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IDENTIFICATION OF ESSENTIAL OIL COMPOSITIONS IN CINNAMON OIL BY GC-MS METHOD

Bilal Yilmaz [1 *] and Leyla Guven [2]

Department of Analytical Chemistry [1], Department of Pharmaceutical Botany [2], Faculty of Pharmacy, Ataturk University, Erzurum, Turkey.

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Correspondence to Author:
Prof. Dr. Bilal Yilmaz

Department of Analytical Chemistry, Faculty of Pharmacy, Ataturk University, Erzurum, Turkey.

E-mail: yilmazb@atauni.edu.tr

ABSTRACT: Essential oils are obtained from plant material. The essence or aromas of plants are due to volatile or essential oils, many of which have been valued since antiquity for their characteristic odours. In this study, qualitative and quantitative analyses of the essential oil compositions in cinnamon oil were made by using gas chromatography-mass spectrometry (GC-MS). In this analysis, the main constituents of cinnamonoil are cinnamal (63.59%), eugenol (8.32%), cinnamyl acetate (7.48%), caryophyllene (6.88%), linalool (6.31%) and eucalyptol (2.57%). These six components account for 95.15% of the total relative content of the cinnamon oil. This research also demonstrated that the cinnamonoil is rich in cinnamal, eugenol, cinnamyl acetate, caryophyllene and linalool could be a good source for these compounds.

INTRODUCTION: Essential oils have been of the highest importance for fine perfumery applications, aroma, and cosmetic preparations for a long time because of their intense, pleasant, sweet, floral odour as well as their fixative properties. Essential oils may contain hydrocarbons, terpene alcohols, aldehydes, ketones, phenols, and esters [1-2]. An estimated 3000 essential oils are known, of which about 300 commercially important are destined chiefly for the flavours and fragrances market [3]. It has long been recognized that some essential oils have antimicrobial properties [4-10], antiviral [11], antimycotic [12-15], antitoxigenic [16-18], antiparasitic [19, 20] and insecticidal [21, 22] properties.

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Therefore, they have been applied in the fields of pharmacology, medical and clinical microbiology, phytopathology, and food preservation [24]. Techniques commonly employed for extracting essential research work concerned with cinnamon essential oil **Fig. 1** and physical-chemical characteristics of the oil concerned with its application to the product in pharmaceutical, food, perfumery industries have been studied by many scientists.

In recent research works apart from antioxidant and antimicrobial properties, the effect of antitumor activity of cinnamon in animals have been investigated [25, 26]. Gas chromatography-mass spectrometry (GC-MS) is the most popular method for the determination of essential oil composition. Components existing in the essential oil can be identified by a comparison of their relative retention time or indices and their mass spectra (MS). Identification of individual components of essential oils, however, is not always possible using

MS data alone often, different spectra are reported in a library for a single compound, with different common names or systematic names corresponding to an individual component sometimes apparent [27]. The aim of the present study was to investigate the chemical composition of essential oils in cinnamon oil consumed in Turkey using the GC-MS method. In this study, the sixteen chemical content of the essential oil composition in cinnamon oil was determined.

MATERIALS AND METHODS:

Chemicals and Reagents: Analytical purity chemicals were used in the study. α-thujene, β-pinene,α-pinene, eucalyptol, linalool, L-α-terpineol, cinnamal, α-phellandrene, α-terpinene, eugenol, caryophyllene, δ-cadinene, caryophyllene oxide, isoeugenol, cinnamyl acetate, and acetyl eugenol were purchased from Sigma-Aldrich (St. Louis, MO, USA). Cinnamon oil was obtained the pharmacy (Erzurum, Turkey).

GC-MS System: Chromatographic analysis were carried out on an Agilent 7820A gas chromatography system equipped with 5977 series mass selective detector, 7673 series autosampler, and chemstation (Agilent Technologies, Palo Alto, CA). HP-5 MS column with 0.25 µm film thickness (30 m × 0.25 mm I.D., USA) was used for separation. The temperatures of the inlet, transfer line, and detector were 250, 250 and 300 °C, respectively.

GC-MS Conditions: Different temperature programs were investigated for the GC-MS method. At the end of this investigation, the temperature program of the GC-MS was as follows: the initial temperature was 60 °C, held for 10 min, increased to 220 °C at a rate of 4.0 °C/min held for 10 min, increased to 240 °C at a rate of 1.0 °C/min and held for 1 min.

Identification of Components: Identification was based on the molecular structure, molecular mass, and calculated fragments. Interpretation on mass spectrum GC-MS was conducted using the database on National Institute of Standard and Technology (NIST), having more than 62,000 patterns. The name, molecular weight, and structure of the components of the test materials were ascertained.

The relative percentage amount of each component was calculated by comparing its average peak area to the total areas. The spectrum of the unknown component was compared with the spectrum of the component stored in the NIST Library Version (2005), Software, Turbo mass 5.2.

RESULTS AND DISCUSSIONS:

Method Development and Optimization: In this study, the GC-MS method was developed for the analysis of essential constituents in cinnamon oil. The capillary column coated with 5% phenyl, 95% dimethylpolysiloxane is a good choice for the separation of these analytes since they elute as symmetrical peaks at a wide range of concentrations.

Different temperature programs were investigated for GC oven. At the end of this investigation, the best temperature program was selected for good separation. The temperature programs of the GC oven were as follows: the initial temperature was 60 °C, held for 10 min, increased to 220 °C at a rate of 4.0 °C/min held for 10 min, increased to 240 °C at a rate of 1.0 °C/min and held for 1 min. The spli injection mode was chosen. The injector volume was 1 µl in split (1:40) mode, and the carrier gas was helium at a flow rate of 0.8 ml/min.

