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Sweet potato (*Ipomoea batatas* L. [Lam]) as an alternative to climate change in Europe

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Abstract: Climate changes in the recent period, with a tendency to increase pedological and atmospheric droughts, determine Europe to choose new plant species that can more easily withstand thermal and hydrothermal stress, because the southern part of Hungary, Romania, Slovakia, and Poland is a natural background, who favouring of significant the impact of drought on crops. The importance of growing sweet potatoes is due both to the possibility of expanding the yield in areas where potatoes are degenerating and the need to diversify the vegetable assortment with less known species but with high nutritional value that will effectively use the mesoclimatic conditions, especially in sandy soil in of Romania, or Polish. New varieties of sweet potatoes to establish profitability of their cultivation in marginal soils in south-eastern and central-eastern Europe. The high nutritional, energy, pharmacological and fodder value of sweet potato is an important subject of scientific research, not only in America, Africa, and Asia, but also in Europe under the conditions of climate change. The content of basic substances, such as carbohydrates, proteins, lipids, carotenoids, anthocyanin's, vitamins, minerals, and secondary metabolites, both in the root tubers and in sweet potato leaves, makes it a very nutritious herbaceous plant ensuring food safety for humans and animals. Sweet potato products can be effectively used as ingredients in food, medicine, cosmetics, but also as an energy base in European conditions and can compete with products imported from other continents.

Keywords: Sweet potato, Food safety, Energy value, Medicinal value, Nutritional value, Use value, Functional food, Climate changes, Mesoclimatic conditions

Introduction

Columbus in 1492 brought *Ipomoea batatas* L. (Lam.) tubers to Europe, and Portuguese explorers in the 16th century brought it to Africa, India, Southeast Asia, and East India. Spanish sweet potatoes were brought from Mexico to the Philippines in the 16th century. The introduction of sweet potatoes to the Pacific Islands apparently occurred in prehistoric times. Fossil charred sweet potato storage roots were found in northern New Zealand and were dated about 1,000 years ago, strongly supporting the prehistoric transfer theory, possibly by Peruvian or Polynesian travelers (Zhang, Wang, Liu, and Wang, 2009, Lebot, 2019). This species was first described in Spain around 1564, and it was well known even before the potato (*Solanum tuberosum* L.) (Zhang et al. 2009). The first sweet potato clones introduced in Europe were of tropical origin and could not cope with the temperate European climate, so the species remained a botanical curiosity for decades. Soon, new, selected sweet potatoes began to be introduced into cultivation in Southern Europe and they were soon distributed around the world, where it is cultivated to this day on over 8 million hectares with an annual production of over 90 mln t (FAO, 2020). Sweet potato has a cross-breeding system and reproduces vegetative, with each variety being considered a clone. The consumption of sweet potatoes (*Ipomoea batatas* L. Lam.) In Europe is steadily increasing. *I. batatas* is a hexaploid species (2n = 6x = 90) with a basic chromosome number x = 15 (Salehi, Krochmal-Marczak, Skiba, Patra, Anil, Tripathi, Al-Snafi, Arserim-Uçar, Konovalov, Csupor, Shukla, Azmi, Mishra, Sharifi-Rad, Sawicka, Fokou, Martorell and Capasso, 2020; Shen, Xu, Li, Jin, Liu, Clements, Yang, Rao, Chen, Zhang & Zhu, 2019). The first sweet potato clones introduced into cultivation were of tropical origin and did not cope with the temperate European climate (Roullier, Benoit, McKey and Lebot, 2012a; Roullier, Kambouo, Paofa, McKey and Lebot, 2012b; Sawicka, Michałek, Pszczółkowski and Danilčenko 2018). The sweet potato propagates vegetatively, and each variety is considered a clone. The border crossing and self-compliance system maintains a high level of heterozygosity and genetic diversity (Roullier, Duputié, Wennekes, Benoit, Manuel, Rossel, Tay, McKey and Lebot, 2012c; Lebot, 2019). In recent decades, improved varieties have been introduced in Europe (from Georgia, North Carolina, Louisiana, Israel, Ireland, or the USA). However, they are characterized by a low dry matter content, rich in sugars, which, although meeting the requirements of the American market, is not to the liking of European consumers. Sweet potato is already grown in many European countries, including Portugal (24,000 t), Spain (14,000 t), Italy (13,000 t), Greece (4,000 t) and France (over 5,000 t) (Lebot, 2019, FAO, 2020). This is important not only for South-Western Europe, but also for Central and Eastern Europe, where the demand for safe, gluten-free food and a vegetarian diet is constantly growing. So, there was an opportunity to diversify crops in this region of Europe.

