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# Plant species used for cosmetic and cosmeceutical purposes by the Vhavenda women in Vhembe District Municipality, Limpopo, South Africa

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## ABSTRACT

The uses of plant species have a long history and become important sources of welfare and healthcare in South Africa. These plant species and their associated indigenous knowledge may be lost due to rapid change in socio-economic and environmental conditions. The aim of the study was to document the plant species used as natural-based cosmetics and cosmeceuticals by the Vhavenda women in Vhembe district municipality, Limpopo province, South Africa. Ethnobotanical information such as the local names of plants, method of preparation and administration were collected among 79 Vhavenda women who were knowledgeable in phytocosmetics using semi-structured questionnaires. Thereafter, quantitative ethnobotanical indices, including frequency of citation (FC) and cultural importance index (CI), were calculated. A total of 49 plant species from 31 families were identified as natural-based cosmetics and cosmeceuticals by the Vhavenda women in Vhembe district. *Dicerocaryum zanguebaricum* (Museto) and *Ricinus communis* (Mupfure) were the most commonly cited plants. In terms of families, Leguminosae had the highest (4) number of plants while Meliaceae and Rhamnaceae had three (3) plants. Leaves and bark were the most frequent used plant parts. Furthermore, maceration and poultice were the most common preparation methods that were used to prepare these plants. The majority (75%) of plant preparations were applied topically. The current findings reveal the richness of indigenous knowledge on plant-based cosmetics and cosmeceuticals among the Vhavenda women. If properly explored, potential low-cost product(s) can be developed which can strengthen the socio-economic well-being of the Vhavenda women in South Africa. However, there will be a need to conduct laboratory-based experiments to establish the efficacy and safety of these documented plants using relevant biological assays.

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## 1. Introduction

As the largest organ in humans, the importance of protection and nourishment of the skin cannot be over-emphasized. Globally, skin diseases remain a public health concern and affects several individuals regardless of the age, sex and gender (Lim et al., 2017). Even though many of the skin diseases have low mortality rate and often treated with existing medications, their affordability and efficacies remain a major

challenge in recent times. As a part of cosmetology, phytocosmetics involve the use of plant species for cosmetic purposes (Pieroni et al., 2004). Generally, natural-based remedies are not limited to the beauty of the skin but also for therapeutics focused on treating various skin diseases. According to Aftel (2002), cosmetics are regarded as “any substance or preparation intended to be placed in contact with the various external parts of the human body or with the tooth whitening and the mucous membranes of the oral cavity with a view, exclusively or mainly, to cleaning them, perfuming them, changing their appearance and or correcting body odours and/or protecting them or keeping them in good conditions.” As highlighted by Costa (2015), natural products have been used for ages and are often the only option for most human necessities. The majority of traditional cosmetics are employed in enhancing beauty, eliminating body odors, cleansing, and treating certain skin disease conditions in both children and adults. More than 80% of women are more prone to be frequent users of herbal-based

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cosmetics and cosmeceuticals (Corazza et al., 2009; Mahomoodally and Ramjuttun, 2016). However, various cultures have specific beauty recipes; For instance in South West Nigeria, natural products including plants, minerals and fats serve as the main composition of the recipes for traditional cosmetics (Fred-Jaiyesimi et al., 2015).

South Africa is a country with a high plant diversity of over 30,000 species of higher plants, and 3000 of these plant species have been found to be used in traditional medicine (van Wyk et al., 1997). Limpopo province in South Africa, is referred to as one of the hotspots due to the rich plant diversity (Mongalo and Makhafola, 2018). The use of plant species remains popular and well-enriched in the culture of the Vhavenda especially among the women who often utilize different plant species for cosmeceutical purposes. Several studies have explored the ethnobotanical diversity in Limpopo province (Arnold and Gulumian, 1984; Maanda and Bhat, 2010; Mabogo, 1990; Magwede et al., 2018; Mongalo and Makhafola, 2018; Netshiungani, 1981; Tshisikhawe, 2002; Van Warmelo, 1989; van Wyk, 2015). However, there is paucity of information regarding indigenous knowledge and practices on natural-based cosmetics and cosmeceuticals among the Vhavenda women. Documenting of plant species used for natural-based cosmetics and cosmeceuticals is expected to have a significant role in increasing public awareness and proper utilization among the Vhavenda women. This may eventually serve as an impetus for more research that will unravel the potential for new phytocosmetics. Therefore, current study aims at documenting plant species, indigenous knowledge and practices used for cosmetics and cosmeceuticals by the Vhavenda women in Vhembe district municipality, South Africa. The study was geared towards addressing the following research questions:

- What types of plant species are locally used for natural-based cosmetics and cosmeceuticals among women in Vhembe district?
- How are the plant remedies prepared and utilized for treating various skin diseases and general skin nourishment?

## 2. Materials and methods

### 2.1. Description of the study area

The study was conducted across 16 villages covering four municipalities (Thulamela, Makhado, Collins Chabane and Musina) in Vhembe District Municipality, Limpopo Province (Fig. 1; Table 1). The area has a land mass covering about 25,597 km<sup>2</sup>, with the majority of the people living in villages (Stats SA, 2012). Vhembe is one of the five (5) districts of Limpopo Province, South Africa. It is the northernmost district of the country and shares its northern border with Beit-bridge district in Zimbabwe. Vhembe consists of all territories that were part of the former Venda Bantustan. However, two large densely populated districts of the former Tsonga homeland of Gazankulu, particularly, Hlanganani and Malamulele were also incorporated into Vhembe, hence the ethnic diversity of the district. The capital of Vhembe is Thohoyandou which was also the capital of the former Venda Bantustan. This area is diverse in heritage and consists of different languages such as Tshivenda (most dominant), Pedi and Tsonga. Given that Vhembe district area consists of four local municipalities, the research was conducted in all four municipalities across 16 villages (Table 1). Vhembe consists of significant biodiversity and rich heritage (Stats SA, 2012). The majority of people in the study area belong to the Vhavenda ethnic group. This ethnic group

