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The Contribution of Javanese Pharmacognosy to Suriname's Traditional Medicinal Pharmacopeia: Part 2

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Abstract

The Republic of Suriname (South America) is among the culturally, ethnically, and religiously most diverse countries in the world. Suriname's population of about 600,000 consists of peoples from all continents including the Javanese who arrived in the country between 1890 and 1939 as indentured laborers to work on sugar cane plantations. After expiration of their five-year contract, some Javanese returned to Indonesia while others migrated to The Netherlands (the former colonial master of both Suriname and Indonesia), but many settled in Suriname. Today, the Javanese community of about 80,000 has been integrated well in Suriname but has preserved many of their traditions and rituals. This holds true for their language, religion, cultural expressions, and forms of entertainment. The Javanese have also maintained their traditional medical practices that are based on *Jamu*. *Jamu* has its origin in the Mataram Kingdom era in ancient Java, some 1300 years ago, and is mostly based on a variety of plant species. The many *Jamu* products are called *jamus*. The first part of this chapter presented a brief background of Suriname, addressed the history of the Surinamese Javanese as well as some of the religious and cultural expressions of this group, focused on *Jamu*, and comprehensively dealt with four medicinal plants that are commonly used by the Javanese. This second part of the chapter continues with an equally extensive narrative of six more such plants and concludes with a few remarks on the contribution of Javanese *jamus* to Suriname's traditional medicinal pharmacopeia.

Keywords: Suriname, Javanese, ethnopharmacology, medicinal plants, ethnobotanical uses, phytochemistry, pharmacology

1. Introduction

The Republic of Suriname is a small independent country in South America that is renowned for its ethnic, cultural, and religious diversity [1]. The Javanese are currently the fourth most numerous ethnic group in Suriname, after the Hindustanis, the Creoles, and the Maroons [1]. The Javanese are the descendants of indentured laborers from particularly the Indonesian island of Java who were attracted by the

Dutch colonizers from the former Dutch East Indies - modern-day Indonesia - at the end of the 19th century to work on the sugar cane plantations in Suriname following the abolition of slavery in the year 1863 [2, 3]. They had signed contracts for five years, and although some returned to their home country and others relocated to The Netherlands [2, 3], most remained in Suriname and settled in the district of Commewijne where the first groups of Javanese had been put to work [2, 3].

Today, only five generations later, the Javanese have integrated well in Suriname, actively participating in all sections of the society including politics, arts, entertainment, and sports. For instance, Iding and Willy Soemita and Paul Somohardjo were prominent Surinamese Javanese politicians. Iding Soemita was born in West Java and came as an indentured laborer to Suriname, and founded the political party *Kerukunan Tulodo Pranatan Inggil* (KTPI) in 1949, giving Surinamese Javanese for the first time a political voice. Iding Soemita's son Willy succeeded his father as chairman of the KTPI in 1972 and served several times as a minister until 1996. As a more outspoken and assertive alternative to the KTPI, Paul Somohardjo founded the Javanese party *Pendawa Lima* in 1977 that was superseded in 1998 by the *Pertjajah Luhur*. Somohardjo became the first-ever Javanese Speaker of the National Assembly in 2005 and also served several terms as a minister.

The Surinamese-Javanese writer Karin Amatmoekrim studied Modern Literature at the University of Amsterdam, graduated with a thesis on 'The ethnicity in literature in Suriname', and won the 2009-Black Magic Woman Literature Prize for her novel 'Titus'. The Surinamese-Javanese singers Ragmad Amatstam, Oesje Soekatma, and Eddy Assan are among the greatest and most beloved musicians Suriname has brought forth. Specializing in pop-Jawa songs, they reached a broad audience in both Suriname and The Netherlands. Notable Surinamese-Javanese sports heroes are Andy Atmodimedjo, Virgil Soeroredjo, and Mitchel Wongsodikromo. Andy Atmodimedjo was an impressive professional football player and became the successful manager of several clubs in Suriname's highest soccer league as well as the head coach of the country's senior and under-21 national soccer teams. And Virgil Soeroredjo and Mitchel Wongsodikromo were among the world's top badminton players who excelled on various national, Caribbean, Central American, and South American competitions.

Nevertheless, the Javanese have preserved their own identity, speaking their own language and adhering to their own specific religious and cultural customs. This also holds true for their traditional medical customs which are based on *Jamu*, the centuries-old traditional form of medicine from Indonesia that mainly involves the use of plants with medicinal properties. The first part of this chapter gave some background on Suriname; then addressed some of the religious and cultural expressions of Surinamese Javanese; focused on *Jamu*, and concluded with an extensive account of the traditional, phytochemical, and pharmacological aspects of four medicinal plants that are mainly used by Surinamese Javanese. This second part of the chapter continues with a comprehensive narrative about six additional popular 'Javanese' medicinal plants and concludes with the contribution of the Javanese pharmacognostic knowledge to Suriname's traditional medicinal pharmacopeia.

2. Plants used in Javanese pharmacognosy

Hereunder, six medicinal plants that are traditionally mainly used by Surinamese Javanese - in addition to four that have been addressed in the first part of this chapter - have in detail been assessed for their phytochemical contents and pharmacological activities in order to provide a scientific rationale for their ethnopharmacological applications. The plants have been selected on the basis of the

number of times they have been dealt with in a number of comprehensive publications describing the use of medicinal plants in the country [4–12]. All the ten plants and their main traditional use by Surinamese Javanese have been given in **Table 1**.