GC-MS Analysis: 16 essential chemical constituents were identified based on GC-MS in cinnamon oil supplied from the pharmacy. A total of sixteen different components with different retention times were eluted from the GC column as indicated by the chromatogram and were further analyzed with an electron impact MS detector. Identification of constituents was done on the basis of their retention time and mass spectra library search. The relative amount of individual components was calculated based on GC peak areas. The essential oil compounds in cinnamonoil are presented as compound chromatogram is in **Table 1**. The identification of the main constituents cinnamal (63.59), eugenol (8.32%), cinnamyl acetate (7.48%), caryophyllene (6.88%), linalool (6.31%) and eucalyptol (2.57%). These components account for 95.15% of the total relative content of the cinnamon oil. This research also demonstrated that cinnamon oil is rich in cinnamal could be a good source for these compounds.

The cinnamon spice is used for flavouring baked products. The bark and leaf oil are used in the manufacture of perfumes, soaps, and toothpaste and also as a flavouring agent for liquors and in dentifrices. Besides, cinnamon has a broad spectrum of medicinal and pharmacological applications [28]. Cinnamon possesses various biological activities such as antioxidant, antimicrobial, antidiabetic, and antiallergic. For many centuries, cinnamon and its essential oil have been used as preservatives in food due to the antioxidant property of cinnamon. *In-vivo* lipid peroxidation causes tissue damage, which can lead to inflammatory diseases. Phenolic compounds, such as hydroxyl cinnamaldehyde and hydroxy cinnamic acid, present in the cinnamon extract, act as scavengers of peroxide radicals and prevent oxidative damages. Therefore the essential oil and possibly various extracts from cinnamon might be employed to retard autoxidation chain reactions in oils and fats [29]. Cinnamon is reported to possess anti-inflammatory activity [30].

TABLE 1: CHEMICAL COMPOSITION OF THE ESSENTIAL OIL IN CINNAMONOIL

Peak	Retention Time (min)	Compound	Molecular formula	Molecule weight g/mol	% of total
1	3.22	α-thujene	$C_{10}H_{16}$	136.23	0.08
2	3.24	β-pinene	$C_{10}H_{16}$	136.23	0.11
3	3.54	α-pinene	$C_{10}H_{16}$	136.23	0.38
4	3.60	Eucalyptol	$C_{10}H_{18}O$	154.25	2.57
5	4.88	Linalool	$C_{10}H_{18}O$	154.25	6.31
6	7.68	L-α-terpineol	$C_{10}H_{18}O$	154.25	0.13
7	11.07	cinnamal	C_9H_8O	132.16	63.59
8	12.22	α-phellandrene	$C_{10}H_{16}$	136.23	0.31
9	12.97	α-terpinene	$C_{10}H_{16}$	136.23	0.12
10	13.19	Eugenol	$C_{10}H_{12}O_2$	164.2	8.32
11	14.87	Caryophyllene	$C_{15}H_{24}$	204.35	6.88
12	18.22	δ -cadinene	$C_{15}H_{24}$	204.35	0.08
13	20.07	Caryophyllene oxide	$C_{15}H_{24}O$	220.35	0.35
14	29.48	Isoeugenol	$C_{10}H_{12}O_2$	164.2	0.16
15	32.01	Cinnamyl acetate	$C_{11}H_{12}O_2$	176.21	7.48
16	34.19	Acetyl eugenol	$C_{12}H_{14}O_3$	206.24	0.25
				Total	97.12

Cinnamon extract has anti-diabetic effect. Cinnamon is reported to reduce the blood glucose level in non-insulin-dependent diabetics. Therapeutic studies have proved the potential of cinnamaldehyde and hydroxycinnamic acid as anti-diabetic agents. Cinnamaldehyde inhibits aldose reductase, a key enzyme involved in the polyol pathway. This enzyme catalyzes the conversation of glucose to sorbitol in insulin-insensitive tissues in diabetic patients. This leads to the accumulation of orbital in chronic complications of diabetes, such as cataract neuropathy and retinopathy. Aldose-reduct inhibitors prevent the conversation of glucose to sorbitol, thereby preventing several diabetic complications. A decoction of dried twigs of cinnamon can produce an antipyretic effect in mice. Studies conducted in anesthetized dogs and guinea pigs indicated that cinnamaldehyde or sodium cinnamate, also produced hypothermic and antipyretic effects. It also causes a hypotensive effect, which is due mainly to vasodilation of peripheral vessels. Cinnamaldehyde produced an analgesic effect in mice [31].

CONCLUSION: The main components of oils can often be identified from the peak pattern of the chromatograms obtained directly from GC-MS analysis. Similarly, unique qualitative and quantitative patterns from a GC analysis will often help identify the source of many oils. The construction of chromatographic fingerprints aims at evaluating the quality of essential oil. The importance of the study is due to the biological activity of some of these compounds. In this study, the essential constituents of cinnamon oil were analyzed qualitatively and quantitatively by the GC-MS method.

The present study, which reveals the presence of essential components in cinnamon oil, suggests that the contribution of these compounds on pharmacological activity should be evaluated. Due to different chemical components present in the cinnamon oil and the mechanism and the pathway, they behave in respect of antioxidant, anti-microbial, anti-inflammation, antidiabetic and antitumor properties and activities, its application

to replace the related medicines or as a supplement in diseases, kinds of cancers and chemotherapy might be suggested.

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