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Local knowledge of traditional medicinal plants use and education system on their young of Ammatoa Kajang tribe in South Sulawesi, Indonesia

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Abstract. *Azis S, Zubaidah S, Mahanal S, Batoro J, Sumitro SB. 2020. Local knowledge of traditional medicinal plant use and education system on their young Ammatoa Kajang tribe in South Sulawesi, Indonesia. Biodiversitas 21: 3989-4002.* Kajang tribal community in Indonesia has been using plants as traditional medicine for long periods of time; however, this traditional knowledge has not been appropriately documented. Therefore, to prevent the knowledge from being degraded or vanished, it needs to be documented. This study aimed to (i) document the local knowledge of Ammatoa Kajang tribe on the use of traditional medicinal plants, (ii) describe the education system of their young generation, and (iii) conduct Informant Consensus Factor (ICF) and Use Value (UV) analyses. The research data were obtained from 114 informants through semi-structured interviews. This research uses descriptive analysis, quantitative ICF, and UV. A total of 104 plant species from 50 families were identified. Parts of plants that were frequently used by the tribal community were leaves (48.56%). Before using the medicinal plants, the people customarily boiled (33.09%) the plants. The youth received education through informal education that became the highest level of education delivered orally by the family (51.75%). The highest ICF was found in the Digestive System Diseases category, and the highest UV was observed in *Piper betle*.

Keywords: Education system, local knowledge, local herbalists, medicinal plant, young generation

INTRODUCTION

Traditional medicinal plants are used more in the world than in modern medicine (Prabhu and Vijayakumar 2016). Medicinal plants' usage has taken place in Asia (Wangchuk and Tobgay 2015), including in Indonesia. Traditional medicinal plant resources in Indonesia are national assets that continue to be optimally developed by exploring local knowledge. Local knowledge of traditional medicine in Indonesia is quite broad because of the high level of cultural diversity, especially in tribe communities (Sujarwo et al. 2014). The tribes in Indonesia consider that natural resources play a vital role in human life; therefore, they must be protected and used as part of the culture to ensure the balance of nature (Tamalene et al. 2016). The Ammatoa Kajang tribe is one of the local communities in Indonesia that still maintain the culture and utilizes natural resources to this day (Azis et al. 2017). The area of Ammatoa tribe is deep in the forest and grows a variety of flora that is believed and used by the community one of them as a treatment.

The Ammatoa Kajang live in groups and isolate themselves from the outside world or distance themselves from everything related to modernization (except education) (Akifah and Mukrimin 2012). Since it is difficult for them to accept changes from outside (Adhan 2005). The community believes that modernity can separate them from nature and plants are the source of life and the source of healing. The use of plants as medicine is a part of a long-standing tradition that has been empirically proven hundreds to thousands of years ago and passed on through local knowledge.

Local knowledge of the Ammatoa Kajang tribe is articulated through messages, myths, and rituals, which contain specific and essential information about plant utilization (Mithen et al. 2015). The local knowledge of medicine was passed down from their ancestors. Unfortunately, the environmental-management culture of the Ammatoa Kajang tribe only been conveyed from an oral tradition since thousands of years ago (Lullulangi et al. 2018). Therefore, era development and globalization will lead to the result in degradation, scarcity, and even the extinction of the local knowledge that only orally delivered (Srithi et al. 2009).

Local knowledge is one of the Indonesian's heritage, and the young generation is one of the parties contributing to traditional knowledge loss. The youth's tendency to be curious about medicinal plants' properties and how to cultivate them is, in fact, low (Gallois and Reyes-García 2018; Caballero-Serrano et al. 2019). The young generation also seems to ignore medicinal plants (Patrick and Tunnicliffe 2011) and lacks interest in studying traditional

practices (Giday et al. 2009). The loss of local knowledge in the young generation occurs in some countries including America (Vandebroek and Balick 2012), North America (Saynes-Vásquez et al. 2016), Africa (Fongod et al. 2014), and Brazil (Sousa et al. 2012). The youth's poor traditional knowledge mainly results from an inadequate education system that fails to maintain local knowledge inherited from their ancestors (Khastini et al. 2019). Preserving local knowledge can be done through documentation.

Until now, local knowledge research of medicinal plants has been widely performed in the World including America (Thomas et al. 2011), Ethiopia (Kefalew et al. 2015), Pakistan (Jan et al. 2017), Myanmar (Ong et al. 2018), and India (Ju et al. 2019). In addition, some areas in Indonesia have done so between Kalimantan (Supiandi et al. 2019), Bengkulu (Wiryono et al. 2019), Banten (Khastini et al. 2019), Aceh (Suwardi et al. 2020), and Sumatera (Silalahi et al. 2019). But unfortunately local knowledge in the region of South Sulawesi especially the people of Ammatoa Kajang people have not been documented. The documentation of the medicinal plant knowledge is can encourage medical practitioners to improve the use of medicine traditionally (Yirga and Zeraburk 2011), utilized as a basic data to formulate sustainable conservation (Song et al. 2014) and provide insights into environmental management strategies and add to the archipelago's cultural wealth (Al-Fatimi 2019). This study aimed to (i) documentation the local knowledge of medicinal plant species used by the Ammatoa Kajang tribe, (ii) describe the youth education system held in the tribe, and (iii) knowing the analysis of Informant Consensus Factor (ICF) and Use Value (UV).

MATERIALS AND METHODS

Study area

Ammatoa Kajang is a sedentary tribe. They live permanently in Tanah Towa Village, Kajang Sub-district, Bulukumba District, South Sulawesi Province, Indonesia (Figure 1). Tanah Towa is about 230 km from Makassar, the capital city of South Sulawesi. Tanah Towa is located at 5° 19′18″ South 120° 17′45″ East. Tanah Towa has an area of about 1.698 ha/m^2, surrounded by Batunilamung Village as the northern border, Malleleng Village as the eastern border, Bonto Baji Village as the southern border, and Pattiroang Village as the western border. Tanah Towa is divided into nine hamlets, namely Sobbu, Benteng, Pangi, Tombolo, Lurayya, Balambina, Jannaya, Balagana, and Bongkina. Tanah Towa is a low-lying area with an altitude of 200 meters above sea level. This area has an average rainfall of 13-29 ºC and humidity of 70% per year.

