



An Ethnomedicinal Study; Joint Pain Therapy by Traditional Healers of Solo City

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Abstract

Healers of Jamu- a Traditional Medicine in Solo City, Central Java, Indonesia apply several therapies for treatment of different diseases, including joint pain. The aim of the ethnomedicinal study is the identification of herbal formulations/ medicinal plants/ method of preparation and their mode of administration for joint pain therapy in Jamu Medicine. An ethnomedicinal survey was conducted to collect data from traditional healers of Jamu Medicine regarding the practice of joint pain therapy. Data was collected from 25 healers through interview by snowball technique. The data obtained from the study revealed that, 25 herbal formulations / potions consisting of 32 types of medicinal plants from 19 families have been registered by traditional healers for joint pain therapy. Most commonly used plants for joint pain therapy have been identified as *Piper retrofractum* Vahl, *Zingiber officinale* Roscoe, *Curcuma xanthorrhiza* D.Dietr., *Kaempferia galanga* L., and *Curcuma longa* L. Traditional herbal formulations are prepared by different processing methods like washing, peeling, crushing, pounding then squeezing with warm water (infusion)/ boiling in water (decoction) to get their extract. These herbal formulations are administered orally or applied locally as massage on the affected joint. Through this study we will preserve the traditional knowledge of Jamu Medicine because the younger generation of traditional healers is no more interested in continuing it and their number is gradually decreasing. This valuable data will help the scientist to make new medicinal breakthroughs in the future especially to treat joint pain.

Keywords: Joint pain therapy; Solo city; Jamu medicine; Traditional healers; Traditional medicine

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Introduction

WHO defines traditional medicine (TM) as the sum total of the knowledge, skills, and practices based on the theories, beliefs, and experiences indigenous to different cultures, whether explicable or not, used in the maintenance of health as well as in the prevention, diagnosis, improvement or treatment of physical and mental illness. Whereas Ethnomedicine is defined as a study or comparison of the traditional medicine based on bioactive compounds in plants and animals and practiced by various ethnic groups, especially those with little access to western medicines, e.g. indigenous peoples. The word ethnomedicine is sometimes used as a synonym for traditional medicine. Integration of TM in national health systems by the developing countries and its propagation to the developed countries is the part of WHO strategies. In developing countries like Indonesia priority option of 80% population in health care is on traditional health systems. Examples of traditional medicines that have been used in various countries are Ayurveda in India, Unani in Arabic, TCM, Chinese Medicine, Kambo, Siddha, and Jamu. In Indonesia, 49% of traditional medicines are used in the form of potions for various reasons, namely maintaining health, and have been passed down from generation to generation. In-depth knowledge of ethnobotanical research is important for the conservation and use of biological resources. Ethnobotany is the scientific study of the relationship between botany and community groups in various parts of the world [1]. Ethnobotany utilizes the intellectual values of traditional communities and provides valuable insight into the cultural understanding of community groups in the real use of plants [2].

The interaction between humans and disease has existed for a long time; thus, encouraging humans to formulate disease concepts and ways of preventing and treating them. Joint pain is a sign of a disorder in the musculoskeletal system. It is often associated with a decrease in joint function which causes movement limitations to disability. Usually, there will be discomfort in the joints, swelling, inflammation, and stiffness that can occur causing movement limitations. Joint pain is caused by age, immune mechanisms, and metabolic, genetic, and environmental factors [3]. The main causes of joint pain are trauma, as well as acute and chronic arthritis.

The traditional medicine system of the Solo Palace is often preserved in ancient manuscripts. Serat Centini was written in 1814 AD, and the Serat Kawruh chapter Jampi Jampi Jawi in 1831 AD contains various medicinal uses of plants. Next by Sunan Pakubuwono IX which was written in the Serat Boreh Saha Parem, and continued by Sunan Pakubuwono X in the Serat Husada Paku, and Primbon Jampi Jawi. This proves that traditional medicine has been known and applied in the palace environment since time immemorial [4]. The purpose of this study was to determine the diversity of compositions and uses of medicinal plants in traditional medicine of Solo City for their

safety and effectiveness in maintaining health. This is the first scientific study that investigated the Jamu Medicine a local traditional medicine for joint pain therapy practiced in the Solo City and inherited from generation to generation. More specifically, this study aims to enlist the botanically identified medicinal plants used by traditional healers to treat bone and joint diseases.

