

SECTION

5

FOOD PRODUCTION



FOODS AND NUTRITION

Food Production Technology

INTRODUCTION

This section covers Food Production Technology. In this section you will learn about food production, nutritional science and human health to promote healthy growth and the development of the individual, the family and society. The detailed areas covered include comparison of various food laboratories, evaluation of the factors that affect the planning of food laboratories, ways of redesigning food laboratories, types of beverages and their uses, analysis on enriching and fortifying beverages, experimentation with beverage production and ways of ensuring hygiene in food laboratories.

After studying this section, you will be equipped with a deep understanding of the links between food production, nutritional science and health outcomes. This will help you make informed choices of food laboratories and beverages that will contribute to individuals and community well-being.

At the end of this section, you will be able to:

- Compare the types of food laboratories.
- Evaluate the factors that affect the planning of food laboratories.
- Suggest ways of re-designing a food laboratory.
- Discuss the types of beverages and their uses.
- Analyse how to enrich or fortify beverages.
- Experiment with beverage production - non-alcoholic
- Experiment with beverage production - alcoholic
- Discuss ways of ensuring hygiene in the food laboratory

Key Ideas

- A food laboratory is a combined facility that serves both as a laboratory for food testing, analysis and as a kitchen for food preparation and cooking.
- Factors to consider when planning the renovation/refurbishment of a food laboratory to create a modern, efficient and safe space.
- Beverage production, enrichment and fortification are processes aimed at creating or enhancing the nutritional value, taste and overall quality of beverages.
- The importance of hygiene to ensure the safety and quality of food products and prevent cross-contamination.

Food laboratories

Food laboratories are specialised facilities that focus on preparation, cooking serving, testing and analysing various aspects of food products. These include:

a. Kitchen laboratories

Kitchen laboratories vary in size, layout and equipment based on their purpose and the scale of food operations. These laboratories may be used for food preparation and service, product development and research, the development of new food products or the improvement of existing ones. The research could involve ingredients, formulas and cooking techniques to create innovative and appealing food items.

b. Microbiological laboratories - Food safety

Microbial testing ensures foods we consume are free from harmful micro-organisms: bacteria, viruses, moulds, yeasts, parasites, that cause foodborne illnesses

c. Chemical analysis laboratories

These laboratories study the chemical composition and structure of food which is essential for health claims, nutrition labelling and allergen warnings.

d. Nutritional analysis laboratories - Quality control

Nutritional analysis determines the nutritional content of food. It is part of analytical chemistry that provides information about the chemical composition, processing, quality control and contamination of food.

e. Sensory evaluation laboratories

This is a method of evaluating a product by relying on an individual's sensory perception rather than using instruments or equipment. The samples' appearance, colour, texture and smell are tested.

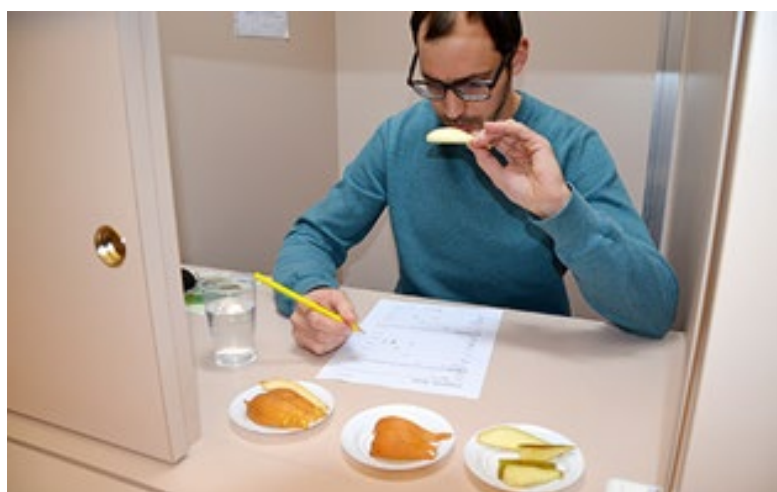


Fig.5.1: Sensory food evaluation

What are the major zones/areas in a kitchen (food) laboratory

- a. **Food preparation area:** It typically includes work surfaces, cutting boards and sinks for food handling.

- b. **Cooking area:** It consists of stoves, ovens, grills, fryers and other cooking appliances.
- c. **Refrigeration and storage:** Refrigerators and freezers for storing perishable ingredients and finished food products. Shelves, cabinets and pantries are used for dry storage of non-perishable items.
- d. **Utensils and tools:** These could include pots, pans, knives, cutting boards, measuring cups and mixing bowls.
- e. **Ventilation system:** Ventilation systems remove smoke, odour and heat generated during cooking.
- f. **Dishwashing area:** For washing and sanitising dishes, utensils and cooking equipment.

Table 5.1: Comparison of traditional and modern laboratories

Traditional food laboratory	Advantages	Disadvantages
	Simple to construct	Inadequate storage space
	Easy to purchase the tools and equipment	Poor ventilation
		Walls become dirty due to smoke

Modern food laboratory	Advantages	Disadvantages
	Use advanced equipment and tools	Expensive to buy tools and equipment
Well organised equipment	Complexity in maintenance of tools and equipment	