2.1 Asteraceae - *Ageratum conyzoides* L. 1753 not Hieron. 1895 nor Sieber ex Steud. 1840

The goat weed *A. conyzoides*, called *wedusan* in Surinamese-Javanese (**Figure 1**), is an annual herb that is native to northern Brazil. It is sometimes grown as an ornamental plant but has become a common invasive weed in many tropical regions in the Americas, the Caribbean, and Africa. It grows to a height of about 1 meter, has an erect stem covered with white hairs, carries leaves and flowers that emit a strong, unpleasant smell, and is commonly found in gardens and open spaces. The pungent smell from the leaf and flower is due to the presence of an essential oil with a strong nauseating odor [13]. Nevertheless, a decoction of fresh shoots and leaves is used as an ingredient of an 'anti-ageing' herbal shampoo [14]. *A. conyzoides* produces hepatotoxic pyrrolizidine alkaloids [15] that are regularly encountered as contaminants in, among others, grains, honey, milk, organ meats, and eggs [16]. For this reason, *A. conyzoides* is not consumed by humans except when taken for medicinal purposes.

In Suriname, an infusion from the whole plant is drunk against a sore throat, colics, and atony of the digestive tract [11], as well as gynecological diseases and gonorrhea [9]. A tea prepared from the root as well as the juice from the leaf are also used against a sore throat and, in addition, for reducing fever and fighting colds [12]. Itching all over the body, diarrhea, and chest conditions are treated by drinking a tea from the leaves [6]. A concentrated leaf decoction is used against chiggers [17], the juvenile forms of a type of mite (Trombiculidae) that are also known as berry bugs and that produces itching and blisters on the skin [18]. An infusion from the leaves is externally used against allergic conjunctivitis [6]. And a paste from the crushed leaves is applied on abscesses or burn wounds [6].

Most of the traditional uses and supporting pharmacological activities of *A. conyzoides* have been attributed to its essential oil [19]. The oil contains monoterpenes and sesquiterpenes that are mainly responsible for its fragrance [19], as well as important bioactive constituents such as flavonoids, alkaloids, steroids, benzofurans, tannins, chromenes, and coumarins [19]. A number of alkaloids and flavonoids have been encountered in other parts of the plant [19]. Several of these compounds may be associated with some its traditional uses and pharmacological activities.

The use of preparations from *A. conyzoides* against a sore throat, fever, and colds [11, 12] may have its rationale in the analgesic, antiinflammatory, antimicrobial, and wound healing activities of the plant. Evidence for analgesic activity was provided by the inhibitory effects of aqueous and ethanolic whole-plant or leaf extracts on acetic acid-induced writhing and/or formalin-induced licking in laboratory rodents, and the increase in the threshold of pain the animals experienced on a hot plate [20, 21]. Notably, an aqueous extract of the whole plant had been reported to accomplish analgesic effects and improvements in articulation mobility in patients with arthrosis [22]. The antinociceptive effects of *A. conyzoides* might be due to saponins and/or flavonoids in the plant [20, 23].

Indications for antiinflammatory effects of *A. conyzoides* came from the significant reduction in carrageenin-induced hind paw edema in rats by methanolic and ethanolic root, whole-plant, aerial, and leaf extracts of the plant [21, 23]. A leaf extract also exerted antiinflammatory effects in cotton pellet-induced granuloma and formaldehyde-induced arthritis models of inflammation in rats [24].

Family	Species (vernacular names in English; Surinamese-Javanese)	Part(s) used	Traditional indications	References
Acanthaceae	<i>Strobilanthes crispa</i> Blume (black face general; <i>ketji beling</i>)	Leaf	Disorders of the urinary system, diabetes mellitus	[8]
Araceae	<i>Acorus calamus</i> L. (sweet flag; <i>dlingo</i>)	Rhizome	Gastrointestinal disorders, intestinal parasites, common cold, convulsions and seizures in children, evil eye and evil spirits	[7, 8, 12]
Arecaceae	<i>Cocos nucifera</i> L. (coconut; <i>klapa</i>)	Coconut oil, coconut meat, coconut water, husk fibers	Respiratory problems, pimples, shingles due to herpes, diabetes mellitus, hypertension, gastrointestinal disorders, skin and hair care, skin lesions, burns, sprains, sore muscles, evil eye and luck	[6–10]
Asclepiadaceae	<i>Calotropis gigantea</i> (L.) Aiton (crown flower; <i>bidari</i> , <i>widuri</i>)	Latex, stem	Bleeding, skin lesions, burns, toothache, tonsillitis, colds, heart conditions	[10, 12]
Asteraceae	<i>Ageratum conyzoides</i> L. 1753 not Hieron. 1895 nor Sieber ex Steud. 1840 (goatweed; <i>wedusan</i>)	Whole plant, leaf, root	Symptoms of flu, gastrointestinal problems, gynecological disorders, gonorrhea, itching, skin lesions, burns, allergic conjunctivitis	[6, 9, 11, 12]
Caesalpiniaceae	<i>Tamarindus indica</i> L. (tamarind; <i>asem</i>)	Leaf, fruit pulp	Health-promoting <i>jamus</i> , fever, gynecological conditions, gastrointestinal disorders, itching, skin lesions	[4, 8, 12]
Fabaceae	<i>Sesbania grandiflora</i> (L.) Poiret (vegetable hummingbird; <i>turi</i>)	Leaf, bark	Abdominal disorders, throat and oral infections	[12]
Portulacaceae	<i>Portulaca oleracea</i> L. (green purslane; <i>krokot</i>)	Whole plant, leaf	Skin lesions, sprains, swellings, stiff joints, pain, bronchitis, conjunctivitis, anemia	[5, 9, 12]
Zingiberaceae	<i>Curcuma longa</i> L. (turmeric; <i>kunjit</i>)	Rhizome	Health-promoting <i>jamus</i> , gynecological disorders, gastrointestinal diseases, fever, inflamed gums, conjunctivitis, skin lesions, pinworm infection	[8, 12]
Zingiberaceae	<i>Zingiber officinale</i> Roscoe (ginger; <i>djahe</i>)	Rhizome	Health-promoting <i>jamus</i> , overweight, respiratory diseases, gastrointestinal disorders, gynecological problems, bruises, rheumatic joints, sore muscles	[8, 12]

