# MICROMORPHOLOGY, ANATOMY AND HISTOCHEMISTRY OF *TECOMARIA CAPENSIS* LEAVES

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**Abstract.** Morphoanatomical and histochemical studies hold significance in the classification, identification, and furthering of our understanding of plants and their interactions with environments. These investigations aid in improving our understanding of the adaptive strategies of plants, which are impacted by both abiotic and biotic elements. *Tecomaria capensis* a native southern African plant has often been used in traditional medicinal practices. However, there is a lack of specific studies on the physical characteristics and microstructures of the plant. This study aimed to analyze the morphoanatomy of the leaves of *T. capensis*. The analysis of the microstructures present was accomplished using microscopy (stereomicroscopy, compound light microscopy, and scanning electron microscopy) and histochemical analysis. The investigations revealed two distinct trichome types on the abaxial and adaxial leaf surfaces, namely glandular and non-glandular trichomes. The histochemical analysis suggests the presence of phenolics, which are known to have healing properties in humans. This study reported on the morphoanatomy of the surface structures present on *T. capensis* leaves, including their distribution, basic function, and chemical composition.

**Keywords:** *cape honeysuckle, dendritic trichomes, glandular trichomes, histochemistry, leaf morphoanatomy, non-glandular trichomes*

## Introduction

Since the beginning of civilization, people have reaped the multiple benefits that plants could provide such as being a nutritionally valuable food source to opening the pathway to modern medicine (Gurib-Fakim, 2006). Before hospitals, pharmacies, and modern medicine, people would treat their wounds and ailments using extracts from plants (Da Cheng et al., 2015). For centuries *Handroanthus impetiginosus* or *Tabebuia avellanedae* (Bignoniaceae family) was used in traditional indigenous South American medicine to treat various ailments (Nahar et al., 2023). The phenolic chemical compound Lapachol (also known as naphthoquinone) was originally isolated from *Handroanthus impetiginosus* and was found to have multiple pharmacological properties such as anti-cancer, anti-inflammatory and anti-microbial activities and is subject to many investigations due to its potential (Zhang et al., 2020). Therefore, plants


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have been an integral part of the development of modern medicine and successively, the survival of mankind. The study of chemical compounds which plants produce are highly important in modern medicine (Gurib-Fakim, 2006). Plants produce primary metabolites, such as carbohydrates and amino acids, that are formed through metabolic processes and contribute directly to plant growth and development (Wagner, 1991; Gurib-Fakim, 2006). However, plants also produce secondary metabolites which are by-products of plant metabolism and do not affect plant growth or development directly (Fahn, 1988; Wagner, 1991; Werker, 1993). Secondary metabolites were found to be the chemical compounds responsible for the biologically active properties of plant extracts, such as the healing effects in humans, and are referred to as bioactive compounds or phytochemicals (Gurib-Fakim, 2006). Unlike primary metabolites, secondary metabolites are not universally produced by all plants, as they are highly specific to different vascular plant families (Taiz and Zeiger, 2010). The secondary metabolites are produced, stored, and released (secreted/exuded) by plant secretory structures.

Trichomes, nectaries, salt glands, hydathodes, laticifers, resin, and gum ducts are examples of secretory structures found in some plants, that are classified based on the biochemicals found within them (Fahn, 1988). There are 2 types of trichomes: glandular and non-glandular. The morphology of the trichome depends on the plant species, habitat, tissue type, and function (Wagner, 1991; Fahn and Shimony, 1996). Hence, there are different types of trichomes such as the protective non-glandular trichomes, and the secretory glandular trichomes (Payne, 1978). Non-glandular trichomes are hair-like structures that form a physical barrier between the plant surface and its environment (Werker, 2000). For example, non-glandular trichomes can be rigid, and needle-like which can cause physical and internal damage to organisms that attempt to consume the plant (Payne, 1978; Kariyat et al., 2017). However, these trichomes differ from other physical defence structures such as spines, prickles, and thorns that originate from the subepidermal tissue (Evert, 2006; Dias et al., 2019). The non-glandular trichomes are highly diverse, for example, they can be simple with a uniseriate stalk, a basal cell, and variable length observed in *Plumbago auriculate* (Plumbaginaceae) (Singh et al., 2019). This variety is due to there being a vast number of plant families, the distinct types of trichomes have been classified and defined by Payne (1978). Beyond physical defense from biotic factors, non-glandular trichomes also reflect light rays, shield stomata from direct UV rays to prevent water loss via transpiration, and aid in thermal and water balance (Johnson, 1975, as quoted by Makeyiso et al., 2008). Glandular trichomes produce secretions that have a variety of functions that serve as a survival mechanism in plants, for example, protecting the plant from abiotic and biotic factors, however, it could also attract pollinators (Demarco, 2017). Glandular trichomes are further categorized as peltate and capitate glandular trichomes. Capitate trichomes usually have a multi-cellular stalk that is more than half the height of the head (Werker, 2000; Gairola et al., 2009). Peltate trichomes are characterized by their short, usually unicellular stalk and broad head (Fahn, 1988). The glandular peltate and capitate trichomes usually exude bioactive lipophilic substances such as essential oils (Fahn, 1988; Werker, 2000). A morphoanatomical study of plants involves the analysis of their physical characteristics and structures that are influenced by various environmental factors (Milan et al., 2006; Teixeira et al., 2018). Trichomes in the Bignoniaceae family are highly variable and information concerning the development in its evolutionary path, including its genetic characteristics and adaptive morphology, is limited (Nogueira


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et al., 2013). The understanding of the morphology and anatomy is highly important as it is indicative of the selection agents that lead to the development of these structures, which would help in comparisons across the taxa (Fahn, 1988).

*Tecomaria capensis* (Thunb.) Lindl./(Thunb.) Spach., commonly known as the Cape honeysuckle, belongs to the family Bignoniaceae Juss. (Gentry, 1974). Members of this highly diverse family are primarily trees, shrubs, and lianas with 110 genera and 800 species (Simpson, 2010). *Tecomaria capensis* was previously classified under the *Tecoma* genus, due to its similar morphology, in the clade Tecomeae (Goldblatt and Gentry, 1979; Fischer et al., 2004; Kedar et al., 2018). However, with molecular evidence (using chloroplast DNA), the difference observed was significant and the African species were classified separately as *Tecomaria* (Olmstead et al., 2009).

