

shipped to New England and New York. There also begins to be a demand for it in the better European markets.

MANUFACTURE OF YEAST WITHOUT ALCOHOLIC FERMENTATION.

A method of manufacturing yeast without alcoholic fermentation, and without the formation of subsidiary products, has been patented in this country by Dr. J. Rainer, of Vienna. The process is carried out in the following manner:—The vegetable albuminous substances in the corn cereals or other vegetables, or such refuse of industrial establishments as bran cornings, malt residuum, gluten, and the like, are extracted with the aid of from 15 to 20 parts by measure of water made slightly alkaline. They are then either peptonized by adding an excess of lactic acid (about 4 per cent.) or mineral acids (about $\frac{1}{2}$ per cent. of phosphoric acid, or about 4 to 10 per cent. of either sulphuric acid or hydrochloric acid) at a temperature of from 85 to 100 degrees Fahrenheit, or they are at once macerated in dilute solutions of the above acids, and simultaneously converted into peptone. A portion of the albuminous substances (from 5 to 10 per cent. of the total weight) in the dried cornings will be already transformed into peptone by the process of vegetation. The albuminous substances in cereals, maize, or other vegetables, and in bran and malt residuum are transformed into peptone by the addition of diastase. In order to effect the conversion it is sufficient to add to one part by weight of albuminous matter when dry by weight of dry malt, or five parts by weight of cornings. As stated the liquid in which the albuminous matter is to be transformed into peptone must contain lactic acid (4 per cent.), phosphoric acid (as much as $\frac{1}{2}$ per cent.), sulphuric acid or hydrochloric acid (about 2.5 per cent.), because the presence of an acid is absolutely necessary in the process of converting these substances into peptone.

A temperature of about 100 degrees Fahrenheit is the most suitable for the conversion of the substances into peptone, and a period of from 18 to 20 hours will be sufficient to effect it. It may, however, be also carried out at lower temperature during a correspondingly longer time. In working cornings it is superfluous to add malt, because the diastase contained in the cornings is more than sufficient for the process of conversion into peptone. Therefore, it is only necessary in this case to use one of the above-named acids in the proportions given. The slimy pectates contained in the cornings as well as in other materials are dissolved by the combination of diastase and acids. When the preparation of pure peptone is required the pectates may be separated by an endosmotic apparatus or dialysed through such a manner that the peptone is dialysed through proper membranes in water, while the gelatinous pectates remain as a residuum. The acids are neutralized by means of soda, or by saturating the liquid with basic phosphate of lime. The prepared peptone liquid, with or without a percentage of sugar, may be shipped as a saleable article, or it may be delivered in a dry state, or as a syrup or extract obtained by boiling the liquid down in a water bath, by steam, or preferably in a vacuum. The liquid containing peptone may be separated from solid matter (hydrocarbons, vegetable fibre, or the like) by simple extraction, maceration or pressure, or by centrifugal action, or it may be carefully cleaned by filtering or settling. It is advisable, however, before cleaning by filtering or settling to neutralize any acid present by means of soda, or to saturate the liquid with basic phosphate of lime, the latter being preferable because the phosphoric acid required by the yeast is thus abundantly furnished to it. In order to start the growth of the yeast, gelatinised starch is added after being transformed in the usual way into dextrose by boiling with an addition of mineral acids. In the place of starch thus prepared an addition may be made of maltose, molasses, or sugar mixed with beer-yeast or compressed yeast. The amount thus added should correspond to the percentage of peptone in the liquid, being one half of the dry weight of the peptone. Hydrocarbons should, however, always be only from $\frac{1}{2}$ to 1 per cent. of the weight of the entire liquid, and should even then serve exclusively for the formation of the walls of the cells of the yeast.

The vegetation of the yeast will take place most satisfactorily at temperatures varying from 57 to 64 degrees Fahrenheit. At a higher temperature losses may easily occur by reason of the partial conversion of the sugar used into coagulated lactic acid or into alcoholic fermentation, instead of furnishing the yeast with substance for cells. The yeast is either propagated, as is the custom in Holland, in shallow vessels in which the depth of liquid is about five inches, so that a sufficient quantity of atmos-

pheric air has access thereto; or it may be better and more safely effected in vats made of wood, glass, masonry, cement, or other suitable material, into which atmospheric air is conducted by suitable distributors through tubes or pipes by means of blowers or compressors.

