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A TREATISE ON THE MANUFACTURE AND DISTILLATION OF ALCOHOLIC LIQUORS.

P ART I.

CHAPTER I.

ALCOHOL.

Under this name modern chemists designate a spirituous liquid of any degree or density. The terms brandy, spirits of wine, of molasses, beets, or whiskey employed in the market to designate the varieties and extreme degrees of concentration of the same liquid, are replaced in scientific language by this generic term.

The word alcohol is of Arabic origin, and signifies a very subtle or highly divided body. It was formerly employed to indicate the extreme tenuity given to certain powders. Boërhave used it to express the inflammable principle reduced to its simplest terms without being decomposed.

Pure or anhydrous alcohol is a transparent, colorless liquid, of a strong and penetrating odor; of a warm and acid taste, very volatile; when exposed to the air it evaporates by degrees; inflammable by contact with flame, it burns with a white flame, leaves no residuum, and disengages much heat. When diluted with water it burns with more difficulty, and its flame is blue and less brilliant. It is very sensitive to the influence of changes of temperature; expanding under the effects...
DISTILLATION OF ALCOHOL.

of heat, contracting in the cold. Exposed to a temperature of 173° Fahr. (78° cent.) under a pressure of 0.76 mm. it boils and evaporates entirely. It has never been frozen.

The specific gravity of pure alcohol at 60° Fahr. (15°.5 cent.) is 0.793. Its elementary composition is

<table>
<thead>
<tr>
<th>Element</th>
<th>Composition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon</td>
<td>52.32%</td>
</tr>
<tr>
<td>Oxygen</td>
<td>34.38%</td>
</tr>
<tr>
<td>Hydrogen</td>
<td>13.30%</td>
</tr>
<tr>
<td>Total</td>
<td>100.00%</td>
</tr>
</tbody>
</table>

Pure alcohol is decomposed by passing it in the form of vapor through a porcelain tube heated to redness. It is converted into carbonic acid, carburetted hydrogen, and water. These products indicate the constituent principles of alcohol in a positive manner.

Alcohol mixes with water in all proportions. The increase of temperature which takes place in the mixture indicates the condensation and complete union of the two bodies. The volume of the mixture is in fact much less than the sum of the volumes of the original liquids. The maximum of contraction takes place in a mixture of 580.625 parts of alcohol and 674.880 parts of water. 100 volumes of this mixture contain 53.939 volumes of alcohol, and 49.836 volumes of water; in other words, 103.775 volumes are reduced to 100.

As has been said above, spirits and brandies* are alcohols of different titles or degrees of strength, the former known in commerce as rectified spirits (trotse mix), at 85 or 95 degrees of the centesimal alcoholmeter. The second vary from 40 to 60 degrees, according to the nature of the substances which have been used to manufacture them. The chapters on the distillation of alcohols and brandies, and the reduction of spirits will give more ample details in regard to this subject.

Alcohol is of the greatest importance in chemistry. Next to water, it is the most general solvent. It dissolves iodine, the resins, volatile oils, vegetable alkalies, almost all of the acids, &c. It precipitates from their solutions gum, starch, albumen, gelatine, and many other substances. On account of these properties alcohol is an invaluable agent in analysis.

It has numerous applications in medicine and the arts; it serves as the vehicle for a host of remedies, forming the bases of the ethers, tinctures, aromatic spirits, &c. It is never employed pure for these purposes, but of different degrees of strength, as indicated by the alcoholmeter. It enters into the preparation of liquors and cordials for the table, absinthes, perfumed extracts, and vinegars, and aromatic spirits, and is therefore used in very large quantities by the perfumer and liquorist. It is used by the anatomist and naturalist to preserve their preparations from putrefaction. Finally, it enters into the manufacture of varnishes, stearine candles, gun caps, &c., for which large quantities are consumed.

Alcohol is found in all substances (vegetable or other) which contain sugar or glucose; it is the product of the decomposition of the saccharine principle which takes place during the vinous or alcoholic fermentation. It does not exist ready formed in these substances, but only after they have passed through this kind of fermentation, and it may, by reason of its very great volatility, be separated by distillation from the water with which it is united. It is on this principle that is founded the extraction of this product.

