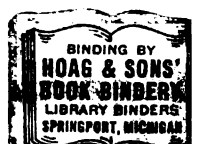


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THESIS

T.F.BAKER and W.REILEY

COMPARISON of ALCOHOLIC AND ACETIC
FERMENTANION.

~~BACTERIOLOGY DEPT.~~

7/1/48
G. Bacteriology

INTRODUCTION.

Although much work has been done along the line of Chemical analysis of cider and vinegars, this work has for the most part been limited to a single analysis for the purpose of detecting adulteration, perhaps, or to ascertain what varieties of fruit would produce the highest alcoholic and acetic content. The analyses, therefore, have not extended over a great length of time in most cases, nor have they been periodical.

Perhaps in recent years the Bacteriological side of vinegar making has received its share of scientific attention, so this phase, although touched upon in our work, was not made the major consideration. In a Bacteriological way all we attempted to determine was, which method would in the long run prove best in the making of cider vinegar, to inoculate the sterilized cider with pure cultures of yeast and Bacteria, or to simply press the juices from the pulp and, without sterilization, allow them to become spontaneously or self inoculated.

It need not be more than stated that the processes which take place in the formation of vinegar from cider are briefly: first, the transformation of the sugar in the juice to alcohol through the agency of yeasts, and secondly, the transformation of the alcohol into acid by means of a certain species of Bacterium. There is no distinct line of demarcation between these changes, but the whole procedure is gradual and measureable. To measure the original amount of sugar and watch its gradual transformation into alcohol and finally acetic acid is what we set out to accomplish in the selection of this thesis.

The work at a glance can be seen to cover a broad field and in starting out with twenty-three varieties of apples, we soon found that for the best results in the time allotted, we should have had about half that number and much more cider from each variety than we actually had. Starting out on March 15, 1913, with cider from ten pounds of apples of each variety, we found that on May 12th. after having completed three analyses of each, our supply was so low that we were unable to continue. In some cases the supply was markedly cut down by the formation of jellies through the action of the alcohol on the pectins in the cider.

The apples used were all taken from the College Cold Storage Plant during the first half of the month of March. They were for the most part a little under color, and in their selection no attention was paid to uniformity of size they, being taken, just as they came from the boxes in storage. As soon as the initial analysis of each variety was made, the cider was placed in the temperature room of the Bacteriological Building in which a uniform temperature of 20°C. is maintained.

OUTLINE OF WORK.

Ten pounds of each variety were taken from the cold storage plant and pressed. As the cider came from the press it was filtered through several thicknesses of cheese cloth and weighed. The initial analyses for sugar and acid were made immediately before the ciders were placed in the temperature room. Some of the cider was placed in previously sterilized pint bottles with cotton stoppers and some in unsterilized bottles. The cider in the sterilized bottles was sterilized in a steam sterilizer on three successive days for one half hour at a time. In the mean while the non sterilized cider was placed in cold storage at a temperature of 31° - 35° F. to prevent fermentation. As soon as the necessary sterilizing was completed, the sterile varieties were inoculated with one cubic centimeter of a pure culture of Champaigne yeast and about one half of a square inch of a mother of vinegar culture (*Bacterium aceti*). The cider in the non sterilized bottle was not inoculated. All of the cider, inoculated and not inoculated, was then placed in the temperature room.

Three analyses were made of both the inoculated and noninoculated samples of each variety and these as near three weeks apart as possible. The first analysis was made for sugar and acid, the remaining two for sugar, acid and alcohol. The acid titrations were all made with normal tenth sodium hydroxide ($N/10$ NaOH). In all acid calculations the molecular weight of acetic acid was used..

In analyzing for sugar the centigrade temperature was taken, and Brix readings made with a Brix hydrometer. With a pipette, graduated to Brix readings the necessary amount, as designated by the hydrometer, was drawn from each bottle and placed in a two hundred cubic centimeter flask (200 C.C.). To this was added seven cubic

centimeters of lead sub-acetate and this diluted up to the 200 C.C. mark on the flask. The flask was then shaken and the contents filtered. A Polariscope reading was then made of the filtrate.

The next step was the inversion of 50 C.C. of the filtrate. This was accomplished by placing the 50 C.C. in a beaker and adding a few grams of sodium carbonate to precipitate the lead. The precipitate was filtered off and the filtrate placed in 100 C.C. flasks. It was then diluted up to about 90 C.C., 5 C.C. of concentrated Hydrochloric acid added, and placed in a water bath at a temperature of 70°C. for ten minutes. After being removed from the bath, the flask was cooled down to room temperature, filled up to the 100 C.C. mark and the invert reading of the solution made on the Polariscope. The percentage of sugar was then computed by the following formula:

$$S = \frac{100(\text{first reading} - \text{invert reading})}{14266 - \frac{(\text{Temperature at which readings were made})^2}{2}}$$

in which S = % of sugar.

The percent of alcohol in these samples was found by the following method: the temperature and specific gravity of each was first taken; then 100 C.C. of the sample was diluted with distilled water to about 150 C.C. and the acid Neutralized with Calcium carbonate. A little paraffin was placed in the flask to keep the contents from boiling over in the process of distillation. The sample was then placed in the still and about 95 C.C. distilled over. This was diluted up to 100 C.C., cooled, and the specific gravity taken by means of the pycnometer. By consulting a table the amount of alcohol in such a sample at any specific gravity was found. By dividing the amount of alcohol in the sample, as shown by the table, by the specific

gravity of the original sample we found the percentage of alcohol in the original sample.

YELLOW BELLEFLOWER

INITIAL ANALYSIS

3/18/13	Percent of juice	35.6
	" " sugar	2.18
	" " acid	.2

NON-INOCULATED

4/11/13	" " sugar	.0
	" " acid	.6
	" " alcohol	7.06
4/30/13	" " sugar	.0
	" " acid	1.0
	" " alcohol	7.53

INOCULATED

4/11/13	" " sugar	.14
	" " acid	.7
	" " alcohol	7.46
4/30/13	" " sugar	.0
	" " acid	2.0
	" " alcohol	6.47

BUCKINGHAM.

INITIAL ANALYSIS

3/18/13	Percent of juice	46.2
	" " sugar	.88
	" " acid	.2

NON-INOCULATED

4/11/13	" " sugar	..15
	" " acid	.3
	" " alcohol	2.48
4/30/13	" " sugar	.0
	" " acid	2.8
	" " alcohol	6.33

INOCULATED

4/11/13	" " sugar	.0
	" " acid	.5
	" " alcohol	6.83
4/30/13	" " sugar	.0
	" " acid	3.4
	" " alcohol	6.1

INOCULATED WITH YEAST ONLY.