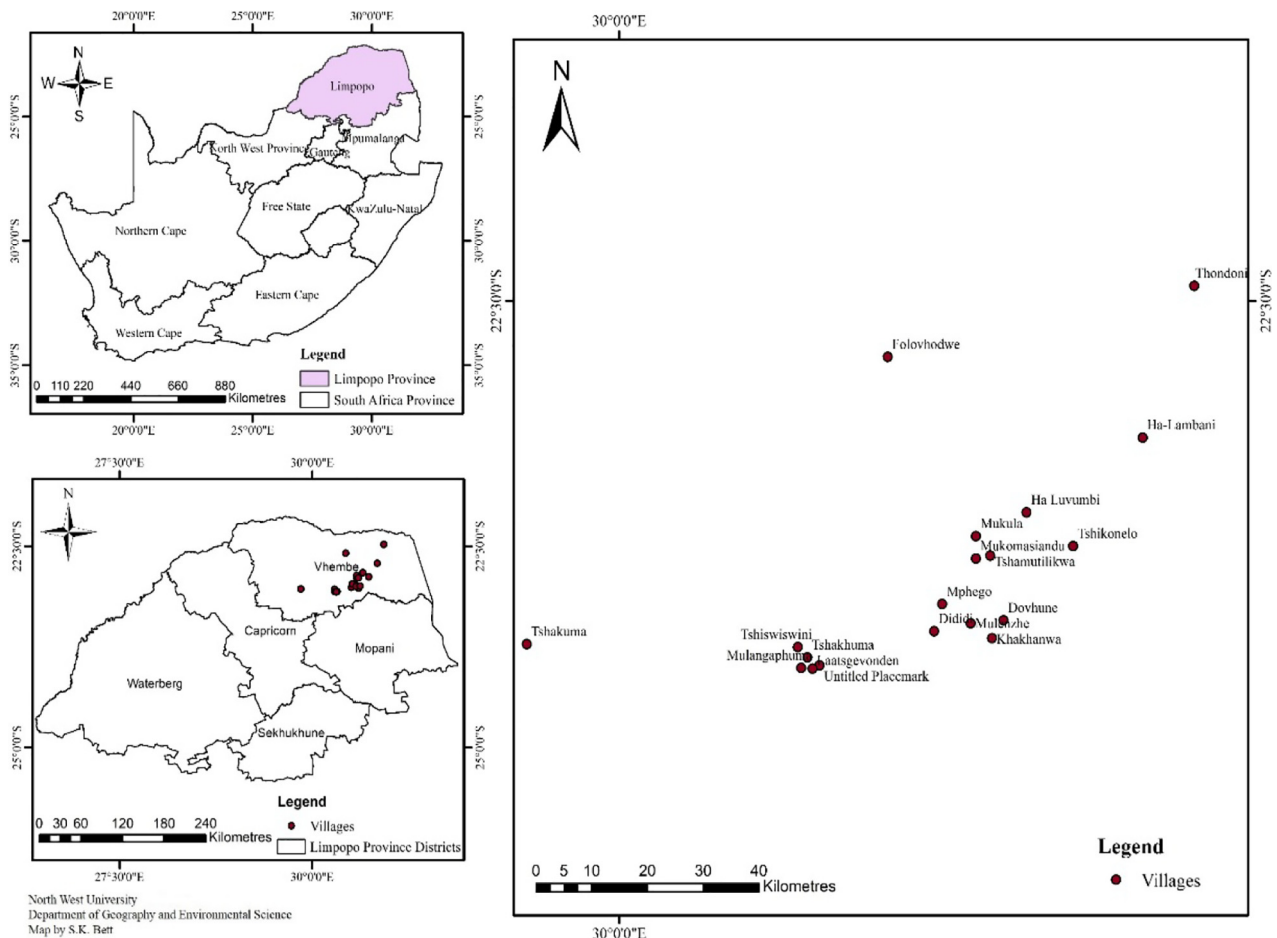


Fig. 1. Selected study villages in Vhembe district municipality, Limpopo province, South Africa.

**Table 1**

Study sites (villages) in the four local Municipalities in Vhembe district municipality, Limpopo province, South Africa.

| Local Municipality              | Villages            |
|---------------------------------|---------------------|
| 1. Thulamela municipality       | 1. Mphego           |
|                                 | 2. Tshimutikili     |
|                                 | 3. Levumbhi         |
|                                 | 4. Mukomaasaanandou |
|                                 | 5. Mukula           |
| 2. Collins Chabane municipality | 6. Khakhanwa        |
|                                 | 7. Tondoni          |
|                                 | 8. Dididi           |
|                                 | 9. Tshakuma         |
| 3. Makhado municipality         | 10. Ludanani        |
|                                 | 11. Muhovheya       |
|                                 | 12. Dovhuni         |
|                                 | 13. Tshikonelo      |
|                                 | 14. Muguvhumi       |
| 4. Musina municipality          | 15. Diambele        |
|                                 | 16. Folovhodwe      |

is one of the largest in Limpopo Province, with 67.2% of the population of the province (Stats SA, 2012).

## 2.2. Ethnobotanical survey

The ethnobotanical information was collected from February to March 2018, based on face-to-face interviews using semi-structured questionnaires where information such as the local names of the plant species used for natural-based cosmetics and cosmeceuticals, their preparation and administration methods were recorded. This kind of investigation, in sociological terms, is called “participant observation” (Abbet et al., 2014; Busto et al., 1997; Tuxill and Nabhan, 2001). For the current study, 79 participants with a specific profile (women) were selected in order to obtain high quality and reliable information. The age of the participants varied consisting of both the young and old. They were all living in a rural environment and from a variety of socio-economic strata, with knowledge of medicinal plants. A digital voice recorder was used to register interviews and to create an audio pool of the information. In addition, photographs of each of the plant species were captured. Plants collected during the field walk were identified and voucher specimens were deposited in the herbarium of the South African National Biodiversity Institute (SANBI), Pretoria, South Africa. Botanical names of the collected plant species were identified in the herbarium using a detailed regional dichotomous key (Khan et al., 2017).

## 2.3. Data analysis

The information collected were subjected to data analysis using SPSS (version 25). Quantitative ethnobotanical indices, including frequency of citation (FC) and cultural importance index (CI), were calculated. Based on the work of Heinrich et al. (1998) and Fongnzossie et al. (2017), frequency of citation (FC) of the plant species was calculated as follows:

$$FC = (N_p/N) \times 100$$

Where  $N_p$  = number of times a particular species was mentioned;  $N$  = total number of times that all species were mentioned

According to Tardío and Pardo-de-Santayana (2008), CI takes into account the spread of the use (number of participants) for each species along with its versatility, i.e., the diversity of its applications. Cultural importance index (CI) was calculated as described by Tardío and Pardo-de-Santayana (2008). This index was calculated using the

following mathematically expressed formula:

$$CI_i = \frac{\sum_{u=1}^{u=NC} \sum_{i=1}^{i=N} UR_{ui}}{N}$$

First, we sum the  $CI_i$  of all the participants (from  $i=1$  to  $i=N$ ) within each use-category for that species ( $s$ ), i.e., the number of participants who mention each use-category for the species. Second, we sum all the UR of each use-category (from  $u=1$  to  $u=NC$ ).

