Bangladesh Journal of Veterinary and Animal Sciences
Journal home page: www.bjvas.com
pISSN 2227-6416
eISSN 2709-2542

Research article

Evaluation of nutritive value of different fruit juices available in local market of Bangladesh

M. A. Islam[1*], M Parvin[2], S. Hossain[1], A. Begum[3] and M.T Ahamed[1]

[1]Dept. of Applied Chemistry and Chemical Technology, Chattogram Veterinary and Animal Sciences University, Chattogram-4225, Bangladesh.
[2]Dept. of Chemistry, University of Dhaka, Dhaka-1000.
[3]Department of Applied Food Science and Nutrition, Chattogram Veterinary and Animal Sciences University, Chattogram-4225, Bangladesh.

A R T I C L E I N F O

Article history:

Received: 02/09/2021

Accepted: 23/02/2022

Keywords:

Acidity, TSS, Ascorbic acid, Protein, Kjeldahl, Floch, Refractometer

*Corresponding author:
Cell: +8801739192257
E-mail: ashrafulsh05@gmail.com

A B S T R A C T

The study was conducted to know the nutritive values of different types of branded fruit juices, namely orange juice, guava juice, mixed fruit juice and five types of mango juices collected from the local markets of Chattogram. The moisture content was determined by the conventional physical method. The pH, Total Soluble Solids (TSS) was determined using a pH meter and refracto meter, respectively. Fat and protein was determined by the methods of Floch and Kjeldahl method, respectively. Vitamin C, acidity and sugar content were determined by conventional chemical methods. The fruit juices contain higher amount of moisture ranged from 83.20% to 89.30% on fresh weight basis. It was observed that the fruit juices were slightly acidic in nature, having pH ranged from 3.6 to 4.1. The TSS content of fruit juices ranged from 10.5 to 15.47%. Fat present in the juices are in small amount (0.025 to 0.091%). The vitamin C content of fruit juices was varied from 20mg to 60mg per 100 g of sample. Protein content of different types of juices was 0.92 mg to 1.14mg per 100g sample. Ash content of juices ranged from 0.050 to 0.093mg per 100g sample. Overall, these fruit juices showed a significance difference on the nutritive value for that we can vary these fruit juices on our purposes.

To cite this paper: *M. A. Islam, M Parvin, S. Hossain, A. Begum and M.T Ahamed, 2021. Evaluation of nutritive value of different fruit juices available in local market of Bangladesh. Bangladesh Journal of Veterinary and Animal Sciences, 9(2): 37-43.*

1. INTRODUCTION

Juice is the liquid that is naturally contained in fruit or vegetable tissue, which is prepared by mechanically squeezing or macerating fruit or vegetable flesh without the application of heat or solvents (Islam et al., 2015). The consumption of fruit juices has been increasing during the last decades due to its various health benefits and consumption of fresh fruit is often replaced by the fruit juices (Liu et al., 2003). As an important source of micronutrients, like vitamins and mineral fruit juices are widely consumed in tropical countries as part of habitual diet. Bangladesh is located in the tropical regime and many tropical fruits like mangoes, guavas, jackfruits, star fruits, oranges, bananas etc. are widely grown in Bangladesh. These fruits are beneficial for human health considering its nutritional value. For example, mango juice is rich in carbohydrate, sugar, vitamin C, protein and trace metals (Jahan et al., 2011). The juice may be prepared in the home from fresh fruit and vegetables using a variety of hand or electric juicers. Juice is one of the most popular drinks to go to breakfast in the

morning. Many commercial juices are filtered to remove fiber or pulp, but high-pulp, fresh orange juice is a popular beverage. Common methods for processing and preservation of fruit juices include canning, freezing, pasteurization, evaporation and spray drying (Kulkarni et al., 2012). Juices are often consumed for their perceived health benefits. For example, orange juice is rich in vitamin C, folic acid, potassium (Kurowska et al., 2020). Many fruit juices have a higher sugar (fructose) content than sweetened soft drinks; e.g., typical grape juice has 50% more sugar than Coca Cola, while soft drinks (e.g. Coca Cola) cause oxidative stress when ingested and may even lead to insulin resistance in the long term, the same thing cannot be attributed to fruit juices. On the contrary, fruit juices are actually known for their ability to raise serum antioxidant capacity and even offset the oxidative stress and inflammation normally caused by high-fat and high-sugar meals (Bhardwaj et al., 2015). On the other hand, day by day people are getting busier and hence the demand for ready to eat food/drink is increasing rapidly. This evaluation was done to estimate nutritional quality of commercially available processed fruit juices sold in Chattogram city with the focus of designing the consciousness of the regulatory authorities and helping the uninformed consumers to make a healthful selection. Therefore, considering all the facts, the present study was conducted to provide updated information about the nutritional composition of fruit juices which are available in local markets at reasonable costs.

