COURSE TITLE: ECONOMIC BOTANY AND ETHNOBOTANY (3 CREDITS)

COURSE CODE: PBB 226

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GENERAL OVERVIEW OF LECTURE

- Introduction to economic botany and ethno botany.
- Timber and wood products
- Vegetable Fibres
- Phytochemicals

INTENDED LEARNING OUTCOMES

At the end of this lecture, students should be able to:

- define ethnobotany, economic botany and economic importance,
- write an essay on how humans use plants,
- understand the basic working methods in ethnobotany,
- independently carry out an ethnobotanical survey
- list the economic benefits of algae, fungi, lichens and bacteria.
- Students should appreciate Forest and forest products
- Identify useful resources of plants beyond crop plant
- Know the relevance of ethno-botany and Economic botany to both conservation and sustainable development

MAIN LECTURE

WHAT IS ETHNOBOTANY ?

Ethnobotany is the scientific study of the traditional knowledge and customs of a people concerning plants and their medical, religious, and other uses.

Ethnobotany is an important branch of Plant Science that deals with the study of the relationship between plants and people. It includes the traditional use of plants in different fields like medicine and agriculture. These plants are mostly used by the rural and tribal people for their livelihood. Unfortunately, this traditional knowledge is being lost because it is not being preserved. Since the time immemorial, people are using plants for food, medicine, shelter and agriculture.

Ethnobotany as a discipline is connected with archeology, chemistry, ecology, anthropology, linguistics, history, pharmacology, sociology, religion and mythology.

Ethnobotanists work with herbal/traditional medicine practitioners within a native culture, examining that culture's concepts of diseases.

Basic working methods in ethnobotany

1. Folk knowledge of the plant's possible benefit accumulates and is passed on from generations to generations.
2. Indigenous people use the plant to benefit themselves.
3. Ethnobotanists or other scientists get the knowledge from indigenous people.
4. The scientist collects and identifies the plant.
5. The scientist tests the plant to determine if it is really beneficial to humans in the way that has been reported.
6. The scientist will attempt to determine what exactly makes the plant beneficial. E.g. phytochemicals
7. The substance may further be purified.

WHAT IS ECONOMIC BOTANY?

The branch of science that deals with the study of plants and their products in relation to their utility for mankind. It is the study of the benefits of plants to human beings. It is the study of plants utilized directly or indirectly by Man (S.E.P.A.S.A.T. 1982).

Ancient uses of Plants

- Food
- Shelter
- Clothing
- Medicine
- Weapon
- Protection
- Aesthetic view

Economic benefits of Bacteria

In Agriculture

- Symbiotic nitrogen fixation e.g. *Rhizobium species, Pseudomonas species.*
- Non symbiotic nitrogen fixation e.g. *Clostridium species, Azotobacter species.*
- Increase in soil fertility involving bacteria such as *Nitrosomonas* and *Nitrobacter species*.

Economic benefits of Bacteria

In Industry

- Production of dairy products.
- Production of organic acids e.g. *Mycoderma aceti*

- Production of acetone e.g. *Clostridium species*
- Fibre retting e.g. *Clostridium butylicum*
- Curing and ripening of tobacco and tea e.g *Micrococcus candisans*
- Tanning of leather.

Economic benefits of Bacteria

In Medicine

- Production of antibiotics e.g. *Bacillus brevis* for thrythrocin and *Bacillus subtilis* for subtilin.
- Production of vitamins e.g. *Clostridium species* which produces riboflavin, a kind of vitamin B.

Economic benefits of Bacteria

Others

- Cycling of carbon and other important elements in nature.
- Degradation and disposal of sewage.
- Digestion of cellulosic food materials of ruminants.
- Synthesis of vitamin B in human colon by *Escherichia coli* (a symbiotic bacterium inhabiting human gut).

Economic benefits of Algae

- They serve as primary producers.
- Some serve as food for humans.
- They serve as fodder for domestic animals.
- Food for fish.
- Used in the production of agar.

