



HARD WHITE WHEAT

QUALITY SURVEY

2023

HARD WHITE



The smallest class of wheat in the United States, hard white (HW) is grown in the Southern Plains, Idaho and California, and when available for export, shipped via Pacific and Gulf ports. HW wheat has a hard endosperm, white bran and a medium to high protein content of 10.0 to 14.0% (12% mb). HW includes winter and spring varieties increasing the protein range and functionality within the class.

For the miller, HW delivers whiter flour at higher extraction levels due to its lighter bran color. HW is a true hard wheat creating excellent granulation, maximizing course semolina production and low ash flour.

For the baker, the greatest advantage of HW wheat flour is the whiter end product color. Higher extraction rates generally improve water absorption. Using ultra fine, white whole wheat flour, whole wheat bread can be produced with the color and texture of bread from white flour. HW wheat flour is also lower in polyphenol oxidase (PPO), an enzyme that can cause dough browning. Lower PPO content improves the color of wet noodles and Asian steamed bread products.



APPLICATIONS

U.S. HW wheat receives enthusiastic reviews when used for Asian noodles, whole wheat or high extraction applications, pan breads or flat breads.

Applications include:

- Bulgur
- Flat breads
- Hard rolls
- High extraction applications
- Asian noodles
- Pan breads
- Tortillas
- Whole wheat breads
- Yeast raised products



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HARD WHITE PRODUCTION

FOR THE MAJOR PRODUCING STATES (MMT)

	2023	2022	2021	2020	2019
California	0.0	0.0	0.0	0.0	0.0
Colorado	0.1	0.0	0.1	0.0	0.2
Idaho	0.3	0.2	0.2	0.3	0.3
Kansas	0.2	0.2	0.4	0.2	0.3
Nebraska	0.1	0.0	0.1	0.0	0.1
Five-State Total	0.6	0.5	0.7	0.6	0.8
PNW-Exportable	0.3	0.2	0.2	0.3	0.3
Southern Plains-Exportable	0.4	0.3	0.5	0.3	0.5
Total SRW Production	0.6	0.5	0.7	0.6	0.9

Based on USDA crop estimates as of September 29, 2023.

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SAMPLES OF
HARD WHITE

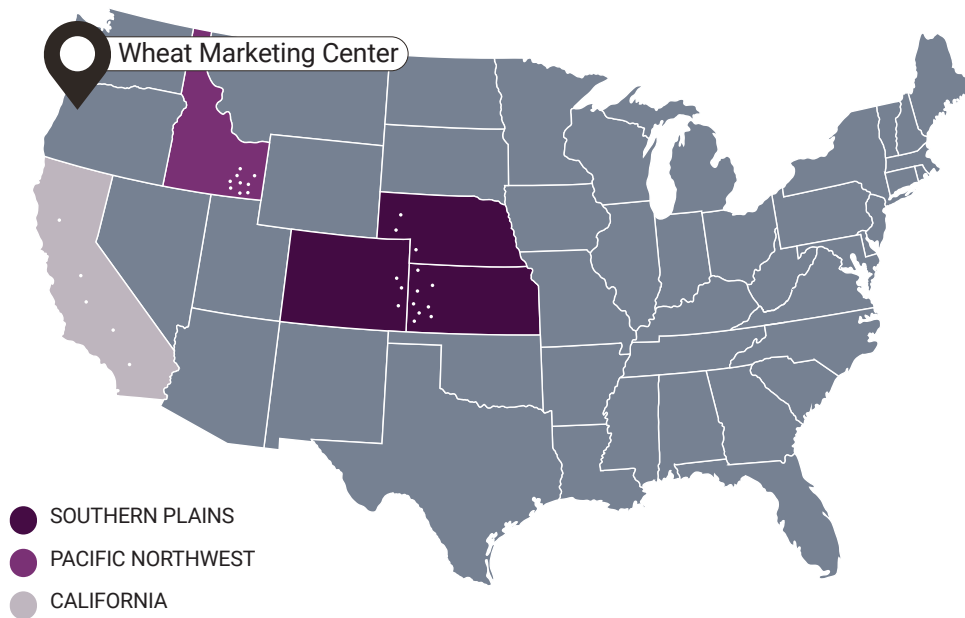
collected by state and private inspection agencies; commercial wheat handlers; Plains Grains, Inc.; and state wheat commissions.

