NUTRIENT COMPOSITION OF OKLAHOMA YELLOW CORN

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Story in Brief

Thirty one yellow dent corn hybrids grown at four Oklahoma locations during three years were analyzed for dry matter, crude protein, lysine threonine, isoleucine and methionine + cystine. Significant differences among hybrids were observed for crude protein, lysine, threonine, isoleucine and methionine + cystine when expressed as percent of corn on a dry matter basis. Significant differences among hybrids were also observed for threonine, isoleucine and methionine + cystine when expressed as percent of crude protein. Significant differences among production locations were observed for dry matter, crude protein, lysine, threonine, isoleucine and methionine + cystine expressed as percent of corn on a dry matter basis. Significant location differences were also observed for threonine and methionine + cystine expressed as percent of crude protein. Early maturing hybrids had significantly higher levels of lysine and threonine when expressed as percent of dry matter or as a percent of crude protein than later maturing varieties. Hybrid production location and days to maturity influenced nutrient composition of Oklahoma produced yellow dent corn.

(Key Words: Corn Composition, Amino Acids, Protein, Dry Matter.)

Introduction

Corn production is a minor enterprise in Oklahoma compared to other cereal grains, yet 5 to 9 million bushels are produced annually. Much of this production is available to swine producers. However research is not available to evaluate yellow dent corn hybrids produced in Oklahoma for specific amino acids and is very limited for crude protein and dry matter. Thus, this study

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was conducted to determine the protein and essential amino acid composition of 31 yellow dent corn hybrids grown at four Oklahoma locations.

Materials and Methods

Yellow dent corn hybrids were grown in 1987, 1988 and 1989 at four different sites in Oklahoma as shown in Table 1. Note that only some of the varieties were grown within each year and location. Of the thirty one hybrids grown six were classified as early maturing (90-104 days), 15 medium maturing (105-119 days) and 10 late maturing (120-140 days).

All corn samples were analyzed on a dry matter basis for crude protein, lysine, threonine, isoleucine, methionine and cystine. Amino acid concentrations were determined from acid hydrolysates by ion exchange chromatography using a Beckman model 6300 amino acid analyzer. The hydrolysis procedure did not protect from potential loss of methionine and cystine. Therefore, concentrations of these two amino acids here will be lower than actual concentrations. Difference among varieties may or may not be relative. Values for methionine (an essential amino acid) and cystine (a nonessential amino acid) were combined in all the data reported since cystine can meet up to 50% of the methionine requirements of swine.

Date from a total of 164 samples from the 31 hybrids were statistically analyzed using a least squares procedure to estimate means. Adjustments were made for hybrid, location and year within location. Partial correlations of crude protein with each of the amino acids were calculated to measure the association between each of these.

Table 1. Number of hybrids grown by year and location.

	Location			
Year	Haskell[b]	Goodwell[a]	Bixby[b]	Colbert[b]
1987	14	--	16	15
1988	24	23	--	24
1989	12	10	14	12

[a] Irrigated.
[b] Nonirrigated.

Results and Discussion

Least squares means for dry matter and crude protein of each hybrid are shown in Table 2. Differences among hybrids for dry matter were not significant with a range of 90.47 to 91.69%. Crude protein values expressed on a dry matter basis differed ($P<.01$) among hybrids ranging in value from 9.14% for Pioneer 3184 to 10.98% for Pioneer 3906 hybrid varieties.

Least squares means for lysine, threonine, isoleucine and methionine + cystine expressed as percent of corn on a dry matter basis are shown in Table 3. Differences ($P<.01$) were observed among hybrids for threonine, isoleucine and methionine + cystine, and ($P<.05$) for lysine.

Least squares means for lysine, threonine, isoleucine and methionine + cystine expressed as a percent of crude protein are shown in Table 4. Differences among hybrids for isoleucine ($P<.01$) and for threonine and

Table 2. Effect of hybrid on dry matter and crude protein of yellow corn.[ab]

Hybrid variety		No. samples	Dry matter, %	Crude[c] protein, %
R.C. Young	0R0 150	8	90.49	9.73
R.C. Young	0R0 180	4	90.50	9.20
R.C. Young	0R0 190	7	90.99	9.70
R.C. Young	0R0 Exp. 801	4	90.48	9.83
Pioneer	3906	6	90.84	10.98
Pioneer	3475	6	90.89	9.49
Pioneer	3184	6	90.54	9.14
Pioneer	3343	7	90.97	10.10
Stauffer	S3306	6	90.78	9.95
Stauffer	S6210	6	91.69	10.68
Stauffer	S8656	6	90.84	10.22
Funks	G-4323	6	91.14	10.95
Funks	G-4616	6	90.85	10.48
Golden Acres	T-E 6920-A	6	90.91	10.21
Golden Acres	T-E 6994	6	90.91	9.32
Golden Acres	T-E 7317	6	90.72	10.66

(Table 2 continued on next page)

Table 2. (Continued).

