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Eksplorasi Jamu Pahitan, Minuman Pahit Tradisional Asli Jawa, Indonesia: Kajian Etnofarmakologi dan Bukti Ilmiah

[Exploring of Jamu Pahitan, a Traditional Bitter Drink Originating from Java, Indonesia: Ethnopharmacological Studies and Scientific Evidence]

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ABSTRACT

Jamu is a traditional Indonesian drink that has been recognized worldwide, and is usually drunk by Indonesians, especially Javanese, as a health drink. Jamu pahitan is a type of jamu that is made from one, two, or a mixture of herbal ingredients like Andrographis paniculata and Tinospora cordifolia, with or without adding other herbal ingredients. In Indonesia, jamu pahitan has long been used by local communities, particularly Javanese, as a blood purifier, an anti-allergy, and even a treatment for skin conditions. On another hand, Jamu pahitan could potentially be used to diabetes mellitus management, based on recent studies. Nevertheless, there are still few thorough and scientific investigations on the composition, processing, public health perception, and efficacy of jamu pahitan and its herbal constituents, particularly with regard to diabetes management. Therefore, the formula composition, processing, societal health perception, and pharmacological clinical evidence of jamu pahitan and its constituent herbal ingredients, particularly for the control of diabetes, are all covered in this review. This study's methodology was a narrative literature review, using 1992 - 2023 data as foundational information on the subjects covered. In vitro and in vivo investigations have demonstrated that the herbal ingredients contain a variety of bioactive chemicals, and the aqueous extract of the herbal ingredients composed of jamu pahitan and jamu pahitan alone has pharmacological action as antidiabetic agent.

Keywords: anti-diabetic, bioactive compound, formula composition, jamu pahitan, traditional medicine

ABSTRAK

Jamu adalah minuman tradisional Indonesia yang telah dikenal di seluruh dunia, dan biasanya diminum oleh orang Indonesia, terutama orang Jawa, sebagai minuman kesehatan. Jamu pahitan adalah jenis jamu yang dibuat dari satu, dua, atau campuran bahan herbal seperti sambiloto (*Andrographis paniculata*) dan brotowali (*Tinospora cordifolia*), dengan atau tanpa menambahkan bahan herbal lainnya. Di Indonesia, jamu pahitan telah lama digunakan oleh masyarakat lokal, khususnya masyarakat Jawa, sebagai pembersih darah, anti alergi, dan bahkan sebagai pengobatan untuk penyakit kulit. Di sisi lain, jamu pahitan juga berpotensi untuk digunakan sebagai pengobatan diabetes melitus, berdasarkan penelitian terbaru. Namun demikian, masih sedikit penelitian yang dilakukan secara menyeluruh dan ilmiah mengenai komposisi, proses pengolahan, persepsi kesehatan masyarakat, dan khasiat jamu pahitan dan konstituen herbalnya, terutama yang berkaitan dengan manajemen diabetes. Oleh karena itu, komposisi formula, proses pengolahan, persepsi kesehatan masyarakat, dan bukti klinis farmakologis jamu pahitan dan bahan-bahan herbal

penyusunnya, terutama untuk pengendalian diabetes, semuanya tercakup dalam tinjauan ini. Metodologi penelitian ini adalah tinjauan literatur naratif (TLR), menggunakan data tahun 1992 - 2023 sebagai informasi dasar tentang subjek yang dibahas. Penelitian *in vitro* dan *in vivo* telah menunjukkan bahwa bahan herbal mengandung berbagai bahan kimia bioaktif, dan ekstrak air dari bahan herbal penyusun jamu pahitan dan jamu pahitan memiliki efek farmakologis sebagai agen antidiabetes.

Kata kunci: anti diabetes, jamu pahitan, komposisi formula, obat traditional, senyawa bioaktif

Introduction

Jamu is an Indonesian traditional drink passed down from generation to generation based on ancestral recipes. It has many health benefits and has recently been recognized by UNESCO as an intangible cultural heritage of Indonesia (Masduki, 2024). This drink is a concoction made from several combination ingredients from various parts of herbal plants such as rhizomes, leaves, stems, roots, barks, or their combinations, which are in the yard of the house, better known as "*TOGA*" (*tanaman obat keluarga*) or family medicinal plants and can be made independently at home, so it is also known as "*obat rumahan"* or a home remedy (Army, 2018). In Indonesia, the oldest documentation of herb plants as raw materials for making *jamu* can be found in several relief panels at the Borobudur Temple (Aprilistyawati, 2014; Metusala et al., 2020).

Jamu has been made and consumed throughout Indonesia's Hindu and Buddhist Kingdoms for hundreds of years. Reliefs from several Indonesian temples, such as those at Tegalwangi, Prambanan, Sukuh, and Borobudur, which depict scenes from the making or consuming *jamu*, provide considerable validity to this tradition (Aprilistyawati, 2014; Isnawati & Sumarno, 2021; Sukini, 2018). Additionally, artifacts like *cobek* and *ulekan*, which were supposed to have been utilized as mashing instruments for making *jamu*, were discovered and identified at the Liyangan archaeological site on the slopes of Mount Sindoro in Central Java, offered additional archeological convincing evidence of *Jamu*'s past existence (Lindayani, 2021). Historically, the term *jamu* first appeared in the 13th century A.D. during the *Mataram* Kingdom Era, which incidentally comes from the two ancient Javanese words, namely *"Djampi*" which means healing, and "*Oesodo"* which means health (Siregar, 2020), and combining words have the meaning of healing using medicinal herbs or "*do'a-do'a*" (Nurbaidah, 2022).

In East Java, the tradition of concocting *jamu* has been carried out since the mid-14th century A.D. when the *Majapahit* Kingdom was in power, which is indicated by the discovery of relief in the *Rimbi* temple depicting an "*acaraki*" (herbal medicine compounder) figure grinding plant-based herbs using simple tools, such as "*lumpang"* (mortar) and "*alu*" (pestle) made of stone (Isnawati & Sumarno, 2021; Waqiah, 2021). In the past, *jamu* was generally only formulated by "*wiku*" or shamans, who had high spiritual power for certain circles (palace circles). Nevertheless, nowadays, *jamu* can be made and produced by everyone with specific recipes and processing methods, both by home-based people, MSMEs, and large industries (Sukini, 2018). One of the most famous *jamu* in the community is *jamu gendong*, which refers to how to sell it by carrying it and is usually done by women in Java (Riswan & Sangat-Roemantyo, 2002). One of *jamu* sold in *jamu gendong* is *jamu pahitan* (Wulandari & Azrianingsih, 2014).

Jamu pahitan is one of the variants of *jamu gendong*, which is widely sold among the public and is generally made from *sambiloto* (*Andrographis paniculata*) leaf and *brotowali* (*Tinospora*

cordifolia) stem as the main herbal ingredients (Husain et al., 2021). However, some make *jamu pahitan* from one type of herbal ingredient only, such as *sambiloto* leaf (Trisusilo et al., 2020) or *brotowali* steam (Purlianto, 2015). Sometimes the composition formula of *jamu pahitan* is commonly substituted with optional other herbal ingredients, such as *babakan pule, daun meniran, daun papaya, kumis kucing*, *serai*, or *empon-empon* to reduce bitterness level, and their additions depend on the *jamu* makers (Aprilistyawati, 2014; Hartanti, Chatsumpun, Kitphati, et al., 2023; Husain et al., 2019). In society, *jamu pahitan* is believed to have been passed down from generation to generation in local culture as an anti-allergic, blood purifier agent and is also used to treat and cure skin diseases, such as itching (Wulandari & Azrianingsih, 2014). Furthermore, recent scientific studies show that *jamu pahitan* has antidiabetic bioactivity effects on health based on *in-vitro* tests (Hartanti, Chatsumpun, Kitphati, et al., 2023). Based on the above facts and the author's knowledge, literature studies that discuss and review *jamu pahitan* comprehensively, related to the formula composition, processing, society beliefs and perception, and scientific evidence as an antidiabetic agent, are still limited. Hence, this study aims to comprehensively review the formula composition, processing, society's beliefs and perception, and scientific evidence of *jamu pahitan* as an antidiabetic agent.

Materials and Methods

This study used Narrative Literature Review (NLR) approach as research methodology as suggested by (Khabibulloh et al., 2024). The literature reviewed in this study is retrieved from locally published and online journals, national books, and international journals. It is retrieved from open-access resources like Google Scholar (https://scholar.google.com/) and Crossref (https://www.crossref.org/), and also from national printed book media sources related to the topics discussed, which are *jamu pahitan* including formula composition, processing, traditional society belief and perception, and also its scientific evidence as the antidiabetic potential. The review also briefly explained the bioactive compounds, traditional uses, and the potential water extract of herbal ingredients composed of *jamu pahitan* as antidiabetic agent. The keywords used for this research include "*jamu pahitan*", "*Andrographis paniculata* leaf", "*Tinospora cordifolia* stem", "*Curcuma aeruginosa* Roxb. Rhizome", "*Alpinia galanga* rhizome", "*Orthosiphon aristatus"*, "*Cymbopogon citratus*", "*Curcuma longa* rhizome", "*Carica papaya* leaf", "*Alstonia scholaris* stem bark", "*Zingiber zerumbet* (L) Roscoe rhizome", "*Phyllanthus urinaria* leaf", "*Curcuma xanthorriza* rhizome", "water extract", "bioactive compounds", "traditional society belief and perception", "bioactivity", "anti diabetic", and "antidiabetic activity of *jamu pahitan*". This review study used previous studies from 1992 to 2023 as the literature data, as suggested by earlier research (Paré & Kitsiou, 2017).

