Bangladesh J. Bot. **45**(1): 181-186, 2016 (March)

NUTRITIONAL EVALUATION OF FRESH AND PROCESSED FRUIT JUICES AVAILABLE IN DHAKA CITY, BANGLADESH

ROWSHON ARA[1]*, BARUN KANTI SAHA[2], MD MOTALAB[2], MD ZAHURUL HAQUE[2] AND ANM FAKHRUDDIN

Department of Environmental Sciences, Jahangirnagar University, Dhaka-1342, Bangladesh

Key words: Fruit Juices, Nutritional properties, Minerals, Vitamin C

Abstract

The nutritional properties of the fruit juices which are available in Dhaka city, Bangladesh, was studied and found that the nutritional properties are higher in the fresh fruit juices compared to the processed fruit juices. The pH range in fresh juices was 3.40 ± 0.00 to 4.50 ± 0.00 whereas it varied in processed juices from 2.70 ± 0.01 to 4.10 ± 0.00. The total soluble solid content was found maximum in fresh and processed mango juices, 23.53 ± 0.53% and 19.74 ± 0.71%, respectively. The highest amount of vitamin C was observed in the fresh guava juices (57.76 ± 5.32 mg %). The significant ($p < 0.05$) variations of mineral contents are found. Manganese was not detected in the processed fruit juices and in the fresh juice. It was high in mango juices (5.84 ± 0.83 mg %). Among the processed fruit juices iron was found only in the orange juices (1.05 ± 0.27 mg %) while it was high in the fresh litchi juices (7.05 ± 1.07 mg %).

Introduction

The demand of the fruit juices has increased since their beneficial contribution to health was obtained from fresh, ripe and healthy fruits, available in natural concentrations or in the processed forms and prepared by mechanically squeezing fresh fruits or extracting by water (Franke *et al*. 2005, Karabiyikli *et al*. 2012). The nutritional quality and deliciousness of fruit juices depends on the variety and maturity of fresh fruits which are full of nutrients, minerals, soluble solids fraction and proper balance between the concentrations of sugars and organic acids (Nagy *et al*. 1993, Zerdin *et al*. 2003).

A large number of tropical fruits which are grown in Bangladesh have a high nutritional value and play an important role in human nutrition and also are enriched in antioxidant, minerals, vitamins and dietary diversification. Small amount of micronutrients are needed for good health along with energy. The fruit juices are known as considerable sources of minerals and ascorbic acid (vitamin C). Vitamin C is one of the most important antioxidants and it helps neutralize free radicals that can damage cell and tissues (Rahman *et al*. 2007, Jahan *et al*. 2011, Islam *et al.* 2014). An attempt was taken to measure nutritional quality of fresh and commercially available processed fruit juices sold in Dhaka city with the aim of sketching the awareness of the regulatory authorities and helping the uninformed consumers to make a healthful selection. The locally available fruit juices (mango, orange, pineapple, tamarind, litchi and guava) and the processed fruit juices of these forms are considered in this study.

Materials and Methods

Twenty samples of fresh fruit juices and 45 samples of processed fruit juices are available in Dhaka City, Bangladesh which were collected and brought to the laboratory of Institute of Food Science and Technology, Bangladesh Council of Scientific and Industrial Research (IFST,

*Author for correspondence: <rowshon_sust@yahoo.com> [1]Department of Food Engineering and Tea Technology, Shahjalal University of Science and Technology, Sylhet -3114, Bangladesh. [2]Institute of Food Science and Technology, Bangladesh Council of Scientific and Industrial Research, Dhanmondi, Dhaka-1205, Bangladesh.

BCSIR), Dhaka. All the samples were collected in sterile containers and analyzed as soon as possible. The fresh and the processed juice samples A, B, C, D, E and F were made from mango (*Mangifera indica*), orange (*Citrus sinensis*), pineapple (*Ananas comosus*), tamarind (*Tamarindus indica*), litchi (*Litchi chinensis*) and guava (*Psidium guajava*), respectively. The samples were analyzed for five replications.