2. MATERIALS AND METHODS

Total soluble solids (TSS)

Total soluble solids content (TSS) of a solution is determined by the index of refraction. This is measured by using a refractometer, and is referred to as the degrees Brix. Brix is the term used when a refractometer equipped with a scale, based on the relationship between refractive indices at 20°C and the percentage by mass of total soluble solids of a pure aqueous sucrose solution. This tests the solids concentration of a sucrose containing solution. It is widely used during fruit and vegetable processing to determine the concentration of sugar in the products. Sugar concentration is expressed in degrees Brix. At 20°C, the Brix is usually, considered equivalent to the percentage of sucrose (sugar) in the solution (60° Brix is equivalent to a sugar content of 60%). The measurement made at 20°C to get an accurate value.

Determination of TSS or Brix

The Brix can be defined as a unit of measurement of total soluble solids (TSS) present in any sugar solution either prepared or in natural state such as fruit juices, pulp etc. It is the measurement of the refractive indices of the said substances at 20^0 C (Islam et. al 2015).The Brix of all the fruit samples were determined by a hand refractometer (ranges from 0^0 to 99^0ATAGO 9909, Japan).

Moisture

Determination of moisture content

In a porcelain crucible 10-15g of the fruits sample was taken. Before using the crucible, it was cleaned and heated to about 100^0C, then cooled and weighted. The crucible with the fruits sample was heated in an electric oven at 105^0C for about six to eight hours. After which, it was cooled in a desiccator and weighted again (ASTM D4944, Standard Test Method for Determination of Moisture Content).

$$\text{Moisture content}\left(\frac{\text{g}}{100\text{g}}\right) = \frac{\text{Weight of the moisture} \times 100}{\text{Weight of the fruits sample}}$$

Determination of pH

Calibration of pH meter

The pH 4.0 and 7.0 buffer solution was used to calibrate the pH meter.

Procedure of pH measurement

The electrode assembled of the pH meter was immersed in the standard buffer solution having pH-4.0 taken in a clean and dry beaker. The fine asymmetry potential knob was adjusted to pH-4.0 .The electrode assembled pH meter was dipped into the fruit juice samples ;The pH was then read out and washed twice with distilled water (Hanna instruments-ORP, pH, salinity-sodium tester, ISO-9001 Certified Company; Woonsocket, RI 02895).

Determination of fat

In a conical flask, the moisture free fruit juice sample was taken. In which chloroform, methanol mixture (1:2) solution (20ml-50ml) was added and allowed to stand for overnight. The mixture was then filtered and the filtrate was taken in a seperatory funnel and 0.58% sodium chloride solution (7ml-20ml) was added. The seperatory funnel was vigorously shaken for accurate mixing and assured to stand for 5 to 7 hours. The lower phase was then collected and the washing with NaCl was repeated till the phase was clear. At last the lower phase was collected in a dry weighted conical flask. Finally, the fat was estimated gravimetrically (Method of Folch et al., 1957).

$$\text{Moisture content}\left(\frac{\text{g}}{100\text{g}}\right) = \frac{\text{Weight of the extractive} \times 100}{\text{Weight of the fruits sample taken}}$$

Determination of vitamin C

Preparation of dye solution

A total of 50g 2, 6- di chloro indophenol was taken and dissolved it in hot water and then added 42g $NaHCO_3$. After which the solution was cooled and diluted in the solution up to 200 ml with water. Finally, it was stored in refrigeration and standardized every day before use.