Results and Disscussion

Formula Composition of Jamu Pahitan and Its Processing

Historically, *jamu pahitan* is one of eight *jamu* served in the *Majapahit* Kingdom, which was drunk by the king and the royal family, apart from seven *jamu*, such as *kunyit asam*, *beras kencur*, *cabe puyang*, *kunci suruh*, *kudu laos*, *uyup-uyup*, and *sinom*, which has fitness, and youthful

functions. Furthermore, *jamu pahitan* symbolizes the next phase of life, which, even though it is bitter, must still be swallowed or endured (Sukini, 2018). The name *jamu pahitan* refers to the taste of the drink, which is bitter (Aprilistyawati, 2014) and has a dark colour, as shown in Figure 1. The bitter taste in *jamu pahitan* comes from the rearrangement formula composition of this drink, which consists of bitter-tasting herbal ingredients, such as *sambiloto*, *brotowali*, *babakan pule*, *daun meniran*, *daun papaya*, *kumis kucing*, *serai* or *empon-empon* (Aprilistyawati, 2014; Hartanti, Chatsumpun, Kitphati, et al., 2023; Husain et al., 2019). *Jamu pahitan* has a variation formula composition and percentage ratio of herbal ingredients (Hartanti, Chatsumpun, Kitphati, et al., 2023; Husain et al., 2019) during the manufacturing process between *jamu* makers and manufacturing locations detailed in Table 1.

Figure 1. *Jamu pahitan*. Adapted from (Sukini, 2018)

Based on Table 1, each formula's herbal ingredients composition for making *jamu pahitan* was different. The main herbal ingredients for making all formulas of *jamu pahitan* were the *sambiloto* (*Andrographis paniculata*) leaf and the *Brotowali* (*Tinospora cordifolia*) stem. Moreover, other herbal ingredients are added to *jamu pahitan* to give a unique taste or flavor to this *jamu.* The herbal ingredients composed of *jamu pahitan* are shown in Figure 2, and bioactive compounds and traditional uses of herbal ingredients composed of *jamu pahitan* are detailed in Table 2.

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Table 1. Detailed formula composition of *jamu pahitan* from several authors

Herbal ingredients	Formula 1[1)]	Formula 2[2)]	Formula 3[3)]	Formula 4[4)]	Formula 5[5)]	Formula 6[6)]
Sambiloto (*Andrographis paniculata*) leaf	√	√	x	√	√	√
Brotowali (*Tinospora cordifolia*) stem	√	x	√	√	√	√
Kumis kucing (Orthosiphon aristatus)	√	x	x	√	x	x
Pepaya (Carica papaya) leaf	√	x	x	√	x	x
Temu hitam (Curcuma aeruginosa Roxb.) Rhizome	√	x	x	√	x	x
Meniran (*Phyllanthus urinaria)* leaf	x	x	x	√	x	x
Serai (Cymbopogon citratus)	x	x	x	√	x	x
Lempuyang (Zingiber zerumbet (L.) Roscoe Rhizome	x	x	x	√	x	√
Pule (*Alstonia Scholaris*) stem bark	x	x	x	√	x	x
Temulawak (Curcuma xanthorriza) Rhizome	x	x	x	√	x	x
Lengkuas (Alpinia galanga) Rhizome	x	x	x	√	x	x
Kunyit (Curcuma longa) Rhizome	x	x	x	x	x	√

Noted : (√) remarks on the main herbal ingredients used for making jamu pahitan, and (x) remarks on herbal ingredients not added to make *jamu pahitan* in specific formulas. [1)](Hartanti, Chatsumpun, Kitphati, et al., 2023), [2)](Trisusilo et al., 2020), [3)](Purlianto, 2015), [4)](Aprilistyawati, 2014), [5)](Wulandari & Azrianingsih, 2014), [6)](Husain et al., 2019)

Figure 2. The herbal ingredients for making *jamu pahitan.*

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Table 2. The bioactive compounds and traditional uses of herbal ingredients composed of *jamu pahitan*

Herbal ingredients	Compoundsor Groups of Bioactive	References	Traditional Uses	References
Sambiloto (*Andrographis paniculata*) leaf	Phenolic	(Rizkita et al., 2023)	Dysentery, insect bite, snake bite, malaria, fever	(M. S. Hossain et al., 2014)
Brotowali (*Tinospora cordifolia*) stem	Alkaloids, berberine, columbine, palmitin, glycosides, picroretin, harsa	(Fatikhurokhmah & Agustini, 2022)	Hypertension, stem sap applied to the mother's skin when weaning the baby	(Ismail et al., 2018)
			Diabetes, malaria, stimulates bile secretion, diuretics, diarrhea, dermatology, detoxification	(Fatikhurokhmah & Agustini, 2022)
Kumis kucing (Orthosiphon aristatus)	Alkaloids, steroids, triterpenoids, flavonoids, tannins, quinones, coumarins	(Septiana et al., 2021)	Diabetes medications	(Septiana et al., 2021)
			Hypertension, gout, diabetes	(Ismail et al., 2018)
Pepaya (Carica papaya) leaf	Alkaloids (carpaines)	(Nur, 2002)	Deworming	(Oktofani & Suwandi, 2019)
	Tannins	(Mukholifah, 2014)	The chikungunya	(Patil et al., 2022)
	Flavonoids	(Prasetya et al., 2018)	Dengue fever	(Patil et al., 2022)
			Improve the quality of breast milk, dengue fever, hypertension, and diabetes.	(Ismail et al., 2018)
Temu Hitam (Curcuma aeruginosa Roxb.) Rhizome	Saponins, flavonoids, polyphenols, triterpenoids, glucans,	(Kitamura et al., 2007), (Sweetymol & Thomas, 2014)	Excavated decoction, rheumatism, cough, asthma	(Reanmongkol et al., 2006)
			Skin disease	(Djauharia & Sufiani, 2007)
			Cough and asthma	(Nasrullah et al., 2010)
	Curcuminoids, essential oils	(Bermawie, n.d.)	Dengue fever	(Bermawie, n.d.; Moektiwardoyo et al., 2014)
Meniran (*Phyllanthus urinaria)* leaf	Alkaloids, flavonoids, lignans, phenols, tannins, terpenes	(Calixto et al., 1998), (Nahar et al., 2011)	Jaundice, diabetes, hypertension	(Lans, 2006)

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Herbal ingredients	Compoundsor Groups of Bioactive	References	Traditional Uses	References
Serai (Cymbopogon citratus)	Flavonoids, essential oils, phenolics	(Oladeji et al., 2019)	Rheumatism, diabetes, gastrointestinal infections, relieve anxiety and depression, malaria, pneumonia	(Chinsembu, 2015; Costa et al., 2016; Manvitha & Bidya, 2022)
Lempuyang (Zingiber zerumbet (L.) Roscoe Rhizome	Flavonoids (kaempferol, quercetin, curcumin), essential oils (cyclic sesquiterpene zerumbone, humulene camphene)	(Yob et al., 2011)	Headache, swelling, runny nose, ulcers, wounds, loss of appetite, nausea, menstrual discomfort	(Rout & Acharya, 2011; Yob et al., 2011)
Pule (*Alstonia Scholaris*) stem bark	Flavonoids, phenolics, saponins, triterpenoids, steroids, alkaloids, coumarins	(Itam et al., 2018)	Arthritis, impotence, wounds, wounds, impotence, earache, asthma, vaginal discharge, dog bite, fever, cancer, tumor, jaundice, hepatitis, malaria, diarrhea, skin diseases	(Dey, 2011)
	Alkaloids, flavonoids, phenolics, steroids, saponins, and tannins	(Dey, 2011)		
Temulawak (Curcuma xanthorriza) Rhizome	Curcuminoids, limonines, flavonoids	(Syamsudin et al., 2019)	Diuretic	(Ismail et al., 2018)
			Indigestion, jaundice, vaginal discharge	(Syamsudin et al., 2019)
Lengkuas (Alpinia galanga) Rhizome	Phenolics, flavonoids	(Eram et al., 2019)	Dyspepsia, wound care	(Ismail et al., 2018)
Kunyit (Curcuma longa) Rhizome	Curcuminoids, essential oils	(S. Li, 2011)	Anti-aging, dyspepsia, postpartum care, flu, detoxification, facial and skin care, deep wound healing, and pain relief.	(Ismail et al., 2018)

The composition formula ratio or the number of each herbal ingredient of *jamu pahitan* depends on the herbal medicine maker, and no reference regulates the dosage of each herbal ingredient. Furthermore, making jamu pahitan is very simple and easy to conduct. Several formulas for the ratio or amount of each herbal ingredient used in making jamu pahitan are shown in Table 3. As shown in Table 3, *jamu pahitan* with formulas A and B was created by precisely weighing each herbal ingredient and decocting it in water for an hour at a ratio of 1:20 (w/v). Following filtration, the filtrate was dried by evaporating it over a water bath to obtain viscous *jamu pahitan* (Hartanti, Chatsumpun, Kitphati, et al., 2023). However, the amount of water used in formulas C, D, and E adjusts to the taste of the *jamu pahitan* maker, and there is no exact dosage. For formulations C, D, and E, the making of jamu pahitan followed as instructions: in short, the *sambiloto* leaf or *brotowali* steam and optional other herbal ingredients (for formula E only) were prepared and mixed using water in a specific ratio and homogenized using a blender, followed by boiling at 100 °C until a blackish color form, and have a bitter fragrant smell (± 1 hour), and then filtering. After cooling, the filtered *jamu pahitan* is packed in bottles (Aprilistyawati, 2014; Purlianto, 2015; Trisusilo et al., 2020). In formula C, the water used for making *jamu pahitan* is 1 liter (Trisusilo et al., 2020).

