Scholars Journal of Agriculture and Veterinary Sciences **e-ISSN 2348–1854**
Sch J Agric Vet Sci 2016; 3(5):397-401 **p-ISSN 2348–8883**
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(An International Publisher for Academic and Scientific Resources) DOI: 10.36347/sjavs.2016.v03i05.009

Nutritional and Antioxidant Components of Ridge Gourd (*Luffa acutangula* L. Roxb) Fruits of Promising Genotypes and Varieties

Kandoliya, U.K.*, Marviya, G.V., Bodar, N.P., Bhadja, N.V., Golakiya, B.A.
Food Testing Laboratory, Department of Biotechnology, Junagadh Agricultural University, Junagadh, India

***Corresponding Author**
Name: Kandoliya U.K
Email: ukkandolia@yahoo.com

Abstract: Ridge gourd (*Luffa acutangula* L. Roxb), popularly known as Kalitori belongs to genus Luffa of Cucurbitaceae family is a popular vegetable in India and other Asian countries generally used for vegetable purpose. Ridge gourd like fruit vegetables are known as a 'vegetables of diet food' because of high moisture per cent and low calorific value. However, ridge gourd fruits having a high moisture content (90.47 - 92.78 %) and low calorific value due to low sugar and protein content, it proves a comparable source of various components of antioxidants like ascorbic acid (8.64-14.13 mg.100g^{-1}), flavonoid (0.77-1.59 mg.g^{-1}) and phenolics (0.416-0.742 mg.100g^{-1}) with variable amount of nutritional compounds like soluble sugar (1.21-1.58 %), protein (0.175-0.253 %), carotenoid (14.5-36.1 mg.100g^{-1}) and chlorophyll (1.59-1.85 mg. g^{-1}) content on fresh weight basis.
Keywords: *Luffa acutangula* L , Ridge gourd, Antioxidant activity, Nutritional component, Chlorophyll, Carotenoid

INTRODUCTION

Ridge gourd (*Luffa acutangula* L. Roxb), popularly known as Kalitori, angled gourd and angled loofah, belongs to genus Luffa of Cucurbitaceae family and has chromosome number 2n = 26. Ridge gourd is a popular vegetable consumed in Asian, African and Arabic countries and a common vegetable in daily Indian diet. It has different vernacular names in different languages like English (Ridge gourd, Angled lufa), Hindi (Jhimani, Karvitarui, Karvituri, Sankirah, Rantorai), Sanskrit (Gantali, Kosataki,), Urdu (Turai), Kannada (Kahire, Kahi Heere, Naaga daali balli), Malayalam (Athanga), Marathi (Divali, Kadudodaki, Kadushirali, Kaduturai, Ranturai, Kadudodka, Dadudodaka), Telugu (Adavibira, Chedubira, Sendubirai, Verribira, Adivibeera), Punjabi (Jhinga, Shirola), Tamil (Peerku, Itukari, Itukarikkoti, Kacappi, Kacappuppirkku, Kaccam, Kaippuppirkku, Karniti) [1].

The most common use of the ridge gourd fruit is cooked as a vegetable. It is very nutritive vegetable and has a bitter taste if taken raw. Ridge gourd has been also used extensively in Indian traditional system of medicines as diuretic, expectorant, laxative, purgative, hypoglycemic agent and bitter tonic. Ridge gourd has a sweet taste after cooking, cooling in nature and easy to digest. They form a low calorie diet, which is considered good for diabetes. Both the soft pulp and skin of ridge gourd are used in making various recipes, especially in South Indian cuisine. Chutneys made from the pulp and the peel of ridge gourd is known for their health benefits [2] . It is reported to contain many phytochemicals such as flavonoids, saponins, luffangulin, sapogenin, oleanolic acid and cucurbitacin B. Ridge gourd acts as an appetizer and it is a healthy food and contains good amount of fiber, vitamins and minerals including Vitamin B_2, Vitamin B_3, Vitamin C, carotene, calcium, phosphorus and iron in small quantities. However, the data on the antioxidant activity of ridge gourd fruit grown in this region is unavailable. Therefore, the present study was undertaken to evaluate nutritional components as well as antioxidant compounds like ascorbic acid and phenolics from edible portion of ridge gourd and the relative antioxidant activities using DPPH assays.

