Asian Journal of Chemistry; Vol. 28, No. 7 (2016), 1498-1500

ASIAN JOURNAL OF CHEMISTRY

http://dx.doi.org/10.14233/ajchem.2016.19733

Spectrophotometric Analysis of Protein Contents in Twenty Five Accessions of Ginger Rhizomes from Kumaun and Garhwal Regions of Uttarakhand, India

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Received: 18 November 2015; *Accepted*: 3 March 2016; *Published online*: 31 March 2016; AJC-17836

The aim of the present work is to study and compare the protein content in 25 accessions of ginger rhizomes collected from Kumaun and Garhwal regions of Uttarakhand, India and correlation study with altitudes of different collection place. The analysis indicate significant differences in protein content of ginger rhizomes revealing the positive correlation between protein content *versus* altitude of collection place. Finally, the results provided evidence that ginger rhizomes from Kumaun region of Uttarakhand, India are good source of protein and could have wide utility in the food, agricultural, medicinal and pharmaceutical industries.

Keywords: Spices, Ginger, Protein, Bradford, Coomassies dye.

INTRODUCTION

Food condiments or spices are strong smelling, sharp tasting substances used to improve or adjust the flavour of food [1]. The rhizomes of ginger (*Zingiber officinale Roscoe)* belonging to Zingiberaceae family, commonly used as a spice for over 2000 years and contains characteristic odour and flavour such as the pungent taste [2,3]. Ginger also known as "The Great Medicament" in Ayurvedic medicines is an important root spice, used both in fresh and dried forms. It has been widely used in traditional system of medicines all over the world, for a wide array of unrelated ailments including arthritis, rheumatism, sprains, muscular aches, pains, sore throats, cramps, constipation, indigestion, vomiting, hypertension, dementia, fever and helminthiasis [4].

Plants have basic nutritional importance that can be assessed by their content of protein, carbohydrates, fats, oils, vitamins, in addition to water which are required for growth and development in man and animals [5]. Plant foods can contribute significantly to human nutrition and health, because they contain almost all essential human nutrients. It shows that 70-80 % of the world population rely on non-conventional medicine, especially from herbal sources [6].

Protein is an important nitrogenous macromolecule that are composed of amino acids linked together by peptide linkages [7]. Proteins play significant biological role in humans as well in plants. These can be analyzed from seeds and other parts of plants such as leaves and stems [8-10]. Proteins are also used in membranes, such as glycoproteins when broken down into amino acids, they are used as precursors to nucleic acid, co-enzymes, hormones, immune response, cellular repair and other molecules essential for life [11]. Additionally, protein is needed to form blood cells [1,7]. Protein is also used as anaerobic fuel when carbohydrates are low, or as aerobic fuel when lipid resources are also low [12,13].

Proteins are often used as food ingredients for their functional properties or to impart certain specific characteristics to the final product. These properties are intrinsic physico-chemical characteristics, which affect the behaviour of proteins in food system during processing, manufacturing, storage and preparation [14]. Ginger is important in nutritional point of view as it contain vitamins, proteins, carbohydrates, minerals, *etc*.

A number of dyes have been used in dyeing of proteins for example Lawsone and Coomassies dyes [15]. The present study was carried out to assess protein content in ginger rhizomes from Kumaun and Garhwal region of Uttarakhand and to find out their correlation with different altitude of the collection place. However many researchers have been carried out on ginger rhizomes but no systematic report on the protein content of 25 accessions of ginger rhizomes from Kumaun and Garhwal region and their association with altitudes of different collection place has been reported.

EXPERIMENTAL

Twenty five accessions of ginger rhizome were collected from ten districts of Uttarakhand State *viz.* of Kumaun and Garhwal region. Fifteen of these accessions (accession no. 1

to 15) from Kumaun region (29°36′N, 79°42′E) and ten (accession no. 16 to 25) of these from Garhwal region (30°30′N, 78°30′E).

Analytical grade chemicals Coomassie Brilliant Blue G 250 (CBB-G250), ethanol, orthophosphoric acid, bovine serum albumin (BSA), mono and dibasic sodium phosphate were procured from Hi-Media, S.D. Fine Chemicals, E. Merck and Sigma Chemicals.

Determination of proteins by spectrophotometric method

Preparation of reagents: CBBG-250 dye was prepared by mixing 100 mg in 50 mL ethanol and add 100 mL (85 %) orthophosphoric acid, volume adjusted upto 1 L with double distilled water [16]. Solution was filtered and stored at 4 °C in amber coloured bottle. 1000 ppm stock solution of BSA was prepared in phosphate buffer (pH 7.6).

Procedure of protein extraction by Bradford's method: 0.5 g of ginger rhizome powder were ground in pastel mortar with 3 mL phosphate buffer. These samples were kept overnight for complete extraction of protein and were centrifuged at 10,000 rpm for 30 min. The supernatant is used for protein analysis. 50 µL of supernatant was adjusted to 250 µL with phosphate buffer and to this 3 mL of Bradford dye reagent was added and absorbance recorded at 595 nm in UV-visible spectrophotometer against reagent blank. A standard calibration curve is drawn by using bovine serum albumin as standard [16,17] he protein content was expressed as mg/g.

Statistical analysis: Results are presented as mean ± standard deviations. One way analysis of variance (ANOVA), Tukey's test ($p < 0.05$) and the Correlation between different altitude of collection place (Kumaun and Garhwal) and protein content was evaluated by using SPSS16 Statistical Package for Social Science.