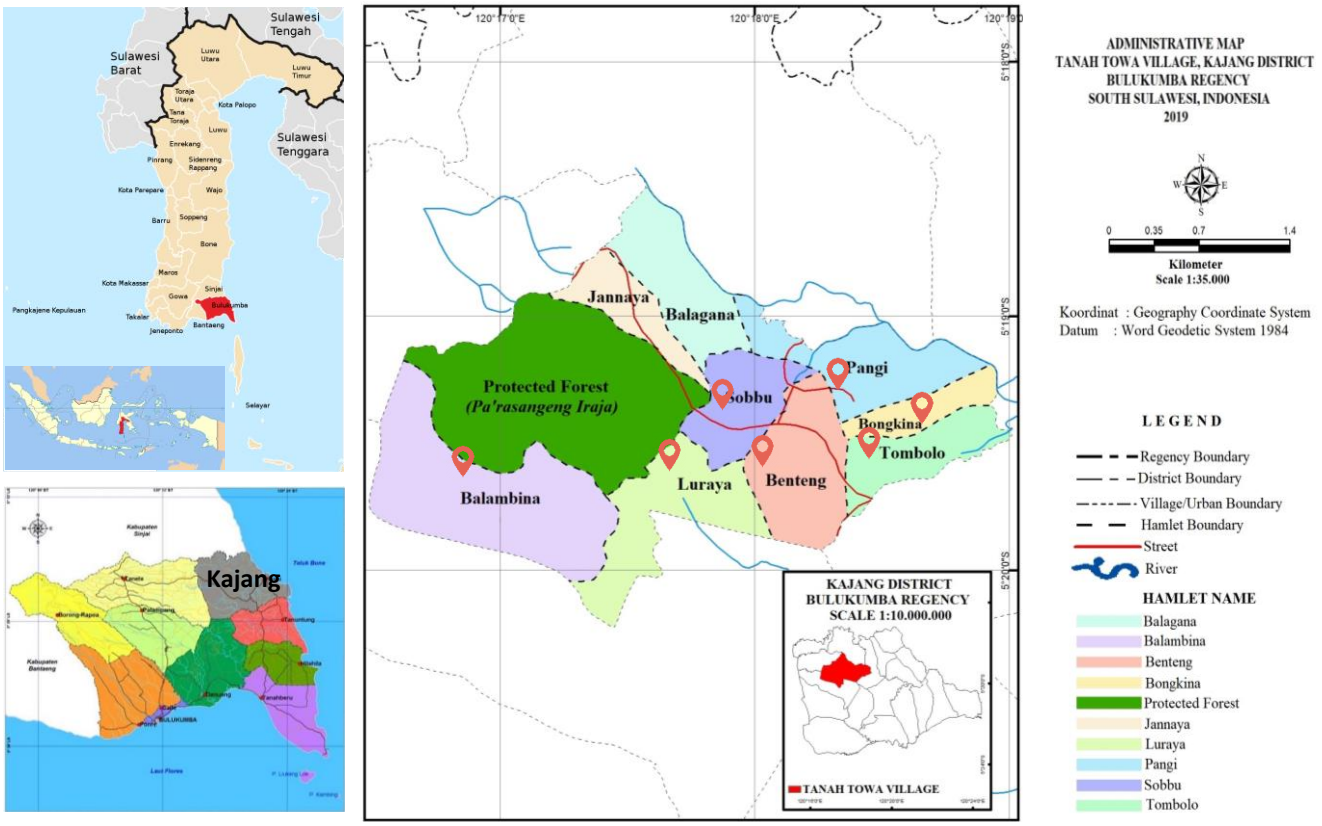

Figure 1. Map of research locations ( ). Kajang Sub-district, Bulukumba District, South Sulawesi Province, Indonesia

The Ammatoa Kajang community is divided into two groups, the Inner and Outer regions' groups. The Inner region group consists of Ammatoa Kajang's natives, who still live based on *Pasang* (rules). Their predecessors inhabited seven hamlets in Tana Towa, i.e., Sobbu, Benteng, Pangi, Buttono, Bongkina, Lurayya, and Balambina. Their custom activities are centered on Benteng, where their traditional leader (referred to as *Amma*) resides. On the other hand, the Outer region group consists of Ammatoa Kajang's natives who no longer practice *Pasang*. They are more likely influenced by modern culture. These people can be found in Balagana and Jannaya hamlets. The current study focused on the Inner region group. Areas inhabited by the Ammatoa Kajang tribe can also be referred to as *Kamase-mase* (simple) lands, but not all people who come from Tanah Towa belong to the Ammatoa Kajang tribal community (Nas et al. 2019). The Ammatoa Kajang tribal community can be identified by their consistent use of *Pasang* (rules) (Syamsurijal 2014). This study was focused on the hamlets found in the inner area community. The inner area or known as the forest is divided into three parts, namely community forests (*Borong Luara*), border forests (*Borong Batasayya*), and sacred forests (*Borong Karamaka*). Plants that grow in the border forest and sacred forest may only be taken by traditional stakeholders who have previously received permission from *Amma* (the tribal chief). The most difficult problem faced when identifying plants in the forest was due to the chief's permission.

Procedures

Selection of the informants

The informants of this study were selected from the Ammatoa Kajang tribal community using the snowball sampling technique. Snowball sampling is a technique used to collect data from a core source that can develop into several branches. The sample was determined based on information obtained from the key informants (the tribal chief, village head, customary leaders, and other trusted sources who understood the research matters, such as the *Sanro* (local herbalists). A total of 114 informants who represented demographic characteristics were invited to the interviews.

Botanical identifications

Data collection on the use of traditional medicinal plants by the Ammatoa Kajang tribal community was continued with the identification of the plants. The scientific name and family of each plant were identified immediately after obtaining their local names. If the scientific name could not be assigned, the plant was identified with herbarium. During the research process, the plants were photographed, and the dried specimens of the plants were collected. The collection was only made for certain plants because the retrieval of some plants was highly restricted by *Pasang* (rules) due to their sacredness. However, the local name, the usage, and the parts of the plants used by the community were recorded in this research. The medicinal plants were identified based on information obtained from books and herbarium institutions. Books used to determine the plants included Flora of Malesiana and Flora of Java. Furthermore, the determination of the nomenclature and the correct species quote was based on online databases, including the plant list (http://www.theplantlist.org) and plantamor (http://www.plantamor.com).

