**IJP (2015), Vol. 2, Issue 10** **(Research Article)**

Received on 19 May 2015; received in revised form, 26 September 2015; accepted, 19 October 2015; published 31 October 2015

# PHYSICO-CHEMICAL AND NATURAL PRODUCT INVESTIGATIONS OF ESSENTIAL OIL AND VARIOUSLY EXTRACTED MEDICINALLY USEFUL MATERIALS FROM THE RHIZOMES OF *ALPINIA SPECIOSA* K. SCHUM.

Nitin Kumar Agrawal

Department of Applied Sciences & Humanities, Moradabad Institute of Technology, Ram Ganga Vihar, Phase - 2, Moradabad - 244001, Uttar Pradesh, India.

**Keywords:**

*Alpinia speciosa*, *Alpinia zerumbet* *Alpinia nutans, Chatiun* Zingiberaceae, Physico-chemical

**Correspondence to Author:**
**Dr. Nitin Kumar Agrawal**

Assistant Professor (Chemistry), Department of Applied Sciences & Humanities, Moradabad Institute of Technology, Ram Ganga Vihar, Phase - 2, Moradabad - 244001, Uttar Pradesh, India.

**E-mail:** nitinkumarag@yahoo.co.in

**ABSTRACT:** Essential oil isolated from the rhizomes of *Alpinia speciosa* K. Schum. by hydrodistillation has a yield of 0.69 percent by weight. Light yellow oil from *Alpinia speciosa* has a spicy odor; specific gravity 0.8577; optical rotation $+6^{o}30'$. Acid and saponification values are also determined and reported. Extractions of medicinally useful materials separately through solvents of decreasing polarities, viz., water, ethanol, diethyl ether, and petroleum ether are carried out from its rhizome. Ethanol extract has a maximum yield. Odors vary in differently extracted materials. Diethyl ether and petroleum ether extracted materials show a sufficient degree of unsaturation. The essential oil is dextrorotatory. All of the solvent extracted materials are dextrorotatory. Specific gravities, refractive indices, acid, saponification and iodine values of these variously extracted materials are also reported. Tests for the presence of specific natural products indicate the presence of carbohydrates, flavonoids, and steroids in most of the extracted materials.

**INTRODUCTION:** The plant *Alpinia speciosa* K. Schum. (Syn. *Alpinia zerumbet*, *Alpinia nutans*, *Catimbium speciosum*, *Languas speciosa*, *Zerumbet speciosum* and *Costus zerumbet* [1]) belongs to Zingiberaceae family. It is called *Chatiun* [2] in Hindi. A fine, rhizomatous, perennial herb, up to 3 m in height, occurring in the eastern Himalayas from West Bengal eastwards, and frequently cultivated in gardens for its foliage and showy flowers, it is also planted in hedges[3].

QUICK RESPONSE CODE

**DOI:** 10.13040/IJPSR.0975-8232.IJP.2(10).519-22

**Article can be accessed online on:** www.ijpjournal.com

**DOI link:** http://dx.doi.org/10.13040/IJPSR.0975-8232.IJP.2(10).519-22

The flowers are beautiful and the whole plant fragrances like the cardamom; its leaves *etc*., when bruised, have a strong smell of cardamoms and are sometimes named *ilachi*. The rhizomes of *Alpinia speciosa* are useful in rheumatism and catarrhal afflictions. In afflictions of the gastrointestinal tract, the drug can be used like other volatile oils [4]. The rhizomes exhibit anti-ulcer activity [5]. The rhizomes contain 5,6-dehydrokawain, and dihydro 5,6-dehydrokawain reported to inhibit the aggregation of ATP release from rabbit platelets induced by arachidonic acid and collagen [6].

The presence of phenolic compounds in rhizomes has been reported, and their use as a source for natural antioxidant in tea preparations or food products such as meat, dairy, and bakery has been suggested [7]. The fibrous stem contains 49.9% of cellulose and can be used for making paper [8].

Recently the fatty acids have been investigated in the rhizome oil of *Alpinia speciosa* [9].

Looking to the variety of uses, a detailed study of physicochemical properties of the various solvent extracted materials and essential oil from the rhizomes and determination of natural product groups seem to be important.

