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Development of a Sustainable System for Cassava Starch Extraction

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Abstract
Cassava production in Africa received a major boost due to the joint efforts of African leaders through the New Partnership for Africa's Development (NEPAD). One of the challenges identified by NEPAD is the need to develop technologies for processing cassava in order to reduce post-harvest losses. One major problem associated with cassava processing is low level of mechanisation. In recent times, renewed efforts at improving cassava processing technologies are being made by design engineers especially in Nigeria, Brazil and China. One of the major industrial products from cassava requiring mechanization is starch. The demand for starch, which is used as raw material in many agro and agroallied industries, in Africa and Asia is enormous, making adequate investment in the starch industry a necessity. In many developing countries, starch production has been dominated mainly by cottage industries. However, starch extraction by cottage industries is largely done using manual methods. There is a need to develop equipment for small to medium scale starch industries in developing countries. In this study, equipment for starch extraction in one pass of fresh cassava tubers is proposed. The machine consists of a specialised serrated auger, tuber inlet, water delivery system, perforated cage, and an arrangement of sieves, starch delivery outlet, fiber delivery outlet and the power source. The machine is conceived as a low cost equipment to enhance productivity at the small to medium scale levels in developing countries. The major advantages of small to medium scale starch industries is the closeness to the source of raw materials which is cost saving particularly for cassava with about 60 to 70% moisture content. The highest stakeholders in starch processing are also in this category. It is believed that the equipment would enhance sustainable starch production, reduce human drudgery and promote timeliness of the production process.

Keywords: Cassava, production and processing, sustainable Approach

Introduction

Cassava Manihot Esculentus thrives in those areas where it has comparative advantage over other crops. It is very draught resistant, water efficient and exceptional tolerant to high soil acidity and low levels of Phosphorus (P) (Howeler et al., 2004). Cassava production in Asia increased from 51.6 million tonnes in 1993 to 55.5 million tonnes in 2003. FAO 2001 identified Nigeria as the largest producer of cassava in the world with about 34 to 37.9 tonnes per annum. Cassava is cultivated in almost all states in Nigeria. Cassava is utilized for domestic as well as export purposes. Nweke (1996) describe the uses of cassava as: cash earner for growers, low cost food source for both urban and rural dwellers and for household food security. Generally market for cassava has been for starch and starch products. Emerging areas of research were identified in areas of production cost reduction, increased yield, to broaden starch functional properties, increase starch content, and the nutritional value

of products. Processing methods and efficiency also need to be improved. Market for cassava products, new processes and new products need be developed. Uses of cassava include, direct human consumption after boiling and preparation into various products, on farm feeding of livestock, processing into native starch, modified starch, sweeteners, and alcohol. In 2003 54% of cassava production in the world was produced in Africa, 29 % in Asia and 14% in Latin America. FAOSTAT (2004) reported that about 3% annual production increase was recorded in Asia while 0.9% and 0.3% were recorded in Africa and Latin America respectively. Cassava production is challenged by rapid urbanization and competition from other crops such as rice, maize etc. Although demand for cassava as export commodity is declining in Europe, it is compensated by the increase in Asia. Increase in cassava production in Asia has been attributed to substantial increase in planted area as well as remarkable increase in yield. Howeler et al (2004) reported that introduction of new varieties and chemical/organic manures nearly doubled yield over a period of five years.

Cassava is Africa's second most important food staple, after maize, in terms of calories consumed. Cassava is a major source of calories for roughly two out of every five Africans. In some countries, cassava is consumed daily and sometimes more than once a day. Cassava is adapted to zone within latitudes 30°north&south of the equator, at elevations up to 2000m above sea level, in temperatures ranging from 18°C to 25°C to rainfall of 50 to 5000mm annually, and to poor soils with a pH from 4 to 9 (Nweke, 2004). Nigeria received the mandate for cassava research and development, which in turn triggered the formation of many National cassava research programmes. Nevertheless, the number of researchers working on cassava and the research budgets dedicated to this crop, are minimal in comparison with those for most of the competing crops (Howeler, 2003). Traditionally, cassava roots are processed by a variety of methods in many different products and used in diverse ways according to local customs and preference to provide the carbohydrate part of diet. Processing cassava reduces food losses and stabilizes seasonal fluctuation in supply of the crop (Nweke, 1994).

