

Research Application Summary

Processing qualities of potato varieties grown in Uganda: A brief review

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Abstract

Uganda is the third largest producer of potato (*Solanum tuberosum*) in East Africa beside Rwanda and Kenya. With its highland areas where most of potato is produced, Uganda is well placed to benefit from the regional growing demand for potato products such as French fries, crisps, starch and flour. However, lack of sufficient data on available local potato varieties to support industrial-level processing is one of the major challenges facing the Ugandan potato value chain. In order to provide this lacking information, a project titled “*Making Potato Value Chain Enhance Productivity and Incomes in Uganda*” is currently under implementation with objectives to document the physical and chemical properties of the potato varieties grown in Uganda for potential value added products, and develop and test innovative potato-based value added products with potential for commercialization. *Cruza, Kachpot1, Kachpot2, Kimuli, Kinigi, Mitare, Mumba, Rutuku, Rwashaki, Rwangume and Victoria* are the most important varieties grown by farming communities in Uganda. Only scattered data on tuber size are available for some varieties. Other features such as shape, color or eyes depth are unknown. The key parameters for value addition for each potato variety should be established to enable farmers, researchers and processors to take evidence based investment decisions.

Key words: Amino acid, crisps, dry matter, french fries, potato, value chain

Résumé

L'Ouganda est le troisième producteur de pommes de terre (*Solanum tuberosum*) en Afrique de l'Est, après le Rwanda et le Kenya. Avec ses régions montagneuses où la plus grande partie de la pomme de terre est produite, l'Ouganda est bien placé pour profiter de la demande régionale croissante de produits à base de pomme de terre tels que les frites, les chips, l'amidon et la farine. Toutefois, le manque de données sur les variétés locales de pommes de terre disponibles pour soutenir la transformation au niveau industriel est l'un des principaux défis auxquels est confrontée la chaîne de valeur de la pomme de terre ougandaise. Afin de pallier ce manque d'informations, un projet intitulé “*Making Potato Value Chain Enhance Productivity and Incomes in Uganda*” est actuellement en cours de réalisation. Il a pour objectif de documenter les propriétés physiques et chimiques des variétés de pommes de terre cultivées en Ouganda pour générer des produits à valeur ajoutée potentiels, et de développer et tester des produits innovants à valeur ajoutée à base de pommes de terre ayant un potentiel de commercialisation. *Cruza, Kachpot1, Kachpot2, Kimuli, Kinigi, Mitare, Mumba, Rutuku, Rwashaki,*

Rwangume et Victoria sont les variétés les plus importantes cultivées par les communautés agricoles en Ouganda. Seules des données éparses sur la taille des tubercules sont disponibles pour certaines variétés. D'autres caractéristiques telles que la forme, la couleur ou la profondeur des yeux sont inconnues. Les paramètres clés de la valeur ajoutée pour chaque variété de pomme de terre doivent être établis pour permettre aux agriculteurs, aux chercheurs et aux transformateurs de prendre des décisions d'investissement sur la base de données fiables.

Mots clés : Acide aminés, chips, matière sèche, frites, pomme de terre, chaîne de valeur

Introduction

Potato is an important crop for food and income generation in Uganda where it has been recognized as a strategic commodity with the potential to make a significant contribution to increasing rural incomes and improving food and nutrition security (Mugisha *et al.*, 2017). Despite the importance of potato in Uganda, its potential has not been fully realized. Use of non-improved or uncertified varieties and limited industrial processing/value addition of the crop are some of the major constraints affecting the potato value chain (Mbowa and Mwesigye, 2016).

In Uganda, value addition that would be critical in upgrading the entire potato value chain remains limited. Not only can value addition provide a means to carry over surpluses from one season to another, it also contributes to increase the shelf life, facilitates easy handling and helps reduce transportation costs (Abong *et al.*, 2010). It has also been noted that value addition bridges agriculture and industry and creates employment. Additionally, it produces 'convenience' foods in response to changing lifestyles and provides products with improved nutritional content in response to the increasing public demand for healthy diets.