The EU market is valued at over 350 million euros, with over 300 000 tons of imported sweet potatoes per year. The demand for sweet potato in this region of the world is growing by as much as 12% per year (FAO, 2020), while the consumption of sweet potato per capita in Europe is still low. The use of sweet potatoes is becoming widespread, and their popularity is steadily increasing, leading to an increasing demand for both fresh and processed consumer products. There is therefore a need for genotyping and morphological characterization of commercial varieties that should be performed in different countries in order to identify duplicate sweet potato clones known by different names. *I. batatas* viruses can be established and transmitted between cultivation cycles by stalk cuttings or slips (shoots grown from ripe sweet potatoes) used as planting material. These viruses are transmitted from one plant to another by sap-sucking insects such as aphids. Over the years, many European farmers have imported planting material as seedlings directly from abroad without serious control. This species is a very efficient "carbon sink" and can produce up to 50 t ha^{-1} of fresh root tubers in good conditions in five months of vegetation, practically without the use of herbicides, thanks to the fast vegetative soil cover (Mwanga, Andrade, Carey, Niski, Yencho & Gruneberg, 2017). However, routine tests are possible to test the health of the materials in commercial nurseries prior to using the cuttings for propagation. PCR is a more sensitive and specific method of detecting these viruses compared to conventional tests or ELISAs (Lebot, 2019). Variety selection in Europe aims to identify genotypes adapted to long days and summer droughts, especially in organic farming systems. Sweet potato produces significantly more energy per day than wheat or rice, while requiring less water (Manners and van Etten, 2018). Hence, in this review attention was paid to the adaptation of sweet potato to the weather conditions prevailing in south-eastern and central-eastern Europe. The aim of the study was also to summarize the existing knowledge about the health benefits of sweet potato, as well as to determine the possibilities of using this species in the production of functional food. A better understanding of the relationship between the genetics of sweet potatoes and their adaptation to Europe's diverse environments will yield forms suitable for field cultivation.

Materials and methods

Database. The following databases like: Cochrane, Google Scholar, PubMed, ProQuest, ScienceDirect, and Semantic Scholar were searched using key terms such as: "antibacterial effect", "anti-diabetic", "anticarcinogenic effect", "antioxidant effect", "antifungal effect", "hepatoprotective effect", "climate changes", "type 2 diabetes", "food

energy value", "functional food", "food safety", "medicinal value", mesoclimatic conditions "," nutritional value " , "use value", "carbohydrates", "bioactive compounds", "natural compounds", "antidiabetic compounds", "health".
Admission Criteria. Scientific studies (in silico, in vitro and in vivo) using various research models, such as human cell lines and laboratory animals, have reported that bioactive sweet potato compounds have health effects, including on type 2 diabetes, were analyzed. only in English, but also in other languages, so as not to limit the scope of the work. In addition, a manual search was performed to locate previous articles based on references to already published narrative articles and systematic review articles.

Exclusion criteria. All studies that looked at other types of diabetes were excluded. Presentations, letters to the editor, unpublished data and theses were excluded. Search results were limited to original scientific articles published between 1990 and 2021. Duplicate articles from different databases were searched and only one was kept. Data on the effects of climate change and its impact on the yield and quality of sweet potato were also extracted.

