PHYSICOCHEMICAL PROPERTIES OF *Khaya grandifolia* (OGANWO) EXUDATE GUM

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Abstract

Khaya grandifolia exudates gum was extracted locally from the stem of the plant. Qualitative identification test and some physicochemical properties were evaluated. The parameters evaluated for the physicochemical data of the gum power include; Appearance (white), moisture (9.21 ± 0.24%), Ash value (2.23 ± 0.15%), Nitrogen content (0.56 ± 0.03%), Protein (3.51 ± 0.03%), fat content (40.30 ± 0.10%). The percentage of the natural elements present in the gum like calcium (0.60 ± 0.01%), Magnesium (8.45 ± 0.01%), Iron (0.38 ± 0.02%), Zinc (0.06 ± 0.01%), Copper (0.02 ± 0.016%), Lead (0.02 ± 0.015%), Potassium (18.59 ± 0.09%), Sodium (3.14 ± 0.10%), were determined using atomic absorption spectrophotometer except Na, and K (Flame photometer was used). The gun has substantial amount of potassium, magnesium and sodium. The functional properties revealed that the gum has water and oil absorption capacities of 3.01 ± 0.03% and 20.0 ± 0.10 respectively, the least gelation capacity of 6.0 ± 0.20% and foaming capacity of 8.0 ± 0.01%.

Keywords: physicochemical, metals, functional, *Khaya grandifolia* gum.

Introduction

Substances frequently called gums are hydrocarbons of high molecular mass that give viscous solution at low concentration. Recently, the term "gum", as technically employed in industry refers to plant or microbial polysaccharides and their derivatives that are capable of forming dispersions in cold or hot water, and producing viscous mixtures or solution. Gums are also referred to as soluble cellulose derivatives and those derived from the modification of other polysaccharides that in their natural form would be insoluble (Raquel da Silveira *et al* 2002). Gums are soluble in water, either dissolving or swelling, but they are insoluble in alcohol and ether. They may come from stems (e.g. gum Arabic), seed (e.g. locust bean) and microbial growth (e.g. Xanthan gum).

It is very evident that gums have very vast application in pharmaceutical and food industries, as a result of this, there is increasing in demands for gums globally, which causes the increase in prices of the existing gums in the local and international market. For the price to be stable and less expensive there is need to look for alternative or discoveries of more suitable natural gums which will be of the same quality or even surpass the existing ones.

Khaya grandifolia is an example of lesser known plant producing gum. The gum is bark exudates from mahogany tree, which belongs to the family "meliaceae", and are very common in many tropical and subtropical countries of West Africa and some part of South America. (Odeku.and Itiola, 2003).

However, *Khaya grandifolia* exudates gum has not been utilized due to lack of information about the quality and properties of the gum produced from it.

It is therefore, the aim of this work to provide the information about the nutritional values, the metal composition and the functional properties of the gum.

Materials and method

Source of sample

The gum was obtained from *Khaya grandifola* plant stem found at the botanical gardens of Forest Research Institute of Nigeria (FRIN), Ibadan, Nigeria. Some matured *Khaya grandifolia* trees were wounded to allow the exudates to come out. The gum exudates were collected and sundried, ground and well pulverized in a milling machine to obtain a powdery sample. This powdered sample was then used for all the analyses.

Identification test

Identification test listed for gum by FAO (1991) and AOAC (1984) were applied for *Khaya grandiflolia* gum.

Proximate analysis

Moisture contents were determined by drying to constant weight at 105°C. Total ash contents were established by ashing at 550°C (in a muffle furnace) to constant weight (AOAC, 1984). The ash obtained was dissolved in dilute hydrochloric acid and the mineral content was analyzed by atomic absorption spectrophotometry (Perkin Elmer model 238, U.S.A) Potassium and Sodium were estimated by flame photometry.

Nitrogen contents of the gums were determined by kjeldahl method (AOAC, 1984), Protein content was calculated using the conversion factor 6.25. Tannins were extracted in 1% hydrochloric acid in methanol and estimated by the Folin – Denis method (AOAC, 1984).

Fibre content was estimated by AOAC method (1984) with a modification, i.e. centrifugation was used to separate soluble and insoluble fibre fractions.

Functional properties

The least gelation concentration, water and oil absorption and foaming capacities were determined using Xu and Diosady (1994) method. Foaming capacity and stability were determined by the method of Nath and Rao (1981). The foam height and volume of liquid collected at the bottom of the cylinder were measured at 30 minutes intervals over a 12.0 minutes period.

Results and discussion

Khaya grandifolia exudates gum was subjected to qualitative identification test developed specifically for exudates gums by FAO (1991). *Khaya grandifolia* gum is similar (Table 1) to gum Arabic except with potassium hydroxide and neutral lead acetate, where the latter gave faint yellow and no precipitate respectively (Glicksmann 1969). *Khaya grandifolia* gum gave no colour change with 10%potassium hydroxide solution; makes it resemble *ghatti* and *karaya* gums.

The physical appearance of *Khaya grandifolia* gum was observed to be white, this falls within the range of exudate gums (Glicksmann; 1969). The proximate composition of *Khaya grandifolia* gum (Table 2) has a moisture content of 9.21 $\pm$ 0.24% which is low compared to acacia gum – 13.8% (Mhinzi and Mrosso, 1995). *Kondagogu* 15.25%, *karaya* 16.52% (Janaki and Sashidhar, 1998). This implies that exudate gums obtained from *Khaya* grandifolia has smaller amount of water content which is favourable to food designers and manufacturers because there will be reduction in the growth of micro-organism on the finished products (Scott Hegenbart, 1991).

Table 1: Qualitative identification of *Khaya_grandifolia* exudate gum.

