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Abstract

Ethnopharmacological research is an approach to exploring the local knowledge of specific communities regarding the use of medicinal plants. This article discusses the use of cinnamon (*Cinnamomum*) as an effective alternative medicine in several regions in Indonesia. The method used is data collection through searching for literature published in scientific research articles and journals. A literature search was conducted using search engines posted on several sites, such as Google Scholar, Pubmed, and Science Direct. Based on the review conducted, it can be concluded that the *Cinnamomum* genus is widely used by various ethnic groups in Indonesia as a natural ingredient to help control blood glucose levels and is used as an alternative supplement for diabetes mellitus sufferers. Among the species from the *Cinnamomum* genus that have the potential to help prevent blood glucose levels are *Cinnamomum burmanii*, *Cinnamomum verum*, *Cinnamomum tamala*, and *Cinnamomum zeylanicum*.

Keywords: nanopharmaceuticals, cinnamon, cinnamomum, antidiabetic

1. Introduction

Ethnopharmacy is a scientific discipline that combines traditional knowledge and medicinal practices carried out by a particular ethnic group or society with modern scientific research. This field studies the use of plants, minerals, animals, and other natural ingredients in traditional medicine and knowledge systems and medicinal practices related to local culture and wisdom. The main goal of ethnopharmacy is to understand the conventional knowledge inherent in specific communities in their traditional medicine, as well as analyze the effectiveness and safety of using these natural ingredients. Research in ethnopharmaceuticals involves gathering information about medicinal plants, their traditional uses, processing methods, dosages, and possible side effects (Roudotuljannah & Azizah, 2019).

Ethnopharmacy not only studies the use of natural ingredients in traditional medicine but also pays attention to the cultural, spiritual, social, and economic contexts in which these medicinal practices occur. Research in ethnopharmaceuticals involves collaboration between scientists, traditional practitioners, and local communities. This is important to ensure respect for local wisdom and maintenance of traditional knowledge to understand and utilize natural resources sustainably. A critical aspect of ethnopharmacy is the documentation of traditional knowledge, which is vulnerable to loss of information. Traditional healing practices are often unwritten, and this knowledge is passed down orally from generation to generation (Mandasari, 2018).

Cinnamon (*Cinnamomum verum*) is a spice that is widely used in traditional medicine in Indonesia. Cinnamon comes from the Lauraceae family and can be found in several regions in Indonesia, such as Sumatra, Java, and Kalimantan. In Indonesia, cinnamon has been used for a long time in various traditional medicinal practices. Cinnamon has a distinctive taste and aroma as well as various potential pharmacological properties. The part generally used is cinnamon bark which is dried and ground into powder or made into small

pieces (Rodiah, 2018).

Cinnamon (*Cinnamomum verum*) is a plant that has many potential benefits in traditional medicine. Apart from being used in traditional medicine, cinnamon is also often used as an additional ingredient in food, drinks and health products. The aroma and taste of cinnamon gives a distinctive touch to certain dishes and drinks (Helmalia et al., 2019), however, the use of cinnamon in ethnopharmaceutical practices in several regions in Indonesia has not been comprehensively researched.

Although cinnamon has been widely used in traditional medicine, scientific research supporting these claims is limited. Research exploring the use of cinnamon in ethnopharmaceutical practices in several regions in Indonesia will provide valuable insight into the potential of this plant in traditional medicine. This research aims to bridge the existing knowledge gap by studying the use of cinnamon in depth in ethnopharmaceutical practices in several regions in Indonesia. Through this research, it is hoped that relevant data and information can be collected about the use of cinnamon, the processing methods used, and the effects felt by local people after consuming it. The main aim of this research is to collect comprehensive data on the use of cinnamon in ethnopharmaceutical practices in several regions in Indonesia. The information obtained will provide a better understanding of the potential and benefits of cinnamon in traditional medicine, as well as provide a basis for further research into the effectiveness and safety of its use in modern medicine.

2. Method

The research was carried out by collecting data through searching for literature that has been published in scientific research articles and journals. A literature search was carried out using search engines published on several sites, such as Google Scholar, Pubmed and Science Direct. This mini review aims to examine the *Cinnamomum* genus which has the potential to have antidiabetic activity by comparing several species found in the *Cinnamomum* genus from previously published research results. It is hoped that the results of this research will provide an illustration in determining the use of more optimal species for antidiabetic bioactivity.

