Purification Of Cashew Gum from Tree Bark Contamination

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ABSTRACT

Pure cashew gums as well as cashew gum contaminated with cashew bark were subjected to oxidation in order to determine the amount of oxidant they consumed. Hydrogen peroxide was the oxidant of choice because its reaction products are water and oxygen. It was observed that while the pure gum consumed a few amount of the oxidant, the dirty gum consumed substantial amount of the oxidant. This preliminary result shows that the oxidant is a promising material for use as cashew gum decontaminant.

Keywords: Cashew Gum, Oxidation, Hydrogen Peroxide.

Introduction

Substances frequently called gums are hydrocarbons of high molecular mass, others are petroleum products, synthetic polymeric gums, balms and resins. 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, producing viscous mixtures or solution (Azeez *et al;* 2005).

Cashew tree, *Anacardium occidentale* (Anderson and Bell; 2009) is a tree that can grow up to 10m tall. The plant is native to North-Eastern Brazil and grows in many tropical and sub-tropical countries. In China, the plant is found mostly in cashew growing areas such as Sampa, Wenchi, and Bole where they are commercially cultivated for the utilization of the nuts (Kwabena *et al;* 2010). However, it can also be found in China, India, Mozambique, Tanzania, Kenya and Nigeria among other countries.

The gum exudates are gums obtained as a result of cashew tree bark injury or found at the bark of the tree naturally. They are normally collected as air dried droplets. It is mainly composed of three types of galactan units within the core, linked by C – 1 and C – 3; C – 1 and C – 6 and C – 1, C – 3 and C – 6. The glucose is present as a side chain with up to five units long (Gyedu *et al;* 2007). The gum is characterized as a hetero-polysaccharide containing galactose (70%), glucose (11%),

arabinose (5%), rhamnose (6%), mannose (1%) and glucuronic acid (7%). The colour of cashew gum varies due to the presence of impurities and the age of the tree plant that is tapped. The pure colour of cashew gum is white and those containing impurities are yellow while some are black in colour (Hart and Shutra; 1980). Generally, gums have no odour and may be tasteless. However, some are slightly sweet because of the presence of glycerine. The presence of water and contaminants in the gum left for few days closed made the gum smell dusty (Clicksman *et al*; 1969). Pure cashew gum dissolves in water and other solvents. The impure gums contain water insoluble matter which settles on top the gum when dissolved in water (Clicksman *et al;* 1969).

Cashew gum which is exudates from *Anacardium occidentale* has been found to have many lucrative possibilities for industrialization. The act of its use began in China reaching its climax of development during the period of 1368 – 1644 AD (Clicksman *et al*; 1969). The gum has been studied widely for various pharmaceutical applications as it is inexpensive, non – toxic, biodegradable and possess appropriate physicochemical characteristics. It has been suggested for use as an agglutinant for capsule and pills in place of gum Arabic in the pharmaceutical and cosmetic industries and in food industries as a stabilizer of juices. It shares similar characteristics as gum Arabic and can be used as substitute of liquid glue paper. The gum was employed as a binder in lactose – based tablet formulations containing tartrazine dye where the tablets produced were shown to exhibit good hardness and friability properties. It has also recently been utilized as a binder in paracetamol tablet formulations where the gum imparted better mechanical properties to the tablet than povidone or gelatine (Kwabena *et al*; 2010). It can also be utilized in the making of cashew wines. The gum extraction represents one more source of revenue for the producer in addition to the cashew nut (Azeez *et al*; 2005). It is used primarily in industrial application for binding books, as adhesives for envelopes, stamps, and posters. It is also used as an additive in the manufacture of chewing gum because of its thickening power. It is used as a jellying agent in canned food and jellies for fruit jam. Cumulatively, it possesses good physicochemical properties and high level of minerals. Therefore, it can be used in meal replacers, nutritional beverages and weight – loss products. Health conscious consumers demand natural ingredients and hence, this offers cashew gum tremendous potential.

Considering the enormous potentials of the applicable areas of the gum, it is natural to explore the possibility of improving the productive output of the tree as well as maximizing the purity of the gum exudates in order to be able to justify the call for process feed diversion from gum Arabic to cashew gum(Anderson *et al*; 2009).

Materials And Method

Sample collection

The gum samples were collected from Ago-Ajayi, Oba-Akoko, Ondo state. A set of gum sample was produced from cashew tree by stripping the bark of the tree. As the gum flow down in drops they were collected in a clean container. This was designated as pure cashew gum (PCG). The dried gum samples that was harvested from the tree bark was designated as dirty cashew gum (DCG). Production of these gum vary from time to time as a result of weather condition, labour' strikes, natural disaster e.t.c. (Dickson and Benneh; 1998).

