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Article

Health promoting pigments and bioactive compounds of six vegetables grown in Bangladesh

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Abstract: Increasing of chronic diseases due to low consumption of vegetables considered one of the crucial challenges to human being in current circumstance. Adequate intake of vegetables only the possible solution from get rid of the problem. So it is indispensible to determine food value present in vegetables which were the core objective of our present study. Among the tested vegetables beetroot showed the highest nitrate content (874 mg Kg^{-1}) whereas the lowest nitrate content was found in bitter gourd (56 mg Kg^{-1}). Total chlorophyll content was in cucumber, bitter gourd, beetroot, tomato and brinjal was 10 5.89, 4, 0.80 and 0.78 mg $100g^{-1}$, respectively. The highest carotene contain was found in cucumber (1.63 $mg100g^{-1}$). Beetroot, tomato, brinjal and bitter gourd showed reduction in carotene content at 61.96, 71.16, 87.73 and 97.71%, respectively in response to cucumber. Lycopene content was the highest in beetroot (3.46 mg $100g^{-1}$) and the lowest in brinjal (0.115 mg $100g^{-1}$). All the tested vegetables contained abundance vitamin C (ranges from85.71 to 17.14 mg $100g^{-1}$). DPPH radical scavenging activity was present in all tested vegetables in which beetroot exhibited the highest DPPH radical scavenging activity with an IC_{50} value of 1.17 μgml^{-1}.

Keywords: anti-oxidant properties; bioactive compounds; cardio-protective molecule; vegetables; vitamin C

1. Introduction

Inadequate dietary intake of vegetables leads cardio-vascular and ROS related diseases (Miller and Welch, 2013) which is becoming major public health problem and insert a serious headache to health professionals in Bangladesh. Mamun *et al.* (2016), reported, about 95.7% people are deprived of consuming adequate fruits and/or vegetables in Bangladesh. In this context, vegetables were highlighted as a potential candidate for ROS and cardio protection (Alissa and Ferns, 2017; Sakil *et al.*, 2018; Polash *et al.*, 2018). Vegetables are essential to human health since they are good source of nitrate, vitamins, minerals and biologically active substances (Alarcon-Flores *et al.*, 2014; Sakil *et al.*, 2018; Polash *et al.*, 2019). So, WHO stressed to increase the consumption of vegetables since they are the fundamental components of a healthy diet (WHO, 2005). In spite of conferring with plenty of green vegetables around and almost everywhere there is no proper scientific data about cardiovascular molecule, bioactive compounds and anti-oxidant properties of popular vegetables. Therefore, the current research work was designed to determine cardiovascular molecule, bioactive compounds and anti-oxidant properties of some popular vegetables.

2. Materials and Methods

Cucumber, beetroot, tomato, eggplant and bitter gourd (which were selected by sensory attribute test according to Xiao *et al.,* 2015b) were the experimental materials of this study which were collected at maturity from local market of Mymensingh, Bangladesh. The experiment was conducted in Plant Physiology Lab, Department of Crop Botany and Food Biochemistry Lab, Department of Biochemistry and Molecular Biology from November 2018 to March 2019. Each test was replicated with three times for more accuracy.

2.1. Determination of nitrate (NO_3^-) content

Nitrate content of cucumber, beetroot, bitter gourd, eggplant and tomato were determined by portable nitrate detector named 'greentest Eco'. The total nitrate content was expressed by $mgKg^{-1}$ fresh weight. The lower limit of detection (LOD) of nitrate ions by the detector is 4 mg Kg^{-1}.

2.2. Bioactive compounds assessment

The fleshy edible part of plants (6.67g) was extracted in 10 ml of chilled acetone solution in dark. After centrifugation at 4000 rpm for 10 minutes the absorbance of supernatants was taken at 453, 505, 645 and 663 nm wave length. Contents were calculated according to the equation depicted in Barros *et al.* (2010), and expressed in mg $100g^{-1}$ fresh weight.

2.3. Vitamin C content in tested vegetables

Ascorbic acid was determined following a procedure previously described by the authors Xaio *et al.* (2012), with 2.6-dichloroindophenl and measuring the content by titrimetric method. The results were expressed as mg of ascorbic acid per 100g of fresh weight.

2.4. DPPH radical scavenging activity

1,1-diphenyl-2-picrylhydrazyl (DPPH) assay is carried out with some modifications of Sanja *et al.* (2009). DPPH radical scavenging activity is measured by reduction in intensity of purple color and quantified by decrease in absorbance at wavelength 517 nm. Radical scavenging activity was calculated using the following formula:

$$\%\ \text{radical scavenging activity} = \frac{\text{OD of control-OD of sample}}{\text{OD of control}} \times 100$$

Here, OD= Optical density

2.5. Statistical analysis

The collected data were statistically analyzed by using Minitab 17. Fishers LSD test was applied to compare the treatment means at 0.05 level of confidence.