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STATES SURVEYED

99%

OF TOTAL HRW PRODUCTION REPRESENTED



SURVEY METHODOLOGY

SAMPLE COLLECTION AND ANALYSIS

The Wheat Marketing Center (WMC) conducted the quality analyses. The Federal Inspection Service (FGIS) graded and ran wheat proteins on the samples.

SAMPLE TESTING

Official grade factors were determined on each sample. Non-grade factors and functionality tests were conducted on 6 composite samples categorized by growing region and protein ranges of <11.5%, 11.5 to 12.5%, 12.6 to 13.5% and >13.5%. The methods are described in the Analysis Methods section of this booklet.



HARVEST SURVEY

The 2023 U.S. hard white (HW) wheat samples show acceptable quality performance in milling, dough properties and finished products, including pan breads, Asian noodles and steamed breads. The Pacific Northwest (PNW), California and Southern Plains composites all show acceptable to excellent bread baking potential according to their respective protein contents. For Asian noodle applications, using 60% extraction patent flour is recommended to improve noodle color while maintaining noodle texture. For steamed breads, it is recommended that high protein HW flour be blended with a portion of soft white (SW) flour to improve product quality.

CROP HIGHLIGHTS

PLANTED and **HARVESTED** area for the 2023 HW crop reflect high abandonment in the Southern Plains due to drought. USDA estimates total HW planted area at 616,800 acres and harvested area at 473,520 acres, with abandonment of 23% compared to 15% in 2022.

PRODUCTION was supported by late-season rain in Colorado and Nebraska, and much better growing conditions in the PNW. USDA's estimate of total winter and spring HW wheat is 0.62 million metric tons (MMT) for 2023, 32% more than 0.47 MMT in 2022.

The **GRADE** for low- and medium-protein composites for California and the Southern Plains grade as U.S. No. 1. Very high protein composites from the PNW and Southern Plains grade as U.S. No. 2 primarily due to lower test weights.

TEST WEIGHTS range from 59.3 to 64.4 lb/bu (78.0 to 84.6 kg/hl), a wider spread than in the 2022 crop.

PROTEIN contents range from 10.8 to 13.7% (12% mb) with **WHEAT MOISTURE** ranging from 9.9 to 12.8%.

1000 KERNEL WEIGHTS are ≥ 30.0 g except for the low-protein Southern Plains composite at 29.6 g.

FALLING NUMBER values are ≥ 338 sec for all composites.

Buhler **LABORATORY MILL** straight-grade flour extractions range from 69.8 to 70.6% on a tempered wheat weight basis, L* values (whiteness) from 91.6 to 92.4, and flour ash 0.42 to 0.50% (14% mb). Flour extractions should not be compared to previous years as the calculation has shifted from a total product weight basis to a tempered wheat weight basis. Commercial mills should see better extractions, although some adjustments may be necessary for portions of the crop with lower test weights and 1000 kernel weights.

Flour **WET GLUTEN** contents range 23.3 to 33.9% depending on protein content.

STARCH PASTING PROPERTIES including amylograph and RVA peak viscosities range from 615 BU/2455 cP to 834 BU/2881 cP and indicate the crop will produce noodles with acceptable texture.

DOUGH PROPERTIES show this year's crop has lower water absorption values, weaker mixing properties, and less extensibility compared to last year.

BAKING EVALUATION for all composites shows acceptable to excellent baking performance relative to protein content, with bake absorptions in the range of 62.6 to 68.5%, loaf volumes of 773 to 1026 cc, and crumb grain and texture scores that are similar to or better than a typical HRW flour.

For **CHINESE WHITE SALTED NOODLE** performance, L* values are acceptable for all composites except the PNW and Southern Plains very high protein composites. The sensory color stability scores are excellent for the California medium protein composite with all other composites rating as poor. Cooked noodle texture is softer than the control for all composites primarily due to lower starch pasting viscosities and water absorptions than last year.

CHINESE YELLOW ALKALINE NOODLE L* values are similar or better than the control for parboiled noodles from the California and Southern Plains composites. Cooked noodle texture is softer for all composites primarily due to lower starch pasting viscosities and water absorptions compared to last year.

STEAMED BREAD results show most composites have acceptable specific volumes. Total scores are lower than the control flour due to smaller volumes, tighter and yellower internal crumbs, and surface blisters. Blending 25% SW flour with high protein HW flour may improve overall steamed bread quality.