- Production of iodine, potash and diatomite.
- In sewage treatment.
- Stimulating the growth of rice.

Economic benefits of Fungi

- They are used in the production of antibiotics e.g. Penicillin from *Penicillium notatum* and *Penicillium chrysogenum*.
- Some serve as food for humans e.g. *Lentinus squarrosolus*.
- They increase soil fertility.
- They are used in the production of bio-pesticides.
- They are used in the production of alcoholic beverages.

Economic benefits of Lichens

- Some are eaten as food by man and mammals.

STUDY QUESTIONS

- Differentiate between ethnobotany, economic botany and economic importance.
- Write an essay on the ancient uses of plants.
- List the economic importance of bacteria, fungi, lichens and algae.

IMPORTANCE OF PLANTS AND PLANT PRODUCTS

The three basic needs of man i.e. food, shelter and clothing are gotten from plants and plant derivatives. Animals are totally dependent on plants for food also, as plants are primary producers. Plants however, have several other uses that spans beyond the three mentioned above. The uses are discussed briefly as follows.

1. FOOD

The main sources of food for man e.g. cereals, legumes, millets, vegetables, fruits, are all derived from plants. Cereals are large grained plants such and wheat, rice, rye and barley. Millets are small grained plants such as pearl millet and sorghum. Pulses or legumes are important source of vegetable protein such as cowpea, chick peas, kidney beans etc. Vegetables are plants which reserve food material and can either be eaten raw or cooked, they may be modified o unmodified roots, stems leaves and fruits. Fruits are the mature and ripened ovary developed after fertilization, they are highly nutritious due to their accumulated organic acids, vitamins and minerals.

2. FIBRES

These are economically important derivatives of plants that are useful in the manufacture of items like ropes, threads, bags, clothes, paper, cellulose and rayon.

3. WOOD

Wood is a very important plant derivative used in construction and structural work. It is also used as a source of fuel and in the production of wood gas, tar, paper, cardboard resins, wood alcohol etc.

4. RUBBER AND LATEX

Many plants exude whitish, sticky, liquid substances known as latex. This organic component hardens on exposure to air. The most valuable latex is derived from rubber tree and is also known as rubber. Rubber has a high degree of elasticity and pliability which makes it a source for economically important products like tyres, mattresses, gloves, tubes etc.

5. OILS

Oils are important parts of our diets daily. True oils or fatty oils are stored in seeds, fruits and other parts of plants as reserve food materials. Some oils used in the preparation off food include olive oil, rapeseed oil, coconut oil, groundnut oil, etc. Some oils are also used in the preparation of paints, printer inks, soap etc. Essential and volatile oils are pleasantly fragrant and are extracted from leaves, flowers, seeds etc. Essential oils are used in the manufacture of toilet soap, perfumes, talc powders etc.

6. SUGARS

Sugars are universally present in all actively metabolizing plant cells, in the form of simple sugars such as glucose ($C_6H_{12}O_6$) or complex sugars, such as sucrose or cane sugar ($C_{12}H_{22}O_{11}$). Sugar forms the main constituents of all ripe fruits and some plants, such as sugar beets and sugar cane.

7. PULP AND PAPER

The cell wall of all plants is composed of a complex carbohydrate – cellulose. One of the important uses of cellulose is the manufacture of paper.

8. BEVERAGES

Nutrition taken in form of liquid is known as beverage. They may be alcoholic or non-alcoholic. Alcoholic beverages are fermented products of sugars present in fruits, grains and other plant products. The toxicity of alcoholic beverages such as wines, beer, whisky etc. is due to the presence of high alcoholic contents. Non-alcoholic beverages includes tea, coffee and cocoa. Their stimulating and refreshing property is due to the presence of an alkaloid caffeine which serves as a nerve stimulant and soothing agent.

