

# Buck Wheat (*Fagopyrum esculentum*): A Gluten Free Product

## Review Article

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### Abstract

Buckwheat (*fagopyrum esculentum*) is a plant cultivated for its grain-like seeds, and also used as a cover crop. Despite the name, buckwheat is not related to wheat, as it is not a grass. Instead, buckwheat is related to sorrel, knotweed, and rhubarb. Because its seeds are eaten, it is referred to as a pseudocereal. It contains no gluten and may consequently be eaten by people with celiac disease or gluten allergies. Buckwheat proteins bear little molecular similarity to wheat prolamins and therefore their description as 'gluten' or 'gliadin' is unfortunate and can lead to unnecessary exclusion of valuable sources of dietary protein in gluten-sensitive individuals. It is a good source of magnesium, which has been associated with a lower risk of diabetes, and of dietary fibre, and it also contains essential amino acids.

### Introduction

A significant population is averse to wheat because they are allergic or sensitive towards gluten present in it. Allergy or sensitivity towards gluten is due to the presence of a kind of disorder in human body which includes celiac disease. This allergic trait or disorder causes an adverse effect on the intestinal tract. Giving this fact a due consideration, Buck wheat has been found to be a better and viable alternative substitute for wheat.

Energizing and nutritious, buckwheat is available throughout the year and can be served as an alternative to rice or made into porridge. While many people think that buckwheat is a cereal grain, it is actually a fruit seed that is related to rhubarb and sorrel making it a suitable substitute for grains for people who are sensitive to wheat or other grains that contain protein glutes. Buckwheat flowers are very fragrant and are attractive to bees that use them to produce a special, strongly flavored, dark honey [1].

### Background

Buckwheat is native to Northern Europe as well as Asia. From the 10th through the 13th century, it was widely cultivated in China. From

there, it spread to Europe and Russia in the 14th and 15th centuries, and was introduced in the United States by the Dutch during the 17th century. Other countries where buckwheat is cultivated commercially include the United States, Canada, and France, the country famous for its buckwheat crepes [2].

Many people think that it is a cereal grain; it is actually a fruit seed that is related to rhubarb and sorrel. Common and tartary buckwheat are the varieties that are popular in the United States. Its name is supposedly derived from the Dutch word *bockweit*, which means "beech wheat," reflecting buckwheat's beechnut-like shape and its wheat-like characteristics. Buckwheat flowers are very fragrant and are attractive to bees that use them to produce a special, strongly flavored, dark honey [2].

While buckwheat is of similar size to wheat kernels, it features a unique triangular shape. In order to be edible, the outer hull must be removed, a process that requires special milling equipment due to its unusual shape. Unroasted buckwheat has a soft, subtle flavor, while roasted buckwheat has more of an earthy, nutty taste. Its color ranges from tannish-pink to brown. Buckwheat is often served as a rice alternative or porridge. Buckwheat is also ground into flour,

available in either light or dark forms, with the darker variety being more nutritious. Since buckwheat does not contain gluten, it is often mixed with some type of gluten-containing flour (such as wheat) for baking [2].

### Recent Studies

Diets that contain buckwheat have been linked to lowered risk of developing high cholesterol and high blood pressure. The Yi people of China consume a diet high in buckwheat (100 grams per day, about 3.5 ounces). When researchers tested blood lipids of 805 Yi Chinese, they found that buckwheat intake was associated with lower total serum cholesterol, lower low-density lipoprotein cholesterol (LDL, the form linked to cardiovascular disease), and a high ratio of HDL (health-promoting cholesterol) to total cholesterol.

Buckwheat's beneficial effects are due in part to its rich supply of flavonoids, particularly *rutin*. Flavonoids are phytonutrients that protect against disease by extending the action of vitamin C and acting as antioxidants. Buckwheat's lipid-lowering activity is largely due to rutin and other flavonoid compounds. These compounds help maintain blood flow, keep platelets from clotting excessively (platelets are compounds in blood that, when triggered, clump together, thus preventing excessive blood loss, and protect LDL from free radical oxidation into potentially harmful cholesterol oxides. All these actions help to protect against heart disease.

