Vol.64: e21200568, 2021
https://doi.org/10.1590/1678-4324-2021200568
ISSN 1678-4324 Online Edition

Review - Food/Feed Science and Technology

Sweet Potato (*Ipomoea batatas* L.): a Versatile Raw Material for the Food Industry

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Editor-in-Chief: Paulo Vitor Farago
Associate Editor: Paulo Vitor Farago

Received: 2020.09.01; Accepted: 2020.10.01.

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HIGHLIGHTS

- Sweet potatoes (SP) are cultivated worldwide and feed millions of people, mainly in developing countries.
- SP composition includes starch and other carbohydrates, which may change during postharvest and processing.
- SP may serve as source of slowly digestible and resistant starch and other ingredients for the food industry, including bioactive compounds with potential for promoting health benefits.

Abstract: Sweet potato (SP) starchy roots have a broad range of colors, high-quality nutritional composition including bioactive substances (anthocyanins and β-carotene), vitamins, minerals, dietary fiber and starch. Several studies report the versatility of this root crop as part of the human diet and its possible health benefits. In this review the SP chemical composition, nutritional properties and its potential use in food processing for developing nutritious and healthy products are explored. Due to the adaptation of sweet potatoes to several agricultural managing conditions, accepting low technology /low cost with reasonable performance, it has called attention as a strong candidate of accessible functional food market.

Keywords: starch; tuber crop; flour; food ingredient; bioactive compounds.

INTRODUCTION

Sweet potatoes (*Ipomoea batatas* L.), from Convolvulaceae family, have great genetic diversity offering many different sensory aspects including a broad range of colors (pulp and peel), taste and texture for the consumers. This tuberous crop is cultivated for the nutritional value of its starchy roots and also because it adapts to several cultivation conditions without special needs or elevated manage costs when compared with potato (*Solanum tuberosum*), for example. Although the sweet potato cultivation is spread worldwide [1,2,3], Asia and Africa account for around 85% of the global production [4]. World production of sweet potatoes is reported to be 105 million metric tons/year [5,6].

Originated from Latin America, its cultivation is made in more than 100 countries, with China accounting for more than 75% of total production; some African countries are also important producers, mainly Uganda and Nigeria that harvest around 3% of the global production [7,5]. Sweet potato roots are used mainly as direct food for millions of people, with some amount being processed by the food industry or used for animal feeding [3,8,9]. In Brazil sweet potatoes have great genetic diversity and are frequently present in family farming due to wide adaptability, tolerance towards drought, rusticity and easiness of cultivation with production throughout the country totaling 740,000 metric tons harvested in 2018 [5].

The United States are big traders of sweet potatoes and are in the eighth position in global ranking of the producers. North Carolina is the main producer among the North American states, responsible for 40% of their national harvest [10].

Even though sweet potatoes are grown in many places, only 1% is marketed with Canada, United Kingdom, Netherlands and Japan, which are the main importers. The United States are the most important exporters accounting for 44% of such trade [5].

Sweet potato can be considered an ancient crop, relevant for many countries as source of energy for human diet. It outstands as one of the main food crops together with cereals (rice, wheat and corn), legumes (soybeans, dry beans, peas) and other tubers (cassava and potato), generally occupying the third place when considering the production value and the fifth place in caloric importance for the human diet [3,1,8].

This review aims to report and discuss aspects involving the chemical composition, nutritional value and the development of new products (foods and beverages) based on sweet potato as the main raw material.

Sweet potato cultivation

The sweet potato plant has a long life cycle (up to 36 months), but the maturity of its roots is reached in only four months with staggered harvesting starting after root maturation [11,8]. Sweet potato plant growing divides in three stages. During the first stage, aerial part and the peripheric roots develop. The tuberous root formation begins in the second stage with starting of nutritious reserve accumulation. Roots volume increases with change in consistency and they become fleshy. The third stage comprises the complete development of the tuberous roots, with intense storage of starch and other photosynthetic compounds [12,13].