9. TANNINS AND DYES

Tannins are complex phenolic compounds of plant origin, secreted in the bark, wood, fruits, leaves etc. Although most plants contain tannins, only few can be used commercially. They are used in the colouring of leather, ink and in Phytomedicinal industries. Dyes are naturally secreted

products of plant tissues obtained from plants and are mainly used in the manufacture of paints, inks vanishes and in the textile industries.

10. GUMS AND RESINS

Gums are non crystalline colloidal substances present in between the cells of plants or produced by the process of cellulose decomposition. They are natural cementing substances and are widely used in the manufacture of polishes, syrups, cosmetics confectionaries, etc. Resins are complex oxidation products of various essential oils, secreted naturally in glands of plants. They are insoluble in water and impart impermeability to the surface on which they are applied. They are used in producing plastics, waterproof and stiffening agents or gums.

11. SPICES AND CONDIMENTS

They are also referred to as food adjuncts because they are added to increase the flavouring of food. Spices are aromatic vegetable materials obtained from the rhizome, bark, flower buds, fruits, seed, leaves etc. They do not possess nutritive values hence, they are not referred to as food, but can be used as medicine and food seasoning.

12. FUMITORIES AND MASTICATORIES

Plants or plant products taken in the form of inhalants are known as fumitories. They are of little medicinal value and are simply for pleasure or psychological effects. Masticatories are products of plants which are chewed for pleasure, medicinal or digestive purposes.

13. MEDICINAL PLANTS

Medicinal plants are plants that have in one or more of its organs, active substances (alkaloids, flavonoids, phenols etc.) that produce therapeutic effects when used to manage or treat any illness. Drugs from plants can be gotten from different parts of the plant.

14. ROLE OF PLANTS IN SOIL FERTILITY AND CONSERVATION

The top layer of the soil is being eroded by natural agents like wind, rain etc. which leads to loss of fertile layers of the soil. The technique of checking this loss by planting trees and conserving the soil is known as soil conservation. The root system of plants helps to bind the soil particles and to a great extent, prevents erosion. The improvement of the physical, nutritional and

microbiological status of the soil depends upon the plants. Plants are continuously absorbing water and mineral salts from the soil and converting them to organic matter. This organic matter is returned to the soil by leaf fall and death of plants. In the soil there are various micro-organisms, which constitute a small group of the plant kingdom and which are responsible for breaking down the complex non-available organic matter to simple available inorganic form. Thus, plants help to maintain the nutritional equilibrium.

15. ROLE OF PLANTS IN NATIONAL ECONOMIES

The economies of several Nations depends largely on agriculture. The higher the value of crops produced the higher the revenue earned. Other plant products aside food (drugs, wood, fibre, oil) are also source or income to Nations. If a country cannot produce sufficient sources for food, it becomes dependent on other producing countries. Plants also affect Nations socially e.g. aesthetics.

STUDY QUESTION

- Write an essay on the importance of plants and plant products.

TIMBER AND WOOD PRODUCTS

Trees are an extremely valuable and an often over-exploited and endangered natural resource of timber, fuel and numerous non-wood forest products . Following the primary conversion of the felled trees into manageable forms, they provide timber, i.e. wood other than fuel wood, for construction, carpentry and joinery purposes. Timber uses include heavy and light structural and marine timbers, i.e. beams, pilings, planks, poles, props, stakes, for building houses, ships and boats, vehicle bodies, agricultural implements, bridges, fencing, handles, ladders, boxes, crates, food containers, matches, pattern making, etc.

The more decorative woods are used for veneer, parquetry and carving, including interior decoration, furniture, cabinet work, musical implements, toys and novelties, sporting goods and precision equipment. Other wood uses, either as timber or as a by-product, are for wood pulp, sawdust, wood wool, plywood, wood chips for particle board, blackboard, chipboard, hardboard, laminated wood, etc. Trees also provide cork and cork substitutes, gums, resins, latexes and rubbers.