Buckwheat is also a good source of magnesium. This mineral relaxes blood vessels, improving blood flow and nutrient delivery while lowering blood pressure—the perfect combination for a healthy cardiovascular system.

The nutrients in buckwheat may contribute to blood sugar control. In a test that compared the effect on blood sugar of whole buckwheat groats to bread made from refined wheat flour, buckwheat groats significantly lowered blood glucose and insulin responses. Whole buckweats also scored highest on their ability to satisfy hunger.

When researchers followed almost 36,000 women in Iowa during a six-year long study of the effects of whole grains and the incidence of diabetes, they found that women who consumed an average of 3 servings of whole grains daily had a 21 percent lower risk of diabetes compared to those who ate one serving per week. Because buckwheat is a good source of magnesium, it is also important to note that women who ate the most foods high in magnesium had a 24 percent lower risk of diabetes compared to women who ate the least.

Canadian researchers, publishing their findings in the *Journal of Agricultural and Food Chemistry* have found new evidence that buckwheat may be helpful in the management of diabetes. In a placebo-controlled study, a single dose of buckwheat seed extract lowered blood glucose levels by 12-19% at 90 and 120 minutes after administration when fed to laboratory animals with chemically-induced diabetes. No glucose reduction was seen in animals given placebo. The component in buckwheat responsible for its blood glucose-lowering effects appears to be chiro-inositol, a compound that has been shown in other animal and human studies to play a significant role in glucose metabolism and cell signaling. While researchers do not yet know precisely how it works, preliminary

evidence suggests chiro-inositol makes cells more sensitive to insulin and may even act as an insulin mimic. Results of the Canadian study were so promising that one of the lead investigators, Roman Przbylski, is currently collaborating with Canadian-based Kade Research to develop new buckwheat varieties with much higher amounts of chiro-inositol. Although the animals used in this study had the equivalent of Type 1 diabetes in humans, the researchers are confident that buckwheat will exert similar glucose-lowering effects when given to animals with Type 2 diabetes, which is the next study on their agenda. Type 2 or non-insulin dependent diabetes, which is by far the most common form in humans (90% of diabetes in humans is Type 2), is characterized by an inability of cells to respond properly to insulin.

Buckwheat and other whole grains are also rich sources of magnesium, a mineral that acts as a co-factor for more than 300 enzymes, including enzymes involved in the body's use of glucose and insulin secretion.

The FDA permits foods that contain at least 51% whole grains by weight (and are also low in fat, saturated fat, and cholesterol) to display a health claim stating consumption is linked to lower risk of heart disease and certain cancers. Now, research suggests regular consumption of whole grains also reduces risk of type 2 diabetes. (Van Dam RM, Hu FB, *Diabetes Care*).

In this 8-year trial, involving 41,186 participants of the Black

**Table 1:** Buckwheat, Nutritional value per 100 gm.

Principle	Nutrient Value
Energy	323 Kcal
Protein	10.3 g
Fat	2.4 g
Crude Fibre	8.6 g
<b>Vitamins</b>	
Thiamine	0.90 mg
Riboflavin	0.34 mg
Niacin	4.4 mg
<b>Electrolytes</b>	
Sodium	16.2 mg
Potassium	362 mg
<b>Minerals</b>	
Calcium	64 mg
copper	0.17 mg
iron	15.5 mg
Magnesium	227 mg
phosphorus	355 mg
<b>Amino Acids</b>	<b>Mg per gm</b>
Lysine	300
Methonine	100
tryptophan	080

(Source: Nutritive value of Indian Foods, National Institute of Nutrition)

Women's Health Study, research data confirmed inverse associations between magnesium, calcium and major food sources in relation to type 2 diabetes that had already been reported in predominantly white populations.

