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## Macaroni or Durum Wheats: A Continuation of Bulletin 92

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**SOUTH DAKOTA**

# **Agricultural College**

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## **Macaroni or Durum Wheats**

**A CONTINUATION OF BULLETIN 92**

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**DEPARTMENT OF CHEMISTRY**

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## MACARONI OR DURUM WHEATS

(A Continuation of Bulletin 92)

Department of Chemistry

Jas. H. Shepard, Chemist

At the close of the season of 1904, I deemed it advisable to make a selection of the most promising of the Durum wheats, for further investigation along the same exhaustive lines laid down in Bulletin 92 of this Station. My reasons were twofold. In the first place, such work would tend to give a more extended basis for judgment, and in the second place, would also give an opportunity to test out the wheats grown at Highmore under absolutely ideal conditions.

The season of 1904 at Highmore was practically a perfect one, so far as the growing of Durum wheat was concerned. The rainfall was just sufficient for the perfect maturation of the crop and there was a complete freedom from all diseases incident to the grain fields. The varieties selected were those that had given the best results in the test of the previous year, and included six varieties of the northern and two of the southern Durums. The rust resisting variety, Lumillo, was also included, in hopes that it might show some improvement over the previous test. But the improvement was so slight that further tests will only serve to emphasize its inferiority.

It will not be necessary to repeat here the history of the samples selected, as that is given in detail in Bulletin 92. The names of the varieties will appear in the several tables contained in this Bulletin.

The high grade of the Highmore samples will be readily seen in the Milling and Moisture table under the heading Grade. The best varieties gave a grade closely approximating 64 pounds per bushel, or that of Kubanka 5639, which is probably the best variety experimented with.

When it came to milling these wheats it was at once evident that these perfect conditions had made some slight changes in ease of milling. The wheats were harder, and I found that the power required for reduction had advanced about one point in every instance. I also found that in order to make as clean a separation of the different mill products as in the previous test, it would become necessary to return the unfinished products one or two times more to the reduction rolls. It also became apparent that the yield of semolina suitable for the manufacture of macaroni had increased to a very large degree. But in order to make the results of this Bulletin comparable with those of the previous tests I did not make the extra reductions, but treated the samples exactly as before.

This different behavior of these samples gave rise to some interesting queries. The 1903 samples had not been grown at Highmore from Highmore grown seed, but from seed grown at the home Station. The 1904 crop came from Highmore grown seed. Was the change due to the repeated growing at Highmore under the different soil and climatic conditions, or was it due to the scanty but sufficient rainfall? It was evident that these questions could not be answered by the data at hand at the close of 1904. Consequently I deemed it best to withhold the results until the close of the season of 1905.

The season of 1905, both at Highmore and at the home Station, was not so favorable for the Durums. There was an excess of moisture. Moreover, the harvest was a wet one. When the 1905 samples were milled the ease of reduction returned to the original tests reported, the flour yield increased under normal treatment, and as a matter of course the semolina yield showed a diminution.

The results show very plainly that the differences found in the 1904 crop were caused by the sole factor of rainfall. And this emphasizes the fact very forcibly that the Durums are emphatically dry weather wheats and that they will reach their greatest development in the driest portions of our country, where the rainfall is not sufficient to grow ordinary bread wheats. That the difficulty of reduction increases under



those ideal conditions need cause no alarm. More powerful reducing machinery is the remedy.

It will be seen from the Milling and Moisture table which follows that Kubanka 5639 continues to lead in the percentage of flour. In the sample grown by the writer in 1905 both the grade and percentage of flour are lower than in the Highmore sample. The conditions at Brookings were altogether unfavorable as far as moisture is concerned. But nevertheless it has been necessary to grow a small quantity of this excellent variety in order to keep the pedigree and strain of this seed pure. Our work has shown that home grown seed carried to dryer regions immediately responds to the changed conditions. Whether the continuous growing of this variety will finally produce a bread wheat pure and simple remains to be seen.