## 2.4. Intellectual property agreement/ethical approval

The ethnobotanical survey was carried out with the full consent of all participants, which included the terms and the conditions that were expected from both researcher and participants. It stated that should the participant feel a need to discontinue with the interview, they should feel free to leave at any given time. Ethical principles were applied when conducting this study; the principle of anonymity was applied whereby the identities of the participants remained confidential. Concerning the principle of autonomy, permission was requested from local chiefs and knowledge holders. The principle of respect also was applied whereby all participants were treated with respect and dignity, and also encouraged to treat others the same as well as respect each other's opinions. Ethical clearance (NWU-00557-18-A9) was obtained from the ethics committee, Faculty of Natural and Agricultural Sciences, while the permit to collect plant species was provided by the Limpopo environmental affairs.

## 3. Results

### 3.1. Demographic profiles of participants

In term of age distribution, the majority (39%) of the participants were aged 56–70 followed by 41–55 year old individuals (32%). Other were either 26–40 years (11%) or above 71 year old (18%). Different education status among the participants was secondary (34%), primary (30%) and tertiary level (13%). On the other hand, 23% of the participants had no formal education.

### 3.2. Diversity of plant species used as natural-based cosmetics and cosmeceuticals

In this study, 49 plant species belonging to 31 families were identified to be commonly used for cosmetics and cosmeceuticals (Table 2). The plant families mostly represented included Leguminosae with 4 plants, Rhamnaceae and Meliaceae with 3 plants, while other families had 1 or 2 plants (Fig. 2). Based on FC (Table 2), the top 10 plant species that were mentioned are *Dicerocaryum zanguebaricum*, *Ricinus communis*, *Helinus integrifolius*, *Solanum incanum*, *Persea americana*, *Peltophorum africanum*, *Senna obtusifolia*, *Sclerocarya birrea*, *Musa paradisiaca* and *Acanthospermum hispidum*. Based on CI (Table 2), *Dicerocaryum zanguebaricum* has the highest CI (0.5), followed by *Ricinus communis* (0.3) and *Helinus integrifolius* (0.15).

In the current study, 48% of the reported plants were trees, while creepers constituted 2% of the documented plants (Fig. 3). Both aerial and underground parts are used for cosmetic and cosmeceutical purposes. Leaves were the most frequently cited plant part used as natural-based cosmetics and cosmeceuticals (Fig. 4). Other plant parts such as flowers, stem, seeds and aerial parts accounted for 59%. Most (91%) of the plant species are collected from the wild while a few (9%) are domesticated (Fig. 5). In total, 11 different cosmetic and cosmeceutical uses were recorded for the cited plants among the Vhavenda women (Fig. 6). These included the treatment of abscess, boils, burns, eczema, pimples, ringworms, tooth whitening and wounds.

**Table 2**

Ethnobotanical information on plant species used for cosmetics and cosmeceuticals by the Vhavenda women in Vhembe district municipality, Limpopo province, South Africa. CI = cultural importance index; FC = frequency of citation.