Risk of type 2 diabetes was 31% lower in black women who frequently ate whole grains compared to those eating the least of these magnesium-rich foods. When the women's dietary intake of magnesium intake was considered by itself, a beneficial, but lesser—19%—reduction in risk of type 2 diabetes was found, indicating that whole grains offer special benefits in promoting healthy blood sugar control. Daily consumption of low-fat dairy foods was also helpful, lowering risk of type 2 diabetes by 13%. Get the benefits of both buckwheat and dairy by enjoying a hearty breakfast of hot buckwheat topped with low-fat milk and a spoonful of maple syrup.

Eating foods high in insoluble fiber, such as buckwheat, can help women avoid gallstones, shows a study published in the *American Journal of Gastroenterology*.

Studying the overall fiber intake and types of fiber consumed over a 16 year period by over 69,000 women in the Nurses Health Study, researchers found that those consuming the most fiber overall (both soluble and insoluble) had a 13% lower risk of developing gallstones compared to women consuming the fewest fiber-rich foods.

Those eating the most foods rich in insoluble fiber gained even more protection against gallstones: a 17% lower risk compared to women eating the least. And the protection was dose-related; a 5-gram increase in insoluble fiber intake dropped risk dropped 10%.

How do foods rich in insoluble fiber help prevent gallstones? Researchers think insoluble fiber not only speeds intestinal transit time (how quickly food moves through the intestines), but reduces the secretion of bile acids (excessive amounts contribute to gallstone formation), increases insulin sensitivity and lowers triglycerides (blood fats). Abundant in all whole grains, insoluble fiber is also found in nuts and the edible skin of fruits and vegetables including tomatoes, cucumbers, many squash, apples, berries, and pears. In addition, beans provide insoluble as well as soluble fiber.

Research reported at the American Institute for Cancer Research (AICR) International Conference on Food, Nutrition and Cancer, by Rui Hai Liu, M.D., Ph.D., and his colleagues at Cornell University shows that whole grains, such as buckwheat, contain many powerful phytonutrients whose activity has gone unrecognized because research methods have overlooked them.

Despite the fact that for years researchers have been measuring the antioxidant power of a wide array of phytonutrients, they have typically measured only the "free" forms of these substances, which dissolve quickly and are immediately absorbed into the bloodstream. They have not looked at the "bound" forms, which are attached to the walls of plant cells and must be released by intestinal bacteria during digestion before they can be absorbed.

Phenolics, powerful antioxidants that work in multiple ways to prevent disease, are one major class of phytonutrients that have been widely studied. Included in this broad category are such compounds as quercetin, curcumin, ellagic acid, catechins, and many others that appear frequently in the health news.

When Dr. Liu and his colleagues measured the relative amounts of phenolics, and whether they were present in bound or free form, in common fruits and vegetables like apples, red grapes, broccoli and spinach, they found that phenolics in the "free" form averaged 76% of the total number of phenolics in these foods. In whole grains, however, "free" phenolics accounted for less than 1% of the total, while the remaining 99% were in "bound" form.

In his presentation, Dr. Liu explained that because researchers have examined whole grains with the same process used to measure antioxidants in vegetables and fruits&mash;looking for their content of "free" phenolics—the amount and activity of antioxidants in whole grains has been vastly underestimated.

Despite the differences in fruits', vegetables' and whole grains' content of "free" and "bound" phenolics, the total antioxidant activity in all three types of whole foods is similar, according to Dr. Liu's research. His team measured the antioxidant activity of various foods, assigning each a rating based on a formula (micromoles of vitamin C equivalent per gram). Broccoli and spinach measured 80 and 81, respectively; apple and banana measured 98 and 65; and of the whole grains tested, corn measured 181, whole wheat 77, oats 75, and brown rice 56.