**MATERIALS AND METHODS:** Authenticated rhizomes of *Alpinia speciosa* were procured from Dehradun, Uttarakhand, India and further authenticity verified from F.R.I. Dehradun, India. The procured rhizomes were washed with lukewarm water and dried in the shade.

**Isolation of Essential Oil:** The isolation of essential oil was carried out by hydrodistillation using a Clevenger apparatus. 100 g crushed rhizome was placed in a round bottom, a short-necked flask of one-liter capacity. 600 mL distilled water was added to the flask and proper essential oil trap and condenser were attached; enough water was added to fill the trap. Placing the flask in an electric heater, the temperature was adjusted, so that condensation of about one drop per second was obtained.

The distillation was continued until no further increase of the essential oil was observed. After the complete distillation, the oil was permitted to stand undisturbed and then extracted with anhydrous sodium sulphate to remove any aqueous part. 0.80 mL (0.69 g) of essential oil was obtained from *Alpinia speciosa* rhizome. Oil was stored in a dark-colored airtight bottle under refrigeration.

**Extraction through Solvents:**

**Extraction through Water:** 100 g of the crushed rhizomes were boiled with doubly distilled water for 1 h. The extract was filtered, and the water was evaporated. 4.90 g reddish brown semi-solid material was obtained.

**Extraction through Ethanol:** 100 g crushed material was kept in a sufficient quantity of ethanol in a Soxhlet extractor for 72 h. The yellowish-orange decoction was collected. A fresh quantity of ethanol was added again to the same material and kept for another 72 h. The process was repeated until the extract became colorless. Extracted solutions were mixed and ethanol separated by vacuum distillation. 7.3 g dark brown solid was obtained.

**Extraction through Diethyl Ether:** A similar procedure, as for ethanol, was carried out. 3.65 g dark brown highly viscous oil was obtained.

**Extraction through Petroleum Ether:** A similar procedure, as for ethanol, was carried out. 2.01 g reddish brown viscous oil was obtained.

**Study of Properties:** The specific gravity, refractive index, pH and optical rotation were determined, and presence of various possible families of natural product compounds was tested. Acid, saponification, and iodine values were determined for essential oil, and also for the various extracted materials using the methods described by Garratt [10], Guenther [11] and in monographs of I.S.I. [12] The presence of various possible specific natural products, *viz*., carbohydrates, alkaloids, steroids, proteins, flavonoids, and carotenoids were tested by usual methods.

**RESULTS AND DISCUSSION:** Yield and physicochemical properties of the essential oil is given in **Table 1**, those of extracted materials are described in **Table 2**, while the results of the presence of specific natural products are summarized in **Table 3**. Also, the oil gives positive tests for the presence of aldehydic, ketonic, alcoholic and ester groups.

The rhizomes of *Alpinia speciosa* on hydrodistillation yield essential oil. Because of the sharp, characteristic odor, their solubility in alcohol and no side effects, the essential oils can be used in perfumery. *Alpinia speciosa* oil is dextrorotatory, indicating their possible biologically different activities. The high iodine value, however, indicates a high degree of unsaturation in *Alpinia speciosa* oil. Low acid values and the pH values of higher than 5.0 indicate that not much free acids are present in the oil and, thus, support its use in perfumery. Extracted materials give positive tests for the presence of ketonic, aldehydic, ester and alcoholic groups that seem to be because of the oxygenated terpenes in the essential oil.

Indrayan *et al*., [13] have identified the constituents of the essential oils by GC-MS, and their report

confirm the presence of such compounds. In general, the esters are most balancing of all the chemical families of essential oils. They are relaxing and soothing, and many have antifungal properties [14].

As the aroma-therapy is picking up, the use of oil either alone or as a mixture with other suitable essential oils, cannot be denied. Ferulic acid glucoside ester **Fig. 1** is among the components of *Alpinia speciosa* rhizome [15].

