Agricultural Experiment Station.

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I. THE COMPOSITION OF FODDERS, WHEAT AND MILLED PRODUCTS.

II. THE COMPOSITION OF DAIRY PRODUCTS.

III. SUGAR BEETS.

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I. THE COMPOSITION OF FODDERS AND GRAINS.

BY HARRY SNYDER.

A. WHEAT AND MILLED PRODUCTS.

During the year 1892 a number of analyses have been made of different grades of wheat, together with the flour and products obtained from them. These samples represent a number of different grades of wheat from the crop of 1891. No attempt is made to distinguish between the different commercial grades of wheat as to chemical composition, since this would require a larger number of analyses than have yet been made. The results are given, as they show fairly well the average composition of wheat as grown in Minnesota. These analyses show that these samples are much richer in gluten and other valuable food compounds than the average as generally given for American wheat.

The results are expressed in percentages, or parts per hundred. In the table the averages are first given, then the extremes or highest and lowest percentages. The starch and dextrin (soluble starch) were separately determined in each sample. In the flour, sixteen samples are reported. The flour was made from eight of the eighteen samples of wheat whose analyses are reported, and contains more starch and less gluten and nitrogenous matters than the original wheat. The small amount of ether soluble matter (mainly fat) is noticeable. In the wheat, it will be seen that the ratio of the gluten to the starch is about 1 to 4; in the flour 1 to 6.5.

The composition of the wheat germ is extremely interesting, inasmuch as there is more nitrogenous matter in this product than in the original wheat or any of the other

products. This is quite suggestive. The germ is too valuable a food product to be incorporated into the by-products. The shorts and bran reported are not from the same milling as the wheat, flour and germ. They represent, however, the average composition of bran from exhaustive milling. The shorts contain less nitrogen, ash and fiber than the bran; these same compounds in the shorts are, as a rule, more digestible than those of the bran. The reader is referred to bulletin 26 page 29 for a more complete discussion of the digestibility of bran and shorts.

It will be seen on examining the table, that on the average there is more water in the flour and each one of the products, than was present in the original wheat. Whether this is true in general yet remains to be seen. Wheat starch is quite hydroscopic, and without doubt many of the discrepancies in the weighings of large quantities of wheat are due to the differences in the amounts of hydroscopic moisture present. A difference of one-half of one per cent of water would make a difference of a half a pound on a hundred pounds of wheat. A difference of half of a per cent of water in the same sample of wheat at different times is not an uncommon occurrence. In the wheat 97 per cent of the nitrogen is in the form of gluten and other albuminoids; in the flour 98. Practically all of the nitrogen is in the form of gluten and albuminoids. This is not in accord with statements found in many chemical journals and books, but it must be remembered that the chemical methods for the determination of nitrogen have been materially improved within comparatively recent years.

The per cent of starch and dextrin in the wheat ranged from 62.4 to nearly 68, with an average of about 65. The starch and gluten make up about 90 per cent of the total composition of the dry organic matter of the wheat. The extremes reached in the composition of these wheats were marked by the Ladoga wheat. It contained the most mineral matter, fiber (woody material) and the least gluten of any of the wheats examined; and the same was true of the Ladoga flour.

WHEAT AND ITS MILLED PRODUCT.

Kind of Sample.	Number of Samples.	Water.	Ash.	Ether Extract.	Protein.		Starch and Dextrin.	Undetermined	Fiber.
					Total.	Gluten.			
Wheat (1891)—									
Average	18	10.16	1.84	2.01	13.75	13.50	64.90	4.14	3.20
Highest		12.10	2.10	2.26	14.12	14.01	67.86	5.64	4.32
Lowest		9.61	1.61	1.71	10.10	9.37	62.40	1.71	2.90
Flour—									
Average	16	10.63	.45	.55	11.25	11.00	70.39		
Highest		13.98	.76	.71	13.35	13.05	74.00		
Lowest		9.53	.35	.34	6.88	6.81	68.80		
Wheat Germ—									
Average	8	10.41	2.74	3.50	15.74	15.31			
Highest		10.98	3.33	5.00	18.75	18.42			
Lowest		10.32	2.51	3.01	13.75	13.13			
							Nitrogen free extract.		
Wheat Shorts—									
Average	6	10.12	3.12	2.90	13.11	12.87	65.33		5.42
Highest		14.12	4.40	4.00	14.16	13.70	68.80		6.98
Lowest		9.04	2.18	2.41	10.06	9.68	61.60		4.12
Bran—									
Average	5	10.40	5.95	5.05	15.38	14.81	52.87		10.25
Highest		13.12	6.25	5.62	18.12	17.64	59.80		14.8
Lowest		9.40	4.87	4.37	12.16	11.81	50.04		7.12

B. FODDER PRODUCTS OF CORN.

The composition of corn ensilage, corn, corn and cob meal and the tops and butts of corn stalks are given in tabular form. In the case of ensilage the results are the averages of duplicate analyses of eight samples. For the sake of a uniform basis for comparison, the composition of corn stalks, with and without the grain, and of ensilage, is given in terms of the dry matter (water free basis.) Comparing the composition of corn and of corn and cob meal, it will be seen that there is more fiber (woody material,) more ash, less protein and ether extract in the corn and cob meal than in the corn meal. Comparing the composition of the tops and butts of corn stalks, it will also be seen that there is about the same difference, namely: more fiber and ash in the butts than in the tops. The tops are richer in the more valuable food materials than the butts.

The composition of the dry matter of ensilage is practically the same as the composition of the stalks with the grain, when cured as dry corn fodder.

In the corn ensilage 88 per cent of the total nitrogen is in the form of albuminoids; in the corn and stalks about 90 per cent. The corn and corn and cob meal are not strictly comparable as to this point, since they are not from the same corn. As a rule, the more nitrogen there is present in the form of albuminoids the more valuable the fodder.

FODDER PRODUCTS OF CORN.

COMPOSITION EXPRESSED IN POUNDS PER HUNDRED.

Kind of Sample.	Number of Samples.	Water.	Ash.	Ether Extract	Protein.		Nitrogen Free Extract.	Crude Fiber.	Nitrogen in form of Albuminoids.
					Total.	Albs.			
Corn Ensilage—									
Average	8	73.85	1.41	.89	1.96	1.73	13.88	6.28	88%
Highest		77.21	1.47	.95	2.22	1.79	16.00	6.51	
Lowest		71.00	1.20	.84	1.89	1.65	12.00	6.17	
Corn (whole kernel)—Average	5	10.73	1.46	3.88	10.25	9.60	70.4	2.25	93%
Highest		11.75	1.49	4.16	11.25	10.20	72.01	2.30	
Lowest		10.60	1.42	2.88	9.92	9.01	68.80	2.10	
Corn and cob meal									
Average	4	6.48	1.65	3.65	7.56	7.22	70.55	10.11	95%
Highest		10.16	1.69	3.79	7.84	7.71	74.80	11.63	
Lowest		5.12	1.61	3.41	7.41	7.05	68.24	9.83	

IN THE FOLLOWING SAMPLES THE RESULTS ARE GIVEN ON DRY MATTER.

