

BIOELECTRICAL AND MINERALOGICAL PROPERTIES OF *ELAEOCARPUS GANITRUS* (RUDRAKSHA) BEAD

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ABSTRACT : *Elaeocarpus ganitrus*, popularly known as Rudraksha is among the revered medicinal plants in India used for treatment and management of multiple chronic disease conditions. Rudraksha beads were reported to exhibit immense medicinal value due to its electromagnetic properties, although scientific evidences pertaining to its compositional analysis responsible for its electromagnetic effect are highly sparse. The present study aims to investigate the bioelectrical and mineralogical components of Rudraksha beads which may contribute in their electromagnetic properties of therapeutic importance. Two hundred Rudraksha fruits were randomly collected from University medicinal garden, de-pulped, dried, and powdered under aseptic conditions for biochemical, physical and mineralogical analyses. Samples were analyzed in triplicate and data was represented as Mean and SD. Results indicated the presence of protein, carbohydrates, fat, moisture and mineral content in Rudraksha bead powder. Moreover electrical properties like resistance, reactance, capacitance and inductance were also observed in Rudraksha beads. The results of this paper provide the background to justify that biochemical and mineralogical composition are associated with the electrical behavior of Rudraksha beads. Such associations may be exploited for the development of targeted alternative healing using Rudraksha.

Key words : Rudraksha, bioelectrical, mineralogical, biochemical parameters.

INTRODUCTION

According to Joshi *et al* (2014), Rudraksha or *Elaeocarpus ganitrus* Roxb (Syn. *E. sphaericus* Gaertn; Family *Elaeocarpaceae*) is well known for its attractive fruit beads with religious, aesthetic and medicinal importance. Iyyapopan *et al* (2017) said that Rudraksha beads has been reported to exhibit multiple pharmacological activities including anti-inflammatory, analgesic, sedative, antidepressant, antiasthmatic, hypoglycemic, antihypertensive smooth muscle relaxant, hydrocholeretic, antiulcerogenic and anticonvulsant. Beside these aforementioned pharmacological properties, Rudraksha bead has been believed to reduce psychosomatic stress ailments and help in self-empowerment and enlightenment. It is known that present stressful lifestyle critically disrupts the mind-body interface which exert cumulative negative impact on human physiology as stated by Dantzer *et al* (2017). According to Indigenous medicinal system, these psychosomatic stress ailments can be very much modulated by wearing Rudraksha bead, perhaps by virtue of its electrical and magnetic properties that may influence neurophysiology of human beings. Rudraksha bead are believed to possess dielectric and magnetic properties

which may impart positive changes in the bioelectrical system of the human body. This is reported in few studies which highlighted that wearing Rudraksha can remarkably control heartbeat and had a positive effect on blood pressure, stress, anxiety depression, palpitations and lack of concentration. Additionally, Rudraksha bead are also known to possess other bioelectrical properties including conductivity, resistivity, inductance, dynamic polarity etc. (Shah *et al*, 2010)

Although, several studies highlighted the electromagnetic properties of Rudraksha, peer-reviewed evidences for the same are highly sparse. Therefore, it would be of great advantage to analyze the biochemical and mineralogical components as well as their physical characteristics, which may attribute to their electromagnetic characteristics. The present study aims to investigate the biochemical, mineralogical and physical properties of Rudraksha beads.

MATERIALS AND METHODS

Collection and isolation of Rudraksha bead

The fully developed Rudraksha fruit in taste, potency and smell were collected from the repository of Kunwar Shekhar Vijendra Ayurvedic Medical College and

Research Center, Shobhit University, Gangoh. Fruits were washed and soaked in water for manual de-pulping and the isolated beads were shade dried and powdered using grinder for biochemical, physical and mineralogical characterization as stated in Rasheed *et al* (2012) for each assessment, samples were analyzed in triplicate and demonstrated as Mean and SD.

Estimation of moisture content

Moisture content in powdered sample was detected using air dry oven method. Briefly, 10 g of sample was accurately weighed and dried at 100°C in air-oven. The percentage of moisture content was estimated by dividing the difference in weight by the original weight of sample before drying multiplied by 100 (Isengard *et al*, 2012).

Estimation of total fat, protein and carbohydrate content (Biochemical analysis)

Total fat and protein content was estimated in Rudraksha bead powder by Goldfish extraction procedure and Lowry's Method respectively as described previously as stated by Akoh *et al* (2002), Smedes (1999), Lowry *et al* (1951), Everette *et al* (2010). For estimation of total carbohydrate content powdered sample was hydrolyzed for three hours in a boiling water bath in presence of 5.0 ml of 2.5 N HCl followed by neutralization using sodium carbonate. The sample was centrifuged and appropriately diluted supernatant (1.0mL) was mixed with 4.0 ml of anthrone reagent. The resultant samples were heated for eight minutes in a boiling water bath, cooled rapidly and the change in color from green to dark green was read at 630 nm against glucose as standard (Hedge *et al*, 1962).