Globally, the selection of raw material based on their physical and chemical characteristics is a critical and fundamental step in food processing, especially in the process flow of most of potato processed products (Keijbets, 2008). Processors therefore require potato varieties with specific characteristics to meet demand for quality products, and hence are drivers of modern potato breeding (Singh and Kaur, 2016). This has created a demand for unique potato varieties that may not be available in some potato seed systems involving small farmers. To date, very little is known on the processing properties of varieties released and grown in Uganda. This has motivated development and implementation of a project titled "*Making Potato Value Chain Enhance Productivity and Incomes in Uganda*", a CARP+ project. One of the project objectives is to develop and test innovative potato-based value added products with potential for commercialization and determine market potential and profitability of the potato value added products. This requires a review of the available information on physical and chemical characteristics of the major potato varieties cultivated in Uganda, thus their processing properties and potential to support value addition. This review focuses on the major potato varieties grown in Uganda namely; *Cruza*, *Kachpot1*, *Kachpot2*, *Kimuli*, *Kinigi*, *Mitare*, *Mumba*, *Rutuku*, *Rwashaki*, *Rwangume* and *Victoria* (Mbowa and Mwesigye, 2016).

Materials and methods

Monographic method has been used for the present review. Available literature on major potato varieties grown in Uganda. Physical characteristics, chemical composition of the potatoes and the current level of potato postharvest handling and processing in Uganda have been examined with the aim to cover broad spectrum of information essential to support industrial-level processing in the Ugandan potato value chain.

Potato characteristics and processing in Uganda

Physical characteristics. Potato size, shape, color and eye depth are strongly related to the genotype and are essential to determine the usage of a given lot of potatoes. For example, medium-large round tubers are preferred by the chip industry, as their shape facilitates peeling with minimal loss. The long, oblong type of potato is preferred by the French fry industry, and size uniformity is preferred for processing in all cases to obviate the need for size grading, rejection of tubers or cutting large specimens before processing (Singh and Kaur, 2016).

Mbowa and Mwesigye (2016) named 11 varieties most cultivated in Uganda stating that potato varieties that are 'big' in size were preferred by processors. The authors listed Rwangume, Kinigi, and Kachpot 1 as varieties with desired size. However, they did not provide any specific number to indicate how big were the size of aforementioned varieties. In their evaluation of potato genotypes for adaptability in Mt. Elgon Region of Uganda, Kwaka *et al.* (2017) established a brief characterization of potato tubers produced in Uganda. All the varieties were scored as very small with tubers smaller than 3 cm in the first season (2016A), while in the second season (2016B); majority of the potato tubers of different varieties were medium size (4- 6 cm). In addition, most of the varieties were categorized as having intermediate level of uniformity regarding their shape. Still, no detail on the method of measurements (determination of size and shape) was provided by the authors, nor specifications in terms of color, eye depth and sampling.

Chemical properties. Dry matter, reducing sugars and amino acid content are the main chemical properties that affect the processing of potato into different products. Dry matter is a key determinant for starch production, while reducing sugars content and total amino acid in raw potatoes are closely related to the final color of baked and fried potatoes as they participate in the Maillard browning reaction (Singh and Kaur, 2016).

Kesiime (2014) determined the dry matter of three potato varieties grown in Uganda and found that the highest dry matter content across the watering regimes was in variety Kachpot1 (25.3%) and Rutuku (24.5%). The lowest mean dry matter (of 20.16%) was recorded in Victoria variety. This result was corroborated by Senkumba *et al.* (2017) who stated that most of the varieties grown in Uganda had a dry matter content of 20-24% (Victoria 22.42%, Rwashaki 20.84%, Rwangume 21.73%, Kinigi 22.22% and Cruza 20.2%) indicating that they are ideal for processing into products such as chips and crisps. However, the dry matter content of varieties such as Kachpot2, Kimuli, Mitare and, Mumba, representing more than 44% volumes in the ware potato traded (Mbowa and Mwesigye, 2016), is still unknown. On the other hand, none of the two cited works (Kesiime, 2014 and Senkumba *et al.*, 2017) used potatoes grown under standard agronomic practices. Indeed, Kesiime (2014) determined the effect of watering regimes on the tuber dry matter, while Senkumba *et al.* (2017) studied the effect of storage conditions on the processing quality of different potato varieties grown in Eastern Uganda.

