Unit 2. Classification of medicinal and aromatic plants.

2.1. According to their usage.
2.2. According to their active constituents.
2.3. According to their period of life.
2.4. Botanical Classification of Medicinal and Aromatic Plants.
2.5. Classification of Natural Products.
2.6. References

Classification of medicinal plants is organized in different ways depending on the criteria used. In general, medicinal plants are arranged according to their active principles in their storage organs of plants, particularly roots, leaves, flowers, seeds and other parts of plant.

These principles are valuable to mankind in the treatment of diseases. Reports on the classification of many plant species yielding vegetable oils used in cosmetics and body and skin care preparations are sporadic or lacking.

Herbs are classified in many ways. Some of them are

1. According to the usage
2. According to the active constituents
3. According to the period of life
4. According to their taxonomy

The classification system is discussed in detail under but we will describe the herbs as classified according to the period of the life.

2.1 According to the usage

The herbs are classified in four parts: Medicinal herbs, culinary herbs, Aromatic herbs, Ornamental herbs.

A. Medicinal Herbs

Medicinal herbs have curative powers and are used in making medicines because of their healing properties.

B. Culinary Herbs

Culinary herbs are probably the mostly used as cooking herbs because of their strong flavours like mint, parsley, basil.

C. Aromatic Herbs

Aromatic herbs have some common uses because of their pleasant smelling flowers or foliage. Oils from aromatic herbs can be used to produce perfumes, toilet water, and various scents. For e.g. mint, rosemary, basil etc

D. Ornamental Herbs

Ornamental herbs are used for decoration because they have brightly coloured flowers and foliage like lavender, chives.
2.2 According to the active constituents.

Present in them, the herbs are divided into five major categories: Aromatic (volatile oils), Astringents (tannins), Bitter (phenol compounds, saponins, and alkaloids), Mucilaginous (polysaccharides), and Nutritive (food stuffs).

A. Aromatic Herbs

Aromatic Herbs, the name is a reflection of the pleasant odour that many of these herbs have. They are used extensively both therapeutically and as flavourings and perfumes. Aromatic herbs are divided into two subcategories: stimulants and nervines.

*Stimulant Herbs* increase energy and activities of the body, or its parts or organs, and most often affect the respiratory, digestive, and circulatory systems. E.g. fennel, ginger, garlic, lemon grass.

*Nerving Herbs* are often used to heal and soothe the nervous system, and often affect the respiratory, digestive, and circulatory systems as well. They are often used in teas or in encapsulated form, e.g. ginger, catnip.

B. Astringent Herbs

Astringent Herbs have tannins, which have the ability to precipitate proteins, and this "tightens," contracts, or tones living tissue, and helps to halt discharges. They affect the digestive, urinary, and circulatory systems, and large doses are toxic to the liver. They are analgesic, antiseptic, ant abortive, astringent, emmenagogue, hemostatic, and styptic. For e.g. peppermint, red raspberry.

C. Bitter Herbs

Bitter Herbs are named because of the presence of phenols and phenol glycosides, alkaloids, or saponins, and are divided into four subcategories: laxative herbs, diuretic herbs, saponin-containing herbs, and alkaloid-containing herbs.

*Laxative Bitter herbs* include alterative, ant catarrhal, antipyretic, cholagogue, purgative, hypotonic, sialagogue, vermifuge, and blood purifier. For e.g. aloe, cascara, liquorice, pumpkin, senna, yellow dock, yucca, barberry, gentian, safflowers, and golden seal.

*Diuretic Herbs* induce loss of fluid from the body through the urinary system. The fluids released help cleanse the vascular system, kidneys, and liver. They are alterative, antibiotic, ant catarrhal, antipyretic, and antiseptic, lithotripter, and blood purifier in nature. For e.g. asparagus, blessed thistle, burdock, butcher's broom, buchu, chaparral, chickweed, corn silk, dandelion, dog grass, grapevine, and parsley.

*Saponin-containing Herbs* are known for their ability to produce frothing or foaming in solution with water. The name "saponin" comes from the Latin word for soap. They emulsify fat soluble molecules in the digestive tract, and their most important property is to enhance the body's ability to absorb other active compounds.

