

On the Results of the Panary Fermentation, and on the Nutritive Values of the Bread and Flour of different countries. By ROBERT D. THOMSON, M. D., *Conductor of the Laboratory, and of the Classes of Practical Chemistry in the University of Glasgow.**

Several years have elapsed since the author first had his attention directed to the comparative chemical and medical values of fermented and unfermented bread as articles of food. The common idea, which yielded the palm of superiority to the former, did not appear to be based on solid data, and it was, therefore, considered desirable, that in reference to a subject of such importance to the nourishment of man, the arguments in favor of such an opinion should be subjected to a careful examination. Judging *à priori* it did not seem evident that flour should become more wholesome by the destruction of one of its important elements, or that the vesicular condition of bread could alone be gained by a process of fermentation.

When a piece of dough is taken in the hand, being adhesive, and closely pressed together, it feels heavy, and if swallowed in the raw state, it would prove indigestible to the majority of individuals. This would occur from its compact nature, and from the absence of that disintegration of its particles, which is the primary step in digestion. But if the same dough were subjected for a sufficient length of time to the elevated temperature of a baker's oven, (450°) its relation to the digestive powers of the stomach would be changed, because the water to which it owed its tenacity would be expelled, and the only obstacle to its complete division, and consequent subserviency to the solvent powers of the animal system would be removed. This view of the case is fully borne out by a reference to the form in which the flour of the various species of *Cerealia* is employed as an article of food by different nations. By the peasantry of Scotland, barley-bread, oat-cakes, peas-bread, or a mixture of peas and barley-bread, and also potatoe-bread mixed with flour, are all very generally employed in an unfermented form, with an effect the reverse of injurious to health. With such an experience under our daily observation, it is almost superfluous to remark, that the Jew does not labor under indigestion when he has substituted, during his passover, unleavened cakes for his usual fermented bread—that biscuits are even employed when fermented bread is not considered sufficiently digestible for the sick, and that the inhabitants of the northern parts of India, and of Afghanistan, very generally use unfermented cakes, similar to the scones of Scotland.

Such then being sufficient evidence in favor of the wholesomeness of unfermented bread, it becomes important to discover in what respect it differs from fermented bread. Bread making being a chemical process, it is from chemistry alone that we can expect a solution of this question. In the production of fermented bread, a certain quantity of flour, water, and yeast are mixed together, and formed into a

* Abstract of papers read before the Philosophical Society of Glasgow, 14th February, 1842, and 26th April, 1843; and now communicated by the author.

dough, or paste, which is allowed to ferment for a certain time at the expense of the sugar of the flour. The mass is then exposed in an oven to an elevated temperature, which puts a period to the fermentation, expands the carbonic acid resulting from the decomposed sugar, and the air contained in the bread, and expels the alcohol formed, and all the water capable of being removed by the heat employed. The result, gained by this process, the author considers to be merely the expansion of the particles of which the loaf is composed, so as to render the mass more readily divisible by the preparatory digestive organs. But as this object is gained at a sacrifice of the integrity of the flour, it becomes a matter of interest to ascertain the amount of loss sustained in the process. To determine this point, the author had comparative experiments made upon a large scale with fermented and unfermented bread. The latter was raised by means of carbonic acid generated by chemical means in the dough; but to understand the circumstances, some preliminary explanation is necessary.

