3	0.5

Mineral content of curry leaf powder

Parameters (mg/100gm)	Values
Zinc	2.433
Sodium	47.81
Potassium	1235.88
Calcium	2218.22
Magnesium	568.03

Self-Assessment Exercise 1

1. ---------- is the percentage protein content of bay leaves.
2. What is the botanical name of curry leaves?

2.4 Chemical compositions of coriander and lemon grass

2.4.1 Coriander

Coriander (*Coriandrum sativum L.)* belongs to family Umbelliferae. The "Coriander", is consequential from Greek word for "bed-bug", as smell of spanking new foliage is said to resemble that of bug plague-ridden bed line. Coriander is referred to as "kusthumbari" or "dhanayaka" in the Sanskrit literature. Coriander was used in time-honoured Greek medicines by Hippocrates (460-377 BC). The Egyptians called this herb as "Spice of Happiness". The Romans and Greeks used coriander to flavour wine and also as a medication.

Chemical compositions of coriander

S. No.	Parameter	Local Variety (V1)	Hybrid Variety (V2)
1.	Moisture (%)	85.09	85.33
2.	Carbohydrate (%)	4.29	4.01
3.	Total Solids (%)	14.91	14.67
4.	Crude Protein (%)	3.06	3.02
5.	Crude Fiber (%)	2.01	1.92
6.	Ash (%)	4.50	4.45
7.	MINERALS %)		
	a) Calcium	0.66	0.68
	b) Potassium	1.62	1.58
	c) Iron	0.03	0.03
	d) Magnesium	0.52	0.47
	e) Sodium	0.20	0.18

2.4.2 Lemon Grass

Lemon grass is also used as an addition to tea, and in preparations such as kadha, which is a traditional herbal brew used against coughs, colds, etc. It has medicinal properties and is used extensively in Ayurvedic medicine. It is supposed to help with relieving cough and nasal congestion. Antioxidant, anti-cancer properties, anti-inflammatory property.

Chemical composition of lemongrass includes proximate analysis, mineral analysis and antioxidants determination. Uraku *et al*., (2015) collected lemongrass leaf samples from Ebonyi state of Nigeria for the evaluation of proximate components on dry basis. The reported value of proximate in lemongrass leaf were high for protein (22.59 %), fiber (37.53 %), moisture (11.35 %), carbohydrates (19.64 %) and ash (7.15 %) but low for fat (2.43 %).

Belewu *et al*. (2011) reported proximate components of lemongrass leaves samples on dried basis. The reported results of proximate analysis of lemongrass were moisture

12.36%, fat 1.94%, ash 6.13%, fiber 27.72%, protein 15.72% and carbohydrate 29.58%. *Asaolu et al*., (2009) evaluated the proximate components present in lemongrass leaves collected from Ekiti state of Nigeria. The results reported on dry basis were moisture 5.76%, ash content 20%, crude protein 4.56%, crude fat 5.10%, crude fiber 9.28% and carbohydrates 55.00%. Food energy of lemongrass was found to be 360.55 cal/100g.

2.4.3 Essential Mineral Elements in lemon grass

Uraku *et al*., (2015) collected lemongrass leaf samples from Ebonyi state of Nigeria for the evaluation of mineral contents. The reported value of minerals (mg/kg) in lemongrass leaf were Zn (0.3 ± 0.), Cu (3.9 ± 0.1), K (6.4 ± 0.1), Co (3.9 ± 0.1), Fe (1.1 ± 0.2), Ca (21.4 ± 0.2), Na (4.1 ± 0.1) and Mg (25.7 ± 0.4), respectively. The presence of essential mineral elements at high level and the absence of heavy metals made lemongrass a best choice for use in food products.

2.4.3 Antioxidant Activity of Lemongrass

Essential oil of lemongrass is reported rich in antimicrobial and antioxidant activity. Both, extract and oil of lemongrass contains a variety of valuable number of bioactive components like flavonoids, alkaloids, tannins, terpenes, phenolics, anthocyanins, steroids, saponins, isoflavones, coumarins, lignin’s, catechin, isocatechins and ascorbic acid.

The phytochemical contents of lemongrass leaf samples from Ebonyi state of Nigeria has been reported by Uraku *et al.* (2011). Vitamins C, B2, B9, A, B1 and E contents (mg/100g) were 2.43, 2.23, 0.13, 1.25, 2.33 and 0.91, respectively.

Self-Assessment Exercise 2

1. Coriander (*Coriandrum sativum L.)* belongs to family Umbelliferae and genus---------
2. Essential oil of lemongrass is rich in antimicrobial and --------

activity.

2.5 Chemical composition of parsley and Basil

2.5.1 Parsley

Parsley is a source of flavonoid and antioxidants, especially luteolin, apigenin, folic acid, vitamin K, vitamin C, and vitamin A. Half a tablespoon (a gram) of dried parsley contains about 6.0 µg of lycopene and 10.7 µg of alpha carotene as well as 82.9 µg of lutein+zeaxanthin and 80.7 µg of beta carotene.

Parlsey leaves

2.5.2 Basil

Basil is an English name for *Ocimum basilicum* L., while it is called Basilic, Basilikum and Albahaca, in French, German and Spanish, respectively.

Basil (*Ocimum basilicum* L.), is an important essential oil crop, medicinal plant and culinary herb, belongs to the *Lamiaceae* family, which grows in tropical and sub-tropical climates, and its essential oil is a component of oral health, dental products, and has been used in the fragrance and food industry.

The nutrient content of common basil (g/100g) according to Kiczorowska *et al.* (2015) are dry matter (90.91), ash (8.98), crude protein (20.88), ether extract (1.12), crude fiber (4.59), NFI (sugars readily hydrolyzed) (55.33). The mineral composition of the leaves are Mg (79.8 μg g^{-1}), Ca (1278 μg g^{-1}), K (2135 μg g^{-1}), Na (218.5 μg g^{-1}), Fe (26.31 μg g^{-1}), Cu (1.95 μg g^{-1}), Mn (8.56 μg g^{-1}) and Zn (45.14 μg g^{-1}).[49]

The important essential oil components of basil are terpenes, phenylpropanoids, alcohols and aldehydes. These components varies from plant to plant and influenced by location, growing conditions, cultivars, different agronomic management, seasonal variation, harvesting, drying and processing methods. Phenolic acids and flavonol-glycosides are the main phenolic components in basil.

Basil leaves

Self-Assessment Exercise 3

1.  This picture shows ---------- leaves
2. *Ocimum basilicum* is the scientific name for ----------

2.6 Summary

Culinary herbs are those plants whose fresh or dried leaves are used in cooking. Herbs and spices are naturally low or free of calories, fat, saturated fat, sugars and sodium, they are a perfect way to increase the flavour of foods without additional

calories. Herbs contain proteins, vitamins and minerals in appreciable quantity. The nutritional compositions of the various herbs are outlined in this units.

2.7 References/Further Readings

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2.7 Possible Answers to Self-Assessment Exercises

Self-Assessment Exercise 1

1. 7.62%

2. *Murraya koenigii*

Self-Assessment Exercise 2

Self-Assessment Exercise 2

1. Coriandrum

2. Antioxidant

Self-Assessment Exercise 3

1. Parsley

2. Basil

UNIT 3: NUTRITIONAL COMPOSITION OF INDIGENOUS SPICES

3.1 Introduction

Herbs and spices are plant-derived seasonings used for culinary purposes. The terms ‘herbs’ and ‘spices’ are often used interchangeably, but they have specific definitions in botany. Herbs store flavor component in their leaves, whereas spices store theirs in seeds, bark, and root. In addition to making food taste good, culinary spices have been used as food preservatives and for their health-enhancing properties for centuries. Herbs and spices are also rich in very important nutrients for health.

Nigeria and indeed Africa is blessed with a rich array of indigenous herbs and spices that contain a wealth of nutrients. Over the years, indigenous fermented condiments have been produced from varying plant parts for adding flavour to foods. These condiments also contain high levels of such nutrients as proteins and minerals.

In this unit we shall be discussing the nutritional composition of our indigenous spices and condiments.

3.2 Learning outcomes

By the end of this unit, you will be able to

1. Explain the nutritional composition of two indigenous spices
2. Discuss the nutritional composition of two indigenous herbs
3. Discuss the nutritional composition of two indigenous condiments.

3.3 Nutritional Composition of Some Indigenous Spices

3.3.1 *Piper guineensis* (Black pepper)

Piper guineensis commonly known as black pepper is known as *uziza* among the igbos, and *Iyre* by the Yorubas. The leaves and seeds are consumed widely as spice and used in preparation of different dishes. The leaves and seeds are considered to be medicinal as have been reported in literatures. In some parts of Nigeria, the seeds and leaves are used in preparation of a popular dish consumed by women after childbirth, to enhance the contraction of uterine and also to enhance the expulsion of placenta and other remains from the womb.

The protein content of *uziza* seeds has been reported to be about 11%. This makes the seed to be a moderate source of protein. The ash and crude fibre contents are 6.5% and 2.88% respectively. The high ash content is indicative of the mineral content of the seed.

Uziza seeds contains high levels of calcium, phosphorus and potassium (317.68mg/100g, 146.85mg/100g and 122.07mg/100g respectively). A balance proportion of calcium and phosphorus is needed in the body. Phosphorus is essential component of bone mineral. Deficiency of phosphorus- calcium balance result in osteoporosis, arthritis, pyorrhea, rickets and tooth decay.

The most abundant vitamin detected in the seeds of *uziza* is vitamin A (17.48 mg /100g) followed by vitamin C (2.51mg/100g).The seed also contains vitamin B_1 and B_2. The least of the vitamins was thiamine (vitamin B_1) with values 0.028 mg/100g and 0.082mg/100g for the leaves and seeds of *uziza* respectively. Vitamin A is important for visual health, immune function and fetal growth and development. Vitamin A deficiency is a public health problem in many parts of the world, particularly Africa and South-East Asia. The recommended daily intake of vitamin A for children (7 – 10years) is 400µg.

3.3.2 African nutmeg (*Monodora myristica*)

African nutmeg contains moderate amounts of protein (about 16%). The fat content is appreciable (28.60%). The seed contain high fibre content and high ash content. High fibre foods consumption has been associated with reduction in the risk of cardio-vascular diseases.

The vitamin composition of the raw *Monodora myristica* as observed were ascorbic acid (180.60g/100g), thiamin (0.77mg/100g), riboflavin (0.15 mg/100g) and niacin (18 mg/100g). The high value of ascorbic acid in Monodora seed is an indication that the spice if can protect against oxidative damage by scavenging free radicals. African nutmeg is rich in minerals such as potassium, phoshours, calcium and iron. The iron content is significant since iron help in the reduction of iron deficiency anaemia which is of public health concern in the developing countries.

3.3.3 *Tetrapleura tetraptera*

The crude protein content of the seed has been reported as 8.65%,. The recommended daily intake (RDI) for protein ranges from 14 g to 65 g (14 g for infants younger than 1 year; 16 g for children between 1 and 4 years; 60 g for pregnant women; and 65 g for nursing mothers). The ash content is 3.84%.

T. tetraptera contained minerals that are essential in human nutrition . The iron (Fe) content ranged from 29.69 mg/kg. Results of this study show that *T. tetraptera* fruits have higher Fe content than some spices such as dried pepper, garlic, fig, etc. *T. tetraptera* is a good source of Fe, which is an important component of the hemoglobin and plays a role in the transportation of oxygen from the heart to all the cells. The use of this fruit by lactating mothers to regenerate lost blood may be due to the high Fe content. The zinc (Zn) content ranged from 5.45 mg/kg, this indicates that *T. tetraptera* can be a good source of this mineral. Zinc is a very useful trace element in

the human body as it provides a natural protective mechanism against virus, especially those causing respiratory tract infections.