Corn Stalks, (no grain)	2		6.25	1.90	4.30	3.88	54.17	29.20	90%
Corn Tops	1		5.80	2.01	5.01	4.82	59.24	25.12	96%
Corn Butts	1		7.06	1.46	4.03	3.60	51.44	32.41	89%
Stalks with Corn			5.00	3.45	7.61	6.84	52.09	25.00	90%
Corn Ensilage			5 04	3.43	7.52	6.12	53.39	24.00	88%

C. MISCELLANEOUS GRAINS AND FODDERS.

Comparing the average composition of barley with that of oats, it will be seen that oats contain more fiber, ash and ether extract, the average amount of protein in each being about the same. The peas are characteristically rich in nitrogenous compounds; gluten meal is even more so; while

germ meal is richer than ordinary grain. The flax seed is rich in both the fat and the albuminoid compounds. The average per cent of the total nitrogen in the form of albuminoids is the same for both the oats and the barley, viz: 94. It would appear that there is but little amide nitrogen in the grains. This is of great importance since the amide compounds are considered to have a lower food value than the albuminoid compounds. In calculating crude protein no distinction is made between amide and albuminoid nitrogen. With ordinary grains this does not seriously affect the results. Hence but little or no correction is necessary for non-albuminoid nitrogen in wheat, flour, oats, barley, corn, gluten meal and flax seed; with the hay and straw this does not hold true, as a reference to the table will show.

The per cent of ash in the wheat straw, oat straw, timothy and millet appears incredibly large when compared with older analyses. In the older analyses, the insoluble silica and carbon dioxide were deducted from the ash. In the case of all of the above samples this seriousiy affects the per cent of ash, since in the case of wheat straw nearly half the ash is insolubie silica (sand); and if this insoluble silica was deducted from the ash, the wheat straw would contain about 4.50 per cent ash, instead of 9. The total, soluble and insoluble silica were determined in each sample, and since they compose such a large per cent of the mineral matters of the straw, they are interesting to observe:

	Wheat Straw.	Oat Straw.	Timothy.
Total Silica	57.95	45.25	46.65
Insoluble Silica	48.7	41.76	44.62
Soluble Silica	9.25	3.49	2.03

This also affects the per cent of nitrogen free extracts in these samples from 3 to 4 per cent, making the samples so much less valuable. Nitrogen free extract is a very broad term, and at one time it included a little sand.

Among the miscellaneous fodder articles timothy, millet and ths straws will be found to be poor in protein compared with clover, pea hay and lucern. The plants that are rich in

nitrogenous compounds are frequently called the nitrogenous plants; clover, lucern and pea hay are good examples of such fodders. Pea hay compares closely and favorably with clover hay; pea hay is extremely rich in mineral matter. Wolff, in his "Aschen Analysen," gives average results of analyses with even higher percentages of ash. Pea hay ash is rich in lime, phosphoric acid and potash, all essential materials for bone growth in young and growing animals. In bulletin No: 26, page 12, it will be found that the ash is quite completely digested by milch cows.

Millet and timothy hay are quite similar in composition, with the advantage as far as protein is concerned, in favor of millet. The dry matter of the rape, particularly of the leaves, is rich in nitrogenous compounds. Attention should be given to the raising of fodders that contain more of the albuminoid compounds.

With the exception of the wheat the grain and fodder crops reported were grown upon the experiment station farm during the seasons of 1891 and 1892. A number of these fodder articles can be added, to advantage to many farmers' crops.

GRAINS AND SEEDS.

Kind of Sample.	Number of Samples	Water	Ash	Ether Extract	Protein.		Nitrogen Free Extract	Fiber	Per cent of total Nitrogen in form of Albumin'ds
					Total	Albumenoids			
Barley—									
Average	4	11.78	3.32	2.70	11.57	10.92	67.63	3.00	94
Highest		13.60	2.64	2.98	13.60	13.16	68.80	5.12	
Lowest		9.80	2.12	2.41	10.12	9.58	62.12	4.48	
Oats—									
Average	5	8.60	3.62	4.88	11.70	11.01	60.94	6.64	94
Highest		9.43	3.38	5.32	11.84	11.71	62.99	11.70	
Lowest		8.09	2.85	4.12	10.14	9.84	61.34	5.64	
Flax Seed	1	5.10	3.54	38.60	27.50	26.12	19.24	7.40	95
Germ Meal	1	6.52	1.25	6.47	14.00	13.01	63.71	8.25	93
Gluten Meal	1	9.02	.87	7.62	27.46	25.40	55.64	1.39	93
Peas—									
Average	4	9.84	3.40	1.03	22.00	21.05	58.00	5.73	96
Highest		11.90	3.62	1.16	23.04	22.12	59.60	7.46	
Lowest		9.72	3.06	.85	21.69	21.02	55.04	5.64	
Buckwheat (wild)	1	11.92	2.65	3.25	10.60	8.42	60.81	10.77	

HAY, STRAW AND MISCELLANEOUS.

Kind of Sample.	Number of Samples.	Water.	Ash.	Ether Extract	Protein.		Nitrogen Free Extract.	Crude Fiber.	Per cent of total Nitrogen in form of Albuminoids.
					Total.	Albuminoids.			
Wheat Straw	1	7.41	9.22	.97	3.25	2.50	38.27	40.88	71.4
Oat Straw	1	8.36	9.00	1.40	4.06	2.90	41.11	38.07	70.
Clover Hay	1	10.25	6.45	2.59	13.43	12.00	42.64	24.67	89.
Timothy Hay	1	10.17	5.64	1.60	5.62	4.80	44.56	32.41	85.
Millet Hay	1	7.65	9.33	1.55	6.68	5.98	43.79	31.00	88.
Lucern Hay	1	10.12	6.91	2.10	13.54	12.02	39.13	28.20	89.
Rape, dry (whole plant)	1	84.51	7.60	1.80	11.75	7.18	63.56	15.29	61.
Rape, dry leaves	1	88.16	7.50	3.20	17.04	13.09	60.03	11.06	75.
Pea Hay	1	9.75	12.72	2.63	14.58	12.25	32.86	27.46	84.

II. THE COMPOSITION OF DAIRY PRODUCTS.

A. MILK.

General Composition.—Milk is composed of water and solid matter. The milk solids obtained by evaporating milk to dryness at the temperature of boiling water form a light brown, shiny, brittle mass, made up of four classes of compounds, viz: Fats, sugar, nitrogenous matters such as casein, albumen and ash. The fats, nitrogenous matters and ash are each in their turn made up of a number of compounds; the ash, for example, is partially composed of common salt, lime and potash. A complete analysis of milk usually means nothing farther than a determination of the percentage amounts of each class of compounds such as the fats, ash, and milk sugar, that are present, and not a separation of these groups into simpler compounds. Milk is extremely complex in its composition and to separate a sample into the twenty-four or more compounds of which it is composed is the labor of a number of days.

