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# MORPHOLOGY AND PHYTOCHEMICAL CHARACTERIZATION OF NATIVE *DENDROBIUM* USED AS A HERBAL MEDICINE IN LAMPUNG, INDONESIA

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**SUMMARY**

*Dendrobium* contains alkaloids, flavonoids, saponins, tannins, and triterpenoids, which served as medicines, including antioxidants and skin brighteners. The presented research sought to determine the conservation through morphological and phytochemical characterization and the potential of native orchids of *Dendrobium* in Lampung, Indonesia. This research transpired on the entire native collection of *Dendrobium* at the Liwa Botanical Garden, West Lampung, Indonesia, particularly, 13 samples with four *Dendrobium* species (*D. nobile*, *D. purpureum, D. minutigibbum*, and *D. montanum*) as comparative controls. Morphological characterization relied on 13 leaf and nine phytochemical characters using the spot test method. The results showed six of the 13 traits, i.e., leaf shape, width, length, shape, tip shape, and cross-section, could be beneficial in identifying orchid species. Cluster analysis on morphological traits based on the phenetic and PCA analyses enunciated positive correlation in the native *Dendrobium* species identification. The phytochemical characterization revealed *Dendrobium* contained alkaloids, flavonoids, saponins, tannins, and triterpenoids with potential as herbal medicines. The results indicated leaf morphology and phytochemical characterization can be applicable for identifying plant types and their potential.

**Keywords:** herbal medicines, leaf traits, phytochemicals, morphological characterization, native *Dendrobium*

**Key findings:** In morphological characterization, 13 leaf traits emerged as key characters in identifying the *Dendrobium* species. Phytochemical characterization of *Dendrobium* exhibited contents of the alkaloids, flavonoids, saponins, tannins, and triterpenoids, with the potential as herbal medicines.

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## INTRODUCTION

*Dendrobium* is a genus of mostly epiphytic and lithophytic orchids of the family Orchidaceae, which has the second-largest number of members worldwide at 2,037 species (Dressler and Dodson, 2000). Apart from being a highly aesthetic ornamental plant, it has long served as a food ingredient, traditional medicine, and cosmetic constituent (Wang, 2021). Historically, Chinese people have used orchids for medicine, with its first recording in Shen-Nung-Ben-Cao-Jing (the earliest Chinese medicine herbs book) and publishing more than 1900 years ago (Wu *et al*., 2023). In *Dendrobium* species, the stems, typically called Shih-hu, occurred in traditional Chinese medicines as a tonic to promote fluid production, aid digestion, nourish 'yin' (cool energy), and eliminate 'evil heat' (unhealthy energy) (Ramesh *et al*., 2019).

*Dendrobium* utilization as an herbal medicine continues to develop due to its therapeutic properties. Past studies reported 483 types of *Dendrobium* contain phytochemicals, with 73 species identified with therapeutic benefits, and 19 species as widespread across Indonesia (Teoh, 2016). Various therapeutic phytochemicals in *Dendrobium* are alkaloids, phenanthrene, bibenzyl, fluorenone, and sesquiterpene. It also helps reduce fever, treat coughs, as a tonic, maintain stomach and lung health, reduce asthma, and heal tuberculosis, itchy skin, boils and acne, nervous disorders, wounds, broken bones, stomach ache, headache, earache, and snake bites. Likewise, it can serve as analgesics, hair tonic, aphrodisiac, astringent, expectorant, anti-inflammatory, anti-coagulant, antibacterial, antitumor, anticancer, antioxidant, and skin lightening (Teoh, 2016; Wu *et al.*, 2023).

Several studies disclosed the use of *Dendrobium* as a traditional medicine on the island of Sumatra, Indonesia. Heyne (1987) first reported the use of native *Dendrobium* by local communities in Sumatra. Silalahi and Nisyawati (2015) have also stated the Batak ethnic in North Sumatra uses leaves and tubers of *D. salaccense* as a medicine for stomachaches and digestive tract disorders. However, ethnobotanical studies on the potential use of native *Dendrobium* as an herbal medicinal in Lampung, Indonesia have never materialized, although some reports existed on its use in the field. This research, apart from involving local communities, also includes the Liwa Botanical Gardens, West Lampung, Indonesia, which has carried out ex-situ conservation of various native species of *Dendrobium.*

Based on the previous research, in addition to disease infection (Anbiya et al., 2024; Septiana *et al*., 2024; Mahfut *et al*., 2021b and c), other hindrances are prevalent in conservation and utilization efforts of native *Dendrobium* in Lampung, such as, unfamiliar identification (Mahfut *et al*., 2023a and d). This research is a continuation supporting the previous research through morphological and phytochemical characterization. Identification efforts also continued conventionally using morphological characterization of the complete organs (Dressler and Dodson, 2000). Phytochemical characterization ensued by testing the content of secondary metabolites with the potential as herbal cosmetics for skin beautification (Meitei *et al*., 2019).