| Scientific name<br>(voucher<br>number)  | Vernacular name<br>(Vhavenda) | Family                 | Plant part and<br>method of<br>preparation | Administration   | <sup>a</sup> Plant<br>form | <sup>b</sup> Occurrence | CI   | FC   | Frequency<br>(N) |
|---|-------------------------------|------------------------|--|--|----------------------------|-------------------------|------|------|------------------|
| <i>Acanthospermum hispidum</i> DC. (TN 014)   | Tshidavhula                   | Compositae/Astereaceae | Leaves, Maceration                         | The leaves are burned and applied topically on the wound.  | H                          | W                       | 0.08 | 2.9  | 7                |
| <i>Adansonia digitata</i> L. (TN 032)   | Muvhuyu                       | Bombacaceae            | Bark, Maceration                           | It is applied topically on wounds.   | T                          | W                       | 0.02 | 0.8  | 2                |
| <i>Aloe aageodonta</i> L. E. Newton (TN 009)  | Tshikhophha tshituku          | Xanthorrhoeaceae       | Leaves, Poultice                           | The sap or gel is applied as a paste on skin sores and wounds  | H                          | W                       | 0.05 | 1.7  | 2                |
| <i>Aloe marlothii</i> A. Berger (TN 030)  | Tshikhophha                   | Xanthorrhoeaceae       | Leaves, Poultice                           | The sap from the plant is squeezed directly on skin wounds.  | S                          | W                       | 0.07 | 2.5  | 4                |
| <i>Annona senegalensis</i> Pers. (TN 018)   | Muembe                        | Annonaceae             | Seeds, Maceration                          | Mixed with soil for cleaning teeth. It is used orally as toothpaste  | S                          | W                       | 0.02 | 0.8  | 2                |
| <i>Bidens pilosa</i> L. (TN 010)  | Mushidzhi                     | Asteraceae             | Leaves, Poultice                           | The leaves are applied topically on wounds and sores.  | H                          | D                       | 0.07 | 2.5  | 4                |
| <i>Brackenridgea zanguebarica</i> Oliv.<br>Syn: <i>Brackenridgea bussei</i> Gilg (TN 048) | Mutavhatsindi                 | Ochnaceae              | Bark, Maceration                           | Bark is used for wounds and it rejuvenates the skin. Furthermore, it is applied topically on the skin or wounds. | S                          | W                       | 0.02 | 0.8  | 2                |
| <i>Cannabis sativa</i> L. (TN 031)  | Mbanzhe                       | Cannabaceae            | Seeds, Maceration                          | Stimulate hair growth; it is applied topically.  | H                          | D                       | 0.05 | 1.6  | 2                |
| <i>Cassia petersiana</i> Bolle (TN 033)   | Munembenembe                  | Caesalpinaceae         | Roots, Maceration                          | It is taken orally as a mouthwash.   | T                          | W                       | 0.03 | 1.2  | 1                |
| <i>Cassine transvaalensis</i> (Burt Davy) Codd (TN 034)                                   | Mulumanama                    | Celastraceae           | Bark, Maceration                           | Bark is taken orally because it is believed the skin is affected from the inside.                                | T                          | W                       | 0.01 | 0.4  | 1                |
| <i>Catharanthus roseus</i> (L.) G. Don (TN 002)   | Liluvha                       | Apocynaceae            | Flowers, Decoction                         | It is taken orally as a mouthwash.   | H                          | D                       | 0.02 | 0.8  | 1                |
| <i>Citrus assamensis</i> R.M.Dutta & Bhattacharya (TN 049)                                | Tshikhavhavhe                 | Rutaceae               | Fruit, squashed as sap                     | Fruit sap are administered topically as a facial wash.   | T                          | D                       | 0.02 | 0.8  | 2                |
| <i>Commiphora mollis</i> (Oliv.) Engl. (TN 024)   | Muukhuthu                     | Burseraceae            | Bark, Maceration                           | Bark is applied topically on burn wounds (burns).  | T                          | W                       | 0.02 | 0.8  | 1                |
| <i>Dicerocaryum senecioides</i> (Klotzsch) Abels (TN 001)                                 | Museto/Dinda                  | Pedaliaceae            | Leaves, Poultice                           | The leaves are applied topically as a substitute for soap.   | C                          | W                       | 0.5  | 17.7 | 44               |
| <i>Dichrostachys cinerea</i> (L.) Wight & Arn (TN 016)                                    | Murenzhe                      | Leguminosae            | Leaves, Poultice                           | The leaves are applied topically via sprinkling on wounds and pimples.   | H                          | W                       | 0.06 | 2.1  | 3                |
| <i>Diospyros mespiliformis</i> Hochst. Ex A. DC. (TN 011)                                 | Musuma                        | Ebenaceae              | Stem, Fruit, Poultice                      | The fruit is applied topically on ringworms while the stem is used orally as toothpaste.                         | T                          | W                       | 0.07 | 2.5  | 5                |
| <i>Ehretia rigida</i> (Thunb.) Druce (TN 025)   | Mutepe                        | Boraginaceae           | Leaves, Poultice                           | The leaves are applied topically on wounds resulting from burns.   | S                          | W                       | 0.01 | 0.4  | 1                |
| <i>Ekebergia capensis</i> Sparrm (TN 047)   | Mutobvuma                     | Meliaceae              | Leaves, Maceration or poultice             | Leaves are applied on wounds topically by sprinkling.  | T                          | W                       | 0.01 | 0.4  | 1                |
| <i>Ensete ventricosum</i> (Welw.) E.E. Cheesman (TN 046)                                  | Mulala                        | Musaceae               | Leaves, Poultice                           | Leaves are applied orally and as lotion on burn skin (burns) and wounds.   | T                          | W                       | 0.01 | 0.4  | 1                |
| <i>Euclia divinorum</i> Hiern (TN 023)  | Mutangule                     | Ebenaceae              | Leaves, Poultice                           | Leaves are applied topically on wounds.  | T                          | W                       | 0.07 | 2.5  | 6                |
| <i>Eugenia capensis</i> subsp. <i>natalitia</i> (Sond.) F.White (TN 035)                  | Tshitanzwa-tanzwane           | Myrtaceae              | Bark, Maceration<br>Roots, infusion        | Bark is applied topically for washing wounds, and the roots are soaked in water before being utilized.           | T                          | W                       | 0.01 | 0.4  | 1                |
| <i>Euphorbia cupularis</i> Boiss. L.C. Wheeler (TN 027)                                   | Muswoswo                      | Euphorbiaceae          | Roots, Maceration                          | The roots are mixed with <i>Ricinus communis</i> (Mupfure) oil and applied topically for swelling body.          | S                          | W                       | 0.02 | 0.8  | 2                |

(continued on next page)

Table 2 (continued)

