



North Dakota Barley Council

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Crop Quality Report 2002

2002 Regional Barley Crop Quality for North Dakota & Minnesota

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Introduction

This report presents the results of the 24th annual survey of regional barley crop quality.

Six-rowed barley samples (240) were collected in all crop reporting districts (CRD) of North Dakota and in the northwestern and west central districts of Minnesota (Figure 1).

Two-rowed barley samples (40) were collected in the five districts of North Dakota where significant amounts of two-rowed barley are produced. Sample collections were taken at farms and elevators, and they were coordinated by the United States Department of Agriculture (USDA) North Dakota Agricultural Statistics Service in Fargo, ND.

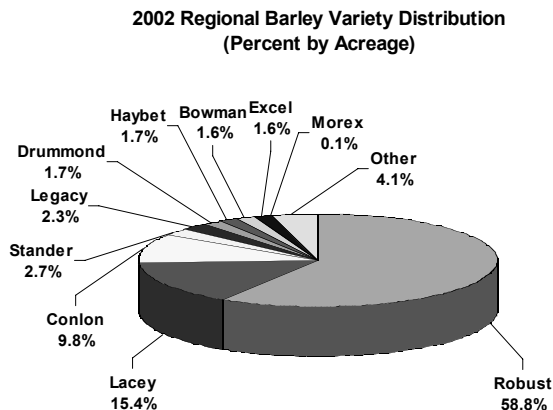
Grain quality evaluations were conducted by the Department of Cereal and Food Sciences at North Dakota State University (NDSU), while nutritional analyses were conducted by the NDSU Department of Animal and Range Sciences.

Grade determinations were performed by the North Dakota Grain Inspection Service, Inc of Fargo, ND.

Financial support was provided by the North Dakota Barley Council (Fargo, ND) and the American Malting Barley Association (AMBA), Inc. (Milwaukee, WI).

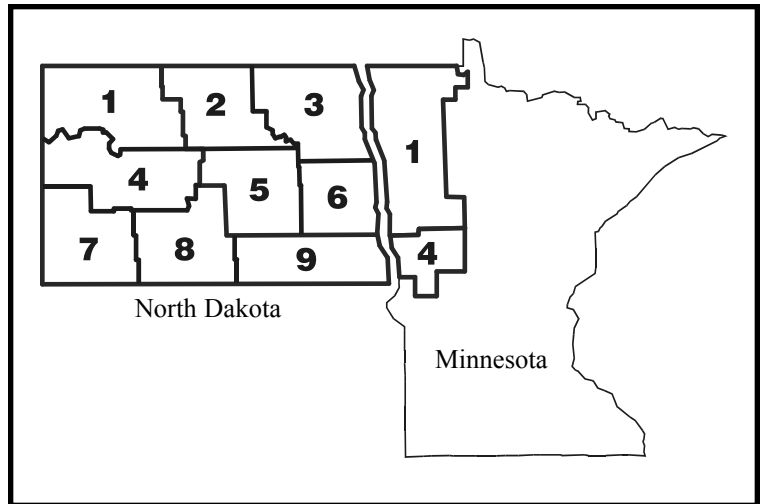
2002 Regional Barley Variety Distribution

Chart I.



Regions in North Dakota and Minnesota

Figure 1.



According to the September 30, 2002 U.S. Department of Agriculture estimate, the 2002 barley production in North Dakota and Minnesota was at 63.5 million bushels (1.38 million metric tons), which represents 1.405 million harvested acres.

The greatest production of barley was in the northwestern (245,000 acres), north central (340,000 acres), northeastern (300,000 acres), and central (210,000 acres) districts of North Dakota.

Yields in North Dakota and Minnesota were 46 and 39 bushels/acre, respectively.

Total production in 2002 represented a decline (-28%) from the previous year. This lower level of production was due to lower yields and abandonment of some seeded acres, which largely resulted from drought conditions and flooding, respectively.

