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RESEARCH ARTICLE

# Identification of bioactive compound of the essential oils of *Cinnamomum burmannii* from several areas in Indonesia by gas chromatography–mass spectrometry method for antidiabetic potential

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## ABSTRACT

**Background:** Cinnamon is a flavoring ingredient that has been used in daily routines as a spice. Data from various literature on cinnamon reveal that it mainly contains essential oils and important compounds such as cinnamaldehyde, eugenol, cinnamic acid, and cinnamate. These compounds are used as an anti-inflammatory, antioxidant, antidiabetic, and many other beneficial activities. **Aims and Objectives:** This research tries to reveal the latest comprehensive bioactive compounds that are up to date on the essential oils of *Cinnamomum burmannii* which are related to phytochemicals and various pharmacological activities from several regions in Indonesia. **Materials and Methods:** Steam distillation was used for extraction of the essential oil. The identification of active compound from the essential oil was conducted using gas chromatography–mass spectrometry techniques. **Results:** We found that there was able to clarify the crucial role of cinnamaldehyde as a potent antidiabetic compound of the *C. burmannii's* essential oil, the largest percentage of cinnamaldehyde on essential oil was from Kerinci, Jambi Province. **Conclusion:** Therefore, from our study, we would like to conclude that there is a link between the compound of *C. burmannii's* essential oil and antidiabetic potential.

**KEY WORDS:** *Cinnamomum burmannii*; Antidiabetic; Essential Oil; Cinnamaldehyde; Gas Chromatography–Mass Spectrometry Techniques

## INTRODUCTION

Diabetes mellitus (DM) is a metabolic disease characterized by hyperglycemia due to insufficiency in the amount and function of insulin so that abnormalities of carbohydrate, fat, and protein metabolism occur. DM is a non-communicable disease in Indonesia that needs attention because the incidence and its incidence are increasing and can be fatal. Factors associated with an increase in the prevalence of DM in Indonesia include changes in people's diet, an increase in the number of children with obesity, urbanization, smoking habits, and lack of exercise. Various acute and chronic complications can affect DM patients due to oxidative stress caused by hyperglycemia conditions.[1] The 8$^{th}$ edition of the International Diabetes Federation at the 2017 edition revealed that the number of diabetics in Indonesia had reached 10.3 million people.[2] As a non-communicable disease with a relatively high number of sufferers, diabetes is one of the diseases that grab the attention of many people. Indonesia government currently focusing on controlling diabetes risk factors through promotive and preventive efforts. One of the efforts to promote and prevent diabetes

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is the use of natural materials such as *Cinnamomum burmannii's* essential oil.[3]

Cinnamon is used as a traditional Chinese medicine that has been used for thousands of years. Cassia cinnamon is often added to food preparation to enhance taste and aroma. In recent years, this herb has been reported to have strong antioxidants, antimicrobials, and antipyretic properties. Much attention has been given to the efficacy of cinnamon which can provide benefits for diabetic patients who resemble insulin action. Interest in cinnamon as a potentially beneficial treatment for Type-2 diabetes began almost 28 years ago.[4,5] Since then, many *in vitro* and *in vivo* studies have explained the effect of cinnamon on insulin signal transduction. Most experiments state that cinnamon is a natural insulin sensitizer and an inhibitor of advanced glycation products.[6] In addition, cinnamon has the ability to reduce serum glucose, triglycerides, low-density lipoprotein cholesterol, and total cholesterol in Type-2 diabetics.[7]

Therefore, the present study was designed to extract the essential oil of *C. burmannii's* bark from several areas in Indonesia. The active compound of *C. burmannii's* barks essential oils by gas chromatography–mass spectrometry (GC–MS) method is expected to show antidiabetic potential. It will help to reduce the progression of the disease and the emergence of complications as a result of preventing oxidative stress, but little research has been done on this. Research on the essential oil content of *C. burmannii's* is expected to help determine the source of *C. burmannii's* which can help resolve DM cases in Indonesia.

## MATERIALS AND METHODS

### Ethical Approval

*C. burmannii's* essential oils were used in this study; hence, ethical approval was not necessary. *C. burmannii's* essential oils were collected from three areas in Indonesia.

### Sample Preparation

*C. burmannii's* barks were collected from Kerinci, Jambi Province, Padang, West Sumatra Province, and Karanganyar, Central of Java Province, Indonesia, on February–June 2018. The bark was then cut into pieces and ground to produce coarse powder using a grinder. Ground samples had been kept in closed container and stored at room temperature until further used.