Identification is the initial stage in the conservation of plants. Mahfut (2021) has identified eight orchid genera in the Liwa Botanical Garden, namely, *Agrostophyllum, Polisthacia, Dipodium, Eria, Trichotosia, Pholidota, Bulbophyllum*, and *Appendicula*. The results showed the most significant similarity in morphological characters was only in the *Bulbophyllum* and *Appendicula* groups. This indicates a more close relationship of members in the same genus. Mahfut *et al*. (2021a) stated orchids in one group showed a considerable level of similarity due to identical morphology. Meitei *et al*. (2019) and Krisnawan *et al*. (2020) also reported the phytochemical characterization of *D. nobile* and *D. anosmum-gigantea* through phytochemical characterization, showing the content of alkaloids, flavonoids, tannins, and phenols. Furthermore, the presented results can help to determine the diversity of native *Dendrobium* species in Lampung in realizing conservation efforts, as well as, being the basis for further ethnomedicine studies with potential as herbal

ingredients in skin enhancement. The latest research aimed to determine the potential of native *Dendrobium* in Lampung, as well as, to support conservation strategies through distinction.

## MATERIALS AND METHODS

### Plant materials

The research commenced using an ethnobotanical approach in Liwa, West Lampung, Indonesia. The study proceeded on the plant material of the entire native *Dendrobium* collection at the Liwa Botanical Gardens. This study also used four species of *Dendrobium* as comparison controls, namely, *D. nobile, D. purpureum, D. minutigibbum*, and *D. montanum*.

### Morphological characterization

For observations on morphological characters, the study followed the method of Dressler and Dodson (2000) and Mahfut *et al*. (2021a). The 13 morphological characters included habitus (H), type of branching (Tper), type of pseudobulb (Tpse), leaf width (LD), leaf length (PD), leaf shape (BD), leaf tip shape (BUD), leaf cross-section (BHD), leaf arrangement (SD), leaf edge shape (BTD), surface texture (TPD), symmetry (SD), and phyllotaxis (DD).

In morphological characterization, the analysis followed the method of Windiyani *et al*. (2022) and Mahfut *et al.* (2024a and c). The observational data's descriptive analysis compared the characteristics between the entire sample and the controls. The kinship relationship analysis progressed by scoring descriptive data into binary data. The results of the grouping analysis among the accessions bore a depiction through a dendrogram using the Multivariate Statistical Package (MVSP) software version 3.2 and the genetic distances in cluster analysis, using the Unweighted Pair-Group with Arithmetic Average (UPGMA) method. Determining the agronomic characteristics influencing the grouping among species resulted from the Principal Component Analysis (PCA) (Putera *et al*., 2024; Sari *et al*., 2025).

### Phytochemical characterization

At the initial stage of phytochemical characterization, an extraction using one leaf sample succeeded. For the characterization of phytochemicals, such as, alkaloids, saponins, phenols, flavonoids, steroids, triterpenoids, and tannins, the conduct of the spot test method followed the technique of Krisnawan *et al*. (2020) and Meitei *et al*. (2019). Carrying out the alkaloid test comprised three trials, namely, using reagents of Dragendroff, Mayer, and Bouchardat. The phenol test employed a solution of ferric chloride, magnesium powder, and hydrochloric acid. For steroid and triterpenoid tests, using chloroform, glacial acetic acid, and concentrated sulfuric acid as ingredients. Meanwhile, the tannin test occurred by adding the $FeCl_3$ solution.

