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Review Article

Study of Traditional Drug Ethnopharmacology Used for The Treatment of Metabolic Disorders in Pamona Puselemba District

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Abstrack: People in Pamona Puselemba Subdistrict in Poso Regency have used various plant species to maintain health and prevent various diseases, one of which is metabolic disorders. This study aims to determine the types and parts of plants, processing methods, use, duration of treatment, frequency of use, and chemical content contained in plants that are efficacious as drugs for metabolic disorders. The research was conducted descriptively using qualitative methods and the technique of taking informants (Hattra and sufferers) with the purposive sampling method. The results obtained were 32 types of plants, consisting of 24 families, for the treatment of metabolic disorders. The plant parts used were 49% leaves, 12% stems, 21% fruit, 6% tubers, 3% flowers, 3% rhizomes, 3% seeds, and 3% hair. Processing method: 77%, blended, brewed 13%, without processing 77%. How to use: drink 89%, eat directly 11%, duration of treatment 1 week, and frequency of use 2 times a day. The content of compounds contained in medicinal plants is very diverse, such as flavonoids, terpenoids, saponins, tannins, alkaloids, allisin, and other chemical compounds that can be used in the treatment of metabolic disorders. People in Pamona sub-district still use traditional medicine to treat metabolic diseases.
Keywords: Metabolic disorders; medicinal plants; Pamona sub-district; Poso district

1. Introductions

Indonesia is a tropical country that is well known as a producer of various agricultural commodities, including medicinal plants. Fertile soil conditions, a good climate, and a diversity of flora support Indonesia as a potential producer of medicinal commodities of natural origin, including medicinal plants. Traditional medicine is a hereditary heritage from ancestors that is deeply rooted in the nation's culture; therefore, both the ingredients and its use as traditional medicine are still based on experience passed down from generation to generation, both orally and in writing (Asdah 2009). The use of plants that are efficacious as drugs or ingredients by various ethnic groups or groups of people living in the interior is often referred to as "ethnopharmacology" (Ito 2019).

Ethnopharmacology is the study of the benefits contained in plants that have pharmacological effects for the treatment and maintenance of public health (Qamariah, Handayani, and Novaryatiin 2019). One of the diseases that can be treated using medicinal plants is metabolic disorder. Currently, metabolic disorders are a public health problem, regardless of age or ethnicity. In everyday life, we encounter diseases such as high blood pressure, hyperlipidemia, and diabetes. Metabolic syndrome is a collection of clinical symptoms, including low levels of HDL cholesterol, high triglycerides, increased blood sugar, increased blood pressure, and abdominal obesity (Yusuf 2014).

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Metabolic disease based on health data in January 2021-May 2022 obtained from Puskesmas in Pamona Puselemba District, North Pamona District, West Pamona District, and East Pamona District, people with high blood pressure ranked first in the highest number (2,375 people) with diabetes are the second most common (1,148 people), and hyperlipidemia is the third highest (936 people). Diet and a high intake of animal fat but low in fiber are dietary patterns and habits of the people in Pamona Puselemba District, North Pamona District, West Pamona District, and East Pamona District, which is one of the risk factors for the occurrence of metabolic disorders. High intakes of carbohydrates, fats, and proteins can cause obesity, changes in blood lipid profiles, and increased blood sugar concentrations. This will lead to an increase in the incidence of metabolic disorders (Putri 2014).

Research on the knowledge and empirical use of medicinal plants by local communities has been widely carried out in Indonesia. However, research on the use of medicinal plants against metabolic disorders by the community in Pamona Puselemba District, North Pamona District, West Pamona District, and East Pamona District is still very limited, although health efforts through the use of medicinal plants have been known for generations to date. This has prompted efforts to preserve public knowledge about traditional medicine that have been empirically carried out by the community in Pamona Puselemba District, North Pamona District, West Pamona District, and East Pamona District. These efforts include the use, cultivation, and re-excavation of local community knowledge about medicinal plant.

2. Materials and Methods

Materials

The materials used in this study were labels, alcohol, newspapers, and plants found in the field during research.

Methods

This study used a descriptive type of research using qualitative methods. The informants in this study are (Hatra and Sufferers). Informants were selected using the purposive sampling method. Data collection was carried out directly with Hattra and sufferers, using a structured interview method with an interview guide in the form of a questionnaire sheet attached. The collection of plant specimens is taken from the place where they grow and documented and identified at the Plant Biosystematics Laboratory, Biology Department, Faculty of Mathematics and Natural Sciences (FMIPA), Tadulako University, used in treating metabolic disorders by the community in Pamona Puselemba District, North Pamona District, West Pamona District, East Pamona District, and Poso Regency.

3. Result

In this study, there were 18 informants (Hattra) and 57 people (patients) who were willing to be interviewed by the researcher. Informants (Hattra) in each sub-district are the result of recommendations from the village head, and local people who have had treatment at Hattra in each sub-district and sufferers are the result of recommendations by Hattra who are willing to interview researchers. Patients with metabolic disorders in each sub-district interviewed were different in each sub-district; in the Pamona Puselemba sub-district, there were 18 sufferers from 5 Hattra; in the North Pamona sub-district, there were 15 sufferers from 5 Hattra; in the West Pamona sub-district, there were 9 sufferers from 3 Hattra; and in the East Pamona sub-district, there were 6 sufferers from 3 Hattra. There were 15 sufferers from five Hattra, so the total number of patients with metabolic disorders was 57 people who were interviewed by the researchers. Based on the results of interviews conducted with 18 Hatra people, 32 species of plants from 24 families of medicinal plants were found and used for treatment. Identification was carried out at the Plant Biosystematics Laboratory, Department of Biology, Faculty of Mathematics and Natural Sciences, Tadulako University. for the treatment of metabolic disorders in Pamona Puselemba District, North Pamona District, West Pamona District, East Pamona District, and Poso Regency. Types and parts of plants can be seen in Table 1 and Figure.

