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MANUAL/BATCH PROCESSING/PRODCTION OF CASSAVA STARCH

(INDUSTRIAL GARRI FROM CASSAVA ROOT TUBER USING MANNAL/BATCH PORCESSING/PRODUCTION)

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ABSTRACT
Starch is a polysaccharide of glucose that is highly versatile in its domestic and industrial uses and applications. It can be used either as a native starch or modified forms. It finds applications in pharmaceutical, adhesive, paint, textile, paper, cosmetics, energy and food industries, to mention but a few. It is obtained from green plant (from cassava root tuber the focus of this article) it is widely cultivated in African, Asia and Latin/south America. In this paper, the focus is on its production by manual/batch process/production. It is a natural polymer, and thus, is a renewable resources. It has huge market globally.

Keyword: starch, polysaccharide, polymer, glucose, cassava and batch processing/production.

INTRODUTION

One of the signs that the economic of a country is developed is the state of its chemical industry. This is so because the chemical industry can take essentially simple or very cheap raw materials and transform them into more valuable finish product (value addition through the value chain) (Eliasson, 2004). Very often, these raw materials come from poorer nations of the world i.e. they produce the feedstock. The developed countries add value or transform these original materials using their sophisticated chemical plants. These advanced nations make the most money from this arrangement as the final product can be sold at a much greater project than the feedstock. As a result of this, the poorer nations have attempted to develop their own chemical industries/processes (Adetan et al 2006)

Our daily lives are meaningless without the use of chemicals. The foods or component of the foods we eat are complex chemicals. Chemicals are in the clothes we wear, the medicines we take when we are not well and the numerous articles that we use. At some stage, the industrial chemists involved in nearly all the materials we touch, the polymers and dyes in clothes, the bathroom cabinet, toiletries, creams, perfumes, etc. Organizing the economics of large production/manufacturing plant/processes depends on understanding the chemistry of industrial processes (Chris and Phil, 2002)

MANUAL/BATCH PROCESSING/PRODUCTION

Manual production involves the use of hands or physical strength; manual labor /jobs/skills; operated or controlled by hand rather than automatically or electricity, etc. Batch processing is the opposite of continuous or automated processing. Continuous processing is only suitable for processes where the raw materials or reactants are gases or liquids. Here mixing challenges are relatively easy to manage. For example, in processes which involve solids and liquids, it can be extremely difficult to design mixers that will prevent solid materials from settling out. But this kind of process involving solids and liquids, the best approach is batch process. In batch processing, it is also easy to clean the plant thoroughly between batches. In addition, small plants can be made from specialized materials such as very high grade steel or polymer, which would otherwise be unsuitable for prohibitively expensive, for large scale continuous processes. But batch processing is not without its disadvantage: it is more labor intensive than continuous processing. Batch processing is very suitable to make small quantities of chemicals for research, pharmaceuticals, dyes, and increasingly biochemical products. (Chris and Phil 2002)

Batch production, the product is built in series of stages. At each stage, a number of unit of product, the batch are processed before the whole batch moves into the next stage. Modification can be incorporated into product at the next, batch but are difficult to introduce part-way through a batch because of the difficulty in tacking what happens when each unit of product does not have unique identification; it is the batch which is identified.

In batch production, one operator or machine is usually dedicated to a particular process but is able to work on a number of different products requiring that process. Batch production is particularly suitable if the manufacturer has to support and produce a wide range of products. Also it is appropriate when there are limitations on the equipment and skills available such that these have to be shared, or when specialized skills or equipment are required that could not justify being kept work. This kind of production can be used when organization produces a variety of products and when the demand for product is variable, as batch size can be varied to suit requirement (Howeler and Hershey, 2002).

company that uses batch production typically use a function factory layout in which similar processes and function are group, requiring the processes in a particular area are processed in the area on any of the area on any of the available frailties.