3. Results

3.1. Nitrate (NO_3^-) content

All tested vegetables contained nitrate (Figure 1). Here beetroot showed the highest nitrate content (874 mg Kg^{-1}) followed by Cucumber (94 mg Kg^{-1}). Tomato and brinjal showed nitrate content at 82 and 80 mg Kg^{-1}, respectively. The lowest nitrate content was found in bitter gourd (56 mg Kg^{-1}) (Figure 1).

3.2. Chlorophyll content

The highest total chlorophyll content was found in cucumber (10 mg $100g^{-1}$) followed by bitter gourd (5.89 mg $100g^{-1}$). Beetroot, tomato and brinjal contained total chlorophyll at 4, 0.80 and 0.78 mg $100g^{-1}$, respectively. Among the tested vegetables, chlorophyll a was always higher than chlorophyll b (Table 1).

3.3. Carotene content

In case of carotene, a significant difference was found in the tested vegetables (Figure 2). The highest carotene contain was found in cucumber (1.63 mg $100g^{-1}$) whereas the lowest result was found in bitter gourd (0.034 mg $100g^{-1}$). Beetroot, tomato and brinjal showed reduction in carotene content at 61.96, 71.16 and 87.73%, respectively in response to cucumber (Figure 2).

3.4. Lycopene content

The highest lycopene content (3.46 mg $100g^{-1}$) was found in beetroot followed by tomato (1.96 mg $100g^{-1}$). The lycopene content of cucumber, bitter gourd and brinjal was 0.205, 0.166 and 0.115 mg $100g^{-1}$, respectively (Figure 3).

3.5. Vitamin C content

All the tested vegetables contained vitamin C in abundance (Figure 4). The highest vitamin C content was found in bitter gourd (85.71 mg $100g^{-1}$) followed by cucumber (34.28 mg $100g^{-1}$). The lowest vitamin c content was found in both beetroot and tomato (17.14 mg $100g^{-1}$) (Figure 4).

3.6. DPPH radical scavenging activity

Among tested vegetables beetroot exhibited the highest radical scavenging activity with an IC_{50} value of 1.17 µg ml^{-1}. Moderate radical scavenging activity was shown by tomato whose IC_{50} value was 2.17 µg ml^{-1}. Cucumber showed the lowest radical scavenging activity with an IC_{50} value 3.26 µg ml^{-1} (Figure 5). The lowest IC_{50} value means had the highest anti-oxidant capacity (Figure 5).

Table 1. Chlorophyll a, chlorophyll b and total chlorophyll of the edible part of some dainty vegetables at maturity.

Vegetables	Chlorophyll a (mg $100g^{-1}$)	Chlorophyll b (mg $100g^{-1}$)	Total Chlorophyll (mg $100g^{-1}$)
Cucumber	8.35±0.35a	1.97±0.19b	10.32±0.415a
Beetroot	2.48±0.18c	1.9±0.11b	4.38±0.21b
Tomato	0.46±0.03d	0.344±0.02c	0.804±0.04c
Bitter gourd	3.66±0.18b	2.23±0.15a	5.89±0.19b
Brinjal	0.452±0.02d	0.329±0.01c	0.781±0.04c

The values represent the mean ±SE (Standard Error). Values marked with the same letter within the columns do not differ significantly @ 5% level of probability.

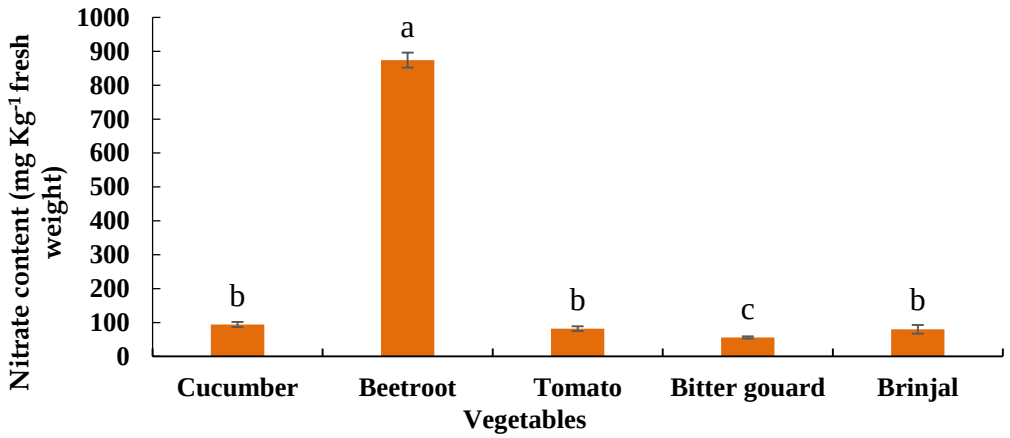

Figure 1. Nitrate content of the edible part of some dainty vegetables at maturity stage. The vertical bars represent the mean±SE (Standard Error).