Saponins have the ability to effectively dissolve the cell membranes of red blood cells and disrupt them. They are alterative, ant catarrhal, antispasmodic, and aphrodisiac, emmenagugue, cardiac stimulant, and increased longevity in nature. For e.g. yam root, schizandra, black cohosh, blue cohosh, devil's claw, liquorice, alfalfa, yucca, ginseng, and gotu kola.
D. Mucilaginous Herbs

Mucilaginous herbs derive their properties from the polysaccharides they contain, which give these herbs a slippery, mild taste that is sweet in water. All plants produce mucilage in some form to store water and glucide as a food reserve. Since most mucilage are not broken down by the human digestive system, but absorb toxins from the bowel and give bulk to the stool\(^1\), these herbs are most effective topically as poultices and knitting agents, and are also used topically in the digestive tract. When used as lozenges or extracts, they have a demulcent action on the throat.

They eliminate the toxins from the intestinal system, help in regulating it and reduce the bowel transit time. They are antibiotic, antacid, demulcent, emollient, vulnerary, and detoxifier in nature. For e.g. althea, aloe, burdock, comfrey, dandelion, Echinacea, fenugreek, kelp, psyllium, slippery elm, dulse, glucomannan from Konjak root, Irish moss, and mullein.

E. Nutritive Herbs

These herbs derive both their name and their classification from the nutritive value they provide to the diet. They are true foods and provide some medicinal effects as fiber, mucilage, and diuretic action. But most importantly they provide the nutrition of protein, carbohydrates, and fats, plus the vitamins and minerals that are necessary for adequate nutrition. For e.g. rosehips, acerola, apple, asparagus, banana, barley grass, bee pollen, bilberry, broccoli, cabbage, carrot, cauliflower, grapefruit, hibiscus, lemon, oat straw, onion, orange, papaya, pineapple, red clover, spirulina, stevia, and wheat germ.

2.3 According to the period of life, herbs also can be classified as annuals, biennials, and perennials. Annuals bloom one season and then die. Biennials live for two seasons, blooming the second season only. Once established, perennials live over winter and bloom each season.

\(^1\) solid excretory product evacuated from the bowels
Annual herbs complete their life cycle in one year; start them from seed. Annual herbs include:
- Anise
- Basil
- Borage
- Calendula (Pot Marigold)
- Chamomile
- Chervil
- Cilantro/Coriander
- Dill Bouquet
- Dill Dukat
- Fennel, smoky
- Marjoram
- Parsley
- Shiso
- Saffron
- Summer Savoury

Perennial herbs grow for more than one season and include sweet marjoram, parsley, mint, sage, thyme and chives. Most can be started from young plants except for parsley.
- Alfalfa
- Allispice
- Aloe Vera
- Angelica
- Acrimony
- Bee Balm
- Bay leaves
- Catnip
- Chives, Common
- Common Thyme
- Echinacea
- Fennel, Florence
- Lavender
- Lemon Balm
- Mints (Spearmint, peppermint, apple mint, orange mint)
- Marjoram
- Mitsuba
- Oregano
- Rosemary
- Sorrel
- Salad Burnet
- Sage
- Tarragon
- Thyme
- Watercress
- Yarrow

Biennial herbs are plants which live two season and bloom in the second season only.
- Caraway seeds
- Prime rose
- Bai Zhi
- Mullein
- Teasel
- Viper's Bugloss

Plants with aromatic foliage
- *Allium spp*, basal leaves smell of onions
- *Artemisia spp*, aromatic/pungent silvery foliage - spring & summer
- *Foeniculum vulgare*, aromatic leaves used in cooking
- *Helichrysum italicum*, 'Curry Plant', curry-scented aromatic
- *Helichrysum stoechas*, aromatic leaves smelling of curry
- *Hedychium gardnerianum*, fragrant lemon and red flowers
- *Lavandula spp & cvs*, all highly scented flowers and aromatic foliage
- *Origanum spp*, aromatic culinary herb
- *Pelargonium graveolens, P. tomentosum* etc, scented leaves
- *Pistacia lentiscus*
- *Ruta graveolens*, aromatic herb with pungent foliage
- *Ruta graveolens 'Jackman's Blue*', aromatic leaves which are blue
- *Ruta chalepensis*, foetid rue, leaves very aromatic,
- *Ruta angustifolia*
- *Rosmarinus officinalis*, whole plant aromatic all year
- *Salvia officinalis*, aromatic all year
- *Satureja montana*, grown for aromatic foliage
- *Tagetes minuta*, whole plant has strong unpleasant odour
- *Thymus vulgaris*, grown for its aromatic foliage
2.4 Botanical Classification of Medicinal and Aromatic Plants

Modern Botanical Nomenclature.

