

PHYLOGENY OF CENTROSPERMAE

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INTRODUCTION



- Centrospermae represents one of the most controversial orders in the Angiosperms
- Eichler(1876) first introduced the term Centrospermae consisting of 3 orders:
 - 1.Oleraceae
 - 2. Caryophyllales
 - 3. Opuntinae
- Engler and Prantl also erected the order Centrospermae which included the families:
 - Aizoaceae
 - Chenopodiaceae
 - Nyctaginaceae
 - Phytolaccaceae
 - Cactaceae
 - Basellaceae
 - Caryophyllaceae
 - Cynocrabaceae
 - Portulacaceae
- Engler later separated the family Cactaceae and raised it to the ordinal rank, the Opuntiales consisting the only family Cactaceae



- Mabry(1976) included 11 families based on the available data from ultrastructural,serological,embryological and morphological information along with evolutionary relationships.His order Caryophyllales/Centrospermae included 2 sub-orders
- Sub Order1. Chenopodinae consisting of Aizoaceae, Amaranthaceae, Basellaceae, Cactaceae, Chenopodiaceae, Didiereaceae, Nyctaginaceae,Phytolaccaceae and Portulacaceae
- Sub Order2. Caryophyllinae consisting of Caryophyllaceae and Molluginaceae
- The first nine families consist of unique N-containing pigments ,the Betalins
- The other 2 families show Anthocyanins
- Bentham and Hooker(1862-1883) kept these above families at three different places.
- Caryophyllaceae and Portulacaceae kept in sub class Polypetalae,series Thalmiflorae and order Caryophyllinae
- Cactaceae and Aizoaceae in sub class Polypetalae,series Calyciflorae and order Ficoidales
- Amaranthaceae,Nyctaginaceae,Phytolaccaceae and Chenopodiaceae in sub class Monochlamydeae,series Curvembryae
- Family Molluginaceae has been kept in the Aizoaceae as a sub family Molluginoideae
- Basellaceae included in Chenopodiaceae as a tribe
- The Didiereaceae were not known at that time



- Hutchinson kept the eleven families at different places.
- Phytolaceaceae, Basellaceae, Chenopodiaceae and Amaranthaceae included in order Chenopodiales, Division Herbaceae
- Molluginaceae, Caryophyllaceae, Ficoideae and Portulacaceae included in order Caryophyllales, Division Herbaceae
- Nyctaginaceae kept in order Thymeleales while Didieraceae in order Sapindales, both in division Lignosae.
- Cactaceae kept under order Cactales as the only family, in the division Lignosae
- Takhtajan order Caryophyllales include Phytolaceaceae, Cactaceae, Aizoaceae, Basellaceae, Chenopodiaceae, Hectorellaceae, Amaranthaceae, Didieraceae, Molluginaceae, Caryophyllaceae, Achatocarpaceae, Portulacaceae, Nyctaginaceae and Stegnospermaceae
- Takhtajan kept the order under sub class Caryophyllidae
- Cronquist grouping was similar to Takhtajan.
- Cronquist (1981) order Caryophyllales include Phytolaceaceae, Cactaceae, Aizoaceae, Basellaceae, Chenopodiaceae, Amaranthaceae, Didieraceae, Molluginaceae, Caryophyllaceae, Achatocarpaceae, Portulacaceae and Nyctaginaceae

CHARACTERISTICS OF CENTROSPERMAE



- Curved Embryo
- Superior ovary
- Usually one whorl of perianth
- P111 subtype sieve element plastids
- Betalins(except Molluginaceae and Caryophyllaceae)

PHYTOLACACEAE



- Herbs, shrubs or trees
- Leaves alternate, simple, entire, rarely stipulate
- Flowers bisexual, actinomorphic, in cymose or racemose inflorescence
- Perianth uniseriate, composed of 4-5 usually more or less connate persistent sepals
- Stamens 3-many
- Ovary of 1-16 distinct or connate carpels, superior, ovule 1 in each carpel on axile placentation
- Fruit drupe, schizocarp, utricle or achene
- Seed with curved embryo and large amount of endosperm and perisperm, often arillate
- Multicarpellate gynoecium
- Family consist of 12 genera, 100 species
- Distributed chiefly in tropical America and South Africa
- Example: *Rivinia*, *Phytolacca*, *Seguiera*, *Schimdleria*
- Phytolaccaceae is considered as the most primitive family of Centrospermae