3. Results and Discussion

Cinnamon contains protein, fiber, calcium, iron, potassium, selenium, phosphorus, vitamin A, vitamin B, vitamin K, as well as substances with antioxidant, antibacterial and anti-inflammatory properties (Putri, 2014). Thanks to its contents, it is not surprising that cinnamon has so many health benefits. Here are some of them:

- a) Reduces inflammation and pain. The antioxidant polyphenol and flavonoid content in cinnamon helps overcome inflammation, accelerates wound healing, and prevents damage to cells and body tissue due to free radicals. Meanwhile, the pain relieving effect produced by cinnamon can be used to treat aches and pains in sufferers of headaches, toothaches, joint and muscle pain.
- b) Lowers blood sugar
Cinnamon extract can lower blood sugar and keep it stable. In addition, cinnamon is known to improve the performance and effectiveness of the insulin hormone in people with type 2 diabetes, as well as preventing diabetes and insulin resistance in healthy individuals.
- c) Maintain heart health
Cinnamon extract has the ability to reduce levels of bad cholesterol (LDL) and triglycerides, which are types of bad fats that can cause blockage of blood vessels (atherosclerosis). These benefits make cinnamon a good herbal medicine for reducing the risk of cardiovascular disease, such as stroke and heart disease.

- d) Blood pressure control
 Cinnamon contains a lot of potassium and antioxidants so it has a good effect in controlling blood pressure and preventing hypertension. To maximize these benefits, you should adopt a healthy lifestyle, namely exercising regularly, not smoking, consuming balanced nutritious food, and limiting salt intake.
- e) Fights fungal and bacterial infections. The active ingredient cinnamaldehyde found in cinnamon is thought to help fight various infections, such as fungal infections that cause respiratory problems and bacterial infections that cause tooth decay and bad breath.

Apart from that, cinnamon can also be used as a traditional medicine in the treatment of various diseases, as shown in the following Table 1. Table 1

Research Data on the Use of the Cinnamomum Genus in Indonesia

No	Name of Regional Location	Species Name	Parts Used	Utility	Tribes	References
1.	Kerinci Regency, Jambi Province	<i>Cinnamomum burmani</i>	Parts of young leaves, mature leaves, old leaves, twig bark, twig bark and bark	Antioxidant	Inner Minangkabau Malay	Latief et al. (2013)
2.	South Maja Village, Maja District, Majalengka Regency.	<i>Cinnamomum burmani</i>	Parts of young leaves, mature leaves, old leaves, twig bark, twig bark and bark	Antidiabetic	Sunda	Roudotuljannah & Azizah (2019)
3.	Palu Sulawesi	<i>Cinnamomum burmani</i> / <i>Cinnamomum Cassiavera</i>	Parts of Young Leaves, Mature Leaves, Old Leaves, Twig Bark, Branch Bark, and Stem Bark	Anti Fungus	Kaili	Handayani et al. (2022)
4.	Talaga Jaya Gorontalo	<i>Cinnamomum burmani</i>	Twig Bark, Branch Bark, and Bark	Antihypertension	Gorontalo	Nuryanti et al. (2015)
5.	Kedungkandang Malang City	<i>Cinnamomum burmani</i>	Parts of young leaves, mature leaves, old leaves, twig bark, twig bark and bark	Healing Postpartum Wounds	Java	Mandasari (2018). Wally (2020).
6.	Tegal	<i>Cinnamomum burmani</i>	Parts of young leaves, mature leaves, old leaves, twig bark, twig bark and bark	Anti-Bacterial (Healing Wound Infection Diarrhea)	Java	Ratu (2014)
7.	South Lampung	<i>Cinnamomum burmani</i>	Twig Bark, Branch Bark, and Bark	Mouthwash	Hajimena, Natar	Gunawan et al. (2020)
8.	Surakarta, Boyolali, Sukoharjo, Wonogiri, Sragen, and Klaten.	<i>Cinnamomum burmani</i>	Twig Bark, Branch Bark, and Bark	Lowering Cholesterol	Java	Handayani et al. (2022)

Source: Processed data (2023)