Tabel 1. The types of plants used for the treatment of metabolic disorders in the districts of Pamona Puselemba, North Pamona, West Pamona, East Pamona, and Poso Regency

Plant Name	Family	Species	Part Used	Disease Treatment
Garlic	Amaryllidaceae	*Allium sativum* L.	Tuber	Hypertension Hyperlipidemia
Salam	Myrtaceae	*Syzygium polyanthum* (Wight) Walp.	Leaf	Hyperlipidemia Diabetes
Moringa	Moringaceae	*Moringa oleifera* Lam.	Leaf	Hyperlipidemia Diabetes
Gedi Red	Malvaceae	*Abelmoschus manihot* (L.) Medik.	Leaf	Hyperlipidemia Diabetes
Brotowali	Menispermaceae	*Tinospora crispa* (L.) Hook.f. & Thomson.	Stem	Diabetes
Lime	Rutaceae	*Citrus aurantiifolia* (Christm.) Swingle	Fruit	Hyperlipidemia
Lamtoro/ Petai Cina	Fabaceae	*Leucaena leucocephala* (Lam.) de Wit.	Seed	Diabetes
Maja	Bignoniaceae	*Crescentia cujete* L.	Leaf	Diabetes
Klorofil/ Afrika	Asteraceae	*Gymnanthemum amygdalinum* (Delile) Sch.Bip.	Leaf	Hypertension Hyperlipidemia Diabetes
Andrographolide	Acanthaceae	*Andrographis paniculata* (Burm.fil.) Nees	Leaf	Hypertension Diabetes
Pinang	Arecaceae	*Areca catechu* L.	Fruit	Diabetes

Kumis Kucing	Lamiaceae	*Orthosiphon aristatus* (Blume) Miq.	Leaf	Diabetes
Suruhan	Piperaceae	*Peperomia pellucida* (L.) Kunth	Stem and leaf	Hyperlipidemia
Ginger	Zingiberaceae	*Zingiberofficinale* Roscoe.	Rhizome	Hypertension Hyperlipidemia
Celery	Apiaceae	*Apium graveolens* L.	Stem and Leaf	Hypertension Hyperlipidemia
Coconut	Arecaceae	*Cocos nucifera* L.	Fruit	Hypertension Hyperlipidemia
Soursop	Annonaceae	*Annona muricata* L.	Leaf	Hypertension Hyperlipidemia Diabetes
Gersen	Muntingiaceae	*Muntingia calabura* L.	Leaf	Hypertension Hyperlipidemia Diabetes
Lemongrass	Poaceae	*Cymbopogon nardus* (L.) Rendle	Stem	Hypertension
Noni	Rubiaceae	*Morinda citrifolia* L.	Fruit	Hyperlipidemia Diabetes
Papaya	Caricaceae	*Carica papaya* L.	Leaf	Hypertension
Jarak Pagar	Euphorbiaceae	*Jatropha curcas* L.	Leaf	Hypertension
Avocado	Lauraceae	*Persea americana* L.	Leaf	Hypertension Hyperlipidemia Diabetes
Palola	Solanaceae	*Solanum melongena* L..	Fruit	Diabetes
Onion	Amaryllidaceae	*Allium ascalonicum* L.	Tuber	Hyperlipidemia
Kecombrang	Zingiberaceae	*Etlingera elatior* (Jack) R.M.Sm.	Fruit	Hyperlipidemia
Binahong	Basellaceae	*Anredera cordifolia (Ten.) Steenis*	Leaf	Hypertension
Corn	Poaceae	*Zea mays* L.	Hair	Hypertension
Chives	Amaryllidaceae	*Allium tuberosum* Rottler ex Spreng.	Leaf	Hypertension Hyperlipidemia
Asoka	Rubiaceae	*Ixora paludosa* (Blume) Kurz.	Flower	Hypertension
Cucumber	Solanaceae	*Cucumis sativus* L.	Fruit	Hypertension
Arogo	Lamiaceae	*Callicarpa* sp.	Leaf	Hypertension Hyperlipidemia

Parts of plants used in the treatment of metabolic disorders are as follows:

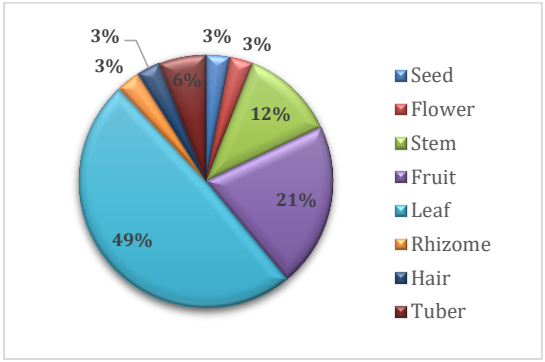

Fig.1. Percentage of Plant Parts

The percentage results showed that the most widely used plant part was the leaves (49%). Leaves are more widely used because it is considered that the processing method is easier, the efficacy of the leaves is greater than that of other plant parts, and this method is sustainable. The use of leaves does not require the taking of whole plants, such as retraction or felling, so that the plants used can still be preserved (Fadilah, I. L., & Linda 2015). Leaves are very easy to get and do not depend on the season like fruit and seeds; besides that, leaves are also easier to mix compared to roots, bark, and stems. The use of other plant parts can affect the ecology, such as the roots, rhizomes, tubers, and stems. This happens because utilizing this part uses plant extraction and logging so that it can have a direct effect on the amount in nature (Eva Tavita and Yusro 2020). Treatment using traditional medicinal plants by the community in Pamona Puselemba District, North Pamona, West Pamona, and East Pamona Poso Regency has been carried out for generations. Based on the interviews that have been conducted, the medicinal plants used are medicinal plants that are still fresh.Based on the results of interviews with 18 Hattra in Pamona Puselemba District, North Pamona District, West Pamona District, East Pamona District, and Poso Regency, all Hatra use plants with an odd number because it is based on beliefs and teachings that have been practiced for a long time that to consume traditional medicine, one must have an odd number. The percentage of processing methods and how to use medicinal plants in treating metabolic disorders can be seen in Figures 2 and 3.

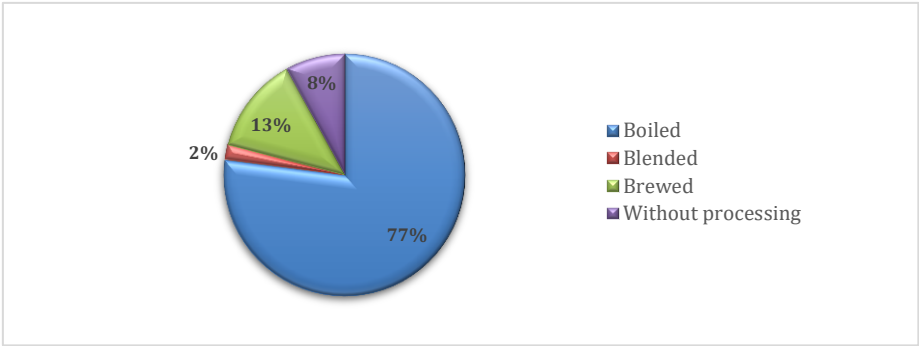

Fig.2. Percentage of Plant Processing

Based on the percentage, the method of processing plants for the treatment of metabolic disorders by boiling 77% of them is the most widely used method of processing. Boiling medicinal plants is a technique that will remove active compounds from plant parts, especially from the parts that have the most secondary metabolites, namely the leaves, which are very soluble in water so that they are very easy to digest by the body (Ningsih 2019).

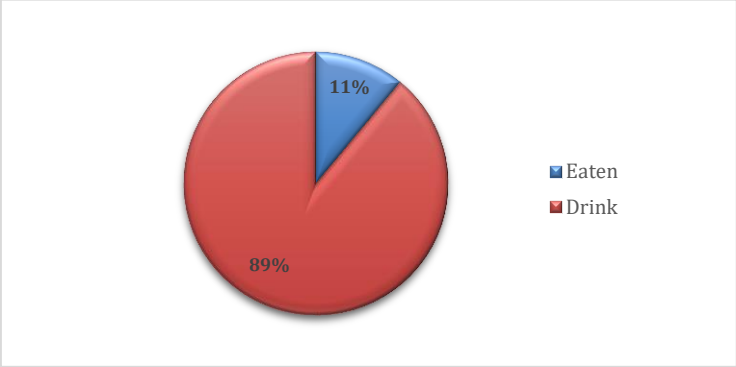

Fig.3. Percentage How to Use Plants

Based on the percentage of plants used in the treatment of metabolic disorders, the most widely used method is drinking 89% According to the results of interviews with Hattra, the use of alcohol can provide a quick reaction to the healing of the illness. Medicinal plants that are consumed by mouth are more often used to treat internal diseases (Eva Tavita and Yusro 2020). Internal medicine is a treatment that involves eating and drinking preparations from medicinal plants. treatment of internal diseases such as hypertension, diarrhea, diabetes, intestinal worms, Hyperlipidemia, stomach ulcers, and others (Mulyani, Hasimun, and Sumarna 2020). This very simple processing and use of medicinal plants is related to people's knowledge about medicinal plants, which is generally obtained from generation to generation and based on their daily habits and experiences. The results of interviews conducted by researchers for the frequency of using traditional medicines are 2 times a day (morning and evening). This rule of use has been widely used by informants (Hattra and sufferers) in using medicinal plants with a duration of treatment. One week is the duration of use according to the effect of treatment felt by patients who consume medicinal plants. Basically, the use of medicinal plants by the community is simple and is only sourced from the experience and information of previous parents From the results of the literature study that has been carried out, an explanation of medicinal plants that contain chemical compounds against metabolic disorders is obtained. can be seen in Table 2.