The magnesium (Mg) content is 509.22 mg/kg, with the woody shell having the highest amount. The RDI for Mg is 350 mg (30); values obtained in this study are higher than the RDI for Mg, indicating that *T. tetraptera* fruits when used as a spice can provide substantially to the RDI of this element.

The vitamin content of the fruits ranged from 3.22-4.69%, 2.66- 3.69%, 0.88 – 1.24%), 0.11-0.12%, 0.01 -0.04 and 0.01- 0.03% for vitamins A, E, C, Niacin, thiamine and riboflavin respectively. Vitamin A is important in the body for vision, healthy skin, mucus membranes, immune system, and bone and tooth growth. It is also needed for vision, healthy skin, mucous membranes, bones and tooth growth and immune system. Vitamin E is an antioxidant for protecting cell walls. Vitamin C (Ascorbic) is an antioxidant enzyme needed for protein metabolism, important for immune system, healing of wounds and aids in iron absorption. Niacin (vitamin B3) is needed for energy metabolism, important for skin health, nervous and digestive system. Thiamine (vitamin B_1) is part of an enzyme needed for energy metabolism and important in nerves functioning. It helps to break down carbohydrate, fat and alcohol. Riboflavin (vitamin B_2) is needed for energy metabolism, important for normal vision and skin health.

Self Assessment Exercise 1

1. Piper guineenses contains ---------- amount of protein
    a. high
    b. low
    c. moderate
    d. none
2. Which of the following spice contains high amount of fat
    a. African nutmeg
    b. *Piper guineensis* seeds
    c. *Piper guineensis* leaves
    d. T. tetraptera

3.4 Nutritional Composition of Some Indigenous Herbs

3.4.1 African basil leaves

African Basil Leaf, *Efirin, daidoya, nchanwu* or scent leaf, whose botanical name is *Ocimum gratissimum* is a tropical plant species that belongs to the family of Labiatae. The nutritional profile of fresh and dried African basil is shown below. Fresh *O. gratissimum* is low in protein and other nutrients but the dried samples had higher levels of these nutrients due to concentration effect as a result of moisture loss.

Table 1: Proximate composition of *Ocimum gratissimum* Leaf (g/100g sample)

	Fresh leaves	Dried leaves
Moisture	86.90	7.0
Protein	3.0	11.4
Crude fibre	4.0	13.7

Crude lipid	0.9	3.7
Ash	1.0	16.4
Carbohydrates	4.2	47.8
Gross energy	43.9	297.0

The fresh leaves are very rich in β-carotene and ascorbic acid but low in niacin and riboflavin.. Drying of the leaf brought significant reduction in value of water-soluble vitamins (Vitamin Bs and vitamin C) and an increase in concentration of βcarotene compared with the fresh sample. Table 2 shows the vitamin composition of African basil leaves.

Table 2: Vitamin Composition of *Ocimum gratissimum* Leaf (mg/100g)

Vitamin	Fresh leaves	Dried leaves
Niacin	0.27	0.11
Riboflavin	0.14	0.03
Thiamine	0.18	0.07
β -carotene (µg/100g)	571.60	871.00
Ascorbic acid	36.47	11.87

The fresh leaf was low in sodium, potassium, calcium, magnesium, iron, phosphorus and copper, but high in manganese and zinc. Drying on the other hand seemed to significantly concentrate the minerals compared with the fresh sample. Table 3 shows the mineral composition of fresh and dried African basil leaves.

Table 3: Mineral Composition of *Ocimum gratissimum* Leaf (mg/100g)

Mineral	Fresh leaves	Dried leaves
Sodium	11.3	206.7
Potassium	30.7	323.3
Calcium	15.7	256.7
Magnesium	14.3	340.0
Iron	0.3	2.4
Phosphorus	39.3	466.7
Manganese	5.3	6.1
Zinc	3.7	4.1
Copper	0.3	5.4

3.4.2 *Gongronema latifolium*

Gongronema latifolium (Amaranth globe) is a tropical rainforest plant which belongs to the family Asclepiadaceae and genus Gongronema. It is commonly *grown* in West Africa and is locally called "Utasi" by the Ibibios, Quas and Efiks; "Utazi" by the Igbos in South East and "Arokeke" by the Yorubas in South Western part of Nigeria. The leaves of *G. latifolium* are used as vegetables in preparation of soups to which they add a bitter-sweet flavor . The leaves are also sometimes used to spice locally brewed beer.

The proximate composition of the dried leaves of G. latifolium showed that the dried leaves contains 25.55 % crude protein, 13.69% crude fibre, 6.13% crude fat and 11.63% ash . The leaves contains significant amounts of important vitamins and minerals. the vitamin A, E and C contents have been reported to be 393.00 mg/100g,

44.03 mg/100g, and 0.20 mg/100g, while the levels of riboflavin, thiamine and niacin are 0.96 % , 0.18% and 0.81 respectively .

The mineral compositions of the dried leaves are shown in Table 4.

Table 4: Mineral composition of *G. latifolium*

Mineral	Amount
Manganese (mg/100 g)	0.04
Selenium (mg/100 g)	Trace
Zinc (mg/100 g)	0.05
Iron (mg/100 g)	0.28
Copper (mg/100 g)	0.10
Magnesium (%)	1.06
Chromium (mg/100 g)	0.04

Self Assessment Exercise 2

1. Drying of *Ocimum gratissimum* leaves caused reduction in the amounts of water soluble vitamins. True or False.
2. *Ocimum gratissimum* leaves are good sources of phosphorus. True or false

3.5 Nutritional Composition of Fermented Condiments

The use of fermented vegetable proteins as seasonings is wide spread in Africa, especially among the rural dwellers. In West Africa, some of the common fermented vegetable condiments include iru or dawadawa from locust bean (*Parkia biglobosa*),

ogiri from melon seeds (*Citrullus vulgaris*), daddawa from soybean (*Glycine m*ax), soumbala from soybean (*Glycine max*) , ugba from African oil bean seed (*Pentaclethra macrophylla*) and owoh, from cotton seeds (*Gossypium hirsutum*).

A large percentage of Africa's population live below poverty line with diets that are poor in protein and other essential nutrients. Fermented food condiments have been found to be rich in proteins and other essential nutrients and, therefore, serve as affordable supplements for these nutrients outside their usage as flavoring agents .

3.5.1 Proximate composition of some indigenous condiments

Table 5 shows the proximate composition of five indigenous condiments in Nigeria. it could easily be seen that these condiments are rich in protein except for ugba. plant sources of protein are very important in the diets of people in the developing countries. This is because a significant proportion of the population cannot afford the animal sources of protein like meat, fish, egg etc. these condiments could therefore serve as affordable sources of protein to their diet. these local condiments also contain appreciable amounts of fat.

Table 5: Proximate composition (%) of some indigenous condiments

Condiment	Moisture	Ash	Crude fibre	Crude protein	Carbohydrate	Fat
Iru/Dawadawa	52.0	3.6	4.0	32.9	16.3	24.2
Ogiri	44.1	3.0	15.6	19.9	25.2	—
Owoh	46.6	2.21	6.01	16.37	14.06	20.76
Ugba	34.4	1.11	2.93	7.13	17.48	19.72

Okpehe	9.46	4.84	2.99	36.88	47.18	11.35

3.5.2 Mineral composition of some indigenous condiments

Table 6: mineral composition (mg/100g) of some fermented condiments

Condiment	P	K	Na	Ca	Mg	Zn	Fe	Mn
Iru/Dawadawa	80.00	205.00	—	9.01	35.00	—	3.31	—
Ogiri	91.17	1075.00	369.36	78.60	58.72	1.17	14.50	1.15
Owoh	-	464.50	416.50	246.0	150.0	119.7	16.0	-
Ugba	291.02	110.39	172.06	208.92	334.98	9.23	42.46	26.87
Okpehe	-	183.1	-	45.3	-	14.2	10.24	4.2

Magnesium is an important trace element involved in calcium (Ca) metabolism in bones and management of circulatory diseases such as ischemic heart disease. Mg serves as a catalyst in energy producing reactions within the cells and facilitates muscle relaxation. all the condiments contain rich amounts of magnesium especially ugba and owoh. the condiments also contain high amounts of potassium, phosphorus and calcium. Calcium together with phosphorus is involved in bone and teeth formation, blood clotting, and transmission of nerve muscles. the iron content of ugba is worthy of note, this is because iron deficiency anaemia is a public health concern in the developing countries. the consumption of local condiments especially ugba could assist in the reduction of this health challenge.

Self Assessment Exercise 3

1. Which of these local condiments contains the highest amount of protein
   a. iru
   b. owoh
   c. okpeye
   d. ogiri
2. The high amount of iron in *ugba* condiment is very important for the developing countries because------
   a. it will help reduce anaemia
   b. it will promote the prevalence of obesity
   c. it will help reduce iron induced kwashiorkor
   d. it causes dysentery

3.6 Summary

Indigenous spices, herbs and condiments are used to add flavour to our dishes and improve their sensory properties. these food ingredients are also rich in nutrients. the spices and herbs are rich in vitamins and minerals while the condiments are good sources of protein.

effort must urgently be made, to promote the utilization of these indigenous food ingredients in order to promote the nutritional status and well being of the populace especially in the developing countries.

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3.8 Possible Answers to Self-Assessment Exercise(s)

1. C- Moderate
2. A- African nutmeg

Self Assessment Exercise 2

1. True
2. True

Self Assessment Exercise 3

1. C- Okpeye
2. A- it will help reduce anaemia
3.

MODULE 5: HEALTH BENEFITS OF SPICES, HERBS AND CONDIMENTS

1.1. Introduction

Spices contribute to the quality, nutritive value, and flavor of food. Since ancient times, they hold a great medicinal value. Their antimicrobial, antiviral, antibacterial, anti-inflammatory, and other numerous properties have made them a potent source of therapeutic agents. Phytochemical analysis revealed presence of active constituents

such as eugenol, curcumin, carotenoids in clove, turmeric, saffron respectively that explains the efficacious nature of these spices.

Photochemicals such as phenolic compounds possess great antioxidant properties. Natural antioxidants contained in spices help to reduce oxidative stress. Oxidative stress, which is caused by high concentration of free radicals in cells and tissues, can be induced by various negative factors, such as gamma, UV, and X-ray radiation, psycho-emotional stress, polluted food, adverse environmental conditions, intensive physical exertion, smoking, alcoholism, and drug addiction. Chronic oxidative stress has been reported to lead to a variety of diseases, including cancer, heart related diseases, and the acceleration of aging.

In this module, we shall be discussing the health benefits of some common and well known spices. like cinnamon, ginger, turmeric, garlic etc.

1.2 Learning outcomes

by the end of this unit, you will be able to

1. Discuss a minimum of two health benefits each of Cinnamon, ginger and Tumeric

2. Discuss a minimum of two the health benefits each of Black pepper, garlic and Chilli pepper

3. Analyze the antioxidant properties of two common spices

1.3 Health Benefits of Cinnamon, Ginger and Turmeric

1.3.1 Health Benefits of Cinnamon

Health benefits of cinnamon include the following:

- Cinnamon has the ability to reduce many forms of oxidative stress, including the ability to limit nitric oxide build up in the blood and lipid (fat) peroxidation, which can both add to instances of brain disorders, cancer, heart disease and other conditions.

- It contains anti-inflammatory properties. The antioxidants in cinnamon have anti-inflammatory effects, which may help lower the risk of heart disease, cancer, brain function decline and more. Researchers have identified over seven kinds of flavonoid compounds alone in cinnamon, which are highly effective at fighting dangerous inflammation levels throughout the body.

