Evaluation of Nutritive Value of Mango Juices Found in Bangladeshi Markets

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Abstract

Health valued juices extracted from various available fruits are familiar to people all over the world. Mango is an important fruit because of its abundance, taste and health value. Mango juice is made from mango extract. So, investigation of mango juice is needed for evaluation its health value by determining different types of nutritive parameter and comparative studies. Our research deals with the investigation of 8 types of mango juices of different local and foreign companies available in the markets of Bangladesh for the determination of pH, moisture content, TSS, sugar content, fat, ascorbic acid, protein, acidity and ash content. All the parameters are determined by the conventional physical and chemical methods including Floch method, Kjeldal method. This study demonstrates that mango juices contain a considerable amount of different types of these nutritive factors. The results of this study were compared to the original mango extract which will be helpful for consumers to consider the nutritional and safety of mango juices.

Key words: Acidity, Chemical methods, Conventional methods, Kjeldahl method, TSS

Introduction

Juice is the liquid that is naturally contained in fruit or vegetable tissue. Juice is prepared by mechanically squeezing or macerating fruit or vegetable flesh without the application of heat or solvents. Fruit juices are widely consumed in tropical countries as part of habitual diet and are an important source of vitamins and minerals. The consumption of fruit juices has been increasing during the last decades because of its various health benefits and consumption of fresh fruit is often replaced by the fruit juices (Liu, 2003). But the micronutrient contents of fruit juices are seldom taken into account, neither by doctors nor by dietitians when advising their patients about balanced nutrition or in case of supplementation. Primarily, this is due to the scarcity of reliable published data on this subject. Bangladesh is a land of mango. Mango is an important fruit considering its nutritional value. For example, mango juice is rich in carbohydrate, sugar, vitamin C, protein and trace metals (Jahan *et al.,* 2011). It can be one of the most popular drinks to go with breakfast in the morning. Common methods for preservation and processing of fruit juices include canning, pasteurization, freezing, evaporation and spray drying (Kulkarni *et al.,* 2012). When juices are prepared from the extract, the value of nutritive parameter are lessened by different types of juices making process and operations (Akhter *et al.*, 2012). Mangoes are most popular seasonal fruits in Bangladesh. But now a day it is alarming that various type of chemicals is mixing to mangoes to preserve it for long time. This adulteration and contamination can prove very dangerous for the development of a health community and this can lead to a number of diseases such as cancer, paralysis, mental retardation and hypertension etc (Per *et al.*, 2007). On the other hand, people are getting busier day by day and hence the demand for ready to eat food/drink is increasing rapidly. So it is safe to use mango juices instead of raw fruits. By considering all the facts, the present study was conducted to prepare new and updated information about the nutritional composition of mango juices. The authors believe that this study will help consumers purchase mango juices compare to other juices as well as aware them about the nutritional facts of these juices.

Materials and Methods

Analysis of fruit juices

Determination of TSS or Brix

The Brix is defined as a unit of measurement of Total Soluble Solids (T.S.S) 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. The Brix of all the fruit samples was determined by a hand refractometer (ranges from 0^0 to 99^0 ATAGO 9909, Japan).

Determination of moisture content

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

Moisture content (g per 100g) = (Weight of the moisture×100)/ Weight of the fruits sample.

Determination of pH

Calibration of pH meter

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

Determination method

The electrode assembled of the pH meter was dipped into the standard buffer solution of 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). The samples, chemicals and instruments used for the study are shown in Table 1.

Determination of fat

The moisture free fruit juice sample was taken in a conical flask. Chloroform, methanol mixture (1:2) solution (20ml-50ml) was added and allowed to stand for overnight and was filtered. 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 proper mixing and allowed to stand for 5-7 hours. The lower phase was then collected. The washing with NaCl was repeated till the phase was clear. Finally the lower phase was collected in a dry weighted conical flask .The fat was then estimated (Folch *et al.*, 1957). Percent (%) of fat content= (Weight of the extractive×100)/ Weight of the sample taken.