### Steam Distillation

Essential oil from the bark of *C. burmannii* was extracted using a steam distillation technique. Liquid-liquid extraction is carried out for distillates collected to separate essential oils from water by adding dichloromethane to a mixture of water and essential oils in a separating funnel in a ratio of 1:3. Essential oils are collected and dried with anhydrous sodium sulfate to remove water traces. The extracted essential oil is stored at 4°C until it is used further.

### Compound Identification

Isolated compound was identified by GC–MS analysis. The GC–MS analysis of the essential oil was performed using Agilent 7890A GC system equipped with MS detector 5975C inert XL EI/CI MSD having automatic sampler circulating tumor cells analysis CombiPAL robotic arm. For GC/MS detection, an electron ionization system with ionization energy of 70 eV was used. Helium gas was used as the carrier gas at a constant flow rate of 1 ml/min. The inlet temperature was set at 270°C. The specification of the capillary column used was Agilent 19091S–433: 1548, 52849 HP-5MS 5% Phenyl Methyl Silox 30 m 250 μm × 0.25 μm HP-5MS. The oven temperature was programmed from 80°C to 300°C. The diluted samples (1/100, v/v, in Hexane) of 2 μL were injected.

## RESULTS

The chemical composition of phytocomponents present in *C. burmannii* bark essential oil is presented in Table 1. A total of three major different components, with different retention times, eluted from the GC column as shown by the chromatogram [Figures 1, 2, and 3] and further analyzed with MS electron impact voyager detector. Identification of constituents is carried out on the basis of their retention time and spectrum search for mass libraries that a mass spectrograph of the identified constituents is given in Table 1. The relative number of each component calculated based on the GC peak area. Comparison

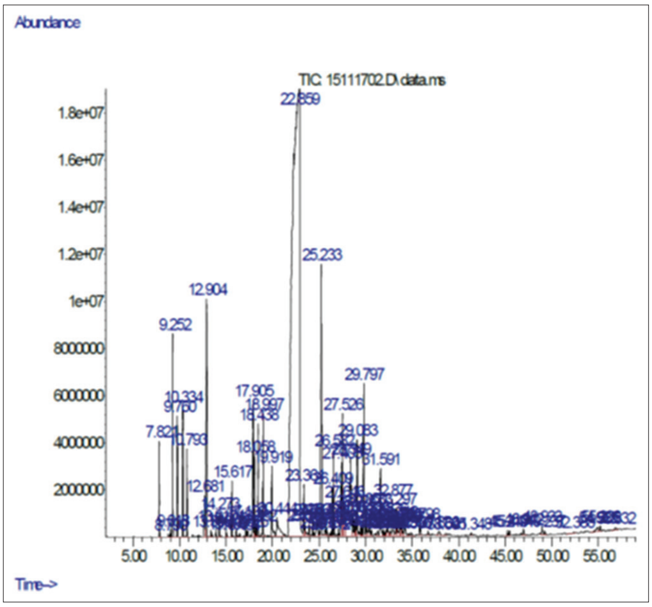


**Figure 1:** Gas chromatography–mass spectrometry chromatogram of the essential oil of *Cinnamomum burmannii* shows that one highest peak of cinnamaldehyde compound is present from Karanganyar, Central of Java

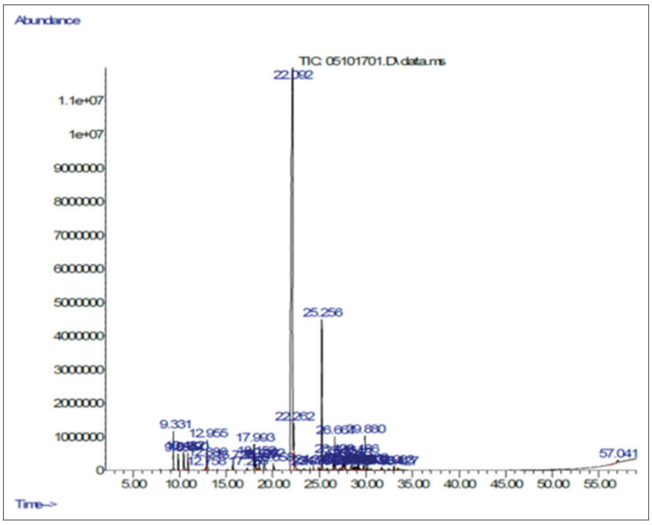


**Figure 2:** Gas chromatography–mass spectrometry chromatogram of the essential oil of *Cinnamomum burmannii* shows that one highest peak of cinnamaldehyde compound is present from Padang, West Sumatra

