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# Chemical Analysis of Essential Oil of Ginger (*Zingiber officinale*)

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**Abstract:** The present project was undertaken to evaluate the quality of ginger rhizomes imported from China and Thailand, on the basis of their essential oil content and composition. Essential oil of two ginger rhizomes imported from China and Thailand was extracted by hydro distillation. Essential oil content was found to be 0.98 (China) and 1.58% (Thailand). Chemical analysis of essential oil was carried out by GC-FID. Essential oil of Thailand ginger sample contained α-pinene 3.59, α-phallendrene 2.84, myrecene 4.58, β-pinene 0.74, γ-terpinene 2.49, 1, 8-cineol 3.87, citral 5.39 and zingibrene 30.81%. Essential oil of China ginger sample contains α-pinene 0.305, α-phallendrene 1.02, myrecene 4.82, γ-terpinene 2.88, 1, 8-cineol 2.4, α-terpinene 6.5, citral 4.5 and zingibrene 8.0%. Ginger sample from Thailand was found to be better in quality due to higher percentage of essential oil (60%).

**Key words:** Ginger, Zingibrene, gas chromatography, hydro distillation, essential oil

## INTRODUCTION

Ginger (*Zingiber officinale*), a well-known ingredient of our dishes, is a large tuberous perennial plant native to southern Asia, now cultivated extensively in almost all tropical and subtropical countries, especially China, India, Nigeria, Australia, Jamaica and Haiti[1-4]. China and India are the world's leading producers of ginger. Major exporting countries are China, India, Australia, Nigeria, Thailand and Fiji[5]. Fresh ginger is used for flavoring and taste in different foods during cooking. It is extensively used in the formation of compounded aromas for flavoring confectionery, bakery products, condiments, sauces and carbonated beverages. The dried powder is used as a spice.

Ginger has been used as a medicine since ancient times, recorded in early Sanskrit and Chinese texts and ancient Greek, Roman and Arabic medical literature[6]. In Asian medical practices, dried ginger has been used as a drug to treat stomachache, diarrhea and nausea for thousands of years. It is traditionally prepared in aqueous decoctions and infusions[2,7]. The approved modern therapeutic applications for ginger are supportable based on its history of use in well-established systems of traditional and conventional medicine, extensive phytochemical investigations, pharmacological studies in animals and human clinical studies.

Ginger rhizome contains oleoresin (4.0-7.5%), non-volatile pungent substances phenols such as gingerols and their related dehydration products, non-pungent substances (fats and waxes) and volatile oils, of which 30-70% are sesqui-terpenes. Besides volatile oil rhizome also contain carbohydrates, mainly starch (40-60%); proteins (9-10%); lipids (6-10%), free fatty acids (oleic, stearic and linoleic acids) vitamins (Niacin and Vitamin A), minerals (Na, K, Mg, Zn) and amino acids[2-4,8,9]. Specific essence of ginger is due to its volatile organic compounds. These volatiles are called the essential oils of ginger (varies from 1-3%), can be extracted by different techniques, from which the most common is steam distillation[10].

The present project was undertaken to evaluate the quality of ginger rhizomes imported from China and Thailand, on the basis of their essential oil content and composition.

## MATERIALS AND METHODS

The present research was conducted in the Department of Chemistry, in collaboration with Nuclear Institute for Agriculture and Biology, Faisalabad during February- July, 2005.

**Collection of sample:** Ginger rhizome samples imported from two different sources (China and Thailand), were collected from local market of Faisalabad.

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**Extraction of essential oil:** Extraction of essential oil was carried out with hydro distillation as reported by Bailey-Shaw[10].

**Analysis of oil:** The extracted oil was chemically analyzed by Gas chromatography using 10% SE-30 packed glass column and FID (Flame ionization detector) as described by Balladin and Headley[11]. Components of the essential oil were identified by running some standards and their concentration was determined by the peak area.

**Proximate analysis:** Proximate analysis of ginger samples (China and Thailand) was carried out according to standard methods[12].

