

# Ethnobotany of polyherbal formulations in the Mount Slamet Region, Central Java, Indonesia

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**Abstract.** Hartanti D, Wahyuningrum R, Rachmani EPN. 2026. Ethnobotany of polyherbal formulations in the Mount Slamet Region, Central Java, Indonesia. *Asian J Ethnobiol* 9 (1): y090122. <https://doi.org/10.13057/asianjethnobiol/y090122>. Though the locals around Mount Slamet, Central Java, Indonesia, have extensive traditional knowledge about polyherbal remedies, this knowledge has not been systematically documented, and, because of this, their ethnobotanical and therapeutic potentials remain largely unexplored. The present research was an effort to document the species forming the basis of the local polyherbal formulations, to measure their relative importance, and also to reveal their composition, medicinal uses, and the major clinical applications. Information from 42 local informants, who were purposively selected, was obtained through semi-structured interviews in the period from September to November 2022. The cultural significance of the plant constituents was measured by Species Use Value (SUV) and Relative Frequency of Citation (RFC) indices. A total of 98 polyherbal formulations, including 84 plant species from 34 families, were identified. Zingiberaceae was the most represented family, with *Curcuma longa* (SUV = 1.05, RFC = 0.74), *Zingiber officinale* (SUV = 0.83, RFC = 0.64), and *Kaempferia galanga* (SUV = 0.76, RFC = 0.67) being the main medicinal plants in the area. The therapies were aimed at postnatal care, digestive problems, and immune-related disorders. They used 2-13 plant species prepared as decoctions or infusions. A high correlation between SUV and RFC reflects the agreement between cultural consensus and therapeutic application. Leaves, rhizomes, and fruits were the most commonly used plant parts, which were mainly prepared by boiling for oral consumption. Because of this, these polyherbal formulations are a reflection of the optimized botanical assemblage that is determined by local ecology and medicinal requirements. The use of dominant Zingiberaceae species with specific therapeutic targets offers a strong foundation for further pharmacological validation and drug development.

**Keywords:** Ethnomedicine, medicinal plants, Mount Slamet, plant diversity, polyherbal formulations

**Abbreviations:** ANOVA: Analysis of variance, RFC: Relative Frequency of Citation, RISTOJA: *Riset Tumbuhan Obat dan Jamu*, SUV: Species Use Value

## INTRODUCTION

Polyherbal formulations involve blending two or more herbal components in the correct ratios for therapeutic purposes. They often produce stronger synergistic effects compared to single herb (monoherbal) formulations. This synergism implies that the therapeutic effect will be more than a mere sum of individual components, thereby resulting in increased efficacy, safety, and bioavailability (Zainulabdeen et al. 2025). This synergistic idea is deeply rooted in ancient healing systems like *ayurveda*, traditional Chinese medicine, and *jamu* of Indonesia. All of these systems rely on complex combinations to supply a healthy and multitargeted lifestyle therapy (Heinrich et al. 2023). While they have been a critical component of traditional reliance worldwide, ethnopharmacological studies on polyherbal formulations remain limited. In Indonesia, limited academic research has been carried out on the use of medicinal plants in polyherbal compositions. The Madurese community had recourse to 74 species of medicinal plants to prepare 27 different polyherbal formulations mostly for women's health (Muharrami et al.

2024). One documented use of *uyub-uyub*, a polyherbal galactagogue originally prescribed to stimulate breast milk production, was in Jogonalan, Klaten. The main ingredients of this formula include *Carica papaya*, *Curcuma longa*, and *Kaempferia galanga* (Sayuti and Atikah 2023). In the Mount Slamet area, only one ethnobotanical research has studied the polyherbal methods of the Baturraden community, recording 33 different formulations made from 43 species for treating numerous conditions, including gastrointestinal disorders and muscular pain (Utamingrum et al. 2021).

Mount Slamet is the second-highest mountain on Java Island, Indonesia and offers a protected forest and the Baturraden Botanic Garden as habitats for high biological diversity (Devenish et al. 2021). The mountain covers the territories of the five districts (Banyumas, Brebes, Pemalang, Purbalingga, and Tegal) in Central Java. In connection with this, a number of ethnobotanical studies have revealed a well-established use of nature for healthcare among the Javanese people, who have been mainly living on the Banyumas and Brebes side slopes of the mountain. Baturraden, located in Banyumas, is a well-

known center not only because of its wide ecological variety but also due to the presence of the Baturraden Botanical Garden. Besides 47 species being used for general ailments, 21 species for women's health, 12 species for the treatment of diabetes, and 10 species for combating diarrhea were previously recorded (Permatasari et al. 2011; Utaminingrum et al. 2020, 2022; Nofrianti et al. 2021). Moreover, 40 species of medicinal plants proposed for respiratory tract diseases were identified in Cilongok, while 101 plant taxa were employed for drug purposes in the Pekuncen Sub-district (Hidayah et al. 2022; Wahyuningrum et al. 2022). On the other hand, people from Paguyangan and Bumiayu in Brebes utilize 73 types of medicinal plant species for acute and chronic ailments (Rosmi et al. 2025). In fact, the Zingiberaceae family is the dominant and most frequently used taxon in the region, with *C. longa*, *Zingiber officinale*, *Piper betle*, and *Andrographis paniculata* recognized as the major medicinal plants. Across all studies, all the regions mainly use decoction as the preparation of medicinal formulations, and the aqueous extract obtained is given orally. However, the ethnobotanical usages of these species by the communities in Banyumas and Brebes are quite different. For example, *C. longa* is one of the most important ingredients in polyherbal therapies for stomach disorders, skin problems, and dysmenorrhea in Banyumas, but in Brebes, it is mainly used to reduce joint pain, prevent cardiovascular diseases, and improve skin condition. Similarly, *Z. officinale* is the first choice in Banyumas for the treatment of respiratory track disorders, stimulation of appetite, and treatment of *masuk angin*, but it is used for increasing immunity and alleviating colds in Brebes.

Ethnobotanical research in the Mount Slamet Region has mainly focused on single-plant preparations. This has resulted in polyherbal formulations being underreported. Moreover, most reports available are qualitative in nature, listing only species without the use of quantitative indices

to assess their relative cultural importance. To date, no research has documented the medicinal uses of plants for specific indications on the slopes of Tegal, Pemalang, and Purbalingga. This is the main reason why comparisons of phytomedicinal use patterns in communities living around the different districts of Mount Slamet are almost absent. To address this gap, this study aims to carry out a detailed ethnopharmacological survey of polyherbal formulations in five districts. The component species, methods of preparation and administration, ailments treated, and quantitative indices were systematically examined.

## MATERIALS AND METHODS

### Study area and period

The study was conducted in 20 villages around the top of Mount Slamet, which is located in five districts in Central Java, Indonesia, i.e., Banyumas (Gunungluluh, Kalikesur, Karangnangka, Panembangan, Sambirata, and Sokawera), Brebes (Winduaji), Tegal (Sumbaga), Pemalang (Banyumudal, Cletakatan, Gambuhan, Kebanggan, and Sima), and Purbalingga (Bojongsari, Karangjengkol, Karangreja, Siwarak, Sumingkir, Tlahab Kidul, and Tlahab Lor) (Figure 1). These villages lie near the Mount Slamet protection forest, which experiences a transition from tropical to monsoon conditions, with annual rainfall of 4500 mm (rainy season October-May). The region is inhabited primarily by Javanese communities influenced by Islamic and residual Kejawen traditions. Ethnobotanical knowledge is held mainly by older generations, including traditional midwives and bone healers. Fieldwork and data collection were conducted from September to November 2022, which facilitated plant identification and site access.

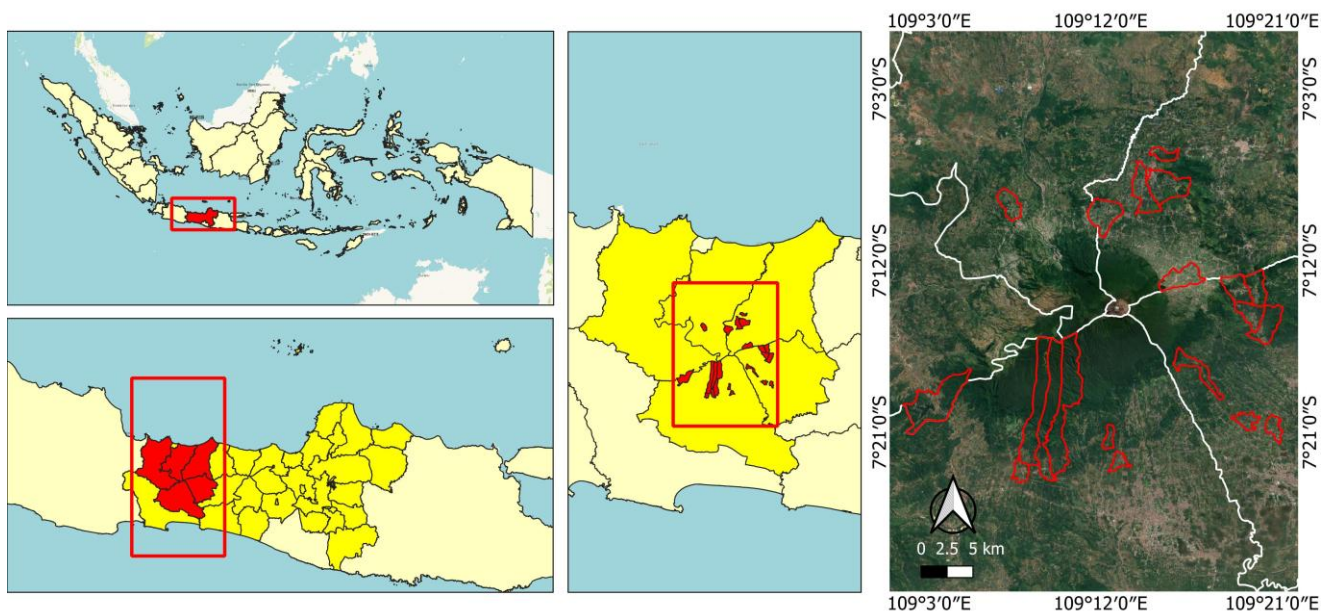


Figure 1. Map of the study area in Mount Slamet, Central Java, Indonesia

### Informant selection

A total of 42 informants were selected using purposive sampling. Inclusion criteria for selecting informants were as follows: local residency, possession of medicinal plant knowledge, actively practicing (self or clients) for  $\geq 10$  years, and age  $\geq 30$  years. The exclusion criterion was prior participation in similar studies. The ethical approval for the study protocol was granted by the Health Research Ethics Committee of Universitas Muhammadiyah Purwokerto, Indonesia (ref. KEPK/UMP/14/XII/2022).

### Data collection

Ethnobotanical data were collected through semi-structured interviews and field walks. Prior informed consent was signed and documented for all participants. The International Society of Ethnobiology's code of ethics was followed throughout the study (International Society of Ethnobiology (ISE) 2006). Interviews, conducted in Javanese, focused on plants used in polyherbal formulations, including local names and plant parts, as well as details of the formulations, such as plant composition, indications of use, preparation methods, and routes of administration. Data were cross-checked through repeated discussions and triangulation across informants and villages. For each cited species, specimens were collected during field walks in the informant's presence, photographed, and processed into herbarium specimens following standard procedures.

### Species identification

Taxonomic validation was performed using key morphological characteristics and verified against Flora Malesiana. The scientific names of the collected plants were updated to their respective accepted names in the World Flora Online (<http://www.worldfloraonline.org/>). Voucher specimens were deposited at the Directorate of Scientific Collection Management, National Research and Innovation Agency, Cibinong, Indonesia, and the Faculty of Pharmacy, Universitas Muhammadiyah Purwokerto, Indonesia.

### Data coding

Each polyherbal formulation was coded by the body system treated, following the Economic Botany Data Collection Standard (Cook 1995). Level 1 = medicine category (11xx), level 2 = disorder group or body system (1101-1124), level 3 = specific disorder (11011-11242). Informant demographics (age, gender, domicile, occupation, knowledge source, practice duration, client numbers, and other traditional approaches) were recorded qualitatively. The demographic profile of informants is presented in Table 1.

