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## EXERCISE 26 NON-ALCOHOLIC BEVERAGES

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Date .....

Session # .....

Time allocated – 1 Hour

Structure	Page No.
26.1 Introduction .....	539
Objectives	
Study Guide	
26.2 Tea .....	540
26.3 Coffee .....	551
26.4 Cocoa .....	560



We believe you have got into the habit of reading in advance the text, and planning your work before coming for the lab session.

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### 26.1 INTRODUCTION

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Non-alcoholic beverages are stimulants to the central nervous system owing to the presence of certain alkaloids in them. In addition, they also contain tannins and essential oils which give the distinct colours and the unique flavours. Tea, coffee and cocoa are the three most important beverages of the world. These beverages have become an integral part of our daily life and are a part of social etiquette for people across the continents. With so many positive points of these beverages, their habit forming nature could perhaps be their only minus point.



We also trust that you wear lab coat while working in the lab.

#### Objectives

After completing this exercise, you should be able to:

- identify a tea plant/twig;
- describe the morphological characteristics, and anatomical details of tea leaves;
- ascertain the genuineness of a given sample of tea leaves;
- list, highlighting the features of different grades/kinds of tea leaves;
- identify a coffee plant/twig;
- describe the characteristic features of coffee fruit and beans;
- point out the peculiarities of different kinds of coffee available in the market;
- differentiate between pure and mixed/adulterated coffee;
- list the common adulterants and flavour enhancers of coffee;
- explain the fruiting habit of cocoa plant;
- point out the structural peculiarities of a cocoa fruit; and
- list the products made with cocoa.

#### Study Guide

1. Management of time is the key to making maximum learning out of this exercise. Prior reading for familiarization, and planning the work schedule is essential. Some activities in this exercise can be done in your free time, that is, these do not require you to necessarily work in the lab. You may take on these activities before or after this lab session. Thus making more time available for the rest of the activities.
2. The salient points for the plant specimens to be studied are given in this manual just before the beginning of the related activity/task. However, for further guidance, you may refer to Unit-18 of the LSE-13 Course.

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## 26.2 TEA

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1. Tea is an evergreen or semi-evergreen woody shrub.
2. The leaves are arranged in alternate manner. The mature ones are tough and coriaceous. These are generally elliptic to lanceolate and have acute tips and toothed (serrate) margins. The characteristic fragrance and aroma of the leaves is due the presence of numerous oil glands.
3. It has rose-like flowers that are white or pinkish with yellow center and are borne in leaf axils (axillary), either solitary or in groups.

In this section, you will study tea by the following **five activities**:

1. Morphological study of a tea plant/twig.
2. Study of v.s. leaf.
3. Study of a peel mount of the leaf.
4. Tests for identifying the adulterants of tea.
5. Study of different grades of tea.

### 1. Morphological study of a tea plant/twig

#### Materials required

1. Fresh/herbarium specimen of a tea plant/twig.
2. Hand lens/dissecting microscope.

#### Procedure

Observe the given specimen, making a mental note of its salient morphological characters.

#### Observations and Interpretations

- Illustrate the given specimen of tea and jot down its diagnostic features in the Worksheet # 26.1. The description given above and the points for observation given in the worksheet would help you in your study. For further information, you may refer to the related theory Unit # 20, LSE-13 Course, Block-3B, pp. 31-40.

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*Your Notes*

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Diagram space

**Q.1:** Make an outline diagram of the specimen of tea provided, highlighting its diagnostic characters.

**Q.2:** Comment on the following aspects of the tea plant:

Leaves : phyllotaxy- .....

texture - .....

shape (base, tip, overall shape) - .....

.....

margin - .....

surface (upper and lower as seen with a hand lens/dissecting microscope) - .....

.....

Flower: position - .....

colour - .....

single/many - .....

description - .....

Other features: .....

.....

.....

## 2. Study of v.s. leaf

This involves either cutting a section of tea leaf and observing it. If time is a constraint, then a permanent slide of the same may be observed.

### Materials required

1. Fresh/fixed (preferably unprocessed) leaves of tea
2. A sharp razor/blade
3. Microslides
4. Coverslips
5. Safranin
6. Watch-glass
7. Water
8. Camel hair brush
9. Pith for sectioning
10. Glycerine
11. Compound microscope

### Procedure

1. Cut vertical section (v.s.) of leaf, i.e., at right angles to the leaf surface. The section should include the midrib and the lamina
2. You may look back at Exercise # 1 if you need any guidance for cutting v.s. of leaf.
3. It would be easier for you if you use pith for section cutting.
4. Select the best sections, stain with safranin, and mount in glycerine.
5. Fix the above temporary preparation under the compound microscope and observe.
6. If using a permanent slide, observe it also under the compound microscope.