Table 1.
Plants commonly used in Javanese traditional medicine addressed in this chapter, parts preferentially used, and traditional indications in the Surinamese-Javanese community.

Figure 1.

The goat weed *Ageratum conyzoides* L. 1753 not Hieron. 1895 nor Sieber ex Steud. 1840 (Asteraceae) (from: <https://images.app.goo.gl/1tsLVnadhCW6kXSr6>).

The antiinflammatory activity of *A. conyzoides* might be attributed to certain flavonoids [25]. This supposition is based on the amplification of the inhibitory effect of a methanol extract of the aerial part of the plant on the carrageenan-triggered edema in rats by a flavonoid fraction [25].

Support for antimicrobial activities of *A. conyzoides* was provided by the broad activity of aqueous, methanolic, and ethanolic extracts from the leaf and the whole plant as well as the essential oil of the plant against both Gram-positive and Gram-negative pathogenic bacteria [26, 27]. The plant extracts were also active against bacteria from wound isolates [28], methicillin-resistant *Staphylococcus aureus* [29], and clinical isolates of *Helicobacter pylori* [30]. Furthermore, the essential oil exhibited meaningful fungitoxic effects [26, 31] including activity against *Microsporum gypseum*, the causative agent of ringworm [32], *Candida* spp. [26], and the aflatoxin B1-producing *Aspergillus flavus* [33]. That *A. conyzoides* may possess, in addition, wound healing properties, has been suggested by the improved rates of epithelialization and wound contraction as well as the increased tensile strength of open excision wounds in Wistar rats accomplished by aqueous, methanolic, and ethanolic extracts of the leaf [34].

The analgesic, antiinflammatory, antimicrobial, and wound healing properties of *A. conyzoides* may also (partially) explain the traditional use of leaf preparations against burning eyes and skin lesions [6], itchy skin [6, 11], gonorrhea [9] as well as against gastrointestinal disorders caused by infectious microorganisms [6, 11]. The latter use is further supported by the *in vitro* schistosomicidal effect of the essential oil of the plant against the blood fluke *Schistosoma mansoni* [35]; the protective activity of aqueous and ethanolic leaf extracts against ethanol-induced gastric lesions in rats [36]; and the spasmolytic effect of an aqueous leaf extract on isolated rat intestine smooth muscles [37].

2.2 Caesalpiniaceae - *Tamarindus indica* L.

The tamarind *T. indica*, called *asem* in Surinamese-Javanese (**Figure 2**), is a long-lived, slow-growing, evergreen tree that can reach a height of 20 meters. The plant has a dense, spreading crown and an extensive root system that makes it very tolerant of windy conditions and drought. Its origin is uncertain but is thought to lie in tropical Africa. From there, it has long ago been introduced in more than fifty tropical and subtropical parts throughout the world. *T. indica* has fragrant flowers and is extensively cultivated for its edible, sweet-sour-tasting seedpods due to their relatively high concentrations of tartaric acid and reducing sugars. The pods, along with the young leaves, seedlings, and flowers, are extensively used for preparing a large variety of dishes, beverages, and confections, and the dried seeds can be roasted and ground as a coffee substitute.

T. indica also has a wide range of medicinal applications in various traditional systems throughout Asia, Africa, and the Americas. The plant has presumably been introduced in Suriname by enslaved Africans who used it to fight fever, diarrhea, and worm infections on board of the slave ships [11]. Since then, it is abundantly used medicinally in this country. Javanese use the leaves, together with the rhizomes from *Curcuma* spp., in various health-promoting *jamus*, and drink an infusion from the fruit pulp to ease menstrual pain and vaginal discharge [8]. The pulp is used

Figure 2.
The tamarind Tamarindus indica L. *Caesalpiniaceae* (from: <https://images.app.goo.gl/ViLrKniuZfAGExDb7>).

for treating constipation as well as skin conditions, heartburn, and jaundice [4]. Preparations from the leaf are drunk to stimulate perspiration in patients with fever [4] and in herbal baths to ease itching and skin irritation caused by measles, chicken pox, or rubella [12]. And Maroon women who have recently given birth incorporate *T. indica* leaves in a hot steam bath to cleanse the uterus and the vagina [12], presumably because of the presence of astringent, antimicrobial, and wound healing properties of the tannins in the plant [38].

T. indica contains a variety of phytochemicals with nutritious and pharmacological properties which can account, at least partially, for the traditional uses of the plant and for the pharmacological studies supporting these uses [39]. Important bioactive constituents in the plant are terpenoids and phenolic compounds including tannins; citric, malic, and tartaric acid; pectin and various pentoses and hexoses; many essential dietary minerals; as well as amino acids and proteins [39].