Fig.re 5.2: Traditional laboratory



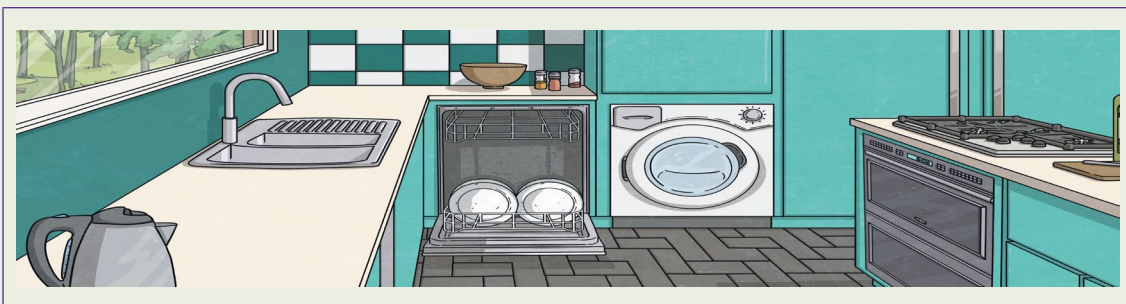
Fig.re 5.3: Modern laboratory

Activity 5.1

1. Design/sketch your dream kitchen food laboratory bearing in mind the major zones in the kitchen. Use the blank text box below to design your kitchen food laboratory. Think about the types of kitchen equipment and furniture that you would use and who is going to be using your kitchen. You could complete the template below before starting work on your design.
 - a. Once you have produced your design, evaluate your work to check that it fulfills your original brief. You can use the evaluation form to make a note of the key points.
 - b. Check out the links below which will provide you with ideas of different kitchen designs and techniques for drawing them.
 - i. <https://www.dimensions.com/collection/kitchen-layouts>
 - ii. <https://www.roomsketcher.com/blog/kitchen-layout-ideas/>
 - iii. <https://www.youtube.com/watch?v=Gnnc4A-PU4o>

Design Brief

Colour scheme:	
Appliances:	
Furniture:	
Who is it for:	



Evaluation Form
How does your layout suit the needs of those using it?
How does the furniture fit the needs of the target user?
Are there any further appliances or gadgets you would add to suit the target user?

2a. Visit any food establishment in your community, observe and gather information on the following

- a) The type of food laboratory that you have observed
- b) The food laboratory layout
- c) The tools and equipment used in the food laboratory
- d) The types of food prepared, personal practices, environmental and hygiene practices used in the food laboratory.

You need the following to help you gather your information

- a) A questionnaire or interview guide
- b) Camera/phones to take pictures.

Interview Tips

- Plan the questions in advance.
- Make and maintain eye contact.
- Ask open-ended questions so the interviewee can expand on their answers.
- Listen carefully to their responses.
- Take notes.
- If you do not understand something, ask them to explain.

You could use a template to record your questions and the respondent’s answers:

Instructions: You must think of questions about the food laboratory that you will put to the respondent’s during the interview.
Question: Answer:
Question: Answer:
Question: Answer:

2b. Write a report on the food establishment that you visited and present it to the class. The tips below will help you structure your report

Analysing data that you have gathered for your report:

- It involves extracting (taking out) important facts and patterns from the data gathered.
- Draw conclusions.
- Make informed decisions based on the results.

Prompt sheet for report writing:

- Informative and fact-based.
 - Formally structured.
 - Usually written with a specific purpose and reader in mind
 - Written in style appropriate to each section.
 - Include section headings.
 - Often uses bullet points.
 - Often includes tables or graphs.
 - Offer recommendations for action.
 - Uses a clear structure.
 - Based on evidence (data, other reports, experiment results.)
 - Has a clear introduction and conclusion.
- 3.** Search the internet and other sources for further information on the types of food laboratories and classify them using any of the following methods; tables, charts, concept maps or albums.

Factors that affect the planning of food laboratories

Factors that will guide you when planning a food laboratory to ensure its efficiency, functionality and compliance with industry standards.

1. **Purpose and scope:** What is the intended purpose e.g. for cooking, testing of food samples, research and development. This will determine the selection of equipment and space required.
2. **Building infrastructure:** The physical building or space must have the necessary utilities, such as water, electricity, ventilation and waste disposal systems to support the laboratory's operations
3. **Space and layout:** The size and layout of the food laboratory space will influence the smooth operation of the kitchen. Factors such as the arrangement of workspaces,

equipment placement and the flow of ingredients/samples through the food laboratory need careful consideration to save energy and prevent accidents.

4. **Equipment selection:** The selection of the equipment should be based on the purpose, the function and the durability as well as available budget.
5. **Safety and security:** Safety measures, such as fume hoods, emergency eyewash stations and safety training, should be incorporated into the laboratory plan.

Table 5.2: Factors to consider when planning food laboratories for family use

Socio-Cultural Factors	Economic Factors
Family needs	Family budget
Fuel	Size and shape of the food laboratory
Position of doors and windows	Equipment and tools
Functions of the food laboratory	Care and maintenance of the food laboratory
Environment	

Activity 5.2

1. Discuss the factors that affect **three** different types of food laboratory planning with your friends. Record the factors for each laboratory and share your findings with the whole class. You may want to produce a template to record the factors you have discussed and their importance

Exemplar template

Type of food laboratory	Functionality	Economic factors	Compliance with standards	Socio-cultural Factors
1.				
2.				
3.				

Re-designing a food laboratory

1. Re-designing/renovation/refurbishment of a food laboratory

The goal when renovating an existing food laboratory is to create a modern, efficient and safe food laboratory that complies with industry standards and regulations. Steps in this process include:

- a. **Changing layout and flow:** Optimize the layout and workflow to maximise efficiency and minimise unnecessary movement and potential cross-contamination
- b. **Budgeting and planning:** Develop a comprehensive budget that includes construction costs but also equipment, furniture and other essential elements. Plan the renovation timeline carefully, considering any potential disruptions to laboratory operations.
- c. **Flooring and walls:** Select materials for the flooring and walls that are easy to clean and sanitize to maintain a hygienic environment. Seamless and non-porous surfaces are ideal for food laboratories.
- d. **Lighting:** Proper lighting is crucial in a laboratory setting to ensure accuracy in testing and to minimise eye strain for staff.