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Table 3. Formulas ratio or the number of each herbal ingredient for making *jamu pahitan* from several recipes

Herbal ingredients	Formula A[1)]	Formula B[1)]	Formula C[2)]	Formula D[3)]	Formula E[4)]
Sambiloto (*Andrographis paniculata*) leaf	3	1	100	Not added	300 g
Brotowali (*Tinospora cordifolia*) stem	3	1	Not added	100	50 g
Kumis Kucing (Orthosiphon aristatus)	3	1	Not added	Not added	Not added
Pepaya (Carica papaya) leaf	2	1	Not added	Not added	Not added
Temu hitam (Curcuma aeruginosa Roxb.) Rhizome	2	1	Not added	Not added	3 rhizome segments
Meniran (*Phyllanthus urinaria) leaf*	Not added	Not added	Not added	Not added	200 g
Serai (Cymbopogon citratus)	Not added	Not added	Not added	Not added	300 g
Lempuyang (Zingiber zerumbet (L.) Roscoe) Rhizome	Not added	Not added	Not added	Not added	200 g
Pule (*Alstonia Scholaris*) stem bark	Not added	Not added	Not added	Not added	100 g
Temulawak (Curcuma xanthorriza) Rhizome	Not added	Not added	Not added	Not added	400 g
Lengkuas (Alpinia galanga) Rhizome	Not added	Not added	Not added	Not added	200 g

Noted: [1)](Hartanti, Chatsumpun, Kitphati, et al., 2023), [2)](Trisusilo et al., 2020), [3)](Purlianto, 2015), [4)](Aprilistyawati, 2014). Formula 1-4 in a ratio of each herbal ingredient used for making *jamu pahitan* and formula 5 in the number of each herbal ingredient used for making *jamu pahitan*

Jamu Pahitan in Society Beliefs and Perception

As exemplified by *jamu pahitan*, traditional herbal medicine holds significant cultural importance in Indonesia, particularly among older people, for its perceived ability to enhance vitality, boost immunity, and contribute to longevity. Rooted in generations of tradition, the Javanese community values *jamu* as a complement to mainstream healthcare, driven by perceived safety, affordability, and positive effects. This cultural connection extends to demographic variations, influencing perceptions and preferences among different consumer groups (Andriati & Wahjudi, 2016; Prabawani, 2017; Putra & Triratnawati, 2021).

Despite varying regional formulations, *jamu pahitan* offers diverse health benefits, including improved digestion, strengthened immune system, inflammation reduction, and relaxation promotion. Despite evolving perceptions, especially among the younger generation, *jamu pahitan* remains a sought-after natural healthcare choice, prompting efforts to revitalize its image and preserve its cultural significance (Hartanti, Chatsumpun, Kitphati, et al., 2023; Roosinda, 2021; Valenti, 2023). In the martial art discipline of *Pencak Silat*, *jamu pahitan* derived from papaya leaves, has emerged as a remedy for ailments, emphasizing its enduring role in traditional practices (Suparno, 2023). Moreover, Wulandari and Azrianingsih's interviews (Wulandari & Azrianingsih, 2014) in Karangrejo Village, Kromengan District, Malang Regency, indicated that people who live there believe *jamu pahitan* is a valuable herb for treating itching, purifying the blood, and preventing allergies.

Scientific Evidence of Jamu Pahitan

Jamu pahitan consists of many herbal ingredients in its formulation composition, commonly known as polyherbal. Naturally, making *jamu pahitan* was a decoction of herbal ingredients formulation using water as a solvent at a specific temperature. Scientifically, *Jamu pahitan* has a bitter taste caused by alkaloid compounds in its formulated herbal ingredients (Sumarni et al., 2019). The herbal ingredients composing *jamu pahitan* have diverse and different amounts of alkaloid content, as listed in Table 4.

Table 4. The alkaloid content of herbal ingredients composed of *jamu pahitan*

Herbal ingredients	Extract type	Alkaloid Content	Reference
Sambiloto (*Andrographis paniculata*) leaf	Ethanolic extract	9.84 %	(Therasa et al., 2020)
		60.54 - 120.13 mg/g	(Paul et al., 2021)
		6.266±0.376 mg/100g	(Idorenyin et al., 2020)
	Water extract	46.46±1.26%	(Natania & Haniel, 2021)
	Methanolic extract	11.29%	(Abirami et al., 2023)
	Chloroform extract	85.48%	
	Acetone extract	20.96%	
	Petroleum Ether extract	70.80%	
Brotowali (*Tinospora cordifolia*) stem	Water extract	0.31%	(R. Sharma et al., 2013)
	Whole stem	0.49 ± 0.04 - 4.25 ± 0.03%	(Pradhan et al., 2013)
Pepaya (Carica papaya) leaf	Ethanolic extract	84.72%	(Devi et al., 2020)
		1.57 ± 0.3 mg/g	(Sobia et al., 2016)
	Methanolic extract	1.21± 0.3 mg/g	
	n-hexane extract	0.53± 0.1 mg/g	
	Chloroform extract	0 0.64± 0.3 mg/g	
Temu hitam (Curcuma aeruginosa Roxb.) Rhizome	Methanolic extract	3.28 ± 0.15 mg/g	(Zohmachhuana et al., 2022)
	Ethyl acetate extract	1.12 ± 0.27 mg/g	
Meniran (*Phyllanthus urinaria)* leaf	Water extract	0.86±0.03%	(Awomukwu et al., 2014)
Serai (Cymbopogon citratus)	Water extract	~25%	(R. Abdullah et al., 2023)
	Water extract	44.29 mg/g	(Omagha et al., 2020)
Pule (*Alstonia Scholaris*) stem bark	Water extract	7.26 ± 0.06 % w/w	(Dhruti et al., 2016)
	Methanolic extract	9.07 ± 0.08 % w/w	
Temulawak (Curcuma xanthorriza) Rhizome	Ethanolic Extract	14.06 mg/g	(Halim et al., 2012)
Lengkuas (Alpinia galanga) Rhizome	Alkaloid fractions	1340 mg/kg	(Nampoothiri et al., 2017)
Kunyit (Curcuma domestica) Rhizome	Water extract	0.310±0.020%	(Mohammed et al., 2019)
	Methanolic extract	7.972±0.124%	
	n-Hexane extract	0.226±0.261%	
	Methanolic extract	0.397-0.702%	(Jadhav et al., 2023)
	Water extract	4382.20 mg/g	(Omagha et al., 2020)
Kumis Kucing (Orthosiphon aristatus)	No information available		
Lempuyang (Zingiber zerumbet (L.) Roscoe) Rhizome	No information available		

According to the study (Hartanti, Chatsumpun, Kitphati, et al., 2023), *jamu pahitan* has antidiabetic bioactivity effects on health based on in-vitro tests. The antidiabetic activity of *jamu pahitan* was already impacted by the bioactive compounds in the herbal ingredients, such as alkaloids, phenolics, tannins, terpenoids, etc. The potential antidiabetic activity of water extract from herbal ingredients formulated for *jamu pahitan* and *jamu pahitan* are summarized in Table 5.

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Table 5. The antidiabetic activity of water extract of herbal ingredients formulated of *jamu pahitan* and *jamu pahitan*

Water extract of herbal ingredients or *jamu*	Compounds or groups bioactive	Reference	Results of Previous Study	Reference
Sambiloto leaf	Alkaloids, flavonoids, glycosides, tannins, phenolic, steroids, saponins, anthraquinone, and terpenoids	(Das & Srivastav, 2014; Hartini et al., 2021; Malahubban et al., 2013)	The aqueous extract of *sambiloto* leaf, with an IC_{50} of 14.203 mg/mL, exhibits a lower inhibitory activity against the α-amylase enzyme in an in vitro study compared to the ethanolic extract (IC_{50} of 9.253 mg/mL)	(Hartini et al., 2021)
			A water extract of *Andrographis paniculata* demonstrates effective anti-diabetic properties, restoring the disturbed metabolic profile of obese diabetic rats to normal conditions.	(Akhtar et al., 2016)
			The ethanolic and water extracts of *Andrographis paniculata* leaf, ranging from concentrations of 100 to 400 µg/mL, display significant α-amylase inhibitory activity in vitro, though comparatively less potent than acarbose	(Kokila & Mathavi, 2019)
Brotowali stem	Alkaloids	(Hamid et al., 2015)	The water extract of *Tinospora cordifolia* stem exhibited protective effects on pancreatic β-cells and enhanced glucose uptake in adipocytes, indicating potential control over glucose metabolism in diabetic rats	(B. R. Sharma et al., 2019)
			The water extract of *Tinospora cordifolia* stem demonstrated a gradual increase in glucose uptake activity at dosages ranging from 1 to 100 µg in ETA (Ehrlich ascites tumor) cells, serving as a diabetic model system.	(Joladarashi et al., 2014)
Pepaya leaf	catechin, quercetin, cinnamic acid	(Husin et al., 2019)	The aqueous extract of *Carica papaya* exhibited differential effects on insulin levels. Following treatment, plasma insulin levels in diabetic rats did not significantly impact, while a substantial increase was observed in non-diabetic animals.	(Juárez-Rojop et al., 2012)
	Flavonoids, polyphenols	(H. Li et al., 2023; A. Sharma et al., 2022)	Administered of the aqueous extract of *C. papaya* leaf at doses of 400 mg/kg body weight for 21 days led to a noteworthy reduction in blood glucose levels and serum lipid profile, including total cholesterol, triglyceride, and serum urea, in diabetic albino rats	(Pandey et al., 2016)
			Feeding an aqueous extract of *C. papaya* leaf at doses of 120 mg/kg body weight for eighteen days effectively lowered glucose levels, total cholesterol, total glycerides, and LDL in albino rats induced by alloxan.	(Ukpabi et al., 2019)