*Tecomaria capensis* is native to South Africa, it is found mainly as a shrub throughout Limpopo, Mpumalanga, and along the coasts of KwaZulu-Natal and Eastern Cape (Mutshinyalo and Notten, 2016). This plant has been cultivated globally as an ornamental and hedge plant. *Tecomaria capensis* grows up to 4 meters as a clambering, semi-erect and multi-stemmed shrub (Acevedo-Rodríguez, 2005; Mutshinyalo and Notten, 2016). It is an evergreen plant found in warm and tropical regions (Mutshinyalo and Notten, 2016). The leaves are imparipinnate, which is a compound leaf that is composed of a central stem with leaves on either side and a singular leaflet at the tip (*Fig. 1A*). The individual leaves have an oval or obtuse shape with a serrate margin. The abaxial (lower) side of the leaf is a lighter green than the dark green adaxial side (Gentry, 1992; Acevedo-Rodríguez, 2005). The inflorescence consists of numerous flowers that occur as axillary racemes. The corolla is curved, tubular, and can be a deep orange or yellow (*Fig. 1B*). The flowers produce nectar that attracts a wide range of pollinators such as birds (especially sunbirds), bees, and other insects (Rivera, 2000). The seeds have hyaline membranous wings and are therefore dispersed via wind (Gentry, 1992).


***Figure 1.*** *Imparipinnate compound leaf of T. Capensis (A). Multiple flowers of T. capensis attached to an axillary raceme (B)*


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Medicinally, the leaves of *T. capensis*, are used to treat diarrhea and gastroenteritis (Van Wyk and Gericke, 2000; Würger et al., 2014; Adebayo and Amoo, 2019). Furthermore, methanolic extracts from the leaves was found to have analgesic, anti-inflammatory, and antipyretic properties (Saini and Singha, 2012). Several bioactive compounds which promote healing, such as flavonoids, phenolics, and tannins, have been found in the leaf extracts of *T. capensis* (Saini and Singha, 2012; Saini et al., 2012). Despite the studies on the extracts of *T. capensis*, there is little information on the surface structures present on the leaves. This study aimed to describe and analyze the morphoanatomy of the leaves of *T. capensis* to gain an understanding of the characteristics of the microstructures present on the surface of the leaves. This study investigated the significance of the distribution and the functioning of the microstructures on the surface of the leaves. The objectives of this study were to collect observational data on the microstructures present on the abaxial and adaxial leaf surfaces using stereomicroscopy, light microscopy, scanning electron microscopy, and histochemical analysis to test for the presence of chemical compounds.

## Materials and methods

### *Plant collection*

Fresh *T. capensis* leaves were collected from Malvern, KwaZulu-Natal, Durban, South Africa (29.8835° S, 30.9217° E) in March 2022, early autumn. This shrub was fully-grown and is used as a hedge plant in a garden. Five leaves each from 3 plants (at the same location) were collected at two developmental phases (emergent and mature) and were examined throughout the study. Emergent leaves were identified by their size (small ~1 cm) and light green coloration on both sides whereas mature leaves were bigger (~2 cm) and darker green on the adaxial surface and lighter green on the abaxial side.

### *Stereomicroscopy*

Stereomicroscopy was conducted using a Nikon AZ100 stereomicroscope (Nikon Corporation, Yokohama, Japan) equipped with a Nikon Fiber Illuminator and images were photographed using the NIS-Elements Software (NIS-elements D 3.00). The abaxial and adaxial surfaces of the fresh leaves were examined, whilst focusing on the surface details, at low magnification and high magnification.

### *Scanning electron microscopy*

Scanning electron microscopy (SEM) was used to examine the microstructures present on the leaf surfaces (adaxial and abaxial). The fresh leaves were cut into 3 mm sections and were placed in 2.5% glutaraldehyde for 2-24 h, then were rinsed three times in a neutral buffer. Thereafter, sections were submerged in 0.5% osmium tetroxide for 1 h and then rinsed with distilled water. To allow for dehydration, the sample was treated with a gradual series of ethanol (30%, 50%, 75%) for 5 min each and then with 100% ethanol for 10 min. The sections were dried in a critical point dryer (Quorum K850) for 1-3 h and finally, the sections are sputter coated (Quorum K850) with gold to enhance the conductivity of the sample for viewing in the SEM.


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### *Compound light microscopy*

The emergent and mature leaves were first sectioned into 3 mm pieces and fixed using the chemical fixation method. Thereafter, the dehydrated samples were infiltrated with varying ratios of Spurr's resin and acetone. Samples were then embedded in 100% resin in silicone molds and placed in the oven at 70°C for 8 h. The sections were stained and sectioned using the Leica EM UC7 ultra-microtome equipped and stained with toluidine blue. The survey sections were examined using a compound light microscope (Nikon Eclipse 80i light compound microscope), focusing on the anatomy.

### *Histochemistry*

Histochemical analysis was done to determine the chemical secretions present in the leaf sections. This method was done using different stains, based on Demarco (2017). The control was treated with 1:1 methanol/chloroform (Lison, 1960). Hydrophilic substances, such as mucilages, pectins, and nucleic acids, were stained using ruthenium red, which stained pink/red (Colombo and Rascio, 1977; Demarco, 2017). Lipids were stained using Sudan III-IV (Buda et al., 2009). Phenolic compounds were stained using ferric trichloride (Zarate and Yeoman, 1994). Alkaloids were stained using Dittmar's reagent and Wagners reagent (Johansen, 1940). Terpenes were stained using NADI Reagent, such as essential oils (that stain blue) and resins (that stain red) (David and Carde, 1964; Demarco, 2017). Lignin aldehydes were stained using phloroglucinol (Jensen, 1962). Carboxylated polysaccharides and polyphenols were stained using toluidine Blue (O'Brien et al., 1964).

