

## Nutrient profiling and antioxidant potential of three different varieties of *Zingiber officinale*

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### Abstract

**Background:** Ginger (*Zingiber officinale*) is well known and widely used herb especially in Asia, which contains several interesting bioactive constituents and health promoting properties.

**Objectives:** In this view, study was conducted to analyze the inter and intra varietal differences of nutritional as well as antioxidative capacity of three varieties viz- IP 376, Suprabha and Balua Sagar of ginger.

**Methods:** The nutritional composition was determined by the standardized procedure as described by AOAC where antioxidant activity was determined by Total Phenolic Content (TPC) and 1, 1-Diphenyl Hydrazyl (DPPH) assay.

**Result:** It was seen that the mean value of three different varieties and three different parts of ginger showed 16% increase in % antiradical activity along with 54% increase in TPC in mg gallic acid equivalent/g dry wt. from inner to outer part. A significant difference ( $P \leq 0.05$ ) in antioxidant activity between three varieties and three parts of ginger was found. Total phenolic content was higher in outer part in comparison to middle and inner part of all the three varieties and it was highest in the outer part of the variety IP376 showing the highest value of 800mg Gallic acid equivalent/gm dry wt. The % antiradical scavenging activity was higher in outer part in comparison to middle and inner part of all the three varieties and it was highest in the outer part of the variety IP376 showing the highest value of 82.50%.

**Conclusion:** Therefore the result reveals that the outer part of ginger contains maximum amount of antioxidant compared to inner and middle part. Thus it can be concluded that ginger appears to be good and safe source of natural antioxidant which play a major role in preventing many degenerative diseases such as cardiovascular diseases, diabetes and cancer etc because of its antiviral, antibacterial and antioxidant properties.

**Key words** - Ginger, Proximate Composition, Total Phenolic Content, 1,1-Diphenyl Hydrazyl (DPPH) assay.

### Introduction

Ginger, (*Zingiber officinale* Roscoe, Zingiberaceae) is one of the important medicinal plant which naturally occurs in various country like India, China, South East Asia, West Indies, Mexico and other parts of the world. This natural gold has been consumed worldwide as a spice and flavoring agent from the ancient time. Ginger plants are generally 1-3 ft. in height and having different chemical constituents like Aldehyde, Gingerol, Shogaol, and Paradol etc. It has some tremendous beneficial effect to human body to cure various types of diseases. Ginger bears an enormous number of pharmacological activities among those, neuro-

protective activity and activity against colon cancer have facilitated the extent of further research for finding out less toxic and more potent drugs for the better treatment of those diseases. This review will facilitate to gain all about the past scientific research and the necessary information about the enormous pharmacological activities of ginger which will insist researchers for future research to protect human beings from several types of diseases and may serve as a natural gold for the promotion of mankind. The oil of ginger is a mixture of constituents, consisting of monoterpenes (phellandrene, camphene, cineole,

citral, and borneol) and sesquiterpenes (zingiberene, zingiberol, zingiberenol, s-bisabolene, sesquiphellandrene, and others). Aldehydes and alcohols are also present.

The characteristic odor and flavor of ginger is caused by a mixture of zingerone, shogaols and gingerols, volatile oils that compose one to three percent of the weight of fresh ginger. In laboratory animals, the gingerols increase the motility of the gastrointestinal tract and have analgesic, sedative, antipyretic and antibacterial properties. Ginger oil has been shown to prevent skin cancer in mice and a study at the University of Michigan demonstrated that gingerols can kill ovarian cancer cells. [6]-gingerol (1-[4'-hydroxy-3'-methoxyphenyl]-5-hydroxy-3-decanone) is the major pungent principle of ginger. The chemopreventive potentials of [6]-gingerol present a promising future alternative to expensive and toxic therapeutic agents.