NYCTAGINACEAE



- Trees, scandent shrubs or herbs
- Leaves simple, entire, opposite, exstipulate
- Inflorescence cymose
- Flowers bisexual or rarely unisexual, actinomorphic, usually 2-5 foliaceous and often highly colored bracts subtending each flower
- Perianth uniseriate, composed of petaloid calyx of 5 connate sepals, persistent, usually the upper part drops away and the fruit remains in the lower part which is termed as anthocarp, and may become glandular or form an umbrella like wing.
- Stamens one to many, distinct or the filaments connate basally in a tube
- Ovary 1-carpelled, unilocular, superior, with a single ovule on basal placentation
- Fruit an achene or utricle
- Seed with straight or curved embryo and endosperm and perisperm
- Family consist of 30 genera, 290 species
- Distributed in tropics and sub tropics
- Example: *Bougainvillea*, *Boerhavia*, *Pisonia*, *Mirabilis*
- *Bougainvillea* and *Mirabilis* are grown as ornamentals

MOLLUGINACEAE



- Scarcely or non-succulent, annual herbs, with mostly prostrate to erect, often much-branched stems from a short, narrow tap root
- Leaves simple, exstipulate
- inflorescence basically cymose, axillary or terminal
- Flowers actinomorphic, bisexual, hypogynous
- Perianth uniseriate, inconspicuous, tepals 5, sepaloid, free
- Stamens 3-10, alternating with carpels when 3, or with tepals when 5.
- Ovary of 3-5 united carpels, superior, 3-5 locular, ovule one per locule on basal placentation or several to many on axile placentation
- Fruit loculicidal capsule or achene
- Seeds with curved embryo and large endosperm and perisperm
- Family consist of 14 genera, 95 species
- Distributed in tropics and sub tropics
- Example: *Mollugo*, *Glinus*, *Gisekia*, *Corbichonia*
- Takhtajan separated *Gisekia* from Molluginaceae because it shows betalins which are absent in Molluginaceae and included it in Phytolaccaceae

AIZOACEAE



- Slightly fleshy to markedly succulent annual or perennial herbs
- Leaves succulent, stipulate or exstipulate, simple, entire
- Flowers bisexual, actinomorphic, axillary, solitary, paired or few in a cymose or spike like cluster, flanked by a pair of bracts
- Tepals 5, united below into a usually shallow tube
- Stamens 3-5 or few with often colored staminodes
- Ovary usually of 3-5 united carpels, ovary half inferior to inferior, 3-5 locular or incompletely 2-chambered, placentation axile, basal or parietal, ovules 1-numerous
- Fruit a loculicidal or circumscissile capsule.
- Seed with curved embryo and a large endosperm
- Family consist of 11 genera, 2500 species
- Distributed in South Africa and other parts of the tropics
- Example: *Aizoon*, *Trianthema*, *Sesuvium*, *Mesembryanthemum*, *Tetragonia*

BASELLACEAE



- Perennial climbing herbs, fleshy
- Leaves simple, fleshy, exstipulate, entire
- Inflorescence spike, raceme, or panicle
- Flowers subtended by 2 involucral bracts, bisexual, actinomorphic, hypogynous
- Perianth uniseriate, tepals 5, free or basally connate, often colored, persistent
- Stamens 5, opposite to tepals
- Ovary trilocular syncarpous, unilocular with a single ovule on basal placentation.
- Fruit fleshy berry or drupe
- Seeds with curved embryo and large amount of endosperm and perisperm
- Family consist of 4 genera, 25 species
- Distributed in tropical America and West Indies
- Example: *Basella*, *Anredera*, *Ullucus*
- *Basella alba* and *B. rubra* are used as leafy vegetables

PORTULACACEAE



- Annual or perennial herbs
- Leaves fleshy, opposite or alternate, simple, stipules scarious or setaceous
- Inflorescence cymose or solitary
- Flowers bisexual, actinomorphic, hypogynous
- Perianth biseriate
- Sepals 2, the lower overlapping the upper, free or basally connate, caducous
- Petals 4-6, free
- Stamens as many as and opposite petals or 2-4 times as many
- Ovary superior, 2-3 carpellary, unilocular with several stigmas
- Fruit a loculicidal capsule
- Seeds with curved embryo and copious endosperm and perisperm
- Family consist of 19 genera, 580 species
- Cosmopolitan in distribution especially in America
- Example: *Portulaca*, *Talinum*, *Claytonia*
- *Portulaca* is grown as ornamental

