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PRODUCTION OF STARCH FROM CASSAVA (MAIHOT) AND ITS CROSS LINKED DERIVATIVES

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Abstract

The study into the production of starch from cassava and formulation of its crosslinked derivatives, various tests were carried out in the starch produced such as ash content (0.2%), moisture content, (10.46%), pH value (6.6), and gelatinization temperature (75^0 c – 78^0 c) of the native starch produce which is higher than the cross – linked derivatives. This is as a result of reduced cohesion, rubbery characteristics of starch paste to a smooth salve like and creamy paste of the cross – link starch. Finally, a high quality product is produced which is suitable for noodle, custard & salad cream makeup. This work is also recommended to find out the use of cross-linked starch as a flocculant in the removal of heavy metal from waste water before they are discharged to the environment.

Keywords: Starch, Cassava, Potatoes, Floculant.

Introduction

Starch can be obtained from cassava, sorghum, maize, sago and potatoes. But this project focused on the production of starch from cassava. Starch can be cross-linked, a product that will be suitable for noodle, salad cream custard making. Normally it is easier to make this product from corn and potato starch, but cassava which is readily available and cheap can be employed to meet the demand of the people. Other synthetic starch produced from cassava includes; carboxymethyl starch (which is produced when one of the hydrogen atom of the starch is replaced by carboxymethyl groups, starch acetate, starch xanthate and hydroxyl alkyl starch. These are used as thickening agents, stabilizer and emulsifier in products. Cassava starches when treated with phosphate are used in frozen products when they are defrosted to prevent them from dripping. This study investigated the production of starch from cassava and preparation of cross-link derivatives. Generally, acetylated starches show a better paste and gel clarity, a better stability, an increased resistance to retrogradation, and an increased freeze-thaw stability when compared to the original starches (Agboola et al, 1991). Although acetylated and hydroxypropylated starches have rather similar hydrophobic interaction due to their functional groups (Galcia & Walter, 1998), it is assumed that the acetylation occurs exclusively in certain parts of the starch granules, whereas hydroxypropylation was more uniform through out the starch granules (Biliaderis 1982).

Materials and methods

Raw materials used :

Cassava tubers

The raw materials were purchased from Ihiala market and the whole production and analysis took place at Nigeria starch mill Ihiala.

- Equipment Used
- Moisture Analyzer
- PH Meter
- A filter machine
- Weighing balance
- Pipette
- Beaker
- Measuring dish
- Cutlass
- Grinding machine
- Stirrer
- Measuring cylinder
- Litmus paper • Test tube
- REAGENT USED
- NaOH
- Na2Co3
- Epychlorohydrine
- HCl
- Vinyl Acetate Monomer (VAM)
- H_2O
- Sodium bisulphate.

Methods of production of cassava starch

Sorting/selection:

The raw materials were specially sorted and selected on the basis of their wholesomeness, maturity, colour and level of bruises.

Cleaning/Washing

Washing of the sorted cassava was done thoroughly with clean H_2O with the aim of removing contaminants like dust/dirt and residuals from the tubers.

Peeling/Grinding

The tubers were peeled and washed the second time with clean H_2O and grinded with a grinding machine. The tubers were properly grinded so as to ensure a finely powdered end product. Sodium bisulphate solution was added to the product to avoid black coloration.

SIEVING/FILTRATION

The filtration of the grinded cassava was done by the use of a filter. Plenty H_2O was added to the grinded cassava and filtered on a filter so as to ensure a clean end product.

DRYING/BLENDING

The residue is dried in an oven (45%) and blended with the back of a bottle to make it be in a finely powdered form.

CASSAVA STARCH PRODUCTION

Fresh cassava → Initial raw material

↓ Wasting

↓ Peeling

↓ Wasting

↓ Grinding

↓ Sieving/filtration

↓ Drying

↓ Blending

↓ Cassava starch (end product).

PRODUCTION OF CROSS-LIKED DERIVATIVES

ANALYTICAL DETERMINATION

Weight of starch used - 500g

Weight of NaOH-4% - 16%

Vol. of H_2O - $2000cm^3$

Weight of NaCl - 0.73g

Weight of Na_2CO_3 - 0.025g

Weight of Epychlorotydrine - 0.5g

Weight of HCl - 8.3g

Weight of VAM-4.2% - 21.0g

PROCEDURES

16gms of NaOH was dissolved in $2000cm^3$ of H_2O and shaken vigorously to ensure a homogenous mixture. 1940ml of H_2O was poured into a beaker and a stirrer inserted into it. Starch 500gm dry (i.e. 560gms as such based on 10.8% mixture) was dispersed in 1940ml H_2O while stirring

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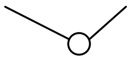
then 0.147%-073gms of NaCl and 0.005% -0.025gms of Na_2Co_3 were added. The pH was increased to 11.0-11.5 with

NaOH 4% solution (total requirement 700ml).