4/11/13	Percent of sugar	.0
	" " acid	.3
	" " alcohol	6.74
4/30/13	" " sugar	.0
	" " acid	3.0
	" " alcohol	3.77

COLVERT.

INITIAL ANALYSIS

3/18/13	Percent of juice	49.3
" "	sugar	.58
" "	acid	.41

NON-INOCULATED

4/11/13	" "	sugar	.0
"	"N	acid	.8
"	"	alcohol	6.28
4/30/13	" "	sugar	.0
"	"B	acid	3.1
"	"	alcohol	7.21

INOCULATED

4/11/13	" "	sugar	.14
"	"	acid	.7
"	"	alcohol	2.28
4/30/13	" "	sugar	.59
"	"	acid	3.1
"	#	alcohol	2.87

INOCULATED WITH YEAST ONLY

4/11/13	Percent of sugar	.0
	" " acid	.4
	" " alcohol	7.3
4/30/13	" " sugar	.0
	" " acid	na test.
	" " alcohol	5.21

GAÑO.

INITIAL ANALYSIS

3/18/13	Percent of juice	36.8
"	" sugar	.79
"	" acid	.3

NON-INOCULATED

4/11/13	" sugar	.22
"	" acid	.4
"	" alcohol	5.06
4/30/13	" sugar	.22
"	" acid	1.8
"	" alcohol	5.9

INOCULATED

4/11/13	" sugar	1.49
"	" acid	1.4
"	" alcohol	2.42
4/30/13	" sugar	.22
"	" acid	2.8
"	" alcohol	2.6

PEWAUKEE.

INITIAL ANALYSIS

3/18/13	Percent of juice	42.5
	" " sugar	1.54
	" " acid	.4

NON-INICULATED

4/11/13	/ #	" sugar	.075
	"	" acid	.5
	"	" alcohol	5.83
4/30/13	"	" sugar	.0
	, "	" acid	2.2
	"	" alcohol	6.17

INOCULATED

4/11/13	"	" sugar	.37
	"	" acid	.5
	"	" alcohol	6.99
4/30/13	"	" sugar	.0
	"	" acid	1.1
	"	" alcohol	7.52

NORTHERN SPY.

INITIAL ANALYSIS

3/18/13	Percent of juice	45.9
	" " sugar	1.59
	" " acid	.4

NON-INOCULATED

4/11/13	" " sugar	.0
	" " acid	.5
	" " alcohol	8.27
4/30/13	" " sugar	.0
	" " acid	1.0
	" " alcohol	7.53

INOCULATED

4/11/13	" " sugar	.0
	" " acid	.5
	" " alcohol	6.77
4/30/13	" " sugar	.0
	" " acid	4.4
	" " alcohol	4.78

INOCULATED WITH YEAST ONLY.

4/11/13	Percent of sugar	.0
	" " acid	.4
	" " alcohol	8.5
4/30/13	" " sugar	.0
	" " acid	1.1
	" " alcohol	7.18

ALBERMARLE.

INITIAL ANALYSIS

3/18/13	Percent of juice	30.6
	" " sugar	2.05
	" " acid	.3

NON-INOCULATED

4/16/13	" " sugar	.37
	" " acid	.9
	" " alcohol	4.71
5/2/13	" " sugar	.37
	"B " acid	1.8
	" " alcohol	6.23

INOCULATED

4/16/13	" " sugar	.0
	" " acid	.7
	" " alcohol	4.88
5/3/13	" " sugar	.074
	" " acid	1.0
	" " alcohol	6.62

KRAUSER.

INITIAL ANALYSIS

3/18/13	Percent of juice	41.8
	" " sugar	.88
	" " acid	.4

NON-INOCULATED

4/16/13	" " sugar	.59
	" "n acid	1.0
	" " alcohol	2.65
5/2/13	" " sugar	.15
	" " acid	1.3
	" " alcohol	5.09

INOCULATED

4/16/13	" " sugar	.15
	" " acid	.9
	" " alcohol	,2.08
5/2/13	" " sugar	.29
	" " acid	1.3
	" " alcohol	,5.26

ROUND BORSBORFF

INITIAL ANALYSIS

3/18/13	Percent of juice	19.4
" "	sugar	1.1
" "	acid	.2

NON-INOCULATED

4/16/13	" "	sugar	.3
	" "	acid	1.2
	" "	alcohol	4.8
5/2/13	" "	sugar	.36
	" "	acid	3.0
	" "	alcohol	7.22

INOCULATED

4/16/13	#	" "	sugar	.22
	" "	" "	acid	1.6
	" "	" "	alcohol	3.72
5/2/13	" "	" "	sugar	.22
	" "	" "	acid	3.1
	" "	" "	alcohol	4.57

CELESTIAL.

INITIAL ANALYSIS

3/18/13	Percent of juice	25.0
	" " sugar	1.01
	" " acid	.2

NON-INOCULATED

4/16/13	" " sugar	.0
	" " acid	1.2
	" " alcohol	4.88
5/2/13	" " sugar	.0
	" " acid	2.0
	" " alcohol	5.28

INOCULATED

4/16/13	" " sugar	.0
	" " acid	1.0
	" " alcohol	4.74
5/2/13	" " sugar	.0
	" " acid	1.8
	" " alcohol	8.05

COFFELT.

INITIAL ANALYSIS

3/18/13	Percent of juice	25.0
	" " sugar	1.59
	" " acid	.3

NON-INOCULATED

4/16/13	" " sugar	.52
	" " acid	.6
	" " alcohol	5.77
5/2/13	" " sugar	.14
	" " acid	1.6
	" " alcohol	6.41

INOCULATED

4/16/13	" " sugar	.21
	" " acid	.6
	" " alcohol	5.51
5/2/13	" " sugar	.074
	" " acid	.9
	" " alcohol	7.86

LADY.

INITIAL ANALYSIS

3/22/13	Percent of juice.....	33.7
"	" sugar.....	.98
"	" acid.....	.2

NON-INOCULATED

4/18/13.	Percent of sugar.....	.37
"	" acid.....	.3
"	" alcohol.....	2.5
5/15/13	" sugar.....	.44
"	" acid.....	2.1
"	" alcohol.....	1.6

INOCULATED

4/18/13	" sugar.....	1.18
"	" acid.....	1.01
"	" alcohol.....	2.43
5/15/13	" sugar.....	.14
"	" acid.....	1.3
"	" alcohol.....	1.11

LIVELAND.

INITIAL ANALYSIS

3/22/13	Percent of juice.....	53.1
"	" sugar.....	2.47
"	" acid.....	.3

NON-INOCULATED

4/18/13	Percent of sugar.....	.0
"	" acid.....	.5
"	" alcohol.....	7.52
5/15/13	" sugar.....	.0
"	" acid.....	2.3
"	" alcohol.....	4.95

INOCULATED

4/18/13	" sugar.....	.44
"	" acid.....	.8
"	" alcohol.....	6.62
5/15/13	" sugar.....	.0
"	" acid.....	5.0
"	" alcohol.....	1.12

GRAND MOTHER.