## Results

### *Stereomicroscopy*

In *Figure 2*, the adaxial surface of the mature and young leaves appear dark green. The mature leaf has a sparse scattering of non-glandular trichomes and secretory glands over the entire adaxial surface. However, there is a denser distribution of trichomes along the midrib (*Fig. 2B*). The non-glandular trichomes are subulate, acicular, and hair-like in appearance, defined following the classification of trichomes by Payne (1978). The young leaf has a denser distribution of trichomes and secretory glands over the entire adaxial surface (*Fig. 2C-D*). The tip and margin of the young leaf have a dense distribution of acicular non-glandular trichomes (*Fig. 2C*). The base of the young leaf has a dense distribution of glandular structures along the midrib (*Fig. 2D*). In *Figure 3*, the abaxial side of the mature and young leaves are light green. The mature leaf has a noticeably dense distribution of dendritic non-glandular trichomes along the midrib (*Fig. 3A*). The dendritic trichomes can be seen clustered together as a network of branched trichomes (*Fig. 3B*). On the midrib, unbranched subulate, acicular non-glandular trichomes are observed (*Fig. 3B*). The young leaf has mostly subulate, acicular non-glandular trichomes along its midrib and more secretory structures than the mature leaf (*Fig. 3C-D*). The margin of the young leaf is rimmed with acicular trichomes and is especially dense at the tip of the leaf (*Fig. 5C*). The secretory structures are found mainly along the midrib and vein out branches at a higher density than on the mature leaf abaxial surface (*Fig. 3D*).


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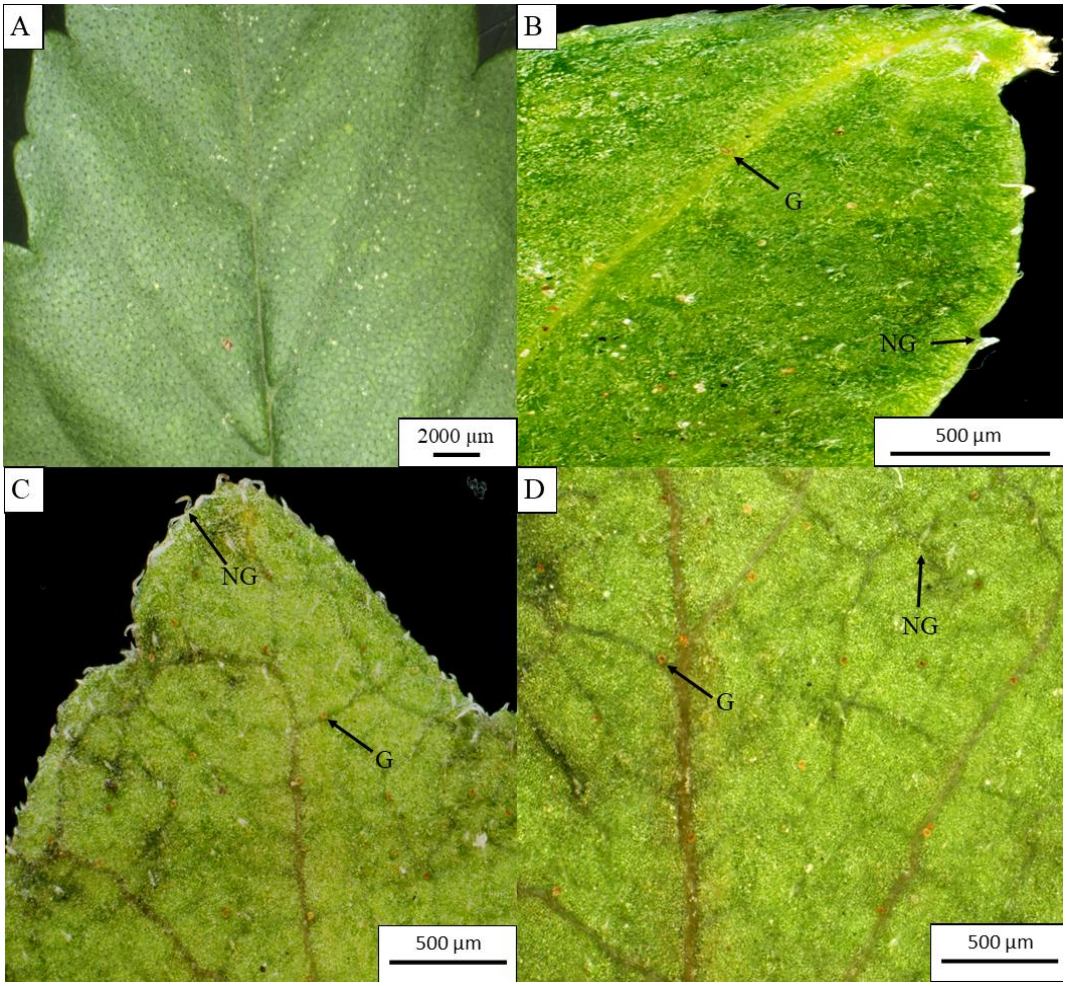


***Figure 2.*** *Stereomicrographs showing the adaxial surface on T. capensis young and mature plant leaves. (A) Micrograph showing a low magnification image of the adaxial surface of a mature leaf. (B) Micrograph showing a high magnification distribution of subulate non-glandular trichomes sparsely distributed on the leaf (white), glandular trichomes seen along midrib and leaf surface orange in color). (C) Micrograph showing a low magnification image of the adaxial surface of a young leaf with an increased distribution of acicular non-glandular trichomes at the leaf tip. (D) Micrograph showing a high magnification distribution of subulate, acicular trichomes on leaf margins and surface, with an increased distribution of glandular trichomes on the mid-rib. Abbreviations: NG = Non-glandular trichomes, G = Glandular trichomes*

### *Scanning electron microscopy*

In *Figure 4*, the adaxial surface of the mature and young leaves was imaged under high magnification using SEM. The young leaf had a higher density distribution of non-glandular and glandular trichomes over the entire adaxial leaf surface (*Fig. 4A*). The non-glandular trichomes were adjacent to the glandular trichomes (*Fig. 4B*). The adaxial surface of the mature leaf had only non-glandular trichomes observed on the leaf surface, they were acicular and subulate, some were straight and other were slightly curved (*Fig. 4C*). There were no glandular trichomes to be seen on the adaxial surface of the mature leaf (*Fig. 4C*). The non-glandular trichomes had a visible epidermal cellular pedestal (*Fig. 4D*).