Materials and Methods

Study Area

This study was conducted in Solo City, Central Java province, Indonesia, (Figure 1). This city has an area of 44.03 km² and a population of 577,202 inhabitants. Solo City is located between the coordinates of 7°34'0" south latitude and 110°49'0" east longitude. This City has a tropical climate, the rainy season is usually from October to March, and the dry season is usually from April to September (time may vary). The type of climate affects the diversity of medicinal plants in this region. The average annual temperature in the district ranges from a maximum of 32.5°C to a minimum of 21°C. The average annual rainfall is 2,200 mm.

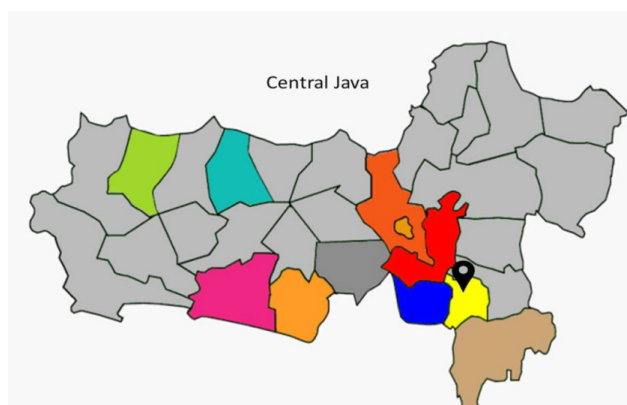


Figure 1. Map of central java showing the study area; solo city (yellow area)

Ethical Permission

An ethical test permit was obtained from the Health Research Ethics Committee of Universitas Airlangga with certificate number of 12/LE/2020 before conducting this research.

Interview Methods

An ethnomedicinal survey was conducted to collect data from 25 healers through interview by snowball technique. This study was conducted in June 2020 at Solo City according to the method of snowball technique described by Jain and Rao. Researchers visited the medical practice room and interviewed the healers. The healers were selected based on their good knowledge and vast experience in traditional medicine. The interview was started with the oldest healer from Solo City, then switches to another healer on the recommendation of the previous

healer. The data was collected on the basis of set questionnaires focused on Traditional herbal formulations (medicine)/ composition/method of preparation and mode of administration in Joint pain therapy in Solo City [33]. The data was collected in the form of photos, recordings, and notes.

Plant Materials

The medicinal plants were collected during interviews from the healers in Solo City and were sent to the Purwodadi Botanical Gardens for their botanical identification. The data of identified medicinal plants was sent to the Indonesian Institute of Sciences (LIPI) of Indonesia for verification of the scientific name and taxonomy.

Data Analysis

The healers gained knowledge of TM through various ways i.e. Analysis of data revealed that 80% of healers obtained the knowledge of TM as hereditary knowledge/ family legacy from parents. See the table 1.

Data analysis in this study was performed qualitatively and quantitatively. Quantitative analysis is conducted by calculating the relative frequency of citation (RFC) and family importance value (FIV). RFC is used to explain the spread of knowledge in the community regarding the use of botanicals to overcome joint pain ailments calculated by the formula.

$$RFC = Fc/N$$

Where Fc is the number of informants mentioning plant species use, and N is the total number of informants participating in the survey. The RFC value is '0' if the information provider does not mention usefulness and 1 if the type is useful [5].

FIV distinguishes between major families based on the number of informants reported and the number of plant species used for treatment. FIV is calculated using the formula:

$$FIV = (Fc/N) \times 100$$

Where FC is the plant family citation frequency, and N is the total number of informants. FIV values indicate the local importance of medicinal plant families ranging from 0 to 100, with the most important families having values close to 100 [6].

Results

Demographic Profile of the Informants/Healers

There were 25 informants/traditional healers consisting of 4 men and 21 women. Most patients who sought treatment from traditional healers in the Solo City were locals (80%) and only 20% were coming from outside the area. The traditional healers administered the herbal formulation/potion directly to these patients. The demographic profile was shown in table 1.

Knowledge of healers

The healers who participated in this study had a wealth of expertise and they were practicing for 10 years (16%), 10–30 years (60%), and more than 30 years (24%). The study revealed that the healers/informants have good expertise in administration of traditional joint pain therapy. The informant got this knowledge by observing others using traditional medicine or perhaps learning how to do it themselves. The knowledge of healers shown in table 2. Traditional healers had various ways to sell or promote their herbal products, including visiting customers (72%), setting up a shop permanently in one location (20%), such as a market or stall offering herbal medicine, and advertising products online (8%).