### Ethnobotanical index calculation

Species Use Value (SUV) and Relative Frequency of Citation (RFC) of the plants were calculated using standard equations (Saensouk et al. 2025).

$$SUV = \sum U_i / N \quad [1]$$

Where,  $U_i$  is the number of uses mentioned by each informant, and  $N$  is the total number of informants.

$$RFC = FC / N \quad [2]$$

Where,  $FC$  is the number of informants citing the species.

### Statistical analysis

The amount of knowledge per informant was at first measured by the number of polyherbal formulations reported by each informant. To identify what predicts knowledge, multivariable linear regression was carried out to test the effects of continuous (age) and categorical (gender, practitioner status) variables. With this multivariable method, one can find out the exclusive involvement of each explanatory variable while adjusting for confounders, which is statistically more robust and reliable than several univariate tests. It is a well-recognized standard, robust method for identifying socio-demographic trends in ethnobotanical datasets, even with minimal sample sizes. Before analysis, the data file was tested for normality and homoscedasticity. Knowledge scores across the five districts did not follow a normal distribution. Consequently, a nonparametric Kruskal-Wallis test was carried out for a group comparison. Differences in knowledge between adult and elderly, male and female, and practitioner and non-practitioner groups were statistically tested through independent T-tests. The relationship between SUV and RFC was computed using the Pearson correlation coefficient. All the analyses were done at the 95% level of confidence using SPSS version 26 (IBM SPSS Statistics, US).

**Table 1.** Demographic profile of informants

Variables	Categories	Number of informants	Percentages (%)
Gender	Female	32	76.19
	Male	10	23.81
Age	< 40	6	14.29
	40-50	3	7.14
	50-60	13	30.95
	60-70	14	33.33
	>70	6	14.29
Occupation	Bone healer	2	4.76
	Eyelash artisan	1	2.38
	Farmer	5	11.90
	Herbal seller	9	21.43
	Make-up artist	1	2.38
	Preschool teacher	1	2.38
	Traditional midwife	19	45.24
	Ethnicity	Chinese-Javanese	1
Javanese	41	97.62	

## RESULTS AND DISCUSSION

### General observations on informant knowledge

A multiple linear regression model was fitted to predict knowledge of the polyherbal formulation from age, gender, and practitioner status. The resulting model is presented in Table 2. The overall model was statistically significant ( $R^2$  model = 0.208;  $p = 0.030$ ). However, the regression model did not provide a good fit to the data, possibly due to non-normality in the distribution. The sample size of 42 in the regression analysis was adequate but insufficient to predict the factors contributing to knowledge. It likely affects the non-significant results for age and gender.

Small increase in knowledge with each year of age, but the effect is very small. Consequently, a 10-year increment only predicts a 0.04-unit increase in knowledge. This almost flat slope shows that knowledge of polyherbal medicines is not totally dependent on age. Rather, it is spread through adults talking to each other (horizontal transmission) instead of people only learning from older generations (vertical transmission). The results of an independent t-test showed that knowledge levels did not differ significantly between adult (30-59 years) and elderly ( $\geq 60$  years) groups ( $p = 0.067$ ). Still, most adult informants were in late adulthood, which may have influenced the sample. For example, younger informants like eyelash artists, make-up artists, and preschool teachers might take a flexible, multifaceted approach, including the use of digital media, to ethnobotanical knowledge acquisition at a fast speed. This allows them to get a knowledge level comparable to older cohorts. The core of essential, multipurpose formulations that remain widely recognized at all ages of the informants is more than likely shared. A similar pattern of dynamic knowledge acquisition was reported in Alagoas, Brazil (Mata et al. 2024). However, the small number of younger generation participants is cause for concern, and a formal strategy for transmission is needed to ensure the survival of this traditional medicinal knowledge in a rapidly changing sociocultural context.

The positive coefficient for gender shows that male informants recorded a bit more knowledge through metrics than females ( $\beta = 0.396$ ), although this difference was not statistically significant ( $p = 0.506$ ). Such an equal formulation of knowledge among genders might be due to similar transmission pathways, no matter the sex. This finding suggests that the traditional division of labor in the study area is changing: women are taking up roles outside the home, and thereby their knowledge is also expanding into domains which men used to occupy. A total of 76% of the informants were female, and 59% of those are traditional midwives. Consequently, most of the respondents were primary domestic healthcare practitioners who had predominantly procedural knowledge of polyherbal treatments during pregnancy, labor, and other gynecological conditions. Taking into account this demographic distribution, the relative male informants' input might be very limited, and thereby it did not result in a statistically significant difference in the community knowledge pool.

On the other hand, practitioner status was the only factor that had a unique and significant effect on informant knowledge about polyherbal formulations. Traditional midwives and bone healers, as specialists, reported many more formulations than non-practitioners (e.g., farmers, herbal vendors, artists, and preschool teachers). Consequently, specialized therapeutic roles were highly correlated with higher polyherbal knowledge. Taken together, these outcomes suggest that ethnomedicinal knowledge in the studied area is preserved through specialized healing roles and clinical practice rather than just age or biological sex. These specialists are the main holders of traditional knowledge in social-ecological networks, helping to keep the key adaptive structures necessary for multi-component treatments. Interestingly, the informants from the Banyumas and Tegal borders near urban areas are becoming more receptive to the biomedical modern developments (Lima-Mota et al. 2023). Conservation and healthcare provision should identify and allow for the activities of these specialists, who are crucial points for knowledge.

According to the Kruskal-Wallis test, mean ranking (17.00-27.90) showed that there was no substantial difference in polyherbal knowledge among the informants from different districts ( $H = 3.734$ ,  $p = 0.443$ ). The small sample, in particular in Brebes ( $n = 3$ ), and the high variance within groups likely led to this non-significant result. Therefore, the location of residence does not affect absolute knowledge measures in this group. Informants from Banyumas, Brebes, Tegal, Pemalang, and Purbalingga have equivalent knowledge of the number of formulations known, possibly because of the similar ecological and botanical conditions around Mount Slamet. However, qualitative data from the earlier studies disclose that the main medicinal taxa in Banyumas are used for different diseases, prepared, and administered in manners quite distinct from those in Brebes (Utaminigrum et al. 2022; Khusna et al. 2023).

### Ecological, cultural, and phytochemical aspects of the dominant plants

A total of 84 medicinal plant species were utilized by Mount Slamet communities to create polyherbal preparations, with these plants belonging to 34 different families. Among these families, Zingiberaceae, Fabaceae, and Piperaceae were the most dominant ones. In fact, the most shared species in various polyherbal formulations were *C. longa*, *K. galanga*, *Z. officinale*, *Cymbopogon citratus*, *Curcuma zanthorrhiza*, and *Tamarindus indica* (Figure 2). Mainly rhizomes, leaves, and fruits were harvested for medicinal use (Table 3). The entire list of medicinal plants recorded can be found in Supplementary Table S1.

The majority of ingredients used in polyherbal formulations are plants from the Zingiberaceae, Fabaceae, and Piperaceae families, primarily because of their great diversity, wide distribution, high adaptability, and rich sources of bioactive compounds. Also, these three families are very well represented in the area under study. Zingiberaceae are highly diversified in Southeast Asia,

accounting for more than 1,960 species, while Fabaceae ranks as the third-largest family of plants worldwide, having approximately 19,500 species (WFO 2026a, b, c). They are mostly grown in home gardens or gathered from the wild within protected forests. Besides their use in ethnomedicine, these families have various other functional purposes. For example, *Alpinia galanga*, *C. longa*, *Etilingera elatior*, *K. galanga*, *Wurfbainia compacta*, *Z. officinale* (Zingiberaceae), *Piper nigrum* (Piperaceae), and *T. indica* (Fabaceae) are the major spices used in local foods (Apriliani et al. 2014). In addition, *P. betle* (Piperaceae), *Erythrina variegata*, *Pachyrhizus erosus*, and *Vigna unguiculata* (Piperaceae) play significant roles in the sociocultural aspect of Javanese ceremonies (Mukarromah et al. 2024). On the other hand, Indonesian Zingiberaceae rhizomes contain a diverse range of phenolic compounds and essential oils, ultimately exhibiting anti-inflammatory, antioxidant, and antibacterial properties (Windarsih et al. 2015). Based on their volatile oil content, ethnomedicinal systems consider them as warming, drying agents that work against cold and damp conditions, which are related to postpartum hemorrhage, sluggish digestion, and joint pain (Tilaar and Widjaya 2014). Meanwhile, Piper plants contain piperamide alkaloids, which give them a sharp taste. These plants are, at a conceptual level, regarded as hot, sharp, and penetrating remedies aimed at alleviating infections and bloating due to gastrointestinal problems, fever, and other stomach diseases (Beers 2001; Luca et al. 2021).

Figure 3 illustrates the scatter plot of SUV against RFC for 79 medicinal plants that exhibit a strong, significant positive correlation ( $r = 0.938$ ,  $p = 0.001$ ). *Curcuma longa*, *Z. officinale*, *K. galanga*, *C. citratus*, *C. zanthorrhiza*, and *T. indica* had very high SUV values, which reflected their wide range, as they are the main ingredients of numerous formulations. Besides having high SUV, such plants possessed a high RFC, indicative of cultural consensus around their uses. Consequently, plants that were referred to by a larger proportion of informants tend to be utilized for a wide range of purposes. This consistent use implies that different communities have chosen a set of core polyvalent plant components for different formulations and diverse purposes. These species are definitely perceived as the most important to the Mount Slamet community. Most data cloud clusters occur in the low-value region (SUV and RFC < 0.20), and a small number of high-value plants drive the correlation. Nonetheless, some plants are positioned away from the main trend. For instance, *Centella asiatica* (SUV = 0.19, RFC = 0.02) and *Biancaea sappan* (SUV = 0.14, RFC = 0.02) work as solo herbs in various polyherbal mixtures, but only a few informants use them. Conversely, *Blumea balsamifera* (SUV = 0.02, RFC = 0.14) and *Catharanthus roseus* (SUV = 0.02, RFC = 0.12) find their application only in one formulation, but many informants are aware of this particular use. It is a common pattern in plant ethnobotany where few culturally salient species

make up most of the local knowledge (Ralte et al. 2024; Saensouk et al. 2025).

Table 4 presents a connection between cultural values, functional uses, and the bioactive potential of major plants in local polyherbal formulations. In these mixtures, *C. longa*, *Z. officinale*, *K. galanga*, and *C. zanthorrhiza* exhibit essential roles as core ingredients, while their respective bioactive compounds inducing pharmacological activity supports their validation as folklore remedies. *C. citratus* and *T. indica* also act as secondary ingredients, enhancing chemical stability and organoleptic qualities to maximize therapeutic effects. This method aligns with the *jamu* formulation bioinformatic notions whereby effective prescriptions must include both the main and supporting components (Afendi et al. 2016). It is an approach that has been employed in evidence-based *jamu* where adding *C. longa*, *C. zanthorrhiza*, and *Phyllanthus niruri* to drug formulations counts as for their anti-inflammatory, analgesic, and immunomodulatory properties (Rahayu et al. 2016; Novianto et al. 2020). The gingerbread house effects of traditional phytotherapy may be attributed to the essential oils of these Zingiberaceae species, which are responsible for their heating, tonifying, and cleansing effects. Moreover, the volatile oils and flavonoids of *C. citratus* combined with the organic acids of *T. indica* are responsible for their cleansing and cooling attributes. This last underlies the comprehensive characteristics of traditional herbal medicines, where the multi-ingredient mixtures not only work together but also synergistically in enhancing at least one of the properties of efficacy or safety (Tilaar and Widjaya 2014; Heinrich et al. 2023).

