

Exploring of the Genus *Coffea* L. (1753) in North Maluku: a Preliminary Study for Coffee Database

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Abstrak

Genus *Coffea* L. (1753), famili Rubiaceae, memiliki 171 spesies yang telah diakui dan memiliki banyak sinonim dari seluruh dunia. Kopi merupakan tanaman eksotis di Indonesia yang diimpor oleh Belanda. Kini, di Maluku Utara, kopi merupakan salah satu tanaman yang masih dibudidayakan. Penelitian ini secara resmi melaporkan untuk pertama kalinya data mengenai *Coffea* spp. di Maluku Utara. Penelitian eksplorasi dilakukan pada bulan Januari hingga Juni 2023 dan berhasil mengoleksi tiga spesies dan satu varietas *Coffea* yang telah diakui, yaitu *Coffea arabica* L., *C. canephora* Pierre ex Froehner, *C. liberica* Bull. Ex Hiern, dan *C. liberica* var. *dewevrei* (De Wild. & T. Durand) Lebrun. Spesies kedua dan *C. liberica* var. *dewevrei* lebih dikenal sebagai kopi Robusta dan Excelsa. Semua spesies ditemukan sebagai tanaman budidaya dan tersebar di banyak tempat di Maluku Utara. Kopi *C. liberica* var. *dewevrei* atau kopi excelsa hanya dibudidayakan di Kabupaten Sula. Publikasi ini juga memberikan informasi tentang lokasi dan perbandingan setiap takson.

Kata kunci: Excelsa, Kopi, Robusta, Rubiaceae, Sula

Abstract

Genus *Coffea* L. (1753), family Rubiaceae, is well known as coffee; it has 171 accepted species with many synonyms from around the world. Coffee is exotic plant in Indonesia that was imported by Dutch. Now, in North Maluku, coffee is one of the cultivated plants. This study formally reported for the first time the data for *Coffea* spp. in North Maluku. The exploration research was conducted from January to June 2023 and collected three accepted species and one variety of *Coffea* namely *Coffea arabica* L., *C. canephora* Pierre ex Froehner, *C. liberica* Bull. Ex Hiern, and *C. liberica* var. *dewevrei* (De Wild. & T. Durand) Lebrun. The second species and *C. liberica* var. *dewevrei* are more popular known as coffee Robusta and Excelsa respectively. All species are discovered as cultivated plants and spread in many places in North Maluku. The *C. liberica* var. *dewevrei* or excelsa coffee is only cultivated in Sula district. This publication also shares information about the location and comparison of every taxon.

Keywords: Excelsa, Coffee, Robusta, Rubiaceae, Sula

INTRODUCTION

The genus *Coffea* L. (Family Rubiaceae) encompasses a diverse range of plant species collectively known as coffee. Renowned for its stimulating effects and rich aroma, coffee has become one of the most popular beverages worldwide. The cultivation and consumption of coffee has a long and storied history that spans centuries and continents. *Coffea* comprises numerous species, commonly referred to as coffee plants. *Coffea* spp., especially for *Coffea arabica* is native to tropical regions of Africa, specifically Ethiopia, where the plant's cultivation and consumption originated (Smith, 1985). Over time, coffee cultivation spread to other parts of Africa, as well as to regions in Asia, the Americas, and the Pacific. Today, coffee is grown in over 50 countries worldwide, with varying climates and altitudes influencing the unique flavor profiles of different coffee regions (Hameed et al., 2020).

The distribution of *Coffea* in Indonesia plays a significant role in the economy and cultural heritage of the country. It has been documented that the climates in the Indonesian archipelago are well-suited for the cultivation of coffee. Coffee thrives in tropical regions due to the presence of favorable conditions such as appropriate rainfall, temperature, soils, and humidity. Significantly, the fertile lands found in numerous locations throughout Indonesia offer optimal environments for growing coffee (Hakim, 2021). North Maluku, an Indonesian province located in the eastern part of the country, boasts favorable climatic conditions and fertile soil, making it an ideal region for coffee cultivation. **Historical Background** The history of coffee distribution in North Maluku dates back to the colonial era when the Dutch introduced coffee plants to the region. Coffee cultivation rapidly gained popularity among local farmers, leading to the establishment of coffee plantations across the province. Over the years, the distribution of *Coffea* has evolved, with both small-scale farmers and large-scale plantations contributing to the coffee production in North Maluku.

