

ORAVEL, H. SKINNER



125
984
THS

THESIS
Effect of Varying Pressure
To Cossettes on Sugar Purity
O. H. SKinner

THESIS

John A. McKim

From copy -

THESIS

Handwritten signature

T H E S I S .

E F F E C T
O F
V A R Y I N G P R E S S U R E T O C O S S E T T E S
O N T H E
S U G A R P E R C E N T A G E
A N D
P U R I T Y O F J U I C E .

By
named
O. H. Skinner.

Class 1902.

1.5.

Michigan Agricultural College.

THESIS

103507

T H E S I S.

Effect of Varying Pressure Applied to Cossettes on the Sugar Percentage and Purity of the Juice.

In most of the sugar factories of Michigan the beets are purchased under contract, at a price varying with the percent sugar contained. In one factory of New York state all beets must test 12% sugar or more, such beets bringing \$5.00 per ton. Here, in almost every case, 12% beets bring \$4.50 per ton with 33 1/3¢ per ton, additional, for every one percent of sugar over 12%. In this way every beet raiser is encouraged to raise beets of the best quality possible with his land, while when the beets are paid for at a flat price, large tonnage is the beet raisers goal.

In Michigan we have three distinct methods of testing which should bring like results but doubtless do vary a trifle for various causes.

1. Hot water extraction. (Pellet's method)

A normal weight of finely pulped cossettes is thoroughly digested and soluble parts diffused through water. A lead solution is then added which precipitates all soluble impurities and then by filtering a clear solution is obtained.

2. The sucrose pipette.

From the finely pulped cossettes the juice is extracted by pressure and from this the test is made. By means of a Brix spindle the percent of solids is determined. Then with a sucrose pipette a double normal weight of juice is taken, which will in the pipette have the same reading as the Brix reading. This is then placed in a flask leaded and diluted to standard amount (100 or 200 c. c.) and then filtered. This does not require the digestion with heat as with cossettes direct. It is obvious that this would give a higher test than would cossettes and by experiment it has been found that usually the sugar in the cossettes is about 92% of that in the juice pressed therefrom. Therefore it is customary to take 92% of the test made of the juice as the percent sugar in the beet.

3. 110 c. c. method.

The juice is extracted by pressure and after finding percent solids 100 c. c. is taken in a flask, to this is added 10 c. c. of lead solution, shaken, and filtered. The polariscope reading from this is then corrected by a table designed by Schmidt to the correct percent, and as before taking 92% of this for the percent in the beet.

In all practical work the polariscope is used to determine the amount of sugar in the clear filtrate obtained by these methods, as other chemical methods

require too much time and labor.