#### **Polyherbal formulation use categories, composition, preparation, and administration**

Table 5 describes 98 polyherbal formulations, which contain 2-13 plant components (average = 4.7 species/mix). These formulations were targeted at 37 different diseases belonging to 15 body systems, with the main focus on maternal healthcare (pregnancy/birth/puerperium), musculoskeletal problems, and the immune system (Tables S2-S4). Traditional medical systems show marked differences in the complexity of formulations. For example, Ayurveda, Unani, Kampo, and traditional Chinese medicine formulations have an average of 12.9, 8.5, 7.3, and 6.8 components, respectively (Chen et al. 2025). Complexity corresponds to the therapeutic target and/or the particular phytotherapy system. Moreover, synergism in phytotherapy refers to the idea that some combinations of plants have additive effects, whereas others exhibit antagonistic properties (Famewo et al. 2017; Heinrich et al. 2023). The stable component number of the commonly used herb-pair (i.e., *C. longa* and *T. indica*) likely acts as a platform to which other plants are incorporated. It is in line with TCM and Kampo styles, which are distinguished by the common, combined usage of *Glycyrrhiza uralensis* and *Z. officinale* (Chen et al. 2025).

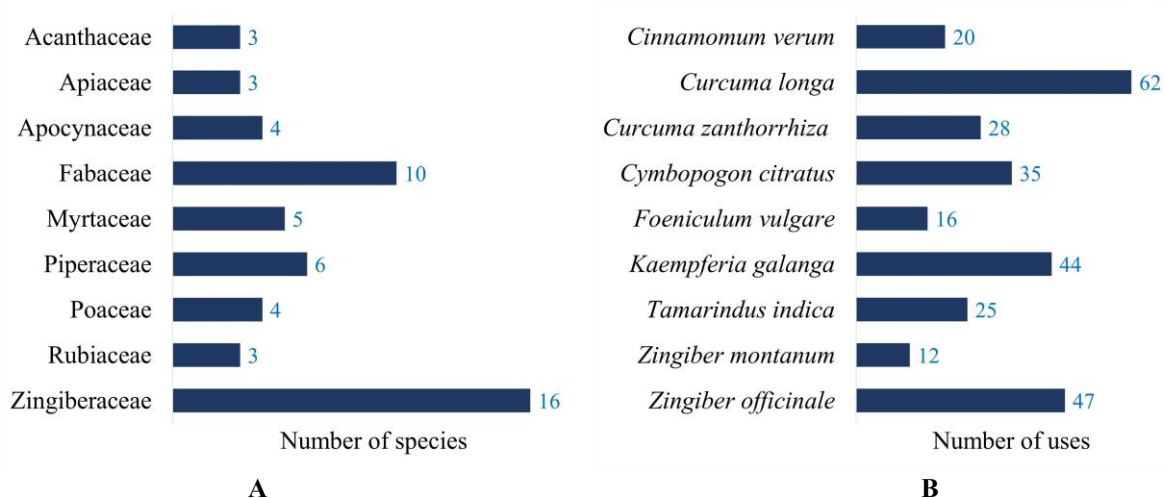
**Table 2.** Logistic regression results for factors influencing ethnobotanical knowledge on the polyherbal formulation

Variable	Coefficient ( $\beta$ )	Std. error	Odds ratio (Exp $\beta$ )	95% CI	P-value	Interpretation
Age	0.004	0.019	0.032	-0.035 - 0.043	0.837	Age is not the predictors for the knowledge; it was comparable across all ages
Gender (male = 1)	0.396	0.589	0.103	-0.797 - 1.588	0.506	Gender is not a predictor of the knowledge; male informants' knowledge is statistically comparable to that of the female ones
Status (practitioner = 1)	1.428	0.542	0.422	0.330 - 2.525	0.012*	Practical experience defined the practitioners' knowledge, which was significantly higher in practitioners than in non-practitioners

Note:  $R^2$  model = 0.208, Model significance  $p = 0.030$

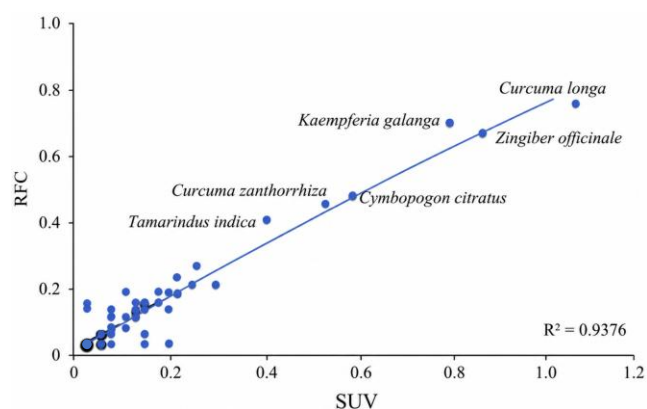
**Table 3.** The botanical details of the most commonly used plants as polyherbal formulation components

Plant name	Local name	Family	Plant part
<i>Acorus calamus</i> L.	<i>Dringo, dlingo</i>	Acoraceae	Rhizome
<i>Centella asiatica</i> (L.) Urb.	<i>Panigoang, panikula, pegagan</i>	Apiaceae	Aerial part
<i>Foeniculum vulgare</i> Mill.	<i>Adas</i>	Apiaceae	Aerial part
<i>Alyxia reinwardtii</i> Blume	<i>Pulasari</i>	Apocynaceae	Bark
<i>Pluchea indica</i> Less.	<i>Beluntas, teluntas, truntas</i>	Asteraceae	Leaf
<i>Carica papaya</i> L.	<i>Gandul, pepaya</i>	Caricaceae	Leaf
<i>Biancaea sappan</i> (L.) Tod.	<i>Secang</i>	Fabaceae	Wood
<i>Tamarindus indica</i> L.	<i>Asam, asam jawa</i>	Fabaceae	Fruit, leaf
<i>Orthosiphon aristatus</i> (Blume) Miq.	<i>Kumis kucing, remujung</i>	Lamiaceae	Leaf
<i>Cinnamomum burmannii</i> (Nees & T.Nees) Blume	<i>Kayu manis, manis jangan</i>	Lauraceae	Bark
<i>Piper betle</i> L.	<i>Sirih, suruh</i>	Piperaceae	Leaf
<i>Piper nigrum</i> L.	<i>Lada, mrica</i>	Piperaceae	Fruit
<i>Cymbopogon citratus</i> (DC.) Stapf	<i>Kamijara, kamijaran, sereh</i>	Poaceae	Leaf
<i>Oryza sativa</i> L.	<i>Beras, padi</i>	Poaceae	Fruit
<i>Alpinia galanga</i> (L.) Willd.	<i>Laos, lengkuas</i>	Zingiberaceae	Rhizome
<i>Curcuma longa</i> L.	<i>Kunir, kunyit</i>	Zingiberaceae	Rhizome
<i>Curcuma zanthorrhiza</i> Roxb.	<i>Temulawak</i>	Zingiberaceae	Rhizome
<i>Curcuma zedoaria</i> (Christm.) Roscoe	<i>Kunir putih, temu putih</i>	Zingiberaceae	Rhizome
<i>Kaempferia galanga</i> L.	<i>Kencur</i>	Zingiberaceae	Rhizome
<i>Wurfbainia compacta</i> (Sol. ex Maton) Škorničk. & A.D.Poulsen	<i>Kapulaga</i>	Zingiberaceae	Fruit
<i>Zingiber montanum</i> (J.Koenig) A.Dietr.	<i>Benglai, bengle</i>	Zingiberaceae	Rhizome
<i>Zingiber officinale</i> Roscoe	<i>Jae, jae</i>	Zingiberaceae	Rhizome
<i>Zingiber zerumbet</i> (L.) Sm.	<i>Lempuyang, puyang</i>	Zingiberaceae	Rhizome

**Figure 2.** The botanical and utilitarian profiles of the plants composed polyherbal formulations. A. The most represented plant families and B. The most frequently cited plant species

**Table 4.** Cultural importance, functional use, and bioactive potential are the basis of the most utilized species in Mount Slamet, Indonesia, polyherbal formulations

Species	SUV	RFC	Primary local use category	Formulation role	Traditional phytotherapy approach	Key bioactive compounds	Key pharmacological activity	Reference
<i>Curcuma longa</i>	1.05	0.74	Postpartum recovery	Core species	Warm and drying remedy to cleanse blood and counteract cold uterine conditions	Curcumin	Anti-inflammatory, antioxidant, wound healing	(Madbouly et al. 2024)
<i>Zingiber officinale</i>	0.83	0.64	Masuk angin	Core species	Hot remedy to warm the cold, damp stomach and expel trapped wind	Gingerols, shogaols	Antiemetic, carminative	(Gupta et al. 2025)
<i>Kaempferia galanga</i>	0.76	0.67	Joint pain, muscle aches	Core species	Hot remedy to relieve deep-seated joint pain and to dry rheumatic dampness	Ethyl p-methoxy cinnamate	Analgesic, antiinflammatory	(Dwita et al. 2021)
<i>Cymbopogon citratus</i>	0.57	0.45	Fever	Core and supporting species	Cooling remedy for febrile conditions and a fresh ingredient to improve palatability	Citrals	Carminative, antioxidant	(Emilio-Silva et al. 2017)
<i>Curcuma zanthorrhiza</i>	0.52	0.43	Liver tonic	Core species	Bitter, hot remedy to cleanse a stimulated liver and stimulate bile flow	Essential oils	Hepatoprotective, immunomodulatory	(Pramono et al. 2018)
<i>Tamarindus indica</i>	0.38	0.38	Postpartum recovery	Supporting species	Sour, cooling remedy to slow stimulated digestion and to improve palatability	Organic acids	Antioxidant, antiinflammatory	(Susanti et al. 2017)

**Figure 3.** Scatter plot showing the correlation between SUV and RFC of medicinal plants

One factor that determines the complexity of polyherbal formulations is the degree of diagnostic certainty (or specificity) of the disorders being treated. For particular diseases, healers in Northern Peru rely mainly on just one or two formulations, whereas for a broader category like inflammation or psychosomatic disorders, several preparations are used (Bussmann et al. 2010). Conversely, in the present study, an opposite pattern was observed. A four-combination herbal mix consisting of *Acorus calamus*, *C. citratus*, *Plantago major*, and *Syzygium aromaticum* was applied for body warming, a non-specific ailment. On the other hand, a combination of 12 plants (i.e., *Allium cepa*, *C. asiatica*, *C. longa*, *C. zanthorrhiza*, *C. citratus*, *E. variegata*, *E. elatior*, *Grona triflora*, *K. galanga*, *P. betle*, *Pluchea indica*, and *Zingiber zerumbet*) was employed for lactation stimulation. Complexity in formulations for metabolic disorders also varies given the ailment. For instance, in Pakistan, the treatment of obesity is done with

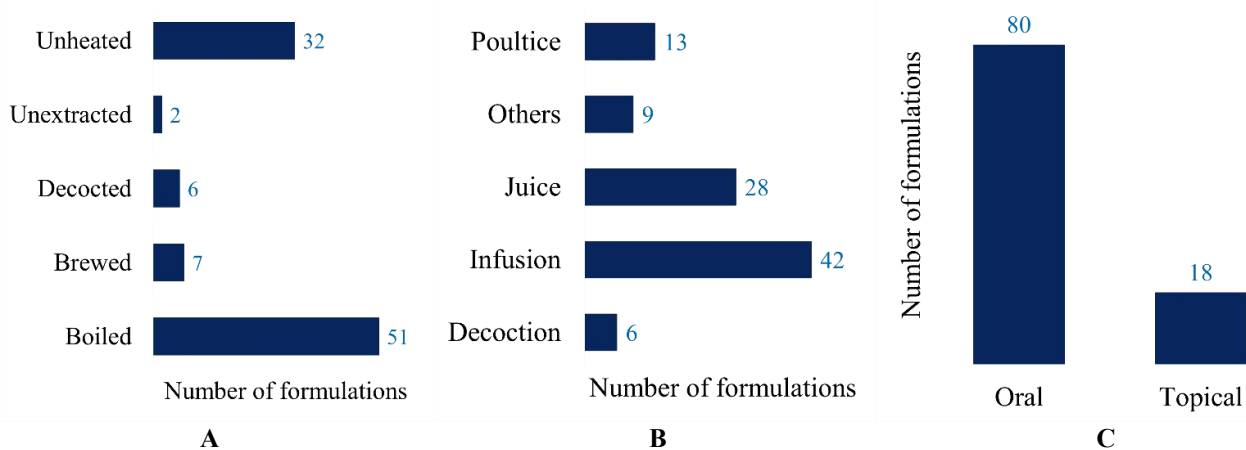
a formulation consisting of 9 components, while in Baturraden, hypercholesterolemia is treated with 2, 3, or 7 plants (Mussarat et al. 2021; Utamingrum et al. 2021). Here, hypercholesterolemia was managed with 5 (*A. galanga*, *Boesenbergia rotunda*, *C. citratus*, *P. betle*, and *Z. officinale*), 7 (*Anredera cordifolia*, *P. betle*, *P. nigrum*, *Piper retrofractum*, *S. aromaticum*, *Imperata cylindrica*, and *Z. officinale*), and 8 (*A. paniculata*, *C. longa*, *C. zanthorrhiza*, *K. galanga*, *T. indica*, *Tinospora crispa*, *Zingiber littorale*, and *Z. officinale*) component formulations.