Water extract of herbal ingredients or *jamu*	Compounds or groups bioactive	Reference	Results of Previous Study	Reference
Temu hitam rhizome	terpenoids, sterols, organic acids, fatty acids and sugars	(Simoh & Zainal, 2015)	The potential of *temu hitam* as an antidiabetic agent was rarely explored. Although, compared with the other species of *Curcumin* species, like *Curcuma longa* and *Curcuma xanthorriza*, which contain curcuminoid compounds in their rhizome, *Curcuma aeruginosa* also had the potential as an antidiabetic agent in the future.	(Simoh & Zainal, 2015)
Meniran leaf	alkaloids, tannins, glycosides, phenolics, and flavonoids	(Disoriya et al., 2022)	The oral administration of aqueous leaf and seed extract of *Phyllanthus amarus* (PAE) in doses of 150-600 mg/kg/day in normal and 10% sucrose-induced insulin resistance rats, could effectively manage diabetes mellitus insulin resistance, which was mediated by an improvement in insulin resistance	(Adeneye, 2012)
	rutin, quercetin, corilagin, and isoquercetin	(Puspitarini et al., 2022)	The water extracts of *Phyllanthus amarus* and *Phyllanthus urinaria* inhibited α-glucosidase with IC_{50} of 1.70 ± 0.03 and 6.10 ± 0.10 µM, respectively	(Trinh et al., 2016)
	corilagin, repandusinic acid A, and mallotinin	(Trinh et al., 2016)	The leaf extract of *Phyllanthus urinaria* exhibited good α-glucosidase inhibitory activity, although it was relatively lower than the fruit, root, and stem extracts	(Han et al., 2023)
Serai	flavonoids	(Garba et al., 2020)	The flavonoids present in *Cymbopogon citratus* effectively blocked the activity of the enzyme α-glucosidase, responsible for breaking down carbohydrates and potentially causing elevated blood sugar levels	(Borges et al., 2021)
			Oral intervention with Lemongrass tea (LGT) showed antidiabetic effects in rats with Type 2 Diabetes (T2D), including a decrease in body weight, reduced food and fluid consumption, improved insulin sensitivity, glucose tolerance, β-cell functioning, and amelioration of dyslipidemia.	(Garba et al., 2020)
			The oral administration of fresh leaf aqueous extract of *Cymbopogon citratus* at doses ranging from 125 to 500 mg/kg in normal Wistar rats for 42 days demonstrated minimal toxicity, suggesting its general safety and validating its traditional application in individuals with suspected Type 2 diabetes.	(Adeneye & Agbaje, 2007)
Pule stem bark	steroids, alkaloids, flavonoids, saponins, reducing sugars, phenolic compounds	(Sookying et al., 2023)	Orally administered the aqueous extract of A. scholaris bark at doses of 150 mg/kg and 300 mg/kg for four weeks significantly improved fasting blood glucose levels in diabetic rats.	(Bandawane et al., 2011)
	β-sitosterol, lupeol acetate, and α-amyrin acetate	(Adotey et al., 2012)	The oral administration of the ethanolic extract of A. scholaris bark at doses of 200 and 400 mg/kg for one month not only led to improvements in blood glucose levels and serum lipid profiles but also facilitated	(Shahin et al., 2022)

Water extract of herbal ingredients or *jamu*	Compounds or groups bioactive	Reference	Results of Previous Study	Reference
			pancreatic β-cell regeneration in streptozotocin-induced diabetic rats, bringing these parameters closer to normal levels	
Temulawak Rhizome	flavonoids, tannin, saponin, terpenoids, sterols, phenolics,	(Anjusha & Gangaprasad, 2014)	the administration of optimal doses (10 mL/kg BW/day) of *temulawak* water extract synergic with *Morinda citrifolia* Linn., to streptozotocin-induced diabetic rats during *in vivo* demonstrated pancreatic protection by reducing lipid peroxidase activity and protecting against insulin resistance.	(Santoso et al., 2018)
	curcumin	(Santoso et al., 2018)	Oral administration of the optimal doses of 10 mL/kg BW/day of temulawak water extract was found to lower glucose levels in streptozotocin-induced diabetic rats during an *in vivo* investigation.	(Rahmayani et al., 2016)
	xanthorrhizol, demethoxycurcumin, and bisdemethoxycurcumin	(Rahmayani et al., 2016)		
Kunyit Rhizome	curcuminoids, alkaloids, flavonoids, triterpenoids/steroids	(Andrie et al., 2014)	The giving streptozotocin-induced diabetic rats optimal doses of 9.5 mL/kg BW of *kunyit* water extract resulted in lower blood glucose levels by synergizing with antioxidant activity in repairing pancreatic cells and triggering insulin production during *in vivo* study	(Andrie et al., 2014)
Lengkuas Rhizome	tannins, coumarins, sterols, glycosides	(Iyer et al., 2013)	The administration of *A. galanga* aqueous extract at a dose of 4 g/kg to normal rabbits led to a significant decrease in blood glucose levels 2 to 8 hours after oral administration, followed by a subsequent elevation at 12 and 24 hours.	(Zafar et al., 2023)
	flavonoids	(Tungmunnithum et al., 2020)	Administered 200 and 400 mg/kg b.w. of methanolic extract of A. galanga in diabetic rats, resulting in reduced fasting blood glucose levels and various improved biochemical parameters compared to the control group of diabetic rats. The positive effects observed in the diabetic rats treated with the extracts were attributed to their potential stimulation of regenerating and surviving cells.	(Verma et al., 2015)
Kumis Kucing	terpenoids, polyphenols, sterols	(Abd Aziz et al., 2021; Rizkita et al., 2023)	The antidiabetic potential of *Orthosiphon aristatus* water extract has been explored, revealing its anti-inflammatory, antioxidant, and blood glucose-lowering properties	(F. I. Abdullah et al., 2020; Alshehade et al., 2023)
	rosmarinic acid and various caffeic acid derivatives	(Chua et al., 2018)	sub-fraction of the p *Orthosiphon stamineus* extract demonstrated the ability to both increase and decrease glucose uptake by liver cells.	(Mohamed et al., 2013)

Water extract of herbal ingredients or *jamu*	Compounds or groups bioactive	Reference	Results of Previous Study	Reference
Lempuyang Rhizome	shogaol, gingerol, and other gingerones	(Koga et al., 2016)	administered an aqueous extract of *Z. zerumbet* in 200 mg/kg doses in streptozotocin-induced diabetic rats, it did not significantly demonstrate any antidiabetic effect in contrast with glibenclamide, a standard antidiabetic drug.	(Lal et al., 2010)
Jamu pahitan	Polyphenols	(Hartanti, Chatsumpun, Sa-Ngiamsuntorn, et al., 2023)	*Jamu pahitan* is potent as an antidiabetic agent via *in vivo* study through mechanisms that improve the insulin secretion in pancreatic β-cells, which is necessary for sustaining normal blood glucose levels, and increases glucose uptake in muscle cells, which helps to lower blood glucose levels.	(Hartanti, Chatsumpun, Kitphati, et al., 2023)
			The decoction form of formulation of *jamu pahitan* was a practical and secure method to manage diabetes, which was probably achieved by stimulating skeletal muscle's glucose uptake and having a protective antioxidant effect	(Hartanti, Chatsumpun, Sa-Ngiamsuntorn, et al., 2023)

Conclusion

A traditional beverage from Indonesia, *jamu*, is passed down through the generations using family recipes, which are manufactured from a mixture of several different parts of herbal plants, the dependence of type *jamu* produced and has numerous health advantages. One of the popular variations of *jamu* is *jamu pahitan*, which is typically made with one type or both of the main herbal ingredients of sambiloto (*Andrographis paniculata*) and brotowali (*Tinospora cordifolia*), with or withour added additional herbal ingredients to lessen the bitter taste. Traditionally, *jamu pahitan* is a popular blood purifier, anti-allergic, and used to treat and cure skin conditions in many Indonesian local communities. The scientific evidence highlighted that the herbal ingredients and the water extract of herbal ingredients composed of *jamu pahitan* contain various bioactive substances. Apart from that, the water extracts of each herbal ingredient composed of *jamu pahitan* also show pharmacological activity as antidiabetic activity either *in vivo* or *in vitro*. The current research found that *jamu pahitan* has an anti-diabetic bioactivity based on *in vitro* tests.

References

Abd Aziz, N. A., Hasham, R., Sarmidi, M. R., Suhaimi, S. H., & Idris, M. K. H. (2021). A review on extraction techniques and therapeutic value of polar bioactives from Asian medicinal herbs: Case study on Orthosiphon aristatus, Eurycoma longifolia and Andrographis paniculata. *Saudi Pharmaceutical Journal*, *29*(2), 143–165. https://doi.org/10.1016/j.jsps.2020.12.016

Abdullah, F. I., Chua, L. S., Mohd Bohari, S. P., & Sari, E. (2020). Rationale of Orthosiphon aristatus for Healing Diabetic Foot Ulcer. *Natural Product Communications*, *15*(9). https://doi.org/10.1177/1934578X20953308

Abdullah, R., Zaheer, S., Kaleem, A., Iqtedar, M., Aftab, M., & Saleem, F. (2023). Formulation of herbal tea using Cymbopogon citratus, Foeniculum vulgare and Murraya koenigii and its anti-obesity potential. *Journal of King Saud University - Science*, *35*(6), 102734. https://doi.org/10.1016/j.jksus.2023.102734

Abirami, M., Rubika, K., Devi, V. K., Poongothai, P., Muthumani, V., Abirami, M., & Nadu, T. (2023). Screening and characterization of bioactive phytocompounds from andrographis paniculata. *International Journal of Research and Analytical Reviews*, *10*(2), 657–683.

