



TOPIC: SUPPLY CHAIN, AGRIBUSINESS

## BREWERY SPENT GRAINS AS ANIMAL FEED

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Back in the 1990s, Sioux Falls, South Dakota got a brewpub. Like a lot of brewpubs at the time, the names of their beers stressed the local angle. For example, their amber ale was called Ringneck Red — after the ringneck pheasant, the state bird of South Dakota. South Dakota is a ranching state, and the brewpub also served burgers (made from both beef and bison). That's not unusual, but the menu told a story about the burgers that likely resonated with many locals. The spent grains from the brewery went to a local farmer to feed his cattle. The beef for the burgers, in turn, came from those cattle. A neat little story.

Spent grains are a major source of brewing waste. About 85% of the solid waste a brewery produces is spent grains. [i] At the same time, animal feed is a major cost for farmers who raise cattle or other livestock. And brewery spent grain (BSG) can be used to supplement animal feed, especially for cattle. Across North America, breweries are pairing with farmers to help each other out. In a typical craft brewery arrangement, the brewery gives the BSG to the farmer as long as he or she is willing to pick it up and cart it away promptly. In some agricultural areas, the brewery may charge a small fee. This saves the brewery money it would have had to spend on grain disposal. The farmer uses the BSG to supplement his or her feed and this saves money. And for brewpubs that buy or barter some beef from the farmer it supplies, it allows them to tell their customers a Brewery-to-Farm-to-Brewpub-Table story that may resonate with those who enjoy local goods or support better ecological practices.

## **Other Uses**

Many uses for brewery spent grains (BSGs) have been suggested. There have been attempts to combust BSGs and harness the resultant heat for energy production. Alaskan Brewing, for example, dries their BSGs in a boiler fueled by dried BSGs. Biogas (methane) production and ethanol production via specialized types of fermentation have also been tried. BSGs also contain some valuable compounds — including ferulic acid and p-coumeric acid — and attempts to extract these in an economical fashion have been tried. Composting BSG has been tried, by Bell's, for one. A small amount of BSG is even pressed into dog treats or cookies for human consumption. Otter Creek Brewing Company, for example, mixed it with other substrates and used it as a growing medium for gourmet mushrooms sold to Vermont restaurants. For now, however, the most common use for brewery spent grains is for use as animal feed. Cattle are the primary consumers of BSG, but BSG can also be used to feed bison, goats, sheep, pigs, chickens, ducks, geese, and carp.

## **BSG as Animal Feed**

It is widely known that barley has been used as animal feed for centuries. But spent grain is, by definition, spent. It has been malted, mashed, and the vast majority of the carbohydrates that the kernels once held have been washed away when the grains were lautered. As such, some may question how it can be of value as animal feed.

By weight, spent grains are 77–81% water. The remaining solid matter is fiber, protein and other associated organic matter.

The fiber — which includes the husk, pericarp, and seed coat of the malted barley grains — is primarily composed of cellulose and hemicellulose. These, in turn, are composed of mainly xylose, arabinose, and glucose. The husk material also contains lignin. The fibrous husk material constitutes about 70% of the dry weight of brewery spent grains.

Fiber is digestible by ruminant mammals, including cattle, bison, goats, and sheep. And in fact most brewery spent grain (BSG) is used to feed cattle. However, BSG can be fed to poultry if the exogenous enzymes xylanase and B-glucanase are added. [ii] These enzymes degrade the fiber from the BSG and make them digestible to the chickens. Hogs will also eat BSGs, although they will derive less nutrition from them than cattle. [iii]

The rest of the dry weight of brewery spent grains, around 30%, is protein. And, in cattle, 36% of this protein is rumen degradable. A small amount of simple sugar, mostly maltose, is likewise present in spent grains. Spent grains also contain 7–10% crude fat.

Spent grain has many minor elements that are nutritionally important. It contains essential amino acids, with lysine being the most abundant. It also contains non-essential amino acids, with histidine and glutamic acid being the most abundant. When supplemented with an outside nitrogen source (such as urea), brewery spent grains can provide all the amino acids cattle require.

Spent grains also contain the vitamins biotin, folic acid, niacin, choline, riboflavin and thiamine, pantothenic acid and pyroxidine. Additionally, spent grains contain many minerals, of which silicon is the most abundant. Phosphorous and calcium are the next most abundant minerals. Cattle require more calcium than spent grains supply, so some supplemental calcium is required if they are used as a significant proportion of the cattle's feed.