## RESULTS AND DISCUSSION

### Morphological characterization

The 13 samples with four native *Dendrobium* species procured from the collection of Liwa Botanical Garden, West Lampung, Indonesia, were specimens for the morphological studies. The results based on the observations of 13 leaf morphological characters in 13 accessions showed varying average values for each character. The complete identification of native *Dendrobium* showed 100%-character similarity in habitus (H), type of branching (Tper), type of pseudobulb (Tpse), leaf arrangement (SD), leaf edge shape (BTD), surface texture (TPD), symmetry (SD), and phyllotaxis (DD) (Table 1). Meanwhile, diversity of the morphological characters appeared in leaf width (LD), ranging from 0.3 ± 1 to 0.9 ± 1.6 cm, length (PD) (from 3.4 to 15.7 cm), and leaf shape (BD), with a total of 76.9% lancet, 7.7% oval, and 15.4% needle. Likewise, variety occurred for tip shape (BUD) with sharp at 93.3% and blunt at 7.7% and cross-section (BHD) with acuminate (53.8%) and acute (46.2%). The

**Table 1.** Variations in morphological characters of 13 accessions of native *Dendrobium* in Lampung, Indonesia.

| Morphological Traits | Dendro 1 L2012070164 | Dendro 2 L2014040296 | Dendro 3 L2012070164 | Dendro 4 L2018080087 | Dendro 5 L2013030164 | Dendro 6 L2013030162(A) | Dendro 7 L2013030162(B) | Dendro 8 2013030164(A) | Dendro 9 L2012700108 | Dendro 10 L2013030164(B) | Dendro 11 L2018080094 | Dendro 12 L2018080086 | Dendro 13 L2016110168 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Habitus (H) | epiphyte | Epiphyte | homoblastic | epiphyte | Epiphyte | epiphyte | epiphyte | epiphyte | epiphyte | epiphyte | epiphyte | epiphyte | epiphyte |
| Type of branching (Tper) | monopodial | monopodial | monopodium | monopodial | monopodial | monopodial | monopodial | monopodial | monopodial | monopodial | monopodial | monopodial | monopodial |
| Type of pseudobulb (Tpse) | homoblastic | homoblastic | homoblastic | homoblastic | homoblastic | homoblastic | homoblastic | homoblastic | homoblastic | homoblastic | homoblastic | homoblastic | homoblastic |
| Leaf width (LD) | 0.7 ± 2.1 | 0.7 ± 1 | 0.3 ± 1 | 0.5 ± 1.1 | 0.8 ± 1.1 | 0.5 ± 0.8 | 0.5 ± 0.8 | 0.6 ± 1 | 0.9 ± 1.6 | 0.7 ± 1.2 | 0.8 ± 1.2 | 0.8 ± 1.3 | 0.4 ± 0.9 |
| Leaf length (PD) | 15.7 | 3.7 | 11.3 | 3.8 | 5.7 | 3.4 | 3.4 | 5.3 | 7.7 | 5.5 | 5.4 | 5.5 | 6.8 |
| Leaf shape (BD) | lanceolate | lanceolate | lanceolate | lanceolate | lanceolate | lanceolate | lanceolate | lanceolate | lanceolate | lanceolate | lanceolate | lanceolate | lanceolate |
| Leaf tip shape (BUD) | acuminate | acute | acuminate | acute | acute | acute | acuminate | acute | acuminate | acuminate | acuminate | acute | acuminate |
| Leaf cross section (BHD) | terete | semi-terete | terete | semi-terete | semi-terete | semi-terete | terete | semi-terete | terete | terete | terete | semi-terete | terete |
| Leaf arrangement (SD) | duplicate | duplicate | duplicate | duplicate | duplicate | duplicate | duplicate | duplicate | duplicate | duplicate | duplicate | duplicate | duplicate |
| Leaf edge shape (BTD) | entire | entire | entire | entire | Entire | Entire | entire | Entire | entire | entire | entire | entire | entire |
| Surface texture (TPD) | glaber | glaber | glaber | glaber | glaber | glaber | glaber | glaber | glaber | glaber | glaber | glaber | glaber |
| Symmetry (SD) | symmetry | symmetry | symmetry | symmetry | symmetry | symmetry | symmetry | symmetry | symmetry | symmetry | symmetry | symmetry | symmetry |
| Phyllotaxis (DD) | alternate | Alternate | alternate | alternate | alternate | alternate | alternate | Alternate | alternate | alternate | alternate | alternate | alternate |

results showed leaf organs were the main morphological characters in orchid identification, apart from flower organs. This follows the statement of Chaneva *et al*. (2022), who explained leaves become an alternative identification of orchids in the absence of floral organs.