Traditional herbal formulations (medicine)/ composition/ method of preparation and mode of administration in Joint Pain Therapy

From the analysis of survey data; 25 herbal formulations have been identified which are in use of traditional

Table 1. Demographic profile of healers (N= 25)

Biography	Group of Informant	Percentage of Informant n (%)
Gender	Male	4 (16.00)
	Female	21 (84.00)
Age	< 50 years old	12 (48.00)
	51-60 years old	10 (40.00)
	> 61 years old	3 (12.00)
Education Levels	Illiterate	2 (8.00)
	Elementary School	12 (48.00)
	Junior High School	4 (16.00)
	Senior High School	6 (24.00)
	Diploma/Bachelor Degree	1 (4.00)
Main Profession	Herbal Medicine	25 (100)

Table 2. The knowledge of healers about traditional medicinal plants (N= 25)

Local Concept	Group of Informant	Percentage of Informant n (%)
Knowledge and Experimental of Healer	Hereditary	20 (80.00)
	Learn from Books, etc.	5 (20.00)
Attending of Training	Yes	1 (4.00)
	Never	24 (96.00)

healers in joint pain therapy. The analysis of the data revealed that the main dosage form of the medication is oral (92%), followed by local application as massage (8%) on the affected joint (See table 3).

Based on table 3, we identified 32 different plants species used to prepare traditional herbal formulations/medicines. Relative Frequency of Citation (RFC) describes the distribution of knowledge of traditional healers in using plants to treat joint pain complaints. RFC calculations showed that the type of plants often used by traditional healers in Solo City for joint pain were *Piper retrofractum* (0.72), *Zingiber officinale* (0.56), *Curcuma xanthorrhiza* (0.48), *Kaempferia galanga* (0.44), and *Curcuma longa* (0.36) (table 4).

Botanical identification of medicinal plants used in traditional medicine for joint pain therapy

The analysis of the table 4 revealed that different parts of the medicinal plants, i.e., leaves (14 species), rhizomes (7 species), seeds (5 species), fruit (2 species), stem bark (2 species), flowers, and rind are used by traditional healers. Traditional herbal formulations are prepared by different processing methods like washing, peeling, crushing, pounding then squeezing of medicinal plants with warm water (infusion)/ boiling in water (decoction) to get their extract. Traditional healers believe that mixture of medicinal plants producing an herbal formulation (potion/ medicine) have good medicinal properties.

The analysis of the study data revealed that most of the herbal formulations were administered orally 2-3 times a day for one to several weeks or till the disappearance of the pain/patient feels better. After relief in pain the treatment was continued as preventive measure in backache as a part of healthy life style.

Family Important Value (FIV) analysis

The data obtained from the study revealed that 25 herbal formulations/ potions consisting of 32 types of medicinal plants from 19 families have been registered by traditional healers for joint pain therapy.

Family Important Value (FIV) Analysis revealed that most of the medicinal plants (8 species-25%) belonged to Family Zingiberaceae, followed by Acanthaceae (3 species 9.38%), Piperaceae (2 species-6.25%), Myrtaceae (2 species 6.25%), and Meliaceae (2 species 6.25%)

(Table 5).

Discussions

The basic concept of Javanese people including Solo community is recognition of diseases with personalistic and naturalistic systems. Factors such as changes in weather, food, and body conditions are naturalistic properties which causes imbalance of the body and it results in Osteoarthritis. Different methods of treatment of diseases based on the local knowledge of the community developed in different traditional cultures resulting in emergence of different Traditional Medicines. One method of traditional medicine that is still widely used by people in Solo City of central Java, Indonesia is known as Jamu Medicine. For them, the tradition of drinking herbal formulations/ concoction/ potion is not only for healing/ treatment, but also for the prevention of the disease.

