UNIT 7 COMMERCIAL CROPS, SPICES, MEDICINAL AND AROMATIC PLANTS

Structure

7.0 OBJECTIVES

After reading this unit, you should be able to:

- state the importance of commercial crops, spices, medicinal and aromatic plants in the national economy;
- know about post harvest processing of these crops into value added products; and
- describe the by products and other uses of these crops.

7.1 INTRODUCTION

Commercial crops, spices and medicinal and aromatic plants are high value crops. These crops require special attention during production and also during post harvest processing, handling and storage. Some of these crops play a significant role in the national economy, export or in employing large number of people. Therefore, the study of these crops is to be separated from the other crops like cereals, pulses and oil seeds or horticultural crops.

The Unit 4 has been divided in three sections namely; commercial crops, spices and medicinal and aromatic plants. Under section 4.2 mainly two main commercial crops namely sugarcane and cotton are discussed. In the section

4.3, six major spices namely chilli, cardamom, pepper, tamarind, turmeric and ginger are discussed. Lastly medicinal and aromatic plants are discussed.

7.2 COMMERCIAL CROPS (SUGARCANE AND COTTON)

7.2.1 Importance

Crops, which are important from commerce points of view, are called commercial crops. Mainly two crops are considered as major commercial crops in India namely sugarcane and cotton.

Sugarcane is widely grown in almost every state of the country and two union territories. Sugar industry is the second largest processing industry in the country. There are more than 400 sugar industries in the country who receive raw material from 35 million sugarcane growers in the country. India is the largest sugarcane producer of the world and at one time (1975-76) it had exported over 1 million tonnes of sugar and earned Rs. 468.5 crores.

Wealth of Sugarcane: From energy transformation points, sugarcane is the most efficient crop. It receives the solar energy and converts it in to energy producing substances like sugar, cellulose and non-cellulose products. Thus its processing is valuable contribution to food and industry. Sugarcane produces sucrose which is a direct source of food and wide range of by products as shown in Figure 7.1. These products are useful for human and animal consumption and also provide huge renewable energy.

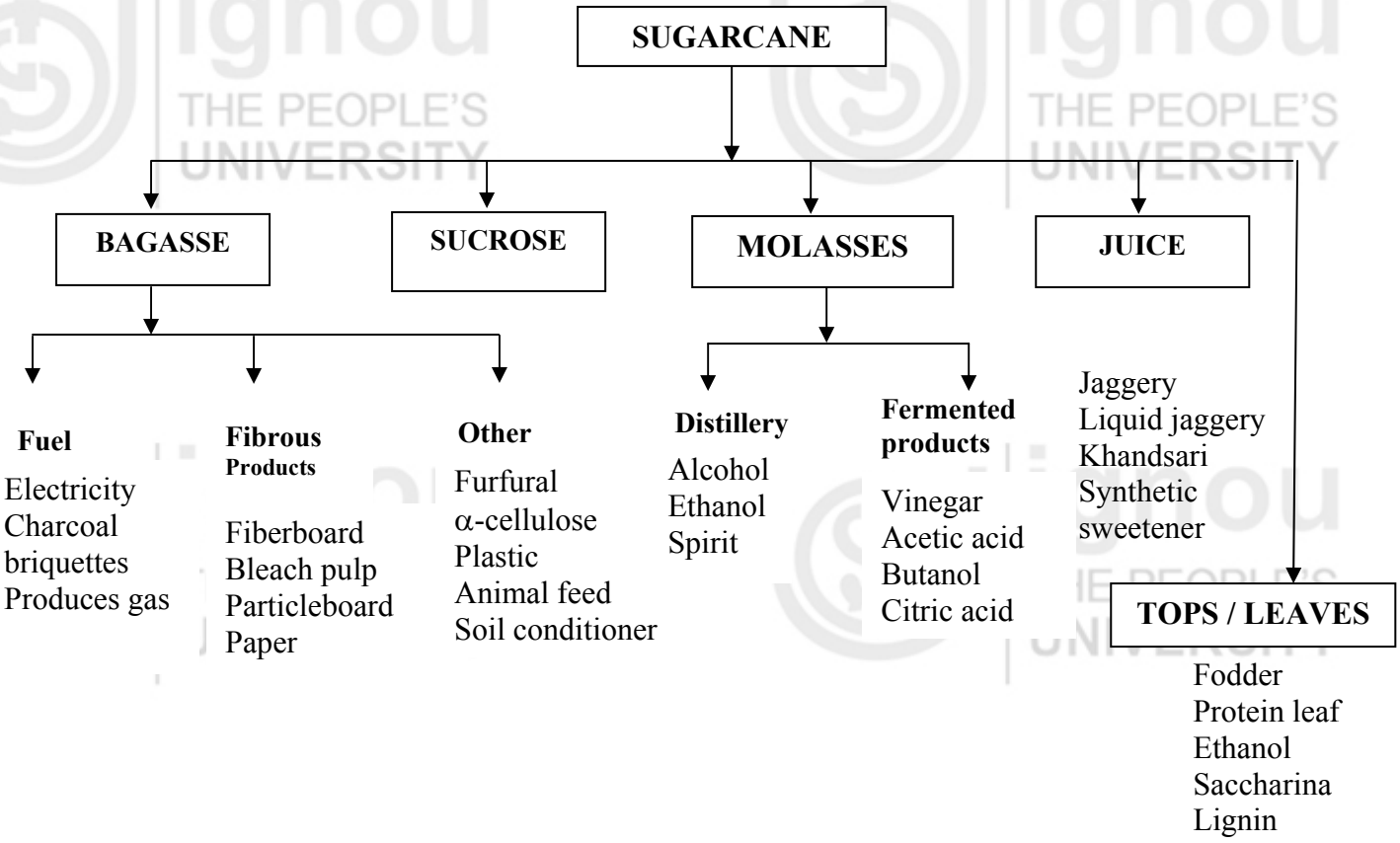


Figure 7.1: Products and by products of sugarcane

Cotton is the most important commercial crop playing a key role in economic, political and social fabric of the world. In India it is the biggest organized sector which provides employment to several million people. It is the largest industry in terms of annual value of output and labour employment. Besides this large number of power loom and handloom have employed around 2.5 million people.