2. Reasons for re-designing the food laboratory

- a. **Promoting safety and hygiene:** To make sure that food is safe to eat, by preventing foodborne illnesses.
- b. **Promote efficiency and productivity:** Creating products with the least amount of waste as it is associated with time, capital, resources and **productivity**. **Productivity** is a measure of how effectively inputs are turned into output.
- c. **Ensure compliance and adaptability to changing needs:** Available budgets will determine the kind of food laboratory, equipment and utensils that is required.
- d. **Promote comfort of use:** Food laboratories should be well lit and ventilated and allow for ease of movement
- e. **Easy care and maintenance:** The redesigned food laboratory should be easy to care for and maintain.

Activity 5.3

1. Look at pictures A & B which are local food laboratories and suggest ways of re-designing them. Consider the steps involved in the process.



Picture A



Picture B

2. Read the case study below and prepare a presentation on the redesign process of a food laboratory.

A commercial restaurant must expand due to an increase in customers. The layout and flow are no longer suitable or sufficient to serve the increased number of customers. The owners need to build an extension to the kitchen area and increase the workstations/areas/zones.

Discuss the requirements for the design process with your friends. Prepare a presentation to share your findings with the whole class. Your presentation should include the following:

- a. Three reasons for the re-design of the food laboratory.
 - b. Three ways of re-designing the food laboratory to suit the needs of the restaurant.
 - c. The budget requirement and challenges the restaurant management may face in re-designing the kitchen.
3. In groups, Design your dream or ideal food laboratory with a well-labelled layout. Exhibit your re-designed food laboratories for a gallery walk and peer appraisal. You should consider the following factors when designing a food laboratory
 - Function/purpose of the food laboratory i.e. Commercial (restaurant); Food safety testing; Quality control; Research and development or Family use
 - Budget
 - Layout and flow required
 - Safety and hygiene
 - Equipment and technology

EXTENDED READING

To read more about Re-designing a Food Laboratory

1. <https://agriculture.ny.gov/food-laboratory>

2. <https://customfabricators.net/food-microbiology-lab-equipment/> (visit the site and read more information on microbiological food laboratories. Write anything that you find exciting and new and share in class.)
3. <https://youtu.be/RvBbo8-U0t0> (Watch the video on sensory evaluation of food. Write down any new information and report in class).
4. <https://youtu.be/2dMSjPej6rg?t=81> (Watch the video on nutritional analysis of food. Write down any new information and report in class).
5. [https://www.sparkinstitute.in/admin/assets/pdf/chemical_analysis_of_food_\(2\).pdf](https://www.sparkinstitute.in/admin/assets/pdf/chemical_analysis_of_food_(2).pdf) (visit the site on chemical analysis of food. Write down any new information and share in class).

Types of beverages and beverage production

1. Classification of Beverages

- a. **Alcoholic Beverages:** These beverages are drinks that contain ethanol (alcohol) as the primary psychoactive ingredient (ingredient that affects the mind). They are produced through the fermentation and/or distillation of grains, fruits or other natural ingredients. They include soft and hard liquor such as beer, wine and spirits. In Ghana, local alcoholic beverages include pito (produced from fermented millet), palm wine (from the palm tree), and akpeteshie (Ghana's local gin with a very high alcohol content).

Pictures of Alcoholic Beverages



Fig. 5.4: Beer



Fig. 5.5: Akpeteshie



Fig. 5.6: Pito

- b. **Non-Alcoholic Beverages:** These beverages are drinks that do not contain alcohol or have very low alcohol content or stimulants. These beverages are popular for hydration, refreshment, nourishment and enjoyment. They include water, juices, soft drinks, coffee, cocoa drink, smoothies and milk. In Ghana, local non alcoholic beverages include asana, unfermented palm wine, unfermented pito and zomkom (made from spicy millet).

Pictures of Non –Alcoholic beverages



Fig. 5.7: Asana



Fig. 5.8: Sobolo



Fig. 5.9: Unfermented Palm wine



Fig. 5.10: Zomkom (Millet drink)



Fig. 5.11: Soft drinks

2. Uses of beverages

- a. Hydration
- b. Quenching thirst
- c. Nutrition
- d. Energy boost
- e. Social enjoyment with friends and family
- f. Business networking events

3. Factors to consider when selecting beverages

- a. **Nutritional content:** Check nutritional information on the label to assess the calories, sugar content, vitamins, minerals and other nutrients present in the beverage.
- b. **Health conditions:** Consider any health or medical considerations. Diabetic patients are usually advised against the consumption of sugar and should avoid beverages with high sugar content.
- c. **Environmental impact:** Consider the environmental impact of the production of beverages and their packaging materials which could include the depletion and degradation of water resources, greenhouse gas emissions, soil and air pollution and waste production.

4. Beverage production: The main steps in beverage production include:

- a. Pre-preparation activities
 - Ingredient sourcing (obtaining and looking for ingredients)
 - Cleaning and processing of raw materials
- b. Preparation activities
 - Mixing or blending
 - Squeezing
 - Pasteurisation or sterilisation (if necessary)
 - Filtration
- c. Post preparation activities
 - Packaging
 - Cleaning and tidying up

Activity 5.4

1. Make an album of local beverages in your community for peer assessment. Classify them into different categories and explain their uses under the following headings:

- Health benefits
 - Social enjoyment
2. Search the internet and other sources on how to make any **one** non-alcoholic beverage of your choice and share with your colleagues in class: The information to share should include:
 - Name of beverage
 - Ingredients used
 - Process/steps to make the beverage
 - Nutrient content
 - Possible use of the drink
 3. Create a table and classify the following drinks into alcoholic and non-alcoholic categories: Beer, Wine, Coffee, Whiskey, Asana, Palm Wine, Sobolo, Akpeteshie, Zomkom and Fanta. You can add more to the categories.

