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Total Antioxidants Activity and Proximate Analysis of Selected Fruits and Vegetables in Jashore Region, Bangladesh

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Abstract

Antioxidant plays essential roles in the maintaining of good health. Fruits and vegetables are the primary sources of antioxidants. Antioxidant contents in fruits and vegetables could vary in geographical distribution and also in the same soil for different time intervals. Therefore, the present study aimed to analyze the total antioxidant status and proximate analysis of some selected locally available fruits and vegetables and they were *Mangiferaindica, Musa acuminate, Psidium guajava, Carcia papaya, Lagenariasiceraria, Trichosanthesdioica, Momordica charantia, Basella alba,* and *Amaranthus gangeticus* from three villages. In this analysis, total antioxidant status was determined by DPPH free radical scavenging assay, and proximate analysis of moisture, ash, fat (Soxhlet extraction method), and protein (Kjeldahl method with N × 6.25) were determined as the method outlined in AOAC (2005). Among the four fruits sample, Papaya hadthe highest moisture content (88.08%)but was lower in ash, protein, fat, and carbohydrate contents. Among the vegetables, Bottle gourd had the highest moisture content (94.14%).Regarding all samples, Red amaranth showed the highest ash (1.59%) and protein (4.32%) content. However, both Mango and Papaya showed the lowest protein content (0.70%). Fat content was low in Papaya and Bottle gourdwith 0.10% and 0.15% respectively. For the carbohydrates, Banana was the greatest source with 22.62%. Furthermore, among the fruits Guava had the highest total antioxidants activity of 70.90% and among vegetables, Bitter gourd had 45.47% which was the highest compared to other studiedvegetables. Whereas, Indian spinachhad the

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lowest antioxidants activity and the value was 28.60%. The above results indicate that the selected fruits contents higher levels of antioxidant activity compared to selected vegetables samples.

Introduction

In recent years, increasing attention has been paid to the role of fruits and vegetables in the diet and human health. Fruits and vegetables are an essential part of our daily diet. They are naturally good and contain vitamins and minerals and thousands of biologically active phytochemicals that can help to keep people healthy.[1] Moreover, they are rich sources of dietary fiber.[2] WHO and FAO recommend 400g of fruit and vegetables per day to prevent and alleviate several micronutrient deficiencies or eat at least five servings of vegetables and two servings of fruits each day.[3] Fruits and vegetables have a negative effect on chronic disease risk, like cardiovascular disease, cancer, diabetes, obesity, and others.[4,5,6] Furthermore, worldwide, half and one-third of cardiovascular disease and cancer cases are diet-related.[7,8] Fruits and vegetables intake have shown a direct correlation with healthy lifestyles, which may explain among the individual who adequately consumes fruits and vegetables every day. Higher fruits and vegetables intake are related to a healthy diet pattern correlated with lower CHD (chronic heart disease) incidence rates and negatively associated with the consumption of saturated fat-rich food.[9–11] In fact, fruits and vegetables are the main sources of antioxidants, which are the phytochemicals that prevent some of the processes of developing cancer and cardiovascular diseases.[12] Antioxidants prevent the oxidation process of lipids or other molecules by hindering the initiation of oxidizing chain reactions where redox reactions are fundamental for the biological processes.[13] In the Human body, at the time of ATP (adenosine triphosphate) production, cells use oxygen and release free radicals by the mitochondria. Where also reactive oxygen species (ROS) and reactive nitrogen species (RNS) are produced as a result of the cellular redox process.[14]

