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## Value-added food products from Buckwheat (*Fagopyrum*) species: A functional food

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### Abstract

A wide population of the Himalayan region is dependent on wild edible plants as a source of their sustenance. *Fagopyrum* is a rich source of bioactive components like triterpenoids, flavonoids, bioactive proteins, bioactive polysaccharides, etc. People living in this advanced era are becoming very conscious regarding their health and food choices. Value-added products made from buckwheat species possess many health benefits such as antioxidant, anti-inflammatory, anticancer, antiobesity, antihypertensive, hepatoprotective, and remarkable antidiabetic activities. Food products that can be prepared from buckwheat include bread, biscuits, noodles, sprouts, tea, etc. These products will be gluten-free, rich sources of antioxidants, flavonoids, proteins, and insoluble dietary fiber. This review compiles the present progress in our knowledge concerning the nutritional benefits of *Fagopyrum* species.

**Keywords:** Buckwheat, *Fagopyrum*, Rutin, antioxidant, flavonoid, value-added, food products

### Introduction

Buckwheat is a plant that belongs to the Polygonaceae family and is used as a pseudocereal due to its nutritional properties (Bastida *et al.* 2015) [9]. Buckwheat is a highly nutritious pseudocereal that has been consumed for thousands of years in many parts of the world. It is a seed of a plant that is related to rhubarb and sorrel and is grown in many regions, including Asia, Europe, North America, and Russia. Buckwheat has a unique nutty flavour and is used in a variety of dishes, including pancakes, noodles, and porridge (Zou *et al.* 2021) [30].

Buckwheat is an excellent source of protein, containing all eight essential amino acids. It is also a good source of several important vitamins and minerals, including magnesium, potassium, iron, and B vitamins (Arum *et al.* 2021) [3]. Buckwheat is naturally gluten-free, making it a safe and nutritious option for people with celiac disease or gluten intolerance (Tang *et al.* 2021) [29]. Additionally, buckwheat has a low glycaemic index, which means it can help regulate blood sugar levels and may reduce the risk of developing type 2 diabetes.

Due to its high nutritional value, versatility in cooking, and gluten-free nature, buckwheat is becoming increasingly popular as a health food. It is also a sustainable crop that can be grown in a variety of environments, making it an important food source for many cultures around the world. Overall, buckwheat is a highly nutritious and versatile food that is well worth incorporating into your diet (Bassore *et al.* 2017) [5]. Buckwheat is a highly nutritious food that has been consumed for thousands of years in many parts of the world. The plant is native to Asia, but is now grown in many other regions as well, including North America, Europe, and Russia. Buckwheat is a versatile ingredient that can be used in a variety of dishes, and it has a unique, nutty flavour that is popular in many cuisines (Fujita *et al.* 2019) [8].

### Here are some of the nutritional benefits of buckwheat

**High in protein:** Buckwheat is an excellent source of protein, containing all eight essential amino acids. This makes it a good choice for vegetarians and vegans who may struggle to get enough protein from other plant-based sources (Rodríguez *et al.* 2020) [21].

**Rich in vitamins and minerals:** Buckwheat is a good source of several important vitamins and minerals, including magnesium, potassium, iron, and B vitamins.

**Gluten-free:** Buckwheat is naturally gluten-free, making it a safe and nutritious option for people with celiac disease or gluten intolerance (Appiani *et al.* 2021) [2].

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**Low glycaemic index:** Buckwheat has a low glycaemic index, which means it can help regulate blood sugar levels and may reduce the risk of developing type 2 diabetes.

**High in fiber:** Buckwheat is a good source of dietary fiber, which can help promote digestive health and may reduce the risk of heart disease.

Buckwheat can be prepared in a variety of ways, such as in pancakes, porridge, and noodles. It can also be used to make flour, which is a popular ingredient in gluten-free baking (Bhinder *et al.* 2022) [6]. Overall, buckwheat is a highly nutritious and versatile food that can be enjoyed in many different forms

Functional foods are foods that have a positive effect on health beyond their basic nutritional value. They are often fortified with additional nutrients, bioactive compounds, or other health-promoting substances (Aubert *et al.* 2021) [4]. Functional foods may help reduce the risk of chronic diseases such as heart disease, cancer and diabetes, and may also improve overall health and well-being.