Hybrid variety		No. samples	Dry matter, %	Crude[c] protein, %
Taylor Evans	T-E6988	6	90.91	9.60
Garst	8808	6	90.98	9.41
Garst	8108	6	90.97	10.01
Garst	8344	6	91.11	9.96
Seedtec	ST-7680	3	91.02	9.50
Seedtec	ST-7711	3	91.33	9.65
Hyperformer	HS-566	3	91.32	10.26
Hyperformer	HS-64	4	91.34	10.63
Hyperformer	HS-67	7	91.04	9.95
Hyperformer	HS-88	4	90.58	10.17
Warner	W-2160	4	90.65	9.83
Warner	W-2192	4	90.62	10.61
Warner	W-2192A	4	90.57	10.09
Seedco	SC-123	4	90.47	10.49
Seedco	SC-119	4	90.93	9.70

[a] Dry matter basis.
[b] Standard errors for dry matter and crude protein are .289 and .247, respectively.
[c] Significant differences among hybrids ($P < .01$).

methionine + cystine ($P < .05$) were observed. No significant difference ($P > .10$) was observed among varieties for lysine expressed as percent of crude protein.

The effect of production location on dry matter and crude protein content is shown in Table 5. Differences ($P < .05$) among locations were observed for both crude protein and dry matter. Location also had an effect ($P < .05$) on lysine, threonine, isoleucine and methionine + cystine expressed as percent of dry matter as shown in Table 6. When the same amino acids were expressed as percent of crude protein, significant differences ($P < .05$) were also observed for lysine, threonine and methionine + cystine but not for isoleucine (Table 7).

Table 3. Effect of hybrid on lysine, threonine, isoleucine and methionine + cystine content of yellow corn. [ab]

Hybrid variety[c]		Lysine[d] %	Threonine[e] %	Isoleucine[e] %	Methionine[e] + cystine %
R.C. Young	0R0 150	.32	.38	.31	.23
R.C. Young	0R0 180	.32	.34	.30	.18
R.C. Young	0R0 190	.30	.35	.31	.24
R.C. Young	0R0 Exp. 801	.32	.36	.33	.28
Pioneer	3906	.34	.41	.34	.26
Pioneer	3475	.29	.39	.31	.17
Pioneer	3184	.27	.31	.26	.22
Pioneer	3343	.30	.35	.30	.27
Stauffer	S3306	.34	.41	.35	.27
Stauffer	S6210	.30	.38	.35	.31
Stauffer	S8656	.31	.36	.31	.31
Funks	G-4323	.33	.37	.35	.31
Funks	G-4616	.30	.36	.32	.32
Golden Acres	T-E 6920-A	.31	.36	.32	.35
Golden Acres	T-E 6994	.29	.32	.29	.25
Golden Acres	T-E 7317	.31	.38	.34	.33
Taylor Evans	T-E 6988	.31	.35	.29	.27
Garst	8808	.30	.33	.28	.24
Garst	8108	.31	.34	.30	.30
Garst	8344	.32	.36	.31	.31
Seedtec	ST-7680	.26	.33	.30	.24
Seedtec	ST-7711	.29	.33	.29	.21
Hyperformer	HS-566	.30	.31	.25	.24
Hyperformer	HS-64	.29	.38	.35	.28
Hyperformer	HS-67	.30	.36	.31	.29
Hyperformer	HS-88	.30	.36	.29	.30

(Table 3 continued on next page)

Table 3. (Continued).