Cotton is not only known for production of lint, which is the basic raw material of textile industry but also to produce cottonseed, which is rich in oil.

7.2.2 Processing of Sugarcane

In a typical sugar factory 100 tones of cane produces: Sugars (10 t), molasses (4 t), filter mud (3 t), Bagasses (30 t) and cane tops and leaves 30 t. Besides these it also can produce electricity of 1500 kW.

Juice Extraction

Sugar cane is crushed in sugarcane crusher (IS:1973-1973) in general where first dry crushing is done and about 73% of total available juice is recovered. Then wet crushing is done to recover remaining juice. IS-6983-1973 is the specification of rollers and axles for sugar cane crusher. Extracted juice is acidic (pH 5.2-5.5) in nature. It is neutralized to pH 6.4 by the addition of lime solution. In general in 100 kg juice, 1 kg lime (80-90% purity) is mixed with 4 litre of water and 60-75 ml of milk of lime is sufficient to bring desired neutralization.

Juice boiling: To avoid sugar inversion, the boiling should be done within 8-12 h of juice extraction. A traditional furnace, where *bagasse* is used as fuel should have high heat utilization efficiency and Juice clarification.

Jaggery

Jaggerry and *Khandsari* are ancient *sweetners* and still popular among masses for its high food value and medicinal properties. In India about 40% of sugarcane produced is used for making *jaggery* in the organized and unorganized sector. The *jaggery* is considered to be diuretic, refreshing tonic and cooling. Table 7.1 provides the comparison of composition of sugar, *Jaggerry* and *Khandsari.*

Table 7.1: Proximate composition of sugarcane sweeteners (100g)

Sweetener	Sucrose (g)	Reducing sugar (g)	Protein (g)	Fat (g)	Moisture (g)	Ca (mg)	P (mg)	Fe (mg)	Energy (Kcal)
Sugar	99.5	-	-	-	0.4	-	-	-	398
Jaggery solid	60-85	5-15	0.4	0.1	3-10	8	4	11.4	383
Khandsari	96	-	-	-	0.5	100	-	-	398
Bura	90-95	1-3	-	0.5	1.5	100	-	-	395
Misri	99.5	-	-	-	0.2	-	-	-	402

Source: Annual report of ISARI< Lucknow 1999-2000

The traditional process of *jaggery* preparation is shown in Figure 4.2. Sugarcane is crushed in sugarcane crusher. About 48 % of sugarcane mass as juice goes to clarifier. The clarified juice is boiled. To neutralize the juice lime

is added and concentrated juice is put in the moulds (1, 5, 10 and15 kg). After cooling moulds are stored. Bagasse, which is a byproduct, is used as source of fuel in the *jaggery* preparations.

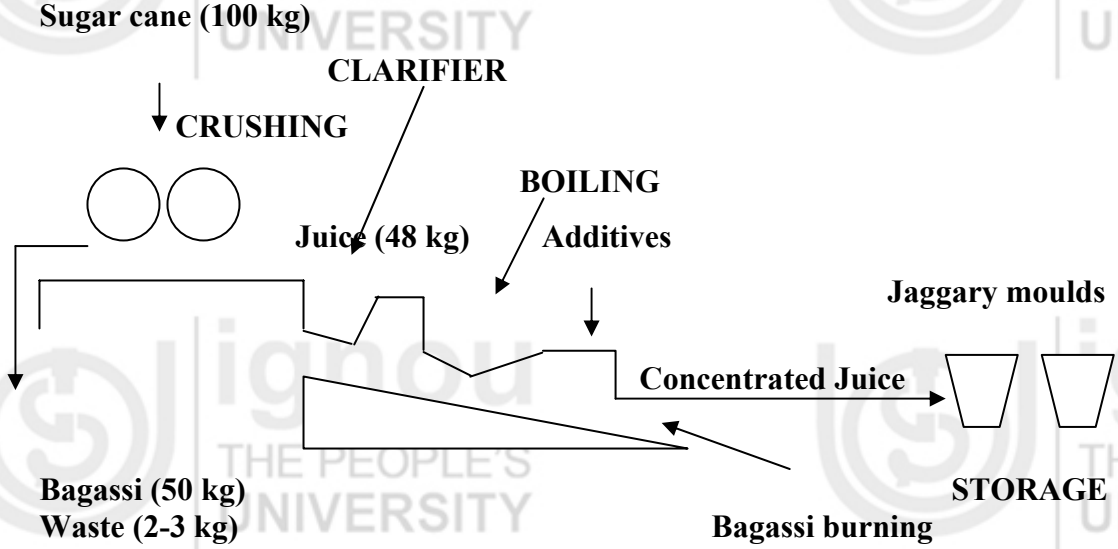


Figure 7.2: Traditional process for *jaggery* preparation

7.2.3 Byproducts of Sugarcane

Sugarcane plant has four major byproducts namely bagasse, molasses, sucrose, tops and leaves.

Bagasse

Bagasses, is the fibrous residue of cane stalk after crushing and extraction of juice. It consists water, fibers and small quantity of soluble solids. Its composition includes fiber 46-52%, moisture 43-52% sugar 3% and minor constituents 0.55%. Where as the dry bagasses composition is: Cellulose (45%), Pentosans (28%), Lignin (20%), Ash (2%) and sugar (5%).

