

Nutritional value and value-added products of potatoes

Arvind Kumar Jaiswal^{1*}, Dinesh Kumar² and Brajesh Singh²

¹ICAR-Central Potato Research Institute, Regional Station, Jalandhar, Punjab 144 026

²ICAR-Central Potato Research Institute, Shimla, Himachal Pradesh 171 001

*Globally, potato (*Solanum tuberosum* L.) shares a major part of our daily diet. Due to frequent consumption, potatoes and their processed products have nutritional significance for human health. Potatoes are carbohydrate rich foods containing plenty of dietary fibre, proteins, vitamins, minerals, bioactive molecules, phytochemicals, anthocyanin, carotenoids, and metabolites that have beneficial effects on human health. Among the processed products of potatoes, chips and French fries are most popular, beside this, various frozen products such as mashed potatoes, hash browns and puffs, dehydrated potatoes, and starch are also available in the market. In the past few years, ICAR-CPRI Shimla has developed several potato-based novel value-added products such as potato cookies, potato millets cookies, halwa premix, semolina, porridge, gulab jamun, jalebi, muffins, and many more, which are rich in dietary fibre, protein, vitamin C, and potassium. The low sodium content and gluten-free composition make these products also suitable for celiac/wheat allergic and hypertensive populations. This article provides a better understanding of nutritional significance and an overview of new dimensions of value addition in potatoes.*

Keywords: Crops, Environmental impact, Farmers, Inputs, Knowledge

POTATO (*Solanum tuberosum* L.) is one of the most popular food commodities globally, sharing a major part of the diet either in fresh or in processed form. As per FAO data, global total potato production in 2021 was 376 million metric tonnes from 18.1 million ha, with a 52% production share coming from Asia. India, the second largest producer, had potato production of 54.2 million metric tonnes from 2.2 million ha area. About 50% of potatoes grown worldwide are freshly consumed and the rest is processed into different potato food products and ingredients; feed for animals and birds, starch for industry and as seed potatoes. The processed form includes fried, pre-fried, frozen, baked, dehydrated and other miscellaneous products such as alcohol, canned and mashed potatoes. With technological advancements and growing market

demand, potato processing is growing rapidly. Presently, mainly frozen French fries and chips/crisps constitute a major proportion of the value-added potato products market worldwide.

Nutritionally, potatoes are a versatile, carbohydrate-rich and low-fat food. Fresh potatoes contain about 80% water and 20% dry matter. About 60 to 80% of the dry matter is starch and on a dry weight basis the protein content of potatoes is comparable to that of cereals and better than other root and tuber crops. In addition, potatoes are rich in several micronutrients, especially vitamin C, and when eaten with skin, a single medium-sized potato of around 150 g can provide nearly half of the daily requirement of this vitamin. Potatoes are a moderate source of iron however, its high vitamin C content promotes iron

absorption in the body. It is a good source of vitamin B1, B3 and B6 and minerals such as potassium, phosphorus, and magnesium. Potatoes also contain dietary fibres and antioxidants, which may be helpful in the prevention of diseases and provide several health benefits.

In India, potatoes are utilized largely for consumption as fresh potatoes, and the major part of the harvest (approx. 68.5%) goes to domestic table consumption. Whereas, in developed countries, table potato utilization is merely 31%, the rest being frozen French fries, chips, shoestrings and dehydrated products. In recent years, consumption of "convenience foods" like chips and other fried products has increased mainly in urban areas; however, overconsumption of these high-energy products coupled with reduced physical activity can lead to

overweight problems and obesity-linked diseases. Therefore, it is necessary to increase consumption of potatoes in non-fried forms. Convenience foods may not be sufficient to increase consumption of potatoes in rural India. Keeping Indian taste and food habits in mind, ICAR-Central Potato Research Institute has developed a number of novel value-added potato products to cater to the larger population of India.

Innovative value-added products

Several novel potato products have been developed keeping in view the food preferences of the Indian population (Fig. 1, Table 1). The most notable element of these products is that they can be made from potatoes of any shape, size, colour, dry matter and after storage.