Although free radicals are considered as important factors for normal physiology, they cause cellular damage when produced in excess. ROS include free radicals such as superoxide anion radicals(O_2^-), hydroxyl radicals (-OH) and non-free radical species such as hydrogen peroxide (H_2O_2) and singlet oxygen ($^1O_2$).[15] ROS are produced at the time of unequal cleavage of a chemical bond, so, each atom gets unpaired electron, which donates or receives an electron from others and acts as reductant or oxidant.[16,17] Generally, free radicals are produced from two sources: endogenous, due to cellular and intracellular enzymatic reactions and exogenous, which is the non-enzymatic oxygen reaction or produced by the ionizing radiation.[18] Reactive oxygen species are associated with more than 100 diseases, like cancer and inflammatory conditions, atherosclerosis, hypertension, Alzheimer's disease, Parkinson's disease, ischemic diseases, etc.[19] ROS cause oxidation of lipid component in LDL (Low-Density Lipoprotein), to continue this process blood vessel is damaged, which generate foam cell and plaque formation, the symptoms of atherosclerosis.[20] Moreover, free radical causes DNA damage by reacting with DNA bases and sugar moiety, which leads to mutation, carcinogenesis, aging, and ultimately cancer.[20–22] Where, Superoxide dismutase, catalase, glutathione peroxidase, and α-tocopherol act as an antioxidant defense system in mitochondria, peroxisomes, cytoplasm and lipoproteins in the body, respectively and they reduce the cell damage caused by free radicals.[23] These multiple defense systems fail due to increased production of ROS or decreased level of cellular antioxidants.

Consequently, there is a need to identify newer antioxidants sources. Natural resources like fruits and vegetables provide enormous scope in fixing the imbalance of ROS and antioxidants.[24,25] Antioxidants present in fruits and vegetables may help in decreasing the level of oxidative stress.[26] Oxidative stress is the imbalance situation of antioxidants and oxidants in the body which favor oxidants.[27] Oxidative stress has been identified as the major cause of many life-threatening diseases like neurological disorder, hypertension, organ transplantation, ischemic diseases, inflammatory diseases, and many others.[28,29] Antioxidants from

exogenous sources like fruits and vegetables help reduce the oxidative stress by reducing the ROS level in the body. Antioxidants lower the free radicals by breaking chain reaction, reducing the concentration of reactive oxygen species, and scavenging the initiating radicals, they do it by electron donation or metal ion chelation.[30,31] The significant antioxidants are vitamins C and E, carotenoids, and phenolic compounds, especially flavonoids. Besides, phenolic compounds have higher antioxidant activity than antioxidant vitamins and carotenoids.[32] Phenolics can scavenge reactive oxygen species due to their electron-donating properties. Their antioxidant effectiveness depends on the stability in different systems and the number and location of hydroxyl groups.[33] These antioxidants scavenge radicals and inhibit the initiation of oxidative chain reaction propagation.[20] Moreover, carotenoid-rich fruits and vegetables offer a protective effect than carotenoid dietary supplements by increasing LDL-oxidation resistance, lowering DNA damage, and inducing higher repair activity in human.[21,22] It is better to intake a variety of them, as antioxidant capacity differs significantly among fruits and vegetables.[34]

Fruits and vegetables contain not only high levels of antioxidants but also macronutrients such as moisture, ash, fat, protein, and carbohydrate. The moisture content plays a vital role in determining their nutrition level, shelf life, microbial stability, and quality of them, whereas ash content means the total amount of minerals.[35,36] At the same time, fat content presents the total sensory characteristics of fruits and vegetables, for instance, flavor, texture, and mouthfeel, and a significant source of energy.[37] Polymers of amino acids are known as protein, and in the human body, it is needed to produce many biomolecules and building blocks of skin, bones, and blood.[38] Furthermore, carbohydrate content is the calculation of the total amount of sugar and polysaccharides and also the source of energy.

Some locally available fruit and vegetable species are frequently consumed by the local people in their daily diet. To our knowledge there was no available data about their composition and it was encouraged us to carry out this proximate and micronutrient analysis. The species were: *Mangiferaindica, Musa acuminate, Psidium guajava, Carcia papaya, Lagenariasiceraria, Trichosanthesdioica, Momordica charantia, Basella alba* and *Amaranthus gangeticus.* The details these species are given in Table 1. The content of polyphenols in fruits and vegetables, such as levels of other phytochemicals and macronutrients, can be affected by the various factors as like varieties, climatic conditions, cultural practices, maturity at harvest and storage conditions.[39,40] Therefore, the study objectives were to determine the antioxidants activity and proximate composition (moisture, ash, protein, fat and carbohydrates) of nine locally available fruits and vegetables of three selected villages.