Bagasse can also be used as –

i) **Pulp**: Bagasse can be converted in to pulp. This pulp can be used to make paper for wrapping, printing, writing, toilet, tissue, corrugated medium, linerboard etc. Fluff pulp can be used to make sanitary napkins and absorbent disposable products.

ii) **Paper Industry:** Process of paper manufacturing includes **digestion**, **washing, screening, bleaching, dewatering and thickening.** Bagasses are digested in close units at pre-specified pressure, temperature and time with chemicals. Later washing is done to remove the effect of chemicals.

iii) Fuel (briquettes, charcoal, produces gas)

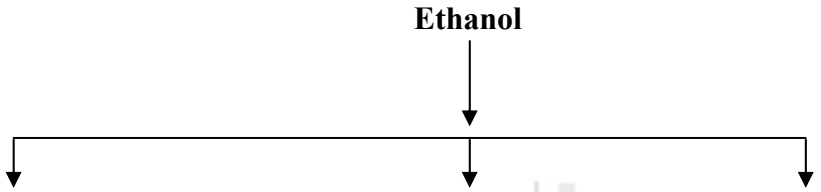
iv) Fodder for animals

v) Production of mushroom

vi) Soil conditioner

Molasses Based Products

Molasses yield is 2.2 to 3.7% of the total cane crushed. It is graded based on total sugar content and yield of ethyl alcohol produced from it. Alcohol producing industry consume about 80-90% of the molasses produced in the country. The other important product is ethanol. The ethanol produced is used for



Dehydration	Oxidation Dehydrogenation	Modification
Polystyrene	Ethyl butyl acetates	Chloroform
Polyethylene	Acetic anhydride	Butadiene
Poly ethers	Charcoal	Diethyl then
	Butaaraldehyde	Ethylamines
	Acetamide	Ethyl chloride

Sucrose

Sucrose is a regenerable potential raw material obtained from sugarcane. Though it is not as sweet as saccharin, suralose, aspartame etc, but it has wide commercial applications. There are some added derivatives which have market potential such as:

- Ethers and anhydro derivatives
- Esters of fatty acids as surfactant and emulsifiers
- Sulfuric acid or sulphate esters.
- Polymers and resins, acrylics, etc

The other uses of sugarcane tops press mule and waste is in animal feed, fertilizer cane wax etc.

Check Your Progress Exercise 1

Note: a) Use the space below for your answer.
b) Compare your answers with those given at the end of the unit.

1. Why sugarcane is called energy efficient crop?

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2. Why cotton is the most important commercial crop?

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3. How much sugar can be produced from 1000 kg sugarcane?

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4. Why sugarcane juice is to be boiled with in 8- 12 hours of extraction?

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5. What are the medicinal properties of jaggery?

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6. List the unit operations are to be performed in paper manufacturing.

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7.2.4 Processing of Cotton

Ginning

It is an important unit operation in the handling cotton as a raw material from field to the factory for processing. It is the process of separation of lint from seed cotton. It is done either by roller gin or with saw gins.

Quality Evaluation of Cotton

The quality of cotton is judges by the quality of yarn which be spun from it. The spinning performance in expressed as **"Highest Standard Count" (HSC)** which cotton can spin. For i.e. 40 counts means one pound of a particular yarn contain 40 lakhs of 840 yards each. Based on the end-use of the yarn, certain strength standard have been prescribed. The maximum HSC for cotton is the finest count of yarn, which can be spun to satisfy the yarn strength standards. Thus important parameters are fineness, maturity and strength.

Fiber length – Longer lnited cotton provides better spinning performance than shorter linted ones.

Short staple	19 mm or below
Medium staple	20 .0 – 21.5 mm
Superior medium staple	22.0 – 24.0 mm
Long staple	24.5 – 26.0 mm
Superior long staple	27.0 mm and above

7.3 SPICES

7.3.1 Importance

The Indian spices are perhaps older than the recorded history. India is well known to the world as **Home of spices**. Spices contribute an important group of agriculture commodity as they are considered as indispensable in the culinary art for flavouring of foods. These crops will also show our heritage and national wealth in utilization of them for several medicinal uses. Some are also used as pharmaceuticals, perfumery, cosmetics etc. Besides this, spices play an important role in the national economy.

Chilli is the dried ripe fruit of genus "capsicum" which is also called as red pepper and it is considered as an important commercial crop used as a condiment, culinary supplement as a vegetable. In India, chilli is cultivated in about 10 lakh hectares with an annual production of 10 lakh tonnes, which is about one fourth of the world's chilli production. The annual Indian export of chilli in recent times is around 13000 tonnes valued about Rs. 500 million. Together with whole chilli, the value-added products like chilli powder, curry powder, chilli oleoresins etc. add a major share to our export earnings.

Among the various spices cultivated in India, cardamom is called "**Queen of spices**". It is native of India; enjoys a unique position in the International spice market. At present, India is the second largest consumer of small cardamom in the world after Saudi Arabia. The cardamom growing tracts in the country are facing severe ecological degradation due to diminishing forest cover, leaving

the region open to devastation by floods and droughts. As cardamom requires tropical forest conditions for better growth, both the area and production of cardamom in the country are declining.

Pepper (*Piper nigrum*) popularly known as the **King of spices**. It is the dried fruit of perennial climbing vine, mostly found in hot and moist parts of Southern India. Kerala alone contributes 96% of the total production in India. Apart from Kerala, pepper is also cultivated in the hill districts of Karnataka and Tamil Nadu. Mostly pepper is cultivated as intercrop with other plantation crops.

Pepper is widely used as a condiment, preferred for its characteristic aroma, pungency and biting taste. It is used to garnish culinary preparations, ketchups, sauces pickles and in pharmaceutics. Indian pepper, commonly known as "Malabar pepper" is considered to the best in the world for its excellent aroma flavour and pungency. India is the largest producer, consumer and exporter of black pepper. India contributes about 35 to 40 percent to the total world production and thus occupies the unique position in the international trade of pepper. The annual production of pepper in India is in the range of 60,000-85,000 tonnes.