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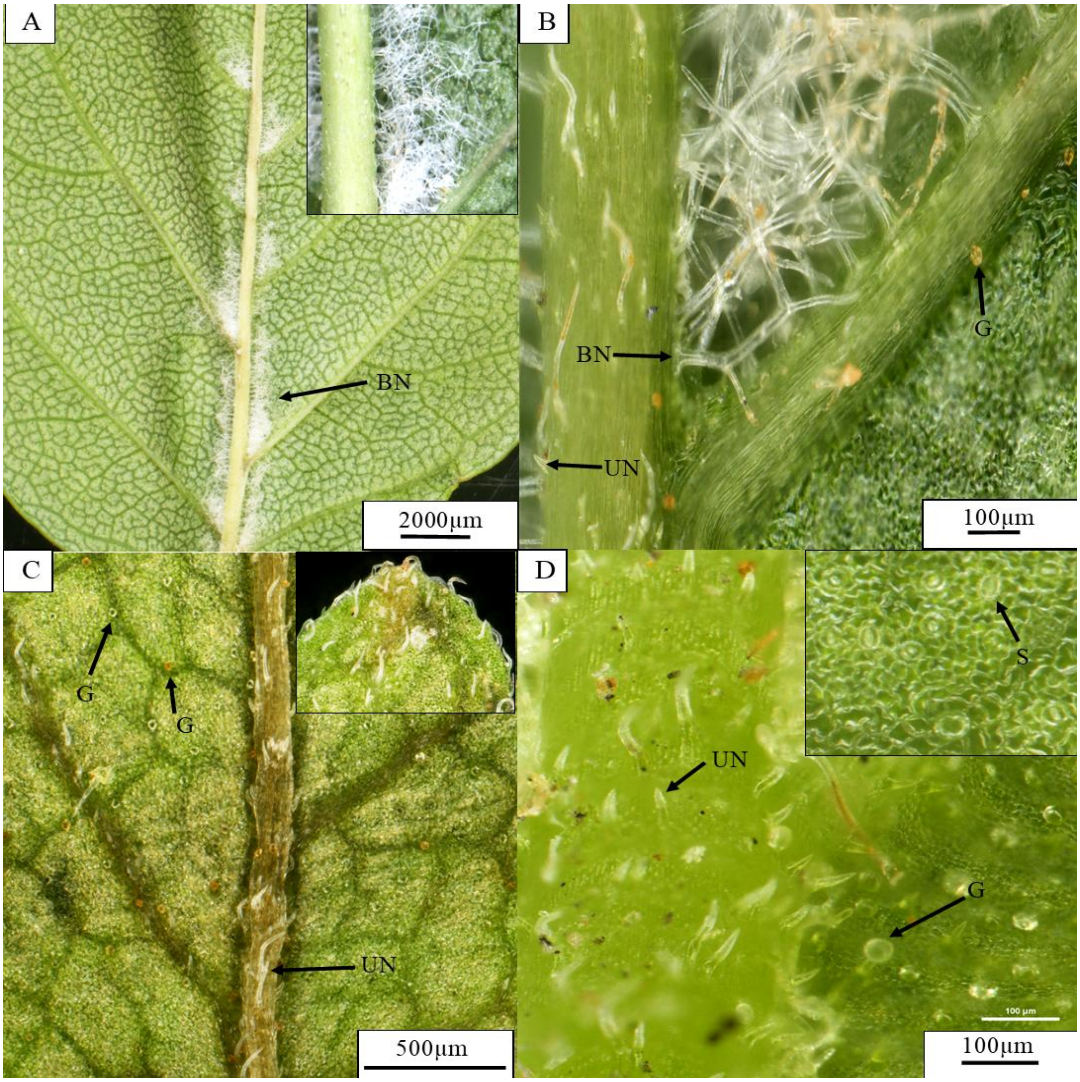


***Figure 3.*** *Stereomicrographs showing the abaxial surface on T. capensis young and mature plant leaves. (A) Micrograph showing a low magnification distribution of non-glandular trichomes along the midrib of a mature leaf. (B) Micrograph showing a high magnification dendritic non-glandular trichomes densely distributed along the midrib and unbranched subulate trichomes on the midrib of a mature leaf, exudate appears orange in color. (C) Micrograph showing a low magnification abaxial surface of a young leaf with an increased distribution of subulate, falcate non-glandular trichomes along the midrib, margin and at the leaf tip (inset) with glandular trichomes along the midrib and vein outer branches. (D) Micrograph showing a high magnification distribution of subulate, falcate trichomes on the concentrated along the midrib, with an increased distribution of glandular trichomes on the surface of a young leaf. Abbreviations: UN = unbranched, Non-glandular trichomes, BN = Branched non-glandular trichomes, G = Glandular trichomes, S = Stomata*

In *Figure 5*, the abaxial surface of the mature and young leaves was examined under high magnification using SEM. The young leaf had glandular and non-glandular trichomes along its abaxial surface (*Fig. 5A*). There were unbranched acicular non-glandular trichomes and branched dendritic trichomes seen alongside glandular trichomes and stomatal pores, mainly along the midrib (*Fig. 5B*). The mature leaf had a dense dendritic non-glandular trichome network adjacent to the midrib and acicular,


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subulate non-glandular trichomes along its midrib (*Fig. 5C*). The dendritic trichomes were multicellular, seen by the septation of its branches (*Fig. 5D*). A peltate glandular trichome is seen in *fig. 5D*, however, its head burst open. The longer, acicular, and unbranched non-glandular trichomes were seen along the midrib (*Fig. 5D*). The epidermal cells surrounding the stomata were irregular in shape but consistent in their distribution over the entire surface (Fig 5*A, B, E*). At a higher magnification of the abaxial surface of a young leaf, the stomatal pores, and glandular and non-glandular trichomes can be seen densely distributed in the same area alongside the midrib (*Fig. 5E*). Whereas the mature leaf has its stomatal pores underneath the dendritic network and no visible glandular trichomes (*Fig. 5F*).