Table 1. Used samples, chemicals and instruments

Sample materials	Chemicals and reagents	Instruments and apparatus
Different types of fruit juices collected from local market	1) Fehling solution, 2) Metaphosphoric acid, 3) Dye solution, 4) Chloroform and methanol, 5) Sulfuric acid, 6) Hydrochloric acid, 7) Sodium hydro oxide, 8) Copper, 9) Different indicators, 10) Other chemicals	1) Muffle furnace, 2) pH meter, 3) Refracto meter, 4) Burner, 5) Heater, 6) Desecator, 7) Conical flask, 8) Round bottom flask, 9) Porcelain crucible, 10) Burette, Measuring cylinder, 11) Test tube, 12) Beaker, 13) Glass tube, 14) Condenser, 15) Dropper

Determination of vitamin C

Preparation of dye solution

50 gm of 2, 6- di chloro indophenols was taken and dissolved in hot water and then added 42 gm of $NaHCO_3$. The solution was cooled and then diluted the solution up to 200 ml with water. It was stored in refrigeration and standardized every day before use.

The method of determination

0.5 gm of the sample was taken. It was mixed well with 3% HPO_3 acid in a 100 ml flask and filtered with a filter paper (40). An aliquot (5ml) of metaphosphoric extract of the sample was taken and titrated with dye solution until a faint pink color present.

Ascorbic acid (vit C) = (b×c×d×100) / (e×f)

b = burette reading

c = dye factor

d = volume made up

e = aliquot of extract

f = weight of sample

Standardization of dye solution

Standard ascorbic acid solution (5 ml) or 1ml ascorbic acid solution was taken and added 5 ml of HPO_3 for titration. The solution was titrated to a pink color. Dye factor = (ml of standard ascorbic acid, ml × concentration of ascorbic acid) ml^{-1} of dye consumed. Accurately 0.25 g of the fat was taken in a flask. Fifty ml of 95% ethanol was added into the flask, and the mixture was neutralized with 0.1 N aqueous alkalis using 0.5 ml of the 1% phenolphthalein indicator. The neutralized ethanol was poured in the flask and mixed the contents of the flask. Then the solution was boiled as hot as possible titration was carried out with 0.1 N aqueous alkali solutions. The solution was shaken vigorously during the titration. The first appearance of the red coloration that did not fade within 10 sec. was considered the end point and the volume of the alkali required were recorded (British Standard Methods of Analysis of Oils and Fats, 1958).

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

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

Where, A = Volume of the alkali required.

N= Normality of the NaOH solution.

W= Weight of the sample taken in g.

Determination of acidity

10ml of juice sample was taken in a 250 ml beaker and added 50 ml water into the beaker. It was mixed properly. Then 3 drops of phenolphthalein indicator was added to the juice water solution. The solution was titrated by the standard 0.1 M NaOH. The burette reading was recorded.

Acidity = (acidity factor × reading)/ weight of sample. Where, factor = 0.0064

Determination of reducing sugar

10 ml of the sample was taken and added water to make 100 ml solution. Then 5 ml HCl was added to the mixture. Heat was applied to the solution for hydrolysis. NaOH was added to neutralize the solution. It was tested with litmus paper. Fehling solution + $CuSO_4$ (5 ml+5 ml) were taken in a beaker and titrated with stock sample solution. Reading should be above 15 ml. finally calculation of determining reducing sugar was performed by titre 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 were powered with mortar and pestle and mixed well. Concentrated HCl was used for titration. Sodium Hydroxide (40 g) was dissolved in distilled water and the volume was made up to 100ml.

Preparation of receiver solution

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

The method of determination

Digestion of the sample

The Sample (0.5-1.0 g) was taken in weighting paper and measured accurately. This Sample was poured into a 500 ml clean and dry Kjeldahl flask, to which 10gm of Digestion mixture and 12-15 ml of Conc. HCl were added .To avoid frothing and bumping , 2-5 glass beads was placed inside the flask . 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 400^0 C until the solution become colorless. At the end of digestion period, the flasks were cooled and diluted with 100 ml distilled water. A small piece of litmus paper was placed in the solution and the reaction was found to be acidic.