The incorporation of *T. indica* parts in *jamus* for improving well-being [35] may be associated with its antioxidant, weight-reducing, and immunomodulatory properties. Evidence for the former property was provided by the potent antioxidant activity exhibited by seed, pericarp, and fruit pulp preparations in various *in vitro* assays [40–42], and the improved efficiency of the antioxidant defense system in hypercholesterolemic hamsters treated with an ethanolic extract of the seed coat [41]. The antioxidant activity could be attributed to the polyphenolic compounds such as proanthocyanidins in the preparations [40, 42].

Indications for weight-reducing properties of *T. indica* came from the hypolipidemic and antioxidant activities of the fruit pulp or a fruit extract in rats on a cholesterol-rich diet [41] and the hypolipidemic and slimming effects of an ethanolic fruit pulp extract in obese rats on a cafeteria diet or on sulpiride (an antipsychotic drug that causes weight gain) [43]. And suggestions for immunomodulatory activity of *T. indica* were given by the stimulatory effects of a polysaccharide isolated from the fruit pulp on the uptake of foreign bodies by phagocytes, the promotion of lymphocyte proliferation, and the inhibition of leukocyte proliferation *in vitro* [44], as well as the increase in total white blood cell count, CD4⁺ T-cell population, and bone marrow cellularity in BALB/c mice which had receiving the polysaccharide intraperitoneally [45].

The use of *T. indica* against skin lesions [12] as well as menstrual pain and vaginal discharge [8] may be accounted for by the analgesic, antiinflammatory, and antimicrobial properties of the plant. Indications for both former activities came from the increase in reaction time of laboratory rodents in a tail immersion, acetic acid-induced writhing, tail flicking, and hot-plate assay, and the reduction in carrageenan-induced hind paw edema in the animals accomplished by a petroleum ether stem bark extract, an aqueous fruit extract, a hydroethanolic leaf extract, and a methanolic seed extract [46, 47]. Evidence for antimicrobial activity came from the broad *in vitro* antibacterial and antifungal activity of preparations from various parts of the plant [48–50]. The analgesic and antiinflammatory activities of *T. indica* have been attributed to sterols, triterpenes, and phenolic compounds in the plant [46, 47]. The antimicrobial activities have mainly been associated with phenolic compounds and the essential oil [48].

Further support for the traditional uses of *T. indica* mentioned in the preceding alinea lesions [12] are its antihistaminic potential as suggested by the inhibitory effects of a leaf methanolic extract on the histamine-induced contraction of goat tracheal chain and guinea pig ileum [51], and its wound healing activity, as indicated by the accelerated wound closure, epithelial migration, and re-epithelialization of various types of wounds in laboratory rodents caused by water and methanol seed extracts [52], the fruit paste [53], and the cork and seed ash [54].

The claims of efficacy of *T. indica* against gastrointestinal problems [4] is supported by the efficacy of preparations from the fruit pulp against constipation [55] due to the presence of relatively high amounts of tartaric acid and malic acid in their salt form which improve the movement of the bowel and act as a mild laxative [38]. Furthermore, a methanolic seed coat extract elicited meaningful antiulcer effect on ibuprofen-, alcohol-, and pyloric ligation-induced gastric lesions in rats when compared to the antipeptic agent ranitidine [56]. Finally, the use of *T. indica* against fevers [4] is supported by the antipyretic activity of a water-soluble crude polysaccharide fraction from the fruit pulp against the raised body temperature in rats and mice which had subcutaneously been injected with yeast or intraperitoneally with a lipopolysaccharide (LPS) from *Escherichia coli*, respectively [57].

2.3 Fabaceae - *Sesbania grandiflora* (L.) Poiret

The vegetable hummingbird *S. grandiflora*, known as *turi* in Surinamese-Javanese (Figure 3), is a fast-growing, relatively short-lived, highly branched tree that can grow to about 4 meters tall, and has rounded leaves, white, red, or pink flowers, as well as flat, long, thin, and green bean-like fruits. The plant probably originates from Indonesia and/or Malaysia, but is abundantly found in other hot and humid locations throughout the world. It is cultivated in various countries for its many edible parts. *S. grandiflora* also has many traditional medicinal uses in various parts of the world [58]. In Suriname, the plant is mainly used by Javanese, who cook the flowers, leaves, and young pods and eat them as a vegetable [12]. They also prepare a tea from the astringent bark for treating abdominal disorders and use the leaf juice as a gargle against a sore throat and mouth sprue [12].

Phytochemical studies revealed the presence of several bioactive in *S. grandiflora* that may account for its traditional uses including alkaloids, flavonoids, tannins, terpenoids, glycosides, steroids, and saponins [59]. Some of these compounds have been associated with, among others, the antimicrobial, hepatoprotective, antioxidant, and hypolipidemic activities of the plant [60–62].

Figure 3.
The vegetable hummingbird *Sesbania grandiflora* (L.) Poiret (Fabaceae) (from: <https://images.app.goo.gl/8oo6WbZ8MJsEr5e2A>).

