NUTRIENT COMPOSITION OF NINE VARIETIES OF HARD RED WINTER WHEAT

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Story in Brief

Nine varieties of hard red winter wheat grown at four Oklahoma locations for two years were analyzed for dry matter, crude protein, lysine, threonine, isoleucine and methionine + cystine. Significant differences among varieties were observed for crude protein and isoleucine when expressed as percent of wheat on a dry matter basis. Nonsignificant differences were observed for dry matter, lysine, threonine and methionine + cystine among the varieties tested. Little difference among varieties was found for any of the amino acids analyzed 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 wheat on a dry matter basis. Significant differences between years were observed for dry matter, crude protein, threonine and isoleucine expressed as percent of wheat on a dry matter basis and methionine + cystine expressed as percent of crude protein. Significant year x location interactions were observed for crude protein, dry matter, threonine, isoleucine and methionine + cystine expressed as percent of wheat on a dry matter basis and methionine + cystine expressed as percent of crude protein. Non-hybrid varieties were significantly higher in crude protein and lysine than hybrids. Differences between hybrids and non-hybrids among other nutrients analyzed were not significant.

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

Introduction

There have often been periods in recent years when hard red winter wheat has been competitively priced with other cereal grains, justifying its use in swine rations. When wheat becomes competitively priced with other

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cereal grains, it becomes especially attractive to Oklahoma pork producers since Oklahoma is a major wheat producing state. Wheat production in the state ranges from 130 to 225 million bushels annually.

Since wheat is normally higher in crude protein and essential amino acids than corn, its relative nutritional value to corn is often greater. However, many varieties of wheat are grown in Oklahoma and the variability in protein and amino acid composition has not been determined. This study was conducted to determine the protein and essential amino acid composition of nine varieties of wheat grown in four different locations.

Materials and Methods

All hard red winter wheat varieties were grown in 1984 and 1985 performance trials at four different Oklahoma Agricultural Experiment Stations located at Altus, Goodwell, Lahoma and Stillwater. All wheat 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 121 automatic amino acid analyzer. Values for methionine (an essential amino acid) and cystine (a non-essential amino acid) were combined in all the data reported since cystine can meet up to 50% of the methionine requirements of swine.

Results and Discussion

Least squares means for dry matter and crude protein for each variety are shown in Table 1. Differences among varieties for dry matter were not significant with a range of only 90.30 to 90.91%. Crude protein values expressed on a dry matter basis differed significantly ($P<.05$) among varieties with Payne, Triumph 64, Newton, TAM-101 and TAM-105 being higher than the other varieties.

Least squares means for lysine, threonine, isoleucine and methionine + cystine expressed as percent of wheat on a dry matter basis are shown in Table 2. Significant differences among varieties for isoleucine ($P<.05$) were observed. No significant differences ($P>.10$) were observed for the other amino acids analyzed although differences in lysine approached significance ($P<.11$). Least squares means for lysine, threonine, isoleucine and methionine + cystine expressed as a percent of crude protein are shown in Table 3 with no significant differences ($P>.10$) observed among varieties. Partial correlations between crude protein and lysine, threonine, isoleucine

Table 1. Effect of variety on dry matter and crude protein content of hard red winter wheat[ab].

Variety	Dry matter,%	Crude[c] protein,%
Bounty 100	90.69	16.08[efg]
Chisholm	90.91	15.91[fg]
HW 1010	90.69	16.00[efg]
Newton	90.54	17.24[def]
Payne	90.67	17.56[d]
TAM-101	90.30	16.88[defg]
TAM-105	90.65	16.82[defg]
Triumph 64	90.83	17.28[de]
Vona	90.44	15.79[g]

[a]Dry matter basis.
[b]Standard errors for dry matter and crude protein are .139 and .257, respectively.
[c]Any two means in the same column not sharing a common superscript are different (P<.05).

Table 2. Effect of variety on lysine, threonine, isoleucine and methionine + cystine content of hard red winter wheat[ab].