Table 2. Study of the literature and content of chemical compounds of medicinal plants for metabolic disorders

Plant Name	Disease	Chemical Compound Content	Study of Literature
Garlic	Hypertension	Allicin and hydrogen sulfida	These substances have the same effect as high blood pressure drugs, namely, to enlarge blood vessels and make blood vessels flexible so that blood pressure will decrease

			(Izzati 2017).
	Hyperlipidemia	Allicin	Allicin in garlic plays a significant role in lowering LDL-cholesterol levels and can increase HDL-cholesterol levels (Asdah 2009).
Bay Leaf	Hyperlipidemia	Tannins, essential oils, saponins and flavonoids	Bay leaves contain tannins, essential oils, saponins, and flavonoids, which can have the effect of lowering cholesterol levels in the blood (Chendri Rivardo 2019).
	Diabetes	Flavonoids, saponins, tannins, essential oils	Tannin compounds in bay leaves are also known to reduce blood glucose levels (Base et al 2020).
Moringa	Hyperlipidemia	Tannins, saponins and flavonoids	Compounds that act as antihyperlipidemia (Isyraqi, Rahmawati, and Sastyarina 2020).
	Diabetes	Flavonoids, saponins, alkaloids, tannins, and phenols	Moringa is a medicinal plant that has properties as antidiabetic and antioxidant (Dwika et al. 2016).
Red Gedi	Hyperlipidemia	Flavonoids, saponins, alkaloids, and tannins	Alkaloids have antidiabetic activity (Setyawan, N. R., Elyani, H., & Purnomo 2021).
	Diabetes	Tannins, phenols and flavonoids	Red Gedi leaves contain tannin compounds, which have functions as antioxidants, astringents, and inducers of hypercholesterolemia. Anticholesterol activity in red gedi leaf extract is due to the presence of important content in red gede leaves, including flavonoids, tannins, and phenolics (Tubagus, Momuat, and Pontoh 2015).
Brotowali	Diabetes	Alkaloids, diterpenoids, flavonoids, phenols, lactones, lignins.	Brotowali has various activities, and one of them is as an antidiabetic (Rosidah et al. 2015).
Lime	Hyperlipidemia	Flavonoids, saponins, citric acid, essential oils	Due to its content of flavonoid compounds, lime has a very strong antioxidant effect. Lime juice has been shown to be able to lower total cholesterol levels in the blood. In a study conducted by Elon (2015), it was shown that lime juice therapy accompanied by regular exercise was able to reduce blood cholesterol levels (Hendra Krisnawan and Ikhrom Eka Jayani 2018).
Chinese petai/Lamtoro	Diabetes	Alkaloids, flavonoids, saponins. Tannins,	Chinese petai/lamtoro seeds have antidiabetic activity (Rivai 2021).

		triterpenoids	
Maja	Diabetes	Alkaloids (aegline, marmachin, marmin, marmelosin)	This plant is known to be able to reduce blood sugar levels in rabbit test animals after giving extracts from maja leaves for 10 days. Research conducted by Derminati et al. (2018) also showed that administration of maja leaf extract (Aegle marmelos L. Corr) at a dose of 600 mg/kg BW showed the effectiveness of maja leaves in reducing blood glucose levels in diabetic rats induced by high-fat and fructose feed (Benge et al. 2020).
Klorofil/ Afrika	Hypertension	Flavonoids, saponins, tannins	Chlorophyll/Africa leaves contain flavonoid compounds, saponins, and tannins that can be used to treat cholesterol disease so that they can reduce low-density lipoprotein (LDL) levels (Siswanto, Astriani, and Abstraks 2016).
	Hyperlipidemia Diabetes	Saponin group (vernonioside, steroidal saponin), sesquiterpene	African leaf research has not been done scientifically intensively, but testimonials from the community and some literature have revealed that African leaves are very well used as antidiabetic, for hypertension, rheumatism, calcification of bones, kidney disease, and others. Besides that, they can be used as external medicine for skin inflammations, wounds, and infections (Jayanti 2015).
Andrographolide	Hypertension	Andrographolide substances, alkaloids, potassium	Potassium in bitter leaf is useful for removing water and salt to treat hypertension (Syaffitri 2020).
	Diabetes	Andrographolide and glycoside substances, diterpenes.	Andrographolide is an active compound that is antibacterial and anti-diabetic. Andrographolide is the main compound in bitter leaf, which has a function in lowering blood glucose levels (Prasetyo 2019).
Pinang	Diabetes	Alkaloids, flavonoids, tannins, saponins	Pinang is a traditional plant that is often used by the general public for the treatment of diabetes mellitus (Astuti 2012).
Kumis Kucing	Diabetes	Saponins, polyphenols, flavonoids	Flavonoids and saponins have the ability to reduce blood glucose levels (Dewi, N. P., & Tandi 2021).
Suruhan	Hyperlipidemia	Alkaloids, flavonoids,	The plant extract has potential as

		phenolics, saponins, tannins	an antidiabetic (Adnyana 2019).
Ginger	Hypertension Hyperlipidemia	Zingiberin, camphor, lemonin, borneol, Shogaol, cineol, fellandren, zingiberol, gingerol, and Zingeron (Aryanta, 2019).	Ginger has activity as an antihypertensive and antihyperlipidemic agent (Nengah Mini Arie, Muntamah, and Keperawatan Ngudi Waluyo Ungaran 2014).
Celery	Hypertension Hyperlipidemia	Flavonoids, vitamin C, apiin, apigenin, calcium, and magnesium.	Celery is useful for lowering high blood pressure and cholesterol levels (Endang et al. 2018).
Coconut	Hypertension	Potassium	Potassium can reduce high blood pressure (Agung, I. S., & Kaligawe 2016).
	Hyperlipidemia	Polyphenols, vitamin C	Coconut water can lower cholesterol levels (Salsabila 2021).
Soursop	Hypertension	Flavonoids, saponins, tannins and alkaloids	Giving soursop leaves to hypertensive patients has been shown to lower blood pressure (Lispita Wulandari, Susilowati, and Asih, n.d.).
	Hyperlipidemia	Flavonoids, alkaloids, fatty acids, phytosterols, myrisyl alcohol and anonol	Flavonoid compounds can lower cholesterol levels in the blood by increasing the excretion of bile acids and reducing blood viscosity (viscosity). thus reducing the deposition of fat in the blood vessels (Nova Iyos and Dhea Astuti 2017).
	Diabetes	Flavonoids, tannins, phytosterols, calcium oxalate, alkaloids.	Flavonoid compounds and tannins function as antidiabetics (Sakaria, H., Rumi, A., & Masyita 2021).
Gersen	Hypertension	Flavonoids, tannins, triterpenoids, saponins, and polyphenols	Flavonoids contained in gersen leaves function as high blood pressure drugs (Putri, C. A., Yuliet, Y., & Khaerati 2018).
	Hyperlipidemia	Flavonoids, saponins, Steroids, tannins, alkaloids.	Compounds that play a role in reducing cholesterol levels are flavonoids and saponins (Kurnia 2020).
	Diabetes	Proteins, fats, carbohydrates, Ash, calcium, phosphorus, iron, tianin, riboflavin, niacin, flavonoids	The decrease in blood glucose levels with the use of gersen leaves is due to the presence of flavonoid compounds (Wicaksono, R. R., & Sulistiono 2021).
Lemongrass	Hypertension	Geraniol	The content of geraniol compounds in lemongrass can lower blood pressure (Risna 2012).
Noni	Hyperlipidemia	alkaloids, saponins, flavonoids, and terpenoids.	Giving saponins can reduce cholesterol levels (Sogandi, S., & Rabima 2019).