Table 1: List of the selected plant samples and their details

English name	Scientific name	Local name	Part used
Fruits			
Mango	*Mangiferaindica*	Amm	Fruit (without peel)
Banana	*Musa acuminate*	Kola	Fruit (without peel)
Guava	*Psidium guajava*	Peyara	Fruit
Papaya	*Carcia papaya*	Pepe	Fruit (without peel)
Vegetables			
Bottle gourd	*Lagenariasiceraria*	Lau	Fruit (without peel)
Pointed gourd	*Trichosanthesdioica*	Potol	Fruit
Bitter gourd	*Momordica charantia*	Korola	Fruit
Indian spinach	*Basella alba*	Puishak	Leaf and stem
Red amaranth	*Amaranthus gangeticus*	Lal shak	Leaf

Materials and Methods

Plants Collection

The sample of mature fruits (Mango, Banana, Guava, Papaya) and vegetables (Bottle gourd, Indian spinach, Red amaranth, Bitter gourd, Pointed gourd) were collected from Joghati, Ambottola and Churamonkati villages of Jashore region, Bangladesh. Fruits were taken from the household and Vegetables from the field cultivation and collected only their edible portions. After collecting they were kept in plastic bags immediately.

Chemicals

DPPH (2,2-diphenyl-1-picrylhydrazyl), Ethanol and for the proximate analysis chemicals were used according to the AOAC (2005) method.

Preparation of Extract

The collected vegetable and fruit samples were washed with clean water to remove dust particles. The samples were then cut to separate the non-edible portion using a knife. Then samples were dried at 70˚C until they were suitable for grinding. After that samples were ground into a fine powder using a commercial blender and the samples such as Mango, Banana, Papaya (for containing higher amount of pectin) were processed for instant prepared juice and were used for extracts by using ethanol for 16 hours to dissolve thoroughly. After that the samples were filtrated and evaporated respectively and stored the sample extracts.

Determination of Antioxidant Activity by DPPH Free Radical Scavenging Assay

At first 0.1 mM solution of DPPH was prepared in ethanol and the extracted samples diluted in ethanol 15µg/ml concentration of each sample. Then, 1.5ml of sample taken and added 0.5ml (500µl) of 0.1 mM DPPH solution to make 2 ml in tube. After that, the solution was vortex thoroughly and incubated 30 minutes in dark box at 37˚C.Then after 30minutes the absorbance was taken at 517 nm against a blank sample scavenging. Finally, the capability to scavenge the DPPH radicals was calculated using the following equation (Tuba et al.,2008).

The DPPH scavenging effect (%) = 1-As/(Ac)×100

As = The absorbance in the presence of sample and Ac =The absorbance of the control (0.5 ml DPPH solution of 0.1 mM without sample)

Proximate Analysis

All procedures for the determination of moisture, ash, protein, fat, total carbohydrates and crude fiber were based on AOAC (2005).

Statistical Analysis

The results of the study were analyzed using statistical package for the social sciences (SPSS version 22.0). Descriptive statistics were used to calculate the mean value of the samples. Statistical significance was considered at the 95% confidence level ($P<0.05$) and independent sample t-test was performed to understand the relationship between the villages and where relevant.

Results

Proximate Analysis

Table 2-6 presents the result of proximate analysis of selected nine fruits and vegetables. This analysis encompassed the moisture, ash, protein, fat and total carbohydrates and fiber content of them. proximate analyses are important for determination of food quality, texture, mouthfeel, shelf life and microbial stability and can be used for nutritional labeling.

Among the fruits, Banana contents the lowest level of moisture and in Churamonkathi village that was only about 72%. Whereas, Papaya showed the highest level of moisture percentage (88.08%) and in Joghati that was 89.33%. In addition, Mango and Guava showed about 76% and 78% moisture. In Vegetables species, Bottle gourd had 94.14% moisture which was the highest level. Interestingly, the bottle gourd from Ambottola village had the highest level of moisture (95.18%) than all the fruits and vegetables from three villages. However, Red amaranth showed the lowest level of moisture in vegetables group and that was 84.38%.