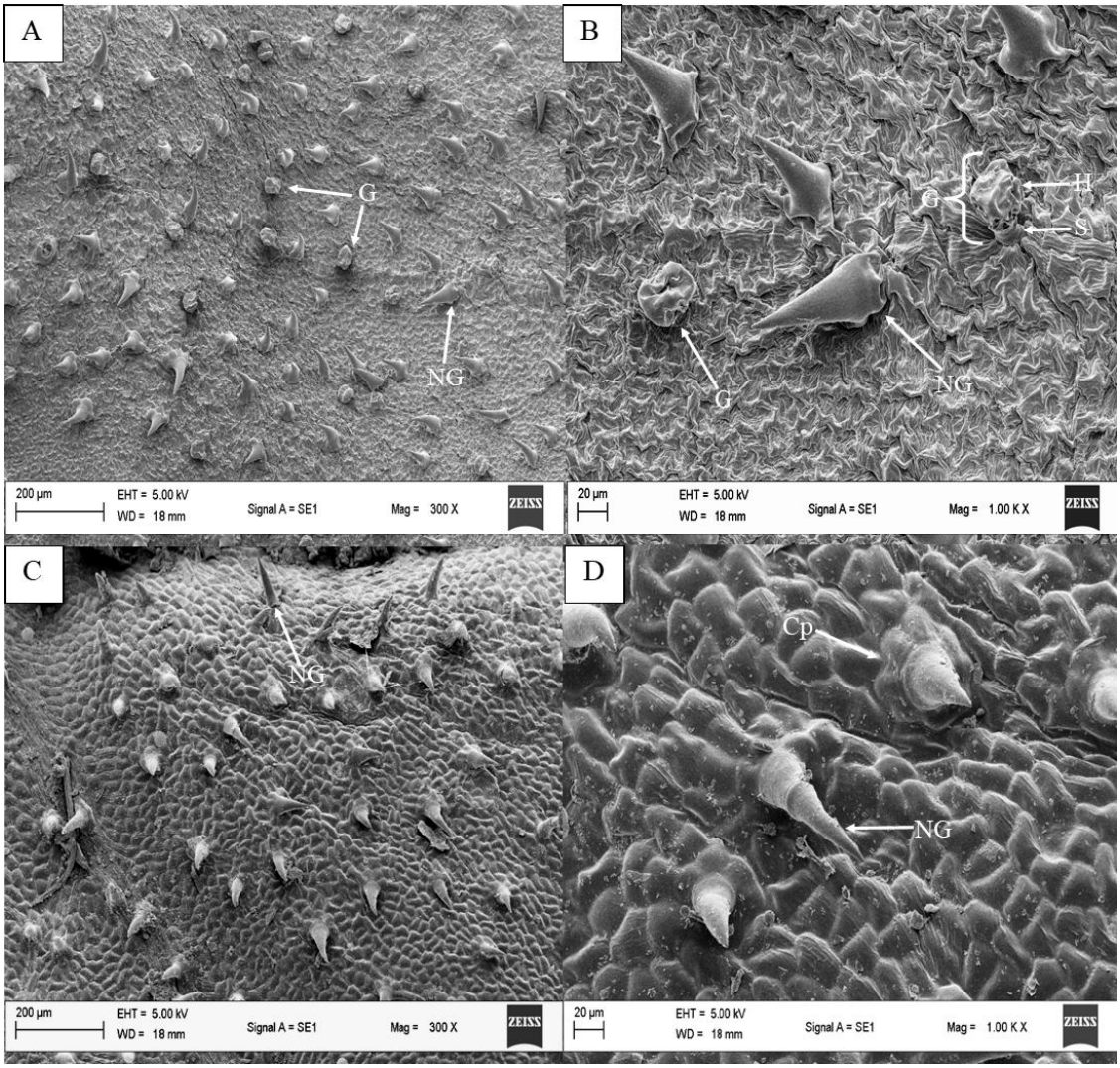


***Figure 4.*** *Scanning electron micrographs showing the adaxial surface of a young and mature leaf of T. capensis. (A) Micrograph showing a low magnification distribution of non-glandular and glandular trichomes on young leaf surface, the density of each is almost equal. (B) Micrograph showing a high magnification distribution of a unicellular non-glandular and a glandular capitate trichome on young leaf surface. (C) Micrograph showing a low magnification distribution of trichomes, mostly subulate, unbranched non-glandular trichomes. (D) Micrograph of a high magnification subulate, unicellular non-glandular trichomes. Abbreviations: NG = Non-glandular trichome, G = Glandular trichome, H = Head, S = Stalk, Cp = Epidermal cellular pedestal*