		anthraquinones, alkaloids	
	Diabetes	Tannins, flavonoids, steroids, saponins	Noni fruit can be used in the treatment of diabetes (Ibrahim, M. D., & Widiarto 2019).
Papaya	Hypertension	Tannins, saponins, alkaloids, flavonoids	Antihypertensive activity of papaya leaves (Sadik 2021).
Jarak Pagar	Hypertension	Flavonoids, phenolic	Flavonoid and phenolic compounds are efficacious as antihypertensives (Ayu Virginia Irawati 2015).
Avocado	Hypertension	Saponins, tannins, flavonoids, alkaloids, and steroids	Avocado leaves have antihypertensive properties (Zubaidatul Muqowwiyah et al. 2021).
	Hyperlipidemia	Flavonoids, alkaloids, saponins, tannins, and triterpenoids	Flavonoids, alkaloids, saponins, tannins, and triterpenoids are among these compounds that can play an active role in lowering cholesterol levels (Putri, E. P. K., Hamzah, B., & Rahman 2013).
	Diabetes	Alkaloids, terpenoids, steroids, saponins, and tannins	Alkaloids, terpenoids, steroids, saponins, and tannins are among the bioactive substances known to play an active role in lowering blood glucose levels in people with diabetes mellitus (Tandi 2016).
Palola	Diabetes	Flavonoids, alkaloids, polyphenols, tannins, and saponins	The content of palola fruit can reduce blood glucose levels (Aryanta 2019).
Red Onion	Hyperlipidemia	Allisin and Diallylsulfide	Red Onion can lower cholesterol levels (Fitriyah et al. 2013).
Kecombrang	Hyperlipidemia	Flavonoids, saponins, and polyphenols	Kecombrang is useful as a cholesterol neutralizer (Saragi 2018).
Binahong	Hypertension	Flavonoids, alkaloids, terpenoids, and saponins	The use of binahong leaves can reduce high blood pressure (Febtrina and Simamora 2018).
Corn	Hypertension	Flavonoids	The active substances contained in corn silk are flavonoids, which function as antihypertensives (Ningsih, D., Harsono, S. B., Kusumawati, A. D., & Mahmudah 2017).
Chives	Hypertension	Phenolics, flavonoids, and saponins	Chives can be used to lower high blood pressure (Risky, Kusharyanti, and Handini 2014).
	Hyperlipidemia	Flavonoids, triterpenoids, saponins, allicin	Chives can reduce cholesterol (Sri Hartati 2019).
Asoka	Hypertension	Alkaloids, flavonoids, tannins, and saponins (Ningsih, 2019).	Benefits of flower to prevent hypertension (Elya, Hermawan, and Trismiana 2016)

Cucumber	Hypertension	Magnesium, and potassium	Potassium, along with magnesium, is considered to be a good source of nutrients in the blood (Erwin 2016).
Arogo	Hypertension Hyperlipidemia	Diterpenes, irdoids, steroids, triterpenes, and flavonoids	There is currently no reference.

4. Discussion

Based on the results of a literature study, the chemical components of medicinal plants used to treat metabolic disorders in Pamona Puselemba District, North Pamona District, West Pamona District, and East Pamona District, Poso Regency, were identified as many as 32 types of medicinal plants. Each type of medicinal plant used in the treatment of metabolic disorders contains various chemical compounds such as flavonoids, terpenoids, saponins, tannins, alkaloids, allicin, and other chemical compounds that can be used in the treatment of metabolic disorders. There is one type of medicinal plant, namely arogo (*Callicarpa* sp.) which only has chemical ingredients, namely diterpenes, irdoids, steroids, triterpenes, and flavonoids, however, there is no reference for its specific activity for the treatment of metabolic disorders.

5. Conclusion

Obtained 32 types of medicinal plants from 24 families for the treatment of metabolic disorders which based on literature studies are in accordance with the mechanism of the plant content. The plant parts used were: 49%, 12% stem, 21% fruit, 6% tuber, 3% flower, 3% rhizome, 3% seed, and 3% hair. The plants were processed as follows: 77% boiled, 13% brewed, 8% unprocessed, 2% blended. Drink 89% of the time and eat straight 11% of the time. The frequency of using traditional medicine is twice a day (morning and evening), with a treatment duration of 1 week. The types of medicinal plants used in the treatment of metabolic disorders contain various chemical compounds such as flavonoids, terpenoids, saponins, tannins, alkaloids, allisin, and other chemical compounds that can be used in the treatment of metabolic disorders.