Timber

Two major types of commercial timber are recognized,

1. Softwood obtained from the gymnosperms and
2. Hardwood from the angiosperms.

The value of trees as timber for commercial utilisation depends not only on their relative availability and wood properties but also on tree habit, with a long, straight, not twisted, clear, wide bole being particularly desirable. It is the skill of the sawyer that determines the conversion of a log into the optimum quantity of sawn timber with the minimum of knots and other defects. The outer zone provides cleaner, knot-free wood than that from nearer the centre, with the heartwood producing the heavier dimension timber and large beams. However, not all timbers are sawn. Pole timbers for telegraph poles, fencing posts, etc. are debarked and used in the round.

Wood Characteristics

The wood characteristics refer to the general appearance of the wood

1. Natural splitting or shake is obviously undesirable. Both *Castanea* (sweet chestnut) and *Quercus* (oak) are prone to shake.
2. Knots represent cross section of a branch that was covered by lateral growth of a tree's main stem. They are undesirable and the size being largely species-linked.
3. Colour of the sapwood and heartwood and whether the latter changes in colour on exposure to the atmosphere. The dark-coloured woods will often show good resistance to fungal attack due to their heavy impregnation by extraneous toxic substances.
4. Texture is largely determined by the size and arrangement of the vessels. Wood with large and irregular anatomical features are recorded as having a coarse and uneven texture, while those with small and even features are fine and even textured
5. Grain or the surface pattern of worked wood will also vary according to the arrangement and alignment of the wood tissues and is defined as straight, spiral or interlocked.
6. Distinctive scents and taste, noteworthy examples are the fragrant wood from *Santalum album* (Indian sandalwood), the stench of rotting cabbages from freshly cut *Combretodendron macrocarpum* (essia) and the odourless but bitter tasting *Carapa grandiflora*
7. Gums and resins, where present, may also make the wood difficult to work. For example, the gummy sawdust obtained when sawing green timber of *Baikiaea* sp. clogs the saw teeth, while a high tannin content may cause staining of moist wood in contact with iron.
8. Wood allergies, although most people are unaffected most woods possess constituents to which somebody somewhere will be allergic or even find toxic, e.g. The wet sawdust from *Chlorophora excelsa* (iroko), can cause dermatitis.

Rattans

The true rattans are Old World members of the Arecaceae (palms) . They are considered to be the second most important forest product after timber. The bare rattan stems are light, strong, flexible and uniform in diameter. They can be bent into the desired shape by steaming or by the application of a hot iron. They are consequently a valuable and versatile resource. Rattans are widely used commercially either in the whole or round form for furniture frames, or in splits, peels and cores for woven chair seats, matting and basketry. They are also extremely important in the domestic economy for cordage, basketry, matting, thatching, traps, brooms, walking sticks, furniture, construction purposes, etc.

Bamboo

Bamboo (*Bambusa vulgaris*) are members of the Poaceae subfamily Bambusoideae, They are essentially pantropical in distribution. The bamboos are perennial trees, shrubs and climbers, usually with woody, hollow culms divided into cylindrical segments by the nodes. Domestic applications include the use of culms (bamboo stem) for making chopsticks, containers, cooking pots, fish traps and fishing rods, heads and shafts for spears and arrows, blowpipes, fencing, pipes, poles, rafts, troughs, irrigation channels, agricultural implements, fencing, boats, masts, fibre for ropes and cordage and biofuel.

Wood Pulp

Pulp is a lignocellulosic fibrous material prepared by chemical or mechanically separating cellulose fibre from wood and other fibre crops. The major source of fibre for the pulp industries is wood. Both softwoods and hardwoods are utilised, the main differences between them being the presence in the latter of a mixture of large vessel elements of greater diameter than the fibres but shorter in length; they are absent in softwoods. In general softwoods consist almost entirely (97% by weight) of fibres, known as tracheids, 2-8 mm in length, while hardwood fibres are from 0.5 to little over 2 mm long. The softwood fibres are preferred for paper making since their length and flexibility allows them to be packed closely together into non-porous, tightly bonded sheets, whereas the hardwood fibres pack less tightly and produce an inferior paper.