More than 90% of barley acreage in the North Dakota and Minnesota survey region was seeded to malting types (Chart 1). The primary six-rowed malting varieties were Robust and Lacey. Robust has been the most widely seeded six-rowed malting variety for more than ten years.

Drummond, Lacey and Legacy have only recently received recommendations as malting varieties from AMBA.



Table I. 2002 Regional Two-Rowed Barley Crop Quality

State and Crop Reporting District (CRD)	Dockage (%)	Moisture Content (%)	Test Weight (lbs/bu)	Test Weight (kg/hl)	1000 Kernel Weight (g)*	Protein Content (%)	Color Score**	Kernel Assortment***	
								% Plump	% Thin
ND CRD 1	0.3	12.8	48.2	62.0	47.3	12.7	6	94.8	1.0
ND CRD 2	0.8	13.0	46.8	60.2	44.0	12.5	7	92.2	1.4
ND CRD 4	0.5	13.2	47.7	61.4	46.4	13.2	6	87.6	2.4
ND CRD 7	0.6	11.0	45.6	58.7	37.0	15.3	3	67.7	5.8
ND CRD 8	1.1	13.9	45.9	59.1	45.3	15.8	6	88.8	3.0
State Two Rowed Average	0.7	12.4	46.7	60.1	42.6	14.2	5	82	3.4

Comments for Table I and II

* 1000 kernel weight was determined on every third sample collected.

** The lower the color score the brighter the barley (scale 1 to 10).

*** % Plump: kernels retained on or above a 6/64 x 3/4 inch (2.4 x 19 mm) slotted sieve.

% Thin: kernels passing through a 5/64 x 3/4 inch (2.0 x 19 mm) slotted sieve.

Table II. 2002 Regional Six-Rowed Barley Crop Quality

State and Crop Reporting District (CRD)	Dockage (%)	Moisture Content (%)	Test Weight (lbs/bu)	Test Weight (kg/hl)	1000 Kernel Weight (g)*	Protein Content (%)	Color Score**	Kernel Assortment***	
								% Plump	% Thin
ND CRD 1	1.2	13.2	45.7	58.8	36.5	12.7	7	80.9	2.2
ND CRD 2	0.6	13.6	44.9	57.8	34.9	13.3	7	72.9	4.2
ND CRD 3	0.7	14.5	45.6	58.7	34.9	13.3	7	80.8	2.6
ND CRD 4	2.0	13.1	45.6	58.7	36.3	13.2	6	81.4	2.2
ND CRD 5	1.4	14.0	45.7	58.8	36.0	13.7	7	75.7	3.3
ND CRD 6	2.4	13.6	45.7	58.8	34.6	13.4	7	75.9	3.6
ND CRD 7	0.6	11.4	45.5	58.6	36.6	14.7	5	72.6	3.2
ND CRD 8	1.0	12.6	45.4	58.4	32.5	14.4	6	65.6	5.9
ND CRD 9	0.9	14.0	44.2	56.9	32.2	14.8	7	68.8	6.6
State Six Rowed Average	1.2	13.6	45.4	58.4	35	13.5	7	75.9	3.6
MN CRD 1	1.6	15.0	45.6	58.7	35.1	13.2	8	78.5	3.1
MN CRD 4	0.3	13.4	42.8	55.1	32.2	14.2	8	65.2	6.8
State Six Rowed Average	1	14.7	45	57.9	34.6	13.4	8	75.6	3.9
Regional Six Rowed Average	1.2	13.8	45.3	58.3	35	13.5	7	75.9	3.6

Two-rowed barley varieties are seeded in the western and southern crop reporting districts of North Dakota.

Historically, only two-rowed feed varieties have been produced. However, in 2000 the variety Conlon was added to AMBA's list of recommended malting barley varieties. Conlon is the most widely planted two-rowed variety and accounted for 9.8% of barley acreage.