Data collection

Snowball sampling technique combined with a survey using a semi-structured interview using *Konjo* language (the local language). These data consisted of the community's demographic information, the local name of the plants used, parts of the plants used, methods for processing the plants, and diseases treated by the plant (Cunningham 2001). Additionally, data on the education system in young generations are obtained through semi-structured interviews. This research was conducted for eight months, starting in May 2018 until January 2019.

Data analysis

Quantitative and descriptive data analyses were performed. The results of the descriptive analyses were presented in tables or pictures explaining the informants' demographic characteristics and inventory of the plants and education system on their young generation. The education system Data in their young community is analyzed descriptively (percentages) by comparing the information obtained from each respondent. Furthermore, quantitative data analysis was performed using the Informant Consensus Factor (ICF) and Use Value (UV).

Informant consensus faktor (ICF)

ICF can be calculated using the following formula: $\mathrm{ICF} = \frac{N_{ur} - N_t}{N_t - 1}$ (Trotter and Logan 1986). ICF stands for Informant Consensus Factor, N_{ur} is the amount of reported usage of plants (close to 0 are categorized into the low category which suggests that there is no proper exchange of informants), and N_t is the number of taxa used by all informants. The ICF values range between 0-1. Any values close to 1 are categorized into the high category, which means that there is a good exchange of information on medicinal plants among the people surveyed, while any values information on medicinal plants among the community members (Gazzaneo et al. 2005). Diseases treated by the medicinal plants reported in this research were sorted and grouped according to 14 categories modified from the International Classification of Primary Care (ICPC) (Miller et al. 2009), Integument Diseases (InD), Animal Bites (AnB), Circulatory System Diseases (CSD), Digestive System Diseases (DSS), Respiratory System Diseases (RSD), Reproductive System Diseases (RSS), Nervous System Diseases (NSD), Urinary System Diseases (USD), Diseases in Children (DiC), Immune System Diseases (IyS), Muscular System Diseases (MSD), Injury (Wound) Diseases (InD), Diseases in Animals (DiA), and others (Oth). The categorization of the diseases was based on the anatomical physiology system that was arranged to make it easier to examine the relationship between one ill-ness with another in the same physiological system.

Use value (UV)

UV (use-value) analysis was performed to investigate the relative value of a plant species known locally (Tabuti 2003). UV values can be obtained using the following formula $UV = \frac{\sum UVis}{is}$ (Philips 1996), where *UV* refers to the use-value of a plant species. *UVis* refers to the number of informants using the plant species and *is* refers to the total number of the informants. Use Value (UV) ranges between 0-100. A high UV (approaching 100) suggests that many informants use the plant species, so it can be concluded the plant species is highly significant for the community. Conversely, a low UV (approaching 0) indicates that very few informants use the plant species, so it can be concluded that the plant species is less significant for the community.

RESULTS AND DISCUSSION

Local knowledge based on the informants' demographic characteristics

Based on sociodemography, information collection is essential because it plays a significant role in the analysis and interpretation of the information (Bouyahya et al. 2017). The 114 informants involved in this study were categorized based on their age group, sex, and education level. The demographic characteristics of the informants can be seen in Table 1. Local knowledge is part of local wisdom that is still maintained until today and will be passed on to the next generation. Local knowledge of the community varies in terms of medicine use, age, and gender.

The majority of the Ammatoa Kajang community (63%) preferred to use traditional medicine. Knowledge about medicinal plants has been maintained by the community because they consider the use of the plants to be more effective, side-effect free, easy to find and produce, and thus affordable. Only 6% of the informants reported the use of modern medicine because it is thought to be less effective and it takes time to process. Besides, about 45% of the people claimed that they used both traditional and modern medicines to support their health because they believed that the combination of both could help them recover more quickly. The results of this study differ in the North-West community in Morocco reporting a traditional treatment with a more commonly used modern treatment (Bouyahya et al. 2017).

In terms of age, it was reported that the elderly (44.74%) from the Ammatoa Kajang tribal community possessed more knowledge about medicinal plants, followed by the adults (30.70%), and the adolescents (24.56%). This can happen because they have a strong belief to hold tight to the teachings passed by their ancestors. Also, adolescents who are already affected by modernity are more likely to be less aware and interested in knowing the benefits of traditional medicinal plants. These results are similar to the data on the southern slope of Mount Merapi, Yogyakarta, Indonesia (Nahdi and Kurniawan 2019a), the Nigerian community of Awwasoma (Alade et al. 2016) where members of the community with age parents have gained a better knowledge of the use of traditional medicine compared to adolescents.

The use of medicinal plants is better known by the elderly and adult members of the community since they still have high cultural awareness and hold fast to the teachings given by their ancestors. On the other hand, teenagers are more likely to be less aware and less interested in knowing the benefits of traditional medicinal plants because they have been affected by modernity. Lack of local knowledge will have an impact on the degradation and loss of cultural identity and values. The lack of knowledge possessed by the adolescents will lead to the loss of their cultural identity and values as well as threaten the existence of traditional medicinal plants in their environment (Huai and Pei 2004).

The results of the analysis also indicated a difference in the community members' local knowledge based on gender. The tendency of using traditional medicinal plants by men is higher than that of women. Men play a significant role in family health management, so they need to be more active in collecting traditional medicines for themselves and for their families. In addition, men are more agile in discovering the presence of medicinal plants, while women are more interested in household chores, such as cooking. The findings are in line with a study in the Bajaur Agency in Pakistan Community which suggests that unlike women, men are more interested in utilizing plants as a medicine (Aziz et al. 2017), but differ in the Gunung Kidul community Yogyakarta, Indonesia, where women are more active in using medicinal plants than men (Nahdi et al. 2019b).