Cork

Cork is an impermeable buoyant material. It is the phellem layer of bark tissue that is harvested for commercial use primarily from *Quercus suber* (cork oak), an evergreen tree of the Mediterranean basin. The cork is first harvested when the trees are at least 20 years old, and the operation is repeated every 8-10 years. Because cork is both compressible and resilient without any lateral spread, it makes a perfect seal as a stopper, liner in crown bottle caps. It is impervious to water, due to air-filled cork cells in a natural resinous binder. Its buoyancy is due to its low relative density.

Vegetable Fibres

Vegetable fibres have been used by man for cordage, clothing, basketry and matting since time immemorial, although archaeological evidence of their use by early man is often inadequately represented because they do not preserve well. Vegetable fibres are used for a wide range of products, including cardboard, fibre board, non-wood board, paper, paper substitutes, cord/string/twine, thread/yard, woven material such as cloth and sacking, packing/stuffing, filling materials, matting, netting, basketry, thatch and tow, also for their cellulose derivatives such as cellulose ethanoates (acetates), cellophane, plastics, rayon, etc.

Global fibre production for 1993 (FAO, 1994)

Crop	1000 tonnes
Gossypium spp. (cotton lint)	16,805
Corchorus capsularis, *C. olitorius*, *Hibiscus* spp., *Urena lobata* (jute and allied fibres)	3,391
Linum usitatissimum (flax fibre and tow)	610
Agave sisalana (sisal)	291
Cannabis sativa + *Crotalaria juncea* (hemp fibre and tow)	121
Boehmeria spp., *Ceiba pentandra*, *Furcraea* spp., *Neoglazovia variegata*, *Phormium tenax*, *Samuela carnerosana* (other fibre crops)	408

Fibre classification and characteristics

Fibres can be classified botanically according to their anatomical and morphological origins, or by their commercial use.

(1) **Hairs cells fibres** known as trichomes: these are borne on the seeds or inner walls of the fruit, and consist of elongated, unicellular or multicellular, and non-conducting, epidermal outgrowths. These are referred to as ultimate fibres, free of any extraneous plant tissue. Cotton, for example, from the seeds of *Gossypium* spp and kapok from the inner capsule wall of *Ceiba pentandra* (silk cotton tree).

(2) **Bast fibres**: Include fibres of the cortex, pericycle and phloem. Among the more commercially important sources of bast fibres are *Corchorus* spp. (jute), hemp, flax, etc.

(3) **Leaf fibres** : these are fibres obtained from the lamina and petioles of certain monocot, e.g. *Agave sisalana* (sisal).

(4) **Wood or xylary fibres** : these are fibres obtained from trees and shrubs and include the fibre tracheids, i.e. Wood fibres are widely used in paper-making.

PHYTOCHEMICALS

Phytochemicals are chemical compounds produced by plants, generally to help them thrive or thwart competitors, predators, or pathogens. The chemical products that can be obtained from plants include gums and resins, tannins, dyestuffs, latexes and rubbers, essential oils, waxes, alcohols and other chemicals.

Some useful phytochemical

Natural Gums

Natural gums are polysaccharides of natural origin, capable of causing a large increase in a solution's viscosity, even at small concentrations. They are botanical gums, found in the woody elements of plants or in seed coatings. They are soluble in water which makes them different from resins. Gums find useful applications in food industry they are used as thickening agents, gelling agents, emulsifying agents, and stabilizers. In other industries, they are also used as adhesives, binding agents, crystal inhibitors, clarifying agents, encapsulating agents, flocculating agents, swelling agents, foam stabilizers, etc. Natural gums are obtained from seaweeds (marine source): Agar Alginic acid and Sodium alginate; Carrageenan and non-marine botanical resources: e.g Gum arabic, from the sap of *Acacia* trees, Gum ghatti, from the sap of *Anogeissus* trees, Gum tragacanth, from the sap of *Astragalus* shrubs, Karaya gum, from the sap of *Sterculia* trees, *Anacardium occidentale* gum