Adeneye, A. A. (2012). The leaf and seed aqueous extract of Phyllanthus amarus improves insulin resistance diabetes in experimental animal studies. *Journal of Ethnopharmacology*, *144*(3), 705–711. https://doi.org/10.1016/j.jep.2012.10.017

Adeneye, A. A., & Agbaje, E. O. (2007). Hypoglycemic and hypolipidemic effects of fresh leaf aqueous extract of Cymbopogon citratus Stapf. in rats. *Journal of Ethnopharmacology*, *112*(3), 440–444. https://doi.org/10.1016/j.jep.2007.03.034

Adotey, J. P. K., Adukpo, G. E., Opoku Boahen, Y., & Armah, F. A. (2012). A Review of the Ethnobotany and Pharmacological Importance of Alstonia boonei De Wild (Apocynaceae) . *ISRN Pharmacology*, *2012*(Figure 1), 1–9. https://doi.org/10.5402/2012/587160

Akhtar, M. T., Sarib, M. S. B. M., Ismail, I. S., Abas, F., Ismail, A., Lajis, N. H., & Shaari, K. (2016). Anti-diabetic activity and metabolic changes induced by Andrographis paniculata plant extract in obese diabetic rats. *Molecules*, *21*, 1026. https://doi.org/10.3390/molecules21081026

Alshehade, S. A., Al Zarzour, R. H., Mathai, M., Giribabu, N., Seyedan, A., Kaur, G., Al-Suede, F. S. R., Majid, A. M. S. A., Murugaiyah, V., Almoustafa, H., & Alshawsh, M. A. (2023). Orthosiphon aristatus (Blume) Miq Alleviates Non-Alcoholic Fatty Liver Disease via

Antioxidant Activities in C57BL/6 Obese Mice and Palmitic–Oleic Acid-Induced Steatosis in HepG2 Cells. *Pharmaceuticals*, *16*(1), 1–25. https://doi.org/10.3390/ph16010109

Andriati, & Wahjudi, R. M. T. (2016). Society's Acceptance Level of Herb as Alternative to Modern Medicine for Lower, Middle, and Upper Class Group. *Masyarakat, Kebudayaan Dan Politik*, *29*(3), 133–145.

Andrie, M., Wintari, T., & Rizqa, A. (2014). Uji aktivitas jamu gendong kunyit asam (Curcuma domestica val.; Tamarindus indica l.) sebagai antidiabetes pada tikus yang diinduksi streptozotocin. *Traditional Medicine Journal*, *19*(2), 95–102.

Anjusha, S., & Gangaprasad, A. (2014). Phytochemical and Antibacterial Analysis of Two Important Curcuma species, Curcuma aromatica Salisb. and Curcuma xanthorrhiza Roxb.(Zingiberaceae). *Journal of Pharmacognosy and Phytochemistry*, *3*(3), 50–53. http://www.phytojournal.com/vol3Issue3/Issue_sep_2014/27.1.pdf

Aprilistyawati, A. (2014). *Ramuan dan khasiat jamu tradisional*. Balqist Yogyakarta.

Army, R. (2018). *Jamu, ramuan tradisional kaya manfaat* (M. T. Qodratillah (ed.)). Badan Pengembangan dan Pembinaan Bahasa, Kementerian Pendidikan dan Kebudayaan.

Awomukwu, D. A., Nyananyo, B. L., Onukwube, N. D., Uka, C. J., Okeke, C. U., & Ikpeama, A. I. (2014). Comparative Phytochemical Constituents and Pharmacognistic Importance of the Vegetative Organs of Some Phyllanthus Species in South Eastern Nigeria. *International Journal of Modern Botany*, *4*(2), 29–39. https://doi.org/10.5923/j.ijmb.20140402.01

Bandawane, D., Juvekar, A., & Juvekar, M. (2011). Antidiabetic and antihyperlipidemic effect of Alstonia scholaris linn bark in streptozotocin induced diabetic rats. *Indian Journal of Pharmaceutical Education and Research*, *45*(2), 114–120.

Bermawie, N. (n.d.). *Mengatasi demam berdarah dengan tanaman obat*.

Borges, P. H. O., Pedreiro, S., Baptista, S. J., Geraldes, C. F. G. C., Batista, M. T., Silva, M. M. C., & Figueirinha, A. (2021). Inhibition of α-glucosidase by flavonoids of Cymbopogon citratus (DC) Stapf. *Journal of Ethnopharmacology*, *280*(May), 1–9. https://doi.org/10.1016/j.jep.2021.114470

Calixto, J. B., Santos, A. R. S., Filho, V. C., & Yunes, R. A. (1998). A review of the plants of the genus Phyllanthus: their chemistry, pharmacology, and therapeutic potential. *Medicinal Research Reviews*, *18*(4), 225–258.

Chinsembu, K. C. (2015). Plants as antimalarial agents in Sub-Saharan Africa. *Acta Tropica*, *152*, 32–48.

Chua, L. S., Lau, C. H., Chew, C. Y., Ismail, N. I. M., & Soontorngun, N. (2018). Phytochemical profile of Orthosiphon aristatus extracts after storage: Rosmarinic acid and other caffeic acid derivatives. *Phytomedicine*, *39*(December 2017), 49–55. https://doi.org/10.1016/j.phymed.2017.12.015

Costa, G., Grangeia, H., Figueirinha, A., Figueiredo, I. V., & Batista, M. T. (2016). Influence of harvest date and material quality on polyphenolic content and antioxidant activity of Cymbopogon citratus infusion. *Industrial Crops and Products*, *83*, 738–745.

Das, P., & Srivastav, A. K. (2014). Phytochemical Extraction and Characterization of the Leaves of Andrographis Paniculata for Its Anti-Bacterial, Anti-Oxidant, Anti-Pyretic and Anti-Diabetic Activity. *International Journal of Innovative Research in Science, Engineering and Technology*, *03*(08), 15176–15184. https://doi.org/10.15680/ijirset.2014.0308016

Devi, S., Ropiqa, M., Murti, Y. B., & Nugroho, A. K. (2020). Screening of Extraction Process and The Estimation of Total Alkaloids in Carica papaya Linn. Leaf. *Majalah Obat Tradisional*, *25*(2), 90–95. https://doi.org/10.22146/mot.52184

Dey, A. (2011). Alstonia scholaris R.Br. (Apocynaceae): Phytochemistry and pharmacology: A concise review. *Journal of Applied Pharmaceutical Science*, *1*(6), 51–57.

Dhruti, M., Bhavika, P., & Meonis, P. (2016). Studies on phytochemical constituents and antioxidant

activity of Alstonia scholaris. *Int. J. of Life Sciences*, *4*(4), 529–538. www.ijlsci.in

Disoriya, B., Jadon, A. S., & Bhadauriya, P. (2022). In vitro screening of Phyllanthus urinaria for antimicrobial activity using dosk diffusion method. *World. J. Pharmaceut Sci.*, *11*(10), 1631–1642. https://doi.org/10.20959/wjpps202210-23395

Djauharia, E., & Sufiani, S. (2007). Observasi keragaan tanaman temu hitam (Curcuma aeruginosa Roxb.) pada berbagai jarak tanam. *Warta Tumbuhan Obat Indonesia*, *7*(1), 21–23.

Eram, S., Mujahid, M., Bagga, P., Ansari, V. A., Ahmad, M. A., Kumar, A., Ahsan, F., & Akhter, M. S. (2019). a Review on Phytopharmacological Activity of Alpinia Galanga. *International Journal of Pharmacy and Pharmaceutical Sciences*, *11*(3), 6–11. https://doi.org/10.22159/ijpps.2019v11i3.31352

Fatikhurokhmah, H. M., & Agustini, R. (2022). Concentration Effect of Brotowali Stem (Tinospora Crispa (L.)) in Ethanol Extracts on the A-Glukosidase Enzyme Inhibition. *Indonesian Journal of Chemical Science*, *11*(3).

Garba, H. A., Mohammed, A., Ibrahim, M. A., & Shuaibu, M. N. (2020). Effect of lemongrass (Cymbopogon citratus Stapf) tea in a type 2 diabetes rat model. *Clinical Phytoscience*, *6*(1). https://doi.org/10.1186/s40816-020-00167-y

Halim, M. R., Zabri Tan, M. M., Ismail, S., & Mahmud, R. (2012). Standardization and Phytochemical Studies Of Curcuma Xanthorrhiza Roxb. International Journal of Pharmacy and Pharmaceutical Sciences. *International Journal of Pharmacy and Pharmaceutical Sciences*, *4*(3), 606–610.