Table 1. Potato based value added products developed by ICAR-CPRI

Category	Products
Baked	Potato-fruit-butter cookies Potato-Kodo millet cookies Potato-Finger millet cookies Potato-Sorghum cookies Potato-Pearl millet cookies Potato-Chickpea cookies Potato-Barnyard cookies Potato-Coconut cookies Potato-Tapioca cookies Potato-Water chestnut cookies Potato-Finger millet dry cake Potato-Corn dry cake Muffins Pastry
Dehydrated	Porridge Semolina Cubes and shreds Sticks Flour
Premix	Gulab jamun premix Jalebi premix Halwa premix Idli premix
Sweets	Potato preserve Lactose free burfi Frozen gulab jamun Ice-cream
Fried	Cheeselings Potato Murukku Boondi Ready-to-reconstitute jalebi

Details of some the ICAR-CPRI developed novel value-added products is given below.



Fig. 1. Potato based gluten-free novel value-added products developed by ICAR-CPRI

Gluten-free Potato-Fruit Butter cookies

The pleasure that people of all ages derive in these bite-sized baked cookies is limitless. But people suffering from gluten-related allergies/intolerance are unable to enjoy wheat based cookies. Although many gluten-free formulations are available, none are made from potatoes. ICAR-CPRI has developed a unique gluten-free potato cookie that has a mixture of candied fruits and a rich taste of butter. These cookies are high in dietary fibre (6.1%), calcium, potassium and phytonutrients with a shelf life of up to 4 months.

Gluten-free Potato-Millet cookies

Millet are grains with small seeds that people have grown and used for thousands of years, however in the past, their contribution to our foods decreased. However, in the past few years, there has been increasing interest in these grains due to their high nutritional value, gluten free trait and several health advantages. The year 2023 has been celebrated as ‘International Year of Millets’ and there is renewed interest of the public in large regarding increased millet consumption. ICAR-CPRI has created many types of cookies using a unique combination of potato and different millets flour:

Potato-Kodo: These cookies are made of a unique blend of potato (70%) and Kodo (*Paspalum scrobiculatum*) millet (30%). These cookies are rich in dietary fibre,

calcium and potassium. These cookies have a shelf life of up to 4 months under dark and dry conditions.

Potato-Pearl millet: Pearl millet (*Pennisetum glaucum*), also known as *Bajra*, is a well-known millet that contains insoluble dietary fibres, protein, iron, magnesium, phosphorus, potassium and several polyphenolic compounds. Unfortunately, this nutrient-dense dish has a lesser number of diversified products available. To harness the value of this millet, it has been combined with whole potato flour to make gluten-free cookies with a unique composition. Developed cookies are high in dietary fibre, minerals, protein and a variety of health-promoting phytonutrients.

Potato-Sorghum: Sorghum (*Sorghum* spp.), also known as *Jowar*, is a well-known millet rich in insoluble dietary fibres, protein, calcium, magnesium, phosphorus, potassium, PUFA, and MUFA. Sorghum flour has been blended with whole potato flour to make gluten-free cookies. Developed cookies are rich in dietary fibre (5.8%), minerals, protein (5.6%) and many other health-promoting phytochemicals.

Potato-Finger Millet (Ragi): Finger millet (*Eleusine coracana*) is also a nutrient-dense millet, containing a good amount of calcium, iron, potassium, MUFA, PUFA and many other phytochemicals. These cookies

are developed by blending whole potato flour with *ragi* (finger millet). These cookies contain about 6% protein, 26% fat, 6.4% dietary fibre, and a good amount of calcium, iron, potassium and other minerals.

Potato-Barnyard millet: Barnyard millet (*Echinochloa esculenta*), also known as *Samak*, is a seed that is commonly used in dishes produced in India on sacred Hindu fasting days. *Samak* is considered a nutritious food since it is abundant in fibre, proteins and resistant starch. It has fewer calories, making it perfect for diabetics. It is also an excellent source of readily digested protein. ICAR-CPRI has mixed this special millet (30%) with whole potato flour to create cookies. This creative product adeptly meets a variety of market demands, including gluten-free and fasting-friendly options, while providing considerable health advantages also with a 4-month shelf life.

