

PLANT SCIENCE TODAY, 2020  
Vol 7(2): 154-156  
<https://doi.org/10.14719/pst.2020.7.2.664>  
ISSN 2348-1900 (online)

HORIZON  
e-Publishing Group 



## RESEARCH COMMUNICATION

# Antioxidant properties of BJRI vegetable mesta-1 (*Hibiscus sabdariffa* L.)

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### ARTICLE HISTORY

Received: 24 November 2019  
Accepted: 15 December 2019  
Published: 01 April 2020

### KEYWORDS

Roselle; BJRI vegetable mesta-1; calyx; antioxidant properties

### ABSTRACT

Roselle or Mesta (*Hibiscus sabdariffa*) is one of the plants whose plant parts are used to prepare juices. The Roselle calyx is considered as a good source of antioxidants. But the antioxidant properties of BJRI (Bangladesh Jute Research Institute) released Roselle vegetable variety, BJRI vegetable mesta-1, is not quantified yet. With the objective of making this vegetable more popular among the consumers, an experiment was conducted at the Jute Agriculture Experimental Station, Bangladesh Jute Research Institute, Jagir, Manikganj to find out the antioxidant properties of BJRI vegetable mesta-1. Total four antioxidant components eg., total phenol content, total flavonoid content, proanthocyanidin content, anthocyanin content and three antioxidant activities eg., DPPH (1,1-diphenyl-2-picrylhydrazyl) radical scavenging, (FRAP) ferric ion reducing antioxidant power, H<sub>2</sub>O<sub>2</sub> (hydrogen peroxide) radical scavenging were measured from the calyx sample of BJRI vegetable mesta-1. Among the four antioxidant components, total flavonoid contents (959.53 mg 100 g<sup>-1</sup>) possess the highest position and anthocyanine contents (0.17 mg 100 g<sup>-1</sup>) were in the lowest position. FRAP activities were highest among the antioxidant activities of the calyx of our studied vegetable mesta. Our findings represented the quantity of antioxidant contents of the calyx of BJRI vegetable mesta-1 which justify its uses as natural antioxidants. Thus, Roselle calyx may act as an alternative source of antioxidant rich natural herbal tea.

## Introduction

Roselle (*Hibiscus sabdariffa* L.) of Family Malvaceae is popularly known as 'mesta' or 'chukur' in Indian subcontinent including Bangladesh (1, 2). It is widely cultivated crop in tropical countries, Sudan, Egypt, Mali, Nigeria, India, Indonesia, Malaysia, Brazil, Australia and Mexico. Roselle leaves and flower calyx are consumed as vegetable (3). Roselle flower has a solid fleshy calyx at the base, 1 cm to 2 cm wide, enlarging to 3 cm to 3.5 cm. The calyx (red and dark red) are used to extract juice for fresh drink and the leaves (green colored calyx) are used as vegetables (4). Roselle calyx is sweet in taste and should be picked 10 to 15 days after they lose its blooms, otherwise it will taste more tart (5, 6).

In many countries, this plant is primarily cultivated for bast fiber from the stem. The fiber is used as a substitute for jute in making burlap. The red calyx of the plant are used as food colorings and dyes

(7). The food and beverage manufacturers and pharmaceutical concerns have considered Roselle as a herbal medicine and an alternate source of colorant for synthetic dyes (8). The most important use of Roselle calyx as Roselle tea that regulates blood pressure, cholesterol and prevents cardiovascular diseases. Roselle tea acts as an anti-inflammatory agent, assists in digestion and reduces the risk of cancer (8). Roselle calyx tea is also rich in vitamin C, minerals and antioxidants. It has distinct maroon color along with sweet and tart flavor similar to that of cranberries (3). It can be enjoyed both hot and cold depending on consumer's preferences (8).