Influence of climatic and physiological factors on the yield and quality of sweet potato

A sweet potato needs an adequate supply of water during planting and for several weeks after planting. This species can tolerate moderate drought in the 2nd and 3rd month of growth, and in the 4th or 5th month it can tolerate even severe drought (Manners and van Etten 2018). In semi-dry growing conditions, the yield requires about 500 mm of water for a period of 4 months. Assuming the average yield of root tubers for storage on the level 30 t ha-1, with 33% DM of tubers for storage. This corresponds to a water requirement of 500 dm kg^{-1}, which is much lower than that of rice, which requires 1600 dm kg^{-1} DM or wheat (900 dm kg^{-1} DM) (Manners & van Etten 2018; Krochmal-Marczak, Sawicka, Bienia & Otekunrin, 2020a). Under conditions of high water stress, the relative water content of the leaves decreases and the leaves wilt, while their water potential decreases and the leaves age rapidly. However, in the early stages of drought, sweet potato returns to the turgor after wilting, but there are large differences between cultivars in response to water shortage during vegetation. The relative content of free amino acids, soluble sugars, ATP, and chlorophyll a / b is positively correlated with drought tolerance (Zhang et al., 2009; Roullier, Rossel, Tay, Mckey & Lebot, 2011; Manners & van Etten, 2018; Sawicka et al., 2018). In *I. batatas plants*, drought increases water use efficiency (WUE), thus minimizing evapotranspiration by reducing photosynthesis regulation, leading to biomass loss (Agarwal, Aponte-Mellado, Premkumar, Shaman, and Gupta, 2012; Gouveia, Ganança, De Nóbrega, De Freitas, Lebot, & Carvalho, De. 2019a, Gouveia, Ganança, Slaski, Lebot & Pinheiro de Carvalho 2019b, Gouveia, Ganança, Lebot, Pinheiro de 2020, Krochmal-Marczak, Krochmal-Marczak, Kiełtyka-Dadasiewicz, Sawicka, 2019a, Krochmal-Marczak, Sawicka, Michałek, 2019b). Sawicka et al. (2018), Gouveia et al., (2019b, 2020) suggests a drought avoidance strategy. The characteristics of the canopy are therefore crucial. Crop growth rate (CGR), net assimilation rate (NAR) and leaf area index (LAI) depend on the phenotypic variability of the cultivars. After planting, the LAI grows rapidly and then gradually decreases, but usually remains above 4.0 in the second half of the crop (Sawicka et al., 2018).

Average air temperature and solar radiation are considered to be the main climatic factors influencing the CGR (Krochmal-Marczak & Sawicka 2006). In the first half of the sweet potato development cycle, DM production depends on the size of the LAI, and these are closely related to air temperature. In the second half of the cycle, DM production and the root tuber growth rate depend on the NAR value and their relationship to solar radiation. The growth rate of storage roots is significantly influenced by solar radiation through NAR and CGR, of course when the LAI is above the optimal value (Sawicka et al. 2018). The canopy type may also have an impact on the net assimilation coefficient of sweet potato cultivars (Lebot, 2019). The taller varieties usually have an efficient photosynthetic surface and give a high yield of tubers in a relatively short time (Sawicka et al., 2018; Krochmal-Marczak et al., 2019b).