A sample of Red Fife was carried through with the 1905 crop in order to get comparative results. The table shows the data obtained:

Milling and Moisture Table

Sample						Mill Products				Color of Flour		Color of Semolina		Moisture—Per Cent			
Laboratory Number	Name	Yield bu. per acre	Grade lbs. per bu.	Condition	Reduction	Per Cent Bran	Per Cent Shorts	Per Cent Flour	Per Cent Error	Yellow	Orange	Yellow	Orange	Wheat	Bran	Shorts	Flour
	Northern or Russian Macaroni Wheats, Crop of 1904																
48	5639 Kubanka.....	23.3	64	P	M	11.50	19.60	68.00	-0.90	.25	.05	.18	.20	9.61	9.01	8.54	9.47
60	5642 Yellow Gharovka.....	11.3	63	P	H	20.88	21.30	57.00	-0.82	.30	.10	.....	.....	9.85	9.38	8.50	9.66
67	1350 Pererodka.....	21.3	63.5	P	H	20.78	19.36	56.12	-3.74	.25	.10	.....	.....	11.57	9.88	8.65	10.13
135	1516 Kubanka.....	23.3	64	P	H	18.60	18.80	62.40	-0.20	.25	.10	.20	.25	9.69	9.04	8.07	8.42
132	1513 Beloturka.....	12.3	63.5	P	M	10.50	19.40	69.50	-0.60	.25	.10	.20	.20	9.36	9.32	9.20	9.97
139	1537 Arnautka.....	18.0	63	P	H	17.60	23.20	58.30	-0.90	.25	.05	.20	.20	10.41	9.73	9.04	10.69
	Average.....	18.3	63.5			16.64	20.28	61.89	-1.19	.26	.08	.19	.21	10.08	9.39	8.66	9.69
	Southern or Mediterranean Macaroni Wheats, Crop of 1904																
149	7785 Pellissier.....	12.3	62	P	H	25.30	24.00	51.40	-0.70	.20	.15	.....	.....	9.62	10.27	9.88	10.42
162	9130 Saragolla.....	11.5	58	SS	H	25.40	27.50	46.80	-0.30	.20	.15	.25	.20	9.71	9.13	8.41	9.41
	1736 Iumillo.....	16.6	60.5	SS	H	40.18	20.00	42.40	+2.58	.22	.18	.05	.40	9.34	9.92	8.73	9.53
	Average.....	13.5	60.2			30.29	23.83	46.83	+0.95	.21	.16	.15	.30	9.56	9.29	9.01	9.29
	Miscellaneous Macaroni Wheats, Crop of 1904																
122	1492 Nicaragua.....	14.6	62.5	P	H	28.90	26.30	43.40	-1.40	.23	.12	.20	.30	9.54	9.35	9.09	9.32
	Average of wheats milled, crop 1904.....	....	62.4			21.96	21.95	55.53	-0.66	.24	.11	.18	.25	9.87	9.50	8.81	9.68
	Northern or Russian Macaroni Wheats, Crop of 1905																
48	5639 Kubanka (J. H. S.).....	..	59	SS	M	12.90	19.40	68.00	+0.10	.25	.05	.....	.....	12.75	12.17	11.17	12.48
48	5639 Kubanka (Highmore).....	23.3	64	P	M	8.10	13.30	77.80	-0.80	.25	.10	.....	.....	7.53	8.26	8.17	8.47
67	1350 Pererodka.....	28.5	61.5	P	M	9.10	21.00	71.00	+1.10	.25	.10	.....	.....	7.49	9.10	8.93	8.79
139	1537 Arnautka.....	36.0	60.5	SS	M	12.90	18.60	68.30	-0.20	.25	.15	.....	.....	7.45	8.31	7.89	8.16
60	5642 Yellow Gharovka.....	25.2	59	P	M	12.30	21.10	66.40	+0.30	.27	.18	.....	.....	7.40	7.67	7.51	7.90
52	Arnautka.....	25.0	62.5	P	M	19.90	20.10	62.30	+2.30	.24	.06	.....	.....	10.75	10.75	10.56	10.92
123	1493 Wild Goose.....	25.0	63	P	M	21.80	23.10	54.50	-0.60	.27	.08	.....	.....	9.69	10.47	10.57	10.83
	Average.....	27.2	61.4			13.90	19.50	66.90	+0.30	.25	.10	.....	.....	9.01	9.55	9.26	9.65
	Miscellaneous Wheats, Crop of 1905																
	1736 Iumillo.....	23.2	59.5	S	M	22.10	25.90	53.60	+1.60	.20	.15	.....	.....	9.57	9.48	9.93	
	Red Fife.....	18.3	59	P	E	18.10	20.20	61.00	-0.70	.15	.20	.....	.....	9.99	9.99	9.31	10.10

In the Crude Protein Distribution table it will be seen that Kubanka 5639 for the two years is the most desirable, since it yields the largest per cent of protein to the flour produced. Some of the others nearly approach this variety in the total protein.

It will be noticed that the total protein is less in all varieties in a wet season than it is in a dry one. But taking it on an average, it is now evident that the Durums will not suffer protein diminution when grown in our climate. This is a very encouraging factor. The export trade is now opening up and promises to be of vast importance to farmers living in the Durum wheat belt.