Mineralogical analysis

The dried powder was used to obtained the mineralogical analysis using X-ray Fluorescence Spectrometry (XRF). This is a precise and powerful technique in elemental analysis which is commonly used for a vast range of materials analysis. The pressed pellets were prepared with the powdered material and the minerals were analyzed due to the difference in elemental position in the matrix, caused by the difference in oxidation state and coordination of a specific atom in different matrices (Willis *et al*, 2014).

Estimation of electrical properties

For electrical properties estimation, 10 chips of specified dimension 2x2 cm were composed from 5 gm of powdered sample using hydraulic pressing (Rai *et al*, 2011). These chips were then coated with aquadec carbon to make uniform electrical contact of powdered sample with electrode assembly. In-order to find out that whether

Rudraksha beads possess any bioelectric property, a basic experimental set up was built as demonstrated in Figure 1. Low impedance Ag-AgCl electrodes were used for the induction and measurement of current whereas output was recorded with the help of Caddo LCR Meter 9340 and Multimeter. The electrical characteristics of Rudraksha beads powder chips were examined by inducing an electrical current of 1 Amp, 45 V at 50 Hz frequency through a variable power supply unit. 50 Hz is the basic operating frequency for electrical appliances in India. Initially, baseline data was recorded without applying any external alternative current which can be utilized to assess the change in the electromagnetic properties of the material both in presence or absence of external electric field. Further, before applying the current, the unit was calibrated with the help of function generator and CRO. A bidirectional Sinusoidal waveform was applied to the chip. The experiment was carried out in a desiccator to avoid the interference of atmospheric moisture that may affect the conductive behavior of the chip (Kohli *et al*, 1998).

Fig. 1 demonstrates the experimental setup utilized to generate 1 Amp current at 45 V, 50 Hz frequency and to analyse the resistive, capacitive and inductive behaviour of Rudraksha.

RESULTS

The present study results demonstrated the biochemical, mineralogical and biochemical properties of Rudraksha bead sample. The percentage moisture content was found to be 2.89 ± 0.16 , while the total fat, protein and carbohydrate content were found to be 2.02 ± 0.29 , 4.25 ± 0.13 , and 88.53 ± 0.54 mg/mL, respectively in the Rudraksha bead powder.

Table 1 demonstrated the mineralogical content of Rudraksha bead powder indicating the presence of both main group elements and transition metals. Among the main group elements calcium and potassium were found to be in the highest concentration while strontium was present at minimum concentration. Other main group elements like silicone, magnesium, sulfur, chlorine, phosphorus, aluminum and sodium were also present in noticeable amount. Among the transition metals, considerable level of iron content was found in powdered sample while other metals were present in negligible amount.

Table 1 represents the presence of different metallic ions in Rudraksha analyzed through Wd-XRF. The quantification was carried out in parts per million and the results are represented as Mean and SD.

Mean values of the resistance, reactance, inductance,

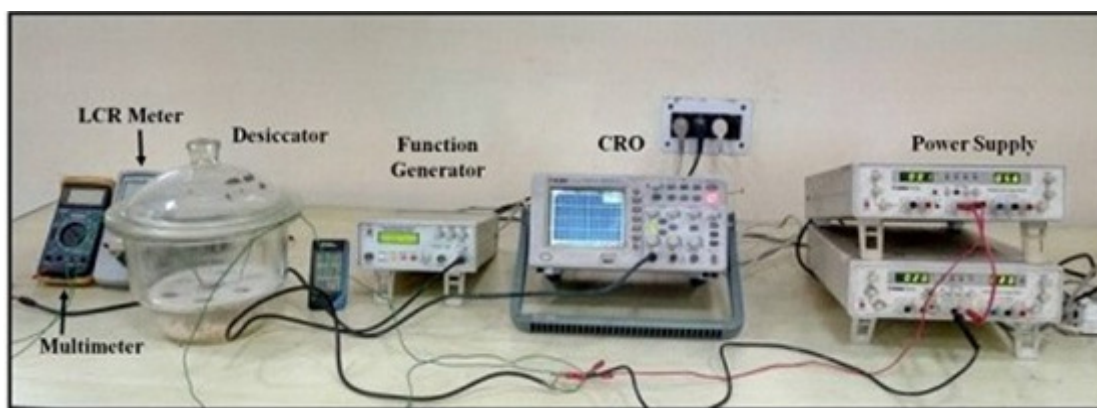


Fig. 1 : Experimental setup for the measurement of electrical property of Rudraksha bead powder chips.

Table 1 : Concentration of different elements present in Rudraksha bead powder.

