Philosophical Magazine Series 1

ISSN: 1941-5796 (Print) 1941-580x (Online) Journal homepage: http://www.tandfonline.com/loi/tphm12

XL. On the agency of the carbonate of magnesia in improving bread made from the new flour

Edmund Davy Esq.

To cite this article: Edmund Davy Esq. (1817) XL. On the agency of the carbonate of magnesia in improving bread made from the new flour , Philosophical Magazine Series 1, 49:227, 161-166, DOI: 10.1080/14786441708637871

To link to this article: http://dx.doi.org/10.1080/14786441708637871

Published online: 27 Jul 2009.

XL. *On the Agency of the Carbonate of Magnesia in improving Bread made from the new Flour.* By EDMUND DAVY, *Esq. Professor of Chemistry, and Secretary to the Cork Institution.*

To Mr. Tilloch.

DEAR SIR,—IN a recent communication*, I stated that new seconds flour, of indifferent or bad quality, is materially improved for the purpose of making bread, when the common carbonate of magnesia is well mixed with it in the proportion of from 20 to 40 grains to a pound of flour.

Since I announced this fact, I have made a number of comparative experiments on the worst seconds flour I could procure, with and without the addition of the magnesia; and the results have uniformly been satisfactory. The efficacy of this substance has also been repeatedly proved by trials made in Cork, and in different parts both of Ireland and England.

In a few cases, however, it has been said, the magnesia failed to produce the desired effect on the new flour; at which I am not surprised; for to my knowledge the *calcined* magnesia has in some instances been used instead of the *common carbonate*, and there is too much reason to apprehend this last substance has in other cases been adulterated by admixture with foreign bodies. In an early stage of my experiments, I found the calcined magnesia (when used in the quantity of from 20 to 30 grains to a pound of flour) to injure the colour of the bread and to render it heavy: and in the proportion of 40 grains to a pound it even changed the colour of the dough, and made it assume a yellow hue, not unlike that tint imparted by saffron. In the proportion of 12 grains to a pound of flour, however, the *calcined* magnesia improved the bread, but not nearly to the same extent as the *carbonate*.

There certainly may exist a difference of opinion as to the quantity of improvement effected in the bread by the magnesia. Slight circumstances, by no means easy to appreciate, may in different cases materially alter the nature of results. But no one who has fairly tried the magnesia, in the way I have recommended, can hesitate to admit the fact. I venture to speak confidently from experience. I do it under the full conviction that, whilst too much caution cannot be exercised in drawing conclusions from one or two hasty trials, the most legitimate inferences may be deduced from experiments carefully made and frequently repeated.

In the communication to which I have alluded, I merely hinted at the probable agency of the magnesia in correcting the bad qualities of the new flour. I now beg leave to notice the circumstances

* See Phil. Mag. for December 1816.

cumstances that led me to use this substance, and to bring forward some facts that tend to elucidate the mode of its operation.

On examining several samples of new wheat, it appeared to me the injury they had sustained arose principally from the grain having germinated. In this process it is understood a part of the farinaceous matter of the grain is converted into sugar. The changes thus produced in the grain seem to be analogous to those effected in starch by diluted sulphuric acid and heat: only in the one case they result from chemical agencies alone; in the other, the chemical agencies are assisted by the living powers of the infant plant. The production of saccharine matter in the grain is conceived to be accompanied by an incipient fermentation: this, though checked in the act of drying the corn, might, in the subsequent operations to which the flour was exposed when made into dough and baked, induce the acetous fermentation. Hence, I thought it not improbable that acid matter might be developed in bread made from the new flour with the usual additions.

In order to try if the new flour was at all acid, I put samples of the worst quality in distilled water; but after several hours the fluid did not affect litmus paper, or the still more delicate test of an infusion of red cabbage. I likewise exposed fermented dough made from the same flour (with the additions of yeast, salt, and warm water,) to an infusion of cabbage; but no change of colour could be perceived in it. But after some of the dough had been baked, the bread was clammy, had a singular smell, a sourish taste, and left on the palate a sense of bitterness. When some of this bread was put in distilled water and suffered to remain for about a day, the fluid produced a slight tint of red in an infusion of cabbage; and after three days it had a slight acid taste, and perceptibly reddened litmus paper. On making a comparative trial with bread made from good old flour, under similar circumstances, I could not by the most delicate tests detect the presence of any acid. Hence it seemed acid matter was formed in the baking of the new flour, and the bread had a tendency to acidity. I found likewise, in cases when a few drops of vinegar, or any of the mineral acids diluted, were put into dough made from good old flour, the bread was disposed to be clammy, and had a taste similar to that of bread made from bad new flour. These circumstances led me to imagine that the bad qualities of bread made from the new flour were connected with the appearance of acid matter during the baking: and the application of alkaline substances, as correctives, immediately became obvious. After repeated trials, I found that the fixed and volatile alkalies, their subcarbonates and carbonates, improved the new flour to a certain extent; and

I was

I was in consequence led to try the effects of the common carbonate of magnesia, a substance well known to be slightly alkaline. The trial was attended with perfect success; the improvement by the subcarbonate of magnesia was greater than by any of the other alkaline bodies.