Milk fats are familiar to every one as the product recovered in the butter. A pound of butter contains only about .85 of a pound of pure milk fats, the remaining .15 being made up of water, casein, salt and other matters.

Pure milk sugar in appearance resembles ordinary confectionery sugar; the milk sugar of commerce usually has a yellowish hue due to impurities. Since it is not sweet to the taste it is quite unlike cane sugar.

The nitrogenous matters in milk are extremely complex and

comprise the casein and albumen groups. The casein is commonly known as the curd. The albumen in milk is not recovered in either butter making or ordinary cheese making.

During the past year approximate analyses have been made of the milk from the individual cows. Some of the results are given in the following tables, and show the daily composition of the milk of different cows for periods of 1 week. At the time these samples were taken the cows were all in about the same condition, their food was practically uniform, and hence the differences in composition and yield are due mainly to breed and individuality.

The quantity of milk yielded is equally as important in determining the value of a cow as the percentage composition or quality. Either factor taken alone possesses but little value, but when taken together they determine the total yield of fats or solids for that particular period. In the tables will be found both the daily percentage composition of the milk, and under the headings "yield per day" the total number of pounds of solids, ash, casein, sugar, and fat in the two milkings for that particular day.

The figures in heavy type at the end of each separate table are the averages for that particular cow.

BECKLEY.

Per Centage Composition.					Yield Per Day in Pounds.					
Solids.....	Fat.....	Ash.....	Casein.....	Sugar.....	Solids.....	Fat.....	Ash.....	Casein.....	Sugar.....	Milk.....
14.80	6.00	.69	3.56	4.46	2.83	1.14	.13	.68	.85	19.1
14.09	5.45	.67	3.47	4.50	2.77	1.07	.13	.68	.89	19.7
14.79	5.20	.68	4.01	4.90	2.99	1.05	.14	.88	.99	20.2
14.89	5.90	.67	3.62	4.65	2.92	1.06	.12	.71	1.02	19.7
14.61	5.40	.70	4.01	4.50	2.88	1.06	.14	.79	.88	19.7
14.64	5.30	.76	3.78	4.80	3.06	1.10	.16	.79	.99	20.9
14.98	5.75	.77	3.56	4.99	2.93	1.13	.15	.70	.96	19.6
14.70	**5.57**	**.71**	**3.71**	**4.67**	**2.91**	**1.09**	**.14**	**.75**	**.94**	**20.**

GERTIE.

15.24	6.50	.72	3.17	4.85	2.96	1.26	.14	.61	.94	19.4
14.89	5.80	.69	3.45	4.90	3.25	1.26	.15	.75	1.07	21.8
15.13	5.40	.78	3.90	5.05	3.37	1.20	.17	.87	1.15	22.3
14.88	5.25	.78	3.85	5.00	3.18	1.12	.17	.82	1.07	21.4
14.87	5.30	.74	3.98	4.85	3.19	1.14	.16	.85	1.04	21.5
15.13	5.10	.78	4.20	5.05	3.36	1.13	.17	.93	1.13	22.2
14.68	5.50	.76	3.35	5.1	3.19	1.19	.16	.72	1.10	21.7
14.97	**5.55**	**.75**	**3.70**	**4.97**	**3.21**	**1.19**	**.16**	**.79**	**1.07**	**21.4**

OLIVE.

Per Centage Composition.					Yield Per Day in Pounds.					
Solids	Fats	Ash	Casein	Sugar	Solid	Fat	Ash	Casein	Sugar	Milk
12.71	4.7	.64	3.07	4.30	4.32	1.6	.22	1.04	1.46	34.
12.18	3.9	.69	3.09	4.50	4.35	1.37	.25	1.10	1.60	35.7
12.52	3.8	.62	3.10	5.05	4.42	1.35	.22	1.10	1.78	35.4
12.40	3.8	.60	3.00	5.00	4.34	1.33	.21	1.05	1.75	35.
12.36	4.0	.64	3.02	4.70	4.36	1.41	.23	1.06	1.65	35.3
12.76	4.0	.66	3.00	5.10	4.53	1.42	.24	1.06	1.81	35.5
12.89	4.4	.64	3.00	4.85	4.63	1.58	.23	1.07	1.74	35.9
12.56	**4.09**	**.64**	**3.04**	**4.78**	**4.42**	**1.44**	**.23**	**1.07**	**1.68**	**35.2**

REDDY.

13.97	5.45	.66	3.36	4.50	3.19	1.25	.15	.77	1.03	22.9
13.80	5.10	.63	3.22	4.85	3.87	1.43	.18	.90	1.36	21.8
13.34	5.00	.61	3.03	4.70	3.25	1.22	.15	.74	1.15	24.4
14.01	4.95	.65	3.46	4.95	3.24	1.14	.15	.80	1.14	23.1
14.24	5.30	.65	3.54	4.75	3.37	1.22	.15	.82	1.10	23.1
14.34	5.00	.70	3.59	5.05	3.20	1.11	.15	.80	1.13	22.3
13.63	4.40	.65	3.68	4.90	3.23	1.04	.15	.87	1.16	23.7
13.91	**5.03**	**.65**	**3.41**	**4.81**	**3.34**	**1.20**	**.15**	**.81**	**1.15**	**23.**

ROSSIE.

12.69	4.20	.64	3.25	4.60	2.73	.90	.14	.69	.99	21.5
12.73	3.7	.60	3.32	4.90	3.09	.89	.14	.79	1.26	24.
13.01	3.8	.59	3.62	5.00	2.92	.85	.14	.81	1.12	22.5
12.64	3.45	.62	3.62	4.95	2.84	.77	.14	.81	1.11	22.5
12.80	3.7	.67	3.63	4.80	3.20	.92	.16	.91	1.20	25.3
12.86	3.9	.63	3.28	5.05	3.11	.95	.15	.80	1.23	24.3
12.90	4.00	.62	3.48	4.80	3.47	1.07	.16	.92	1.28	26.9
12.80	**3.82**	**.62**	**3.46**	**4.87**	**3.05**	**.91**	**.15**	**.82**	**1.03**	**23.8**

ROXY.

13.59	5.05	.67	3.17	4.60	4.41	1.64	.22	1.03	1.49	32.5
13.32	4.55	.63	3.09	5.05	4.88	1.67	.23	1.13	1.85	36.7
13.25	4.10	.65	3.35	5.15	4.38	1.36	.21	1.10	1.70	33.1
13.33	4.35	.66	3.22	5.10	4.61	1.50	.23	1.09	1.76	34.6
13.21	4.05	.67	3.39	4.95	4.52	1.38	.23	1.17	1.69	34.2
13.20	4.20	.70	3.20	5.10	4.75	1.51	.25	1.15	1.87	36.0
12.83	4.20	.67	3.06	4.90	4.70	1.43	.24	1.12	1.80	36.7
13.25	**4.33**	**.67**	**3.21**	**4.97**	**4.61**	**1.50**	**.23**	**1.11**	**1.74**	**34.7**

SWEET BRIAR.