HARVEST DATA

2023 DATA BY GROWING REGION AND PROTEIN¹

	PNW	CALIFORNIA		SOUTHERN PLAINS		
	Very High	Very High	Low	High	Med	Very High
WHEAT GRADE DATA:						
Test Weight (lb/bu)	59.3	63.7	64.4	60.7	61.2	59.8
(kg/hl)	78.0	83.7	84.6	79.8	80.5	78.7
Damaged Kernels (%)	0.0	0.0	0.0	0.7	0.0	0.2
Foreign Material (%)	0.0	0.1	0.0	0.1	0.0	0.0
Shrunken & Broken (%)	0.7	0.3	0.3	1.6	0.5	1.3
Total Defects (%)	0.7	0.4	0.3	2.4	0.5	1.5
Grade	2 HW	1 HW	1 HW	1 HW	1 HW	2 HW
WHEAT NON-GRADE DATA:						
Dockage (%)	0.6	0.0	0.0	0.3	0.2	0.7
Moisture (%)	11.1	10.5	10.5	9.9	12.8	12.0
Protein (%) 12%/0% mb	13.7/15.6	10.8/12.3	12.1/13.8	10.8/12.3	12.3/14.0	13.7/15.6
Ash (%) 14%/0% mb	1.61/1.88	1.39/1.62	1.48/1.72	1.57/1.82	1.58/1.83	1.59/1.85
1000 Kernel Weight (g)	30.0	35.6	43.6	29.6	34.5	31.6
Kernel Size (%) lg/md/sm	76/23/1	84/16/0	93/7/0	70/29/1	82/18/0	79/20/1
Single Kernel: Hardness	70.0	81.0	77.0	63.0	65.0	49.0
Weight (mg)	31.8	37.2	42.2	31.6	35.3	33.3
Diameter (mm)	2.66	2.80	2.87	2.60	2.70	2.65
Sedimentation (cc)	41.7	32.3	27.8	35.0	47.0	46.1
Falling Number (sec)	338	356	345	411	367	381
FLOUR DATA:						
Lab Mill Extraction (%)	69.8	69.1	70.4	69.7	70.5	70.6
Color: L*	91.6	92.4	91.9	92.1	91.6	91.8
a*	-1.7	-1.8	-1.1	-1.9	-2.0	-1.7
b*	7.8	7.4	5.4	8.0	9.0	8.0
Protein (%) 14%/0% mb	13.0/15.6	9.8/12.3	11.0/13.8	9.1/12.3	10.9/14	12.5/15.6
Ash (%) 14%/0% mb	0.50/0.58	0.49/0.56	0.43/0.50	0.42/0.49	0.46/0.53	0.47/0.55
Wet Gluten (%)	30.5	25.5	27.3	23.3	28.6	33.9
Falling Number (sec)	339	398	394	408	376	381
Amylograph Viscosity: 65g (BU)	794	641	834	698	615	719
RVA: Pasting Temp. (°C)/Peak Viscosity (cP)	66.8/2686	66.0/2649	66.9/2881	66.1/2765	66.2/2455	67.0/2628
Hot Paste Viscosity (cP)/Final Viscosity (cP)	1459/2449	1439/2506	1566/2602	1853/3055	1497/2639	1535/2645
Damaged Starch (%)	5.7	8.1	8.6	6.0	6.3	4.1
SRC: Water/50% Sucrose	65/119	66/113	70/111	64/110	65/112	63/118
5% Lactic Acid/5% Na ₂ CO ₃	158/76	111/96	153/91	138/84	134/83	145/79
Gluten Performance Index (GPI)	0.81	0.53	0.76	0.71	0.69	0.73
DOUGH PROPERTIES						
Farinograph: Peak Time (min)	15.5	8.1	9.5	7.2	9.0	6.5
Stability (min)	58.8	60.8	63.4	57.7	58.9	59.0
Absorption (%)	8.2	3.0	2.8	2.0	3.0	5.8
Alveograph: P (mm)	74	102	134	87	85	62
L (mm)	119	75	53	56	78	127
P/L Ratio	0.62	1.36	2.53	1.55	1.09	0.49
W (10 ⁻⁴ J)	340	266	288	194	244	237
Extensograph (45/135 min): Resistance (BU)	752 / 1507	326 / 643	389 / 990	486 / 924	669 / 931	533 / 1015
Extensibility (cm)	16.4 / 10.2	9.5 / 6.2	9.5 / 7.2	11.4 / 8.1	20.2 / 15.2	17.9 / 13.4
Area (cm ²)	150 / 171	43 / 48	50 / 82	72 / 88	170 / 176	120 / 166
% OF SAMPLES:						

¹Protein Range: Low, <11.5%; Med, 11.5 - 12.5%; High, 12.6 - 13.5%; Very high, >13.5%.