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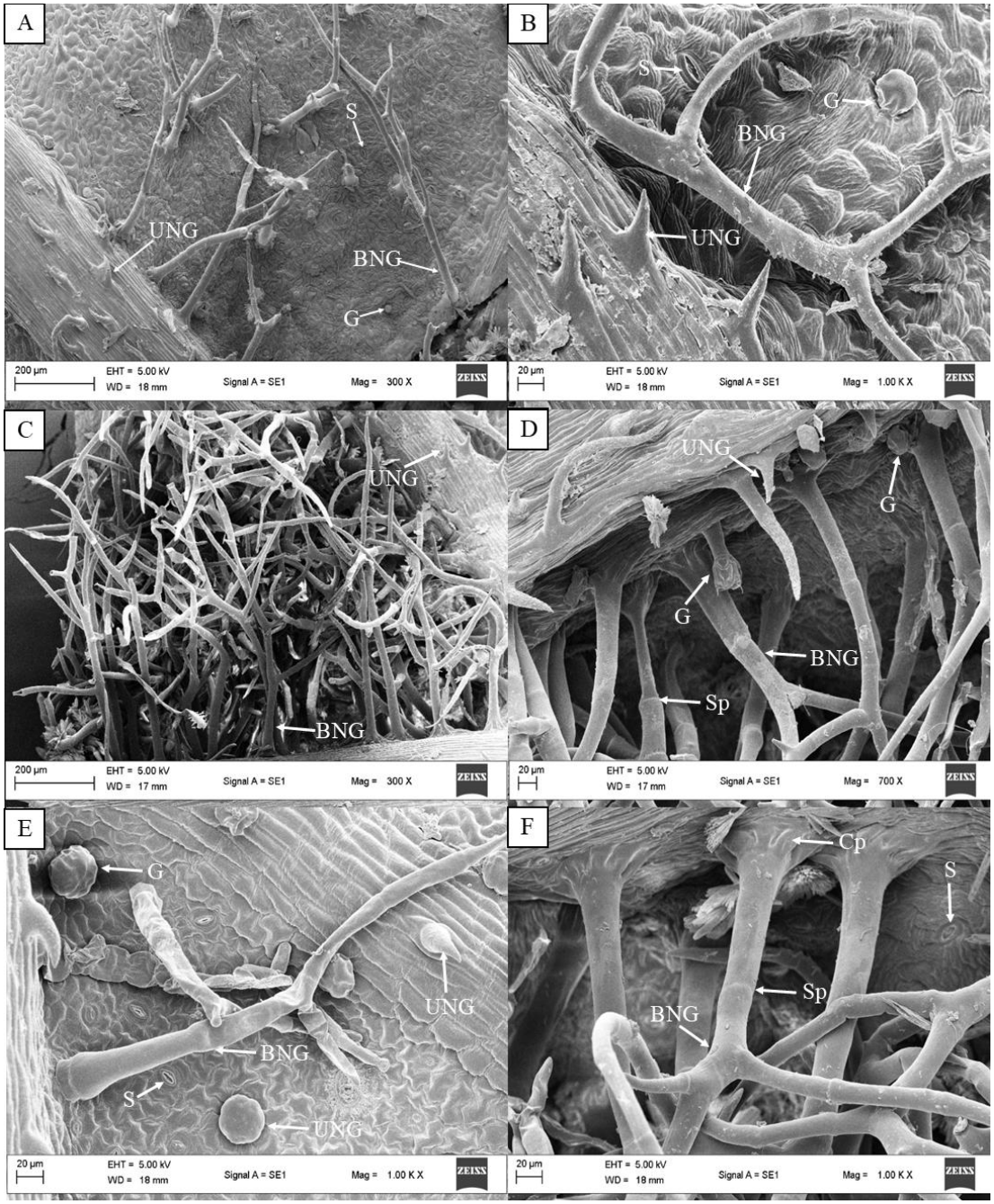


***Figure 5.*** *Scanning electron micrographs showing the abaxial surface of a young and mature leaf of T. capensis. (A) Micrograph showing low magnification of a branched non-glandular and glandular capitate trichomes on young leaf surface, branched and unbranched non-glandular trichomes. (B) Micrograph showing high magnification of two types of non-glandular and glandular trichomes on young leaf surface, stomata and multicellular non-glandular trichomes. (C) Micrograph showing a low magnification of distribution of dendritic branched non-glandular trichomes on mature leaf. (D) Micrograph of a high magnification image of non-glandular and glandular trichomes on a mature leaf. (E) Micrograph showing medium magnification of non-glandular and glandular capitate trichomes on young leaf. (F) Micrograph of high magnification dendritic non-glandular trichomes and stomata underneath on a mature leaf. Abbreviations: UNG = Unicellular Non-glandular trichome, BNG = Branched Non-glandular trichome, G = Glandular trichome, S = Stomata, Sp = septation of multicellular trichome, Cp = Epidermal cellular pedestal*


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### *Light microscopy*

In *Figure 6,* a thin cuticle (wax layer) is seen above a uniform upper epidermal layer. There is a single layer of palisade cells that are followed by a few horizontal cells before the spongy mesophyll layer of cells (*Fig. 6*). A vascular bundle can be seen, with a layer between the xylem and phloem. In *Figure 7,* the acicular, subulate trichomes are unicellular (*Fig. 7A*) and the peltate trichomes have a multicellular head and unicellular short stalk (*Fig. 7B*).

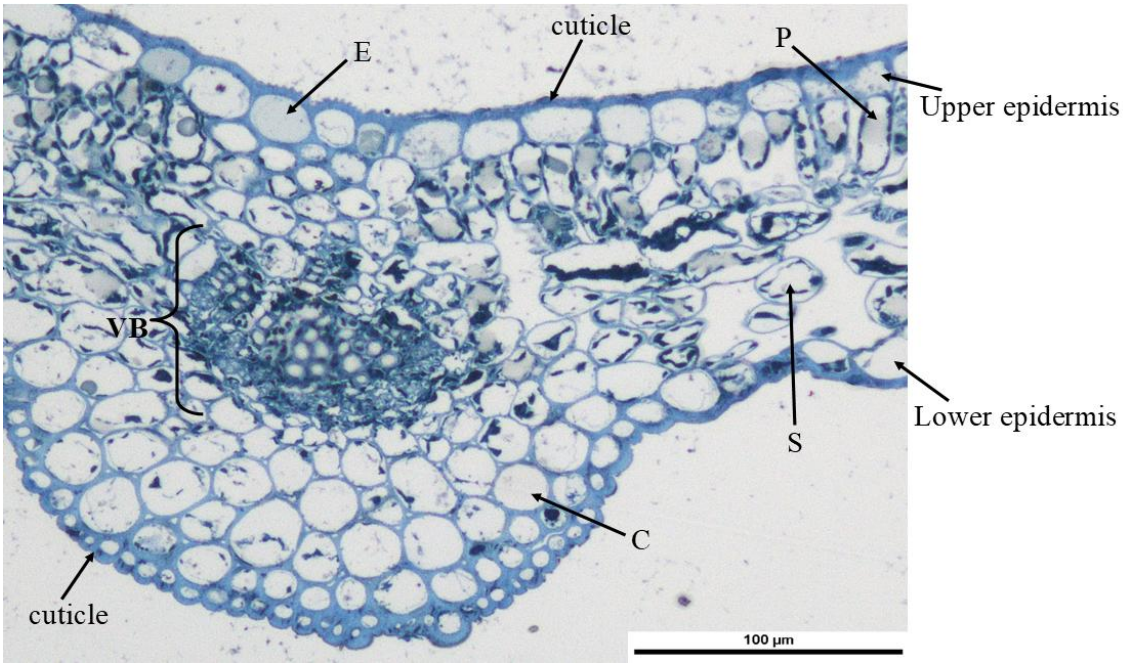


***Figure 6.*** *Light micrograph showing transverse sections of T. capensis leaf. (A) Light micrograph showing the anatomy of a T. capensis leaf. Abbreviations: E = Epidermal cell, S = Spongy mesophyll, P = Palisade cell, C = collenchyma, VB = vascular bundle*

