**Ginkgoales:**

The order Ginkgoales is today represented by only one living member, i.e. Ginkgo biloba. Ginkgoales was, however, very abundantly represented in the world by several species of about 16 genera during the Triassic period of Mesozoic age, i.e. about 200,000,000 years ago. Today, all the genera, except Ginkgo biloba, are extinct.

Due to the presence of a number of primitive characters, as well as because of its long geological records, Ginkgo is called a “living fossil”.

Details of the geological history of Ginkgoales indicate that its members started appearing on the earth during Permian, achieved luxuriance and worldwide distribution during Triassic and Jurassic periods of Mesozoic age, started fading out of existence during Cretaceous and now represented only in some parts of Southern and Eastern China by only one living member, Ginkgo biloba..

Seward (1938) considered Ginkgo “as one of the wonders of the world” and stated that has persisted with little change until the present through a long succession of ages when the earth was inhabited by animals and plants”. Arnold (1947) mentioned that “Ginkgo biloba is one of the oldest living plants and may indeed be the oldest living genus of the seed plants”

**General Characteristics of Ginkgoales:**

1. Tall, well-branched trees with short and long shoots. However, some earliest fossil members were without short and long shoots.

2. Wood is pycnoxylic.

3. Leaves are large, leathery and fan-shaped or strap-shaped. They are often deeply divided.

4. Dichotomous venation is usually present in the leaves.

5. Un-branched, catkin-like male organs are axillary in position.

6. Male organs bear micro-sporangiophores.

7. Each micro-sporangiophore possesses 2-12 pendulous microsporangia.

8. Spermatozoids are motile and contain spiral bands of flagella.

9. Ovules are terminal in position on branched or un-branched axillary axes. They are 2-10 in number.

10. Seeds are large-sized.

11. Each seed contains a fleshy outer layer and a middle stony layer.

**Classification of Ginkgoales:**

Formerly, Ginkgo was included under Coniferae but Engler placed it under a new order Ginkgoales. Florin (1936) included various other genera in Ginkgoales, such as Baiera, Ginkgodium, Ginkgoites, Czekanosia, Stephanophyllum, etc. But the validity of some of them has been questioned as to whether they belong to Ginkgoales or not.

Sporne (1965) divided Ginkgoales into following two families:

1. **Trichopityaceae**, represented by an extinct genus Trichopitys.

2. **Ginkgoaceae**, represented by one living genus (Ginkgo) and six extinct genera (Arctobaiera, Baiera, Eretmophyllum, Ginkgoites, Sphenobaiera and Windwardia).

**Phylogeny of Ginkgoales:**

Some of the striking peculianties of Ginkgo biloba include:

(i) Bilobed, fan-shaped leaves with dichotomous open venation,

(ii) Ovule bearing a collar at the base,

(iii) Micro-sporangiophore bearing a hump-like outgrowth at its apex,

(iv) Presence of tent pole at the tip of the female gametophyte, and

(v) Absence of suspensor in its embryo.

In-spite of these characteristics, Ginkgoales resemble in some or other aspects with Cordaitales, Pteridospermales, Filicales, Cycadales and even Coniferales.

These resemblances are briefly discussed below:

**Resemblances with Cordaitales**

(i) Presence of double leaf trace,

(ii) Endospermic beak in the mature ovule, and

(iii) The probable motility of the spermatozoids of the members of both Ginkgoales and Cordaitales are some of the resemblances between these two groups.

**Resemblances with Pteridospermales:**

(i) Presence of leaf gap in the stem,

(ii) Dichotomous open venation in the wedge-shaped leaves of Ginkgo and pinnules of some seed ferns (Ptendospermales),

(iii) A distinct pollen chamber,

(iv) A massive fleshy layer in the ovules, and

(v) Collar at the base of the ovules in Ginkgo and cupule in ovules of some Pteridospermales, are some of the characteristics showing resemblance between Ginkgoales and Pteridospermales.

Resemblances with Filicales:

A few points of resemblances between Ginkgoales and Filicales (ferns) include:

(i) The similarities between the primary xylem structure, secondary xylem structure and periderm of Ginkgo and some ferns (Ophioglossum and Botrychium),

(ii) Dichotomous open venation in their leaves,

(iii) Multi-flagellated and motile spermatozoids, and

(iv) Presence of ventral canal cell in the archegonia in some of their members.