Alcoholic Drinks	Non-Alcoholic Drinks

Enrichment and fortification of beverages

1. **Beverage enrichment and fortification** are processes aimed at creating or enhancing the nutritional value, taste, quality and overall acceptability of beverages. These processes involve the addition of various ingredients to improve the product's health benefits, flavour, texture and shelf life.
 - a. **Enrichment:** This refers to the addition of specific nutrients or substances lost during preparation to restore/increase its nutritional value. This is particularly common in juices, milk and certain health drinks. E.g., fruit juices may be enriched with added vitamins (such as vitamin C or vitamin D) to enhance their nutritional profile. Milk may be enriched with vitamins A and D or calcium to improve its health benefits.
 - b. **Fortification:** The process of adding new or extra essential vitamins, minerals, or other bioactive (biologically active) compounds to beverages to address specific nutrient deficiencies in the population.

2. **Food substances used for beverage enrichment and fortification** - The substances used for enrichment and fortification can vary based on the specific nutrients targeted and the type of beverage. These are some common food substances used for beverage enrichment and fortification:
 - a. **Vitamins:** Various water-soluble and fat-soluble vitamins can be added to beverages. Vitamin C (ascorbic acid) is commonly added to fruit juices and drinks due to its antioxidant properties. Vitamin D is often added to milk and plant-based milk alternatives to support bone health. B-complex vitamins, such as thiamine, riboflavin, niacin, vitamin B6 and vitamin B12, may also be added to energy drinks and fortified beverages.
 - b. **Minerals:** Minerals like calcium, iron, zinc, magnesium and potassium are frequently used for fortification. Calcium may be added to certain fruit juices or beverages to promote bone health. Iron is commonly added to some fortified drinks to address iron deficiency. Magnesium and potassium are minerals that may be added to sports and energy drinks to support electrolyte balance (electrolyte balance is the condition of having the right amount of minerals that carry an electric charge in your body fluid).
 - c. **Proteins:** Protein enriched beverages are popular among athletes and individuals looking to increase their protein intake. Proteins from sources like whey, casein, soy, or plant-based proteins can be added to smoothies, shakes and nutritional beverages. Nutritional beverages encompass a wide range of products, including fortified juices, protein shakes, plant-based drinks, and functional beverages designed to provide essential nutrients, vitamins, minerals, and other beneficial substances.
 - d. **Fibre:** Fibre can be added to certain beverages, such as fruit juices and smoothies, to increase their dietary fibre content. Soluble fibre from sources like psyllium husk which is a shrub like herb. Psyllium is a soluble fibre used primarily as a gentle bulk-forming laxative in products such as Metamucil (a fibre supplement). Chia seeds, flax seeds, eggs, and gelatin can be substituted for psyllium. Inulin (a starchy substance found in a wide variety of fruits, vegetables, and herbs, including wheat, onions, bananas, leeks, artichokes, and asparagus) is also commonly used as fibre in beverages.
 - e. **Omega-3 Fatty Acids:** Some fortified beverages, especially milk and milk alternatives, may contain added omega-3 fatty acids, such as docosahexaenoic acid (DHA-found in seafood) and eicosapentaenoic acid (EPA- found in cold-water fatty fish, such as salmon), ALA (found in plants) which are essential for brain health. Some foods that can help you add omega-3s to your diet include fatty fish (like salmon and mackerel), flaxseed and chia seeds.
 - f. **Plant Extracts:** Certain beverages may be enriched with plant extracts like green tea extract, ginseng, or echinacea (herbaceous flowering plants in the daisy family) for their potential health benefits.
3. **Functions of beverage enrichment and fortification:**
 - a. **Nutrition and flavour enhancement (improvement):** This involves the addition of natural or artificial flavours to beverages, for example, orange, lime, apple and chocolate.

- b. **Texture and mouth-feel improvement:** Certain additives, such as stabilizers (pectin, lecithin, locust bean gum) and emulsifiers (lecithin, soy lecithin, Gum arabic and modified starches), are used in beverage production to improve texture and mouthfeel.
- c. **Shelf-life extension:** Preservatives and other additives may be used to extend the shelf life of beverages, ensuring that they remain safe and enjoyable for consumers over an extended period. Sodium benzoate and potassium benzoate are used as preservatives in beverages to extend their shelf-life. Also, ingredients like Vitamin C, citric acid, malic acid, and honey can prevent browning, while essential oils, Vitamin E, and a little fresh juice from a different batch can preserve flavour.

4. Nutritional and food safety implications of beverage enrichment and fortification

Consumers should be aware of the potential benefits and risks associated with fortified beverages and make informed decisions based on their individual dietary needs and health conditions.

Nutritional implications	Food safety implications
Addressing nutrient deficiencies	Overconsumption
Improved nutritional profile	Quality control and stability
Promoting health benefits	Potential interactions
Convenience and handy	Allergies and sensitivities
Accessibility	Adverse effects

Activity 5.5

1. Visit your community in groups and interview at least four different ethnic groups on their beverage enrichment and fortification processes.

Hints for the Interview

- Ask for their reasons for the enrichment and fortification of beverages.
- Ask for the food substances used for beverage enrichment, fortification and their functions
- Research the nutritional and food safety implications of their beverage enrichment and fortification

You need the following to help you gather your information

- a. A questionnaire or interview guide
- b. Camera to take pictures.

