COMPOSITIONAL AND MINERAL PROFILING OF ZINGIBER OFFICINALE

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ABSTRACT

Zingiber officinale is a medicinal herb that is used all around the world as spice. The mandate of current study was to explore the nutritional worth of ginger because of its easily availability and mostly use. The raw materials were analyzed for the proximate like moisture, fat, protein, fiber, ash & NFE and mineral profile. The composition profiling of Zingiber officinale indicated moisture, protein, fat, fiber, ash and nitrogen free extract as 75.14±13.9, 8.43±0.32, 5.35±0.17, 3.14±0.13, 2.60±0.09 and 5.37±0.18%, respectively. Moreover, Zingiber officinale contained appreciable amount of minerals especially potassium 410.91±13.97, magnesium 45.02±1.80, phosphorus 32.56±1.24, calcium 15.76±0.57, manganese 0.70±0.04, copper 0.58±0.02, iron 0.54±0.03 and zinc 0.33±0.01 mg/100g, respectively. However, potassium, magnesium, phosphorous, calcium and sodium were present in meager amounts.

Key words: Zingiber officinale, proximate composition, moisture, crude, minerals.

INTRODUCTION

Ginger (Zingiber officinale) is among the leading herbs considered for an array of applications in traditional medicines like Chinese, Ayurveda, and Unani-Tibb (Rong et al., 2009). Owing to its generally considered as safe status, it possesses certain pharmacological activities like cardiovascular protection, antioxidant, anti-inflammatory, glucose lowering and anti-cancer activities etc. (Shukla and Singh, 2007; Nicoll and Henein, 2009).

Ginger is reported to be rich in antioxidant content and has been used as a curative medicine from ancient time (Grant and Lutz, 2000). The volatile essential oils that give the distinguishing flavor of ginger vary from 1-3% whilst oleoresins are accountable for pungent flavor ranges from 4-7.5% and also possesses extensive antioxidant activity (Balachandarn et al., 2006). The active components of ginger are α-zingiberene, 6-gingerol, β-sesquiphellandrene, 6-shogaol, α-farnesene, β-bisabolene and α-curcumene, present in percentage of 22.29, 9.38, 8.58, 7.59, 3.93, 3.87 and 2.63%, correspondingly (Zhan et al., 2008).

Various scientific investigations have documented composition as well as the biological activities (antimicrobial, antioxidant, and immune enhancing perspectives) of ginger extracts (Leal et al., 2003). Owing to provision of properties, ginger rhizome is used from many centuries. Fresh ginger is also being used in food preparation aid (Altman and Marcussen, 2001). Ginger is also used in different confectionary products as well as flavoring agent for baked products (McGee, 2008). Compositional analysis has revealed the presence of carbohydrates, fats, vitamins, minerals and extractable oleoresins (Shukla and Singh, 2007). Ginger contains 9% of lipids or glycolipids and 5-8% of oleoresin (Chrubasik et al., 2005). Owing to numerous health benefits and chemical profiling, ginger must be consumed on daily bases. In the instant research chemical composition along with its nutritional status were observed.
MATERIAL AND METHODS

The current study was conducted in the Functional and Nutraceutical Food Research Section, National Institute of Food Science & Technology (NIFSAT), University of Agriculture, Faisalabad, Punjab, Pakistan.

Procurement of materials

Ginger was procured from local market of Faisalabad. Reagents (analytical) and standards were purchased from Merck (Merck KGaA, Darmstadt, Germany) and Sigma-Aldrich (Sigma-Aldrich Tokyo, Japan).

Sample preparation

Ginger was cut into small pieces in order to obtain desired size. Afterwards, slices were sun dried and ground to a fine powder using grinder. Resultant ginger powder was analyzed for their chemical and biological characteristics.

Proximate analysis

Ginger samples was analyzed for moisture, crude protein, crude fat, crude fiber, ash, and nitrogen free extract (NFE) according to their respective methods as described in AACC (2000). All the tests were carried out in triplicates. Principal of each method is briefly described as follow:

Moisture Content

The moisture content of ginger was determined following method mentioned by AACC (2000) Method No. 934-01. Accordingly, 10 g sample was dried in hot air oven (Model: DO-1-30/02, PCSIR, Pakistan) at a temperature of 105±5°C for the duration until weight was constant.