### Observations and Interpretations

1. Study the v.s. of this dorsiventral leaf of tea. Recall and compare the anatomical features of a typical dorsiventral leaf with the preparation you have made, or the permanent slide provided to you.
2. Focus particularly on:
  - epidermis;
  - palisade and spongy parenchyma;
  - vascular bundle in the mid-rib, note whether it is surrounded by tissues, if yes, which kind of tissues, is it sclerenchyma or some other cells?
  - astrosclereids or the idioblasts in the palisade and in the mid rib region are very prominent, don't miss out on them! These are the characteristic features of the leaves and are sometimes as long as the leaf.
3. Make an outline diagram of the section in the Worksheet # 26.2. Also, enlarge an astrosclereid and jot down the anatomical details of the leaf.



Be careful about your fingers while using the razor/blade.

Diagram space

**Q.1:** Make an outline diagram of v.s. leaf and enlarge an astrosclereid.

Description space

**Q.2:** Write the main anatomical features of the leaf, commenting particularly on the astrosclereids.

### 3. Study of a peel mount of the leaf

This exercise is meant for observing the trichomes or the hairs present on the leaf surface.

#### Materials required

1. Fresh/preserved (preferably unprocessed) young leaves of tea
2. Watch-glass
3. Water
4. Forceps (fine)
5. Microslides
6. Coverslips
7. Glycerine
8. Compound microscope
9. A sharp blade
10. Needles
11. Safranin

#### Procedure

Prepare a peel mount of the leaf. The method of taking out a peel is given in Exercise # 1. You may stain the peel with safranin; it makes the structure clear. Mount the peel in glycerine and observe under the compound microscope.

#### Observations and Interpretations

The young leaves have trichomes or hairs on their surface. These hairs are unicellular with a swollen base, short shaft and a lumen, which runs a little way into the shaft. Study and describe the hairs as seen in the peel-mount that you have prepared. Illustrate a couple of hairs in the Worksheet # 26.3 and write their characteristic features.

*Your Notes*

Diagram space

Description space

**Q.1:** Make one or two hairs in enlarged view along with the epidermal cells surrounding them.

**Q.2:** Describe the characteristic features of the leaf-hairs.

*Your Notes*

#### 4. Tests for identifying the adulterants of tea.

How can one determine whether the tea we consume is genuine tea? This may not be the problem with the reputed brands, but the tea that is sold 'loose', is many a times mixed with non-tea substitutes. How do we find out whether a given sample is pure tea or has some other ingredients? This is precisely what you would learn to do now.

##### Materials required

1. Tea leaves (processed tea that we use for making the beverage)
2. Rose, *Cassia*, strawberry leaves
3. Spent leaves
4. Saw dust/husks of grains, beans, and other seeds.
5. Filter paper
6. Water
7. Test tubes
8. Test tube holder
9. Bunsen burner/spirit lamp
10. Compound microscope
11. Microslides
12. Coverslips
13. Safranin
14. A sharp blade/razor

##### Procedure

The following **five** things are to be done in this regard:

- i) Study the anatomy of leaves of the given sample.
- ii) Prepare peel mounts from (previously soaked) leaves from the given samples.
- iii) Boil the tea leaves (genuine) in a test tube. Similarly, boil the rose, *Cassia*, and strawberry leaves in separate tubes that are well labelled (with the name of the source plant written on them). The texture of these leaves is to be felt by hand.
- iv) Put the sample of tea – fresh and spent, separately on wet filter papers. See, what happens. Mark the papers as 'fresh' and 'spent'.
- v) Take saw dust, husks of various seeds that have been coated brown like that of tea. Take a bit of these and put them on a wet filter paper and note what happens. The second thing you could do is soak these materials in water, and try to cut their sections and observe them under the microscope. If sectioning is difficult, you may tease the materials on different slides, put a small drop of glycerine and place a coverslip on each and observe under the compound microscope.

##### Observations and Interpretations

1. You are well-versed with the diagnostic features of tea leaf, i.e., its anatomical features and trichomes on the surface. With these in mind, you can easily identify the adulterant materials that will exhibit variant anatomy. This is what you have to do for points # i and # ii mentioned in the procedure; and note your observations in Worksheet # 26.4.