# Crude Protein and Its Distribution

Nx5.7=Crude Protein

Sample		Per Cent Crude Protein				Pounds Protein in 100 lbs. Wheat and in Mill Products Therefrom					Per Cent Distribution Between Mill Products of Total Protein in Wheat				
Laboratory Number	Name	Whole Wheat	Bran	Shorts	Flour	Whole Wheat	Bran	Shorts	Flour	Error	Bran	Shorts	Flour	Error	
Northern or Russian Macaroni Wheats, Crop of 1904															
48	5639 Kubanka.....	14.02	12.48	13.17	14.19	14.02	1.43	2.57	9.63	-.40	10.16	18.29	68.70	-2.85	
60	5642 Yellow Gharnovka.....	14.88	15.50	14.42	15.62	14.88	3.25	3.08	8.89	+.34	21.84	20.69	59.77	+2.30	
67	1350 Pererodka.....	14.86	14.36	14.19	14.36	14.36	2.96	2.74	8.09	-.57	20.63	19.05	56.85	-3.97	
132	1513 Beloturka.....	15.16	14.31	14.31	14.93	15.16	1.48	2.79	10.43	-.46	9.77	18.42	68.80	-3.01	
135	1516 Kubanka.....	14.19	14.42	13.51	13.51	14.19	2.68	2.62	8.44	-.45	18.88	18.48	59.44	-3.20	
139	1537 Arnautka.....	14.99	14.82	14.82	14.99	14.99	2.62	3.42	8.72	-.23	17.49	22.81	58.17	-1.53	
	Average.....	14.60	14.31	14.07	14.60	14.60	2.40	2.87	9.03	-.30	16.46	19.62	61.87	-2.05	
Southern or Mediterranean Macaroni Wheats, Crop of 1904															
149	7785 Pellissier.....	15.90	16.13	14.76	15.33	15.90	4.10	3.53	7.87	-.40	25.81	22.22	49.46	-2.51	
162	9130 Saragolla.....	17.90	17.50	17.50	17.78	17.90	4.46	4.79	8.32	-.34	24.84	26.75	46.50	-1.91	
	1736 Iumillo.....	15.33	14.93	14.59	14.99	15.33	5.99	2.91	6.38	-.05	89.03	18.96	41.64	-0.37	
	Average.....	16.38	16.19	15.62	16.03	16.38	4.85	3.74	7.52	-.27	29.89	22.96	45.87	-1.28	
Miscellaneous Macaroni Wheats, Crop of 1904															
122	1492 Nicaragua.....	14.42	14.42	14.19	14.19	14.42	4.16	3.71	6.16	-.39	28.84	25.69	42.69	-2.78	
	Average of wheats milled, crop 1904	15.12	14.89	14.55	14.99	15.12	3.31	3.22	8.29	-.50	21.73	21.14	55.15	-1.98	
Northern or Russian Macaroni Wheats, Crop of 1905															
48	5639 Kubanka (J. H. S.).....	12.31	13.62	18.45	12.31	12.31	1.71	2.11	8.38	-.11	13.89	17.13	68.06	-0.92	
48	5639 Kubanka (Highmore).....	12.31	11.46	12.65	12.25	12.31	.91	1.71	9.52	-.17	7.41	13.88	77.31	-1.40	
67	1350 Pererodka.....	12.65	12.26	12.83	12.64	12.65	1.14	2.68	8.89	+.06	9.09	21.17	70.27	+0.53	
139	1537 Arnautka.....	14.65	14.76	14.82	14.42	14.65	1.88	2.74	9.86	-.17	12.84	18.68	67.31	-1.17	
60	5642 Yellow Gharnovka.....	13.05	13.34	13.74	12.83	13.05	1.71	2.91	8.49	+.06	13.10	22.27	65.06	+0.43	
52	Arnautka.....	12.14	12.03	12.94	11.42	12.14	2.39	2.62	7.30	+.17	19.71	21.60	60.09	+1.40	
123	1493 Wild Goose.....	11.63	12.26	12.43	10.83	11.63	2.68	2.85	5.93	-.17	23.04	24.51	50.98	-1.47	
	Average.....	12.68	12.82	13.27	12.37	12.68	1.77	2.52	8.34	-.05	14.15	19.89	65.58	-0.38	
Miscellaneous Wheats, Crop of 1905															
	1736 Iumillo.....	.....	12.83	13.22	12.14	.....	2.85	3.42	6.50	.....	22.14	26.79	50.90	.....	
	Red Fife.....	12.54	13.22	12.77	11.46	12.54	2.39	2.57	7.01	-.57	19.09	20.46	55.09	-5.36	

The Bread and Macaroni table is given next. The loaf volume does not vary greatly among these better varieties. It averaged slightly smaller for the 1905 wheats. The 1905 sample from Highmore was damaged by water during harvest. This accounts for the poorer showing of the Kubanka 5639 sample.