All vinous liquors which yield alcohol by distillation do not furnish it in equal quantities, the result depending on the quantity of saccharine matter contained in the liquid. The larger the proportion of sugar the greater will be the alcoholic product, the latter being derived entirely from the former.

Among the vegetables employed in Europe for the production of alcohol, the grape holds the first place, the beet and rice come next. Potatoes, artichokes, carrots, turnips, the stalks of Indian corn, sorghum and the daffodil, although producing notable qualities of alcohol, are much less employed. It is the same of the cereals

* The term "brandy" is used here as generic to indicate the spirit from grape. From molasses comes rum; from grain, whiskey, &c.
and fruits in general. The molasses of the sugar factories and refineries is almost entirely converted into alcohol, and takes rank after the beet and rice.

In the United States, on the other hand, potatoes, Indian corn, and the cereals furnish almost the whole of the alcohol found in the market, while large districts of country depend on the product of the orchards for their brandy.

Hereafter we shall examine the method of obtaining alcohol from each of the substances named above. It is impossible to obtain anhydrous alcohol by a simple distillation.

Whatever may be the merit of the rectifying apparatus, it is necessary to have recourse to very deliquescent salts or other substances which have a great affinity for water, such as carbonate of potash, acetate of potash, chloride of calcium dried and melted, quicklime, clay dried and finely divided, &c.

Pure alcohol being very difficult to find in the market, the following, if not the most economical, is at least the most convenient and prompt method for procuring it:-

The spirit is allowed to macerate at a gentle heat for two days upon one-tenth of its weight of carbonate of potash dried by the fire (100 grammes to the litre of alcohol at 85 degrees). It is agitated from time to time, then distilled in a water bath, to draw off all the alcohol marking 94 degrees. To this alcohol is then added pulverized quicklime in the proportion of 500 grammes to the litre, leaving them in contact for two or three days in a hot room, and after decanting the alcohol from the calcareous deposit it is distilled very gently. The product is perfectly pure dephlegmated alcohol, that is to say, absolutely free from water.

When we wish to ascertain if alcohol contains any water, a fragment of caustic baryta is placed in contact with the liquid. If it contains no water the baryta is not altered; on the contrary, if any water is present it whitens, swells, becomes hydrated and falls into a powder. The phenomenon is more marked in proportion as the quantity of water is greater.

The degree of concentration of alcohol is ascertained by the use of instruments especially adapted to the purpose, the uses of which will be described in the article on the "Determination of the alcoholic strength of liquids."

Alcohol is a diffusible stimulant. Its energy varies with the quantity of water with which it is mixed. When concentrated it acts as a caustic on the living tissues of the animal economy, coagulating the albumen, and depriving them of their water. By injection into the veins it causes sudden death by coagulating the blood. Its introduction into the stomach almost always causes death. Taken properly its action is restricted, especially to the sensitive and intellectual organs.

"Alcohol," says Brillat-Savarin, "is the king of liquids; it excites the taste to the highest degree; its various preparations have opened up to mankind new sources of enjoyment; it supplies to certain medicines an energy which they could not have without it; it has become in our hands a formidable weapon; for the nations of the new world have been almost as much overcome and destroyed by brandy as by fire-arms."

CHAPTER II.

FERMENTATION.

An intestinal reaction which occurs spontaneously in any vegetable or animal substance under the influence of a peculiar principle, called ferment aided by heat, whence are produced certain new substances which were not originally contained therein.

As the periods of decomposition are characterized by some peculiar predominating principle, the distillers distinguish four kinds of fermentation, viz: The saccharitic or glucosic, the vinous or alcoholic, the acid or acetic, and the putrid.

Although the vinous or alcoholic fermentation most
especially concerns the distiller, it is nevertheless indispensable, on account of the different alcohols extracted from starch and the cereals (of which we shall speak hereafter), that he should be perfectly familiar with the laws which govern the saccharine fermentation. As to acid and putrid fermentation, they may be considered, so far as the distiller is concerned, among the accidents to which we must refer further on.

