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Physico-chemical and natural products investigations of essential oil from the rhizomes of *Kaempferia galanga* L.

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ABSTRACT

The essential oil isolated from the rhizomes of Kaempferia galanga L. was tested for physicochemical properties and some natural products. The oil was isolated by hydro-distillation method with a yield of 0.52% (v/w). The physicochemical properties namely physical appearance, odor, density, refractive index, acid value, free fatty acids, saponification value, ester value, glycerol contents and iodine value were determined and found to be yellow liquid, aromatic, 0.8791 g/cm^3, 1.478, 1.12 mg KOH/g, 0.56%, 190.77 mg KOH/g, 189.65 mg KOH/g, 10.38%, 2.28 g/100g respectively. The oil was tested for several natural products to evaluate its therapeutic potential. The results showed the oil is suitable for making bath soaps, cosmetics and perfumery products.

Key words: *Kaempferia galanga* L. oil, Physico-chemical properties, Natural products

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INTRODUCTION

Plant essential oils are composed by highly volatile organic molecules which contribute special flavors and fragrances [1]. They have significant physical properties namely, color, characteristic odor and high refractive index. The fragrance oils contribute a major role in the commercial production of cosmetics, bath soaps and perfumery items [2]. Apart from these they are widely used in food flavoring, beverages and pharmaceuticals.

Natural products are important plant metabolites, used as a source of medicine from ancient times worldwide. Since 1981, natural products isolated from plants were used in the discovery of new drugs to cure disease e.g. antimicrobial, anticancer, antibiotics, antihypertensive, antituberculosis etc. [3]. The natural products based on plant origin produce flavors and fragrances. The knowledge of physicochemical properties like acid value, saponification value, ester value, iodine value and presence of natural products in essential oils decide their utilization in eating, pharmaceuticals and industrial making.

Kaempferia galanga L. is an aromatic plant belongs to Zingiberaceae family, native to India, Malaysia, Africa, Java, China and Sri Lanka (Sirirugsa, 1989). The rhizomes of this species are highly aromatic and have been widely used as spice, food flavoring and in folk medicines (Bungorn Sripanidkulchai, 2011). The essential oil from the rhizomes have bioactive components of therapeutic potential and exhibits several biological activities (Padma S. Vankar, 2004, Yatri R. Shah et al., 2011). The aim of the present study was to investigate the physico-chemical properties and natural products of *Kaempferia galanga* L. rhizome oil.

MATERIALS AND METHODS

Collection of Plant Material

The fresh rhizomes of *Kaempferia galanga* L. were collected from Dr. Shushila Tiwari Herbal Garden Rishikesh, India in April, 2012. The plant was identified by the staff of Botanical Survey of India, Dehradun, and a voucher specimen (Acc. No. 114816) was deposited in the Herbarium of Botanical Survey of India, Dehradun.

Isolation of Essential Oil

100gm of fresh rhizomes of the plant were chopped and subjected to hydrodistillation for 8 hours in a Clevenger-type apparatus. Thereafter, the oil was extracted from the distillate with n-hexane, dried over anhydrous sodium sulfate and stored in a fridge at 4 °C.

Physico-Chemical Analysis

The percentage yield, specific gravity, refractive index, acid value, saponification value and iodine value of the oil were measured according to the methods described by Guenther [4]. The percentage of free fatty acids was calculated as oleic acid by the acid value [5] according to the relation (1):

Acid Value = 2 x Free Fatty Acids (1)

The ester value is the 'mg' of KOH required to react with glycerol/glycerin after saponify 1 g of oil sample. Ester value is calculated by the following relation (2):

Ester Value = Saponification Value – Acid Value (2)

The glycerol content was determined by the relation (3), derived from the hydrolysis reaction by which triglyceride of fatty acids are converted into corresponding alkali salts of fatty acids.

Glycerol (%) = 0.05476 x Ester Value (3)

The Abbe's refractometer was used for the determination of refractive index of essential oil. The presence of various natural products was screened by following standard methods.

RESULTS AND DISCUSSION

Physicochemical properties like color, odor, percentage yield, specific gravity and refractive index of *Kaempferia galanga* L. oil were observed as shown in Table 1. The percentage yield of essential oil was 0.52 by volume.

Table 1: Physicochemical properties of essential oil of *Kaempferia galanga* L

Properties	Essential Oil
Physical State	Transparent Liquid
Color	Light Yellow
Odor	Aromatic
Yield (%)	0.52
Refractive Index (20 °C)	1.478
Specific gravity (20°/20°)	0.8791
Acid Value (mg KOH/g)	1.12
Free Fatty Acids (%)	0.56
Saponification Value (mg KOH/g)	190.77
Ester Value (mg KOH/g)	189.65
Glycerol(%)	10.38
Iodine Value (g/100g)	2.28

Physico-Chemical Properties

Color and Odor: The essential oil was noted as light yellow transparent liquid with strong aromatic fragrance. The color and fragrance of the oil can be used in bath soaps, cosmetics and perfumery items.