Variety	Lysine %	Threonine %	Isoleucine[c] %	Methionine + cystine %
Bounty 100	.40	.44	.52[de]	.50
Chisholm	.44	.43	.50[e]	.48
HW 1010	.44	.46	.55[de]	.54
Newton	.48	.47	.56[de]	.48
Payne	.44	.46	.57[d]	.53
TAM-101	.43	.45	.53[de]	.51
TAM-105	.47	.46	.52[de]	.49
Triumph 64	.43	.47	.56[de]	.58
Vona	.43	.45	.53[de]	.53

[a]Dry matter basis.
[b]Standard errors for lysine, threonine, isoleucine and methionine + cystine are .015, .011, .015 and .025, respectively.
[c]Any two means in the same column not sharing a common superscript are different (P<.05).

and methionine + cystine were .27 ($P<.05$), .45 ($P<.01$), .50 ($P<.01$) and .11 respectively. However, the relationship between crude protein and amino acids varied greatly within location and year.

The effect of production location on dry matter and crude protein content is shown in Table 4. Significant differences ($P<.05$) among locations were observed for both crude protein and dry matter. Location also had a significant effect ($P<.01$) for lysine, threonine, isoleucine and methionine +

Table 3. Effect of variety on lysine, threonine, isoleucine and methionine + cystine expressed as % of crude protein[a].

Variety	Lysine[bc] %	Threonine[bc] %	Isoleucine[bc] %	Methionine[bc] + cystine %
Bounty 100	2.51	2.72	3.23	3.12
Chisholm	2.77	2.72	3.13	3.64
HW 1010	2.77	2.90	3.45	3.37
Newton	2.76	2.72	3.24	2.79
Payne	2.49	2.63	3.26	3.04
TAM-101	2.57	2.69	3.19	3.02
TAM-105	2.79	2.74	3.08	2.95
Triumph 64	2.50	2.73	3.23	3.24
Vona	2.76	2.86	3.32	3.36

[a]Dry matter basis.
[b]No significant differences among varieties (P>.10).
[c]Standard errors for lysine, threonine, isoleucine and methionine + cystine are .107, .067, .088 and .157, respectively.

Table 4. Effect of location on dry matter and crude protein content of hard red winter wheat[ab].

Location	Dry matter[c] %	Crude protein[c] %
Stillwater	90.39[e]	15.64[f]
Goodwell	90.87[d]	16.57[e]
Lahoma	90.72[de]	15.93[ef]
Altus	90.56[de]	18.33[d]

[a]Dry matter basis.
[b]Standard errors for dry matter and crude protein are .09 and .17, respectively.
[c]Any two means in the same column not sharing a common superscript are different (P<.05).

cystine expressed as percent of wheat on a dry matter basis as shown in Table 5. However, when these same amino acids were expressed as percent of crude protein, significant differences across locations were only observed for isoleucine ($P<.05$) as shown in Table 6.

The effect of year grown (1984 or 1985) on the nutrient content of hard red winter wheat is shown in Table 7. Significant differences among years were observed for dry matter ($P<.01$), crude protein ($P<.01$), threonine expressed as percent of wheat on a dry matter basis ($P<.01$), isoleucine expressed as percent of wheat on a dry matter basis ($P<.05$) and methionine

Table 5. Effect of location on lysine, threonine, isoleucine and methionine + cystine content of hard red winter wheat[ab].

Location	Lysine[c] %	Threonine[c] %	Isoleucine[c] %	Methionine[c] + cystine %
Stillwater	.42[b]	.43[a]	.51[a]	.46[f]
Goodwell	.46[a]	.46[a]	.51[a]	.55[d]
Lahoma	.42[ab]	.44[a]	.52[a]	.49[ef]
Altus	.46[ab]	.49[b]	.61[b]	.54[de]

[a]Dry matter basis.
[b]Standard errors for lysine, threonine, isoleucine and methionine + cystine are .010, .007, .010 and .017, respectively.
[c]Any two means in the same column not sharing a common superscript are different ($P<.05$).