The macaronis were all so good in the 1904 crop that it was deemed unnecessary to repeat the macaroni tests in 1905. The Iumillo made a poor showing in this respect also.

On account of their large field yield two samples, one an unknown Arnautka, and the other a Wild Goose wheat, were run in the 1905 samples. They have shown no particular superiority in any of the tests.

# Bread and Macaroni

Laboratory Number	Sample		Baking Test					Macaroni Test						
	Name		Loaf		Crumb		Quality	Color			Flavor	Texture	Quality	
			Weight grams	Volume C. C.	Color			Texture	Orange	Yellow				Black
					Yellow	Orange								
	<b>Northern or Russian Macaroni Wheats, Crop of 1904</b>													
48	5639	Kubanka.....	460	1600	.55	.30	98	98	.90		.40	100	100	100
60	5642	Yellow Gharnovka.....	455	1600	.50	.25	100	100						
67	1350	Pererodka.....	447	1600	.40	.35	100	100						
132	1513	Reloturka.....	445	1550	.40	.40	98	98	.90		.30	100	100	100
135	1516	Kubanka.....	468	1450	.45	.35	90	90	.90		.40	100	100	100
123	1537	Arnautka.....	465	1620	.50	.25	98	98	1.00		.30	100	100	100
	Average.....		457	1570	.47	.32	97	97	.92		.35	100	100	100
	<b>Southern or Mediterranean Maca- roni Wheats, Crop of 1904</b>													
149	7785	Pellissier.....	454	1600	.35	.25	90	95						
162	9130	Saragolla.....	455	1400	.40	.40	90	90	.90		.30	100	100	100
	1736	Iumillo.....	465	1380	.40	.55	50	60	.30		1.00	90	80	75
	Average.....		456	1460	.38	.40	78	82	.85		.65	95	90	88
	<b>Miscellaneous Macaroni Wheats, Crop of 1904</b>													
122	1492	Nicaragua.....	450	1500	.45	.30	95	95	.90	.20	.30	100	100	100
	Average of wheats milled, crop 1904		456	1530	.44	.34	91	92	.90		.42	99	97	96
	<b>Northern or Russian Macaroni Wheats, Crop of 1905</b>													
48	5639	Kubanka (J. H. S.).....	440	1500	.55	.30	90	92						
42	5639	Kubanka (Highmore).....	455	1450	.50	.35	90	88						
67	1350	Pererodka.....	437	1500	.50	.25	92	92						
139	1537	Arnautka.....	440	1500	.45	.35	90	92						
60	5642	Yellow Gharnovka.....	440	1500	.50	.30	90	92						
52	Arnautka	.....	455	1550	.55	.25	95	98						
123	1493	Wild Goose.....	445	1500	.55	.30	95	96						
	Average.....		445	1500	.51	.30	92	93						
	<b>Miscellaneous Wheats, Crop of 1905</b>													
	1736	Iumillo.....	450	1450	.55	.35	85	85						
	Red Fife	.....	440	1550	.40	.40	95	98						

The next table deals with the Gluten, Gliadin and Baker's Sponge Test. The constants obtained in these tests compare favorably with those reported in Bulletin 92. But as one would naturally expect, the 1905 tests are not quite so high as those of 1904. The gliadin numbers reported in this Bulletin are not strictly comparable with those of the 1903 test. The latter were made by the polarization method, and sufficient allowance was not made for the variation in the sugar content of the different varieties of the Durum wheats. This makes the 1903 tests average about 1.5 per cent too low. The 1904 and 1905 tests were made by determining the nitrogen by the Kjeldahl-Gunning method, and they are correct.

It is a peculiarity of the Durums that while they carry more protein than bread wheats, the gliadin content is usually lower. It seems as if the greater per cent of gluten offsets to a certain degree the lack of gliadin when the flours are made into bread.