Resemblances with Cycadales:

Some of the resemblances between Ginkgo and Cycadales may be listed as under:

(i) Presence of multi-flagellated spermatozoids,

(ii) Well-developed nucellar beak and pollen chamber,

(iii) Haustorial nature of pollen tube,

(iv) Presence of large egg, massive female gametophyte and well-developed venter,

(v) Endoscopic embryo with two cotyledons,

(vi) Seed with thick and well-developed integument, and

(vii) Hypogeal type of seed germination.

In-spite of these above-mentioned similarities, there are several major **differences between Ginkgoales and Cycadales** which put them quite apart from each other.

(i) General structure of their male and female reproductive organs,

(ii) Vascular supply of their ovules,

(iii) Development of their male gametophytes,

(iv) Branched (Ginkgoales) and generally un-branched (Cycadales) nature of their stems,

(v) Simple (Ginkgoales) and compound (Cycadales) nature of their leaves, and

(vi) Presence (Cycadales) or absence (Ginkgoales) of circinate venation in their leaves, etc.

Resemblances with Coniferales:

(i) General appearance of tree is cone like,

(ii) Extensively branched stem with two types of branches, i.e. long shoots and dwarf shoots,

(iii) Leaves are simple with sunken stomata,

(iv) Cortex and pith are narrow and wood is pycnoxylic,

(v) Secondary wood is well-developed,

(vi) Medullary rays are uniseriate,

(vii) Circular bordered pits arranged uniseriately along the radial walls of the tracheids,

(viii) Microsporangia show longitudinal dehiscence, and

(ix) Sessile nature of ovule.

**Ginkgo biloba**

**(a) Vegetative Organs:**

1. Medium-sized trees with spreading branches, dioecious.

2. Leaves long-stalked, flattened and lobed in various ways with dichotomous venation.

3. A thick cortex, a comparatively thin vascular cylinder and a large pith with mucilage canals or reservoirs.

4. Vascular cylinder is made up of collateral and endarch bundles.

5. No direct leaf trace.

**(b) Spore-Producing organs:**

1. Flowers unisexual.

2. Microsporophylls in loose catkin-like structure; each microsporophyll bears 2 pendant microsporangia.

3. Megasporophylls collected in strobili.

4. Ovules generally in pairs, one ovule on each side of the apex of a long stalk, which arises in the leaf-axis at the end of a short shoot.

5. Fertilization by flagellated sperms.

6. No formation of pro-embryo or suspensor.

7. Seed drupe-like containing a dicotyledonous embryo em­bedded in the copious endosperm.

**Distribution and Ecology**

After long years of debate whether Ginkgo was extinct in the wild and persisted only in cultivation, the matter was largely resolved in the early 21st Century with field studies of populations in the Dalou Mountains of Guizhou that concluded "current species composition of Ginkgo forests in the Dalou Mountains agrees closely with floristic assemblages from fossil records bearing G. biloba. Current populations are found in habitats similar to those of fossil Ginkgo, which, as today, favored rock crevices. Female to male ratios are 3:2. Estimated ages for many of the trees show that Ginkgo was present in this area prior to human settlement and indigenous peoples of this area are unlikely to have planted Ginkgo because of traditional beliefs. The Ginkgo trees occur in a structurally complex mixed forest that includes many canopy tree species, among them the conifers Cunninghamia lanceolata and Taxus sumatrana.

Regardless of its origin, the "population is biologically significant by virtue of its long survival in a semi-natural state under conditions of intense interspecific competition. Many of the trees grow on disturbance-generated microsites, such as stream banks, steep rocky slopes, and the edges of exposed cliffs. Many individuals are multitrunked, consisting of at least two trunks greater than 10 cm in diameter at breast height. Most of these secondary trunks originated from root-like 'basal chichi,' that are produced at the base of trees that have experienced damage from soil erosion or other factors.

The great majority of ginkgoes live as ornamentals. In this role the species is nearly cosmopolitan, planted in temperate and subtropical areas around the globe.

Ethnobotany

The unusual shape of the crown, natural resistance to disease, and yellow leaf color in fall make this a favorite street and park tree. Ovulate trees produce an abundance of seeds, which have a particularly obnoxious odor; the planting of ovulate ginkgoes is often discouraged for this reason. Seeds (canned with fleshy outer coat removed) are sold in ethnic markets as "silver almonds" or "white nuts," the gametophyte and embryo being edible. Oils from the outer coat are known to cause dermatitis in some humans.