Table 6 shows the use of major plant species in various formulations for pathologies of different physiological systems. These adaptable plants occur in almost all types of remedies, except those for injuries and tumors. *Curcuma longa*, the dominant species in the study area, is mainly used in formulations for gastrointestinal disorders and obstetric/perinatal conditions. On the other hand, *C. citratus* is often a component of perinatal care and immunological disorder remedies. These results highlight that the major taxa in Mount Slamet are also the most versatile ones. Interestingly, species targeting neoplasms (i.e., *E. variegata*, *Moringa oleifera*, *Nigella sativa*, and *Spatholobus littoralis*), as well as those for treating injuries (i.e., *Archidendron pauciflorum*, *Garcinia mangostana*, *G. triflora*, *Leucaena leucocephala*, and *Peperomia pellucida*), consistently exhibit low SUV and RFC values.

Figure 4 depicts that the most polyherbal formulations underwent thermal extraction via boiling and brewing. Non-thermal methods mainly consisted of grinding fresh botanicals for a poultice or squeezing them to obtain juice. The two top forms of preparation were infusions and expressing juices, with the oral route being the main way of administration. Thermal extraction stands as the leading mechanism of processing polyherbal preparations under the study area. Decoction refers to the continuous boiling of plant parts in water until the resulting liquid volume is just half or one-third of the original volume. This technique is thought to effectively release the phytochemical compounds in the formulations, a tradition well-known in

the Mount Slamet area and Pakistan (Mussarat et al. 2021; Utamingrum et al. 2021). By contrast, infusion and brewing need a brief time for boiling or sometimes pouring hot water over the plant material. It is a common working practice in the Central Balkans and South Africa. In both countries, it is mostly tied to the preparation of tuberculosis polyherbal remedies (Famewo et al. 2017; Janačković et al. 2022). In comparison with Persian medicine in Tehran, where dosage forms like capsules, syrups, and tablets have been modernized, preparations in the examined area are much simpler (Bozorgia et al. 2018). Nevertheless, the use of poultices as topical applications remains the same as in Australia, where pastes and poultices are the common treatments for wounds, sores, and joint pain (Yeshi et al. 2022). The solvent employed in the preparation of polyherbal formulations at Mount Slamet is only water, which is in harmony with Islam, the major faith of the local community. This differs from the Balkans, where alcohol, oils, fats, and honey are frequently used for the preparation of herbal formulations (Janačković et al. 2022).

Table 7 presents the linkages among plant parts, therapeutic indications, and typical routes of preparation. The plant parts most used were leaves, rhizomes, and fruits. In the case of leaves, they are readily available and plentiful throughout the year. Using leaves also enables the sustainability of the environment, as they may be collected without adversely killing the plant. Specific ones, like *C. citratus*, had very high amounts of essential oils and phenolic compounds, which reflect in their bioactivity (Hosseini et al. 2021). A small percentage of preparations took fresh plant parts, particularly those containing *P. betle* leaves for topical use, as the heat treatment would impart a benumbed quality, thereby decreasing efficacy. The chemical properties of chavibetol and eugenol, predominant bioactive compounds in *P. betle*, are highly volatile to the point of rapidly vaporizing when exposed to heat (Biswas et al. 2022). This explanation could be used for all aromatic rhizomes and leaf routes for topical treatment. Alternatively, they could be simply crushed in a non-thermal environment, like a poultice.



**Figure 4.** A. The methods of preparation, B. Dosage forms of the formulations, and C. The routes of administration of polyherbal formulations in Mount Slamet, Indonesia

**Table 5.** The polyherbal formulation categories

Body system treated	No. of formulations	No. of components	Abnormalities or disorders treated
Unspecified medicinal disorders (1101)	7	15	Blood circulation (11011) Body warming (11012) Blood cleansing (11013) <i>Masuk angin</i> in baby (11014)
Circulatory system disorders (1104)	2	13	Hypertension (11041)
Digestive system disorders (1105)	18	36	Unspecified digestion problems (11051) Bloating (11052) Constipation (11053) Diarrhea (11054) Gastric ulcers (11055) Nausea (11056)
Endocrine system disorders (1106)	2	8	Diabetes (11061)
Genitourinary system disorders (1107)	8	38	Diuretic (11071) Men's aphrodisiac (11072) Women's infertility (11073) Leukorrhea (11074) Unspecified urinary problems (11075)
Immune system disorders (1109)	14	32	Overall fitness (11091) Stamina booster (11092)
Injuries (1112)	2	5	Diabetic wound (11121) Wound (11122)
Metabolic system disorders (1114)	3	17	Hypercholesterolemia (11141)
Musculoskeletal system disorders (1115)	8	24	Muscle relaxant (11151) Gouty arthritis (11152) Fracture (11153)
Neoplasms (1116)	2	4	Unspecified neoplasms (11161)
Nervous system disorders (1117)	1	6	Convulsions in babies (11171)
Nutritional disorders (1118)	10	18	Appetite stimulant (11181) Weight loss (11182)
Pain (1119)	6	24	Headache (11191) Muscle sore (11192) Sprained muscle (11193)
Pregnancy/birth/puerperium disorders (1121)	29	46	Lactation stimulant (11211) Menstrual pain (11212) Post-partum (11213)
Skin/subcutaneous cellular tissue disorders (1124)	5	19	Itching (11241) Acne (11242)

**Table 6.** Mapping of the most versatile plants and their uses in the formulations for different body system disorders in Mount Slamet, Indonesia

Species	Number of uses in formulations to treat particular body system disorders													Total	
	1101	1104	1105	1106	1107	1109	1110	1114	1115	1117	1118	1119	1121		1124
<i>Alyxia reinwardtii</i>		1	2		2	2			1			2	3		13
<i>Biancaea sappan</i>			1		1	4	1		1		1	1	1		11
<i>Cinnamomum verum</i>					5	6	1				2		5	1	20
<i>Curcuma longa</i>		1	12	1	4	6		1	4		5	4	22	2	62
<i>Curcuma zanthorrhiza</i>		1	6		1	2	1	1	2	1		1	11	1	28
<i>Curcuma zedoaria</i>			1		1				1		3	1	3		10
<i>Cymbopogon citratus</i>	1		4	1	3	6		1	5		5	1	7	1	35
<i>Foeniculum vulgare</i>	1	1	2		2	2			1		1	4	2		16
<i>Kaempferia galanga</i>	1	1	5	1	3	4		1	2		6	3	16	1	44
<i>Oryza sativa</i>	1		2		2	2					3	1	2		13
<i>Parkia timoriana</i>			2		3	3					1		1		10
<i>Piper nigrum</i>			1		1	2		1	1				4		10
<i>Syzygium aromaticum</i>	1		1		1	1		1	4				1		10
<i>Tamarindus indica</i>				1	4	3		1	1		2	1	11	1	25
<i>Wurfbainia compacta</i>			1		2	2			1		1		5	1	13
<i>Zingiber montanum</i>	1					1			1	1		1	6	1	12
<i>Zingiber officinale</i>			4	1	4	8	1	1	3	1	7	2	14	1	47

**Table 7.** Association between plant parts, typical preparation, and treated body systems

Plant part	Total use (%)	Predominant body systems treated	Typical preparation method
Leaf	34.1	Digestive, immune, skin/subcutaneous, genitourinary	Infusion, poultice, juice
Rhizome	17.6	Pregnancy/birth/puerperium, digestive, immune, musculoskeletal	Decoction
Fruit	14.1	Digestive, genitourinary, and immune	Infusion, freshly consumed
Whole plant	6.7	Immune, genitourinary, injuries	Decoction, poultice
Wood/stem	6.5	Musculoskeletal, digestive, and neoplastic	Decoction
Bark	5.6	Digestive, genitourinary	Decoction

Zingiberaceae rhizomes are also plentiful in the study region, which makes them widely available throughout the year (Utaminigrum et al. 2022). Rhizomes are used to treat neoplasms in African traditional medicine because of their high content of bioactive secondary metabolites (Fakudze et al. 2023). Decoction and boiling are the basis for the traditional preparation of ayurvedic formulations containing *C. longa* and other Zingiberaceae rhizomes for oral use in the region. This heat-processing in the traditional medicine concept is essential to optimize the medicine's opening and obtain an effective remedy. It is a requirement based on the compound's water solubility (curcuminoids are insoluble in cold water, but solubilize on heating). Other food items are also popular for the presence of a range of phytochemicals such as anthocyanins, flavonoids, tannins, and phenolic acids, which exhibit several health benefits (Junsongduang et al. 2025). *T. indica* is rich in flavonoids as well as organic acids, which influence the acidity of the mixture and serve to modify the stability of the curcuminoids present in *C. longa*. Such a mechanism would provide a biochemical rationale for the development and popularity of the *kunyit asam* formulation (Estiasih et al. 2025).

### Polyherbal formulation utilization

A total of 98 (75.5%) polyherbal formulations come from the single-indication category, demonstrating the focus on the development of specific preparations for particular problems. Mixture composition is usually optimized per the indicated application and generally centered on core species or plant families with proven efficacy. Within the region under study, Zingiber and Curcuma are key genera for various indications. The noted over-represented use of several families in one indication category is similar to the over-selection of Apiaceae and Zingiberaceae in Pakistani gastrointestinal applications. Rhizome Apiaceae-based anti-tuberculosis medications in South Africa are also comparable (Famewo et al. 2017; Mussarat et al. 2021). For multi-indication preparations, the mixture composition varies with practitioner use optimization. The ingredient list is often the same, but ingredients are used in different proportions and combinations, given the purpose. For instance, *Alstonia scholaris*/*T. crispera* mixtures proved to be effective for improving blood circulation, alleviating non-specific digestive problems, and treating diabetes. Blood circulation preparations use a greater proportion of *A. scholaris* than *T. crispera*, whilst gastrointestinal preparations are made up of

an equal ratio of these plants, albeit both as a dilute infusion. A much stronger dose of the preparation for diabetes is made up to a highly concentrated decoction to contain a higher proportion of *T. crispera* (Table S2). This difference in constituent content between the two preparations, owing to different handling procedures, alters the final yield of active principles. For instance, the most concentrated decoction contained a higher proportion of glycosidic terpene compounds typical of *T. crispera*, which are likely responsible for its hypoglycemic activity (Haque et al. 2023). The dose variation due to the preparation method was also reported in some Mediterranean multi-ingredient teas. Random dosing occurs because each prepared cup may have a slightly different composition depending on what is scooped from the bag (Obón et al. 2021).

