

A Guide to Understanding Prolamins

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Corn is a Seed: The corn seed is comprised of three basic morphological parts, pericarp, germ, and endosperm. The endosperm represents 75-80 percent of the corn kernel and contains primarily starch and protein. The endosperm of corn is virtually devoid of fiber (ADF or NDF) but contains abundant proteins (albumins, globulins, **prolamins**, and glutelins) of which prolamins are of primary importance in ruminant nutrition.

Prolamins Make Corn Vitreous: Prolamins are proteins solely associated with starch in all cereal grains. Prolamins for cereal grains have specific names: wheat (gliadin), barley (hordein), rye (secalin), corn (zein), sorghum (kafirin) and oats (avenin). In corn, prolamin proteins are named zein and comprise 30-60 % of the protein in whole corn. Prolamin proteins are not located inside starch granules but are primarily located on the exterior of starch granules. Prolamin proteins cross-link encapsulating starch into a water tight (hydrophobic) matrix. Prolamin proteins have industrial uses as biodegradable plastic, pill coatings and edible films.

Floury, opaque and high moisture corns have lower prolamin content as compared to dry flint or normal dent corn varieties. Differences in starch encapsulation by prolamins can be seen using scanning electron microscopy Figure 1. Prolamins define differences in the chemical composition between vitreous dry corn (glassy, translucent) and floury, opaque or high moisture corn. Starch in vitreous dry corn is more extensively encapsulated by prolamins and is less degradable in the rumen as compared to floury, opaque or high moisture corn. Lower prolamin values are observed in fermented corns such as high moisture corn because prolamins can be degraded in the fermentation process.

Prolamins Decrease Starch Digestion: Research studies have observed negative relationship between the vitreousness (prolamin) of a feed grain and starch degradability or digestibility. In a University of Wisconsin study total tract starch digestibility was decreases 0.86 percentage units for each percentage unit increase in the grain prolamin content when prolamin was expressed on a percent starch basis.

Prolamin Values in Corn: Floury, opaque and well fermented high moisture corns generally have < 4 g prolamin/100 g starch while highly vitreous dry corns have > 7-10 g of prolamin/100 g starch. A numerical guide to prolamin values in corn feed grains is presented in Table 1 below.

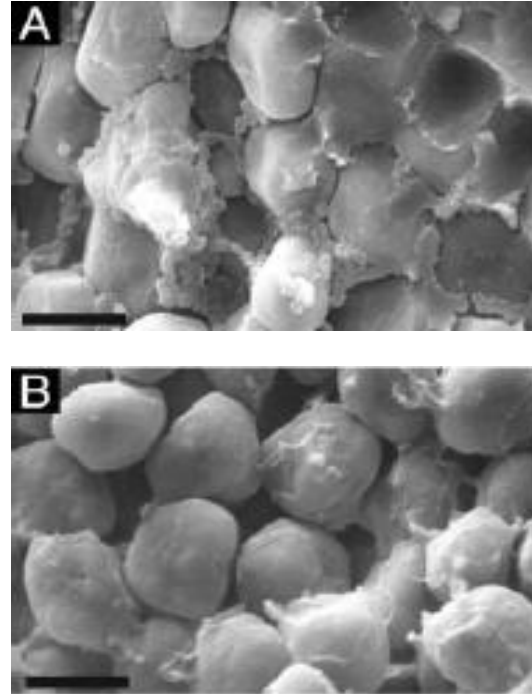


Figure 1. Scanning electron microscopy of starch granules in corn: A) starch granules heavily imbedded in prolamin-protein matrix, B) starch granules in opaque corn with less extensive encapsulation by prolamin-proteins (Gibbon et. al., 2003). Published with permission: *Copyright (2003) National Academy of Sciences, U.S.A.*

Table 1. Corn prolamin content classifications.

Prolamin % of Starch	Classification
>10.0	Extremely High
10.0	
9.0	Very High
8.0	
7.0	High
6.0	
5.0	Moderate
4.0	
3.0	Low
2.0	
< 2.0	Very Low