2. For point # **iii**, with little concentration you can feel the difference of texture of the boiled tea leaves from the adulterant rose and *Cassia* leaves. Describe how you felt regarding the texture of the different leaves in the Worksheet # 26.4.
3. Point # **iv** is simple. No hints being given. Observe and record your findings in the Worksheet # 26.4.
4. Some hints for point # **v**. Saw dust is mainly wood, so what do we get in wood – the xylem elements. If the section/teased material shows elements like vessels, tracheids, and xylem parenchyma. So it conclusively shows that the material is fine wood shavings or saw dust. Also note down your finding regarding this test in the Worksheet # 26.4.

If husks of various seeds are used as adulterants, their structure too would be very different from the tea leaf. Like sawdust make their preparations and observe them under the compound microscope.

*Your Notes*



## 5. Study of different grades of tea.

This small activity is to test your familiarity with different grades of tea. Some brand names are very commonly heard/seen in advertisements, and some we know from our use and experience. A few names would have been added to your list from your study of Unit-20 of LSE-13 Course. How about doing a hands-on with as many samples/grades/types of tea as we can? It's going to be interesting!

### Materials required

1. Different kinds of tea – green, black, oolong, scented, brick, CTC, tea-bags, and whatever other types could be arranged.
2. Dissecting microscope/hand lens

### Procedure

1. Take a little tea sample on a small white sheet. This will give a contrasting background, and help focus on the constituents of the tea.
2. Observe the sample with a hand lens/dissecting microscope.
3. Similarly, observe each type of the tea provided.
4. The previously soaked samples could also be observed for their constituents.

### Observations and Interpretations

Size of tea leaves, and the processing mechanism mainly are the basis of different grades and kinds of teas. Study and observe the samples provided and record your observations in the Worksheet # 26.5.

*Your Notes*



## 26.3 COFFEE

1. It is an evergreen shrub or a small tree, often kept short by pruning.
2. The leaves are ovate-elliptic, opposite, glabrous and glossy. Its margins are undulate, and tips are acuminate. Interpetiolar stipules are present.
3. Flowers are star-like, snow-white, and smell delicately like jasmine flowers. These occur in dense axillary clusters and are produced in flushes 3 or 4 times in a year.
4. The fruit is a drupe, about 1.5 cm long. It is green when young and turns crimson-red at maturity. It takes about 6-9 months after flowering for the fruits to develop to maturity.

The drupe has 3 distinct regions:

- i) exocarp or epicarp, it is the outer, thin, deep crimson skin;
  - ii) mesocarp is the yellowish mucilaginous or fleshy layer; and
  - iii) endocarp is hard, cartilaginous and parchment-like, enclosing two and sometimes one ellipsoidal or oval seeds called coffee beans.
5. The coffee seeds or beans have an outer delicate seed coat called the silver skin. The bulk of the seed is composed of a curiously folded corneous endosperm enclosing a very small embryo.
  6. The three species of coffee consumed world-over are:  
*Coffea arabica* – Arabic coffee  
*C. canephora* – Robusta or Congo coffee  
*C. liberica* – Liberian coffee

This section requires you to perform the following **four studies**.

1. Morphological study of a reproductive twig.
2. Morphological study of coffee fruit and bean.
3. Study of the different kinds of coffee available in the market.
4. Study of pure and mixed/adulterated coffee in whole / powdered forms.

### 1. Morphological study of a reproductive twig.

#### Materials required

1. Fresh/herbarium specimen of a coffee twig bearing fruits, or a photograph of the same
2. Hand lens/dissecting microscope

#### Procedure

Study and observe the given specimen minutely.

#### Observations and Interpretations

Illustrate the given specimen of a reproductive twig of coffee. Make an outline diagram only. Depict the details of one node, and draw one leaf. Use the diagram space in the Worksheet # 26.6 for this purpose. The description given above and the points of observation given in the worksheet would help you in your study. For further information, you may refer to the related theory unit, # 20, LSE-13 Course, Block-3B, pp. 40-46.



Reference for more information

Diagram space

Q.1: Illustrate the given specimen of coffee. Highlight the details of one node and a leaf.

Q.2: Based on your observations, comment on the following aspects of a coffee plant:

Leaves : phyllotaxy - .....  
texture - .....  
shape (base, tip, overall shape) - .....  
.....  
margin - .....  
surface (upper and lower as seen with a hand lens/dissecting microscope) - .....  
.....