Table 1. The characteristics of the informants' demography

Categories informant	Total	Percentage (%)
Medicine use		
Traditional medicine use only	63	55.26
Modern medicine use only	6	5.26
Use modern and traditional medicine	45	39.47
Age		
Adolescent (13-19 Years)	28	24.56
Adult (20-40 Years)	35	30.70
Elderly (> 41 Years)	51	44.74
Gender		
Male	62	54.39
Female	52	45.61
Degree		
No school	26	24.561
Didn't pass Elementary	23	21.930
Elementary graduated	27	23.684
Junior high school graduated	20	17.544
Senior high school graduated	13	9.649
University graduated	5	2.632

Table 2. Medicinal plants used by the Ammatoa Kajang tribal community

Scientific name	Local name	Voucher number	Status	UV	Part used	Mode of the preparation	Method of the uses	Ailments
Acanthaceae								
Andrographis paniculata (Burm. f.) Wall. ex Nees	*Sombere*	SA086	Wild	0.46	LF	Bi	Drink	Malaria
Barleria cristata L.	*Buno bampo*	SA116	Wild	0.44	LF	Bi	Drink	Gastritis
Barleria prionitis L.	*Pai-pai (balle)*	SA099	Wild	0.68	LF	Sq	Drink	Gastritis. low back pain
Graptophyllum pictum (L.) Griffith	*Lahunga*	SA098	Wild	0.55	LF	Po	Rub	Vulnus excoriasi
Justicia gendarussa Burm.	*Bullu-bullusu*	SA083	Cultivation	0.61	LF	Po	Rub	Blow air
Amaranthaceae								
Amaranthus spinosus L.	*Tambara*	SA131	Wild	0.54	ST	Bi	Drink	Back Pain
Anacardiaceae								
Dracontomelon dao (Blanco) Merr. & Rolfe	*Rao*	SA096	Cultivation	0.53	ST	Bi	Drink	Itchy throat and dry cough
Koordersiodendron pinnatum Merr.	*Bugisi*	SA088	Cultivation	0.65	ST	Po	Paste	Vulnus excoriasi in animals
Lannea coromandelica (Houtt.) Merr.	*Kuma-kuma*	SA058	Cultivation	0.64	SP	Dr	Drink	Vomiting blood
Lannea nigritana (Scott-Elliot) Keay	*Kaju monro*	SA063	Cultivation	0.68	LF	Bi	Drink	Boils
Mangifera foetida Lour.	*Pao macang*	SA031	Cultivation	0.62	ST	Po	Paste	Diarrheal
					LF	Sq	Drink	Muscle cramp
Mangifera indica L.	*Pao*	SA030	Cultivation	0.54	SP	Po	Drink	Asthma, nausea and vomitus, hematemesis, vomiting blood
Annonaceae								
Annona muricata L.	*Sarikaja*	SA042	Cultivation	0.80	LF	Sq	Paste	Fever
						Bi	Drink	Fatigue
Apiaceae								
Pityrogramma calomelanos (L.) Link	*Tadddung-taddung balaho*	SA087	Cultivation	0.71	LF	Sq	Paste	High fever; asthma
Apocynaceae								
Alstonia scholaris (L.) R. Br	*Kaju Rita/ Bote-bote*	SA082	Cultivation	0.69	SP	Dr	Rub	Toothache, pneumonia, diabetes
					LF	Bi	Mouthwash	Swollen gums
Catharanthus roseus (L.) G. Don	*Song-song*	SA109	Wild	0.58	LF	Bi	Drink	Diabetes mellitus
Arecaceae								
Areca catechu L.	*Rappo*	SA057	Cultivation	0.72	SD	-	Chewable directly	Asthma, tuberculosis, sprue or mouth sores, hepatitis, cardiovascular
						Cu	Chewable directly	Dyspnea
					RT	Po	Drink	Impotence, premature ejaculation
Arenga Pinnata (Wurmb) Merr.	*Inru*	SA049	Cultivation	0.75	FL	-	Drink	Diabetes, fatigue, wor50m
						Br	Rub	Stomach pain in farm animals
						Bi	Drink	Hypotension
Borassus flabellifer L.	*Tala*	SA055	Cultivation	0.67	LF	Bu	Paste	Gastroenteritis
Cocos nucifera L.	*Kaluku*	SA022	Cultivation	0.74	FR	-	Drink	Poisoning

Cocos nucifera var. eburnean.	*Kaluku eja*	SA023	Cultivation	0.63	ST	Cu	Chewable directly	Cephalalgia
Metroxylon sagu Rottb.	*Kaluku lohe*	SA009	Cultivation	0.52	RT	Br	Drink	Impotence, Premature ejaculation
Asphodelaceae								
Aloe vera (L.) Burm. f.	*Lila buaya*	SA069	Cultivation	0.53	LF	Cu	Rub	Telogen effluvium, black spots on the face, vulnus combustio
Asteraceae								
Ageratum conyzoides (L.) L.	*Ruku-ruku bembe*	SA083	Wild	0.66	LF	Bi	Drink	Asthma, Gastritis
Artemisia vulgaris L.	*Burangga*	SA134	Wild	0.54	LF	Sq	Paste	Vulnus excoriasi
Carthamus tinctorius L.	*Relle*	SA117	Wild	0.79	FL	Bi	Drink	Urticaria, pharyngitis, exanthema subitum
Chromolaena odorata (L.) R.M. King & H. Rob.	*Lahuna*	SA112	Wild	0.64	LF	Po	Paste	Abrasions
Elephantopus scaber L.	*Dappa-dappa*	SA089	Wild	0.53	LF	Sq	Paste	Prevents breast enlargement
Gynura segetum (Lour.) Merr.	*Lahira*	SA092	Wild	0.61	LF	Bi	Drink	Fever
Pluchea indica (L.) Less.	*Biccoro*	SA076	Wild	0.54	LF	Bi	Drink	Cause to fall sweat
Auriculariaceae								
Auricularia auricula-judae	*Pippi eja*	SA071	Wild	0.33	AP	Po	Drink	Diarrheal
Bombacaceae								
Ceiba pentandra (L.) Gaertn.	*Kahu-kahu borong*	SA105	Cultivation	0.51	LF	Sq	Rub	Simplify labor, diabetes mellitus
Boraginaceae								
Symphytum officinale L.	*Didi bulang*	SA090	Wild	0.53	LF	Sq	Paste	Allergy
Bromeliaceae								
Ananas comosus (L.) Merr.	*Pandang*	SA033	Cultivation	0.46	FR	Gr	Drink	Launch menstruation
Caricaceae								
Carica papaya L.	*Kaliki*	SA014	Cultivation	0.79	RT	Po	Drink	Stomach pain in farm animals
					FR	-	Chewable directly	Expedite defecation
					LF	Cu	Blew	Buzzing ears
						Bi	Drink	Malaria
Combretaceae								
Terminalia bellirica (Gaertn.) Roxb.	*Jaha*	SA129	Wild	0.62	ST	Po	Drink	Diarrheal, nausea and vomitus
Crassulaceae								
Kalanchoe pinnata (Lam.) Pers.	*Dinging-dinging*	SA073	Wild	0.83	LF	Sq	Paste	Very high fever, bruised from falling
Cucurbitaceae								
Benincasa hispida (Thunb.) Cogcun.	*Boyo lompo*	SA040	Cultivation	0.64	FR	Gr	Drink	Typhus
Momordica charantia L.	*Paria*	SA038	Cultivation	0.69	LF	Bi	Chewable directly	Diabetes mellitus
Dennstaedtiaceae								
Pteridium aquilinum (L.) Kuhn	*Paku balaho*	SA106	Wild	0.55	LF	Sq	Paste	Febrille convulsions/step
Euphorbiaceae								
Aleurites moluccanus (L.) Willd.	*Sapiri*	SA059	Cultivation	0.82	LF	Bi	Drin	Fever
					SP	Dr	Drink	Fever, sprue or mouth sores, dysentery
					SD	Po	Paste	Cradle crap and boils
Antidesma bunius (L.) Spreng.	*Bu'nne*	SA043	Cultivation	0.56	LF	Bi	Drink	Hypertension