Tamarind (*Tamarindus indica* Linn) is one of the important economic trees of India. Tamarind is a much-loved tree throughout the semi-arid regions for its deep, cool shade and for its valuable fruit. It is an ideal plant for optimum use of wastelands. It is a regular bearer and provides assured returns to the farmers even under extreme soil and climatic conditions.

Turmeric adds typical flavour and colour in curries and makes them the best. Turmeric is also used as dye in textile industries, it is also used for medicinal purposes and cosmetics. India exports only 5-8 % of its turmeric produce and ranks 6th in spice export and earns over Rs. 100 million annually.

India is the largest producer and exporter of pepper, chilli, ginger and turmeric. It also exports substantial amount of cardamom and black pepper. India alone contributes 50% of the world ginger requirement. Ginger is used principally as an ingredient in various spices blends, food processing and beverage industry.

Check Your Progress Exercise 2

Note: a) Use the space below for your answer.
b) Compare your answers with those given at the end of the unit.

1. What are the indices to evaluate quality of the cotton?

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2. What should be the best quality fiber length?

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3. Name the following

i) Home of spices : ……

ii) Queen of spices : ……

iii) King of spices : ……

7.3.2 Proximate Composition of Spices

Spices are an important group of agriculture commodity as they are considered indispensable in the culinary art for flavouring of foods. These crops also show our heritage and national wealth. Some are also used as pharmaceuticals, perfumes, cosmetics etc. Proximate composition of spices is given in Table 7.2.

7.3.3 Harvesting and Drying of Chilli

The crop becomes ready for harvesting in about 105-120 days after planting. The picking of ripe fruits continues for about 2 months. Chilli is picked in about 6-10 pickings with an interval of 7 or 8 days. Some traditional varieties require only 5-6 pickings; while the hybrids may require up to 12 pickings. Harvesting is done after 1 or 2 days of irrigation and picked fruits are kept in shade to avoid sunscald.

Chilli is harvested at moisture content of around 60-70% (w.b.) and need to be dried for further preservation and storage. In the absence of efficient mechanical drying systems, currently all the chilli produced in the country is sun dried.

Table 7.2: Nutritional constituents of spices per 100 g

S. No.	Nutrient	Green Chilli	Red Chilli	Cardamom	White pepper	Turmeric	Ginger
1.	Carbohydrate	3.0	31.6	45.4	68.6		66.5
2.	Proteins	2.9	15.9	10.3	10.4	8.6	8.6
3.	Fat	0.6	6.2	8.3	2.1	8.9	6.4
4.	Fiber	6.8	30.2	9.2	4.3	6.9	5.9
5.	Moisture	85.7	10.0	8.3	11.4	58	5.9
6.	Minerals	1.0	6.1			6.8	
7.	Calcium	0.03	0.16	0.3	0.45	0.2	0.1

8.	Phosphorous	0.08	0.37	0.21	0.2	0.26	0.15
9.	Sodium			0.01		0.05	0.03
10.	Potassium			1.2		2.5	1.4
11.	Iron	0.0044	0.0023	0.012	0.017	0.05	0.011
12.	Ash			5.0	1.6		5.7
13.	Vit.A (IU) Vit – C Vit – B_1 Vit – B_2 Niacin	454 111	576 50	175 12 0.18 0.23 2.3	1800	175 49.8 0.09 0.19 4.8	175 12 0.05 0.13 1.9
14.	Calorific value					390	360

Source: NIN, ICMR, Hyderabad

7.3.4 Processing and Uses of Cardamom

As the flowering continues over a long period, cardamom capsules ripen successively over an extended period. Thus, it requires several pickings. In most of the areas, the peak harvesting is continued at an interval of 15 days and completed in 8 to 10 rounds

Harvesting should be taken up only at a time when seeds inside the capsules have become black in colour. It is the index of maturity stages of the fruit. At this stage the pericarp (the seed cover or skin of the capsule) will still be green. When light picking is done, great care is to be exercised to harvest only the green and mature capsules. This process will naturally give a lower green crop per picking. When the hard picking is done, semi-mature crop is also removed. While this process could reduce curing percentage, it could increase the picking average and ensure green coloured capsules.

Bleaching is an important pre-treatment given to either dried cardamom or freshly harvested capsules as starting material. The bleached cardamom is creamy white or golden yellow in colour. The advantages of bleached cardamom are white appearance and their resistance to weevil infestation due to sulphur dioxide content. Different methods to achieve bleached cardamom and are given in Table 7.3.

Table 7.3: Treatments for bleaching of cardamom

Treatment	Concentration of content bleaching agent	Contact time (min)	Remarks
Steeping in H_2O_2 containing 0.5% sodium silicate	6% H_2O_2	15	For dry cardamom
Bleaching with H_2O_2 and SO_2 fumigation	0.3%	60	Dry cardamom
Steeping in acidified powder solution	20 g/l	75	Fresh cardamom
Subsequent steeping in H_2O_2 containing 0.5% sodium silicate	1% H_2O_2	30	Fresh cardamom

Cardamom capsules should be dried within 24 to 36 hours of harvest to avoid deterioration. Drying is one of the important unit operations as it determines the colour of the end product, which is the attractive and most important quality character. The retention of green colour is very important in cardamom drying as green coloured cardamom fetches premium price in the export market.

Cleaning of cardamom by removing the discoloured ones, split capsules and other impurities is done by manual method. The grading of dried capsules as per AGMARK specifications is generally carried out using round sieves. Mostly 7 mm round holes sieves are used for grading.

