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RESEARCH NOTE

Trichome Composition of Leaf Domatia as Potential Morphoanatomical Marker of the Four Commercially Viable *Coffea* Species

Lloyd O. Balinado[1,2]* and **Lourdes B. Cardenas**[2]

[1]Department of Biological Sciences, College of Arts and Sciences
Cavite State University, Indang, Cavite 4122 Philippines
[2]Plant Biology Division, Institute of Biological Sciences, College of Arts and Sciences
University of the Philippines Los Baños, Laguna 4031 Philippines

Trichomes are epidermal extensions that play a role in providing structural defense, affecting photosynthesis, and accumulating secondary metabolites. These trichomes may also occur in leaf domatia – providing various roles for interaction with mites and other arthropods. In the present study, leaf domatia of four *Coffea* species – namely *C. arabica* L., *C. canephora* Pierre ex. A. Froehner, *C. liberica* Hiern, and *C. excelsa* A. Chev – were examined for trichome composition. Leaf domatia were observed in all species and were found to be in association with trichomes. Its distribution, on the other hand, interestingly differed among species and could thus serve as a potential morphoanatomical marker. Trichomes in *C. arabica* were observed to exist around domatia pore, while it forms along the adjacent epidermal tissue in *C. canephora*. However, no difference was found between *C. liberica* and *C. excelsa*. Both exhibited trichome formation within domatia chambers and along the entry point of domatia pore.

Keywords: *Coffea*, coffee, domatium, leaf anatomy, trichome

One economically important member genus of Rubiaceae is *Coffea*. It consists of approximately 100 taxa and is mostly grown in the tropical and subtropical regions (Krishnan 2017, Prakash *et al.* 2015). The Philippines is one of the few countries that produce the four varieties of commercially-viable coffee – namely *C. arabica* L., *C. liberica* Hiern (locally known as *kapeng barako*), *C. excelsa* A. Chev., and *C. canephora* Pierre ex A. Froehner (Cao *et al.* 2014, Mojica 2002).

Coffea spp. may or may not possess tiny structures known as domatia that are usually present in the vein axils on the underside of many Angiospermae leaves (Romero *et al.* 2011). Domatia primarily function as refuges for beneficial mites, which inhibit pathogen attacks and leaf herbivory by predators. In case it is present, it usually occurs in a glabrous to pilosulous foveolate form. However, only a few studies on this structure in coffee leaves – specifically in terms of trichome distribution – have been reported, making the genus less known for trichome composition. Most of these researches focused only on domatium morphology, specifically of *C. arabica*, and its role in plant-mite association (Romero *et al.* 2011, O'Dowd 1994, Nakamura *et al.* 1992); hence, this study was conducted to preliminarily investigate the morphology and distribution of trichomes in domatia of *C. arabica*, *C. canephora*, *C. liberica*, and *C. excelsa* leaves.

With permission from the National Coffee Research Development and Extension Center (NCRDEC), Cavite State University, Indang, Cavite, healthy mature domatium-containing leaf samples were collected from

*Corresponding author: lloydbalinado@gmail.com

five representative trees of each of the *Coffea* species (except for *C. liberica*, which only involved one tree due to its unavailability). Five leaves were taken from each tree, specifically from the third node of each branch for consistency. This gave a total of 25 leaves per species – a sample size that is enough to obtain qualitative data that would sufficiently address the research problem (Williams 2007; Creswell 1998, 2003). The samples were placed in resealable plastic bags containing wet cotton balls to maintain a moist environment. These were immediately brought to the Department of Biological Sciences, College of Arts and Sciences of the same institution for microscopic examination.

Cross-sections of fresh coffee leaf samples were prepared by freehand sectioning. These were made at the location of the domatia *i.e.*, at the intersection between the midrib and secondary veins on the abaxial side of the leaf blade. Resulting specimens were examined for the presence and distribution of trichomes using a compound binocular light microscope.

Morphologically, coffee leaf domatium appears as a round or elliptical structure that is either of pit type where leaf surface is invaginated reaching the mesophyll, or pocket type where the cavity is always larger than the pore. In addition, these leaf domatia were found in association with hair-tufts or trichomes. Microscopic examination further revealed that these trichomes exist as unicellular, non-glandular structures with thick walls protruding from the invaginated epidermal surface of the leaf underside (Fig. 1). Interestingly, a difference in the position of trichomes in the domatium among the four *Coffea* species was observed (Figs. 2 and 3).

Trichomes in leaf domatia of *C. arabica* were found to be situated outside the domatium around the domatium pore. In case of closed domatia, trichomes were found on the same spot *i.e.*, protruding at the center of the domatium where pore would most likely develop. Few trichomes may also develop within the compartment; however, this was rarely observed. For *C. canephora* – trichomes were also found outside the domatium but in a different position. It was found lining the epidermis from the domatium up to the midrib. Lastly, for *C. liberica* and *C. excelsa*, trichomes were observed within the compartment. In addition, these were found lining the entry point of domatium pore. These observations in both *C. liberica* and *C. excelsa* may then support the idea that *C. excelsa* is only a variety of *C. liberica*. Further, the observation that open and closed domatia of these *Coffea* plants both contained trichomes suggests the non-influence of domatium opening to trichome development and positioning. This could also indicate that trichome formation is constitutive and is not induced by the presence of associated mites that usually occupy the chambers of open domatia. O'Dowd and Wilson (1989) hypothesized that such trichomes in leaf domatia function to: (1) trap pollen and fungal spores that serve as food for mites; (2) increase the humidity levels, thus protecting mites from desiccating conditions; and (3) provide mites with physical refuges from predatory arthropods, including other mite species.