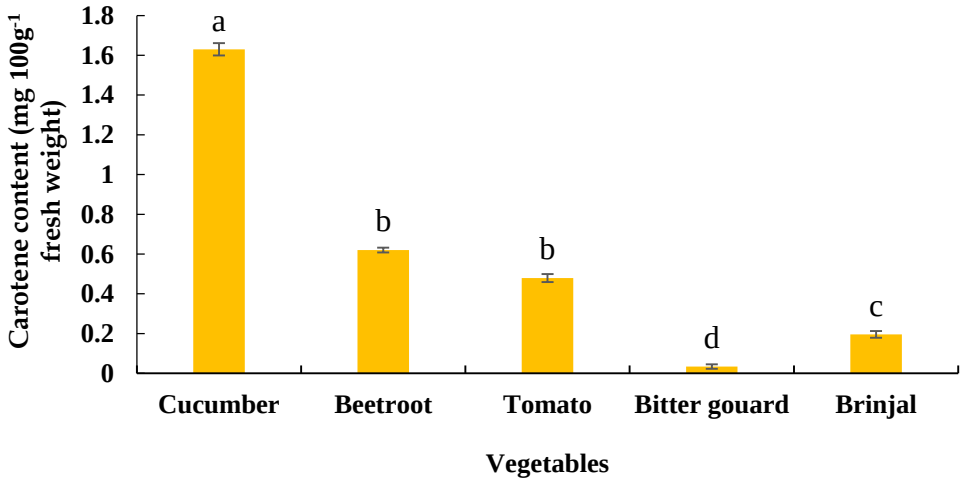

Figure 2. Carotene content of the fresh edible part of some dainty vegetables at maturity stage. The vertical bars represent the mean±SE (Standard Error).

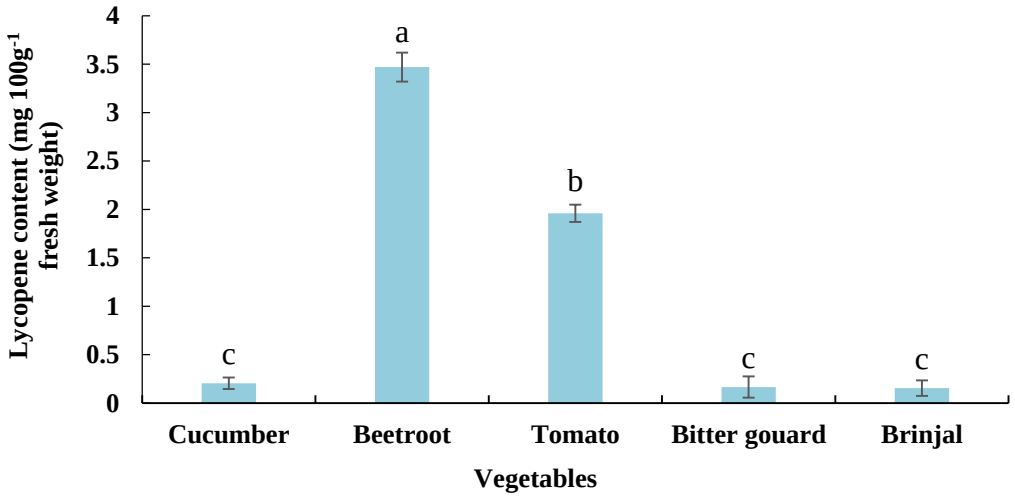

Figure 3. Lycopene content of the fresh edible part of some dainty vegetables at maturity stage. The vertical bars represent the mean±SE (Standard Error).