The moisture content of fruit juices was determined by digital moisture analyzer ((AnD MX-50). The pH of fruit juices was determined with a digital pH meter (Type H1 98106 by HANNA) and titratable acidity was estimated by known weight of sample in distilled water and then titrated against 0.01N NaOH using phenolphthalein as the indicator (Srivastava and Sanjeev 2003). The percentage of total soluble solid (TSS) was obtained from direct reading of the hand refractometer (Type ATAGO, Model-9099). The total and the reducing sugar were determined by the Lane and Eynon method (Ranganna 2003). The estimation of total protein was made by Kjeldahl method (Kirk and Sawyer 1991). The total fat and crude fiber content of samples were determined by AOAC method (AOAC 2005). Ash was determined by heating sample at 600^0C for six hours until a constant weight was reached. Vitamin C was estimated by 2, 6-dichlorophenolindophenol visual titration method according to AOAC (2005). All the minerals were estimated by Flame Atomic Absorption Spectrometric method (Thermo-Scientific iCE 3000 series, Atomic Absorption Spectrometer).

One way analysis of variance (ANOVA) and Duncan Multiple Range Test (DMRT) were used to see the individual difference of the parameters among the fruit juices. The nutritional properties and the minerals in the fruit juices are presented and each value is expressed as mean values ± standard deviations (SD).

Results and Discussion

The nutritional values obtained from the fresh and processed fruit juices are presented in Tables 1 and 2, respectively. The moisture content of different fresh fruit juices ranged from 86.43 ± 1.51 to 91.80 ± 0.89% (Table 1), whereas for different processed fruit juices, the moisture content ranged from 86.48 ± 1.87 to 90.17 ± 1.06% (Table 2). Ayub *et al*. (2005) reported that the high moisture content is very important factor affecting the flavor of the juices and minimum shelf stability. It is seen that the pH values varied significantly ($p < 0.05$). The highest pH of the fresh and the processed fruit juices was found 4.50 and 4.10, respectively. Concurrently the lowest pH of the fresh and the processed fruit juices was found 3.40 and 2.70 ± 0.01, respectively. The titratable acidity of the fresh and the processed fruit juices varied significantly ($p < 0.05$) among the fruit juices. The titratable acidity was maximum (0.60 ± 0.02%) in the fresh juices sample, while it is minimum (0.18 ± 0.00%) in the processed juices. The titratable acidity of the fruit juices is due to the presence of a mixture of different acids, whose composition varies depending on fruit nature and maturity (Ezeama 2007).

The total soluble solids (TSS) contents of the fruit juices varied significantly ($p < 0.05$). The TSS contents are found maximum in the fresh fruit juices ranged from 15.70 ± 1.06 to 23.53 ± 0.53% and in the processed juices the TSS ranged from 6.28 ± 1.02 to 19.74 ± 0.71%. In this study, it was found that the total sugar content of the fresh and the processed juices have varied significantly ($p < 0.05$). In the fresh juices it varied from 9.05 ± 0.87% to 14.47 ± 0.71% and in the processed juices varied from 3.25 ± 0.69 to 14.91 ± 1.54%. The total soluble solids (TSS) are directly related to both sugars and fruits acids and it may be significantly influenced by the combined effect of stages of maturity and ripening conditions. Tasnim *et al.* (2010) found that the TSS in different fruit juices ranged from 9 - 13.50%. However, in our study the TSS contents of different fruit juices found higher than reported study.

Table 1. Nutritional properties of fresh fruit juices.