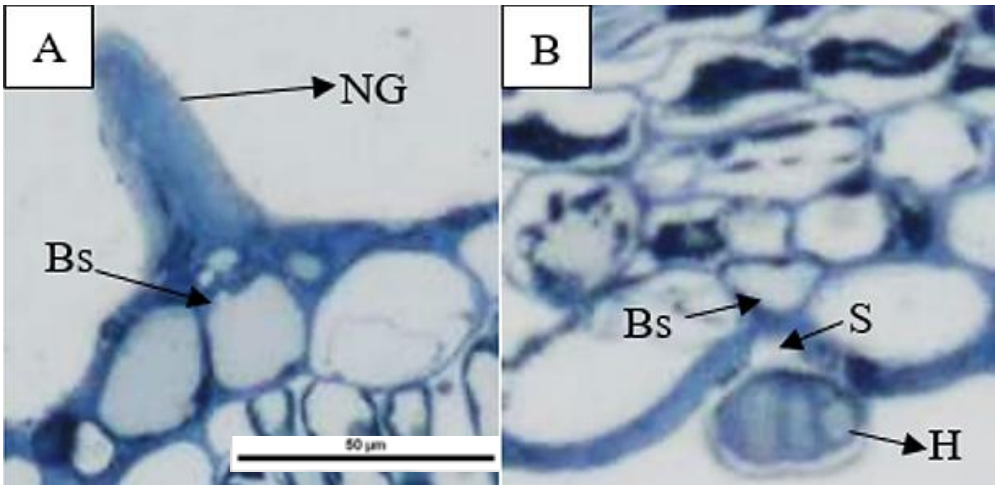


***Figure 7.*** *Light micrographs showing transverse sections of T. capensis leaf trichomes (A) Light micrograph showing the anatomy of a unicellular non-glandular trichome. (B) Light micrograph showing the anatomy of a glandular capitate trichome. Abbreviations: Bs = Basal cell, H = Head, NG = non-glandular trichome, S = stalk (scale bar = 100 µm)*


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### *Histochemistry*

The results of the histochemical tests are summarized in *Table 1*. The histochemical tests were positive for alkaloids (*Fig. 8A, B*), lipids (*Fig. 8C*), mucilage and gums (*Fig. 8D*), terpenes containing steroids (*Fig. 8E*), carboxylated polysaccharides and polyphenols (*Fig. 8H*). However, the phloroglucinol test was negative (no color change) and therefore no lignin aldehydes (*Fig. 8G*). The phenolics test using ferric trichloride was positive (*Fig. 8F*).

***Table 1.*** *Histochemical stain results summary of T. capensis leaf sections obtained*

| Stain | Phytochemical group | Results |
|---|---|---|
| **Dittmar's Reagent** | Alkaloids | Positive (golden/brown) |
| **Wagners Reagent** | Alkaloids | Positive (red/brown) |
| **Sudan III-IV** | Lipids | Positive (reddish orange) |
| **Ruthenium Red** | Mucilage and gums | Positive (pink/red) |
| **NADI** | Terpenes containing steroids | Positive (resins that stain red) |
| **Ferric Trichloride** | Phenolics | Positive (brown/black deposits) |
| **Phloroglucinol** | Lignin aldehydes | Negative |
| **Toluidine Blue** | Carboxylated polysaccharides and polyphenols | Positive |

## Discussion

Previous studies on *T. capensis*, have shown that the anatomy of the leaves consists of phloem that contains intermediary cells (specialized parenchyma), which are large and have a dense cytoplasm containing multiple small vacuoles and abundant plasmodesmata connecting the bundle sheath cells that enclose the vascular system, with the xylem being separated into smaller bundles (Turgeon et al., 1993; Ogundipe and Wujek, 2004; Slewinski et al., 2013; Botha and Murugan, 2021). On the hypodermis, a transition layer was reportedly seen between palisade and spongy mesophyll cells (Ogundipe and Wujek, 2004; Kedar et al., 2018). Another study done by Kedar et al. (2018) using scanning electron microscopy (SEM) reported the findings of unicellular, branched trichomes (subulate, dendric) with raised basal cells (abundant on veins) on the abaxial leaf surface and anomocytic stomata (the cells surrounding the guard cells of the stomata are normal epidermal cells) on the abaxial leaf surface.

In the present study, *T. capensis* leaves were found to have both glandular and non-glandular trichomes (*Fig. 3*). The presence of a fine covering of unbranched non-glandular trichomes, especially on the midrib, and branched dendritic trichome network along the axils of the midrib have been reported as a definite characteristic (Gentry, 1992). The purpose of the non-glandular dendritic networks, adjacent to the midrib, are to protect the glandular trichomes that are found along the leaf midrib. A reason for the presence of glandular trichomes beside stomatal pores may be explained by the secreting function of glandular trichomes. The exudate may prevent excessive water loss (Werker, 2000). The presence of a higher density of trichomes on both the abaxial and adaxial surface of young leaves may be due to the vulnerability of young leaves compared to mature leaves (Ascensão and Pais, 1987; Naidoo et al., 2012). Mature leaves relied less on glandular trichomes and their exudates for protection (Naidoo et al., 2012). Acicular and dendritic trichomes protected the mature leaves from abiotic and biotic pressures (Ogundipe and Wujek, 2004). Non-glandular trichomes are a


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common trichome present in the Bignoniaceae family (Ogundipe and Wujek, 2004; Nogueira et al., 2013). The non-glandular trichomes are supposedly functioned to provide physical defense against UV rays and herbivores (Werker, 2000).