Apart from the uses above, cinnamon is also believed to prevent dementia and

Alzheimer's disease, help fight the HIV virus, and inhibit the growth of cancer cells. (Adrian, 2018). Cinnamon can also be used in the treatment of diabetes by drinking boiled cinnamon water (Handayani et al., 2022). The chemical content is; essential oils, safrole, cinnamaldehyde, tannins, resins, calcium oxalate, flavonoids, triterpenoids and saponins. The benefits of cinnamon are as a medicine for gout, hypertension, ulcers, loss of appetite, flatulence and diabetes (Prapti & Desty, 2013). According to Ervina et al. (2016), cinnamon has antidiabetic effects. Cinnamon extract is used to treat type II diabetes which is characterized by insulin resistance. The main antidiabetic compounds are methylhydroxy chalcone polymer, cinnamaldehyde polymer, and procyanidin. Research conducted by Hastuti & Rustanti (2014) with the title "The effect of adding cinnamon on the antioxidant activity and total sugar content of the functional drink secang and stevia leaves as an alternative drink for type 2 diabetes" shows that the drink with the addition of 1.5% cinnamon is the best. This was liked by the panelists with very good assessments of color parameters as well as aroma and taste. This drink has a pH of 6.39; brightness (L*) 37.10; antioxidant activity 38.43%; and total sugar content of 4.77%.

The essential oil of *Cinnamomum camphora* and several other aromatic camphor-containing plants, such as sage, rosemary and basil which are widely used in traditional medicine, contain monoterpenes. Research has shown that some components of essential oils, especially monoterpenes have suppressive and antimutagenic effects on a number of human cancer cells including colon cancer, gastric cancer, liver tumors, breast cancer, leukemia, and others. Most cancer chemotherapy treatments are drugs that are highly cytotoxic to proliferating cancer cells as well as healthy cells that can be harmful to the body. With different mechanisms of action, essential oils with their monoterpene components can have some pharmacological tumor suppressor activity, mostly without causing harm to the body.

Research conducted by Ngadiwiyan, et al (2011) with the title "The potential of cinnamaldehyde isolated from cinnamon oil as an antidiabetic compound" As a result, cinnamaldehyde isolated from cinnamon oil has an IC₅₀ value of 27.96 ppm compared to the α -glucosidase enzyme, so it has great potential to become a compound that inhibits the activity of the α -glucosidase enzyme so that it can be developed into an anti-diabetic compound.

Another research conducted by Fatmalia (2017). With the title "The effect of consuming cinnamon on the blood glucose of diabetes mellitus sufferers in Lamongan plosong village" it shows that cinnamon can lower blood glucose levels because it contains flavonoids which can regulate blood glucose levels and increase the sensitivity of pancreatic beta cells to produce the hormone insulin. From the results of 20 samples of diabetes sufferers who received cinnamon infusion, it can be concluded that consumption of cinnamon infusion has an effect on reducing blood sugar in diabetes sufferers. Tambak Ploso Village.

This ethnopharmaceutical study revealed that cinnamon is rich in active compounds such as essential oils, antioxidants and other components. These compounds provide important health benefits in traditional medicine in Indonesia. The use of cinnamon in traditional medicine has been around for a long time and is believed to provide benefits in reducing inflammation, fighting infection, regulating blood sugar, and accelerating wound healing. However, it is important to note that the medicinal use of cinnamon must be supported by further scientific research to validate the claims (Zulfa et al., 2019).

Research conducted by Kumar et al. (2012), regarding the potential use of *Cinnamomum* as an antidiabetic, antioxidant and hypolipidemic was carried out with