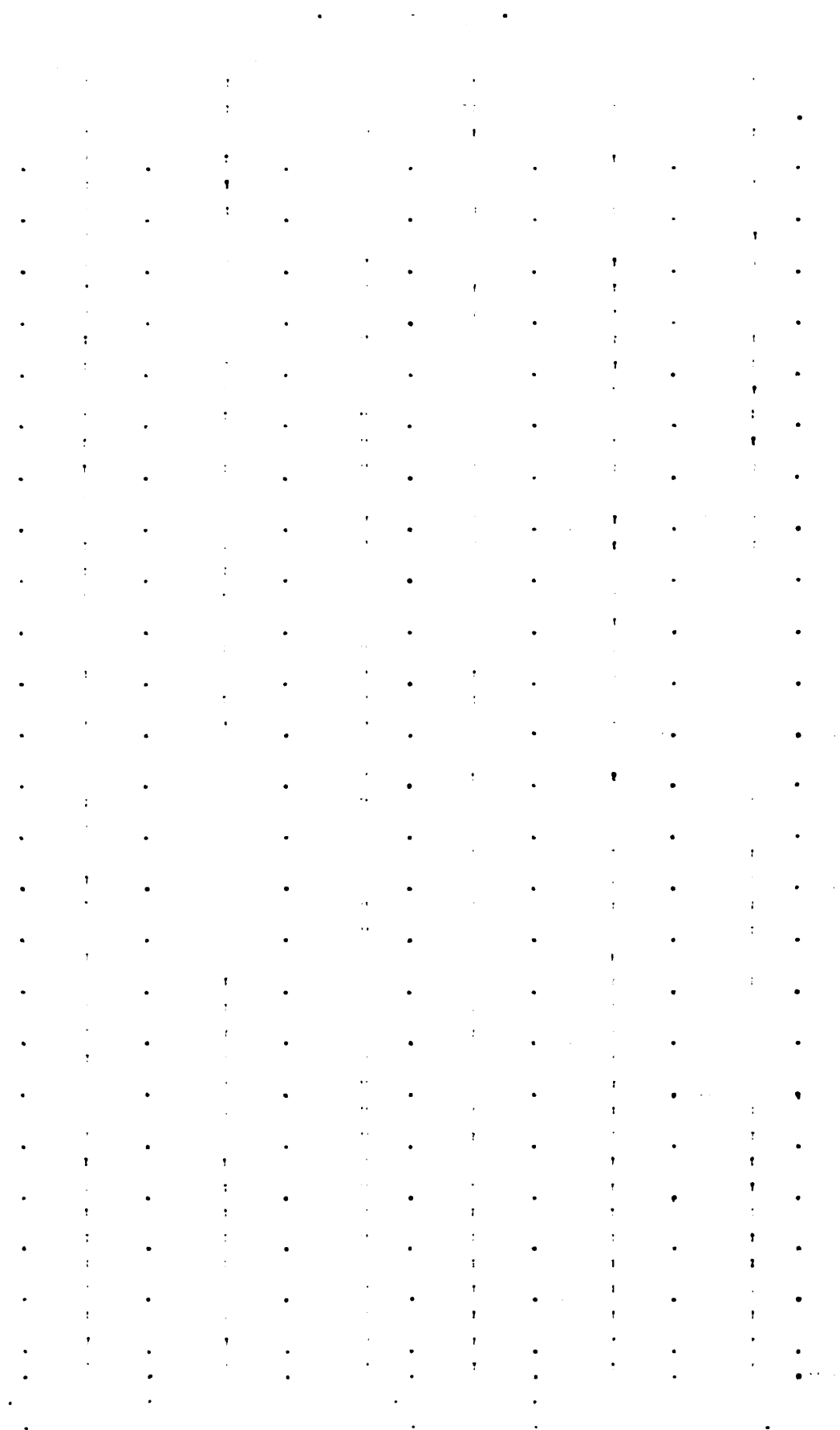
In a number of Michigan factories the question has arisen, as to whether the difference in pressure applied to two samples of cossettes made any difference in the percent sugar obtained. Mr. Jessurman, Supt. of Alma Sugar Co., claims that by increased pressure certain cells of the beet are broken which contain soluble impurities and no sugar and which should therefore be included in either of the juice methods. If this were true and the cells were not broken except by extreme pressure it would seem that the proper method to correct it would be to improve the machines pulping the beets, so that if not all at least a great majority of the cells would be broken in grinding. To determine with some degree of certainty whether the sugar percentages were affected in any way by this, I made some tests which are the basis of this article.

On Dec. 26th, 1901, I took twenty-five samples of beets, all in good condition, and such as were being delivered to the Alma Sugar Co. Each sample was very carefully pulped and this pulp thoroughly mixed. Each sample was then in turn placed in a screw press and normal pressure applied. To the juice coming off under this pressure a tag was attached bearing a serial number and No. 1. Then high pressure was applied, until in many cases the press cloths burst under the strain. This bore a tag with the same serial number and No. 2. These

samples of juice were then carefully tested by the sucrose pipette method and the purity of each sample recorded with it. Then by comparing Nos. 1 and 2 of each serial number any difference in sugar percent or purity of each sample is readily seen. The accompanying figures illustrate this. It is to be noted that in five cases there was a loss in the percent of sugar of from .1 to .2. In eight cases there was no difference, while in the remaining twelve there was an increase of from .1 to .5. The purity in but one of these samples was lowered by the increased pressure and then only .6 of a percent, while in all others it was increased. In one from 85.4 to 87.4, a difference of two percent. The averages show an increase of .09% of sugar and .7% in purity.

