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## Value addition in Potato

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### Abstract

Since after the introduction of the potato in India in the early seventeenth century by the Portuguese traders, the potato has been widely grown and consumed in the country. These tuberous nutritious crops known as the king of vegetables is ranked as the fourth largest food crop in the world. A variety of processed products can be achieved that enhances the market value, marketability, and desirability of the product. In this review, we will discuss on the potato, current global and Indian scenario, scope and potential of processing market, health -related issues of potato. And discuss popular potato processed products and future outlook to improve the processing industry.

**Keywords:** Potato processing, global processing scenario, Indian processing potential, processed products

### Introduction

The potato (*Solanum tuberosum*) is a starchy, tuberous herbaceous annual (surviving only one growing season) belonging to Solanaceae family ("Potato –Definition of potato by Merriam-Webster,"). Being the world's fourth largest food crop after maize, wheat and rice, the potato also known as the king of vegetables, is staple food in many parts of the world grown for its edible tubers and contributes substantially in the world's caloric intake ("Potato Pro," 2017) contributing around 2% of the world's dietary energy supply. Present-day southern Peru and extreme north-western Bolivia, where domestication of potato was commenced approximately 7,000-10,000 years ago (Between 8000 and 5000 BC), were considered the place of its origin (Spooner *et al.*, 2005) Morphologically the potato (Refers to the plant itself, but can also refer to the edible tuber) are herbaceous about 60 cm high bearing white, pink, red, blue or purple flowers with yellow stamens and bears white or pink skinned edible tubers that grow underground generally 25 cm in the soil generally the white flowers bearing plants tend to have white skinned tuber while those possessing colorful flowers have pink skinned tubers) (Winch, 2006). The plant has a branched stem with alternately arranged oval to oblong green leaflets of unequal shape and size (Kesaulya, *et al.* 2015) [13]. Under the cool and wet condition, the fertile plants may even produce small, green tomato alike potato berries. Though they look like a tomato, due to high glycoalkaloids content (In between 177 mg/kg to 1350 mg/kg or more with the permissible range being 200mg/kg) they are unfit for human consumption (Machado *et al.* 2007). The berries possess the seeds called "true potato seeds" or TPS and are botanical potato seed. These seeds are viable and used for virus-free seed production and also for the production of new varieties the common practice of potato cultivation is via tubers which are the clones of the parents (Wiersema, 1986).

### Status of Potato in India

Out of total horticulture production (including fruits, vegetables, spices, plantation crops, and flowers), the fruits and vegetables account 90% of share in India. The country is the major contributor of global fruits and vegetable production ranking second largest producer only next to China while being a leader in several crops, like mango, banana, papaya, cashew-nuts, areca nut, potato, and okra. The country has made a significant improvement in the total horticulture production from a meager 191.8 million tonnes in 2006-07 to whopping 299.8 million tonnes in 2016-17 surpassing the production of food grains in India (Horticultural Statistics at a Glance 2017). Potato plays an important fraction of total vegetable production in the country. Potato is cultivated in more than 160 countries and around 4200 varieties have been reported

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and the number is increasing with continuous research and advancement (Struik, 2008). China and India are the biggest producers with almost a third of global potato production.

### Processing industries in India

Among the several constraints in the development of processing industries, availability of suitable processing quality potato was the major bottle-neck. Among all the exotic varieties imported by the processing industries, "Atlantic" showed some promise but due to its low yield and susceptibility towards disease like late blight and physiological disorder like 'hollow heart' the processors are compelled to use Indian varieties which were grown for table purpose (Marwaha *et al.* 2010)<sup>[21, 22]</sup>. To overcome this major hinderance CPRI (Central Potato Research Institute), Shimla released two processing grade varieties 'Kufri Chipsona-1' and 'Kufri Chipsona-2' in 1998 (Kumar, 1998) and other improved varieties 'Kufri Chipsona-3' and 'Kufri Himsona' in the later years. Indian population is skyrocketing and the purchasing ability is enhancing which has opened a new avenue for the processing industries as with the increased purchasing ability the food preferences of the people are also changing. To live up with the expectation of the consumers, Golden Crisp established in 1997 at Faridabad (Haryana) is the first potato chips industry in India. The other brands like Binnie's in 1988 at Noida, Uncle Chips at Noida in 1989 and Lay brand chips established by PepsiCo India Holdings Pvt. Ltd. in 1989 at Channo (Punjab) followed after. Apart from them many other processors like Haldiram, ITC, McCain Foods India, G.P. Foods, Vimal Oil and Food Ltd. has established their units seeing the vast potential and increasing demand for the processed items (Rana *et al.*, 2009). Among all the processed products that include Potato chips, French fries, Potato flakes/powders and other products like dehydrated chips, alubhujia, samosa, etc., the potato chips continue to be the most popular one. (Pandey *et al.*, 2009). Potato chips production sector is dominated by Frito-Lay operating approximately 67 plants in 27 countries worldwide processing around 4 million tonnes accounting about half of the world total. Frozen potato products, primarily French fries sector is under the domination of the Canadian family-owned company, McCain Foods processing one-third of the world total. It has about 55 plants in 13 countries (Kirkman, 2007)<sup>[15]</sup>. Selection of suitable potato varieties is the most important criteria in processing industries. Various morphological and biochemical characteristics are judged for the selection of suitable varieties. Though morphological attributes like shape, size, physical and biological damage aren't very important they affect the appearance and consumer acceptability. The most important factors like dry matter, reducing sugar, free amino acids, phenol content comes under bio-chemical attributes which determine the quality and recovery of the processed materials (Gupta *et al.*, 2014)<sup>[10]</sup>.

