Б О Т А Н И К А

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The position of the genus *Camellia* L. (Theaceae) in some classification systems

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Abstract. The genus *Camellia* was first established by Linnaeus in "Species Plantarum". It is a genus of flowering plants in the family Theaceae. More than 400 species have been named and published, but the number has been reduced to between 80 and 280 species by combination during taxonomic revisions. Distribution of this species ranges from Bhutan, Northeastern India, China, Japan, to Southeast Asia. Many studies have been conducted to classify the genus *Camellia* based on morphological characteristics or molecular biological techniques. Through studies, it is shown that the morphological characteristics of fruits, flowers, and leaves are still important for the classification and arrangement of the *Camellia* genus in the classification system. Over different periods, the genus *Camellia* was classified into different positions in the classification systems. Some research on taxonomic systems of the Theaceae family determined the position of the genus *Camellia*. Although the genus *Camellia* can be categorized into different sub-families, tribes, or sub-tribes, the genus name *Camellia* has remained. The position of the genus *Camellia* belongs to the Theaceae family.

Keywords: *Camellia*, classification system, Theaceae, taxonomy, morphological characteristics

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Положение рода Camellia L. (Theaceae) в некоторых классификационных системах

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Аннотация. Род Camellia L. был впервые описан Линнеем в "Species Plantarum". Это род цветковых растений относится к семейству Theaceae. Первоначально было описано более 400 видов, но их количество постоянно сокращалось до 80–280 видов в результате переописания во время таксономических пересмотров. Ареалы видов этого рода растений простираются от Бутана, Северо-Восточной Индии, Китая,

Японии до Юго-Восточной Азии. Было проведено множество исследований для уточнения классификации рода Camellia на основе морфологических характеристик или молекулярно-биологических методов. Исследования показали, что морфологические характеристики плодов, цветов и листьев по-прежнему часто используются для классификации видов и выяснения таксономического положения рода Camellia. В разные годы род Camellia занимал разные позиции в классификационных системах. Исследователи таксономической системы семейства Theaceae по-разному определили положение рода Camellia. Хотя род Camellia можно разделить на различные подсемейства, трибы или субтрибы первоначальное название рода Camellia сохранилось.

Ключевые слова: Camellia, система классификации, Theaceae, таксономия, морфологические характеристики

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Introduction

Camellia L. is the largest genus in the Theaceae family [1–4]. The first understanding of the *Camellia* was a tea tree. In addition to being used as a beverage, the *Camellia* was served widely in China as a kind of herb that significantly benefited human health. Linnaeus reported this species in "Species Plantarum" with the name *Thea sinensis*, then renamed *Camellia sinensis* [5]. He further documented the *Camellia japonica*, an ornamental plant grown in Japan. Additionally, the author established two genera *Thea* and *Camellia*: *Thea sinensis* belonged to the genus *Thea* (Class Polyandria Monogynia) and *Camellia japonica* belonged to the genus *Camellia* (Class Monadelphia Polyandria). That the *Camellia* genus was first established by Linnaeus in "Species Plantarum" is considered the foundation for studying the classification of *Camellia* later [5].

Seemann is the last author who remained *Thea* and *Camellia* names as two distinguished genera [6]. After Seemann, two genera *Thea* and *Camellia* were merged into a consistent name, *Camellia*. Many studies have been conducted to classify the genus *Camellia* based on morphological characteristics [1, 3, 7–10] or molecular biological techniques [11]. Over different periods, the genus *Camellia* was classified into different positions in the classification systems. Some taxonomic systems of the Theaceae were reviewed for an overview of the position of the genus *Camellia*.

Materials and methods

Some taxonomy systems of the Theaceae family and documents related to the genus *Camellia* have been studied to determine the position of the genus *Camellia* in the taxonomic system. The main systems studied include the morphological classification system of Airy-Shaw [7], Sealy [10], Keng [9], Chang [1, 8], and Ming & Bartholomew [3], and molecular biology techniques of Prince & Parks [11].

Results and discussion

The classification system of Airy-Shaw (1936)

Airy-Shaw's system divides the family Theaceae into two tribes, Camellieae and Gordonieae. The tribe Camellieae includes the subtribe Camelliinae (*Camellia*,

Tutcheria, *Piquetia*, and *Stereocarpus*) and the subtribe Laptaceinae (*Laplacea*, *Polyspora*, and *Pyrenaria*). The tribe Gordonieae includes the subtribe Gordiniinac (*Gordonia*, *Franklinia*, and *Schima*) and the subtribe Stewartiinae (*Stewartia*) (Table 1).