A system to distinguish plants which is based purely on common names would be both ambiguous and confusing, and could group together plants which bear similar names, but are not related to each other e.g. here are some listings for Laurel (Mabberley 1998):

- Alexandrian Laurel *Calophyllum inophyllum* L.
- Bay Laurel *Laurus nobilis* L.
- Californian Bay Laurel *Umbellularia californica* (Hook. & Arn.) Nutt.
- Cherry Laurel *Prunus laurocerasus* L.
- Chinese Laurel *Antidesma bunius* (L.) Sprengel etc. etc.

So, today, plants are classified under the binomial system invented by Carl Linnaeus (1707-78), a Swedish botanist. In this system, the first name given is the genus, whereas the second is the specific epithet e.g. for: creeping or Corsican mint is known as *Mentha requienii* Bentham, its genus is *Mentha* and its specific epithet is requienii. In this genus, there are 25 species including M. requienii and therefore the binomial
double naming system gives a precise classification of the particular plant. Botanists have further developed this system into a comprehensive diversely branched family tree of classifications, which includes all known plants. The complete ascending sequence is species, genus, family, order, class and division.

The meaning of the botanical name may be indicative of the history of the plant i.e. a genus may be named after a particular botanist e.g. the Kaempferia, is named after the German physician Englebert Kaempfer 1651-1716. The name may also tell something of the habit or morphological characteristics of the plant e.g. in *Gaultheria procumbens* L., the latter name derives from 'procumbent' which describes the plant's habit. A useful publication is listed below under Stearn (199, includes which is the standard reference for botanical Latin (& which includes comprehensive listings of the meaning of plant names)

The Rules of Plant Nomenclature.

The rules pertaining to plant nomenclature have been set out in two publications: The International Code of Nomenclature for Cultivated Plants (first edn 1952 – the latest 6th edn. being published in 1995)

Plants are divided into families in which similarly related plants are grouped together basic on the clear similarity of morphological characteristics.

**Families** may contain one genus or a large number. A **genus** may similarly contain one species or a large number of related individuals – for example the Rosmarinus genus contains just two species, Rosmarinus eriocalix Jord. & Fourr. and R. officinalis L. (although some workers recognise Rosmarinus tomentosus Huber-Morath & Maire, as a third species of the genus). Variations occur within a species and these are accommodated in the following manner: a **subspecies** (ssp.) is a distinct variant often arising because of evolution of plant form from geographic factors, **varieties** (var.) have small differences in morphology, and the form (forma), has very minor differences e.g. leaf or fruit colour. **Cultivars** offer further evidence of diversity and according to The International Code of Nomenclature for Cultivated Plants (1980), cultivars named since 1959 should be given vernacular names, which should be in roman type within quotes e.g. “Rosa”.

**Hybrid plants** arising from the sexual crossing of distinct species within the same genera are called interspecific hybrids and are indicated by a multiplication sign e.g. Lavandin plants Lavandula x intermedia are sterile hybrids between Lavandula angustifolia Mill. and Lavandula latifolia Medic. Less commonly met are plants arising from sexual crossings between different genera (intergeneric hybrids). Grafting one plant onto another can also produce hybridised plant growing onwards from the grafting point: these are indicated by a + sign linking the two involved species.

**Chemotypes** (ct.) are of especial interest in the world of essential oils. These are marked by differences in products of secondary metabolism (e.g. essential oil composition) which can occur even in morphologically stable species, such as Chamomilla recutita (L.) Rauschert. For example, four chemotypes of Ocimum sanctum L. from the highly varied Ocimum genus were described by Hegnauer (1966): a citral-type, a eugenol type, a methyl chavicol type and a chavibetalonal type. The distinguishing criteria for chemotype identification are the major components only of the essential oil from a named specific part of the plant (seeds, leaves etc.). Genetic control of essential oil biosynthesis has been investigated and a bank of knowledge now exists for specific oil-bearing plants. It is probable however that many chemotypes of common aromatic plants have yet to be properly identified.