- Because cinnamon lowers swelling and inflammation, it can be beneficial in pain management, with studies showing that cinnamon helps to relive muscle soreness,

- It protects heart health. Studies have shown that another health benefit of cinnamon is that it reduces several of the most common risk factors for heart disease, including high cholesterol levels, high triglyceride levels and high blood pressure.

- Cinnamon has also been shown to reduce high blood pressure, which is another threat for causing heart disease or a stroke.

- Research shows that cinnamon is a helpful blood coagulant and prevents bleeding by helping the body to form blood clots. Cinnamon also increases blood circulation and advances bodily tissue’s ability to repair itself after it’s been damaged. This includes heart tissue, which is in need of regeneration in order to help fight heart attacks, heart disease and stroke.

- It helps fight diabetes. Cinnamon is known to have an anti-diabetic effect. It helps lower blood sugar levels and also can improve sensitivity to the hormone insulin, which is the vital hormone needed for keeping blood sugar levels balanced.

1.3.2 Health Benefits of Ginger

Ginger is a popular spice. It is high in gingerol, a substance with powerful anti-inflammatory and antioxidant properties. Gingerol is the main bioactive compound in ginger, responsible for much of its medicinal properties.

- Ginger can treat many forms of nausea, especially morning sickness. Ginger may also relieve nausea and vomiting after surgery, and in cancer patients undergoing chemotherapy.

- Ginger may reduce muscle pain and soreness. Ginger has been shown to be effective against exercise induced muscle pain. These effects are believed to be mediated by the anti-inflammatory properties.

- The Anti-Inflammatory effects Can Help With osteoarthritis. Osteoarthritis is a common health problem. It involves degeneration of the joints in the body, leading to symptoms like joint pain and stiffness

- Ginger may lower blood sugarand improve heart disease risk factors.

- Ginger can help treat chronic indigestion. After eating soup, ginger reduced the time it took for the stomach to empty from 16 to 12 minutes.

- Ginger powder may significantly reduce menstrual pain.

- Ginger may lower cholesterol levels. High levels of LDL lipoproteins (the "bad" cholesterol) are linked to an increased risk of heart disease. The foods you eat can have a strong influence on LDL levels. There are some evidence, in both animals and humans, that ginger can lead to significant reductions in LDL cholesterol and blood triglyceride levels.

- Ginger contains a substance that may help prevent cancer. The anti-cancer properties are attributed to 6-gingerol, a substance that is found in large amounts in raw ginger.

1.3.3.Health Benefits of Turmeric

Bioactive ingredients found in tumeric are pleiotropic in nature, the same molecule can bind to a variety of enzymes and other molecular targets in the body.

- Curcumin is the compound in turmeric that has potent anti-inflammatory One advantage over conventional anti-inflammatory agents is that turmeric does not cause gastric side effects.

- Curcumin’s anti-inflammatory property contributes to its painkiller. This painkiller property has been found to be useful in dealing with postsurgical pain and burn injuries. Additionally, curcumin is also found to relieve neuropathic pain which is similar to pins and needles sensation.

- Curcuminoids present in turmeric are strong antioxidants. Their antioxidant activity is comparable to vitamin C and E. As antioxidants they function in 3 ways:

i. Reduce oxidative stress or imbalance between prooxidant and antioxidant species in the body

ii. Raise the level of antioxidant enzymes

iii. Scavenge free radical species that cause oxidative damage thus they ameliorate oxidative stress in conditions like diabetes and thalassemia.

- Turmeric improves digestion, exerts bactericidal effect on H.pylori infection, prevents the formation of ulcers, soothes inflammation and even protects from silent reflux.
- Research shows that curcumin can prevent and treat pancreatitis. Its anti-inflammatory activity benefits in pancreatitis. It reduces severity of various types of arthritis.
- It is also beneficial in pancreatic cancer however, if taken at high doses or an empty stomach, it may trigger acid reflux in some.
- Curcumin also protects bone tissue and prevents bone loss. It can help in healing of bone fractures.

Self Assessment Exercise

1. The most important phytochemical in ginger is called ----------
2. Turmeric may have antiulcer activity. True or False

1.4 Health benefits of Black pepper, garlic and Tumeric

1.4.1 Black Pepper

Black pepper contains from 5 to 9% piperine, the major active constituent. Black pepper also contains alkamides, piptigrine, wisanine, and dipiperamide.

health benefits of black peper are as follows

- Antioxidant effect.—Piperine, the active compound of black pepper, has been demonstrated within in vitro studies to protect against oxidative damage by inhibiting or quenching free radicals and reactive oxygen species.

- Anti-inflammatory effect.—Piperine has revealed remarkable anti-inflammatory and analgesic activities. The antiinflammatory activity of piperine has been confirmed in many rat models. In addition, piperine relieved pain in an arthritis animal model.

- Antiallergic effect.— piperine may inhibit both histamine release and eosinophil infiltration and also suppressed allergic airway inflammation and airway hyperresponsiveness. Asthma is an inflammatory disease caused by irregular immune responses in the airway mucosa.

- Digestion aid.—Black pepper may accelerate the overall digestive process by enhancing the activity of digestive enzymes, increasing gastric acid and bile acid secretion, and reducing food transit time.

- Cardiovascular health.—Piperine has been shown to inhibit lipid droplet accumulation in mouse macrophages that are converted to foam cells in an animal study, suggesting it may help retard the progression in which fatty

deposits build up in the arterial wall. Piperine also reduced plasma lipid and lipoprotein levels.

- Weight management.—Piperine may enhance energy expenditure or thermogenesis through the sympathetic nervous system by increasing levels of catecholamine and activating the adrenal sympathetic nerves in animal studies.

1.4.2 Health benefits of garlic

Many of the biological effects of garlic are attributed to the allicin, ajoene, and other organosulfur constituents. The health benefits of garlic include:

- Anti-inflammatory activity.—Garlic and its sulfur-containing compounds exert anti-inflammatory properties. In a clinical trial, daily dose supplementation of a 1000 mg garlic tablet for 12 weeks significantly improved stiffness, pain, and physical function in overweight or obese women.

- Cardiovascular health and endothelial function.—Garlic has traditionally been used to promote cardiovascular health through a variety of mechanisms. Evidence from in vitro, animal, and human research has shown that taking garlic may slow the development of atherosclerotic process (hardening of the arteries, a condition that can lead to heart attacks and strokes, by beneficially reducing fatty streak formation in blood vessels and atherosclerotic plaque size, inhibiting oxidation of LDL-C (as oxidized LDL is what damages the blood vessels; suppressing inflammatory cell adhesion to endothelial cells, and improving impaired endothelial function .

- Blood cholesterol–lowering effects.— Animal and human cell lines studies have demonstrated that garlic may reduce blood lipids levels.

- Blood pressure–lowering effects.—The antihypertensive effects of garlic and its constituents in vitro and in vivo are well documented. Furthermore, garlic-derived organic polysulfides are converted by red blood cells into hydrogen sulfide gas, which leads to vasorelaxation. Antithrombotic and anticoagulant properties.— Antithrombotic activity has been documented for garlic extract in both in vitro and in vivo human studies. Garlic has been shown to inhibit platelet aggregation (stickiness).

- Hypoglycemic activity.—Garlic has blood glucose–lowering properties in diabetic rats. In a human trial, it was demonstrated that treatment with time-released garlic product (Allicor) resulted in better metabolic control because of the lowering of fasting blood glucose and triglyceride levels.

- Brain health.—Experimental evidence has shown that some garlic-derived products have a protective effect against ischemic brain injury, thereby improving learning and memory retention.

- Immunomodulatory activity.—In vitro and in vivo (animal) studies have found that garlic and its constituents have several immune-enhancing effects such as stimulation of lymphocyte proliferation.

1.4.3 Health benefits of Chilli pepper

Red pepper contains 0.2–2% capsaicinoids, which are responsible for the pungency. Capsaicin, an alkaloid, accounts for about 50–70% of the total capsacinoids and dihydrocapasaicin for 20–25%, which, together with capasaicin, provides the fieriest notes from midpalate to throat. Red pepper also contains newly discovered,

nonpungent compounds called capsinoids (e.g., capsiate and dihydrocapsiate). The following are the health benefits of chilli pepper:

- Cardiovascular health.—The antioxidant and antiplatelet properties of capsaicin and the important role of capsaicin in regulating energy metabolism may also contribute to its beneficial effects on the cardiovascular system.

- Blood glucose control.—Human trials found that 5 g or more of chili pepper (Capsicum frutescens) was associated with a decrease in blood glucose level and maintenance of healthy insulin levels.

- Thermogenesis, satiety, and weight management.— Shortterm consumption of red pepper may have the potential to assist in body weight management by increasing satiety and fullness, reducing energy and fat intake, increasing body heat production (thermogenesis), raising the body's metabolic rate, preventing fat cells from growing into mature cells and increasing the rate of fat burn-off (fat oxidation).

- Gut health.— Capsaicin is a gastroprotective agent in peptic ulcer disease. Capsaicin inhibits acid secretion and stimulates alkali and mucus secretions (particularly gastric mucosal blood flow), which help in the prevention and healing of ulcers.

- The antimicrobial activity of spices, has been highlighted by inhibitory effects against Helicobacter pylori and other bacteria and fungi. Chili pepper has long been recognized to have a beneficial effect on the gut microbiota in humans. Gut microbiota has been implicated as a novel and important metabolic factor that affects the health of the host, abundance, composition, and metabolites of

gut microbiota has been related to risk of obesity, diabetes, liver cirrhosis, and cardiovascular disease.

Self Assessment Exercise 1

1. The major phytochemical in chilli pepper is ----------
2. Garlic, black pepper and chilli pepper may help in the management of cardiovascular diseases. Answer True or False

2.5 Summary

Spices contribute to the quality, nutritive value, and flavor of food. Since ancient times, they hold a great medicinal value. Their antimicrobial, antiviral, antibacterial, anti-inflammatory, and other numerous properties have made them a potent source of therapeutic agents. Phytochemical analysis revealed presence of active constituents such as eugenol, curcumin, carotenoids in clove, turmeric, saffron respectively that explains the efficacious nature of these spices.

These phytochemicals conveys health promoting benefits to these spices. Some of these health benefits include cardiovascular health promoting effect, anti diabetic properties, blood pressure and blood cholesterol lowering properties.

It should be noted that many of these health benefits has only been tested on animals and still require extensive human studies therefore caution must be applied in using spices for prevention or cure of diseases. One should always consult a medical expert before doing so.

2.6 References/further readings

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2.7 Possible answers to self assessment exercises

Self Assessment Exercise 1

1. gingerol
2. True

Self Assessment Exercise 1

1. Capsaicin
2. True

UNIT 2. HEALTH BENEFITS OF COMMON HERBS

2.1 Introduction

Culinary herbs are herbaceous plants that are used to add flavour and colour to all types of meals. Herbs have been used for thousands of years to add flavour to meals, as medicine and as a preservative. examples of herbs include rosemary, thyme, oregano, basil leaves etc.

In this unit we shall be discussing the health benefits of some common herbs.