CROP QUALITY

Grade. A portion of each sample collected within a district was blended to prepare district composite samples. These district composites were submitted to the federally licensed North Dakota Grain Inspection Service, Inc. for determination of an average district grade. Separate composites were prepared for two- and six-rowed barley. With the exception of the west central district of Minnesota, all six-rowed district composite samples were graded as US No. 2 six-rowed malting barley. Test weights below 47 lbs/bushel was the primary reason that these sample composites did not meet the requirements

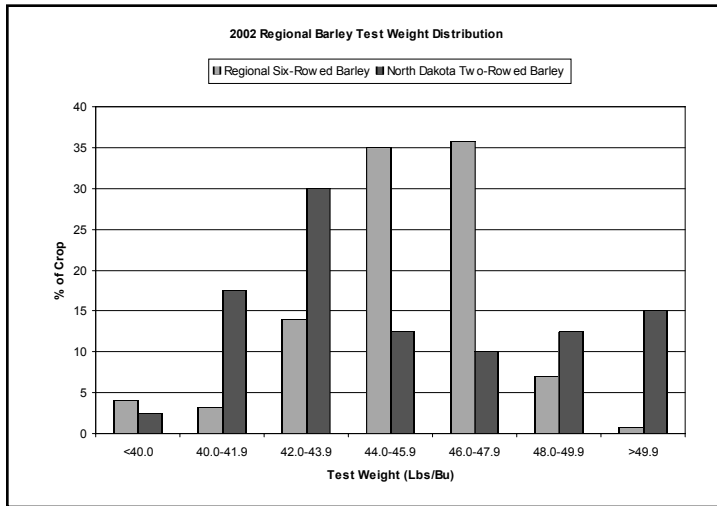
for US No. 1 six-rowed malting barley. The composite from the west central district of Minnesota was graded as US No. 4 six-rowed barley.

As the two-rowed district composite samples were a mixture of malting and feed varieties, they were graded according to the requirements of two-rowed barley. Only the composite sample from the southwest district of North Dakota was graded below US No. 1 two-rowed barley. All other district composites were graded as US No. 1 two-rowed barley.

Protein. (Graph III) The 2002 regional six-rowed barley crop exhibited an average protein content of 13.5%.

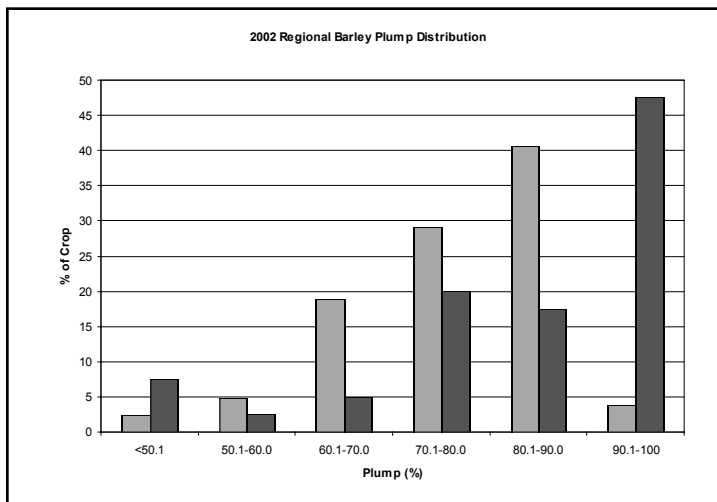
Approximately 55% of six-rowed samples displayed protein levels of 13.5% or lower, while 50% of the two-rowed crop was at or below this level. On the average, the lowest proteins were recorded in North Dakota's northwestern district. Protein levels were the highest in the southern districts of North Dakota, and the west central district of Minnesota.

Graph I.