Most of the medicinal and aromatic plants belong to the following families:

- Compositae
- Labiatae
- Umbelliferae
- Leguminosae
- Roseaceae
- Rutaceae
- Solanaceae
- Cruciferae
- Liliceae
- Caryophyllaceae
- Boraginaceae
- Ranunculaceae
- Papaveraceae
- Malvaceae
- Cucurbitaceae
- Verbenaceae
- Scrophulariceae
- Phytolaccaceae
A. Medicinal plants of the Compositae family

The Compositae family, also known as the Daisy family, contains the highest number of medicinal plants as compared to other families. Medicinal plants belonging to this family include the chamomile, the field and pot marigolds, daisy, wormwood, chicory, thistles, ragwort and artichoke.

- Chamomile. *Matricaria chamomilla*.
- True chamomile, *Anthemis nobilis*.
- Marigold. *Calendula*.
- Daisy. *Bellis annua*.
- Wormwood. Also known as *Artemisia absinthium*.
- Chicory. *Cichorium intybus* and *Cichorium spinosa*.
- Thistles. Milk thistle, known as *Silybum marianum*.
- Silver ragwort. *Senecio bicolour*.
- Artichoke, *Cynara cardunculus*.

B. Medicinal plants of the Labiatae family

A very important medicinal plant family is the Labiatae family, also known as the mint family. Plants in this family are herbs or shrubs often with an aromatic smell. They are common in the Mediterranean countries for the fact that some of them produce a high amount of essential oil that enables them to survive the hot summer season. Some examples from this family include horehound, lavender, balm, micromeria, the mints, thyme and rosemary.

The lavender is a term given to a group of plants that have similar shape and properties. In Spain there are several species and subspecies.

- *Lavandula officinalis*.
- *L. angustifolia* Miller
- *L. angustifolia* Miller subsp. *pyrenaica*
- *L. latifolia* Medicus
- *L. lanata* Boiss.
- *L. dentata* L.

The mints constitute a large group of plants. Their scent varies from pungent to sweet. These properties are owned by the distinct mint species.

- Pennyroyal (*Mentha pulegium*).
- Water mint (*Mentha aquatica*).
- Peppermint (*Mentha piperita*).
- Spearmint (*Mentha spicata*).

Thyme has also many representatives in Europe.

- Mediterranean thyme (*Thymus capitatus*).
- *Thymus granatensis* (red thyme)
- *Thymus hyemalis* (sauce thyme)
- *Thymus longiflorus* (long flower thyme)
- *Thymus mastichina* (Mejorana)
- *Thymus serpylloides* (sierra thyme)
- *Thymus vulgaris* (common thyme)
- *Thymus zygis* (olive thyme)

Finally we can find rosemary (*Rosmarinus officinalis*), Horehound (*Marrubium vulgare*), Balm, also known as *Melissa officinalis*, Micromeria (*Micromeria microphylla*).
C. Medicinal plants of the Umbelliferae family

The Umbelliferae or carrot family consists of plants with a characteristic umbrella-arranged fruit. These plants usually produce an essential oil, an asset to survive during the hot summer days. In fact the oil has a cooling effect on the plant. Some examples from this family include bullwort (Ammi majus), wild celery (Apium graveolens), wild carrot (Daucus carota), sea holly (Eryngium maritimum), fennel (Foeniculum vulgare), anise (Pimpinella anisum), wild parsley (Petroselinum crispum), hemlock (Conium maculatum) and alexanders (Smyrnium oslusatrum).

- Bullwort (Ammi majus).
- Wild celery (Apium graveolens).
- The wild carrot (Daucus carota).
- The sea holly (Eryngium maritimum).
- Fennel (Foeniculum vulgare).
- Parsley or Petroselinum.
- One of the most poisonous herbs is the spotted hemlock or Conium maculatum.
- Alexanders (Smyrnium oslusatrum).

D. Medicinal plants of the Leguminosae family

The Leguminosae or pea family consists of large number of plants, both native and naturalised, that have been cultivated for fodder, food and ornamental purposes. Amongst these plants, those with medicinal virtues include the carob tree (Ceratonia siliqua), the pea (Pisum sativum), white and red clovers (Trifolium repens and pratense), false acacia (Robinia pseudoacacia), Judas tree (Cercis siliquastrum), alfalfa (Medicago sativa) and fenugreek (Trigonella foenum-graecum).

A group of closely related species in the Leguminosea family are the clovers. Two important species are the white and red clovers (Trifolium repens and T. pratense).