| Scientific name (voucher number)                            | Vernacular name (Vhavenda) | Family           | Plant part and method of preparation                               | Administration  | <sup>a</sup> Plant form | <sup>b</sup> Occurrence | CI   | FC   | Frequency (N) |
|---|----------------------------|------------------|--|---|-------------------------|-------------------------|------|------|---------------|
| <i>Helinus integrifolius</i> (Lam.) Kuntze (TN 012)         | Mupupuma                   | Rhamnaceae       | Whole herb, Poultice   | The herb is applied topically as a substitute for soap.   | S                       | W                       | 0.1  | 5.0  | 11            |
| <i>Lippia javanica</i> (Burm.f.) Spreng. (TN 015)           | Musudzungwane              | Verbenaceae      | Leaves, Poultice and maceration                                    | Leaves are applied topically on wounds.   | H                       | W                       | 0.03 | 1.2  | 2             |
| <i>Musa paradisiaca</i> L. (TN 045)                         | Muomva                     | Musaceae         | Leaves, Poultice   | Leaves are applied topically to repair damaged skin and wounds.   | S                       | W                       | 0.08 | 2.9  | 7             |
| <i>Parinari curatellifolia</i> Planch. ex Benth. (TN 041)   | Muvhula                    | Chrysobalanaceae | Leaves, Decoction and poultice                                     | Leaves are administered orally to rinse the mouth and topically on wounds. Used as mouthwash.                         | T                       | W                       | 0.01 | 0.4  | 1             |
| <i>Pettophorum africanum</i> Sond. (TN 020)                 | Musese                     | Leguminosae      | Bark, Maceration   | The powder from the bark is applied as a paste on the mouth sores.  | T                       | W                       | 0.1  | 3.3  | 7             |
| <i>Persea americana</i> Mill. (TN 042)                      | Afukhuda                   | Lauraceae        | Fruit, Poultice  | Fruit is applied topically to soften the skin and as nourishment of the hair  | T                       | D                       | 0.1  | 3.3  | 3             |
| <i>Phyla nodiflora</i> (L.) Greene (TN 007)                 | Tshishengelaphofu          | Verbanaceae      | Flowers, Poultice  | Leaves or roots are taken orally through chewing to treat oral thrush.  | H                       | W                       | 0.06 | 2.1  | 5             |
| <i>Piper capense</i> L.f. (TN 044)                          | Mulilwe                    | Piperaceae       | Bark, Maceration   | Bark is applied orally and topically on wounds, sore throat and tongue sores  | H                       | W                       | 0.01 | 0.4  | 1             |
| <i>Prunus persica</i> (L.) Batsch (TN 043)                  | Muberegesi                 | Rosaceae         | Bark, Maceration   | Bark is applied topically on wounds.  | T                       | D                       | 0.01 | 0.4  | 1             |
| <i>Pterocarpus angolensis</i> DC. (TN 021)                  | Mutondo                    | Leguminosae      | Leaves are poultice and the stem just harvested and used directly. | Stem is used to wash or clean the skin, while the leaves are applied topically on rashes                              | T                       | W                       | 0.01 | 0.4  | 1             |
| <i>Ricinus communis</i> L. (TN 005)                         | Mupfure                    | Euphorbiaceae    | Seeds, Poultice or Maceration                                      | The oil is extracted from the seeds and applied topically to repair and beautify the skin.                            | H                       | W                       | 0.3  | 10.1 | 20            |
| <i>Salacia rehmannii</i> Schinz (TN 036)                    | Phatatshimima              | Celastraceae     | Bark, Maceration   | Bark is applied topically through washing of wounds and sprinkled to dry the wound.                                   | T                       | W                       | 0.01 | 0.4  | 1             |
| <i>Sclerocarya birrea</i> (A.Rich.) Hochst. (TN 040)        | Mufula                     | Anacardiaceae    | Fruit, Maceration  | Fruit is applied as lotion and taken orally as drink for skin to glow.  | T                       | W                       | 0.08 | 2.9  | 7             |
| <i>Searsia lancea</i> (L. f.) F.A. Barkley (TN 039)         | Mushakaladza               | Anacardiaceae    | Leaves, Poultice or paste  | The leaves are pasted, sprinkled topically on pimples, sores, skin irritation and wounds.                             | S                       | W                       | 0.01 | 0.4  | 1             |
| <i>Senna obtusifolia</i> (L.) H.S.Irwin & Barneby. (TN 028) | Mutshketsheke              | Leguminosae      | Leaves, Poultice   | Leaves are applied topically on burn skin (burns) and further used as soap substitute.                                | S                       | W                       | 0.03 | 1.2  | 3             |
| <i>Solanum incanum</i> L. (TN 004)                          | Mututulwa                  | Solanaceae       | Fruit, Decoction   | The fruit is applied orally for cleaning the teeth.   | S                       | W                       | 0.12 | 4.2  | 11            |
| <i>Striga asiatica</i> (L.) Kuntze (TN 008)                 | Vhuri                      | Orobanchaceae    | Whole plant, Marection   | The whole plant is applied topically on burn wounds (burns) by burning the herb and applying it as a paste on wounds. | H                       | D                       | 0.08 | 2.9  | 8             |
| <i>Strychnos aculeata</i> Soler. (TN 038)                   | Mukwakwa                   | Loganiaceae      | Roots, Maceration  | Roots are applied topically on burns as lotion.   | T                       | W                       | 0.01 | 0.4  | 1             |
| <i>Tabernaemontana elegans</i> Stapf (TN 006)               | Muhatu                     | Apocynaceae      | Roots, Maceration  | Roots are applied topically as lotion on burnt skin (burns).  | S                       | W                       | 0.02 | 0.8  | 2             |
| <i>Terminalia sericea</i> Burch. ex DC (TN 017)             | Mususu                     | Combretaceae     | Leaves, Poultice and maceration                                    | The leaves are applied topically for cuts and sprinkled on burns as powder.   | T                       | W                       | 0.07 | 2.5  | 5             |
| <i>Trichilia emetica</i> Vahl (TN 013)                      | Mutshikili                 | Meliaceae        | Leaves, Poultice   | The leaves are used as toothpaste, while others apply it topically on wounds.   | T                       | W                       | 0.02 | 0.8  | 2             |
| <i>Xanthoxylum fagara</i> Sarg. (TN 037)                    | Munungu                    | Rutaceae         | Bark, Maceration   | Bark is applied topically and orally for mouth sores and as toothpaste.   | S                       | W                       | 0.07 | 2.5  | 7             |



Table 2 (continued)

| Scientific name (voucher number)          | Vernacular name (Vhavenda) | Family     | Plant part and method of preparation | Administration  | <sup>a</sup> Plant form | <sup>b</sup> Occurrence | CI   | FC  | Frequency (N) |
|---|----------------------------|------------|--------------------------------------|---|-------------------------|-------------------------|------|-----|---------------|
| <i>Ximenia caffra</i> Sond. (TN 019)      | Muthanzwa                  | Oleaceae   | Roots, Maceration and poultice       | Roots are applied topically to rejuvenate the skin, wounds and pimples. | S                       | W                       | 0.05 | 1.6 | 2             |
| <i>Ziziphus mucronata</i> Willd. (TN 026) | Mutshetshete               | Rhamnaceae | Leaves, Poultice                     | Leaves are applied topically on burns and pimples ( <i>Maphodo</i> ).   | T                       | W                       | 0.02 | 0.8 | 2             |

<sup>a</sup> Plant form: T = Tree, S = Shrub, H = Herb and C = Creepers.

<sup>b</sup> Occurrence: W = Wild, D = Domesticated. N = Number of participants.

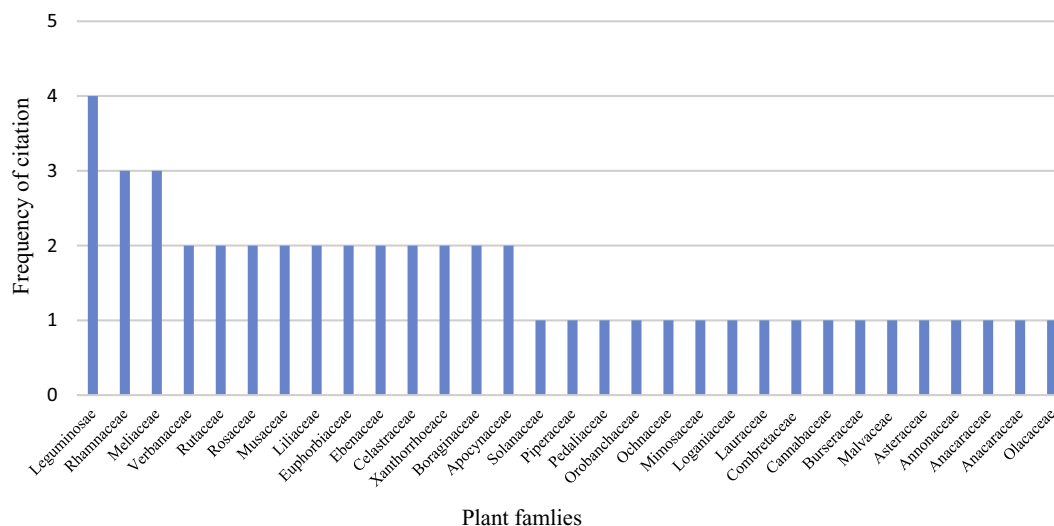


Fig. 2. Frequency of plant families used for cosmetic and cosmeceutical purposes in Vhembe district municipality, Limpopo province, South Africa.

