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Barley Proteins

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FS 759

barley proteins

COOPERATIVE EXTENSION SERVICE
SOUTH DAKOTA STATE UNIVERSITY
U.S. DEPARTMENT OF AGRICULTURE

barley proteins

Phil Price*

Usually a grain lot with the highest protein content will sell at the highest market price, but this is not true with barley.

The problem with barley is that there is no single percentage that is suitable. Barley is both a nutritious livestock feed and the principal grain used in the production of malt. The same varieties are used for both purposes.

For this reason it has two market classes: feed barley and malting barley.

The protein requirements for each differ. The best protein content for good livestock nutrition is in the 14% to 15.5% range. The most desirable protein level for malting and the brewing of beer is about 12% and should not exceed 13.5%.

When protein content is too high, the grower either takes a premium discount or his crop is classed as feed barley—at a considerably lower market value.

Quality, as well as quantity, of barley protein also affects market value. As total protein content goes up, less digestible classes of protein predominate. These proteins benefit neither livestock nor the malting industry.

Farmer controls all but two factors which affect barley protein

Protein is one of the major food classes of the barley grain. It usually ranges from 9% to 15% of the total seed weight, but under very adverse growing conditions it may range as high as 18%. The protein content of the developing barley kernel (caryopsis) is determined by several factors: varietal genetics, soil type, soil fertility, soil moisture (barley is seldom irrigated), air and soil temperatures, lodging, and plant diseases.

These factors are not necessarily equally important in determining physical and chemical grain quality. The dominant factor or factors may shift from one year to the next.

The barley grower can exert considerable control over everything except soil moisture and temperature. Consequently, the best managed farm operation often fails to achieve the desired protein level in the harvested grain. Profit suffers.

These factors determine protein content because they directly affect the vegetative growth (plant height, leaf size and function, root distribution, amount of tillering, straw strength) and reproductive capacity (number of spikes, kernel number, kernel weight).

Manipulating these factors through proper crop management gives the barley plant the best chance to express its genetic potential and produce high yields of good quality grain.

This is why it is so important to seed barley early, at the proper seeding rate, into a well prepared seedbed containing adequate amounts of the primary nutrients (nitrogen, phosphorus, and potassium), secondary nutrients (calcium, magnesium, and sulfur), and trace elements (boron, chlorine, copper, iron, manganese, molybdenum, and zinc).

Early seeding allows the developing barley plant to establish a strong root system, to tiller well, construct strong stems, and deploy well-expanded, photosynthetically active leaves during those weeks in April and May when temperature and moisture stresses are moderate.

(For further information on barley cultivation see Bulletin 661, Barley in South Dakota, and Fact Sheet 747, Irrigating barley in South Dakota.)

As the barley plant develops during the growing season, the plant roots extract nitrogen from the soil in the form of ammonia and nitrates. Most of this nitrogen is taken up by the plant by heading time and is translocated into the developing seeds very soon after heading. The continuation of good growing conditions from heading to harvest time is essential to the development of high quality grain.

During kernel development, starches and fats accumulate. The nitrogen (protein) present is gradually diluted by these other food classes and stabilizes at a proper level at kernel maturity.

The amount of nitrogen in each seed, then, depends on the number of seeds on the plant and on the kernel plumpness or bushel weight which the crop achieves.

Poorest quality proteins increase fastest when total protein goes up

There are four classes of protein in barley grain. These are albumin, globulin, glutelin, and prolamine. The first two are highly soluble and easily digestible, but together represent less than 20% of the total protein in the kernel. The albumins are found only in the embryo (germ) and globulins in the embryo and aleurone (bran) layer.

The glutelin and prolamine classes are found in the aleurone layer and throughout the endosperm of the seed, and each class represents about 40% of the total protein. These two large protein classes require harsh treatment even under laboratory conditions to make them soluble, and they have a poor amino acid balance. As a result, the efficiency of utilization of these proteins is

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lower than with the albumins and globulins.

Glutelin and prolamine are said to have a lower biological value. This is defined as the percentage of the nitrogen absorbed which is retained by the animal.

As the protein content goes beyond 15.5%, the prolamine fraction hordein (same as zein in corn) with the poorest amino acid balance increases, and the percentage of the three other classes declines. There is no point, then, in increasing the percent protein through cultural practices because only the poorest type of protein is available in greater quantity and the animal does not digest and assimilate it for the production of muscle.

The quality of the protein is determined by its amino acid constitution. Amino acids are the building blocks in proteins as bricks are in a brick wall.

A number of these amino acids are necessary for the proper growth and development of animals. If they are present in the grain in very small quantities or are entirely absent, the growth rate is reduced. Prolonged absence of these essential amino acids in the animal's ration will result in stunted growth, illness, and eventual death.

Three amino acids, lysine, methionine, and threonine are not present in sufficient amounts in barley and most other cereal grains to meet the daily requirements of hogs and poultry. A protein concentrate is added to the ration because of this deficiency.

Barley breeders are engaged in extensive efforts to genetically improve the protein quality of the grain without decreasing yield potentials.

The malting and brewing industry discounts high protein barley. The insoluble protein reduces the water soluble extract, causes problems during the fermentation process, and lowers the appearance, taste, and shelf life of the bottled beer.

The same protein classes, glutelin and prolamine (hordein), which are only partially broken down in an animal's digestive tract are also only partly broken down by protein degrading enzymes during the malting process.

A variety with a large percentage of poor quality proteins is not useful in the making of beer for two reasons.

First, the amino acid balance may provide insufficient amounts of lysine and other essential amino acids for rapid yeast cell multiplication and a proper fermentation rate.

Second, the insoluble proteins go into suspension during brewing and cause a haziness of the beer when they combine with polyphenols (tannin-like substance from the hulls). Eventually, unless removed, these complexes precipitate out and settle on the bottom of the bottle. Over a period of time the beer taste can be altered by these and other insoluble materials.

Barley breeders are now developing barley selections with a genetically lower protein content, selections which maintain this lower content under a fairly wide range of environmental conditions. Hopefully, high protein will not be as great a problem in the future in the marketing of malting barley.

Barley still better than corn sometimes, if it's planted early

Barley protein is quantitatively superior to that of corn and sorghum, but all three have chemical deficiencies which must be compensated by adding supplements. Barley enjoys wider geographic and climatic adaptability, lower cost of production, and the potential for a market premium. For these reasons barley merits serious consideration for production at many farm operations in the upper Midwest.

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