Mr. Henry, of Manchester, at the end of the last century, suggested the idea of mixing dough with carbonate of soda, and muriatic acid, so as to disengage carbonic acid in imitation of the usual effect of fermentation; but with this advantage, that the integrity of the flour was preserved, and that the elements of the common salt required as a seasoner of the bread, were thus introduced, and the salt formed in the dough. Dr. Hugh Colquhoun, first, it is believed, carried this suggestion into practice, in 1826, and made numerous experiments on bread making.* But it was not till within a very few years, that the idea of using bread thus baked on a large scale was carried into execution. From the result of several experiments made at the author's request, it appears that upon an average there is a great loss sustained by flour when it is fermented. In comparison with the bread raised by carbonate of soda, and muriatic acid, there is a loss in the sack of flour of 30 lbs. 13 oz.; or, in round numbers, a sack of flour would produce 107 loaves of unfermented bread, and only 100 of fermented bread, of the same weight. Hence, it appears, that by the common process of fermented baking, in the sack of flour, 7 loaves, or $6\frac{1}{2}$ per cent. of the flour, are driven into the air and lost.† An important question now arises from the consideration of the result of this experiment, viz., does the loss arise entirely from the decomposition of sugar, or is any other element of the flour attacked?

It appears from a mean of 8 analyses of wheat flour from different parts of Europe, by Vauquelin, that the quantity of sugar contained in flour amounts to 5.61 per cent. But it is obvious, that as the quantity lost by baking exceeded this amount by nearly 1 per cent., the loss cannot be accounted for by the removal merely of the ready formed sugar of the flour. We must either ascribe this extra loss to a conversion of a portion of the gum of the flour into sugar, and its

* *Annals of Philosophy*, N. S., vol. xii.

† In consequence of these and other facts brought forward by the author, the unfermented system of baking has been introduced into many of the unions in England, where, he believes, it has been found that he has not overrated the saving, which the above experiments would indicate to be upwards of a fifteenth.

decomposition by means of the ferment, or we must attribute it to the action of the yeast upon another element of the flour; and if we admit that yeast is generated during the panary fermentation, then the conclusion would be inevitable that another element of the flour, besides the sugar, or gum, has been affected. For Liebig has well illustrated the fact, that when yeast is added to wort, ferment is formed at the expense of the gluten, while the sugar is decomposed into alcohol and carbonic acid. Now, in the panary fermentation, which is precisely similar to the fermentation of wort, we might naturally expect that the gluten of the flour would be attacked to reproduce yeast.

The author has succeeded in forming a wholesome and palatable bread, by the employment of ammoniacal alum, and carbonate of ammonia, or soda, as a substitute for yeast. In this process the alum is destroyed by the heat; the bread is vesicular and white, and rises, according to the judgment of the baker, as well as fermented bread. It is obvious that none of the ingredients added can affect the integrity of the constituents of the flour, an occurrence which possibly may happen in the preparation of bread by the common process of fermentation, as has been shown, even to the azotized constituents. The disadvantage of such a deterioration is sufficiently evident if we view these principles as the source of nutrition in flour.

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[NOTE.—The remaining portion of this article is devoted to a comparison of the value of different flours founded upon a chemical analysis; the result of which is that the flour from the United States falls far below all others in the quantity of nutritive matter contained in it—one of the European flours (Naumburg) being fifty per cent. more valuable. Would it not be worth while to inquire how far this result was affected by bone-dust, which, if our information upon this side of the Atlantic be correct, is a favorite adulteration in England and Scotland.]

COM. PUB.

*On the use of Larch Bark in Tanning. From an article on the
"Examination of Astringent Substances, by J. STENHOUSE, Esq."*

The bark of the larch is employed in Scotland to some extent in tanning. The quantity of tannin it contains is considerable, but the leather made with it is of inferior quality. The aqueous solution of the bark is strongly acid to test paper, and has at first a pale yellow color, which exposure to the air renders brownish-red; it gives a copious fawn colored, precipitate with gelatine, but none with tartar-emetic. With the sulphate, chloride and nitrate of iron, it gives olive-green precipitates. Acetate of iron throws it down of a bluish-purple color. Sulphuric acid precipitates it of a reddish-yellow color. When boiled with the acid it dissolves, and the liquid assumes a fine scarlet color, like the infusion of Brazil wood. The altered tannin precipitates on cooling in beautiful red flocks, as it is but little soluble in cold water. It is very soluble in alcohol and alkalies, and its solutions