Pharmacological support for the use of a concoction from *S. grandiflora* stem-bark against gastrointestinal disorders [12] is provided by the preventive action of an ethanolic extract of this part of the plant against acute gastric injury in rats caused by stress or non-steroidal anti-inflammatory drugs [63]. Of note, the extract did not modify the volume, pH, and hydrochloric acid contents of the gastric secretion of the animals [63]. Importantly, ethanolic extracts of the leaf substantially inhibited the development of ulcers in adult albino rats caused by pylorus ligation and ethanol when compared to omeprazole [64]. Furthermore, the seed oil showed considerable anthelmintic activity [65], speaking in favor of its traditional use to expel parasitic worms and other internal parasites from the gastrointestinal tract. Moreover, an *S. grandiflora* ethanolic leaf extract exerted a substantial protective effect on liver injury in rats produced by the antibiotic erythromycin estolate [61].

The use of the leaf juice against conditions of the throat and the oral cavity [12] may be accounted for by the antibacterial and wound healing activity of this preparation. Support for the former suggestion came from the notable activity of extracts from the leaf - but also from the stembark, the flower, and other parts of the plant - against a variety of bacterial strains [66–68]. The antimicrobial activity was most prominent with extracts prepared with organic solvents [66–68] and was also directed against methicillin-resistant *Staphylococcus aureus* and vancomycin-resistant enterococci, either in culture or in silkworms infected with these pathogens [68]. In some cases, the antimicrobial properties of the plant have been associated with the presence of bioactive constituents such as tannins, sterols, saponins, phenolic compounds including flavonoids, and alkaloids [66, 68, 69].

Indications for wound healing activity of *S. grandiflora* came from the rapid repair of excision and/or incision wounds in Wistar albino rats following the topical application of a methanolic extract of the stembark or an ethanolic extract from the flower when compared to the topical antibiotics framycetin sulphate and nitrofurazone, respectively [70, 71]. Furthermore, the use of a semi-purified extract of the stembark significantly stimulated the healing of incision wounds on the mucosa of the lower lip of rats when compared to the topical antiseptic and disinfectant dequalinium chloride [72]. This activity has been attributed to the astringent and antimicrobial properties of the stembark and has been interpreted as support for the traditional use of the plant against mouth ulcers [72]. As well, an ethanolic extract of *S. grandiflora* flower showed potent *in vitro* activity against *Streptococcus mutans* - that is commonly found in the human oral cavity and is a significant contributor to tooth decay - that was comparable to that of erythromycin [73].

2.4 Portulacaceae - *Portulaca oleracea* L.

The green purslane *P. oleracea*, called *krokot* in Surinamese-Javanese (**Figure 4**), is an erect annual succulent herb that can reach a height of about 40 centimeters. The origin of this plant is uncertain but may lie in western Asia, India, and/or even Africa. *P. oleracea* was probably one of the first plants to be domesticated as a food crop. Now, it often grows as a weed in fields, waste grounds, roadside verges, and cultivated grounds in many temperate tropical parts of the world. However, it is among the richest vegetable sources of omega-3 fatty acids and also contains high levels of vitamins C and E, β -carotene, and dietary minerals such as potassium, magnesium, calcium, phosphorus, and iron [74].

P. oleracea has also been used in various folk medicinal systems since ancient times and is still one of the most widely used medicinal plants in the world [75]. In Suriname, individuals from all ethnic groups including those from Javanese ancestry, mainly use preparations from *P. oleracea* as a dressing on abscesses and sores; as an ointment with coconut oil for sprains, swellings, stiff joints, as well as

Figure 4.

The green purslane *Portulaca oleracea* L. (*Portulacaceae*) (from: <https://images.app.goo.gl/wmwxjiB8FvgpzF7JA>).

back and neck pain; to stop bronchitis, and against conjunctivitis [5, 9]. The plant is also widely used against anemia [12] because of its relatively high iron content [74]. Incidentally, administration of *P. oleracea* seeds to adolescent females with iron deficiency anemia led to appreciable increases in the girls' hemoglobin, hematocrit, and mean corpuscular volume [76].

Some of the traditional uses may be associated with the presence in the plant of potent bioactive compounds such as flavonoids and alkaloids [77, 78]. Some of the flavonoids have been associated with antibacterial, antiviral, antiinflammatory, and/or antioxidant activities of the plant [77–79]. Potent alkaloids identified in the plant are dopa, dopamine, and noradrenalin as well as oleracimines which have been associated with the antiinflammatory properties of the plant [77, 78, 80].

The apparent usefulness of *P. oleracea* as a dressing on abscesses and sores and for treating sprains, swellings, stiff joints, and back and neck pain [12] may be explained by the wound healing, antiinflammatory, analgesic, antioxidant, and/or antimicrobial activity elicited by preparations of parts of the plant. Support for the wound healing-promoting properties of *P. oleracea* came from the stimulation of contraction, the decrease in surface area, and the increase in tensile strength of excision wounds in mice following topical treatment with an extract of the aerial parts of the plant [81]. An ethanolic extract of the aerial parts of the plant also accelerated the healing of excision wounds in streptozotocin-induced albino rats by stimulating wound contraction and promoting granulation and organization formation [82].