Euphorbia pulcherrima Willd. ex Klotzs	*Tangnging-tangnging balanda*	SA077	Cultivation	0.69	SP	Dr	Rub	Yaws and vulnus excoriasi
Jatropha curcas L.	*Tangnging-tangnging*	SA081	Cultivation	0.67	LF	Bi	Drink	Hypertension
						Br	Flush	Fatigue
					SP	Dr	Rub	Paralysis and toothache
Phyllanthus acidus (L.) Skeels	*Jaramele*	SA035	Cultivation	0.63	FR	-	Chewable directly	Anemia
					ST	Bi	Drink	Allergy
Sauropus androgynus (L.) Merr.	*Manya-manya*	SA053	Cultivation	0.67	LF	Bi	Drink	Increase breast milk production
					RT	Po	Drink	Pneumonia
Fabaceae								
Caesalpinia sappan L.	*Seppang*	SA094	Cultivation	0.77	ST	Bi	Drink	Poisoning. dysentery, tuberculosis
Cassia alata L.	*Kiti-kiti*	SA102	Wild	0.65	LF	Sq	Rub	Pityriasis versicolor, ringworm, athlete's foot
Crotalaria pallida Aiton	*Bangkasa*	SA103	Wild	0.64	LF	Po	Rub	Stomach pain in farm animals
Desmodium triquetrum DC.	*Linrapa*	SA127	Wild	0.58	LF	Bi	Drink	
Indigofera tinctoria L.	*Tarung*	SA059	Cultivation	0.69	RT	Po	Drink	Asthma
					LF	Br	Drink	Diarrheal
Tamarindus indica L.	*Camba*	SA036	Cultivation	0.77	FR	Bi	Drink	Dry cough, urolithiasis
					ST	Po	Drink	Acute asthma
Lamiaceae								
Ocimum basilicum L.	*Talasi*	SA110	Wild	0.60	LF	Sq	Sipping	Influenza, take a cold, diarrheal, dysentery
Orthosiphon stamineus Benth.	*Kumisi cammi*	SA072	Wild	0.51	LF	Bi	Drink	Cystitis
Lauraceae								
Cinnamomum burmanni (Nees & T. Nees) Blume	*Kaju tanning*	SA065	Cultivation	0.77	ST	Br	Drink	Uric acid, hypertension
Persea americana Mill.	*Apoka*	SA048	Cultivation	0.49	LF	Bi	Drink	Hypertension
Liliaceae								
Allium cepa L.	*Lasuna eja*	SA045	Cultivation	0.74	BL	Po	Paste	Asthma
Allium sativum L.	*Lasuna pute*	SA046	Cultivation	0.75	BL	Po	Rub	Tetanus
Malvaceae								
Hibiscus tiliaceus L.	*Baru*	SA070	Cultivation	0.72	LF	Bi	Drink	Fever
						Sq	Paste	Fever, tonsillitis
Sida rhombifolia L.	*A'llupang*	SA108	Wild	0.48	LF	Sq	Paste	Boils, itching stung by insects
Menispermaceae								
Tinospora crispa (L.) Hook. f. & Thomson	*Tambarapai*	SA066	Cultivation	0.74	LF	Po	Paste	Vulnus combustio, vulnus insivum, vulnus excoriasi, laceration
					ST	Bi	Rub	Rheumatoid arthritis
Melastomataceae								
Melastoma malabathricum L.	*Biroro*	SA107	Wild	0.56	LF	Po	Rub	The tongue is white in children
						Bi	Drink	Diarrheal
Moraceae								
Artocarpus heterophyllus Lam.	*Nangka*	SA039	Cultivation	0.58	ST	Po	Rub	Increase breast milk production
Ficus fistulosa Reinw. ex Blume	*Lambere susu*	SA067	Cultivation	0.77	LF	Bi	Paste	Feverish
						Sq	Rub	Increase breast milk production