Interview Tips

- Plan the questions in advance.
- Make and maintain eye contact.
- Ask open-ended questions so the interviewee can expand on their answers.
- Listen carefully to their responses.
- Take notes.
- If you do not understand something, ask them to explain.

You could use a template to record your questions and the respondent's answers:

<p>Instructions: You must think of questions about beverage production, enrichment and fortification that you will put to the respondent's during the interview.</p>
<p>Question:</p> <p>Answer:</p>
<p>Question:</p> <p>Answer:</p>
<p>Question:</p> <p>Answer:</p>
<p>Question:</p> <p>Answer:</p>
<p>Question:</p> <p>Answer:</p>

2. Use the information gathered from your community visit to produce a report that you can deliver in class. The tips below will help you structure your report

Analysing data that you have gathered for your report:

- It involves extracting (taking out) important facts and patterns from the data gathered.
- Draw conclusions.
- Make informed decisions based on the results.

Prompt sheet for report writing

- Informative and fact-based.
- Formally structured.
- Usually written with a specific purpose and reader in mind
- Written in style appropriate to each section.
- Include section headings.

- Often uses bullet points.
- Often includes tables or graphs.
- Offer recommendations for action.
- Uses a clear structure.
- Based on evidence (data, other reports, experiment results.)
- Has a clear introduction and conclusion.

EXTENDED READING

- **Link on beverage enrichment:** <https://en.wikipedia.org/wiki/Drink>

Steps and processes of enrichment and fortification of beverage production - Non-alcoholic beverages

1. The main steps in beverage production

The main steps include:

- a. Pre-preparation activities
 - Ingredient sourcing
 - Cleaning and processing of raw materials
- b. Preparation activities
 - Mixing or blending
 - Squeezing
 - Pasteurisation or sterilisation (if necessary)
 - Filtration
- c. Post preparation activities
 - Packaging
 - Cleaning and tidying up

2. Process of producing, enriching and fortifying non-alcoholic beverages:

- a. **Selection of base/main ingredients:** Choose the main ingredients for the non-alcoholic beverage such as water, fruit juices or botanical extracts like turmeric, guava, tea plant and herbs.

- b. **Processing and preparation:** Prepare the ingredients by cleaning, peeling and cutting fruits or vegetables.
- c. **Extraction:** Extract juices, pulps or concentrates from the chosen ingredients.
- d. **Blending and mixing:** Combine the extracted juices, pulps, concentrates and other ingredients in the desired proportions. Mix the ingredients thoroughly to create a uniform blend.
- e. **Sweetening and flavouring:** Add sweeteners such as sugar, honey or alternative sweeteners based on the desired level of sweetness. Incorporate natural or artificial flavours to enhance the taste profile of the beverage. Example of natural or artificial flavours, lime, cloves, spices, fruit or fruit juices, vegetable or vegetable juice, essence.
- f. **Enrichment and fortification:** Identify the nutritional elements to be added to the beverage such as vitamins, minerals, amino acids or antioxidants. Measure and add the desired nutrients to the beverage mixture.
- g. **Filtration and clarification:** Pass the beverage through filters (sieve, strainer) to remove any solids, particles or impurities. Continue filtering the beverage until it is very clear to achieve a visually appealing appearance
- h. **Carbonation (for carbonated beverages):** Introduce carbon dioxide gas into the beverage to create carbonation and bubbles. Adjust the level of carbonation according to the desired effervescence (sparkle, fizzy).

The pictures below show how to prepare orange juice



Fig. 5.12: Oranges



Fig. 5.13: Squeezing oranges (use gloves)



Fig. 5.14: Bottled orange juice

EXTENDED READING

Click on the link for more information on how non-alcoholic beverages are made: <https://www.dryatlas.com/articles/how-are-non-alcoholic-beverages-made>

Activity 5.6

1. Interview selected local or small-scale beverage businesses in your community and find out how the beverages are produced and report in class. You need the following to help you gather your information
 - a. A questionnaire or interview guide.
 - b. Camera /phone to take pictures.

Interview Tips

- Plan the questions in advance.
- Make and maintain eye contact.
- Ask open-ended questions so the interviewee can expand on their answers.
- Listen carefully to their responses.
- Take notes.
- If you do not understand something, ask them to explain.

You could use a template to record your questions and the respondent's answers:

<p>Instructions: You must think of questions about enrichment and fortification of non-alcoholic beverage production that you will put to the respondent's during the interview.</p>
<p>Question:</p> <p>Answer:</p>
<p>Question:</p> <p>Answer:</p>
<p>Question:</p> <p>Answer:</p>
<p>Question:</p> <p>Answer:</p>
<p>Question:</p> <p>Answer:</p>

Use the information gathered from your visit to local beverage producers to produce a report that you can deliver in class. The tips below will help you structure your report

Analysing data that you have gathered for your report:

- It involves extracting (taking out) important facts and patterns from the data gathered.
- Draw conclusions.
- Make informed decisions based on the results.

Prompt sheet for report writing

- Informative and fact-based.
 - Formally structured.
 - Usually written with a specific purpose and reader in mind
 - Written in style appropriate to each section.
 - Includes section headings.
 - Often uses bullet points.
 - Often includes tables or graphs.
 - Offer recommendations for action.
 - Uses a clear structure.
 - Based on evidence (data, other reports, experiment results.)
 - Has a clear introduction and conclusion.
2. Observe the teacher or watch a video on how to prepare, enrich or fortify beverages using local ingredients. The links below are videos on how to prepare some local non-alcoholic beverages.
- https://youtu.be/2_bCNeQ0O6Q
 - <https://youtu.be/ez1rwYPsff8>
- a. Conduct experiments to prepare, enrich or fortify a non-alcoholic beverage of your choice using local ingredients.
- b. Package the local non-alcoholic beverages that you have made
- c. Display your local beverage for peer assessment and produce a presentation reflecting on the experiment you have conducted. Follow the guidelines below.
- *List the main steps in beverage production.*
 - *Describe the processes involved in beverage fortification and enrichment of non-alcoholic beverages.*
 - *Describe the potential nutritional benefits and risks of beverage enrichment and fortification.*
 - *Explain to the class how you used the local ingredient to fortify it.*
 - *Use various forms of presentation e.g., videos, power point, charts, written and exhibition.*

Note the resources required for the experiment:

- Raw materials e.g. water, fruit juices, botanical extracts etc.