Ethnobotany and ethnopharmacology studies play an important role in the search for new drugs and compounds [7]. Indonesia is a country with a tropical climate and has a diversity of plants that play an important role in the discovery of new herbs [8]. Each plant produces varying amounts of secondary metabolites, depending on its defense system against herbivores and pathogens [9,10]. These compounds work synergistically to increase their potency, reduce side effects, and develop resistance [11]. In Solo City, Central Java, many plant species are used in the treatment of joint pain, one of which is from the Piperaceae family. Plants belonging to this family usually contain flavonoids and essential oils. Flavonoid compounds are one of the most common phenolic compounds found in medicinal plants with well-known activity against allergies, inflammation, tumors, and microbes [12]. *Piper retrofractum* or Javanese pepper is one of the members of the Piperaceae family that is used in Solo City as herbal formulation for treating joint pain. This is due to the presence of major secondary metabolites such as piperine, piperonaline, guineensine, piperocetadecalinine, sitosterol, and bisabollene in this plant [13], in addition to other compounds like alkaloids, saponins, tannins, flavonoids, steroids, triterpenoids, and glycosides [14]. Piperine has an anti-inflammatory effect by decreasing IL-6, MMP-13, activator protein (AP-1), and PGE2, significantly reducing rheumatism in the rat in studies employing animal models of arthritis [15].

Table 3. Traditional Herbal formulations (medicine) /composition/method of preparation and mode of administration in Joint pain in Solo City

Herbal Formulations	Composition	Method of Preparation	Administration
Herbal formula-1	- <i>Zingiber officinale</i> - <i>Curcuma xanthorrhiza</i> - <i>Piper retrofractum</i> - <i>Curcuma zedoaria</i> - <i>Moringa oleifera</i> - <i>Cymbopogon citratus</i> - <i>Garcinia mangostana</i> - <i>Annona muricata</i>	All ingredients were washed, ground, and then squeezed with warm water	Herbal formula was consumed 2-3 times a week orally
Herbal formula-2	- <i>Zingiber officinale</i> - <i>Curcuma longa</i>	All ingredients were washed and crushed before being squeezed with warm water	Herbal formula was consumed 2-3 times a week orally
Herbal formula-3	- <i>Curcuma longa</i> - <i>Curcuma xanthorrhiza</i> - <i>Kaempferia galanga</i> - <i>Zingiber officinale</i>	All ingredients were washed, pounded, crushed, and squeezed. Then the squeezed water was boiled	Herbal formula was consumed 2 times a week orally
Herbal formula-4	- <i>Curcuma longa</i> - <i>Curcuma xanthorrhiza</i> - <i>Kaempferia galanga</i> - <i>Zingiber officinale</i> - <i>Solidago virgaurea</i> - <i>Amomum compactum</i>	All ingredients were peeled, washed, pounded, boiled, and filtered	Consumed orally, daily until the pain was gone and feel better
Herbal formula-5	- <i>Curcuma longa</i> - <i>Curcuma xanthorrhiza</i> - <i>Kaempferia galanga</i> - <i>Zingiber officinale</i> - <i>Annona muricata</i>	All ingredients were washed, pounded, ground, squeezed, and filtered with warm water	Consumed orally, daily until the pain was gone and feel better
Herbal formula-6	- <i>Annona muricata</i> - <i>Garcinia mangostana</i> - <i>Melaleuca leucadendra</i> - <i>Woodfordia floribunda</i> - <i>Cymbopogon citratus</i> - <i>Citrus aurantiifolia</i> - <i>Amomum compactum</i>	All ingredients were washed, boiled, drained, and taken the boiled water	Herbal formula was consumed 2-3 times a week orally
Herbal formula-7	- <i>Cymbopogon citratus</i> - <i>Annona muricata</i> - <i>Garcinia mangostana</i> - <i>Syzygium polyanthum</i> - <i>Curcuma longa</i>	All ingredients were washed, grated, and boiled. Then taken the boiled water	Herbal formula was consumed 2 times a week orally
Herbal formula-8	- <i>Moringa oleifera</i> - <i>Kaempferia galanga</i> - <i>Zingiber officinale</i> - <i>Piper retrofractum</i> - <i>Curcuma xanthorrhiza</i>	All ingredients are washed, pounded, and boiled. Then taken the boiled water	Herbal formula was consumed 3 times a week orally
Herbal formula-9	- <i>Piper retrofractum</i> - <i>Solidago virgaurea</i> - <i>Curcuma xanthorrhiza</i> - <i>Curcuma zedoaria</i> - <i>Annona muricata</i> - <i>Garcinia mangostana</i> - <i>Andrographis paniculata</i>	All ingredients were washed, pounded, and squeezed. Then the squeezed water was boiled	Herbal formula was consumed one time each day orally after waking up
Herbal formula-10	- <i>Piper retrofractum</i> - <i>Moringa Oleifera</i> - <i>Annona muricata</i>	All ingredients were washed, pounded, and boiled. Then taken the boiled water	Herbal formula was consumed 2 times a week orally
Herbal formula-11	- <i>Piper retrofractum</i> - <i>Tithonia diversifolia</i> - <i>Tinospora cordifolia</i> - <i>Phyllanthus urinaria</i> - <i>Swietenia mahagoni</i>	All ingredients were washed, pounded, and boiled. Then taken the boiled water	Herbal formula was consumed 2-3 times a week orally
Herbal formula-12	- <i>Zingiber officinale</i> - <i>Piper retrofractum</i> - <i>Elephantopus scaber</i> - <i>Moringa oleifera</i> - <i>Tectona grandis</i> - <i>Strobilanthes crispa</i> - <i>Andrographis paniculata</i> - <i>Tinospora cordifolia</i>	All ingredients were washed and crushed before being squeezed with warm water	Herbal formula was consumed one time each day orally