Problem Statement

Starch production in Nigeria is dominated by cottage industries. Although Adepomola et al 2004 identified 10 large scale starch industries in Nigeria , only one (Matna Food Company, Ogbese, Ondo State, Nigeria) is functional. The survey conducted by Adepomola et al (2004) revealed that processing of cassava is largely done using traditional manual methods into products such as garri, Lafun, fufu and flour. Value added products such as alcohol, sweeteners, dextrins, glue, sweeteners and monosodium glutamate (MSG) and modified starch are not yet extracted from cassava in Nigeria. NEPAD (2006) reported that conversion of cassava into products for starch, food, plywood, paperboard, textile and pharmaceutical industries could contribute significantly to the transformation of rural African economies and thus improve livelihoods. Several needs were also identified particularly in the area of appropriate technologies for the conversion of cassava to value added products.

Machine Description

The machine is a modification of a fruit juice extractor (Fig. 1). The starch extractor (Fig.2) consists of the milling/extraction mechanism, the transmission system, the upper half of the extraction chamber (cage) the perforated lower half of the extraction chamber (basket), the hopper, water pump and water delivery system, fibre outlet and the starch collector. The machine mills the peeled cassava tubers, and conveys the mash into a stream of water flowing with high pressure, starch is separated through the perforated concave into the starch sedimentation tank.

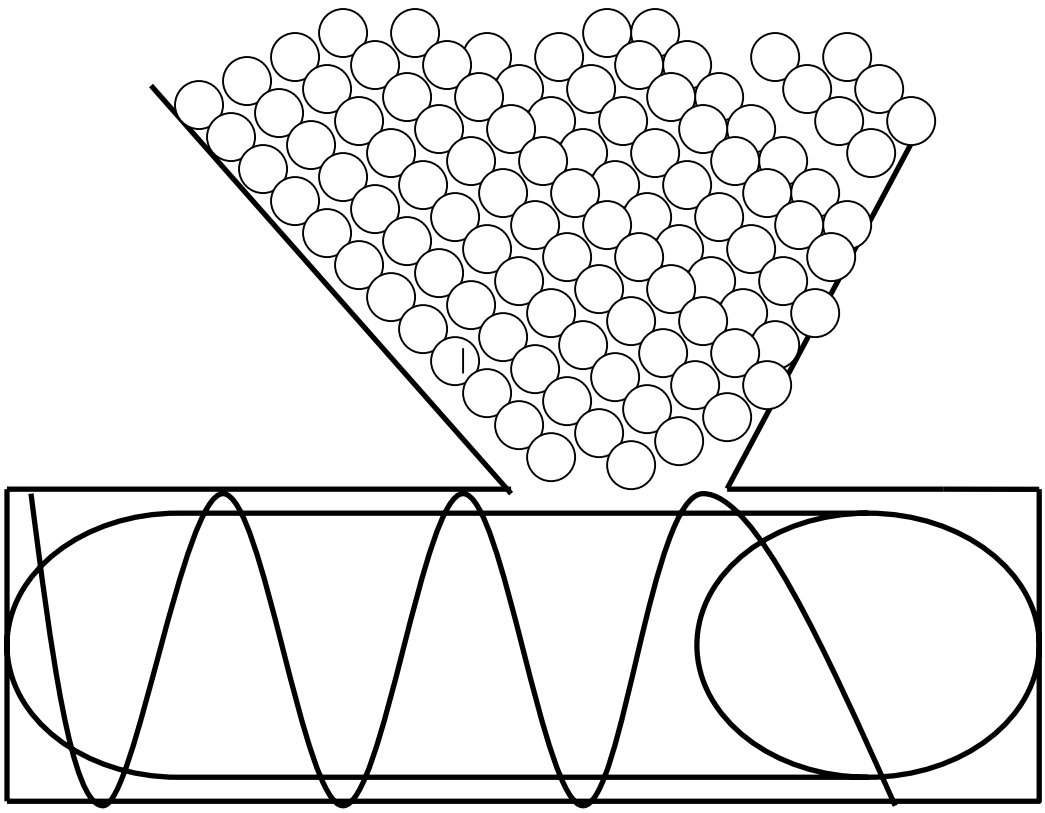

Fig. 1: Schematic Diagram of the Starch Extraction Machine

Conclusion

A sustainable system for extraction of starch from cassava tubers was developed. The machine combines milling with extraction in one operation, it is simple and quite efficient. The major advantages of small to medium scale starch industries is the closeness to the source of raw materials which is cost saving particularly for cassava with about 60 to 70% moisture content. The highest stakeholders in starch processing are also in this category. It is believed that the equipment would enhance sustainable starch production, reduce human drudgery and promote timeliness of the production process.

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