INITIAL ANALYSIS

3/22/13	Percent of juice.....	41.2
"	" sugar.....	1.94
"	" acid.....	.3

NON-INOCULATED

4/18/13	Percent "	sugar.....	.29
"	"	acid.....	.5
"	"	alcohol.....	6.95
5/15/13	"	sugar.....	.0
"	"	acid.....	1.6
"	"	alcohol.....	3.44

INOCULATED

4/18/13	"	" sugar.....	.37
"	"	acid.....	.6
"	"	alcohol.....	6.93
5/15/13	"	sugar.....	.44
"	"	acid.....	3.5
"	"	alcohol.....	3.26

NO NAME.

INITIAL ANALYSIS

3/22/13	Percent of juice.....;	21.2
"	" sugar.....	.97
"	" acid.....	.4

NON-INOCULATED

3/18/13	Percent "	sugar.....	.59
"	"	acid.....	.6
"	"	alcohol.....	7.24
5/15/13	"	sugar.....	.15
"	"	acid.....	5.2
"	"	alcohol.....	2.26

INOCULATED

3/18/13	"	" sugar.....	.29
"	"	acid.....	1.0
"	"	alcohol.....	4.95
5/15/13	"	" sugar.....	.22
"	"	acid.....	4.5
"	"	alcohol	1.64

AROBKA.

INITIAL ANALYSIS

3/22/13	Percent of juice.	39.9
"	" sugar	.22
"	" acid	.4

NON-INOCULATED

4/23/13	Percent "	sugar	.0
"	"	acid	.76
"	"	alcohol	2.21
5/12/13	"	sugar	.53
"	"	acid	2.8
"	"	alcohol	2.2

INOCULATED

4/23/13	"	" sugar	.37
"	"	acid	1.49
"	"	alcohol	, .998
5/12/13	"	sugar	.53
"	"	acid	1.44
"	"	alcohol	.67

DAVES.

INITIAL ANALYSIS.

3/22/13	Percent of juice	39.3
"	" sugar	.83
"	" acid	.2

NON-INOCULATED

4/23/13	Percent of sugar	.0
"	" acid	2.3
"	" alcohol	3.22
5/12/13	" sugar	.0
"	" acid	3.9
"	" alcohol	.98

INOCULATED

4/23/13	" sugar	.37
"	" acid	2.1
"	" alcohol	2.11
5/12/13	" sugar	.15
"	" acid	3.2
"	" alcohol	1.33

FALIX.

INITIAL ANALYSIS.

3/29/13	Percent of juice	39.52
"	" sugar	.508
"	" acid	.08

NON-INOCULATED

4/23/13	"	" sugar	.60
	"	" acid	.62
	"	" alcohol	5.16
5/12/13	"	" sugar	.29
	"	" acid	1.8
	"	" alcohol	3.61

INOCULATED

4/23/13	"	" sugar	.37
	"	" acid	2.6
	"	" alcohol	.926
5/12/13	"	" sugar	.29
	"	" acid	2.0
	"	" alcohol	.51

WEALTHY.

INITIAL ANALYSIS

3/29/13	Percent of juice	52.5
	" " acid	.2
	" " sugar	.508
NON-INOCULATED	" "	
5/23/13	" " sugar	.075
	" " acid	1.7
	" " alcohol	5.16
5/12/13	" " sugar	.074
	" " acid	3.6
	" " alcohol	1.92
INOCULATED.		
5/23/13	" " sugar	.83
	" " acid	1.4
	" " alcohol	1.38
5/12/13	" " sugar	.22
	" " acid	1.4
	" " alcohol	.4

SMOKE HOUSE.

INITIAL ANALYSIS

3/29/13	Percent of juice	33.1
	" " sugar	1.74
	" " acid	.4

NON-INOCULATED

4/23/13	" " sugar	.0
	" " acid	1.77
	" " alcohol	4.1
5/12/13	" " sugar ¹ ₂	.29
	" " acid	3.62
	" " alcohol	1.02

INOCULATED

4/23/13	" " sugar	.37
	" " acid	2.67
	" " alcohol	2.33
5/12/13	" " sugar	.36
	" " acid	4.05
	" " alcohol	.55

ARKANSAS BLACK.

INITIAL ANALYSIS

3/29/13	Percent of juice	41/8
	" " sugar	.65
	" " acid	.1

NON-INOCULATED

4/23/13	" " sugar	.6
	" " acid	1.3
	" " alcohol	4.94
5/12/13	" " sugar	.74
	" " acid	3.8
	" " alcohol	1.87

INOCULATED

4/23/13	" " sugar	.6
	" " acid	2.7
	" " alcohol	1.09
5/12/13	" " sugar	.07
	" " acid	2.4
	" " alcohol	.48

RAMBO.

INITIAL ANALYSIS

3/29/13	Percent of juice	25.9
	" " sugar	1.62
	" " acid	.1

NON-INOCULATED

4/18/13	" " sugar	.0
	" " acid	.8
	" " alcohol	4.82
5/15/13	" " sugar	.29
	" " acid	5.0
	" " alcohol	1.48

INOCULATED

4/18/13	" " sugar	.74
	" " acid	1.5
	" " alcohol	3.47
5/15/13	" " sugar	.29
	" " acid	1.4
	" " alcohol	1.07

PARAGON.

INITIAL ANALYSIS

3/29/13	Percent of juice	39.2
	" " sugar	1.43
	" " acid	.2

NON-INOCULATED

4/18/13	" " sugar	.27
	" " acid	.5
	" " alcohol	4.17
5/15/13	" " sugar	.0
	" " acid	.25
	" " alcohol	5.86

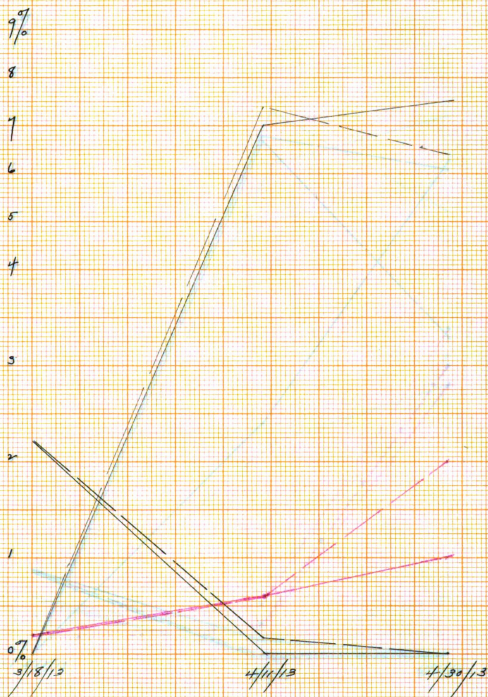
INOCULATED

4/18/13	" " sugar	.21
	" " acid	1.0
	" " alcohol	5.6
5/15/13	" " sugar	.0
	" " acid	5.4
	" " alcohol	1.27