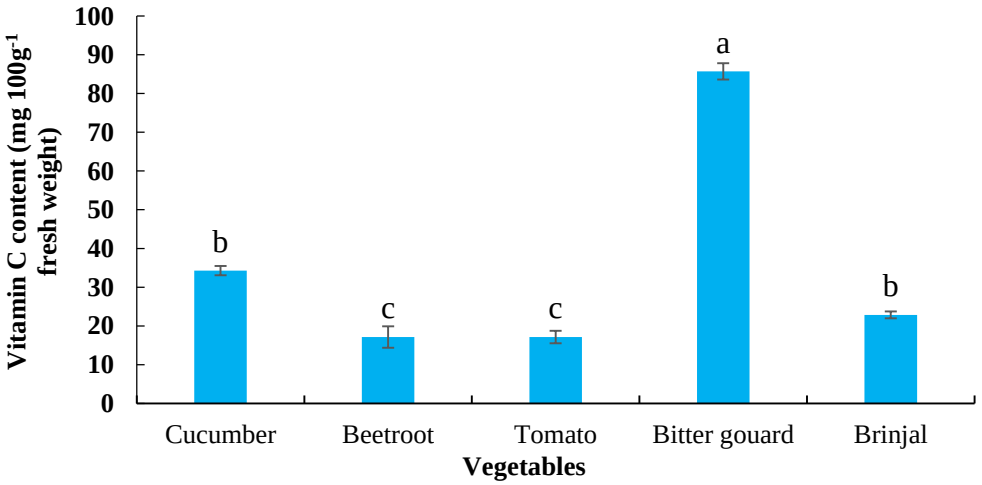

Figure 4. Vitamin C content of the fresh edible part of some dainty vegetables at maturity stage. The vertical bars represent the mean±SE (Standard Error).

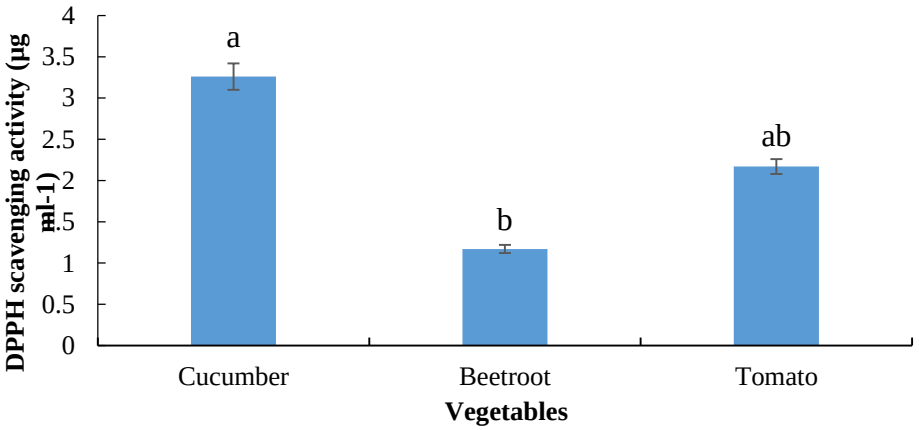

Figure 5. Vitamin C content of the fresh edible part of some dainty vegetables at maturity stage. The vertical bars represent the ±SE (Standard Error).

4. Discussion

Antioxidant lobbed chlorophyll (Lanfer-Marquez *et al.*, 2005) is believed to protect the DNA from the hazardous effect of carcinogens (Ferruzzi and Blakeslee, 2007). Chlorophyll also assist in chelation of heavy metals thus reduce heavy metals toxicity (Hosikian *et al.*, 2010) and it deliverers magnesium effectively that helps blood to carry oxygen to the cells and tissues. Antioxidant properties of beta-carotene and lycopene, is believed to protect our body from disease-causing reactive oxygen species and assist to preserve the health of our skin, eyes and immune system (Burri, 1997; Kang *et al.* 2003). Generally, fresh vegetables are a magnificent source of vitamin C. According to Stratton and Godwin (2011) vitamin C defend our body from the detrimental effects of free radicals. It also helps in prevention of generation of peroxynitrite (ONOO) by scavenging the superoxide (O_2^-) ions. Again cold and skin infections are positively cured by vitamin C **(***Heimer et al., 2009***).** To treat cardiovascular diseases physicians recommend trinitroglycerin (NO_3 containing drugs). However, nitrate from vegetables work as a prospective candidate for cardio-protection (Lundberg *et al.*, 2009) without any side effects. Nitrate supports in lowering of blood pressure, improvement of endothelial function and decline in platelet aggregation (Joshipura *et al.*, 1999; Joshipura *et al.*, 2001).

5. Conclusions

From the experiment we found the cardio-protective molecule, bioactive compounds and anti-oxidant properties were abundant in tested vegetables. Being natural and cheap they could be better source of nourishment and treat ailment in Bangladesh.

Conflict of interest

None to declare.

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