Regarding reducing sugars, Senkumba *et al.* (2017) observed a general increase in the reducing sugar content of the potato tubers between week 6 and week 9, with a mean in the reducing sugar of 0.27% for Victoria, 0.18% for Rwashaki and, 0.34% for Kinigi. However, no information related the content in reducing sugars was provided on other varieties representing around 85% of volumes of potatoes traded in Uganda. In addition, no data was reported on the amino acids content of major potato varieties grown in Uganda.

Potato postharvest handling in Uganda. Harvesting and postharvest handling are critical operations undertaken to avoid disease development in store, minimize postharvest losses and ensure better prices. Damage during harvest should be minimized by using appropriate equipment, potatoes should be free from soil, clods, stones and haulm when entering the store; aeration should be sufficient to remove respiration heat, dry the crop, remove any condensation and maintain the crop dry in store (Pringle *et al.*, 2009).

Unfortunately, Uganda is characterized by poor postharvest handling and lack of organized storage facilities amongst the value chain actors. This affects farmers, traders and processors (Mbowa and Mwesigye, 2016) since it results into high postharvest losses and reduced income. In order to address these challenges, Senkumba *et al.* (2017) introduced ambient storage structures and studied their effects on the processing quality of different potato varieties grown in Eastern Uganda. The authors found that all varieties with sufficient dormancy (two months or greater) were suitable for storage; and basing on the difference in temperature and relative humidity within the stores, together with the genetic makeup of the potato varieties, the potatoes in ambient store could be sold off at a maximum of 6 to 9 weeks if they are to have better processing quality characteristics. However, the potential for use of ambient storage structures among the value chain actors has not yet been established. As a result, farmers are still forced to sell potatoes at low prices immediately after harvest to avoid losses.

Potato processing in Uganda. Potatoes are produced for either the fresh market (boiled, baked) or for further processing into products such as crisps and French fries (Singh and Kaur, 2016). In the developed countries, a large proportion of the potatoes is more dedicated for processed products than for fresh consumption (Keijbets, 2008). The authors stated that processed potato products such as French fries fit exactly in these trends since they are convenient to use and have an improved taste, flavor and texture (crispiness) in contrast with fresh potatoes which are not convenient for the modern consumer since they have to be first peeled and boiled and do not have a distinct taste or texture.

Available information shows that Uganda has few potato processors. The existing potato processors largely operate in an informal market and on very small scale using simple tools and limited facilities to mainly producing chips (Kyomugisha *et al.*, 2017; Mugisha *et al.*, 2017). To date, Uganda has one modern processor of potato crisps in Kabale established by the Uganda Industrial Research Institute (Mugisha *et al.*, 2017). It, however, faces a challenge of inadequate supply of suitable potato varieties to support its value-added business operations (Mbowa and Mwesigye, 2016). Processing of the potatoes into French fries is limited to homes, hotels and restaurants.

Conclusion and recommendations

The potato value chain in Uganda has great potential but remains limited by the availability of empirical information needed to support industrial-level processing of value-added products, a key aspect in improving the value chain. The physical properties of most varieties grown in Uganda remain unknown. Only scattered data on tuber size are available for some varieties. The other important features such as shape, color or eyes depth are completely unknown. With regard to chemical properties, the available data on the dry content and reducing sugars of certain varieties show that some of the potato varieties grown in Uganda are suitable for processing. However, the lack of information on amino acid content is a serious problem for the potato industry in Uganda as this parameter is a key factor in the processing of lucrative products such as crisps and French fries.

Information on the physicochemical and processing properties of these varieties is the cornerstone on which the decisions of the stakeholders in the potato value chain can be made. The potential of each potato variety should be established to provide evidence based data needed by researchers and processors in product development, market analysis and investment in any potato-based product (starch, flour, snacks from peels), and by farmers interested in commercial farming to make informed choices on the potato varieties to grow.

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