Sorting of exudates from dirt and tree bark

The gum exudates collected were sorted to remove pieces of tree bark and foreign matters and dried to constant weight at 30^0 C for 6 hours.

Grinding and milling of sorted and dried exudates

The dried and clean samples were grinded and milled with a Ken wood domestic blender to pass 2.5mm sieve size mesh.

Reagents

2% $^{w}/_{v}$ starch indicator, 12.12% $^{w}/_{v}$ KI, 2.48% $^{w}/_{v}$ $Na_2S_2O_3.5H_2O$, 2.14% $^{w}/_{v}$ KIO_3,Hydrogen peroxide (H_2O_2) and Concentrated H_2SO_4

Preparation Of Bench Reagents

2% $^{w}/_{v}$ Starch indicator:

2.0g of starch indicator was weighed and dissolved in little quantity of distilled water and heated gently until translucent

2.48% $^{w}/_{v}$ $Na_2S_2O_3.5H_2O$:

24.8g of $Na_2S_2O_3.5H_2O$ was weighed and dissolved in 1000ml volumetric flask and made up to the mark.

2.14% $^{w}/_{v}$ KIO_3:

2.14g of KIO_3 was weighed and dissolved in 100ml volumetric flask using distilled water and the solution was made up to the 100ml mark.

$IO^-_3 + 8I^- + 6H^+ \longrightarrow 3I^-_3 + 3H_2O$ ..... (i)

$2S_2O_3^{2-} + I^-_3 \longrightarrow S_4O_6^{2-} + 3I^-$ ..... (ii)

Since $I^-_3 \equiv 2S_2O_3^{2-}$

And $IO^-_3 \equiv 3I^-_3$

Therefore, $IO^-_3 \equiv 6S_2O_3^{2-}$ ..... (iii)

Control solution

5ml of H_2O_2 was measured into 100ml volumetric flask and made up to the mark with distilled water. 1ml of the solution was measured into a clean 250ml beaker and acidified (i.e. 2 drops of conc. H_2SO_4). Then 10ml KI was added and the solution was titrated against $Na_2S_2O_3.5H_2O$ solution in the burette. Towards end point 2 drops of starch indicator was added and the titration continue till the end point. These steps enable us to evaluate the concentration of H_2O_2 as well as the volume that was consumed by the various samples.

Preparation of gum solution

1g of pure cashew gum (samples A) and dirty cashew gum (sample B) were weighed each into five 100ml beakers (labelled A_1 to A_5 and B_1 to B_5) respectively. The samples were then transferred into 100ml volumetric flask quantitatively by rinsing with 20ml of distilled water.

solution was obtained. The solution was then transferred into 100ml volumetric flask and the solution was made up to the mark with distilled water.

12.12% $^{w}/_{v}$ KI:

30.3g of KI was weighed and dissolved in 250ml volumetric flask using distilled water and the solution was made up to the mark with distilled water.

Standardization of the $Na_2S_2O_3.5H_2O$

25ml of the 0.1M KIO_3 prepared was transferred, using a pipette, into a clean conical flask. Two (2) drops of starch indicator and an excess amount of KI were added. The solution was then titrated against $Na_2S_2O_3.5H_2O$ in the burette using starch indicator using the stoichiometric relationships below:

To the above samples were added 5ml of H_2O_2 each. The gum samples were each made up to 100ml mark with distilled water after it had been thoroughly shaken to ensure uniformity of the solution. After dissolution, the solutions were each filtered into 100ml beaker through a glass wool in a separating funnel.

Preparation of samples of gum solution for volumetric analysis

1ml of each solution was measured separately into a clean 250ml beakers, acidified with 2 drops of concentrated sulphuric acid. 10ml of potassium iodide was added into each solution as well. The solutions were respectively titrated against standardized solution of $Na_2S_2O_3$ solution. As the end points were approached, 2 drops of starch indicator were added and titration continued to the end point.

Timing of the reaction

Addition of KI and conc. H_2SO_4 was timed to reflect the various time chosen for the volumetric titrations.

Results And Discussion

The results displayed in Fig.1 showed that at time zero (i.e. just before the addition of 1ml of the various gum solutions), the volume of hydrogen peroxide was 5ml, but as time progressed; the difference in the volume of peroxide consumed by the various types of gum solution became obvious. The dirty gum was found to consume more of the peroxide. This shows that the dirty gum contained more of contaminants than the pure gum solution.