The ash content of selected fruits and vegetables from three villages has been illustrated in Table 2. In the fruits and vegetables, Pointed gourd had low ash percentage (0.45%), where Red amaranth showed the highest ash content, and that was 1.59%. The Pointed gourd of Joghati village had the lowest (0.42%) ash among all of the fruits and vegetables, whereas, the Red amaranth of Churamonkathi had 1.68%. In the fruits group, Banana and Guava showed approximately the same ash percentage, which was

0.64% and 0.63%, respectively. However, Mango had 0.67% ash, which was the highest among all fruits, and Papaya had the lowest ash content (0.50%). Mango from Ambottola village had 0.64%, and Papaya from Joghati village had 0.47% ash that was the lowest ash of Mango and Papaya. Furthermore, the ash content of Bottle gourd, Bitter gourd, and Indian spinach was 0.54%, 0.92%, and 1.01%, respectively.

Table 2: Ash content (%, Mean ± SD) of selected fruits and vegetables from three villages

Plants sample	Churamonkathi	Ambottola	Joghati	Total
Fruits				
Mango	0.72±0.05	0.64±0.06	0.70±0.09	0.67±0.06
Banana	0.70±0.03	0.59±0.05	0.63±0.10	0.64±0.07
Guava	0.65±0.05	0.61±0.04	0.62±0.04	0.63±0.04
Papaya	0.65±0.07	0.52±0.05	0.47±0.04	0.50±0.06
Vegetables				
Bottle gourd	0.53±0.08	0.60±0.07	0.49±0.07	0.54±0.08
Pointed gourd	0.47±0.04	0.46±0.06	0.42±0.03	0.45±0.04
Bitter gourd	0.93±0.07	0.89±0.05	0.93±0.05	0.92±0.05
Indian spinach	1.05±0.18	0.98±0.16	0.99±0.10	1.01±0.13
Red amaranth	1.68±0.96	1.51±0.06	1.59±0.18	1.59±0.40

Results are expressed as mean ± SD, n=3 for each variety in each village

Table 3: Protein content (%, Mean ±SD) of selected fruits and vegetables from three villages

Plants sample	Churamonkathi	Ambottola	Joghati	Total
Fruits				
Mango	0.70±0.08	0.70±0.03	0.71±0.06	0.70±0.05
Banana	1.15±0.06	1.14±0.08	1.16±0.05	1.15±0.06
Guava	0.90±0.02	0.85±0.08	0.79±0.11	0.84±0.08
Papaya	0.66±0.03	0.63±0.07	0.82±0.12	0.70±0.11
Vegetables				
Bottle gourd	0.98±0.02	0.98±0.08	0.93±0.09	0.96±0.06
Pointed gourd	1.77±0.08	1.80±0.15	1.92±0.06	1.84±0.14
Bitter gourd	1.93±0.06	1.96±0.04	1.92±0.06	1.94±0.05
Indian spinach	2.22±0.07	2.20±0.12	2.22±0.06	2.21±0.07
Red amaranth	4.24±0.19	4.27±0.13	4.41±0.05	4.32±0.13

Table 3 shows the Protein content of the studiedfruits and vegetables. Red amaranth had the highest protein contents (4.32%), and both Mango and Papaya had the lowest level of protein, which was 0.70%. In the fruits group, Banana had the highest protein content, which was 1.15%, and Banana from Joghati village had a relatively highest protein contents (1.16%) than the other three villages. Guava had 0.84% protein, and in Churamonkathi, the percentage was highest (0.90%). However,

Bottle gourd showed low protein content (0.96%) and, in both Churamonkathi and Ambottola villages the value was 0.98% protein. In the vegetable group, Pointed gourd, bitter gourd, and Indian spinach showed 1.84%, 1.94%, and 2.21%, respectively. The Red amaranth of Joghati village had 4.41% protein, and that was the highest protein content than any other fruits and vegetables from three villages.

Table 4: Fat content (%, Mean ± SD) of selected fruits and vegetables from three villages.