Per Centage Composition.					Yield Per Day in Pounds.					
Solids.....	Fat.....	Ash.....	Casein.....	Sugar.....	Solids.....	Fat.....	Ash.....	Casein.....	Sugar.....	Milk.....
14.55	5.00	.67	3.88	5.00	4.23	1.45	.20	1 13	1.45	29.1
13.75	4.80	.62	3.52	4.80	4.37	1.52	.20	1.12	1.52	31.8
13.76	4.60	.65	3.38	4.95	4.57	1.52	.21	1.23	1.64	33.2
13.47	4.40	.68	3.29	5.10	3.91	1.27	.20	.95	1.47	28.9
13.81	5.00	.72	3.39	4.70	4.46	1.61	.23	1.06	1.52	32.3
13.58	4.50	.72	3.11	5.25	4.28	1.42	.22	.98	1.62	31.5
14.00	5.00	.70	3.34	5.00	4.48	1.60	.22	1.05	1.60	32.0
13.85	**4.76**	**.68**	**3.41**	**4.97**	**4.33**	**1.49**	**.22**	**1.07**	**1.54**	**31.2**

TRIXY.

13.07	4.6	.68	3.19	4.60	4.18	1.47	.22	1.02	1.47	32.
13.21	4.95	.60	3.00	4.65	4.49	1.68	.20	1.02	1.58	34.
13.24	4.80	.70	3.09	4.65	4.63	1.68	.24	1.08	1.53	35.
13.84	5.00	.72	3.15	4.95	4.39	1.58	.23	1.00	1.58	31.7
14.61	4.80	.71	3.90	5.20	4.89	1.60	.24	1.30	1.74	33.5
13.09	4.25	.68	3.66	4.50	4.24	1.37	.22	1.18	1.45	32.4
13.00	4.25	.68	3.37	4.70	4.25	1.47	.22	1.09	1.53	32.7
13.44	**4.66**	**.68**	**3.34**	**4.75**	**4.44**	**1.55**	**.22**	**1.10**	**1.55**	**33.**

THE AVERAGE COMPOSITION OF THE MILK FROM EACH COW FOR FOURTEEN MILKINGS.

Name of Cow.	Per Centage Composition.					Yield Per Day in Pounds.					
	Solids	Fats	Ash	Casein	Sugar	Solids	Fat	Ash	Casein	Sugar	Milk
Beckley	14.70	5.57	.71	3.71	4.67	2.91	1.09	.14	.75	.94	20.0
Gertie	14.97	5.55	.75	3.70	4.95	3.21	1.19	.16	.79	1.07	21.4
Olive	12.56	4.09	.64	3.04	4.78	4.42	1.44	.23	1.07	1.68	35.2
Reddy	13.91	5.03	.65	3.41	4.81	3.34	1.20	.15	.81	1.15	23.0
Rossie	12.80	3.82	.62	3.46	4.87	3.05	.91	.15	.82	1.03	23.8
Roxy	13.25	4.33	.67	3.21	4.97	4.61	1.50	.23	1.11	1.74	34.7
Sweet Briar	13.85	4.76	.68	3.41	4.97	4.33	1.49	.22	1.07	1.54	31.2
Trixy	13.44	4.66	.68	3.34	4.75	4.44	1.55	.22	1.10	1.55	33.0
General Average	13.68	4.74	.67	3.42	4.85	3.79	1.30	.19	.94	1.35	27.8

On examining the table it will be seen that when an ordinary cow produces a pound of butter fat, she produces at the same time a little more than a pound of milk sugar, about .8 of a pound of casein and albumen, and nearly .15 of pound of minerals.

These analyses represent the daily composition of the milk from eight cows for a period of one week or the analyses of 112 samples of milk.

	Average Composition.	Highest.	Lowest.
Water	86.32	84.76	87.82
Dry Matter	13.68	15.24	12.18
Fats	4.74	6.50	3.45
Casein, etc.	3.42	4.20	3.00
Milk Sugar	4.85	5.25	4.30
Ash	.67	.78	.59

The average composition of forty-three samples of milk purchased for the purpose of making cheese during the winter of 1892, shows a somewhat lower percentage composition, and probably represents more nearly the average throughout the state:

Water	12.80	Casein, etc.	3.57
Dry Matter	87.20	Milk Sugar	4.85
Fats	3.65	Ash	.71

The use of the lactometer and milk test in determining the character of milk.—The specific gravity of normal milk ranges from 1.029 to 1.035. The ash, casein and milk sugar are the compounds that increase the specific gravity while the fat tends to decrease it. In normal milk there is a point where these two opposite forces neutralize each other; hence any serious change in the composition of milk immediately affects its gravity. The addition of water lowers the gravity while the removal of the fat raises it. The specific gravity is usually taken with the lactometer, which should always be provided with a thermometer in the bulb, and whenever a reading is taken the temperature should be noted. Corrections are made for a high or low temperature by the table that usually accompanies the instrument. In using the lactometer and test jointly, the following general rules can be applied in cases of suspected adulteration:

1. A high specific gravity and a low fat indicates fat removed.

2. A low specific gravity and a low fat indicates watering.

3. An average specific gravity and a low fat indicates fats removed and watered.

These rules are not infallible but they will aid in detecting any of the ordinary forms of sophistication.

Another important use that can be made of the lactometer and test is in gaining an idea of the total solid matter in milk, and to meet this want a number of formulæ have been proposed. The most recent and trustworthy ones are those given by Fleischman, and Hehner and Richmonds.

Fleischman's formula is: $X = 1.2F + 2.665 \frac{100S - 100}{S}$ in which X = the total solids, F the per cent of fat and S the specific gravity. As a rule this rule gives results nearer those found by analyses than Hehner and Richmond's.

The solids found by calculation, using either formula, in the most extreme cases amounts to about .2 of a per cent, the average being about .1 of a per cent.

Hehner and Richmond's formula is: $F = \frac{5}{6}\left(T - \frac{G}{4}\right)$ from which the value of T is obtained; $T = 1\frac{1}{5}F + \frac{G}{4}$; in which T = the total solids, F the per cent of fat, and G the number indicated on the specific gravity spindle. If the per cent of fat is found to be 4.1 and the specific gravity 1.033 at 60°, applying the formula $4.1 \times 1.2 = 4.92$ and $33 \div 4 = 8.25$. The sum of 4.92 and 8.25 is 13.12, the per cent of total solids in the milk. This formula is simpler to apply and as a rule gives fairly approximate results.

B. BUTTER.

Twenty-seven samples of butter have been analyzed, in connection with various experiments during the year. The samples of butter represent the products from individual

cows, and also that from the whole herd. The percentage composition was found to be:

	Average.	Highest.	Lowest.
Water	12.22	16.20	8.21
Fat	85.00	90.20	79.42
Ash and Salt	2.10	3.03	.74
Casein, etc	.68	2.09	.21

Comparing these results with older analyses it will be seen that with improved butter making there is a tendency to incorporate less casein, water and other foreign matters with the butter. The tendency is thus to improve the keeping qualities of the product.

