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Industrialization of Cassava Sector in Ghana: Progress and the Role of Developing High Starch Cassava Varieties

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Abstract: In Ghana, cassava is a marginalized crop in food policies due to low research attention it has received compared to the popularly known cereals such as maize and rice. However, high starch content of the cassava root is an important characteristic that present the crop as a potential industrial raw material to serve as employment to improve income and livelihoods. In light of this, the government of Ghana in 2001 introduced an initiative called the Presidential Special Initiative (PSI) on Cassava, which aimed at substantially increasing the nation's export revenue through transformed smallholder production methods and development of cassava-starch industries in Ghana. Ethanol is reported as the largest opportunity for cassava industrialization in Ghana followed by food-grade starch. However, local beverage manufacturers such as Kasapreko still imports over 25 million litres of ethanol every year. This is because of inadequate supply of ethanol from local starch factories. This can largely be attributed to lack of cassava varieties that can yield about 75% or more starch of their total dry weight to feed the starch factories for sustainable production. Therefore, this review seeks to explore how important the development of cassava varieties that are high starch yielding (about 75-85% starch of its dry root weight) than the current varieties (around 57.26% starch) sustained industrialization of the cassava sector in Ghana.

INTRODUCTION

Cassava (*Manihot esculenta* Crantz) is an important staple in the world. Over half a billion people depend on cassava for livelihood of which 300 million are in Africa. However, in addition to direct human and animal consumption of cassava roots, cassava starch has great potential in industry (Naziri *et al*., 2014; MFA., 2004; FAO., 2001). Starch constitutes the main component of cassava root and plays an important role in the usage of the crop both for food and non-food purposes (Ceballos *et al*., 2007). Cassava stands as one of the most important sources of commercial production of starch in tropical and subtropical countries (Moorthy, 2002). The demand for starch as an industrial raw material for both food processing industries such as the pastries producers and non-food industries such as the pharmaceutical and the textile producers have been on the rise recently. According to a study by Grow Africa in 2015, the total latent demand of cassava starch as an industrial raw material is estimated to grow to 1.6 million MT per year, accounting for both domestic demand from Ghanaian industries and regional demand from other ECOWAS markets. This presents a great economic opportunity for cassava producers in Ghana and the "Ghana Beyond Aid" agenda by the current government which seeks to decrease the nation's dependency on Foreign aids through increased local production and export revenue. Cassava starch is extensively use for sizing and dyeing in the textile industries to increase brightness and weight of the cloth while in the pharmaceutical industries, it serves as a filler material and bonding agent for making tablets (Singh *et al*., 2003; Graffham *et al*., 2000). Factors that hinder successful industrialization of the cassava sector in Ghana ranges from limited industrial large scale processing (AUDA., 2015) to yield gap (4-12MT ha^{-1} compared to a potential yield of 25-30MT ha^{-1}) (MFA., 2017). However, low starch yielding ability of available cassava varieties also poses a major threat to industrialization of the cassava sector. Compared to the reports of cassava researchers from other parts of the world, cassava varieties in Ghana are not giving the optimum starch content. The best performing starch yielding cassava variety in Ghana, CRI-sikabankye yields only 57.26% starch of its dry root weight which is <73-84% starch yield reported for cassava by other researchers (Sanchez *et al*., 2009; Baguma, 2004). Therefore, this review seeks to explore the benefits of enhancing the starch content of cassava varieties in Ghana and developing varieties with improved starch yielding qualities to better fit the need of different industries to contribute to the industrialization of the cassava sector in Ghana.

MATERIALS AND METHODS

Progress and prospects of industrializing the cassava sector of Ghana: Ethanol production especially for local consumption is the largest opportunity for industrializing the cassava sector in Ghana. The demand for ethanol for both food and non-food industries has been increasing over the years. Over 60 million litres of ethanol is imported every year into Ghana (AUDA., 2015). About 25 mL of total annual imported ethanol is used by only one local beverage manufacturer called Kasapreko which invested about 7.5 million USD into the production of ethanol by local producers as part of the company's strategic program to source local raw material and create jobs.

AUDA. (2015) reported on market opportunities of cassava in three African countries (Mozambique, Ghana, Nigeria) and two Southeast Asia countries (Thailand, Vietnam) describes the Ghana cassava sector as slightly commercial with low supply volumes and unsustainable as shown in Fig. 1.

The constraints of starch producing factories in Ghana: In Ghana, cassava is chiefly used in a popular local staple called fufu (boiled and pounded fresh root). Good pound ability is inversely proportional to the starch content of cassava root. This trait is important in breeding superior cassava varieties in Ghana and a requirement in the adaption of cassava by farmers. For this reason, the currently best starch-yielding cassava variety (CRI-Sika bankye) released by CRI in 2015, yields 19.63% and 57.26% fresh and dry root starch respectively of its total root weight though cassava is reported to be a high starch producer with levels between 73.7 and 84.9% of its total storage root dry weight (Snchez *et al*., 2009; Baguma, 2004). Thus, many starch factories in Ghana will not