### Challenges and remedies to meet challenges

The nation has to look at the challenges that the processing industries are facing to improve the processing industries. Most of the industries are operating under-capacity and the demand is continuously increasing. In such a scenario one must find the constraints associated and look for the possible solutions to overcome the challenge:

1. The major hinderance in the processing industries is the availability of quality grade processing raw materials. The focus should be made to make provision of a year-round supply of processing friendly potatoes by

identifying the hotspots for production of such potatoes and extension of research activities in identifying more suitable varieties.

2. Development of low-cost improved storage chambers for long term storage of raw materials to continue production throughout the year even in its off-season.
3. For the success of any industry, the consumers are the major factors. Due to the high cost of the processed potato products, the consumers are limited as the majority of Indian population belonging to the low-income level. So, diversification in products is essential to produce budget-friendly products like dehydrated chips to connect more consumers and these products can be produced in glass hood level.
4. Focus on development of noble varieties with desirable characteristics like early maturing, temperature insensitive, resistance to cold sweetening, etc.
5. People often link processed potato products with high calorific diet associated with obesity and other health-related problems. The emphasis in the production of fortified low-fat products is the demand of the generation as more consumers have become conscious and aware of what they eat and what health benefits do they possess. Hence, there is an immediate need to identify varieties with low oil consumption properties and rich in antioxidants and other health benefits nutrients.

### Popular potato products

1. Potato chips.
2. French fries.
3. Shreds/ Lachcha
4. Potato flakes, flour, and starch
5. Canned potatoes
6. Dehydrated potato products.

### Potato Chips

Potato chips are thin, fried, baked popular ready to eat snacks used both in domestic as well as in fast food center and restaurants (Wadagavi, Kallihal, Dadanwale, & Choukimath, 2017). Potato chips should be round to oval and its quality is determined by its golden color with a preferred diameter of 40-60 mm (Kaur, Singh, & Ezekiel, 2008a)<sup>[11]</sup>. 100g potato chips provide about 547 calories of energy with a fat content of 37.47g, total carbohydrate 49.74g, protein 6.56g along with Sodium (525mg) and potassium (1642mg). As per ("Potato Chips - India | Statista Market Forecast," 2019), the revenue of potato chips in India is US\$ 370m in 2019 i.e. US\$ 0.3 per person which is expected to grow annually by 9.7%. USA with a revenue of US\$16,791m generates the most revenue. Per capita consumption is around 0.05 kg. The dry matter content should be greater than 20% (Kaur *et al.*, 2008). Some popular varieties suitable for chips preparation are Kufri Chipsona-1, Kufri Chipsona-2, Kufri Chipsona-3 (Subodh Kumar Pandey *et al.*, 2006), Kufri Chipsona-4, Kufri Himsona, Kufri Jyoti, Kufri Lauvkar and Kufri Chandramukhi. Potato chips preparation includes the following steps:

Fresh potatoes free from any deformities are selected and peeled. These potatoes are washed and all the green and damaged parts are removed. Thus peeled potatoes are sliced into thin slices of approximately 1.5 to 2.0 mm. Sliced potatoes are rinsed in water to remove surface starch. Thus starch removed sliced potatoes are blanched in hot water at 60-80 °C for 2-3 minutes. Now the slices are surface dried. Thus dried slices are fried at 180°C till the chips turn golden.

Obtained chips are uniformly salted or spiced and packed in bags in the presence of nitrogen (Singh *et al.*, 2016).

