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Formulation and Quality Evaluation of Instant Soft Drink Powder Prepared from Hog- plum (*Spondius mangifera*) and Mint (*Mentha spicata*)

Md. Shahriar Alam[1], Md. Shakil[1*], Tasmia Bari[2], Mouluda Sohany[3], Md Faridunnabi Nayem[4]
[1] Department of Food Technology, Dhaka Polytechnic Institute, Dhaka, Bangladesh
[2] Department of Food Engineering and Technology, State University of Bangladesh, Dhaka, Bangladesh
[3, 4] Department of Food Engineering and Technology, Hajee Mohammad Danesh Science and Technology University
[1*]Department of Food Engineering and Technology, Hajee Mohammad Danesh Science and Technology University, Dinajpur, Bangladesh

Abstract
The study was designed with an intention to develop an instant drink powder from hog plum with mint and to evaluate its nutritional facts and organoleptic attributes compared to commercially available drink powder. The Instant drink powder was formulated using hog plum powder (10%, 15% and 20%) with crushed sugar and constant amount of mint, citric acid, ascorbic acid, salt and xanthan gum. The amount of ash, fiber and protein content were found to be increased, whereas carbohydrate content declined with the increasing proportion of hog plum. An upward trend was observed with the additional level of hog plum for all the estimated minerals (Ca, Na, K and Fe). In terms of heavy metals, Sn and Cd were absent, while Pd, as and Cu were found in a safe level. Microbial load analysis resulted in a safe level of Total Plate Count, where *E. coli*, Coliform, yeast and mold were not found. However, nine points hedonic rating test (ANOVA, DMRT; $p \leq 0.05$) revealed that instant drink powder with 15% hog plum achieved maximum level of appreciation as resemble as commercial drink powder.

Keywords: hog plum, mint extract, instant drink, fiber content, proximate, sensory

1. Introduction
Hog plum ("amra") is the least utilized fruit in the processing industry which belongs to the *Spondias* genus of the flowering plant family, Anacardiaceae and mostly grows in the lowland moist forest of the Amazon, all of tropical America, Nigeria, West indies and other tropical rain forests of the world [1]. In Bangladesh, hog plums are grown in the southern districts, namely Pirojpur, Jhalokathi, and Barisal [2]. The utilization of hog plum in Bangladesh includes raw with salt and chilli powder, homemade pickles, jam, and chutney [3]. Hog-plum is a healthy fruit with low in calories, high in proteins, fiber, vitamins B1, B2, and minerals. It contains noticeable amount of Vitamin C [4, 5]. Dried hog plum contains relatively a high proportion of nutrient than fresh excluding vitamin C, which is nearly half of that the value for fresh [5]. The fruit juice of hog plum functions as a diuretic and febrifuge. A tea prepared from the hog plum flowers and leaves is consumed to relieve stomach ache, biliousness, and urethritis, cystitis, eye and throat inflammations. The decoction of the astringent bark serves as an emetic as well as a remedy for diarrhea, dysentery, hemorrhoids and a treatment for gonorrhea and leucorrhea [6].

Soft drinks are immensely popular water- based sweat beverages; which are flavored by the use of natural or artificial flavored ingredients, often colored, and frequently contain a sum of fruit juice, fruit pulp or other natural ingredients, usually served cold with a balancing acidity. There are the two basic types of soft drink, one is Ready- to- drink (carbonated /Non- carbonated RTD) products and the other is concentrated (dilute- to- taste,) products. The later one includes syrups and so- called squashes and cordials [7, 8]. The higher consumption rate of soft drink is due to its distinctive taste and flavor as well as their thirst satisfying potential. Apart from taste satisfaction, soft drinks provide other nutrients such as vitamins, organic acids, phosphates, and antioxidants etc. which are beneficial for health [9]. Soft drink powder is a Ready- to- drink (RTD) powder, which is generally served with cold water. The demand for soft drink powder is extremely increasing throughout the world. Considering all perspectives, this experiment was target to formulate a well- accepted soft drink powder using hog plum (powder) and mint with the identical nutritional aspects of the regular marketed one.