Plants are a potential source of natural antioxidants. Natural antioxidants or phytochemical antioxidants are secondary metabolites of plants. Carotenoids, flavonoids, cinnamic acids, benzoic acids, folic acid, ascorbic acid, tocopherols, tocotrienols, etc. are among the antioxidants produced by plants for their own sustenance. Beta-carotene, ascorbic acid and alpha tocopherols are widely used antioxidants. *Zingiberofficinale* contains a number of antioxidants such as beta-carotene, ascorbic acid, terpenoids, alkaloids, and polyphenols such as flavonoids, flavones glycosides, rutin, etc.. Easily cultivable, *Zingiberofficinale* with its wide range of antioxidants can be a major source of natural or phytochemical antioxidants.

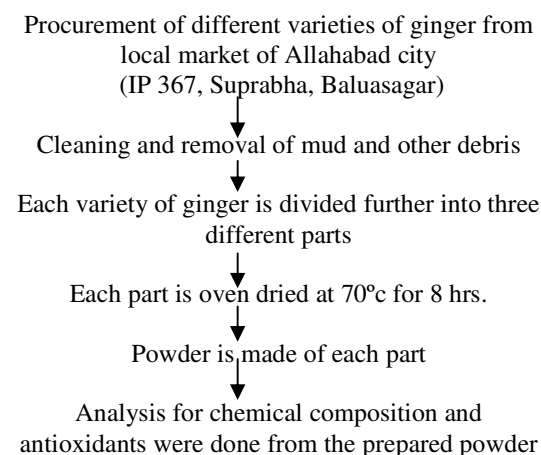
Although various extracts are obtained from ginger (Rehman et al., 2003), it is the CO<sub>2</sub> extracts that are richest in polyphenol compounds and have a

composition that is closest to that of the roots (Bartley and Jacobs, 2000). Methods for the characterization of antioxidants are presented and illustrated by their application to commercial ginger preparations, since it has been widely speculated that ginger might be beneficial to human health because it exerts 'antioxidant activity' (Aruoma et al, 1997). In view of above, the present study was conducted with following objectives to assess and compare the % anti-radical activity and Total Phenolic Content (TPC) between three varieties and three parts of each variety of ginger.

## Material and Methods

### 1. Procurement of raw materials:

The three varieties were obtained from the local market of Allahabad city and these varieties were characterised by horticulturist.



**Figure 1: Flowchart of the sample preparation for the analysis**



**Figure 2: Three different varieties of ginger**

**2. Nutrient Profiling:** Dried powder samples of ginger were analyzed for the moisture content, fat, protein, total ash, carbohydrates as described by AOAC, 2000.

**3. Total polyphenol content (Singleton and Ross 1965):**

Total polyphenol content was calculated by following formula:

Total Polyphenol

$$= \frac{(\text{Sample OD} - \text{Intercept value}) \times \text{sample extraction volume}}{\text{Slope} \times \text{mass in gm of test sample} \times 10,000 \times \text{wt in dry matter}} \times 100$$

**4. Antioxidant activity (Sanjaet al. 2005):**

The free radical scavenging activity (FRSA) (% antioxidant activity) was calculated using the following equation:

$$\% \text{ antioxidant activity} = \frac{\text{Control absorbance} - \text{Sample absorbance}}{\text{Control absorbance}} \times 100$$

**Result and Discussion**

**Comparison of inter and intra varietal proximate composition of three varieties and three parts of ginger:** The moisture content in Suprabha variety in inner part was 12.5, in middle part was 13.1 and in outer part was 14.9. The ash content was 113.2 in inner part, 147.5 in middle and 202.8 in outer part. Fat content was reported 2.8, 3.5 and 4.4 in inner, middle and outer parts. Protein was reported 2.2, 3.2, 4.9 respectively, fiber as 20.5, 19.3, 16.9 and carbohydrate as 19.8, 25.5, 35.5 in the inner, middle and outer parts. The energy was reported as 113.2, 147.5, and 202.8 in inner, middle and

outer parts. Similar results were seen in other two varieties IP376 and Baluasagar. It was observed that there was an increase in moisture content in all the varieties of ginger from inner to outer layer as well as crude protein(g), fat(g), ash(g), carbohydrate(g), energy(kcal) also increases from inner to outer part in all the varieties. (Table 1)