2.2 Learning Outcomes

By the end of this unit, you will be able to

1. Discuss a minimum of two health benefits each of rosemary, thyme and lemon grass

2. Discuss a minimum of two the health benefits each of Bay leaves and Parsley.

3. Analyze the antioxidant properties of herbs

2.3 Health Benefits of Rosemary, Thyme and Lemon Grass

2.3.1 Health benefits of rosemary

Rosemary contains phenolic acids and diterpenes including carnosic acid, carnosol, caffeic acid and its derivatives (i.e., rosmarinic acid), flavonoids (apigenin, diosmin, luteolin), and tannins. Rosemary also contains volatile oils that consist of cineole, pinene, and camphor. the health benefits of rosemary include:

- Antioxidant and anti-inflammatory effects.— Rosemary extract has been shown to have an antidepressant-like effect.
- Vascular health.—rosemary extract could inhibit LDL-C oxidation.
- Rosemary has shown antithrombotic activity.
- Blood glucose control.—In an animal model, a high dose of rosemary extract (100 mg/kg or higher) significantly lowered blood glucose levels and increased serum insulin concentrations in diabetic rabbits. However, more studies are required in animals and humans to confirm this hypothesis.

- Skin care.—Destruction of collagen is a hallmark of skin aging as a result of exposure to UV irradiation. Carnosic acid from rosemary has demonstrated photoprotective action on human skin cells exposed to UVA light in vitro. Rosemary extract inhibited oxidative damage to skin-surface lipids in both in vitro and in vivo studies. Rosemary may be a good candidate for an antiskin aging agent, but more human data are needed.

- Heptoprotective effects.—Rosemary extract has reduced toxic chemical-induced liver damage and cirrhosis and has improved detoxification systems in an animal model .

- Chemopreventive and anticarcinogenic potential.—In vitro studies suggest that rosemary extract may reduce the effects of carcinogenic or toxic agents in many human cell lines. One mechanism through which constituents in rosemary may exert anticancer effects is by reducing the expression of a number of pro-inflammatory genes.

2.3.2 Health benefits of thyme

The antioxidative property of thyme is important in both the medicinal and nonmedicinal context. Oxidative stress contributes to the pathogenesis of many human diseases; therefore, the intake of antioxidative agents is important for the prevention of chronic diseases Several recent papers confirm what has been known for a long time, namely the antioxidative ability of thyme oil (and thyme extracts. The health benefits of thyme are as follows:

- Antispasmodic activity of thyme: The phenols thymol and carvacrol contribute to the antispasmodic effect in most models.

- Respiratory track health: Herbal thyme, thyme extracts and thyme oil are used to treat symptoms of bronchitis and whooping cough as well as catarrh in the upper respiratory tract.

2.3.3. Health benefits of lemon grass

- Antioxidant activity

- Anti inflammatory property Lemon grass oil has anti inflammatory activities. Results revealed that lemongrass oil inhibited inflammatory all tested biomarkers production.

- Anti-malarial activity. Lemongrass extract is known to exhibit anti *Plasmodium berghei* activity even at low dose.

- Anti-tubercular activity – It has been shown that all species of lemongrass exhibited effective antitubercular activity.

- Reduction of blood sugar Lemon grass extract may be able to reduce blood sugar as well as high density and total cholesterol.

Self Assessment Exercise 1

1. One of these is not a component of rosemary

    a. carnosic acid

    b. ,carnosol,

    c. caffeic acid

    d. eugenol

2. ---------- herb may posses antimalarial properties

2.4 Health benefits of Bay leaves and Parsley

2.4.1 Health benefits of bay leaves

- Antimicrobial and antifungal characteristics- The essential oils of bay leaves has been found to be active against Staphylococcus aureus, Escherichia coli, Shigella fl exnerii and Salmonella typhi, pathogens of the intestinal tract
- Hypoglycaemic properties (in the control of diabetes) - Bay leaves potentiated the action of insulin in glucose metabolism and reduced glucose transport
- Anti-ulcerogenic properties -
- Antioxidative properties
- Anti-inflammatory activity.

- The leaf essential oil of bay leaves which has been used as an antileptic remedy in Iranian traditional medicine has been reported to have anticonvulsant activity against experimental seizures.

2.4.2 Health benefits of Parsley

- Antimutagenic properties
- Antioxidant properties - Myristicin in parsley seed oil showed high antioxidant activity
- It has been shown to exhibit anti-inflammatory, antiviral and purgative effects
- Parsley is reported to possess diuretic activities
- Carminative activities
- Antipyretic,
- Myristicin from parsley leaf oil was shown to be an active inducer of detoxifying enzyme glutathione S. transferase (GST),.

Self Assessment Exercise 2

3. Answer true or false. The health benefits from most herbs is because they have antioxidant properties.
4. ---------- and ---------- are the health benefits of bay leaves

2.5 Summary

Culinary herbs are herbaceous plants that are used to add flavour and colour to all types of meals. Herbs have been used for thousands of years to add flavour to meals, as medicine and as a preservative. Herbs have many health benefits majorly as a result of their antioxidant activities.

Many herbs posses hypoglycemic, cholesterol lowering and anti inflammatory properties. Many of these effects have only been tested on animals and so one must be cautious when using herbs for health purposes and should consult with medical experts.

2.6 References/Further Readings

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2.7 Possible Answers to Self-Assessment Exercise(s)

Self Assessment Exercise 1

1. D – Eugenol
2. Lemon grass

Self Assessment Exercise 2

3. True

4. See section 2.4.1

UNIT 3 HEALTH BENEFITS OF UNDERUTILIZED LOCAL SPICES

3.1 Introduction

Underutilized or neglected crops are labels often applied to plant species that are indigenous, rather than non-native or adapted introductions, and which often form a complex part of the culture and diets of the people who grow them. These crops were used as traditional foods for centuries but became increasingly neglected when more productive crops became available in farming systems.

Nigeria is blessed with many indigenous herbs and spices whose application is mostly confined within the country. These spices have not been exploited for international trade. Despite their neglect these herbs and spices have great culinary and medicinal benefits. Effort must be geared towards promoting the utilization and cultivation of these spices especially at the commercial level. Some of these underutilized spices include negro pepper, black pepper, alligator pepper, African nutmeg, African basil to mention but a few.

3.2 Learning Outcomes

By the end of this unit, you will be able to

1. Discuss some of the underutilized herbs and spices
2. Analyze two health benefits each of Negro pepper, Black pepper and Alligator pepper.
3. Analyze two health benefits each of *Tetrapleura Tetraptera,* Africa Basil, Amaranth globe and African nutmeg.

3.3 Health Benefits of Negro pepper, Black pepper and Alligator pepper

3.3.1 Health Benefits of Negro pepper

Pepper Negro Pepper (*Xylopia aethiopica*) known as *uda* in Igbo language, *kimba* in Hausa langruage comes from the tropical West African rain forest tree but its seeds and leaves are widely used in all parts of Nigeria and indeed all over the world as spice and medicine. The spice is aromatic, has an intense flavor and is slightly bitter. The seeds are embedded in pods. In some food and soups, the pods are opened up and the sticky black seeds are removed and discarded because of their bitterness. In others, the pods and seeds are toasted over open fire and then crushed. the health benefits of negro pepper are as follows:

In Eastern Nigeria, where it appears to be more used than elsewhere in Nigeria, it is the culinary herb of choice for nursing mothers. Negro pepper (NP) is used for cooking pepper soups, *nsala* soup for lactating mothers, as well as several other dishes. In Northern Nigeria, where it is called *kimba*, it is ground and used in seasoning meat and a variety of other dishes. Some of the health benefits include:

- Promotes Weight Loss
- Regular use of NP seeds as a spice can help promote weight loss by boosting your metabolism and helping you eat less.
- Bronchitis Treatment - NP seed is a potent natural solution that can be used to tackle the respiratory disease, bronchitis.
- Asthma Relief and for other respiratory diseases – NP seeds are packed full of anti-inflammatory compounds that can be effective in preventing asthmatic

triggers and relieving asthma attacks. A couple of research studies have shown that Uda seed contains chemical compounds that help relieve other respiratory system diseases like common cold and bacterial pneumonia, just to name a few.

- Helps Fight Rheumatism - Rheumatism or rheumatic disorders is a general term used for any disease condition that causes chronic pain and inflammation in the muscles, joints connective tissue. Due to the anti-inflammatory properties of NP seeds, it helps fight against rheumatism and associated pain.
- Can Help Take Care Of Menstrual Problems: NP seed has long been associated with the treatment of menstrual issues. In some places, Uda has been traditionally used in treating amenorrhea and improving menstrual blood flow.
- Great For Treating Skin Issues: NP seeds have long been used traditionally to treat skin conditions such as itches, boils, pimples and so on.
- Helps In Lactation: Crushed NP seed is used by some lactating mothers to increase dmilk production and flow.
- Has Anti-Inflammatory Properties : NP seed is rich in anti-inflammatory properties, which can help can help fight unwanted Inflammation in the body

3.3.2 Health benefits of Black pepper (*Piper guineense*)

Black pepper (*Piper guineense)* knowns as *uziza* in Igbo and and *Iyere* in Yoruba. the phytochemicals identified in black pepper include Alkaloids Flavonoids Saponins

Tannins Terpenes Resins Steroids Essential oil includes dillapiol, elemicin, myristicine, and safrole Cardiac glycosides. Black pepper (BP) has rich content of antioxidants like piperine and other phytochemicals (flavonoids) which are responsible for its many health benefits. The health benefits of this amazing plant include:

- Relieves cold and cough - BP has been in use as ancient African medicine to treat cold and cough symptoms. Piperine, the essential oil in uziza helps to relieve congestion and clear out thick mucus. Furthermore, uziza is rich in essential nutrients that help strengthen immunity and protect your body from infectious diseases.

- Fights infection: The fruits and leaves of BP have long been in use to treat microbial infections in African traditional medicine. Traditional healers use the fresh leaves or dried fruits to make an alcohol infusion that is given to treat bacterial, fungal, and parasitic infections. One study found that the fruit and leaf extract of *P. guineense* showed antimicrobial and antifungal activity against several human pathogens. Another animal study found that extracts of *P. guineense* cleared about 60% of malaria-causing parasites from the blood.

- Prevents cancer: Piperine, the active ingredient in *P. guineense* has been found to inhibit the proliferation and growth of cancer cells in several studies. One study found that piperine present in BP and other peppers (black pepper) may prevent and treat breast cancer. However, more human research is needed.

- Controls blood sugar level: A high blood sugar level is a common symptom of diabetes. Traditional medicine experts believe that eating uziza soup regularly could help treat high blood sugar levels in people with diabetes.

- Has anti-inflammatory properties: Inflammation is often an underlying factor in most health conditions like diabetes, arthritis, heart disease, and cancer. One 2018 study found that hexane extracts of *P. guineense* showed potent anti-inflammatory properties in animal models. Meanwhile, in traditional medicine, a poultice prepared from dried fruits of BP is applied externally to reduce arthritic pain.

- Promotes weight loss: Adding BP to your diet may help boost your metabolism and promote weight loss. Also, drinking uziza tea before meals promote satiety, and reduces overeating.

- Promotes uterine contraction after childbirth: Uziza (*Piper guineense*) is added to soups and given to women after childbirth. It is believed to reduce or shrink the uterus, cleanse the uterus, and promote milk supply.

3.3.3 Health benefits of Alligator pepper (*Aframomum melegueta*)

Aframomum melegueta (alligator pepper or Grains of Paradise) is a spice with a similar composition as Ginger that belongs to the same Zingiberaceae family. It is used in Nigeria, West Africa. Generally, in Nigeria, the seed of Alligator pepper (AP) is used in different formations for nutrition and food purposes. The tiny seeds are extracted from its pods and then grounded and added to soups and stews. This is meant to produce a special tasty flavor, peppery taste and fruity undertone to the soups. Studies have shown that seeds contain important phytochemicals namely, alkaloids, glycosides, tannins, flavonoids, sterols, triterpenes, and oils; some of which are responsible for its pesticdial and antimicrobial properties . AP has traditionally been used to treat these health challenges.