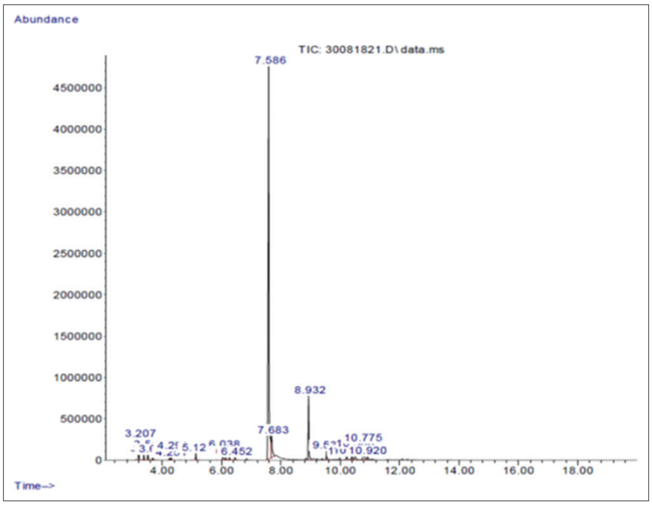


**Figure 3:** Gas chromatography–mass spectrometry chromatogram of the essential oil of *Cinnamomum burmannii* shows that one highest peak of cinnamaldehyde compound is present from Kerinci, Jambi

of GC–MS spectrographs was obtained by bank data instruments along with computers that match WILEY 275 and the National Institute of Standards and Technology (NIST3.0) the library is provided with a computer that controls GC–MS the system reveals that the cinnamon essential oil contained different organic compounds eluted at different retention times depending on the boiling point of the eluted component. That Instrument data banks are also able to identify the existence of cinnamaldehyde, naphthalene, and copaene as mayor component of the essential oil of *C. burmannii* from several areas in Indonesia [Table 1].

## DISCUSSION

Research on antidiabetic materials from nature has been carried out by several researchers.[8] The use of simplicia cinnamon can be used as an antidiabetic material using data from traditional medicine based on empirical experience. Active ingredients such as cinnamaldehyde, cinnamate acid, cinnamic acid, and eugenol in the form of *Cinnamomum burmannii* oil (CBO) have various therapeutic effects. Various aspects of the metabolic syndrome including high blood glucose, dyslipidemia, obesity, and high blood pressure can be corrected using a CBO. Some studies on cinnamon show that this plant is a cardiovascular protective agent and has a potential effect in reducing the complications of metabolic syndrome due to its antidiabetic, antioxidant, anti-inflammatory, and beneficial effects in lipid profiles.[9,10] As the main feature of cinnamon is the effect of mimetic insulin.[11] Evaluation of the beneficial effects of cinnamon on the treatment of Type 2 diabetes and insulin resistance began almost 28 years ago, Khan *et al*. extracted unknown components from cinnamon and named them as insulin potentiation factors.[4] Cinnamon extract can activate insulin receptors and inhibit insulin phosphatase receptors as enhancing insulin receptor function and enzyme inhibitors that block insulin attachment receptors. This condition causes phosphorylation of insulin receptors and increases their effects.[11] The main active component in cinnamon for the antidiabetes effect is in extracting water as a type of double procyanidin connected in water polymer. They are able to increase glucose absorption, increase glycogen synthesis by activating glycogen synthase and inhibit glycogen synthase kinase 3β,[12] and reduce absorption of glucose in the small intestine by increasing the enzyme glucosidase and inhibiting intestinal ATPase.[13,14]

A group of researchers successfully demonstrated that aqueous cinnamon extract at doses of 30 and 300 mg/kg body weight of mice for 3 weeks increased the effect of insulin through increased glucose uptake in adipocytes and increased glucose use induced insulin receptor substrate (IRS)-1 level of tyrosine phosphorylation, stimulation of skeletal muscle insulin receptors, and the relationship of IRS-1 with phosphatidylinositol 3-kinase carried out *in vivo* and *in vitro*.[15] Compounds that have other cinnamon polyphenols such as routine, catechins, quercetin, and kaempferol have activities such as insulin.[6]