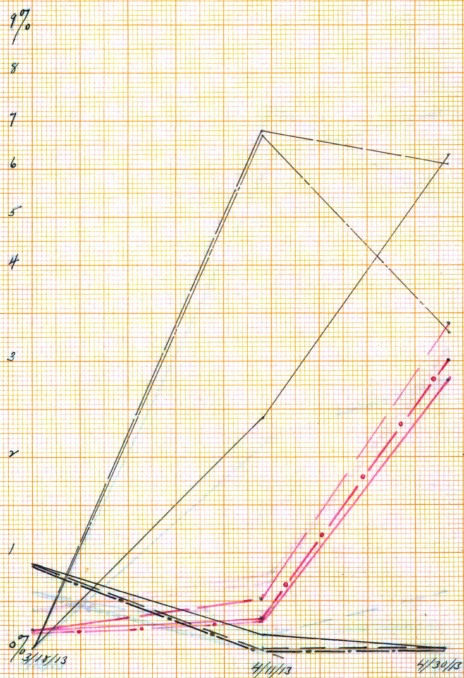
CONVENTIONS.

- Sugar from inoculated sample.
- Sugar from non-inoculated sample.
- Acid from inoculated sample.
- Acid from non-inoculated sample.
- Alcohol from inoculated sample.
- Alcohol from non-inoculated sample.
- Acid from sample inoculated with yeast only.
- Sugar from sample inoculated with yeast only.
- Alcohol from sample inoculated with yeast only.

Yellow Belleflower



Buckingham



1917

1917

1917

1917

1917

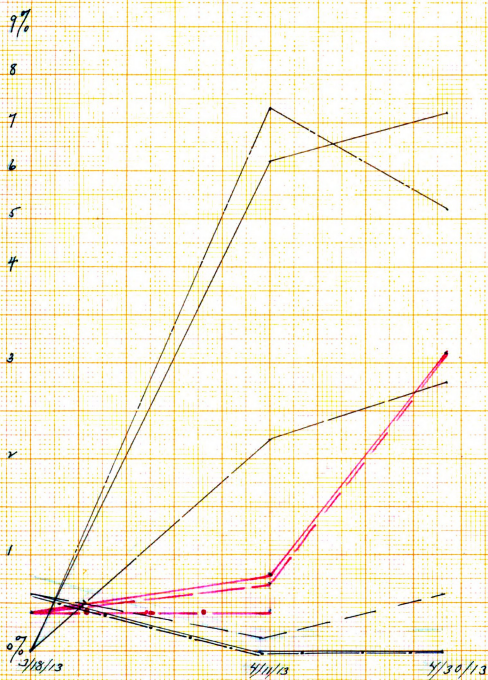
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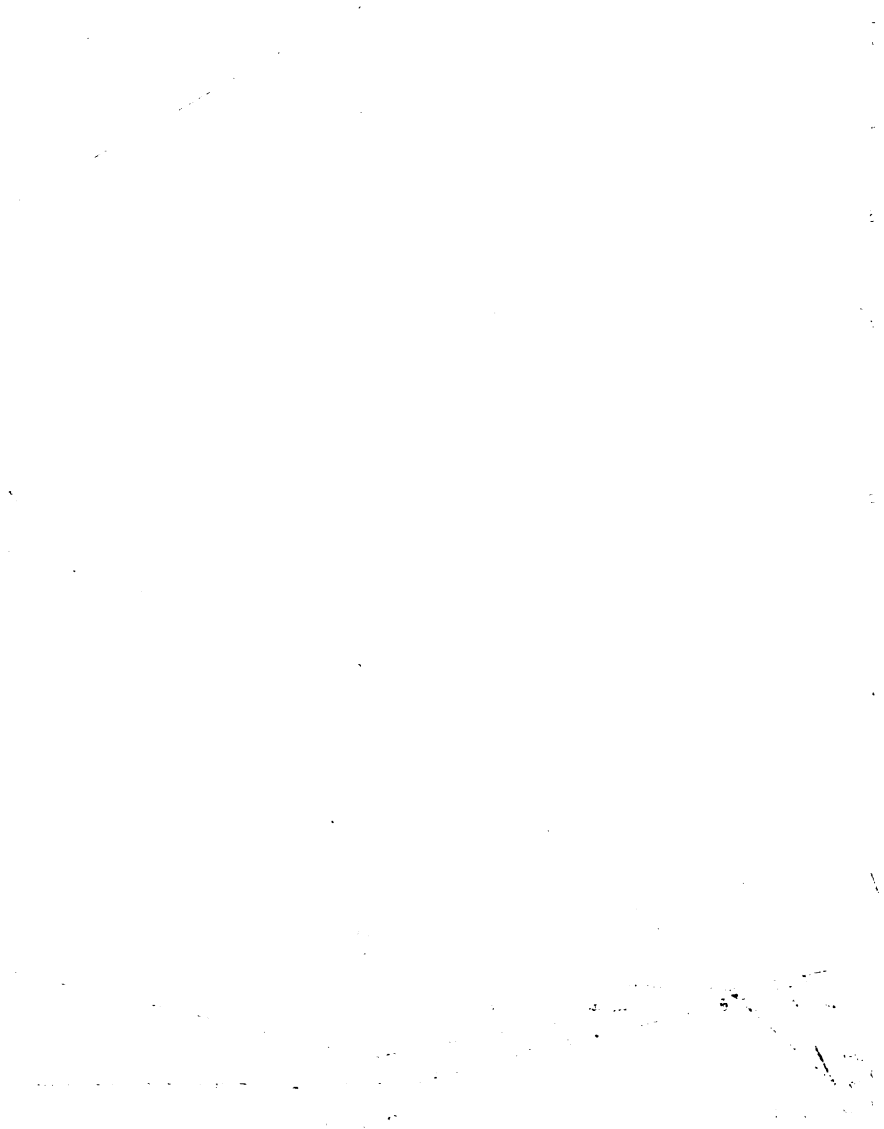
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Colvert