HARVEST DATA

2023 DATA BY GROWING REGION AND PROTEIN¹

	PNW	CALIFORNIA		SOUTHERN PLAINS		
	Very High	Very High	Low	High	Med	Very High
BAKING EVALUATION:						
Pan Bread: Bake Absorption (%)	63.8	65.6	68.5	62.6	63.9	64.0
Loaf Volume (cc)	1026	773	816	823	850	930
WHITE SALTED (RAW) NOODLE EVALUATION:						
Color at 0-24 hr: L*	82.0 / 68.8	85.0 / 76.1	86.8 / 78.7	85.8 / 75.5	84.9 / 73.9	81.1 / 71.2
a*	0.6 / 1.4	-0.7 / -0.5	0.6 / 0.7	-0.2 / 0.6	-0.2 / 0.4	0.1 / 1.2
b*	19.3 / 22.0	17.9 / 20.9	11.9 / 15.2	16.2 / 22.1	17.0 / 23.1	20.6 / 23.6
Change in L* (0-24 hr)	13.2	8.9	8.1	10.3	11.0	9.9
Cooking Yield (5 min, %)	116	132	136	145	132	127
Sensory Color Stability Score	3.0	6.0	9.0	5.0	4.0	2.0
Instrumental Texture:						
Firmness (g)	1093	995	1009	957	1042	1091
Springiness (%)	94	91	94	94	94	93
Cohesiveness (%)	0.65	0.67	0.64	0.62	0.64	0.65
Chewiness (g)	664	603	609	559	622	660
YELLOW ALKALINE (WET) NOODLE EVALUATION:						
Uncooked Color at 0-24 hr: L*	78.3 / 68	82.7 / 72.5	84.1 / 74.1	84.5 / 74.4	79.9 / 70.6	80.1 / 68
a*	-1.6 / -0.5	-1.9 / -1.3	-1.0 / -0.9	-1.3 / -1	-1.3 / -0.9	-1.2 / -0.5
b*	19.8 / 23.4	21.5 / 23.0	14.7 / 16.9	18.0 / 22.7	20.9 / 25.1	20.4 / 23.4
Change in L* (0-24 hr)	10.2	10.2	10.0	10.1	9.4	12.1
Parboiled Color at 0-24 hr: L*	75.5 / 74.1	79.5 / 79.2	78.4 / 78.6	78.8 / 79.1	76.3 / 76.4	76.7 / 76.2
a*	-1.3 / -2.2	-3.0 / -3.5	-2.0 / -2.8	-2.3 / -3.2	-2.3 / -2.9	-2.1 / -2.7
b*	26.4 / 24.5	29.0 / 27.2	25.3 / 23.6	29.5 / 28.2	28.4 / 27.5	27.6 / 26.7
Cooking Yield (1.5 min, %)	90	88	97	97	84	89
Uncooked Color Stability Score	6.0	8.0	7.0	9.0	8.0	7.0
Parboiled Color Stability Score	6.5	9.0	8.0	7.5	7.0	7.0
Instrumental Texture:						
Firmness (g)	706	951	665	773	885	755
Springiness (%)	76.5	92.2	85.3	89.6	87.9	67.7
Cohesiveness (%)	0.69	0.61	0.67	0.56	0.61	0.68
Chewiness (g)	370	538	376	389	473	348
NORTHERN-STYLE STEAMED BREAD EVALUATION:						
Specific Volume (ml/g)	2.4	2.4	2.3	2.3	2.2	2.4
Total Score	58	66	68	58	59	61

¹Protein Range: Low, <11.5%; Med, 11.5 - 12.5%; High, 12.6 - 13.5%; Very high, >13.5%.

ANALYSIS METHOD

HARD WHITE LABORATORY TESTING

All quality data contained in this report is the result of testing and analysis conducted by Wheat Marketing Center in Portland, Oregon.