Mucilages

Mucilages are of plant origin, mucilages are polysaccharides consisting of a mixture of a complex polyuronide, proteinaceous matter and cellulose, which swell in water and have glue-like properties. Within the plant the mucilages are mainly concerned with water retention, e.g. the pentosan mucilages in succulent xerophytes help by increasing the water-holding capacity of the cells and reduce transpiration losses. The mucilaginous coating of many seeds aids dispersal and water uptake during germination. A good example of mucilages is observed as the slippery fluid from *Aloe vera* leaf. Mucilages are used medicinally as a laxative and emollient of the gastro-intestinal tract and also in the cosmetics industry.

Resins

Plant resins are valued for the production of varnishes, adhesives, and food glazing agents. They are also prized as raw materials for the synthesis of other organic compounds and provide constituents of incense and perfume. Resin circulates throughout a coniferous tree and a few others, and serves to seal damage to the tree. Resin is usually collected by causing minor damage to the tree by making a hole far enough into the trunk to puncture the vacuoles, to let sap exit the tree, known as tapping, and then letting the tree repair its damage by filling the wound with resin. This usually takes a few days. Then, excess resin is collected.

Oleoresins

In addition to resinous materials, the oleoresins also contain considerable quantities of essential oils and are consequently more or less liquid; they are widely used in paints and varnishes. Oleoresins are semi-solid extracts composed of resin in solution in an essential oil, obtained by evaporation of the solvent used for their production. Naturally occurring oleoresins are also known as Balsam. Balsams are used pharmaceutically as a base for cough mixtures and other medications; they are also employed as fixatives in the perfume industry.

Latex

Latex is a stable dispersion (emulsion) of polymer micro particles in an aqueous medium. Latex as found in nature is a milky fluid found in 10% of all flowering plants (angiosperms). It is a complex emulsion consisting of proteins, alkaloids, starches, sugars, oils, tannins, resins, and gums that coagulate on exposure to air. It is usually exuded after tissue injury. In most plants, latex is white, but some have yellow, orange, or scarlet latex. It serves mainly as defense against herbivorous insects. Latex is not to be confused with plant sap; it is a separate substance, separately produced, and with separate functions. An example of commercially harvested latex is natural rubber. It is almost exclusively obtained from clonal plantations of *Hevea brasiliensis* (Para rubber), a native of the rain forests of the Amazon basin, but mainly cultivated in SE Asia and West Africa, including Nigeria.

Tannins

Tannins are defined as complex polyhydric phenols with a molecular size and shape permitting suitable solubility in water. They constitute a large class of amorphous, bitter and astringent plant metabolites, which are often present in the bark, leaves, fruit, etc. They are either rare or only present in small quantities in the Lower Plants, comparatively rare in the Monocot except for the Arecaceae, and common but scattered among the Dicot. Globally the most important tannin sources are the Anacardiaceae (*Rhus* spp.), Combretaceae (*Terminalia* spp.), Leguminosae (*Acacia* spp.) and Rhizophoraceae (several genera). Tannins are also used as mordants in the textile industry, to clarify wine and beer, and as an astringent and styptic. Some tannins are dual purpose and used for both dyeing and tanning, e.g. the dark extract known as catechu obtained by boiling heartwood chips of *Acacia catechu*

Natural dyes

Natural dyes are dyes or colorants derived from plants.—roots, berries, bark, leaves, and wood and other biological sources such as fungi and lichens. Typically, the dye material is put in a pot of water and then the textiles to be dyed are added to the pot, which is heated and stirred until the color is transferred. Many natural dyes require the use of chemicals called mordants to bind the dye to the textile fibres; tannin from oak galls, salt, natural alum, vinegar, and ammonia from stale urine were used by early dyers. Plant-based dyes such as woad (*Isatis tinctoria*), indigo, saffron, and madder were raised commercially and were important trade goods in the economies of Asia and Europe. Across Asia and Africa, patterned fabrics were produced using resist dyeing techniques to control the absorption of color in piece-dyed cloth. Others include cochineal and logwood (*Haematoxylum campechianum*).