- Resource materials, e.g., mixing jugs, stirrers
- Sweeteners such as sugar, honey or alternative sweeteners
- Packaging such as glass bottles to package the beverage.

Steps and processes of enrichment and fortification of beverage production - Alcoholic beverages

Process of producing, enriching and fortifying alcoholic beverages

- Selection of base ingredients:** This may include grains (e.g., barley, corn, rice), fruits or other raw materials.
- Milling:** Grains may undergo milling to break down the starches, making them accessible for fermentation.
- Malting:** Involves soaking and germinating grains to activate enzymes that convert starches into fermentable sugars.
- Mashing:** Combine the milled grains with water to create a mash. Heat the mash to specific temperatures to facilitate the enzymatic conversion of starches into sugars.
- Fermentation:** Transfer the mash to a fermentation vessel. Add yeast to the mash, which converts sugars into alcohol and carbon dioxide. Monitor fermentation temperature and duration to control flavour and alcohol content.
- Distillation (for distilled spirits):** Distil the fermented mash to separate alcohol from impurities. Collect the distillate, which consists of different fractions with varying alcohol concentrations.
- Blending and flavouring:** Blend one or two different ingredients such as fruits, herbs, spices or botanicals to enhance aroma and taste to achieve the desired flavour.
- Enrichment and fortification:** This is the addition of nutrients and stabilizers to the beverage.

Pictures showing the process of producing a local alcoholic beverage (Pito)



Fig. 5.15: Soaking of Sorghum



Fig. 5.16: Drying of soaked sorghum



Fig. 5.17: Cooking of milled sorghum



Fig. 5.18: Straining the cooked sorghum



Fig. 5.19: Strained Pito

Activity 5.7

1. Observe the teacher or watch a video on how to prepare, enrich or fortify beverages using local ingredients. The link below is a video on how to prepare some local alcoholic beverages. <https://www.youtube.com/watch?v=Qt0ySErpUuA>
2. With a friend, conduct experiments to prepare, enrich or fortify an alcoholic beverage of your choice using local ingredients.
3. Package the local alcoholic beverages that you have made.
4. Display your local beverage for peer assessment and produce a presentation reflecting on the experiment you have conducted. Follow the guidelines below.
 - *List the main steps in beverage production.*
 - *Describe the processes involved in beverage fortification and enrichment of alcoholic beverages.*
 - *Describe the potential nutritional benefits and risks of beverage enrichment and fortification.*
 - *Explain to the class how you used the local ingredient to fortify it.*
 - *Use various forms of presentation e.g., videos, power point, charts, written and exhibition.*

Note the resources required for the experiment:

- Raw materials e.g. water, fruit juices, botanical extracts etc.
- Resource materials, e.g., mixing jugs, stirrers
- Sweeteners such as sugar, honey or alternative sweeteners
- Packaging such as glass bottles to package the beverage.

Personal, food and environmental hygiene in the food laboratory

1. Personal Hygiene in the Food Laboratory

Personal hygiene is extremely important for food laboratory workers. Key practices that help to prevent harmful bacteria from spreading and contaminating food

- Wear clean, protective clothing.
- Effective and regular handwashing
- Regular bathing
- Trimming of nails
- Washing of clothes



Fig. 5.20: Protective clothing



Fig. 5.21: Hand washing



Fig. 5.22: Bathing



Fig. 5.23: Trimming of nails



Fig. 5.24: Washing clothes

2. Food Hygiene in the Food Laboratory

Food hygiene refers to the practices and procedures used to handle, store, and prepare food safely to prevent contamination and foodborne illness.



Fig. 5.25: Storing food in baskets



Fig. 5.26: Storing food in a fridge

3. Environmental Hygiene in the Food Laboratory

Environmental hygiene refers to the cleanliness and maintenance of the physical environment in which food is prepared, stored, and consumed. This involves

- Cleaning and sanitizing the work area
- Disposal of garbage
- Regular washing of utensils



Fig. 5.27: Cleaning working area



Fig. 5.28: Disposal of garbage



Fig. 5.29: Washing of utensils

Activity 5.8

1. Read about food hygiene practices and/or review the ppt presentation below on food hygiene in food laboratories and share ideas in class.
2. Plan/organise with your friends, a hygiene campaign advocacy to educate your peers on personal, food and environmental hygiene in promoting food safety and healthy living.

Review Questions

Review Questions 5.1

Write your answers to these review questions in your notebook and discuss them with your teacher and friends.

- Q1.** Your father is designing a new house. Plan and draw a diagram or sketch for a safe and efficient kitchen workspace/zones/areas for preparing meals and submit it for appraisal.
- Q2.** Compare at least four types of food laboratories and produce a report for feedback using different presentation modes. You can choose any **four** of the following food laboratories to make your comparisons: Kitchen laboratory; microbiological laboratories; chemical analysis laboratories; nutritional analysis laboratories; sensory evaluation laboratories

You can create a brief like the exemplar template below to gather information and make notes for your comparison.