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Authors Contributions

All the authors have contributed equally.

References

Adnyana, I. K. 2019. "Napak Tilas Jahe Gajah (*Zingiber officinale Roscoe Var Officinale*) dan Jahe Merah (*Zingiber officinale Var Rubrum*)." *Jurnal Farmasi Galenika* 3 (1).

Agung, I. S., & Kaligawe, R. 2016. "Peran Air Kelapa Muda Sebagai Alternatif untuk Menurunkan Kadar Kalosterol Total." *Proceeding Book "Scientific Annual Meeting Forum Kedokteran Islam Indonesia*. http://61.8.75.226/Itblog/Attachments/Article/2275/Peran air kelapa muda sebagai alternatif untuk menurunkan kadar kolesterol total.Pdf.

Asdah, Wardiah Nur. 2009. "Efek Bawang Putih (*Allium sativum*) dan Cabe Jawa (*Piper retrofractum Vahl*.) terhadap Jumlah Limfosit pada Tikus yang Diberi Suplemen Kuning Telur (Doctoral Dissertation, Medical Faculty)." http://eprints.undip.ac.id/7752/.

Astuti, Victoria Cyntia Yogya. 2012. "Pengaruh Pemberian Ekstrak Daun Kumis Kucing (*Orthosiphon aristatus*) terhadap Penurunan Kadar Glukosa Darah Tikus Wistar yang Diinduksi Aloksan." *Jurnal Media Medika Muda Karya Tulis Ilmiah*

Ayu Virginia Irawati, Nur. 2015. "Antihypertensive Effects of Avocado Leaf Extract (*Persea americana Mill*)." *J Majority Vol. 4.*

Benge, Maria Ermelinda, Yohana Krisostoma, Anduk Mbulang, and Frengky R R R Naja. 2020. "Pengaruh Pemberian Ekstrak Etanol Daun Afrika (V*ernonia amygdalina. Del*) terhadap Kadar LDL Serum Tikus Hiperkolesterolemia." *CHMK Pharmaceutical Scientific Journal*. Vol. 3.

Chendri Rivardo, R. 2019. "Pengaruh Ekstrak Daun Salam terhadap Penurunan Kadar Kolesterol pada Mencit Putih (Doctoral Dissertation, Stikes Perintis Padang)." http://repo.stikesperintis.ac.id/301/.

Dewi, N. P., & Tandi, J. 2021. "Uji Efek Antidiabetes Ekstrak Etanol Daun Suruhan pada Tikus Putih Jantan yang Diinduksi Streptozotocin." *Farmakologika: Jurnal Farmasi* 18 (1): 56–65.

Dwika, Wayan, Pratama Putra, Anak Agung, Gde Oka Dharmayudha, and Luh Made Sudimartini. 2016. "Identifikasi Senyawa Kimia Ekstrak Etanol Daun Kelor (*Moringa oleifera L*) di Bali." *Indonesia Medicus Veterinus Oktober* 5 (5): 464–73.

Elya, Rahma, Dessy Hermawan, and Eka Trismiana. 2016. "Pengaruh Jus Mentimun (*Cucumis sativus*) terhadap Penurunan Tekanan Darah pada Penderita Hipertensi di UPTD Panti Sosial Lanjut Usia Tresna Werdha Kecamatan Natar Kabupaten Lampung Selatan Tahun 2015." Vol. 10. http://cybermed.cbn.net.id.

Endang, V M, S P Rahayu, I Made Mertha, Iga Ari Rasdini, I Dewa, Putu Gede, Putra Yasa. 2018. "Pengaruh Pemberian Air Kelapa Muda Terhadap Tekanan Darah pada Pasien Hipertensi." *Politeknik Kesehatan Denpasar.*

Erwin. 2016. "Bioaktivitas dan Kandungan Genus Callicarpa." *Jurnal Kimia Mulawarman* 13 (2).

Eva Tavita, Gusti, and Fathul Yusro. 2020. "Ethnobotany Study of Medicinal Plants in Panding Jaya Village Ketungau Tengah Subdistrict Sintang Regency."

Fadilah, I. L., & Linda, R. 2015. "Pemanfaatan Tumbuhan dalam Pengobatan Tradisional Masyarakat Suku Dayak Kanayatn di Desa Ambawang Kecamatan Kubu Kabupaten Kubu Raya." *Jurnal Protobiont*

Febtrina, Rizka, and Nurvaida Br Simamora. 2018. "Rebusan Rambut Jagung (*Zea mays L*) Efektif Menurunkan Tekanan Darah Penderita Hipertensi di Puskesmas Harapan Raya Pekanbaru." *Jurnal Ners Indonesia*. Vol. 8.

Fitriyah, Nikmatul, Mahendrata K Purwa, M Afi Alfi yanto, Nila Wahuningsih, and Joko Kismanto. 2013. "Obat Herbal Antibakteri Ala Tanaman Binahong." *Jurnal KesMaDaSka-Juli*.

Hendra Krisnawan, Alfian, and Nikmatul Ikhrom Eka Jayani. 2018. "Peningkatan Produktivitas Petani dalam Pengolahan Jeruk Nipis Menjadi Produk Minuman Kesehatan dan Sabun." *Jurnal ABDIMAS* 11 (1).