This crop can be produced in very distinct cultivation levels even with low technology and minimal supervision. Therefore, it attracts attention from small farmers favoring their profits especially if cultivated in organic system with applications both as raw material for industrial processing as well as food for the families and the byproducts / discarded roots for animal feeding [11,7].

Post-harvest losses are a concern for this crop [14,6]. During harvest and also after this stage improper handling of the high-moisture roots can cause mechanical damage impairing quality and increasing losses due to microbial contamination. In developing countries, with warmer and humid climate, the larger post-harvest losses are estimated (15-65%). An alternative to prevent such losses could be the processing of roots to make dry flour.

These tropical origin roots cannot be stored at low temperatures (4 - 10 ºC) because they are susceptible to chilling damage. Storage should be made at temperatures above 13 ºC, but in warmer conditions starch content can decrease and sugar levels increase in some varieties [2].

There is another big issue related to food losses, the farm-level losses. Those values are difficult to estimate because they are not as visible as consumer food waste [15]. Even in the United States and in other developed countries, the data from farm-level losses are unreliable due to lack of field-based measurement. In general, interviews with farmers are performed but not always bring real and reliable data. Harvesting vegetable crops as sweet potatoes can cost a lot of money and produce with size, shape or any defect is left in the field during this step. According to Johnson and coauthors [15], which have developed a field-based study in North Carolina (USA), very high amounts (mean value of 42%) of marketable/edible sweet potato roots remain unharvested and are lost due to commercial issues. Considering that the crop produce remaining in field is mostly edible, opportunity exists for use in foodservice, processing, alternative markets or emergency food supply.

Popular and valued by several populations since ancient times, sweet potato was already considered a special “hunger relief” food for the poorer populations [6]. This root crop has saved people from different regions from hunger and catastrophes. In China during the 1960’s, it was the food that has avoided the death of millions. In Japan it was the relief when typhoons destroyed rice fields throughout the country. In Uganda, in the 1990’s, with very serious phytosanitary issues in their cassava fields, sweet potato was also the food that has fed millions [4].

In order to improve the nutritious quality of food crops, research has been performed for decades. In the specific case of sweet potato, important benefits were described associated with its caloric value, dietary fiber and resistant starch contents as well as the presence of important phytochemicals (anthocyanins, carotenoids) [16]. Although the number of scientific studies on this root crop is increasing there is still limited consumption if compared with other main food crops. An alternative for increasing the use of sweet potatoes would be its incorporation in baked foods, in ready-to-eat dishes, development of ethnic recipes and the processing into flour that could partially replace wheat flour in countries where this cereal is scarce or expensive [14,17,6].

Chemical composition of sweet potatoes

Sweet potato is an important source of nutrients for human diet and also contains bioactive compounds potentially beneficial to health with special interest for the functional food market [10,18].

Sweet potato varieties with higher dry matter content also have higher percentages of starch and soluble carbohydrates and larger starch granule size after storage of the roots. Smaller starch granules tend to degrade faster during storage of the roots [2].

Carbohydrates are the most abundant constituents from SP roots, providing energy for human diet (Table 1). Dietary fiber values (1.3-3.8 %) and glycemic index (63 to 66) are better than those reported for potato (*Solanum tuberosum* L.). Generally, dietary fiber intake is below the desired level (14 g/1000 kcal or 23-38 g/day). Therefore, the development of products or ingredients rich in dietary fiber is increasing and this tropical tuber crop can potentially improve the dietary fiber and also the contents of other nutrients in processed foods [9,8].

High moisture level and low lipid content (0.2%), with protein levels ranging from 0.5 to 2.2% are reported for SP [19,9]. Generally, starch content ranges from 15 to 26 % in wet weight basis [20].

Depending on the SP pulp color distinct vitamin contents are present (mainly A, B and C); in general, β-carotene, anthocyanins, phenolic compounds, folic acid and minerals (potassium, calcium, magnesium, sodium, phosphorous and iron) may be present. High contents of chlorogenic acid, a family of esters formed from cinnamic and quininic acids can also be found [21,3,8].