**French fries:** French fries are turning into the fastest growing snack food and is growing in India at an annual rate of more than 30%. Top french fries processors and suppliers like McDonald's and KFC pointed out this snack food to be in their top three billing items. 100g French fries supply 274 calories of energy. In general 100g fries consist of 14.06g of fats, 35.66g of total carbohydrates and 3.48g of proteins along with a substantial amount of Sodium (300mg) and potassium (527mg). The quality of French fries is determined by its golden color and texture. It should be crisp outside while soft inside (KF *et al.*, 2017) [14]. The Indian fries market is estimated over 3500 tonnes per year with domestic production of 500 million tonnes and remaining mostly contributed by imported French fries. Generally large and oblong potatoes are selected with dry matter more than 20% (Youssef, 2015). Some popular varieties for French fries production are Kufri Frysona (Sohan Vir Singh *et al.*, 2010), Kufri Chipsona-1, Kufri Chipsona-2, Kufri Chipsona-3 and Kufri Chipsona-4 (Singh *et al.*, 2009). French fries preparation includes the following steps: Fresh healthy potatoes are selected and washed to remove dirt and dust and green and damaged parts are removed. Thus cleaned potatoes are peeled and cut into sticks of dimension 10x10 mm (width x height) with the help of a French fry cutter. These sticks are rinsed in water to remove the surface starch. Thus cleaned sticks are blanched in hot water at 60-80 °C for about 5 minutes. These blanched sticks are surface dried to remove excess surface moisture. Dried sticks are fried at 180-190°C for about 2 minutes. Excess surface oil is removed using blotting paper. After oil removal, these fried sticks are let to cool down to room temperature and frozen at -20 °C where they are stored till final frying. The fries are fried at 180-190 °C at the time of serving and salt and spices are added as per the taste (Singh *et al.*, 2016).

### Potato flour

Potato flour used as a thickener-flavoring agent which imparts a distinctive pleasing flavor is used in combination of cereal and pulses flour to make a number of products like biscuits, cakes, parantha, bread (Ezekiel & Singh, 2011) [7], etc. 100g potato flour provides about 357 calories of energy. The fat content is very low around 0.34g with the carbohydrate content of 83.08g and 6.9g of protein. Sodium (55mg) and potassium (1001 mg) are also present. The recovery rate of flour is 20% i.e. 100kg potatoes will give around 20 kg flour. It is used to thicken soups, gravies, sauces and baby foods. Potato flour preparation includes the following steps:

1 Kg of peeled potatoes is cooked in 2L of water in a pressure cooker. Potassium Metabisulphite (5g) is added to reduce browning and boiled (Bharati, Mirajkar, Muniswamappa, Narayanaswamy, & Shobha, 2013) [3].

Boiled potatoes are mashed and spread on a tray in a thin layer. The tray was kept in a hot air oven at 60-80°C for drying. After complete drying, grind the mash in an electric mixer grinder to get the powder. Sieve the flour and store in an airtight container (Singh *et al.*, 2016). Potato Starch: Having high swelling power and high viscosity it is superior to other starch sources. Potato starch is characterized by their larger granule size along with low glass transition temperature, paste clarity along with neutral taste (Tigabu & Abebe Desta, 2018). It is used for the preparation of several products like soups, puddings, cakes, biscuits, and cookies

(Muhamedbegović *et al.*, 2012) [24]. 100g potato starch supplies around 300 calories of energy. Fat content is almost negligible. It is mostly carbohydrate with 80g per 100g of starch. It also has wide industrial application in paper, textile, pharmaceutical industries, adhesives, dextrin, and as a fermentation raw materials, binder for tablets and binder (Kraak, 1992) [17]. All types of defected sub-standard, misshapen potatoes can be used for starch recovery. One quintal potato will approximately give around 10 kg of starch. Potato starch manufacture process involves the following steps:

Fresh potato tubers are selected and peeled. These peeled potatoes are cut into small pieces and in the rate of 1L water per kg of potato is ground in the mixture to get slurry. Addition of 2.5g potassium metabisulphite is recommended. Now the slurry is allowed to sieve through muslin cloth with the help of water. Starch get accumulated on the bottom of the tub. The water collected above the starch is discarded and starch is rinsed with fresh water until the water becomes clean.

Now thus collected starch is dried in a hot air oven at 60°C or in sunlight. Thus obtained crusty starch is ground to get the powder and sieved and packed in an airtight Container (Singh *et al.*, 2016).

### Conclusion

From the above review study, we came to know that there is a huge scope of processing in potato crop. Though some studies have shown some health-related problems associated with the processed products these can be overcome by following the food safety standards. Processed value-added products have the huge market demand with enhanced market value as compared to fresh potatoes used for table purpose which can improve the income of the farmer and uplift the living standard and can definitely be the important milestone in the endeavor of doubling the farmer's income. The Indian processed product market is nominal compared to developed countries like the US. But the trend is continuously shifting forward triggered by the increased income and globalization. Though the consumption of these products is increasing, there are still some bottlenecks in this sector. One of the major issues is the availability of quality and suitable raw materials. This situation can be improved by increased investment in the food processing industry. There is huge potential for the development of the processing industry at the farm level as these do not require expertise and sophisticated machinery. A huge share of the processed item is imported from the international market. If these items can be produced at the village level then import can be reduced substantially. Apart from these, there is an immediate need for the development of those varieties that are processing friendly suitable in Indian climatic condition. There is still a misconception about the health-related issues like obesity, diabetes which is hampering the processing sector and peoples' choice for these products, which requires improved awareness about lies related to potato nutrition. Still, there is much to do in quality up gradation and product diversification to bridge the newer requirements of the people throughout the globe. Thus, value addition in potatoes is definitely going to occupy a larger share in the Indian GDP in the days to come and there is a huge potential considering the present international trade scenario.

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