It has been observed that it has potential use as a medicine for curing diseases in aquatic organisms as roselle extract significantly elevated levels of lactate dehydrogenase (LDH), glutamate oxalate transaminase (GOT), glutamate pyruvate transaminase (GPT) and malondialdehyde (MDA) (9). It significantly reduces levels of superoxide dismutase

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**To cite this article:** Mollah MAF, Tareq MZ, Bashar KK, Hoque BMZ, Karim MM, Rafiq MZA. Antioxidant properties of BJRI vegetable mesta-1 (*Hibiscus sabdariffa* L.). Plant Science Today. 2020;7(2):154-156. <https://doi.org/10.14719/pst.2020.7.2.664>

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(SOD) and glutathione peroxidase (GSH-Px). Limited research work has been done on its antioxidant properties of Roselle calyx. But unfortunately, there is no information on the antioxidant properties of BJRI released Roselle variety named as BJRI vegetable mesta-1. This vegetable Roselle variety is not gaining popularity with its vegetable properties only. Therefore, Roselle calyx tea bearing considerable amount of antioxidant properties may improve the acceptance of BJRI vegetable mesta-1 to the consumer. Considering this fact an effort was made to quantify the antioxidant properties of the calyx of BJRI vegetable mesta-1.

## Materials and Methods

### Plant materials and growth conditions

This experiment was conducted at the Jute Agriculture Experimental Station, Bangladesh Jute Research Institute, Manikganj, Bangladesh from August to December, 2018 to quantify the antioxidant properties of BJRI vegetable mesta-1. The altitude of the experimental field was 4 m in the Old Brahmaputra-Jamuna flood plain (Agro-ecological Zone-8) with a silt loam soil. Seeds were collected from Jute Agriculture Experimental Station, BJRI, Jagir, Manikganj. The crop was sown on 10<sup>th</sup> August, 2018 and calyces were harvested at 10<sup>th</sup> December, 2018.

The unit plot size was 4 x 2 m, with line spacing of 50 cm, plant to plant spacing was 8-10 cm. seeds were sown in line sowing method. The experimental field was medium high land belonging to Old Brahmaputra-Jamuna flood plain having silt loam soil with pH 6.7. The soil contained 1.6% organic matter, 0.08% total nitrogen, 12.31 ppm available phosphorus, 0.21 meq. Potassium 100 g<sup>-1</sup> and 20.93 ppm available sulfur. Land was prepared by cross ploughing with laddering. Soil was fertilized with urea, triple super phosphate, muriate of potash, gypsum and zinc sulphate @ 200 kg, 25 kg, 30 kg, 45 kg and 12 kg ha<sup>-1</sup>, respectively. Half of urea and full amount of other fertilizers were applied as basal dose during final land preparation. Remaining amount of urea was top dressed at 20 days after sowing. All intercultural operations were done when necessary. The experiment was designed by the Randomized Complete Block Design (RCBD) with three replications.

### Chemical analysis

Calyx samples were collected from 120 days old plants. Antioxidant compounds including total flavonoid contents, total phenolic contents, proanthocyanidin content, DPPH radical scavenging, ferric ion reducing antioxidant power and H<sub>2</sub>O<sub>2</sub> radical scavenging (Unit: % inhibition) were analyzed by the method of Goufo and Trindade (10) at the Department of Food Processing and Preservation, Hajee Mohammad Danesh Science and Technology University, Dinajpur-5200, Bangladesh.

### Statistical analysis

All analyses were run in triplicate and the results were expressed as means ± standard deviation (SD).

Statistical analyses were done by using SPSS statistical package (SPSS 22.0 for Windows; SPSS, Chicago, IL, USA).

## Results and Discussion

### Antioxidant contents in the calyx

It has been seen that the total phenol contents were 521.46 mg 100 g<sup>-1</sup> in the calyx of BJRI vegetable mesta-1 (Table 1A). There are reports on the total phenolic contents of Roselle extracts ranged from 108 to 546 µg g<sup>-1</sup> (12) 582 to 606 µg g<sup>-1</sup> (13) respectively. The results of various studies revealed that phenolic contents of Roselle calyx are less variable among various genotypes of Roselle.