Examples of functional foods include:

- **Probiotics:** Foods that contain live bacteria that are beneficial to gut health, such as yogurt, kefir, and fermented vegetables.
- **Prebiotics:** Foods that contain fiber or other nutrients that promote the growth of beneficial bacteria in the gut, such as oats, bananas, and garlic.
- **Omega-3 fatty acids:** Fatty fish, flaxseeds, and chia seeds are examples of foods that contain omega-3 fatty acids, which can reduce inflammation and improve heart health.
- **Antioxidants:** Berries, nuts, and dark chocolate are examples of foods that contain antioxidants, which can help reduce oxidative stress and lower the risk of chronic diseases.
- **Fiber:** Whole grains, beans, and vegetables are examples of foods that are high in fiber, which can promote digestive health and reduce the risk of heart disease and diabetes.
- **Fortified foods:** Foods that have been enriched with additional nutrients, such as vitamin D-fortified milk, iodized salt, or calcium-fortified orange juice.
- **Herbal supplements:** Certain herbs and spices, such as turmeric, ginger, and garlic, have been shown to have health-promoting properties and are often used as supplements or added to food.

It is important to note that while functional foods may offer health benefits, they should not be used as a replacement for a balanced and varied diet. A healthy diet should include a variety of nutrient-dense foods, along with regular physical activity, to support overall health and well-being.

### Buckwheat a pseudocereal

A pseudocereal is a type of non-grass plant whose seeds can be used in much the same way as cereal grains (Obadi *et al.* 2020) [17]. However, unlike true cereal grains such as wheat, rice, and corn, pseudocereals are not members of the Poaceae grass family. Instead, they come from a variety of different plant families, such as the Polygonaceae family (which includes buckwheat and rhubarb), the Amaranthaceae family (which includes quinoa and amaranth), and the Chenopodiaceae family (which includes chia and kiwicha)

(Aziz *et al.* 2021) [1] Like cereal grains, pseudocereals are often used in cooking to make flour, pastas, and other baked goods. They are also high in protein, fiber, and other nutrients, making them a popular ingredient in many health-conscious diets. Additionally, pseudocereals are often gluten-free, making them a good alternative for people with gluten intolerance or celiac disease.

Overall, pseudocereals are an important source of nutrition for many cultures around the world and are increasingly being recognized for their health benefits and versatility in cooking.

Buckwheat is a pseudocereal, which means that it is a non-grass plant that is used in much the same way as a cereal grain. While buckwheat is not related to wheat, it is often used in a similar way to wheat and other cereal grains in cooking and can be ground into flour or used to make noodles or porridge. Buckwheat is a fruit seed that comes from the buckwheat plant, which is related to rhubarb and sorrel. It is naturally gluten-free, making it a popular ingredient in gluten-free diets. Buckwheat is also a good source of protein, fiber, and essential amino acids, as well as several vitamins and minerals (Aubert *et al.* 2021) [4].

Overall, buckwheat is a versatile and nutritious food that can be used in a variety of dishes, from pancakes and bread to salads and stir-fries.

### Food products from Buckwheat

Despite its name, buckwheat is not related to wheat and is naturally gluten-free (Mohapatra *et al.* 2019) [13]. Buckwheat seeds are a rich source of protein, dietary fiber, essential amino acids, vitamins, and minerals, making them a popular ingredient in a variety of food products. Here are some food products made from buckwheat:

- **Buckwheat flour:** Buckwheat flour is a popular ingredient in gluten-free baking, especially for pancakes, waffles, and bread.
- **Buckwheat noodles:** Buckwheat noodles, also known as soba noodles, are a traditional Japanese dish. They are made from buckwheat flour and are often served cold with a dipping sauce or in a hot broth.
- **Buckwheat groats:** Buckwheat groats are the hulled seeds of the buckwheat plant. They can be cooked like rice or used as a filling for stuffed vegetables or in salads (Fujita *et al.* 2012) [8].
- **Buckwheat porridge:** Buckwheat porridge is a traditional Russian dish. It is made by cooking buckwheat groats with milk or water and is often served with butter, honey, or jam.
- **Buckwheat pancakes:** Buckwheat pancakes are a popular breakfast dish in many countries. They are made from a mixture of buckwheat flour, eggs, and milk and are often served with syrup or fruit.
- **Buckwheat bread:** Buckwheat bread is a gluten-free bread made from buckwheat flour. It has a nutty flavour and is dense and hearty.
- **Buckwheat honey:** Buckwheat honey is a dark, rich honey with a strong, distinctive flavour. It is high in antioxidants and is often used as a natural remedy for coughs and sore throats.
- **Buckwheat beer:** Buckwheat beer is a gluten-free beer made from buckwheat malt. It has a nutty flavour and is often used as a substitute for traditional beer in gluten-free diets.

### Value Added Food Products

The term value-added food product applies to any product that has been subjected to additional efforts or combined with supplementary products to boost the overall nutritional value of the product (Shaheen *et al.* 2017) [23]. The value-added food product of *Fagopyrum* will similarly be a food product whose nutritional value will be enhanced by the incorporation of buckwheat compound to it (Obadi *et al.* 2020) [17]. The end product will be enriched and much enhanced nutritionally.

#### *Fagopyrum* Bread

Buckwheat is a promising, rutin, and antioxidant-rich functional food that will enhance the nutritional value of any bread. 'Bread' as the name suggests is part of our daily food requirement, our meal is incomplete without it. Hence it is the best suitable product for value addition. The buckwheat bread will be gluten-free, antioxidant-rich; will be having a good source of protein and soluble fiber, and many more health benefits (Suzuki *et al.* 2020) [28].

#### Method of preparation

- In a bowl take 2 cups of buckwheat flour; add 2 table spoon of sugar, 1 table spoon of yeast and a pinch of salt to it. Mix the ingredients properly in a big bowl. Then add butter (room temperature) and 2 cups of warm water to it. Mix all the ingredients properly into a mixture for 2 minutes. To this mixture add 1 cup of whole wheat flour until the dough is completely ready.
- Take the dough out of the pan, wait for half hour and let the dough rest and rise. After half hour take the dough into a greased pan.
- Preheat oven to 205 °C and let it bake for 35 – 40 minutes until the dough doubles in size. Then remove it from the oven and let it cool down a bit on the counter.

#### *Fagopyrum* Biscuits

Value added biscuits are the best way to reach out to not only the elder generation but to approach the younger generation too. Biscuits and cookies are very handy and travel friendly. It can directly be consumed without pairing with other edibles.

#### Method of preparation

- Take a bowl and add 2 cups of buckwheat flour to it along with baking soda, baking powder and cocoa powder. In a separate bowl add 2-3 eggs, sugar and soften butter and beat all the mixture together. According to the consistency add rest of the flour to it until the mixture looks thick like a thick doughy batter.
- For an hour keep the dough in the refrigerator and then make balls out of the dough. Preheat the oven to 175 °C and line a baking pan with parchment paper in it. Place the balls 3 inches apart on the baking sheet to prevent it from overlapping. Bake for 8-10 minutes so that the tops of the cookies are no longer wet in the middle. Let the cookies cool down completely on the baking sheet. The cookies can be stored in an airtight container at room temperature for up to 4 days.

#### *Fagopyrum* Noodles

Noodles are one of the most consumed street foods in India. But the noodle made out of all-purpose flour is unhealthy for our body. Making noodles healthy will make them a great choice as outside food. Visiting a restaurant will not be

unhealthy anymore as it will be a great healthy option.