Fermentable sugars (glucose, fructose and sucrose) are present in SP pulp that also contains vitamin C in concentrations reported as twice those from common potatoes [8]. SP can be considered as a good source of β-carotene (vitamin A precursor), with reported concentrations of around 18 mg/100 g. This important bioactive prevents vitamin A shortage in the organism avoiding serious diseases (mainly the night blindness) and also has antioxidant property and can aid in prevention of heart diseases and cancer. It also contains certain phenolic acids, especially hydroxycinnamic acid [22,10].

The ingestion of 100 – 125 g of yellow flesh SP per day will provide the recommended dietary allowance of vitamin A for children younger than five years old [7]. In Asian and African countries this starchy root is reported to help avoiding vitamin deficiency in children and women.

The purple flesh SP is rich in acylated anthocyanins and other phenolic compounds with antioxidant activity with good bioavailability, presenting anti-inflammatory action. These anthocyanins are not stable but have beneficial effects to human health. This deep colored SP with high levels of anthocyanins can be used as natural colorant to the food industry [10,23,24].

Some studies show that anthocyanins can eliminate free radicals, have positive effects in memory, decrease blood glucose levels and are able to inhibit growing of certain types of cancer cells [25,24].

Table 1. Nutritional value of raw SP.

Nutrient	**Amount**	**Unity (/100g)**
Water	69.5-81.3	g
Energy	86.0-106.0	kcal
Protein	1.5	g
Lipids	0.1	g
Carbohydrates	21.3-22.0	g
Dietary fiber	3.0	g
Calcium	39.0-63.0	mg
Iron	0.6-1.3	mg
Magnesium	15.0-37.0	mg
Phosphorous	28.0-51.0	mg
Potassium	191.0-337.0	mg
Zinc	0.3-0.7	mg
Vitamin A	1.0-1371.0	µg RAE
Vitamin B	82.5	mg
Vitamin B2	47.3	mg
Vitamin B5	0.55	mg
Vitamin B6	0.21	mg
Vitamin C	3.0	mg

RAE = Retinol activity equivalent

Source: [26, 27] (adapted)

Orange fleshed sweet potato (OFSP) is considered one of the most successful cases of biofortification of a staple food crop in the world. In Africa vitamin A deficiency is still a serious nutritional concern and OFSP consumption delivers β-carotene to the population alleviating this problem [27]. Consumers from South Africa prefer floury/starchy sweet potatoes, which have higher dry matter content. Sweetness and maltose content also seem to be desirable for South African consumers.

Purple fleshed sweet potato has potential for use as source of natural colorants and its antioxidant activity drives this food crop to be included as raw material for the functional food industry [28].

Sweet potato processing

Traditionally, the consumption of SP occurs as cooked roots but its use as ingredient in food formulations, ready-to-eat products and beverages is growing up. The direct use of SP as food is still the most abundant and only a limited percentage of the roots is utilized for animal nutrition and for industrial applications [3, 29].

Boiling, steaming, roasting and frying are the most frequent ways to cook sweet potatoes for human consumption and each of those thermal treatments can benefit their sensory quality. Roasting of Chinese cultivars of sweet potatoes was studied as affecting color and the contents of sugar, amino acids and volatile compounds. Roasting contributed for chemical and sensory changes (mainly associated with the Maillard reaction) as well as partial enzymatic hydrolysis of starch, increasing the maltose contents by roughly 14 to 160 times if compared to its original percentage in dry weight of uncooked roots [30].

Pulsed electric field (PEF), a non-thermal technology was applied to sweet potato roots, also known as *Kumara* in New Zealand, in order to evaluate its effects on structure and frying quality [31]. The results showed that PEF was able to improve the texture and facilitate frying at lower temperature and with less absorption of frying oil by the *Kumara* chips.