**TABLE 1: RESULTS OF THE ANALYSIS OF THE ESSENTIAL OIL**

| Properties | Essential oil |
|---|---|
| Colour of oil | Light yellow |
| State | Transparent liquid |
| Odor | Spicy |
| Yield (%, w/w) | 0.69 |
| pH | 6.2 |
| Refractive index | 1.45 |
| Specific gravity (30°/30°) | 0.8577 |
| Optical rotation (25°C) (0.01% solution) | +6°30′ |
| Acid value | 4.49 |
| Saponification value | 35.06 |
| Iodine value | 103.50 |

**TABLE 2: RESULTS OF THE ANALYSIS OF MATERIALS OBTAINED BY EXTRACTIONS THROUGH SOLVENTS OF DIFFERENT POLARITIES**

| Properties | Material extracted through | | | |
|---|---|---|---|---|
| | Petroleum ether | Diethyl ether | Ethanol | Water |
| Colour of decoction | Brownish yellow | Yellowish brown | Yellowish orange | Reddish brown |
| Colour of extracted material | Reddish brown | Dark brown | Dark brown | Reddish brown |
| State | Viscous oil | Highly viscous oil | Solid | Semi-solid |
| Odor | Mild spicy | Pleasant | Mild Pleasent | Characteristic sharp |
| Yield (%, w/w) | 2.01 | 3.65 | 7.30 | 4.90 |
| pH | 5.60 | 4.10 | 5.02 | 5.48 |
| Refractive index (0.025% solution) | 1.38 | 1.36 | 1.33 | 1.32 |
| Specific gravity (30°/30°) | 0.8218 | 0.9083 | – | 1.364 |
| Optical rotation (25°C) (0.025% solution) | 2°06′ | +5°12′ | 4°18′ | +5°54′ |
| Acid value | 34.70 | 50.49 | 48.25 | 19.63 |
| Saponification value | 183.7 | 84.20 | 190.7 | 28.05 |
| Iodine value | 69.21 | 71.80 | 57.20 | 6.98 |

**TABLE 3: RESULTS OF THE ANALYSIS OF THE ESSENTIAL OIL AND EXTRACTED MATERIALS FOR DIFFERENT SPECIFIC NATURAL PRODUCTS**

| Specific natural products | Material extracted through | | | | |
|---|---|---|---|---|---|
| | Essential oil | Petroleum ether | Diethyl ether | Ethanol | Water |
| Carbohydrates | | | | | |
| Molisch test | -ve | -ve | -ve | -ve | +ve |
| Alkaloids | | | | | |
| Mayer's test | -ve | -ve | -ve | -ve | -ve |
| Steroids | | | | | |
| Salkowski reaction | -ve | +ve | +ve | +ve | -ve |
| Carotenoids | | | | | |
| Sulphuric acid test | -ve | -ve | -ve | -ve | -ve |
| Flavonoids | -ve | +ve | +ve | +ve | +ve |
| Proteins | | | | | |
| Xanthoproteic test | -ve | -ve | -ve | -ve | +ve |
| Biuret test | -ve | -ve | -ve | -ve | +ve |

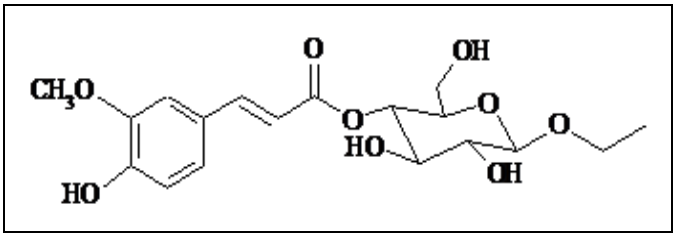


**FIG. 1: FERULIC ACID GLUCOSIDE ESTER**

Antimicrobial [13] and antifungal [16] activities of *Alpinia speciosa* oil are already known.

In *Alpinia speciosa,* the maximum yield of the material is found in ethanol extract that contains certain aldehydes, ketones, esters, steroids, and flavonoids. The water-soluble substances seem to be comparatively less in this rhizome, as indicated by the yield of the material through the water. No ketones and esters are present, but certain carboxylic acids seem to be present in water extract; also positive tests are shown for carbohydrates, flavonoids, and certain proteins. However, a comparatively low saponification and iodine values indicate the presence of comparatively high molecular weight compounds and much less unsaturated compounds in water extract material. This information seem to be quite important because in most of the herbal formularies the components are in the form of extracted elements.