Nutritional properties	Sample A (Mango juice)	Sample B (Orange juice)	Sample C (Pineapple juice)	Sample D (Tamarind juice)	Sample E (Litchi juice)	Sample F (Guava juice)
Moisture (%)	87.49 ± 1.53^{b}	86.43 ± 1.51^{b}	87.77 ± 2.52^{b}	91.53 ± 2.08^{a}	90.02 ± 0.99^{a}	91.80 ± 0.89^{a}
pH	3.51 ± 0.01^{e}	4.19 ± 0.01^{b}	3.60 ± 0.01^{d}	4.50 ± 0.00^{a}	3.79 ± 0.01^{c}	3.40 ± 0.00^{f}
Titratable acidity (%)	0.26 ± 0.01^{c}	0.27 ± 0.00^{c}	0.56 ± 0.01^{b}	0.60 ± 0.02^{a}	0.27 ± 0.00^{c}	0.18 ± 0.00^{d}
TSS (%)	23.53 ± 0.53^{a}	16.00 ± 0.57^{d}	17.71 ± 0.75^{c}	20.18 ± 0.08^{b}	17.29 ± 0.89^{c}	15.70 ± 1.06^{d}
Total sugar (%)	12.10 ± 1.69^{b}	10.11 ± 1.11^{c}	9.05 ± 0.87^{c}	9.32 ± 0.08^{c}	14.47 ± 0.71^{a}	9.61 ± 0.79^{c}
Reducing sugar (%)	6.09 ± 0.20^{c}	8.72 ± 0.78^{a}	6.50 ± 0.44^{bc}	5.18 ± 0.50^{c}	8.59 ± 0.46^{a}	7.27 ± 0.94^{b}
Protein (%)	0.07 ± 0.01^{b}	0.07 ± 0.00^{b}	0.05 ± 0.00^{b}	0.08 ± 0.01^{b}	0.06 ± 0.00^{b}	0.13 ± 0.01^{a}
Ash (%)	0.69 ± 0.02^{b}	0.73 ± 0.01^{a}	0.57 ± 0.02^{d}	0.61 ± 0.01^{c}	0.56 ± 0.02^{d}	0.64 ± 0.02^{c}
Crude fiber (%)	0.20 ± 0.02^{a}	0.14 ± 0.01^{b}	0.07 ± 0.00^{cd}	0.05 ± 0.01^{d}	0.09 ± 0.01^{c}	0.06 ± 0.31^{d}
Total fat (%)	0.01 ± 0.00^{c}	0.05 ± 0.00^{ab}	0.04 ± 0.00^{b}	0.04 ± 0.00^{b}	0.01 ± 0.00^{c}	0.06 ± 0.01^{a}

Results are expressed as 100 ml of fruit juices. Means in rows with different letters are significantly different ($p < 0.05$). One way ANOVA and DMRT were used to analyze for significant differences between samples.

Table 2. Nutritional properties of different processed fruit juices.

Nutritional properties	Sample A (Mango juice)	Sample B (Orange juice)	Sample C (Pineapple juice)	Sample D (Tamarind juice)	Sample E (Litchi juice)	Sample F (Guava juice)
Moisture (%)	88.41 ± 1.18^{ab}	90.17 ± 1.06^{a}	88.59 ± 1.02^{ab}	90.08 ± 1.11^{a}	86.48 ± 1.87^{b}	87.83 ± 2.29^{b}
pH	3.30 ± 0.00^{e}	3.89 ± 0.00^{b}	3.40 ± 0.00^{d}	4.10 ± 0.00^{a}	3.60 ± 0.00^{c}	2.70 ± 0.01^{f}
Titratable acidity (%)	0.26 ± 0.01^{c}	0.19 ± 0.00^{d}	0.32 ± 0.01^{b}	0.56 ± 0.01^{a}	0.15 ± 0.01^{e}	0.11 ± 0.00^{f}
TSS (%)	19.74 ± 0.71^{a}	11.77 ± 0.60^{c}	14.41 ± 1.27^{b}	14.72 ± 0.78^{b}	19.14 ± 0.93^{a}	6.28 ± 1.02^{d}
Total sugar (%)	9.12 ± 0.50^{b}	8.74 ± 0.54^{b}	9.67 ± 0.65^{b}	9.71 ± 0.60^{b}	14.91 ± 1.54^{a}	3.25 ± 0.69^{c}
Reducing sugar (%)	7.37 ± 0.77^{b}	7.09 ± 0.73^{b}	7.44 ± 0.58^{b}	6.80 ± 0.85^{b}	9.86 ± 0.83^{a}	2.04 ± 0.51^{c}
Protein (%)	0.06 ± 0.00^{c}	0.07 ± 0.00^{c}	0.05 ± 0.01^{c}	0.11 ± 0.02^{b}	0.07 ± 0.01^{c}	0.14 ± 0.01^{a}
Ash (%)	0.62 ± 0.01^{c}	0.81 ± 0.05^{a}	0.58 ± 0.01^{c}	0.50 ± 0.03^{d}	0.60 ± 0.04^{c}	0.67 ± 0.02^{b}
Crude fiber (%)	0.18 ± 0.01^{a}	0.10 ± 0.02^{b}	0.09 ± 0.01^{bc}	0.04 ± 0.01^{d}	0.07 ± 0.01^{c}	0.05 ± 0.00^{d}
Total Fat (%)	0.02 ± 0.00	0.03 ± 0.00	0.03 ± 0.00	ND	0.03 ± 0.00	0.05 ± 0.00

ND = Not detected. Results are expressed as 100 ml of fruit juices. Means in rows with different letters are significantly different ($p < 0.05$). One way ANOVA and DMRT were used to analyze for significant differences between samples.