MATERIAL AND METHOD

Source of Materials

Fruits of six promising genotypes and varieties of brinjal viz., JRG-05-4, JRG-05-6, JRGH-28, Pusa Nasdar, Jaipur Long and GARG-1 obtained from Vegetable Research Station, Junagadh Agricultural University, Junagadh were divided in three replications and used for analysis of different parameters as under. The nutritional parameters were carried out from evenly homogenized fruit pulp along with the skin part. Whereas analysis of pigments like chlorophyll and carotenoids etc. were done from skin of the ridge gourd fruits only.

Nutritional components

Moisture was determined by oven drying at 105°C for 8 hours from the fruit pulp [3]. The amount of total soluble sugar was estimated from metanolic extract of fruit pulp[4]. True protein was estimated and Folin-Phenol reagent [5]. Total chlorophyll from skin of

the ridge gourd was determined using DMSO [6]. Total carotenoid was measured as per Mahadevan and Shridhar [7]. The phenol content was determined using same methanolic extract used for sugar estimation[8]. Ascorbic acid was quantified according to the method described by Omaye *et al.*, [9]. Total Flavonoid was estimated using methanolic extract in which 0.5 ml of 2% w/v $AlCl_3$ in methanol and 0.5 ml potassium acetate (120 mM) were added and incubated at room temperature for 30 minutes. Absorbance was read at 415 nm [10].

Determination of Antioxidant Activity by DPPH

Out of various *in vitro* radical scavenging assays, DPPH assay is simple, rapid, inexpensive and widely used assay. The assay is based on the measurement of the scavenging capacity of antioxidants. In present study, methanolic extract (100 µL) of sample was mixed with 900 µL of Tris HCl buffer (50 mM, pH 7.4) and 2 ml of DPPH (0.1 mM in methanol). The solution was incubated at room temperature for 30 minutes and the absorbance was read at 517 nm. The percentage of DPPH scavenging activity was determined as follows,

DPPH Radical Scavenging Activity (%) =[(A0 A1)/A0]

where A0 is the absorbance of control and A1 is the absorbance of sample [11, 12].

Statistical analysis

For interpretation, data was statistically analyzed as per CRD design [13].

RESULTS AND DISCUSSION

The results of various nutritional components as well as antioxidant contributing factors like total phenol, flavonoids, ascorbic acid content and radical scavenging assays etc. in fruits of ridge gourd varieties and genotypes are given in Table.1 and Fig.1 to 6**.** The results were reported as mean values from three replication on fresh weight basis only.

Table 1: Nutritional components of studied ridge gourd genotypes and varieties

Promising Genotype/ Variety	Moisture %	Protein %	Total Soluble Sugar %	Reducing Sugar%	Chlorophyll-a $mg.g^{-1}$ fresh fruit	Chlorophyll-b $mg.g^{-1}$ fresh fruit
JRG-05-4	91.93	0.217	1.44	0.748	0.58	1.26
JRG-05-6	90.65	0.253	1.45	0.811	0.49	1.33
JRGH-28	92.78	0.274	1.30	0.733	0.33	1.26
Pusa Nasdar	90.47	0.201	1.21	0.694	0.61	1.06
Jaipur Long	91.95	0.175	1.58	0.731	0.71	1.14
GARG-1	90.96	0.182	1.55	0.726	0.59	1.16
S.Em.±	1.16	0.003	0.02	0.01	0.021	0.04
C.D. at 5 %	NS	0.008	0.07	0.03	0.064	0.12
C.V.%	2.14	4.78	2.95	2.26	6.49	5.54

Ridge gourd, sponge gourd, bottle gourd and brinjal like fruit vegetables were known as a 'vegetables of diet food' because of high moisture per cent and low calorific value. Moisture of food is essential factor which plays important role in maintaining level of water in body and for many metabolic activities. In a present study, the moisture content was varied from 90.47 to 92.78 % in fruits of ridge gourd studied. There were no statistical significant differences found among the varieties.

The protein content in ridge gourd fruits indicates that its intake can contribute to the formation of hormones which controls a variety of body functions such as growth, repair and maintenance (replacement of wear and tear of tissues) of body. Protein present in the ridge gourd fruit is responsible for its nutritional value. It varied from 0.175 % to 0.274 %. The highest protein was recorded in JRGH-28 (0.274 %) followed by JRG-05-6 (0.253 %) in ridge gourd fruits.