Test	Observation
Physical appearance;	white.
Solubility in water;	Soluble.
Alcohol precipitate (95%); Non-adherent precipitate;	very fine flocculants.
Swelling by ethanol solution;	positive.
Potassium hydroxide;	Negative (No physical change).
Neutral lead acetate; 20% solution;	voluminous precipitate.
Neutral ferric chloride 5 % solution;	precipitate solution in excess.

Table 2: Proximate composition of *Khaya grandifolia* gum exudates.

Parameters	Percentage (w/w)
Moisture	9.21 ± 0.24
Ash	2.23 ± 0.15
Nitrogen	0.56 ± 0.03
Protein	3.51 ± 0.03
Fat	0.72 ± 0.02
Crude fibre	40.30 + 0.10

Mean of 3 determinations ± SD.

The ash content of *Khaya grandifolia* exudates gum was 2.23 ± 0.15%, which is low, compared to that of acacia gum; 4.2% (Mhinzi and Mrosso, 1995), karaya; 5.2%, and kondagogu; 7.3% (Janaki and Sashidhar 1998) but higher than that of cashew gum (0.95%) (Raquel da Silveira *et al* 2002). The nitrogen content was found to be 0.56 ± 0.03% which is higher than that of acacia gum – 0.44% (Mhinzi and Mrosso 1995), karaya 0.20% (Janaki & Sashidhar, 1998) but lower than that of kondagogu gum 1.0% (Janaki and Sashidhar 1998). Protein content of *Khaya grandifolia* gum was found to be 3.51 ± 0.03%, an amount that is higher than that of cashew gum exudates 0.5% (Raquel de silveira *et al;* 2002), Acacia gum; 2.75% (Mhinzi and Mrosso, 1995), karaya; 1.2% (Janaki and Sashidhar; 1998). This shows that *Khaya grandifolia* gum is a good source of protein. The amount of fat in *khaya grandifolia* gum was found to be 0.72 ± 0.02%, which is higher than that of cashew gum exudates – 0.06% (Raquel da Silveira *et al;* 2002). This value is lower than that of *Irvingia gabonensis* (Ogbono), 68.2% (Ejoh and Mbiapo 1996).The crude fibre content was found to be 40.30 ± 0.10% which is higher than that of *Irvingia gabonensis* (Ogbono); 5.3% (Ejoh and Mbiapo, 1996) cashew gum exudates; 0.95% (Raqued da Silveira *et al* 2002).

The level of metals such as Ca, Mg, Fe, Zn, Cu, Pb, K and Na in *Khaya grandifolia* gum exudates are summarized in Table 3.

Table 3: Metallic composition of *Khaya grandifolia* exudates gum.

Metals	Percentage (w/w)
Ca	0.60 ± 0.01
Mg	8.45 ± 0.10
Fe	0.38 ± 0.02
Zn	0.06 ± 0.01
Cu	0.02 ± 0.016
Pb	0.02 ± 0.015
K	18.59 ± 0.090
Na	3.14 + 0.10

Mean of 3 determinations ± S.D.

Calcium content of the gum was found to be 0.60 ± 0.01% which is lower than that of kondagogu – 2.01 ± 0.19%, karaya – 1.16 ± 0.19% (Janaki and Sashidhar 1998) but higher than that of *Irvingia gabonensis* 0.116 ± 0.010% (Ejoh and Mbiapo 1996).

Magnesium content of *Khaya grandifolia* gum was 8.45 ± 0.10% which is very high compared to acacia gum – 0.17% (Mhinzi and Mrosso 1995) *Irvingia gabonensis* – 0.014 ± 0.009% (Ejoh and Mbiapo 1996) cashew gum exudates – 0.14% (Raquel da silveira *et al;* 2002).

Iron (0.38 ± 0.02%), Zinc (0.06 ± 0.01%), Potassium (18.59 ± 0.90%), Copper (0.02 ± 0.015%) and Sodium (3.14 ± 0.10%) contents of *Khaya grandifolia* gum were higher than *Irvingia gabonensis* (Ejoh and Mbiapo 1996), kondagogu and karaya (Janaki and Sashidhar 1998). The functional properties of *khaya grandifolia* are given in Table 4.

The water and oil absorption capacities are generally lower than the legume seed flours and their protein concentrates, for example *Mucuna sloanei* seeds has 100% and 130% water and oil absorption capacity respectively (Yusuf *et al* 2003). Foaming capacity and least gelation capacity is shown to be 8.0 ± 0.01 and 6.0 ± 0.20 respectively.

Table 4: Functional properties of *Khaya grandifolia* exudates gum.

Parameters	Percentage
Water Absorption capacity	30.1 ± 0.03
Oil Absorption capacity	20.0 ± 0.10
Least Gelation capacity	6.0 ± 0.20
Foaming capacity	8.0 + 0.01

Mean of 3 determinations ± S.D.

In Table 5, the foaming stability was given as a function of time. The foam volume (4%) of *Khaya grandifolia* gum over 120 minutes, decreased more than that of glycine max flour which has 12% (Jane *et al* 1995). But *khaya grandifolia* gum has the same foam volume as *Afzelia africana;* 4% (Jane *et al;* 1995). The foam volume was 4% at 30 minutes and was stable throughout the 120 minutes duration.

Table 5: Foaming capacity of *khaya grandifolia* gum.

Time (mins)	% Volume change
0	8
10	6
30	4
60	4
90	4
120	4

In conclusion, nutritional values, metal composition and functional properties of the gum as outlined in this work suggest its usefulness in food designing, manufacturing and formulation. However, reologyical properties and toxicological test need to be carried out in order to ascertain the gum safety.

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