Mainly cardamom has three products namely decorticated seed or seed powder, essential oil and oleoresin. The decorticated seed or its powder has poor storability, as volatiles are lost during the storage. Thus it is stored in pods. Cardamom oil is produced by steam distillation of crushed fruits. Cardamom is used as flavouring material as whole, decorticated seed and ground powder. It has medicinal value for scanty urination, diarrhoea, dysentery, and exhaustion due to over work, depression.

7.3.5 Post Harvest Technology of Pepper and its Products

The stage of harvest is very important for the production of black pepper. Well-matured but unripe berries are harvested. Pepper becomes ready for harvest in about 6-8 months after flowering, during November-December and harvest continues up to March-April. The spikes are picked when they are blackish green and most pungent.

Harvesting is done manually, by climbing on the ladders. The well-matured spikes, of dark green colour are picked by the person standing on the ladder and dropped. The person standing on the floor will collect the spikes in the bags. A pair of women will be able to pick about 90 to 100 kg of spikes and paid @ Rs. 1 per kg of berry picked.

The harvested green spikes are some times heaped for a day, before threshing for easy separation of the berries. In few estates, mechanical threshes are used for separating and cleaning the berries. However, the threshing efficiency of these machines is only about 90 percent. The freshly harvested berries contain moisture of above 70% (w.b.). The berries as soon as they are harvested are separated from spikes and spread out on mats for drying. In about 2 days, the moisture content decreases to 20-25%. Due to enzymatic oxidation of colourless compounds present in the skin, the colour of pepper fruits turn black and masks the green colour after drying. The subsequent operations involve further drying of safe moisture level below 11% (w.b.)

Since drying with periodic turning is commonly adopted, since it is feasible when the quantity is small and monsoon does not interfere. But for large scale drying, artificial drying is preferred. The moisture in partially sun-dried pepper is brought down from 25 to 11 % in two stages in a counter current hot air flow system. After one pass in dryer, the pepper is stored for 24-48 hours, after which it is dried again to safe moisture level.

The dried pepper is cleaned for removal of extraneous matter such as dirt, girt, stones, stalks leaves, etc. Magnetic separator is used to remove metallic contamination such as iron fillings and stray nails. Vibration conveyors with inclined decks in combination of air classification are used for efficient de-

stoning of spices. The composition of the dried black pepper is given in the Table 7.4.

Table 7.4: Composition of the dried black peppe

Composition	Value in per cent
Moisture Content	8.7 – 14.1
Total Nitrogen	1.55- 2.60
Nitrogen in non volatile ether extract	2.7 – 4.22
Volatile ether extract	0.3 – 4.2
Non-volatile ether extract	3.9 – 11.5
Alcohol extract	4.4 – 12.0
Starch (acid hydrolysis)	28 – 49
Crude fibre	8.7 –18
Crude piperine	2.8- 9.0
Ash	3.6 –5.7

The ungarbled black pepper contains pinheads, immature pepper and large berries. Broken pepper and light pepper grades are separated pneumatically; pin heads which come along with garbled pepper are separated by sieving. As the export market potential for pepper is more, the market value can be increased by the removal of unwanted foreign materials.

Grading is done by a combination of size sieving and weight classification by air blast. The major grade is the average sized black pepper known as Malabar Garbled (MG), which constitutes 95% of India's export. Tellichery Garbled (TG) is another bold grade of black pepper. The recovery of black pepper from fresh berries is 33-36%. According to Agmark grading, grades have been formulated as given in Table 7.5.

Table 7.5: AGMARK specification of pepper

Pepper grade	Diameter (mm)
Tellichery Garbled Black pepper Special Extra Bold (TGSEB)	>4.75
Tellichery Garbled Extra Bold (TGEB)	4.25
Tellichery Garbled (TG)	4.0-4.25
Malabar Garbled Black Pepper (MG)	3.75
Malabar Ungarbled Black Pepper (MUG)	<3.75

Pungent principle

The alkaloid piperine (melting point 130^{o}C) is considered to be the major constituent responsible for pungency. It is not present in the leaves and stem. It is also not soluble in the water, readily soluble in alcohol and on hydrolysis splits into piperdine and piperic acids. Major adulteration in the black pepper is done with the papaya seeds. The best method to identify them is cut the seed in

to two pieces. Papaya is a dicot, so it will show a line. Black pepper berries are monocot, have a hollow cavity in the center.

Processing of White Pepper

White pepper is the white inner corn obtained after removing the outer skin or pericarp of the pepper berries. It is preferred over black pepper in light-coloured preparations such as sauces, cream soups etc., whereas dark coloured particles are undesirable. White pepper imparts pungency and a modified flavour to food. White pepper is liked for its mellow flavour, mild pungency, low fiber, high starch content and above all the white colour itself is liked. Varieties like Balankotta and Panniyur-1, are ideal for making white pepper owing to their large sized berries. The composition of white pepper is given in Table 7.6.

Table 7.6: Composition of white pepper

Constituent	Water	Protein	Fat	Carbohydrate	Fiber	Ash
Content, (%)	11.4	10.4	2.1	68.6	4.3	1.6

Packaging

Black pepper berries are hygroscopic, so have to stored in cool, dry atmosphere away from sunlight. For retail packaging in 200 gauges HDPE pouches are used. Ground powder is packed in laminated heat sealed aluminium foil.

Check Your Progress Exercise 3

Note: a) Use the space below for your answer.
b) Compare your answers with those given at the end of the unit.

1. In India, chilli is mainly dried by ……...

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2. To get quality product of cardamom it should be dried with in …….

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3. Pungent principal in the pepper is due to ……...

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4. Main adulterant in the whole pepper is ……..

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7.3.6 Products and By-Products of Tamarind and their Uses

Tamarind is a forest tree. It is rarely grown as orchards. However, it is planted as social forestry. Every part of the tamarind is useful for human being as culinary or medicinal purposes.