Saccharine or Glucosic Fermentation.

This fermentation is developed in starch dissolved in water, when brought in contact either with malt (germinated barley), gluten, or with a mineral or vegetable acid, agents which act as a ferment or leaven.

It also takes place in the act of germination of seeds and the ripening of fruit. It is effected without any visible movement in the material, solid or fluid, and without disengaging carbonic acid.

The operation of saccharification is nothing more than the transformation of the amylaceous matter into glucose, that is to say, a true saccharine fermentation.

The substances just named are not the only ones which may, under the influence of certain reagents, be transformed into sugar; gum, pectine, cellulose, etc., also enjoy this property.

Green or unripe fruits contain a very small proportion of sugar, and, on the other hand, a considerable quantity of gum, mucilage, pectin, starch, lignine, and a great amount of free acid. During the maturation a part of the acid disappears under the influence of heat and the oxygen of the air, the cellular tissue diminishes and the quantity of sugar increases in such a manner that instead of ligneous and acid fruits we have, if the maturation is complete, some weeks after gathering them, fruits which contain a sweet and syrupy juice enclosed in tough or leatherlike envelopes.

The following table will exhibit the proportions of sugar contained in 100 parts of certain fruits, both green and ripe:

<table>
<thead>
<tr>
<th>Fruit</th>
<th>Green</th>
<th>Ripe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pears</td>
<td>6.4</td>
<td>11.5</td>
</tr>
<tr>
<td>Currants (red)</td>
<td>0.5</td>
<td>6.25</td>
</tr>
<tr>
<td>Apples</td>
<td>4.9</td>
<td>11.6</td>
</tr>
<tr>
<td>Apricots</td>
<td>6.6</td>
<td>16.5</td>
</tr>
<tr>
<td>Peaches</td>
<td>0.6</td>
<td>11.6</td>
</tr>
<tr>
<td>Cherries</td>
<td>0.12</td>
<td>18.11</td>
</tr>
</tbody>
</table>

Experiment has demonstrated that the maturation of fruits is analogous to that produced by the reaction of feeble acids upon gum, starch, and the shavings of wood.

Vinoas or Alcoholic Fermentation.

Among the proximate principles of organic substances, sugar alone gives occasion to vinous fermentation from which alcohol is derived.

This fermentation cannot proceed without the concurrence of five agents acting, each in a different direction, the union of which is, however, indispensable, viz:—


If one of these agents is suppressed, the vinous fermentation will not take place, and consequently no alcohol will be produced, whatever be the materials used or the processes followed. The rôle of each is of more or less importance, and the success of the fermentation depends absolutely on their employment and combination.

We shall now examine, in turn, the part played by each of these agents in the fermentation in order to bring about the formation of alcohol.

Sugar.—As we have said above, sugar is the only constituent element that can produce alcohol. The rest are mere auxiliaries to the decomposition.

According to the principles of chemistry, as understood to-day, sugar is a substance which, when dissolved and brought in contact with a ferment, possesses the property of being transformed into alcohol and carbonic acid; entirely composed of oxygen, carbon, and hydrogen. It consists by weight of carbon 42.47; oxygen 50.73; hydrogen 6.80.
DISTILLATION OF ALCOHOL.

There are two marked varieties of sugar, the common or crystallizable and the uncrystallizable sugar. The first of these, generally obtained from the cane and beet, is also found in the stalks of sorghum, Indian corn, etc. The second is met with in the grape, pear, and other fruits, in the potato, in beans and in seeds.

From a number of vegetables sugar may be extracted, differing more or less from that derived from the cane, as the maple, beet, grape, or potato. This sugar will also undergo the vinous fermentation, and alcohol may be obtained from it by distillation.

Again, there exist certain sugars susceptible of fermentation which, although differing entirely from the preceding, are employed in a fluid state in the form of syrup or juice. These can neither be crystallized nor solidified.

Sugar is transformed into alcohol by the separation of it part of the carbon or oxygen which it contains. In the course of this transformation it loses half its weight in gas. This result may serve to make known the quantity of alcohol of any desired strength which may be obtained from a properly fermented vat.