Plants sample	Churamonkathi	Ambottola	Joghati	Total
Fruits				
Mango	0.48 ± 0.03	0.50 ± 0.04	0.41 ± 0.06	0.46±0.06
Banana	0.72 ± 0.05	0.75 ± 0.06	0.71±0.04	0.73±0.05
Guava	0.43 ± 0.05	0.45 ± 0.07	0.46±0.06	0.45±0.05
Papaya	0.09 ± 0.02	0.11 ± 0.02	0.10±0.03	0.10±0.02
Vegetables				
Bottle gourd	0.17 ± 0.02	0.16 ± 0.02	0.12±0.03	0.15±0.03
Pointed gourd	0.32 ± 0.05	0.38 ± 0.03	0.32±0.06	0.34±0.05
Bitter gourd	0.37± 0.03	0.46 ± 0.04	0.37±0.10	0.40±0.07
Indian spinach	0.45±0.04	0.42 ± 0.04	0.38±0.03	0.41±0.04
Red amaranth	0.14±0.04	0.18 ± 0.04	0.21±0.06	0.19±0.06

Table 4 reveals the fat content of selected fruits and vegetables from three villages. Banana had the maximum fat content (0.73%) in the fruits group and also in all selected samples. On the contrary, Papaya showed low-fat content (0.10%) than other fruits and vegetables, and Papaya from Churamonkathi village showed the lowest fat content (0.09%) than any other villages and also than any other samples. Also, the Banana from Ambottola village had 0.75% fat, and it was the highest fat content among the selected plant samples. At the same time, Mango and Guava had approximately the same fat contents, which was 0.46% and 0.45%.

Table 5: Crude fiber content (%, Mean ± SD) of selected fruits and vegetables from three villages

Plants sample	Churamonkathi	Ambottola	Joghati	Total
Fruits				
Mango	0.84±0.04	0.79±0.02	0.83±0.03	0.82±0.02
Banana	1.56±0.01	1.62±0.02	1.59±0.01	1.59±0.03
Guava	6.43±0.03	6.71±0.01	6.57±0.03	6.57±0.14
Papaya	1.52±0.01	1.43±0.02	1.40±0.02	1.45±0.06
Vegetables				
Bottle gourd	1.62±0.05	1.54±0.04	1.60±0.03	1.59±0.04
Pointed gourd	2.03±0.02	2.44±0.03	2.39±0.04	2.29±0.22
Bitter gourd	4.47±0.03	2.08±0.05	2.63±0.02	3.06±1.25
Indian spinach	2.51±0.04	2.38±0.00	2.01±0.04	2.30±0.26
Red amaranth	6.80±0.03	6.83±0.02	6.78±0.05	6.82±0.02

Similarly, Bitter gourd and Indian spinach showed a close fat percentage, which was 0.40% and 0.41%. Further, the Indian spinach from Churamonkathi and Guava from Ambottola village showed the same fat percentage (0.45%). However, the Bottle gourd had 0.15% fat, and that was the lowest fat content in the vegetable group where Pointed gourd and Red amaranth had 0.34% and 0.19% fat content, respectively.

Table 6: Carbohydrate content (%, Mean ± SD) of selected fruits and vegetables from three villages

Plants sample	Churamonkathi	Ambottola	Joghati	Total
Fruits				
Mango	21.82±0.33	20.17±0.36	22.28±0.74	21.42±1.07
Banana	23.91±0.09	23.04±0.51	20.93±0.30	22.62±1.32
Guava	15.56±0.09	12.64±0.73	12.73±1.46	13.64±1.43
Papaya	9.83±0.44	9.70±0.93	7.86±0.84	9.13±1.14
Vegetables				
Bottle gourd	4.06±0.65	1.53±0.35	2.21±0.49	2.59±1.22
Pointed gourd	1.55±0.25	2.86±0.24	2.49±0.73	2.29±0.67
Bitter gourd	4.45±0.44	2.03±0.18	2.74±1.04	3.07±0.99
Indian spinach	1.80±0.52	1.41±0.64	0.95±1.29	1.38±0.73
Red amaranth	2.97±0.47	1.45±2.25	2.33±0.34	2.23±1.31

