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Development of a System for Fresh Fruit Juice Extraction and Dispensary

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Abstract

In Nigeria and many other African countries fruit juice is almost becoming a luxury found only on the table of the rich. Processing of raw fruits or juice concentrate into juice is done by large-scale industries resulting in high and unaffordable prices for the low income earners in developing countries. However the need for fruit juice in human diet cannot be over-emphasised. Although, the poor can eat raw fruits, the perishable nature of these fruits underscores the need for processing in order to make fruits available the year round. Locally available fruits that are widely grown in Nigeria include cashew, mangoes, watermelon, guava, pineapples, paw paws, oranges, tomatoes, tangerines, and many other indigenous fruits. Production of fruits in Nigeria can be estimated at hundreds of thousands of metric tones per year. Unfortunately, over 50% are lost due to perishable nature of fruits occasioned by high moisture content and poor post harvest handling and marketing strategies. In this study, a system for handling, processing and preservation of fruits was developed and tested. The system consists of the washing unit, the juice extraction unit, juice filtration, conditioning unit and dispensary unit. The system was packaged in a way to make juice available in the fresh form for consumption. Fruits such as orange, mango and pineapple could be processed to obtain 100% juice. A combination of one or more fruits is feasible to obtain mixed fruits. The systems provides for quick processing and dispensary of fresh fruits at affordable prices. The system has been introduced to some schools, villages, establishments and corporate organisations in Nigeria. Results show that majority accepted the product readily because of its positive health implications of fresh fruit without additives/ preservatives. The equipment used is affordable to small-scale industrialists. Thus, the
system offers a sustainable approach for processing and consumption of fresh-fruit juice in developing countries. It is believed that the adoption of this system would enhance healthy living among the rural poor, provide employment, promote industrialisation and food security. The initial cost of the system was estimated at 1,500 US dollars

Keywords*: Fresh-fruits, Juice extraction and Dispensary*

Introduction

Fruit juice is the next best thing to fresh fruit, and can be packaged in aseptic, easily transportable containers that are less susceptible to damage and have a relatively long storage life. Juice extraction and separation therefore open up new market opportunities for tailoring

fruit products to modern consumer demands. The yield from any fruit juice process depends on good solids handling. Extraction equipments should therefore be designed to handle high levels of solids content during separation. Removing the solid matter and pulp, and then clarifying the juice can control the colour, taste and overall quality of the end product. Kazembe (2005) reported that National production of fruits in Malawi is estimated at over 200,000 metric tones per year. Unfortunately, most of this undergoes post-harvest losses accounting to over 70% due to fruit perishability, poor marketing and lack of improved post harvest processing techniques strategic to product development for value-addition to fruits.

Nanjundaswamy (1986) confirmed that lack of local and simple mechanical means for fruit processing into juice and other intermediate products, results in limitations on fruit utilization and thus more post-harvest losses due to rotting. This inefficiency in turn presents limitations to the rural income by small-scale farmers. Fortunately, in Malawi, most of these farmers run out of food (Maize- Zea mays) reserves when most fruits are in season. This means therefore that improved fruit juice agro-processing would assist to minimize the problem among the fruit-growing farmers. Hrapsky et al (1985) stated that a promotion of efficient fruit juice processing techniques raises the produce market value. Such an industry has an Internal Rate of Return (IRR) greater than 50%. Post-harvest losses would also be minimized.