North Maluku remains a relatively unexplored territory in terms of *Coffea* species. This article aims to shed light on the coffee diversity in North Maluku, examining its unique geographical characteristics, potential coffee species present, and the significance of exploring this untapped resource. By delving into the coffee landscape of North Maluku, we hope to contribute to the knowledge base of *Coffea* spp. and uncover new possibilities for sustainable coffee production in the region. Exploring and documenting the coffee diversity in North Maluku can yield several significant benefits. Firstly, it contributes to the broader knowledge base of *Coffea* spp., expanding our understanding of the genus and its evolutionary history. Secondly, it offers an opportunity to discover coffee species with unique flavor profiles, potentially leading to the development of specialty coffees that can capture the interest of the global market. Lastly, the exploration of coffee resources in North Maluku can support local communities by promoting sustainable coffee production and creating economic opportunities.

METHODS

The research was exploration research by collecting information of coffee trees around the North Maluku. The method to earn the data of coffee was by asking the first information from local farmers, who have coffee plantations or simply grow coffee. and department of agriculture in Ternate. General information including species was taken from fields.

Detailed information of coffee was obtained along with taking pictures of coffee tree. The information of species was verified. The main reference book to confirm the species is Flora of Java (Backer & Brik, 1968), Flora Malesiana (Van Steenis, 1950), and Flora of China (Tao et al., 2011), also the online reference including WFO (WFO, 2023). Specimen also compared to herbarium specimen in world Herbarium i.e., BM, BR., and K by online. All the confirmed species than described in detail from the first protologue, type specimens, morphological characters and distribution.

RESULTS AND DISCUSSION

Coffee, in North Maluku, is cultivated on many islands namely: Bacan, Halmahera, Makian, Kayoa, Morotai, Sula, Taliabu, and Loloda. Commercial Coffee in North Maluku is not popular, farmers only cultivated it in small scale and only for household consumption or for daily need. There are three species with one variety of *Coffea* cultivated in North Maluku i.e., *Coffea arabica* Linn, *C. canephora* Pierre ex A. Froehner, *C. liberica* W. Bull ex Hiern and *C. liberica* W. Bull ex Hiern var. *dewevrei*. Distribution of coffee plant in North Maluku is contained in the table 1.

Table 1. The distribution of coffee plant in North Maluku

No	Taxa	Distribution (Regency: Villages)
1	<i>C. arabica</i>	Halmahera Selatan: Kampung Makian Halmahera Timur: Buli, Maba Tidore Kepulauan: Tului, Bale, Hager
2	<i>C. canephora</i>	Kep Sula: Sama, Fatkauyon, Waibu Halmahera Selatan: Kampung Makian Halmahera Barat: Bobaneigo Pulau Taliabu: Keramat
3	<i>C. liberica</i>	Morotai: Sofi Halmahera Selatan: Kampung Makian
4	<i>C. liberica</i> var. <i>dewevrei</i>	Kepulauan Sula: Pohea

Specifically, all taxa of coffee found in Nort Maluku are described below:

1. *Coffea arabica* Linn. Sp. Pl.: 172. 1753 (Linnaeus, 1753); Backer Fl. Java: 322. 1965 (Backer & Brik, 1968). Type: No location information, cultivated material from the garden of George Clifford III: Hartekamp Garden (lectotype **BM** [BM000558021]).

Synonym (The Plant List, 2013):

Coffea vulgaris Moench Methodus: 504. 1794.

C. laurifolia Salisb., Prodr. Stirp. Chap. Allerton 62. 1796.

C. corymbulosa Bertol., Nuovi Ann. Sci. Nat. 1: 411. 1838.

C. moka hort. ex Heynh., Alph. Aufz. Gew. 153. 1846.

C. sundana Miq. Fl. Ned. Ind. 2: 306 1857.

Morphologically, *Coffea arabica* is shrubs or small trees with 5-8 m tall and glabrous branches. Petiole glabrous and 8-15 mm long. Leaf blade drying thinly leathery, elliptic, elliptic-oblong, or occasionally ovate lanceolate, 6-22 × 3.5-8.5 cm, glabrous on both surfaces, base cuneate to obtuse and rarely rounded, margins occasionally crisped-undulate, apex acuminate with tip usually 10-15 mm; secondary veins 7-13 pairs; stipules broadly triangular, 3-12 mm, aristate at least on youngest branches.

