

## REPORT ON THE SACCHARINE CONTENTS OF NATIVE AMERICAN GRAPES IN RELATION TO WINE-MAKING.

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Wine is properly the fermented juice of grapes, and contains alcohol, variable proportions of grape sugar, bi-tartrate of potash, and some tartrate of lime, with a very little malic and tannic acids, and some mucilagenous matters, besides oenanthic acid, and in old times oenanthic ether and some volatile oils, derived from the grapes or produced by fermentation.

The tartrates are characteristic of the wines produced from the grape, and do not characterize fermented currant, gooseberry, or apple juices; citric acid being contained as the chief acid of the currant and gooseberry juice, while malic acid is that of the juice of the apple. Currant and gooseberry juices, therefore, are not wines, but are similar to punch made of lemon juice and alcohol, sweetened. Fermented apple juice is not a wine, for it does not contain the tartrates, nor any tartaric acid, but does contain malic, acetic, and tannic acids. If we intend to produce wine we must resort to the juice of grapes exclusively, and it therefore becomes important to inquire if the native American grapes will produce good wines. The object in the present analysis is to ascertain the most important facts bearing upon this subject, and although the limited researches, extending only through one season, may not fully settle the question, we trust that they may throw some light on the subject, and open the way to more extended researches.

It was obvious at the outset that we must find out the proportion of saccharine or alcohol-producing matter in the American grapes; for if they will not produce alcohol in sufficient proportions to keep the wine from souring, we should have to add saccharine matter in some other form to make a sound wine. If the acids in our grapes are not the same as those in foreign wine grapes then the task would be more difficult. It was, therefore, desirable to determine this point; for it has been supposed by many that malic, and not tartaric acid was characteristic of the native American grapes.

I have, therefore, paid especial attention to the proportions of saccharine matter, and to the nature of the acids in the grapes submitted to me for analysis, and have found that, although many of our grapes are too poor in saccharine matter to produce sufficient alcohol for the preservation of the wine, without the addition of sugar to form more alcohol, or of ready formed spirits, that there are some grapes rich enough in saccharine matter to produce, without these additions, excellent light wines, similar to those of France. I have ascertained that malic acid exists in grape juice, in the proportion of nearly one grain to the ounce of grape juice. This acid was found by Mulder in

Bordeaux wines, but he does not state in what proportions, though he says it exists in small quantity.

Tartaric acid and the bi-tartrates, have been found to characterize all the native American grapes which I have analyzed; this acid existing in rather too large proportions for the saccharine matter in most of our grapes.

Cultivation appears to increase somewhat the proportion of saccharine matter, and to diminish that of the tartaric acid; but we have not carried this experiment of cultivation far enough to determine its full effects on the character of the grapes. When we reflect on the fact that all the wine grapes of Europe are the products of cultivation of some very small and not very palatable wild grapes of Asia, and when we see how various are the kinds of grapes thus produced, we cannot fail to perceive that similar experiments with our native grapes may reward us with new and valuable varieties not yet known.

A northern grape transferred to a more genial climate at the south will, without doubt, yield a sweeter fruit. This may not be effected at once, but will come about gradually. Perhaps we may have to resort to seedling vines, and gradually to acclimate the grapes we would cultivate.

The Catawba, Isabella, and Concord grapes are examples of the great improvement we can bring about by cultivation of grape vines, for all these were native American wild grapes, much inferior to those at present cultivated for wine-making and for table use.

On examination of the tabular statement accompanying this report, the reader will see that there are many grapes which promise to repay for cultivation. The Henshaw grape will make a good light wine, like the French clarets; and the Amber grape, of Dracut, Massachusetts, by cultivation, will doubtless become much sweeter, and will produce a highly-flavored wine, with a rich bouquet.

The Catawba, Isabella, and Scuppernong grapes have already proved to be excellent wine grapes, and are extensively cultivated for that purpose. The Clinton, Bartlett, Petit Noir, and Hartford Prolific, will all make good wines.