The major viable option is the extraction and preservation of juice from fruits. In the developed countries such as Britain, Germany and the United States of America, various equipment are available for small to large-scale fruit juice production. However in Africa and especially in Nigeria, there is a dearth of small to medium scale processing equipment for fruit juice production. FAO (1995) reported that there is far less attention paid to minor juices, small or local manufacture of such products and the specific problems faced by producers who have not shared in the growth recorded by large scale manufacturers of fruit juice. Other fruits such as mango, guava, etc require pulping - that is, after peeling and stone removal, the flesh of the fruit is pushed through a perforated metal plate. For this process, there is a range of equipment available including several versions of hand-powered pulper/sieves, all of which force the fruit pulp down through interchangeable metal strainers. Fruit squashes contain about 25% fruit material mixed with sugar syrup to give a final sugar concentration of about 40%. These are diluted with water prior to use and as the bottle is opened, partly used and then stored, the addition of a preservative is necessary (for example 800ppm sodium benzoate). These products are pasteurized at 80-95°C for 1-10 minutes prior to filling hot. At the small to medium scale processing stage, this may be carried out in a stainless steel, enameled or aluminum saucepan over a gas flame, which may result in overheating at the base of the pan, with consequent flavour changes. To avoid the use of large expensive, stainless steel pans, a large aluminum pan can be used to boil sugar syrup. A given amount of the syrup is then mixed with fruit juice in a small stainless steel pan and this increases the temperature to 60-70°C. The juice/syrup mixture is then quickly heated to pasteurising temperature. Except for cool temperature climates, storage life was limited to few hours before incipient fermentation modified the character of the juice appreciably.

Design Considerations

In order to obtain high efficiency, and reliability, the machine (Fig.1) was designed based on the following considerations

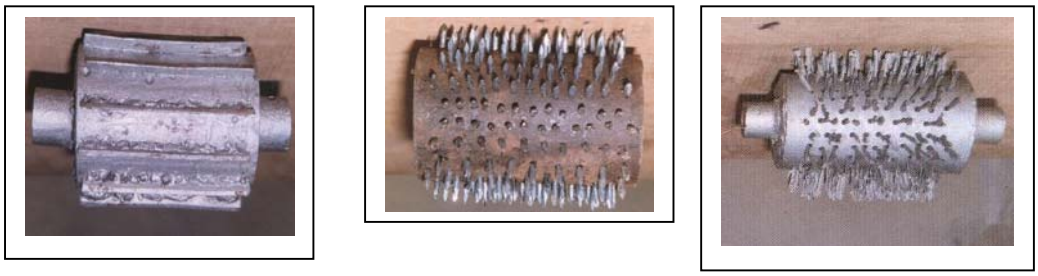
1. The equipment should be relatively cheap and be within the buying capacity of small scale juice processors
2. The equipment should able to handle different varieties of fresh fruits
3. The equipment should be made with readily available materials.
4. It should reduce the labour input in traditional methods of handling, processing and preservation of fruits

Machine Description

The Machine (Fig.1) 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, fibre outlet and the juice collector.

Fig.1 The Fresh Fruit Juice Extractor

The peeling brushes (Fig. 2) in the celebrated cassava peeling machine (Olukunle, 2005, Olukunle et al 2005, Olukunle et 2006a) were adopted but modified as the active ingredient in the juice milling/extraction machines. The three mechanisms consist of spiral arrangements of these components to form a continuous auger which represents the extraction tool in the machine Thus translating the brushes to auger for milling, extraction and conveyance.



A Knife B **B** Nail Brush **C** Wire Brush

Fig. 2: Peeling brushes in the celebrated cassava peeling machine

Materials and Methods

A survey of the various fruits in Nigeria in terms of availability, seasons and potentials was conducted. An appraisal of the traditional methods of handling, processing and preservation of fresh fruits was carried out. A system was developed for processing, preservation and dispensary of fresh fruit juice. The system consists of the washing unit, the juice extraction unit, juice filtration, conditioning unit and dispensary unit. The system was packaged in a way to make juice available in the fresh form for consumption. Fruits such as orange, mango and pineapple could be processed to obtain 100% juice. A combination of one or more fruits is feasible to obtain mixed fruits. The systems provides for quick processing and dispensary of fresh fruits at affordable prices. The system has been introduced to some

schools, villages, establishments and corporate organisations in Nigeria. The initial cost of the system was estimated at 1,500 US dollars.

Conclusion

A system for fresh fruit juice extraction and dispensary has been developed. The equipment used is affordable to small-scale industrialists. Thus, the system offers a sustainable approach for processing and consumption of fresh-fruit juice in developing countries. It is believed that the adoption of this system would enhance healthy living among the rural poor, provide employment, promote industrialisation and food security. The initial cost of the system was estimated at 1,500 US dollars.

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