An Evolutionary Particularity Principle for Evolutionary System of Classes of Fructophyta

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Abstract: Fructophyta D. L. Fu & H. Fu, a new division established in 2018, including all fruit or flowering plants, conventionally named as angiosperms, occupy the highest evolutionary phylum taxa and an important position in terrestrial ecosystems and human wellbeing, whose origin and evolution had always been thought as puzzling. To scientifically settle the puzzle and using the evolutionary continuity principle of new science of Evolutionomy, the author proposed that evolutionary taxa should have particularly evolutionary characters to be distinguished to the closer taxa, which could be called evolutionary particularity principle. Based on the principle, the evolutionary system of five classes of Fructophyta D. L. Fu & H. Fu can be affirmed, which is a system of dichotomous evolution. Two new classes, Leguminopsida D. L. Fu and Scutellopsida D. L. Fu, are established based on the common particularity of evolutionary characters, legume and scutellum, respectively. Three old classes are selected as Magnoliopsida Brongn., Rosopsida Batsch and Monocotyledonopsida Benth. et Hook., based on the evolutionary continuity principle, and some evolutionary characters such as flower disks, pseudanthic inflorescences, and syncarpous pistils with serrate leaves were first to be used for the class classification of Rosopsida Batsch, which will make an important advancement in the taxonomy of fruit or flowering plants. The evolutionary particularity principle is a new scientific basis for the new science of Evolutionomy, which can also scientifically overcome the limitations of partiality and subjectivity in the tree of life or phylogenetic system.

Keywords: Evolutionary Particularity Principle, Leguminopsida, Scutellopsida, New Class, Evolutionomy, Fructophyta

1. Introduction

Occupying the highest evolutionary phylum taxa and an important position in terrestrial ecosystems and human wellbeing, including all fruit or flowering plants, commonly called angiosperms, Fructophyta D. L. Fu & H. Fu are a new phylum of Regnum Plantae L. emend. D. L. Fu built in 2018 [1]. The origin and phylogeny of fruit plants have puzzled plant systematics for quite some time, just as that Hongda Zhang [2] had pointed out: "because of the long age, it is rare to find the complete fossils of the primitive flowering plants belonging to the Triassic..., at present, that we do not have a rational evolutionary system of primitive flowering plant is understandable." But in fact, the mystery of the origin and evolution of fruit plants is closely related to their unscientifically evolutionary position, which had been called angiosperms for more than a century. Botanist and taxonomists had always considered the evolution and systematic classification of fruit plants based on the idea of seed plants, and lacked sufficient understanding of the evolutionary continuity and particularity of fruit plants.

At present the system of two classes of Fructophyta D. L. Fu & H. Fu, Dicotyledonopsida Bentham et Hooker (or Magnoliopsida Brongn.) and Monocotyledonopsida Bentham et Hooker (1862) (or Liliopsida Scop.) occupies absolutely main position in the systems of Fructophyta D. L. Fu & H. Fu (angiosperms), such as Hutchinson system [3], Takhtajan system [4], Cronquist system [5], Zhang Hongda system [2] and so on. Moreover the APG system [6-10] based on the phylogenetic relationships had established the taxonomic taxa such as Eudicots, Core Eudicots and Monocots. The number of cotyledons seems to be the main basis for traditional
taxonomy and modern systematics of fruit plants. But in fact, the number of cotyledons of plants especially that of dicots cannot scientifically reflect the main evolutionary contexts of fruit plants, because there are many gymnosperm plants also having dicotyledon as fruit plants, such as Ginkgo biloba L., Platycladus orientalis Franco and Taxus chinensis (Pilger) Rehd. Of Ginkgopsida, Cycadopsida and Taxopsida, [11] respectively, see Figure 1. So the taxa of Dicotyledonopsida, Eudicots and Core Eudicots established in taxonomic system or APG system based on the number of cotyledons are really confusable and subjective taxonomic groups.

In addition, it must also be acknowledged that monocotyledon usually is regarded as the seed evolution of Spermatophyta in traditional taxonomy or plant systematics but it is really the embryo evolution of Fructophyta. Not clearly understanding this, it’s very easy to regard monocots should be attributed to Spermatophyta as today’s Botany [2], and it is inevitably to resist the new division of Fructophyta scientifically built in 2018.