### 3.3. Method of preparation and administration

In the study area, maceration and poultice are the most common preparation methods that are used to prepare plant-based cosmetics and cosmeceuticals (Fig. 7). According to the participants, these processes are the simplest methods for extraction. This process is used by the Vhavenda women to soften and extract materials that can be used in the production, healing processes and beautifying the skin. Furthermore, some participants use poultice as a mode of preparation and is regarded as technology.

The natural-based cosmetics and cosmeceuticals are applied on different parts of the body. In addition, these natural-based cosmetics and cosmeceuticals are mainly administered topically (75%) while oral infusions (25%) was less common (Fig. 8). The participant highlighted that plants used for natural based cosmetics or skin ailments may be administered as a powder (leaves, root or wood powder) through different mechanisms depending on the patient or the skin disease.

### 3.4. Indigenous knowledge and cultural practices

In Vhembe district municipality, indigenous knowledge about natural-based cosmetics and cosmeceuticals is widely spread among the Vhavenda women population. However, the Vhavenda women do not regularly exchange knowledge with those of other community around Vhembe district municipality. The Vhavenda women played a primary role in the preparation and administration of natural-based cosmetics and cosmeceuticals. Their homemade remedies were prepared for the whole community who are in need of different forms of preparations such as poultices or compresses. Women were also the only producers

and “consumers” of natural-based cosmetics and cosmeceuticals, including simple seed oil as lotion and perfumes.

The Vhavenda women believe that the plant species should not be harvested from the north and south sides because they bring uncertainty to the people who will use them. The plant species are collected from the east side if they are going to be used to treat someone below the age of 60; it is assumed that the person still has a long time to live. Whereas it is believed that those over 60 years have short time to live, and that they might even just rest. Plant species that are used for natural-based cosmetics and cosmeceuticals among the Vhavenda women are mostly used as an aspect of healing and not to enhance the skin

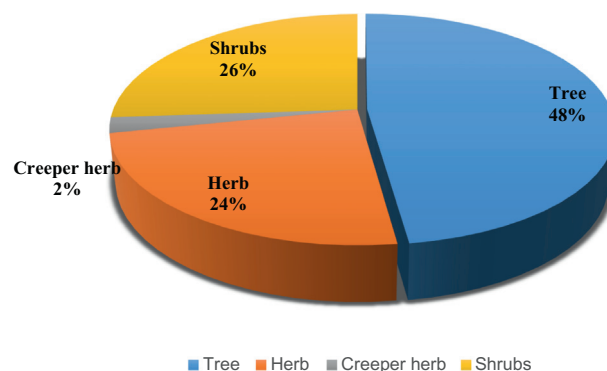


Fig. 3. Life-forms of the plant species used for natural-based cosmetics and cosmeceuticals by the Vhavenda women in Vhembe district municipality, Limpopo province, South Africa, n = 49.

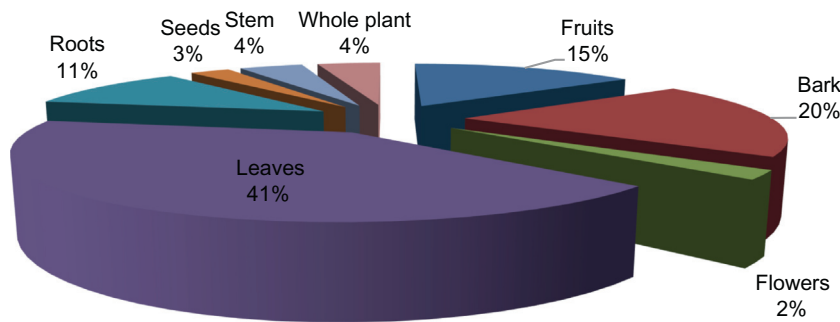


Fig. 4. Distribution of the plant parts for plant species used for cosmetics and cosmeceuticals by the Vhavenda women in Vhembe district municipality, Limpopo province, South Africa, n = 51.

only. Hence, the Vhavenda women who were knowledgeable articulated that natural-based cosmetics and cosmeceuticals are an inter-disciplinary practice which heals and promotes the beauty of skin.

Plant species are collected throughout the year, and seasonality only plays a role when plant parts such as fruits or leaves are to be collected. Plant species are mostly collected based on the need of that plant species depending on the demand seasonally or occasional. It was observed that the Vhavenda women who were knowledgeable about natural-based cosmetics and cosmeceuticals harvested and carried as many plants as they could when they go out for collection. They mentioned that it would be a waste of time, money and energy to harvest only a few species when out in the wild. When asked about this practice they reasoned that harvesting larger quantities of plants was necessary because of the increased distance they had to travel to the collection site. According to them, the scarcity of certain species also warrants the collection of larger volumes, an approach that might in the end result in the destruction of certain wild populations.