The study of Airy-Shaw is based on flower and fruit characteristics [7]. In the Theaceae family, Airy-Shaw characterized the tribe Camellieae as a pedicel with many bracteated leaves, petals and sepals randomly arranged in a spiral fashion, and a fruit capsule with a persistent columella [7]. He further divided the tribe Camellieae into two sub-tribes Camelliinae and Laplaceinae based on the difference between wingless seeds and winged seeds or drupaceous berries. He then divided the Camelliinae sub-tribe into several genera, including *Camellia*. To conclude, according to this classification system, the *Camellia* genus belongs to the sub-tribe Camelliinae, the tribe Camellieae of the Theaceae family.

The classification system of Sealy (1958)

Sealy's system classified the family Theaceae into one tribe Gordonieae including the sub-tribe Camelliinae (*Camellia*, *Pyrenaria*, *Yunnanea*, and *Tutcheria*), the sub-tribe Gordiniinac (*Gordonia*, *Laplacea*), and the sub-tribe Schiminae (*Schima*, *Hartia*, and *Franklinia*) (Table 1).

The classification system of Sealy was strongly influenced by the fruit dehiscence, the gross morphology, as well as seed characteristics such as the presence or absence of petals and the amount of endosperm [10]. In the tribal classification systems, Sealy's explanatory text is limited or entirely lacking treatments. As a conclusion, the *Camellia* genus belongs to the sub-tribe Camelliinae and the tribe Gordonieae of the Theaceae family.

The classification system of Keng (1962)

Keng's system divides the family Theaceae into two tribes, Camellieae and Gordonieae. The tribe Camellieae includes the sub-tribe Camelliinae (*Camellia*, *Stereocarpus*, *Piquetia*, and *Yunnanea*) and the sub-tribe Pyrenariinae (*Pyrenaria* and *Tutcheria*). The tribe Gordonieae includes the sub-tribe Gordiniinac (*Gordonia* and *Laplacea*), the sub-tribe Schiminae (*Schima* and *Franklinia*), and the subtribe Stuartieae (*Hartia* and *Stuartia*) (Table 1).

Keng concurred with Sealy's classification system in the use of fruit and seed characteristics for classification [9]. However, he stated that the classification would be better if more fruits and seeds' characteristics were used. Despite reusing the morphological characteristics of Sealy (1958), he examined more detailed characteristics such as whether the endosperm is copious or scanty and whether the columella center lacked or absence. Besides, he added anatomical characteristics such as the sclereid distribution in the leaves. Keng categorized the fruit with a persistent central columella, seeds having a thin endosperm, and a large embryo into the tribe Gordonieae. Characteristics such as central columella, unwinged seeds without endosperm, and large embryo referred to the tribe Camellieae. According to the classification of Keng, the Theaceae family consists of two tribes in which the tribe Camellieae is divided into two sub-tribes Camelliinae and Pyrenariinae. Also, the sub-tribe Camelliinae is subdivided into four genera, including the *Camellia* genus. To sum up, in the system of Keng (1962), the genus *Camellia* belongs to the sub-tribe Camelliiae and the tribe Gordonieae of the family Theaceae.

Table 1

The position of the genus *Camellia* in the classification systems
(CAPITAL letters are sub-family or tribe, underlines are sub-tribes, *italics* are genus)

Airy-Shaw (1936)	Sealy (1958)	Keng (1962)	Chang (1984, 1998)	Prince & Parks (2001)	Ming & Bartholomew (2007)
CAMELLIEAE Camelliinae ***Camellia*** *Tutcheria* *Piquetia* *Stereocarpus* Laptaceinae *Laplacea* *Polyspora* *Pyrenaria* GORDONIEAE Gordiniinac *Gordonia* *Franklinia* *Schima* Stewartiinae *Stewartia*	GORDONIEAE Camelliinae ***Camellia*** *Pyrenaria* *Yunnanea* *Tutcheria* Gordiniinac *Gordonia* *Laplacea* Schiminae *Schima* *Hartia* *Franklinia*	CAMELLIEAE Camelliinae ***Camellia*** *Stereocarpus* *Piquetia* *Yunnanear* Pyrenariinae *Pyrenaria* *Tutcheria* GORDONIEAE Gordiniinac *Gordonia* *Laplacea* Schiminae *Schima* *Franklinia* Stuartieae *Hartia* *Stuartia*	THEEAE ***Camellia*** *Tutcheria* GORDONIEAE *Gordonia* *Schima* *Apterosperma* STEWARTIEAE *Hartia* *Stewartia* PYRENARIEAE *Pyrenaria* *Parapyrenaria*	THEEAE ***Camellia*** *Polyspora* *Pyrenaria* *Laplacea* *Apterosperma* GORDONIEAE *Franklinia* *Gordonia* *Schima* STEWARTIEAE *Stewartia*	Subfam. THEOIDEAE ***Camellia*** *Pyrenaria* *Polyspora* *Apterosperma* *Schima* *Stewartia* Subfam. TERNSTROEMIOIDEAE *Ternstroemia*, *Anneslea*, *Eurya Euryodendron*, *Adinandra* *Cleyera*