- Used to treat arthritis
- For boils and pimples
- It has anti-inflammatory properties
- Antimicrobial properties used and used to treat dental problem

Self Assessment Exercise 1

1. Most local herbs and spices are traditionally used for only food purposes. True or False
2. ---------- and ---------- may help in the treatment of common cold.

3.4 Health Benefits Of Tetrapleura Tetraptera, Africa Basil, Amaranth globe and African nutmeg

3.4.1 Health benefits of *Tetrapleura tetraptera,*

Aidan tree (*Tetrapleura tetraptera*) The Aidan tree, a deciduous perennial native to West Africa, has many uses. It is referred to as *apapa* in Ijaw, while the Binis call it *ighimiaka*. The fruit of the Aidan tree has its unique flavor and aroma that spices up white soup (afia afere in Efik or ofe nsala in Igbo). In Ibibio land, it is used in spicing nearly all foods. The Igbo tribe in Nigeria use it mainly for cooking pottage. Ijaw people use it to prepare pepper soups and other dishes. The plant is used as a spice, a medicine and as a dietary supplement rich in vitamins. The health benefits include:

- it is used as post parturition and lactation aid.

- it may be used for the management and treatment of arthritis and other inflammatory related ailments
- it may help reduce blood sugar and blood pressure
- it could be used to control epilepsy

3.4.2 African Basil (*Ocimum gratissimum*)

African Basil (*Ocimum gratissimum*) is a very important culinary herb is widely used all over the world. As an awesome multi-purpose plant, used fresh or dried, African Basil is commonly cultivated for dietary and medicinal uses. Due to its peculiar and pungent aroma, African Basil is known all over Nigeria as scent leaf. Its use as meat seasoning in contemporary Nigeria is almost without equal among Nigerian culinary herbs. Others put the leaves in salads. It tastes great in stews. For its taste and strong aroma, the Ijaw from south-southern part of Nigeria use the leaves in sauces, soups, and meat. It is used in the famed ekpang nkwukwo soup of the Efik and Ibibio people. It has also been an Igbo plant for ages and tastes great with ofe akwu, ukwa and other Igbo delicacies. it is called *effirin* in Yoruba and *nchawu* in Igbo

The plant serves as a mosquito repellent, and is used for the traditional treatment of fever, tooth and gum disorders. The pulped foliage is believed to have antiseptic properties. Phytochemical constituents include tannins, flavonoids, terpenoids, saponins and alkaloids. It has been reported to have anti-inflammatory, antibacterial, antifungal, anti-carcinogenic and antioxidant properties.

3.4.3 Health benefits of Amaranth globe (*Gongronema latifolium* Benth)

G. latifolium is referred to as *utazi* and *madumaro* by the Igbo and Yoruba tribes of Nigeria respectively. This plant has been used in the Eastern part of Nigeria, particularly Igbo land, over the ages but has now become a regular feature in Nigerian delicacies across the country. The leaves serve as edible vegetables for soups. It is used for the bitter taste it imparts to soups and stews.

Its peculiar bitter taste is believed to be its unique antidote for treatment of some stomach related ailments and management of other diseases like diabetes and high blood pressure. The leaves are used as a bitter tonic to treat loss of appetite and for management of diabetes. An infusion of the aerial parts is taken to treat cough, intestinal worms, dysentery, dyspepsia, and malaria. The plant is similarly used in the treatment of hypertension, muscular pains, arthritis, joint inflammation and control of cholesterol. Gongronema latifolium possess antihepatotoxicity effect against liver damage induced by paracetamol , anti-ulcer, analgesic and antipyretic properties.

3.4.4. Health benefits of African nutmeg (*Monodora myristica*)

Monodora myristica has the common names of African nutmeg and calabash nutmeg and in Nigeria, it is called “Ehuru” in Igbo, “Abolakoshe” in Yoruba and “Ebenoyoba” in Benin. In addition, the bark, seeds and leaves are used in treating various ailments in African traditional medicine. However, the most economically important parts are the plant is the seeds, which are embedded in the white, sweet-smelling pulp of the subspherical fruit. The seeds have nutritive and calorific values that make them necessary in diets. The kernel obtained from the seed has an aromatic fragrance, which makes it suitable as a spicing agent in both African and

continental cuisines in Nigeria. In eastern countries, the kernel is used as a drug more than as a condiment.

Monodora myristica has a bitter pungent taste and is therefore used for bronchitis and to improve appetite. Following roasting and grinding, the seeds are rubbed on the skin for skin diseases, thus suggesting that the seeds of the *M. myristica* plant could be germicidal or antiseptic. When ground to powder, the seed may be taken as a stimulant to relieve constipation and to control passive uterine hemorrhage in women immediately after child birth. it also has diuretic properties and used for mild fever and antiseptic . *Monodora myristica* produced favourable lipid profile, ameliorated antioxidant levels.

Self Assessment Exercise 2

3. All these can be classified as local herbs except

a. African Basil

b. Amaranth globe

c. black pepper leaves

d. African nutmeg

4. The underutilized herbs and spices posses numerous health benefits because they contain

    a. antioxidants

    b. antirepellants

    c. antiduretics

    d. antidiabetics

3.5. Summary

Nigeria is blessed with many indigenous herbs and spices but many of them are unfortunately underutilizedm their application being mostly confined within the country. These spices have rich food and medicinal benefits and therefore must be promoted for commercial utilization.

Some of these underutilized spices include negro pepper, black pepper, alligator pepper, African nutmeg, African basil to mention but a few. many of these local spices have been shown to have good medicinal properties like helping in the treatment of common cold, as lactation aid, they may also posses antidiabetic and cholesterol lowering abilities.

3.6 Glossary

1. Carminative - An agent that prevents or relieves flatulence (gas in the gastrointestinal tract.

2. Gut Microbiota - The gut **microbiota** is the system of microorganisms in a person's gastrointestinal system. This includes many bacteria, fungi, viruses, and other organisms.

3. Pleiotropic - When one single gene starts affecting multiple traits of living organisms, this phenomenon is known as **pleiotropy.**

3.7 References/Further Readings

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3.8 Possible Answers to Self-Assessment Exercise(s)

Self Assessment Exercise 1

1. False

2. **Negro pepper, black pepper, amaranth globe etc**

Self Assessment Exercise 2

1. African nutmeg. it can be classified as a spice not a herb since it is not from the leaves of a plant.

2. A- antioxidants

MODULE 6: COLLECTION, PRODUCTION, PACKAGING AND STORAGE

UNIT 1: COLLECTION, PRODUCTION, PACKAGING AND STORAGE OF SOME COMMON SPICES

CONTENT

1.1 Introduction

Spices are high value export oriented crops, to meet this challenge, spices have to be produced, processed to have high market quality with internationally accepted food safety standards. Hence precautions have to be taken from the pre harvesting, harvesting, post harvesting and primary processing which includes, washing, threshing, blanching, drying, cleaning, grading and packaging in order to meet the standards.

In this module we shall be discussing the collection, production, packaging and storage of spices for extended shelf-life and optimal quality.

1.2 Learning Outcomes

By the end of this unit, you will be able to

1. Discuss the processing of ginger rhizomes into different products
2. Discuss the processing of Clove buds
3. Discuss the processing of cinnamon spice

1.3 Collection, Production and Storage of Ginger

1.3.1. Production of ginger

Ginger is cultivated in several parts of the world, the most important producing regions being India, China, Indonesia, Nepal, Thailand, Nigeria, Bangladesh, Japan and the Philippines. Among them, India and China are the dominant suppliers to the world market. In terms of quality, Jamaican and Indian ginger are considered superior followed by West African ginger. Jamaican ginger possesses delicate aroma and flavour and is sometimes considered as first grade. Indian ginger, entering the world market as 'Cochin' and 'Calicut' ginger, has a lemon-like byenote which some prefer to Jamaican ginger. Nigerian and Sierra Leone dried gingers possess somewhat camphoraceous and coarser odour and is rich in aroma and pungency factors. There is demand for them for oil distillation and oleoresin extraction.

1.3.2 Processing of ginger

The fresh ginger immediately after harvest is subjected to washing, which is performed to remove dirt, residues of farm chemicals and other foreign materials. Other post harvest operations include:

a. peeling and drying: Peeling and drying After washing the ginger rhizomes are subjected to peeling operation.
   The scrapped or peeled rhizomes are again washed well
   and dried in sun for a week or more.The sun dried ginger is brown in colour, more or less irregular wrinkled surface

b. Polishing: Polishing of dried ginger is done to remove the wrinkles developed during drying process. This improves the appearance of the dried ginger rhizomes.

1.3.3 Products of ginger rhizomes

The primary products of ginger rhizomes for flavouring purposes are fresh ginger, preserved ginger in syrup or brine and dried ginger. Secondary products are ginger powder, oils and oleoresins from dry ginger.

a. Fresh ginger: Fresh ginger is outstanding for flavouring as it contains the full note of the spice compared to other products made from it.
b. Preserved ginger: Immature green ginger is preserved in brine or sugar syrup. The processing technology for preserved ginger varies with country.
c. Dry ginger: Dry ginger obtained by drying of fresh ginger enters the spice trade for the preparation of ground ginger, extraction of oleoresin and oil.
d. Ginger powder: Ginger powder is made by pulverizing dry ginger to a mesh size of 50–60. Ginger is ground to release the flavour. The finer the powder, the more readily available the flavour and readily dispensable it is in the matrix.
e. Ginger oil: Ginger oil is produced commercially by steam distillation of freshly ground dry ginger. The yield of oil varies from 1.5–3.0 % with an average of 2.0 %. The oil obtained is a green or yellow mobile liquid which becomes viscous on ageing. The most suitable material for oil distillation is coated African ginger, followed by Nigerian splits and Cochin ginger. Ginger oil is used as a flavourant in food processing, pharmaceuticals and also in perfume ry.

f. Ginger oleoresin: Ginger oleoresin is obtained by extraction of powdered dry ginger with suitable organic solvents such as alcohol, acetone and ethylene dichloride, etc. Concentration of solvent extract under vacuum and complete removal of traces of solvent yields ‘oleoresin of ginger’.

1.3.4 Storage and packaging of ginger

Packaging: Bulk rhizomes can be packed in jute sacks, wooden boxes or lined corrugated cardboard boxes for shipping. Dry slices or powder are packaged in multi-wall laminated bags. Some laminates are better than others due to film permeability. The packaging material should be impermeable to moisture and air. Sealing machines can be used to seal the bags. Attractive labels should be applied to the products.

The label needs to contain all relevant product and legal information – the name of the product, brand name (if appropriate), details of the manufacturer (name and address), date of manufacture, expiry date, weight of the contents, added ingredients (if relevant) plus any other information that the country of origin and of import may require (a barcode, producer code and packer code are all extra information that is required in some countries to help trace the product back to its origin).

Storage: Dried rhizomes, slices and splits should be stored in a cool place (10-15°C). At higher temperatures (23-26°C) the flavour compounds start to deteriorate and ginger loses some of its taste and aroma. The storage room should be dry and away from the direct sunlight. During storage the rhizomes should be protected from attack

by insects and other pests. Natural pesticides such as the leaves of *Glycosmis pentaphylla* or *Azadirachta indica* can be added to the rhizomes to prevent damage from the cigarette beetle *(Lasioderma serricome*). The storage room should be clean, dry, cool and free from pests. Mosquito netting should be fitted on the windows to prevent pests and insects from entering the room. Strong smelling foods, detergents and paints should not be stored in the same room.