Ficus septica Burm. f.	*Tobo-tobo*	SA097	Cultivation	0.46	ST	Bi	Drink	Libido
					LF	Sq	Drink	Osteoarthritis, myalgia
Moringaceae								
Moringa oleifera Lam.	*Keloro*	SA013	Cultivation	0.78	LF	Po	Rub	Vernal keratoconjunctivity
						Sq	Paste	Wound from dog bite
					RT	Po	Drink	Cystitis
Musaceae								
Musa paradisiaca L.	*Loka*	SA011	Cultivation	0.59	SP	Po	Rub	Vulnus excoriasi
					LF	Br	Paste	Prickly heat
Myrtaceae								
Melaleuca cajuputi Powell	*Kaju pute*	SA093	Wild	0.68	LF	Po	Rub	Osteoarthritis
Psidium guajava L.	*Jammu bo'ddong (borong)*	SA034	Cultivation	0.83	LF	Sq	Sipping	Cold
						Bi	Drink	Diarrheal, itchy throat
						-	Chewable directly	Sprue or mouth sores, tonsillitis, cheilitis
Syzygium aromaticum (L.) Merr. & L.M. Perry	*Cengke*	SA044	Cultivation	0.57	FR	Po	Paste	Breast cancer
Syzygium cumini (L.) Skeels	*Rappo-rappo jawa*	SA052	Cultivation	0.70	ST	Bi	Drink	Hypertension
Orchidaceae								
Dendrobium crumenatum Sw.	*Tinoko*	SA126	Wild	0.44	ST	Po	Drops	Otitis interna, ootitis externa, tennitus
Oxalidaceae								
Averrhoa bilimbi L.	*Bainang*	SA025	Cultivation	0.77	LF	Bi	Drink	Hypertension
					FR	Sq	Rub	Contact dermatitis
Pandanaceae								
Pandanus amaryllifolius Roxb.	*Bunga*	SA041	Cultivation	0.72	LF	Cu	Flush	Fatigue
Piperaceae								
Piper betle L.	*Leko*	SA064	Cultivation	0.89	LF	Sq	Paste	Fever, hives; vaginal discharge, body odor
						Sq	Drink	Dyspnea
						Sq	Sipping	Nosebleed
Plantaginaceae								
Plantago major L.	*Rampu-rampu*	SA123	Wild	0.56	LF	Bi	Drink	Typhus
Plumbaginaceae								
Plumbago zeylanica L.	*Sumbila oto*	SA060	Wild	0.44	RT	Sq	Paste	Back Pain
Poaceae								
Cymbopogon citratus (DC.) Stapf	*Serre*	SA020	Cultivation	0.82	RT	Bi	Drink	Hyperhidrosis, oliguria
					ST	Po	Drink	Hepatitis
Oryza sativa L.	*Pare*	SA008	Cultivation	0.79	SD	Po	Paste	Flatulence in children
Oryza sativa var glutinosa “Black Sticky Rice”	*Pare pulu le'lleng*	SA010	Cultivation	0.78	SD	Bi	Chewable directly	Myalgia, diabetes, anemia
Zea mays L.	*Baddo*	SA012	Cultivation	0.63	FR	Bu	Paste	Gastroenteritis
Portulacaceae								
Talinum paniculatum	*Munyi-munyi*	SA119	Wild	0.46	FR	Bi	Drink	Gastric acid
Rubiaceae								
Morinda citrifolia L.	*Bangkuru*	SA118	Cultivation	0.63	LF	Po	Paste	Paralysis

Timonius ledermannii Valeton	*Bae'*	SA091	Cultivation	0.79	LF	Po	Drink	Gastritis, gonorrhea
Uncaria gambir (Hunter) Roxb.	*Gambere*	SA056	Cultivation	0.63	LF	Po	Drink	Diarrheal
						-	Chewable directly	Cardiovascular, halitosis, tuberculosis, sprue or mouth sores, hepatitis
Rutaceae								
Citrus aurantiifolia (Christm.) Swingle	*Lemo kacci*	SA061	Cultivation	0.68	FR	Br	Drink	Cough with phlegm
Citrus hystrix DC.	*Lemo lohe*	SA062	Cultivation	0.39	FR	Wr	Paste	Smoothing facial skin
Murraya paniculata L.Â Jack	*Bila-bila*	SA124	Cultivation	0.24	FR	Po	Paste	Rheumatism
Sapindaceae								
Nephelium lappaceum L.	*Balatung*	SA047	Cultivation	0.42	ST	Po	Drink	Diarrheal
Schleichera oleosa (Lour.) Merr.	*Kadieng*	SA051	Cultivation	0.68	LF	Bi	Drink	Cough
Sapotaceae								
Manilkara zapota (L.) P. Royen	*So manila*	SA068	Cultivation	0.67	FR	Bi	Drink	Typhus
Scrophulariales								
Justicia adhatoda L.	*Galiri*	SA115	Wild	0.59	LF	Sq	Rub	Malnutrition
Selaginellaceae								
Selaginella doederleinii Hieron	*Pasassa lahu*	SA078	Wild	0.63	LF	Bi	Drink	Dizzy
Simaroubaceae								
Brucea javanica (L.) Merr.	*Puru*	SA125	Wild	0.64	LF	Sq	Sipping	Very high fever
Solanaceae								
Capsicum frutescens L.	*Pesse manu*	SA037	Cultivation	0.57	FR	Po	Paste	Boils
						Po	Drops	Toothache
					LF	Po	Paste	Boils
Nicotiana tabacum L.	*Tambako*	SA054	Cultivation	0.56	LF	Bu	Suction	Cardiovascular, hepatitis
						Sq	Paste	Itching stung by insects
Sterculiaceae								
Kleinhovia hospita L.	*Paliasa*	SA095	Cultivation	0.78	LF	Bi	Paste	Jaundice
						Bi	Drink	Hepatitis, cardiovascular, hypertension
						Sq	Rub	Contact dermatitis, athlete's foot
Urticaceae								
Poikilospermum suaveolens (Blume) Merr.	*Usa*	SA085	Wild	0.62	LF	Sq	Rub	Contact dermatitis, athlete's foot
Verbenaceae								
Clerodendron serratum (L.) Spr.	*Pe'ngo*	SA101	Wild	0.42	LF	Bi	Drink	Gastritis
Lantana camara L.	*Carru-carru*	SA114	Wild	0.67	LF	Br	Paste	Obesity
Stachytarpheta jamaicensis (L.) Vahl	*Bakka'ru*	SA128	Wild	0.60	LF	Sq	Paste	Diarrhea in children
Zingiberaceae								
Curcuma longa L.	*Didi*	SA061	Cultivation	0.77	RH	Po	Paste	Flatulence in children
						Bi	Drink	Dysmenorrhea
Zingiber officinale Roscoe	*Passe pempeng*	SA050	Cultivation	0.78	LF	Br	Paste	Gastritis

Notes: LF: leaf; ST: stem; FR: fruit; RT: root; FL: flower; SP: sap; SD: seed; RH: rhizome; BL: bulbs; AP: all part; Bi: boiled; Sq: squeeze (then pour hot water); Gr: grated (add hot water); Cu: cut; Po: pounded/mashed (add pour hot water); Br: brewed (add pour hot water); Wr: wring; Bu: burn; Dr: dredger.