E. Medicinal plants of the Rosaceae family

A large of species in Rosaceae or rose family, have a medicinal value. Most of these are trees or shrubs with variable characteristics. This family is popular for its edible and juice fruit shrubs and trees. Some examples of this family include bramble (Rubus ulmifolius), rose (Rosa gallica), wood strawberry (Fragaria moschata), quince (Cydonia oblongata), round pear (Pyrus amygdaliformis), loquat (Eriobotrya japonica), hawthorn (Crataegus monogyna), peach, almond and apricot (Prunus persica, amygdalus and armeniaca).

- Bramble (Rubus ulmifolius).
- The wild rose (Rosa gallica).
- Wood strawberry (Fragaria moschata).
- Quince (Cydonia oblongata).
- The round pear (Pyrus amygdaliformis).
- Hawthorn (Crataegus monogyna).

The Prunus genus includes several stone fruits such as the peach, almond, apricot, plum and blackthorn. Most of these are cultivated for their fruit, as all have a local market. However, most have naturalised in valleys and gardens.

- Peach (Prunus persica).
- Almond (Prunus dulcis).
- Blackthorn (Prunus spinosa).
F. Medicinal plants of the Rutaceae and Solanaceae families

The Rutaceae or rue family is a small family that consists of cultivated fruit trees and medicinal herbs. Plants in this family include the wall and garden rues (*Ruta chalepensis* and *graveolens*), orange (*Citrus aurantium*), lemon (*Citrus limon*), tangerine (*Citrus paradisi*) and grapefruit (*Citrus paradisi*).

The rues (*Ruta graveolens* and *R. montana*) are two related species that have different medicinal uses.

A citrus tree with great medicinal value is the bitter orange tree (*Citrus aurantium*).

A family with several poisonous, but medicinally-important herbs is the Solanaceae or potato family. A species in this family that is widely cultivated (*Solanum tuberosum*). Other cultivated edible crops are the tomato (*Lycopersicum esculentum*) and the aubergine (*Solanum melongena*). The potato is only edible when ripe, as green potatoes were found to be poisonous. Also although these three crops come from this poisonous family, through cultivation and experimentation, the genetic material that codes for the toxic compounds has been phased out, resulting in safer and non-toxic cultivars. Mediterranean natives in this family include the white henbane (*Hyoscyamus albus*), the Mediterranean withania (*Withania somnifera*) and garden thorn apple (*Datura metel*). Other important species include glaucous tobacco (*Nicotiana glauca*) and black nightshade (*Solanum nigrum*).

- White henbane (*Hyoscyamus albus*).
- Mediterranean withania (*Withania somnifera*).
- Garden thorn apple (*Datura metel*).
- Stramonium (*Datura stramonium*).
- Glaucous tobacco (*Nicotiana glauca*).
- Black nightshade (*Solanum nigrum*).

G. Medicinal plants of the Cruciferae family

The Cruciferae or cress family is characterised by plant that have flowers with cross-like petals. This family groups a large group of medicinal plants that include Wallflower (*Cheiranthus cheiri*), Bitter cress (*Cardamine hirsuta*), Shepherd's purse (*Capsella bursa-pastoris*), Black mustard (*Brassica nigra*), Horseradish (*Armoracia rusticana*), Hedge mustard (*Sisymbrium officinale*), White mustard (*Sinapis alba*), Wild radish (*Raphanus raphanistrum*), Watercress (*Nasturtium officinale*).

- Wallflower (*Cheiranthus cheiri*).
- Bitter cress (*Cardamine hirsuta*).
- Shepherd's purse (*Capsella bursa-pastoris*).

Although the *Brassica* plants are important crop, some of them have a medicinal value, such as the black mustard (*Brassica nigra*).

Other vegetable crops include cabbages and cauliflower.

- Horseradish (*Armoracia rusticana*).
- Hedge mustard (*Sisymbrium officinale*).
- White mustard (*Sinapis alba*).
- Watercress (*Nasturtium officinale*).
- Wild radish (*Raphanus raphanistrum*).
**H. Medicinal plants of the Liliaceae family**

The Liliaceae or lily family is composed of a large number of plants with medicinal virtues. Most of these are herbs and rarely shrubs. Examples from this plant family include Asphodel (Asphodelus aestivus), Wild asparagus (Asparagus aphyllus), Seaside squill (Drimia maritima), Mediterranean smilax (Smilax aspera), Greater butcher's broom (Ruscus hypophyllum), Butcher's broom (Ruscus aculeatus), Tassel hyacinth (Muscaria comosum), Madonna lily (Lilium candidum), Bluebell (Hyacinthus orientalis), Aloe (Aloe vera), Garlic (Allium sativum), Garden onion (Allium cepa), Mediterranean meadow saffron (Colchicum cupani), Meadow saffron (Colchium autumnale).

