COMPARATIVE STUDY OF PHYSIOCHEMICAL PROPERTIES OF CHIRONJI (*Buchanania lanzan*) GUM AND BAHERA (*Terminalia bellerica*)gum

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Abstract
Manyexudate gums fromplants have been discovered by Scientists in the past few years. These are natural gums which are secreted by plants and solidify when exposed to air and sunlight. These gums vary in properties showing their diverse use. Thus, a comparative study was done by identifying various physiochemical properties of Chironji and Bahera gum. The moisture content of Chironji gum was11.82%while that of Bahera gum was found to be 12.64%. Ash content in Bahera gum was approximately 15 times higher than that of Chironji gum. Protein content in Chironji gum and Bahera gum was found to be 1.12% and 0.19%, respectively.Fat content of Chironji gum was 0.02% while that of Bahera gum was 0.41%. The carbohydrate content in Bahera gum is less than that of Chironji gum.The angle of repose obtained for Chironji and Bahera gums was 26.35° and 29.57°, respectively. The bulk density of Bahera gum was found to be comparatively lesser than Chironji gum. Similarly, compressibility of Chironji gum was higher than Bahera gum.The Hausner index of Bahera gum was lower than Chironji gum.
Keywords: *Chironji gum, Bahera gum, physicochemical properties*

Introduction

A large number of plant gum exudates have been discovered in the last few decades. These natural gums, secreted by trees and shrubs, solidify upon exposure to air and heat of the sun which hardens them into different shapes including tears, semisolid nodules and lumps (Bashir and Haripriya, 2016).It is evident from earlier studies that exudate gums are safe for human consumption as being used as pharmaceutical substances or as food additives in addition to other industrial uses (Mahfoudi *et al*., 2012).They vary in their physicochemical properties to a great deal which is due to source specificity and most importantly governed by discrepancy of agro-climatic conditions. Physical properties like bulk density, tapped density, porosity, wettability, particle size and their distribution are the indicators that determine the quality of powders (Mirhosseini *et al.,* 2013).*Buchanania lanzan*commonly known as Chironji belongs to family Anacardiaceae. The tree is wild and found in the tropical deciduous forests of northern, western and central India, mostly in the states of Chhattisgarh, Jharkhand, Madhya Pradesh and in Varanasi and Mirzapur districts of Uttar Pradesh. Besides India, the plant is also found in other tropical Asian countries, Australia and Pacific islands (Siddiqui *et al.,* 2016).Chironji gum is reported to have various medicinal and culinary uses and hence, it is important to calculate its various physiochemical properties.The plant *Terminalia bellerica*, locally named as Bahera, is a medicinal plant.Bahera gum is soluble in warm alkaline water, which confirms its polysaccharide nature. But not much has been done regarding determination of its various properties. Hence, a work was undertaken to evaluate physicochemical properties of Chironji and Bahera gums.

Materials and methods

Raw exudate gums of *Buchananialanzan* (Chironji) and *Terminalia bellirica* (Bahera) were procured for determination of various properties.

Physiochemical analysis

Chemical composition

Moisture Content

Moisture content of Chironji and Bahera gums was determined by following the standard AOAC, 1999 method. The moisture content of the samples was thereafter calculated using the following formula:

$$Moisture(\%) = \frac{(W1 - W2)}{W1} * 100$$

Where, W1= Weight (g) of sample before drying
W2= Weight (g) of sample after drying

Fat

Fat content of the samples was determined by employing solvent extraction using Soxhlet extraction unit.

$$Fat(\%) = \frac{Extracted fat}{sample weight} * 100$$

Total Ash

Total ash content was determined as the total inorganic matter by incineration of the sample at 600ºC.

Protein content

Total nitrogen content (N2)was determined by the Kjeldahl methodand protein content was estimated by multiplying the nitrogenvalue by 6.25 (Jahanbin*et al*., 2012).

Total carbohydrate content

10 mg of pure freeze-dried gum samples was hydrolyzedby heating at 120°C for 3 h with 1 ml of 2 M trifluoroacetic acid(TFA, CF_3COOH) in sealed tubes. Excess acid was removed by flashevaporation on a water bath at a temperature of 40°C and codistilledwith water (1 ml x 3). The hydrolyzed products werereduced with $NaBH_4$ (50 mg) and filtered through a 0.45 mm filter,and 0.02 ml of the samples was injected into the HPLC column.Acetonitrile-water(80:20 v/v) was used as the solvent at a flow rate of 2 ml min^{-1}.A refractive-index detector was used, and the column oventemperature was 30°C. Monosaccharides were identified bycomparing their retention times with the following sugar standards:D-mannose, L-rhamnose, D-galactose, D-xylose, D-arabinoseand D-glucose. They were quantified according to their percentagearea, obtained by integration of the peaks(Jahanbin *et al*., 2012).