The crude fiber content of the selected fruits and vegetables from three villages of Jashore region has been shown in Table 5. In the fruits group, the highest crude fiber (6.57%) content in Guava and among three villages, Guava from Ambottola village had the highest value (6.71%). Where in vegetable group Red amaranth content the highest-fiber (6.82%) and sample from Ambottola village had the highest crude fiber content than other two villages. Mango had 0.82% crude fiber, which was the lowest percentage in all fruits and vegetable samples. Further, Bottle gourd had the lowest crude fiber percentage in the vegetable group. However, both Banana and bottle gourd had the same fiber content (1.59%). Furthermore, in vegetables, Pointed gourd and Indian spinach had approximately the same crude fiber percentage, and those were 2.29% and 2.30%, respectively.

The carbohydrates content of selected fruits and vegetables have been shown in Table 6. Here, the overall carbohydrate content is relatively higher in the fruits group than in the vegetable group. Banana had the highest (22.62%), and Indian spinach had the lowest (1.38%) carbohydrate content. Banana from Churamonkathi showed the maximum percentage, and that was 23.91%. Moreover, in the fruits group, Papaya had the lowest (9.13%), and Bitter gourd in the vegetable group had the highest level of carbohydrate content (3.07%).

DPPH Free Radicals Scavenging Assay

Free radical Scavenging Activity (Total antioxidant activity) was determined by using the DPPH methodand it was expressed as percentage (%) of scavenged free radicals.

Table 7 reveals the total antioxidants activity of the selected nine fruits and vegetables from three selected villages. According to this table, Guava had highest antioxidant activity (70.90%), whereas Indian spinach had lowest (28.60%) antioxidant activity among all fruits and vegetables. Indian spinach of Churamonkathi had the lowest free radicals scavenging capability, and the value was 27.39%. However, in the fruits sample, Mango had the lowest total antioxidants activity (54.40%). Banana and Papaya had approximately the same scavenging capability, and it showed 69.42% and 69.31%, respectively. On the other hand, in vegetable group Bitter gourd had the highest antioxidants activity (45.47%), and Bottle gourd from Joghati village

showed the maximum free radicals scavenging ability (46.87%) than other villages. Additionally, Pointedgourd and Indian spinach had 32.25% and 28.60% antioxidants activity, respectively. For the Mango, Banana, and Papaya in Churamonkathi village, the total antioxidants activity was significantly lower than Ambottola (p=0.022, 0.028, and 0.030) and Joghati (p=0.031, 0.014 and 0.017) villages. Whereas, the free radicals scavenging capability of Guava from Churamonkathi village was only significantly lower (p=0.01) than Ambottola village. On the other hand, in the vegetable group, Bottle gourd from Churamonkathi village had significantly lower total antioxidants activity than Ambottola (p=.033) and Joghati (p=0.01) villages. Both Pointed gourd and Red amaranth from Churamonkathi had significantly lower (p=0.002 and 0.01) antioxidants activity compared to Joghati village. Bitter gourd from Joghati village was significantly higher (p=0.01 and 0.004) in antioxidant activity than the other two villages. However, Indian spinach from Churamonkathi village was only significantly lower (p=0.001) compared to Ambottola village.

Table 7: Total antioxidant activity (%, Mean±SD) of the selected fruits and vegetables from three villages

Plants sample	Churamonkathi (1)	Ambottola (2)	Joghati (3)	Total	t/p value‡		
					1 vs 2	2 vs 3	3 vs 1
Fruits							
Mango	53.45±0.53	54.71±0.27	55.04±0.65	54.40±0.42	-3.65/0.02*	-0.80/0.47	-3.27/0.03*
Banana	68.49±0.45	70.05±0.66	69.72±0.24	69.42±0.45	-3.35/0.03*	0.79/0.47	-4.16/0.01*
Guava	70.04±0.67	71.87±0.44	70.80±0.75	70.90±0.62	-3.93/0.01*	2.06/0.10	-1.37/0.24
Papaya	67.92±0.80	69.75±0.52	70.26±0.63	69.31±0.65	-3.30/0.03*	-1.07/0.34	-3.95/0.02*
Vegetables							
Bottle gourd	36.33±0.34	37.68±0.64	37.88±0.39	37.29±0.45	-3.19/.033*	-0.46/.66	-5.15/0.01*
Pointed gourd	30.77±0.45	32.86±0.72	33.14±0.39	32.25±0.52	-4.24/.013	-0.58/.59	-6.90/.002*
Bitter gourd	44.25±0.59	45.28±0.27	46.87±0.45	45.47±0.44	-2.77/.050	-5.24/0.01*	-6.14/.004*
Indian spinach	27.39±0.27	29.2±0.03	29.20±1.09	28.60±0.46	-8.09/.001*	0.02/0.98	-2.78/0.09
Red amaranth	35.81±0.27	37.08±0.44	37.88±0.39	37.29±0.36	-2.26/.086	-2.32/.08	-3.78/0.01*