#### 4. Discussion

##### 4.1. Plant species composition of natural-based cosmetic and cosmeceutical in Vhembe district

The immense use of plants in ethno-medicine for skin care is very common among different ethnic groups in South Africa (Lall and Kishore, 2014). In the current study, the Vhavenda women who were knowledgeable about natural-based cosmetics and cosmeceuticals indicated that the different types of plant species are inspired mainly by their culture. According to the participants, natural-based cosmetics and cosmeceuticals products are mainly used in cultural activities such as traditional healing and skin-related issues. The high number (49) of plant species from the 79 participants provides an indication that the Vhembe district municipality has diverse flora used as cosmetics and cosmeceuticals. The number of plants specifically used for

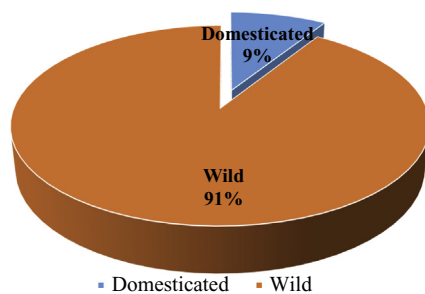


Fig. 5. Occurrence of plant species used for natural-based cosmetics and cosmeceuticals by the Vhavenda women in Vhembe district municipality, Limpopo province, South Africa, n = 49.

cosmetics and cosmeceuticals documented in the study area was higher than that of the other reports in Limpopo province particularly in Vhembe district municipality (Arnold and Gulumian, 1984; Mabogo, 1990; Magwede et al., 2018). The biodiversity, including plant species, had been widely used a long time ago. It has played a key role in preserving the culture of the Vhavenda community and as source of welfare; it is strictly prohibited to cut or collect any plant species in the study area, except by knowledge holders (Bomaine).

Currently, many plant species are being studied for their medicinal properties in order to explore them for commercial value (van Wyk, 2011). In the current study, the range of natural-based cosmetics and cosmeceuticals is similar to the survey conducted in Amatole district where 106 plant species from 61 families were identified as being used to treat one or more skin disorders (Afolayan et al., 2014). According to Lall and Kishore (2014), about 35 out of the 117 species are totally unexplored for the treatment of skincare in South Africa. Plants from families such as Asteraceae, Euphorbiaceae, Lamiaceae, Rubiaceae, Fabaceae and Anacardiaceae were used by traditional healers to manage skin ailments. In the current study, 31 families are used for natural-based cosmetics by the Vhavenda women. Interestingly, more than 50% of the plant families are recorded for the first time as having ethno-botanical relevance in natural-based cosmetics and cosmeceuticals. Leguminosae, Rhamnaceae and Meliaceae were the most common families (3–4 species) each with application summarized in Fig. 2. However, the plant families in Vhembe district municipality in Limpopo Province used for natural-based cosmetics and cosmeceuticals are different from other provinces in South Africa (Afolayan et al., 2014; De Wet et al., 2013; Thibane et al., 2018).

Analysis of the data in Table 2 provides interesting insights into the main patterns of plant use. For example, in Fig. 3, it is noteworthy that the trees have 22 recorded species, nearly double the number of shrubs (12 species). The remaining plant habits in descending order are herbs (11 species) and creepers (1 species). This could be related to the floristic composition of the vegetation of Vhembe district municipality which is dominated by trees and shrubs as highlighted in other studies (Constant and Tshisikhawe, 2018; Mabogo, 1990; Magwede et al., 2018). A high usage of trees, shrubs and herbs in Vhembe district municipality is also likely associated with the tropical climate of the Vhembe region which, in turn, helps the plants to be widely available and abundant in the study area.

As shown in Fig. 4, the most utilized plant part was the leaves (41%). Similar observation of the dominance of the leaves over other plant parts have been recorded by other researchers (Afolayan et al., 2014; Mahomoodally and Ramjuttun, 2016; Saikia et al., 2006). Generally, the leaves are the most popular plant parts used to treat skin infections in Southern Africa (Mabona and Van Vuuren, 2013). The authors also highlighted that many other indigenous communities worldwide, including India, mostly utilize leaves for the preparation of traditional medicines used for natural-based cosmetics and cosmeceuticals. On the other hand, Fongnzossie et al. (2017) highlighted that fruits were



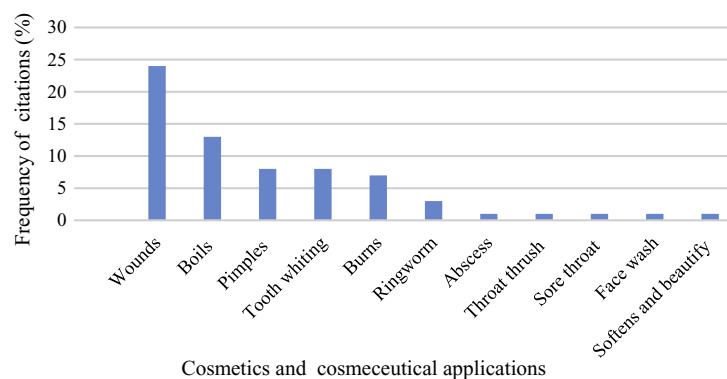


Fig. 6. Cosmetic and cosmeceutical applications treated with different plant species by the Vhavenda women in Vhembe district municipality, Limpopo province, South Africa, n = 97.

the most commonly used plant parts as cosmetics and cosmeceuticals among the Gbaya ethnic group in Eastern Cameroon. Thus, indigenous knowledge on plant-based cosmetics and cosmeceuticals differs across different communities and ethnic groups globally.

In the present study, the majority of the identified plants were used for wounds and skin burns. In South Africa, other studies have also reported that plant species are frequently used for skin treatment (Afolayan et al., 2014; Thibane et al., 2018; Xaba, 2016). This could be due to the prevalence of the use of medicinal plants to treat skin infections which is common in many rural areas (Naidoo and Cooposamy, 2011). South Africa is an important focal point of botanical and cultural diversity but only a few plant species have previously become fully commercialized as medicinal products (van Wyk, 2011). Plant species are highly sought after to treat dermatological ailments due to their ability to stop bleeding, speed-up wound healing, as treatments for burns and to alleviate other skin conditions.