Essential Oils

Essential oils are more or less volatile oils which are mainly formed in specialised glands, rarely in ducts, and are extracted from plants. They occur throughout the plant kingdom, among both higher and lower plants. Among the natural exudates are the balsams, elemis, and gum resins, including oleogum resins and oleoresins. They are called 'essential'

because the oils are believed to possess the very essence of colour and flavour. They were certainly used for aromatics and perfumes by the early Egyptians and Hebrews, amongst others. Essential oils are secondary metabolites consisting mostly of terpenoids, also as aliphatic and aromatic esters, phenolics and substituted benzene hydrocarbons. They are usually liquid but can also be solid (orris) or semisolid (rose) depending on the temperature. The function of essential oils is either to attract pollinating insects or to repel hostile insects and animals; sometimes their function is allelopathic. A number have antiseptic, insecticidal, fungicidal and bactericidal properties. Insecticidal activities have been found in the steam volatile fraction of cedarwood oil obtained from the heartwood of *Juniperus recurva* (Himalayan weeping juniper) of Nepal. Essential oils with fungicidal properties from *Cymbopogon flexuosus* (Malabar oil grass) and *Santalum album* (sandalwood), have been shown to inhibit growth of *Microsporum gypseum, Trichophyton equinum* and *T. rubrum,* which are among the pathogenic fungi responsible for ringworm

Waxes

The term wax was formerly limited to fatty acid esters with monohydric fatty alcohols having plastic and water-repelling wax-like properties. The term is now arbitrarily used for any organic substance having such properties. The waxes are important components of the cuticle covering the stems, leaves, flowers and fruits of most plants. They originate in the epidermal cells as oily droplets and migrate via tiny canaliculi to the cell surface. Waxes are used in paper coating, polishes, electrical insulation, textiles, leathers, cosmetics and pharmaceuticals. Extraction usually involves beating the harvested leaves to free the wax.

Sugars

Sugar is the generic name for sweet-tasting, soluble carbohydrates, many of which are used in food. There are various types of sugar derived from different sources. Sugars are found in the tissues of most plants and are present in sugarcane and sugar beet in sufficient concentrations for efficient commercial extraction. Refined sugar is made from raw sugar that has undergone a refining process to remove the molasses. Raw sugar is sucrose which is extracted from sugarcane

or sugar beet. While raw sugar can be consumed, the refining process removes unwanted tastes and results in refined sugar or white sugar.

STUDY QUESTIONS

1a. List four (4) characteristics of wood.
1b. Differentiate between hard wood and soft wood.
1c. Draw the transverse section of a wood and identify its part.

2a. Based on their anatomical and morphological origins, list the different types of vegetable fibres.
2b. Identify the plant source of the under listed economic fibres.

i. Coir fibre
ii. Flax fibre
iii. Hemp fibre
iv. Silk cotton fibre
v. Sisal fibre
vi. Jute fibre
vii. Cotton fibre

3. Give two useful applications of the following plant products.

i. Resins
ii. Rattan
iii. Bark
iv. Bamboo
v. Natural gums
vi. Latexes
vii. Essential Oils
viii. Waxes
ix. Mucilages

Further Reading

1. Economic Botany: Principles and Practices by Gerald E. Wickens
2. A Textbook of Botany: Plant Anatomy and Economic Botany, Volume III by S. N. Pandey and A. Chadha