Samanhudi *et al.* (2023) reported the morphological characterization of *Phalaenopsis* by colchicine application based on qualitative traits, showing similarities in leaf color, edge shape, and surface texture. Mahfut *et al.* (2021a; 2024b) also described the leaf arrangement, edge shape, surface texture, and symmetry characters had 100% similarity in identifying leaf morphology in *Dendrobium*. Meanwhile, Windhiana *et al.* (2023) also stated morphological characterization of leaves of several *Dendrobium* with colchicine application, indicating a significant effect on leaf length and width. Asadudin *et al*. (2024) and Mahfut *et al*. (2023b) mentioned notable variations in the characteristics of leaf shape, width, length, tip shape, and cross-section. The results authenticated leaf characters like leaf shape, width, length, tip shape, and cross-section can serve as key traits in identifying orchid species based on observing leaf morphology.

**Table 2.** Similarity index (%) of morphological characters in 13 accessions of native *Dendrobium* in Lampung, Indonesia.

| *Dendrobium* sp. & accessions | *D. nobile* | *D. purpureum* | *D. minutigibbum* | *D. montanum* | Dendro 1 | Dendro 2 | Dendro 3 | Dendro 4 | Dendro 5 | Dendro 6 | Dendro 7 | Dendro 8 | Dendro 9 | Dendro 10 | Dendro 11 | Dendro 12 | Dendro 13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *D. nobile* | 1.000 | | | | | | | | | | | | | | | | |
| *D. purpureum* | 1.000 | 1.000 | | | | | | | | | | | | | | | |
| *D. minutigibbum* | 1.000 | 1.000 | 1.000 | | | | | | | | | | | | | | |
| *D. montanum* | 1.000 | 1.000 | 1.000 | 1.000 | | | | | | | | | | | | | |
| Dendro 1 | 0.769 | 0.769 | 0.769 | 0.769 | 1.000 | | | | | | | | | | | | |
| Dendro 2 | 0.769 | 0.769 | 0.769 | 0.769 | 1.000 | 1.000 | | | | | | | | | | | |
| Dendro 3 | 0.692 | 0.692 | 0.692 | 0.692 | 0.900 | 0.900 | 1.000 | | | | | | | | | | |
| Dendro 4 | 0.769 | 0.769 | 0.769 | 0.769 | 0.818 | 0.818 | 0.900 | 1.000 | | | | | | | | | |
| Dendro 5 | 0.769 | 0.769 | 0.769 | 0.769 | 1.000 | 1.000 | 0.900 | 0.818 | 1.000 | | | | | | | | |
| Dendro 6 | 0.846 | 0.846 | 0.846 | 0.846 | 0.909 | 0.909 | 0.818 | 0.909 | 0.909 | 1.000 | | | | | | | |
| Dendro 7 | 0.769 | 0.769 | 0.769 | 0.769 | 1.000 | 1.000 | 0.900 | 0.818 | 1.000 | 0.909 | 1.000 | | | | | | |
| Dendro 8 | 0.769 | 0.769 | 0.769 | 0.769 | 1.000 | 1.000 | 0.900 | 0.818 | 1.000 | 0.909 | 1.000 | 1.000 | | | | | |
| Dendro 9 | 0.769 | 0.769 | 0.769 | 0.769 | 1.000 | 1.000 | 0.900 | 0.818 | 1.000 | 0.909 | 1.000 | 1.000 | 1.000 | | | | |
| Dendro 10 | 0.769 | 0.769 | 0.769 | 0.769 | 1.000 | 1.000 | 0.900 | 0.818 | 1.000 | 0.909 | 1.000 | 1.000 | 1.000 | 1.000 | | | |
| Dendro 11 | 0.769 | 0.769 | 0.769 | 0.769 | 1.000 | 1.000 | 0.900 | 0.818 | 1.000 | 0.909 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | | |
| Dendro 12 | 0.769 | 0.769 | 0.769 | 0.769 | 1.000 | 1.000 | 0.900 | 0.818 | 1.000 | 0.909 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | |
| Dendro 13 | 0.769 | 0.769 | 0.769 | 0.769 | 1.000 | 1.000 | 0.900 | 0.818 | 1.000 | 0.909 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |

**Phenetic analysis**

The data analysis of 13 morphological characters of habitus, pseudobulb, and leaves in the comparison of control species and 13 *Dendrobium* accessions showed varied similarity indices (%), ranging from 0.692 to 1.000 (Table 2). The highest similarity index (1.000) was evident in the comparison of four control species. However, following this were the *Dendrobium* accessions Dendro 1, 2, 5, 7, 8, 9, 10, 11, 12, and 13. Meanwhile, based on the dendrogram, the 13 accessions' grouping resulted into two clusters, clusters A and B. Cluster A has a similarity index of 0.846, which further split into two subclusters. The subcluster I consisted of *Dendrobium* accessions Dendro 1, 2, 5, 7, 8, 9, 10, 11, 12, 13, and 6. Moreover, subcluster II comprised the landraces Dendro 3 and 4. However, cluster B only has one subcluster, namely, the four controls of *Dendrobium,* i.e., *D. nobile, D. purpureum, D. minutigibbum*, and *D. montanum,* with a similarity index of 1.000.

In each cluster, the closely related *Dendrobium* accessions were likely to be the same species (Figure 1). This was in accordance with the field data, which showed these accessions have very similar morphological characters and were difficult to differentiate. The analysis further indicated consistency in cluster separation with higher numbers. Roshyara and Scholz (2015) stated the *Dendrobium* accessions with the same genetic distance as the similarity index allowed for a closer relationship between the genotypes (Aritonang *et al*., 2024; Simamora *et al*., 2024).

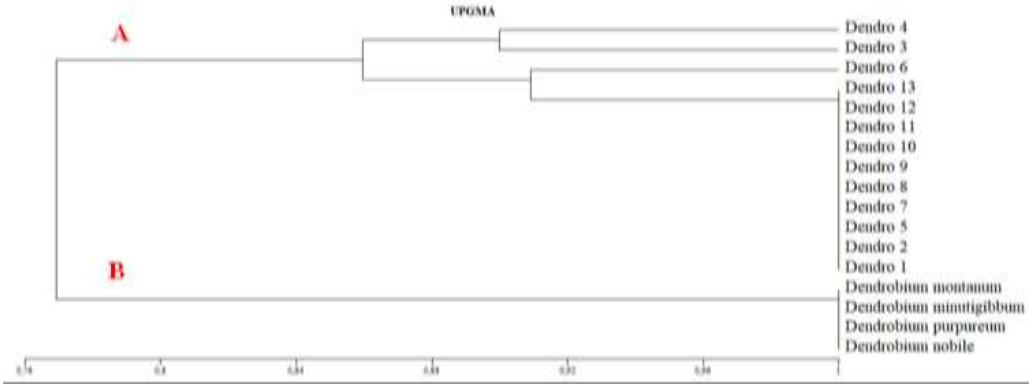


**Figure 1.** Dendrogram of the phenetic relationship among the 13 accessions of native *Dendrobium* in Lampung, Indonesia with comparative control using Jaccard's Coefficient. Dendrogram of phenetic relationships of 13 native *Dendrobium* accessions with comparative control based on morphological characters.

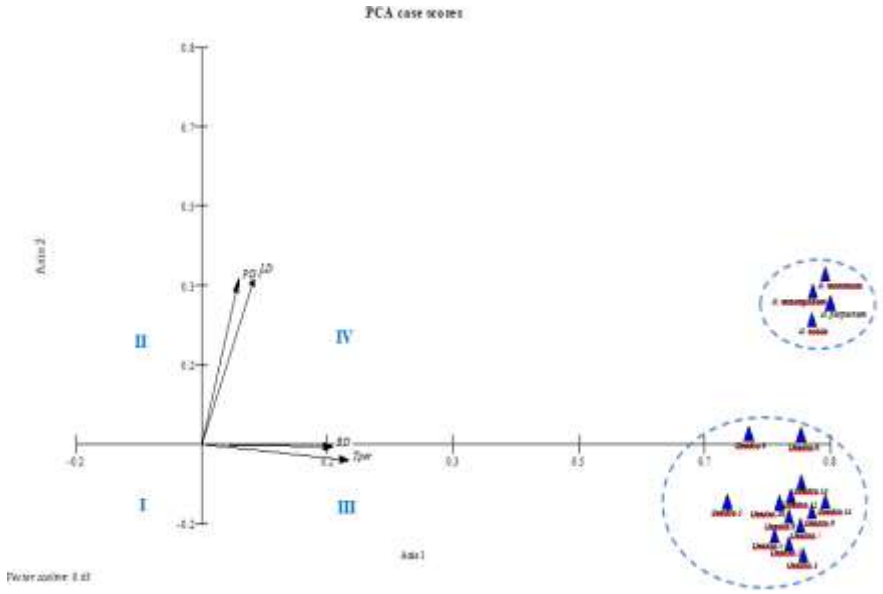


**Figure 2.** Principal Component Analysis (PCA) of 13 accessions of native *Dendrobium* in Lampung, Indonesia with comparative controls based on morphological characters. Note: Axis 1: Principal Coordinate 1, Axis 2: Principal Coordinate 2.