The liquid which the vat contains before fermentation having been weighed by means of a densitometer or saccharometer (peso strappo), it is easy to calculate the weight of the sugar which it contains in solution, and the half of this weight will give approximately the weight of pure alcohol which the fermentation will produce; yet it must be observed that practice often destroys the calculations of theory, because the liquid tested may contain tartrate of potassa, or other foreign matters, and consequently less sugar than is indicated by the saccharometer; moreover, it is proper to take into account the acetic acid which is formed at the expense of the alcohol as well as the loss by evaporation.

Water.—Of all natural agents for the disorganization of material substances, water occupies the first place. The presence of this solvent par excellence, is not only indispensable, but the more or less active and complete change of the sugar into alcohol is dependent on the proportion in which it is used.

The fermentation is rapid or slow in accordance with the quantity of water employed. To hasten or retard the operation, it is only necessary to increase or diminish the dose, by adding water in the first case, and evaporating it in the second; the best guide being the saccharometer.

In order to exhibit more clearly the action of water in the course of the vinous fermentation, we shall proceed to give the results of some experiments made by M. Duplais in June, 1854.

Five fermenting vats, of a capacity of 25 hectolitres each, situated in a place having an even temperature of 20° C., received each 300 kilogrammes of molasses from the sugar refineries (215 litres at 42 degrees), and a quantity of water sufficient to make, in No. 1, 600 litres, marking on the saccharometre 15°; in No. 2, 750 litres marking 12°; in No. 3, 1000 litres marking 9°; in No. 4, 1500 litres marking 6°; and in No. 5, 2250 litres marking 4°.

The following table will exhibit the duration of the fermentation and the alcoholic product of each vat:

<table>
<thead>
<tr>
<th>Vat</th>
<th>Quantity of liquid.</th>
<th>Duration of experiment.</th>
<th>Alcoholic product.</th>
<th>Proportion per 100.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>600 litres at 15°</td>
<td>8 days</td>
<td>78.75 litres</td>
<td>26.25</td>
</tr>
<tr>
<td>2</td>
<td>700 &quot; &quot; 12</td>
<td>5 &quot;</td>
<td>83.55 &quot;</td>
<td>27.86</td>
</tr>
<tr>
<td>3</td>
<td>1000 &quot; &quot; 9</td>
<td>3 &quot;</td>
<td>90.45 &quot;</td>
<td>30.15</td>
</tr>
<tr>
<td>4</td>
<td>1500 &quot; &quot; 6</td>
<td>2 &quot;</td>
<td>93.15 &quot;</td>
<td>31.05</td>
</tr>
<tr>
<td>5</td>
<td>2250 &quot; &quot; 4</td>
<td>1 &quot;</td>
<td>93.90 &quot;</td>
<td>31.30</td>
</tr>
</tbody>
</table>

Thus it is evident that the proportion of water exercises a great influence, both on the duration and on the products of the fermentation, and although it requires more fuel to distil 1500 litres of a liquid which will produce 93.15 litres of alcohol, than for 750 litres which will produce 83.55 litres, the increase of fuel is more than compensated by the increase of the product.

The choice of water for the vinous fermentation is not
a matter of indifference. That which contains organic
matters in solution should be rejected, on account of its
tendency to run into the putrid fermentation. Water
strongly impregnated with lime, or salts of iron, should
also be rejected. Without the employment of filtered
water, as for cordials, liquors, etc., it is indispensable to
have it pure and clear to obtain a good result from the
fermentation.
This article cannot be closed without one observation
of very great importance. In distilleries where the fer-
menting vats are heated by steam, if the pipes are not
sufficiently inclined, the water resulting from the con-
densation of the steam in them may check or even
arrest the fermentation. This inconvenience may be
abated by the use of a "drip."
Heat.—In the disorganization of organic substances,
the intervention of heat is as important as that of water.
Like water, heat may be the cause of hastening or
retarding the vinous fermentation. Below a temperature
of 12° C. it is checked, and ceases entirely with a very
cold temperature. Between 15° and 18° C. fermentation
sustains itself, and becomes more lively and more perfect
beyond this point. It is not, however, necessary to ex-
ceed 28° or 30°, because this high temperature excites
the acetic fermentation and will become very injurious.
This inconvenience may be obviated by cooling the
mass by means of a coiled pipe placed in the vats, in which
cold water is caused to circulate, as is done in many
English distilleries.
Heat is retained longer in large masses than in small,
and the fermentation becomes of itself the source of heat,
by reason of the rapidity of the decomposition of the
sugar; this rapidity being also in proportion to the
mass. Hence it follows that the heat should be increased
in inverse proportion to the bulk of the mass to be fer-
ment.
In general, with some exceptions which will be indi-
cated hereafter, the heat which should be applied to
fermenting vats, is as follows:—