2. Materials and Methods
2.1 Preparation of ingredients
The fresh, mature and spot free hog plum (Figure 1) and mint (Figure 2) were collected from Kawran bazar, Dhaka. Collected hog plum and mint were washed thoroughly with running water to eliminate foreign materials adhered to the surface. The cleaned hog plums were peeled and flesh was detached from seed to do almost equally sized slices with a sharp stainless knife. Slices were blanched with hot water for 3-4 minutes followed by cooling using cool water. The slices of hog plum were then subjected to drying in a cabinet dryer at 70ºC for 8 hours and thereafter ground to powder. Prepared powder was carefully stored in an airtight glass jar for further use to formulate soft drink powder. Clean and disease free mint leaves were blended and the juice was filtered by a muslin cloth.

2.2 Preparation of soft drink powder

Table 1 shows the formulations selected after conducting several trial to prepare soft drink powder. First of all, accurately weighed ingredients were mixed properly by slow rotation blender for 10 min and then the mixer was dried at 70^{O} C by cabinet dryer for 1 hour. Prepared soft drink powder was cooled in a humidity controlled room and then packed in the glass jar for further analysis (Figure 3).

F_1, F_2 and F_3 codes were used for denoting 10%, 15% and 20% hog plum powder, whereas F4 was for commercial drink powder.

Table 1: Formulations of soft desired drink powder

Ingredients (%)	F_1	F_2	F_3
Hog plum powder	10	15	20
Crushed sugar	87.2	82.2	77.2
Citric acid	1	1	1
Acetic acid	1	1	1
Salt	0.5	0.5	0.5
Xanthium gum	0.3	0.3	0.3
Mint extract	5 ml/100g	5 ml/100 g	5 ml/100 g

Fig 1: Photographic view of mint leaves

Fig 2: Photographic view of raw hog plum

Fig 3: Photographic view of final hog-plum instant soft drink powder

2.3 Chemical analysis of prepared soft drink powder

2.3.1 Proximate composition analysis of prepared soft drink powder

Moisture, ash, crude fat, crude protein and crude fiber were determined by AOAC method. The energy value of the samples was determined according to the formula as follows: Energy value (Kcal) = (Crude fat × 9) + (Crude protein × 4) + (Total carbohydrate × 4)

2.3.2 Determination of minerals, vitamin, beta-carotene and heavy metals

Wet ashing method was used to digest the hop plum drink powder and then atomic spectroscopy and mass spectrometry ((ICP-MS, Spectro Analytical Instruments GmbH, Germany) was conducted to determine calcium, sodium, potassium and iron according to the AOAC methods 997.15 and 990.08 (AOAC, 2005) [10]. The results were revealed in mg/100 g. All analyses were performed in triplicate. Beta-carotene was determined by the method reported by Carvalho *et al*., (2012) [11]. Vitamin C was analyzed by using titration method (Rangana, 2002) [12]. The heavy metals were determined according to the method described by Hadiani *et al*., (2014) [13] using SHIMADZU AA-6300 Graphite Furnace Atomic Absorption Spectrophotometry (GFAAS).

2.3.3 Microbial analysis of prepared soft drink powder

The microbiological quality of hog plum soft instant drink powder was determined by enumeration of total plate count (TPC) in the TGEA (Triptone Extract Glucose Agar) after incubation for 72 hours at 30°C. The plates those containing 30-300 colonies were counted for microbes and multiplied by dilution factor. Arithmetic average was counted as total plate count per gram (AACC, 2007) [14]. Desoxycholate lactose agar was used to count total coliforms incubating for 24 to 48 hours at 37^{0}C.Yeast and Mould were counted on pour plates of potato dextrose agar (PDA, Hi-Media, M 096) with 2% antibiotic (Chloramphenicol and chlortetracycline, 1: 1) and the plates were incubated at 25°C for 120 hours. The result was expressed as, weather yeast and mold growth was present or not [15].

2.3.4 Sensory evaluation of prepared instant soft drink powder

All the formulated samples were evaluated for sensory attributes in terms of taste, color, flavor and overall acceptability using a 9-point hedonic rating test with the rating scale of following: 9=like extremely, 8=like very much, 7=like moderately, 6= like slightly, 5= neither like nor dislike, 4= dislike slightly, 3= dislike moderately, 2=dislike very much and1= dislike extremely [3].