Naturally the fruit juices contain a very small amount of protein. From Tables 1 and 2 it is seen that the total protein content in fruit juices varied significantly ($p < 0.05$). The maximum protein contents found in the fresh and the processed fruit juices were 0.13 ± 0.01 and $0.14 \pm 0.01\%$, respectively, whereas the minimum protein content were 0.05% in both fresh and the processed fruit juices. Ash contents reveal the communal picture of minerals present in the food.

Ash content of the fresh fruit juices ranged from 0.56 ± 0.02 to 0.73 ± 0.01% and the processed juices it ranged from 0.50 ± 0.03 to 0.81 ± 0.05%. The variations in ash contents of the samples may be attributed to the formulations of each manufacturer (Hussain *et al*. 1993).

Crude fiber was significantly varied ($p < 0.05$) in the fresh and the processed fruit juices. Low amount of crude fiber was seen in the fresh juices (0.05 ± 0.01%) and the processed juices (0.04 ± 0.01%), whereas a high amount of crude fiber were found in the fresh juices (0.20 ± 0.02%) and the processed juices (0.18 ± 0.01%). In the fresh fruit juices the amount of total fat varied significantly ($p < 0.05$) but in the processed juices they do not vary significantly. The amount of total fat of the fresh and the processed fruit juices ranged from 0.06 ± 0.01 to 0.01% and 0.02 to 0.05%, respectively.

Table 3. Vitamin C and mineral contents of fresh fruit juices.

Vitamin C and minerals	Sample A (Mango juice)	Sample B (Orange juice)	Sample C (Pineapple juice)	Sample D (Tamarind juice)	Sample E (Litchi juice)	Sample F (Guava juice)
Vitamin C (mg %)	32.91 ± 2.79^{b}	55.44 ± 3.72^{a}	20.65 ± 1.68^{c}	30.32±3.81^{b}	23.46 ± 2.30^{c}	57.76 ± 5.32^{a}
Sodium (mg %)	25.69 ± 1.69^{b}	42.81 ± 4.61^{a}	20.27 ± 2.43^{c}	9.56±2.03^{d}	26.22 ± 2.61^{b}	26.46 ± 1.66^{b}
Sodium (mg %)	25.69 ± 1.69^{b}	42.81 ± 4.61^{a}	20.27 ± 2.43^{c}	9.56±2.03^{d}	26.22 ± 2.61^{b}	26.46 ± 1.66^{b}
Potassium (mg %)	27.46 ± 4.04^{a}	17.06 ± 4.86^{b}	7.13 ± 1.67^{c}	9.35±0.71^{c}	9.28 ± 0.75^{c}	3.14 ± 0.60^{d}
Calcium (mg %)	9.12 ± 3.11^{bc}	5.98 ± 1.22^{d}	ND	10.19±1.33^{b}	6.80 ± 1.22^{cd}	17.30 ± 2.81^{a}
Magnesium (mg %)	6.33 ± 0.84^{b}	8.79 ± 0.67^{a}	5.02 ± 0.97^{c}	4.21±0.75^{cd}	4.89 ± 0.39^{c}	3.80 ± 0.80^{d}
Iron (mg %)	3.54 ± 1.16^{c}	5.80 ± 0.60^{b}	3.25 ± 0.50^{c}	2.64 ± 0.86^{c}	7.05 ± 1.07^{a}	5.00 ± 0.51^{b}
Manganese (mg %)	5.84 ± 0.83	4.98 ± 0.56	1.50 ± 0.38	ND	ND	1.19 ± 0.19
Zinc (mg %)	8.07 ± 0.36	3.09 ± 1.00	ND	2.93 ± 0.28	ND	3.83 ± 0.46

ND = Not detected; Results are expressed as 100 ml of fruit juices. Means in rows with different letters are significantly different ($p < 0.05$). One way ANOVA and DMRT were used to analyze for significant differences between samples.