Total soluble sugar and reducing sugar content varied significantly in the ridge gourd varieties were ranged between 1.21 to 1.58 $mg.g^{-1}$ and 0.694 to 0.811 $mg.g^{-1}$ on fresh weight basis respectively (Table.1). The highest amount of soluble sugar was noted in case of Jaipur Long (1.58 %) compared to other whereas highest reducing sugar was recorded for the genotype JRG-05-6. These high amounts of sugar components in varieties investigated confer the significant roles to human health. This is because, apart from the supply of energy, they are also needed in numerous biochemical reactions not directly concerned with energy metabolism.

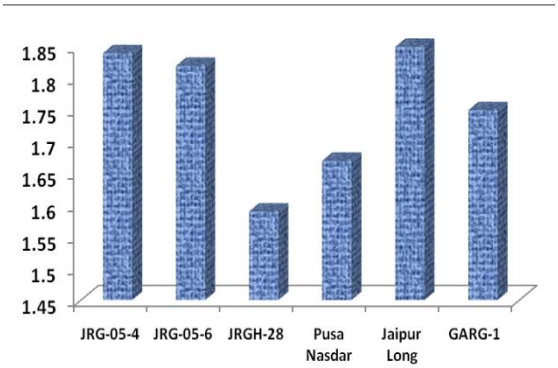

Fig-1: Total Chlorophyll content mg. g^{-1} in fruit skin of different ridge gourd genotypes and varieties (S.Em± :0.021 C.D. at 5%: 0.064)

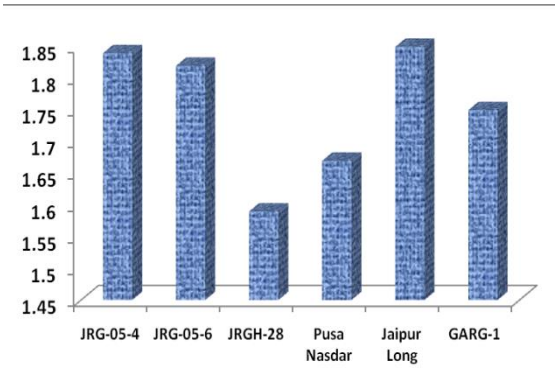

Fig-2: Total Carotenoid content mg. 100g^{-1} in fruit skin of different ridge gourd genotypes and varieties (S.Em± : 0.402 C.D. at 5%: 1.332)

Chlorophyll is a green pigment present in plants which facilitates the absorption of light from the sun. It has the ability to convert this light energy into usable form which is utilized for various processes such as photosynthesis by virtue of which the green plants prepare their own food. An interesting fact about chlorophyll is that its molecular structure is similar to that of haemoglobin which is a critical part of human blood. The only exception is their central atom which is iron for haemoglobin and magnesium for chlorophyll. In present investigation, Chlorophyll-a, b and total varied significantly among the genotypes and varieties (Table.1). Minimum content of chlorophyll-a (0.33 mg.g^{-1}) was found in the genotype JRGH-28 which was maximum (0.71 mg.g^{-1}) in the variety Jaipur Long. The highest value for chlorophyll-b (1.33 mg.g^{-1}) was observed in the genotype JRG-05-6 while, the variety Pusa Nasdar contained the lowest (1.06 mg.g^{-1}) value. Total chlorophyll content was significantly high in the variety Jaipur Long with 1.85 mg.g^{-1}which was at par with the genotypes JRG-05-4 (1.84 mg.g^{-1}) and JRG-05-6 (1.82 mg.g^{-1}) while the genotype JRGH-28 had the lowest value (1.59 mg.g^{-1}) for total chlorophyll (Fig.1).

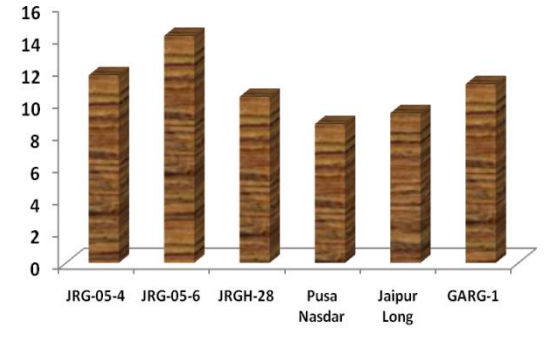

Fig-3: Total Ascorbic acid mg. 100g^{-1} in fruit pulp of different ridge gourd genotypes and varieties (S.Em± :0.191 C.D. at 5%: 0.634)