**Principal component analysis**

The use of principal component analysis (PCA) determined the distance between groups (Sukmawati *et al*., 2021) of the *Dendrobium* accessions studied. Apart from that, the PCA can show the large influence of morphological characters in a grouping (Elhaik, 2022). Based on the PCA results on 13 morphological traits of habitus, pseudobulb, and leaves, the comparison of 13 accessions with four *Dendrobium* species as controls, displayed the grouping of four clusters (Figure 2). The grouping of accessions focused on clusters III and IV only. Cluster III consists of *Dendrobium* accessions 1, 2, 3, 5, 7, 8, 9, 10, 11, 12, and 13, grouped based on growth type (Tper) and leaf shape (BD). Meanwhile, cluster IV consists

of *Dendrobium* accessions 4, 6, and the four controls of *Dendrobium* (*D. nobile, D. purpureum, D. minutigibbum*, and *D. montanum)* grouped based on leaf length (PD) and width (LD). Putra *et al.* (2024) and Mahfut *et al.* (2025a) explained the leaf shape, width, and length characters showed significant variation among the native *Dendrobium* accessions which could possibly be the key qualities in identification.

The morphological characters played a vital role in the grouping of the 13 *Dendrobium* accessions (Table 3). Based on the PCA analysis, several features played a positive role in grouping these accessions. These characters were leaf shape (BD), leaf tip shape (BUD), leaf cross-section (BHD), leaf arrangement (SD), leaf edge shape (BTD), leaf surface texture (TPD), leaf symmetry (SD), phyllotaxis (DD), habitus (H), and type of branching (Tper). They played a remarkable role in the PC1. The pseudobulb type trait (Tpse) and leaf length (PD) played a considerable role in the PC2. The leaf width (LD) was the only character with a positive role in PC1 and PC2.

Past studies revealed leaf width was the only morphological trait in 39 accessions of rice grown in rainfed lowland ecology, which showed highly significant differences among the genotypes (Gana *et al*., 2013). Characters with high variability have expectations of providing high gene transfer in plant breeding programs (Sinha *et al*., 2023). Apart from that, the PCA analysis also showed several characters' grouping in the same cluster, as the result of the dendrogram from the phenetic analysis. This was possible because these attributes have more variations compared with other traits (Mahfut *et al*., 2023c; 2025b). These results also agree with past findings, which revealed the highest variability in the accessions and characters of bambara groundnut to provide wider room for breeding aspects (Khan *et al*., 2020; Nuraini *et al*., 2024).

In PCA, an eigenvalue shows the percentage of contribution value in each grouping. Axis I contributed 93.741%, with a value of 10.663, while Axis II contributed 4.724%, with a value of 0.537. The eigenvalue revealed the influence on each character based on the size of the projection formed. Apart from the cluster grouping pattern, similarities emerged in the characters, playing a vital role in separating *Dendrobium* accessions between cluster analysis and PCA. Similarity in results reported in both analyses is a common tool used to recognize the cluster structures in numerical taxonomy and to differentiate the closely related plants (Nadeem *et al*., 2020; Al-Nema *et al.,* 2023; Khedr *et al*., 2024; Panjaitan *et al*., 2024).

**Table 3.** Morphological characters in a grouping of 13 accessions of native *Dendrobium* in Lampung, Indonesia.

| Code | Characters | PC 1 | PC 2 |
|---|---|---|---|
| BD | Leaf shape | 0.281 | -0.008 |
| BUD | Leaf tip shape | 0.315 | -0.055 |
| BHD | Leaf cross-section | 0.315 | -0.055 |
| SD | Leaf arrangement | 0.315 | -0.055 |
| BTD | Leaf edge shape | 0.315 | -0.055 |
| TPD | Surface texture | 0.315 | -0.055 |
| SD | Symmetry | 0.315 | -0.055 |
| DD | Phyllotaxis | 0.315 | -0.055 |
| H | Habitus | 0.315 | -0.055 |
| Tper | Type of branching | 0.315 | -0.055 |
| Tpse | Type of pseudobulb | 0.080 | 0.563 |
| LD | Leaf width | 0.116 | 0.583 |
| PD | Leaf length | 0.080 | 0.563 |
| | *Eigenvalues* | 10.663 | 0.537 |
| | *Percentage* | 93.741 | 4.724 |
| | *Cum. Percentage* | 93.741 | 98.465 |