Instead of atmospheric air alone it is more advantageous to use air containing an increased amount of ozone or of oxygen partially converted into ozone. The latter is prepared by successively adding hydrogen dioxide to the propagating liquid. The percentage of ozone in the air is increased by means of phosphorus, or by causing it to pass through a closed vessel in which permanganate of potassa is mixed with the necessary quantity of mineral acid. The air thus enriched with ozone is allowed to pass into the propagating liquid.

The growth of the yeast will be completed within from 6 to 8 hours after every sufficient addition of dextrose, maltose or other material, according to the density of the propagating liquid used, the temperature of the latter, and the amount of the ozone in the air. The percentage of peptone of the mass may amount to from 1 to 2 per cent. or more of its weight, while only from half to one per cent. of dextrose or other hydrocarbons is added at each time in order to be sure to prevent the formation of coagulated lactic acid or alcoholic fermentation.

When the entire amount or bulk of the dextrose or other sugar added to promote the growth of the yeast has been consumed after from 6 to 8 hours, a further quantity thereof, say from 1.20 to 1.10 per cent., is added. The peptone may also, after having been consumed, be added in portions, or may be allowed to flow in gradually and continuously. The same propagating liquid made by successive replacement of the matter consumed remains in use for weeks or months, unless it is rendered impure by other substances, or by subsiding fermentation is made unfit for further use. In the same manner as the materials necessary for the propagation of the yeast are added the yeast produced may be successively withdrawn, and only the yeast suspended in the liquid remains behind as the germ for the ferments of alcohol to be afterwards formed. The yeast is obtained either by skimming it from the surface of the liquid or by separating it from the propagating liquid by filtration or finally by gathering it after tapping the vats from the bottom upon which it is deposited in a compact layer. In working on a large scale it is advisable to place the vat in terraced batteries in order to effect the transfer of the propagating liquid from one vessel to the other with facility. In order to produce yeast as free as possible from subsidiary ferments the propagating liquid may be prepared in a more dilute state, that is to say with a percentage of peptone of only from $\frac{1}{2}$ to 1 per cent. The hydrocarbons (dextrose, maltose, or the like) may also be added in smaller quantities, for example, as a first dose about 1.3 per cent., and then every three hours about 1.20 per cent.

The greater part of the peptone present will then be transformed into yeast in from 12 to 15 hours, a sufficient supply of pure air, if necessary, conducted through sulphuric acid or oxygen containing ozone, being provided, and the entire process being carried on at a temperature varying from 54 to 63 degrees Fahrenheit. The whole liquid is then cooled by a suitable apparatus, or by adding cold water or ice; the best temperature being from 45 to 50 degrees Fahrenheit. Within from 36 to 48 hours the yeast obtained will settle on the bottom of the vat. The propagating liquid may be allowed to flow away. The yeast obtained by this improved process is purified and condensed in the usual manner, but in order to increase its durability phosphate of lime amounting to from 4 to 5 per cent. of the total weight of the yeast to be made may be added before compressing it.

Experience has shown that from 250 to 300 parts of pure and active compressed yeast may be obtained from 100 parts of pure peptone. For the growth of that quality of yeast only about 200 parts of dextrose or sugar are required.

In a recent number *Dinglers Polytechnische Journal* is described the alarm-clock of Herr Pfyffer, which, at a given hour, lights a small lamp. The lamp is above the clock. Near it is a disc, with a sectoral piece cut out, and with horizontal axis. This has a spiral spring, and, by means of a handle, is turned round to a tense position, in which it is held by a projecting nose and catch. When the nose is released at the proper time, the disc springs back and ignites a match over the lamp. The arrangement is said to work with great certainty. The same number of the journal describes an instrument for measuring velocity of rotation in locomotives and steamers especially. The special feature of it is the employment of a spiral spring for measurement of centrifugal force.