Compare Types of Food laboratory		Similarities	Differences	
e.g.	Kitchen	Nutritional	Food preparation and cooking facilities Washing & cleaning facilities Staff wear protective clothing	Kitchen contains pots, pans and other utensils Nutritional lab contains testing equipment, microscopes, thermometers
1				
2				

Review Questions 5.2

- Q1.** Explain why each of the following factors are important when choosing and planning a food laboratory. Describe the impact of these factors on the smooth running of the food laboratory. Location and accessibility
- Equipment and technology available
 - Size and layout of the laboratory
 - Safety and hygiene standards
 - Budget and funding availability

Review Questions 5.3

Q1. Scenario

- a. Imagine that your school has recently received a grant or money to re-design its food laboratory. The current food laboratory is outdated, poses safety and hygiene risks, lacks both modern equipment and an efficient layout.
- b. Suggest four ways that you can improve the food laboratory to make it more modern, functional and efficient.

Q2. How will you ensure a high-efficiency ventilation system in the new school food laboratory?

Review Questions 5.4

Q1. It is your mother's birthday, and you have been asked to plan her birthday party.

- a. What factors should you consider when buying beverages/drinks to provide for the needs of the different types of guests coming?
- b. Describe the beverages/drinks that you will choose and justify your choice.

Q2. Describe four uses of beverages

Q3. List one non-alcoholic and one alcoholic beverage that can be used for any of the following functions and explain why they are considered suitable for that specific function.

- a. Wedding
- b. Funeral
- c. Outdooring
- d. Annual family re-union

Review Questions 5.5

Q1. Your friend is in the beverage production business. What advice will you give your friend to enhance the beverages to attract more customers?

Q2. What precautions should your friend take when enriching and fortifying the beverages?

Review Question 5.6

Q1. What is the difference between enrichment and fortification with reference to non-alcoholic beverages?

Q2. Using the workplan template below, record the procedure involved in preparing a local non-alcoholic beverage of your choice. Include the following information in your plan

- The beverage chosen and reason for your choice
- The ingredients, quantities and costs
- Tools and equipment required

- Steps/method of preparation

Section A

Beverage chosen	Reasons for choice	Ingredients	Quantities	Cost

List of tools and equipment required

Section B: Work plan

Method of preparation	
Step 1	
Step 2	
Step 3	
Step 4	

Q3. Students are required to write a report on the preparation of their selected local non-alcoholic beverage. Students should refer to the **Prompt sheet for report writing** in content above.

Review Questions 5.7

Q1. You have been given an opportunity to prepare a local alcoholic beverage for a special occasion. Using the workplan template below, record the procedure involved in preparing the beverage of your choice. Include the following information in your plan:

- The beverage chosen and reason for your choice
- The raw ingredients, quantities and costs
- Tools and equipment required
- Steps/method of preparation

Section A

Beverage chosen	Reasons for choice	Ingredients	Quantities	Cost

List of tools and equipment required

Section B: Work plan

Method of preparation	
Step 1	
Step 2	
Step 3	
Step 4	

Review Question 5.8

- Q1** Design a concept map to illustrate how hygiene practices in food laboratories affect food safety and quality.
- Q2** You are the manager of a catering establishment. During a routine inspection, you noticed that the floor drains were blocked/clogged, flies hovering around, and some plates were left unwashed in the sink. What advice would you give to your workers to ensure proper kitchen hygiene?

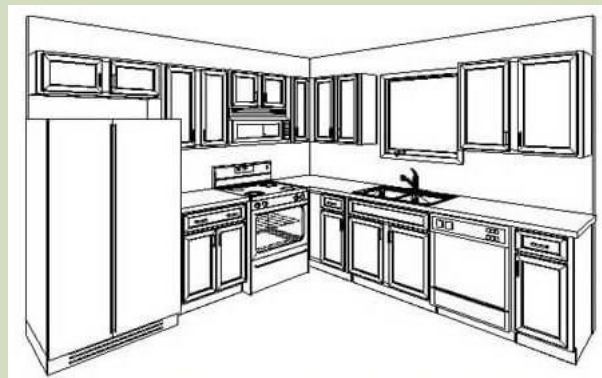
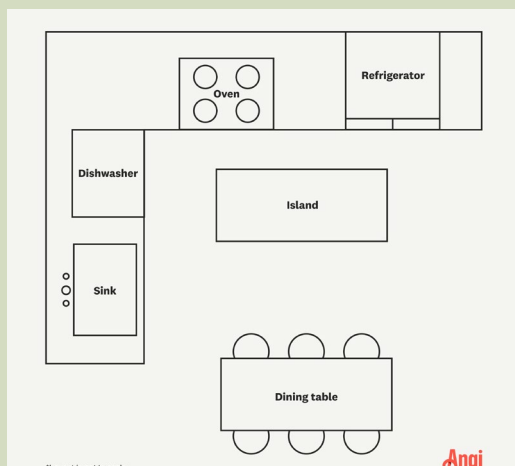
Answers to Review Questions

Answers to Review Questions 5.1

Q1. See samples below of a well-designed kitchen (food) laboratory that is functional and meets the required standard, indicating the various zones. Your designs may differ from those below, but they must include the following key zones

- Food preparation area
- Cooking area
- Refrigeration
- Storage areas
- Dishwashing area

Sample kitchen layouts



Q2. Your report and presentation will involve research into the different types of food laboratories. Learners should be able to provide a detailed comparison between four different types of food laboratories comparing aspects such as facilities, equipment, utensils, research equipment, protective clothing and health and safety.

Answers to Review Questions 5.2

Q1. You should be able to explain the importance of each of the factors above and justify their impact on the running of the food laboratory .