Flavonoids act as anti-cancerous agents (3). Thus, required flavonoid intake may reduce the risk of cancer in human (14). There was 959.53 mg 100 g<sup>-1</sup> flavonoid in the calyx of BJRI vegetable mesta-1 (Table 1A) which agrees with the earlier findings (15). They reported flavonoid contents ranging from 9.31-404.40 µg g<sup>-1</sup>. Thus, our tested variety has higher flavonoid contents.

Anthocyanin improves overall visual acuity, blood flow, blood pressure, decreases cholesterol levels and fights against oxidative stress (16, 17). In the present case, the total anthocyanins were 0.17 mg 100 g<sup>-1</sup> (Table 1A). Similar results were also reported (18, 19). The present findings differ from our earlier work (15). Different extraction procedures (modified protocol) and genotypes may account for this variation (10, 20). Proanthocyanidins have much stronger antioxidant activities than vitamin C or vitamin E (21). The total 284.27 mg 100 g<sup>-1</sup> proanthocyanidin contents were measured in the calyx of BJRI vegetable mesta-1 (Table 1A), which agree with a previous record (10).

**Table 1.** Antioxidants and Antioxidant activities of BJRI vegetable mesta-1 calyx samples.

Name of the components	Average Contents (mg 100 g <sup>-1</sup> )
<b>A. Antioxidant components</b>	
Total phenol contents	521.46 ± 15.26
Total flavonoid contents	959.53 ± 13.50
Proanthocyanidin contents	284.27 ± 0
Anthocyanin contents	0.17 ± 0.01
<b>B. Antioxidant activities</b>	
DPPH radical scavenging	5039.16 ± 15.63
Ferric ion reducing antioxidant power (FRAP)	29060.83 ± 693.06
H <sub>2</sub> O <sub>2</sub> Radical Scavenging (Unit: % inhibition)	1358.76 ± 136.21

### Antioxidant activity of the calyx

Roselle possessed antioxidant properties that may provide health benefits to people (22, 23). The DPPH radical scavenging activity, H<sub>2</sub>O<sub>2</sub> radical scavenging and ferric ion reduction antioxidant power are presented in the Table 1B. These results clearly indicate the antioxidant activity of the Roselle calyx. The vegetable mesta-1 contains 5 g 100 g<sup>-1</sup> DPPH radical scavenging activity (24). In the FRAP assays, the Roselle calyx extract presented good ferric ion reducing antioxidant power (29 g 100 g<sup>-1</sup>). The high

FRAP value of the Roselle calyx aqueous extract could be correlated with the reported presence of chlorogenic acid and its derivatives, which are the main compounds in *H. sabdariffa* extract (25). H<sub>2</sub>O<sub>2</sub> radical scavenging is an important antioxidant activity of BJRI vegetable mesta-1. Total 1358.76 mg 100 g<sup>-1</sup> H<sub>2</sub>O<sub>2</sub> radical scavenging was measured in the present case. Thus, the Roselle calyx may act as a good source of H<sub>2</sub>O<sub>2</sub> radical scavenging.

In the present findings, BJRI vegetable mesta-1 has rich antioxidant properties and is a good source of fresh drink. The leaf is consumed as vegetables and calyx can be consider as an alternative herbal tea. Our findings will open a new avenue for producing the calyx powder from Roselle, which would be used as fresh drink in the form of Roselle tea. Thus, our findings will create an opportunity to quantify the nutritional composition of the calyx of BJRI vegetable mesta-1 along with our studied antioxidant properties.

### Acknowledgements

The authors are thankful to the Head, Department of Food Processing and Preservation, Hajee Mohammad Danesh Science and Technology University, Dinajpur-5200, Bangladesh for his cordial support.

### Author's contribution

MAFM and MZT Designed and conducted the experiment and analyzed the data; KKB, ABMZH, MMK and MZAR prepared the manuscript.

### Competing interest

Authors do not have any conflict of interest to declare.

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