Root: The root of tamarind is bitter and used in controlling the dysentery. It is cleaned, boiled and consumed or the powder is taken with water.

Stem bark: The stem bark is an astringent and a tonic. The bark is also used medicinally for loss of sensation in paralysis. The ash of the bark with salt is used as a remedy for colic and indigestion. A gargle of bark ash with water is used in sore throat to heal aphthous sores. The ash is given in urinary discharges and gonorrhea. The dry bark of the tree is peeled off for medicinal purposes. Usually it is done after the flowering season. The bark contains about seven percent tannin and is used in tanning industry.

Timber: The wood is hard, close-grained, yellowish white with red streak. The heartwood is small, near the center of the old trees and is dark purplish brown. It is a most valued timber for making tool-handles, agricultural implements, wheels, mallets, planks, furniture, rice-pounders, and oil and sugar crushers. It is also priced much higher as a fuel as it has high calorific value (4980) and chiefly used for making gun-powder, charcoal, and in brick kilns where great heat is required for brick-making.

Leaves: The tamarind leaves contain tartaric and malic acids. The latter is being found in excess and increasing with the age of the leaves. The leaves also contain certain enzymes. The leaves are astringent and the tender leaves are cooling and anti-bilious. A poultice of leaves is used as for inflammatory swellings and in rheumatism to relieve pain. Decoction of leaves is used for gargle, and juice is used in dysentery bilious fevers and in urinary troubles. The leaves yield a reddish yellow dye, which is used locally in colouring woollen and silk fabrics. The leaves and flowers are also used as auxiliaries in dyeing.

Flowers: The flowers of tamarind are also cooling and antibilious. Poultice of flowers is used in inflammatory affections of the conjunctiva. The juice extracted from flowers is used in cases of internal bleeding of piles.

Fruits: The fruits contain 55% pulp, 33.9% seeds and 11.1% shell and fiber. In India, the production of pulp is estimated at about 3,00,000 tons per year. Dry pulp of fruits yield about 16% of free tartaric acid and its salts along with Citric, Malic acids. Two kinds of pulp are known, the red coloured and the brown coloured. The former is having the superior quality. The pulp is non-proteinaceous and the pulp of tender fruits contains far less nitrogen than the ripe fruits. The pulp consists of crude protein 3.1%, carbohydrate 67.4%, fiber 5.6%, and minerals 2.9%. Chemical analysis of pulp give tartaric acid with potassium bi-tartarate 10-12%, moisture 20-30%, reducing sugars 25-30%, other solubles 3-4%, and the rest insoluble cellulose. Its vitamin contents are as

follows: riboflavin 0.07mg, niacin 0.7mg and vitamin 'C' (3mg/100 g) and carotene (60 μ per 100 g). Of the reducing sugars present, about 70% is glucose and 30% fructose.

The pulp is edible and largely used for culinary purposes. The pulp contains tartaric acid, which is used as acidulent for soft drinks and fruit jellies. It is refrigerant, carminative and antibilious. It is also useful in preventing and curing scurvy and in sobering the intoxicating effects of alcohol and *Ganja (Cannabis sativa* Linn.). The pulp with wood-ash is extensively used for cleansing and brightening brass and copper vessels.

During storage, the reddish-brown colour of the pulp becomes darker and in about a year it is almost black. This is mostly due to the onset of Maillard reaction, since, free amino acids and reducing sugars are present in the pulp. The pulp also becomes soft and sticky as pectolytic degradation takes place and moisture is absorbed, especially in humid climates. The pulp could be preserved well for 6-8 months without any treatment, if packed in airtight containers and stored in cool and dry place.

Seeds: The seeds are used as famine food and for cattle in several districts in Tamil Nadu, Andhra Pradesh, Madhya Pradesh and elsewhere. The hard kernel is dried, roasted and powdered into flour and used for making cakes and chappatties, either alone or with flour of other edible kinds. The tamarind kernel powder can be fortified up to 15% in the preparation of bread and biscuit.

Industrial Uses

Tamarind Kernel Powder (T.K.P): Tamarind kernel powder is about 50% of the weight of the seeds. Commercial samples of T.K.P has the composition of : polysaccharides 48.7%, albuminoids 18.9%, fatty matters 7.5% moisture 8.8% ash 1.6%, soluble matters 3.2% and insoluble matters 11.3%. The commercial TKP finds extensive use as a sizing material in the textile industry. The sizing properties of TKP are due to the presence of a polysaccharide (called jellose) which is present to the extent of 6 percent.

7.3.7 Processing of Turmeric and its Uses

After harvesting the turmeric fingers are separated from mother rhizomes. Mother rhizomes are usually kept as seed material. Curing of green turmeric is done by boiling in the water with 20 g of sodium bi sulphite and 20 g of hydro chloric acid per 45.3 kg of tubers. It provides a yellow tint. The cured tubers are sun dried for 10-15 days till they become hard, brittle and produce metallic sound on breaking. Thereafter they are cleaned and then polished in a metallic drum rotated manually or by power. Generally dried cured turmeric is 20% of freshly harvested green rhizomes. It is also recommended that to develop attractive colour, half polished 100 kg turmeric rhizomes are mixed with the alum (0.040 kg), turmeric powder (2 kg), castor seed (0.14 kg), Sodium bisulphite (30 g) and concentrated hydrochloric acid (30 ml). After thoroughly mixing it is again dried in the sun.

Common products of turmeric are its powder, volatile oil and oleoresin. It is mainly used as food flavourant and colourant, cosmetics and as dye. It is used as medicine for stomachic, carminative, tonic, blood purifier, vermicide and antiseptic. Its powder is also used in tooth powder for relieving dental problem. It is also used as a face pack as it helps in clearing pimples and unwanted hairs.