Potato-Water Chestnut Cookies

Water chestnut or Chinese chestnut (*Eleocharis dulcis*) called Singhara in India, is an aquatic vegetable that grows in marshes and underwater. It contains potassium, manganese, vitamin B6, riboflavin, copper, and dietary fibre besides the carbohydrates and negligible fat. Whole potato flour and water chestnut flour gluten-free cookies were made with a unique culinary choice on special occasions such as *Navratri* fasting.

Potato Murukku

Murukku is a deep-fried Indian dish, mainly popular in Southern states, traditionally prepared from rice flour. A similar type of snack was prepared from whole potatoes (with peel). The studies have shown that the crispness of potato based *murukku* is better than traditional *Murukku* and is rich in dietary fibres and potassium.

Potato Boondi for sweets, raita and salty snacks

Boondi is a deep-fat fried spherical traditional product of India, made out of droplets of chickpea flour batter. After sugar syrup

impregnation, *boondi* is served as a *prasad* and *Ladoo* at religious events and as a festive treat. ICAR-CPRI has also developed a similar kind of *boondi* (3 variants) by replacing more than 50% of Bengal gram flour with the whole potato flour. From the texture analysis, it has been found that the crispness and crunchiness of the developed *boondi* is better than the traditional *boondi*. Developed *boondi* is suitable for preparation of sweets, *raita* and salty snacks. Under inert gaseous storage and absence of light and moisture conditions, the potato based *boondi* can be preserved for up to 3 months.

Ready-to-reconstitute potato Jalebi and premix

Jalebi, a fermented, crispy, sweet, deep-fried pretzel, is a popular Indian sweet delicacy. *Jalebi* is made by combining refined wheat flour with *dahi* (curd), an indigenous source of lactic acid bacteria, adding water and leaving it overnight at room temperature. ICAR-CPRI recently developed and standardized a technique for chemically leavened, gluten-free, ready-to-reconstitute potato *jalebi* and Instant *Jalebi* premix. Potato *jalebi* has a storage life of three to four months when kept at room temperature.

Dry cake

Potato-Finger millet dry cake: Finger millet (20%) along with whole potato flour was used to prepare a unique dry cake enriched in dietary fibre and various health-promoting phytochemicals. The technology used to make this cake is versatile and can be applied to potatoes of any shape, size or variety, whether fresh or cold-stored.

Potato-Corn dry cake: Corn supplies moderate levels of protein and is a decent source of energy due to its carbohydrate content. It is quite low in fat and a rich source of dietary fibre, especially when eaten whole. Corn is also high in vitamins and minerals, particularly vitamin C, potassium, and magnesium. ICAR-CPRI created a new dry cake loaded with dietary fibre and numerous health-promoting phytochemicals

by combining whole corn flour (22%) and whole potato flour (25%).

These cakes' technique is flexible enough to work with potatoes of any size, shape, or type, whether these are cold-stored or fresh. This cake is distinct from other cakes on the market since it is suitable for those with celiac disease and has a shelf life of around 10 days.

Muffins

A method has been standardized for making chemically leavened, gluten-free muffins with over 60% potato flour. The muffins have a shelf-life of around 10 days at room temperature. These muffins contain about 5% protein, 18% fat, 3.5% dietary fibre and a good amount of calcium and potassium.

Gluten-free Gulab Jamun

No Indian festival is complete without *Gulab Jamun*, an Indian delicacy. This traditional dessert is typically made from *khoya* (milk solid) kneaded with refined wheat flour. ICAR-CPRI has also developed a process for potato-based *Gulab Jamun* using whole potato flour. Because of its unique formulation, potato *Gulab jamun* is high in dietary fibre and is gluten-free. These *Gulab Jamun* can be stored for up to 6 months at -20°C temperature.

Lactose-free Burfi

Burfi is a delectable sweet treat originating from the Indian subcontinent, made from partially dehydrated and heat-desiccated whole milk also known as *khoa*. The process of making lactose-free potato *burfi* has been standardized by ICAR-CPRI, utilizing fresh potatoes. Both fresh and cold-stored potatoes can be utilized for the preparation of potato *burfi*.

Low-fat halwa premix

The institute has developed and standardized the process for ready-to-cook potato *halwa* premix. *Halwa* premix is gluten-free, fasting-friendly, very low-fat, low-sodium and a fibre-rich product with a shelf life of 6 months at ambient storage conditions. This *halwa* premix requires less than 10 minutes of

cooking in boiling water or milk before consumption.