TEST:	METHODOLOGY:
WHEAT GRADE FACTORS	
Grade	Official U.S. Standards for Grain.
Test Weight	AACCI 55-10.01.
Damaged Kernels	Official U.S. Standards for Grain.
Foreign Material	Official U.S. Standards for Grain.
Shrunken and Broken	Official U.S. Standards for Grain.
Total Defects	Official U.S. Standards for Grain.
WHEAT NON-GRADE FACTORS	
Dockage	Official USDA procedures.
Moisture	Official USDA conductance method
Protein (12% mb)	AACCI 39-25.01 (NIR method)
Ash (14% mb)	AACCI 08-01.01 expressed on a 14% mb.
1000 Kernel Weight	Based on the average weight of three 100-kernel samples multiplied by 100, expressed on a 14% mb.
Kernel Size	Wheat is sifted with a RoTap sifter using Tyler No. 7 (2.82 mm) and No. 9 (2.00 mm) screens.
Single Kernel Characterization System (SKCS)	AACCI 54-31.01 using Perten SKCS 4100.
Sedimentation	AACCI 56-61.02.
Falling Number	AACCI 56-81.04; 2019 FGIS barometric pressure correction procedure; average value is a simple mean of sample results.
DON	Neogen ELISA.
FLOUR FACTORS	
Laboratory Milling Extraction	AACCI 26-21.02. All extraction rates are calculated against total products on an "as is" mb. Samples are milled on a Buhler Laboratory mill (MLU 202) using a 183-micron (μ) sieve.
Color	CIE 1976 L*a*b* color system. Minolta Chroma Meter with Granular-Materials attachment CR-A50 and CR-410 colorimeter.
Protein (14% mb)	AACCI 46-30.01 (Dumas CNA method).
Ash (14% mb)	AACCI 08-01.01 expressed on a 14% mb.
Wet Gluten	AACCI 38-12.02.
Gluten Indexw	AACCI 38-12.02.
Falling Number	AACCI 56-81.04; 2019 FGIS barometric pressure correction procedure; average value is a simple mean of sample results.

ANALYSIS METHOD

HARD WHITE LABORATORY TESTING

TEST:	METHODOLOGY:
FLOUR FACTORS	
Wet Gluten	AACCI 38-12.02.
Gluten Index	AACCI 38-12.02.
Falling Number	AACCI 56-81.04; 2019 FGIS barometric pressure correction procedure; average value is a simple mean of sample results.
Amylograph Viscosity	AACCI 22-10.01 modified to use 65 g flour (14% mb) and 450 ml distilled water with pins.
Damaged Starch	AACCI 76-33.01 (SDmatic).
Solvent Retention Capacity	SRC manual shake.
DOUGH PROPERTY FACTORS	
Farinograph	AACCI 54-21.02 (constant flour weight method) with 50 g bowl.
Alveograph	Constant hydration method.
Extensograph	AACCI 54-10.01; modified 45 and 135-min rest.
EVALUATION OF END-PRODUCTS	
Bread	AACCI 10-10.03 ("pup loaf" method) with 180 min fermentation.*
Steamed Bread	Steamed bread is prepared using no-time dough method (WMC procedures): HW flour; flour 100%, instant yeast 1.5%, sugar 12%, shortening 2% and water is calculated based on the Farinograph. Yeast is dissolved in water before use.
Chinese Noodles	<p>Noodle texture is determined on five strands of cooked noodles with a strand cross-cut dimension of 2.5 x 1.2 mm for raw noodles, W x T (Width x Thickness); 1.7 x 1.7 mm for wet noodles (Wheat Marketing Center (WMC) procedures), W x T using a Stable Micro Systems TA.XTPlus Texture Analyzer.</p> <p>Two noodle types are prepared from each HW flour:</p> <p>WHITE SALTED NOODLE FORMULA: HW flour 100%, salt 1.2% and deionized water 28%. Noodle sheet color is measured once on both sides of a dough sheet that is resting atop two other dough sheets to ensure color consistency. This is done for three dough sheets (six readings total) using a Minolta CR-410 Chroma Meter; the mean value is reported.</p> <p>YELLOW ALKALINE NOODLE FORMULA: HW flour 100%, salt 2%, K₂CO₃ 0.45%, Na₂CO₃ 0.45% and deionized water 32%. Noodle sheet color is measured on both uncooked and parboiled (for 1.5 min) sheets. Cooking yield is percent of weight gain after cooking for 1.5 min, rinsing in 26 to 27°C (79 to 81°F) tap water and draining.</p>



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