Batch production is preferred when the availability of skills and /or equipment is limited or high levels of utilization are required. this no doubt, means a longer manufacturing lead time than in job production (when production are made singly or in small batch), and will involve having non- value added activity (Kolawole et al 2012).

Unit Operation/Process Chemistry

Process chemistry can be organized based on two facts;

1. Number of individual processes which is broken down into series of steps, called operations, which in turn appears in process after process.

2. The individual operations have common techniques that are based on the same scientific principle. For instance in most processes solids and fluids must be mixed; heat or other forms of energy must be transferred from one substance to another; and tasks such as drying, size reduction, distillation, and evaporation must be performed in unit operation, the operation s themselves are systematically studied operations that clearly cross industry and process lines - The treatment of all processes is unified and simplified.

Chemical aspects of processing are strictly studied in process chemistry called reaction kinetics unit operation are largely used to conduct the primary physical steps of preparing the reactants/raw materials separating and purifying the products, recycling unreacted reactants/raw materials, and controlling the energy transfer into or out of the chemical reactor/equipment (Iita, 1990).

Unit operations are applicable to many physical as well as to chemical processes. For example in the manufacture of common salt, the following are the sequence of unit operations: Transportation of solids and liquids, Transfer of heat, evaporation, crystallization, drying, and screening. All these operation/steps do not involve chemical reaction. In other chemical process such as the cracking of petroleum, with or without the aid of a catalyst, is a typical chemical reaction that is conducted on an enormous scale. In this case the unit operation involve transportation of solids and fluids, distillation, and various mechanical separations (The cracking reaction could not be done without them) (Thomas and Atwell, 2005). The chemical steps themselves are conducted by controlling the flow of materials and energy to and from the reaction zone.

Unit operations being a branch of engineering/Ind. Chem. They are based on both science and experience.

SOLVENT EXTRACTION

This is a chemical separation technique whereby a substance or solute is transferred from one medium to another when the medium is contacted with a solvent (which can be water or organic solvents like benzene, toluene etc.). It can be performed at different temperatures, we use hot or boiled water to extract tea from dry leave, here it is liquid-solid extraction, the extraction of iodine or bromine from a reaction mixture of chlorine after added to solution of an iodine or bromine using 1,1,1-trichloromethane; and the extraction of starch from cassava pulp into water to form a colloid solution (Biliaderis, 1992)

Percentage extraction/yield

Suppose starch is extracted into water and the solution (colloidal solution in this case) is allowed to stand for sometimes, it will be formed that the starch will settle out after sometimes. If the top liquid is decanted leaving the wet starch, and this weighed, say y gram and if this wet starch is dried to give x gram of dried starch, then

$$\text{Percentage extraction/yield} = \frac{X(g)}{y(g)} \times 100\%$$

$$\text{i.e \% yield} = \frac{\text{actual yield}}{\text{Theoretical yield}} \times 100\%$$

and the % of water that dried off is;

$$\text{\% of water dried off} = \frac{y - x(g)}{y(g)} \times 100\%$$

(Chris and Phil, 2002)

Theory and practice must combine to yield designs for equipment that can be fabricated, assembled, operated, and maintained.

A number of scientific principles and techniques are basic to the treatment of the unit operations. Some of these are elementary physical and chemical laws such as the conservation of mass and energy, physical equilibrium, kinetics and certain properties of matter (Benesi, 2005)

Production of cassava starch from cassava root tuber.

Production equipment

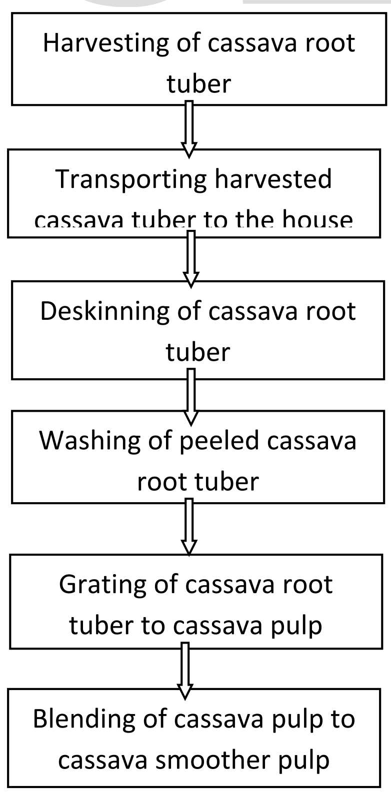
1. Camry dial spring scale
2. Plastic bowls/cup
3. knife
4. Grater
5. Filter
6. Sieve
7. Stainless steep tray
8. Electric blender
9. Ceiling fan