Cinnamomum tamala, oil (CTO) in streptozotocin (STZ) induced in diabetic rats. GC-MS (Gas chromatography-mass spectro-metry) analysis showed 31 constituents where cinnamaldehyde was found as the main component (44.898%). CTO and cinnamaldehyde were administered orally to diabetic mice to study their effects in acute and chronic antihyperglycemic models. Body weight, oral glucose tolerance test and biochemical parameters viz. Glucose levels, insulin levels, liver glycogen content, glycosylated hemoglobin, total plasma cholesterol, triglycerides and antioxidant parameters in mice were estimated for all treatment groups and compared with the diabetic control group. The treatments carried out were CTO (100 mg/kg and 200 mg/kg), cinnamaldehyde (20 mg/kg) and glibenclamide. (0.6 mg/kg) in each group of diabetic mice given for 28 days can reduce blood sugar in streptozotocin-induced diabetic mice. The results of CTO and cinnamaldehyde were found to be comparable to the standard drug glibenclamide. In vitro antioxidant studies on CTO using various models showed significant antioxidant activity. In vivo antioxidant studies in STZ-induced diabetic mice revealed a decrease in malondialdehyde (MDA) and an increase in reduced glutathione (GSH). CTO has significant antidiabetic, antioxidant and hypolipidemic activities. The study showed that oral administration of Cinnamomum tamala oil and its main constituents have potential antidiabetic, antihyperlipidemic and antioxidant effects in STZ-induced diabetes. CTO for use as a natural oral agent with antidiabetic, antihyperlipidemic and antioxidant effects.

Research by Hen et al. (2010) that intake of cinnamon (*Cinnamomum zeylanicum*) can relieve the pathological condition of diabetes. However, it remains to be further discussed whether the beneficial effects depend on insulin or insulin mimetics. The research in question aims to determine the insulin effects of cinnamon. Streptozotocin-induced diabetic rats were divided into four groups and administered orally with cinnamon liquid extract (CE) for 22 days. Diabetic mice that took CE at a dose of more than 30 mg/kg/day did not develop hyperglycemia and nephropathy, and these mice were found to have upregulation of Uncoupling Protein-1 (UCP-1) and glucose transporter 4 (GLUT4) in adipose tissue in the muscle. This was verified using 3T3-L1 adipocytes where CE regulates GLUT4 translocation and increases glucose uptake. CE demonstrated the anti-diabetic effect of insulin through two mechanisms, namely upregulation of mitochondrial UCP-1, and increased GLUT4 translocation in muscle and adipose tissue.

Chakraborty et al. (2010) have evaluated the anti-hyperglycemic activity of liquid extract of *Cinnamomum tamala* leaves (CTLEt) on the blood glucose of albino mice. CTLEt was administered at a dose of 125 and 250 mg/kg body weight, respectively, to streptozotocin-induced diabetic mice for 3 weeks. Diabetic mice weigh less than normal mice. Administration of the extract at a dose of 250 mg/kg body weight/day provides a decrease in fasting blood glucose and urine sugar levels, accompanied by a simultaneous increase in body weight. This extract results in a decrease in the production of peroxidation, namely thiobarbituric acid. A significant decrease in glutathione and glycogen content after induction of diabetes was accompanied by an increase in liver tissue of STZ-diabetic mice treated with CTLEt. STZ-diabetic mice treated with CTLEt (250mg/kg) significantly returned to normal. The ascorbate and carotenoid content of *C. tamala* leaves shows that there is high antioxidant activity. It was shown that CTLEt induced antihyperglycemic and antioxidant activity in STZ-diabetic mice.

4. Conclusion

Based on the review carried out, it can be concluded that (1) the *Cinnamomum* genus is widely used by various ethnic groups in Indonesia as a natural ingredient to help control blood sugar and can be used as an alternative supplement for diabetics. (2) *Cinnamomum burmanii* and *Cinnamomum verum* are proven to reduce inflammation, lower blood sugar, maintain heart health, control blood pressure, and fight infection. (3) *Cinnamomum tamalaha*s antidiabetic, anti-hyperlipidemic and antioxidant effects on streptozotocin (STZ) induced diabetes. (4) *Cinnamomum zeylanicum* can relieve the pathological condition of diabetes through two mechanisms, namely increased regulation of mitochondrial Upregulation Uncoupling Protein-1 (UCP-1), and increased translocation of glucose transporter 4 (GLUT4) in muscle and adipose tissue. (5) *Cinnamomum tamala*It contains high antioxidant activity which can induce anti-hyperglycemic activity while also having antioxidant activity.