Among several varieties of SP cultivated in different regions from the world, those of different pulp colors (purple, yellow/orange, white/beige) are considered potential raw materials for the industrial processing. Their differences surpass the color and also involve physicochemical, nutritional and antioxidant properties, and the right selection for industrial processing is a key-factor. Varieties with light color pulp, for example, contains the highest percentages of starch and are though recommended for processors interested in that polysaccharide [6].

Primary processing includes proper storage and handling of the fresh roots. Classification is one of the most relevant post-harvest operations, in which the roots are separated by size, shape, weight, uniformity and presence of defects. One of the most important handling steps is known as cure, which promotes wound healing of surface injuries that were produced during harvest. Performed in the farm to retard deterioration by exposing the roots to mild temperature for a specified time to allow the auto cure of the roots. Raw SP roots can be stored for two to three weeks if not consumed just after harvest [6].

If secondary processing is made value-added products can be obtained. The production of SP flour, for example, involves bleaching (with sulfur dioxide) previous to (sun- or oven-) drying step for avoiding undesirable enzymatic browning [32,6].

Another method for preserving SP roots involves fermentation in a similar way as carried out for other vegetables, resulting in peculiar sensory quality [33,34].

In Japan, besides being directly consumed as cooked roots and for livestock, manufacturing of starch, beverages and domestic products is also important for the sweet potato production chain. Starch is the main component of the reserve roots and drives most SP uses, affecting the texture of cooked roots and together with sugars (glucose, fructose, sucrose and maltose), the eating quality [35].

Alternative starches are of great interest because they can replace some types of modified starches in the food industry. Each starch will present distinct technological properties that depend on the genetic background as well as on environmental conditions during crop development. Sweet potato starch has been studied and presents unique properties, which can be explored benefiting and broadening the starch market [36]. SP starch was pregelatinized by spray-drying with changes in the granules that have lost partially or totally the crystallinity depending on the degree of gelatinization [37]. The authors explain that their study was justified by the growing interest of the industry in non-conventional sources of starch, like starch from sweet potato.

Processed Foods

The high nutritional value and the presence of good levels of polyphenols, antioxidant pigments in SP varieties are calling attention from the consumers; this tuberous root reaches trade needs for functional foods and also the food and beverage industry search for new nutritious and functional ingredients [38].

The main compound found in SP roots is starch and it is the most important industrial commodity to be produced from this raw material; depending on the variety, starch accounts for 50 to 80% of the roots dry matter [39, 40]. Starch main properties (gelatinization, thermal and rheological behavior) vary depending on SP genetic background. SP starch granules have diameters and amylose contents in between those reported for cassava and potato starches [24,36]. Sweet potato starch differs from cereal starches (A-type) in several properties, including its C-type polymorph under X-ray diffraction. Even though, these two starches behaved as compatible polymers when tested using a thermodynamic approach [41]. There are some sweet potato cultivars available only in Japan that present B-type polymorph and the lowest gelatinization and pasting temperatures reported so far (50.1 - 52.2 ºC and 58.4 – 58.8 ºC, respectively) [35]. Energy saving gelatinization would be one of the great advantages of using those Japanese cultivars in food processing and also as feedstock for production of bioethanol.

Knowing of the physicochemical and technological properties of the starch will result in the best industrial uses with the desired results and high quality products [36].

Processing promotes extended availability of sweet potatoes as well as value-adding. Flours, purees, flakes and other products can be made and used directly or as ingredients in breadmaking and confectionary, for example [27].

Studies on the production of bread and bakery products with gluten-free flours are also relevant for the use of SP. In general, flour mixes are made with locally produced gluten-free cereals, tuber and legumes and are advantageous for developing countries in which wheat is not available in large amounts, being imported or a high costing crop [42].

In addition to the economic advantage, incorporating SP flour in breadmaking can also result in nutritional benefits. If the right variety is used, containing yellow/orange pulp, for example, it can deliver β-carotene and also serving as a natural colorant to the bread crumb; the purple fleshed SP can also be used as a natural colorant and can also be beneficial to human health. These flours have important chemical characteristics and can be used together with wheat flour to alter rheological and sensory quality [25, 43,36,44]. An example of the effect of chemical composition on breadmaking is related to the presence of sugars like maltose, sucrose, fructose, glucose and some fructooligosaccharides, which even in low concentrations favor the processing of long-time fermentation baking products [14].