Gano



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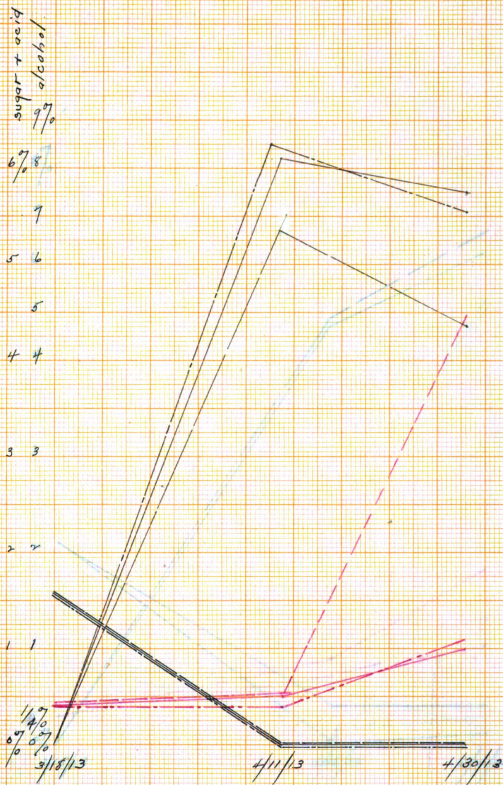
Pewaukee



1990-1991



Northern Spy



1000

1000

1000

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1000

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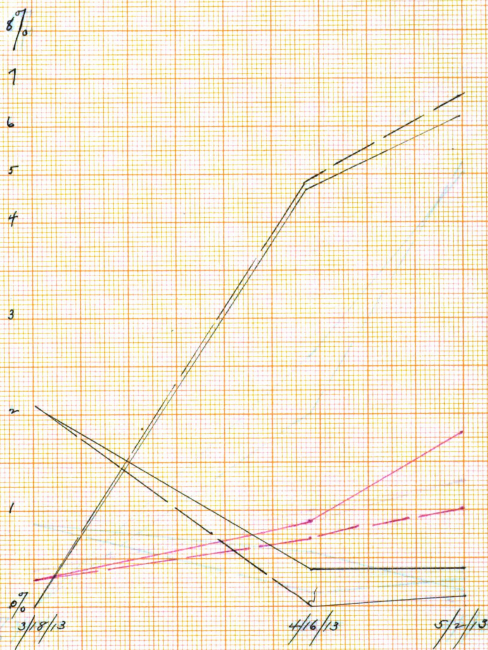
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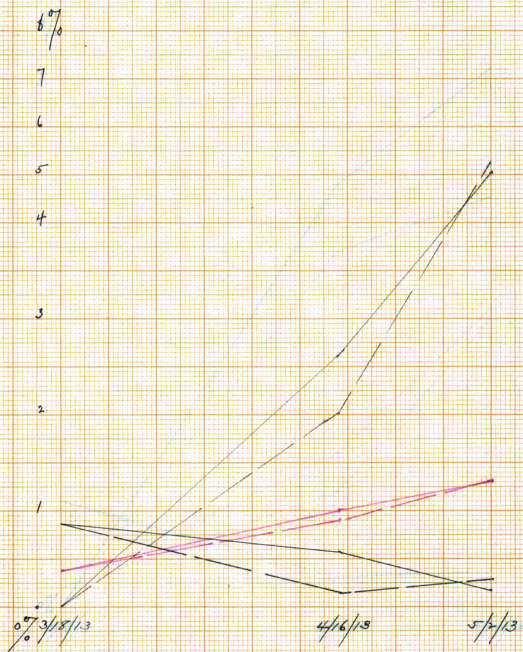
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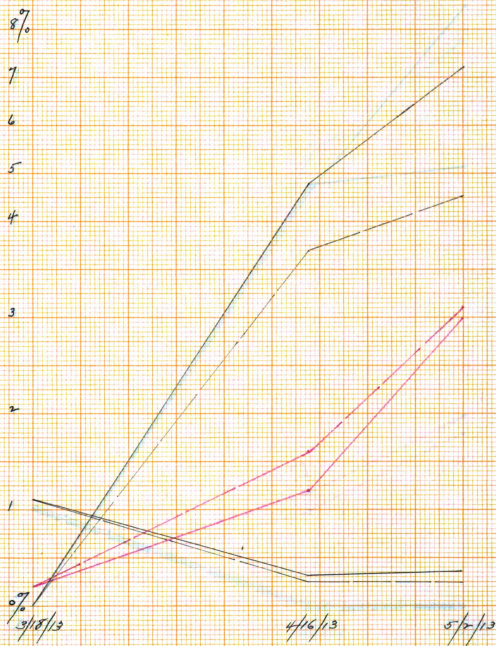
Albermarle



Krauser vrsdorff



Round Borsdorff



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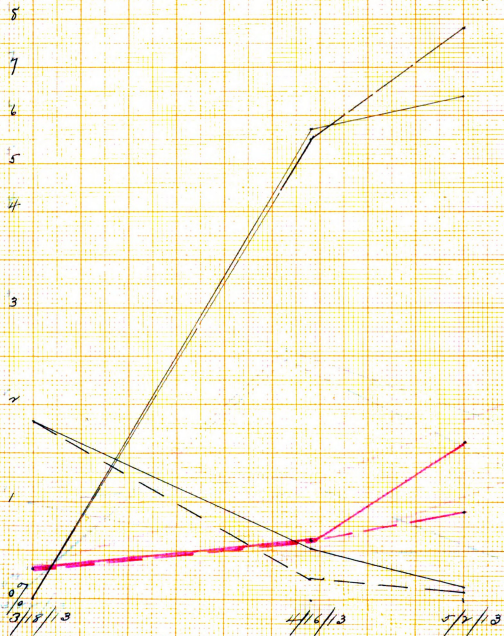
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3/18/13