The factors that modify the photosynthetic surface are the length of the stem and the number of leaves per stem length unit. Some varieties with only small canopies, a short stem and small leaves may yield higher yields than those with long stems and broad leaves (Lebot, Michalet & Legendre, 2016). Identification and quantification of phenolic compounds responsible for the antioxidant activity of sweet potatoes with different flesh colors using high performance thin layer chromatography (HPTLC) (Krochmal-Marczak et al. 2019a). Varieties with short internodes produce short stems and a large photosynthetic surface in a small area and are more productive than the scattered, long internode varieties (Lebot 2019; Sawicka et al., 2018). On the other hand, varieties with small canopies showed a positive reaction to tuber storage. The efficiency of DM and the effective growth of DM in their roots is important (Lebot, 2019). At harvest time, sweet potato root tubers are exposed to a variety of fungal, bacterial and insect pests; the most serious is the sweet potato retractor (Cylas formicarius, Coleoptera: Brentidae). Sweet potato growers have tried to identify compounds in the storage root periderm that could inhibit the growth of fungi or bacteria or act as a natural deterrent to weevil weevils to contribute to the development of resistant cultivars (Krochmal-Marczak, Krochmal-Marczak, Sawicka, Krzysztofik, Danilcenko & Jariene 2020b). Hydroxycinnamic acids (HCA) are associated with weevil resistance (Wallingford, Lebot, Abraham, Kaoh, Rogers & Molisalé 2019; Lebot 2019). Breeding of varieties with higher HCA content may be interesting (Sawicka et al. 2018, Low & Thiele 2020). The individual HCAs were also analyzed and tested in bioassays. Caffeic acid, in turn, inhibits the growth of pathogenic fungi. Its inhibitory effect suggests an effect on the thickness of the periderm. Caffeic acid levels may also help protect sweet potatoes (Jackson, Harrison, Thies & Bohac, 2011). Chlorogenic acid (CGA) and dicavoylquinic acids (DICQA) are the most important HCAs in the periderm. They may contribute to the improvement of resistance to storage root diseases. CGA has also been shown to be an effective insect growth repellent (Wallingford et al., 2019, Krochmal-Marczak et al. 2020b). Scopolamine and scopoline (its glycoside) were analyzed both in the periderm and cortex tissues. Tested in vitro on various species of fungi, they inhibited their growth. Scopolamine and scopoline concentrations may be useful chemical markers, especially useful in the cultivation of sweet potato varieties with resistance to root diseases (Wallingford et al., 2019; Low & Thiele 2020). For both HCA and coumarin, there is a need to test their bioactivity on a wider spectrum of pathogenic fungal species and sweet potato insect pests in Europe. The content of these bioactive compounds could be increased by conventional breeding (Low & Thiele, 2020), an analytical technique could screen numerous hybrids to select those with the highest content for selection. High-performance thin layer chromatography (HPTLC) is a powerful high-throughput analysis tool. It was used in the studies by Lebot et al. (2016), who to analyse nearly 300 sweet potato varieties and secondary metabolites in the periderm.

For sweet potato consumers, however, the taste criteria are the most important for the registration of new varieties. A breeding program was developed and carried out to breed sweet potato varieties rich in secondary metabolites (Lebot, 2012; Low & Thiele, 2020; Moyo, Ssali, Namanda, Nakitto, Dery, Akansake, Adjebeng-Danquah, van Etten, de Sousa, Lindqvist-Kreuze, Carey & Muzhingi, 2021). It turned out that the purple-flesh varieties are very rich in DICQA (Lebot et al., 2016). The varieties with orange flesh, on the other hand, contain more carotenoids than varieties with white or cream-colored tuber flesh. Sugar-free varieties have also been identified. The sweetness of tuber flesh comes from the content of maltose resulting from the hydrolysis of starch and beta-amylase during baking (Lebot, 2017). A positive correlation was also found between starch and dry matter content, and a negative correlation between starch content and protein, minerals, fiber, and sugars. Orange-colored varieties tend to contain more carotenoids than white or cream-colored varieties. Consumers, on the other hand, prefer varieties rich in starch and dry matter (Moyo et al., 2021).