Another way of incorporating SP in bread doughs is by cooking the roots and producing a puree. This puree has around 80 % moisture and low contents of protein and lipids but considerable levels of fiber and minerals [9]. SP that is not directly consumed cooked in human diet can be used to produce flour or starch. Studies reporting fermented foods from SP are available (Table 2). In the African country Gana, for example, the traditional cassava fermented flour known as *Gari* was produced replacing the original raw material by SP [45]. The fermentation process in which predominates lactic acid bacteria influences the sensory quality in several ways with acidification, for example (lactic acid produced will cause pH drop) [33].

The purple fleshed SP that is rich in anthocyanins is frequelntly used as a raw colorant, because those colored compounds are water soluble and safe for ingestion. This pigment, however, degrades under light, pH changes, temperature, oxygen, ascorbic acid and sugar. The main anthocyanins from thee purple flesh SP are cyanidin and peonidin [46].

Besides the food uses of SP roots, the vegetative parts of the crop (leaves and stems) and also those roots without commercial value (bad shaped, too big or too small) can be fermented for animal feeding in many countries, like China and Japan [47,19].

The wastes generated by SP flour processing are being used as cheap substrates in bioprocess technology for producing microbial enzymes, for example [48].

The continuous increase of the demand for bio-renewable fuels together with the alternative sources of energy generation, poses SP bioethanol as a potential bioproduct [49].

Sweet potato starch outstands in East and South Asia as an important ingredient for oriental foods as noodles and vermicelli. China is the leading country in the commercial production of SP starch, but processing technology still needs to be improved. The largest sweet potato starch factory in China produces 120,000 metric tons of starch, 70,000 metric tons of noodles, and 10,000 tons of vermicelli [28].

The main reported use of sweet potato starch is as a cheaper ingredient for noodle production, replacing mung bean starch. Other applications described include the production of thermoplastic materials (biofilms), component of pharmacological and medical products (binding agent for tablets, controlled drug release carriers) and source of nutrients in several bioprocesses (maltose, bioethanol, lactic acid, cyclodextrin, trehalose). Many other possibilities are still underexplored for SP starch when comparing with the largely available starch sources [50].

Innovative foods are continuously under development estimulated by consumer's demands for nutritious, healthy and tasty products. 3D printing is an emerging technology adopted by many industrial sectors, including the food processing chain. Similar to 3D printing, the concept of 4D printing was introduced in the last decade and involves smart materials that will change over time due to environmental effects, like pH values, light exposition, temperature and so on. 4D printing of mashed potato together with purple sweet potato puree with spontaneous color channge was promoted and a three-dimensional multi-color ready-to-eat food was developed. The color of the printed product, rich in anthocyanins, would change gradualy with storage time as a response to pH values [51].

Sweet potato starch *in vitro* digestibility was investigated and improved by enzymatic selective hydrolysis [52] and heat moisture treatment [53]. Considered a cheap and available source of starch, increased levels of slowly digestible and resistant starch (SDS and RS, respectively) were produced by using fungal α-amylase from *Aspergillus oryzae*, maltogenic α-amylase from *Bacillus* sp and pullulananse from *Bacillus subtilis* [52] .

An optimized SDS production from sweet potato starch was described as being the use of moisture level at 22.8 %, at 113 ºC/8.6 h and the authors suggested possible technological uses of this thermally modified starch in low glycemic index processed foods such as crackers and cookies [53]. Sweet potato is a major source of opportunities for the food and beverage industry as well as for other industrial applications, including bioprocess technology and biofuel (Table 2).

Table 2. Sweet potato products.