The rapid development of molecular biology has promoted the development of plant systematics. The main basis of plant systematics is the "tree of life" of Darwin's theory of evolution [1], based on the theory of "common ancestor" and "germogenesis" [6]. The system can show phylogenetic relationships among different beings, but cannot show evolutionary relationships, which can lead to a subjective system sometimes [1]. For example, The tree of phylogenetic relationships among Anita, Magnoliids, Eudicots and Monocots with Picea abies as an outgroup, showed in Figure 3 published in Nature Plants by Chen et al. [15], is subjective for the hypothesis of a common ancestor of fruit plants maybe in 180.8 Ma based on the analysis of modern plants. Assuming the ancestor being objective, it is also necessary to analyze which taxa is the most primitive fruit plants among Amborella trichopoda, Liriodendron chinense and other species, and then to analyze the phylogenetic relationships among different taxa with the most primitive species of fruit plants as new outgroup.
instead of Picea abies to avoid the partiality and subjectivity with only one species of Gymnospermophyta D. L. Fu & H. Fu as the outgroup. Furthermore it was devoid of the scientific hiberarchy because the phylogenetic theory itself offers no scientific ideas and methods for understanding the “noise [5].”

The system of Five classes of Reveal [16] and Eight classes of Wu Zhengyi [13, 14] all are poly-class system combined with the bases of DNA phylogenetic relationships as APG system [6-10], which tried to reveal the polyphyletic-polychronic- polytopic system of fruit plants. Especially the Eight-class system is the typical representation

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**Figure 2.** Monocotyledon of Monocots. (1) Seedling of Trachycarpus fortunei Wendl. of Monocotyledomopsida (from NIFI: Atlas of seedlings of main tree species [11]), (2) Longitudinal section of embryo of wheat of Scutellopsida D. L. Fu, class. nov. (from Lu et al.: Botany [12]).

**Figure 3.** Phylogenetic relationships among Anita, Magnoliids, Eudicots and Monocots. Dated phylogeny for 11 plant species with Picea abies as an outgroup. (from Chen et al. [15]).
for its eight principal lineages of angiosperms of the Early Cretaceous [13, 14]. Since it is impossible to obtain all the fruit plants of the Early Cretaceous, the eight principal lineages and the genealogical relationships of angiosperms are subjective and partial based on the modern plants. If the lineages and the relationships were comprehensive and real, the eight principal lineages are not limited to the hierarchies of class, may be that of order or even just that of family. The system failed to clarify the evolutionary particularity of classes of eight principal lineages, such as the particularity of Lauropsida, Piperopsida, Caryophyllopsida, Ranunculopsida and Hamamelopsida. Furthermore it is also obviously unscientific for disobeying the evolutionary continuity principle of new science of Evolutionomy that put Monocotyledonopsida (Liliopsida) before Ranunculopsida and Rosopsida of Dicots.

How to overcome and correct the unscientificity of existing system of fruit plants, the author proposed the evolutionary particularity principle based on the evolutionary continuity principle, analyzed the main evolutionary contexts and established the evolutionary system of classes of Fructophyta D. L. Fu & H. Fu.

2. Evolutionary Particularity Principle

Monocotyledonopsida traditionally include the scutello-plants, which regarded the scutellum as monocotyledon [2, 12]. But the cotyledons of scutello-plants really include scutellum, epiblast, coleoptile and coleorhiza, which can better complete the nutrient extraction and self-protection of embryos and which all can be called cotyledon and be the highest evolutionary level of embryos of fruit plants, see Figure 2. Obviously differing from the real monocotyledon, the new class of Scutellopsida D. L. Fu, class. nov. can be scientifically established in order to reveal the highest evolutionary level of embryos of fruit plants. The main evolutionary context of Fructophyta, Monocotyledonopsida \(\rightarrow\) Scutellopsida D. L. Fu, class. nov., can be clearly presented.

To avoid the partiality of embryos, it is necessary to consider the evolutions of other organs such as roots, stems, leaves, flowers and fruits of fruit plants. The particular caryopsis of Scutellopsida D. L. Fu, class. nov. usually covered by palea and lemma, healing peels of fruit and seed can also reflect the evolutionary particularity of the new class of Scutellopsida D. L. Fu. Excluded the scutello-plants, Monocotyledonopsida emended include the particular monocotyledons with sheath and usually have fibrous root system, closed bundle without cambium and parallel leaf veins, which obviously distinguished from dicots with tap root system, open bundle with cambium and net leaf veins, but their simple flowers and fruits are close to dicots especially Magnoliopsida. So the new evolutionary context, Magnoliopsida \(\rightarrow\) Monocotyledonopsida more in line with the evolutionary continuity principle than that of Dicotyledonopsida \(\rightarrow\) Monocotyledonopsida generally accepted today.