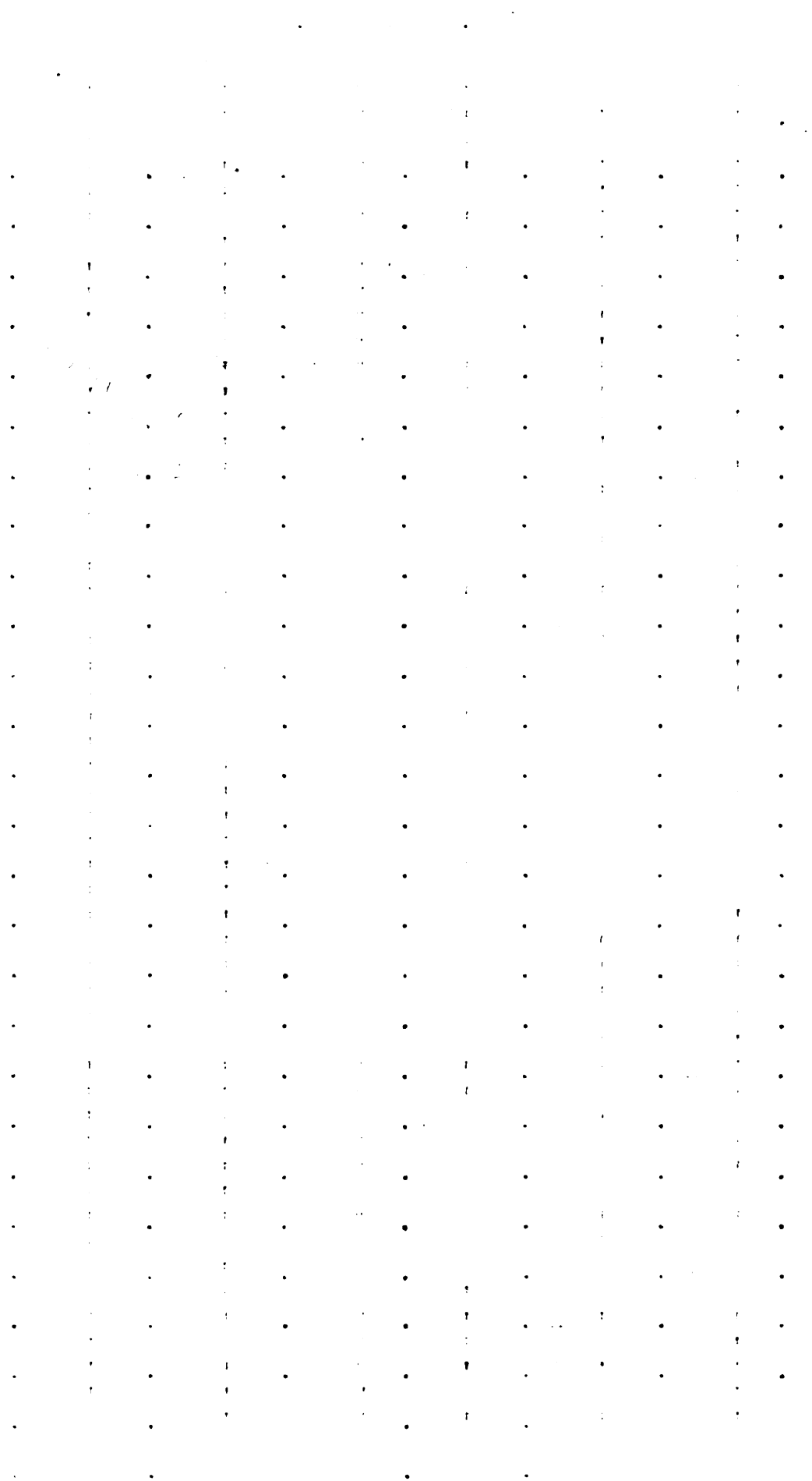
Dec. 26th, 1901.