Self Assessment Exercise 1

1. Which of the following steps is not used in the processing of dried ginger rhizome
   a. cleaning
   b. baking
   c. polishing
   d. drying
2. A product from ginger obtained by extraction dry ginger with suitable organic solvents is called -------
   a. ginger oil
   b. ginger bits
   c. ginger raisins
   d. ginger oleoresin

1.4 Collection, Processing and Storage of Cloves

1.4.1. Processing of cloves

Dried clove buds Dried clove buds are harvested at the time when the buds have reached their full size before the corolla open, and the hypanthium have turned reddish. The harvested buds are separated from the stems by hand or thresher machine. After separation, the buds are dried by the sun or an artificial dryer.

1.4.2 Products from cloves

- **Ground clove**: Ground clove is produced by milling and/or grinding of dried clove buds. The process is usually conducted at room temperature (25–35 °C) to prevent the loss of much of the valuable volatile components during processing. Various techniques such as pre-chilling, water cooling or refrigeration of the grinding chambers have been developed to minimize the heat formed during processing. Ground clove is produced with several degree of fineness, depending on the nature of the spice, the ultimate application and consumer preferences.

- **Clove oil**: Clove oil is a mixture of different compounds, with the three main active ingredients being eugenol, eugenyl acetate and caryophyllene. Clove oil is colourless or pale yellow with the characteristic aroma and taste of cloves. Clove oil can be obtained from distillation of buds, leaf or stem, each resulting in oil having different characteristics of oil. The yield and quality of the oil are influenced by origin, variety, post-harvest processing, pre-treatment before distillation, distillation method and post-distillation treatment.

- **Oleoresin**: Clove oleoresin is extracted from the stems or the buds. Its flavour and odour are similar to the spice, for which it is sometimes substituted. Clove oleoresin prepared by solvent extraction of clove bud yielded about 18–22 % oleoresin. It can be produced from ground clove which is extracted by suitable solvent(s) then evaporated or distilled to obtain oleoresin. Oleoresin is an extremely concentrated product, containing all the flavouring ingredients soluble in the particular solvent used, so that it is much closer to the original clove odour and flavour.

1.4.3 Storage of clove products

Storage is one of the important factors in maintaining a good quality of clove. Dried whole clove bud is usually packed in gunny bags and stored in a clean, dry room with good ventilation. This manner of storing should not cause any significant changes except loss of sheen. Storage usually causes loss of oil by evaporation, the rate depending on the physical condition of the spice, mainly the moisture content of the products, temperature and relative humidity during storage. Loss of volatile oil during storage from whole clove is relatively slow compared to ground clove. Ground clove is more sensitive to high ambient temperature and moisture content which can change its stability and flavour profile. Poor storage conditions could cause more loss of volatile oil, mould growth and development of musty flavour and odour

Clove bud and clove oil

Self Assessment Exercise 2

1. Clove oil can be obtained from distillation of all the following except ------
   a. root
   b. bud
   c. stem
   d. leaf
2. Loss of volatile oil during storage from whole clove is relatively slow compared to ground clove. True or false.

1.5 **Collection, Production and Storage of Cinnamon**

1.5.1 Harvesting and production of cinnamon

Cinnamon spice is obtained from the bark of the cinnamon tree. Harvesting for bark is made after the second or third year of planting, and the subsequent harvest is made between 12 and 18 months after the previous harvest. The branches harvested this way are processed by scraping off the outer bark, then beating the branch evenly with a hammer to loosen the inner bark. The outer bark of the tree is thick and brownish. The inner bark is more useful than the outer one. The ideal time for cutting the stem is when the red flush of the young leaves turns to green and is the indication of the free flow of sap between the bark and the wood. The shoots ready for peeling are removed from the stems and the terminal ends of shoots are also removed.

1.5.2 Processing of Cinnamon bark

The bark must be processed immediately after harvesting, while still wet. The processing steps are as follows:

Production of quills

Cinnamon quills are 8cm lengths of tightly rolled, concentric layers of the very thin underneath layer of bark. This has been carefully peeled off cut branches and then rolled by cinnamon peelers into metre-long quills like a giant cigar. These long quills are then cut into the familiar short 'sticks

The commercial products of cinnamon are quills, cinnamon bark oil and cinnamon leaf oil. There are a number of stages involved in the production of quills:

- **Peeling**: The harvested shoot needs to be peeled for the extraction of quills. A special knife is used to scrap off the rough outer bark. Subsequently, the scraped

portion is polished with a brass rod to facilitate easy peeling. A longitudinal slit is made from one end to other and the bark is peeled off.

. • **Rolling**: The barks are packed together, placed one above the other and pressed well. The bark slips are reduced to 20 cm length and are piled up in small enclosures made by sticks. Then they are covered with dry leaves or mat to preserve the moisture for the next day's operation and also to enhance the slight fermentation. The retention of moisture is important for the next operation, piping.

• **Piping**: Rolled slips are taken to the piping yard for piping operations. The outer skin is scraped off with a small curved knife. The scraped slips are sorted into different grades according to thickness. The graded slips are trimmed; they are cut and pressed over pipes. Slips are rolled into pipes and, soon after, they are allowed to dry. During drying, smaller quills are inserted into bigger ones, forming smooth and pale brown compound quills, which are known as pipes. The quills are arranged in parallel lines in the shade for drying as direct exposure to the sun at this stage would result in wrapping. The dried quills, thus obtained, consist of a mixture of coarse and fine types and are yellowish brown in colour. The quills are bleached, if necessary, by sulphur treatment for about 8 hours.

Grinding: Most consumers, from wholesalers to individual customers, prefer to buy whole spices. Cinnamon is sometimes ground to powder form prior to sale. The ground powder should be packaged in moisture proof packaging (polypropylene bags) to retain the flavour.

1.5.3 Products from cinnamon

Ground cinnamon: Grinding can be a method of adding value to a product and cinnamon is sometimes ground to a powder prior to sale. The heat of grinding is very destructive to the volatile oil content of cinnamon. Grinding also reduces the shelf-life of cinnamon: it renders the spice more vulnerable to spoilage because the flavours and aroma compounds are not stable and will quickly disappear.

Oils and oleoresins: Hydrodistillation or steam distillation methods are employed for the production of bark oil. Cinnamon bark produces two oils, namely a superior type derived from inner bark and a poorer quality from broken quills, chips and bark. The barks to be distilled for oil should not be placed in wet bundles or become damp as this may facilitate mould or fermentation which directly affects the oil quality. The leaves of cinnamon can be used as a raw material for the extraction of leaf oil. The oil is rich in eugenol

1.5.4 Packaging and storage

Packaging: Cinnamon quills are normally cut into pieces of 10 cm in length and packed into moisture proof polypropylene bags for sale. The bags should be sealed to prevent moisture entering. The label on the bags should contain all relevant product and legal information – the name of the product, brand name, details of the manufacturer (name and address), date of manufacture, expiry date, weight of the contents, added ingredients etc.

Storage: Dried cinnamon quills must be stored in moisture-proof containers away from direct sunlight. If they have absorbed moisture, they should be re-dried to a moisture content of 10%. The storage room should be clean, dry, cool and free from pests. Mosquito netting should be fitted on the windows to prevent pests and insects

from entering the room. Strong smelling foods, detergents and paints should not be stored in the same room as they will spoil the delicate aroma and flavour of the cinnamon.

Cinnamon Quills and Ground cinnamon

Self Assessment Exercise 3

1. Grinding reduces the shelf-life of cinnamon. True or false
2. The label on the bags for packaging of cinnamon should contain all relevant product and legal information such as -------- and --------

1.6 Summary

Spices are high value export-oriented crops. To meet this challenge, spices have to be produced, processed to have high market quality with internationally accepted food safety standards. In this unit you learnt the collection, production, processing, packaging and storage of common spices like ginger, clove and cinnamon.

Spices can be processed into various products like ground spices, spice oils and oleorisins.

Dry spices should be packaged in materials that are impermeable to moisture and air. moisture and air cause reduction in volatile contents of the spices.

The label on the packaging materials should contain all relevant product and legal information – the name of the product, brand name (if appropriate), details of the manufacturer (name and address), date of manufacture, expiry date, weight of the contents etc.

1.7 References/Further Readings

1. Peter, K.V. (2012) Ed. *Handbook of herbs and spices*. Second edition (Vol.1). Woodhead Publishing Limited

2. Peter, K.V. (2012) Ed. *Handbook of herbs and spices*. Second edition (Vol.2). Woodhead Publishing Limited.

3.Pruthi J S (1980) *Spices and condiments: Chemistry, Microbiology and Technology*. Academic press Inc. Newyork.

1.8 Possible Answers to Self-Assessment Exercise(s)

Self-Assessment Exercise 1

1. B- Baking

2. D- ginger oleoresin

Self-Assessment Exercise 2

1. A – Root
2. True

Self Assessment Exercise 3

1. True
2. the name of the product, brand name (if appropriate), details of the manufacturer (name and address), date of manufacture, expiry date, weight of the contents, added ingredients (if relevant) plus any other information that the country of origin and of import may require. Any two of the listed.

UNIT 2: COLLECTION, PRODUCTION, PACKAGING AND STORAGE OF SOME COMMON HERBS

CONTENT

2.1 Introduction

Herbs just like spices are high value export oriented crops, to meet this challenge, spices have to be produced, processed to have high market quality with internationally accepted food safety standards. Hence precautions have to be taken from the pre harvesting, harvesting, post harvesting and primary processing which includes, washing, threshing, blanching, drying, cleaning, grading and packaging in order to meet the standards.

In this unit we shall be discussing the collection, production, packaging and storage of common herbs for extended shelf-life and optimal quality.

2.2 Learning Outcomes

By the end of this unit, you will be able to:

1. Discuss the processing of rosemary into different products
2. Discuss the processing of lemongrass
3. Evaluate the packaging requirements for the spice products

2.3 Collection, Production and Storage of rosemary

2.4.1 Post-harvest technology and further processing

Rosemary leaves, flowering tops, flowers and twigs are of economic importance. Fields of rosemary are usually harvested once or twice a year, depending on the geographical area and whether the harvest is for plant material or essential oil. The first harvesting is carried out about eight months after planting, with the onset of flowering or just before flowering.

2.3.2.Production of fresh and dried rosemary

For the fresh market, the herb is cut frequently at a young stage as young, fresh shoots are used in culinary preparations. Woody stems will lower the price. Fresh rosemary is harvested early in the morning and kept cooled at 5 °C before packaging for the market. With a temperature of 5 °C, a minimum shelflife of 2 to 3 weeks can be expected. After temperature, prevention of excess moisture loss is the second most important post-harvest factor affecting the quality and shelf-life of herbs.

The dried product should be processed to remove the leaves from the stems and then sieved to remove dirt and to produce a uniform product. Several methods exist from sun to sophisticated driers. The use of sun-drying methods results in poor quality. Artificial drying methods allow better control of product quality. A forced air-flow drier is a suitable system to dry better-quality leaves. Rosemary should be dried at temperatures lower than 40 °C to reduce loss of flavour through volatilisation of essential oil, and to maintain a good green colour. After drying, the leaves should be separated further from the stems, sieved and graded.

production of rosmary oils

Essential oils are volatile oils extracted from essential oil bearing plants by the process of steam based distillation. Tender, non-hardy shoots are also harvested for distillation upon attaining full size. However, the leaves and twigs can also be used after drying for oil extraction.

Rosemary oil is colourless to pale yellow. Rosemary oil is usually recovered by steam or water distillation, although supercritical fluid extraction (SFE) using CO2 as a solvent is also now being used.

2.3.4 Packaging and storage

Essential oils can be packaged in bulk or smaller quantities. Smaller quantities usually have higher prices owing to extra handling and packaging materials needed. Essential oils are volatile and as such need to be handled with care. Deterioration begins if the liquid is much darker or more viscous than normal. The relative humidly in the packing area, cold stores, and transport vehicles should be maintained at a high level (> 95 %) where practical.