**Inter and Intra varietal comparison of total phenolic content between three varieties and three parts of ginger:** In this study significant difference was seen between three varieties and three parts of ginger. The total phenolic content of IP 367, suprabha and baluasagar ranges from 337 to 860 mg of gallic acid equivalent/gm. IP 367 showed highest total phenolic content where as baluasagar showed the lowest total phenolic content. The outer part of all the three varieties showed highest total phenolic content in comparison to other two parts. A significant increasing trend was seen from inner to outer part. Duncan multiple range test revealed that total phenolic content in three varieties at different parts classified inner parts into group a, middle into b and c, and outer into group d, f and e. (table 2, fig 3)

In previous studies, Stoilova *et al* (2006) investigated antioxidant effect and the total phenols of ginger extract the total phenols of the alcohol extract were found to be 870.1 mg/g dry extract. Ali *et al* (2010) determined the reducing ability of different parts of ginger extracts was in the range of 368.2–767.2 µm of Fe(II)/g dry weight. Shirinet *et al* (2010) reported the total phenols of the methanol extract as 780 mg/g dry weight. The values of the hydrophilic phenolic of the reported ginger varieties falls within the range reported in previous studies.

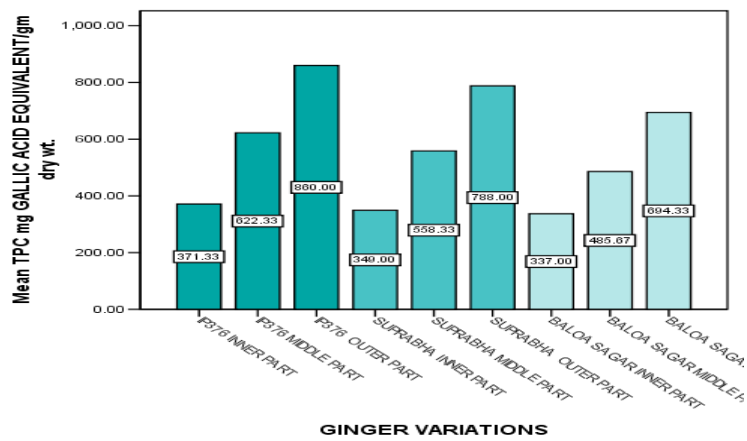
**Table 1: Proximate composition of three varieties and three parts of ginger**

Variety	Parts	Moisture (%)	Protein (g)	Fat (g)	Ash (g)	Fiber (g)	Carbohydrate (g)	Energy (kcal)
Suprabha	Inner	12.5	2.2	2.8	113.2	20.5	19.8	113.2
	Middle	13.1	3.2	3.5	147.5	19.3	25.8	147.5
	Outer	14.9	4.9	4.4	202.8	16.9	35.9	202.8
I P 376	Inner	12.2	2.5	1.1	101.9	20.1	20.8	101.9
	Middle	13.2	3.8	1.6	147.6	18.6	29.5	147.6
	Outer	14.8	5.2	2.2	192.6	15.5	38.6	192.6
Baluasagar	Inner	12.9	2.9	1.6	101.6	23.3	18.9	101.6
	Middle	13.6	3.4	2.3	124.3	19.9	22.5	124.3
	Outer	15	4.5	3.9	187.9	15.2	33.7	187.9

**Table 2: Total phenolic content (mg Gallic acid equivalent/gm dry wt) of inner, middle and outer parts in three varieties of ginger.**