Indications for antiinflammatory and analgesic activities of *P. oleraceae* were provided by the inhibitory effects of extracts from aerial-parts, leaf, and seed extracts of the plant in the paw edema and ear edema tests, as well as the paw licking, writhing, tail flicking, and hot plate tests [83, 84]. Importantly, intraperitoneal administration of the alkaloid allantoin isolated from the seed gave comparable results [85]. The anti-inflammatory and analgesic efficacies of the plant-derived products were similar to those found with diclofenac and aspirin [83–85]. Furthermore, aqueous extracts of the dried aerial parts of the plant prevented the TNF- α -induced vascular inflammatory events in cultured human umbilical vein endothelial cells (HUVECs) [86], and

substantially inhibited the protein expression of iNOS as well as the production of PGE₂, IL-6, and TNF- α in LPS-activated cultured RAW 264.7 murine macrophages [87]. The antiinflammatory activities of the *P. oleracea* preparations have been attributed to oleracimines, since these compounds inhibited the secretion of various inflammatory mediators by LPS-stimulated macrophages [88].

Indications for antioxidant activity of *P. oleracea* have been provided by the protective effects of an aerial-parts aqueous extract against DNA strand breakage in human lymphocytes caused by hydrogen peroxide [89], and of aqueous and ethanolic seed extracts against hemolysis of erythrocytes caused by the free radical initiator 2,2'-azobis hydrochloride [90]. Furthermore, administration of leaf and stem preparations prevented oxidative damage in the liver of laboratory mice treated with streptozotocin [79] or fed with a high-fat diet, among others, by modulating blood and liver antioxidant enzyme activities [91]; increased the levels of reduced glutathione, catalase, superoxide dismutase, glutathione reductase, glutathione-S-transferase and glutathione peroxidase, and inhibited lipid peroxidation and nitric oxide in liver, kidney, and testis of male Wistar albino rats [92]; and improved serum levels of superoxide dismutase and catalase in sensitized rats [93]. The latter results were also achieved with the use of α -linolenic acid, one of the constituents of the leaf and stem of the plant [93].

P. oleracea probably also possesses antibacterial, antifungal, and antiviral activities. These suppositions are supported by the growth-inhibitory activity of extracts of the leaf and stem against a wide range of both Gram-negative and Gram-positive pathogenic bacteria [94, 95] as well as *Candida albicans* [94]. An ethyl acetate extract of the aerial parts of the plant also inhibited the growth of dermatophytes of the genera *Trichophyton* [96]. And a polysaccharide isolated from the aerial part of the plant was active against herpes simplex virus type 2 [97] and a methanolic extract of the aerial parts against hepatitis C virus genotype-3a infected in cultured Huh-7 human liver cells [98]. The apparent antiviral activities of *P. oleracea*, along with the above-mentioned antibacterial and antifungal properties of the plant may account for its traditional use in Suriname against conjunctivitis [5] and bronchitis [9].

2.5 Zingiberaceae - *Curcuma longa* L.

The turmeric *C. longa*, known as *kunjit* in Surinamese-Javanese (**Figure 5**), is an erect, herbaceous, perennial plant that grows to a height of about 1.5 meters. It is believed to have arisen in southern or south-eastern Asia by selection and vegetative propagation of a hybrid between the wild turmeric *Curcuma aromatica* Salisb. and other closely related species. As a result, *C. longa* is not found in the wild and is only known as a domesticated plant. The maternal plant carries yellow-white flowers that do not produce viable seed and multiplies by producing new sprouts from its underground rhizomes. The plant is abundantly cultivated for its pulpy orange-yellow rhizome in Indonesia and India as well as many other tropical and subtropical parts of the world. The pungent and bitter-tasting rhizome is dried and ground into a yellow powder, an essential ingredient of curry powders and pastes for coloring and flavoring many meat and fish dishes in Asian cuisine and as a bright yellow constituent that is used in the food industry as a natural food colorant.

C. longa preparations have also a centuries-long medicinal use in various traditional systems, particularly in Indonesian Jawa and Indian Ayurveda, Unani, and Siddha [99]. In Suriname, *C. longa* rhizome is an essential ingredient of many *jamus* to promote health and fitness and to enhance mental functioning and well-being, as well as in *jamus* for treating inflamed gums, abscesses, menstrual pains, and skin rash [8]. In addition, drinking a tea from the fresh rhizome would purify the

Figure 5.
The turmeric *Curcuma longa* L. (*Zingiberaceae*) (from: <https://images.app.goo.gl/1QbEoBg45CR8ub2m6>).

blood and treat stomach pain, chewing on the fresh rhizome and swallowing the sap would help against diarrhea, drinking the sap mixed with chalk would help against menstrual pains, and having children drink the sap of the grated rhizome mixed with that of other plants would take care of pinworm infection [12]. Moreover, the sap from the fresh rhizome is rubbed on the abdomen to ease bellyache and fever, dripped on watering eyes and inflamed eyelids, and used to disinfect pierced ears and the navel of newborn babies [12].

The main constituents of *C. longa* rhizome that may be associated with these beneficial effects are polyphenolic compounds such as diarylheptanoids and diarylpentanoids, as well as terpenoids such as sesquiterpenes, monoterpenes, diterpenes, and triterpenoids [100, 101]. The most common diarylheptanoids are the yellow-colored curcuminoids curcumin along with its derivatives demethoxycurcumin and bisdemethoxycurcumin [100, 101]. These constituents impart the characteristic color and flavor to preparations from this part of the plant [100, 101]. The sesquiterpenes are the main constituents of the rhizome essential oil, while the monoterpenes dominate the essential oils from the leaves and the flowers [101]. The major volatile principles of the rhizome oil are the aromatic compounds α - and β -turmerone [101].