Porridge and Semolina

Potato porridge and semolina are made from 100% potatoes and can be cooked in milk or water. Likewise, potato semolina can be used to prepare *halwa*, *upma*, *idli*, etc. The production process involves proper cleaning and pre-treatment of potatoes and further drying at a controlled temperature. These potato-based products are completely free from wheat and gluten and have novelty in their composition, which makes them unique. These products contain more than 10.5% dietary fibre, which may have beneficial effects on gut health. Potato porridge and semolina have a shelf life of 9 months if stored in a cool, dark and dry place.

SUMMARY

With increased potato production

in India, there is an urgent need to boost potato consumption. This can only be accomplished by developing low-cost potato products with superior nutritional quality when compared to their market competitors. It is critical to develop indigenous low-cost technologies for processing potato products in order to make them accessible to a large portion of the population at an affordable price. Because this sector can be sustained at the village level by forming rural co-operatives, it has enormous potential for downstream job creation. These items, if developed on an industrial scale and effectively promoted, have the potential to become extremely successful in the Indian market. Potato cookies and potato cake are new bakery goods that could be popular with customers right away. Food allergies and intolerances are an increasing public health problem, resulting in a surge in

demand for gluten-free foods. The majority of the products indicated above have no wheat or gluten. Furthermore, the combination of high potassium in potatoes can be useful in hypertension. Because these products are made from whole potatoes, they are also high in fibre. Another area is the market for fast/*vrata*/*upvaas*-friendly items, which otherwise have extremely few alternatives for customers. Similarly, lactose-free potato *burfi* is a lactose-free alternative to milk *burfi*, particularly for customers who are lactose intolerant or dislike milk or dairy products. Because consumers are acquainted with comparable products, these items may be easily sold at Kirana shops, shopping malls, supermarkets and department stores.

*Corresponding author e-mail:
Arvind.Jaiswal@icar.gov.in

NUTRITIONAL BENEFITS OF POTATOES



A nutritional powerhouse, potatoes are a nutrient-dense vegetable that provides the energy, potassium and vitamin C you need to fuel your day.*

CARBOHYDRATES

Potatoes have 26 grams of carbohydrate per serving, which is 9% of the daily value. Carbohydrates are a key source of energy for muscles to help you fuel, perform and recover.¹ Carbohydrates are also important for optimal physical and mental performance.²



IRON

Potatoes have 1.1 mg of iron per serving, which is 6% of the daily value and more than half the amount in a 3-ounce beef patty (2.06 mg per serving).³ Iron is a mineral involved in making proteins that carry oxygen to all parts of the body, including to the muscles.



VITAMIN C

Potatoes have 27 mg of vitamin C per serving, which is 30% of the daily value. Potatoes are considered to be an excellent source of this antioxidant. Vitamin C aids in collagen production—a major component of muscle tissue—and supports iron absorption.⁴

VITAMIN B6

Potatoes have 0.2 mg of vitamin B6 per serving, which is 10% of the daily value and considered to be a good source. Vitamin B6 plays important roles in carbohydrate and protein metabolism.



PROTEIN

Potatoes have 3 grams of protein per serving. Protein is a key component of muscle and an important nutrient for athletic performance.



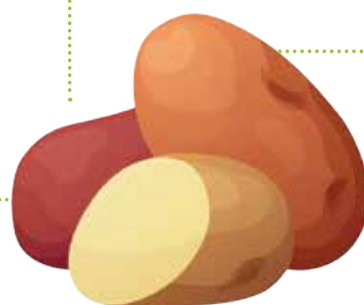
POTASSIUM

Potatoes have 620 mg of potassium per serving, which is 15% of the daily value and more than a medium-sized banana (422 mg per serving).⁵ Potassium is an electrolyte essential for muscle functioning. Potassium is lost in sweat, so it needs to be replenished for optimal performance.²



FIBER

Potatoes have 2 grams of fiber per serving, which is 7% of the daily value. Dietary fiber has been shown to have numerous health benefits, including improving blood lipid levels, regulating blood glucose and increasing satiety.⁵



Source: Potatoes USA