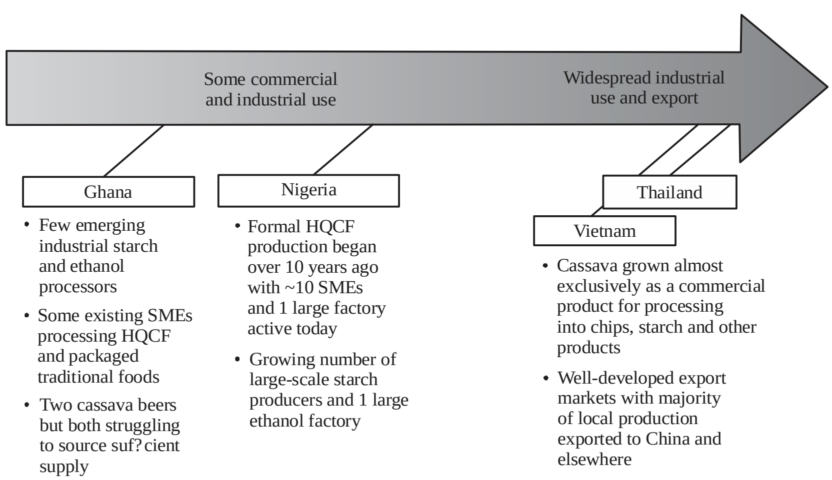

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Fig. 1: Comparison of progress of Ghana cassava sectors industrialization to that of Nigeria Thailand and Vietnam (AUDA., 2015)

be able to operate at efficient level would have to process large number of fresh root for relatively small amount of starch due to low starch yielding ability of the currently available cassava varieties. There is therefore, a need to improve the starch content of cassava varieties through breeding and crop management to meet the starch factories demand and industrial standards. Sourcing for high starch genotypes from IITA (International Institute of Tropical Agriculture) and CIAT (International Center for Tropical Agriculture) for hybridization program could contribute massively to developing cassava varieties that could yield about 75-85% starch of their dry root weight. In modern business, manufacturing activities is comparatively competitive. Therefore, actors of all value adding activities must operate at an efficient pace to maximize output and sustain production. The sustainability of starch factories in Ghana is heavily plagued with a very weak supply chain linkage resulting in factories operating below the capacity. However, with the availability of high starch varieties that can yield about 75-85% starch of their total dry root weight, starch factories will not only be able to increase productivity to meet consumption demand but also less land area will be needed for cassava cultivation to feed the starch industries for sustainable production and supply.

Need for diverse novel cassava starch for different applications: Cassava starch is an essential raw material for food and non-food industries worldwide (Mweta, 2009). Over the years, there have been an increasing need for diverse novel starches for both food and non-food applications. The quality characteristics of cassava starch indicates its potential use either in the food or non-food industry; the waxy type of cassava starch is preferred in the food industry (Sanchez *et al*., 2010). Waxy starch is amylose-free and very important, especially to the food industry because of its freeze-thaw stability (Ceballos *et al*., 2007). High viscosity is an indication of good quality starch (Dzogbefia, 2008). Starch is incorporated in many foods ranging from pastries to noodles and other staple foods (Dankwa *et al*., 2017). Some of these products are usually exposed to temperature fluctuations during preparation or storage and the freeze-thaw stability of starch in these products is very important to maintain textural quality of the product after production and during storage.

Although, a lot of work has been done on physicochemical properties (granule structure, pasting properties, swelling power and solubility) of cassava in Ghana and around the world, however, there is limited research on amylose-free cassava in Ghana (Charles *et al*., 2004; Gomes et al., 2005; Zaidul *et al*., 2007). There is a clear genetic influence on the content of amylose in the starch and neither the age of the plant nor environmental factors seem to play a major role in determining it (Ceballos *et al*., 2007). Therefore, it will be of great importance for cassava breeders in Ghana to introduce amylose-free cassava genetic materials from research centers such as CIAT (international center for tropical agriculture) where the first natural waxy cassava genotype (AM206-5) was discovered (Sanchez *et al*., 2010).

RESULTS AND DISCUSSION

Growing international cassava market and lessons from Thailand's success story: The global trade in cassava products has been growing rapidly in recent years, largely driven by Chinese imports and Thai and Vietnamese exports. With the competitive advantages of using cassava for ethanol production than other materials (FAO., 2010; Sriroth *et al*., 2010; Nguyen *et al.* 2007), China now imports millions of tonnes of cassava chips to make ethanol and invested 1 billion USD in cassava in Tanzania, a country with only 5.5MT annual production (FAOSTAT, 2013). Cassava starch plays a major role in generating the income in many tropical countries like Thailand and Vietnam (Sriroth *et al.* 2000). Thailand's earnings from the export of cassava products reached nearly \$2.8 billion in 2014 having grown at about 15% annually, since, 2010 (AUDA., 2015). The modern starch manufacturing process was developed in Thailand due to the significant increased demand for cassava starch in the local market (Piyachomkwan and Tanticharoen, 2011). Thailand's successful industrialization of cassava is largely due to the research attention that led to the development of high-yielding cassava varieties and the promotion of the use of cassava products (starch) in the manufacturing sector. Cassava continues to play a major role in Thailand economy though it is not a stable. It is mainly used for fuel (ethanol) or feed (Treesilvattanakul, 2016). This success story presents great opportunity and lessons, especially to Africa countries that produces a lot cassava yet gain relatively little to nothing from their cassava sector due to limited industrialization.

CONCLUSION

Research and development attention for cassava starch production presents a great opportunity for industrialization of the cassava sector in Ghana. The available best high starch yielding variety in Ghana (57% starch of its total dry root weight) is below the attainable of 75-85%. There is therefore, the need to improve on cassava varieties that can yield about 70% or more starch of its total dry weight to meet the growing demand. Furthermore, there is a need to develop cassava with specific characteristics to fit diverse industries. For example, developing waxy cassava (amylose-free starch) for the food industries. The success story of Thailand indicates that with policy and Government of Ghana support in Research and Development (R&D) high quality starch yielding cassava variety for industrialization can be achieved.

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