The butter made from cream separated by the DeLaval Danish Weston, and other centrifugals, is about the same in composition as butter made from the cold deep setting process, The average of duplicate churnings gave for the composition of the butter product from these various machines:

Water	10.42	Casein, etc	1.03
Fat	86.98	Ash and Salt	1.57

The examination of the product from the butter extractor showed the average composition of different churnings:

	Water.	Fat.	Casein.	Salt and Ash.
December 10	11 29	83.37	2.74	2.50
" 11	13.40	81.20	2.74	2.66
" 22	16.19	79.85	2.46	1.50
January 6	16.08	79.56	2.81	1.55

C. LOSSES OF MILK SOLIDS IN CHEESE MAKING.

A clearer understanding of this question can be gained by first following, in a general way, the solid matters in the milk through the process of cheese making.

A hundred pounds of milk ordinarily contains from 12.50 to 13 pounds of dry solid matter. This solid matter is composed of 3.5 to 4 pounds of milk fats, 3¼ to 3¾ pounds of casein and albumen, about 4.80 pounds of milk sugar, ¾ of a pound of ash, and at the time the rennet is added there is

about .15 of a pound of lactic acid. When the whey is drawn off and weighed there is from 85 to 88 pounds of whey for every hundred pounds of milk.

While the milk is in the vat, about two pounds of water are lost by evaporation, for every hundred pounds of milk, the amount lost depending upon the temperature and condition of the atmosphere of the cheese room.

Of the 12.5 to 13 pounds of solids in the milk from 6 to 6.3 pounds are lost in the whey, so that but little more than half of the solids in the milk are recovered in the green cheese. From .28 to .34 of a pound of fat is lost out of the 3.50 to 4 pounds in the milk. The nitrogenous matters (casein and albumen) are not so economically recovered as the milk fats; of the 3¼ to 3¾ pounds of casein and albumen in the milk, about .8 of a pound is lost in the whey, mainly albumen which is not coagulated by the rennet, and is a very valuable food product. But little of the milk sugar is retained in the cheese, and out of the 4.8 pounds originally present in the 100 pounds of milk, from 4.30 to 4.60 are lost in the whey. Hence the solid matter recovered in the cheese is composed mainly of fats and casein. When the milk solids are increased, the amount recovered in the green cheese is increased, while the amount of solid matter lost in the whey remains about the same. Any increase in the solids of milk is due to an increase in fat or casein, since the variations in the per cents of ash and milk sugar are limited.

All of these points are illustrated in the following samples of milk as given in the table. All of the results are expressed in pounds per hundred of the milk used. The figures in the first column indicate the number of pounds of each compound in the milk. Under the whey column is the pounds of each lost in the whey, and in the green cheese column are the pounds recovered in the green cheese. In the cheese 90 and 120 days old are given the amounts as found by analysis at those dates. The salt used and the cheese bandage is deducted from the weight of the solid matter of the cheese.

In the column headed loss in curing is given the number of pounds of each compound lost in the 120 days of curing. Finally, the percentage composition of the cheese is given.

A more extended series of tables could be given, but a few typical examples are selected. The first is that of average milk, requiring about ten pounds of milk to make one pound of cheese; the second, one of richer milk; the third one testing the same in fats as the second but making a less number of pounds of marketable cheese, and the fourth example one of milk made rich by the addition of cream, while the last one is a good example of skim milk cheese.

Example No. 1.

Milk and Products in Pounds per 100 of Milk Used.

	Milk	Whey and Press	Green Cheese	Cheese 90 Days	Cheese 120 Days	Loss in Curing	Composition of Cheese Percentages
Water	87.52	80.97	3.65	3.41	3.20	.45	34.29
Solid Matter	12.48	6.23	6.25	6.12	6.05	.20	65.71
Ash	.80	.52	.28				
Fat	3.50	.30	3.20	3.17	3.15	.05	33.76
Casein and Albumen	3.22	.84	2.38	2.30	2.32	.06	24.47
Milk Sugar	4.80	4.35					
Lactic Acid	.15	.22					

Example No. 2.

Water	86.79	80.89	3.59	3.30	3.17	.42	31.3
Solid Matter	13.21	6.11	7.11	6.94	6.86	.25	68.7
Ash	.64	.40	.24				
Fat	4.00	.34	3.66	3.60	3.58	.08	35.3
Casein and Albumen	3.71	.81	2.90	2.84	2.81	.09	27.7
Milk Sugar	4.50	4.30					
Lactic Acid	.15	.26					

Example No. 3.

Water	87.14	81.00	3.85	3.52	3.45	.40	34.84
Solid Matter	12.86	6.25	6.61	6.38	6.29	.22	65.16
Ash	.64	.53	.11	.12	.10		
Fat	4.00	.31	3.69	3.68	3.62	.07	36.56
Casein and Albumen	3.52	.80	2.72	2.68	2.64	.08	25.86
Milk Sugar	4.60	4.35					
Lactic Acid	.10	.24					

Example No. 4.—Creamed Milk.

Water	85.87	76.01	4.56	4.22	4.02	.52	32.42
Solid Matter	14.13	5.69	8.44	8.25	8.19	.25	67.58
Ash	.77	.42	.35	.36	.32		
Fat	6.00	.49	5.51	5.49	5.40	.11	43.55
Casein and Albumen	3.12	.52	2.60	2.50	2.48	.12	20.00
Milk Sugar	4.12	4.00					
Lactic Acid	.12	.26					

Example No. 5.—Skimmed Milk.

				Cured Cheese.		
Water	87.8	80.8	3.00	2.67	.33	30.68
Solid Matter	12 20	6.19	6.01	5.81	.20	69.32
Fat	2.75	.34	2.41	2.36	.05	27.09
Ash	.80	.31	.49	.49		
Casein and Albumen	3.95	.82	3.13	3.86	.07	36.00
Milk Sugar	4.55	4.45				
Lactic Acid	.15	.27				

Losses of Fats in Cheese Making.

SUMMARY OF RESULTS.

No. of Trials.	Fat in Milk.	Average Fat.	Pounds Fat lost Per 100 Pounds Milk.	Per Cent Fat Recovered in Cheese.
28	3.5—4	3.85	.32	91.69
31	4.1—4.4	4.29	.31	92.77
14	4.4—4.9	4.62	.33	92.86
4	5.00	5.05	.28	94.45

The per cent of water and dry matter in the cheese does not depend upon the richness of the milk in fat, for there is a greater difference in the per cent of water in the two cheeses made from 4 per cent milk than between the ones made from milk testing 2.75 and 6 per cent fat. The per cent of water in the cheese depends upon the thoroughness of pressing. The per cent of fat in the skim milk cheese was 27, and the creamed milk cheese 43.5. The cheese made from the 3.5 per cent milk contained 33.76 per cent fat. Comparing the second and the third examples it will be seen that the per cent of fat in the milk was 4 in each case. In example No.2, 7.11 pounds of solid matter was recovered in the green cheese, while in No. 3 there was 6.61 pounds. This difference was due to the fact that in No.2 there was ½ a pound more casein in tne milk than in No. 3. This is partly balanced by the fast that No. 3 contained more water than No. 2. Hence two samples of milk testing the same in fats may not make the same amounts of marketable cheese.