Dr. Liu's findings may help explain why studies have shown that populations eating diets high in fiber-rich whole grains consistently have lower risk for colon cancer, yet short-term clinical trials that have focused on fiber alone in lowering colon cancer risk, often to the point of giving subjects isolated fiber supplements, yield inconsistent results. The explanation is most likely that these studies have not taken into account the interactive effects of all the nutrients in whole grains—not just their fiber, but also their many phytonutrients. As far as whole grains are concerned, Dr. Liu believes that the key to their powerful cancer-fighting potential is precisely their wholeness. A grain of whole wheat consists of three parts—its endosperm (starch), bran and germ. When wheat—or any whole grain—is refined, its bran and germ are removed. Although these two parts make up only 15–17% of the grain's weight, they contain 83% of its phenolics. Dr. Liu says his recent findings on the antioxidant content of whole grains reinforce the message that a variety of foods should be eaten good health. "Different plant foods have different phytochemicals," he said. "These substances go to different organs, tissues and cells, where they perform different functions. What your body needs to ward off disease is this synergistic effect—this teamwork—that is produced by eating a wide variety of plant foods, including whole grains.

One type of phytonutrient especially abundant in whole grains such as buckwheat are plant lignans, which are converted by friendly flora in our intestines into mammalian lignans, including one called enterolactone that is thought to protect against breast and other hormone-dependent cancers as well as heart disease. In addition to whole grains, nuts, seeds and berries are rich sources of plant lignans, and vegetables, fruits, and beverages such as coffee, tea and wine also contain some. When blood levels of enterolactone were measured in 857 postmenopausal women in a Danish study published in the *Journal of Nutrition*, women eating the most whole grains were found to have significantly higher blood levels of this protective lignan. Women who ate more cabbage and leafy vegetables also had

higher enterolactone levels.

Eating a serving of whole grains, such as buckwheat, at least 6 times each week is an especially good idea for postmenopausal women with high cholesterol, high blood pressure or other signs of cardiovascular disease (CVD).

A 3-year prospective study of over 220 postmenopausal women with CVD, published in the American Heart Journal, shows that those eating at least 6 servings of whole grains each week experienced both:

- Slowed progression of atherosclerosis, the build-up of plaque that narrows the vessels through which blood flows, and
- Less progression in stenosis, the narrowing of the diameter of arterial passageways.

The women's intake of fiber from fruits, vegetables and refined grains was *not* associated with a lessening in CVD progression.

Heart failure is the leading cause of hospitalization among the elderly in the United States. Success of drug treatment is only partial (ACE inhibitors and beta-blockers are typically used; no evidence has found statins safe or effective for heart failure), and its prognosis remains poor. Follow up of 2445 discharged hospital patients with heart failure revealed that 37.3% died during the first year, and 78.5% died within 5 years.

Since consumption of whole grain products and dietary fiber has been shown to reduce the risk of high blood pressure and heart attack, Harvard researchers decided to look at the effects of cereal consumption on heart failure risk and followed 21,376 participants in the Physicians Health Study over a period of 19.6 years.

After adjusting for confounding factors (age, smoking, alcohol consumption, vegetable consumption, use of vitamins, exercise, and history of heart disease), they found that men who simply enjoyed a daily morning bowl of whole grain (but not refined) cereal had a 29% lower risk of heart failure.

When researchers looked at how much fiber 35,972 participants in the UK Women's Cohort Study ate, they found a diet rich in fiber from whole grains, such as buckwheat, and fruit offered significant protection against breast cancer for pre-menopausal women. (Cade JE, Burley VJ, et al., International Journal of Epidemiology).

Pre-menopausal women eating the most fiber (>30 grams daily) more than halved their risk of developing breast cancer, enjoying a 52% lower risk of breast cancer compared to women whose diets supplied the least fiber (<20 grams/day).

Fiber supplied by whole grains offered the most protection. Pre-menopausal women eating the most whole grain fiber (at least 13 g/day) had a 41% reduced risk of breast cancer, compared to those with the lowest whole grain fiber intake (4 g or less per day).