- Asphodel (Asphodelus aestivus).
- Wild asparagus (Asparagus aphyllus).
- Seaside squill (Drimia maritima).
- Mediterranean smilax (Smilax aspera).

Two closely related species are Butcher's broom (Ruscus aculeatus) and greater butcher's broom (Ruscus hypophyllum).

- Tassel hyacinth (Muscaria comosum).
- Madonna lily (Lilium candidum).
- Bluebell (Hyacinthus orientalis).
- Garlic (Allium sativum).
- Garden onion (Allium cepa).
- Mediterranean meadow saffron (Colchicum cupani).
- Meadow saffron (Colchium autumnale).

**I. Medicinal plants of the Caryophyllaceae and Boraginaceae families**

The Caryophyllaceae or pink family group plants that usually have four to five petalled flowers that are usually white or pink in colour. Examples from this family include sandwort (Arenaria serpyllifolia), common chickweed (Stellaria media), sand spurrey (Spergularia rubra), nail wort (Paronychia argentea), smooth rupture-wort (Herniaria glabra), viscid sandwort (Alsine tenuifolia).

- Sandwort (Arenaria serpyllifolia).
- Common chickweed (Stellaria media).
- Sand spurrey (Spergularia rubra).
- Nail wort (Paronychia argentea).
- Smooth rupturewort (Herniaria glabra).
- Viscid sandwort (Alsine tenuifolia).

The Boraginaceae or borage family is made up of herbs or small shrubs with bristly stems and leaves. Examples in this family include borage (Borago officinalis), common comfrey (Symphytum officinale), purple alkanet (Anchusa asurea), yellow gromwell (Neatostema apulum), viper's bugloss (Echium vulgare) and southern hound's tongue (Cynoglosum creticum).

- Borage (Borago officinalis).
- Common comfrey (Symphytum officinale).
- Purple alkanet (Anchusa asurea).
- Yellow gromwell (Neatostema apulum).
- Viper's bugloss (Echium vulgare).
- Southern hound's tongue (Cynoglosum creticum).
J. Medicinal plants of the Ranunculaceae and Papaveraceae families

The Ranunculaceae or buttercup family is characterised by showy flowers that usually have 5 petals. Examples from this family include pheasant's eye (Adonis annuus), lesser celandine (Ranunculus ficaria), poppy anemone (Anemone coronaria), love in the mist (Nigella damascena), short-spurred larkspur (Delphinium staphysagria), larkspur (Delphinium ajacis), traveller's joy (Clematis vitalba), evergreen traveller's joy (Clematis cirrhosa).

- Pheasant's eye (Adonis annuus).
- Lesser celandine (Ranunculus ficaria).
- Poppy anemone (Anemone coronaria).
- Love in the mist (Nigella damascena).
- Larkspur (Delphinium ajacis).
- Short-spurred larkspur (Delphinium staphysagria).
- Evergreen traveller's joy (Clematis cirrhosa).

The Papaveraceae or poppy family consists of a group of plant that contain a latex or water sap. There are four petals in a flower and these are cross shaped with two opposite petals above the other two. Plants with a medicinal value include greater celandine (Chelidonium majus), opium poppy (Papaver somniferum), common poppy (Papaver rhoeas), sea poppy (Glaucium flavum), fumitory (Fumaria officinalis) and fumitory (Fumaria capria capreolata).

- Greater celandine (Chelidonium majus).
- Opium poppy (Papaver somniferum).
- The common poppy (Papaver rhoeas).
- The sea poppy (Glaucium flavum).
- Fumaria officinalis and Fumaria capria capreolata. The Latin name Fumaria means smoke of the earth, as these have a unpleasant smoky smell.

K. Medicinal plants of the Malvaceae and other families

The Malvaceae or mallow family groups those plants that have five-petalled flowers and a nutlet-like fruit. Examples include common mallow (Malva sylvestris) hairless cotton (Gossypium herbaceum), hollyhock (Althaea rosea) and marsh mallow (Althaea officinalis).

- Common mallow, also known as Malva sylvestris.
- Hairless cotton (Gossypium herbaceum).
- Hollyhock (Alcea rosea).
- Marsh mallow (Althaea officinalis).