The most common therapeutic classification includes gestation and other perinatal disorders, comprising 29 herbal formulations. It exemplifies a cultural mandate, where care of mother and child prevails as an impetus for community continuity (Tilaar and Widjaya 2014), ultimately typifying the expertise of women as custodians of reproductive health care. This is concordant with the sample under study, which identified 45% of the informant pool as traditional birth attendants. The objectives of phytotherapy in perinatal medicine tend to be analgesic and anti-infective, and promote breastfeeding. Inclusive selection based on pharmacological phase, ecological availability, and cultural comity seems to be overall a product of synergisms in the global protocol of phytomediated obstetrics, which generally employs aromatic, pungent, and, in some instances, phytochemically culinary taxa that possess abundant antimicrobial and anti-inflammatory volatile oils. In particular, 97% of the Mount Slamet obstetrical applications incorporate Zingiberaceae, 90% contain Curcuma, and 76% utilize *C. longa*. Curcuminoids in this species possess anti-inflammatory, antimicrobial, and carminative properties that promote uterine recovery, sepsis prevention, and postpartum analgesia (Madbouly et al. 2024). The most common species employed to prepare formulations aimed at combating perinatal disorders include *C. longa* and *T. indica*. The efficacy of the traditional *kunyit asam* formulation for dysmenorrhea has been sustained by preliminary clinical trials and is primarily attributed to these anti-inflammatory effects (Astuti et al. 2020). Seven formulations derived from this foundational *kunyit asam* mixture, supplemented with other botanical taxa including

*C. zanthorrhiza*, *C. citratus*, *K. galanga*, *Paederia foetida*, *P. betle*, *P. indica*, *W. compacta*, *Zingiber montanum*, and *Z. officinale*. For the species traditionally used for dysmenorrhea and perinatal problems, the indigenous knowledge systems differ from other ethnobotanical examples from across the world. In Thakurgaon, Bangladesh, healing formulas entail the use of *Phyllanthus reticulatus*, *P. nigrum*, and *Senegalia catechu* for dysmenorrheal problems (Afroze et al. 2022). Moreover, constituents of the Mindanao region employ *Cocos nucifera*, *Jatropha curcas*, *Nicotiana tabacum*, and *Z. officinale* for post-delivery maintenance (Pucot and Demayo 2021). Herbal formulations developed as lactation stimulants are locally referred to as *uyub-uyub* and primarily consist of *Breynia androgyna*. These formulations have been shown to upregulate the expression of prolactin and oxytocin genes in lactating mice. The core plant species (*B. androgyna*) contains carotenoids, vitamins C and E, polyphenols and flavonoids, squalene E, linolenic acid, and volatile oils (Khairani et al. 2021; LactMed 2026). It is abundant in the study area and is produced in home gardens and planted as living fences. *Uyub-uyub* can be prepared by combining *B. androgyna* with *Curcuma heyneana*, *C. longa*, *C. zanthorrhiza*, *K. galanga*, and *Z. zerumbet*, or by co-administering it with herbaceous taxa such as *C. asiatica*, *Orthosiphon aristatus*, *P. pellucida*, and *Strobilanthes crispata*. The core galactagogue species utilized as lactation stimulants in the study area differ substantially from those documented in Northern Sudan, where key taxa include *Trigonella foenum-graecum*, *Cymbopogon schoenanthus*, and *Solenostemma argel* (Delile) Hayne (Mohammed et al. 2026).

The health-balancing concept rooted in the practice of *jamu* considers the gastrointestinal system as the center of harmony and life-force (Beers 2001). Our research supports the importance of gastrointestinal health, with 18 formulations being used to promote digestion within the study area. All herbal formulations with a gastrointestinal focus contain Zingiberaceae species, with 72% containing *C. longa*, *K. galanga*, and *Z. officinale*. The anti-inflammatory, antimicrobial, and gastroprotective activities assigned to the curcuminoids and essential oils of these plant groups are corroborated in several studies (Fuloria et al. 2022; Gupta et al. 2025). Moreover, the antiemetic activity of *Z. officinale* is attributed to gingerols, which counter chemotherapy-induced nausea (Totmaj et al. 2019; Zhong et al. 2022). Ecological and cultural variables further influence the range and selection of taxa in treatments for digestion. An antidiarrheal prescription from Pakistan contains locally prevalent *Mentha x piperita*, *Camellia sinensis*, and *Elettaria cardamomum* (Ullah et al. 2019), while a formulation for Indian dyspepsia uses 12 taxa in its ingredients, with a prevalence of Fabaceae and Apiaceae (Tiwari et al. 2025).

Culturally, vitality, or *kebugaran*, is one of the most important factors for a person's productivity and becoming a fully functioning member in society (Tilaar and Widjaya 2014). It is represented by 14 formulations, which are

mainly used locally to increase the immune system response and generally as a stamina booster and fitness enhancer. Plants rich in supportive nutrients, antioxidants, or health-promoting compounds are one of the most commonly used to maintain a healthy immune system. Consequently, there is a great diversity in the selection of those herbs globally, with contrasting differences between those found at Mount Slamet and other places. Approximately 79% of the local formulations contain rhizomes from the Zingiberaceae family, where curcuminoids, gingerols, and essential oils are the bioactive compounds responsible for the immunomodulatory and antioxidant activities (Memarzia et al. 2021; Ayustaningwarno et al. 2024; Muzzazinah et al. 2024). One typical example of this category is *beras kencur*, a preparation consisting of the rhizomes of *K. galanga* and *Oryza sativa* starch. These results are consistent with the *Riset Tumbuhan Obat dan Jamu* (RISTOJA) data, which also pointed Zingiberaceae species as the backbone of Indonesian tonic preparations (Kristiana et al. 2022). Our findings are different from those of the Philippines, where most of the health-maintaining preparations come from the Fabaceae family (Pucot and Demayo 2021).

#### Comparison with the global polyherbal formulation studies

The worldwide comparative analysis of ethnobotanical data shows important differences in the choice of plants, the complexity of formulations, and therapeutic targets among different cultures (Table 8). The prominence of particular plant families changes from one region to another and reflects the local floristic biodiversity. Asteraceae is a main source of polyherbal mixtures in Northern Peru and the Central Balkans. Apiaceae is key in Persian Medicine and in the Eastern Cape of South Africa, whereas Poaceae is the lead in formulations within Aurora, Philippines. In line with our results, Fabaceae plants are widely used in Brazil. Leaves and aerial parts are the most frequently used plant parts worldwide. In the Central Balkans, leaves comprise 44.7% of the records. Persian medicine uses mainly aerial parts and leaves, while the Australian Aboriginals use leaves and bark for topical and internal administration. In contrast, traditional usage in South Africa is mainly based on underground parts like rhizomes and roots for tuberculosis treatment. However, these remedies use non-Zingiberaceae rhizomes, in contrast with our findings.

Preparation of polyherbal formulations is different worldwide. For example, Tehran standardize their remedies in the form of capsules, syrups, and tablets, whereas other parts of the world are still using traditional dosage. Northern Peru employs very complex formulations with 2-7 components as a rule and occasionally up to 27. Methods of preparation in the regions of the Balkans, South Africa, and the Philippines are by aqueous extractions, like infusions and decoctions (50%, 67%, and 65%, respectively).

**Table 8.** Global comparison of polyherbal ethnobotanical features

Studied area	Dominant plant family	Most used plant parts	Preparations	Primary indications	Reference
Mount Slamet, Indonesia	Fabaceae, Zingiberaceae	Fruits, leaves, rhizomes	Decoction, infusion	Perinatal, digestive, and immune	-
Tehran, Iran	Apiaceae	Aerial parts, fruits, leaves	Capsules, syrups	Liver dysfunction, gastrointestinal disorders	(Bozorgia et al. 2018)
Rio Jauaperi, Brazil	Fabaceae	Barks, leaves, stem	-	Respiratory, cerebrospinal, and intestinal diseases	(Pedrollo et al. 2016)
Amathole, South Africa	Apiaceae	Bark, rhizomes, roots	Decoctions, infusions	Tuberculosis	(Famewo et al. 2017)
Eastern Serbia	Asteraceae, Rosaceae	Leaves	Fresh applications, infusions	Digestive, circulatory, and respiratory disorders	(Janačković et al. 2022)
Aurora, Philippines	Arecaceae, Musaceae, Poaceae	Bark, leaves, roots	Infusions, poultices	<i>Bughat</i> (relapse), fatigue, headache	(Pucot and Demayo 2021)
Tropical Australia	Asteraceae, Euphorbiaceae	Aerial parts	Decoctions, infusions, pastes	Inflammation-related diseases	(Yeshi et al. 2022)

On the other hand, in Australia, the wound and skin lesions are commonly treated with pastes for healing. Therapeutic targets are usually based on regional health priorities or cultural syndromes. For example, whilst perinatal conditions have been the focus of this study, tuberculosis and inflammatory conditions have been priorities in South Africa and Australia, respectively. Peru's main focus on psychosomatic disorders accounts for approximately 30% of all recognized conditions. Balkan practices predominantly deal with digestive and circulatory problems, and liver dysfunction is the main goal in Tehran. The Philippines uses polyherbal formulations to treat a group of local syndromes, namely *bughat* (relapse), *pasmo* (irregular habits/exposure), and *kabuhi* (chest discomfort). These local syndromes are equivalent to *masuk angin*, which also exists in our study and is addressed with polyherbal remedies.

#### Conservation implications and relevance to future bioprospecting and public health

Heavy dependence on taxa with high RFC and SUV values, like *C. longa*, *K. galanga*, *Z. officinale*, and *C. zanthorrhiza* in the polyherbal formulations, signals a high level of demand that could bring overharvesting. Protecting these culturally important plants is necessary, which is a concern similar to that of traditional remedies in Eastern Ethiopia (Alemayehu et al. 2026). At the local level, Zingiberaceae species are either grown in home gardens or wild-harvested from the Mount Slamet protected forest. Increasing active cultivation is a critical ex situ conservation measure for reducing pressure on wild populations and ensuring a year-round supply. Since these species are particularly used in perinatal treatment, traditional birth attendants are the main holders of knowledge and chief custodians of the local ethnomedicinal system (Saensouk et al. 2025). This susceptibility also extends to species like *C. asiatica* and *B. sappan* that have multiple uses but low informant consensus. There is a need for controlled harvesting of *B. sappan* to maintain ecological stability while also satisfying market demands. Harvesting of wood in a

destructive manner is, by default, less sustainable than harvesting leaves, as woody tissues do not regenerate fast after being exploited (Alemayehu et al. 2026).

Results substantiate that indigenous groups have come up with consistent, common polyherbal recipes for treating perinatal, immunological, and gastrointestinal ailments. These polyherbal formulations for perinatal care document a readily available, culturally appropriate source of healthcare. Community-based maternal healthcare programs incorporating standardized *uyub-uyub* for lactation and *kunyit asam* for postpartum recovery alongside clinical services in remote areas with limited access to the facilities. However, these formulations have to possess satisfactory safety and efficacy profiles prior to becoming institutional practices. Due to the lack of scientific evidence for both formulations, well-designed clinical trials are warranted to support this integration (Juliastuti 2019; Astuti et al. 2020). Formulations based on *beras kencur*-aimed at adaptogenic conditioning, antidiarrheal drugs based on *C. longa*, and the antiemetic drugs based on *Z. officinale* have considerable potential as affordable first-line care measures. These compounds are not as well understood as the perinatal formulations, and thereby standardization of raw botanical materials, refinement of dosage forms, and thorough pharmacological testing to verify traditional uses will be required.

#### Limitations and recommendations for future study

This research is limited by a small sample size, regional differences, and a focus on polyherbal preparations. The small sample size showed that the regression analyses were underpowered, with insufficient explanatory power for age, gender, and practitioner status to explain the variance in ethnobotanical knowledge. Non-Gaussian distribution of the data also limited the strength of the statistical tests. Demographic imbalances also affected the trends uncovered by this research. The preponderance of older study subjects and the dominance by female traditional midwives tended towards capturing female-specific knowledge, while possibly obscuring the transmission of ethnobotanical knowledge from men to the children.

Moreover, this study did not detect regional differences. Although five districts surrounding Mount Slamet were represented, small subsamples, especially in Brebes, make the statistical differentiation of these regions unlikely. Quantitative measures of knowledge concur with reports of similarities between regions, but qualitative accounts of differences in goals and methods have been reported elsewhere. By focusing on polyherbal remedies, this research did not account for monoherbal formulations, consequently focusing only on the more complex aspects of the materia medica. Finally, interview-based methods introduced recall bias, causing underreporting of rarely used formulations and over-emphasizing culturally salient taxa like Zingiberaceae. The absence of systematic ecological data (i.e., provenance, abundance, and regeneration rates) limited the evaluation of sustainability and conservation risks. Although some informants gathered rhizomes from protected forests, ecological data are needed for developing evidence-based conservation recommendations. Future research should incorporate new ecological assessments and more complex ethnobotanical surveys to feasibly determine sustainability and conservation measures for high-demand species.