‡ Values were obtained from Independent-Sample T Test, *Significant at p<0.05

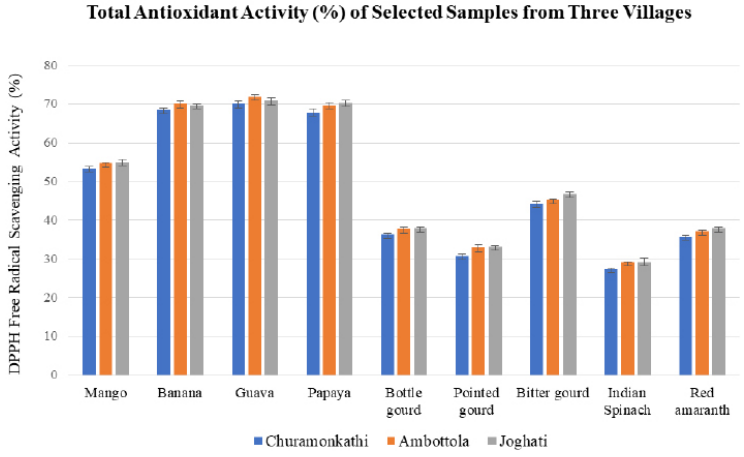

Fig. 1: Total antioxidant activity based on free radicals scavenging activity of selected fruits and vegetables from three villages

Figure 1 illustrates the total antioxidant activity of selected locally available fruits and vegetables stand on the DPPH free radicals scavenging method. Antioxidant activity of fruits and vegetables denotes the strength of antioxidants available in fruits and vegetables furthermore, the proficiency to trap free radicals. Here, among the fruit and vegetable samples, Guava showed the maximum strength of antioxidants along with another plant samples. That means Guava can scavenge more free radicals compared to other fruit and vegetable samples.

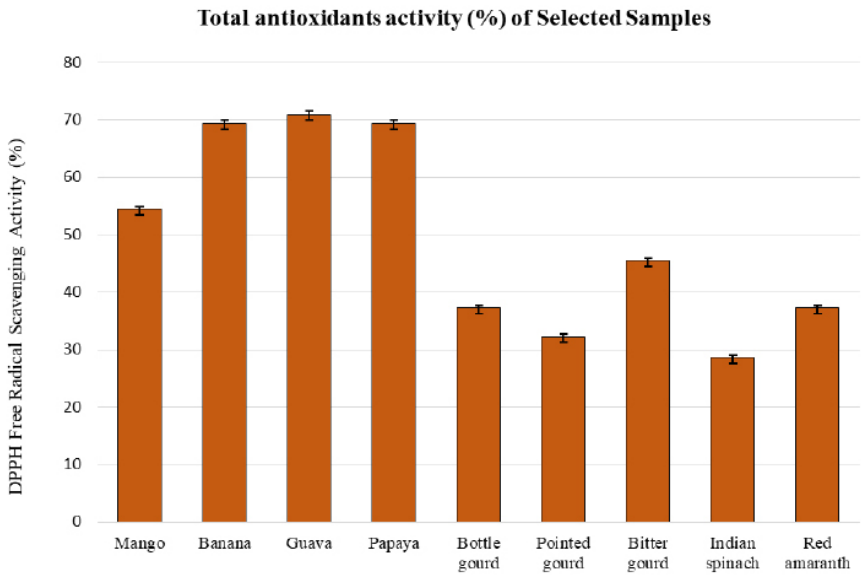

Fig. 2: Total antioxidants activity (Mean±SD) of selected fruits and vegetables of Jashore region based on DPPH free radicals scavenging activity

Figure 2 demonstrates thetotal antioxidants activity of selected fruits and vegetables of Jashore region. Where Guava had the highest antioxidants activity (70.90%) and Bitter gourd had the lowest antioxidants status (28.59%).