Table 6. Effect of location on lysine, threonine, isoleucine and methionine + cystine expressed as % of crude protein[ab].

Location	Lysine %	Threonine %	Isoleucine[c] %	Methionine + cystine %
Stillwater	2.67	2.76	3.29[de]	2.95
Goodwell	2.77	2.77	3.06[e]	3.34
Lahoma	2.66	2.77	3.30[d]	3.11
Altus	2.54	2.68	3.31[d]	3.06

[a]Dry matter basis.
[b]Standard errors for lysine, threonine, isoleucine and methionine + cystine are .071, .045, .059 and .105, respectively.
[c]Any two means in the same column not sharing a common superscript are different ($P<.05$).

+ cystine expressed as percent of crude protein on a dry matter basis ($P<.10$). A significant ($P<.01$) year x location interaction was observed for dry matter, crude protein and threonine, isoleucine and methionine + cystine expressed as percent of wheat on a dry matter basis. A significant ($P<.05$) year x location interaction was also observed for methionine + cystine expressed as percent of crude protein. A partial explanation for the interaction may have been the severe drought conditions occurring in 1984 at Altus and Lahoma. This may have had an effect on nutrient composition for the wheat produced at these two sites. A significant ($P<.05$) year x variety interaction was observed for isoleucine expressed as percent of crude protein.

Table 7. Effect of year on nutrient content of hard red winter wheat[a].

Nutrient[a]	1984	1985	SE[b]	Significance
	%	%		
Dry matter[c]	91.68	89.58	.066	P<.01
Crude protein (CP)[c]	16.96	16.27	.121	P<.01
Lysine, % of wheat	.44	.44	.007	
Lysine, % of CP	2.63	2.69	.050	
Threonine, % of wheat[c]	.47	.44	.005	P<.01
Threonine, % of CP	2.77	2.72	.032	
Isoleucine, % of wheat[c]	.55	.53	.007	P<.05
Isoleucine, % of CP[d]	3.24	3.24	.041	
Methionine + cystine				
% of wheat[c]	.51	.52	.012	
% of CP[e]	3.01	3.22	.074	P<.10

[a]Dry matter basis.
[b]Standard error of means.
[c]Significant (P<.01) year x location interaction.
[d]Significant (P<.05) year x variety interaction.
[e]Significant (P<.05) year x location interaction.

Table 8. Nutrient content of hybrid versus non-hybrid hard red winter wheat[a].

Nutrient[a]	Hybrid[b]	Non-hybrid[c]	SE[d]	Significance
Dry matter	90.69	90.62	.086	
Crude protein (CP)	16.04	16.78	.195	P<.05
Lysine, % of wheat	.42	.44	.010	P<.10
Lysine, % of CP	2.64	2.67	.064	
Threonine, % of wheat	.45	.46	.006	
Threonine, % of CP	2.81	2.73	.040	
Isoleucine, % of wheat	.54	.54	.010	
Isoleucine, % of CP	3.34	3.21	.055	
Methionine + cystine				
% of wheat	.52	.51	.014	
% of CP	3.25	3.08	.088	

[a]Dry matter basis
[b]Hybrids are Bounty 100 and HW1010
[c]Non-hybrid varieties are Chisholm, Newton, Payne, TAM-101, TAM-105, Triumph 64 and Vona.
[d]Standard error of means.

Two of the nine wheat varieties grown, Bounty 100 and HW1010, were hybrids while Chisholm, Newton, Payne, TAM-101, TAM-105, Triumph 65 and Vona were non-hybrids. Table 8 presents least squares means for the nutrients evaluated. Non-hybrids were higher in crude protein ($P < .05$) and lysine expressed as percent of wheat on a dry matter basis ($P < .10$) than hybrids. Values observed among other nutrients were similar.

More differences occurred in nutrient composition of hard red winter wheat in relation to location and year grown than among varieties. However, significant differences did occur among varieties for crude protein and isoleucine. Non-hybrid varieties tended to be higher in crude protein and lysine than hybrid varieties.