The results of vitamin C (ascorbic acid) and the minerals of fresh fruit juices and processed fruit juices are presented in Tables 3 and 4, respectively. Vitamin C and the mineral contents of fruit juices varied significantly ($p < 0.05$). Vitamin C of different fresh fruit juices ranged from 20.65 ± 1.68 to 57.76 ± 5.32 mg %. It is seen (Table 4) that vitamin C of different processed fruit juices ranged from 3.17±0.13 to 7.10 ± 0.83 mg %. Saeed *et al*. (2012) reported that vitamin C content in different brand of mango juices varied from 2.72 to 3.63 mg%. In our findings the amounts of vitamin C in processed juices are less than fresh fruit juices. Time and temperature during processing and storage reduce the vitamin C content in fruit juices (Tasnim *et al*. 2010).

The mineral contents (sodium, potassium, calcium, magnesium, iron, manganese and zinc) of the fresh and the processed fruit juices are presented in Tables 3 and 4, respectively. In the fresh juices significant ($p < 0.05$) variations of sodium, potassium, calcium, magnesium and iron contents are found but the variation in manganese and zinc contents are insignificant. In the processed fruit juices it is seen that sodium, potassium, magnesium contents varied significantly

($p < 0.05$), however the variation in calcium, manganese, iron and zinc contents are not significant. The sodium content in the fresh fruit juices ranges from 9.56 ± 2.03 to 42.81 ± 4.61 mg% and in the processed fruit juices it varied from 13.67 ± 1.44 to 33.87 ± 2.41 mg%. In the fresh juices potassium varied from 3.14 ± 0.60 to 27.46 ± 4.04 mg%, whereas in the processed fruit juices it was 3.49 ± 0.78 to 21.37 ± 3.69 mg%. The amount of calcium ranged from

Table 4. Vitamin C and mineral contents of different processed fruit juices.

Vitamin C and minerals	Sample A (Mango juice)	Sample B (Orange juice)	Sample C (Pineapple juice)	Sample D (Tamarind juice)	Sample E (Litchi juice)	Sample F (Guava juice)
Vitamin C (mg %)	3.39 ± 0.42^{b}	6.42 ± 0.58^{a}	7.10 ± 0.83^{a}	6.32 ± 1.31^{a}	3.17 ± 0.13^{b}	6.44 ± 0.73^{a}
Sodium (mg %)	22.18 ± 2.24^{b}	33.87 ± 2.41^{a}	15.16 ± 2.14^{c}	13.67 ± 1.44^{c}	15.30 ± 2.83^{c}	14.56 ± 1.18^{c}
Potassium (mg %)	21.37 ± 3.69	6.12 ± 1.13	7.13 ± 0.44	3.13 ± 0.94	3.49 ± 0.78	ND
Calcium (mg %)	9.24 ± 0.71	4.33 ± 1.58	ND	4.43 ± 1.10	3.86 ± 0.57	23.02 ± 1.35
Magnesium (mg %)	2.90 ± 0.23^{a}	1.20 ± 0.75^{d}	1.87 ± 0.32^{bc}	2.76 ± 0.64^{a}	2.25 ± 0.57^{ab}	1.58 ± 0.32^{bc}
Iron (mg %)	ND	1.05 ± 0.27	ND	ND	ND	ND
Manganese (mg %)	ND	ND	ND	ND	ND	ND
Zinc (mg %)	0.93 ± 0.21	0.79 ± 0.16	0.62 ± 0.08	ND	0.17 ± 0.04	0.91 ± 0.15

ND = Not detected; Results are expressed as 100 ml of fruit juices. Means in rows with different letters are significantly different ($p < 0.05$). One way ANOVA and DMRT were used to analyze for significant differences between samples.

5.98 ± 1.22 to17.30 ± 2.81 mg% in the fresh fruit juices and 4.33 ± 1.58 to 23.02 ± 1.35 mg% in the processed fruit juices. In the fresh fruit juices the highest magnesium (8.79 ± 0.67 mg %) was found in orange juice, the maximum amount of iron was found in the litchi juice and the mango juice contains the highest amount of manganese (5.84 ± 0.83 mg %) and zinc (8.07 ± 0.36 mg%). Iron was found only in the orange juice (1.05 ± 0.27 mg %) of the processed juices, while it was found in all the samples of the fresh fruit juices. It was reported that in the fruit juices, the range of iron varies between 1.22 and 3.50 mg% (Ndife *et al*. 2013), which is in accord with our study. Manganese is required for the process of metabolism and digestion and helps to break down fats and cholesterol which is also vital for the formation of healthy bones and tissues. Manganese was not detected in the processed fruit juices, however in the fresh fruit juices manganese was detected in four samples out of six.