## RESULTS AND DISCUSSION

Essential oils from both the ginger rhizome samples were extracted by hydro distillation and their chemical compositions were determined by Gas Liquid Chromatography (GLC). Extracted oils were compared for their color, flavor chemical compositions. The fresh extracted oils from both the ginger samples (China and Thailand) were pale yellow and their aroma was pleasant and clearly ginger like. The essential oil yield on dry bases from ginger samples of China and Thailand were 0.98% and 1.58%, respectively. Budavari[3] and Leung and Foster[4] reported ginger oil yield 1.0-3.3% by steam distillation. The difference in yield might be due to loss of peel of rhizomes which is mainly responsible for essential oil content. This loss of peel occurred during transportation of rhizomes. A number of compounds in essential oil were detected in both samples but due to limitation of standards only the important ones were identified and quantified. The analysis of ginger rhizomes from Thailand is reported in Table 1. The results revealed that the percentage composition of identified compounds in ginger imported from Thailand was α-pinene 3.59, α-phallendrene 2.84, myrecene 4.58, β-pinene 0.74, γ-terpinene 2.49, 1, 8-Cineol 3.87, Citral 5.39 and zingibrene 30.81%. (Table 1).

The results of analysis of ginger rhizomes from China are given in Table 2. The identified components were α-pinene 0.305, α-phallendrene 1.02, myrecene 4.82, γ-terpinene 2.88, 1, 8-cineol 2.4, α-terpinene 6.5, citral 4.5 and zingibrene 8.0%. Concentration of zingibrene was significantly high (31.0%) in Thailand sample as compared to the China (8.0%). Concentration of zingibrene was quite comparable to those of Pallado *et al.*[13] who reported 31% of zingibrene. However Shao *et al.*[14] reported 4.15%, of zingibrene in the essential oil of ginger. In essential oil of ginger the content of α-terpinene was 6.5% in China ginger. The content of α-terpinene in essential oil of ginger from China was significantly higher to those of reported 0.73%. The amount of Myrecene was 4.58 and 4.82% in Thailand and China, gingers, respectively. The amount of Myrecene was also higher than to the literature values[15].

Table 1: Identified compounds in the essential oil of ginger rhizomes of Thailand by GC on 10% SE-30 packed glass column

| Peak No. | Identified compounds | Conc. (%) |
|---|---|---|
| 5 | α-pinene | 3.59 |
| 6 | α-phallendrene | 2.84 |
| 7 | Myrecene | 4.58 |
| 8 | β-pinene | 0.74 |
| 9 | γ-Terpinene | 2.49 |
| 12 | 1,8-Cineol | 3.87 |
| 13 | Citral | 5.39 |
| 15 | Zingibrene | 30.81 |

Table 2: Identified compounds in the essential oil of ginger rhizomes of China by GC on 10% SE-30 packed glass column

| Peak No. | Identified compound | Conc. (%) |
|---|---|---|
| 3 | α-pinene | 0.305 |
| 4 | α-phallendrene | 1.02 |
| 5 | Myrecene | 4.82 |
| 7 | γ-Terpinene | 2.88 |
| 10 | 1,8-Cineol | 2.40 |
| 11 | Citral | 4.50 |
| 12 | Zingibrene | 8.00 |
| 13 | α-Terpinene | 6.50 |

Table 3: Proximate analysis of China and Thailand ginger

| Contents | China ginger (%) | Thailand ginger (%) |
|---|---|---|
| Moisture | 89.20 | 88.00 |
| Protein | 12.25 | 6.67 |
| Crude Fiber | 6.00 | 15.00 |
| Fat | 7.78 | 9.00 |

The concentration of citral, which was 5.39% in Thailand ginger and 4.5% in China ginger. The concentration of citral was significantly higher to those of Bailey-Shaw *et al.*[10] in essential oil of ginger.

The results obtained reveals that ginger samples had a large amount of water content, approximately 90%, China ginger contained 12.25% proteins, 6% crude fiber and 7.78% fats while Thailand ginger had 6.67% proteins, 15% crude fibers and 9% fats (Table 3). The protein content was also well in line to those of the reported (9-10%) proteins content and lipids content in ginger (6-10%) were also reported[6].

It was concluded that ginger sample imported from Thailand had approximately 60% higher essential oil content as compared to China ginger. Moreover the concentration of zingibrene was 70% higher in essential oil of Thailand sample.

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