The yield of the material obtained by extraction through petroleum ether is lowest, indicating less amount of free fatty acids. However, the presence of unsaturated compounds is highest in petroleum ether extracted materials as indicated by high iodine value, indicating the free fatty acids to be mostly unsaturated.

**CONCLUSION:** The possible use of oil can be in perfumery. It can also be tried in aroma-therapy. The rhizome extracts of *Alpinia speciosa* seems to have good medicinal use.

**ACKNOWLEDGEMENT:** Nil

**CONFLICT OF INTEREST:** Nil

## REFERENCES:

1. Pullaiah T: Encyclopedia of World Medicinal Plants, Regency Publications, New Delhi, Vol. I, 2006: 127.
2. Torkelson AR: The Cross Name Index to Medicinal Plants, CRC Press, Boca Raton, New York, Vol. IV, 1999; p. 1639.
3. The Wealth of India: A Dictionary of Indian Raw Materials & Industrial Products, CSIR, New Delhi, Vol. I: A 1985: 197.
4. Nadkarni KM: Indian Materia Medica, Popular Prakashan, Bombay, Vol. I, 1976: 80.
5. Lin JH: Studies on the antiulcer components of the rhizomes of *Alpinia speciosa* K. Schumann. *Guoli Zhongguo Yiyao Yangjiuso Yanjiu Baogao* 1982: 147-162.
6. Teng CM, Hsu SY, Lin CH, Yu SM, Wang KJ, Lin MH and Chen CF: Antiplatelet action of dehydrokawain derivatives isolated from *Alpinia speciosa* rhizome. Chin J Physiol 1990; 33: 41-48.
7. Elzaawely AA, Xuan TD and Tawata S: Essential oils, kavapyrones and phenolic compounds from leaves and rhizomes of *Alpinia zerumbet* (Pers.) B.L. Burtt. & R.M. Sm. and their antioxidant activity. Food Chem 2007; 103: 486-494.
8. The Wealth of India: A Dictionary of Indian Raw Materials & Industrial Products, CSIR, New Delhi, Vol. I, 1948: 63.
9. Indrayan AK, Agrawal NK and Tyagi DK: Naturally occurring odd number fatty acids in the rhizome oil of *Alpinia speciosa* K. Schum. J Indian Chem Soc 2009; 86: 1246-1248.
10. Garratt DC: The Quantitative Analysis of Drugs, Chapman Hall International, London, Vol. III 1964.
11. Guenther E: The Essential Oils, D. Van Nostrand Company, USA, Vol. II, 1963.
12. I S: 548 (Part-1), Indian Standards Institution, New Delhi, 1984.
13. Indrayan AK, Tyagi PK and Agrawal NK: Chemical composition and antimicrobial activity of the essential oil of *Alpinia speciosa* K. Shum. Rhizome from India. J. Essent. Oil Res 2010; 22: 179-182.
14. Keville K and Green M: Aromatherapy: A Complete Guide to Healing Art. The Crossing Press, USA 1995: 130.
15. Masuda T, Mizuguchi S, Tanaka T, Iritani K and Takeda Y: Isolation and structure determination of new antioxidative ferulic acid glucoside esters from the rhizome of *Alpinia speciosa*, a Zingiberaceae plant used in oxinawan food culture. J Agric Food Chem 2000; 48: 1479-1484.
16. Lima EO, Gompertz OF, Giesbrecht AM and Paulo MQ: *In-vitro* antifungal activity of essential oils obtained from officinal plants against dermatophytes. Mycoses 1993; 36: 333-336.

**How to cite this article:**
Agrawal NK: Physico-chemical and natural products investigations of essential oil and variously extracted medicinally useful materials from the rhizomes of *Alpinia speciosa* K. Schum. Int J Pharmacognosy 2015; 2(10): 519-22. doi: 10.13040/IJPSR.0975-8232.2(10).519-22.

This Journal licensed under a Creative Commons Attribution-Non-commercial-Share Alike 3.0 Unported License.

This article can be downloaded to **ANDROID OS** based mobile. Scan QR Code using Code/Bar Scanner from your mobile. (Scanners are available on Google Playstore)