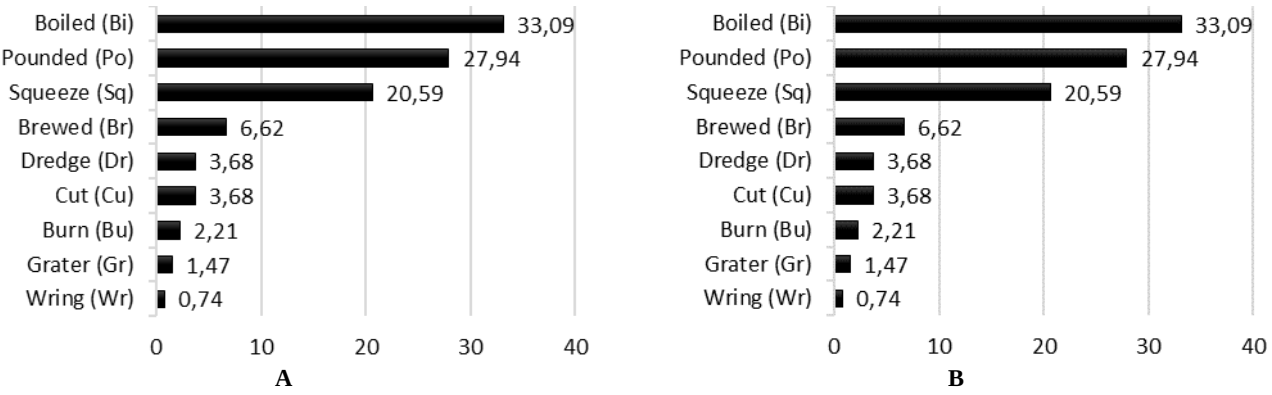

Figure 2. Percentage (A) parts used and (B) mode of preparation in traditional medicines

Traditional medicinal plants Ammatoa Kajang Community

Diversity of plant species used

The Ammatoa Kajang tribal community used a total of 104 plant species from 50 families as medicinal plants in Table 2. These medicinal plants mostly come from the Asteraceae families (6.73%), then Anacardiaceae, Arecaceae, Euphorbiaceae, and Fabaceae (each of 5.77%).

Plant family from Asteraceae, Anacardiaceae, Fabaceae, Euphorbiaceae, and Arecaceae can be easily found in their surroundings and thus have a significant contribution to the community's health. The Asteraceae family is also mostly used by people in some areas of Indonesia including Poncokusumo in East Java Province (Batoro and Siswanto 2017), different to the Tobelo community in the province of North Maluku dominant using the family Euphorbiaceae (Yakub et al. 2019) and the village Dayak community in Kalimantan dominant utilizing family Araceae (Supiandi et al. 2019).

All species of plants used by the Ammatoa Kajang as medicinal materials obtained both through cultivation and wild (Table 2.). Cultivation Status (64.42%) is the most crop acquisition used by communities compared to wild plants (35.58%). The use of the highest cultivated plants is also reported in the Baduy tribe of Indonesia (Khastini et al. 2019). The most culturally cultured plants are used by the people of Ammatoa because the community preserves the plants mostly and believes that the plants are part of their lives.

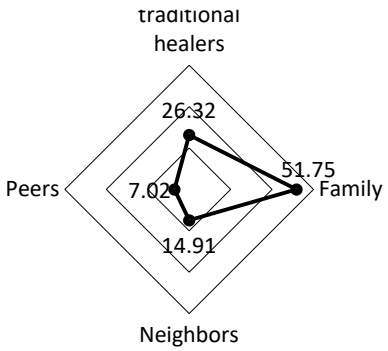

Figure 3. The percentage of informal education system pathway local knowledge Ammatoa Kajang

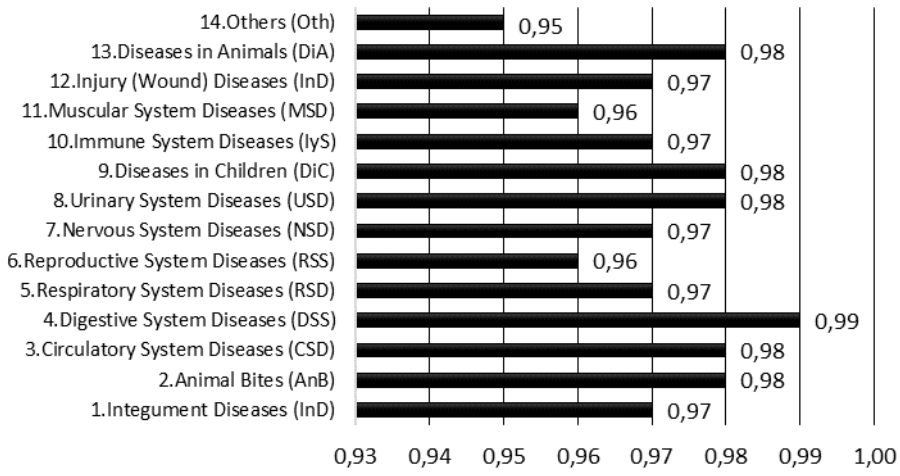

Figure 4. Category of diseases and ICF values

Plant parts used and mode of preparation in traditional medicines

Parts of plants used by the Ammatoa Kajang community for remedies include the leaf, stem, fruit, rhizome, bulb, flower, seed, sap, and root (Figure 2).

Leaf part (48.56%) is the highest part used and followed by a section of the stem (15.93%), and the rhizome section (0.88%). The lowest used by the community of Ammatoa Kajang. This result is similar to the data obtained in Indonesia for the Ranggawulung West Java, Indonesia (Putri et al. 2016), but different from the Minangkabau community in Nagari Pagaruyung, West Sumatra, which has more to tighten the plant stem as a medicine (Monita et al. 2018). Leaves are the center of bioorganic metabolism and provide storage for secondary metabolites (Bouyahya et al. 2017). Leaves also play a crucial role in photosynthesis (Ghorbani 2005), and therefore, they contain a lot of secondary bioactive compounds that aim to defend themselves from herbivores (Bhattarai et al. 2006). To avoid deforestation, the Ammatoa Kajang community only use young shoots. They keep themselves from damaging plant roots because they realize this will be able to kill the plant. The dosage given depends on age; for example, 3-5 leaves for children and 7-9 leaves for adults.

Traditional medicine plant preparation mode varies among boiling, pounded, squeeze, brewed, dredge, cut, burn, grater, and wring (Figure 2.). The preparation of traditional medicinal plants of the highest ethnic community was carried out through boiling mode (33.09%), and the lowest in wring mode (0.74%). This result is similar to the data obtained in Indonesia for the Peadundung Village, North Sumatra Indonesia (Silalahi et al. 2019). The boiling method can maintain the effectiveness of herbal medicines (Kayani et al. 2015), and accelerate biological reactions so as to produce many responses of active compounds (Chen et al. 2008). Boiling herbs can be done 2-3 times a day, depending on the age or type of disease being treated. The herbs stew can be given two times a day to children (day and night), and three times a day to adults (morning, noon, night). The community depends on plants that grow in their environment as a traditional medicine because they believe in their effectiveness.