Hamid, H. A., Yusoff, M. M., Liu, M., & Karim, M. R. (2015). α-Glucosidase and α-amylase inhibitory constituents of Tinospora crispa: Isolation and chemical profile confirmation by ultra-high performance liquid chromatography-quadrupole time-of-flight/mass spectrometry. *Journal of Functional Foods*, *16*, 74–80. https://doi.org/10.1016/j.jff.2015.04.011

Han, N., Ye, Q., Guo, Z., & Liang, X. (2023). Metabolomics analysis of differential chemical constituents and α-glucosidase inhibiting activity of Phyllanthus urinaria L. root, stem, leaf and fruit. *Natural Product Research*, *37*(4), 642–645.

Hartanti, D., Chatsumpun, N., Kitphati, W., Peungvicha, P., & Supharattanasitthi, W. (2023). The standardized Jamu pahitan, an Indonesian antidiabetic formulation, stimulating the glucose uptake and insulin secretion in the in-vitro models. *Heliyon*, *9*(3), e14018. https://doi.org/10.1016/j.heliyon.2023.e14018

Hartanti, D., Chatsumpun, N., Sa-Ngiamsuntorn, K., Supharattanasitthi, W., Kitphati, W., & Peungvicha, P. (2023). The pharmacognostic standards, antioxidant and antidiabetic activities, and hepatic safety profile of an Indonesian antidiabetic polyherbal formulation. *Indonesian Journal of Pharmacy*, *34*(1), 65–78. https://doi.org/10.22146/ijp.3243

Hartini, Y. S., Setyaningsih, D., Chang, M. J. V., & Nugrahanti, M. C. I. A. (2021). Sambiloto (Andrographis paniculata Nees.) leaf extract activity as an α-Amylase enzyme inhibitor. *Pharmacy Education*, *21*(2), 305–308. https://doi.org/10.46542/pe.2021.212.305308

Hermansyah, Dahrizal, Wijaya, A. S., & Heriyanto, H. (2020). *Buku Saku Tanaman Obat Keluarga* (A. S. Wijaya (ed.)). Poltekkes Kemenkes Bengkulu.

Hossain, M. A., Hitam, S., & Ahmed, S. H. I. (2020). Pharmacological and toxicological activities of the extracts of papaya leaves used traditionally for the treatment of diarrhea. *Journal of King Saud University - Science*, *32*, 962–969. https://doi.org/10.1016/j.jksus.2019.07.006

Hossain, M. S., Urbi, Z., Sule, A., & Rahman, K. M. H. (2014). A Review of Ethnobotany, Phytochemistry, and Pharmacology. *The Scientific World Journal*, *2014*, 1–28.

Husain, F., Fajar, Sary, D., & Yuniati, E. (2019). The Study of Jamu Plants Ethnobotany in Homegarden and its Implications to Medicinal Plant Conservation in Semarang. *ICESI 2019*. https://doi.org/10.4108/eai.18-7-2019.2290185

Husain, F., Yuniati, E., Arsi, A. A., Wicaksono, H., & Wahidah, B. F. (2021). Ethnobotanical

knowledge on jamu herbal drink among consumer in Semarang. *IOP Conference Series: Earth and Environmental Science*, *743*(1). https://doi.org/10.1088/1755-1315/743/1/012019

Husin, F., Ya'akob, H., Rashid, S. N. A., Shahar, S., & Soib, H. H. (2019). Cytotoxicity study and antioxidant activity of crude extracts and SPE fractions from Carica papaya leaves. *Biocatalysis and Agricultural Biotechnology*, *19*, 101130. https://doi.org/10.1016/j.bcab.2019.101130

Idorenyin, E. I., Ekpenyong, E. U., Ime, J. I., & Alphonsus, I. A. (2020). Antimicrobial properties of Andrographis paniculata (vinegar) leaf on selected human pathogens. *World Journal of Biology Pharmacy and Health Sciences*, *03*(01), 60–65. https://doi.org/10.30574/wjbphs

Ismail, N. A., Sabran, S. F., Mohamed, M., Fadzelly, M., & Bakar, A. (2018). *Ethnomedicinal Knowledge of Plants Used for Healthcare*.

Isnawati, D. L., & Sumarno. (2021). Minuman jamu tradisional sebagai kearifan lokal masyarakat di Kerajaan Majapahit pada abad Abad Ke-14 Masehi. *AVATARA, e-Journal Pendidikan Sejarah*, *11*(2), 305–305. https://doi.org/10.1007/978-3-540-71095-0_5698

Itam, A., Wulandari, A., Rahman, M. M., & Ferdinal, N. (2018). Preliminary phytochemical screening, total phenolic content, antioxidant and cytotoxic activities of Alstonia scholaris R. Br leaves and stem bark extracts. *Journal of Pharmaceutical Sciences and Research*, *10*(3), 518–522.

Iyer, D., Sharma, B. K., & Patil, U. K. (2013). Isolation of bioactive phytoconstituent from Alpinia galanga L. with anti-hyperlipidemic activity. *Journal of Dietary Supplements*, *10*(4), 309–317. https://doi.org/10.3109/19390211.2013.830674

Jadhav, K., Kadam, J., Shirke, G., & Dhumal, R. (2023). Potential harvest of secondary metabolites from turmeric (Curcuma longa L). *The Pharma Innovation Journal*, *12*(5), 2705–2712.

Joladarashi, D., Chilkunda, N. D., & Salimath, P. V. (2014). Glucose uptake-stimulatory activity of Tinospora cordifolia stem extracts in Ehrlich ascites tumor cell model system. *Journal of Food Science and Technology*, *51*(1), 178–182. https://doi.org/10.1007/s13197-011-0480-3

Juárez-Rojop, I. E., Díaz-Zagoya, J. C., Ble-Castillo, J. L., Miranda-Osorio, P. H., Castell-Rodríguez, A. E., Tovilla-Zárate, C. A., Rodríguez-Hernández, A., Aguilar-Mariscal, H., Ramón-Frías, T., & Bermúdez-Ocaña, D. Y. (2012). Hypoglycemic effect of Carica papaya leaves in streptozotocin-induced diabetic rats. *BMC Complementary and Alternative Medicine*, *12*. https://doi.org/10.1186/1472-6882-12-236

Khabibulloh, M. J. M., Suhartatik, N., & Mustofa, A. (2024). Masa Depan dan Pengembangan Bioetanol di Indonesia. *AGRITEKNO: Jurnal Teknologi Pertanian*, *13*, 210–223. https://doi.org/10.30598/jagritekno.2024.13.1.210

Kitamura, C., Nagoe, T., Prana, M. S., Agusta, A., Ohashi, K., & Shibuya, H. (2007). Comparison of Curcuma sp. in Yakushima with C. aeruginosa and C. zedoaria in Java by trnK gene sequence, RAPD pattern and essential oil component. *Journal of Natural Medicines*, *61*(3), 239–243. https://doi.org/10.1007/s11418-006-0131-6

Koga, A. Y., Beltrame, F. L., & Pereira, A. V. (2016). Several aspects of Zingiber zerumbet: A review. *Revista Brasileira de Farmacognosia*, *26*(3), 385–391. https://doi.org/10.1016/j.bjp.2016.01.006

Kokila, G., & Mathavi, P. (2019). Phytochemcial screening and in vitro anti-diabetic activity of Andrographis paniculata leaves extract. *World Journal of Science and Research*, *4*(4), 1–6.

Lal, V. K., Pandey, A., Tripathi, P., & Pandey, R. D. (2010). Insignificant antidiabetic activity of rhizome of Zingiber zerumbet. *Journal of Pharmaceutical Negative Results*, *1*(2), 58–60. https://doi.org/10.4103/0976-9234.75707

Lans, C. A. (2006). Ethnomedicines used in Trinidad and Tobago for urinary problems and diabetes mellitus. *Journal of Ethnobiology and Ethnomedicine*, *2*, 1–11. https://doi.org/10.1186/1746-4269-2-45

Li, H., Beg, O. U., Rafie, A. R., Kanwal, S., Ovalle-Cisneros, A., Faison, M. O., & Siddiqui, R. A.

(2023). Characterization of Green and Yellow Papaya (Carica papaya) for Anti-Diabetic Activity in Liver and Myoblast Cells and Wound-Healing Activity in Fibroblast Cells. *Nutrients*, *15*, 1929. https://doi.org/10.3390/nu15081929

Li, S. (2011). Chemical Composition and Product Quality Control of Turmeric (Curcuma longa L.). *Pharmaceutical Crops*, *5*(1), 28–54. https://doi.org/10.2174/2210290601102010028

Lindayani. (2021). Minuman Herbal (Jamu) dari Zaman Old ke Kafe Modern. In E. M. Dukut (Ed.), *Herbal untuk Kalangan Muda* (pp. 2–19). Universitas Katolik Soegijapranata.

Malahubban, M., Alimon, A. R., Sazili, A. Q., Fakurazi, S., & Zakry, F. A. (2013). Phytochemical analysis of Andrographis paniculata and Orthosiphon stamineus leaf extracts for their antibacterial and antioxidant potential. *Tropical Biomedicine*, *30*(3), 467–480.