Those grapes which contain less than 15 per cent. of saccharine matter, will require sugar or alcoholic spirit to be added to them in order to make a wine that will keep. The celebrated Scuppernong wine will not keep without the addition of spirit or sugar, since the grape juice will not produce more than four and nine-tenths per cent. of alcohol. The rich flavor of this grape renders it particularly valuable, the wine having the flavor and bouquet of the celebrated Tokay wine of Hungary. This grape, however, cannot be cultivated in the open air north of Virginia, and is a native of North Carolina. It is desirable that extensive vineyards should be established in that State expressly for the cultivation of this grape, which will make a wine that will be most eagerly sought for as the best of American native wines.

The Catawba grape has already acquired a just reputation as a wine grape, and is extensively cultivated in Ohio, Kentucky, and the middle States. It ripens very late in the latitude of the New England States, and is apt to suffer from early frosts. We must, therefore, select some more hardy or earlier grape for the northern States. The Concord,



Bartlett, Sage, Amber, sugar grape of Plymouth and Cape Cod, are all good grapes for the northern regions. The Clinton, already cultivated, is one of the best of our hardy grapes, and is rich in saccharine contents, though this season it has not shown its sweetness to so much advantage as usual.

The grapes of Connecticut have, this year, failed to do justice to themselves; but it will be seen, by the analysis of last year's growth, that they are generally much richer in saccharine matter than the samples of the present season have proved.

Some object to the peculiar flavor and bouquet of the new wines made from native wild grapes of the north, and are not aware that the wine, by age and proper sulphuring, loses the "foxy" flavor. Mr. E. Paige has proved this in his extensive operations in making wines from our native northern grapes.

The effect of mixing the juices of several different kinds of grapes together, before fermentation, has not yet been properly tried; and I have no doubt that great improvements in the flavor of the wines may be effected by such a method of operating. Within a few years, the manufacture of wines from our native grapes has made great progress; and the wines made in Ashburnham, by Messrs. Glasier & Flint, and in Boston, by Mr. E. Paige, have acquired a wide-spread reputation, and the demand has for some time been beyond the supply.

Native American wines have not only become common in household use, but have taken their place on the communion-tables of our churches, to the exclusion of foreign wines; and the time will come when America will be able to produce most of the wines her people may need. California is, perhaps, the best wine-growing region, but the middle and southern States, without doubt, can do nearly as well in this business; and the north is not so cold that New England cannot produce good, wholesome, and fine-flavored wines from native grapes. We have yet to learn much in the business of manufacturing wines, and this we can learn readily from the wine-makers of Europe, and from those who have had some experience in Ohio. As much depends on the processes of manufacturing as on the nature of the grapes operated with, as is obvious from the numerous varieties of wines made from the same kinds of grapes in Europe. This art we have still to acquire.

#### CHEMICAL EXAMINATION OF THE JUICE OF GRAPES FROM VARIOUS LOCALITIES IN THE UNITED STATES.

No. 1. Henshaw grapes, from Martinsburg, Virginia. Sent to me from the United States Patent Office, September 1, 1859.

One pound of the grapes when pressed yielded 8 fluid ounces of rich, dark-purple juice, which weighed 9 ounces avoirdupois. The specific gravity of the strained juice was 1.0700. Saccharine matter, by Evans's tables, 17 per cent.

By the copper grape-sugar test, the fluid yields 15.52 per cent. of grape sugar, which will make 7.76 per cent. of absolute alcohol. On fermenting a portion of the juice and distilling it, I obtained 7.5 per cent. of absolute alcohol from the wine.

The coloring matter and the tartaric acid used were precipitated by means of acetate of lead, which gave a fine blue-colored precipitate.

The wine, after fermentation, changed from a deep purple to a deep, rich red color, and was in appearance and taste much like the red wines of Burgundy, in France, but more acid. To diminish the acid taste, and to increase the proportion of alcohol, I took a portion of the grape juice and added water and sugar, and allowed fermentation to take place. It produced an agreeable light wine.

No. 2. Traminer grapes, No. 18, of Weber's list. Received September 16, 1859.

These grapes were obtained in Dorchester, Massachusetts. They are of a pale mahogany-red color. I do not think they were fully ripe.

