Effect of Sprouting on the Nutrition of Grain and Legume Seeds

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Sprouting seeds for food involves germinating them by first soaking them, then putting them in a moist, warm environment for a few days, rinsing them at least twice a day. Over the years, sprouting has been mentioned to us as a beneficial and easy method of increasing the nutrition of cereal and legume seeds. We have wondered about the actual benefit of sprouting. Does it change the nutrient content of seeds significantly?

Finney's Review

We found some answers in a book chapter called "Effect of Germination on Cereal and Legume Nutrient Changes and Food or Feed Value: A comprehensive review" by P. L. Finney (see end of article for full reference). With summaries of more than 300 scientific studies about the effects of germination on nutrient changes, it provided a valuable glimpse into the nutritional impact of sprouting. In this section, we share some highlights from Finney's article

Vitamin C. A deficiency of vitamin C results in scurvy, with symptoms that include swollen, bleeding gums; loss of teeth; sore joints and anemia. Dry, ungerminated cereals and legumes contain almost no vitamin C. Germinated seeds, on the other hand, can have very significant vitamin C content– more than enough to protect against scurvy. In one study, severe cases of human scurvy were cured more quickly with 3-day germinated haricot beans (small white beans; *Phaseolus vulgaris*) than with 4 oz of fresh lemon juice. Many different sprouted grains and legumes protect against scurvy (e.g. mung beans, sprouts of which compare to citrus in terms of vitamin C activity; cowpeas; rye; barley; wheat; oats; rice; broad beans and peas). Sprouted sorghum and soybeans seem to be exceptions in that they do not have much vitamin C. Finney's article referred to an Indian famine during 1938-1941 that led to scurvy and malnutrition. These "were essentially eliminated by the [distribution] of germinated grain. In fact, when the germinated grain was discontinued, the disease reappeared, and thereafter disappeared when the germinated grain was reintroduced as a [preventative measure]. As a curative and preventative measure, over 200,000 people received one ounce of germinated grain biweekly." Some authors have reported that more vitamin C is produced when sprouts are grown in light.

B Vitamins. B vitamins are important for cell metabolism and proper function of the immune and nervous systems. Sprouting seeds generally increases levels of B vitamins:

- Sprouting doubled the content of *thiamin* (vitamin B1) in mung beans, but not in barley.
- Sprouting greatly increased *riboflavin* (vitamin B2) content. "Invariably sprouting increased riboflavin content, generally by a few hundred percent." One serving of pea and bean sprouts was found to contain 1/3 of the recommended daily allowance of riboflavin.
- *Niacin* (vitamin B3) in cereals is bound and nutritionally unavailable. A deficiency of this vitamin causes pellagra, with symptoms of fatigue, sore skin and mental disorders (see EDN 103 (http://edn.link/z9m9wy) for more information). In his article, Finney concluded, "Germination from 2 to 5 days invariably enhances total niacin content of edible cereals and legumes." (In general, cereals contain about double the niacin that most legumes do. Peanuts, however, contain about three times as much niacin as most cereals.)
- Legumes typically contain about three times as much *biotin* (vitamin B7) as cereals. "Two to five days of germination doubles the biotin content of edible cereals as well as legumes."
- *Pyridoxine* (vitamin B6). Levels increased during germination (by 50 to 100%) in wheat, barley, corn, oats, soybeans, lima beans, green eye peas, mung beans and peas.
- *Folic acid* (vitamin B9; especially important during pregnancy for proper development of a fetus). Sprouting seemed to reduce folic acid content of pulses/legumes, but increased the folic acid content of grains.

Other Vitamins

Carotene (the precursor to vitamin A; the article commented that "the carotenes themselves have no intrinsic vitamin A activity but may be enzymatically converted into the active form of the vitamin in the liver or intestine."). Germination of legumes and cereals seems to (on average) double total carotene content.

Vitamin K increased dramatically after germination, by a factor of 25 when grown in the light, and by a factor of around 10 when grown in the dark.

Other Nutritional Changes during Sprouting

Cereals and legumes contain phytate, which binds phosphorous and makes it unavailable to the body. Phytate also interferes with the metabolism and absorption of minerals such as iron, zinc and calcium. The enzyme phytase, activated by germination, can release the phosphorous from phytate. After two or three days of germination, phytase activity increased more than 200%. Phytates can also be reduced by 50 to 75% in small white beans by incubation in warm (~55°C/131°F) water or air. In wheat varieties, phytate content was lowered by 40 to 60% after five days of germination.

Iron. In legumes, germination increased available iron. (Note that germinating seeds may absorb minerals from hard water used for soaking and rinsing seeds. In a study in Peking, mung beans and soybeans were sprouted in hard city water containing calcium and magnesium salts. The resulting sprouts had a large increase in calcium levels. By contrast, if distilled water is used to soak and rinse seeds, minerals may be lost.)

Lysine. In many grains, lysine (an essential amino acid, often lacking in cereals) has been shown to increase by 10 to 50%with germination. In legumes, amino acids do not seem to change very much in response to germination.