Crude Protein

Kjeltech apparatus (Model: D-40599, Behr Labor Technik, Gmh-Germany) was used to assess the nitrogen percentage in ginger using AACC (2000) Method No. 984-13. Accordingly, ginger was digested with concentrated H2SO4 by using digestion mixture (K2SO4:FeSO4:CuSO4 i.e. 100:5:10) until the color was light greenish. The digested material was diluted up to 250 mL in volumetric flask. 10 mL of 40% NaOH as well as 10 mL of digested sample was taken in distillation apparatus where liberated ammonia was collected in beaker containing 4% boric acid solution using methyl red as an indicator. This resulted in formation of ammonium borate that was used for nitrogen determination in sample. Thus percentage of nitrogen in sample is assessed by titrating distillate against 0.1N H2SO4 solution till color is light golden. Crude protein content was estimated by multiplying nitrogen percent (N%) with factor (6.25).

\[
N(\%) = \frac{Vol. \text{ of } 0.1 \text{N } H_2SO_4 \times 0.0014 \times \text{Vol. of dilution (250mL)}}{Vol. \text{ of distillate taken} \times \text{Weight of sample}}
\]

Crude protein (%) = Nitrogen (%) x 6.25

Crude Fat

The crude fat content in ginger was calculated following guidelines of Method No. 920-39 in AACC (2000). Dried sample (3 g) was used in soxhlet apparatus (Model: H-2 1045 Extraction Unit, Hoganas, Sweden) using n-hexane as a solvent.

Crude Fiber

The crude fiber of ginger was calculated by elaborating Method No. 978-10 outlined in AACC (2000). Fat free sample was digested with 1.25% H2SO4 followed by 1.25% NaOH solution in Labconco Fibertech apparatus (Labconco Corporation Kansas, USA). After filtration and washing with distilled water remaining residues was weighed and ignited in muffle furnace at temperature of 550-650°C till grey or white ash was obtained. The crude
fiber percentage was estimated according to the expression given below. The crude fiber percentage can be calculated by using formula

\[
\text{Crude Fiber Percentage} = \left( \frac{\text{Weight loss on ignition (g)}}{\text{Weight of sample (g)}} \right) \times 100
\]

**Total Ash**

The ash content of ginger was estimated according to the procedure mentioned in AACC (2000) Method No. 942-05. For which, 5 g sample was directly charred on flame in crucible until there was no fumes coming out. Afterwards sample was ignited in muffle furnace (MF-1/02, PCSIR. Pakistan) at 550-600°C for 5-6 hours or until grayish white residues were obtained.

**Nitrogen free extracts (NFE)**

The nitrogen free extract (NFE) of ginger was calculated according to the following equation:

\[
\text{NFE} = 100 - (\% \text{ moisture} + \% \text{ ash} + \% \text{ crude fat} + \% \text{ crude fiber} + \% \text{ crude protein})
\]

**Mineral contents**

Ginger was analyzed for its mineral content following AOAC (2006). Sample (0.5 g) was digested by using HNO₃ and perchloric acid at ratio of 7:3 on hot plate until solution turned colorless and remained 1-2 mL. Digested sample was diluted up to 100 mL for mineral analysis. Sodium, potassium and calcium were calculated on Flame Photometer-410 (Sherwood Scientific Ltd., Cambridge) on the other hand, copper, iron, magnesium, manganese, phosphorus and zinc were determined through Atomic Absorption Spectrophotometer (Varian AA240, Australia).

**RESULTS AND DISCUSSION**

**Characterization**

The characterization of raw material is an essential step to determine its quality and nutritional value. Initially, the Zingiber officinale and meal were probed for proximate composition and mineral assay.

**Proximate analysis**

Proximate and mineral analysis have vital role in chemical screening of substance. Proximate composition designated (Table 1) that ginger contains moisture 75.14±2.71, crude protein 8.43±0.32, crude fat 5.35±0.17, crude fiber 3.14±0.13, ash 2.6±0.09 and NFE 5.37±0.18%. Mineral profiling (Table 2) has exposed that potassium is present in maximum amount (410.91±13.97 mg/100g) followed by magnesium 45.02±1.80, phosphorus 32.56±1.24, calcium 15.76±0.57 and sodium (12.37±0.40 mg/100g) while iron, zinc, manganese and copper are found only in minute quantities.

Data collected in this research is in covenant with previous research. Results attained from Odebunmi et al. (2009) showed that on dry basis ginger have moisture content, crude protein, crude fiber, fat and ash as 76.86±1.43, 76.86±1.43, 2.93±0.05, 5.62±0.75 and 2.54±0.20%. Only fiber contents show contradiction with their examined value that is less than our collected value. Compositional analysis has revealed the presence of carbohydrates, fats, vitamins, minerals, extractable oleoresins and a strong proteolytic enzyme called zingibain (Shukla and Singh, 2007). Ginger contains 9% of lipids or glycolipids and 5-8% of oleoresin (Chrubasik et al., 2005). It is extensively used approximately all over the globe in food products as seasoning (Ali, 2009 and Shah and Seikh, 2010). Ginger roots are mostly used as cooking spice and medically used for its antioxidant (Sekiwa et al., 2000) and hypoglycemic properties which were observed in animal modeling (AL-Amin et al., 2006).
Table 1: Proximate composition of ginger