7.3.8 Post Harvest Technology of Ginger

Freshly harvested ginger is cleaned with water to remove adhered soil, and then dried in the sun for 7-10 days. During drying, regular turning is required for uniform drying. After drying rhizomes are rubbed with the gunny bag to remove the remnants of the skin which results in smooth finish of the final product. In some places raw rhizomes are soaked in water and thick milk of lime (1kg slaked lime per 120 kg water). Some times the dried rhizomes are exposed to the sulphur dioxide fumes (3.2 kg of sulphur per tonne of rhizomes for 12 hours). It helps in bleaching the colour and results in white polished rhizomes.

The polished rhizomes are graded as per IS specification IS: 1908-1968. In general, indian ginger is graded in three grades namely (1) 3 fingerd rhizomes; (2) 2 fingered rhizomes and (3) pieces.

For the good quality of ginger its appearance, volatile oil content, fibre content, pungency, aroma and flavour are evaluated and compared with the standards.

In the rural India, ginger is heaped covered with the soil and ginger leaves in a shade. The heap may be plastered with the mud or cow dung. It can be stored well between 21-30^{o}C with 60-90 % relative humidity for two months. Scientifically ginger is stored in cold store at 2-5^{o}C with 90 % relative humidity for 4 months.

There various ginger products available in the market namely ginger oil, oleoresin, dehydrated ginger, bleached ginger, preserve, drinks, candy, pickle and wine. Besides this as a medicine it is considered as a stimulant and a carminative. It is also given in dyspepsia and flatulent colic.

Check Your Progress Exercise 4

Note: a) Use the space below for your answer.
b) Compare your answers with those given at the end of the unit.

1. What is the use of tamarind flower juice?

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2. Name the acid which tamarind pulp has?

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3. Why the tamarind pulp becomes black during storage? How it can be checked?

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4. What is the industrial use of TKP?

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5. What is the use of turmeric base face packs?

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7.4 MEDICINAL AND AROMATIC PLANTS

7.4.1 Uses of Medicinal and Aromatic Plants

Medicinal plants are the local heritage with global importance. Indian herbs are principal form of medicine and presently popular throughout the developed world. Basically herbs work in combination with the body's own defense system. The human body is much better suited to treatment with herbal remedies than with the isolated chemical medicines. The chemical medicines after expiry may cause harm to the body whereas the natural products that have lost their active qualities are not harmful to the system. The digestive systems and physiology of human evolved utilizing capacity of plant based foods and medicines. Many plants provide food as well medicines for i.e.

i) Lemon improves resistance to infections.
ii) Papaya is used for expelling worms in stomach.
iii) Onion relives bronchial infections.

iv) Oats support convalescence.
v) Burdock herbals are helping in removing toxins from the body.
vi) Comfrey encourages blood clotting and help in healing the wounds fast.

It also plays an important role in the rural areas, particularly in remote places with fewer medicinal facilities.

It is estimated that about 70000 plant species are used for medicinal purposes. In Ayurveda about 2000 plant species are considered to have medicinal values, while, Chinese list over 5700 as traditional medicines. The Indian traditional medicine the Charak Samhita (1000 BC) records the use of over 340 drugs of vegetables origin.

Medicinal plants have curative properties due to the presence of various complex chemical substances of different composition, which are found as secondary plant metabolites in one or more parts of these plants. The plant metabolites are grouped as alkaloids, glycosides, cortico steroids, essential oils etc. Table 7.7 indicates name of some herbs useful to cure some diseases.

Table 7.7: Medicinal use of herbs

System/Disease	Plant/Herbs	Uses
Skin		
(a) Antiseptic	Tea tree (Melaleuca attemifolia)	Disinfect the skin
(b) Emollients	Marigold (Calendula officinalis)	Deduce itchiness, edness and soreness
(c) Healing	Comfrey (Symphytum offcinale)	Blood cotting, fast healing of wounds
Respiratory system		
(a) Antiseptic	Garlic (Allium sativum)	Helps the lungs resist infection
(b) Spas molytics	Visnaga (Ammi visnaga)	Relax bronchial muscles.
Urinary system		
(a) Antispectic	Buchu (Barosma betulina)	Disinfect the urinary tubules
(b) Astringents	Horsetail (Equisetum arvense)	Tightness & protect the urinary tubules
Musculo-skeletalsystem		
(a) Analgesics	Yellow Jasmine (Gelsemium sempervirens)	Relieve joints and nerve pain
(b) Antiinflammatories	White willow (Salixalba)	Reduce swelling and pain in joints
(c) Antispasmodics	Cinchona (cinchona spp.)	Relax tense and cramped muscles.
Nervous system		
(a) Relaxants	Lemon balm (Melissa officinalis)	Relax nervous system

(b) Sedatives	Mistletoe (Viscum album)	Reduce nervous activity
(c) Stimulants	Kolanut (Colaacuminata)	Increase nervous activity
(d) Tonics	Oats (Avena Sativa)	Improve nerve function and tone
Circulation and heart		
(a) Cardiotonics	Ddanshen (Salvia mittiorrhiza)	Improve the regularity and strength of the heart contractions
(b) Circulatory stimulants	Cayenne (Capsicum frutescens)	Improve circulations of the blood to the extremities.
(c) Diaphoretics	Juhua (Chrysanthemum × morifolium)	Promote sweating & lower blood pressure
(d) Spasmolytics	Cramp bark (Viburmum opulus)	Relax the muscelers & helps to lower blood pressure
Digestive organs		
(a) Antiseptics	Ginger (Zingiber officinalis)	Protect against infections
(b) Astringents	Bistort (Polygenum bistorta)	Tighten the inner line of intestines and provide protecting coating over them.
(c) Bitters	Wormwood (Artemisia absinthum)	Stimulate secretion of digestive juices
(d) Laxatives	Senna (assia senna)	Stimulate bowel movements
(e) Stomachs	Cardamom (Eletterio cardamomum)	Protect and support

Aromatic plants have been of great interest to mankind from the beginning of civilization. Aromatic plants and their products, particularly the essential oil, are now becoming one of the most important export items from many developing countries. The upswing trends basically is due to raising the standard of living of the people and technological advancement in the production and processing of these essential oils.