5. References

- Adrian, K. (2018). Berbagai Manfaat Kayu Manis untuk Kesehatan dan Efek Sampingnya. (diakses tanggal 22 Agustus 2023, pukul 12.29, situs: <https://www.alodokter.com/manfaat-kayu-manis-belum-sepenuhnya-manis>)
- Dewantari, R., Lintang, M., & Nurmiyati, N. (2018). Jenis Tumbuhan yang Digunakan sebagai Obat Tradisional Di Daerah Eks-Karesidenan Surakarta. *Bioedukasi UNS*, 11(2), 117-122.
- Edris, A. E. (2007). Pharmaceutical and therapeutic potentials of essential oils and their individual volatile constituents: a review. *Phytotherapy Research: An International Journal Devoted to Pharmacological and Toxicological Evaluation of Natural Product Derivatives*, 21(4), 308-323.
- Fatmalia, N. (2017). Pengaruh konsumsi kayu manis terhadap glukosa darah penderita diabetes mellitus di tambak plosolamongan. *Journals Of Ners Community*, 8(1), 106-111. <http://journal.unigres.ac.id/index.php/JNC/article/view/416> diakses 22/08/2023
- Gunawan, I., Ardini, D., & Makdalena, M. (2020). Pelatihan Pembuatan Obat Kumur (Mouthwash) Kayu Manis (*Cinnamomum Burmanii*) Dan Daun Sirih (*Piper Betle L.*) Bagi Kelompok Kader Posyandu Desa Hajimena. *Jurnal Pengabdian Kepada Masyarakat Sakai Sambayan*, 4(1), 14-19. <http://jss.lppm.unila.ac.id/index.php/ojs/article/view/198> diakses 22/08/2023
- Handayani, V., Dahlia, A.A., & Nurvadillah, A.F., (2022). Studi Etnofarmasi Tanaman Obat Tradisional Pada Masyarakat Di Kecamatan Penrang, Kabupaten Wajo, Provinsi Sulawesi Selatan. *As-Syifaa*, 14(1):72-83.
- Hastuti, A. M., & Rustanti, N. (2014). Pengaruh penambahan kayu manis terhadap aktivitas antioksidan dan kadar gula total minuman fungsional secang dan daun stevia sebagai alternatif minuman bagi penderita diabetes melitus tipe 2. *Journal of nutrition college*, 3(3), 362-369.
- Helmalia, A. W., Putrid, P., & Dirpan, A. (2019). Potensi rempah-rempah tradisional sebagai sumber antioksidan alami untuk bahan baku pangan fungsional. *Canrea Journal: Food Technology, Nutritions, and Culinary Journal*, 26-31. <http://agritech.unhas.ac.id/ojs/index.php/canrea/article/view/113> diakses 22/08/2023
- Latief, M., Tafzi, F., & Saputra, A. (2013). Aktivitas Antioksidan Ekstrak Metanol Beberapa Bagian Tanaman Kayu Manis (*Cinnamomum Burmani*) Asal Kabupaten Kerinci Provinsi Jambi. *Prosiding SEMIRATA 2013*, 1(1). <https://jurnal.fmipa.unila.ac.id/semirata/article/view/816> diakses 22/08/2023