Product	Objective	Source	Description
Sweet potato flour	**Flour analysis**	[10]	The fortification of yellow/orange fleshed SP was promoted by adding anthocyanins and polyphenols from fruits and from purple fleshed SP. The study has evaluated the antioxidant capacity, nutritional and sensory quality as well as the polyphenol stability during the shelf life of the flour.
		[54]	Rheological characterization of SP doughs was made for SP varieties cultivated in Malaysia.
		[55]	The objective of this study was to preserve the nutritional properties of orange fleshed SP after processing it into stabilized products, mainly flour that could be used as a food ingredient.
		[48]	The authors have studied 10 SP varieties from China, considering their chemical composition (moisture, total starch, ash, crude protein, lipids, dietary fiber and the amino acid composition). A classification based on the nutritional profile of the varieties was made.
	Bakery products	[1]	Thermal treatment of SP flour was carried out and dough properties as well as final bread quality were studied, considering blends with wheat flour.
		[43]	Partial replacing of wheat flour by SP flour for production of breads was studied. Nutritional and sensory quality of the final products were analyzed.
		[14]	Replacing of wheat flour by orange fleshed SP flour in special long fermentation sweet breads was studied.
		[56]	Evaluation of the effect of using purple sweet potato powder (PSPP) together with α-amylase and hemicellulase on the texture and structure of dough and breads. The bread crumb hardness, moisture, cohesivity were analyzed to understand the effects of PSPP and enzymes on the bread quality.
		[57]	The addition of purple sweet potato powder and enzymes (α-amylase and hemicellulase) were tested in bread formulation and texture and retrogradation as well as the crumb structure of the final product were analyzed.
	Pasta/noodles	[58]	Development of noodles with SP flour in formulation aiming at dietary fiber increase and to have use for this raw material.
Sweet potato starch	**Modification of starch**	[59]	Gelling properties and structural changes in SP starch modified by heat moisture treatment (HMT) were studied.
		[60]	Corn starch was replaced by SP modified starch as a thickening agent in this study.
	Alternative ingredient	[61]	Cassava starch was replaced by SP starch in different levels and physicochemical and sensory analyses were performed.
	Pasta/noodles	[62]	The moisture control was studied in noodles made with SP starch.

Sweet potato starch		[63]	Purple sweet potato powder was used for making fresh noodles and general quality analyses were carried out.
		[64]	The production of antioxidant extracts from orange SP and addition in noodles was studied.
		[65]	Blends of wheat flour and SP flour were used for producing noodles.
		[66]	The effect of fermentation of SP starch, using *Lactobacillus plantarum*, on noodle production was studied. Physicochemical analyses were made in the produced noodles, considering the role of fermentation inn improving the quality of the noodles.
Sweet potato puree	**Bakery and confectionary products**	[67]	Stable SP puree with longer shelf life was reported as a basic ingredient for breads, cakes and porridges.
		[68]	The level of compliance to Good Manufacture Practices and levels of microbial contamination in sweet potato (orange flesh) puree was studied.
		[9]	The use of SP puree was tested in brownie. The authors had the objective of incorporating dietary fiber to this type of cake. Physicochemical and sensory analyses were performed.
	Pasta/noodles	[69]	Physicochemical and sensory properties of noodles made with SP puree blended with wheat flour were studied.
Sweet potato flakes	**Flakes**	[70]	Potato and SP flakes were studied from thermodynamic point of view in order to understand their behavior and stability during storage.
Sweet potato nectar	**Nectar**	[71]	Temperature and packaging effects on the shelf life of purple sweet potato nectar were studied.
		[25]	The effects of high hydrostatic pressure (HHP) and of high temperature short time (HTST) treatments were studied for SP nectar, considering their physicochemical properties, anthocyanins, total phenolic compounds, antioxidant capacity, color en the presence of microorganisms. The analyses were performed right after processing and also during the storage period.
Sweet potato snacks	**Snacks**	[72]	Extruded products were enriched with protein, fiber and bioactive compounds. Physicochemical and sensory properties were studied.
		[73]	This study has evaluated the effect of the type of package on the stability of rich in carotenoids fried SP.
		[74]	The precursors of acrylamide in fried purple SP were studied. The effect of the unsaturation of the frying oil and its effect on the formation of acrylamide was investigated.
Sweet potato snacks	**Snacks**	[75]	Study of lychee snacks with purple sweet potatoes, using microwave drying techniques.