The education system of their young

The differences in the degree (educational background) of the Ammatoa Kajang people were inversely proportional to the local knowledge level (Table 1). The degree of college-level education precisely local knowledge is increasingly lacking. Likewise, the degree of no school but local knowledge is high. This proves that the degree (educational background) of the Ammatoa Kajang tribe does not affect the level of local knowledge it possesses. This is because the education gained by the public does not provide information regarding the local knowledge of medicinal plants traditionally. These results are similar to the Semende tribe Bengkulu Province, Indonesia (Wiryono et al. 2019), Waorani community in Ecuador (Weckmüller et al. 2019) where local knowledge is not influenced by the level of education caused by social-cultural change. In addition, their education level does not influence the community members' local knowledge but because of their awareness of the benefits of using plants (Jaradat et al. 2016; Caballero-Serrano et al. 2019). Most of the local community members were prohibited by Kasipalli (prohibition) to attend formal schools. However, since 1970, the law has been removed, and now the local government has attempted to encourage the tribe to receive an education. Their education level does not influence the community members' local knowledge but because of their awareness of the benefits of using plants (Jaradat et al. 2016; Caballero-Serrano et al. 2019).

The difference in the local knowledge of medicinal plants between the older and younger community members shows the erosion of knowledge. The erosion of local knowledge occurs because knowledge is only conveyed through verbal communication (oral), has no written documentation, the parent's community has diminished knowledge, and the influence of modernity. Modernity has lowered young people's appreciation of local knowledge of traditional medicinal plants. Therefore, the educational system is crucial to raising the young generation's awareness of the importance of local knowledge.

Local knowledge contains facts that must be recognized and learned from experience and observation through education that is inherited from generation to generation. The local knowledge of the Ammatoa Kajang tribal community is obtained from the older generation and inherited to the young generation through the informal education system. The informal education system was delivered to the youth orally by their customary leaders and/or traditional healers, family, neighbors, and peers. (Figure 3). The family had the highest percentage (51.75%) of contribution to the youth education system, while peers contributed the lowest percentage to the system as much as 7%.

In fact, the family education system had some limitations since the knowledge of medicinal plant use was only delivered when a family member was getting sick. There were no educational demands that all children had to understand the treatment system, and the family was unable to develop the youth's interest and motivation to preserve the local knowledge. The inability of the family to give education to the local knowledge of the younger generation is one of the factors that led to the loss of such valuable information (Sousa et al. 2012). Ideally, the family plays an important role as the first education provider to transfer local knowledge to the children and make sure that the knowledge can be transferred completely to the children (Chirico 2008). Besides family, the customary leaders and/or traditional healers provided education was limited to a particular generation so that the youth had different opportunities to access the information.

All this time, the Ammatoa Kajang tribal community has obtained knowledge through informal education so that the knowledge has slowly degraded and gone extinct in the young generation. Education based on the local knowledge

of the Ammatoa Kajang tribal community is most required. The knowledge should be preserved and developed as the ancestral cultural heritage through formal education that is motivated and aware of protecting local knowledge. The formal education curriculum should be designed in such a way to maintain local knowledge owned by particular people and deliver it to the younger generation (Ramirez 2007). An education curriculum serves as the foundation of society's sustainable development (Dziva et al. 2011). Incorporating local knowledge into an education curriculum needs to be done to maintain the local knowledge (Boafo et al. 2016), create an awareness of the values and potential contributions of local knowledge and society's practices to sustainable development (Dei et al. 2012), support national identity (Syarif et al. 2016a). The importance of local knowledge learned, maintained, and used as a filter for the impact of globalization flows (Syarif et al. 2016b).

Informant consensus factor (ICF) and use value (UV) analysis

Informant consensus factor analysis

According to 114 informants, there are these diseases fall into 14 categories. The categories, types of diseases, and ICF values are shown in Figure 4. The category with the highest degree of consensus from the informants was digestive system diseases (0.99). While the ICF value in the digestive system category resides second after the respiratory system category in the Society Delanta Northern Ethiopoia (Meragiaw et al. 2016) and the digestive system is in second place after the category of skin and hair diseases in the Jazan Region Saudi Arabian people (Tounekti et al. 2019).

This study has revealed that the Ammatoa Kajang tribal community has a high diversity of traditional medicinal plants and has a high dependency on these plants due to the belief and confidence in the efficacy and effectiveness of these plants. Traditional medicinal plants play a crucial role in Ammatoa Kajang society, as indicated by the high ICF values possessed by most plants identified in this study. This finding suggests that local knowledge of the traditional medicinal plants owned by the community has been appropriately maintained until today. Medicinal plants that have the highest ICF value will be easily acquired or used by the community so that it can cause damage to the natural plant ecosystem in the future. Therefore, more studies are needed to consider a wise or alternative step in the maintenance of such crops (Song et al. 2014).

Use value (UV) analysis

The use of medicinal plant species by 114 informants showed UV values that ranged between 0.33-0.89 (Table 2). The highest UV, as much as 0.89, was found in *Piper betle* L., followed by *Psidium guajava* L. (0.83) and *Kalanchoe pinnata* (Lam.) Pers. (0.83) and *Aleurites moluccanus* (L.) Willd. (0.82). On the other hand, the lowest value was observed in *Auricularia auricula-judae* (0.33), followed by *Citrus hystrix* DC. (0.34). The Ammatoa Kajang community believed that *Piper betle L*. could be used as a remedy for fever, dyspnea, and nosebleed. According to the tribe, this plant species symbolized soothing calm (Azis et al. 2017). *Piper betle* L. is herb that can be easily found by the community. It is also a compulsory component of the tribe's rituals. *Piper betle* L. contains various beneficial properties, such as Alkaloid, amino acids, steroid, tannin, terpenes (cineole, cadinene, camphene, caryophyllene, pinene, limonene, chavicol, allyl pyrocatechol, carvacrol, safrole, eugenol, and chavibetol) (Pradhan et al. 2013). The compounds in *Piper betle* L. have antimicrobial properties as an inhibitor of microbial and bacterial growth. Betel leaf contains essential oils whose constituent components are phenol compounds which possess anti-bactericidal, fungicidal, or germicidal properties.

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