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# Alternative Uses of Proso Millet

**Dipak K. Santra, Alternative Crops Breeding Specialist**
**Devin J. Rose, Assistant Professor, Food Science and Technology**

The current market for proso millet is mostly limited to bird food, but is this the only market? This NebGuide describes many other uses, including for human food and alcoholic beverages, livestock and poultry feed, and biofuel ethanol.

Proso millet (*Panicum miliaceum* L.) is the best alternative crop for diversifying and intensifying winter wheat-based dryland production systems in western Nebraska. This is due to its ability to produce grain under limited water conditions on marginal soil with low agronomic inputs. When used in a wheat-based rotation, proso millet improves wheat productivity by controlling winter annual grassy weeds, reducing insect and disease pressure, and preserving deep soil moisture for wheat. (See UNL Extension Circular, *Producing and Marketing Proso Millet in the Great Plains,* EC137.) Despite these benefits, proso millet production has been variable in the Great Plains due to extreme price volatility and reliance on a single market, the bird seed industry. Nearly all proso millet in the U.S. comes from Colorado, Nebraska, and South Dakota. In 2012 Nebraska's proso millet production contributed $13 million to the economy of the Nebraska Panhandle.

Alternative and value-added uses of proso millet, such as those found in other countries, would expand its market and minimize price volatility.

## Food for People

Proso and other millets were an important part of the prehistoric diet 8,000-10,000 years ago. Proso millet porridge is a traditional food in Russian, German, and Chinese cuisines. In Russia, it is eaten sweet (with milk and sugar added at the end of the cooking process) or savory with meat or vegetable stews. In China, it is eaten without milk or sugar and frequently with beans, sweet potato, or various types of squash. In Germany it is also eaten sweet. Apples are added to the boiling proso millet and honey is added afterward during the cooling process.

The nutritional value of proso millet is comparable to that of wheat (*Table I*). Proso millet is rich in B vitamins, especially vitamin-B6 and folic acid. The protein content is similar to that of wheat, but it contains no gluten and by itself is not suitable for yeast-leavened bread. When combined with wheat (or xanthan gum for those who have celiac disease), it can be used for bread. Alone, proso millet is suitable for flatbread. Since it's gluten-free, it can be used in foods for people with gluten intolerance or celiac disease.

The food industry in Europe and North America is interested in proso millet for its potential health benefits for humans as well as its mild flavor, light color, and gluten-free characteristics. Several food companies have started incorporating proso millet in their gluten-free recipes for people with celiac disease. Proso millet alone or in combination with other gluten-free grains is now used for making bread, flour, pastas, a couscous-like product, and many other foods (*Figures1a–c*).

### Crop Profile

Proso millet is reported to have been domesticated about 10,000 years ago in central and eastern Asia. It moved from China to the Black Sea region of Europe by 5000 B.C., and in 1875 German-Russian immigrants introduced it to North America.

Proso millet is known as common millet, millet, and hog millet in the U.S., broomcorn millet in China, common millet in Japan, Korea, and other Pacific Asian countries, "hersey" millet in Germany, and French white in France.

**Table I. Nutrient profile of wheat and proso millet.**

| *Component/100g* | *Wheat* | *Proso Millet* |
|---|---|---|
| Protein (g) | 12.6 | 11.0 |
| Fat (g) | 1.5 | 4.2 |
| Carbohydrates (g) | 71.2 | 73.0 |
| Fiber (g) | 12.2 | 8.5 |
| Sugars (g) | 0.4 | 0 |
| Vitamin-B6 (mg) | 0.3 | 0.4 |
| Folic acid (mg) | 38.0 | 85.0 |
| Riboflavin (mg) | 0.1 | 0.3 |


**Figure 1. Foods and alcoholic beverages prepared from proso millet: (a) *awaokoshi*, candied millet puffs, a specialty of Osaka, Japan (Source: Mugu-shisai, GFDL); (b) millet with mushrooms (Source: Kathy Steger); (c) white millet soup (Source: Jean Hediger); and (d) tongba, a millet-based alcoholic brew in Nepal and India.**

### Proso Millet for Alcoholic Beverages

Millets are traditionally important grains used in brewing millet beer in some cultures, such as the Tao people of Orchid Island in Taiwan. The fermented millet is prepared in a large pot with hot water and people share the drink by sipping it through long straws. Millet is also the base ingredient for the distilled liquor rakshi in Nepal and the indigenous alcoholic drink tongba in Nepal and India (*Figure 1d*). In Romania and Bulgaria, millet is used to prepare the fermented drink boza.

Gluten-free products are one of the fastest growing sectors in beverage production in Europe. The number one selling gluten-free beer in Germany is from malted proso millet due to its unique flavor and taste. Recently in the U.S. a few brewing companies in the Great Plains have started producing beer using proso millet as the grain source. Colorado Malting Co. (Alamosa, Colo.) is preparing malting millets from proso millet for commercial brewing companies in Colorado (e.g., New Planet Beer, Eddyline Restaurant and Brewing Co., and Pagosa Brewing Co.) for production of gluten-free beer. In Nebraska the Modern Monks Brewery in Lincoln has brewed beer using proso millet.

### Livestock and Poultry Feed

Proso millet has a nutritive value (*Table II*) similar to that of other grains used for livestock feed and can be used for calves, growing and finishing cattle, dairy cows, sheep, swine, and poultry. A hammer mill with a quarter-inch screen adequately cracks whole millet seeds for such uses.