The classification system of Chang (1984, 1998)

Chang's system divides the family Theaceae into four tribes Theeae (*Camellia* and *Tutcheria*), Gordonieae (*Gordonia*, *Schima*, and *Apterosperma*), Stewartieae (*Hartia* and *Stewartia*), and Pyrenarieae (*Pyrenaria* and *Parapyrenaria*) (Table 1).

In Chang's system (1984, 1998), the explanatory text is limited or entirely lacking treatments [1, 8]. This system divided the Theaceae family into tribes but did not divide them into sub-tribes. Moreover, he did not use the name Camellieae to replace the name Theeae. In Chang's system, the genus *Camellia* belongs to the tribe Theeae of the Theaceae family.

The classification system of Prince & Parks (2001)

Prince & Parks' system divides the family Theaceae into three tribes Theeae (*Camellia*, *Polyspora*, *Pyrenaria*, *Laplacea*, and *Apterosperma*), Gordonieae (*Franklinia*, *Gordonia*, and *Schima*), and Stewartieae (*Stewartia*) (Table 1).

Prince & Parks (2001) based on molecular biology techniques to classify the Theaceae family [11]. This classification system remained three tribes Theeae, Gordonieae, and Stewartieae; simultaneously, erased the tribe Pyrenarieae from Chang's system (1998). In their system, the tribe Theeae has the largest number of genera (five genera), including the *Camellia* genus. All things considered, in this system, the position of the genus *Camellia* is similar to in the system of Chang (1998), relating to the tribe Theeae of the Theaceae family.

The classification system of Ming & Bartholomew (2007)

Ming & Bartholomew' system divides the family Theaceae into two sub-families Theoideae (*Camellia*, *Pyrenaria*, *Polyspora*, *Apterosperma*, *Schima*, and *Stewartia*) and Ternstroemioideae (*Ternstroemia*, *Anneslea*, *Eurya*, *Euryodendron*, *Adinandra*, and *Cleyera*) (Table 1).

The classification system of Ming & Bartholomew (2007) is based on characteristics of bisexual or unisexual flowers, characteristics of stamens, capsular or baccate fruits, dehiscent, drupaceous, or indehiscent fruits to classify the Theaceae family into two sub-families Theoideae and Ternstroemioideae [3]. The sub-family Theoideae is divided into six genera, including the genus *Camellia*. The genus *Camellia* is distinguished from other genera by its large fruit size, wingless seeds, and dehiscent capsule from the apex. By and large, according to Ming & Bartholomew' system (2007), the genus *Camellia* belongs to the sub-family Theoideae of the Theaceae family.

Conclusion

Through studies, it is shown that the morphological characteristics of fruits, flowers, and leaves are still important for the classification and arrangement of the *Camellia* genus in the classification system. The main features for identifying this genus are: Shrubs or small trees, rarely large trees or evergreens; petiolate or rarely sessile and amplexicaul leaves; narrowly elliptic, elliptic, oblong-elliptic, oblong, obovate, oval, and glabrous leaf blade; acuminate, acute or obtuse leaf apex; acute, obtuse or nearly rounded leaf base; serrate, serrulate, or rarely entire margin; pedicellate or sessile flowers; bracteoles differentiated or not differentiated from sepals;

numerous stamens; capsule fruit, rarely drupe; elliptic, flattened-globose, globose, ovoid, obovoid, 3–5-loculed, sometimes reduced to 1- or 2-loculed shape; persistent columella; globose, semi-globose, or polygonal seeds; full and fleshy with high oil content cotyledons; absent endosperm.

Through research into the classification systems of the plant taxonomists, it can be stated that there are many views and many classifications of the family Theaceae. Although the genus *Camellia* can be classified into different sub-families, tribes, or sub-tribes, the genus name *Camellia* has remained. The position of genus *Camellia* belongs to the Theaceae family.

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