Manvitha, K., & Bidya, B. (2022). Review on Pharmacological Activity of Cymbopogon Citratus. *International Journal For Multidisciplinary Research*, *4*(6), 5–7. https://doi.org/10.36948/ijfmr.2022.v04i06.1015

Masduki, A. (2024, January 2). *Jamu Diakui UNESCO Sebagai Warisan Budaya, Ini Tanggapan Guru Besar Farmasi UNAIR*. https://surabaya.inews.id/read/389575/jamu-diakui-unesco-sebagai-warisan-budaya-ini-tanggapan-guru-besar-farmasi-unair

Metusala, D., Fauziah, Lestari, D. A., Damaiyani, J., Mas'udah, S., & Setyawan, H. (2020). The identification of plant reliefs in the lalitavistara story of Borobudur temple, central Java, Indonesia. *Biodiversitas*, *21*(5), 2206–2215. https://doi.org/10.13057/biodiv/d210549

Moektiwardoyo, W. M., Tjitraresmi, A., Susilawati, Y., Iskandar, Y., Halimah, E., & Zahryanti, D. (2014). The Potential of Dewa Leaves (Gynura Pseudochina (L) D.C) and Temu Ireng Rhizomes (Curcuma aeruginosa Roxb.) as Medicinal Herbs for Dengue Fever Treatment. *Procedia Chemistry*, *13*(L), 134–141. https://doi.org/10.1016/j.proche.2014.12.017

Mohamed, E. A. H., Yam, M. F., Ang, L. F., Mohamed, A. J., & Asmawi, M. Z. (2013). Antidiabetic Properties and Mechanism of Action of Orthosiphon stamineus Benth Bioactive Sub-fraction in Streptozotocin-induced Diabetic Rats. *JAMS Journal of Acupuncture and Meridian Studies*, *6*(1), 31–40. https://doi.org/10.1016/j.jams.2013.01.005

Mohammed, A., Usman, M. I., Wudil, A. M., Alhassan, A. J., Abubakar, S. M., & Lat, N. A. (2019). Phytochemical Screening and Proximate Analysis of Root of Curcuma Longa Linn. *European Journal of Pharmaceutical and Medical Research*, *6*(9), 138–141.

Mukholifah. (2014). *Identifiasi Senyawa Tanin dan Penentuan Eluen Terbaik dari Eksrak Etanol 70% Daun Pepaya (Carica papaya) dengan Metode Kromatografi Lapis Tipis Mukholifah*.

Nahar, L., Sarker, S. D., & Delazar, A. (2011). Phytochemistry of the genus Phyllanthus. *Phyllanthus Species: Scientific Evaluation and Medicinal Applications*, 119–138.

Nampoothiri, S. V, Esakkidurai, T., & Pitchumani, K. (2017). Isolation and HPLC Quantification of Berberine Alkaloid from Alpinia galanga and Alpinia calcarata. *International Journal of Pharma Sciences and Research*, *8*(6), 97–104.

Nasrullah, I., Murhandini, S., & Rahayu, W. P. (2010). Phytochemical Study from Curcuma aeruginosa Roxb. Rhizome for Standardizing Traditional Medicine Extract. *Journal of International Environmental Application & Science*, *5*(5), 748–750.

Natania, K., & Haniel, K. (2021). Bitterness reduction of Green Chiretta (Andrographis paniculata) leaves and its functionality. *IOP Conference Series: Materials Science and Engineering*, *1011*(1). https://doi.org/10.1088/1757-899X/1011/1/012036

Nur, F. (2002). *Hambatan Siklus Estrus Mencit (Mus musculus) Setelah Pemberian Perasan Biji Pepaya (Carica papaya)*. FMIPA Undip.

Nurbaidah, S. (2022). Traditional javanese herbal medicine naming system. *Prosiding Seminar Nasional Linguistik Dan Sastra (SEMANTIKS)*, *4*, 460–468. https://jurnal.uns.ac.id/prosidingsemantiks

Nurchayati, N., As'ari, H., & Qirom, I. (2021). *Tanaman Obat Keluarga Warisan Leluhur:*

Melestarikan Sumber Daya Alam dan Kearifan Lokal (A. Syaddad (ed.)). CV. Kaaffah Learning Center.

Oktofani, L. A., & Suwandi, J. F. (2019). Potensi Tanaman Pepaya (Carica papaya) sebagai Antihelmintik Majority. *Medical Journal of Lampung University*, *8*(1), 246.

Oladeji, O. S., Adelowo, F. E., Ayodele, D. T., & Odelade, K. A. (2019). Phytochemistry and pharmacological activities of Cymbopogon citratus: A review. *Scientific African*, *6*, e00137. https://doi.org/10.1016/j.sciaf.2019.e00137

Omagha, R., Idowu, E. T., Alimba, C. G., Otubanjo, A. O., E.O, A., H.C.N, A., & Department. (2020). Physicochemical and phytochemical screening of six plants commonly used in the treatment of malaria in nigeria. *Journal of Phytomedicine and Therapeutics*, *19*(2), 484.

Pandey, S., Cabot, P. J., Shaw, P. N., & Hewavitharana, A. K. (2016). Anti-inflammatory and immunomodulatory properties of Carica papaya. *Journal of Immunotoxicology*, *13*(4), 590–602. https://doi.org/10.3109/1547691X.2016.1149528

Patil, P., Alagarasu, K., Chowdhury, D., Kakade, M., Cherian, S., Kaushik, S., Yadav, J. P., & Parashar, D. (2022). In-vitro antiviral activity of Carica papaya formulations against dengue virus type 2 and chikungunya viruses. *Heliyon*, *8*(12), e11879. https://doi.org/10.1016/j.heliyon.2022.e11879

Paul, A., Vibhuti, A., & Raj, V. S. (2021). Evaluation of antiviral activity of Andrographis paniculata and Tinospora cordifolia using in silico and in vitro assay against DENV-2. *Journal of Pharmacognosy and Phytochemistry*, *10*(2), 486–496. https://doi.org/10.22271/phyto.2021.v10.i2f.13847

Prabawani, B. (2017). Jamu brand Indonesia: consumer preferences and segmentation. *Archives of Business Research*, *5*(3), 80–94. https://doi.org/10.14738/abr.53.2841

Pradhan, D., Ojha, V., & Pandey, A. K. (2013). Phytochemical Analysis of Tinospora Cordifolia (Willd.) Miers Ex Hook. F. & Thoms Stem of Varied Thickness. *International Journal of Pharmaceutical Sciences and Research*, *4*(8), 3051. https://doi.org/10.13040/IJPSR.0975-8232.4(8).3051-56

Prasetya, A. T., Mursiti, S., Maryan, S., & Jati, N. K. (2018). Isolation and Identification of Active Compounds from Papaya Plants and Activities as Antimicrobial. *IOP Conference Series: Materials Science and Engineering*, *349*(1). https://doi.org/10.1088/1757-899X/349/1/012007

Purlianto, N. A. I. (2015). *Uji angka lempeng total dan identfikasi Escherichia coli pada jamu pahitan brotowali yang diproduksi oleh Penjual Jamu gendong keliling di Wilayah Tonggalan Klaten Tengah*. Universitas Sanata Dharma Yogyakarta.

Puspitarini, S., Widodo, N., Widyarti, S., Jatmiko, Y. D., & Rifa'i, M. (2022). Polyherbal effect between Phyllanthus urinaria and Curcuma longa as an Anticancer and Antioxidant. *Research Journal of Pharmacy and Technology*, *15*(2), 671–678.

Putra, I. G. B. A., & Triratnawati, A. (2021). The Edge as The Choice (A Case Study of Jamu Sellers in Three Traditional Markets, Yogyakarta City). *Indonesian Journal of Medical Anthropology*, *2*(1), 36–42. https://doi.org/10.32734/ijma.v2i1.5154

Rahmayani, I., Ambarsari, L., & Safithri, M. (2016). Antihyperglicemic Activity of Curcuma xanthorrizha Roxb. Nanocurcuminoid Emulsion on Streptozotocin Induced Sprague-Dawley Rat. *Current Biochemistry*, *3*(2), 66–79. http://biokimia.ipb.ac.id

Reanmongkol, W., Subhadhirasakul, S., Khaisombat, N., Fuengnawakit, P., Jantasila, S., & Khamjun, A. (2006). Investigation the antinociceptive, antipyretic and anti-inflammatory activities of Curcuma aeruginosa Roxb. extracts in experimental animals. *Songklanakarin Journal of Science and Technology*, *28*(5), 999–1008.

Riswan, S., & Sangat-Roemantyo, H. (2002). Jamu as Traditional Medicine in Java, Indonesia. *South Pacific Study*, *23*(1), 1–10.

Rizkita, N., Machmudah, S., Wahyudiono, Winardi, S., Adschiri, T., & Goto, M. (2023).

Phytochemical compounds extraction from Orthosiphon aristatus, Andrographis paniculata, Gynura segetum using hydrothermal method: experimental kinetics and modeling. *South African Journal of Chemical Engineering*, *46*(August), 330–342. https://doi.org/10.1016/j.sajce.2023.08.010

Roosinda, F. W. (2021). Corporate Communication through the Campaign of Consuming Jamu. *Jurnal The Messenger*, *13*(1), 33–44. https://doi.org/10.26623/themessenger.v13i1.2245

Rout, O. P., & Acharya, R. (2011). *Zingiber zerumbet (L .) Sm ., a reservoir plant for therapeutic uses A Review E-mail : editorijpwr@gmail.com Title : Zingiber zerumbet (L .) Sm ., a reservoir plant for therapeutic uses : A Review*. *June 2011*.