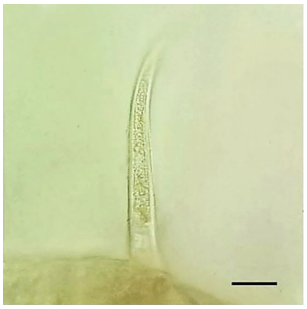

Figure 1. An individual domatial trichome observed in *C. liberica* (scale: 0.25 μm).

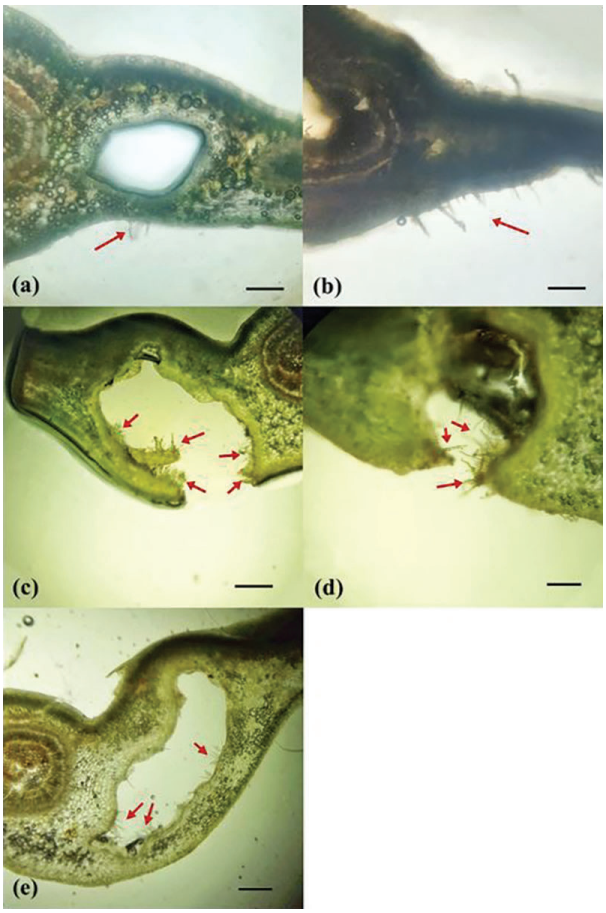

Figure 2. Trichome distribution (as indicated by red arrows) in leaf domatia of (a) *C. arabica*, (b) *C. canephora*, (c) *C. liberica*, (d) *C. excels*, and (e) *C. liberica* (scale: 0.4 mm).

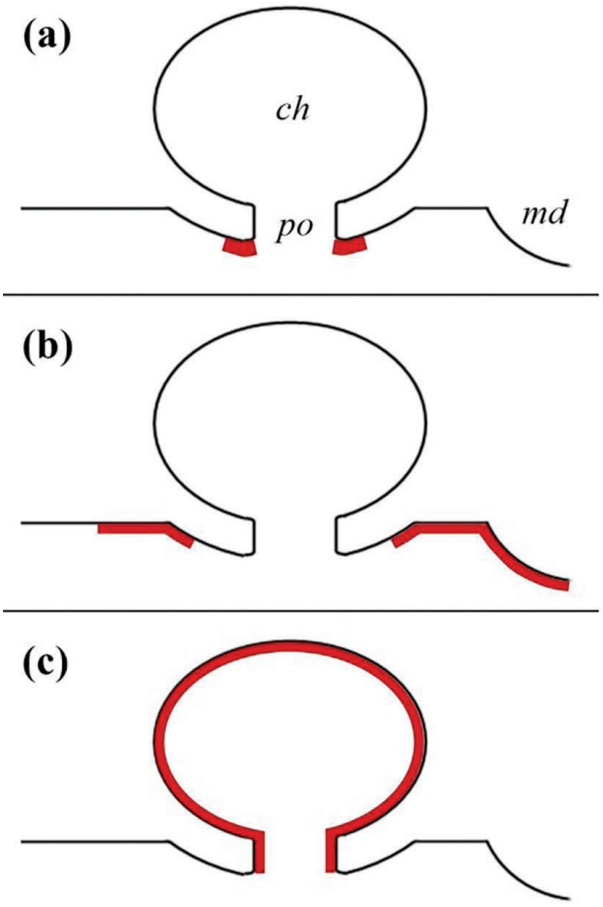

Figure 3. Diagrammatic representation of leaf domatia showing trichome distribution (shown as red highlight) in (a) *C. arabica*, (b) *C. canephora*, and (c) *C. liberica* and *C. excels*: *ch* – domatia chamber; *md* – midrib; *po* – domatia pore. Note: chamber size ranges 1–3 mm.

This study, therefore, demonstrated the presence of trichomes in coffee leaf domatia and the difference in its position among the four local *Coffea* species – namely *C. arabica*, *C. canephora*, *C. liberica*, and *C. excelsa*. This could then indicate that this could serve as potential morphoanatomical marker for these four species in the country; however, more extensive research on this must be carried out especially with *C. liberica*, which only had one representative sample in this study. Further, to investigate the stability of this morphoanatomical trait, it is recommended to compare the obtained results with samples taken from other coffee-producing provinces.

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