#### 4.2. Relationship between present and previous studies

The comparison of earlier ethnobotanical studies conducted in Vhembe district municipality and other parts of South Africa with present study showed that many plant species were confirmed for different use (Table 2). Plant species such as *Adansonia digitata*, *Aloe marlothii*, *Diospyros mespiliformis*, *Lippia javanica*, *Sclerocarya birrea* and *Ziziphus mucronata* have similar uses (Arnold and Gulumian, 1984; De Wet et al., 2013; Mabogo, 1990). However, the preparation and application methods were different. The value of each plant species was evaluated via the use of CI, plant species with the highest cultural importance index were *Dicerocaryum zanguebaricum* (17.7) and *Ricinus communis* (10.1). These high values strongly support the extent to which these plant species are used in the study area. Indeed several published literature are available for these aforementioned plants which is an

indication of their potential as natural-based cosmetics and cosmeceuticals. For instance, the leaves of *Dicerocaryum zanguebaricum* are applied topically as a substitute for soap (Mabogo, 1990; Rambwawasvika et al., 2017). Furthermore, *Ricinus communis*, known locally as Mupture had high cultural importance (10.1) and the seeds are applied topically as lotion. In addition, it is topically applied for treating wounds, burns and skin ulcers in Vhembe district (Arnold and Gulumian, 1984; Mabogo, 1990; Magwede et al., 2018). As documented in the current study (Table 2), *Ricinus communis* is well known among the Vhavenda women and traditional healers for its effectiveness for healing burns and wounds. *Striga asiatica* plays a substantial role in healing wounds or burns as the herb is burned and applied to the skin. *Solanum incanum* is a herb used to heal and wash tooth, and as tooth antiseptic when mixed together with *Commiphora mollis*. Both are used simultaneously on burns and wounds. The current therapeutic uses for these aforementioned plants demonstrate the importance of collecting new ethnobotanical information even on well-known plant species (Demie et al., 2018).

#### 4.3. Method of preparations and mode of application

As documented in other studies (Afolayan et al., 2014; Tadesse et al., 2005) diverse methods of preparation was observed in the current study. Maceration and poultice were the most frequently used preparation method among the participants (Fig. 7). However, this is in contrast to other studies whereby decoction or concoction were generally more popular method of preparation (Afolayan et al., 2014 and Tadesse et al., 2005). In the current study, squashing as a method of preparing plant-based cosmetics and cosmeceuticals was reported among the participants.

In the current study, 75% of plant species were administered topically. The results of the study corroborate with other studies whereby

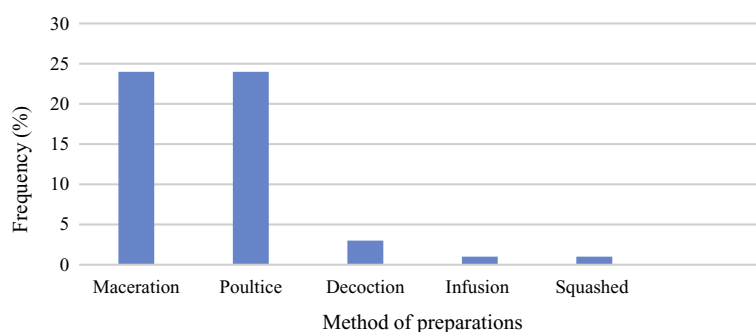
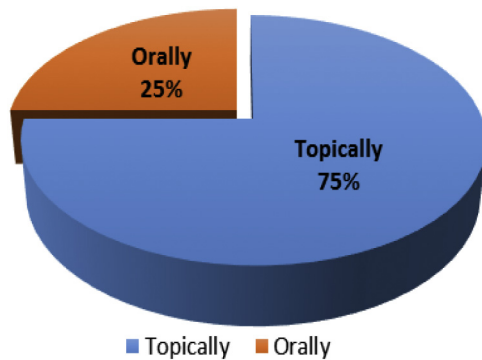


Fig. 7. Distribution of the methods used for preparing plant-based cosmetics and cosmeceuticals by the Vhavenda women in Vhembe district municipality, Limpopo province, South Africa, n = 68.



**Fig. 8.** Distribution of the mode of applications of natural-based cosmetics and cosmeceuticals used by the Vhavenda women in Vhembe district municipality, Limpopo province, South Africa,  $n = 57$ .

topical route was reported as the most common mode of administration of natural-based cosmetics and cosmeceuticals (Saikia et al., 2006; Sumit et al., 2012). Furthermore, this mode of administration was illustrated with 11 different cosmetic applications (Fig. 5). Interestingly, this endorses the fact that plant species are deeply rooted in the cosmetic world with various types of cosmetic and cosmeceutical uses. Application of natural-based cosmetic and cosmeceuticals such as a paste, powder or sap (topically) were also in alignment with the findings by Saikia et al., 2006.

Different types of skin diseases/disorders including abscess, boils, burns eczema, pimples, ringworms, cleaning of tooth and wounds, which were managed through different plant-based cosmetics and cosmeceuticals. Twenty-four plant species were used to treat wounds, followed by boils, pimples, tooth, burns which were treated with three plants each. Wounds was found to be a dominating ailment in the study area According to Jarić et al. (2018), wounds are a disruption to the normal anatomic structure of the tissue which leads to the loss of epithelial continuity as well as the anatomical and functional integrity of the living tissue.

According to Legwaila et al. (2011), harvesting and collection of plants in most developing countries is done by women and children. The present study indicated that the Vhavenda women use various harvesting methods. The choice of methods are strongly influenced by culture and belief (Constant and Tshisikhawe, 2018). This study clearly indicated that most (91%) of the plant species are harvested from the wild (forest). Most of the Vhavenda women preferred to collect various plant species from natural forest because they worried that some patients might use the plants incorrectly, and those plants from the forest are not contaminated by the communities. Collection from the wild is a common practice in Limpopo Province (Arnold and Gulumian, 1984; De Wet et al., 2013; Mabogo, 1990).

## 5. Conclusions

The current ethnobotanical survey revealed that a total of 49 plants from 31 families are used as sources of natural-based cosmetics and cosmeceuticals by 79 women in Vhembe district municipality, Limpopo province. This is the first ethnobotanical study that focused on natural-based cosmetics and cosmeceuticals utilized among the Vhavenda women in Vhembe district municipality. This result provides a relevant contribution to the knowledge of plant species in Vhembe district municipality. Infusions, decoctions, poultice or juice from fresh plants were the methods used for preparing the natural-based cosmetics and cosmeceuticals. The results also indicated that five (5) plant species were mentioned by the participants and have a high cultural use. Findings from this study indicates the rich biodiversity in term of the high number of plants used for cosmetics and cosmeceuticals among the Vhavenda women. Nevertheless, further studies need to investigate

the antimicrobial activity of the extracts of the most cited plants against bacterial and fungal pathogens implicated in skin-related diseases. Positive responses from the scientific evaluation of the selected plants will justify the incorporation and use of these natural-based cosmetics and cosmeceuticals for the local markets.

## Authors' contributions

PTN conducted the field study and analyzed the data. OM was involved with the conceptualization of the research. AOA and WOM conceived and supervised the whole project. PTN prepared the draft manuscript with help from all the other authors. All the authors approved the final manuscript for submission.

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