RESULTS AND DISCUSSION

The collection place and altitude of 15 ginger rhizome accessions from Kumaun region are presented in Table-1. The protein content of all ginger rhizomes (accession no. 1 to 15) from Kumaun region differed significantly from each other ($p < 0.05$) and varied from 11.34 ± 0.018 to 7.16 ± 0.012. The maximum protein content was recorded in accession no. 7 while least amount of protein recorded in accession no. 6 of Kumaun region. Table-2 shows, collection place and altitude of 10 ginger rhizomes (accession no 16 to 25) from Garhwal region and the protein content in all these samples are significantly different ($p < 0.05$) ranged from 10.66 ± 0.039 to 5.38 ± 0.048. In Garhwal region accession no. 25 contain high protein content while accession no. 18 contain least amount of protein.

TABLE-1
PROTEIN CONTENT IN GINGER RHIZOMES COLLECTED FROM KUMAUN REGION (ACCESSION No. 1 to 15)

Accession No.	Collection place	Altitude (m)	Protein content (mg/g)	Correlation coefficient between protein content of ginger rhizomes and altitude
1	Bageshwar	1004	7.54 ± 0.042^{c}	
2	Dharchula	915	7.52 ± 0.018^{c}	
3	Dwarahat	1510	7.67 ± 0.03^{d}	
4	Champawat	1610	7.8 ± 0.018^{e}	
5	Someshwar	1870	10.16 ± 0.042^{l}	
6	Jarapani	520	7.16 ± 0.012^{a}	
7	Belkote	2010	11.34 ± 0.018^{m}	0.753**
8	Dhaulchina	1646	8.43 ± 0.03^{g}	**Significant at $\alpha = 0.01$
9	Pithoragarh	1650	8.64 ± 0.042^{h}	
10	Lohaghat	1706	8.66 ± 0.043^{hi}	
11	Muwani	1611	8.24 ± 0.025^{f}	
12	Didihat	1725	8.75 ± 0.021^{i}	
13	Berinag	1860	9.07 ± 0.043^{k}	
14	Gangolihat	1760	8.91 ± 0.045^{j}	
15	Ramnagar	344	7.39 ± 0.012^{b}	

Values are means of three replicates ± SD. Within a column, mean values followed by the same letter are not significantly different according to Tukey's test ($p < 0.05$).

TABLE-2
PROTEIN CONTENT IN GINGER RHIZOMES COLLECTED FROM GARHWAL REGION (ACCESSION No. 16 to 25)

Accession No.	Collection place	Altitude (m)	Protein content (mg/g)	Correlation coefficient between protein content of ginger rhizomes and altitude
16	Rudraprayag	895	6.43 ± 0.012^{b}	
17	Rishikesh	372	7.08 ± 0.032^{e}	
18	Dehradun	435	5.38 ± 0.048^{a}	
19	Chamba	1524	6.54 ± 0.03^{cd}	
20	Nagri	648	6.63 ± 0.018^{d}	0.661*
21	Tehri	1750	8.37 ± 0.025^{h}	*Significant at $\alpha = 0.05$
22	Fakot	1326	6.46 ± 0.057^{bc}	
23	Gaja	1700	7.38 ± 0.018^{f}	
24	Agrakhal	1600	8.02 ± 0.018^{g}	
25	Paurigarhwal	1814	10.66 ± 0.039^{i}	

Values are means of three replicates ± SD. Within a column, mean values followed by the same letter are not significantly different according to Tukey's test ($p < 0.05$).

The above results indicated that all the 25 ginger accessions possess high variation in protein content and ginger rhizomes from Kumaun region are the richest source of protein than Garhwal region. Accession no. 7 was superior to all others in term of protein content.

In the present investigation, protein content in 25 accessions of ginger were measured to find out their correlation with altitude of collection place. Correlation analysis showed positive correlation of protein content of ginger rhizomes with the altitude of collection place from Kumaun (r = 0.753) and Garhwal (r = 0.661) region at $\alpha = 0.01$ and 0.05 (level of significance). The positive correlation between protein content of ginger rhizomes and altitude indicated high degree of interdependence between these parameters.

The findings are in agreement with USDA as dried ginger rhizome contain high amount of protein 8.89 g/100 g than fresh ginger rhizome contain 1.82 g/100 g [17]. Similar results were found by Pruthi [18] as dry ginger contains 8.6 % protein. Haq *et al*. [19] studied the composition of ginger from Bangladesh and reported 12.3 % protein content and 2.3 % water-soluble proteins.

Rai *et al*. [20] studied chlorophyll a, b, a:b, sugar, carotenoid, protein content and secondary metabolites in leaves of 10 ginger cultivars and their correlation with rhizome yield and found that rhizome yield is positively correlated with chlorophyll a and carbohydrates and negatively correlated with polyphenols, protein content.

Conclusion

To our best of knowledge, this is the first report on protein content of 25 accessions of ginger rhizomes from Kumaun and Garhwal region of India and present study results suggest that ginger rhizomes from Kumaun region of Uttarakhand are good source of protein and could have wide utility in food, agricultural and pharmaceutical industries.

ACKNOWLEDGEMENTS

One of the authors (Jyotsna Dhanik) is thankful to Department of Science and Technology, New Delhi, India for providing DST-INSIPRE for research work.

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