The method of determination

Half gram (0.5g) sample was taken and it was mixed thoroughly with 3% HPO_3 acid in a 100 ml flask. The solution was then filtered through a filter paper (40). After filtration, an aliquot (5ml) of metaphosphoric extract of the sample was taken and titrated with dye solution until a faint pink color present.

$$\text{Ascorbic acid (vit C)} = \frac{\text{burette reading(b)} \times \text{dye factor(c)} \times \text{Volume made up(d)} \times 100}{\text{aliquot of extract(e)} \times \text{weight of sample(f)}}$$

Standardization of dye solution

Five milliliter standard ascorbic acid solution or 1 ml ascorbic acid solution was taken and titrated with 5 ml of HPO_3 to a pink color.

$$\text{Dye factor} = \frac{\text{Volume ofstandard ascorbic acid(mL)} \times \text{concentration of ascorbic acid}}{\text{Volume of dye consumed(mL)}}$$

Precisely 0.25g fat was taken in a flask and 50 ml of 95% ethanol was added into the flask. The mixture was then neutralized with 0.1 N aqueous alkali using 0.5ml of the 1% phenolphthalein indicator. The neutralized ethanol solution was poured into the flask and mixed the contents of the flask thoroughly. Then the solution was boiled as hot as possible and titration was carried out with 0.1 N aqueous alkali solution. During the titration the solution was shaken vigorously. The first appearance of the red coloration that did not fade within 10 sec. was considered as the endpoint and the volume of the alkali required were recorded (British Standard Methods of the Analysis of Oils and Fats, 1958).

$$\text{Acid value} = \frac{56.1 \times \text{A} \times \text{N}}{\text{W}}$$

$$\text{Free fatty acid(as petroselinic acid)} = \frac{2.82\text{T}}{\text{W}}$$

Where, A = Volume of the alkali required.
N = Normality of the NaOH solution
W = Weight of the sample taken (g).

Determination of acidity

Ten mililiter juice sample and 50ml water were taken in a 250ml beaker and the solution was mixed properly. After mixing 3 drops of phenolphthalein indicator was added to the juice/water solution. The solution was then titrated by the standard 0.1M NaOH and the burette reading was recorded carefully.

$$\text{Acidity} = \frac{(\text{acidity factor} \times \text{reading})}{\text{Weight of sample}}$$

Where, factor = 0.0064

Determination of reducing sugar

Ten mililiter sample was taken and additional water was added to make the solution 100 ml. 5ml HCl was then added to the mixture and heat was applied to the solution for hydrolysis. Then NaOH was added to neutralize the solution which was tested with litmus paper. In a beaker Fehling solution + CuSO4 (5 ml+5 ml) were taken and titrated with a stock sample solution properly. Reading should be above 15 ml and finally calculation of determining reducing sugar was performed with the help of titer conversion chart.

Determination of protein

Preparation of digestion mixture

Potassium sulphate (K_2SO_4) and dehydrated copper sulphate ($CuSO_4.5H_2O$) in a ratio of 5g: 1g was powered well with mortar and pestle and mixed properly. Concentrated HCl was taken for titration. 40g Sodium Hydroxide (NaOH) was taken and dissolved in distilled water to make the volume up to 100ml.

Preparation of receiver solution

Boric acid (10g) was added in 500ml deionized water in a one liter Volumetric Flask and it was heated on a medium setting until the boric acid was dissolved. Then 0.02g of Bromocresolgreen was dissolved with 4ml ethanol (C_2H_5OH) in a beaker. Methyl red of 0.014g was dissolved with 4ml ethanol into another beaker. Some Bromocresol green and Methyl red solution was then transferred into that Volumetric Flask. An amount of 0.5ml 1N NaOH was also added and the total volume was made 1000ml with deionized water.

The method of determination

Digestion of the sample

The sample (0.5-1.0g) was taken in weighting paper and measured accurately. This Sample was poured into a 500ml clean and dry Kjeldahl flask, to which 10g of digestion mixture and 12-15ml of Conc. HCl was added. Then 2-5 glass beads were placed in the flask to avoid frothing and bumping. A blank was carried with all reagents except sample material for the comparison. The flasks were then heated in a fume hood digestion chamber at 400^0C until the solution become colorless. At the end of digestion period, the flasks were cooled and diluted with 100ml distilled water. A small piece of litmus paper was placed in the solution and the reaction was found to be acidic.

Distillation

Before starting the distillation the Kjeldahl apparatus was thoroughly washed with distilled water. An amount of 60ml if 40% NaOH was taken in a measuring cylinder, and it was carefully poured down the side of the Kjeldahl flask. The mouth of the flask was closed with a stopper containing connective tube, which was ultimately connected to the ammonia-receiving flask containing 25ml receiver solution. The mixture was boiled at such a rate water and ammonia distilled over at a steady moderate rate. The heating was not too slow, so that the receiver solution might be sucked into the Kjeldahl flask and not too fast so, that the distilling ammonia did not escape the receiver solution without absorption.