From comparisons of the nutritional properties of the fresh and the processed juices, it is assessed that a high amount of the TSS, crude fiber, potassium, manganese and zinc are found in both the fresh and the processed mango juices. Reducing sugar, ash, sodium and magnesium are rich in the fresh orange juices, conversely a high amount of moisture, ash and sodium are found in the processed orange juices. The protein content and vitamin C are found much in the both fresh and processed guava juices. The maximum amount of total sugar and iron are observed in the fresh litchi juices, though the high total sugar and the reducing sugar are found in processed litchi juices. Therefore, the present study suggests that the different varieties of the fresh and the processed fruit juices provide nutritional contents and important minerals which are supportive for health benefit of the individuals and the consumers of this industry.

Acknowledgements

The authors are grateful to the Chairman, Bangladesh Council of Scientific and Industrial Research (BCSIR) and Director, Institute of Food Science and Technology, Bangladesh Council of Scientific and Industrial Research (BCSIR) for providing laboratory facilities to carry out the research work.

References

AOAC (Association of Official Analytical Chemists) 2005. Official methods of analysis of the association of official analytical chemists 18th ed.Verginia, U.S.A.

Ayub M, Zeb A, Ullah J and Kattak MAK 2005. Effect of various sweeteners on chemical composition of guava slices. Sarhad J. Agric. **21**(1): 131-134.

Ezeama CF 2007. Food microbiology: Fundamentals and Applications. Natural Prints Ltd. Lagos.

Franke AA, Cooney RVS, Henning M and Custer LJ 2005. Bioavailability and antioxidant effects of orange juice components in humans. J. Agric. Food Chem. **53**(13): 5170-5178.

Hussain S, Sidddique MI, Parveen N and Parwaz NZ 1993. Effect of packaging on the quality of fruit juices based drinks. J. Anim. Plant Sci. **3**(1-2): 15-18.

Islam MA, Ahmad I, Ahmed S and Sarker A 2014. Biochemical composition and shelf life study of mixed fruit juices from orange and pineapple. J. Environ. Sci. and Natural Resources **7**(1): 227-232.

Jahan S, Gosh T, Begum M and Saha BK 2011. Nutritional profile of some tropical fruits in Bangladesh: specially antioxidant vitamins and minerals. Bangladesh J. Med. Sci. **10**(2): 95-113.

Karabiyikli S, Degirmenci H and Karapinar M 2012. The survival of *Escherichia coli* 0157:H7 and *Salmonella typhimurium* in black Mulberry (*Morus nigra*) juice. African J. Microbiol. Res. **6**(48): 7464-7470.

Kirk RS and Sawyer R 1991. Pearson's composition and analysis of foods. 9th ed. Addision Wesley Longman Ltd., England.

Nagy S, Chen CS and Shaw PE 1993. Fruit juice processing technology, Agscience, Inc., Auburndale, Florida.

Ndife J, Awogbenja D and Zakari U 2013. Comparative evaluation of the nutritional and sensory quality of different brands of orange juice in Nigerian Market. African J. Food Sci. **7**(12): 479-484 doi:10.5897/AJFS2013.1060

Rahman SA, Rahman MF, Codilan AL and Farhana K.M 2007. Analysis of the economic benefits from systematic improvements to shifting cultivation and its evolution towards stable continuous agro forestry in the upland of eastern Bangladesh. Int. For. Rev. **9**(1): 536-547.

Ranganna S 2003. Handbook of analysis and quality control for fruits and vegetables products. Tata Mc Graw-Hill Publications Company Ltd., New Delhi.

Saeed A, Shahid M, Haider SJ, Ijaj A and Saukat U 2012. Quality evaluation of different brands of tetra pack mango juices available in market. Pakistan J. Food Sci. **22**(2): 96-100.

Srivastava RP and Sanjeev K 2003. Fruit and vegetable preservation principles and practices: Important methods for analysis of fruits and vegetables and their products, 3rd ed. International Book Distribution Co., Luccknow.

Tasnim F, Hossain MA, Nusrath SMK, Lopa D and Haque KMF 2010. Quality assessment of industrially processed fruit juices available in Dhaka city, Bangladesh. Malay. J. Nutri. **16**(3): 431-438.

Zerdin K, Rooney ML and Vermue J 2003. The vitamin C content of orange juice packed in an oxygen scavenger material. Food Chem. **82**: 387-395.

(Manuscript received on 27 August, 2015; revised on 18 October, 2015)