An Example from a Human Study

Finney wrote about a study investigating "the effects of feeding scientifically based, nutritionally sound meals and snack foods to young children (average 3 ½ years old) who were underfed. [Before receiving the nutritious meals,] those children suffered gross growth retardation and weighed about as much as average, healthy one-year-old children. In the feeding trials, one main protein calorie dish was conjee, a cereal:legume mixture in which millet and chickpea seeds were sprouted, partially air dried, roasted and ground. The cereal:legume flours were then cooked in water for a few minutes to form a thick gruel to which might be added milk and salt. For another meal dhokla was given. This was a fermented cereal:legume mixture with added chopped greens that was steamed in greased pie plates for about 20 minutes, cooled, cut into pieces and seasoned… .Without going into specific details, those foods were well accepted and tolerated by children. The weight gain and biochemical status of those poorly nourished children, after receiving diets based on locally available foods but subjected to simple processing using ordinary culinary procedures, were comparable to those of upper class children!" Riboflavin content of the millet doubled with sprouting, and niacin content increased by 20%.

Finney's Conclusion. Finney's article concluded, "If the food value of germinated seeds is to be judged by their content of vitamins and readily available amino acids, then it appears that the common use of sprouts in the diets of oriental people rests on a sound nutritional basis and should be introduced on a wide scale.…In summary, based (1) on nearly 100 years of chemical studies, (2) on about 70 years of corroborative rat and other animal feeding studies, (3) on further corroboration by a few well documented human feeding studies, and (4) on hundreds and in some cases thousands of years of experience by millions of people, it is concluded that carefully controlled, optimal germination of edible cereals and legumes is capable of significantly alleviating today's food problems and avoiding tomorrow's food needs."

Sprouting and Enzyme Inhibitors

The book *Nourishing Traditions* points out a further benefit to sprouting, in addition to the increase in vitamin content and neutralization of phytates. "Sprouting… .neutralizes enzyme inhibitors that can [otherwise inactivate] our own enzymes in the digestive tract. Edward Howell, author of *Food Enzymes for Health and Longevity*, describes enzyme inhibitors as follows: 'In nature, seeds sometimes must rest or hibernate for months or years before conditions become satisfactory for them to grow. Enzymes are present in the resting seed but are prevented from being active by the presence of enzyme inhibitors. Germination neutralizes the inhibitors and releases the enzymes. Enzyme inhibitors are part of the seed machinery and serve a purpose. But these inhibitors are out of place in our bodies. They could stop our own enzymes from working.'"

A Few Tips and Cautions about Sprouting Seeds

The actual process of sprouting is straightforward, and detailed instructions can be found on the internet. Here are very basic instructions. Add seeds to a glass jar (fill it 1/3 full for larger seeds; maybe a little less for smaller seeds). Add clean, filtered water, and let the seeds soak overnight. The next morning, pour off the water and set the jar upside down at an angle. Rinse the seeds twice a day (more often in hot weather), being careful to drain the jar well after rinsing.


Figure 2: Mung bean sprouts, ready for consumption

Jerry Henkin has been sprouting seeds since 1962. In the past, he has encouraged people at ECHO to sprout seeds. In addition to the usual instructions for sprouting, he recommends immersing sprouts in water after three or four days of growth, to remove hulls and ungerminated seeds that can otherwise result in a rancid odor.

Use Clean Seed. Be careful to make sure that the seeds you sprout are free of fungicides or other chemicals. In general, seeds meant for human consumption should be clean enough. Others (e.g. seeds for planting) might not be.

Use Clean (but not Distilled) Water, and Drain Sprouts Well. If sprouts are not properly drained, the standing water can make the sprouts turn rancid. Bacterial contamination is also a possibility (from the seeds, the container, or the water). Filtered and disinfected water should be used (see EDN 90 for ideas on how to treat water), but distilled water is not recommended, as noted previously. Important nutrients apparently leach from the cotyledons when distilled water is used. Using water that contains inorganic salts is preferable, and even seems to enhance vitamin C production in sprouts. In addition, mineral salts and other water soluble nutrients in hard water (e.g. calcium) can be absorbed by germinating seeds, actually increasing their nutritional value.

Effect of Temperature on Sprouts. Temperature can affect the growth and nutrient composition of sprouts. For sprouts, more shoot growth than root growth is typically desired. This seems to occur at temperatures of 28°C or higher.

Sprouts are Not Only Eaten Raw. In some locations, few fruits and vegetables are eaten raw due to concerns about bacterial contamination. If you are in a similar situation, it does not mean that you cannot benefit from growing sprouts. In fact, the book *Nourishing Traditions* points out that raw sprouts can contain irritants, and

as a result recommends that sprouts be lightly steamed before eating, or that they be added to soups and casseroles. Seeds tend to cook more quickly once they have been sprouted.

Seeds to Avoid. Almost any seed or grain can be sprouted. A few that are difficult to sprout are flax and oat seeds. Irradiated seeds are dead and will not sprout. Despite their popularity for sprouting, *Nourishing Traditions* recommends against sprouting alfalfa seeds, because the resulting sprouts can inhibit the immune system and also contain a potentially toxic amino acid called canavanine. We have also read that it is best to avoid sprouted sorghum, as it can be poisonous.

Conclusion

In effect, it seems that sprouting turns seeds from a carbohydrate source (containing mainly energy in the form of starch) to a vegetable source (with consequent increase in vitamins and minerals). Though care must be taken to use clean water, sprouting can be an important way to meet dietary needs for vitamins and minerals, especially in seasons and situations when fresh vegetables are difficult to obtain.

References

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