Flower: position - .....  
colour - .....  
single/many - .....  
description - .....

Fruit: to be studied in Worksheet # 26.7.

Other feature(s): .....  
.....  
.....  
.....

## 2. Morphological study of coffee fruit and bean.

### Materials required

1. Fresh/preserved coffee fruits (mature) or photographs of the same
2. Unroasted coffee beans
3. Needles
4. Water
5. Microslides
6. Coverslips
7. Safranin
8. Compound microscope

### Procedure

1. First observe the intact coffee fruit, then cut it open and study it.
2. Similarly, study the coffee bean, and make note of its characteristic features.
3. Scrape the inside of the groove of the coffee bean with your mounted needle. Place the scraping onto a slide. Stain it with safranin. Mount in glycerine and observe under the compound microscope.

### Observations and Interpretations

1. Study the fruit, focus mainly on:
  - the distinctive features of raw vs. mature fruit,
  - the intact fruit,
  - type of fruit, and
  - split-open fruit to see the number and arrangement of seeds.Details of the fruit are given above, see whether they match with the specimen that you have for study. Complete the related tasks in the Worksheet # 26.7.
2. Similarly, pay attention to the coffee seeds, also known as beans.
  - Note how many they are per fruit.
  - How does each bean look like.
  - Do you find it resembling to the grain of wheat?Write your observations in the Worksheet # 26.7.
3. Observe which kind of cells compose the scrapings (parchment plus silver skin) taken from the groove. Illustrate the parchment (endocarp) cells and the silver skin (seed coat) below. Some hint for these: the parchment cells are macrosclereids, and the silver skin is membranous. Draw a few cells of each in the Worksheet # 26.7.

*Your Notes*



### 3. Study of different kinds of coffee available in the market.

Coffee is available as beans – both in roasted and in unroasted forms, also in ground, i.e., powdered form. And there is one very popular form – instant coffee. What are the differences between these? Let us have a detailed look at them.

#### Materials required

1. Roasted beans
2. Unroasted beans
3. Coffee powder – (filter coffee)
4. Instant powder
5. Water
6. Beaker
7. Burner
8. Test tubes
9. Test tube stand

#### Procedure

1. First, study the roasted and unroasted beans one by one. Focus mainly on the differences between the two.
2. Next, study the ground coffee. For this, make comparative observations on the pure coffee powder and the instant coffee. Observe them first in powdered form. And then see their solubility in boiling water. Surely, you know how to make coffee. For this exercise, boil some water in a beaker. Take equal amount of pure coffee powder and instant coffee powder in separate test tubes. Pour equal amount of water in both of them and observe.

#### Observations and Interpretations

1. For interpreting the differences between the roasted and unroasted coffee beans, you can make note of their following features:
  - their relative size,
  - size of one bean,
  - colour,
  - shape,
  - aroma, and
  - other featuresNote these observations in the Worksheet # 26.8.
2. Following the above line you can observe the differences in the two kinds in their dry (powdered) form, and in solution.

For powder form you could make the following observations:

- colour,
- aroma,
- texture and feeling to touch.

## Higher Plants

And in solution, you could observe the following aspects:

- how much time each takes to dissolve;
- see whether they dissolve completely;
- the colour of the solution – you can describe them as different shades of brown colour, e.g., chocolate brown, golden brown and so on; and
- any other features you may notice.

*Your Notes*

**Worksheet # 26.8: Study of different kinds of coffee available in the market.**

**Non-alcoholic Beverages**

**Q.1: How would you distinguish the roasted coffee beans from the unroasted ones?**

S.No.	Characteristics	Unroasted beans	Roasted beans
1.	Size		
2.	Colour		
3.	Shape		
4.	Aroma		
5.	Other features		

**Q.2: What differences did you observe in the powdered coffee and the instant coffee?**

S.No.	Characteristics	Indicate the state (dry/liquid)	Powdered coffee	Instant coffee
1.	Colour	Dry		
2.	Texture and feeling on touch	Dry		
3.	Dissolution time	Liquid		
4.	Colour	Liquid		
5.	Other features			

**4. Study of pure and mixed/adulterated coffee in whole/powdered forms.**

You may recall from your study of Unit # 20 of LSE-13 Course (p. 45) that roasted peas, beans, cereal grains and roasted tamarind seeds are commonly mixed with coffee beans. Therefore, such a coffee is known as adulterated coffee.