Fiber from fruit was also protective. Pre-menopausal women whose diets supplied the most fiber from fruit (at least 6 g/day) had a 29% reduced risk of breast cancer, compared to those with the lowest fruit fiber intake (2 g or less per day).

Results of a prospective study involving 51,823 postmenopausal women for an average of 8.3 years showed a 34% reduction in breast cancer risk for those consuming the most fruit fiber compared to those consuming the least. In addition, in the subgroup of women who had ever used hormone replacement, those consuming the most fiber, especially cereal fiber, had a 50% reduction in their risk of breast cancer compared to those consuming the least.[2]

#### HEALTH BENEFITS

Buckwheat is having lots of beneficial effect on human body, which are as follows:

- Buckwheat enhanced gluten-free bread a healthier gluten-free alternative
- Buckwheat starch is a good energy source
- Buckwheat protein shows promise for lowering blood glucose
- Germinated buckwheat extract decreases blood pressure
- Buckwheat provides prebiotic-like benefits and can be considered a healthy food
- Eating buckwheat products produces lower GI response
- lowered risk of diabetes
- Lignans Protect against Heart Disease
- Significant Cardiovascular Benefits for Postmenopausal Women
- Can be Protective against Breast Cancer
- Protective against Postmenopausal Breast Cancer
- Whole Grains and Fish Highly Protective against Childhood Asthma [3]

#### Nutritional Content

Buckwheat grains compose proportionately more starch than other similar seeds like quinoa and amaranth. 100 g seeds (grains) provide 343 calories. The grains are moderate sources of energy, and calorie content may be compared to that of major cereals such as wheat, maize, rice and that of pulses like chickpea, mung bean, cowpea (black-eye pea), etc.

The protein level in buckwheat grains is the range of 11-14 g of protein per 100 g; relatively less than that in quinoa and pulses. Nonetheless, it composes all the indispensable amino acids for the human body at excellent proportions, especially in lysine which is otherwise a limiting amino acid in grains like wheat, maize, rice, etc.

Buckwheat seeds are very rich source of soluble and insoluble dietary fiber. 100 g provide 10 g or 26% of daily requirement of fiber. Fiber increase bulkiness of the food and helps prevent constipation problems by speeding up bowel movements through the gut. Fiber also binds to toxins and aid in their excretion from the gut and helps protect the colon mucus membrane from cancers. In addition, dietary fibers bind to bile salts (produced from cholesterol) and decrease their re-absorption in colon, thus help lower serum LDL cholesterol levels.

Buckwheat is gluten-free food source. Gluten is a protein present in certain grass family grains and may induce stomach upset and diarrhea condition in individuals with Celiac disease.

The grains compose of several polyphenolic antioxidant compounds such as *rutin, tannins and catechin*. Rutin (quercetin rutinoside) is found to have anti-inflammatory, and antioxidant properties and help prevent platelet clot formation inside the blood vessels. Early laboratory studies suggest that rutin may offer a cure in hemorrhoids, and clotting disorders.

Buckwheat grains have more B-complex group of vitamins, than that of quinoa seeds, especially riboflavin (vitamin B2) and niacin (vitamin B3).

Finally, buckwheat has more concentration of minerals like copper, and magnesium. *Copper* is required for the production of red blood cells. *Magnesium* relaxes blood vessels leading to brain and found to have curative effects on depression, and headache [4-8].

## Conclusion

Taking sufficient amount of buckwheat is good option for those who do not want to consume gluten containing food items. It is rich in calories, dietary fibre, amino acids, electrolytes as well. In addition

it has many health benefits like it helps in controlling blood glucose level, cardiovascular diseases, lowered the risk of diabetes etc. It is a good choice for the people suffering from celiac disease. The grains compose of several polyphenolic antioxidant compounds such as *rutin, tannins and catechin*. Rutin (quercetin rutinoside) is found to have anti-inflammatory, and antioxidant properties and help prevent platelet clot formation inside the blood vessels.

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