Inflorescences with 1 to several cymes in each axil, each cyme sub capitate to fasciculate, (1 or) 2-5-flowered, sessile to pedunculate with peduncles up to 4 mm; pedicels to 2 mm. Calyx glabrous; ovary portion ellipsoid, 1-3 mm. Corolla white and glabrous outside; tube 5-15 mm; lobes 4 6 mm, spatulate-elliptic, 9-20 mm, obtuse. Drupe red, ellipsoid to sub globose, 11-16 × 9-14 mm, when dry smooth or sometimes weakly didymous, glabrous.

Coffea arabica has many synonyms (GBIF Secretariat, 2023). This coffee is type species for genus *Coffea*. Lectotype specimen (Tropicos.org, 2023) is in BM herbarium, the specimen from Herb. Clifford 59, *Coffea* no. 1 and designated by Bridson (1988).

2. *Coffea canephora* Pierre ex A. Froehner, Notizbl. Königl. Bot. Gart. Berlin 1: 237. 1897 (IPNI, 2023). Type: Gabon, *Klaine* 247 (Holotype **P** [P00553357]; isotype **P** [P00553358], **P** [P00553363]).

Synonym (The Plant List, 2013):

Coffea robusta L. Linden in Cat. Pl. Econ.: 64. 1900.

C. laurentii De Wild., in Compt. Rend. Congr. Intern. Bot. 234. 1900.

C. bukobensis Zimmerm., Pflanze iv. 326 (1908).

C. ugandae Cramer, Meded. Dept. Landb. Ned.-Indië 11: 680 (1913).

C. canephora Pierre ex A. Froehner var. *robusta* (Linden ex De Wildem.) Chevalier. Backer Fl. Java: 322. 1965.

Coffea canephora is a shrub or small trees with 4–8 m tall; branches glabrous. Petiole 10–20 mm, glabrous; leaf blade drying thickly papery, elliptic, elliptic-oblong, or occasionally

ovate-oblong, 12–40 × 4.5–22 cm, glabrous on both surfaces, base cuneate to obtuse, margins flat or occasionally crisped-undulate, apex acuminate with tip 10–18 mm; secondary veins 8–17 pairs, domatia present; stipules triangular, 6–18 mm, obtuse to acute.

Inflorescences with cymes 1–6 or more in each axil, each cyme 3–5 flowers or more, subsessile to pedunculate with peduncles up to 5–7 mm; pedicels to 2 mm. Calyx glabrous; ovary ellipsoid, 1–2 mm. Corolla white to pink with glabrous outside; corolla tube long 5–16 mm; lobes (4 – 8), obtuse to rounded. Drupe red, subglobose, 10–12 × 10–12 mm, smooth when dry, glabrous.

Coffea canephora is known as Robusta coffee. This species is also known as the second most popular coffee after Arabica. It Naturally found in Western and Central Africa, ranging from Liberia to Tanzania, and extending southward to Angola.

3. *Coffea liberica* W. Bull ex Hiern, Trans. Linn. Soc. London, Bot. 1(4): 171-172; t. 24. 1876 (IPNI, 2023). Type: Sierra Leone, cult. Mr. Effenhausen's farm, Danielle s.n. [A608] (lectotype **BM** [BM000903343] designated by Bridson, Fl. Trop. East Africa 1988).

Synonym (The Plant List, 2013):

Coffea abeokutae Cramer, Meded. Dept. Landb. Ned.-Indië 11: p. xv, 425. 1913.