2.3.5 Statistical analysis

The statistical software program IBM SPSS Statistic 22 was used for the analysis of variance (ANOVA). Duncan's multiple Range Test (DMRT) was also employed to establish multiple comparisons of the mean values at $p \leq 0.05$.

3. Result and Discussion

3.1 Proximate analysis and energy of instant hog plum drink powder:

Proximate and energy value of formulated instant hog plum drink powder and a commercial orange drink powder are shown in Table 2. Moisture content of formulated instant hog plum drink powder was higher compared to commercial orange drink powder. The highest amount of moisture content (2.64%) was observed for F_3 among the formulated drink powders. It has been found that high amount of moisture content was retained with the increasing proportion of hog plum in drink. Among the samples, F_3 contained significantly higher amount of ash (2.09%) whereas, F_1 contained the lowest which was 1.34%. Adefemi *et al*., (2012) [16] reported that higher ash content is an indication for better source of mineral. Formulated hog plum drink powders (F_1, F_2, and F_3) were found having significantly higher amount of protein than that of commercial one (F_4).This might be due to high amount of protein in hog plum. Fiber content followed an increasing trend with the

higher addition of hog plum, where 2.18% fiber in formulation F_3 was the highest result. On contrast, fiber was absent in commercial brand (F_4). The pH values of the samples were found 3.47±0.15, 3.68±0.08, 3.78±0.08, and 3.26±0.04 respectively. pH value of F_4 was somewhat lower than that of others. However, F_3 revealed the highest pH value may be due to high amount of hog plum. Total energy value of all the formulated instant soft drink powders was significantly lower than that of commercial brand (397.76±0.24). The decreasing tread of energy values may be because of low amount of fat and carbohydrate content in the formulated samples.

Table 2: Proximate analysis and energy of instant hog plum drink powder.

Parameters	Sample			
	F_1	**F_2**	**F_3**	**F_4**
Moisture (%)	1.89±0.05^c	2.51±0.02^b	2.64±0.02^a	0.82±0.05^d
Ash (%)	1.34±0.12^c	1.77±0.13^b	2.09±0.11^a	1.75±0.04^b
Protein (%)	7.14±0.10^c	10.12±0.38^b	12.10±0.15^a	0.59±0.04^d
Fiber (%)	0.92±0.07^c	2.03±0.12^b	2.18±0.03^a	Nil
Fat (%)	0.62±0.06^b	0.69±0.04^b	0.82±0.03^a	0.55±0.02^c
CHO (%)	88.09±0.17^b	83.65±1.07^c	80.19±0.29^d	97.62±0.06^a
PH (%)	3.47±0.15^b	3.68±0.08^a	3.78±0.08^a	3.26±0.04^c
Energy (kcal/100g)	386.52±0.53^b	381.31±2.50^c	376.56±0.50^d	397.76±0.24^a

F_1-10% hug plum powder, F_2:15% hug plum powder, F_3: 20% hug plum powder, F_4: Commercial Brand (Orange). Values are Mean ± Standard Deviation; Mean values with different superscripts in a column differ significantly ($p<0.05$) from each other.

3.2 Vitamins and Minerals content of instant hug plum powder

The quantification of the minerals (Calcium, Sodium, Potassium, and iron), beta-carotene and vitamin C is interpreted in Table 3. Beta-carotene content in all the samples- F_1, F_2, F_3 and F_4 was 344.0µg/100g, 374.3µg/100g, 433.3µg/100g and 499.3 µg/100g, respectively. Such a higher amount beta carotene content of sample F_4 may be due to fortification. Among the prepared samples, the highest amount of vitamin C was found in F_3 which is significantly lower than that of F_4. It is may be due to oxidation and heat labile properties of vitamin C [3]. The calcium content in sample F_1, F_2 and F_3 was significantly higher than that of in *Spondias mombin* crude fruit juice [17]. Maximum potassium content was found in sample F_3 amounting 125.02±2.13mg/100g. Fe content was found in three samples 2.67±0.38 mg/100g, 6.03±0.50 mg/100g and 10.22±0.48 mg/100g individually. All the three formulated samples showed lower level of Ca, Na and Fe than the commercial brand (F_4) except K, which was absent in F_4.