Hybrid variety[c]		Lysine[d] %	Threonine[e] %	Isoleucine[e] %	Methionine[e] + cystine %
Warner	W-2160	.32	.36	.34	.24
Warner	W-2192	.34	.42	.38	.37
Warner	W-2192A	.33	.38	.31	.29
Seedco	SC-123	.29	.38	.36	.32
Seedco	SC-119	.31	.36	.33	.20

[a] Dry matter basis.
[b] Standard errors for lysine, threonine, isoleucine and methionine + cystine are .015, .016, .018 and .029, respectively.
[c] See Table 2 for number samples analyzed of each hybrid.
[d] Significant differences among hybrids ($P < .05$).
[e] Significant differences among hybrids ($P < .01$).

Table 4. Effect of hybrid on lysine, threonine, isoleucine and methionine + cystine expressed as % of crude protein.[a]

Hybrid variety[b]		Lysine %	Threonine[c] %	Isoleucine[d] %	Methionine[d] + cystine %
R.C. Young	0R0 150	3.29	3.88	3.19	2.30
R.C. Young	0R0 180	3.44	3.72	3.30	1.91
R.C. Young	0R0 190	3.08	3.63	3.18	2.50
R.C. Young	0R0 Exp. 801	3.32	3.69	3.34	2.91
Pioneer	3906	3.14	3.70	3.09	2.39
Pioneer	3475	3.05	4.11	3.22	1.88
Pioneer	3184	3.02	3.45	2.88	2.46
Pioneer	3343	3.00	3.50	2.98	2.10

(Table 4 continued on next page)

Table 4. (Continued).

Hybrid variety[b]		Lysine %	Threonine[c] %	Isoleucine[d] %	Methionine[d] + cystine %
Stauffer	S3306	3.41	4.06	3.50	2.72
Stauffer	S6210	2.89	3.59	3.26	2.94
Stauffer	S8656	3.05	3.53	3.00	3.05
Funks	G-4323	3.02	3.42	3.17	2.83
Funks	G-4616	2.92	3.48	3.06	3.08
Golden Acres	T-E 6920-A	3.07	3.54	3.09	3.42
Golden Acres	T-E 6994	3.10	3.44	3.11	2.64
Golden Acres	T-E 7317	2.98	3.55	3.12	3.10
Taylor Evans	T-E 6988	3.20	3.70	3.04	2.81
Garst	8808	3.20	3.55	3.01	2.58
Garst	8108	3.17	3.42	3.00	2.94
Garst	8344	3.21	3.59	3.07	3.05
Seedtec	ST-7680	2.77	3.45	3.15	2.55
Seedtec	ST-7711	3.06	3.44	3.00	2.18
Hyperformer	HS-566	2.91	3.11	2.47	2.42
Hyperformer	HS-64	2.81	3.57	3.22	2.65
Hyperformer	HS-67	3.05	3.60	3.14	2.93
Hyperformer	HS-88	3.01	3.57	2.88	2.94
Warner	W-2160	3.34	3.71	3.47	2.48
Warner	W-2192	3.22	4.00	3.65	3.61
Warner	W-2192A	3.29	3.80	3.12	2.81
Seedco	SC-123	2.80	3.66	3.38	3.01
Seedco	SC-119	3.17	3.68	3.44	2.03

[a] Standard errors for lysine, threonine, isoleucine and methionine + cystine expressed as % of crude protein is .153, .150, .152 and .266, respectively.
[b] See Table 2 for number samples analyzed.
[c] Significant differences among hybrids ($P < .05$).
[d] Significant differences among hybrids ($P < .01$).

Table 5. Effect of location on dry matter and crude protein content of yellow corn.[ab]

Location	Dry matter[c] %	Crude protein[c] %
Haskell	90.14[d]	11.08[d]
Goodwell	91.71[e]	9.58[e]
Bixby	90.64[f]	10.00[f]
Colbert	90.86[f]	9.56[e]

[a] Dry matter basis.
[b] Standard errors for dry matter and crude protein are .104 and .116, respectively.
[c] Any two means in same column not sharing a common superscript are different ($P < .05$).

Table 6. Effect of location on lysine, threonine, isoleucine and methionine + cystine of yellow corn.[ab]

Location	Lysine[c] %	Threonine[c] %	Isoleucine[c] %	Methionine[c] + Cystine %
Haskell	.33[d]	.39[d]	.34[d]	.31[d]
Goodwell	.29[ef]	.36[e]	.30[e]	.25[e]
Bixby	.32[dg]	.37[e]	.31[e]	.32[d]
Colbert	.30[fg]	.35[e]	.30[e]	.21[f]

[a] Dry matter basis.
[b] Standard errors for lysine, threonine, isoleucine and methionine + cystine are .006, .007, .007 and .012, respectively.
[c] Any two means in same column not sharing a common superscript are different ($P < .05$).