Essential oils are complex mixtures of odours and steam-volatile compounds which are deposited by plants in the sub-cuticular space of glandular hairs, in cell organelles (oil bodies of Hepaticae), in idioblasts, in excretory cavities and canals or exceptionally in heartwoods.

The main aromatic plants are mint (mentha oil), cymbopogons. turpentine, sandal wood, vetiver, eucalyptus and ocimum. The other aromatic plants are celery, jasmine, rose, dill, geranium, hops, cinamomum, cedar wood, cyperus etc.

7.4.2 Processing of Medicinal and Aromatic Plants

The unit operations involving processing of plants based medicinal or aromatic constituents are:

1. **Comminution:** It is the process of size reduction. So that the surface area of the produce increases and solvent can easily interact with the produce. Most of the natural produce is to be dried. Drying can be done in sun or shade or in the protected area depending upon the type of the constituents. It is preferred that drying should be slow at low temperature. The dried material is to be crushed or broken into small parts before extraction/ distillation. During crushing/grinding temperature of the produce should not be increased. Some of the volatiles get evaporated even at 45^{o}C. The homogeneity of the ground particle shows the efficacy of the extraction of active ingredient

2. **Extraction of active ingredient:** Extraction is the process of separation of the active constituents from the plant material using a solvent. Firstly plant produce is pre-treated with the solvent outside the extractor. It facilitates the breaking of the cell walls to release the extractable component. The rate at which the solvent reacts with the solute depends upon solute solvent ratio, pH, particle size and temperature. Alcohol is the widely used solvent. It has the ability to extract many soluble constituents. Most of the alkaloids are soluble in acids.

For extraction of essential oil, steam distillation process in widely used. In this the steam is produced and passed through the bed of plant material. The steam carries the volatiles, which generally boils at a temperature lower than steam. It condenses and most of essential oils are insoluble in water. They are separated in the aqueous phase, forming two layers, then they can be easily separated. The factors, which influence the quality and quantity of extraction, are; size of load, steam pressure, density of packing of planting material in the bed, duration of distillation and rate of steam injection.

The aroma constituents are heat sensitive. So the technique must be carried out with pure and low boiling solvents such as pentane or hexane. Extraction with super critical solvents generally carbon-di-oxide is the most effective but capital intensive.

Check Your Progress Exercise 5

Note: a) Use the space below for your answer.
b) Compare your answers with those given at the end of the unit.

1. Why herbal-based medicines are suitable to the human body?

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2. What is the need of comminution in the medicinal and aromatic plants?

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3. Efficacy of extraction mainly depends upon ……

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7.5 LET US SUM UP

The knowledge of commercial crops, spices and medicinal and aromatic plants is necessary. It provides ample employment opportunity. India is known for its knowledge in their cultivation and quality processing since ages. Indians were deployed to other countries to teach cultivation of sugarcane. The merchants traded Indian spices many centuries ago. The ancient herbal medicines suits human bodies as they do not have any side effect.

The production, processing of each of the crop is different. The process technology depends up on the active constituent which is to be extracted. Its purity decides the price.

7.6 KEY WORDS

Molasses : A by-product of sugarcane industry and base material for distillery and fermented products.

H.S.C. : Highest Standard Count (HSC) is a unit to express and evaluate quality of the cotton.

Pungent principal : The main constituent responsible for pungency. For i.e. pepper it is alkaloid piperine.

T.KP. : Tamarind Kernel Powder (TKP) is the powder of dried tamarind kernel seeds. It is used as material in textile industry.

Essential oils : It is a complex mixture of odours and steam-volatile compounds, which are deposited by plants in the sub-cuticular space of glandular hairs, in cell organelles or in canals of woods.

Comminution : It is the process of size reduction of any substances so that surface area is increased.

Steam distillation : It is the process of boiling the substances with water, so that water soluble volatiles oils are carried away by the steam. Then steam is to be condensed so that oils being lighter can be easily separated.

7.7 ANSWER TO CHECK YOUR PROGRESS EXERCISES

Check Your Progress Exercise 1

1. Sugarcane plant harnesses solar energy and converts it into sugar, cellulosic and non-cellulosic energy producing substances. So it is called as energy efficient crop.
2. It provides huge employment, produces lint as well as oil seed.
3. About 100 kg sugar
4. To avoid inversion of sugar.
5. It is diuretic, refreshing and cooling.
6. Digestion, washing, screening, bleaching, dewatering and thickening are the unit operations in paper manufacturing.

Check Your Progress Exercise 2

1. Fineness, maturity and strength are the indices to judge quality of cotton.
2. 27 mm and above
3. i) India ii) Cardamom iii) Pepper

Check Your Progress Exercise 3

1. Sun
2. 24-36 hours
3. Alkaloid piperine
4. Papaya seed

Check Your Progress Exercise 4

1. To check internal bleeding of piles.
2. Tartaric acid.
3. It is due to Millard reaction. It can be prevented by storing in airtight container at cool and dry place.
4. Tamarind kernel powder (TKP) is used in the textile industry.
5. It clears the pimples and unwanted hairs.

Check Your Progress Exercise 5

1. Herbal based medicines work in concert with the body's own defense system.
2. It increases the surface area so that solvent can easily interact with the active constitute.
3. Homogeneity of the product after comminution.

7.8 SOME USEFUL BOOKS

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