Santoso, B. S. A., Sudarsono, Nugroho, A. E., & Murti, Y. B. (2018). Hypoglycemic activity and pancreas protection of combination of Morinda citrifolia Linn. juice and Curcuma xanthorrhiza Roxb. juice on streptozotocin-induced diabetic rats. *Indonesian Journal of Pharmacy*, *29*(1), 16–22. https://doi.org/10.14499/indonesianjpharm29iss1pp16

Septiana, E., Rizka, N. M., Yadi, Y., & Simanjuntak, P. (2021). Antidiabetic Activity of Extract Combination of Orthosiphon aristatus and Oryza sativa L. var glutinosa. *Borneo Journal of Pharmacy*, *4*(3), 202–209. https://doi.org/10.33084/bjop.v4i3.2154

Shahin, H., Shenoy, A., Sultana, R., Farooq, J., Chakrabort, M., Alamri, A., Alhomrani, M., Alsanie, W. F., Asdaq, S. M. B., & Jomah, S. (2022). Anti-Diabetic Potential of Alstonia scholaris Bark Extract Against Streptozotocin-Induced Diabetes Mellitus. *International Journal of Pharmacology*, *18*(7), 1449–1455. https://doi.org/10.3923/ijp.2022.1449.1455

Sharma, A., Sharma, R., Sharma, M., Kumar, M., Barbhai, M. D., Lorenzo, J. M., Sharma, S., Samota, M. K., Atanassova, M., Caruso, G., Naushad, M., Radha, Chandran, D., Prakash, P., Hasan, M., Rais, N., Dey, A., Mahato, D. K., Dhumal, S., … Mekhemar, M. (2022). Carica papaya L. Leaves: Deciphering Its Antioxidant Bioactives, Biological Activities, Innovative Products, and Safety Aspects. *Oxidative Medicine and Cellular Longevity*, *2022*(June). https://doi.org/10.1155/2022/2451733

Sharma, B. R., Park, C. M., Kim, H. A., Kim, H. J., & Rhyu, D. Y. (2019). Tinospora cordifolia preserves pancreatic beta cells and enhances glucose uptake in adipocytes to regulate glucose metabolism in diabetic rats. *Phytotherapy Research*, *33*(10), 2765–2774. https://doi.org/10.1002/ptr.6462

Sharma, R., Amin, H., Shukla, V. J., Kartar, D., Galib, R., & Prajapati, P. K. (2013). Quality control evaluation of Guduchi Satva (solid aqueous extract of Tinospora cordifolia (Willd.) Miers): An herbal formulation. *International Journal of Green Pharmacy*, *7*(3), 258–263. https://doi.org/10.4103/0973-8258.120248

Simoh, S., & Zainal, A. (2015). Chemical profiling of Curcuma aeruginosa Roxb. rhizome using different techniques of solvent extraction. *Asian Pacific Journal of Tropical Biomedicine*, *5*(5), 412–417. https://doi.org/10.1016/S2221-1691(15)30378-6

Siregar, A. H. (2020). JAMU : Traditional Indonesian medicine. *17th Annual Congress on Wellness and Healthcare Informatics*, *May 18-19*.

Sobia, K., Javaid, M. A., Ahmad, M. S., Rehmatullah, Q., Hina, G., Iram, B., Pervaiz, A., Farhana, B., Nyla, J., & Gulfraz, M. (2016). Assessments of phytochemicals and hypoglycemic activity of leaves extracts of carica papaya in diabetic mice. *International Journal of Pharmaceutical Sciences and Research*, *7*(9), 1000–1008. https://doi.org/10.13040/IJPSR.0975-8232.7(9).1000-08

Sookying, S., Panase, A., Srisuttha, P., Chaophothun, A., & Panase, P. (2023). Devil's tree flower (Alstonia scholaris) extract: positive effects on growth performance and serum biochemical indices in Channa striata (Bloch, 1793). *Journal of Applied Animal Research*, *51*(1), 677–683. https://doi.org/10.1080/09712119.2023.2273279

Sukini. (2018). *Jamu gendong, solusi sehat tanpa obat* (D. A. Erinita (ed.)). Badan Pengembangan

dan Pembinaan Bahasa, Kementerian Pendidikan dan Kebudayaan.

Sukweenadhi, J., Yunita, O., Setiawan, F., Kartini, Siagian, M. T., Danduru, A. P., & Avanti, C. (2020). Antioxidant activity screening of seven Indonesian herbal extract. *Biodiversitas*, *21*(5), 2062–2067.

Sumarni, W., Sudarmin, S., & Sumarti, S. S. (2019). The scientification of jamu: A study of Indonesian's traditional medicine. *Journal of Physics: Conference Series*, *1321*, 032057. https://doi.org/10.1088/1742-6596/1321/3/032057

Suparno. (2023). *Pencak Silat dan Minum Jamu, Salah Satu Upaya Warga PSHT Tangkal Penyakit*. https://www.dero.desa.id/artikel/2023/1/21/pencak-silat-dan-minum-jamu-salah-satu-upaya-warga-psht-tangkal-penyakit

Supraja, N., Prasad, T. N. V. K. V., Gandhi, A. D., Anbumani, D., Kavitha, P., & Babujanarthanam, R. (2018). Synthesis, characterization and evaluation of antimicrobial efficacy and brine shrimp lethality assay of Alstonia scholaris stem bark extract mediated ZnONPs. *Biochemistry and Biophysics Reports*, *14*, 69–77. https://doi.org/10.1016/j.bbrep.2018.04.004

Sweetymol, J., & Thomas, T. D. (2014). Compharative phytochemical and antibacterial studies of two indigenous medicinal plant. *Int. J. Green Pharm*, *8*, 65–71.

Syamsudin, R. A. M. R., Perdana, F., & Mutiaz, F. S. (2019). Tanaman Temulawak (Curcuma xanthorrhiza Roxb) Sebagai Obat Tradisional. *Jurnal Ilmiah Farmako Bahari*, *10*(1), 51. https://doi.org/10.52434/jfb.v10i1.648

Therasa, S. A., Sobiya, G., & Parimala, S. M. (2020). Leaves of Andrographis Paniculata Is an Antioxidant and Anticancer Agent. *Asian Journal of Pharmaceutical and Clinical Research*, *13*(8), 213–217. https://doi.org/10.22159/ajpcr.2020.v13i8.37014

Trinh, B. T. D., Staerk, D., & Jäger, A. K. (2016). Screening for potential α-glucosidase and α-amylase inhibitory constituents from selected Vietnamese plants used to treat type 2 diabetes. *Journal of Ethnopharmacology*, *186*, 189–195. https://doi.org/10.1016/j.jep.2016.03.060

Trisusilo, A., Asriani, P. S., & Andani, A. (2020). Profile of traditional jamu business in Bengkulu City. *Journal of Agri Socio-Economics and Business*, *1*(2), 45–58. https://doi.org/10.31186/jaseb.1.2.45-58

Tungmunnithum, D., Tanaka, N., Uehara, A., & Iwashina, T. (2020). Flavonoids profile, taxonomic data, history of cosmetic uses, anti-oxidant and anti-aging potential of alpinia galanga (L.) willd. *Cosmetics*, *7*(4), 89. https://doi.org/10.3390/cosmetics7040089

Ukpabi, C. F., Chukwu, M. ., Onyemaechi, J. N., Ibe, P., & Onuh, E. F. (2019). Antidiabetic and Antihyperlipidemic Effects of Aqueous Extract of Carica papaya Leaf on the Experimental Model against Single Alloxan Toxicity. *World Scientific Research*, *6*(1), 14–18. https://doi.org/10.20448/journal.510.2019.61.14.18

Valenti, L. (2023, March 8). *How Generations of Indonesian Women Are Preserving an Ancient Juicing Tradition*. https://www.vogue.com/article/how-generations-of-indonesian-women-are-preserving-an-ancient-juicing-tradition

Verma, R., Mishra, G., Singh, P., Jha, K., & Khosa, R. (2015). Anti-diabetic activity of methanolic extract of Alpinia galanga Linn. aerial parts in streptozotocin induced diabetic rats. *AYU (An International Quarterly Journal of Research in Ayurveda)*, *36*(1), 91. https://doi.org/10.4103/0974-8520.169006

Wahyuni, S., Bermawie, N., & Kristina, N. N. (2013). Karakteristik morfologi, potensi produksi dan komponen utama rimpang sembilan nomor lempuyang wangi. *Industrial Crops Research Journal*, *19*(3), 99–107.

Waqiah, N. (2021). Sosialisasi pemanfaatan jamu tradisional dan edukasi pencegahan COVID-19 dalam rangka tanggap pandemi COVID-19. *Seminar Nasional Patriot Mengabdi I Tahun 2021*.

Wulandari, R. A., & Azrianingsih, R. (2014). Etnobotani jamu gendong berdasarkan persepsi produsen jamu gendong di Desa Karangrejo, Kecamatan Kromengan, Kabupaten Malang.

Jurnal Biotropika, *2*(4), 2014. https://doi.org/10.3956/2009-30.1

Yob, N. J., Jofrry, S. M., Affandi, M. M. R. M. M., Teh, L. K., Salleh, M. Z., & Zakaria, Z. A. (2011). Zingiber zerumbet (L.) Smith: A review of its ethnomedicinal, chemical, and pharmacological uses. *Evidence-Based Complementary and Alternative Medicine*, *2011*, 543216. https://doi.org/10.1155/2011/543216

Zafar, S. H., Umair, M., & Akhtar, M. (2023). Nutritional evaluation, proximate and chemical composition of mungbean varieties/cultivars pertaining to food quality characterization. *Food Chemistry Advances*, *2*(April 2022), 100160. https://doi.org/10.1016/j.focha.2022.100160

Zohmachhuana, A., Malsawmdawngliana, Lalnunmawia, F., Mathipi, V., Lalrinzuali, K., & Kumar, N. S. (2022). Curcuma aeruginosa Roxb. exhibits cytotoxicity in A-549 and HeLa cells by inducing apoptosis through caspase-dependent pathways. *Biomedicine and Pharmacotherapy*, *150*(March), 113039. https://doi.org/10.1016/j.biopha.2022.113039