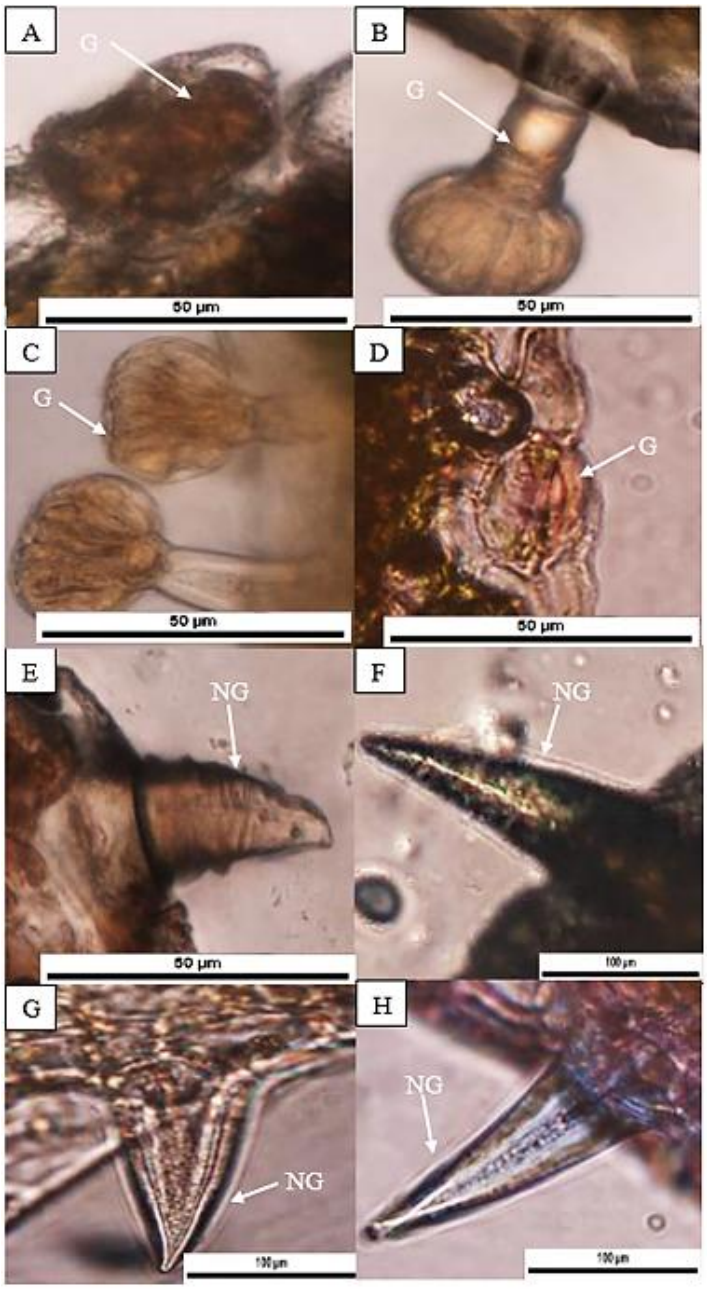


***Figure 8.*** *Light micrograph images of histochemical staining reactions using fresh cross-sections of a T. capensis leaves. (A) glandular capitate trichome stained with Wagners reagent (alkaloids stain reddish brown). (B) Glandular capitate trichome stained with Dittmar's reagent, seen by the stalk and multicellular head. (C) Glandular capitate trichomes stained with Sudan III-IV. (D) Glandular capitate trichomes stained with Ruthenium red. (E) Unicellular non-glandular trichome stained with NADI reagent. (F) Unicellular non-glandular trichome stained with Ferric trichloride. (G) Unicellular non-glandular trichomes stained with Phloroglucinol. (H) Unicellular non-glandular trichomes stained with Toluidine blue Abbreviations: NG = Non-glandular trichome, G = Glandular trichome (scale bar = 50 µm (A, B, C, D) and 100 µm (F, G, H))*


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The surface structures were non-glandular trichomes (subulate acicular and dendritic network), glandular trichomes (peltate), and anomocytic stomata. The trichomes and stomata were in proximity, suggesting that the trichomes protect the plant's leave surface and stomata. Anomocytic stomata is a common characteristic of the family Bignoniaceae, and it is especially distinctive in this species family (Ogundipe and Wujek, 2004; Nogueira et al., 2013). Stomata, another type of surface microstructure, facilitate a relationship between the plant and the atmosphere, through which gaseous exchange and transpiration occur (Taiz and Zeiger, 2010). It is usually found on the abaxial (lower) surface of the leaf (Taiz and Zeiger, 2010).

The histochemical results indicate the presence of certain phytochemicals with a positive reaction to the specific stains used (DeMarco, 2017). Through the histochemical tests the chemicals alkaloids, lipids, mucilage and gums, terpenes containing steroids, carboxylated polysaccharides, and polyphenols were detected in the *T. capensis* leaves (*Table 1*). Alkaloids, terpenes, mucilage, and gums protect the plant and its structures from herbivory (biotic stressor). Lipids on the leaf surface may form a layer of wax, that may protect the leaf surface from excess water loss, which is supported by the presence of the peltate trichomes close to the stomatal pores through which transpiration occurs. Polyphenols defend against ultraviolet radiation (abiotic stressors). Phenolics are known to have antimicrobial and antioxidant properties, which may protect the plant from pathogens. The antimicrobial and antioxidant properties are effective in treating ailments in humans (Saini and Singha, 2012; Saini et al., 2012). Future studies would benefit from focusing on determining the phytochemical composition of the leaves and flowers and testing whether there is a significant difference in the methanolic extract of young and mature leaves of *T. capensis*. This study confirmed the presence glandular and non-glandular trichomes on the abaxial and adaxial leaf surfaces of *T. capensis*. Furthermore, histochemical tests confirmed the presence of bioactive compounds such alkaloids, lipids, mucilage and gums, terpenes containing steroids, carboxylated polysaccharides, and polyphenols. Additional studies should be performed on the phytochemical properties and biological activities of *T. capensis* extracts to establish the use of this species in the development of novel medicine.

## Conclusions

*Tecomaria capensis* was found to have both glandular and non-glandular trichomes over the leaf surface. Young leaves had a higher density of unbranched falcate trichomes distributed over the entire leaf surface compared to mature leaves. Mature leaves were found to have a dense dendritic trichome network adjacent to the midrib. The glandular trichomes found were peltate and concentrated along the midrib area. The histochemical test resulted in the presence of phenolics being detected that could attribute to the medicinal properties.

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