		[76]	Evaluation of the characteristics of sweet potato fries, using vacuum frying.
Biofuel	**Biofuel**	[11]	This study discusses that the demand for sweet potatoes for both subsistence and commercialization, including bioethanol, depends on a sustainable production system.
		[77]	Study on the industrial cultivar CX-1 offers superior potential for feed and fuel.
Natural colorant from sweet potato	**Colorant**	[23]	In this study, methods for extracting colorant from purple sweet potato are described.
Animal nutrition	**Ration**	[78]	Study on the reduction of pollution of residues generated by the sweet potato beverage industry for the environment and the transformation of these residues, mixed with peanut shells, into biomass protein to be used as animal feed.
Beverage made from sweet potato	**Alcoholic beverage**	[33,79,80]	Development of fermented red wine from purple sweet potatoes with *Saccharomyces cerevisiae*, with good sensory acceptance and rich in antioxidants. Wine produced from purple fleshed SP presented anthocyanins that were stable during storage.
		[81]	Alcoholic beverage was produced containing anthocyanins with antioxidant, anticarcinogenic and antihypertensive activities.
		[82]	Study of changes in anthocyanins and volatile compounds during the aging of fermented purple sweet potato alcoholic beverages.
		[83]	Brewing a beer with the Beauregard sweet potato, analyzing its physical chemical and sensory profile.
	Juice	[84]	Production of purple sweet potato juice, with better antioxidant activity and anthocyanin levels.
		[85]	Recovery of polyphenols extracted from purple sweet potato extract.
	Shochu	[86]	Analysis of the effect of diglycoside-specific β-primeverosidase on flavor formation during the manufacture of sweet potato *shochu*.
Fermented products	***Gari***	[45]	Fermented product, use of sweet potatoes instead of cassava, obtaining a sensorially similar product to that used with cassava.
	Juice (lactic fermentation)	[87]	This study has investigated the lactic fermentation as a way to improve SP beverages for human nutrition and health.
	Yogurt	[88]	Studies related to the addition of sweet potatoes to ferment together with milk, thus improving nutritional quality (dietary fibers, starch, minerals and vitamins).
	Pickles	[22]	Production and analysis of SP pickles were the objectives of this study.
		[33]	Potato pickles was produced using a mixed culture of *Lactobacillus plantarum* and *Leuconostoc mesenteroides*.
		[34]	Evaluation of sensory attributes (appearance, color, aroma, texture and acidity) of sweet potato pickles was performed with possible consumers.

CONCLUSION

The available bibliography so far allowed us to consider historical and economy aspects as well as chemical composition, nutritional potentiality of sweet potatoes from different pulp colors and varieties. It becomes evident that SP is a major food crop throughout the world, but with larger production and consumption in Asia and Africa. There are several studies that show the importance of this crop for the rural areas of developing countries as well as the great potential of SP roots to be traded as functional foods. Some examples of industrial uses of SP were highlighted in the present review mainly by the food and beverage sector due to the high nutritional and bioactive quality of its roots.

Funding: *Coordenação de Aperfeiçoamento de Pessoal de Nível Superior* (CAPES/Brazil – DS - PROAP) and *Conselho Nacional de Desenvolvimento Científico e Tecnológico* (CNPq/Brazil - Proc. nº 304260/2019-3).
Acknowledgments: The authors have received financial support and scholarships from the *Coordenação de Aperfeiçoamento de Pessoal de Nível Superior* (CAPES/Brazil) and IMD (Proc. nº 304260/2019-3), LGL and AN are research fellows from the *Conselho Nacional de Desenvolvimento Científico e Tecnológico* (CNPq/Brazil) and are thankful to these official agencies.
Conflicts of Interest: The authors declare no conflict of interest.

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