The production process starts with the following steps;

Step 1: Harvesting the root tubers from the farm.

Step 2: Transporting the harvested root tubers to the house in a nylon bag and washing unexpected tuber.
Step 3: Des-kinning or peeling the tubers.
Step 4: Washing the peeled tubers with activated carbon filtered water.
Step 5: Grating of the tubers to form wh9te cassava pulp.
Step 6: Blending the grated tubers with an electric blender to get another pulp.
Step 7: Addition of water to the blended pulp to extract the starch granules into the water to form a colloidal solution.
Step 8: The starch solution was multi filtered using a filter of fine mash size.
Step 9: Allowing the filtrate to settle under gravity for about eight (8) hours.
Step 10: Decanting the water from the settled starch.
Note: The water used for the process was treated.
PH of c-filtered water is 6.6
PH of membrane filtered water is 7.6
Step 11: Transporting the wet starch in small lumps into a stainless steel tray to air dry under coiling fan.
Step 12: Crushing the semi dried starch using the rough side of the grater to reduce the lumps to finer particles-particle size reduction as larger surface are a facilitates faster drying rate. This was done in semi dust free environment.

PRODUCTION FLOW CHART



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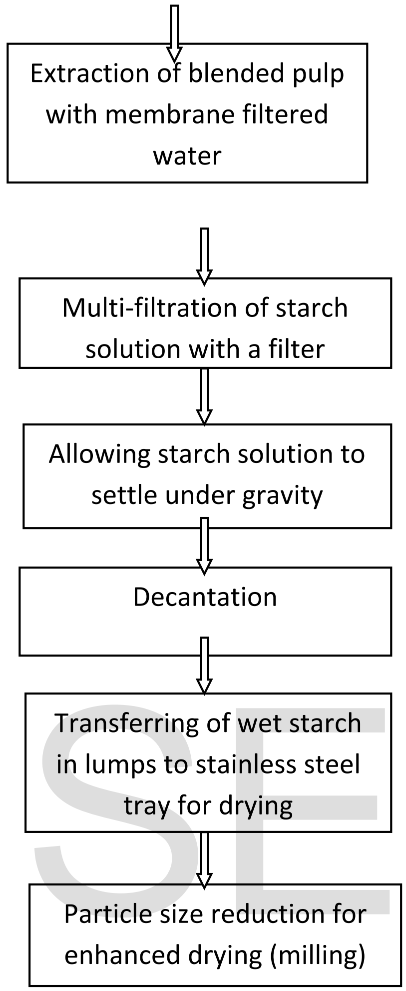

DISCUSSION

The weight of harvested cassava tubers was 25kg. The deskinned tubers weighed 6.0kg. Weight of extracted wet starch was 2.3kg. Weight of dried starch was 1.12kg. The residue after the extraction process was blended with small quantity of the starch, then palm oil was mixed with if to form yellowish pulp that was then pressed overnight to expel water from it. The semi dried yellowish pulp was sieved and then heat treated (fried in a gas flame) to obtain golden coarsed powder called garri. The fried garri was sieved with a sieve, and the sieved garri weighed 1.0kg, while the residue weighed 0.25kg.