Herbal formula-13	- <i>Syzygium polyanthum</i> - <i>Annona muricata</i> - <i>Nigella sativa</i> - <i>Moringa oleifera</i>	All ingredients were washed and boiled. Then taken the boiled water	Consumed orally, daily until the pain was gone and feel better
Herbal formula-14	- <i>Curcuma longa</i> - <i>Kaempferia galanga</i> - <i>Zingiber officinale</i> - <i>Piper retrofractum</i> - <i>Curcuma xanthorrhiza</i>	All ingredients were washed, pounded, squeezed, and boiled. Then taken the boiled water	Herbal formula was consumed 2-3 times a week orally
Herbal formula-15	- <i>Kaempferia galanga</i> - <i>Piper betle</i> - <i>Citrus aurantiifolia</i> - <i>Piper retrofractum</i> - <i>Zingiber officinale</i>	All ingredients were washed, drained, pounded, grinded, and squeezed	Consumed orally, daily until the pain was gone and feel better
Herbal formula-16	- <i>Piper retrofractum</i> - <i>Zingiber officinale</i> - <i>Alpinia galanga</i> - <i>Kaempferia galanga</i> - <i>Solidago virgaurea</i> - <i>Curcuma xanthorrhiza</i> - <i>Parkia timoriana</i> - <i>Annona muricata</i> - <i>Azadirachta indica</i> - <i>Garcinia mangostana</i>	All ingredients were washed, pounded, squeezed, and boiled. Then take the boiled water	Herbal formula was consumed 2-3 times a week orally
Herbal formula-17	- <i>Curcuma zedoaria</i> - <i>Kaempferia galanga</i> - <i>Curcuma xanthorrhiza</i> - <i>Piper retrofractum</i> - <i>Foeniculum vulgare</i> - <i>Cinnamomum verum</i> - <i>Moringa oleifera</i> - <i>Citrus aurantiifolia</i>	All ingredients were washed, drained, pounded, grinded, squeezed, and boiled	Herbal formula was consumed 2-3 times a week orally
Herbal formula-18	- <i>Piper retrofractum</i> - <i>Curcuma xanthorrhiza</i> - <i>Moringa oleifera</i> - <i>Curcuma longa</i> - <i>Curcuma aeruginosa</i> - <i>Andrographis paniculata</i>	All ingredients were washed and crushed before being squeezed with warm water	Herbal formula was consumed 2-3 times a week orally
Herbal formula-19	- <i>Curcuma longa</i> - <i>Kaempferia galanga</i> - <i>Zingiber officinale</i> - <i>Piper retrofractum</i> - <i>Curcuma xanthorrhiza</i>	All ingredients were washed and crushed before being squeezed with warm water	Herbal formula was consumed 2-3 times a week orally
Herbal formula-20	- <i>Zingiber officinale</i> - <i>Piper retrofractum</i> - <i>Tithonia diversifolia</i>	All ingredients were washed, pounded, crushed, and squeezed. Then the squeezed water was boiled	Herbal formula was consumed 2 times a week orally
Herbal formula-21	- <i>Curcuma longa</i> - <i>Piper retrofractum</i> - <i>Alpinia galanga</i> - <i>Andrographis paniculata</i> - <i>Tinospora cordifolia</i>	All ingredients were washed, drained, pounded, and grounded, then squeezed with warm water	Herbal formula was consumed 2 times a week orally
Herbal formula-22	- <i>Piper retrofractum</i> - <i>Cinnamomum verum</i> - <i>Foeniculum vulgare</i> - <i>Zingiber zerumbet</i>	All ingredients were washed and boiled. Then take the boiled water	Consumed orally, daily until the pain was gone and feel better
Herbal formula-23	- <i>Curcuma xanthorrhiza</i> - <i>Piper retrofractum</i> - <i>Zingiber zerumbet</i> - <i>Zingiber officinale</i>	All ingredients were washed, drained, pounded, and grounded, then squeezed with warm water	Herbal formula was consumed one time each day orally
Herbal formula-24	- <i>Kaempferia galanga</i> - <i>Piper retrofractum</i> - <i>Andrographis paniculata</i>	All the ingredients were mixed and pounded, then rubbed on the part that feels in pain	Herbal formula used topically for massage
Herbal formula-25	- <i>Kaempferia galanga</i> - <i>Zingiber officinale</i> - <i>Piper retrofractum</i>	All the ingredients were mixed and pounded, then rubbed on the part that feels in pain	Herbal formula used topically for massage