One pound of these grapes yields 7 fluid ounces of juice, on pressure, and the specific gravity of the strained grape juice was 1.0485. This will indicate, by the saccharometric tables in Evans's book, nearly 12 per cent. of saccharine matter. By the copper test, the proportion of grape sugar was found to be 11 per cent., which indicates the percentage of alcohol would be 5.5 per cent. in the wine.

In order to ascertain the character of the juices of the hard pulps, and of that portion which is contained next to the skins, when the pulp is snapped out from the grapes, I took 8 ounces of the grapes, and separated the pulp from them, and found the pulps by themselves weighed 4½ ounces, and the skins, with what adhered to them, 3½ ounces. On pressure, the pulps gave 2½ fluid ounces of juice, and the skins 2¼ fluid ounces. The specific gravity of the juice from the pulps was 1.052, and from the skins, 1.046. The juice from the pulps yielded 10 per cent. of grape sugar, and that from the skins, 9.5 per cent.

This was an unexpected result, for the juice next the skins tastes sweetest. Undoubtedly, there is more tartaric acid in the hard pulp, and hence the sour taste of the juice therefrom; for the tartaric acid covers the sweet taste.

No. 3. Catawba grapes, from the District of Columbia. Received from United States Patent Office, September 19, 1859.

These grapes were quite ripe. One pound of the grapes, on pressure, yielded 11 fluid ounces of juice, which had the specific gravity of 1.0715, and, by the tables, this should contain between 17 and 18 per cent. of grape sugar. By the copper test, however, the proportion was found to be 21.3 per cent.

The experiment was repeated, and 21.4 per cent. was obtained as the largest yield of grape sugar.

The grape juice was allowed to ferment, and the wine to become clear and fine. The acids were then separated and examined, and tartaric acid, bi-tartrate of potash, and tartrate of lime were obtained, and less than one grain per ounce of malic acid.

In searching for malic acid, the process recommended by Mulder was employed.

The wine was saturated fully with lime, by simmering it upon an



excess of pulverized chalk until all the tartaric acid was converted into insoluble tartrate of lime, and the malic acid, if present, should be converted into the soluble malate of lime. When cold, the solution so saturated by the chalk was filtered, and the malate of lime, with a large quantity of flocculent mucilage, was thrown down. This precipitate, after being washed with alcohol, was dissolved in water, and acetate of lead was added so long as any precipitate fell. This precipitate was collected on a filter, washed, and then was removed and mingled with water saturated with sulphide of hydrogen, which converted all the lead into a sulphide of lead, and set free the malic acid. This was then filtered, and the solution was evaporated to near dryness, and then pure alcohol was added, which took up all the malic acid and left the mucilage insoluble.

This alcoholic solution being evaporated, yielded a small quantity of malic acid, which, on 100 cubic centimeters, about  $3\frac{1}{4}$  ounces of the wine, was only 3 grains of dry malic acid.

The nature of this acid was then proved by experiments on its lime-salt, and by nitrate of silver and sub-nitrate of mercury. It responded to all these tests as malic acid.

I am not aware that the proportion of malic acid existing in European wine grapes has been determined, though Mulder says he found a small portion of it in French Bordeaux wines.

I am satisfied that it is not the characteristic acid of American grapes, which yield an abundance of tartrates, like the European wine grapes, the wine casks being incrustated with the argals, or cream of tartar.

So, likewise, our tests indicate that tartaric acid predominates in the American, as in the European grapes.

No. 4. Grapes "from Fairfax county, Virginia." Received from United States Patent Office, September 20, 1859.

These grapes are a large, red variety. The name of them is not known to me.

One pound of them, on pressure, yielded 10 fluid ounces of juice, which had the specific gravity = 1.0410, and, by saccharometric tables, should yield 10 per cent. of grape sugar. By the copper test, the proportion obtained was 10.9 per cent. This will give 5.45 per cent. of absolute alcohol, which is too little alcohol to preserve the wine, and therefore more sugar must be added when the juice is set to ferment, or alcohol may be added to the wine when made.

No. 5. Mahogany-colored grape, *Vitis labrusca*, No. 17 of Weber's list. From G. W. Clarke, of Malden, Massachusetts. Received September 21, 1859.