Other families that contain a very small number of medicinal plants include the following.

The Cucurbitaceae or cucumber family contains a large number of edible crops such as the cucumbers, melons and pumpkins. Two important medicinal plants in this family include the squirting cucumber (Ecballium elaterium) and the pumpkin (Cucurbita maxima).

Another family, called the Verbenaceae or verbena family contains three important medicinal plants; vervain (Verbena officinalis), chaste tree (Vitex agnus-castus) and the cultivated lantana (Lantana camara).

An important and common medicinal plant of the Scrophularia or figwort family is the snapdragon (Antirrhinum majus). It is a native of West Mediterranean and grows on rocky grounds and old walls. It flowers from January till October. Traditionally it was used as an astringent, diuretic, and hemorrhoids. It contains several constituents such as alkaloids, amino acids and glycosides.

A characteristic plant of the pokeweed or Phytolaccaceae family is pokeweed itself (Phytolacca americana). Due to its poisonous properties, it was used externally only, for the treatment of
rheumatism, with low and skin inflammation. These are probably attributed to the saponins and the oleanolic acid derivative present in the plant. It contains a pokeweed lectin stimulates the white blood cells.

A member of the Euphorbiaceae family castor bean (*Ricinus communis*) is renowned for its medicinal and industrial purposes. It is a native of the tropics but has naturalised in some waste places and valleys. It flowers between March and October. Poisoning from seed ingestion has occurred in children. Traditionally, this plant was used as a laxative and to treat cradle-cap in babies. Castor oil is expressed from the seeds of the plant after they are peeled. Toxic albumins are present in the seed but these are removed by boiling with water. It is safe to use as a laxative and in baby skin products such as zinc and castor oil. It is used in industry as a lubricant to machinery and also in jet engines.

### Distribution of medicinal plants by families

A bar chart showing the distribution of medicinal plants by families.

#### 2.5 Classification of natural Products.

Natural products are compounds consisting essentially of carbon derived from natural sources (flora, fauna, land, etc.). And that generally have very diverse and interesting properties.

Some of the most relevant applications of the Natural Organic Products are using it as:

**Fuels, plastics, fats, soaps, sugars.**

**Petroleum** (Petra = stone; Oil = oil) is a naturally formed by liquid mixture of hydrocarbons, which are processed in the petrochemical industry through fractional distillation and cracking to gasoline, natural gas, etc.

**Soap** is the sodium salt of a fatty acid. Have a party hydrophilic (dissolves in water) and other lipophilic (fat dissolves dirt).

**Sugars** are natural polyhydroxialdehydes or polyhydroxiketones with different functions: structure, energy storage components of the nucleic acids, etc. They are formed by photosynthesis in plants and are classified into monosaccharides (glucose), disaccharides (sucrose) and polysaccharides (cellulose, starch, etc.).

**Sweeteners** are natural or synthetic substance that gives a sweet taste to food. We can find natural sweeteners such as sucrose (cane and beet), fructose (sugar simplier and sweet, honey), lactose and galactose (sugars from milk, less sweet), and synthetic as: saccharin (300 times sweeter than sucrose), aspartame (160 times sweeter), etc.
**Agro-chemicals:** pesticides, plant growth regulators, etc.

Modifiers of animal behaviour (**pheromones**).

**Flavours and perfumes.** Food Additives (flavours, colours, antioxidants, etc.)

**Drugs:** Product to be administered for curative purposes. Although there are many natural source products that are used as drugs, the synthesis of drugs is well developed and provides a large amount of chemicals that are used as such. For example: sedatives, antiinflammatories, diurethics, antiviral, hepatoprotectors, etc.

**Regulators:** like dopamine, used for Parkinson’s syndrome (only L-Dopa is active)

**Antibiotics:** chemical products able to inhibit the growth of microorganisms and even destroy them.

**Analgesics:** drug that relieves pain without causing loss of consciousness. Painkillers are a large group that ranges from the derivatives of opium (solid product obtained drying the milky juice of the opium poppy "*Papaver somniferum*" with a 25% alkaloids), and morphine (potent analgesic, very toxic and produces dependence), codeine (anticoughing, produces no habit), heroin (synthetic derivative obtained by acetylation of morphine, good analgesic with less depression than morphine addiction but more addiction), methadone (synthetic substitute for heroin with analgesic properties but also cause addiction) to opiates, such as aspirin, which is derived from the Silicilina (glycoside from the bark of willow formerly used as an analgesic), Paracetamol and ibuprofen. The application of topical analgesics include all anti-inflammatories, such as hydrocortisone and derivatives, and the general and local anesthetics at low doses.