<table>
<thead>
<tr>
<th>Proximate Composition</th>
<th>Quantity (%)</th>
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<tbody>
<tr>
<td>Moisture</td>
<td>75.14±2.71</td>
</tr>
<tr>
<td>Crude protein</td>
<td>8.43±0.32</td>
</tr>
<tr>
<td>Crude fat</td>
<td>5.35±0.17</td>
</tr>
<tr>
<td>Crude fiber</td>
<td>3.14±0.13</td>
</tr>
<tr>
<td>Ash</td>
<td>2.60±0.09</td>
</tr>
<tr>
<td>NFE</td>
<td>5.37±0.18</td>
</tr>
</tbody>
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Table 2: Mineral composition of ginger

<table>
<thead>
<tr>
<th>Minerals</th>
<th>Concentration (mg/100g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potassium</td>
<td>410.91±13.97</td>
</tr>
<tr>
<td>Magnesium</td>
<td>45.02±1.80</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>32.56±1.24</td>
</tr>
<tr>
<td>Calcium</td>
<td>15.76±0.57</td>
</tr>
<tr>
<td>Sodium</td>
<td>12.37±0.40</td>
</tr>
<tr>
<td>Manganese</td>
<td>0.70±0.04</td>
</tr>
<tr>
<td>Copper</td>
<td>0.58±0.02</td>
</tr>
<tr>
<td>Iron</td>
<td>0.54±0.03</td>
</tr>
<tr>
<td>Zinc</td>
<td>0.33±0.01</td>
</tr>
</tbody>
</table>
EL-Ghorab et al. (2010) investigate the chemical composition of ginger and observed that ginger contain 88.5±0.39% moisture tracked by 0.2±0.01% crude fat, 1.1±0.16% crude fiber, 1.5±0.07% ash, 1.2±0.17% protein and 7.6±0.67% NFE. Their compiled results were somewhat different to our estimated values. Similarly, Nwinuka et al. (2010) determined that on dry basis ginger contain moisture (76.67±0.01), crude protein (8.25±0.15), fat (5.35±0.15) and ash (6.40±0.15). All results were in accordance with our research work except ash which has highest value as compared to our analyzed value, they also reported ginger as a rich source of carbohydrates (3.24±0.08). They also concluded that on consumption of 100 g ginger it provides 375.37 Kcal of metabolized energy. According to Latona et al., (2012) ginger contains moister content 76.53%, crude protein 9.13%, crude fiber 3.07%, fat content 5.09%, ash 2.64% and NFE 3.36%. Results relating to moisture, fat and ash are in agreement to above mentioned findings while ash and fiber contents are highly inconsistent.

Additionally, Okolo et al. (2012) concluded that the moisture, protein, fiber, fat and ash contents of ginger are 74.72±1.32, 7.57±0.59, 6.07±0.64, 4.92±0.61 and 2.92±0.14% respectively on dry basis. Ginger has the highest amount of moisture and lowest for ash. The data collected for the proximate analysis of ginger are somewhat diverse than that of previously by recounted scientists. Ginger is also a source of carbohydrate with a value of 3.80±0.34%. Recently, Nandi et al. (2013) gave an idea about quality composition of ginger.

Rendering to their results the moisture level of ginger is 77.30±0.25%, while other constituents are total ash (1.85±0.07%), protein (6.06±0.16%), crude fiber (4.61±0.12%), fat (2.24±0.05%) and a little amount of essential oils that is 0.23±0.005. they also suggested that on consumption ginger gave an energy level of 50.93±0.95 (Kcal/100g). Results related to mineral analysis were verified by findings of Shirin and Prakash (2010). They concluded that ginger is an amusing source of Phosphorous (174±1.2 mg/100g) followed by Calcium (88.4±0.97), Manganese (9.13±001), Iron (8.0 ± 0.2) and traces amount of Zinc, Chromium and Copper. Iron is essential for blood formation owing to a major constituent of hemoglobin while zinc is required for fertility, insulin working as well as mental and body growth.

Minerals especially calcium and potassium are required in human body in large amounts. Their deficiency results in arthritis, bone and tooth related disorders. Similarly, Famurewa et al. (2011) stated that fresh ginger contain mineral contents as Ca 110 mg/100g, succeeding by Mg 60 mg/100g and K 24.91 mg/100g while iron and zinc are also present in traces. They also informed that on drying of ginger, mineral content gradually increases. Moreover results gained by Latona et al. (2012) indicated that the mineral content of ginger is 8068 mg/100g, 280, 279, 64, 8.80 and 5.90 for phosphorus, calcium, iron, zinc, copper and manganese correspondingly.

REFERENCES