This is a large, red grape, quite ripe, and sweet to the taste.

One pound of the grapes yielded  $10\frac{1}{2}$  fluid ounces of juice, which had specific gravity = 1.050, and when boiled and filtered, specific gravity of 1.045. By the tables this should give 11 to 12 per cent. of saccharine matter.

By the grape-sugar copper test, it yields 10.7 per cent. of grape sugar,

or 5.35 per cent. of absolute alcohol. This is too small a proportion to preserve the wine, without the addition of sugar or spirits.

Some of the juice fermented made a pleasant-flavored wine, but it soon soured.

No. 6. Sweet-water grape. A naturalized foreign species, much used as a table grape.

It was desirable to know if this grape would yield juice of sufficient sweetness to add to our sourer native grape juice. Mr. Weber therefore obtained from Mr. Newell Harding, of Boston, some samples of these grapes—No. 19, Weber's list.

One pound of these grapes yielded 12 fluid ounces of juice, which had specific gravity = 1.0525, and should, by the tables, yield nearly 13 per cent. of saccharine matter. By the grape-sugar test it gave only 9.53 per cent. of grape sugar.

Since, however, there is very little tartaric or any other acid in any quantity present, the juice of these grapes may be advantageously mingled with that of our sourer varieties; but still it will be necessary to add some pure loaf-sugar or clarified syrup, in order to keep the wine sound, and to produce more alcohol by its fermentation, the alcohol which the sweet-water grape produces being only 4.76 per cent.

No. 7. Concord grape. *Vitis labrusca*, No. 22 Weber's list.

This is a medium-sized, purple grape, native in Concord woods. One pound of the grapes yielded 12 fluid ounces of juice, which had specific gravity = 1.0510, and, by the tables, should contain 13 per cent. of saccharine matter, while by the copper test it yielded 15 per cent., and will give by fermentation  $7\frac{1}{2}$  per cent. of alcohol.

No. 8. A large dark-red grape, from Concord, Massachusetts. *Vitis labrusca*, No. 20 of Weber's list.

One pound of these grapes yielded  $10\frac{1}{2}$  fluid ounces of juice, which had specific gravity = 1.0570, and, by tables, should contain 14 per cent. of saccharine matter. By the grape-sugar test, the juice yielded 11.7 per cent., which would produce 5.85 per cent. of absolute alcohol.

It will be necessary to add sugar or alcohol to this wine to make it keep sweet.

No. 9. Concord seedling, from Mr. Bull's estate, No. 24 of Weber's list.

This is a purple grape, of medium size, and is an agreeable fruit to the taste. It yields 12 fluid ounces of juice per pound of grapes, and the juice has specific gravity = 1.0550, and should, by the tables, contain  $13\frac{1}{2}$  per cent. of grape sugar. By the copper test the yield was 11.8 per cent., and the alcohol which this will produce is 5.9 per cent.

No. 10. Second seedling Concord grape, (Bull's,) color purple, size medium, taste sweet and good.

One pound of the grapes yielded 12 fluid ounces of juice, and the



specific gravity of which was 1.0550; saccharine matter, by tables, 13½; grape sugar, by copper test, 11.8; alcohol the juice will produce by fermentation, 5.9 per cent.

It appears, therefore, that the second seedling is not in advance of the first. This may be accidental in this instance, and should not discourage the experiments of cultivation of seedling vines.

No. 11. The Sage grape of Concord—a native of the woods of that town. Cultivated by R. W. Emerson.

This is the largest sized grape I have seen in New England, three of them weighing an ounce. It is No. 25 of Weber's list. Color, pale-red; bunches not very much crowded, but heavy. A pound of these grapes yielded 11½ ounces of juice, which had specific gravity of 1.0465, and, by the tables, should contain 11¼ per cent. of saccharine matter.

By the copper test I obtained from the juice 11 per cent., which is equivalent to 5.5 per cent. of absolute alcohol. Sugar or spirit must be added to this juice when made into wine.

No. 12. Light-red grape, from Bedford, Massachusetts. *Vitis æstivalis*, No. 21 of Weber's list.