Table 3: vitamins and minerals content of instant hug plum drink powder

Sample	Results					
	Beta carotene (µg/100g)	**Vitamin C (mg/100g)**	**Ca (mg/100g)**	**Na (mg/100g)**	**K (mg/100g)**	**Fe (mg/100g)**
F_1	344.0±6.56^d	0.27±0.02^b	79.71±3.34^d	7.49±0.45^d	74.72±2.29^c	2.67±0.38^d
F_2	374.3±6.03^c	0.33±0.03^b	106.66±1.18^c	14.77±0.25^c	95.07±1.76^b	6.03±0.50^c
F_3	433.3±6.11^b	0.37±0.02^b	119.65±2.39^b	24.7±0.44^b	125.02±2.13^a	10.22±0.48^b
F_4	499.3±6.02^a	120.3±2.5^a	167.69±2.34^a	29.18±0.55^a	Nil	11.20±0.66^a

F_1: 10% hug plum powder, F_2:15% hug plum powder, F_3: 20% hug plum powder, F_4: Commercial Brand (Orange). The results were expressed as
Mean ± Standard Deviation and the values with different superscripts in a column differ significantly ($p<0.05$) from each other

3.3 Heavy metal content in the formulated Hog plum soft drink powder

Heavy metal content in the formulated instant soft drink powders was found in ascending trend with the incorporation of hog plum powder (Table 4). Maximum amount of Lead (Pb), Arsenic (As) and Cupper (Cu) was found in F_3 amounting 0.114±0.003, 0.182±0.002 and 0.894±0.004 respectively and Cadmium (Cd) and Tin (Sn) were absent. All the results of heavy metals indicated safe level as Ray *et al* (2010) [18], who reported that the safe values for Lead (Pb), Cadmium (Cd), Cupper (Cu) and Chromium in fruits and vegetables are 0.3mg/kg, 0.2mg/kg, 2.3mg/kg and 40mg/kg based on WHO/FAO recommendation. According to Bangladesh Standards (BDS1586:2007) maximum limits for heavy metals in soft drink powder are 2 mg/kg, 0.1 mg/kg, 0.2 mg/kg, 0.1 mg/kg and 25mg/kg for Copper (Cu), Cadmium (Cd), Lead (Pb), Arsenic (As) and Tin (Sn) respectively. The possible sources of heavy metals in the formulated soft drink powders are due to the presence of hog plum and mint.

Table 4: Heavy metal content in the formulated Hog plum soft drink powder

Sample	Pb (mg/kg)	Cd (mg/kg)	As (mg/kg)	Cu (mg/kg)	Sn (mg/kg)
F_1	0.062±0.003^c	Absent	0.122±0.003^c	0.326±0.005^c	Absent
F_2	0.082±0.035^b	Absent	0.158±0.004^b	0.568±0.004^b	Absent
F_3	0.114±0.003^a	Absent	0.182±0.002^a	0.894±0.004^a	Absent

F_1: 10% hug plum powder, F_2:15% hug plum powder, F_3: 20% hug plum powder. The results were expressed as Mean ± Standard Deviation, and the values with different superscripts in a column differ significantly ($p<0.05$) from each other.

3.4 Microbial evaluation of the hog plum instant powder drink

Microbiological features are indicators of safety, quality and shelf life of prepared instant hog plum drink powder. Total plate count, E. coli, Coliform, yeast and mold count of the instant hog plum drink powders were determined on the same day of preparation. The obtained results are represented in Table 5. The average total plate count (microbial load) indicated the existence of microbes in all the formulations which was within the range of 0.8×10^2 to 1.1×10^2 CFU/g. This continuation of proliferation of microbes might be because of using unsterilized raw materials.