4/6/13

5/2/13



Page 10

10

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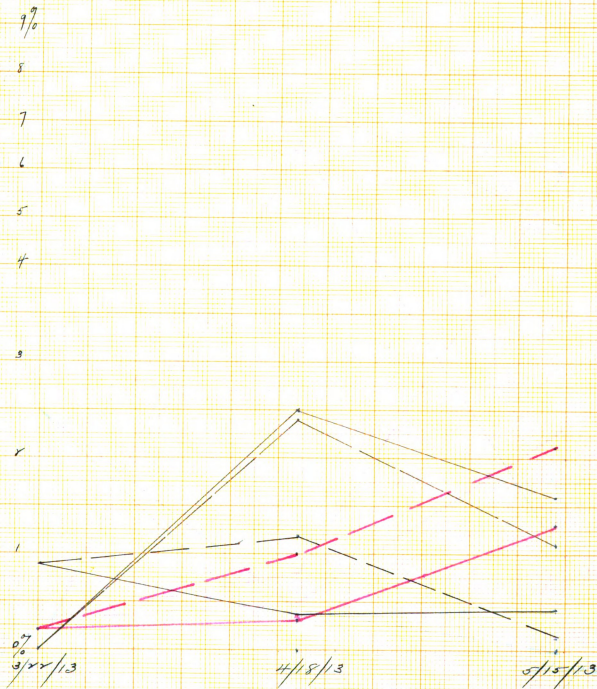
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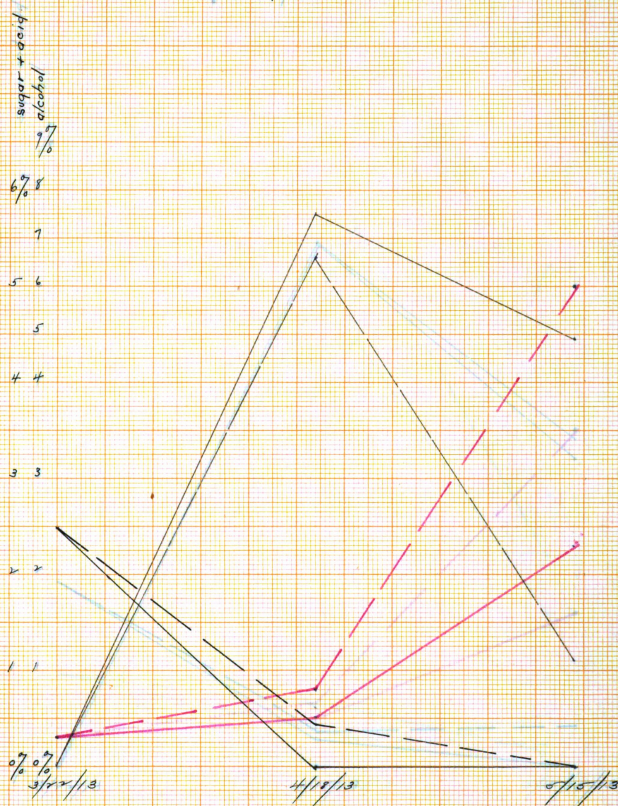
24

25

Lady



Livland ether



100

100

100

Grand Mother

sugar and acid
alcohol
%

6.7.8

7

5 6

5

4 4

3 3

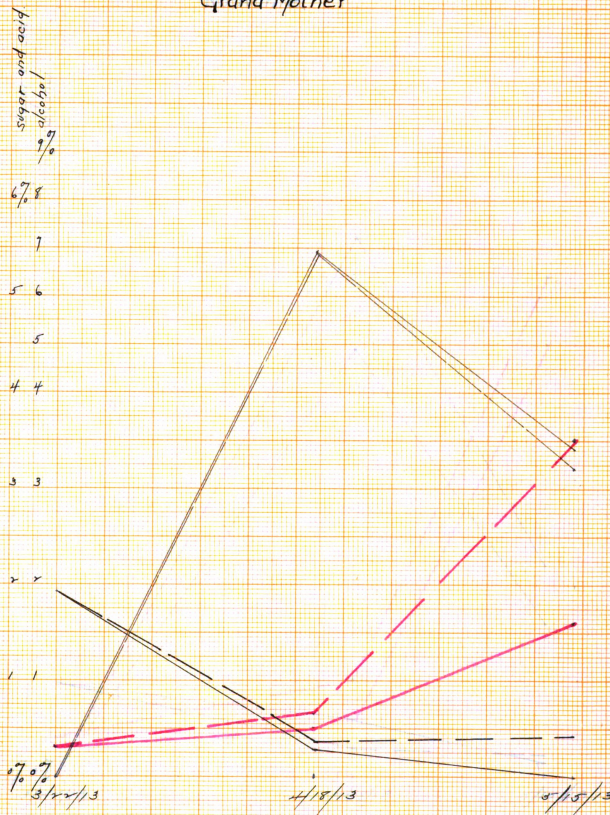
2 2

1 1

0.7.7
3/xx/13

4/18/13

5/15/13



..

10

No Name

sugar + acid
alcohol
9%

67.8

7

5 6

5

4 4

3 3

2 2

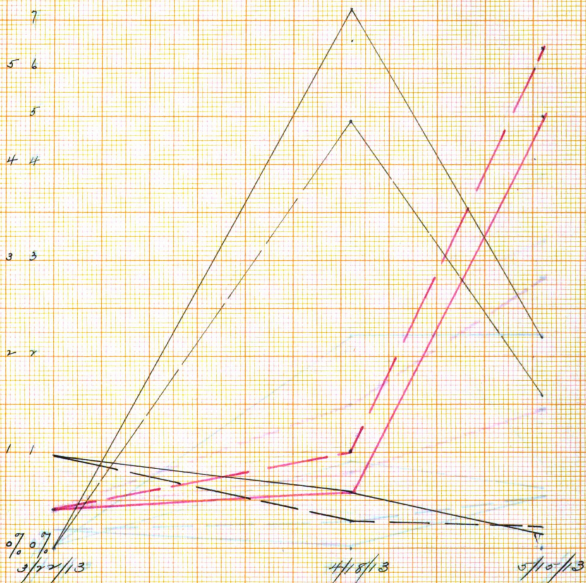
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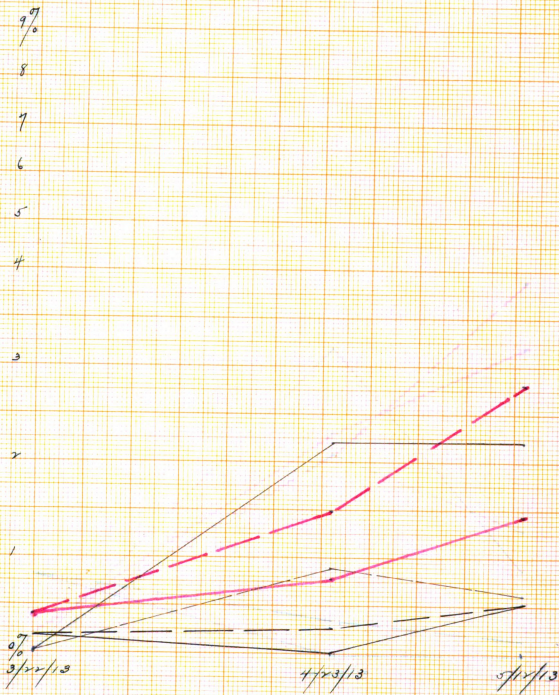
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Гробка



The second part of the document addresses the issue of data security. It highlights the need to protect sensitive information from unauthorized access and disclosure. To this end, the document recommends implementing robust security measures, such as encryption and access controls, to safeguard the organization's data.

The third part of the document focuses on the importance of regular audits. It states that audits are a critical component of the organization's internal control system, as they help to identify and correct errors and prevent fraud. The document provides guidance on how to conduct effective audits, including the selection of audit personnel and the use of audit checklists.

The final part of the document discusses the role of management in ensuring the success of the organization's internal control system. It stresses that management must be committed to the principles of transparency and accountability and must provide the necessary resources and support for the implementation of the internal control system.