Table 4. Plants used as ingredients of the Traditional herbal formulations for Joint pain therapy in Solo City

Plant name	Local name	Family	Part(s) used	RFC (N =25)
<i>Piper retrofractum</i> Vahl	Cabe jawa	Piperaceae	Fruit	0.72
<i>Zingiber officinale</i> Roscoe	Jahe	Zingiberaceae	Rhizome	0.56
<i>Curcuma xanthorrhiza</i> Roxb	Temulawak	Zingiberaceae	Rhizome	0.48
<i>Kaempferia galanga</i> L.	Kencur	Zingiberaceae	Rhizome	0.44
<i>Curcuma longa</i> L.	Kunyit	Zingiberaceae	Rhizome	0.36
<i>Annona muricata</i> L.	Sirsak	Annonaceae	Leaves	0.32
<i>Moringa oleifera</i> Lam.	Kelor	Moringaceae	Leave	0.28
<i>Andrographis paniculata</i> (Burm.f.) Nees	Sambiloto	Acanthaceae	Leaves	0.20
<i>Garcinia mangostana</i> L.	Manggis	Clusiaceae	Rind	0.20
<i>Curcuma zedoaria</i> (Christm.) Roscoe	Kunyit Putih	Zingiberaceae	Rhizome	0.12
<i>Cymbopogon citratus</i> (DC.) Stapf	Sereh	Poaceae	Stem bark	0.12
<i>Solidago virgaurea</i> L.	Ceplikan	Acanthaceae	Seed	0.12
<i>Tinospora cordifolia</i> (Willd.) Miers ex Hook.f. & Thomson	Brotowali	Menispermaceae	Leaves	0.12
<i>Alpinia galanga</i> (L.) Willd.	Lengkuas	Zingiberaceae	Rhizome	0.08
<i>Amomum compactum</i> Soland.ex Maton	Kapulaga	Zingiberaceae	Seed	0.08
<i>Cinnamomum burmanni</i> (Nees & T. Nees) Blume	Kayu Manis	Lauraceae	Stem bark	0.08
<i>Citrus aurantiifolia</i> (Christm.) Swingle	Jeruk Purut	Rutaceae	Leaves	0.08
<i>Foeniculum vulgare</i> Mill.	Adas	Apiaceae	Seed	0.08
<i>Syzygium polyanthum</i> (Wight) Walp.	Daun Salam	Myrtaceae	Leave	0.08
<i>Tithonia diversifolia</i> (Hemsl.) A.Gray	Paitan	Asteraceae	Leaves	0.08
<i>Azadirachta indica</i> A.Juss.	Mimba	Meliaceae	Leaves	0.04
<i>Curcuma aeruginosa</i> Roxb.	Temu Ireng	Zingiberaceae	Rhizome	0.04
<i>Elephantopus scaber</i> L.	Tapak Liman	Asteraceae	Leave	0.04
<i>Melaleuca leucadendra</i> (L.) L.	Kayu Putih	Myrtaceae	Leaves	0.04
<i>Nigella sativa</i> L.	Jintan Hitam	Ranunculaceae	Seed	0.04
<i>Parkia timoriana</i> (DC.) Merr.	Dawung	Fabaceae	Seed	0.04
<i>Phyllanthus urinaria</i> L.	Meniran	Phyllanthaceae	Leave	0.04
<i>Piper betle</i> L.	Sirih	Piperaceae	Leave	0.04
<i>Strobilanthes crispata</i> (L.) Blume	Keji beling	Acanthaceae	Leaves	0.04
<i>Swietenia macrophylla</i> King	Mahoni	Meliaceae	Leaves	0.04
<i>Tectona grandis</i> L.f.	Jati	Lamiaceae	Fruits	0.04
<i>Woodfordia floribunda</i> Salisb	Sidowayah	Lytheraceae	Flower	0.04