CALCULATION

Wt of unskinned tubers	———	7.2kg
Wt of skinned tubers	———	6.0kg
Wt of skin	———	1.2kg
Wt of wet starch	———	2.3kg
Wt of dried starch	———	1.12kg
Moisture content of wet starch	———	1.18kg

% extraction from skinned starch is

$$\frac{2.3}{6.0} \times 100 = 38.33\%$$

% dried starch from wet starch:

$$\frac{1.12}{2.3} \times 100 = 48.70\%$$

Moisture content of wet starch:

$$\frac{1.18}{2.3} \times 100 = 51.30\%$$

CONCLUSION

Starch can be classified into two types: native and modified. Native starches are produced through the separation of naturally occurring starch from either grain or root crops, such as cassava, maize, and sweet potato, and can be used directly in producing certain foods, such as noodles. The raw starches produced still retain the original structure and characteristics and are called "native starches". Native starch is the basic starch product that is marketed in the dry powder form under different grades for food, and as pharmaceutical, human, and industrial raw material. Native starch has different functional properties depending on the crop source, and specific types of starch are preferred for certain applications. Native starch can be considered a primary resource that can be processed into a range of starch products. There was quantitative extraction of 45.70% of native cassava starch.

Recommendation

- The de-skinned cassava root tuber should be machine washed.
- The peeled tubers should be engine milled
- The pulp should be machine pressed.
- Other drying processes such as hot air drying and vacuum drier could be used.

REFERENCES

Adetan, D.A., Adekoya, L.O. and Aluko, O.B. (2006) Theory of a mechanical method of peeling cassava tubers with knives. International Agrophysics, 20: 269–276.

Benesi, I. R., (2005). "Characterization of Malawian cassava germplasm for diversity, starch extraction and its native and modified properties. Bloemfontain: PhD Thesis, Department of Plant Science, University of the Free State, South Africa.

Biliaderis, C.G. (1992). Structure and phase transitions of starch in food systems. Food Technol. 46(6):98–109.

Brabet, C., Chuzel, G., Dufour, D., Raimbault, M. and Giraud, J. (1996) Improving cassava sour starch quality in Colombia, in: Cassava Flour and Starch: Progress in Research Tropical Agriculture, Montpellier, France, pp. 241–246

Chris, C., and Phil, H. (2002). Collins advanced science chemistry. (2nd Ed.) Harper Collins publishers limited pg 2-8.

Eggleston, G., Omoaka, P.E. and Arowosegbe, A.U. (1993) Flour starch and composite breadmaking quality of various cassava clones. Journal of the Science of Food and Agriculture

Eliasson, A.-C. (2004). Starch in Food: Structure, Functions and Applications. Cambridge, UK: Woodhead.

Howeler, R.H. and Hershey, C.H. (2002) Cassava in Asia: Research and development to increase its potential use in food, feed and industry – A Thai example, in: Research January, pp. 1–56. http://faostat.fao.org/site/567/desktopdefault.aspx#ancor

Iita (1990) Cassava in Tropical Africa. A Reference Manual, 15–16. IITA, Ibadan.
Jaleel, S.A., Srikanta, S., Ghildyal, N.P. and Lonsane, B.K. (1988) Simultaneous solid phase fermentation and sacchari□cation of cassava □brous residue for production of ethanol. Starch-Stärke, 40(2): 55–58

Kolawole, P.O., Agbetoye, L., Ogunlowo, A.S., Sanni, L. and Abass A. (2012) Innovative development of cassava processing machine as solution to crisis against agricultural systems. Tropentag, Göttingen, Germany, 19–21 September.

Nwaigwe, K.N., Nzediegwu, C. and Ugwuoke, P.E. (2012) Design, construction and performance evaluation of a modi□ed cassava milling machine. Research Journal of Applied Sciences, Engineering and Technology, 4(18): 3354–3362.

Thomas, D.J. and Atwell, W.A. (2005). Starches. St. Paul, MN: Eagan Press.

Tomasik, P.; Schilling, C. H.(2004) "Chemical Modification of Starch." Advances in Carbohydrate Chemistry and Biochemistry, 59, 175.