Discussion

This study was designed to evaluate the proximate composition and the total antioxidants activity of the locally available fruits and vegetables. Based on this study, the fruits group showed the lowest and vegetables showed the highest moisture content. Bottle gourd showed 94.14% moisture, which was the highest, and Banana had the lowest moisture content (73.06%). These findings were close to the study in India, where they found 96% in Bottle gourd and in Banana 72% moisture.[41,42] This study found the highest ash content in red amaranth, which was 1.59% and the lowest ash content in Papaya (0.50%). These findings were quite similar to the other studies which were done in India and Nigeria, where they found 1.36% ash in red amaranth and 0.49 % ash in papaya.[43,44] According to this study, the Vegetable group was richer in protein than the Fruits group, wherein fruits group mango and Papaya showed 0.70% protein, and in vegetable group, red amaranth had 4.32%. A study on mango in southern Ethiopia found 0.39% protein in mango and in Nigeria, 0.59% protein found in Papaya, where 6.23% protein was found at Mymensingh in Bangladesh.[45–47] Fruits and vegetables are lower in fat content, based on this study. The lowest fat content was found in Papaya (0.10%), and Banana had the highest percentage of fat (0.73%). In the vegetable group, Indian spinach showed 0.41% fat, which was the highest fat content among the vegetable group, but the value was lower than a study on Indian spinach in India, where 0.70% fat found.[48] The fat content of Papaya (0.10%) was very lower than the Papaya of India (0.26%), Banana

of Nigeria content 0.83% fat[49,50] whereas banana of ours had 0.73% fat. The discrepancy of these nutrient contents may explain by the geographical differences and soil conditions. This study revealed that fruits content higher carbohydrates than vegetables. Based on this study, Banana had the highest carbohydrate content, and that was 22.62%, the lowest carbohydrate was in Indian spinach, and that was 1.38%. This study found carbohydrate contentin Banana is lower than the Banana from Spain where a study found 27% carbohydrate.[51] A study on Indian spinach in India found 2.7% carbohydrate, which was higher than the Jashore region.[52]

Based on this study, fruits group showed higher total antioxidants activity than the vegetables group. In the fruits group, Guava showed 70.90% total antioxidants activity and it was the highest percentage among the all fruits and vegetables. In addition, Banana and Papaya showed approximately same total antioxidants activity, which were 69.42% and 69.31%, respectively. A study in Malaysia on Guava, found 66% total antioxidants activity which was the lower percentage than the guava from Jashore region.[53] In Indonesia, a study on banana found 50.64% DPPH inhibition, which was lower than the Banana from Jashore region[54] and Papaya from Malaysia showed 88.12% total antioxidants activity.[55] In vegetables group, both Bottle gourd and Red amaranth showed 37.29% total antioxidants activity. A study on Bottle gourd in Vietnam found 34% total antioxidants activity and Red amaranth in Nigeria had 27.52%.[56,57]

Conclusion

The results highlight the significance of locally available fruits and vegetables as potential source of macromolecules and antioxidants. Red amaranth had the highest protein percentage than other fruits and vegetables sample and lowest fat was found in Papaya. Among the fruits and vegetable samples fruits showed higher total antioxidants activity than the vegetables group, where Guava had the highest antioxidants activity and the lowest antioxidants was found in Indian spinach. In addition, Papaya and Banana also showed similar antioxidants activity as like Guava. As these fruits and vegetables are affordable and locally available, people should increase their consumption rate to reduce free radicals induced diseases and ensure a healthy life.

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Conflict of Interest

The authors declare that there is no conflict of interests regarding the publication of this paper.

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