#### Method of preparation: (Suzuki *et al.* 2019) [27]

- Take a mixing bowl and add one cup of buckwheat flour to it along with 2 cups of wheat flour. Add a small spoon of salt to it and mix it with half cup of warm water for 10 minutes. After mixing, transfer the buckwheat dough mixture to a noodle-sheeting machine.
- Dry the cut noodles at 50 °C and let the water content reach to 13.0%. Then boil the dried noodles in four liters of water for 5-6 min, and then rinse the noodles under cold water to stop the cooking.

***Fagopyrum* Tea:** Green teas are gaining interest among people as it helps in building immunity and boost metabolism. Buckwheat tea has numerous health benefits such as insulin resistance, pre-diabetes, and polycystic syndrome (PCOS). It is caffeine-free having a rich source of Vitamin B, antioxidants, and flavonoids which makes it much preferable (Li *et al.* 2020) [14].

#### Method of preparation: (Guo *et al.* 2017) [10]

- Add half a litter of water into a frying pan. Let the water reach the boiling point and then add a table spoon of roasted buckwheat seeds to it. Let it boil properly until a color change is seen. Take a tea cup and strain the tea into the cup using a sieve. The tea is ready to be served.

***Fagopyrum* Sprouts:** Sprouts in general are known to be a healthy source of nutrition. Buckwheat sprouts have been extensively consumed throughout the world due to their exceptional abundance of bioactive compounds. They are known to maintain a healthy blood pressure, lowering cholesterol. It provides highly digestible protein with a great amount of high fiber (Nam *et al.* 2017) [16].

#### Method of preparation: (Nam *et al.* 2017) [16]

- Take dry seeds of buckwheat and soak them in distilled water for 4-5 hours at room temperature. Then take the seeds and place them in a dark container or in any dark place for 48 hours to expedite the process of germination. This will produce the perfect sprouted seeds of buckwheat.

#### Conclusion

Looking into the nutritional aspect of what we are consuming has become an important step of our dietary habit. People are becoming very health conscious these days. No one desires to compromise with what they are consuming and feeding their children. When it comes to the health care of the family it falls on the food choices of course because "We are what we eat" (Wahl *et al.* 2020) [31]. It has become a very important factor for people that their food should be containing antioxidants, rich sources of protein, and fiber. Plants have always been a helping hand to humans when it comes to their health care, whether it is medicinal plants or free wild edible plants (Abdul *et al.* 2021) [1]. Instead of taking multivitamins, whey protein, or any chemical sources or health-enhancing medicines, we should consume what is present in nature and is free. Buckwheat is less consumed and lesser-known pseudocereal hence there is a need to explore and study much about this wild edible plant (Appiani *et al.* 2021) [2].

### Future aspect of buckwheat in food industry

Buckwheat is gaining popularity as a nutritious and sustainable food source, and its future in the food industry looks promising. Here are some potential future aspects of buckwheat in food:

**Increased demand for gluten-free products:** As more people are diagnosed with celiac disease or gluten intolerance, there is a growing demand for gluten-free food products (Tang *et al.* 2021)<sup>[27]</sup>. Buckwheat, being naturally gluten-free, is a good alternative to wheat flour and is becoming increasingly popular as an ingredient in gluten-free baked goods.

**Expansion of plant-based diets:** As more people adopt plant-based diets, the demand for plant-based protein sources is increasing. Buckwheat, being high in protein and containing all eight essential amino acids, is a good option for vegetarians and vegans.

**Sustainable crop:** Buckwheat is a sustainable crop that can be grown in a variety of environments. It requires little water and can be grown without the use of pesticides, making it an environmentally friendly food source.

**New product development:** There is potential for the development of new buckwheat-based products, such as snacks, cereals, and protein bars. These products would appeal to health-conscious consumers looking for nutritious and convenient food options.

**Increased research:** As the demand for nutritious and sustainable food sources grows, there is likely to be more research into the health benefits of buckwheat (Pereira *et al.* 2020)<sup>[16]</sup>. This research could lead to new applications for buckwheat in the food industry and increase its popularity as a superfood.

Overall, buckwheat has a bright future in the food industry as a nutritious and sustainable food source. As consumer demand for healthy and sustainable food options grows, buckwheat is likely to play an increasingly important role in the food market.

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