Future ethnopharmacological research within the Mount Slamet Region should prioritize larger, demographically balanced cohorts to enhance statistical power and representativeness. A more consistent inclusion of younger representatives and male practitioners would facilitate the understanding of intergenerational transmission and gender-specific knowledge. The addition of monoherbal formulations would also provide an enhanced framework to assess local pharmacopeias. While quantitative indices indicate broad similarities across districts, qualitative data reveal important cultural distinctions in therapeutic goals and preparation methods. Comparative ethnographic studies, supported by more robust statistical sampling, could illuminate these differences and clarify the extent to which local ecological and cultural contexts shape medicinal practices. Finally, integrating ecological assessments into ethnobotanical surveys is essential for evaluating sustainability and conservation risk. Systematic documentation of species provenance, abundance, regeneration rates, and conservation status would enable evidence-based recommendations for resource management. Such ecological data, combined with ethnopharmacological insights, would provide a stronger foundation for conservation strategies that safeguard both biodiversity and cultural heritage.

In conclusion, this study presents 98 polyherbal recipes from the Mount Slamet that relied on 84 plant species, with the Zingiberaceae family being the most represented one. Six species (i.e., *C. longa*, *Z. officinale*, *K. galanga*, *C. citratus*, *C. zanthorrhiza*, and *T. indica*) are highly culturally significant, serving as key ingredients in most community mixtures. These species demonstrate a robust alignment between cultural consensus and therapeutic versatility. Traditionally, the production of polyherbal medicines in the region was mainly concerned with the treatment of reproductive care, highlighting the important role of women as the principal custodians of reproductive

health and survival of the community. Besides, the gastrointestinal and immune systems rank as the top two systems being treated, which are consistent with cultural notions of *kebugaran* and gastrointestinal balance. Typically, a polyherbal formulation consists of about five ingredients that undergo traditional aqueous thermal processing. Plants are combined to achieve synergistic effects, for example, *C. longa* with *T. indica*, or *K. galanga* with *O. sativa*. Traditional healers maintain this knowledge repository, but the system is being threatened by sociocultural changes. Safeguarding this knowledge requires formal recognition of practitioners, conservation of traditional species, and structured intergenerational transmission.

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## Supplementary

Table S1. Botanical details of plant components of polyherbal formulations used in Mount Slamet, Indonesia

Plant name	Local name	Family	Plant part	SUV	RFC
<i>Andrographis paniculata</i> (Burm.f.) Wall.	<i>Kapijanggot, sambilata</i>	Acanthaceae	Aerial part	0.12	0.12
<i>Pararuellia napifera</i> (Zoll.) Bremek. & Nann.-Bremek.	<i>Gempur batu</i>	Acanthaceae	Whole plant	0.02	0.02
<i>Strobilanthes crispa</i> Blume	<i>Keji, keji beling</i>	Acanthaceae	Leaf	0.12	0.14
<i>Acorus calamus</i> L.	<i>Dringo</i>	Acoraceae	Rhizome	0.21	0.21
<i>Allium cepa</i> L.	<i>Brambang</i>	Amarylidaceae	Bulb	0.12	0.10
<i>Allium sativum</i> L.	<i>Bawang</i>	Amarylidaceae	Bulb	0.07	0.07
<i>Cananga odorata</i> (Lam.) Hook.f. & Thomson	<i>Kenanga</i>	Annonaceae	Flower	0.05	0.02
<i>Centella asiatica</i> (L.) Urb.	<i>Panigoang, panikula, pegagan</i>	Apiaceae	Aerial part	0.19	0.02
<i>Coriandrum sativum</i> L.	<i>Ketumbar</i>	Apiaceae	Fruit	0.07	0.07
<i>Foeniculum vulgare</i> Mill.	<i>Adas</i>	Apiaceae	Aerial part	0.24	0.24
<i>Alstonia scholaris</i> (L.) R.Br.	<i>Pule</i>	Apocynaceae	Wood	0.07	0.05
<i>Alyxia reinwardtii</i> Blume	<i>Pulasari</i>	Apocynaceae	Bark	0.17	0.17
<i>Catharanthus roseus</i> (L.) G.Don	<i>Tapakdara</i>	Apocynaceae	Leaf	0.02	0.12
<i>Urceola laevigata</i> (Juss.) D.J.Middleton & Livsh.	<i>Kayu rapet</i>	Apocynaceae	Wood	0.02	0.02
<i>Cocos nucifera</i> L.	<i>Beluluk, kelapa</i>	Arecaceae	Fruit	0.05	0.05
<i>Blumea balsamifera</i> DC.	<i>Sembung</i>	Asteraceae	Leaf	0.02	0.14
<i>Pluchea indica</i> Less.	<i>Beluntas, teluntas, truntas</i>	Asteraceae	Leaf	0.14	0.12
<i>Anredera cordifolia</i> (Ten.) Steenis	<i>Binahong</i>	Basellaceae	Leaf	0.02	0.02
<i>Carica papaya</i> L.	<i>Gandul, pepaya</i>	Caricaceae	Leaf	0.14	0.05
<i>Garcinia mangostana</i> L.	<i>Manggis</i>	Clusiaceae	Pericarp	0.02	0.02
<i>Cyperus rotundus</i> L.	<i>Suket teki</i>	Cyperaceae	Whole plant	0.02	0.02
<i>Euphorbia tirucalli</i> L.	<i>Tikel balung</i>	Euphorbiaceae	Stem	0.05	0.05
<i>Archidendron pauciflorum</i> (Benth.) I.C.Nielsen	<i>Jengkol</i>	Fabaceae	Leaf	0.02	0.02
<i>Biancaea sappan</i> (L.) Tod.	<i>Secang</i>	Fabaceae	Wood	0.14	0.02
<i>Clitoria ternatea</i> L.	<i>Telang</i>	Fabaceae	Flower	0.05	0.02
<i>Erythrina variegata</i> L.	<i>Dadap</i>	Fabaceae	Leaf	0.07	0.02
<i>Grona triflora</i> (L.) H.Ohashi & K.Ohashi	<i>Jarem</i>	Fabaceae	Leaf	0.10	0.07
<i>Leucaena leucocephala</i> (Lam.) de Wit	<i>Mlandingan</i>	Fabaceae	Leaf	0.02	0.02
<i>Neptunia javanica</i> Miq.	<i>Randalengus</i>	Fabaceae	Aerial part	0.02	0.02
<i>Parkia timoriana</i> (DC.) Merr.	<i>Kedawung</i>	Fabaceae	Seed	0.10	0.10
<i>Spatholobus littoralis</i> Hassk.	<i>Bajakah</i>	Fabaceae	Root	0.02	0.02
<i>Tamarindus indica</i> L.	<i>Asam, asam jawa</i>	Fabaceae	Fruit, leaf	0.38	0.38
<i>Mentha ×piperita</i> L.	<i>Mint, permen</i>	Lamiaceae	Leaf	0.05	0.05
<i>Orthosiphon aristatus</i> (Blume) Miq.	<i>Kumis kucing, remujung</i>	Lamiaceae	Leaf	0.14	0.14
<i>Cinnamomum verum</i> J.Presl	<i>Kayu manis, manis jangan</i>	Lauraceae	Bark	0.29	0.19
<i>Persea americana</i> Mill.	<i>Alpukat</i>	Lauraceae	Leaf	0.02	0.02
<i>Strychnos lucida</i> R.Br.	<i>Widara laut</i>	Loganiaceae	Stem	0.02	0.02
<i>Hibiscus sabdariffa</i> L.	<i>Rosela</i>	Malvaceae	Calyx	0.02	0.02
<i>Tinospora crispa</i> (L.) Hook.f. & Thomson	<i>Bratawali</i>	Menispermaceae	Stem	0.12	0.10
<i>Ficus montana</i> Burm.f.	<i>Uyah-uyahan</i>	Moraceae	Leaf	0.02	0.02
<i>Moringa oleifera</i> Lam.	<i>Kelor</i>	Moringaceae	Leaf	0.07	0.12
<i>Myristica fragrans</i> Hoult.	<i>Pala</i>	Myristicaceae	Seed	0.02	0.02
<i>Eucalyptus alba</i> Reinw. ex Blume	<i>Ceplik sari</i>	Myrtaceae	Fruit	0.02	0.02
<i>Melaleuca leucadendra</i> (L.) L.	<i>Kayu putih</i>	Myrtaceae	Leaf	0.05	0.02
<i>Psidium guajava</i> L.	<i>Jambu kluthuk</i>	Myrtaceae	Leaf	0.02	0.02
<i>Syzygium aromaticum</i> (L.) Merr. & L.M.Perry	<i>Cengkeh</i>	Myrtaceae	Flower	0.10	0.10
<i>Syzygium polyanthum</i> (Wight) Walp.	<i>Salam</i>	Myrtaceae	Leaf	0.05	0.05
<i>Pandanus amaryllifolius</i> Roxb.	<i>Pandan</i>	Pandanaceae	Leaf	0.02	0.02
<i>Breynia androgyna</i> (L.) Chakrab. & N.P.Balacr.	<i>Katuk</i>	Phyllanthaceae	Leaf	0.02	0.02
<i>Peperomia pellucida</i> (L.) Kunth	<i>Beron, ketumpang</i>	Piperaceae	Whole plant	0.07	0.10
<i>Piper betle</i> L.	<i>Sirih, suruh</i>	Piperaceae	Leaf	0.19	0.12
<i>Piper cubeba</i> L.f.	<i>Kemukus</i>	Piperaceae	Fruit	0.12	0.12
<i>Piper nigrum</i> L.	<i>Lada, mrica</i>	Piperaceae	Fruit	0.17	0.14
<i>Piper ornatum</i> N.E.Br.	<i>Suruh wulung</i>	Piperaceae	Leaf	0.02	0.02
<i>Piper retrofractum</i> Vahl	<i>Cabe</i>	Piperaceae	Fruit	0.05	0.05
<i>Plantago major</i> L.	<i>Sengkoba</i>	Plantaginaceae	Whole plant	0.05	0.05
<i>Cymbopogon citratus</i> Stapf	<i>Kamijara, kamijaran, sereh</i>	Poaceae	Leaf	0.57	0.45
<i>Imperata cylindrica</i> (L.) P.Beauv.	<i>Alang-alang</i>	Poaceae	Root	0.07	0.10

<i>Oryza sativa</i> L.	Beras, padi	Poaceae	Fruit	0.21	0.17
<i>Saccharum officinarum</i> var. <i>rubrum-altum</i> Hassk.	Tebu wulung	Poaceae	Stem	0.02	0.02
<i>Nigella sativa</i> L.	Habatusaudah, jinten	Ranunculaceae	Seed	0.02	0.02
<i>Morinda citrifolia</i> L.	Mengkudu, pace	Rubiaceae	Fruit, leaf	0.05	0.05
<i>Paederia foetida</i> L.	Sembukan	Rubiaceae	Leaf	0.05	0.05
<i>Rubia argyi</i> (H.Lév. & Vaniot) H.Hara	Sereg	Rubiaceae	Leaf	0.02	0.02
<i>Citrus hystrix</i> DC.	Jeruk purut	Rutaceae	Fruit	0.02	0.02
<i>Citrus limon</i> (L.) Osbeck	Jeruk lemon	Rutaceae	Fruit	0.02	0.02
<i>Illicium verum</i> Hook.f.	Lawang	Schisandraceae	Fruit	0.02	0.02
<i>Physalis angulata</i> L.	Cemplukan, ciplukan	Solanaceae	Whole plant, leaf	0.02	0.02
<i>Alpinia galanga</i> (L.) Willd.	Laos, lengkuas	Zingiberaceae	Rhizome	0.14	0.14
<i>Boesenbergia rotunda</i> (L.) Mansf.	Kunci, temu kunci	Zingiberaceae	Rhizome	0.05	0.02
<i>Curcuma aeruginosa</i> Roxb.	Temu ireng	Zingiberaceae	Rhizome	0.12	0.12
<i>Curcuma heyneana</i> Valeton & Zijp	Temu giring	Zingiberaceae	Rhizome	0.02	0.02
<i>Curcuma longa</i> L.	Kunir, kunyit	Zingiberaceae	Rhizome	1.05	0.74
<i>Curcuma zanthorrhiza</i> Roxb.	Temulawak	Zingiberaceae	Rhizome	0.52	0.43
<i>Curcuma zedoaria</i> (Christm.) Roscoe	Kunir putih, temu putih	Zingiberaceae	Rhizome	0.14	0.14
<i>Etlingeria elatior</i> (Jack) R.M.Sm.	Burus	Zingiberaceae	Leaf	0.02	0.02
<i>Kaempferia galanga</i> L.	Kencur	Zingiberaceae	Rhizome	0.76	0.67
<i>Wurfbainia compacta</i> (Sol. ex Maton) Škorničk. & A.D.Poulsen	Kapulaga	Zingiberaceae	Fruit	0.19	0.17
<i>Zingiber littorale</i> (Valeton) Valeton	Lempuyangan	Zingiberaceae	Rhizome	0.02	0.02
<i>Zingiber montanum</i> (J.Koenig) A.Dietr.	Benglai, bengle	Zingiberaceae	Rhizome	0.24	0.19
<i>Zingiber officinale</i> var. <i>rubrum</i> Theilade	Jahe merah	Zingiberaceae	Rhizome	0.10	0.17
<i>Zingiber officinale</i> Roscoe	Jahe	Zingiberaceae	Rhizome	0.83	0.64
<i>Zingiber zerumbet</i> (L.) Sm.	Lempuyang	Zingiberaceae	Rhizome	0.14	0.14