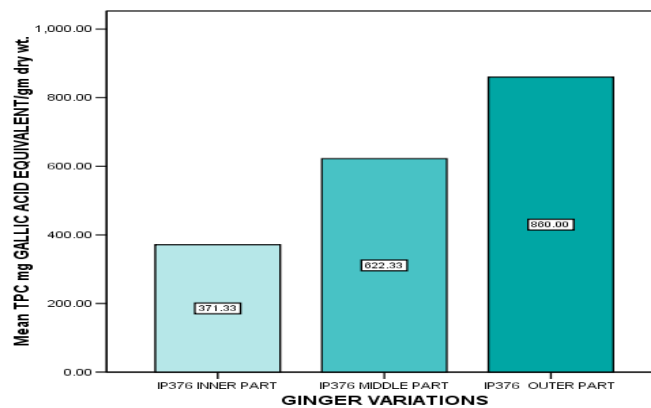
Varieties	Total phenolic content (mg Gallic acid equivalent/gm dry wt)		
	Inner Part	Middle Part	Outer Part
IP376	371.33 ±24.82 <sup>a</sup>	622.33±77.88 <sup>C</sup>	860.00±52.91 <sup>f</sup>
SUPRABHA	349.00±37.46 <sup>a</sup>	558.33±40.41 <sup>b</sup>	788.00 ±64.28 <sup>c</sup>
BALUA SAGAR	337.00±18.00 <sup>a</sup>	485.66±62.69 <sup>b</sup>	694.33±77.88 <sup>d</sup>

Values expressed are mean ± standard deviation of the three experiments. Means in the same column with different letters were significantly different at p < 0.05.



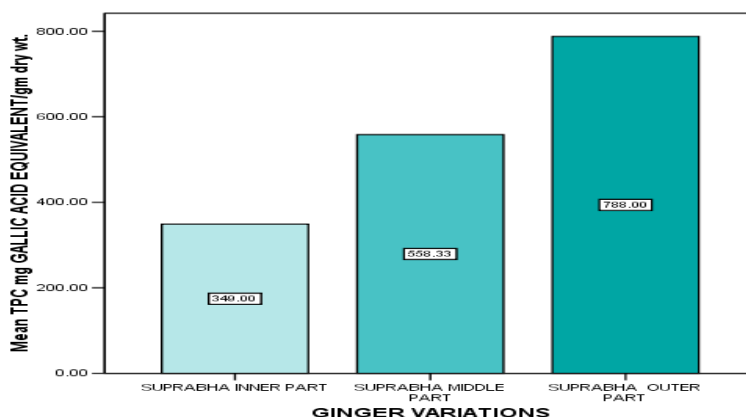
**Fig. 3: Total phenolic content (Total phenolic content (mg Gallic acid equivalent/gm dry wt) of three varieties and three different parts of ginger.**

Total phenolic content was higher in outer part in comparison to middle and inner part of all the three varieties and it was highest in the outer part of the variety IP376 showing the highest value of 800.



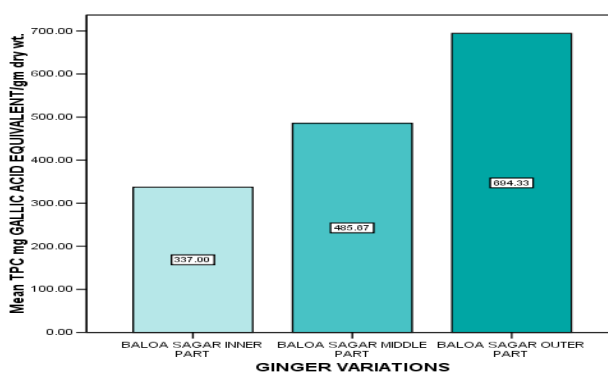
**Fig 4. Total phenolic content (mg Gallic acid equivalent/gm dry wt) of IP 367 variety in three different parts of ginger**

Total phenolic content was highest in the outer part of variety IP376.



**Fig 5. Total phenolic content (mg Gallic acid equivalent/gm dry wt) of suprabha variety in three different parts of ginger**

Total phenolic content was highest in the outer part of variety suprabha.



**Fig 6. Total phenolic content (mg Gallic acid equivalent/gm dry wt) of baluasagar variety in three different parts of ginger**

Total phenolic content was highest in the outer part of variety baluasagar.