The legal standard for cheese in this state is that 40 per cent of the total solid matter of the cheese shall be butter-fat. In the case of milk skimmed from 3.50 to 2.75, a removal of over 20 per cent of the fat, over 40 per cent of the total solid matter of the cheese was butter-fat. In another case in which the milk was skimmed to 2.80 per cent fat, over 40 per cent of total solid matter in the cheese was butter-fat. In the case of normal milk testing 3:50 per cent fat over 50 per cent of the total solid matter was fat. The fats in full milk cheese should always exceed the casein, since there is always more fat in the milk than casein and albumen, and a larger per cent of the fat recovered in the cheese than of the casein and albumen.

The loss of weight in the curing of cheese is largely a loss of water. The loss of solid matter in curing is about a quarter of a pound for every hundred pounds of milk, whether rich or poor. This includes all mechanical losses. The results indicate that there is a slight loss of casein and fat, in curing, in addition to mechanical losses.

Artificial digestion experiments were made of the nitrogenous compounds. The results are not reported since it was found that the per cent of salt in the cheeses compared was not the same, and the salt that was present in variable quantities re-acted with the acid in the digestive mixture, and introduced an unknown factor. In general it can be said that the casein in well cured cheese from normal milk is nearly all digestible.

In the table headed "Losses of Fats in Cheese Making" it will be seen that the amount of fat lost in every hundred pounds of milk is about .3 of a pound, and is practically the same for both rich and poor milk. The per cent of the total milk fats retained in the cheese made from rich milk is greater than that made from poor milk. All of the additional fat that is in a rich milk goes into the cheese, and whether it pays, financially, to make the extra fat into cheese, depends upon the price that the cheese commands. It must be remembered, however, that a good article cannot be made from poor material.

III.—SUGAR BEETS.

The relation of the Experiment Station to the growing of sugar beets and the introduction of the mannfacture of sugar therefrom is limited to sending out beet seed of known origin each season to intelligent farmers in different sections of the state, there to be grown under known conditions of climate, soil and cultivation, and determining in the beets grown the richness and purity of the juice. The chemical investigations are thus directed towards discovering the adaptability of soil and climate of the different sections of the state to the growth of sugar beets sufficiently rich in sugar to warrant their cultivation for the manufacture of that article. The experiments are repeated in order to determine the influence of variations of seasons on the quantity and quality of the beets. Chemical analysis can do more than give this aid towards answering the question whether beet sugar factories would or would not be successful ventures; the purely financial aspect of the question must be left to other hands.

In addition to the analyses of beets grown from seed sent out by this station, there is reported in this bulletin analyses of beets grown from seed distributed in the counties along the line of the St. Paul & Duluth railroad under the direction of Mr. Hopewell Clarke, the land commissioner of the road. Counties from which such beets were received are Washington, Chisago, Pine and Carlton. Many of the beets from Anoka county were grown under the supervision of Mr. Max Wittges, an expert from the Oxnard beet sugar factories of Grand Island, Neb. The purity of the juice and high per cent of sugar of the beets grown on the sandy loams of this county under wise direction is significant as is the small size of the beets sent for analysis.

In the following tables are given first, the results of the analyses of the beets grown during the season upon the station farm, and afterwards the analyses of the beets grown in the different counties of the state.

SUGAR BEETS RAISED AT THE STATION.

Plot.	NAME OF VARIETY.	Date.	Average Weiight in Ounces of Beets.	Per Cent of Sugar in Juice.	Purity of Juice.
1	French, Very Rich	Sept. 26	8	12.2	80.3
2	Vilmorin Improved	" "	10	13.7	83.
3	Zuckerreichste Elite	" "	11	14.2	84.5
4	Kleiner Elite	" 24	12	14.05	82.3
5	Dippe's Klein Wanzlebener	" "	14	14.6	83.9
6	" " "	" "	12	14.3	84.6
7	Vilmorin White Improved	" "	12	14.6	85.4
8	Dippe's Improved	" "	12	15.5	87.9
9	Knauer's Imperial	" "	12	13.9	82.2
10	Klein Wanzlebener	" "	12	14.4	84.7
11	" "	" 26	9	13.4	82.2
A	" "	" "	12	12.5	80.7
A	" "	" "	12	14.1	84.4
A	" "	" "	18	12.6	80.8
A	" "	" "	12	13.8	83.6
A	" "	" "	11	13.6	85.1
A	" "	" "	15	13.4	88.2
B	Vilmorin Improved	" 28	12	14.4	90.1
B	" "	" "	15	15.3	90.
B	" "	" "	13	15.5	86.5
B	" "	" "	15	14.7	88.
B	" "	" "	20	14.3	87.2
	Average			14.4	84.3
1	French, Very Rich	Oct. 5	14	13.5	83 3
2	Vilmorin Improved	" "	12	14.7	88.4
3	Zuckerreichste Elite	" "	15	14.6	86.4
4	Kleiner Elite	" "	12	13.6	83 4
5	Dippe's Klein Wanzlebener	" "	11	14.7	87.5
6	Vilmorin White Imroved	" "	11	15.6	91.8
7	Dippe's Klein Wanzlebener	" "	10	14.7	87.5
8	" Improved	" "	12	15.3	86.
9	Knauer's Imperial	" 6	10	15.1	86.3
10	Klein Wanzlebener	" "	10	14.4	83.2
11	Vilmorin	" "	14	13.7	84.
A	"	" "	11	14.9	84.2
A	"	" "	13	14.4	85.9
A	"	" 7	13	14.1	84.9
A	"	" "	16	15.	89.6
A	"	" "	14	14.1	90.3
B	Klein Wanzlebener	" 8	16	14.1	82.4
B	" "	" "	12	15.7	86.3
B	" "	" "	22	16.1	87.1
B	" "	" "	16	15.9	84.6
B	" "	" "	16	15.7	86.8
	Average,			14.6	86.
1	French, Very Rich	Oct. 25	13	15.75	86.7
1	"	" "	8	16.8	88.9
2	Vilmorin Improved	" "	16	15.8	85.4
2	"	" "	6	16.9	86.6
3	Zuckerreichste Elite	" "	20	15.5	86.5
3	"	" "	9	17.1	91.
4	Kleiner Elite	" "	14	17.	93.9
4	"	" "	8	17.	95.
5	Dippe's Klein Wanzlebener	" "	16	15.5	91.3
5	"	" "	7	15.9	91.9
6	"	" "	15	16.	95.
6	"	" "	8	16.5	95.
7	Vilmorin White Improved	" "	13	16.2	88.9
7	"	" "	6	16.6	90.
8	Dippe's Improved	" 26	19	16.7	83.8
8	"	" "	8	17.	93.4
9	Knauer's Imperial	" "	18	16.6	86.6
9	"	" "	10	16.8	89.2

SUGAR BEETS RAISED AT THE STATION.

(CONTINUED.)