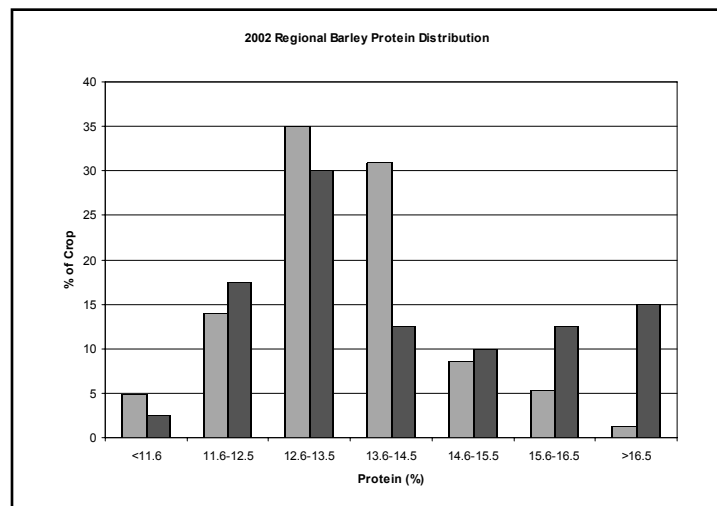
Test Weight. (Graph I) The region's six-rowed barley crop exhibited an average test weight of 45.3 lbs/bushel. Approximately 44% of the six-rowed barley samples collected in 2002 exhibited test weights in excess of 45.9 lbs/bu (59.1 kg/hl). The regional average test weight for the two-rowed barley crop was 46.7 lbs/bushel, and 65% of samples collected were in excess of 45.9 lbs/bushel. Lower average test weights for two-rowed barley in the southwestern district of North Dakota are attributable to drought conditions.

Graph II.



Kernel Plumpness. (Graph II) The average kernel plumpness level for the 2002 regional six-rowed barley crop was 75.9%, and approximately 74% of the regional samples exhibited kernel plumpness in excess of 70%. The average kernel plumpness level for the 2002 regional barley two-rowed barley crop was 82%. Approximately 85% of the regional two-rowed samples were in excess of 70% plump.

Graph III.



1000 Kernel Weight. Every third sample collected was analyzed for 1000 kernel weight. The 2002 regional six-rowed barley crop displayed an average 1000 kernel weight of 35.0 grams (Table II). The regional two-rowed barley average was 42.6 grams (Table I). Regional variation in 1000 kernel weight followed a pattern similar to that seen for test weight.

Color. Color score is based on a scale of 1 to 10, with a lower score indicating brighter barley. Similar to the past three crops years, the 2002 regional six-rowed barley crop exhibited an average color score (brightness) of seven (Table II). The regional average color for the 2002 two-rowed barley crop was five, which reflects drier conditions in much of the two-rowed barley production region (Table I). The brightest barley was found in southwestern North Dakota.

Conclusion. Although yields and the overall total production of barley were lower than average, the quality of the crop was good. The occurrences of Fusarium Head Blight (FHB) were lower than they have been in recent years. Evaluation of protein and kernel plumpness levels suggest that over 40% of the regional six-rowed crop was of malting quality. Approximately 50% of Conlon samples collected and analyzed met malting quality requirements.

NUTRITIONAL ANALYSES

Barley samples from North Dakota and major barley production areas in Minnesota were composited within crop reporting districts and characterized nutritionally. Dry matter, fiber, and mineral content of the barley samples are summarized in Table III and protein characteristics are summarized in Table IV. These nutritional characteristics are compared to published reference values taken from beef (1996), dairy (2001) and swine (1998) nutrient requirements series from the National Research Council (NRC).

Dry matter content on the barley samples from North Dakota and Minnesota indicate that these samples may be expected to store well because of their low moisture content. Similarly, ash content of the samples is desirable. Minerals are contained within the ash portion and are desirable; however, too much ash lowers energy content of the

barley and is undesirable. Both dry matter and ash content of the barley produced in this region is consistent with published values in the NRC.

The fiber fractions (neutral detergent and acid detergent fiber) of these barleys are desirable for both ruminants and non-ruminants. The fiber fraction (mostly the hull) is much less digestible than the endosperm. The fiber fraction of the barley samples are similar to values reported in the 1996 beef NRC and lower than dairy and swine. Because the fiber is less digestible, energy values would be greater than those reported in the swine and dairy NRC.

Phosphorus is the mineral of greatest nutritional significance in cereal grains. Phosphorus is greater in barleys from the 2002 crop year than those reported in the livestock nutrient requirements series.