However, the microbial load in formulated powder was within the safety limit as maximum limit for total plate count is 1×10^3 CFU/ml (Bangladesh Standards, BDS 1586:2007). In addition, low pH of drink powder could be expected to prevent further growth and proliferation of microbes [7]. It is important to note that coliform; E. coli, yeast and mold were not present in the formulated drink powder. Mohammed *et al.,* 2017 [19] reported that *E.coli* counts of 100 CFU/gm. or greater are considered being unsatisfactory for ready to-eat food based on Health Protection Agency (HPA, 2004). He also added that the International Commission on Microbiological Specification of Food set a standard for *coliform;* count of less than 10^2 CFU/g based on above study it can be recommended that the developed instant hog plum drink powder was processed under hygienic conditions and safe for human consumption.

Table 5: Microbial evaluation of the hog plum instant drink powder

Sample	Total Plate Count (CFU/g)	E. Coli	Coliform	Yeast and Mold
F_1	0.8×10^2	Not Detected	Not Detected	Not Detected
F_2	1×10^2	Not Detected	Not Detected	Not Detected
F_3	1.1×10^2	Not Detected	Not Detected	Not Detected

Where, F_1: 10% hug plum powder, F_2:15% hug plum powder, F_3: 20% hug plum powder and F_4: Commercial Brand (Orange). The results were expressed as Mean ± Standard Deviation and the values with different superscripts in a column differ significantly ($p<0.05$) from each other.

3.5 Sensory evaluation of instant hog plum powder drink.

The sensory scores for color, taste, flavor and overall acceptability of the developed instant hog plum drink are displayed in Table-6. In the case of color, there is no significance difference ($P<0.05$) between the formulation F_2 and F_3 and both formulations were similarly appreciated by the panelists. As shown in Table-6, F_4 (commercial brand), ascertained the highest score (8±0.67) and F_1 secured the lowest score (4.20±1.20) for color, which may be due to the application of artificial color in sample F_4.

In case of taste preference, there was significant difference among the samples F_1, F_2 and F_3, where no significant difference between F_2 and F_4. F_1 secured the lowest (4.30±1.05) value whereas consumers highly preferred F_2 with the highest score (7.20±0.63) among the prepared samples. In the case of flavor preference there was no significant difference between the two formulations F_2 and F_4, securing score (7.20±0.63) and (7.60±1.6) respectively and both were ranked "Like very much" together. In terms of overall acceptability, no significant difference ($P<0.05$) was found between the formulations F_2 and F_4, securing the highest score (7.60±0.84) and (7.70±0.48) respectively.

From this sensory evaluation, it is found that formulation F_2 obtained the highest score among the formulated samples for all the attributes and was highly accepted by the panelists. All the sensory attributes for F_2 were scored almost similar to the commercial one (F_4).

Table 6: Sensory evaluation of instant hog plum drink

Sample	Color	Taste (mouth feel)	Flavor	Overall Acceptability
F_1	4.20 ± 1.20^c	4.30 ± 1.05^c	4.10 ± 1.19^c	4.00 ± 0.82^c
F_2	6.40 ± 0.84^b	7.00 ± 1.05^a	7.20 ± 0.63^a	7.60 ± 0.84^a
F_3	7.10 ± 0.88^b	5.70 ± 0.87^b	6.40 ± 0.84^b	6.40 ± 1.08^b
F_4	8.00 ± 0.67^a	6.70 ± 0.82^{ab}	7.60 ± 1.60^a	7.70 ± 0.48^a

F_1: 10% hug plum powder, F_2: 15% hug plum powder, F_3: 20% hug plum powder, F_4: Commercial Bran (Orange). The results were expressed as Mean ± Standard Deviation and the values with different superscripts in a column differ significantly ($p<0.05$) from each other.

4. Conclusion

This study was carried out to prepare a soft drink powder from hog plum powder and mint. The effect of hog plum powder on nutritional and sensory aspects of the prepared drink powders was also evaluated and compared with one commercially available brand. Formulated drink powder (F_1, F_2 and F_3 with 10%, 15% and 20% respectively) was found containing high amount of protein and fiber, but fewer amounts of minerals than that of commercial brand. Sample F_2 was mostly preferred by the panelists and it secured similar scores to that of commercial brand. Prepared samples were found safe for human consumption considering microbial count and heavy metals content. Therefore, taking into account all the mentioned viewpoints, hog plum instant drink powder could have the potentiality for commercial production.

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