Metal Type	Metal component	Ppm
Main Group Element	Calcium	2400±0.023
	Potassium	1100±0.034
	Silicone	700±0.008
	Magnesium	600±0.003
	Sulfur	400±0.005
	Chlorine	300±0.003
	Phosphorus	200±0.002
	Aluminium	200±0.004
	Sodium	100±0.001
	Strontium	11±0.008
Transition metals	Iron	800±0.009
	Palladium	26±0.008
	Ruthenium	26±0.007
	Copper	12±0.001
	Manganese	11±0.002
	Nickel	7±0.000
	Selenium	6±0.001
	Zinc	0.018±0.002
	Molybdenum	0.016±0.005

and capacitance were shown in Table 2. Among the four parameters, powdered Rudraksha bead samples showed the maximum property of resistance due to its woody composition. However, unlike woody structures which are completely insulators Rudraksha beads have shown partial capacitance and inductance activities suggesting its ability to store and transmit modulated signals. Further, the reactance capacity of Rudraksha bead is attributed more towards its inductance capacity. Together, the present study results indicate that Rudraksha beads possess the bioelectrical property and it may allow the selective and modulated signals to pass through the body

Table 2 : Variation in electrical properties of Rudraksha beads powder.

Parameters	Values
Resistance	1.05 ± 0.029 KΩ
Capacitance	1.03 ± 0.011 μF
Inductance	10.1 ± 1.32 mH
Reactance	3.1 ± 0.01 KΩ

leaving behind the unwanted signals.

Table 2 illustrates the presence of resistive and conductive capacity of Rudraksha which indicates the semi electrical behaviour of the material. Values are presented as Mean and SD.

DISCUSSION

The results of the present study deciphered the biochemical, mineralogical and bioelectric components of Rudraksha bead. The present study is the first to provide scientific evidence for the mineralogical and bioelectric components of Rudraksha beads to the best of our knowledge. These outcomes although preliminary but will surely provide the justification for the pharmacological properties of Rudraksha due to its bioelectrical property. The present study results clearly demonstrate that Rudraksha bead possess bioelectrical properties as elaborated in literature (Tripathy *et al*, 2016). These bioelectrical properties can partly be due to its biochemical and mineralogical composition.

Being a woody material, Rudraksha bead samples showed the maximum property of resistance, however unlike woody structures; it is not a complete insulator, as it also possess partial capacitance and inductance activities. The resistive behavior of Rudraksha beads may be attributed in part to its fat content which may impede the flow of current in the object (Dasgupta *et al*, 1984). Additionally, the resistive behavior can also be accredited to the mineralogical components like silicone, sulfur, phosphorus, chlorine, and selenium which are highly resistive in nature.

In the present study, Rudraksha biomaterial was observed to have a capacitance of $1.03 \pm 0.011 \mu\text{F}$, indicating its capacity to store the electric charge. This capacitance of Rudraksha may be due to the presence of carbohydrate and protein content as well as minerals with optimal conductivity like potassium, magnesium, sodium, strontium, palladium, ruthenium, manganese, nickel and molybdenum. Carbohydrates and proteins impart better emulsifying and dielectric properties, due to which the material behaves as a capacitor. The capacitance of Rudraksha makes it capable of storing the excess amount of the bio-electric signals of the body and thereby help in controlling and restoring the overall physiological activity (Teixeira *et al*, 2012; Silva *et al*, 2014). The inductance of Rudraksha bead powder was found to be $10.1 \pm 1.32 \text{ mH}$. This may be due to the presence of highly conductive elements like calcium, aluminum, iron, copper, and zinc. This observed inductive behavior of Rudraksha bead may also contribute to its magnetic properties reported to have positive impact over human physiology said by (Moss *et al*, 2000). Further, presence of moisture content may also help in the conductivity of Rudraksha beads by providing a pathway for the flow of current through it (Bai *et al*, 2000).

Finally, the reactance of Rudraksha bead sample was observed to be $3.1 \pm 0.01 \text{ K}\Omega$, which is mainly attributed to its inductive capacity and partially to its capacitance property. Two studies reported the bioelectric effect of Rudraksha by placing Rudraksha beads rosary over other plants and measuring the electrical difference in plants. These studies provide indirect evidence since the differences can appear due to the presence of other confounders like atmospheric and laboratory conditions as well as medicinal plants (Tripathy *et al*, 2016; Kumane *et al*, 2016). Overall, the present study findings provide scientific evidences for the bioelectrical properties of Rudraksha bead as defined in traditional literature. These bioelectrical properties are accredited in part due to the presence of a combination of minerals with variable resistance, conductivity and capacitance properties as well as biochemical composition. The presence of multiple metals and elements may allow the flow of specific signals throughout the human body and direct them towards brain which may stimulate the neurotransmission pathways thereby modulating the altered physiological effects and maintaining the optimal well-being (Seow *et al*, 2013; Dadhich *et al*, 2013). The main limitation of the present study is that the bioelectrical properties were analyzed at fixed frequency and current. Nevertheless, the study outcomes can be used as a preliminary data to show the presence of bioelectrical properties and their association

with biochemical and mineralogical composition. The findings may be prove to be the rostrum for future researches in the direction of the development novel therapeutic strategies using Rudraksha beads.

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