Titration

The ammonia absorbed in the receiving flask containing receiver solution was titrated with 0.1N HCL. Similarly, a reagent blank was distilled and titrated.

The protein content of the sample on the percentage basis was calculated by the following formula:

$$\%\ \text{of Protein(g)} = \frac{((c - b) \times 14 \times d \times 6.25 \times 100)}{a}$$

Where,

a = Sample weight

b = Volume of sodium hydroxide required for the back titration

c= Volume of sodium hydroxide required for the back and to neutralize 20ml of 0.1N H_2SO_4 (for blank)

d=Normality of NaOH sued for titration

The conversion factor of nitrogen to protein is 6.25 and atomic weight of nitrogen is 14.

Determination of ash content

In a previously cleaned, dried, accurately weighed porcelain crucible 10 to 20 ml juice sample was taken. Firstly, it was heated slowly in an oven at 105^0C. After which it was transferred into the muffle furnace and heated first over a low flame to prevent any loss during charring and then strongly until ash remained followed by heating at 600^0C about 3 to 5 hours. The warm crucible was then transferred to desiccator and weighed to ensure complete ashing. This was repeated till two consecutive weights were the same and the ash almost white in color.

$$\%\ \text{of Ash(g)} = \frac{(\text{weight of ash} \times 100)}{\text{weight of the raw sample}}$$

Statistical analysis of sample

The nutritive value of fruit juices was imported to SPSS 28 from Microsoft Excel 2016. Before statistical analysis in SPSS 28, the data were organized with satisfactorily and recorded. One way ANOVA test was used to assess the significant level of variation at 95% confidence interval.

Table 1. Record for fruit juices

Sample no.	Juice name	Collection period	Location	Expiry	Comments
S-1	Orange Juice	March,2019	WarelessMor, Chattogram	September, 2019	Processed fruit juice
S-2	Mango Juice	March, 2019	New Market, Chattogram	August, 2019	Processed fruit juice
S-3	Guava Juice	March, 2019	New Market, Chattogram	September,2019	Processed fruit juice
S-4	Mixed Fruit Juice	March,2019	GEC, Chattogram	October, 2019	Processed fruit juice
S-5	Mango Juice	March,2019	AK khan, Chattogram	July, 2019	Processed fruit juice
S-6	Mango Juice	April, 2019	Halishahar, Chattogram	November, 2019	Processed fruit juice
S-7	Mango Juice	April, 2019	Wareless Mor, Chattogram	December, 2019	Processed Fruit juice
S-8	Mango Juice	April, 2019	Ak Khan, Chattogram	December, 2019	Processed fruit juice

3. RESULTS AND DISCUSSION

This study reveals that the different fruit juices found in Chattogram Local markets are a reasonable source of vitamin C and other nutritive parameters. In this research, almost all juice varieties contained high amount of ascorbic acid (vitamin C) and other important nutritional components. The highest amount of ascorbic acid was found in the sample-3(guava juice) (60 mg/100 ml) and the lowest amount of ascorbic acid found in sample-1 (orange juice) (20 mg/100ml) (Table 2). The highest amount of TSS was found in the sample-3 (guava juice) (15.47±0.03%) and the lowest amount of TSS found in the sample, 1(orange juice) (10.5±0.03%). Including sugar the brix is related to other soluble solids like vitamins and mineral. In this research, it was found that total solids content was inversely correlated with moisture content, which is similar to the findings of Haque et al. (2009). The pH of fruit juices was varied from 3.6±0.03 to 4.1±0.1 (Table 2). The highest amount of pH was found in both sample 4 (mixed fruit juice) and sample 7 (mango juice) (4.1±0.1) and the lowest amount of pH was found in sample 2 (mango juice) (3.6±0.03) which may due to the presence of nature occurring acids in the fruits. The standard value of the pH of mango juices is ranged from 2.8 to 5.4 (Sharmin et al., 2020). Another study found the value of pH (2.7 to 4.1) of processed fruit juices in the Dhaka city (Rowshon et al. 2015). According to the findings, it can be said that all juices were slightly acidic in nature. It is revealed that there is a strong relationship between total solid content and moisture content in juices and the samples contained high amount of moisture. During analysis the highest amount of moisture was recorded in sample 1 (orange juice) (89.30±0.09%) and the lowest amount of moisture content was found in sample 3 (guava juice) (83.20±0.08%) shown in Table 2. Fat percentage in the fruit juices are in tiny amount. So, from the findings it can be suggested that these fruit juices are suitable for health, because of its low fat content, which is agreed with the findings of Islam et al. (2015). The analysis showed that the highest amount of fat was found