A rather tart grape. Juice pale yellowish. One pound of the grapes yields 11½ fluid ounces of juice, the specific gravity of which is 1.053, and the saccharine contents, by tables, 13 per cent. By the grape-sugar test, however, only 8.97 per cent. was obtained, equivalent to 4.48 per cent. of absolute alcohol. Sugar or spirit is required for this wine, and probably both, with water, will be needed, as the juice is so strongly acid. It contains much tartaric acid, more than many of the other grapes.

No. 13. Amber grape, Dracut; No. 26 of Weber's list.

A light-red grape, with much translucency, very fragrant, bunches well shouldered, full, and heavy. This sample was not quite ripe, and I subsequently procured another which was fully ripe. One pound of grapes from sample 26 yielded 11 fluid ounces of juice, which had specific gravity of 1.0580, and, by tables, should contain 14 per cent. of saccharine matter, but yielded to grape-sugar test only 10.97 per cent., which is equivalent to 5.48 per cent. absolute alcohol.

No. 14. Amber grape. Received from Asa Clement, of Dracut, October 5, 1859.

This lot was fully ripe. These grapes are of medium size and very handsome. The variety was found by Mr. Clement in the woods of Dracut, and has been cultivated by him several years.

A pound of these grapes yielded 11 fluid ounces of juice, having a specific gravity of 1.0550, and containing, by tables, 14 per cent. of saccharine matter, while by copper test the yield was 13.6 per cent. of grape sugar, equivalent to 6.8 per cent. of absolute alcohol. The wine made from the juice of these grapes will have to be reinforced by sugar

or spirit to make it keep sweet; probably water will be required to reduce the acid and sugar to produce more alcohol. The high aroma of the grape makes it desirable as a wine grape, since the wine will have a peculiar bouquet, quite strongly marked.

No. 15. Isabella grapes, from A. Harshbarger, near Veytown, Mifflin county, Pennsylvania. Received from United States Patent Office, October 1, 1859.

These grapes were quite ripe. Color, dark purple; size, medium; bunches well filled. One pound of these grapes yielded, on pressure, 10½ fluid ounces of the juice, and the juice had specific gravity 1.064, from which the tables indicate 16 per cent. of saccharine matter; but the grape-sugar test gives but 14.7 per cent. of grape sugar, equal to 7.03 per cent. of absolute alcohol.

These grapes will make a light wine, but it will keep if well bottled and placed in a cold cellar. A little sugar added during the fermentation will add to its strength. I found about one grain of malic acid to an ounce of the grape juice.

No. 16. Sugar grape, of Plymouth, Massachusetts. A white grape, a little above medium size, and in favorable seasons very sweet and good. Sample furnished by T. O. Jackson, of Plymouth.

One pound of the grapes yields 10 fluid ounces of juice, which has specific gravity of 1.040, and by tables should contain 10 per cent. of saccharine matter. By the grape-sugar test, 10.33 per cent. of grape sugar is indicated, equivalent to 5.16 per cent. of absolute alcohol.

This grape grows abundantly at Manumet, near Plymouth, at Sandwich, and in many places on and near Cape Cod. It is worthy of attention, since the juice of these grapes will make very delicate white wine.

No. 17. *Vitis labrusca*, Hartford, Connecticut, No. 10 of Weber's list.

A medium-sized grape. One pound of the grapes yielded 10 fluid ounces of juice, which had specific gravity 1.036, and, by tables, should contain 9 per cent. of saccharine matter. The grape-sugar test gives only 5.73 per cent., equivalent to 2.86 per cent. of alcohol.

It is probable that the grapes were not quite ripe, for this variety generally yields more saccharine matter than found at this time. The matters which would have formed grape sugar, if the grape were ripened, served to augment the density of the juice, and hence the disagreement between the tabular estimate and the actual result of analysis.

No. 18. A large white grape, from near Hartford, Connecticut, No. 5 of Weber's list.

One pound of the grapes yielded 10½ fluid ounces of juice, having a specific gravity of 1.030, from which the tables indicate 7½ per cent.