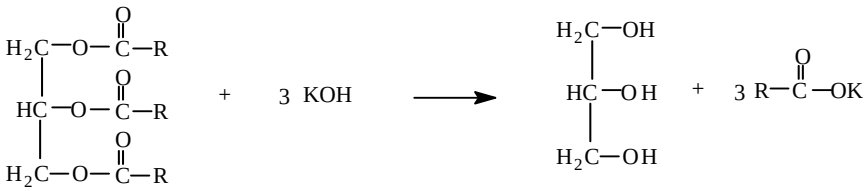
Specific Gravity: Specific gravity is an important physical constant and is specific for each liquid. It is a criterion which indicates about the quality and purity of oil. Specific gravity of the oil was found 0.8791 g/cm^3 at 20ºC which indicates that the extracted oil is highly pure.

Refractive Index: Refractive index is a physical constant which is used frequently to test the purity of oils [6]. The refractive index of the *Kaempferia galanga* L. oil was determined at 20ºC using Abbe's refractometer. The measured refractive index of the essential oil was 1.478 which indicates that oil is highly pure.

Acid Value: It is the amount of free fatty acids present in oil/fat as measured by the amount of KOH (mg), required to neutralize the free fatty acids in 1 g of oil/fat sample. Essential oils are concentrated and contain several volatile aroma compounds; often these are free fatty acids. Free fatty acids are considered as defect in oils/ fats because they are degraded or become rancid. The low acidity of oils is considered as neutralized and safe for making skin care products though high acidity of oils may be harmful for skin. The acid value of the *Kaempferia galanga* L. oil was found 1.12 mg KOH/g indicates that the oil has outstanding storage life and edibility [7].

Free Fatty Acids: The free fatty acids content is an important parameter in edible oil refining. The free fatty acids content were found 0.56% which indicates that the oil is suitable for eating.

Saponification Value: The saponification value is the amount (mg) of KOH required to saponify 1g of an oil/fat. It is a measure of the average molecular weight of all the fatty acids present in the oil/fat. In saponification, triglycerides of fatty acids are hydrolyzed with alkali produce glycerol and alkali salts of fatty acids. This process is highly significant in the making of soap. The reaction is as:



The saponification value was found 190.77 mg KOH/g which is just right quantity required for making bath soap [8].

Ester Value and Glycerol Content: The ester value and glycerol content were found 189.65 mg KOH/g and 10.38% respectively.

Iodine Value: Iodine value is the 'g' of iodine absorbed by 100g of the oil/fat. The iodine value gives an idea of the average degree of unsaturation of an oil/fat. Higher the iodine value, greater the number of C=C double bonds. The iodine value of the tested oil was found 2.28 g/100g which shows that the oil is quite unsaturated and hence it can be used in the production of soap [9].

Table 2: Test for some natural products of essential oil of *Kaempferia galanga* L.

Natural Products	Test	Essential Oil
Terpenoids	Salkowski's test	+ ve
Steroids	Sulphuric acid test	+ ve
Alkaloids	Wagner's test	+ ve
Proteins	Xanthoproteic test	− ve
	Biuret test	− ve
Flavonoids	Shinoda's test	− ve
	Alkaline reagent test	− ve
Carbohydrates	Molisch test	− ve
	Fehling's test	− ve
Phenols	Ferric chloride test	− ve

Natural Products: The results of natural products screening of the oil are summarized in Table 2. Results showed that oil containing natural products like terpenoid and steroid compounds which accountable for the biological properties of the oil. They also have natural antioxidants which are good for skin [10]. Natural products are considered as pharmacologically active compounds and have vast commercial significance for safe cosmetics, dietary supplements and food [11].

The results showed that the essential oil has aromatic fragrance, quite acidity, high saponification value and low iodine value which are acceptable for making bath soaps and cosmetics [12]. Fragrances play an important role in perfumery items. Ethyl cinnamate (29.48%) and ethyl-p-methoxycinnamate (18.42%) were found as major constituents in the oil of *Kaempferia galanga* L. rhizomes in my previous study [13] which indicates the oil has higher esters contents. The oil contains terpenoid compounds exhibit several biological activities. Recent studies showed that the oil has significant antibacterial [14] and antifungal [15] potentials which indicate that the oil is suitable for making shaving creams, soaps, hand wash, skin creams, and lip guards to treat bacterial and fungal skin infections.

CONCLUSION

Soaps used as skin cleaners from thousands of years which are manufactured by the hydrolysis of fats/oils with alkali. Chemically soaps are the alkali salts of fatty acids. Now these days essential oils have great importance to make soaps and cosmetics due to their aroma, and significant chemical and biological properties. Results showed that the oil has significant physicochemical properties; therefore the rhizome oil of *Kaempferia galanga* L. can be used either alone or as a blended mixture with other oils in the manufacturing of soaps and cosmetics on large scale.

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