Table III. 2002 Barley Crop DM, Fiber and Mineral Analyses (dry matter basis)

Sample ID	DM, %	NDF, %	ADF, %	Ash, %	Ca, %	P, %	Mg, %	K, %	Na, %	Fe, ppm	Cu, ppm	Mn, ppm	Zn, ppm
North Dakota													
ND CRD-1, Two-rowed	90.1	18.0	5.6	2.6	0.05	0.42	0.16	0.45	0.01	56	7	16	31
ND CRD-2, Two-rowed	89.7	18.8	5.5	2.7	0.06	0.44	0.15	0.49	0.02	57	8	17	29
ND CRD-4, Two-rowed	90.0	18.7	5.5	2.8	0.06	0.47	0.16	0.48	0.01	71	7	18	39
ND CRD-7, Two-rowed	90.7	19.6	6.7	2.7	0.06	0.49	0.16	0.48	0.02	72	7	18	38
ND CRD-8, Two-rowed	89.2	18.1	5.9	2.8	0.06	0.52	0.16	0.48	0.01	106	13	18	41
ND CRD-1, Six-rowed	89.3	20.5	5.8	2.4	0.06	0.40	0.15	0.45	0.01	55	7	15	36
ND CRD-2, Six-rowed	89.2	18.8	5.6	2.5	0.06	0.44	0.15	0.46	0.02	56	7	15	33
ND CRD-3, Six-rowed	89.6	18.7	5.7	2.8	0.07	0.51	0.15	0.42	0.01	59	8	16	31
ND CRD-4, Six-rowed	90.2	20.0	5.7	2.5	0.06	0.47	0.15	0.46	0.01	60	8	16	35
ND CRD-5, Six-rowed	90.1	20.6	5.4	2.7	0.06	0.51	0.15	0.46	0.01	63	7	17	35
ND CRD-6, Six-rowed	89.8	19.4	5.4	2.9	0.06	0.46	0.15	0.44	0.01	81	8	17	32
ND CRD-7, Six-rowed	90.8	18.5	6.1	2.6	0.07	0.46	0.16	0.45	0.02	113	7	17	38
ND CRD-8, Six-rowed	90.5	21.0	6.2	2.6	0.06	0.53	0.15	0.48	0.01	72	7	18	40
ND CRD-9, Six-rowed	89.9	21.2	6.2	2.8	0.06	0.51	0.16	0.48	0.01	74	8	18	38
ND (Two-rowed) Average	89.9	18.7	5.8	2.7	0.06	0.47	0.16	0.48	0.01	72	8	17	36
ND (Six-rowed) Average	89.9	19.9	5.8	2.6	0.06	0.48	0.15	0.46	0.01	70	7	17	35
ND State Average	89.9	19.4	5.8	2.7	0.06	0.47	0.15	0.46	0.01	71	8	17	35
Minnesota													
MN CRD-1, Six-rowed	89.2	22.0	6.2	3.0	0.06	0.49	0.14	0.46	0.01	84	9	14	31
MN CRD-4, Six-rowed	89.5	21.8	6.5	2.9	0.07	0.47	0.18	0.45	0.02	77	9	17	31
MN State Average	89.4	21.9	6.4	2.9	0.07	0.48	0.16	0.46	0.01	81	9	16	31
Two-State Average	89.8	19.7	5.9	2.7	0.06	0.47	0.16	0.46	0.01	72	8	17	35
NRC													
Beef (1996)	88.1	18.1	5.8	2.4	0.05	0.35	0.12	0.57	0.01	60	5	18	13
Dairy (2001)	91.0	20.8	7.2	2.9	0.06	0.39	0.14	0.56	0.02	70	6	22	38
Swine (1998)	89.0	20.6	7.4	NA	0.07	0.40	0.15	0.52	0.03	93	8	19	22

DM = dry matter; CP = crude protein; NDF = neutral detergent fiber; ADF = acid detergent fiber.