<table>
<thead>
<tr>
<th>Volume of Vat (hectolitres)</th>
<th>Temperature (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>20° to 25° C.</td>
</tr>
<tr>
<td>40</td>
<td>20° to 25° C.</td>
</tr>
<tr>
<td>60</td>
<td>18° to 20° C.</td>
</tr>
<tr>
<td>100 and above</td>
<td>12° to 15° C.</td>
</tr>
</tbody>
</table>

The power which organic substances possess of fer-
menting under the influence of heat and contact with
the air, and thus, when in this condition, of producing
the same phenomena in other substances, will disappear
entirely when they are submitted to the temperature of
boiling water. This general rule has no exception.
If we take a substance naturally susceptible of fer-
menting, of putrefying, and being decomposed, when left
even for a moment exposed to the action of the air, and
if, after having arrested the movement of incipient
change, by means of a temperature of 100° C., we pre-
vent all access of oxygen which alone can cause a re-
vival of this movement of decomposition, the substance
will preserve, as it is easy to conceive, for an indefinite
period of time, the condition and properties which it
possessed at the moment when it was submitted to the
temperature of boiling water. In fact the substance is
in itself incapable of spontaneous motion; so long as no
external cause acts on its atoms, they will preserve their
place and original character.
When a bottle is filled with the fresh juice of the
grape, hermetically sealed, and suffered to remain some
hours in boiling water, or at least until the must has
acquired the same temperature as the water, the small
quantity of oxygen contained in the air which remains
in the bottle is absorbed during the action of the heat
by the elements of the must.
In this manner the alteration of the must is preven-
tive; it will no longer ferment; it will preserve its sweet
taste, and this condition will be maintained until the
bottle shall be opened, that is to say, until the moment
when the liquid shall be brought into a new contact with
the external air. But setting out from this time the
liquid will undergo the same modifications as recent
must; in other words, it will be, after some hours have
DISTILLATION OF ALCOHOL.

elapsed, in full course of fermentation, which may, however, be interrupted and caused to cease entirely as at first, by means of a new ebullition.

The Air.—By reason of its oxygen, the air is the vehicle of decomposition of organized bodies. It acts as a leaven in the vinous fermentation, for which it is essentially the initial force. Nevertheless, when its oxygen has given the impulse, it ceases to be necessary in the different periods through which the fermentation passes. This last, notwithstanding the exclusion of the air, continues its progress without interruption.

The juice of the grape, so long as it is protected by its envelope from contact with the atmospheric air, experiences modifications which are scarcely appreciable. The berry only dries by degrees. But it is sufficient to change all the properties of this juice, if the envelope is opened with the point of a needle. When it is protected from contact with the air, and consequently preserved from the chemical action which the oxygen of the air exercises upon one of its proximate principles, the must of the grape will be preserved indefinitely; for in the absence of a disturbing cause, the elements can experience no change, whatever be their facility of assuming new arrangements.

Nevertheless, if the contact of the air is indispensable to set up the vinous fermentation, particular care should be taken to prevent this contact when the fermentation has commenced; by this precaution will be prevented the formation of acetic acid, which is always produced at the expense of the alcohol, and then becomes itself a most active leaven for the acetic fermentation. It is advisable, then, during the continuance of the fermentation, to abstain as much as possible from uncovering the vat, and producing any movement whatever that may displace the layer of carbonic acid gas interposed between the liquid in fermentation and the atmospheric air. The period most to be apprehended for the formation of acetic acid in the vinous fermentation, is towards the end of the operation, for then the action of the atmosphere is exercised only on the alcohol already formed and favors its transformation into acetic acid.