Several lines of evidence support the inclusion of *C. longa* rhizome in *jamus* to promote health and fitness and to enhance mental functioning and well-being [8]. Firstly, rhizome preparations reduced the deposition of plaques similar to those seen in Alzheimer's disease in the brains of aged mice and the oxidative damage and amyloid pathology in transgenic mouse models of Alzheimer's disease [102]. Secondly, curcumin therapy produced favorable responses in a transgenic mouse model of Alzheimer's disease [103], and both curcumin and dimethoxycurcumin lessened lead-induced memory deficits in Wistar rats [104]. Furthermore, a water extract of the rhizome exerted anti-stress effects in laboratory rats which were comparable to those caused by the antidepressant fluoxetine [105]. Importantly, the results from clinical studies suggested that the daily intake of this extract had a positive influence on emotional fatigue in healthy individuals [106], that curcumin intake reduced fatigue, tension, anger, confusion, and total mood disturbance following 4 weeks of supplementation in non-depressed healthy elderly people [107, 108], and that curcumin reduced depressive symptoms in individuals suffering from depression [109].

The usefulness of *C. longa* against (inflammatory) gastrointestinal conditions [12] is sustained by the inhibitory effects of curcumin on the damage caused by indomethacin to the gastric mucosa of laboratory rats [110] and the production

of inflammatory cytokines, intercellular adhesion molecule 1, and TNF- α in the animals [110]. Furthermore, curcumin substantially improved the profile of inflammatory markers, severity of diarrhea, and colonic architecture in laboratory mice with colitis induced by trinitrobenzenesulfonic acid [111]. Clinical trials indeed showed beneficial effects of curcumin or a standardized *C. longa* rhizome extract in patients with peptic ulcers [112] or inflammatory bowel disease [113]. In fact, a Cochrane analysis revealed that curcumin may be a safe and effective therapy for the maintenance of remission in quiescent ulcerative colitis [114].

These apparent antiinflammatory activities of *C. longa* also support its traditional use against primary dysmenorrhea [12]. The substantial reduction in the level of pain during menstruation accomplished by rhizome preparations in various clinical studies (see, for instance, ref. [115]) was presumably due to blockade of prostaglandin production by curcumin [116], producing analgesic and antiinflammatory effects [116, 117]. The same mechanisms may be involved in the apparent beneficial effects of *C. longa* preparations against inflamed gums, abscesses, pain, inflammatory skin conditions, and conjunctivitis [8], as well as the application of a *C. longa*-based Javanese ointment called *bobok* for alleviating the discomfort of, among others, toothache [8].

The aseptic properties of *C. longa* may contribute to these effects. Indeed, both rhizome preparations and curcumin inhibited the growth of various standard bacterial strains [118, 119] including common periopathogens [120], as well as pathogenic fungi such as *Candida albicans* [121] and *Aspergillus flavus* [122]. Curcumin and its derivatives were also active against a broad variety of pathogenic viruses [123] including the influenza virus [124], accounting for its traditional use for fighting fever [12]. Finally, the broad antiparasitic activity of curcumin [125] may explain the Surinamese-Javanese custom of including *C. longa* rhizome in preparations for treating pinworm infection in children [8].

2.6 Zingiberaceae - *Zingiber officinale* Roscoe

The ginger *Z. officinale*, called *djahe* in Surinamse-Javanese (**Figure 6**), is a slender, erect, herbaceous perennial plant that grows to a height of about 2 meters. It has a thick, branched rhizome that grows horizontally near the soil surface and gives rise to leafy shoots that grow close together. *Z. officinale* has a long history of cultivation and use, with records going back almost 2,000 years [126]. It has probably first been domesticated in tropical Asia, presumably China, and is believed to have spread via south-eastern Asia and Africa to the Neotropics. In all these parts of the world it is abundantly cultivated for its succulent, aromatic, and pungent rhizome. This part of the plant is widely used as a hot, spicy flavoring for a variety of oriental dishes, as well as cakes, candies, and hot and cold beverages. *Z. officinale* also has a very long use as a medicinal herb in many traditional systems, particularly those from Indonesia, India, and China, where the fresh or dried rhizome and the essential oil are ingredients of numerous medicaments [127].

Z. officinale has probably been introduced in Suriname by Javanese indentured laborers [8]. The rhizome is an ingredient of many health-promoting *jamus* including those for maintaining the functioning of heart, muscles, blood vessels, and intestines, as well as those to stimulate fertility, reduce the risk of diabetes mellitus, and decrease stress [8]. Furthermore, all ethnic groups in Suriname also use *Z. officinale* rhizome for treating coughing, influenza, cold, sore throat, hoarseness, laryngitis, and pneumonia; stomach cramps and other abdominal problems; overweight; menstrual pain and to cleanse the uterus after delivery; and externally to massage bruised limbs, rheumatic joints, and sore muscles [12].

Figure 6.

The ginger *Zingiber officinale* Roscoe Zingiberaceae (from: <https://images.app.goo.gl/ETuwvyrgeVMDP5eY9>).

The distinctive odor and flavor of *Z. officinale* rhizome is mainly the result of a combination of volatile oils and non-volatile phenolic compounds [128]. The volatile oils predominantly consist of zingiberol and other sesquiterpene hydrocarbons [128], while the non-volatile phenolic phytochemicals comprise, among others, gingerols, shogaols and paradols [128]. Gingerols, including 6-gingerol - the best studied phytochemical in *Z. officinale* - are the major pungent compounds in the fresh rhizome [128]. The gingerols are thermally labile and easily undergo dehydration reactions during drying, heating, or prolonged storage of the rhizome to form the corresponding shogaols which are about twice as pungent as the gingerols [128].