There are another taxa of fruit plants with evolutionary particularity and occupy the other top of another evolutionary contexts, which can be called Leguminopsida D. L. Fu, class. nov. The plants of the new class all have legumes obviously differing from other fruit types such as follicle, drupe, capsule, hesperidium, pome, pepo, achene, samara, nut, utricle, cremocarp, silique and silicle, and some taxa of the class have the particular papilionaceous corolla with vexillum, alae and carina, the highest evolutionary level of corolla, see Figure 4(3). There are some plants of the new family of Arachaceae D. L. Fu, fam. nov. ined., of the new class with the particular characters of fruit growing in the soil after flowering. So the new class Leguminopsida D. L. Fu can be established and the main evolutionary context is clearly presented as the non-legumes \(\rightarrow\) Magnoliopsida D. L. Fu, class. nov.

The new class of Leguminopsida D. L. Fu highlight the papilionaceous corolla with vexillum, alae and carina, which are obviously not evolved from Magnoliopsida, the primitive taxa of fruit plants without the real corolla (Figure 4.). There must be the taxa with diversiform corolla such as apetalous corolla of Rosaceae Adans. and sympetalous corolla of Rubiaceae Juss., which had been established as Rosopsida Batsch (1802). Since the evolutionary boundary of the tepals and sepals of Magnoliopsida \(\rightarrow\) the corolla and calyces of Rosopsida are not clear and the tepals of Monocotyledonopsida were also called corolla in Hutchinson system [5], it is partial and difficult to classify and demarcate the evolutionary boundary between the class of Magnoliopsida and Rosopsida just based on the perianth evolution. Furthermore, it is more difficult to determine that the families with the simple corolla such as Daphniphyllaceae Müll. Arg., Hamamelidaceae R. Br., Tiliaceae Adans., Euphorbiaceae Juss., etc. (the perianth usually showed just as calyces [2]) naturally belong to the class of Rosopsida. So some other important evolutionary characters can be applied to the classification based on the evolutionary continuity principle.

The disk of flower is one evolutionary character that can be applied to the classification between the classes of Rosopsida and Magnoliopsida. Using the character it can be affirmed that Paeoniaceae Raf. with disks belong to the class of Rosopsida but Ranunculaceae Adans. without disks belong to Magnoliopsida, just as that Salicaceae Mirb. and Aceraceae Juss. belong to Rosopsida, but Piperaeace C. Agardh and Platanaceae T. Lestib. belong to Magnoliopsida. The characters of apocarpous pistils \(\rightarrow\) syncarpous pistils with, entire leaves \(\rightarrow\) serrate leaves or non-centrosperms \(\rightarrow\) centrosperms or simple fruit \(\rightarrow\) collective fruits are other important evolutionary characters can be applied to the classification. The plants of Magnoliopsida usually are entire leaves or apocarpous pistils, such as Trochodendraceae Eichl., Eupteleaceae K. Willh. and Chloranthaceae R. Br. ex Sims with serrate leaves but apocarpous or single pistils, and Lauraceae Juss. and Papaveraeace Adans. with syncarpous pistils but entire leaves. In contrast, the plants of class of Rosopsida without corolla usually are syncarpous pistils with, serrate leaves or centrosperms or collective fruits, such as Eucommiaceae Engl. with syncarpous pistils and serrate
leaves, Centrospermae with syncarpous pistils and centrosperms, and Moraceae Link and Myricaceae Blume with syncarpous pistils and collective fruits. Some taxa of Rosopsida have pseudanthic inflorescences such as Cercidiphyllum japonicum Sieb. et Zucc. of Hamamelidaceae R. Br., Castanea mollissima Bl. of Fagaceae Dumort., Casuarina equisetifolia Forst. Of Casuarinaceae R. Br. and so on, which had been ignored or regarded unscientifically as the original taxa of fruit plants in the previous systems. Of course, it should be attended that some taxa of Rosopsida also have some particular fruits such as hesperidium, pome, pepo, cremocarp, siliqua and siliqua. So the evolutionary contexts, Magnoliopsida → Rosopsida → Leguminopsida, can be clearly presented.

The legumes of Leguminopsida D. L. Fu, class. nov. (Figure 4(3)), monocotyledons of Monocotyledonopsida (Figure 2(1)) and scutella of Scutellopsida D. L. Fu, class. nov. (Figure 2(2)) can be called common particularity of evolutionary characters because almost all individuals of the taxa have the particular characters. The naturally elongate tori of Magnoliopsida (Figure 4(1)) and the sympetalous corolla and pepos of Rosopsida (Figure 4(2)) can be called non-common particularity of evolutionary characters for only some partial individuals of the taxa having the particular characters. Based on the non-common particularity of evolutionary characters, the evolutionary taxa of the classes of Magnoliopsida and Rosopsida should be demarcated and classified using the principal evolutionary contexts of non-corolla → corolla, branched inflorescences → pseudanthic inflorescences, or other contexts such as apocarpous pistils → syncarpous pistils and entire leaves → serrate leaves based on the evolutionary continuity principle.