Table 5. Family Important Value (FIV)

Family	Plant name	Local name	FIV
Zingiberaceae	<i>Zingiber officinale</i> Roscoe	Jahe	25.00
	<i>Curcuma longa</i> L.	Kunyit	
	<i>Curcuma aeruginosa</i> Roxb.	Temu Ireng	
	<i>Amomum compactum</i> Soland.ex Maton	Kapulaga	
	<i>Curcuma zedoaria</i> (Christm.) Roscoe	Kunyit putih	
	<i>Kaempferia galanga</i> L.	Kencur	
	<i>Curcuma xanthorrhiza</i> Roxb.	Temulawak	
	<i>Zingiber zerumbet</i> (L.) J.E. Smith	Lempuyang	
	<i>Alpinia galanga</i> (L.) Willd.	Lengkuas	
Acanthaceae	<i>Andrographis paniculata</i> Nees	Sambiloto	9.38
	<i>Solidago virgaurea</i> L.	Ceplikan	
	<i>Strobilanthes crispata</i> (L.) Blume	Keji beling	
Piperaceae	<i>Piper retrofractum</i> Vahl	Beras	6.25
	<i>Piper betle</i> L.	Sereh	
Myrtaceae	<i>Syzygium polyanthum</i> (Wight) Walp.	Daun salam	6.25
	<i>Melaleuca leucadendra</i> (L.) L.	Kayu putih	
Meliaceae	<i>Azadirachta indica</i> A.Juss.	Mimba	6.25
	<i>Swietenia macrophylla</i> King	Mahoni	
Lythraceae	<i>Woodfordia floribunda</i> Salisb	Sidowayah	3.12
Rutaceae	<i>Citrus aurantiifolia</i> (Christm.) Swingle	Jeruk purut	3.12
Moringaceae	<i>Moringa oleifera</i> Lam.	Kelor	3.12
Clusiaceae	<i>Garcinia mangostana</i> L.	Manggis	3.12
Poaceae	<i>Cymbopogon citratus</i> (DC.) Stapf	Sereh	3.12
Menispermaceae	<i>Tinospora cordifolia</i> (Willd.) Miers ex Hook.f. & Thomson	Brotowali	3.12
Lauraceae	<i>Cinnamomum burmannii</i> (Nees & T.Nees)	Kayu manis	3.12
Apiaceae	<i>Foeniculum vulgare</i> Mill.	Adas	3.12
Ranunculaceae	<i>Nigella sativa</i> L.	Jintan hitam	3.12
Fabaceae	<i>Parkia timoriana</i> (DC.) Merr.	Dawung	3.12
Annonaceae	<i>Annona muricata</i> L.	Sirsak	3.12
Lamiaceae	<i>Tectona grandis</i> L.f.	Jati	3.12
Phyllanthaceae	<i>Phyllanthus urinaria</i> L.	Meniran	3.12

According to FIV data (Table 5), plants from the Zingiberaceae family were the most widely used by healers in Solo City for the treatment of joint pain. In Indonesia, this family is frequently utilized in traditional herbal medicine with about 700 species worldwide [16]. Members of this family typically contain flavonoids and essential

oils. The most well-known and prevalent plant phenolics are flavonoids, which have biological effects that include defense against inflammation, cancer, platelet aggregation, microorganisms, and allergies [17]. *Zingiber officinale*, also known as ginger, is one of the plants in the Zingiberaceae family that is frequently used in Solo City

for joint pain therapy as shown in Table 4. Ginger is a common medicinal plant used in Indonesia with potent antioxidant, antimicrobial, anti-inflammatory, and anti-cancer effects [18]. The bioactive compounds of ginger are zingerone, gingerdiol, gingerol, zingiberene, and shogaol. Other phytoconstituents obtained from this plant include essential oils, diarylheptanoids, paradol, zerumbone, 1-Dehydro-(10) gingerdione, terpenoids, and flavonoids [19]. Gingerol and shogaol in ginger actively inhibit pro-inflammatory cytokines such as interleukin (IL)-1 and tumor necrosis factor (TNF) which affect reducing prostaglandin E2 (PGE2) levels. In addition, these two compounds also inhibit cyclooxygenase (COX)-2 induced by lipopolysaccharides [20]. The major bioactive component in dry rhizomes is 6-shogaol. Some *in vivo* and *in vitro* studies showed that 6-shogaol have neuroprotective effects by drastically reducing inflammatory indicators such as leukocyte infiltration or edema. 6-shogaol reduced the production of proinflammatory cytokines, including interferon, TNF, interleukins, and chemokines, and can inhibit proinflammatory substances such as COX-2, decrease iNOS levels, and reduce NO levels as reported by *in vitro* studies [21].