Ibrahim, M. D., & Widiarto, S. 2019. "Uji Tingkat Kesukaan Terhadap Keripik Bawang dengan Penambahan Daun Pepaya." *Culinaria* 1 (2).

Isyraqi, Nur Amiiroh, Dewi Rahmawati, and Yurika Sastyarina. 2020. "Studi Literatur: Skrining Fitokimia dan Aktivitas Farmakologi Tanaman Kelor (*Moringa oleifera Lam*)." *Proceeding of Mulawarman Pharmaceuticals Conferences* 12 (December): 202–10. https://doi.org/10.25026/mpc.v12i1.426.

Ito, M. F. 2019. "Kajian Etnofarmakologi Penggunaan Tanaman Obat oleh Masyarakat di Kecamatan Soa Kabupaten Ngada." *Doctoral Dissertation, Poltekkes Kemenkes Kupang*: 114–19.

Izzati, Wisnatul. 2017. "Pengaruh Pemberian Air Rebusan Bawang Putih Terhadap Tekanan Darah Pada Pasien Hipertensi Di Wilayah Kerja Pusesmas Tigo Baleh Kota Bukittinggi Tahun 2017. " 4th ed.

Jayanti, N. D. 2015. "Penggunaan *Andrographis paniculata Ness* untuk Menurunkan Hipertensi pada Wanita Menopause" 4 (1): 19-24.

Syaffitri, Nur S Aisyah. 2020. "Inventarisasi Tanaman Obat Tradisional untuk Penderita Diabetes Melitus dan Hipertensi di Desa Minangakecamatan Bambang Kabupaten Mamasa." *Akademi Farmasi Sandi Karsa Makassar, Program Studi D-III Farmasi Sandi Karsa Makassar*

Aryanta, I Wayan Redi. 2019. "Bawang Merah dan Manfaatnya Bagi Kesehatan Kesehatan." *Program Studi Ayurweda Fakultas Kesehatan. Vol. 1.*

Base, Nurul Hidayah and Noena, Raymond Arief. 2020. "Studi Etnofarmakologi Pengobatan Penyakit Diabetes Mellitus di Kelurahan Balocci Baru Kecamatan Balocci Kabupaten Pangkajene Kepulauan." *Journal.Yamasi.Ac.Id. Vol. 4. Program Studi Farmasi, Akademi Farmasi Yamasi*

Kurnia, Dede Christian. 2020. "Pemanfaatan Daun Kersen (*Muntingia calabura L.*) dalam

Penanganan Diabetes Mellitus." *Vol. 7.*

Lispita Wulandari, Ririn, Sri Susilowati, and Murnik Asih. n.d. "Pengaruh Kombinasi Ekstrak Etanol Daun Sirsak (*Annona muricata L.*) dan Simvastatin terhadap Kadar Kolesterol Total dan *Low Density Lipoprotein* (LDL) Tikus yang Diinduksi Pakan Tinggi Lemak."

Mulyani, Yani, Patonah Hasimun, and Rendi Sumarna. 2020. "Kajian Etnofarmakologi Pemanfaatan Tanaman Obat Oleh Masyarakat di Kecamatan Dawuan Kabupaten Subang Provinsi Jawa Barat." *Jurnal Farmasi Galenika (Galenika Journal of Pharmacy) (e-Journal)* 6 (1): 37–54. https://doi.org/10.22487/j24428744.2020.v6.i1.13572.

Nengah Mini Arie, Ni, Ummu Muntamah, and Akademi Keperawatan Ngudi Waluyo Ungaran. 2014. "Pengaruh Pemberian Air Rebusan Seledri pada Lansia Penderita Hipertensi di Dusun Gogodalem Barat." *Jurnal Keperawatan Komunitas*. Vol. 2.

Ningsih, D., Harsono, S. B., Kusumawati, A. D., & Mahmudah, D. N. 2017. "Efek Antihiperlipidemia Kombinasi Ektrak Kelopak Bunga Rosella dan Ekstrak Daun Bawang Kucai." *Jurnal Farmasi Indonesia* 14 (1): 1–8.

Ningsih, Rini Megawati. 2019. "Uji Anti Serangga."

Nova Iyos, Rekha, and Putri Dhea Astuti. 2017. "Pengaruh Ekstrak Daun Sirsak (*Annona muricata L.*) terhadap Penurunan Kadar Glukosa Darah Majority." 6(2)

Prasetyo, Didik. 2019. "Pengaruh Pemberian Sediaan Mikroemulsi Ekstrak Biji Pinang (*Arace catechu Linnaeus*) terhadap Penurunan Kadar Glukosa Darah Puasa pada Tikus Putih."

Putri, C. A., Yuliet, Y., & Khaerati, K. 2018. "Efektivitas Ekstrak Daun Kersen (*Muntingia calabura L.*) terhadap Penurunan Kadar Kolesterol Total Tikus Putih Jantan (*Rattus norvegicus L.*) yang Diinduksi Pakan Tinggi Lemak." *Biocelebes* 12 (1).

Putri, E. P. K., Hamzah, B., & Rahman, N. 2013. "Analisis Kualitatif Zat Bioaktif pada Ekstrak Daun Alpukat (*Persea americana Mill*) dan Uji Praklinis dalam Menurunkan Kadar Glukosa Darah pada Mencit (*Mus musculus*)." *Jurnal Akademika Kimia* 2 (3): 119–27.