Dawes



Felix

sugar + acid
g%

6%

7%

5%

5%

4%

3%

2%

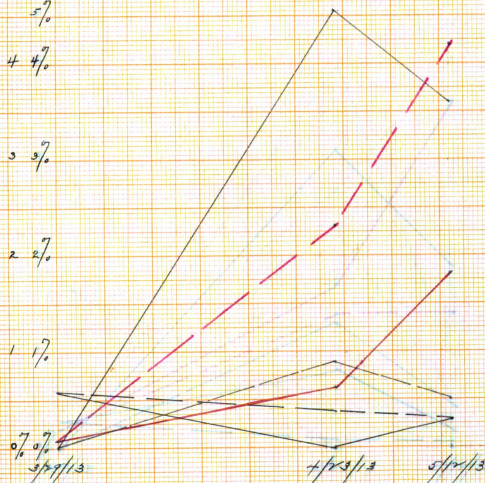
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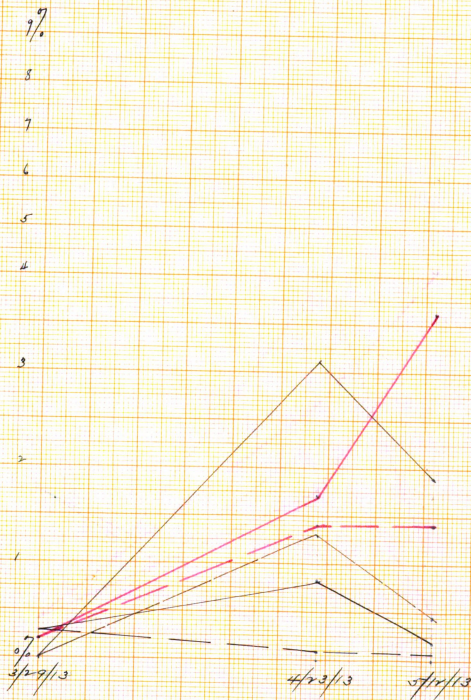
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5/12/13



Wealthy



100

100

Smoke House

97

8

7

6

5

4

3

2

1

0%

3/29/13

4/23/13

5/12/13



Arkansas Black

sugar + acid
alcohol
9%

6% 8

7

5 6

5

4 4

3 3

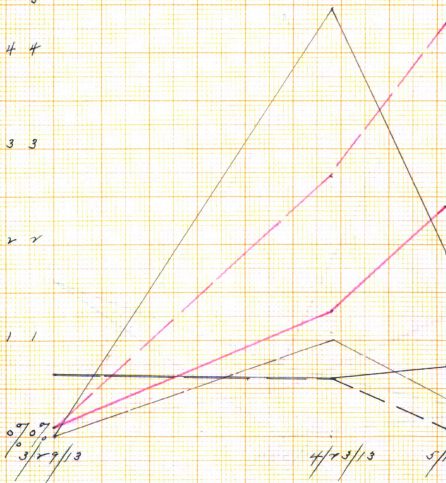
2 2

1 1

0% 0%
3/29/13

4/23/13

5/12/13



Rambo

sugar & acid
alcohol
9%

6% 8

7

5 6

5

4 4

3 3

2 2

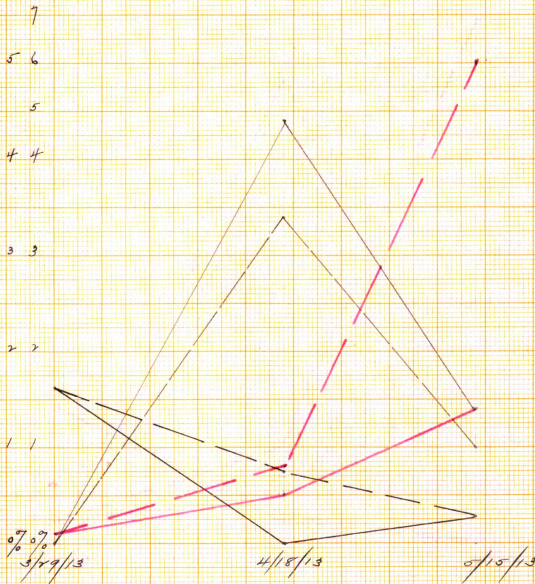
1 1

0% 0%

3/29/13

4/18/13

5/10/13



1000

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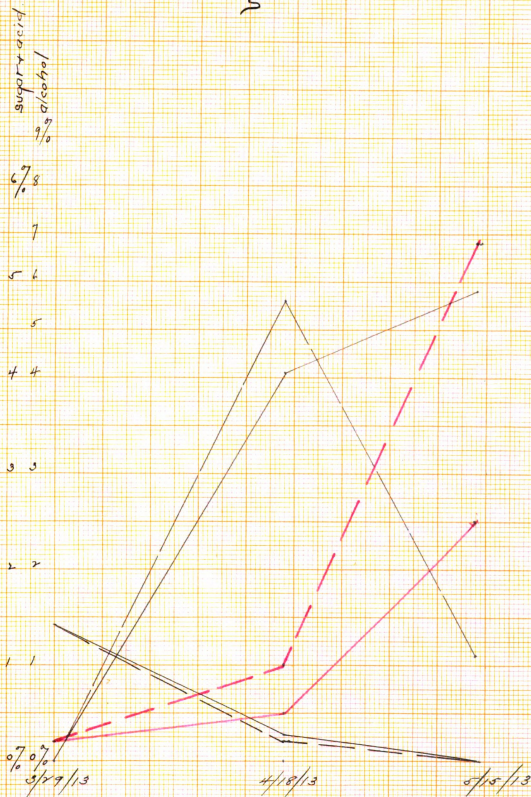
1000

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Paragon





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CONCLUSIONS.

In our work on this thesis we have drawn the following conclusions:

1. Of the varieties used the following ten contained the greatest amount of juice per unit weight in the order named: Liveland, Wealthy, Colvert, Buckingham, Northern Spy, Pewaukee, Krauser, Arkansas Black, Grand Mother and Dawes.
2. In most cases the acetic fermentations was most rapid in the inoculated samples; in the inoculated samples the alcohol dropped more rapidly than in the noninoculated samples.
3. In seven varieties the alcoholic content increased faster in the inoculated samples than in the noninoculated samples; in fourteen varieties it increased faster in the noninoculated samples than in the inoculated; in two varieties the rates were parallel; the alcohol was in most cases used faster by the acetic fermentation in the inoculated samples than in the noninoculated.
4. The inoculated Northern Spy sample reached the highest alcohol percentage with the following next in the order named; Non inoculated Northern Spy, Inoculated Celestial, Noninoculated Yellow Belleflower, Noninoculated Liveland, inoculated Pewaukee, inoculated Yellow Belleflower.
5. The inoculated Paragon sample reached the highest acid content percentage; with the following next in the order named; noninoculated Rambo, inoculated Liveland, inoculated Northern Spy, inoculated Smoke House, noninoculated Dawes, noninoculated Arkansas Black, noninoculated Wealthy,

6. The initial analyses showed the following varieties highest in sugar content in the order named: Liveland, Yellow Belleflower, Albemarle, Grand Mother, Smoke House, Rambo, Northern Spy and Coffelt.