### A. Natural Products classification based on their chemical structure.

It is base don the type of chemical skeleton. So there are

- Aliphatic or non aliphatic fatty compounds of open chain as: fatty acids, sugars and a great amount of amino acids.
- Acyclic and cycloaliphatic compounds as terpenoids, steroids and some alkaloids.
- Aromatic or benzoic compounds as phenols, quinones, etc.
- Heterocyclic compounds such as alkaloids, flavonoids and nucleic acid bases.

Many natural products belong to more than one of these categories. For example, geraniol, farnesol and scualene belong to class 1, and thymol to class 3, but because of the biogenetic considerations they are treated as class 2.

### B. Natural Products classification based on their physiologic activity

Approximately one half of the medicines used today are natural products, i.e. alkaloids, antibiotics or synthetic analogs. For that it is usually employed a classification that represents the physiologic activity, such as hormones, vitamins, antibiotics ad mycotoxins.

Even though the compounds belonging to each group have different structures and biogenetic origins, a narrow relationship is occasionally between those aspects and activity.

### C. Natural Products classification based on their taxonomy

This classification is based on morphological studies of plants, or plant taxonomy. In animals and some of the microorganisms, final metabolites are generally excreted outside the body, while in plant metabolites are stored inside the plant. While it was thought that some metabolites were specific of some plants, we know today that are widely distributed in the plant kingdom and many constituents of plants such as alkaloids and isoprenoides have been
isolated from species, genera, families or specific plant. For example, the "opium" of Papaver somniferum contains twenty alkaloids such as morphine, thebaine, codeine, and narcotine. They are all biosynthesized from precursor 1-bencilisoquinolina by oxidative coupling.

So, alkaloids that have similar structures are characteristic are constituents of this kind of plants and are designated as alkaloids opiates. Similarly, frequently appears in the literature names representing genera and families such as ergot alkaloids, iboga alkaloids, and menispermaceae alkaloids. Our knowledge of the constituent plant has been expanded to a dramatic rate in recent years due to progress in the methods of isolation and microcharacterization. This has led to a new field called "chemotaxonomy" or "chemosystematics", which tries to study the constituents of plants according to their taxonomy. Ultimately, the phytochemical constituents are considered as markers to understand the evolution and classification of plants.

However, the number of compounds known for each plant is still quite limited and, moreover, all plants have not yet studied. Undoubtedly, a meticulous and laborious study from a large amount of plant material, will lead to a clearer idea of its constitution and allow the isolation of products even if they have no known biological activity whatsoever. Still organized knowledge of the constituent plant according to the taxonomy is an area of great interest and importance at the present time.

D. Natural Products classification based on their biogenesis

Although "biogenesis" and "biosynthesis" are terms that are used sometimes indiscriminately, it is customary to use the first term for a hypothesis, and the last for a synthetic route tested experimentally.

The constituents of all plants and animals are biosynthesized in organisms through enzymatic reactions. The most commonly source of carbon used is the glucose, which is photosynthesized in green plants (autotrophic organisms) or obtained from the environment heterotrophic organisms. The relatively recent advances in biochemistry have greatly clarified the interplay between enzymatically catalyzed reactions of the "primary metabolites (such as sugars, amino acids and fatty acids) and biopolymers (such as lipids, proteins and nucleic acids). These metabolites lead to "secondary metabolites," so called because it is obvious his role in the metabolism of many organisms.

When in the years 30 our understanding of the chemistry of natural products had some size, some organic chemicals began to develop routes biogenetic theories of natural products in living organisms on the basis of its structural regularity.

There are at present three known major routes or routes that enable key biosynthesis of the vast majority of different types of natural products known:

- Mevalonic acid route: from it, prenyl units are formed, an after successive links they led to isoprenoids (terpenoids, steroids, carotenoids)
- Shikimic acid route: From it, amino acids are formed and from them, and other aromatic compounds more complex (phenylpropanoids, flavonoids, alkaloids)
- Acetate – Malonate Route (polyketide route): From malonate and acetate are formed polyketides (Ketogenines) and fatty acids are formed.

2.6. References

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