Fresh rosemary is packaged in crates for bulk handling or in clear cellophane sachets that can be marketed directly in shops and supermarkets. Dried rosemary is usually sold in either carton boxes or in glass or plastic containers. Moisture, heat, oxygen and light destroy the properties. Dark air-tight glass is preferred for preservation.

Storing under 18 ˚C will extend shelf-life. Rosemary essential oil should be stored in a cool, dry area until it is used. Once opened, refrigeration and tightly closing the cap will prolong its shelf-life. It should be kept in dark, airtight glass bottles and not exposed to heat or heavy metal

Self Assessment Exercise 1

1. Rosemary should be dried at temperatures lower than -------- to reduce loss of flavour through volatilisation of essential oil.
   a. 30^{o}C
   b. 40^{o}C
   c. 50^{o}C
   d. 60^{o}C
   e. Dark air-tight glass is preferred for preservation.
2. ---------- glass is preferred for packaging of dried rosemary
   a. light coloured glass
   b. blue coloured glass
   c. dark coloured glass
   d. pale coloured glass

2.4 Lemon grass

2.4.1 Harvesting the Herb

Harvesting of the herb

Harvesting is done by cutting the grass 10 cm above ground level, with the help of sickles. The number of harvests in a year depends on the climatological factors

such as temperature, rainfall and humidity and level of soil fertility. Generally the crop thrives best in humid condition. Cutting can begin as soon as the night dew has evaporated from the plants, as wet grass left for later distillation quickly ferments. Sunny days are preferable, since cloudy and misty conditions tend to depress leaf oil content.

2.4.2 Lemon grass processing

- The crop is cut in small pieces and filled into the stills.
- Prior to distillation process grass is set to wilt for 24 hours , wilting process improves the overall yield of essential oils.
- Drying of crop also decreases moisture content by 30% which further helps in distillation process.
- For some products like herbal tea or infusions where the dry leaves or powdered lemongrass is final product, dried and powdered lemongrass packaging takes place after drying step in appropriate packaging material.

2.4.3 Production of lemongrass oil

Lemongrass oil is collected by steam distillation of the herbage. There are three types

of distillation.

1. Hydro-distillation: in this method, the herb is packed in a vessel and partly filled

with water. The vessel is heated by direct fire, steam jacket or immersed steam

coil.

2. Hydro and steam distillation: the plant material is packed on a grid fitted at a height above the base of the still. The lower part of the still is filled with water to a level below the grid and fired from below. In this method, the steam is always fully saturated, wet and never superheated. The plant material is in contact with only steam and not with boiling water.

3. Steam distillation: in this method, no water is added to the still. Instead, saturated

or superheated steam is introduced through open or perforated steam coils below the charge.

2.4.4 Packaging and Storage

Packaging

Essential oils are volatile and as such have to be handled with care. The grass should be packed firmly as this prevents the formation of steam channels. If the grass is too long it can be cut into smaller lengths to ensure firm packaging.

Storage

Lemongrass oil should be stored in dark, air-tight, glass bottles. Do not expose it to heat or heavy metals. Once opened, refrigeration and tightly closing the cap will prolong its shelf-life. Deterioration begins if the liquid is much darker or more viscous than normal. Lemongrass oil is very acidic and will destroy plastic and rubber in a short time.

Self Assessment Exercise 2

1. Mention two major products from lemongrass.
2. Plastic containers are suitable for storing lemongrass oil. True or false

2.5 Summary

Herbs are high value export oriented crops To meet this challenge, herbs have to be produced, processed to have high market quality with internationally accepted food safety standards. In this unit you learnt the collection, production, processing, packaging and storage of common herbs like rosemary and lemongrass.

Herbs can be processed into various products like ground spices, spice oils and oleorisins. Moisture, heat, oxygen and light destroy the properties of dried herbs. Dark air-tight glass is preferred for preservation.

2.6 References/Further Readings

1. Peter, K.V. (2012) Ed. *Handbook of herbs and spices*. Second edition (Vol.1). Woodhead Publishing Limited

2. Peter, K.V. (2012) Ed. *Handbook of herbs and spices*. Second edition (Vol.2). Woodhead Publishing Limited

3. Pruthi J S (1980) *Spices and condiments: Chemistry, Microbiology and Technology*. Academic press Inc. Newyork.

2.7 Possible Answers to Self-Assessment Exercise(s)

Self Assessment Exercise 1

1. B - $40^{o}C$
2. C- dark coloured glass

Self Assessment Exercise 2

1. Herbal tea and lemongrass oil
2. False

UNIT 3: PROCESSING OF FERMENTED INDIGENOUS CONDIMENTS

3.1 Introduction

Fermented foods are products of edible or inedible raw materials that have undergone desirable physic-chemical and biochemical modifications through the activities of microorganisms and/ or their metabolites, but in which the weight of the microorganism (relative to substrate) in the food is small. A distinct group of fermented foods is the traditional alkaline fermented products often used as food condiments/ seasoning agents.

As several people across the world gravitate back to “eating natural”, there is a new emphasis on fermented foods and seasoning agents which are also critical cultural foods in countries and societies where they are important.

In this unit, you will learn how different indigenous fermented condiments are produced.

3.2 Learning Outcomes

By the end of this unit, you will be able to

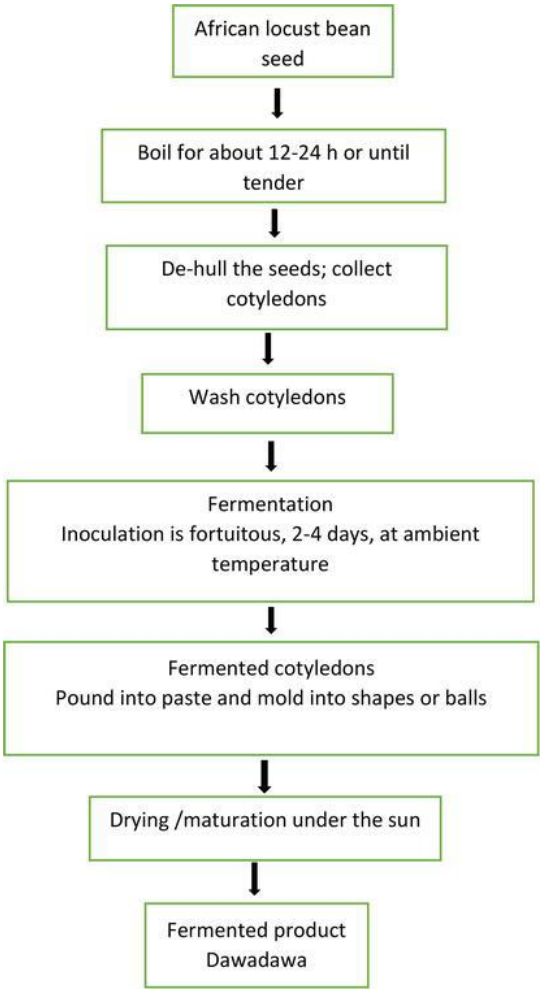
1. Evaluate the processing of dawada and okpeye condiments
2. Discuss the processing of *Ugba* and *Ogiri*
3. Discuss the processing of Less common legume-based alkaline fermented seasoning agents of Africa

3.3 Processing of indigenous fermented condiments – *Dawadawa* and *Okpeye*

3.3.1 Processing of *Dawadawa*

Dawadawa is probably the most popular and commercially successful traditional seasoning agent in West and Central African Savannah where it is known by different ethnic names. *Dawadawa* is processed from the solid substrate fermentation of cotyledons of locust bean (*Parkia biglobosa*). It is widely consumed as a food seasoning in the Northern and some part of Southern Nigeria . The traditional process may vary slightly depending on the processor and locality.

The flow diagram for its production is shown in the figure below.



Flow chart for the traditional method of producing dawadawa.

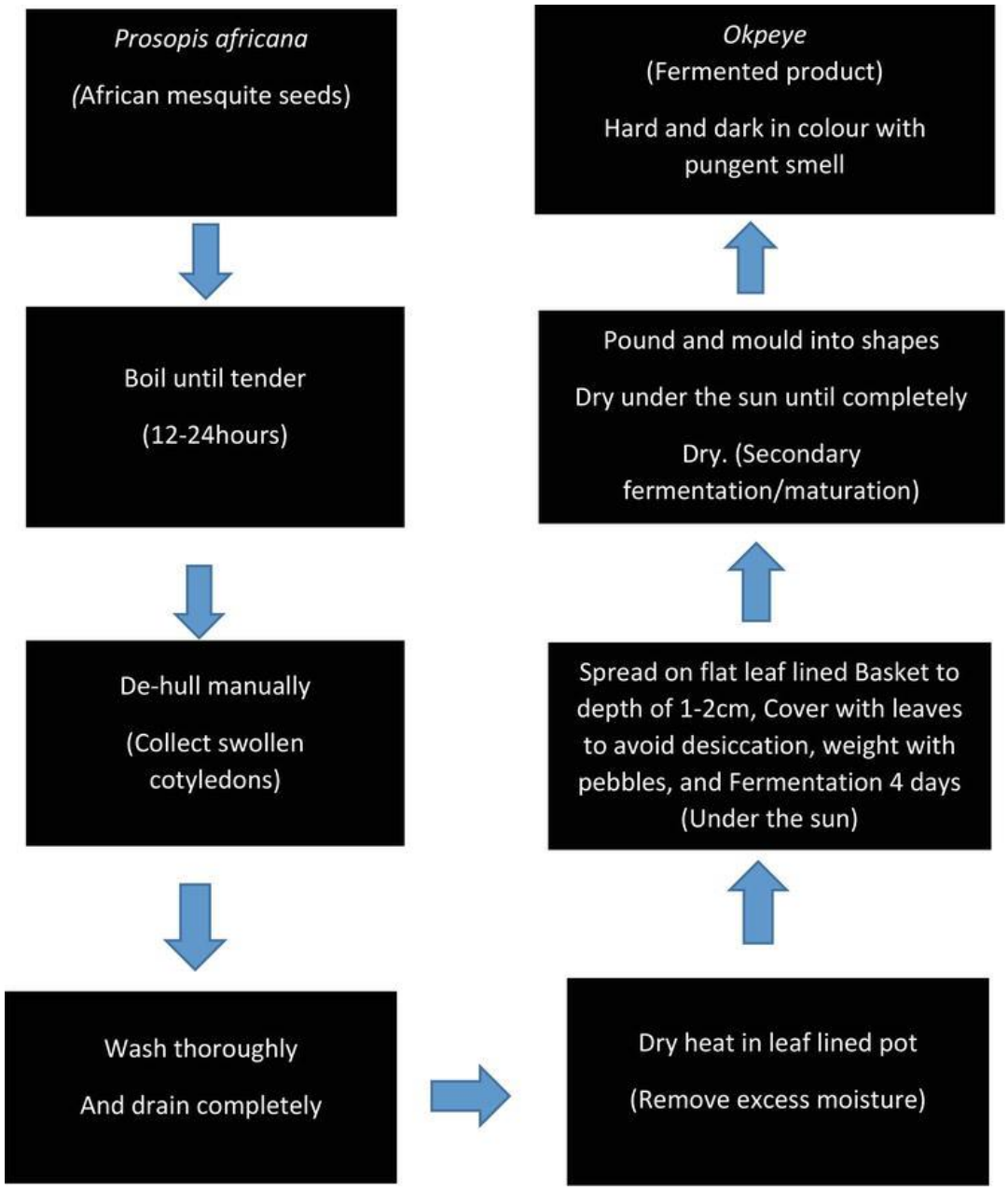
3.3.2. Processing of *Okpeye*

Okpeye, much like *dawadawa* is a traditional seasoning produced by solid substrate alkaline fermentation of *Prosopis africana* (African mesquite) seeds. *P. africana* is mostly used as source of seasoning in the middle belt and parts of the Southeastern Nigeria. The process involves the following:

- Boiling of the mesquite seeds for 12–24 h to cook the seeds, soften the seed coat and ease the de-hulling process.
- De-hulling in a very laborious manual process. The cotyledons are washed thoroughly, drained and reheated (dry heat) in a pot lined with the leaves of *Alchornea cordifolia* popularly known as (*akwukwo okpeye*) by the native people. Other leaves such as banana leaves may be used when the conventional leaves are unavailable. The cotyledons are spread to a few cm depth in a shallow raffia basket already lined with leaves of *Alchornea cordifolia*, covered with more leaves and weighted with pebbles
- Fermentation: Fermentation proceeds for 4 days at uncontrolled temperature. At the end of this stage the fermented cotyledons now dark brown in color with strong ammonia-like smell.
- Grinding and molding: The fermented cotyledons are ground into a smooth paste and molded into different shapes and sizes.
- Drying: the condiment is now sun dried for a variable length of time at the end of which the product becomes hard and black with a more mellow and preferable aroma.