Chemical composition

Ipomoea batatas, due to the high nutritional value of tubers, is becoming an increasingly popular vegetable among consumers in Poland (Sawicka, Pszczółkowski and Krochmal-Marczak, 2004, Sawicka & Krochmal-Marczak 2006, Sawicka, Pszczółkowski, Krochmal-Marczak, Barbaś and Özdemir 2020; Krochmal-Marczak & Sawicka, 2013, 2015; Krochmal-Marczak, Sawicka, Słupski, Cybulak, & Paradowska, 2014; Krochmal-Marczak et al., 2020a). Tubers of this species contain 21.51-34.36% dry matter, including about 14% starch, over 5% sugars; 3-8% protein, 0.6-0.9% crude fiber, 1% crude fat and vitamins: B1, B2, PP, C, as well as small amounts of β-carotene and secondary metabolites (Sawicka et al., 2004; Sawicka et al., 2020a; USDA, 2018). The nutritional value of sweet potato tubers is about 50% higher than that of potato tubers (Sawicka et al. 2004, Krochmal-Marczak et al., 2014, Cartabiano-Leite, Porcu, and de Casas 2020). Tubers and leaves of I. batatas can also be an excellent raw material for food processing, due to their very rich chemical composition, especially processing specializing in the production of nutrients for young children and infants, as well as in baked, fried, or candied products (Krochmal-Marczak et al., 2013; Krochmal-Marczak & Sawicka, 2015).

Sweet potato leaves contain approx. 12.2% dry weight, including approx. 4% protein, B vitamins, β-carotene, and vitamin C (approx. 11 mg / 100 g fresh weight), they are also an excellent source of lutein (Krochmal-Marczak et al. 2019b). The nutritional value of 100 grams of raw leaves is estimated to be 35 Kcal (147 KJ) with significant amounts of mineral salts, especially calcium, phosphorus, and potassium. The Ca: P ratio in the leaves is 0.4: 1. (USDA 2018). Young sweet potato leaves are used in Taiwanese cuisine and in West African countries (Guinea, Sierra Leone, and Liberia), as well as in Northeast Uganda and East Africa as a vegetable and spice (Zhang et al. 2009, Lebot, 2010). Due to the high content of soluble sugars, sweet potato can serve as an easily digestible food for children and an excellent food for diabetics (Allen et al., 2012; Krochmal-Marczak et al., 2014; Krochmal-Marczak & Sawicka, 2015; Sawicka et al., 2020a). *I. batatas* should be considered a raw material for the production of functional foods to aid in the treatment of metabolic diseases such as type 2 diabetes (Sawicka et al., 2020). It is also a valuable medicinal plant with anti-cancer, anti-diabetic and anti-inflammatory properties and can be used as a raw material for the pharmaceutical industry, but it can also be used to enrich the daily diet. The sweet potato is a staple variety with a high nutrient content and higher energy value than potato, and is modeled to thrive on all continents. This species was clonally introduced in Europe, so its genetic base is narrow (Mwanga et al., 2017; Lebot, 2019). In order to breed varieties adapted to the new environment, in the conditions of climate change, resistant to diseases and pests and various market needs, it is necessary to extend the genetic basis of the propagating material. This proposal brings together scientists working with agronomists, breeders, physiologists, private sector producers in France, Germany, Poland, and Romania, and possibly also in other European countries. The integrated approach will add value to varieties, especially as functional foods, and their use in breeding programs can be promoted. Low and Thiele (2020) concluded that the development and growth of Orange Flesh Sweet Potato (OFSP) varieties over the past 25 years is a groundbreaking innovation in sweet potato breeding to address the urgent need for high levels of vitamin A among children under five. years of age in sub-Saharan Africa. When this innovation was introduced, consumers strongly preferred white or yellow-flesh sweet potatoes, so it was necessary to create a demand to meet this need. This was contrary to the overall breeding strategy of responding to consumer demands. An additional element of this innovation was also nutritional education, aimed at educating consumers about the significant health benefits of Orange Flesh Varieties (OFSP). These efforts will focus on sharing increased genotypic and phenotypic information using new data processing tools.