**Table 4.** Spot test phytochemical characterization in five accessions of native *Dendrobium* in Lampung, Indonesia.

| Phytochemicals | Spot test results | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | *D. nobile* | *D. pupureum* | *D. minutigibbum* | *D. montanum* | *Dendro* 2 | *Dendro* 3 | *Dendro* 4 | *Dendro* 6 | *Dendro* 12 |
| Alkaloid (Mayer) | + | + | + | + | + | + | + | + | + |
| Alkaloid (Dragendorfff) | + | + | + | + | + | + | + | + | + |
| Alkaloid (Bouchardat) | + | + | + | + | + | + | + | + | + |
| Flavonoid | - | + | + | + | - | + | + | - | - |
| Saponin | - | + | + | - | - | - | - | - | - |
| Tanin | + | - | - | - | - | - | - | - | - |
| Phenol | - | - | - | - | - | - | - | - | - |
| Steroid | - | - | - | - | - | - | - | - | - |
| Triterpenoid | - | - | - | - | + | + | + | + | + |

**Phytochemical characterization**

Phytochemical characterization was successful on five samples representing 13 native *Dendrobium* accessions, namely, *Dendrobium* 2, 3, 4, 6, and 12, with the four test controls (*D. nobile, D. purpureum, D. minutigibbum*, and *D. montanum)*. The said selection relied on the results of morphological characterization. The *Dendrobium* spot test results about the phytochemical characterization are available in Table 4. The outcomes showed all the extracts of the *Dendrobium* control species and test samples contain the same group of compounds, alkaloids. Most accessions also contain flavonoids, saponins, tannins, and triterpenoids. Phytochemical characterization of several types of *Dendrobium* contains alkaloids, flavonoids, tannins, saponins, steroids, and triterpenoids, which have the potential as herbal medicines (Liu *et al.*, 2022; Rahman *et al.*, 2023).

The identification of alkaloid compounds employed the Mayer, Dragendroff, and Bouchardat tests to determine the similarity between the *Dendrobium* control species and the accessions. The test results on variations in the three mobile phases showed the best mobile phase with the Dragendorf test using chloroform and methanol, with a ratio of 12:2. It produced a separation, namely, two brown stains at Rf 0.42 and 0.83. Ahmad *et al*. (2018) also explained the positive results for alkaloids in the Dragendorf test using chloroform and methanol with a brown stain in *Oryza sativa*.

The phytochemical characterization results indicated the types of alkaloids identified were of the same type. Ramesh *et al.* (2019) explained the native *Dendrobium* contains the highest alkaloid content compared with other orchid types. This is possible because *Dendrobium* is a widely used species for herbal medicine. Li *et al*. (2023) detailed alkaloids were the most commonly found nitrogen-containing compounds in the phytochemistry of 35 *Dendrobium* and an essential source of medical compounds. Zhang *et al*. (2021) reported the typical alkaloids dendrobine in native *Dendrobium*, which has pharmacological activities, such as, anticancer (Wei *et al*., 2022), antitumor, anti-inflammatory, anti-diabetes, and antivirus (Mou *et al*., 2021).

Furthermore, several *Dendrobium* test accessions exhibited differences in phytochemical content. This indicates the samples were of different types of *Dendrobium*, however, experiencing stress conditions in the environment. Xia *et al*. (2024) reported in specific *Dendrobium* species, more phytochemicals' production occur than in other types due to stressful environmental conditions.

## CONCLUSIONS

Morphological characterization of the 13 *Dendrobium* accessions and four species as comparative controls based on 13 morphological traits showed leaf shape, width, length, edge shape, tip shape, and cross-section can serve as key characters in identifying the orchid species. Phytochemical characterization through spot tests revealed *Dendrobium* accessions contain alkaloids, flavonoids, saponins, tannins, and triterpenoids with the potential for use as herbal medicines. The results indicated leaf morphological and phytochemical characterization can be suitable for identifying the *Dendrobium* accessions and their potential.

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