C. excelsoidea Portères ex A.Chev., Ann. Agric. Afrique Occ. 1: 81. 1937.

C. oyemensis A.Chev., Rev. Bot. Appl. Agric. Trop. 1939, xix. 403. 1939.

The habit of *Coffea liberica* is small trees or large shrubs, 6–15 m tall with glabrous branches. Petiole is also glabrous, 8–20 mm; leaf blade drying thinly leathery to stiffly papery, elliptic to obovate or obovate-elliptic, 14–38 × 5.5–20 cm, glabrous on both surfaces, base cuneate to obtuse, margins flat, apex obtuse to shortly acuminate with tip 4–10 mm; secondary veins 7–13 pairs, domatia present; stipules broadly triangular, 2–4.5 mm, obtuse to acute.

Inflorescences with 1–3 cymes per axil, each cyme 2–10-flowered, subsessile; pedicels to 1 mm. Calyx glabrous; Corolla is white and glabrous outside; corolla tube 4–13 mm; corolla lobes 6–8, spatulate to lanceolate or narrowly elliptic, 8–16 mm, obtuse to rounded. The drupe is red, ellipsoid, 19–30 × 15–120 mm, smooth when dry, glabrous.

4. *Coffea liberica* W. Bull ex Hiern var. **dewevrei** (De Wild. & T. Durand) Lebrun, Mém. Inst. Roy. Colon. Belge, Sect. Sci. Nat. (8ov) 11(3): 168. 1941(IPNI, 2023). Type: Democratic Republic of Congo, *Dewèvre 1149* (holotype BR).

Synonym (The Plant List, 2013):

Coffea dewevrei De Wild. & T.Durand in Bull. Soc. Roy. Bot. Belgique 38: 202. 1899.

C. excelsa A. Chev. in Rev. Cult. Colon. 12: 258. 1903.

C. dewevrei var. *excelsa* (A.Chev.) A.Chev. in Encycl. Biol. 22: 29. 1942.

Coffea liberica var. *dewevrei* is known as excelsa coffee. The morphological characters are similar to *Coffea liberica*. Leaf blade 15,2 - 24 cm x 17,3 x 24 cm. The drupe is usually large, 29 to 35 mm long with diameter 19 to 21 mm. Domatia present only on midrib.

The excelsa comes from synonym of this species. Initially, A. Chev in 1903 published the new species of *Coffea excelsa* but finally, in 1941, De Wild. & T. Durand corrected that *C. excelsa* is a synonym of *Coffea liberica* var. *dewevrei*. The excelsa name is still popular in the market and coffee lovers.

Coffee production in North Maluku is very low. Based on Badan Pusat Statistik (Badan Pusat Statistik Maluku Utara, 2023), coffee production in 2021 is lower than 15,000 tons from all regency. It appears that coffee farming does not serve as the main income source for farmers in this province (Tamalene et al., 2023). The main farming is still dominated by Coconut and Cocoa.

Generally, *Coffea arabica* is the most common coffee in the world and it the first published coffee species with the genus *Coffea* L. Arabica coffee is also the most widely produced type of coffee in the world and followed by Robusta coffee (Vanden Abeele et al., 2021). For example, Vionita *et al.*, (2021), also reported that in Karo, North Sumatra, farmers only cultivated for *Coffea arabica*. Robusta coffee is common name for species of *Coffea canephora*. Nevertheless, in North Maluku, the most cultivated coffee is robusta coffee and then liberica. Liberica and excelsa coffee are in the same species namely *Coffea liberica* with different varieties. The first one is *Coffea liberica* var. *liberica* and it is still named as liberica coffee. The last one is *Coffea liberica* var. *dewevrei* however it is well known in the international market as excelsa coffee.

Main character to separate every taxon is fruit size or berries. Berries for two taxa namely *Coffea liberica* and *C. liberica* var. *dewevrei* are generally large with thick mesocarp while others coffee are small with thin mesocarp, especially for Robusta coffee (Bahtiar et al., 2023). Laminar size and domatia separated between liberica and excelsa coffee, the idea was supported by Baltazar and Buot (Baltazar & Buot, 2019). Arabica and robusta coffee have small fruits nevertheless inflorescences for *Coffea arabica* are strict to 3 flowers.

CONCLUSION

Farmers cultivated four taxa of coffee and it distributed on eight main islands in North Maluku. The most widely grown coffee is Robusta coffee (*Coffea canephora*). Liberica and excelsa coffee are from same species but different variety. The differ characters of excelsa coffee from liberica are laminar size and position of domatia on leaf.

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