**Table S2.** Disorder treated, plant composition, preparation method, and uses of polyherbal formulations from around Mount Slamet, Indonesia

Polyherbal formulation	Abnormality or disorder treated	Plant composition	Preparation and use
11011, 11051, 11061,	Blood circulation, Unspecified digestion problems, diabetes	<i>Alstonia scholaris</i> , <i>Tinospora crispa</i>	Boiled, infusion, orally
11011, 11091,	Blood circulation, overall fitness	<i>Piper retrofractum</i> , <i>Zingiber zerumbet</i>	Juiced, juice, orally
11012, 11151,	Body warming, muscle relaxant	<i>Acorus calamus</i> , <i>Cymbopogon citratus</i> , <i>Plantago major</i> , <i>Syzygium aromaticum</i>	Boiled, infusion, orally
11012	Body warming for the baby	<i>Oryza sativa</i> , <i>Kaempferia galanga</i>	Grounded, poultice, topically
11013	Blood cleansing	<i>Andrographis paniculata</i> , <i>Foeniculum vulgare</i> , <i>Orthosiphon aristatus</i>	Boiled, infusion, orally
11014	Masuk angin in children	<i>Allium cepa</i> , <i>Melaleuca leucadendra</i> , <i>Cocos nucifera</i>	Grounded, poultice, topically
11041, 11071	Hypertension, diuretic	<i>Alyxia reinwardtii</i> , <i>Foeniculum vulgare</i> , <i>Peperomia pellucida</i> , <i>Phyllanthus niruri</i> , <i>Physalis angulata</i> , <i>Sonchus arvensis</i> , <i>Strobilanthes crispa</i>	Juiced, juice, orally
11041, 11051	Hypertension, unspecified digestion problems	<i>Breynia androgyna</i> , <i>Curcuma heyneana</i> , <i>Curcuma longa</i> , <i>Curcuma zanthorrhiza</i> , <i>Kaempferia galanga</i> , <i>Zingiber zerumbet</i>	Brewed, tea, orally
11051	Unspecified digestion problems	<i>Curcuma longa</i> , <i>Curcuma aeruginosa</i> .	Boiled, infusion, orally
11051	Unspecified digestion problems	<i>Curcuma zanthorrhiza</i> , <i>Erythrina variegata</i>	Boiled, infusion, orally
11051	Unspecified digestion problems	<i>Curcuma longa</i> , <i>Curcuma zedoaria</i> , <i>Parkia timoriana</i>	Boiled, infusion, orally
11051	Unspecified digestion problems	<i>Curcuma longa</i> , <i>Curcuma zanthorrhiza</i> , <i>Myristica fragrans</i> , <i>Zingiber officinale</i>	Boiled, infusion, orally
11051	Unspecified digestion problems	<i>Oryza sativa</i> , <i>Curcuma longa</i>	Juiced, juice, orally
11051	Unspecified digestion problems	<i>Curcuma longa</i> , <i>Cymbopogon citratus</i> , <i>Psidium guajava</i>	Decoated, decoction, orally
11051	Unspecified digestion	<i>Boesenbergia rotunda</i> , <i>Curcuma longa</i>	Juiced, juice,

11051, 11181	problems Unspecified digestion	<i>Cymbopogon citratus, Kaempferia galanga, Oryza sativa, Zingiber officinale</i>	orally Juiced, juice, orally
11052, 11211	problems, appetite stimulant Bloating, lactation stimulant	<i>Allium cepa, Centella asiatica, Curcuma longa, Curcuma zanthorrhiza, Cymbopogon citratus, Erythrina variegata, Etlingera elatior, Grona triflora, Kaempferia galanga, Piper betle, Pluchea indica, Zingiber zerumbet</i>	Ground and boiled, infusion, orally
11053	Constipation	<i>Kaempferia galanga, Orthosiphon aristatus, Parkia timoriana, Piper cubeba</i>	Boiled, infusion, orally
11054	Diarrhea	<i>Allium cepa, Curcuma longa, Curcuma zanthorrhiza, Kaempferia galanga, Marsilea minuta</i>	Juiced, juice, orally
11054	Diarrhea	<i>Alyxia reinwardtii, Centella asiatica, Cocos nucifera, Curcuma longa, Foeniculum vulgare</i>	Boiled, infusion, orally
11055, 11152, 11212	Gastric ulcers, gouty arthritis, menstrual pain	<i>Alyxia reinwardtii, Biancaea sappan, Curcuma longa, Cymbopogon citratus, Foeniculum vulgare, Illicium verum, Syzygium aromaticum, Syzygium polyanthum, Wurfbainia compacta, Zingiber officinale</i>	Boiled, infusion, orally
11056	Nausea	<i>Piper nigrum, Zingiber officinale</i>	Juiced and boiled, infusion, orally
11056, 11181	Nausea, appetite stimulant	<i>Curcuma longa, Curcuma zanthorrhiza</i>	Juiced and boiled, infusion, orally
11061, 11091, 11181	Diabetes, overall fitness, appetite stimulant	<i>Allium cepa, Curcuma longa, Cymbopogon citratus, Kaempferia galanga, Tamarindus indica, Zingiber officinale</i>	Ground and boiled, infusion, orally
11071	Diuretic	<i>Orthosiphon aristatus, Persea americana, Saccharum officinarum var. rubrumaltum, Strobilanthes crispa</i>	Decocted, decoction, orally
11071, 11241	Diuretic, itching	<i>Andrographis paniculata, Catharanthus roseus, Imperata cylindrica, Neptunia javanica, Physalis angulata</i>	Boiled, infusion, orally
11072	Men aphrodisiac	<i>Alpinia galanga, Coriandrum sativum, Curcuma zanthoiorrhiza, Zingiber officinale</i>	Decocted, decoction, orally
11072, 11091	Men aphrodisiac, overall fitness	<i>Biancaea sappan, Cinnamomum burmanni, Syzygium aromaticum</i>	Boiled, infusion, orally
11073, 11091, 11211	Women infertility, overall fitness, lactation stimulant	<i>Alyxia reinwardtii, Cinnamomum burmanni, Curcuma longa, Foeniculum vulgare, Kaempferia galanga, Parkia timoriana, Piper cubeba, Piper nigrum, Tamarindus indica, Wurfbainia compacta, Zingiber officinale var. rubrum</i>	Juiced, juice, orally
11073, 11091, 11072,	Women infertility, overall fitness, menstrual pain	<i>Cinnamomum burmanni, Curcuma longa, Cymbopogon citratus, Oryza sativa, Parkia timoriana, Tamarindus indica, Zingiber officinale</i>	Juiced, juice, orally
11074	Leukorrhea	<i>Curcuma zedoaria, Piper ornatum</i>	Boiled, infusion, orally
11074, 11181, 11242	Leukorrhea, appetite stimulant, acne	<i>Cinnamomum burmanni, Citrus hystrix, Cymbopogon citratus, Curcuma longa, Kaempferia galanga, Tamarindus indica, Wurfbainia compacta, Zingiber officinale</i>	Juiced, juice, orally
11075	Unspecified urinary problems	<i>Curcuma aeruginosa, Strobilanthes crispa</i>	Ground and boiled, infusion, orally
11075	Unspecified urinary problems	<i>Ficus montana, Kaempferia galanga, Paederia foetida</i>	Ground and boiled, infusion, orally
11075	Unspecified urinary problems	<i>Pararuellia napifera, Strobilanthes crispa</i>	Boiled, infusion, orally
11091	Overall fitness	<i>Alyxia reinwardtii, Biancaea sappan, Foeniculum vulgare, Piper cubeba, Piper nigrum, Strychnos lucida</i>	Boiled, infusion, orally
11091, 11181	Overall fitness, appetite stimulant	<i>Cymbopogon citratus, Kaempferia galanga, Oryza sativa, Pandanus amaryllifolius, Zingiber officinale</i>	Juiced, juice, orally
11091, 11211,	Overall fitness, lactation stimulant, post-partum	<i>Acorus calamus, Allium cepa, Curcuma longa, Curcuma zedoaria, Kaempferia galanga, Piper nigrum, Wurfbainia compacta, Zingiber officinale, Zingiber zerumbet</i>	Ground and boiled, infusion, orally
11092, 11101, 11181	Stamina booster, fever, appetite stimulant	<i>Biancaea sappan, Cinnamomum burmanni, Curcuma zanthorrhiza, Euphorbia tirucalli, Zingiber officinale</i>	Juiced, juice, orally
11092	Stamina booster	<i>Biancaea sappan, Clitoria ternatea, Curcuma longa, Hibiscus sabdariffa, Zingiber officinale</i>	Dried and boiled, infusion, orally
11092	Stamina booster	<i>Curcuma longa, Cymbopogon citratus, Zingiber officinale</i>	Boiled, infusion, orally
11092	Stamina booster	<i>Cinnamomum burmannii, Cymbopogon citratus, Wurfbainia compacta, Zingiber officinale</i>	Boiled, infusion, orally