Plot.	NAME OF VARIETY.	Date.	Average Weight in Ounces of Beets.	Per Cent of Sugar in Juice.	Purity of Juice.
10	Klein Wanzlebener	Oct. 26	12	16.	85.2
10	"	" "	8	15.	86.9
11	Vilmorin	" "	11	14.	84.8
11	"	" "	7	15.	85.7
A	Klein Wanzlebener	" "	8	14.7	85.9
A	"	" "	14	14.9	85.1
A	"	" "	7	14.6	88.
B	Vilmorin Improved	" 27	16	15.	83.9
B	"	" "	10	15.7	86.3
B	"	" "	21	15.4	87.
B	"	" "	16	15.3	86.5
B	"	" "	12	15.7	86.7
	Average,			15.8	88.1

Date of analysis.	Description of Sample.	Total weight in ounces.	Sugar in juice	Purity of juice	No. of plot.	
Oct. 7	4 Beets partly grown above ground	12	11.3	70.4		These samples are not included in the averages.
" "	1 Beet 18½ inches in length	24	14.5	86.3		
" 8	1 Beet grown half above ground	30	12.6	76.2		
" "	1 Beet 2 ft. long, 4 in. above ground	32	12.0	75.9		
" "	5 small b., forked roots, below "	22	13.5	82.3		
" "	5 " " good form, " "	12	14.2	82.1		
" "	1 good form beet, medium size	10	18.5	92 3		
" 3	1 coarse large b., part above ground	35	9.1	74.6		
" 29	1 " " ⅓ " "	80	9.1	70.0		
	Average of 73 Samples raised at the Station		**14.9**	**86.3**		

ANOKA COUNTY.

Date of Analyses.	Name.	Town.	Kind of Soil.	Date. Planted.....	Date. Sampled.....	Averg. weight of Beets. in Ounces.	Per Cent of Sugar in Juice	Purity of Juice.
October 22	George Goetze		Sandy loam	May 5	Oct. 19	12	14.1	83.4
" "	M. Claussen		" "	" 15	" "	8	15.4	90.1
" 27	W. Speiser	Centreville	" "	" "	" 24	5	15.1	85.8
" "	D. Capistrant	"	Black loam	" 27	" "	21	15.9	85.5
" "	Mr. LaMotte	"	Sandy loam	" 25	" "	18	13.3	81.
" "	M. Leibel		" "	June 2	" "	17	14.5	90.6
" "	Mr. Blocher	Burns	" "	May 28	" "	17	14.	84.3
" "	Geo. Wyman	Ramsey		" 16	" "	9	16.8	89.8
" "	Andrew Matuska	Blaine	Sandy loam	" 15	" "	13	15.8	86.3
" "	J. W. Kelsey	Ham Lake		" 8	" 19	10	14.8	86.
" "	Mr. Wedworth	Grow		" "	" "	10	13 4	83.2
" "	J. W. Pope	Blaine	Mixed sand and clay	" 5	" "	12	16.3	85.8
" "	A. J. Smith		Sandy loam	" 28	" 22	12	17.3	87.4
" "	W. H. Staples	Grow	Yellow loam	" 15	" "	16	18.1	90.
" "	Mr. Bryer	Oak Grove	Sandy loam	" 28	" "	8	17.2	91.6
" "	E. C. McLoughlin	Ramsey	" "	" 6	" "	11	17.4	91.
" "	Jas. Ridge	"	" "	" 6	" "	11	18.	86.4
" "	Mr. Eddy	"	" "	" 28	" "	7	15 2	83.5
	Average						15.7	87.

CHISAGO COUNTY.

Sept.	27	M. Benson,	Centre City	Clay loam	May 25	Sept.19	12	12.4	76.1
"	29	Geo. Aucter,	Stacy	Sandy "	June 1	Sept.27	21	13.5	85.7
Oct.	1	Aug. Lafgren,	Lent				23	14.1	82.9
"	15	F. Heinrich,	Rush City	Sandy loam	May 18	Oct. 3	24	14.5	82.8
"	"	Ole Bloom,	"	"	June 8	Sept.17	11	13.2	83.9
"	"	L. Clausen,	"	"	May 28	Sept.17	23	12.	75.5
"	"	G. Ramberg,	"	"	June 10	Sept.23	20	13.7	78.2
"	"	Henry Carteer,	"	"	May 29	Sept.19	21	13.5	78.2
"	"	John Wick,	"	"	June 10	Sept.20	21	12.5	78.
"	"	James Hoor,	"	"	June 1	Sept.28	30	14.1	82.
"	"	P. M. Peterson,	Chisago City	Clay loam	May 21	Oct. 18	30	13.8	77.5
"	27	P. J. Anderson,	Rush City	"		Oct. 12	30	13.	80.6
"	"	L. C. Conier,	"	"	June 10		80	11.1	70.
"	"	Jas. Larkin,	"	"	May 20	Oct. 20	28	13.	77.4
"	"	John Johnson,	Harris	"	June 10	Oct. 13	10	16.	82.
Nov.	4	P. X. Peterson,	"	"	May 21	Nov. 2	14	17.3	86.8
"	4	G. W. Hunt,	North Branch				14	18.7	90.
"	23	P. S. Swanson,	"				25	16.0	89.4
"	"	Jno. Berg,	Chisago City	Sandy loam			32	17.7	78.
"	"	Carl Johnson,	"	Black "	May 25	Oct. 18	20	17.1	88.
"	"	Gus. Strand,	"	" "	May 15		26	17.	92.4
"	"	John Ekstrom,	"	" "			8	19.	82.
"	"	Swan Olander,	"	" "			10	18.	82.
"	5	Chas. W. Hanson,	Rush City	" "	May 20	Oct. 15	12	13.6	85.1
		Average,						14.8	83.4

CARLTON COUNTY.

Date of Analyses	Name	Town.	Kind of Soil.	Date. Planted	Date. Sampled	Averg. Weight of Beets in Ounces.	Per Cent of Sugar in Juice.	Purity of Juice.
October 3	S. Lyon	Carlton	Sandy loam	May 18	Sept. 23	16	14.5	83.4
" 9	S. Kebo	Barnum	Clay loam	" "	Oct. 3	16	15.6	86.8
" 9	A. M. Townsend	"	Sandy loam	June 12	Sept. 18	16	14.5	81.5
" 15	Mard Downs	"	"	" 10	Oct. 7	19	13.2	80.
" 15	S. Johnson	Mahtowa				22	13.6	83.9
" 27	Ole Anderson	Thompson				16	13.0	74.3
" 15	J. B. Mayer	Carlton	Sandy loam	May 31	Oct. 6	16	17.	84.6
" 27	C. Rhoel	Moose Lake	Gravel and loam	June 3	" 20	8	17.4	85.4
" 27	J. Mondry		Black and yellow	May 15	Sept. 23	16	14.	84.3
" 27	F Scheforgen		" " "	" 18	" "	9	13.7	80.1
" 15	O. N. Egberg	Mahtowa				23	14.4	80.5
	Average						14.6	82.3

CARVER COUNTY.