In summary, the evolutionary system of classes of Fructophyta should fully reflect the principal evolutionary contexts of fruit plants and the evolutionary taxa should have particularly evolutionary characters to be distinguished to closer taxa, which can be called evolutionary particularity principle. The principle is a new scientific basis for establishing the evolutionary taxa and the evolutionary system of fruit plants, which can scientifically solve the problems that the current taxonomical systems and plant systematics rely too heavily on some characters not having important evolutionary significance, and the subjective taxa such as dicots of Gymnospermophyta, Dicotyledonopsida, Eudicots and Core Eudicots had caused the confusion or mystery of fruit plant taxonomy and systematics.

3. Evolutionary System of Classes of Fructophyta

Based on the evolutionary particularity principle and evolutionary continuity principle, the new evolutionary taxonomical system of classes of Fructophyta was established and the evolutionary diagram was drawn as Figure 5. The new system includes five classes and two of those classes are new. These are:

Caryophyllaceae Juss., Colobanthaceae D. L. Fu, fam. nov. ined., Muehlebeckiaceae D. L. Fu, fam. nov. ined., Fagopyraceae D. L. Fu, fam. nov. ined., Polygonaceae Juss., Plumbaginaceae Juss., Droseraceae Salisb., Aldrovandaceae D. L. Fu, fam. nov. ined., Dioneaceae D. L. Fu, fam. nov. ined., etc.; II(7) Cornidae Frohne et Jensen ex Reve; Carnaeeae Dumort., Alangiaceae D. L. Fu, fam. nov. ined., Euphorbiaceae Juss., Fouquieriaceae DC., Maesaceae D. L. Fu, fam. nov. ined., Hydrangeaceae D. L. Fu, fam. nov. ined., Eucommiaceae Engl., Nyssaceae Juss. ex Dumort., Aquifoliaceae DC. ex A. Rich., Gonocaryaceae D. L. Fu, fam. nov. ined., Icacinaceae Miers, Picrodendraceae Smal., Aquifoliaceae DC. ex A. Rich., Gentianaceae Juss., Emmenopteryaceae D. L. Fu, fam. nov. ined., Asclepiadaceae Borkh., Strobilanthes Juss., Lamiales Martinov, Perillaceae D. L. Fu, fam. nov. ined., Ocimaceae D. L. Fu, fam. nov. ined., Lavandulaceae D. L. Fu, fam. nov. ined., Dracocophalaceae D. L. Fu, fam. nov. ined., Lentibulariaceae Rich., Lathraeaceae D. L. Fu, fam. nov. ined., Orobanchaceae Vent., Cistancheae D. L. Fu, fam. nov. ined., Bouvardiaeae D. L. Fu, fam. nov. ined., Epifagaceae D. L. Fu, fam. nov. ined., Phelipancheae D. L. Fu, fam. nov. ined., etc..

III. Leguminopsida D. L. Fu, class. nov. Figure 1(4), 4(3), 5. Based on: Fabaceae Lindl., Intr. Nat. Syst. Bot., ed. 2: 148. 1836. Typus: Fabaceae Mill. Fructophyta with papilionaceous or pseudo-papilionaceous corolla. Single pistil or apocarpous pistils usually with alternate ovules. Fruits leguminous. Dicotyledons bigger and epigaeous. Including: Caesalpiniaeae Brown, Cercidicaeae D. L. Fu, fam. nov. ined., Tamarindicaeae D. L. Fu, fam. nov. ined., Adenantheraceae D. L. Fu, fam. nov. ined., Mimosaceae Brown, Indigoferaceae D. L. Fu, fam. nov. ined., Wisteriaceae D. L. Fu, fam. nov. ined., Leguminaceae D. L. Fu, fam. nov. ined., Arachicaceae D. L. Fu, fam. nov. ined., Phaseolaceae D. L. Fu, fam. nov. ined., Wisteriaceae D. L. Fu, fam. nov. ined., Ciceraceae D. L. Fu, fam. nov. ined., Trifoliiaceae D. L. Fu, fam. nov. ined., Fabaceae Lindl., Viciaceae D. L. Fu, fam. nov. ined., etc..


Da-Li Fu: An Evolutionary Particularity Principle for Evolutionary System of Classes of Fructophyta
4. Conclusion

The evolutionary particularity principle is a new scientific basis for the new science of Evolutionomomy, which can also scientifically overcome the limitations of partiality and subjectivity of the tree of life or phylogenetic system. Based on the new principle, five classes of Fructophyta D. L. Fu & H. Fu can be distinguished, which are dichotomous evolution. Two new classes, Leguminopsida D. L. Fu and Scutellopsida D. L. Fu are respectively established based on the common particularity of evolutionary characters, legume and scutellum, which will make an important advancement in the evolutionary taxonomy of fruit or flowering plants.

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