The dried condiment is resistant to spoilage by microorganisms and has a very long shelf life with occasional re-drying under the sun

The flow chart for *okpeye* production is shown below.



Traditional process for the production of *okpeye*.

Steps in the traditional fermentation of P. africana seeds to produce okpeye. (A) Seeds before boiling; (B) boiled seeds; (C) de-hulled seeds before fermentation; (D) de-hulled cotyledons spread on leaf lined basket; (E) fermentation taking place outside under the sun; (F) fermented cotyledons; (G) ground paste; (H) molded seasoning undergoing drying under the sun; (I) dried okpeye seasoning.

Self Assessment Exercise 1

1. --------- condiment is produced from the seeds of *Prosopis africana*
2. At the end of ---------- stage, *okpeye* becomes dark brown in colour with strong ammonia-like smell.

3.4 Processing of *Ugba* and *Ogiri*

3.4.1 Ugba

Ugba is a Nigerian-based condiment prepared by the solid state alkaline fermentation of seeds of the African oil bean (*Pentaclathra macrophylla).* It is also known as *ukpaka* by the Igbos in the Southeastern part of Nigeria where it is most popular. *Ugba* is consumed as a delicacy, appetizer or used as a flavoring agent in various traditional dishes. Prepared in different ways, *ugba* is an important food product for various traditional ceremonies .

The basic procedures involve:

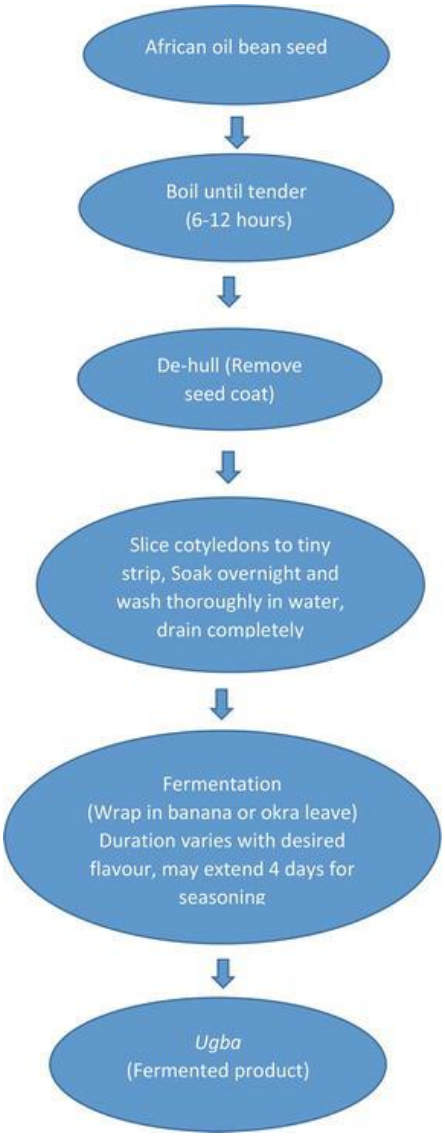
Boiling of oil bean seeds for 12 h or more,

Removing the seed coat and slicing the cotyledons into thin slices.

The slices are then soaked in water overnight, washed thoroughly and wrapped with fresh leaves.

Fermentation: . Fermentation is usually done at ambient temperature and the duration varies depending on the intended use. Fermentation can last as short as 3 days or up to 5 days.

The figures below show the processing steps, African oil bean seeds, fermented slices of oil bean cotyledons and fermented product (*ugba*) packaged in different ways.



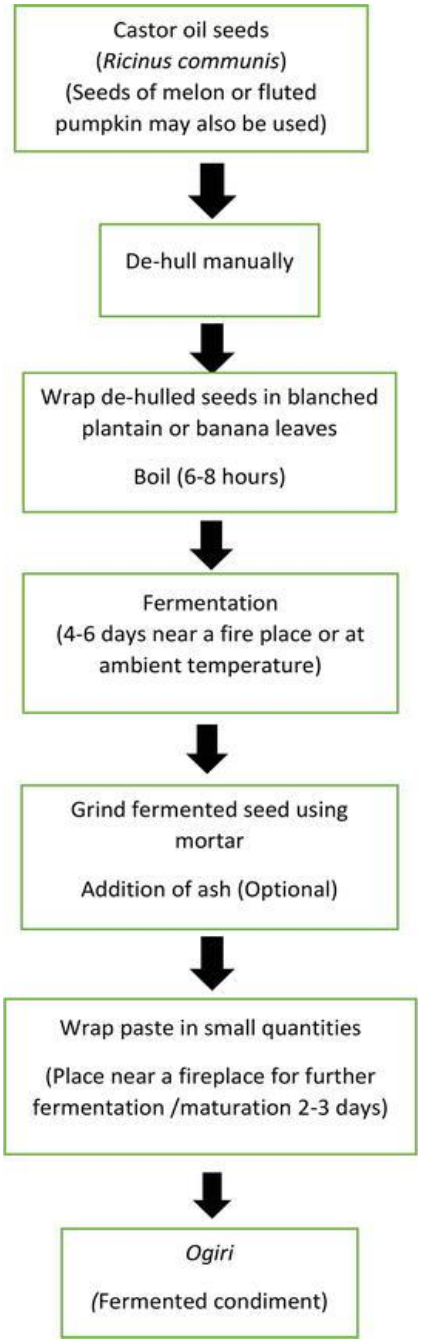
Flow chart for the traditional production of ugba.

A B C

African oil bean seeds (A), fermented slices of oil bean cotyledons (B) and fermented oil seeds cotyledons (ugba) packaged in polythene bags or wrapped with local leaves.

3.4.2 Production of Ogiri

Ogiri is a popular African fermented seasoning, traditionally prepared by the solid state alkaline fermentation of castor oil seeds (*Ricinus communis*). Depending on locality, season and availability it may also obtained by fermenting melon seeds (*Citrullus vulgaris*) and fluted pumpkin seeds (*Telfairia occidentalis)*. *Ogiri* is used in flavoring many traditional soups. In fact, it is regarded as an indispensable seasoning in the preparation of specialized soups which are highly cherished and extensively consumed by the Igbo ethnic group in the Southeastern Nigeria. The flow chart for ogiiri production is shown below.



Flow chart for the traditional production of Ogiri.

A B

Figure 9.

Fermented castor oil seed (Ogiri) condiment (A) and fermented castor oil seeds (Ogiri) condiment wrapped with local leaves (B).

Self Assessment Exercise 2

1. ---------- condiment is consumed in form of slices
2. Ogiri can be processed from the seeds of the following except
   a. *Ricinus communis*
   b. *Prospsis Africana*
   c. *Citrullus vulgaris*
   d. Telfairia occidentalis

3.5 Less common legume-based alkaline fermented seasoning agents of Africa

3.5.1 *Aisa*

Aisa is a Nigerian seasoning agent processed from the solid state alkaline fermentation of *Albizia saman* (Jacq) F. Mull popularly known as monkey pod, rain tree or saman tree . *Albizia saman* is one of the uncommon and under-exploited legumes in the sub-Saharan regions. Like other traditional fermented seasonings, *aisa* is used to flavor various traditional dishes and soups. The production process is similar to dawadawa. The basic method involves boiling of the saman seeds until tender, followed by manual de-hulling. The cotyledons are washed and boiled again for 1–2 h, and washed in water. The cotyledons are wrapped in clean fresh leaves (banana or paw-paw) in bundles. The wrapped bundles are placed in calabashes and allowed to ferment for 1–7 days at ambient temperature. At the end of fermentation, the product is dark brown, sticky mash covered with mucilaginous coat and possessing a strong ammoniacal smell.

3.5.2 *Owoh*

Owoh is another African fermented seasoning whose substrate is under-utilized. It is made by the solid state alkaline fermentation of cotton seeds (*Gossypium hirsutum)* . *Owoh* is mainly used as a seasoning in the mid-Western Nigeria. The raw seeds are toxic and inedible. The traditional process involves boiling of cotton seeds until they are properly cooked and become tender. The seed coats are removed manually. The cotyledons are then washed, wrapped in banana leaves and boiled again for 1–2 h. The wraps are removed from water and placed in calabashes or earthen pots, and then covered with jute sacks and placed in a warm

location (often beside the fire place) to ferment. Fermentation is done at ambient temperature for 2–3 days. At the end of the fermentation, the mash is ground and molded into balls. The product may be used at this point, but preferably it is sun dried to extend the shelf life and also to develop more desirable aroma.

3.5.3 Packaging and storage

The traditional condiments are usually packaged with leaves and stored at ambient temperatures above fireplaces.

Inadequate packaging and poor presentation of product are among the challenges mitigating the global development and consumer appeal of fermented products in Africa and other developing regions. Unlike modern food industries that use attractive and esthetic packaging that increases consumer appeal, the traditional condiments are usually packaged with leaves. On account of this, indigenous fermented foods are often considered as food for the poor. The adoption of modern esthetic packaging and adequate presentation are crucial steps to overcome the challenges of kitchen technology and also for commercialization and industrialization of fermented foods and condiments. These will help to minimize the problems of post process contamination and increase consumer confidence.

The use of modern storage facilities like refrigeration and freezing could extend the quality and shelf life of these products.

Self Assessment Exercise

1--------- condiment is produced from cotton seeds

2Answer true of false. Processing and packaging of local condiments need to be improved

3.6 Summary

Many fermented indigenous condiments are processed by local people in Nigeria. These condiments include dawadawa, okpeye, ogiri, ugha etc. Fermentation helps to prolong their shelf life and impacts the characteristic flavours on them.

The processing methods and packaging of these condiments are still at the crude stages making improvement in the processing and packaging technologies an imperative.

3.7 References/Further Readings

1. Nowak J, & Kuligowski M.(2017) *Functional properties of traditional food products made by mold fermentation*. In: Fermented Foods, Part II: Technological Interventions,Ray RC & Montet D (eds). Food Biology Series. Boca Raton, FL: Taylor and Francis Group LLC, CRC Press

2. Ugwuanyi, J.O & Okpara, A,N. (2019). *Current Status of Alkaline Fermented Foods and Seasoning Agents of Africa* in New Advances on Fermentation Process, Martínez-Espinosa, R.M (ed). Intechopen ntechopen Ltd UK

3.8 Possible Answers to Self-Assessment Exercise(s)

Self Assessment Exercise 1

1. Okpeye
2. Fermentation

Self Assessment Exercise 2

1. Ugba
2. B- *Prosopis africana*

Self Assessment Exercise

1- Owoh- condiment is produced from cotton seeds

3. True