in sample 3 (guava juice) (0.091±0.002%) and the lowest amount of fat was found in sample 1 (orange juice) (0.025±0.0006%). The findings also revealed that fruit juices contained an appreciable amount of protein. The highest amount of protein was found in sample 8 (mango juice) (1.14±0.25mg) and the lowest amount of protein were found in both sample 3 (guava juice) (0.92±0.26 mg) and sample 6 (mango juice) (0.92±0.07 mg). The concentration of ash in the fruit juices was varied from 0.050 to 0.093 mg per 100 ml sample, which is much lower than the standard value of 5% (Rashid et al., 2019). The highest amount of ash was found in sample 3 (0.093±0.001mg) and the lowest amount of ash was found in sample 6 (0.050±0.002mg). Therefore, these market juices also had a small amount of mineral content. The acidity of the fruit juices were ranged from 0.190% to 0.322 %, which is related to the flavor of juices (Islam et al., 2015). The low acidity was found in sample 8 (0.190±0.003%) and the highest acidity was found in sample 6 (0.322±0.007%) (Table 3). All juice items contained a good amount of sugar content, which is related to the total soluble solids. The reducing sugar of the juice items was ranged from 1.208 % to 5.200%, whereas, the total sugar content of mango extract is about 13.7% (Sharmin et al., 2020). The highest amount of reducing sugar was found in sample 6 (5.495±0.23%) and that of the lowest amount was found in sample 7 (1.075±0.01%).The overall findings of the study are shown on Table 2 and 3.

Table 2. Nutritive value of different types of fruit juices

Sample	Name	TSS (%)	Moisture (g)	pH	Fat (%)	Vitamin-C (mg)
S1	Orange juice	10.50±0.03	89.30±0.09	3.9^{a} ±0.01	0.025±0.01	20^{ad} ±3.4
S2	Mango juice	14.73±0.06	84.54±0.05	3.6^{b} ±0.03	0.050^{d} ±0.01	30^{bd} ±6.0
S3	Guava juice	15.47±0.03	83.20±0.08	3.9^{a} ±0.08	0.091^{e} ±0.00	60±8.5
S4	Mixed fruit juice	11.17±.04	88.87±0.08	4.1^{c} ±0.10	0.083^{f} ±0.01	40^{c} ±4.5
S5	Mango juice	14.65±0.02	83.75±0.35	3.7^{b} ±0.20	0.084^{ef} ±0.00	25^{abd} ±7.0
S6	Mango juice	12.70±0.07	86.65±0.12	3.9^{a} ±0.01	0.056^{d} ±0.00	40^{c} ±2.0
S7	Mango juice	10.90±0.02	88.44±0.16	4.1^{c} ±0.02	0.076^{f} ±0.00	30^{bd} ±1.0
S8	Mango juice	12.95±0.04	85.22±0.13	3.9^{a} ±0.04	0.081±0.00	30^{bd} ±2.0

Means in column with different letters are significantly different ($p<0.05$). One way ANOVA was used to analyze for significant differences between samples.

Table 3. Nutritive value of different types of fruit juices

Sample	Name	Acidity (%)	Reducing sugar (%)	Protein (mg)	Ash (mg)
S1	Orange juice	0.192^{e} ±0.00	5.200^{a} ±0.70	1.10^{efh} ±0.20	0.085^{a} ±0.00
S2	Mango juice	0.256^{f} ±0.00	2.074^{bd} ±0.13	1.06^{ef} ±0.25	0.065^{bce} ±0.01
S3	Guava juice	0.320^{g} ±0.01	2.074^{bd} ±0.26	0.92^{g} ±0.26	0.093^{a} ±0.00
S4	Mixed fruit juice	0.192^{e} ±0.00	1.208^{cd} ±0.11	0.96^{g} ±0.12	0.091^{a} ±0.00
S5	Mango juice	0.193^{e} ±0.00	3.545±0.17	1.06^{ef} ±0.20	0.057^{bcd} ±0.01
S6	Mango juice	0.322^{g} ±0.01	5.495^{a} ±0.23	0.92^{g} ±0.07	0.050^{cd} ±0.00
S7	Mango juice	0.257^{f} ±0.00	1.075^{cd} ±0.01	1.04^{ef} ±0.06	0.072^{be} ±0.00
S8	Mango juice	0.190^{e} ±0.00	1.525^{bcd} ±0.02	1.14^{eh} ±0.25	0.090^{a} ±0.01