On the other hand, consumers demand coffee with additives like chicory, flavour enhancers like chocolate, liqueurs, orange or almond extract, and Vanilla. Such types of coffee may be referred to as mixed coffee. So, you must catch the meaning of the mixed and adulterated powdered coffee.

You may now take on the activity given in the Worksheet # 26.9.

*Your Notes*

**Q.1: List the adulterants of unroasted and roasted beans and the coffee powder.**

Before you proceed further, here are some guidelines for this activity.

- i) You could fill in the information asked for from the explanation given above and from the related theory unit.
- ii) However, you must explore and find out more about adulterants/additives used, from other sources/literature related to coffee, coffee drinkers, your friends, shopkeepers, and surely your Counsellor.
- iii) This activity would, therefore require your additional free time for exploration and not solely the practical session time.

Form of coffee → Adulterant ↓	Characteristics	Unroasted beans	Roasted beans
1.			
2.			
3.			
4.			
5.			
6.			

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**26.4 COCOA**


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Read more about –  
branching pattern

1. Cocoa tree grows to a height of about 8-10 m, but is kept low by pruning when it is under cultivation.
2. It has a characteristic branching pattern (see p. 47, Unit # 18, LSE-13 Course).
3. The leaves are spirally arranged on the main stem and subsequent chupons, but are alternately arranged on jorquette branches. The mature leaves are dark greenish, oblong-oval or elliptic-oblong with prominent veins and veinlets.
4. The inflorescence occurs in a peculiar manner on the old, leafless trunk or the main stem and fan branches. The flowers are tiny, white, yellowish or pinkish, pentamerous, pedicellate, and bisexual. The petals are five in number, smaller than sepals, are expanded into concave, cup-shaped pouches; end of the petal is spatulate, yellowish, bending outwards and backwards and attached to pouch by narrow connective. Androecium has five outer staminodes, and five inner fertile stamens that bend outwards and the anthers are concealed in the pouches of corresponding petals. Gynoecium has 5 carpels, ovary is superior, and has numerous ovules.
5. The fruit is a drupe, commonly called a pod. It is borne directly on the stem. In botanical terms, this condition is known as cauliflory. The fruit is indehiscent, white, greenish or reddish, variable in size and shade. Pericarp is fleshy and mesocarp is thick. The pods mature in 4-6 months after fertilization including a month for ripening. The seeds are usually called beans. Each fruit has 20-60 seeds, that are arranged in rows. The seeds are variable in size and shape.

For more details you can look at Unit # 18, LSE-13 Course, pp. 46-50.

In this section, the following **three tasks** have been outlined for your lab work.

1. Study of fruiting habit of a cocoa plant.
2. Morphological study of a pod.
3. Study of various products made with cocoa.

### **1. Study of fruiting habit of a cocoa plant.**

#### **Materials required**

1. A photograph of cocoa plant bearing fruits.

#### **Procedure**

Observe the morphological details of the plant, particularly the bearing of fruit.

#### **Observations and Interpretations**

Illustrate the fruiting habit of cocoa. Pay attention to the details such as how many fruits are present at a given point. Are all of same sizes, and so on. Note your observations in the Worksheet # 26.10.

## 2. Morphological study of a pod.

### Materials required

1. A fresh or fixed museum specimen of a longitudinally cut cocoa pod.

### Procedure

Observe the given specimen minutely.

### Observations and Interpretations

Complete the outline diagram of the fruit depicting the fruit wall, the number, relative size, and arrangement of seeds in the Worksheet # 26.10.

*Your Notes*





**Worksheet # 26.12: The beverage quiz. Test your knowledge and understanding of the non-alcoholic beverages by the following quiz.**

**Q.1:** Why do the tea leaves not get reduced to paste-like form on boiling?

.....  
.....

**Q.2:** Why is tea plantation (originally of tree habit) maintained as bush, under cultivation?

.....  
.....

**Q.3:** Why does tea become dark brown on prolonged boiling? Is it more refreshing?

.....  
.....

**Q.4:** Which of the three beverages (you have studied) is more addictive?

.....

**Q.5:** Why does the instant coffee dissolve completely?

.....  
.....

**Q.6:** Mention any two effects of excessive consumption of coffee on human body.

.....  
.....  
.....  
.....  
.....  
.....

**Q.7:** Of the three beverages, which one has the maximum food value?

.....  
.....

**Q.8:** Which beverage is used in making the 'cola' drinks?

.....  
.....  
.....

(Hint: you can refer to Unit 19, of LSE-13 Course)