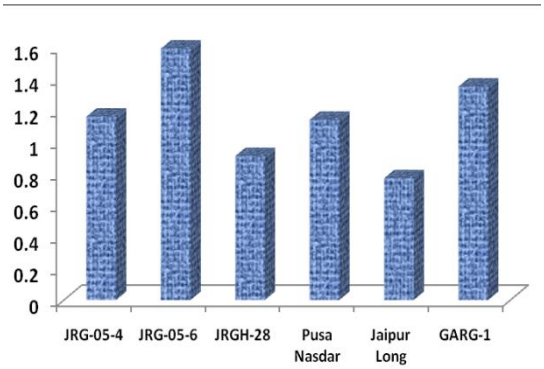

Fig-4: Flavanoid content mg. g^{-1} in fruit skin of different ridge gourd genotypes and varieties (S.Em± : 0.053 C.D. at 5%: 0.177)

The Ascorbic acid content, the major antioxidant and neutraceutically important compound, was analyzed from different varieties of ridge gourd showed statistical significant value. The genotype JRG-05-6 recorded the highest value for ascorbic acid (14.13 mg.$100g^{-1}$). The carotenoid and flavanoid were also showed significant differences having a maximum carotenoid content (36.1 mg.$100g^{-1}$) and flavonoid content (1.59 mg.g^{-1}) in a fresh fruit of same genotype JRG-05-6 ridge gourd. Plants produce various secondary metabolites in response to several stimuli. Among these, polyphenolic compounds including flavonoids are shown to display a wide array of bioactivities including antioxidant activity.

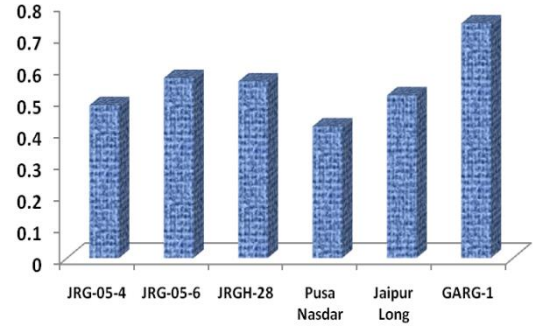

Fig-5: Total Phenol mg. $100g^{-1}$ in fruit pulp of different ridge gourd genotypes and varieties (S.Em± :0.014 C.D. at 5%: 0.042)

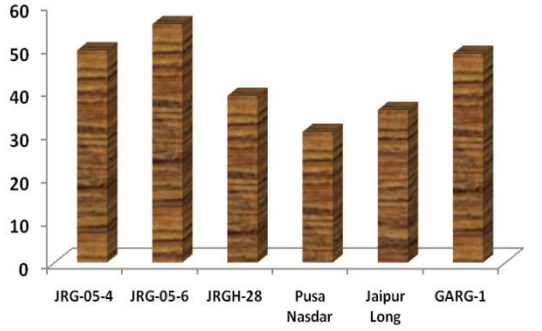

Fig-6: Per cent radical scavenging activity (DPPH) value in fruit pulp of different ridge gourd genotypes and varieties (S.Em± : 0.049 C.D. at 5%: 0.152)

The phenolic compounds may contribute directly to the antioxidant action; therefore, it is necessary to investigate total phenolic content [14, 15]. Phenol content was varied between 0.416 to 0.742 mg.$100g^{-1}$. The highest value (0.742 mg.$100g^{-1}$) was recorded for the fruits obtained from variety GARG-1. In general, the higher phenol content was associated with higher antioxidant capacity [16]. Several studies have also reported a good correlation between the total phenol content of plant extracts and antioxidant activity

[17]. However , there were no clear cut trends was observed between DPPH activity and total phenol content in present study (Fig. 5 and Fig.6). So far as antioxidant activity is concerned, several *in vitro* assays are available for evaluating free radical scavenging of samples. Among these, DPPH assay is widely used as it is simple, rapid and the results are reproducible. The DPPH activity was varied in the range of 30.37 % in the variety Pusa Nasdar to 55.42 % with the variety GARG-1 of ridge gourd. The results showed that the antioxidant activity remarkably increased in variety having high phenol, flavonoid contents as well as ascorbic acid content in present study.

CONCLUSION

Our study has reflected the fact that, in spite of having a high moisture content and low calorific value due to low sugar and protein content in the fruit of ridge gourd studied, it proves a comparable source of various components of antioxidants like ascorbic acid, flavonoid and phenolics with variable amount of nutritional compounds like soluble sugar, protein carotenoid and chlorophyll content.

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