**Inter and Intra varietal comparison of % antiradical scavenging activity between three varieties and three parts of ginger:**

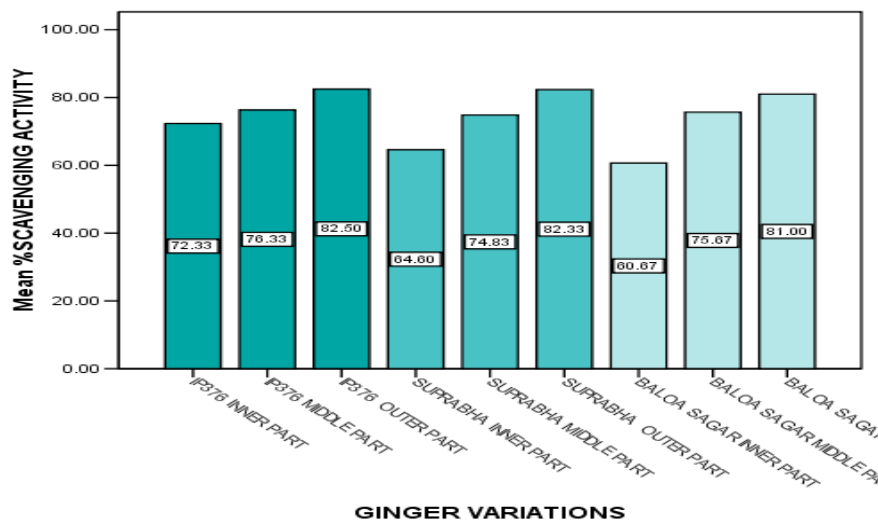
The study shows highest % antiradical scavenging activity in the IP376 variety (72.33-82.50), where as the lowest activity was seen in the variety baluasagar (60.66-81.00). Maximum % antiradical scavenging activity was seen in the outer part of all the three varieties and minimum % antiradical scavenging activity was seen in the inner part. Increasing trend was seen in % antiradical scavenging activity from inner to outer part. Duncan multiple range test revealed % antiradical scavenging activity in inner part

into group c, b, and a, middle into group d, c and outer into group e. (table 3. and fig.7) In previous studies *Aliet al (2010)* reported DPPH• scavenging activity of the extracts was concentration-dependent. Mfr showed significantly higher radical scavenging activity (RSA) (77.97±1.25%) *Shahzadaet al (2010)* significant effect in inhibiting DPPH radical, reaching up to 83.03 ± 0.54%, *Stoilovaet al (2006) investigated* antioxidant effect and the total phenols of ginger extract The total phenols of the alcohol extract were found to be 870.1 mg/g dry extract. 2, 2-Diphenyl-1-picril hydrazyl radical (DPPH) scavenging reached 90.1%. Thus the study falls in the range of above studies.

**Table 3 : % antiradical scavenging activity of inner, middle and outer parts of three varieties of ginger.**

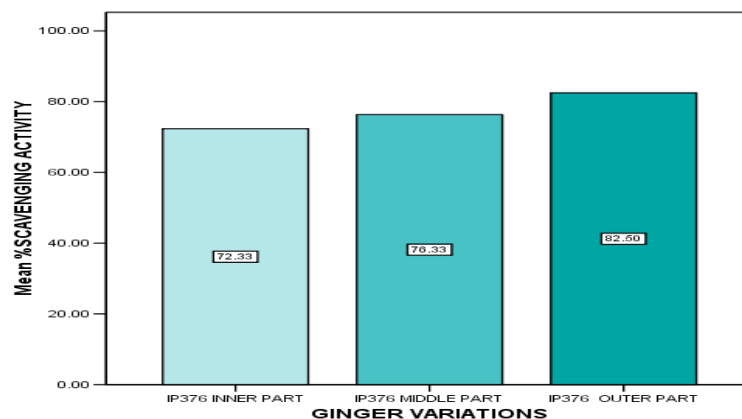
Varieties	% Antiradical Scavenging Activity		
	Inner part	Middle part	Outer part
IP376	72.33 ±.57 <sup>c</sup>	76.33 ±1.15 <sup>d</sup>	82.50 ±.50 <sup>e</sup>
SUPRABHA	64.60 ±.52 <sup>b</sup>	74.83 ±.76 <sup>d</sup>	82.33 ±1.15 <sup>e</sup>
BALUA SAGAR	60.66 ±1.15 <sup>a</sup>	75.66 ±.57 <sup>c</sup>	81.00 ±1.00 <sup>e</sup>

Values expressed are mean ± standard deviation of the three experiments. Means in the same column with different letters were significantly different at p < 0.05.