Table IV. 2002 Barley Crop Protein & Amino Acid Characteristics (dry matter basis)

Calcium, magnesium, and sodium are similar to the NRC publications, whereas potassium is slightly less.

Cereal grains contribute to the trace mineral base of diets for livestock and analyses for several trace minerals are included. These values can be quite variable, depends on geographical area the crop was raised, and generally reflects soil trace mineral profiles. The values reported in Table III can be used in a nutritional database for software used to formulate diets that use barley grown from the region.

The crude protein analyses from the samples of barley produced in this region are also indicative of barley with high nutritional value. These higher crude protein values, relative to the NRC publications, indicate that these barleys may be expected to contain higher levels of nutritionally essential amino acids as shown in Table IV.

Rumen digestion of crude protein impacts efficiency within the rumen whether the animal is being fed high forage or a high grain diet. Barley is a good source of rumen degradable protein,

Sample ID	CP digestion rate, %/hour		RDP, % of CP	Lys, %	Trp, %	Thr, %	Met, %
	CP, %	%/hour					
North Dakota							
ND CRD-1, Two-rowed	12.4	10.4	71.4	0.43	0.14	0.42	0.21
ND CRD-2, Two-rowed	12.5	9.6	72.1	0.43	0.14	0.42	0.21
ND CRD-4, Two-rowed	13.1	9.1	70.0	0.44	0.15	0.44	0.22
ND CRD-7, Two-rowed	15.6	7.8	67.6	0.50	0.17	0.51	0.26
ND CRD-8, Two-rowed	15.2	7.2	67.5	0.49	0.17	0.50	0.25
ND CRD-1, Six-rowed	12.6	9.0	73.1	0.43	0.14	0.42	0.21
ND CRD-2, Six-rowed	13.1	10.9	73.0	0.44	0.15	0.43	0.22
ND CRD-3, Six-rowed	13.2	8.0	73.1	0.44	0.15	0.44	0.22
ND CRD-4, Six-rowed	13.1	8.9	71.8	0.44	0.15	0.44	0.22
ND CRD-5, Six-rowed	13.8	12.0	71.8	0.46	0.15	0.46	0.23
ND CRD-6, Six-rowed	13.3	9.4	72.6	0.44	0.15	0.44	0.22
ND CRD-7, Six-rowed	14.5	9.3	73.1	0.47	0.16	0.48	0.24
ND CRD-8, Six-rowed	14.3	11.2	71.4	0.47	0.16	0.47	0.24
ND CRD-9, Six-rowed	14.6	11.0	70.3	0.48	0.16	0.48	0.24
ND (Two-rowed) Average	13.8	8.8	69.7	0.46	0.15	0.46	0.23
ND (Six-rowed) Average	13.6	10.0	72.2	0.45	0.15	0.45	0.23
ND State Average	13.7	9.6	71.3	0.45	0.15	0.45	0.23
Minnesota							
MN CRD-1, Six-rowed	13.2	10.5	72.4	0.44	0.15	0.44	0.22
MN CRD-4, Six-rowed	14.6	9.6	68.3	0.48	0.16	0.48	0.24
MN State Average	13.9	10.0	70.3	0.46	0.16	0.46	0.23
Two-State Average	13.7	9.6	71.2	0.45	0.15	0.45	0.23
NRC							
Beef (1996)	13.2	12.0	66.9	NA	NA	NA	NA
Dairy (2001)	12.4	22.7	76.3	0.45	0.15	0.42	0.21
Swine (1998)	12.2	NA	NA	0.43	0.13	0.39	0.21

which is the type of protein most often deficient in ruminant diets. Estimates of ruminal protein digestion and amount of rumen degradable protein are very similar to NRC data.