Brewery spent grains (BSGs) contain 71–75% total digestible nutrients (TDN), which is the sum of the digestible fiber, protein, lipid, and carbohydrate components of a feedstuff or diet). For comparison, corn yields 88–90% TDN. BSG is not nutritionally complete for livestock, even ruminants. However, given that BSG can usually be obtained at the price of picking it up and carting it off—or at most obtained at a cost far below normal animal feed—it is an attractive source of nutrition for livestock. A University of Florida publication estimated that using BSG for a portion of a farm's animal feed made economic sense to the farmer if the brewery was within 200 miles of the farm. [iv]

A drawback to brewery spent grains (BSGs) is that they must be used quickly or they will spoil and lose their nutritional value. They will begin to generate off odors after only a day of warm weather. Some farmers have extended the usefulness of spent grains by preserving them with benzoic acid, formic acid, or potassium sorbate. In one case, the addition of 30% beet molasses with 0.3% potassium sorbate worked well to preserve wet spent grains, so long as they were held in plastic bags in which the headspace was minimized. [v] BSGs can also be dried, which retards spoilage, but the energy costs for this are high compared to the economic value of the grains.

## **Feeding Rates**

For cattle, the University of Florida recommends 8–13 lb. (dry weight) of BSG per day for adults and 2–5 lb. (dry weight) per day for calves. A study in which various proportions of spent grains to regular feed were compared found that 15–30% spent grains led to the fastest weight gain.

In chickens, supplementing their regular feed with 10–20% dried spent grains was found to be the most effective.

Anecdotally, it has been said that cattle really enjoy BSGs mixed with their feed. In part, the liquid may make the feed more appealing. However, the small amount of sugar and the low pH may also play a role.

## **At the Brewery**

For the brewery, the most difficult step is finding one or more farmers interested in partnering around BSGs. Fortunately, regardless of the brewery location, there should be a county agricultural extension office that could help with the search. Agricultural extension offices gather information about farms in their area and disseminate information on better farming practices to their constituent farmers. They should know every farmer in the area raising livestock and be able to provide a connection. From there, it's simply a matter of coming to an agreement.

In many cases, the brewery will simply donate the brewery spent grain (BSG), provided the farm is able to pick them up promptly. Used grains take up space and, of course, will start to smell within a day. As such, arrangements should be made for the farm to pick them up the same day they are generated. In an area rich in farms raising livestock, but poor in breweries, the brewery may be able to charge a small fee for the grains.

The way the grains are to be packaged should also be discussed. For this, the farm should provide tough plastic bags or 55-gallon drums to hold the grain. In the case of the latter, the farm should bring enough empty drums to hold the next load of grain when it picks up the current load. Thus, the brewery will always have the next set of barrels on hand. A large flatbed truck or trailer will be needed to haul all the grain, even for small production breweries. A single pickup truck bed will not suffice.

Graining out is done when the mash is still hot, and this is fortuitous. If hot spent grains are shoveled into drums, or placed in plastic bags, and air is excluded, the heat will suppress a wide range of potential spoilage organisms (still the farmer should use them within three days).

The Sioux Falls Brewery closed a long time ago. And, they didn't come up with the idea to give their spent grains to farmers. They were, however, one of the first to publicize this. Although new ways to utilize BSGs are being investigated, the use of them as animal feed is likely to continue to be the most common method of disposal.

[i] Mussatto, Dragone, and Roberto. 2006. Brewers' spent grain: generation, characteristics and potential applications. *Journal of Cereal Science* 43:1-14.

[ii] <https://www.sciencedirect.com/science/article/pii/S0032579119424565p>

[iii] Yaaukugh, Tegbe, Olorunju, and Aduku. 1994. Replacement Value of Brewers' Dried Grain for Maize on Performance of Pigs. *Sci Food Agric* 66: 465-471 p

[iv] Thomas, Hersom, Thrift, and Yelich. Wet Brewers' Grains for Beef Cattle. Publication #AN241. <https://edis.ifas.ufl.edu/an241>

[v] . Lilly, Birch, and Garscadden. 1980. The Preservation of Spent Brewer's Grains by the Application of Intermediate Moisture Food Technology. *Sci. Food Agric.* 31: 1059-1065

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