CARYOPHYLLACEAE



- Annual or perennial herbs, stems often swollen nodes, branching dichotomous
- Leaves simple, opposite decussate, linear lanceolate
- Inflorescence terminal dichotomous cyme or solitary
- Flowers bisexual or unisexual, actinomorphic, hypogynous, penta- or tetramerous
- Perianth biseriata, sepals 5 or rarely 4, petals 5 or rarely 4, free, often differentiated into claw and limb, or none
- Stamens as many as petals or twice the number, obdiplostemonous
- Gynoecium of 2-5 carpels forming incompletely chambered or unilocular ovary
- Ovules solitary to many, placentation axile, free central or basal
- Fruit a capsule, utricle or nutlet
- Seeds with curved embryo and large amount of endosperm and perisperm
- Family consist of 70 genera and 1750 species
- Cosmopolitan in distribution
- Example: *Polycarpaea*, *Saponaria*

AMARANTHACEAE



- Annual or perennial herbs
- Leaves simple, alternate or opposite entire, exstipulate
- Inflorescence spicate or capitate
- Flowers bisexual or polygamous, actinomorphic, each flower subtended by membranous scarious bract and 2 similar bracteoles
- Perianth uniseriate, usually 4-5 membranous segments, free or partially connate
- Stamens 5, opposite perianth lobes, the filaments usually connate for part or all their length into a membranous tube, lobes or petaloid enations may alternate with the anther
- Gynoecium superior, bicarpellary syncarpous, unilocular, with a single basal ovule
- Fruit utricle or nutlet
- Family consist of 65 genera and 850 species
- Distributed in tropical and temperate regions
- Example: *Amaranthus*, *Aerva*, *Gomphrena*, *Pupalia*, *Celosia*, *Achyranthes*, *Alternanthera*
- Economically few members are used as leafy vegetables (*Amaranthus*) while some are grown as ornamentals

CHENOPODIACEAE



- Predominantly halophytic herbs, shrubs or rarely trees
- Plants leafy or leafless
- Leaves usually simple, alternate, exstipulate, fleshy, sometimes reduced to scales or none
- Inflorescence dichasial or unilateral cyme
- Flowers bisexual or unisexual, minute, often greenish, bracteate, actinomorphic, hypogynous
- Perianth uniseriate, sepaloid, tepals 5 (varying from 2-5), connate, persisting in fruit
- Stamens as many as petals and opposite them
- Gynoecium 2-3 carpellary, unilocular with single ovule on basal placentation, superior
- Fruit nut, seed with curved embryo and large amount of endosperm and perisperm
- Family consist of 102 genera and 1400 species
- Cosmopolitan in distribution
- Example: *Chenopodium*, *Beta vulgaris*, *Atriplex*, *Spinacea oleracea*
- Some are used as leafy vegetables e.g *Chenopodium*, *Spinacea oleracea* (Spinach)

CACTACEAE



- Xerophytic, fleshy, herbaceous or woody plants
- Stems fleshy, of various shapes, cylindrical, flattened or fluted, jointed, rarely bearing green leaves, and often with spines
- Leaves present or scale or reduced to spines, spines present in areoles
- Flowers solitary, sessile, bisexual, actinomorphic, epigynous
- Perianth of numerous segments showing gradual transition from sepaloid to petaloid; fused basally to form a hypanthium, the hypanthium adnate to the ovary or free from it
- Stamens numerous arising spirally in groups from the inner face of the hypanthium
- Gynoecium of 3-many carpels, unilocular with numerous ovules on parietal placentation, inferior
- Fruit a berry
- Seeds with curved embryo and no endosperm
- Family consist of 150 genera and 2000 species
- Distributed in the drier regions of tropical America
- Example: *Opuntia*, *Cereus*, *Pereskia*, *Mammillaria*, *Rhipsalis*
- Economically few species are grown as ornamentals

DIDIEREACEAE



- Trees or shrubs with the habit of cacti or cactiform euphorbias often armed with spines
- Leaves simple, entire, alternate, exstipulate
- Flowers in cymes or fascicles, unisexual, hypogynous, involucre 2-leaves
- Perianth 2+2 segments
- Stamens 8-10, shortly united at base
- Gynoecium of 2-4 carpels, unilocular, with single basal ovule
- Fruit dry indehiscent
- Seeds with curved embryo, scanty endosperm and aril
- Family consist of 4 genera and 11 species
- Endemic to Madagascar
- Example: *Didierea*, *Alluadia*, *Alluadiopsis*



THANK YOU