

# Nutritional Analysis of New Mexico Blue Corn and Dent Corn Kernels

Cooperative Extension Service  
College of Agriculture and  
Home Economics



## Guide H-233

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This publication is scheduled to be updated and reissued 2/08.

*Atole*, tortillas, corn chips, and other maize or corn products have been the backbone of most traditional and present-day Native American and Mexican American cuisines. Evolving from a Central American ancestor, blue corn and other flour corns have historically represented the major kernel “type” of corn making up these products in the American Southwest. The endosperms (tissue surrounding the embryo that provides food for the seed’s growth) of flour corns are made up of soft starch with thin pericarps (seed coats).

Dent corns, both white and yellow, now dominate the corn flour and meal markets. Dent corn endosperms have hard, glassy sides and soft cores of flour that cause the tips of the kernels to collapse or “dent” during drying.

### Corn Kernel Parts and Characteristics

Corn kernels, on the average, contain up to 16% moisture, 72% starch and 9–10% protein. Most of the starch is found in the endosperm.

Besides endosperm, corn kernels contain three other parts: germ, pericarp, and tip cap. The germ or embryo contains about 83% of the lipids found in the kernels, most producing triglycerides used in the corn oil industry. The germ also contains most (78%) of the minerals (ash) found in the kernel.

### Vitamin Content

Yellow dent corn is a relatively good source of Vitamin A, a cup containing 10% of the U.S. RDA (Recommended Daily Allowance) for Vitamin A, while a cup of white dent corn provides less than 0.5% of the RDA for humans. Dent corns also supply moderate amounts of Vitamins E, B, and C.

### Protein Content

Most of the protein found in dent corns occurs in the promalin form called zein, which cannot be efficiently utilized by humans. Zein exists in the absence of glutelin, a protein high in lysine and tryptophan, two of the eight essential amino acids that humans cannot synthesize and must obtain from the food they eat.

Corn scientists have found that corns possessing the opaque-2 (o-2) gene contain less zein and more lysine and tryptophan than traditional dent corns. Since 1963, scientists have been attempting to develop opaque-2 varieties for less-developed countries, where human diets characteristically include large amounts of corn. Increased levels of lysine and tryptophan should make these corns more complete protein sources.

Elevated levels of lysine and tryptophan have also been found in corn varieties containing the floury-2 gene (fl-2). In an evaluation of five New Mexico blue corn varieties by the New Mexico Cooperative Extension Service in 1990, all were found to be higher in lysine (averages of 2.3 mg/g of dry kernel) than two commercial varieties of yellow (1.4 mg/g) and white (1.6 mg/g) dent corns used for making tortillas. Thus, like opaque-2 corn varieties, blue corns are a more complete protein source than either white or yellow dent corns.

### Mineral Content

In another evaluation of eight New Mexico blue corn varieties by the New Mexico Cooperative Extension Service in 1990, all blue corns were found to be higher in zinc than either commercial yellow or white dent corns used for making tortillas (table 1). Seven of the eight blue corns were higher in iron, while both

**Table 1. Number of kernels/ounce, percent phosphorous (P) and potassium (K), and parts per million zinc (Zn), iron (Fe), boron (B), and aluminum (Al) in eight blue (flour), one yellow (dent), and one white (dent) corn kernel samples, New Mexico, 1990.**

Source	Kernels/ Ounce	Percent (%)		Parts per million			
		P	K	Zn	Fe	B	Al
Alamo (flour)	87	.29	.21	26	29	7	<1
Utton (flour)	100	.29	.28	38	35	22	14
Curry (flour)	101	.26	.25	22	25	23	20
Santa Ana (flour)	134	.31	.27	25	29	8	<1
Taos (flour)	136	.30	.28	20	26	9	<1
Kinsman (flour)	143	.34	.30	33	31	17	18
Rose (flour)	169	.35	.32	27	17	14	<1
Best (flour)	177	.33	.33	17	40	12	8
Average	131	.31	.28	26	29	14	8
Yellow (dent)	93	.31	.21	10	21	26	22
White (dent)	101	.32	.28	11	22	25	20

dent corns were generally higher in boron and aluminum. Larger-kerneled blue corn varieties (Alamo, Utton, and Curry) tended to be higher in phosphorous and potassium than their smaller-kerneled counterparts. All varieties contained more phosphorous than potassium.

### Blue Corn Uses

Blue corn flour is characterized by a coarser, grainier consistency than yellow or white dent corn flours, resulting in a denser tortilla with a sweeter, nuttier taste. Blue corn flours and meals are also used in making lesser-known Southwestern dishes like piki or paper bread (wafer-thin cake), chaquegue (corn-meal mush), and atole (corn meal drink), as well as new products like cornflakes, muffin mixes, and pancake mixes. Blue corn chips are popular with chile salsas and bean dips.

### Corn Preparation for Tortillas

Nixtamalization is the traditional Latin American/Indian method of processing corn into tortillas. The corn was first boiled in a lime solution for a relatively

short period of time. After the corn steeped overnight, the steeping liquor (nejayote) was discarded. The drained corn (nixtamal) was then washed to remove the loose pericarps that surrounded the seed, as well as any excess ash or alkali. Finally, the nixtamal was ground into a flour made into a dough for tortillas.

A similar process is used by most commercial processors today, although the techniques are more sophisticated. Corn kernels used for tortillas should be free of fissures or cracks, as damaged kernels will disintegrate during drying, lime cooking, and washing.

Alkali cooking improves both water uptake and starch gelatinization. During grinding, the swollen gelatin-like starch granules are disrupted, thereby spreading the hydrated starch and protein around the ungelatinized portion of endosperm, forming the flour from which tortillas are made.

Alkali cooking also improves product flavor and niacin availability. Niacin generally occurs in a bound form in unprocessed corn (non-alkali treated) and is unavailable to single-stomached animals like humans.

Commercial alkali treatments also increase calcium content of processed corn 20- to 30-fold. The calcium present depends on the amount of lime used in processing and the number of times the nixtamal is washed (rinsed).

### Degermed Versus Stoneground Corn

In 1906, the Beall degerminator increased the shelf life of corn flours and meals with the production of corn products having low oil and relatively germ- and bran-free endosperm. In this process, the pericarps or bran and germs are basically stripped away from the endosperm, and much of the fiber and mineral content is lost. Later, however, such products may be fortified (enriched) with thiamin, riboflavin, niacin, and iron.

Stoneground whole cornmeal, on the other hand, is generally higher in phosphorous, potassium, calcium, and magnesium, as well as fiber. Because of its higher oil content, however, it must be refrigerated or frozen to prevent it from turning rancid.