11092	Stamina booster	<i>Andrographis paniculata, Cinnamomum burmanni, Curcuma longa, Curcuma zanthorrhiza, Cymbopogon citratus, Kaempferia galanga, Parkia timoriana, Piper betle, Tinospora crispa, Zingiber montanum, Zingiber officinale</i>	Grounded, poultice, topically
11092	Stamina booster for the elderly	<i>Areca catechu, Gigantochloa apus, Imperata cylindrica</i>	Decocted, decoction, orally
11121	Diabetic wound	<i>Archidendron pauciflorum, Garcinia mangostana</i>	Stir-fried and powdered, powder, topically
11122	Wound	<i>Grona triflora, Leucaena leucocephala, Peperomia pellucida</i>	Grounded, poultice, topically
11141, 11152	Hypercholesterolemia, gouty arthritis	<i>Anredera cordifolia, Piper betle, Piper nigrum, Piper retrofractum, Syzygium aromaticum, Imperata cylindrica, Zingiber officinale</i>	Decocted, decoction, orally
11141	Hypercholesterolemia	<i>Andrographis paniculata, Curcuma longa, Curcuma zanthorrhiza, Kaempferia galanga, Tamarindus indica, Tinospora crispa, Zingiber littorale, Zingiber officinale</i>	Juiced, juice, orally
11141	Hypercholesterolemia	<i>Alpinia galanga, Boesenbergia rotunda, Cymbopogon citratus, Piper betle, Zingiber officinale</i>	Boiled, infusion, orally
11151, 11241	Muscle relaxant, itching	<i>Andrographis paniculata, Curcuma longa, Curcuma zanthorrhiza, Kaempferia galanga, Zingiber montanum</i>	Ground and brewed, tea, orally
11152	Gouty arthritis	<i>Coriandrum sativum, Cymbopogon citratus</i>	Boiled, infusion, orally
11152	Gouty arthritis, rheumatoid	<i>Centella asiatica, Curcuma longa, Curcuma zanthorrhiza, Cymbopogon citratus, Zingiber officinale</i>	Boiled, infusion, orally
11153	Fracture	<i>Cymbopogon citratus, Imperata cylindrica</i>	Unprocessed
11153	Fracture	<i>Curcuma longa, Curcuma zedoaria, Kaempferia galanga, Syzygium polyanthum, Tamarindus indica</i>	Ground and boiled, infusion, orally
11161	Unspecified neoplasms	<i>Erythrina variegata, Moringa oleifera</i>	Grounded, poultice, topically
11171	Convulsions in babies	<i>Acorus calamus, Allium sativum, Curcuma zanthorrhiza, Moringa oleifera, Zingiber montanum, Zingiber officinale</i>	Grounded, poultice, topically
11181	Appetite stimulant	<i>Alpinia galanga, Curcuma longa, Curcuma zanthorrhiza</i>	Dried and boiled, decoction, orally
11181	Appetite stimulant	<i>Eucalyptus alba, Foeniculum vulgare, Kaempferia galanga, Oryza sativa, Parkia timoriana</i>	Boiled, infusion, orally
11181	Appetite stimulant	<i>Kaempferia galanga, Zingiber officinale</i>	Juiced, juice, orally
11182	Weight losing	<i>Alpinia galanga, Curcuma longa, Cymbopogon citratus, Zingiber officinale</i>	Boiled, infusion, orally
11191	Headache	<i>Curcuma longa, Kaempferia galanga, Cananga odorata</i>	Grounded, poultice, topically
11192	Muscle sore	<i>Alyxia reinwardtii, Andrographis paniculata, Curcuma aeruginosa, Curcuma longa, Curcuma zedoaria, Cyperus rotundus, Foeniculum vulgare, Tamarindus indica, Zingiber officinale</i>	Juiced, juice, orally
11192	Muscle sore	<i>Acorus calamus, Alyxia reinwardtii, Biancaea sappan, Centella asiatica, Curcuma aeruginosa, Curcuma longa, Curcuma zanthorrhiza, Foeniculum vulgare, Grona triflora, Kaempferia galanga, Piper cubeba, Zingiber montanum, Zingiber officinale var. rubrum, Zingiber zerumbet</i>	Boiled, infusion, orally
11192	Muscle sore	<i>Curcuma aeruginosa, Curcuma longa, Foeniculum vulgare, Zingiber officinale</i>	Juiced, juice, orally
11192	Muscle sore	<i>Acorus calamus, Alstonia scholaris, Cymbopogon citratus, Kaempferia galanga, Oryza sativa, Tinospora crispa, Zingiber officinale var. Rubrum</i>	Grounded, poultice, topically
11193	Sprained muscle	<i>Euphorbia tirucalli, Foeniculum vulgare</i>	Grounded, poultice, topically
11211	Lactation stimulant	<i>Breynia androgyna, Centella asiatica, Orthosiphon aristatus, Peperomia pellucida, Strobilanthes crispa</i>	Juiced, juice, orally
11211	Lactation stimulant	<i>Centella asiatica, Cinnamomum burmanni, Cymbopogon citratus, Curcuma zanthorrhiza, Kaempferia galanga, Orthosiphon aristatus, Pluchea indica, Tamarindus indica, Zingiber montanum, Zingiber officinale</i>	Juiced and boiled, infusion, orally
11211	Lactation stimulant	<i>Curcuma zanthorrhiza, Cymbopogon citratus, Tamarindus</i>	Juiced and boiled,

11211	Lactation stimulant	<i>indica, Zingiber montanum, Zingiber officinale</i> <i>Curcuma longa, Curcuma zanthorrhiza, Cymbopogon citratus,</i> <i>Kaempferia galanga, Tamarindus indica, Zingiber montanum,</i> <i>Zingiber officinale</i>	infusion, orally Juiced and boiled, infusion, orally
11211	Lactation stimulant	<i>Carica papaya, Curcuma longa, Curcuma zanthorrhiza,</i> <i>Kaempferia galanga, Paederia foetida, Pluchea indica,</i> <i>Tamarindus indica</i>	Ground and boiled, infusion, orally
11211	Lactation stimulant	<i>Carica papaya, Curcuma longa</i>	Decocted, decoction, orally
11211	Lactation stimulant	<i>Curcuma longa, Curcuma zanthorrhiza, Cymbopogon citratus,</i> <i>Kaempferia galanga, Zingiber zerumbet</i>	Juiced, juice, orally
11211	Lactation stimulant	<i>Allium cepa, Curcuma longa, Grona triflora, Kaempferia</i> <i>galanga, Peperomia pellucida, Piper nigrum, Rubia argyi,</i> <i>Zingiber officinale</i>	Juiced and boiled, infusion, orally
11211	Lactation stimulant	<i>Acorus calamus, Curcuma longa, Kaempferia galanga, Pluchea</i> <i>indica</i>	Powdered and brewed, tea, orally
11211, 11213	Lactation stimulant, post- partum	<i>Curcuma longa, Kaempferia galanga, Tamarindus indica,</i> <i>Zingiber officinale</i>	Juiced, juice, orally
11212	Menstrual pain	<i>Curcuma longa, Tamarindus indica, Wurfainia compacta</i>	Dried and boiled, infusion, orally
11212	Menstrual pain	<i>Curcuma longa, Piper betle, Tamarindus indica</i>	Dried and boiled, infusion, orally
11212	Menstrual pain	<i>Curcuma longa, Tamarindus indica</i>	Decocted, orally
11212	Menstrual pain	<i>Curcuma longa, Zingiber officinale</i>	Boiled, infusion, orally
11213	Post-partum	<i>Alpinia galanga, Blumea balsamifera, Carica papaya, Centella</i> <i>asiatica, Zingiber montanum</i>	Juiced and boiled, infusion, orally
11213	Post-partum	<i>Cinnamomum burmanni, Curcuma aeruginosa, Curcuma</i> <i>zanthorrhiza, Curcuma zedoaria, Morinda oleifera,</i> <i>Orthosiphon aristatus, Pluchea indica, Wurfainia compacta</i>	Ground and boiled, infusion, orally
11213	Post-partum	<i>Carica papaya, Centella asiatica, Curcuma longa, Curcuma</i> <i>zanthorrhiza, Curcuma zedoaria, Kaempferia galanga,</i> <i>Orthosiphon aristatus, Oryza sativa, Plantago major, Piper</i> <i>betle, Pluchea indica, Strobilanthes crisper, Zingiber officinale</i>	Powdered and brewed, tea, orally
11213	Post-partum	<i>Allium sativum, Cinnamomum burmanni, Piper nigrum,</i> <i>Zingiber montanum, Zingiber officinale</i>	Grounded, poultice, topically
11213	Post-partum	<i>Acorus calamus, Curcuma longa, Zingiber montanum</i>	Boiled, infusion, orally
11213	Post-partum	<i>Cinnamomum burmanni, Curcuma longa, Curcuma</i> <i>zanthorrhiza, Cymbopogon citratus, Kaempferia galanga,</i> <i>Oryza sativa, Tamarindus indica, Zingiber officinale</i>	Boiled, infusion, orally
11213	Post-partum	<i>Carica papaya, Curcuma longa, Kaempferia galanga, Mentha</i> <i>piperita</i>	Grounded, poultice, topically
11213	Post-partum	<i>Acorus calamus, Allium sativum, Carica papaya, Curcuma</i> <i>longa, Piper cubeba, Zingiber officinale</i>	Grounded, poultice, topically
11213	Post-partum	<i>Alyxia reinwardtii, Curcuma zanthorrhiza, Kaempferia galanga,</i> <i>Piper cubeba, Urceola laevigata, Zingiber officinale</i>	Boiled, infusion, orally
11213	Post-partum	<i>Cananga odorata, Curcuma longa, Curcuma zanthorrhiza,</i> <i>Kaempferia galanga, Mentha piperita</i>	Grounded, poultice, topically
11241	Itching	<i>Alstonia scholaris, Melaleuca leucadendra, Piper betle,</i> <i>Tinospora crispa</i>	Boiled, infusion, topically as bath









<i>Zingiber montanum</i>	1				1				1				1	3		3	1		12
<i>Zingiber officinale</i> var. <i>rubrum</i>													2	1					5
<i>Zingiber officinale</i>	5	1		1		3			1	6	1		2	6	2	6		1	47
<i>Zingiber zerumbet</i>													1	3					8
Total	31	7	3	18	9	24	7	2	6	40	4	3	33	2	89	20	67	14	7

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**Table S4.** Matrix of uses of polyherbal formulation components in each body system category

Plant components	Number of plants used in formulations for a particular body system category														Total uses	
	1101	1104	1105	1106	1107	1109	1112	1114	1115	1116	1117	1118	1119	1121		1124
<i>Acorus calamus</i>	1								1		1		2	4		9
<i>Allium cepa</i>	1		2	1		1						1		3		9
<i>Allium sativum</i>											1			2		3
<i>Alpinia galanga</i>					1			1				2		1		5
<i>Alstonia scholaris</i>	1		1	1									1		1	5
<i>Alyxia reinwardtii</i>		1	2		2	2			1				2	3		13
<i>Andrographis paniculata</i>	1				1	1		1	1				1		2	8
<i>Anredera cordifolia</i>								1	1							2
<i>Archidendron pauciflorum</i>							1									1
<i>Areca catechu</i>						1										1
<i>Biancaea sappan</i>			1		1	4	1		1			1	1	1		11
<i>Blumea balsamifera</i>														1		1
<i>Boesenbergia rotunda</i>			1					1								2
<i>Breynia androgyna</i>		1	1												1	3
<i>Cananga odorata</i>													1	1		2
<i>Carica papaya</i>														6		6
<i>Catharanthus roseus</i>					1										1	2
<i>Centella asiatica</i>			2						1				1	5		9
<i>Cinnamomum burmannii</i>					5	6	1					2		5	1	20
<i>Citrus hystrix</i>					1							1			1	3
<i>Clitoria ternatea</i>						1										1
<i>Cocos nucifera</i>			1													1
<i>Coriandrum sativum</i>					1				1							2
<i>Curcuma aeruginosa</i>			1		1								3	1		6
<i>Curcuma heyneana</i>		1	1													2
<i>Curcuma longa</i>		1	12	1	4	6		1	4			5	4	22	2	62
<i>Curcuma zanthorrhiza</i>		1	6		1	2	1	1	2		1		1	11	1	28
<i>Curcuma zedoaria</i>			1		1				1			3	1	3		10
<i>Cymbopogon citratus</i>	1		4	1	3	6		1	5			5	1	7	1	35
<i>Cyperus rotundus</i>													1			1
<i>Erythrina variegata</i>			2							1				1		4
<i>Etlingera elatior</i>			1											1		2
<i>Eucalyptus alba</i>												1				1



<i>Sonchus arvensis</i>		1			1										2
<i>Strobilanthes crispata</i>		1			4							2			7
<i>Strychnos lucida</i>						1									1
<i>Syzygium aromaticum</i>	1		1		1	1		1	4			1			10
<i>Syzygium polyanthum</i>			1						1			1			3
<i>Tamarindus indica</i>				1	4	3		1	1		2	1	11	1	25
<i>Tinospora crispa</i>	1		1	1		1		1						1	6
<i>Urceola laevigata</i>													1		1
<i>Wurfbainia compacta</i>			1		2	2			1		1		5	1	13
<i>Zingiber littorale</i>								1							1
<i>Zingiber montanum</i>	1					1			1	1		1	6	1	12
<i>Zingiber officinale</i> var. <i>rubrum</i>					1	1						2	1		5
<i>Zingiber officinale</i>			4	1	4	8	1	1	3		1	7	2	14	1
<i>Zingiber zerumbet</i>		1	2			1						1	3		8
Total number of plants	15	13	70	8	65	71	10	18	40	2	6	44	38	176	21