No.	First Pressed			"	Second Pressing.		
	% Solids	% Sugar	% Purity		% Solids	% Sugar	% Purity
1.	18.7	15.5	82.9	"	18.9	15.8	83.6
2.	18.8	16.5	87.8	"	18.8	16.5	87.8
3.	19.1	16.3	85.4	"	19.2	16.6	86.5
4.	18.5	15.7	84.9	"	18.2	15.7	86.3
5.	21.4	18.5	86.4	"	21.4	18.7	87.4
6.	20.0	17.0	85.0	"	19.9	17.2	86.4
7.	20.1	17.4	86.2	"	19.8	17.3	87.4
8.	18.4	16.3	88.5	"	18.4	16.3	88.5
9.	19.1	16.5	86.4	"	19.0	16.6	87.4
10.	21.4	17.2	80.3	"	21.6	17.5	81.0
11.	18.9	16.2	85.7	"	19.0	16.3	85.8
12.	19.3	16.5	85.5	"	19.2	16.6	86.5
13.	21.5	17.9	83.2	"	21.4	17.9	83.6
14.	19.7	16.7	84.8	"	19.6	16.5	84.2
15.	17.8	15.0	84.3	"	17.7	15.0	84.7
16.	18.1	15.3	84.5	"	17.7	15.3	86.5
17.	20.7	17.7	85.5	"	20.7	18.1	87.4
18.	21.3	18.3	86.0	"	21.3	18.3	86.0
19.	18.9	16.1	85.2	"	18.7	16.0	85.6
20.	20.0	17.5	87.5	"	20.0	17.3	86.5
21.	15.5	12.5	80.7	"	15.8	12.8	81.0
22.	20.1	17.3	86.1	"	20.7	17.8	86.1
23.	17.3	14.1	81.5	"	17.1	14.0	81.9
24.	19.2	16.4	85.4	"	19.0	16.6	87.4
25.	18.6	15.5	83.3	"	18.4	15.5	84.3
Total		409.9	2123.0			412.2	2140.8
Average		16.396	84.9			16.488	85.6



Jan. 6th, 1902.

No.	First Pressed			"	Second Pressing.		
	% Solids	% Sugar	% Purity		% Solids	% Sugar	% Purity
1.	20.4	16.8	82.4	"	19.8	16.9	85.4
2.	19.8	16.2	81.7	"	19.2	16.2	84.4
3.	21.3	17.7	83.1	"	20.8	17.9	86.0
4.	18.5	15.6	84.3	"	18.1	15.7	86.8
5.	19.6	16.1	82.1	"	19.1	16.2	84.8
6.	20.2	17.2	85.2	"	19.4	17.3	88.9
7.	19.9	16.8	84.4	"	19.3	16.8	87.0
8.	19.9	17.4	87.4	"	19.3	17.2	88.9
9.	22.0	18.4	80.4	"	21.3	18.2	85.4
10.	18.8	15.9	84.6	"	18.3	15.8	86.3
11.	19.0	15.8	83.2	"	18.4	15.7	85.3
12.	17.7	15.0	84.7	"	17.4	15.2	87.4
13.	19.9	16.8	84.4	"	19.4	16.8	86.6
14.	19.7	16.9	85.8	"	19.9	17.1	86.0
15.	17.0	14.3	84.1	"	16.6	14.3	86.1
16.	19.6	16.5	84.2	"	19.3	16.4	84.9
17.	20.7	17.0	81.9	"	19.8	16.9	85.4
18.	20.9	17.4	83.3	"	21.5	18.0	83.7
19.	17.2	13.9	80.8	"	17.6	14.4	81.8
20.	22.6	18.8	83.1	"	22.1	18.9	85.5
21.	20.7	17.9	86.5	"	20.2	17.8	88.1
22.	18.9	16.0	84.7	"	18.5	16.2	87.6
23.	19.4	16.1	83.0	"	18.5	15.9	86.0
25.	16.0	13.8	86.2	"	15.5	13.8	89.0
25.	20.2	16.9	83.7	"	20.1	16.8	83.6
Total		411.2	2095.2	"		412.4	2150.9
Average		16.448	83.86			16.496	86.04