Sweet potato as functional food

In recent years, functional food has become more and more popular all over the world, which has an additional, documented impact on human health. This food helps to reduce the risk of developing civilization diseases, such as obesity, diabetes, cardiovascular diseases, and cancer. One of the ways to prevent these diseases is food enriched with various bioactive ingredients, incl. vitamins, minerals, polyunsaturated fatty acids, which reduces the risk of developing civilization diseases (Lebot, 2012, 2019; Malapa & Jung, 2013; Krochmal-Marczak, Krochmal-Marczak, Sawicka & Tobiasz-Salach, 2018; Krochmal-Marczak et al., 2019 a, 2020a, 2020b). For example, essential amino acids, present in tubers, in appropriate amounts, contribute to the maintenance of the water balance and the regulation of fluid content in the circulatory system and in intra- and extracellular spaces. Due to the buffering properties of proteins, after consumption, they participate in maintaining the acid-base balance (Sawicka et al., 2004; Krochmal-Marczak et al., 2014, 2020b). Insoluble fiber contained in sweet potato tubers can prevent constipation, diverticulosis, hemorrhoids, and obesity. As a food additive, it can slow down the absorption of glucose and cause a feeling of fullness. Soluble pectin's maintain normal blood cholesterol levels, and soluble fiber helps to reduce LDL cholesterol levels, which is very beneficial for diabetics as they are at increased risk of coronary heart disease (Ayon, Islam & Hossain, 2020). Due to the content of vitamin C, provitamin A, thiamine, riboflavin, niacin, pantothenic acid, vitamin B6, folate, choline, α- and β-tocopherol and vitamin K, sweet potato tubers can prevent: blindness and degenerative eye diseases (Sawicka et al., 2018). β-carotene may support the treatment of certain cancers (stomach, pancreas, mouth, and gums), prevent macular degeneration, improve vision in the dark, increase milk secretion in breastfeeding women, detoxify the body, heal diarrhea, regenerate damaged skin (Krochmal-Marczak & Sawicka, 2015). In addition, β-carotene reduces the risk of type 2 diabetes and contributes to changes in cholesterol fractions - lowering LDL and increasing HDL, as well as reducing the risk of cardiovascular diseases (Low & Thiele, 2020).

The World Cancer Research Foundation, together with the American Cancer Research Institute, indicates that there is a link between β-carotene consumption and the development of esophageal cancer. In turn, chlorogenic acid has antitumor and antiviral properties, and caffeic acid is effective in combating cancer and HIV. Lutein and zeaxanthin are involved in the prevention of atherosclerosis, certain cancers, and eye diseases (Krochmal-Marczak & Sawicka 2013b, Sawicka et al., 2018; Low & Thiele, 2020). Potassium in sweet potato tubers helps to reduce blood pressure and thus minimizes the risk of coronary heart disease. Vitamin B6 prevents heart disease, strokes, depression, and insomnia, while vitamin C strengthens immunity and enhances wound healing (Roullier et al. 2011, 2019). Phytosterols in *I. batatas* tubers lower high cholesterol and may also reduce the risk of cancer by binding to potentially carcinogenic agents in the gastrointestinal tract. In addition to the edible root tuber, the sweet potato also has edible leaves and aerial shoots. The leaves can be used to make infusions for the treatment of type 2 diabetes and inflammation of the mouth. Sweet potato leaves are used in the treatment of the prostate (Sawicka et al. 2018). They contain a number of minerals, such as: Ca, P, Mg, Na, K, S, Fe, Cu, Zn, Mn, Al and Se, and in this respect they are comparable to spinach. The level of iron, calcium and carotenes is among the best vegetables (Krochmal-Marczak & Sawicka, 2013b; Lebot et al. 2013; USDA, 2018). Sweet potato leaves are also rich in protein, vitamins such as: vitamin B and A (Krochmal-Marczak & Sawicka, 2015). There are also fatty acids in the sweet potato leaves. Monounsaturated fatty acids, found in this part of the plant, reduce the concentration of the so-called "Bad" cholesterol (LDL) (Ayon et al., 2020, Low & Thiele 2020). As a result, they have a protective effect on the artery wall and reduce the risk of atherosclerosis. It has been shown that replacing saturated mono- or polyunsaturated fatty acids reduces the level of total cholesterol and LDL cholesterol in the blood serum. In addition, monounsaturated fatty acids do not lower HDL cholesterol and do not affect the level of triglycerides (Low & Thiele, 2020). The polyunsaturated fatty acids in the aerial parts of this plant, such as linoleic acid (omega 6) and α-linolenic acid (omega 3), must be supplied with food, as they are essential for the proper development of young organisms and the health of adults. They are also used to create prostaglandins (tissue hormones) that affect cardiovascular function, digestion, and many other processes. They lower cholesterol and reduce the aggregation of platelets, thus preventing the formation of blood clots and atherosclerosis (Krochmal-Marczak & Sawicka, 2013b, 2015; Low & Thiele, 2020).