7. The following varieties may be recommended for use in jelly making as determined by the large amount of pectins thrown down in the form of a jelly by the alcohol in the process of fermentation: Northern Spy, Kreuser,, Rambo, Paragon, Arkansas Black, Wealthy, Dawes, Arobka,

8. The quality of the vinegar according to taste was highest in the Smoke House, first; and the Northern Spy, second.

References of previous work on the subject.

Observations on cider making. by F.J.FLOWD

Journal Bath. and West England Society ser. 4, 4. (1893-1894), PP 98-106.

CIDER MAKING by J.Harper.

Journal Bath. and West England Society ser. 4, 4. (1893-1894), PP. 82-98.

A PHYSIOLOGICAL STUDY OF ACETIC ACID FERMENTATIONS AND ARTIFICIAL
PRODUCTION of VINEGAR. by F.Lafar.

(Centbl. Bakt. und Par. Allg. 1, (1895 pp 129)).

ANALYSES OF FOODS AND FEEDING STUFFS.

Mass. State Station Report for 1891 pp. 297-300. and 313-326.

Mass. State Station Report for 1892 pp. 291 and 292. and 310-323.

DETERMINATION OF ACID IN VINEGAR (Zur Saurebestimmung im Essig)

L. Vanino-Ztschr. angew. Chem. 1893, No. 22 pp. 676 and 677.

ACID FERMENTATION AND QUICK MANUFACTURE OF VINEGAR. (ESSIGGÄHRUNG

und SNELLESSIGFABRIKATION.) by F.Lafar, Centbl. und Par. 1893, No. 21;
abs in Ztschr angew Chem. 1893, No. 21 pp. 653 and 654.

NOTES ON THE CIDER FRUITS of GERMANY by A.Truelle.

V.L.Coillot 1899, pp. 44.

RATIONAL FERMENTATIONS (VINEGAR CIDER HYDROMEL and ALCOHOL)

Malzville-Nancy: E.Thomas, 1900, pp. 7 and 878.

EXAMINATION of COMMERCIAL VINEGARS SOLD IN THE STATE AT RETAIL.

By P.Schweitzer (Mo. Station Report. 1898, pp. 85 and 86.

A STUDY OF THE CHEMISTRY OF HOME MADE VINEGAR. by L.L.VanSylke
(New York State Station Bulletin 258, pp. 439 to 394).

THE CHEMICAL COMPOSITION OF APPLES AND CIDER. by W.B.Alwood.
R.J.Davison and W.A.P.Moncure. (United States Department of Agriculture,
Bureau of Chemistry Bulletin 88, pp. 44.

CIDER by B.C.Aston. (New Zealand Department of Agriculture)
Report of 1904. pp. 291-293.

CIDER VINEGARS OF PENNSYLVANIA. by W.Friar.
Pennsylvania Department of Agriculture. Bulletin 22, pp. 27.

FRUIT VINEGAR. by J.Jettmar, (Ztschr. Nahr. Untersuch, u Hyg.).
II(1897), No. 21, pp. 345 and 346.

ANALYSIS OF CIDER. by F.W.Morse.
New Hampshire Station Report, 1894, pp. 125 and 126.

SIX VARIETIES OF CIDER APPLES. by G.Hheuze.
Review of Horticulture 68 (1896), No. 16, pp. 376-379.

A CONTRIBUTION TO THE KNOWLEDGE OF CHEMISTRY OF CIDERS,
by A.H.Allen. (Analyst, 27, 1902, No. 315 pp. 183-190.)

A STUDY OF CIDER MAKING IN FRANCE, GERMANY, AND ENGLAND, WITH
COMMENTS AND COMPARISONS WITH AMERICAN WORK. by W.B.Alwood.
United States Department of Agriculture, Bureau of Chemistry Bulletin
71 pp. 114.

THE EFFECT OF FERMENTATION ON THE COMPOSITION OF CIDER AND VINEGAR. by C.A.Brown Jr. (Journal of American Chemical Society 25 (1903) No. 1 pp. 16-33.

NOTES ON VINEGAR MAKEING. by E.F.Pernot
Oregon Station Bulletin 73 pp. 8.

CIDER. By T.McFarlane (Lab. Inland Rev. Dep. Ottawa, Canada, 1903, Bulletin 92,pp. 17.

VINEGAR AND ARTIFICIAL VINEGAR, By Witte. (Ztschr. Offentl. Chemistry, 12 (1909) No. 10, pp. 181-187.

THE COMPOSITION OF CIDER. by B.T.P.Barker and E.Russel. Analyst, 34 (1909) No. 397, pp.125-134.

VINEGAR AND ITS MAKING, Michigan State Circular No.9, pp. 65 and 66.

REPORT ON RESULTS OF INVESTIGATIONS INTO CIDER MAKING.
by F.J.Loyd (London Board of Agriculture and Fisheries, 1903, pp.145.

COMMON CIDER BY A.McGill. (Lab. Inland Review, Department Canada. Bulletin 169, pp. 19.

THE RATE OF FERMENTATION OF CIDERS, By B.T.P.Barker
Journal of Agricultural Science. 3 (1908) No. 1,pp.1-21.

THE INFLUENCE OF SELECTED YEASTS UPON FERMENTATIONS. By.
W.A.P.Moncure, R.J.Davidson and W.B.Ellett, (Virginia Station Bulletin 160, pp. 97-120.

THE COMPOSITION OF ENGLISH FERMENTATION VINEGARS, By,
F.D.Ratcliff. (Analyst 32(1907) No. 372, pp. 85-87).

MANUFACTURE OF VINEGAR FROM PURE CULTURE OF ACETIC ACID
BACTERIA By L.Eberlein. (Pure Products, 3 (1907), No.4, pp.173-177.

VINEGAR, By A.McGill.
Lab. Inland Revenue Department (Canada) Bulletin 108, pp.15.

PURE CULTURES IN VINEGAR MAKING, By W.Henneberg.
Centbl. Bakt.(etc) 2. Abt., 14(1905) No.22-23, p.681.

A STUDY OF THE CIDER APPLES OF SARTHE, By P.L.C.Cassarini,
and E.Poupard.(Bulletin Mens. Off. Renseig. Agr. (Paris) 5 (1906)
No. 2, pp. 157-179.

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