On Jan. 6th, 1902, twenty-five more samples were taken and treated exactly as before. Among these are seven in which the percent sugar was reduced from .1 to .2. In five cases there was no difference and in thirteen cases the sugar percent was increased from .1 to .7. In this as will be seen from the table, are none in which the percent of purity is reduced while in one case it is increased from 80.4 to 85.4. The averages show an increase of sugar of .048% and purity of 2.2%. Now averaging the first twenty-five samples with the second we find the juice from normal pressing to have a sugar percent of 16.42% and that of second pressing 16.49% showing an increase of .07% by high pressure. Similarly averaging the purity we find an increase of 1.45%.

During the vacation preceding the spring term, 1902, I made some experiments in the College Beet Laboratory. After having very thoroughly pulped a large number of clean beets, I carefully mixed the pulp. Previous to this a lever press had been arranged with a long lever and weight. Thus a known pressure could be applied and as the surface was 32 sq. in. we could readily get the pressure per square inch. Samples of pulp were taken and pressed increasing the pressure of each succeeding sample up to No. 10. In this no attempt was made to get the purity and a chemical balance was used to insure accuracy in taking samples of juice. Two sets of ten samples were tested with somewhat conflicting results.

The following table made April 4th, 1902, shows the results:

No. of Sample.	Lbs. pressure per sq. in.	% Sugar.
1.	12.5	12.3
2.	17.2	12.4
3.	20.3	12.5
4.	23.4	12.5
5.	28.1	12.5
6.	31.2	12.6
7.	34.3	12.7
8.	37.4	12.9
9.	40.6	12.9
10.	43.7	12.9

This shows a somewhat gradual increase of sugar percent as a result of increase of pressure. Ten more samples were taken with nearly the same pressure but different results as shown in the following table:

No. of Sample.	Lbs. pressure per sq. in.	% Sugar.
1.	12.5	13.0
2.	17.2	12.7
3.	20.3	12.6
4.	23.4	12.8
5.	28.1	12.8
6.	31.2	12.8
7.	32.8	12.9
8.	35.9	12.8
9.	39.0	12.8

In this set the first five with lower pressure have a slightly higher sugar percentage than the last five, which is just opposite to the preceding ten.

At various times tests were made of samples of juice from pulp under high pressure, in which the pressure had been so great that pulp impalpably fine had exuded with the juice. In all these cases it was found that the percent of sugar and purity went down. An attempt was made to let them stand and have the pulp settle but it was so fine that much time was required and the loss from evaporation would make a larger error. All such samples were excluded from those given in the tables, each sample being removed as soon or before the traces of such pulp appeared.

From these results we may draw the following conclusions:

1. That the difference in pressure applied to cossettes has very slight effect on sugar percentage but tends to increase it with the pressure.
2. That the difference is so slight, as to be of no practical importance.
3. That the purity is increased slightly by a certain amount of high pressure depending somewhat on the press cloths used.
4. That an unlimited amount of increase in pressure will cause much insoluble solids to pass out with juice and thus decrease both sugar percent and purity.

O. H. Skinner.

ROOM USE ONLY

MICHIGAN STATE UNIVERSITY LIBRARIES



3 1293 03169 4494