Answers to review Questions 5.3

Q1. You should be able to describe any four of the following improvements

- Provide improved accessibility and workflow - The layout should be safe, designed to provide a safe working environment for kitchen staff and prevent accidents

- It should be well ventilated by providing cross ventilation windows and doors and fume extractors
- Consider the proximity of different working areas such as food preparation area, storage area, positions of a variety of equipment and tools, dish washing area
- It should have proper lighting systems
- Include the latest technology/equipment in food preparation and preservation
- Include energy-efficient appliances to promote environmental responsibility
- It should have adequate and separate waste disposal areas.

Q2. There should be self-regulating window ventilators in the windows, door or wall to ensure a supply of fresh air indoors and an extraction of stale and unhealthy air outside. In large commercial premises there should also be fume extractor systems installed.

Answers to Review Questions 5.4

Q1.

- a. What factors should you take into consideration when selecting drinks for your mother's birthday party
- Think about the nutritional content of the beverage. Consider the ages of the guests. If there are older people/young children present, it would be beneficial to include drinks with additional vitamins and minerals
 - Consider the health or medical considerations of those attending. Soft drinks, fruit juices and flavoured beverages usually contain a lot of sugar and may be unsuitable for diabetics. Make sure there are alternative low sugar drinks available
 - Be aware of the alcoholic content of drinks don't include drinks with a high ABV due to their potential for intoxication and negative health effects
 - Consider how you will dispose of the packaging of beverages, particularly single-use plastics which can end up as litter in natural environments.
- b. You will produce a list of beverages/drinks for the party and justify why you have selected them.

Q2. Beverages can be used for any of the following reasons

- Hydration
- Quenching thirst
- Nutrition
- Energy
- Social enjoyment
- Business networking

Q3. Learners will provide an explanation of one non-alcoholic and one alcoholic beverage that may be considered suitable for a specific function.

- Wedding: Sobolo, pito, asana, malt, milk shake, fruit juices, fanta and beer
- Funeral: Sobolo, akpetesie, pito, asana, malt, fruit juices, fanta and beer
- Outdooring: Sobolo, pito, asana, malt, fruit juices, fanta and beer
- Annual family re-union: Sobolo, pito, asana, malt, fruit juices, fanta and beer

Explanation: The guests coming will have different preferences, dietary needs and tastes. The choice of alcoholic and non-alcoholic drinks should be appropriate for the occasion and ideal to cater for all the guests who will be coming.

Answers to Review Questions 5.5

Q1. Advice to a friend for beverage enrichment and fortification

Enrich and fortify his/her beverages with ingredients such as antioxidants, minerals, vitamins, dietary fibre, fruit, herbal and seed extracts. For example, if he/she is making zomkom, he/she can enrich it by adding milk which has protein and calcium.

Q2. What precautions should be taken when enriching and fortifying beverages

- The nutrient/ingredient is stable under proper conditions of storage and use.
- The intake of the nutrients is below the desirable level in the diets of a significant number of people and excessive intake of the nutrients/ingredients are not harmful or poisonous
- The beverages used to supply the nutrients are likely to be consumed in sufficient quantities to make a significant contribution to the diet of the population in need.
- The addition of the nutrient is not likely to create an imbalance of essential nutrients
- The nutrients are physiologically available from the food. That is, the nutrients are naturally available in food.

Answers to Review Questions 5.6

Q1. Differences are as follows

Enrichment: The addition of specific nutrients or substances lost during preparation to restore/increase its nutritional value and improve its health benefits.

Fortification: The process of adding new or extra essential vitamins, minerals, or other bioactive (biologically active) compounds to beverages to address specific nutrient deficiencies in the population.

Q2. Learners are to complete the template with the required information for producing beverages

Answers to Review Questions 5.7

Q1. Learners are to complete the template with the required information for producing alcoholic beverages.

Answers to Review Questions 5.8

Q1. The sample concept map below is one method of illustrating the process. Learners may use or devise different concept maps to illustrate their ideas.



The diagram shows that when personal hygiene, food hygiene and environmental hygiene are adhered to in the food laboratory it leads to the production of food that will be safe for consumption and can lead to the production of quality food products.

Q2. A manager should advise their workers to immediately unblock/unclog the drains, clean and sanitize all surfaces which may be affected by flies. They should wash all dirty plates in the sink and be advised that in future, dishes should be washed as they are used and not left in the sink. They should ensure proper waste disposal to prevent contamination. The manager should also give them additional training on the importance of cleaning and sanitizing.

References

1. Adigbo, E. C. & Maddah, C. K. (2011). *A complete course in Food and Nutrition*. Kwadwoan publishing: Accra. Pg. 43-55, Pg. 83-94. Pg. 83-94 , Pg. 302-309
2. Koomson, J. E. & Dollar, J. K. (2019). *Food and Nutrition for Senior High Schools*. Aki-Ola Published: Accra. Pg. 111-123, Pg. 159-175, 532-537
3. Sarkodie, N. K. (2014). *Food and Nutrition for Schools and colleges*. Bookworm publishers: Kumasi. Pg. 36-37, Pg. 39-43, Pg. 235-240

Glossary

1. **Culinary** – anything related to cooking or the art of preparing food. The art, science, and practice of cooking and preparing food.
2. **Zones in the kitchen** – this refers to areas allocated in the kitchen for specific tasks or work functions. Examples are cooking area, washing area and storage etc.

Acknowledgements



Ghana Education Service (GES)



List of Contributors

Name	Institution
Nyarko Lily-Versta	Mancell Girls' SHTS, Kumasi
Karim Ankrah Mohammed	Gbewaa College of Education, Pusiga
Akompi Dorcas Abena	Asesewa SHS
Judith Sakara	