Putri, YOSI IRENE. 2014. "Hubungan Karakteristik dan Total Energi dengan Kejadian Sindroma Metabolik pada Orang Dewasa di Balai Laboratorium Kesehatan Provinsi Sumatera Barat Tahun 2014."

Qamariah, Nurul, Rezqi Handayani, and Susi Novaryatiin. 2019. "Peningkatan Pengetahuan dan Keterampilan Ibu Rumah Tangga dalam Pengolahan Tanaman Obat Keluarga (TOGA) sebagai Ramuan Obat Tradisional." *PengabdianMu: Jurnal Ilmiah Pengabdian Kepada Masyarakat* 4 (1): 50–54. https://doi.org/10.33084/pengabdianmu.v4i1.692.

Risky, Igri Septian, ; Indri Kusharyanti, and Mitra Handini. 2014. "Uji Efek Ekstrak Etanol 70% Daun Bawang Kucai (*Allium tuberosum Rottl. Ex Spreng*) terhadap Penurunan Low-Density Lipoprotein (LDL) pada Serum Darah Tikus Putih Jantan (*Rattus novergicus*) Galur Wistar."

Risna, Yayuk Kurnia. 2012. "Pengaruh Pemberian Tepung Daun dan Tepung Buah Mengkudu (*Morinda citrifolia*) dalam Ransum terhadap Kadar Kolesterol Daging Itik." *LENTERA*. Vol. 12.

Rivai, H. 2021. "Petai Cina (*Leucaena leucocephala*): Penggunaan Tradisional, Fitokimia, dan Aktivitas Farmakologi."

Rosidah, Idah, Humiaty Bahua, Rima Mufidah, and Olivia Bunga Pongtuluran. 2015. "Pengaruh Kondisi Proses Ekstraksi Batang Brotowali (*Tinospora crispa (L) Hook.f & Thomson*) terhadap Aktivitas Hambatan Enzim Alfa Glukosidase." *Media Penelitian Dan Pengembangan Kesehatan* 25 (4). https://doi.org/10.22435/mpk.v25i4.4586.203-210.

Sadik, F. 2021. "Uji Efektivitas Ekstrak Etanol Daun Jarak Pagar (*Jatropha curcas. L*) sebagai Antihipertensi pada Tikus." *Kieraha Medical Journal* 3 (2).

Sakaria, H., Rumi, A., & Masyita, A. A. 2021. "Studi Etnofarmakologi Obat Tradisional Tekanan Darah Tinggi di Desa Onepute Kecamatan Petasia Barat Kabupaten Morowali Utara." *Journal Of Islamic Pharmacy* 6 (1): 22–27.

Salsabila, I. 2021. "Pengaruh Pemberian Daun Sirsak terhadap Penyakit Hipertensi sebagai Antihipertensi." *Jurnal Kesehatan Masyarakat* 1 (02): 27–32.

Saragi, Desi Renika. 2018. "Formulasi Handsoap Gel Dari Ekstrak Etanol Daun Kecombrang (*Etlingera elatior (Jack*) ." *Program Studi DIII Farmasi*

Setyawan, N. R., Elyani, H., & Purnomo, Y. 2021. "Efek Ekstrak Etanol Daun Gedi Merah (*Abelmoschus manihot (L.) Medik*) terhadap Kadar Sel T Cd4+ dan Tumor Necrosis Factor Alfa Tikus Model Diabetes Melitus Tipe 2" 2.

Siswanto, Budi, Ranti Dwi Astriani, and Reza Tp Abstraks. 2016. "Uji Aktivitas Nephrorotektif Ekstrak Air Daun Afrika (*Vernonia amygdalina*) pada Tikus Model Gagal Ginjal." *Jurnal Medikes*. Vol. 3.

Sogandi, S., & Rabima, R. 2019. "Identifikasi Senyawa Aktif Ekstrak Buah Mengkudu (*Morinda citrifolia L.*) dan Potensinya Sebagai Antioksidan." *Jurnal Kimia Sains Dan Aplikasi* 22 (5): 206–12.

Sri Hartati. 2019. "Tanaman Hias Berkhasiat Obat. " *Edited by sri hartati. 1st ed. Vol. 1. IPB Press.*

Tandi, J. 2016. "Hiperkolesterolemia-Diabetes." *Indonesian Journal Of Pharmaceutical Science And Technology* 5 (1).

Tubagus, Tanza A, Lidya I Momuat, and Julius S Pontoh. 2015. "Kadar Kolesterol Plasma Tikus Wistar pada Pemberiak Ekstrak Etanol dan Heksana dari Daun Gedi Merah (*Abelmoschus manihot L.*)." *Jurnal MIPA Unsrat Online*. Vol. 4.

Wicaksono, R. R., & Sulistiono, E. 2021. "Efektivitas Ekstraksi Tanaman Lidah Mertua dan Sereh dalam Mereduksi Kadar Co dalam Ruangan." *Jurnal Kesehatan Lingkungan Indonesia* 20 (2): 128–36.

Yusuf, Alfian. 2014. "Faktor-Faktor yang Berhubungan dengan Sindrom Metabolik Pada Penderita Rawat Jalan di RSUD Ulin Banjarmasin." *Jurnal Skala Kesehatan*. Vol. 5.

Zubaidatul Muqowwiyah, Lilik, Ratna Kumala Dewi, and Uin Sayyid Ali Rahmatullah. 2021. "Potensi Ekstrak Daun Alpukat sebagai Anti Kolesterol." *Info Artikel ABSTRAK* http://ejournal.iainponorogo.ac.id/index.php/jtii.