Another plant of the Zingiberaceae family, *Curcuma xanthorrhiza* widely known as "Temulawak," has various health benefits. The bioactive compounds contained in temulawak are curcuminoids, α -curcumene, turmerone, and xanthorhizol. Xanthorhizol is an anti-inflammatory agent by inhibiting IL-6 and TNF- α and suppressing the expression of COX-2 and iNOS through the nuclear factor (NF)- κ B pathway, which results in the reduction of PGE2 and NO [22].

Kaempferia galanga, known as "kencur," belongs to the Zingiberaceae family and is a medicinal plant widely used in traditional concoctions. This plant is widely used as a treatment due to the anti-inflammatory, analgesic, antioxidant, and antimicrobial properties [23]. The ethyl-p-methoxycinnamate contained in *Kaempferia galanga* is an anti-inflammatory component that can inhibit inflammation by suppressing IL-1, TNF- α , and angiogenesis by blocking endothelial function [24].

Several studies showed that curcumin from *Curcuma longa* plays a role in maintaining the viscosity of joint fluid [25]. The mechanism of curcumin as an anti-inflammatory agent is to inhibit several molecules involved in inflammation, including phospholipases, prostaglandins, IL-12, and NF- κ B which are important regulators of COX-2 expression [26]. Inhibitory effects of curcumin on some of these molecules can reduce the levels of prostaglandins, which act as inflammatory mediators that cause pain.

Other important medicinal plants used by traditional healers of Jamu Medicine in joint pain therapy are *Annona muricata* of Annonaceae family and *Moringa oleifera* of family Moringaceae. *Annona muricata* contains secondary metabolites such as alkaloids, flavonoids, tannins, saponins, triterpenoids, and steroids [27,28]. The presence

of flavonoid compounds and tannins in this plant reduces levels of the pro-inflammatory cytokines TNF- α and IL-1 β so that they have the potential as anti-inflammatory agents [29].

Moringa oleifera have an anti-inflammatory effect by suppressing COX activity.

Quercetin, a flavonoid from this plant, has anti-inflammatory effect [30]. Several studies have shown that quercetin can inhibit COX-2 expression.

Data analysis revealed that out of 25 herbal formulations, 23 are administered orally and two are applied locally as concoction for massage. All parts of the medicinal plant were washed, pounded, and boiled in water, then boiled water was administered orally/locally.

The herbal formulation for topical application is prepared by pounding, mixing and local application/massage of the product on the painful joint to relieve pain, stiffness, muscle spasms, or local vasodilatation [31]. Most commonly used medicinal plants for the treatment of joint pain have been identified as *Piper retrofractum*, *Zingiber officinale*, *Curcuma xanthorrhiza*, *Kaempferia galanga*, and *Curcuma longa*.

In this study, the oldest healer was a 64 years old lady with 37 years of practice of traditional medicine.

In general, each Solo herbal formulation consists of more than 3 plants that were believed to be effective in the prevention and treatment of various diseases, one of which is joint pain. Herbal formulations are prepared by the process of decoction; boiling ingredients in water and then filtering and drinking regularly at a certain time. The boiling process is considered an effective process in extracting plant material and maintaining its stability against microbial contamination [32]; however, this method has a weakness, namely if the heating is high enough and for a long time, it can damage the active compounds of the plants.

The parts of the plant most commonly used for the treatment of joint pain by Solo healers are leaves, fruit, rhizomes, seeds, and roots. Leaves are the main photosynthetic organs of plants and are the most commonly used plant parts because they contain useful bioactive compounds.

Conclusions

In Solo City, Central Java, 25 herbal medicines consisting of 32 plant species from 19 families have been registered by traditional healers as medicinal plants for the treatment of joint pain. These plants are valuable resources to develop natural, semi-synthetic, or synthetic drugs for joint pain in future. Also, such ethnopharmacological studies are essential to keep a record of the traditional and local knowledge to be saved for the next generations.

Conflict of Interests

The authors declare that there are no conflicts of interest

in this article.

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