Amino acid content is generally similar to that of other grains and is an important factor in any feed. It is important to get a thorough feed analysis when proso millet is a substantial portion of any grain ration.

**Feeding Calves.** Combine proso millet with oats for starting calves on feed, as they will go on feed faster. Once started, proso millet alone can be used without any difference in efficiency.

**Growing and Finishing Cattle.** Proso millet has been shown to be equally as effective as corn, barley, and wheat as an energy source in finishing rations. Adding some oats to proso millet may reduce a laxative effect in beef cattle. Like other grains, proso millet is deficient in calcium for ruminants and therefore supplemental calcium may be needed.

**Table II. Composition of digestible nutrients (%) in proso millet and other grains commonly used for livestock feed.**

| *Grain* | *Dry Matter* | *Digestible Protein* | *Total Digestible Nitrogen* | *Crude Protein* | *Fat* | *Fiber* |
|---|---|---|---|---|---|---|
| Corn | 85.0 | 7.0 | 80.0 | 9.1 | 3.9 | 2.1 |
| Barley | 90.3 | 10.8 | 73.2 | 13.5 | 3.5 | 8.7 |
| Oats | 90.2 | 9.4 | 70.1 | 12.0 | 4.6 | 11.0 |
| Milo | 89.0 | 8.5 | 79.4 | 10.9 | 3.0 | 2.3 |
| Rye | 89.5 | 10.0 | 76.5 | 12.6 | 1.7 | 2.4 |
| Wheat | 89.4 | 11.3 | 79.6 | 13.5 | 1.8 | 2.8 |
| Proso millet | 90.4 | 8.4 | 76.9 | 11.9 | 3.4 | 8.1 |

Source: Feeds and Feeding, Abridged, Ninth Edition, F.B. Morrison, Morrison Company, Claremont, Ontario, Canada, 1961.

**Dairy Cows.** Adding as much as 40 percent proso millet to a grain mixture produced as much milk and a slightly higher body weight than pair-mate cows fed equal amounts of oats, corn, and barley.

**Sheep.** As an energy source, proso millet is equal to corn, barley, and wheat in lamb fattening rations. Ground proso millet gives considerably better results on fattening lambs than whole millet.

**Swine.** Proso millet-fed hogs performed the same as those fed corn or barley rations. The relative feeding value of proso millet is comparable (90-95 percent value) to corn when fed to swine.

**Poultry.** Proso millet can be used as a feed for multiple types of poultry: broiler chickens, laying hens, and turkeys. Proso millet is comparable to yellow corn or commercial milo diets for mature hens (52 to 62 weeks of age) and laying hens (28 to 40 weeks of age) in either ground or whole (unground) form. Studies on turkey rations are similar to those of chicken. In some reports proso millet was found superior to corn and milo. Proso millet grain can be pelleted with other grains but as its percent increases, pellets tend to crumble.

**Companion Animals.** Proso millet also can be used in hamster and dog food.

## Biofuel

Another potential use for proso millet is for ethanol production. Proso millet contains a similar starch content as corn, the grain typically used in the U.S. for dry-grind, fuel ethanol industry. In a 2012 University of Nebraska–Lincoln study proso millet cultivars and six advanced breeding lines containing waxy starch were fermented with yeast and the resulting ethanol production was compared with normal corn and "highly fermentable" corn. Fermentation efficiencies in proso millet varieties ranged from 84 percent to 91 percent which compared to 97 percent in highly fermentable corn hybrid. Ethanol production with the experimental waxy line was nearly as high as the "highly fermentable" corn.

Dried distillers grains with soluble (DDGS) are an important co-product of ethanol production. More DDGS were recovered from proso millet lines than from the "highly fermentable" corn and the proso millet DDGS contained more protein than the corn DDGS (*Table III*). This suggests that the DDGS recovered from the proso millet-based fermentation can be used for animal feed similarly to that of corn. These results indicate that proso millet may be useful in fuel ethanol production. Breeding efforts to select proso millet varieties with "highly fermentable" (such as waxy type) characteristics could lead to ethanol production from proso millet that is as efficient as corn.

**Table III. Dry distillers grains with solubles (DDGS) yield and composition.**

| | *DDGS (g/lb grain)* | *Starch (%)* | *Protein (%)* | *Fat (%)* | *Ash (%)* |
|---|---|---|---|---|---|
| **Corn** | | | | | |
| Normal hybrid | 214 | 14 | 17 | 8 | 4 |
| Highly fermentable hybrid | 163 | 4 | 23 | 11 | 5 |
| **Proso millet** | | | | | |
| Non-waxy millet | 201 | 4 | 30 | 9 | 8 |
| Waxy millet | 197 | 2 | 31 | 10 | 9 |

**Summary**

The general public in the Great Plains often associates proso millet with bird food; however, there are many alternative uses for this crop. This NebGuide describes several uses for proso millet which, if promoted and marketed properly, would create new markets and significantly reduce price volatility. Dryland farming systems in the High Plains region would benefit from incorporating proso millet into wheat-based cropping systems, and growers would benefit from new marketing opportunities.

**Resource**

Rose, Devin J. and Dipak K. Santra, Proso millet *(Panicum miliaceum L.)* fermentation for fuel ethanol production, Industrial Crops and Products, 2012.

**This publication has been peer reviewed.**

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