- Mandasari, V. F. (2018). Studi Etnofarmasi Penggunaan Tumbuhan Obat sebagai Antidiare oleh Masyarakat Suku Tengger Kecamatan Tosari Kabupaten Pasuruan. <https://repository.unej.ac.id/handle/123456789/86404> diakses 22/08/2023
- Wu, M., Ni, L., Lu, H., Xu, H., Zou, S., & Zou, X. (2020). Terpenoids and their biological activities from *Cinnamomum*: a review. *Journal of Chemistry*, 2020, 1-14.
- Musfiroh, I., Wilar, G., Rosalianti, E., Hadirana, A. A., & Hanifah, Z. S. (2022). Edukasi Tentang Diabetes Melitus dan Pemanfaatan Kayu Manis sebagai Tanaman Obat Antidiabetes Kepada Masyarakat. *Journal of Community Development*, 3(1), 42-50.
- Ngadiwiyana, I., Nor Basid, A. P., & Purbowatiningrum, R. S. (2011). Potensi sinamaldehyd hasil isolasi minyak kayu manis sebagai senyawa antidiabetes. *Majalah Farmasi Indonesia*, 22(1), 9-14.
- Nuryanti, S., Jura, M. R., & Nursucianti, N. (2015). Uji Aktivitas Anti Jamur Ekstrak Kayu Manis (*Cinnamomum burmannii* Blume) Terhadap Jamur *Candida Albicans*. *Jurnal Akademika Kimia*, 4(3), 123-128.
- Prabowo, Z., Tivani, I., & Purwantiningrum, H. (2021). Uji Aktivitas Antibakteri Kombinasi Ekstrak Etanol Kayu Manis (*Cinnamomum burmannii*) Dan Daun Salam (*Syzygium Polyanthum* Wight) Terhadap Bakteri *Escherichia coli* (Doctoral dissertation, Politeknik Harapan Bersama Tegal). <http://eprints.poltektegal.ac.id/262/> diakses 22/08/2023
- Putri, N. F. U. (2014). Pengaruh Rebusan Kayu Manis (*Cinnamomum burmannii*) Terhadap Pertumbuhan Bakteri *Shigella dysenteriae* (Doctoral dissertation, Universitas Muhammadiyah Surabaya). <http://repository.um-surabaya.ac.id/id/eprint/1287>
- Ranasinghe, P., Piger, S., Premakumara, G. S., Galappaththy, P., Constantine, G. R., & Katulanda, P. (2013). Medicinal properties of 'true' cinnamon (*Cinnamomum zeylanicum*): a systematic review. *BMC complementary and alternative medicine*, 13, 1-10.
- Rizki, F., & Gz, S. (2013). The miracle of vegetables. <https://books.google.co.id/> diakses 22/08/2023
- Rodiah, R. A. (2018). Pengaruh Suplementasi Rempah (Kayu Manis Dan Kunyit) Dan L-Carnitine Dalam Ransum Terhadap Bobot Dan Persentase Karkas, Bagian-Bagian Karkas Dan Lemak Abdominal Itik Lokal Jantan (Doctoral dissertation, Universitas Mercu Buana Yogyakarta). <http://eprints.mercubuana-yogya.ac.id/id/eprint/3926/>
- Roudotuljannah, Y., & Azizah, N. (2019). Studi Etnofarmasi Tumbuhan Yang Berkhasiat Obat Di Kampung Adat Cireundeu. *HERBAPHARMA: Journal of Herb Pharmacological*, 1(2), 44-51.
- Hamidpour, R., Hamidpour, M., Hamidpour, S., & Shahlari, M. (2015). Cinnamon from the selection of traditional applications to its novel effects on the inhibition of angiogenesis in cancer cells and prevention of Alzheimer's disease, and a series of functions such as antioxidant, anticholesterol, antidiabetes, antibacterial, antifungal, nematocidal, acaracidal, and repellent activities. *Journal of traditional and complementary medicine*, 5(2), 66-70.
- Utami, P., Puspaningtyas, D. E., & Gz, S. (2013). *The miracle of herbs*. AgroMedia.
- Chakraborty, U., & Das, H. (2010). Antidiabetic and antioxidant activities of *Cinnamomum tamala* leaf extracts in STZ-treated diabetic rats. *Global Journal of Biotechnology & Biochemistry*, 5(1), 12-18.
- Kumar, S., Kumari, R., & Mishra, S. (2019). Pharmacological properties and their medicinal uses of *Cinnamomum*: A review. *Journal of Pharmacy and Pharmacology*, 71(12), 1735-1761.

- Kumar, S., Vasudeva, N., & Sharma, S. (2012). GC-MS analysis and screening of antidiabetic, antioxidant and hypolipidemic potential of *Cinnamomum tamala* oil in streptozotocin induced diabetes mellitus in rats. *Cardiovascular diabetology*, 11(1), 1-11.
- Wally, H. F. (2020). Pengaruh Pemberian Kayu Manis (*Cinnamomum Burmani*) Terhadap Penyembuhan Luka Perinium di PMB Bidan Sumarya Kecamatan Kedungkandang Kota Malang , Poltekkes RS dr. Soepraoen. <http://repository.itsk-soepraoen.ac.id/565/> diakses 22/08/2023
- Zulfa, L. F., Sunarno, S., Alifah, S., & Prawitasari, S. (2019). Suplemen kombucha dan kayu manis untuk menghasilkan daging broiler kaya antioksidan dan rendah kolesterol. *Jurnal Biologi Tropika*, 2(1), 34-40.