Distillation

The distilling set of Kjeldahl apparatus was thoroughly washed with distilled water before starting the distillation. In a measuring cylinder 60 ml if 40% NaOH was taken 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 25 ml 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 0.1 N HCl. Similarly a reagent blank was distilled and titrated. Protein content of the sample on the percentage basis was calculated by the following formula:

% of Protein (g) = {(c-b) ×14×d×6.25×100}/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

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

Percentage of Ash (g) = (weight of ash × 100)/ weight of the raw sample

Results and Discussion

This study was conducted to evaluate the quality of juices by studying their physico-chemical properties and nutritional values. Eight samples of mango juices were collected for this experiment. All the results were expressed as percentage (%) and 100g of every sample was analyzed. The study indicated that the mango juices found at Bangladeshi markets are reasonable source of carbohydrate, vitamin C and other nutritive parameters. Carbohydrate content is related to the combination of protein, fat, ash and moisture content of the samples (Pigman *et al.*, 972). The overall results are shown on table 1. From the table 1 we see that the amount of TSS was found ranged from 10.93% to 14.85%. This range is similar to the results found by Haque *et al.* (2009). Including carbohydrate and sugar the brix is related to other soluble solids like vitamins and minerals. In the present study it was found that total solids contained was inversely correlated with moisture content (83.94% to 88.87%). If the moisture content increased then the total solids content decreased and vice versa (Haque *et al., 2009*). The pH of mango juices was ranged from 3.7 to 4.1 (Table 2). The low pH of mango juices is due to the presence of nature occurring acids and the standard value of pH of mango juices is ranged from 2.8 to 5.4 (Susser, 2001). Fat present in the mango juices are in small amount. The analysis showed that the fat content was found in range of 0.050% to 0.085% whereas the standard value of fat in mango

extract is about 0.38%. Excessive fat is not good for health. So, the fat percentage was lessened in mango juices. The analysis showed that mango juices contained a reasonable amount of protein in range of 0.90 mg to 1.24 mg per 100 g sample which is less than the standard value (Narain *et al.*, 1998). The acidity of mango juices was ranged from 0.192% to 0.384%. It is related to the flavor of juices. All mango juice samples contained a good amount of sugar content. Sugar content is related to total soluble solids. The reducing sugar content of different juices was ranged from 1.21 % to 5.2 % whereas the total sugar content of mango extract is about 13.7% (Susser *et al*., 2001). Vitamin C content was ranged from of 20% to 50% whereas the standard value is 44%. Ash content of different types of fruit juices were ranged from 0.51% to 0.97% which is very much lower than standard value of 5% (Narain *et al*., 1998). Most of the samples contained small amount of ash. So, these had small amount of minerals also.

Table 2. Nutritive value of different types of mango juices

Sample	TSS (%)	Moisture (%)	pH	Fat (%)	Vitamin-C (%)	Acidity (%)	Reducing sugar (%)	Protein (%)	Ash (%)
S1	12.69	86.65	4.1	0.056	40	0.192	5.200	1.10	0.85
S2	14.73	84.54	4.1	0.050	30	0.320	4.493	0.90	0.51
S3	14.85	83.94	3.8	0.085	20	0.192	3.543	1.08	0.57
S4	12.97	85.23	3.9	0.080	30	0.192	1.524	1.15	0.89
S5	12.32	86.73	3.8	0.082	40	0.384	5.200	1.24	0.97
S6	11.17	88.87	3.7	0.083	40	0.192	1.208	0.96	0.91
S7	11.85	87.77	3.8	0.080	50	0.384	1.208	0.95	0.59
S8	10.93	88.42	4.1	0.076	30	0.256	1.074	1.05	0.70

Conclusions

In this research work, 8 different kinds of mango juices were analyzed for their nutritive and other variables. The variables include pH, moisture content, TSS, sugar content, fat, protein, acidity, ash and vitamin C content. As this work is related to nutritive parameter analysis, it suggests health benefit of mango juices. Most of the juices are contained a good amount of nutritive elements, so poor people can take it as nutritive food. These juices also have a reasonable price.

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