Epychlorohydrine was added 0.1% - 0.5grms at reaction time 30mins (to be confirmed with viscosity curve! Time – viscosity) its function is that it forms a cross-linked bond with 2 molecules of starch in the presence of NaOH.

2st- OH + CH_2 – CH_2 - Cl ⟶ st – o CH_2 – CH_2 – o st



HCl 4% solution was also added to reduce the pH to 8.3 (total requirement 26.5ml). VAM and 4% NaOH solution was introduced simultaneously taking care that pH should be maintained at 8.0 to 8.5. VAM 4.2% 21.0gms and NaOH reaction time 30 mins (care to be taken to maintain the pH 8.0-8.5). And pH was increase to 9.0 with 4% NaOH solution to minimize/avoid VAM odour (NaOH+0=62.6ml) after addition of NaOH 4% solution to 11.0 retain for 15mins (NaOH required is 11ml). The residue was filtered and washed. Again made slurry with water and filter again, then dried in oven at 45% and blend to obtain a textural and finely powdered cross-linked starch.

ANALYTICAL DETERMINATION OF MOISTURE

CONTENT OF THE MOISTURE

Moisture analyzer (digital type). Weight of pan – 2.603gms, weight of pan + sample before drying – 7.603g. Level to obtain a uniform drying then dry.

- Weight of sample + pan after drying – 7.08g that is %of moisture.

$$\% = \frac{7.603g - 7.08g}{5} \times \frac{100}{1}$$

$$= 10.46\%$$

Analytical Determination Of pH Of The Product

A sample solution was prepared by weighing 10grms of starch and dissolve in 100ml distilled H_2O and allow staying for 30mins.

Then a machine socket was connected to the source and meter by turning off MV pH and temp. knot to pH. Electrode was removed from buffer solution and rinse with distilled H_2O. Put electrode into the sample beaker and allow the reaction to determine the pH. Then the display was ensured to be stable before taking the reading. Electrodes was removed from sample and rinse with distilled H2O before storing in buffer solutions then turn off the machine and remove the machine socket from power source.

pH = 6.6 i.e. weakly acid

Analytical Determination Of Ash Content

Initial weight $W_1 = 45.13g$

Add fragrance and put in oven, live it for 21/2hour

Final weight $W_2 = 45.14g$

$$\% \text{ Ash} = \frac{W_2 - W}{5} \times \frac{100}{1}$$

= 0.2

% Ash =0.2

Analytical Determination Of Gelatinization Temperature Of The Native Starch

30g of starch was weigh and dissolve with water in a beaker then placed on a water bath with an electrode inserted into the starch for temperature determination with a constant stirring. The temperature at which the starch forms gel is 75 – 78^{0}c.

Results

MOISTURE CONTENT	10.46%
pH	6.6%
Ash content	0.2%
Gelatinization Temp.	$75^{0}c$ – $78^{0}c$

Conclusion

Normally, native starch or unmodified starch has many features which are not suitable for the production of custards, puddings, etc such features include high gelatinization temperature in boiling water, rubbery cohesiveness, stringy nature of the aqueous dispersion, retro-gradation in a long period of cooling and low texture of the paste and gels. Cross linked starch provides the adequate condition or modifies the starch for the production of custard, puddings, salad creams and so on.

Also, it reduces the properties of the native starch such as the rubbery cohesiveness, ability to form gel aiding to the production of highly textural paste suitable for the production of many products such as custard, puddings and so many others.

Discussion

From the experiment carried so far on formulation of cross-linked bond from cassava starch (starch modification), it is obvious that a high quality of starch was produced with a reduced cohesive rubbery-like and elastic properties which resemble that it of corn starch suitable for custard making.

Recommendation

From the experiment carried out on cassava starch modification which reduces its cohesive rubbery-like and elastic properties, a product which resembles that of corn starch which is used for custard making is produced.

It is obvious that cassava starch can as well be used as custard after modification to form cross-link bond. I recommend that other trial should be carried out on cassava starch to find its use as flocculants in the removal of heavy metals from waste water before they are discarded to the environment.

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