NUMBER OF BARLEY SAMPLES COLLECTED BY TYPE AND LOCATION		
Location	Six-Rowed	Two-Rowed
North Dakota		
CRD 1	32	7
CRD 2	34	4
CRD 3	37	0
CRD 4	12	8
CRD 5	29	0
CRD 6	24	0
CRD 7	7	15
CRD 8	12	6
CRD 9	20	0
State Total	207	40
Minnesota		
CRD 1	28	0
CRD 4	8	0
State Total	36	0
Regional Total	243	40

Methods Employed and Definition of Terms and Symbols

Agriculture Experiment Station
Department of Cereal & Food Sciences and
Animal and Range Sciences

TEST WEIGHT: Test weight was determined on dock-age-free barley using a Seedburo Model 8800 computer grain scale. Test weight was expressed in pounds per bushel. In the event sample moisture exceeded 13.5%, the sample was allowed to air-dry prior to test weight determination.

MOISTURE: Moisture was expressed as a percentage of total weight and was determined with a Motomco Model 919ES Flowthrough Moisture Meter.

PROTEIN: Percent total protein, calculated on a dry matter basis, was determined by measuring the thermal conductivity of nitrogen, following combustion of the sample, using a Leco Model FP-428 Nitrogen Determinator System. Crude protein determination for nutritional quality evaluation using the Keltec Kjeldahl method is expressed on a dry matter moisture basis.

KERNEL ASSORTMENT: Barley (100 g) kernel assortment was determined by standard ASBC method Barley 2-B (Methods of Analysis of the American Society of Brewing Chemists, 1992) using a Eureka-Niagara Sample Barley grader.

1000 KERNEL WEIGHT: 1000 kernel weight was determined by ASBC method Barley-2D (Methods of Analysis of the American Society of Brewing Chemists, 1992) with an electronic kernel counter.

COLOR: Color was determined by a modification of ASBC standard method, Barley-9 (Methods of Analysis of the American Society of Brewing Chemists, 1992) using the L value obtained from a Pacific Scientific XL-800 Series Gardner Colorimeter with XL-845 circumferential sensor. The L-value was converted to a color score (1-10), with a score of one representing bright barley and a score of 10 representing dark or heavily stained barley.

MINERAL ANALYSES:

Cations: Finely ground samples (2.0 g) were weighed into disposable aluminum dishes and placed in a muffle furnace at 5250C for 16 hours. The resulting ash was weighed and dissolved in 2 N HCl and diluted to 110 ml.

Appropriate dilutions were made for the working range of each mineral for a Perkin-Elmer Model 406 atomic absorption spectrophotometer. The instrument settings are from the instrument manual (Analytical Methods for Atomic Absorption Spectrophotometry, Perkin-Elmer Manual No. 303-0152, 1976, revised).

PHOSPHORUS: A 5.0 ml portion of the diluted ash sample was analyzed for total phosphorus content by the method of Fiske and Subbarow (J. Bio. Chem, 1925) as modified and published by A.O.A.C., 14th ed., 1984; method 7.125.

FIBER ANALYSIS: ANKOM Fiber Analyzer (ANKOM Technology, Macedon, NY).

PROTEIN AND AMINO ACIDS:

IN SITU RUMINAL PROTEIN DEGRADATION

5.0 grams of sample (ground through a 2 mm screen) were incubated in polyester bags for 0, 4, 8, 12, 16, or 24 in the rumen of steers fed a barley-based diet. Duplicate bags were incubated per sample and time point in two different steers (24 total bags per sample). Rumen degradable protein was calculated as: $RDP = a + [(1-a)(kd/(kp + kd))]$, where a = N disappearance at 0 hr; kd = ruminal degradation rate calculated as the slope of the natural logarithm of the N remaining in the bag vs time (N remaining = e^{-kt}); and kp = passage rate of undegraded protein from the rumen, assumed to be 8%/hr (Mathers and Miller, 1981)

AMINO ACID ESTIMATION

The amino acid lysine, tryptophan, threonine and methionine were estimated from crude protein by linear equations in the swine NRC (1998).

RUMEN DEGRADABLE PROTEIN (RDP): The fraction of crude protein degraded by microbes in the rumen. Rumen undegradable protein (RUP) is $100 - RDP$. Rumen undegradable protein is also known as bypass or escape protein.



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