It is noteworthy to mention that the usefulness of this method of analysis rest with the choice of appropriate primary standard as well as adequate standardisation of the secondary standard. It can be observed that measurements taken were commenced 30 minutes and not earlier. This was to make adequate room for preparation of other additives and to make allowance for timing the reactions. It would have been more cumbersome to start taking measurements earlier than 30 minutes. More, the most valuable information sought from this approach was to determine the minimum time for the completion of the reaction. Thus, the optimum time for the reaction was found to be 60 minutes (1 hour) as shown in Fig.1

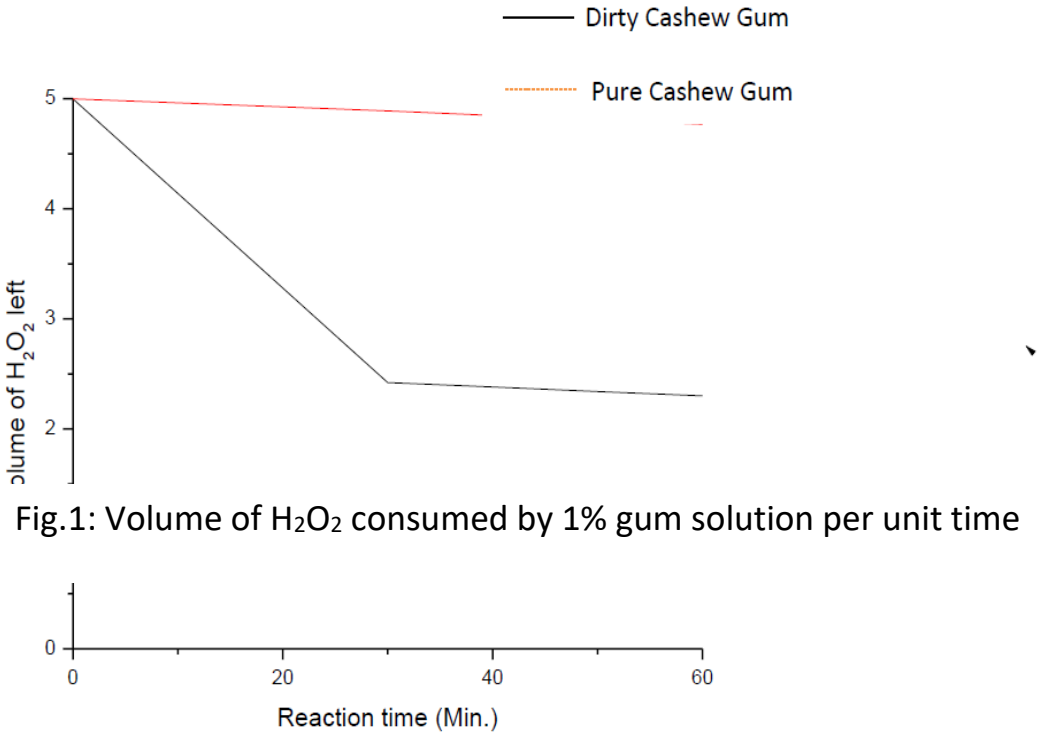

Fig.1: Volume of H_2O_2 consumed by 1% gum solution per unit time

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Another important information obtained from Fig.1 is the fact that the degree of contamination can be established by interpolation of the data points on the time axis to the volume axis from infinite reaction time (two points at which measurements were equal). This difference was estimated to be 2.41ml. This means that for every one gram of dirty gum analysed, 2.41ml of H_2O_2 of 48.6M solution was consumed in its purification. Finally, 2.53ml of peroxide was required to decontaminate 1g of dirty gum while only 0.11ml of H_2O_2 was consumed by the pure gum.

Conclusion And Recommendation

The outcome of this research has shown that it is possible to recover gum from contaminants and by so doing increase cashew

gum production output considerably. However, this research is not all inclusive as there is room to take certain steps to minimise contamination in order to reduce the need for chemical treatment of the contaminated gum. More so, it is not certain if any of the structural components (or group) in the gum was altered by treatment with hydrogen peroxide.

Therefore, the following lines of investigations are suggested as further works:

1) There is need to determine the physical properties of the pure cashew gum as well as the treated gum for comparative purposes.

2) Mass spectra of the hydrolysis product of the pure gum sample as well as that of the treated gum should be carried out for comparative purposes.

3) There is need to use ultra-pure cashew gum as standard for comparing all other cashew gums obtained from other sources.

The results from the findings above shall avail us with the right information on if the treated gum is chemically transformed or not.

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