Other researchers showed that cinnamic acid was able to increase glucose tolerance at a dose of 10 mg/kg in mice comparable to glibenclamide at a dose of 5 mg/kg, but *in vitro* studies showed that glucose stimulation of insulin secretion with cinnamic acid was very high compared to cinnamaldehyde.[16] Cinnamaldehyde as a compound capable of regulating insulin receptor gene expression.[17] Modulation of mitochondrial physiology and increased cell metabolism are other cinnamon antidiabetes mechanisms.[18]

Hyperglycemia is often associated with the generation of reactive oxygen species which causes damage to oxidative action, especially in the heart, kidneys, eyes, nerves, liver,

**Table 1:** Chemical constituents of the essential oil of *Cinnamomum burmannii* from different areas of Indonesia

| Compound | Area origin | | |
|---|---|---|---|
| | Karanganyar (%) | Padang (%) | Kerinci (%) |
| Styrene | 0.62 | 0.00 | 0.00 |
| IR-α-pinene | 1.68 | 1.68 | 2.06 |
| Campene | 0.88 | 0.74 | 0.68 |
| Benzaldehyde | I.21 | 1.20 | 1.22 |
| ß-Pinene | 0.64 | 0.76 | 0.54 |
| Eucalyptol | 3.46 | 1.54 | 1.03 |
| Benzene propanol | 2.11 | 1.85 | 1.50 |
| Borneol | 0.70 | 1.01 | 0.49 |
| 3-Cyclohexen-1ol | 1.04 | 0.67 | 0.46 |
| p-Ment-1-eu-8-ol | 1.04 | 0.86 | 0.00 |
| Cinnamaldehyde | 61.16 | 64.15 | 72.67 |
| Benzene propanol | 0.89 | 0.00 | 0.00 |
| Copaene | 3.54 | 8.68 | 8.94 |
| Caryophyllene | 0.75 | 1.96 | 1.27 |
| 2H-1-Benzopyran-2-one | 1.16 | 0.34 | 0.00 |
| 2-Propen-1-ol, 3-phenyl-acetat | 1.46 | 1.12 | 0.00 |
| α-Caryophyllene | 0.55 | 0.29 | 0.00 |
| Naphthalene | 8.94 | 4.23 | 7.61 |
| α-Cubebene | 0.00 | 0.39 | 0.00 |
| Caryophyllene oxide | 0.98 | 0.36 | 0.00 |

small and large vessels, and the digestive system.[19] Increased plasma glucose levels in diabetic rats can be reduced by the use of *Cinnamomum* oil containing cinnamaldehyde, and the antihyperglycemic action of cinnamaldehyde is a result of insulin potentiation from beta-cells on Langerhans Island.[20] Several studies on the effects of oral administration of the cinnamon essential oil significantly reduced blood glucose levels in diabetic rats which can be caused by reversing insulin resistance or increasing insulin secretion by regenerating damaged pancreatic β-cells in diabetic rats induced by alloxan.[21] Other compounds such as flavonoids are also known to regenerate damaged β-cells in mice induced by alloxan and act as insulin secretagogues.[22] In this way, Anitha *et al*., 2012,[23] reported that flavonoids, steroids, terpenoids, and phenolic acids are known as bioactive antidiabetic components.

Studying the effects of *Cinnamomum* oil on initial investigations carried out using an acute antihyperglycemic model that showed a significant reduction in glucose levels.[24] Effects that can reduce glucose levels because *Cinnamomum* oil may be related to the mechanism of the pancreas (increased insulin secretion) and extra pancreas (peripheral utilization of glucose).[25] The reduction in hyperglycemia is influenced by the presence of cinnamaldehyde compounds as the main component in *Cinnamomum* oil activity.[26]

In short, this study provides evidence that *C. burmannii* from various regions in Indonesia contains active compounds that are effective in reducing glucose levels. In this study, it was recommended that diabetic individuals should use cinnamon in their food preparation regularly due to CBO activity.

## CONCLUSION

In general, the results concluded from this study indicate that all three regional plants of *C. burmannii* from Karanganyar, Padang, and Kerinci have shown potential antidiabetic. Most of the activity of this plant is due to their essential oils. The results of this study indicate that the use of this plant, as a spice in food or medicine for humans or as a nutraceutical, must be treated with caution and care must be taken in the use of other herbal spices preparations to complete phytochemicals and bioassays. This study revealed the potential of CBO to be used as a natural oral agent with an antidiabetic effect because it contains high levels of cinnamaldehyde.

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