Weak mists extracted from various substances in which the vinous fermentation is completed cannot bear, by reason of the small quantity of alcohol which they contain, contact with the air; in them the acid fermentation begins as soon as the vinous fermentation has ceased, and we may almost affirm, that the two fermentations, under the circumstances indicated, in some measure progress side by side.

Ferment.—The term ferment is understood to apply to any substance which, when placed in a liquid capable of being fermented and properly arranged, causes it to ferment with more activity and energy than it would have done if left to itself, and thus shortens this operation.

The ferment is a substance in a state of putrefaction, whose atoms are in continual motion, and which has the property of causing the decomposition of sugar and its conversion into alcohol. May not this substance, which has not been clearly defined, be considered as peculiar, or rather as a modification of certain animal organisms? This last hypothesis is admitted by many philosophers, because many animal substances, when in a state of decomposition, act as a ferment on sugar.

According to the microscopic observations of Quevenne, Turpin, and others, upon substances in a state of fermentation, the ferment is endowed with vital action and partakes of the nature of the animal or vegetable; it appears to be organized, and to exist and develop itself it requires similar nourishment.

"This azotized substance, which exists as a gum in the greater part of organized matters, when placed under certain influences and in proper conditions, is developed, modified, and acts as we shall demonstrate hereafter.
Sometimes it exists already formed, but during the course of fermentation it loses its quality of ferment. Sometimes, on the other hand, it not only exists and acts, but, during the fermentation, it develops itself until it acquires a weight five, six, and even sevenfold more than it had at the beginning.

"In respect to the ferment we recognize three conditions in the phenomena of fermentation; in the first, the ferment does not exist, but may be produced spontaneously, as in the case of saccharine fruits; in the second, the ferment exists and acts, but is not reproduced: this occurs when sugar is mixed with the leaven of beer; and in the third, the ferment may originate, act, and reproduce itself, as happens in the course of the manufacture of beer."

In general the ferment does not act by virtue of its peculiar chemical nature, but simply as the cause of an action which extends beyond the sphere of its own decomposition; it impresses on the organic substances with which it may be brought in contact the state of decomposition in which it happens to be. "The ferment itself takes no part in the chemical changes which it provokes, and we can find, neither in the laws of affinity nor in the forces of electricity, light, or heat, any legitimate explanation of its effects."

Whatever may be the nature of the ferment, it is very evident that to its action, in the course of fermentation, is due the change of sugar into alcohol. Ferment, as we have already said, is a substance undergoing decomposition or putrefaction, the particles of which are in continual motion. This perturbation of elements, by communicating itself to the sugar, destroys the state of equilibrium of its peculiar atoms, which are then grouped in a different manner, according to their special attractions. The carbon of the sugar divides itself between the oxygen and hydrogen in such a manner as to form two more stable and intimate compounds—carbonic acid and alcohol. The elements of the ferment take no part in the formation of the products which result from the sugar during the fermentation. It is only the stimulant which provokes the change without participating therein chemically.

The ferment most generally used is the leaven or yeast of beer. The preference of distillers for this substance is founded on its fermentable power, and on the facility with which it may be procured in the market. Yeast is a frothy substance which is drawn up by the carboic acid gas, and collects on the surface of the liquid during the fermentation of the worts of beer. It is to be had of the brewers either in a liquid or solid state, that is to say, fresh or dry.

Fresh yeast in a semi-fluid state is to be preferred, but it is very difficult to transport and preserve it, therefore dry yeast is most frequently used. The latter has been subjected to the action of a press, to deprive it of the beer and render it solid. In this state it is in the form of a uniform brittle paste, neither stringy nor sticky, of a yellowish-white, and having a slight aromatic odor of hops, without any mixture of an acid or putrid taste.