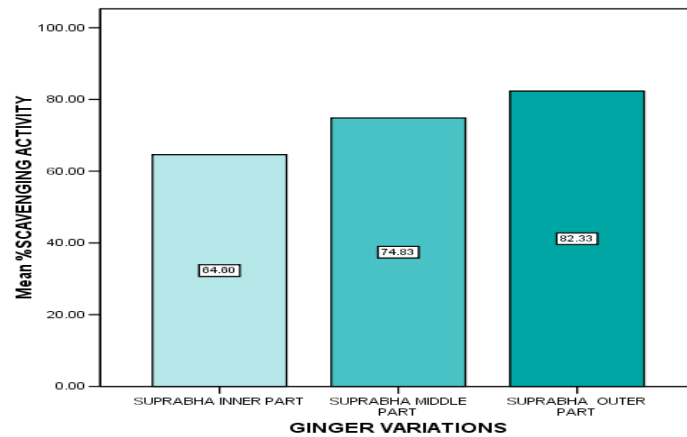


**Fig. 7: % antiradical scavenging activity of three varieties and three different parts of ginger.**

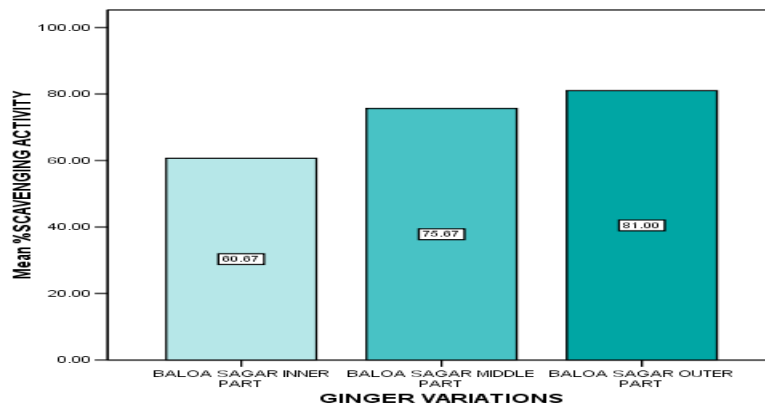
% antiradical scavenging activity was higher in outer part in comparison to middle and inner part of all the three varieties and it was highest in the outer part of the variety IP376 showing the highest value of 82.50%.



**Fig 8. % antiradical scavenging activity of I P 376 variety in three different parts of ginger**  
 % antiradical scavenging activity was highest in the outer part of variety IP 376



**Fig 9. % antiradical scavenging activity of suprabha variety in three different parts of ginger**  
% antiradical scavenging activity was highest in the outer part of variety suprabha



**Fig 10. % antiradical scavenging activity of baluasagar variety in three different parts of ginger**  
% antiradical scavenging activity was highest in the outer part of variety baluasagar.

## Conclusion

From the above results, it has been concluded that the dried ginger powder has high antioxidant activity that is in the %antiradical activity and in the total phenolic content so should be consumed in the diet. The dried ginger powder contain appreciable amount of antimicrobial and antioxidant activity. The consumption of the ginger may play a role in preventing human disease in which free radicals are involved, such as cancer, cardiovascular diseases and aging. The quantity of antioxidants is more in outer part than in the other two parts. Therefore those who are not very fond of delicious taste of ginger and yet want to be benefited with its goodness are advisable to consume outer most part of this natural gold.

## “Cite this Article”

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