# Gluten, Gliadin and Baker's Sponge Test

Sample		Gluten in Flour				Gliadin in Flour		Baker's Sponge Test								
Laboratory Number	Name	Per Cent Moist Gluten	Per Cent Dry Gluten	Grams Water Held by One Gram Gluten	Physical Quality	Per Ct. Gliadin Held by 70% Alcohol Soluble x 5.7	Per Cent Gliadin of Total Protein	Rise						Grams Water Held by Dough from 100 Grams Flour		
								Time—Min.			Volume—C. C.					
								First Rise	Second Rise	Average Time	First Rise	Second Rise	Average Rise		Average Rise for each 100 Grams Gluten	
43	Northern or Russian Macaroni Wheats, Crop of 1904															
5639	Kubanka.....	47.45	16.20	1.93	90	6.16	43.42	85	60	73	660	580	620	38.27	79.5	
60	5642 Yellow Gharnovka.....	50.00	16.95	1.95	90	7.75	49.63	80	70	75	760	700	730	43.07	77.7	
67	1350 Pererodka.....	49.15	16.35	2.01	90	6.84	47.63	80	65	73	700	650	675	41.28	75.1	
132	1513 Beloturka.....	53.35	17.55	2.07	90	6.95	46.55	85	55	70	700	650	675	38.46	82.0	
135	1516 Kubanka.....	43.10	15.75	1.93	90	6.27	46.41	80	50	65	650	550	600	38.09	78.4	
139	1537 Arnautka.....	49.70	16.85	1.95	90	6.61	44.11	80	55	68	620	580	600	35.61	78.7	
	Average.....	49.38	16.61	1.97	90	6.76	46.29	82	60	71	682	620	651	39.13	78.6	
149	Southern or Mediterranean Macaroni Wheats, Crop of 1904															
7785	Pellissier.....	53.65	17.25	2.11	85	6.95	45.36	90	55	73	680	540	610	35.36	78.4	
9130	Saragella.....	60.75	20.65	1.94	80	7.07	39.76	80	45	63	600	560	580	28.09	83.4	
1736	Iumillo.....	51.25	17.45	1.94	70	5.36	35.74	80	50	65	500	400	450	25.79	84.5	
	Average.....	55.22	18.45	1.99	78	6.46	40.29	83	60	67	593	500	547	29.75	82.1	
122	Miscellaneous Macaroni Wheats, Crop of 1904															
1492	Nicaragua.....	47.50	15.85	1.99	80	5.59	39.36	70	50	60	600	500	550	34.70	74.3	
	Average of wheats milled, crop 1904	50.94	17.09	1.98	86	6.56	43.80	81	56	69	647	571	608	35.87	79.2	
48	Northern or Russian Macaroni Wheats, Crop of 1905															
5639	Kubanka (J. H. S.).....	33.44	12.28	1.72	90	5.52	44.81	80	50	65	575	520	547	44.54	80.5	
5639	Kubanka (Highmore).....	35.12	13.45	1.61	90	5.47	44.61	80	50	65	550	450	500	37.17	80.5	
67	1350 Pererodka.....	37.69	13.86	1.72	90	5.81	46.36	85	40	63	600	480	540	39.00	75.8	
139	1537 Arnautka.....	44.41	15.29	1.90	90	6.73	46.64	85	60	68	590	550	570	37.28	75.2	
60	5642 Yellow Gharnovka.....	33.33	13.59	1.67	90	5.76	40.40	80	45	63	600	480	540	39.73	72.9	
52	Arnautka.....	33.51	12.95	1.82	90	5.87	50.00	80	45	63	630	580	605	46.72	76.9	
123	1498 Wild Goose.....	32.57	11.89	1.74	90	5.42	50.02	75	55	65	600	560	580	48.78	75.8	
	Average.....	35.58	13.33	1.74	90	5.80	46.12	81	48	65	592	517	555	41.89	76.8	
1736	Miscellaneous Wheats, Crop of 1905															
Iumillo.....		34.97	13.32	1.63	85	4.87	40.16	80	45	63	550	420	484	36.41	75.9	
Red Fife.....		35.17	12.88	1.73	95	6.73	50.00	85	55	70	750	680	715	56.51	73.1	



The results obtained on the two years' tests confirm those reported in 1903. As a matter of course variations from year to year are to be expected, but the former conclusions have been reaffirmed.

Again it is now evident that taking all in all, yield, hardiness, flour yield, protein distribution, and the quality of both bread and macaroni, that Kubanka 5639 is to be recommended for more general use, while the inferior sorts should be relegated to the elevators as soon as sufficient seed of the 5639 can be obtained.

And in this connection too much stress cannot be laid upon the importance of keeping the seed pure and free from bread wheats and from all other kinds of Durum wheat. The price of Durum wheat will advance as soon as the quality is raised by growing only the best variety.

The work outlined in this Bulletin was distributed as in former reports, but the nitrogen determinations were made by Mr. Koch, my present assistant.