Both gingerols and shogaols exhibit a host of biological activities [129, 130], supporting some of the traditional claims of *Z. officinale* [8, 12]. The incorporation of *Z. officinale* in many health-promoting *jamus* [8] may be related to the ameliorating effects of the essential oil on the antioxidant capacity, inflammatory response, and the building up of fat in the liver in cases of high-fat diet-induced non-alcoholic fatty liver disease [131]. The antioxidant compounds in *Z. officinale* rhizome are primarily gingerols, shogaols, and some related diarylheptanoids [132], and may help protect the cells from oxidative stress [133]. In addition, *Z. officinale* preparations accomplished hypocholesterolemic, hypolipidemic, and antiatherosclerotic effects in cholesterol-fed rabbits and rats [134] and inhibited LDL oxidation and attenuated the development of atherosclerosis in apolipoprotein E-deficient mice [133].

Furthermore, crude rhizome methanol extracts elicited potent positive-inotropic effects in an isolated guinea pig left atria preparation [135]. These extract also induced a dose-dependent fall in blood pressure in anesthetized rats, inhibited the spontaneous force and beating rate of atrial contractions in guinea pig atria similarly to the calcium antagonist verapamil, and caused endothelium-independent vasodilation in rabbit and rat aorta [136]. These apparent cardiotonic activities have been ascribed to the gingerols and the shogaols in the preparations [125, 136]. Additional support for the inclusion of *Z. officinale* rhizome in health-enhancing *jamus* is provided by the ameliorating activity of 6-gingerol on the genotoxicity

(chromosomal aberrations and sister chromatid exchanges) caused in cultured human lymphocyte chromosomes by norethandrolone and oxandrolone [137], and the chemopreventive activities of gingerols and shogaols in animals treated with laboratory carcinogens [138].

The folkloristic use of *Z. officinale* for treating conditions of the respiratory system is supported by the broad *in vitro* antibacterial properties of rhizome preparations as well as gingerols against both Gram-positive and Gram-negative human pathogenic bacteria and fungi [139] including those associated with respiratory tract infections [140]; the potentiation of the antibacterial effect of some commonly used antibiotics by the rhizome extract [141]; and the activity of these substances and compounds against the influenza A/Aichi/2/68 virus [142], the human respiratory syncytial virus (HRSV) [143], and the influenza A (H1N1) virus [144].

Several pieces of evidence support the traditional use of *Z. officinale* against gastrointestinal disorders [12]. Firstly, preparations from the rhizome inhibited the growth of several strains of *Helicobacter pylori* [145] and improved dyspeptic symptoms in patients with *H. pylori*-positive functional dyspepsia [146]. Secondly, rhizome preparations had a stimulatory effect on antiinflammatory cytokines and an inhibitory effect on proinflammatory cytokines in inflammations associated with the alimentary channel such as colitis and inflammatory bowel disease [147]. The antiinflammatory activities have been associated with potent inhibitory effects on prostaglandin, thromboxane, and leukotriene biosynthesis [148] and COX-2 activity [149]. Furthermore, methanolic and aqueous extracts from the rhizome exerted meaningful activity against larvae of the rat long worm *Angiostrongylus cantonensis* and those of the parasitic fish nematode *Anisakis simplex*, the causative agents of angiostrongyliasis, the most common causes of eosinophilic meningitis or meningoencephalitis in south-eastern Asia and the tropical Pacific islands [150], and anisakiasis, a gastrointestinal infection characterized by severe abdominal cramps [151], respectively. This suggests that *Z. officinale* also has activity against parasites of the alimentary tract, further supporting its traditional use against conditions of this organ system [12].

3. Concluding remarks

The Javanese have been in Suriname for over a century. They have been brought to that country as poor and unaccustomed indentured laborers but have become successful individuals who have integrated well into the Surinamese community, actively participating in all its sections. Indeed, the Javanese are full-fledged citizens of the country and an integral part of the vibrant color palette represented by its unique cultural, religious, and ethnic diversity. This is reflected by the presence of the small, often family-owned Javanese restaurants called *warungs* in the smallest of towns, where widely appreciated savory dishes such as *bami goreng* (fried noodles), *nasi goreng* (fried rice), *pityel* (mixed blanched vegetables with a peanut sauce dressing), *teloh* (fried cassava), *pejeh* (prawn crackers), and *saoto* soup (chicken broth, meat, and vegetables) can be enjoyed, and can be washed down with refreshing beverages such as the lemongrass-, corn starch-, and coconut milk-based *dawet*.

Nevertheless, the Javanese have maintained most of their cultural traditions. This particularly holds true for their ancient form of medicine that is based on centuries-old *Jamu*. *Jamu* has added a unique element to the array of traditional forms of medicine throughout the Caribbean and Latin America, most of which are based on practices from the Indigenous American peoples as well as those from Africa, China, India, and various European countries. The influence of *Jamu* is already

noticeable. The use of an infusion of the cat's whiskers or *kumis kutjing* *Orthosiphon aristatus* (Blume) Miq. (Lamiaceae) for treating kidney stones and renal colics is no longer limited to Indonesia and Suriname but has expanded into many other parts of the world. It is foreseeable that many more *Jamu* recipes will one day contribute to Suriname's traditional medicinal pharmacopeia as well as to the development of novel mainstream drugs for treating human diseases.

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