Functional food, in addition to the traditional nutritional function, has an additional, documented, beneficial effect on human health. Consuming it allows you to reduce the risk of developing many civilization diseases, such as obesity, diabetes, skin diseases, diseases of the cardiovascular system, and cancer. Such a raw material used for the production of functional food may be sweet potato (*I. batatas*). "Functional food", apart from its conventional meaning, must have a beneficial effect on the human body in amounts that are expected to be respected with a diet; however, they cannot be tablets or drops, but an integral part of the correct food (Mwanga et al., 2017; Sawicka et al., 2018; Krochmal-Marczak, 2019a). Over the last decade, the traditional perception of sweet potato has changed, and it is now recognized that sweet potato has enormous potential to contribute to the alleviation of malnutrition and hunger in developing countries. Orange-flesh sweet potato in particular, with a high content of provitamin A, has become an outstanding example of the effectiveness of biofortified primary crops in combating vitamin A deficiency, not only in sub-Saharan Africa, however, has a significant research deficit in the Europe, hence, it is an important candidate for additional, innovative research and investment.

Added value to European research and innovation

The added value of sweet potato research is giving Europe access to a broad genetic base and building partnerships through a network of research institutes and universities focusing on organic farming systems. New pest and disease resistant genotypes of I. batatas must be obtained. This will allow the selection of genotypes with maximum allelic diversity to be introduced in populations with high starch content, with low in sugar, high in carotenes and high in phenols. Therefore, there is a chance to select varieties in terms of the variability of their main compounds, as well as secondary metabolites, enabling the identification of potential parents with outstanding features for breeding programs. There is also the possibility of increasing the potential yield of sweet potato, which will be the basis for favoring European varieties over imported ones, leading to an improvement of the varieties for current and future climate change.

Conclusion

Sweet potatoes are highly heterozygous, and selection and replacement of elite varieties will provide sufficient variety. The best genotypes of I. batatas should be selected as raw materials for the production of functional food, on the basis of their chemical composition, according to criteria defined by both producers, consumers, and end-users in the food chain. The distribution of varieties will have a direct impact on the biodiversity of sweet potato. The introduced varieties will directly contribute to increasing the productivity and economic effects in conventional and ecological agricultural systems. This will increase the availability of raw material for a variety of high-quality products, with increased health benefits for consumers and greater economic benefits for producers by creating new functional products and new markets, and in the long term - a steady return on investment (Lebot 2019). Sweet potatoes can be used to fill marginal areas. The international exchange of germplasm can make a direct contribution to the FAO Treaty and Nagoya Protocol (FAO 2020). The transfer of technology and information on germplasm will create a lasting partnership for the conservation of genetic resources and apply to breeding programs. This will help to strengthen the various links between research, the implementation of innovative technologies and the private sector.

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