Means in column with different letters are significantly different ($p<0.05$). One way ANOVA was used to analyze for significant differences between samples.

4. CONCLUSION

It can be concluded from this research, that the fruit juices based on the different variables showed similarities and dissimilarities of nutritive values. The variables included TSS, pH, moisture content, reducing sugar, ascorbic acid, protein, fat, acidity and ash content. As this study is related to nutritive parameter analysis, and based on the findings, it can be

said that, almost all of the juices contain an appreciable amount of nutritional components, so, people of all classes can take it, as a nutritive food at reasonable price are available in the local markets of Bangladesh.

ACKNOWLEDGEMENT

We wish to acknowledge the University Grant Commission of Bangladesh (UGC) Sher-e-Bangla Nagar, Dhaka for the funding of this research work. We acknowledge the staffs who were involved in this project.

REFERENCES

Bhardwaj, R. L., & Nandal, U. 2015. Nutritional and therapeutic potential of bael (Aegle marmelos Corr.) fruit juice: a review. Nutrition & Food Science. 45(6): 895-919.

Folch, J., Lees, M. and Stanley, G. H. S. 1957. A simple method for the isolation and purification of total lipids from animal tissues. Journal of Biological Chemistry. 226:497-509.

Haque, M. N., Saha, B. K., Karim, M. R. and Bhuiyan, M. N. H. 2009. Evaluation of nutritional and physico-chemical properties of several selected fruits in Bangladesh. Bangladesh Journal of Scientific and Industrial Research. 44(3): 353- 358.

Islam, M., Morshed, S., Saha, S., Quader, F., &Alam, M. 2015. Evaluation of Nutritive Value of Mango Juices Found in Bangladeshi Markets. Journal of Environmental Science and Natural Resources, 8(1): 95.

Jahan, S., Gosh, T., Begum, M. and Saha, B. K. 2011. Nutritional profile of some tropical fruits in Bangladesh: specially anti-oxidant vitamins and minerals. Bangladesh Journal of Medical Science. 10(2): 95-103.

Kulkarni, R. S., Chidley, H., Pujari, K. H.,Giri, A. P. and Gupta, V. S. 2012. Flavor of mango: A pleasant but complex blend of compounds, In Mango Vol. 1: Production and Processing Technology (Eds. Sudha G Valavi, K Rajmohan, JN Govil, KV Peter and George Thottappilly) Studium Press LLC.

Kurowska, E. M., Spence, J. D., Jordan, J., Wetmore, S., Freeman, D. J.,Piché, L. A. & Serratore, P. 2020. HDL-cholesterol-raising effect of orange juice in subjects with hypercholesterolemia. The American journal of clinical nutrition. 72(5): 1095-1100.

Liu, R. 2003. Health benefits of fruit and vegetables are from additive and synergistic combinations of phytochemicals. American Journal of Clinical Nutrition. 78(3): 517S-520S.

Rashid, M. M., Khatun, H., Rayhan, M. F., Plabon, M. E. A., Hossain, M. U., Mozid, M. A., Kamal, M. M., Hasan, M. K., Sabagh, A., Islam, M. S. 2019. Comparative study on physicochemical properties of selected mango (mangifera indica l.) varieties in northern Bangladesh. Cercetari Agronomice in Moldova. 52(1): 54-65

Rowshon A., Saha B. K., Motalab M., Haque M. Z. and Fakhruddin A. 2015. Nutritional Evaluation of Fresh and Processed Fruit Juices Available in Dhaka City, Bangladesh. Bangladesh Journey of Botany. 45(1): 181-186.

Sharmin, H., Begum, N. N., Rahman, S. M. 2020. A Study on Microbiological Status of Some Selected Brands of Mango Juice. Journal of Natural Sciences Research. 8(1): 20-27.