Nov. 23.	W. D. Japs	Carver	Clay loam	May 18	Oct. 19	29	13.	82.7
" "	"	"	" "	" "	" "	21	12.6	76.8
							12.8	79.8

DOUGLAS COUNTY.

October 13	F. C. Mead	Alexandria	Sandy loam	May 9	Oct. 4	24	13 1	76.6
" 28	J. G. Winkjer	Garfield	Clay "	June 1	" 11	13	12.	80.
	Average						12.5	78.3

HENNEPIN COUNTY.

October 27	Mr. Bushway	Dayton	Sandy loam	June 8	Oct. 24	13	18.	90.
" "	Jules LaCroix	"	" "	May 15	" "	18	18.	92.
" "	T. Rann	Hassan	Heavy "	May 22	" "	9	17.8	87.5
" "	H. Dalheimer	Dayton	Sandy "	May 15	" "	16	17.4	94.
	Average						17.8	90.8

HUBBARD COUNTY.

Sept. 27	Mrs. Daflenbaugh	Hubbard				26	14.	81.5

KITTSON COUNTY.

Sept. 19	James Gillis	Hallock	Black loam	June 10	Sept. 26	20	12.2	80.

LE SUEUR COUNTY.

Oct. 1	L. B. Donahue,	Le Sueur	Sandy loam	May 25	Oct. 11	25	12.9	78.2
" 15	M. S. Kelly,	"	Black "	May 17	Oct. 11	21	13.1	79.8
" 15	M. S. Kelly,	"	Old Barnyard	June 1	Oct. 11	31	12.2	75.8
" 19	W. Woods,	"	Sandy loam	June 1	Oct. 12	12	13.4	86.5
" 19	J. B. Beer,	"	Garden	June 1	Oct. 12	50	12.5	77.6
" 19	A. Hess,	Cardova	Rich Timber loam	June 1	Oct. 14	21	12.3	76.4
" 19	W. A. Patten,	Le Sueur	Rich Timber loam	June 1	Oct. 13	16	13.4	82.2
" 19	"	"	Loam	June 1	Sept. 28	17	12.8	80.
" 27	C. F. Strath,	"	Loam	June 1	Oct. 22	26	13.	77.8
" 27	J. M. Bevens,	"	Sandy loam	June 4	Oct. 21	9	12.9	79.5
Nov. 5	L. W. Toqiooki,	"	Sandy loam	June 1	Oct. 26	51	12.5	84.5
Dec 3	W. A. Patten,	"		June 10	Nov. 1	32	16.	87.2
" 13	"	"		June 1	Nov. 10	25	13.9	89.
" 17	Wm. Walsh,	"		June 1		29	17.2	80.
" 17	F. Lindeman,	"		June 1	Nov. 1	20	16.3	82.
" 17	S. Bowers,	"		June 1	Nov. 1	16	18.6	84.
" 17	C. Basil,	"		June 1	Nov. 1	36	17.	80.
" 17	B. F. Young,	"		June 1	Nov. 1	14	17.2	81.
	Average,						14.3	81.2

NOTE--These samples were raised under the supervision of Mr. W. A. Patten, secretary of the Le Sueur County Board of Trade.

McLEOD COUNTY.

Date of Analyses	Name	Town.	Kind of Soil.	Variety.	Date. Planted	Date. Sampled	Averg. Weight of Beets in Ounces.	Per Cent of Sugar in Juice.	Purity of Juice.
Dec 21	C. B. Kittridge,	Glencoe	Prairie loam	Vilmorin	May 10	Oct. 10	17	16.6	83.4
" 21	"	"	"	Klein Wanzlebener	May 10	Oct. 10	19	17.2	84.8
" 21	"	"	"	Vilmorin Improved	May 10	Oct. 10	24	15.5	81.8
" 21	"	"	"	Bultern Richest	May 10	Oct. 10	22	16.7	81.5
" 21	"	"	"	Lane's Improved	May 10	Oct. 10	32	12.2	.....
	Average,							15.6	82.8

MEEKER COUNTY.

Sept. 18	A. Kopbell,	Watkins				Sept. 9	30	12.5	80.

MOWER COUNTY.

Nov. 23	J. E. Galloway,	Austin		Clay loam	May 25	Nov. 1	25	12.6	83.4

PINE COUNTY.

Oct. 7	A. T. Rice	Pine City		Clay loam	June 1	Sept. 27	36	14.5	82.1
Oct. 8	J. P. Davis	"		"	June 1	Oct. 3	19	17.4	87.0
Oct. 15	A. Asmus	"		"	June 6	Oct. 9	35	14.5	82.
Oct. 22	E. A. Hogan	Hinckley		Clay loam			11	16.5	86.
Nov. 12	A. Sherwood	Rock Creek		"	May 25	Oct. 25	15	14.6	80.7
Nov. 23	John Best	Hinckley					21	14.7	82.1
Nov. 23	John Best	"					31	16.9	80.
Nov. 23	H. S. Austin	Pine City		Clay loam	June 15	Oct. 20	20	16.5	80.
	Average,							15.7	82.5

RENVILLE COUNTY.

Nov. 5	H. Prahl	Renville	Black loam	May 24	Oct. 29	16	14.7	83.

RAMSEY COUNTY.

Oct. 5	E. O. Rene	White Bear Lake	Heavy loam	May 27	Sept. 28	16	15.1	86.8
Oct. 15	J. H. McCall	"	Sandy "	May 31	Oct. 7	19	13.5	79.6
Nov. 4	Chas. Morgan	St. Paul				16	17.1	87.6
	Average						15.2	84.7

STEVENS COUNTY.

Nov. 23	Milo Camp	Morris	Prairie loam	May 20	Oct. 10	12	19.2	75.

TODD COUNTY.

	Alex. Kop	Eagle Bend	Yellow Clay	May 20	Oct. 6	42	12.	80.

WASHINGTON COUNTY.

Oct. 27	F. Vieth	Forest Lake	Sandy loam	May 20	Oct. 6	16	13.7	80.

WRIGHT COUNTY.

Date of Analyses	Name	Town.	Kind of Soil.	Date. Planted	Date. Sampled	Averg. Weight of Beets in Ounces.	Per Cent of Sugar in Juice.	Purity of Juice.
Oct. 27	W. F. Shattuck,	Clearwater	Clay	June 6	Oct. 17	10	14.6	83.9
Nov. 12	J. J. Braot,	Clearwater	Black, Clay Sub-soil	May	Oct. 26	27	14.2	80.
	Average,						14.4	82.

WABASHA COUNTY.

Oct. 25	Geo. Wilson	Lake City	Clay loam	June 2	Oct. 15	18	15.8	87.3
Oct. 25	Geo. Wilson	Lake City	Clay loam	June 2	Oct. 15	22	16.1	87.1
	Average						15.9	87.2

WATONWAN COUNTY.

Nov. 23	Otto Klose	St. James				23	14.8	80.4
Nov. 26	Wilcy Paine	St. James				12	14.	80.
	Average						14.4	80.2