Table 7. Effect of location on lysine, threonine, isoleucine and methionine + cystine expressed as % of crude protein.[a]

Location	Lysine[b] %	Threonine[b] %	Isoleucine %	Methionine[b] + Cystine %
Haskell	2.99[d]	3.52[d]	3.12	2.81[d]
Goodwell	3.07[de]	3.75[e]	3.18	2.66[d]
Bixby	3.17[e]	3.68[de]	3.19	3.24[e]
Colbert	3.23[e]	3.64[de]	3.17	2.22[f]

[a] Standard errors for lysine, threonine, isoleucine and methionine + cystine expressed as % of crude protein is .056, .058, .056 and .108, respectively.

[b] Any two means in same column not sharing a common superscript are different ($P < .05$).

The effect of relative maturity measured in number of days from planting to maturity for dry matter and crude protein is shown in Table 8. No significant differences ($P > .10$) were observed. Relative maturity had an effect ($P < .05$) on lysine and threonine expressed as percent of dry matter with the early maturing hybrids higher than the medium or late maturing hybrids (Table 9). No significant differences were observed in days to maturity for isoleucine or methionine + cystine.

Table 10 shows the effect of maturity on the levels of lysine, threonine, isoleucine and methionine + cystine expressed as percent of crude protein.

Table 8. Effect of maturity on dry matter and crude protein content of yellow corn.[abc]

Maturity/Days		Dry Matter %	Crude protein %
Early	90-104	90.76	10.20
Medium	105-119	90.90	9.91
Late	120-140	90.86	10.07

[a] Dry matter basis.

[b] Standard errors for dry matter and crude protein are .089 and .100, respectively.

[c] No significant differences among hybrids ($P > .10$).

Table 9. Effect of maturity on lysine, threonine, isoleucine and methionine + cystine content of yellow corn.[ab]

Maturity/Days		Lysine[c] %	Threonine[c] %	Isoleucine %	Methionine + Cystine %
Early	90-104	.33[d]	.38[d]	.33	.28
Medium	105-119	.31[e]	.36[e]	.32	.26
Late	120-140	.30[e]	.36[e]	.31	.29

[a] Dry matter basis.
[b] Standard errors for lysine, threonine, isoleucine and methionine + cystine are .005, .006, .006 and .011, respectively.
[c] Any two means in same column not sharing a common superscript are different ($P < .05$).

Table 10. Effect of maturity on lysine, threonine, isoleucine and methionine + cystine expressed as % of crude protein.[a]

Maturity/Days		Lysine[c] %	Threonine[c] %	Isoleucine %	Methionine + Cystine %
Early	90-104	3.22[d]	3.74[d]	3.23	2.70
Medium	105-119	3.12[c]	3.65[de]	3.20	2.65
Late	120-140	3.01[e]	3.56[e]	3.08	2.85

[a] Standard errors for lysine, threonine, isoleucine and methionine + cystine are .048, .050, .050 and .093, respectively.
[b] Any two means in same column not sharing a common superscript are different ($P < .05$).

The early maturing hybrids tended to be higher in lysine and threonine than the medium or late maturing hybrids with a significant difference ($P<.05$) between the early and late maturing hybrids. The same relationship was observed when the amino acids were expressed as a percent of dry matter. No differences again were observed for isoleucine or methionine + cystine ($P>.10$).

Year within location differences ($P<.05$) were found for dry matter, crude protein and all amino acids on both a percent of dry matter and as percent of protein except for threonine expressed as percent of crude protein. Means for year within location are not presented, however they indicate nutrient composition at a given location can be affected by the year in which they were grown.

Partial correlations of crude protein with lysine, threonine, isoleucine and methionine + cystine were .40, .74, .76 and .47 respectively. This indicates that there is a relatively strong association between crude protein and either threonine or isoleucine as compared to lysine and methionine + cystine. These results suggest that significant nutrient composition differences occur among yellow dent corn hybrids grown in Oklahoma. Significant nutrient composition differences also occurred among production locations and days to maturity. Early maturing hybrids were higher in lysine and threonine than medium or late maturing hybrids even though no significant differences were observed for crude protein.