The fermentable power of yeast varies according to the quality of the beer from which it is derived. If it results from a strong beer, it is much more substantial, acts more gently and more certainly, and is more apt to favor a healthy and sweet fermentation. If, on the other hand, it is derived from a small beer, it acts all at once with a sort of violence, and, after having excited in the wort a hasty bubbling and kind of effervescence, it loses all its energy, from which results a loss of a portion of the spirituous principle, and is frequently followed by acidity.

The facility with which yeast passes to a state of putrefaction renders it necessary to preserve it in the cellar, or some other cool place, for a slightly elevated temperature may readily alter or corrupt it. It may be preserved a sufficiently long time, especially as regards its freshness, when care is taken to cover it with water, which must be renewed every day. A means of preserving yeast at all seasons, and which has been employed with some success, consists in mixing this substance with very thick molasses, so as to form a
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hard paste. "The ferment thus mixed with sugar or molasses," says Dumas, "will for years preserve its characteristic properties." According to M. Payen a better result is obtained by spreading out a thin layer of fresh yeast, and allowing it to dry in the open air by exposure to the sun, or in a current of slightly-heated air.

"I have," says he, "succeeded in rendering the desiccation more prompt by spreading the yeast whipped to a smooth broth on thick tables of plaster well dried, and thus rendered more absorbent." Another means has appeared to me to be at least as efficacious. It consists in mixing the whipped yeast with very dry animal black in powder (and consequently strongly hygroscopic), or with starch strongly heated and cooled in a close vessel. The drying under these circumstances is easily finished in a current of air heated to 30° or 35° C.

Whatever may be the method employed for preserving pure yeast it is very certain that it will never possess either the strength or the energy of that which is newly prepared, therefore it should never be used when fresh yeast can be obtained.

It is important to examine yeast with great care to be assured of its quality. That which is acid, or the result of a bad fermentation, should be rejected. The former is recognized as follows: A strip of litmus paper being dipped into the suspected yeast, if it is acid the blue will be changed to a permanent red; if, however, the yeast be good, fresh, and well preserved, the litmus paper will be slightly reddened, but if washed in fresh water the blue will be restored. As to that which results from a vicious fermentation it is almost impossible to detect it, unless by employing the means hereafter indicated in the article on the phenomena of fermentation, or when the decomposition is so far advanced in the altered leaven that the disagreeable odor which it exhalles may be recognized.

Frequently the dry yeast is sophisticated. The fraud consists in the addition of rye or wheat flour, or, more likely, wheat or potato starch. This mixture is readily detected by dissolving a small quantity of the suspected yeast in a little boiling water, and pouring it into it two or three drops of tincture of iodine. If it is pure, the liquid will not change color; if, however, it is adulterated, a decided blue color will be produced.

Beer yeast is not the only substance which will cause the conversion of sugar into alcohol. All azotized substances, as gluten, albumen, fibrine, caseine, &c., possess this property in a more or less decided degree, and they will act as much more promptly as they are more alterable, and when they have already arrived at a state of incipient putrefaction.

All the vegetable juices that contain sugar enter into a state of fermentation a few hours after they have been expressed, as happens with the juice of sugar-cane, the beet, fruits, the sap of the maple, &c. This phenomenon results from the fact that these juices contain a notable proportion of nitrogenous fermentable material, which, however, does not possess the power of developing fermentation until brought in contact with the air; for, in a vacuum, or in contact with other gases than the air, these saccharine juices undergo no change, while a very small quantity of atmospheric air will in a short time determine their fermentation.

The varieties which exist in yeast, as regards the quality of the ferment, may be recognized by the following methods. Beer yeast is distinguished by its disagreeable odor which it exhalles.

The following receipt will always produce a leaven, the efficacy of which has been proven by experience:

Malted wheat, very dry and pulverized 2 kilogrammes.
Malted barley ground and dried in a furnace 400 grammes.
Hops 250
Strong glue 250
River water 40 litres.
Good fresh and dry yeast 1 kilogr. 500 grms.

Boil the hops in 24 kilos of water until reduced to one-third, filter through a cloth, then, after allowing it