Determination of physical properties

Angle of repose

The static angle of repose, a, was measured according to the fixed funnel and free-standing cone method as described by Emeje*et al*., 2008.

Bulk and tap densities

Bulk and tap densities were determined according to the method described by Emeje *et al*., 2008.

Hausners index

This was calculated as the ratio of tapped density to bulkdensity of the samples (Emeje *et al*., 2008).

Compressibility index (C%)

This was calculated using the equation (Emeje*et al*., 2008):
Compressibility = (Tapped density − bulk density)/Tappeddensity × 100.

Results and discussions

Physicochemical analysis

Chemical analysis

Table 1 shows the various chemical composition of Chironji gum and Bahera gum, respectively. The moisture content of Chironji gum was11.82%while that of Bahera gum was found to be 12.64%.Moisture content is inversely proportional to shelf life. The lesser the moisture content, more is the self-stability of gum(Bashir and Haripriya, 2016). Ash content denotes the presence of inorganic mater in the sample which includes mineral content and heavy metals. Ash content of Chironji gum and Bahera gum significantly differed from each other. Ash content in Bahera gum was approximately 15 times higher than that of Chironji gum which clearly shows the presence of higher inorganic matter in Bahera gum. Protein content in Chironji gum and Bahera gum was found to be 1.12% and 0.19%, respectively. This shows that Chironji gum has 6 times more protein content as compared to Bahera gum and hence has higher emulsion stability (Gashua *et al.,* 2015). Fat content of Chironji gum was 0.02% while that of Bahera gum was 0.41% which clearly suggested that the fat content of the latter is 20 times higher than the former.The difference in composition shows marked difference in chemical properties of gums. However, the composition of both gums is within the specified range set by the FAO, WHO, Joint Expert Committee for Food Additives (JECFA) and accepted by Codex Alimentarius(Phillips *et al*., 2008).

Table 1 Chemical analysis of Chironji and Bahera gums

Analysis	Chironji gum	Bahera gum
Moisture (%)	11.82±0.00	12.64±0.18
Nitrogen(%)	0.18±0.03	0.03±0.00
Protein (%)	1.12±0.02	0.19±0.00
Fat (%)	0.02±0.04	0.41±0.03

Carbohydrate analysis and monosaccharides composition

Exudate gums contain carbohydrates as a major part of their composition. The carbohydrate content in Bahera gum is less than that of Chironji gum. Moreover, gum kondagogu and Karaya gum have carbohydrate content of 71% and 77%, respectively (Janaki *et al.,* 1998).Cheronji gum shows a higher amount of total carbohydrate content corroborating with earlier studies on exudate gums. It was observed that chironji gum was composed of arabinose, galactose, rhamnose and glucuronic acid, while, bahera gumwas mainly composed of mannitol, glucose, fructose, galactose, rhamnose, galloyl glucose. The compositional difference in the polysaccharide chain of gums is responsible for showing different functional and thermal properties of these gums.

Analysis of physical properties

Table 2 shows the various physical properties of Chironji and Bahera gums, respectively, which includes angle of repose and density. Table 3 shows the colour of gums at various concentrations.

Angle of Repose

The angle of repose of a granular material is the steepest angle of descent or dip relative to the horizontal plane to which a material can be piled without slumping. At this angle, the material on the slope face is on the verge of sliding. The higher the angle of repose, greater is the ease of flowability of the material. The angle of repose obtained for Chironji and Bahera gums was 26.35° and 29.57°, respectively. The higher value of angle of repose of Bahera gum compared to Chironji gum indicates its higher flowability.

Density

Bulk and tap density values of the powdered samples mainly have an influence on packing, storage and flowability. Particle size distribution and moisture content of a powdered sample are the determining factors for bulk and tap density, with influence packing, storage and flowability (Koc *et al.,* 2014). The combination of small and large particles helps to increase the bulk density and leads to a uniform distribution by reducing the interparticle spacing. The results indicate that there was a significant difference in bulk and tap densities of Chironji and Bahera gums (Table 2). The bulk density of Bahera gum was found to be comparatively lesser than Chironji gum. The lower bulk density of Bahera gum could be due to its higher moisture content and uniformity in particle size than that of Chironji gum. Uniformity in particle size led to more gaps in two particles due to the absence of smaller particles to fill it. Similarly, compressibility of Chironji gum was higher than Bahera gum. The Hausner ratio, indicates flowability of the powder. The Hausner index of Bahera gum was lower than Chironji gum.

Table 2 Physical properties of Chironji and Bahera gums

Analysis	Chironji gum	Bahera gum
Angle of repose (°)	26.35±0.04	29.57±0.05

Conclusion

Both chironji and bahera gums differed in their physicochemical properties. The gums fulfil the physicochemical regulations set by JECFA.

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