The carbonate of magnesia, I conceived, might act on the bread in two ways: *chemically* and *mechanically*. *Chemically*, by correcting its tendency to acidity;—*mechanically*, by improving its texture. I did not think it necessary to enter into an elaborate analysis of the bread, in order to ascertain how far my views were correct; yet my experiments, some of which I shall give in detail, have perhaps been sufficiently minute to throw some light on the inquiry.

Carbonate of magnesia, I found, improved the colour of bread made from new seconds flour, whilst it impaired the colour of bread from fine old and new flour. This circumstance favoured the idea of its chemical action; for, if it were passive, it was inconceivable that a substance so perfectly white could in the slightest degree injure the colour of the whitest flour. I made the following experiments on bread from new seconds flour of bad quality, containing the carbonate of magnesia in the quantity of from 30 to 40 grains to a pound of flour.

I burnt two ounces of the bread in a Hessian crucible, at a low heat, until it became like a cinder; the temperature was then raised to a dull red; and after twenty minutes the black mass was partially covered with a light white substance, which, on trial, readily dissolved in diluted sulphuric acid with effervescence, and gave a white precipitate with carbonate of ammonia. The heat was continued until all the carbonaceous matter had disappeared, and there remained at the bottom of the crucible a small quantity of a white earthy-like substance. It had a saline taste, partially dissolved in water, and readily with effervescence in sulphuric acid. It was principally common salt used in the bread, and carbonate of magnesia. The preceding experiments were repeated with similar results.

I crumbled two ounces of the soft of the bread, and put it into a pint of distilled water. After remaining about twenty-four hours, the fluid was passed through a filter. (It was of a little darker colour than the fluid furnished by bread made from new or old flour alone.) It had an agreeable taste, and did not affect the colour of litmus. When the fluid was treated with a solution of subcarbonate of ammonia, a light flocculent precipitate soon made its appearance; it was immediately redissolved with effervescence by a few drops of sulphuric acid.

When a half pint of the fluid was boiled down nearly to dryness, and gently heated with strong sulphuric acid, there was a

 violent

violent action, and fumes of acetic acid apparently mixed with a little muriatic acid were disengaged. The excess of sulphuric acid being expelled by heat, distilled water was added, and the solution filtered. On treating it with carbonate of ammonia, there was a copious light flocculent precipitate, which on further examination proved to be carbonate of magnesia. A further quantity of the original infusion of the bread was boiled down to dryness in a platinum crucible; it appeared to be principally mucilage. On being exposed to the atmosphere for a few hours, it slightly deliquesced; and when treated with strong sulphuric acid and carbonate of ammonia, the results were similar to those noticed above.

On two ounces of fresh bread a half pint of distilled water was poured. After remaining about twenty hours, the infusion was decanted, and boiled down to about 1-12th of its original volume. It was put into a tubulated retort with a little strong sulphuric acid, and a heat below the boiling point of the acid was applied for half an hour. The neck of the retort was placed in a glass containing a half cubic inch of pure water. A colourless fluid came over, which had a peculiar empyreumatic odour, a very slight acid taste, and reddened litmus paper. This fluid was neutralized by caustic potash, and evaporated to dryness. The dry mass was treated with a slight excess of strong sulphuric acid; and on being gently heated very pungent fumes, principally of acetic acid, were disengaged. An infusion of bread containing no carbonate of magnesia, on being treated with carbonate of ammonia gave no precipitate. A half pint of such an infusion after being evaporated to dryness, and heated to redness for some time, yielded a little white substance, which appeared to have undergone fusion. It was soluble in water, gave no precipitate with the carbonates of potash and ammonia, but a copious one with nitrate and nitrate of barytes, and was merely the common salt used in the bread.

The foregoing experiments appear to sanction the conclusion, that when the carbonate of magnesia is mixed in certain quantities with the new flour, the magnesia acts chemically on the bread in the act of baking. One portion of it is decomposed by the acetic acid formed: the other part remains in its original state. The disengagement of the carbonic acid gas from the decomposed carbonate, may perhaps tend to increase the lightness and porosity of the bread.

As the new flour appears to contain an excess of gluten, a very tenacious substance, (on account of a portion of the farina of the wheat having been converted into saccharine matter,) the undecompounded carbonate in the bread may exert a mechanical agency on the gluten in the dough; and by lessening its cohesive property,

property, it may improve the texture of the bread, in a manner somewhat analogous to the improvement of stiff clay soils by the mechanical agency of sand or gravel.

Bread made from the new flour with the addition of carbonate of magnesia is much lighter and more porous than when made without it. I have at different times made loaves with and without the magnesia, using equal weights of the materials, and I have always found the magnesian loaves of much larger size. And I may further add (*cæteris paribus*), not only is the relative bulk of the bread increased by the use of magnesia; its actual weight is likewise greater. Magnesia appears to give to the new flour a greater capacity for water. For example: seventeen ounces of new seconds, containing forty grains of magnesia, required eleven ounces of water at the temperature of 80° Fahr. to make it into dough; but ten ounces at the same heat were sufficient for sixteen ounces of the flour. There was also a proportional increase in the weight of the bread. The loaf with magnesia (after making the necessary allowances) weighed 200 grains more than the one without it. Carbonate of magnesia, by giving bread the power of fixing an additional quantity of volatile materials, seems to act not unlike chalks or marles, when applied on a sandstone or gravelly soil; they increase its power of absorbing and retaining moisture.

The facts I have stated must, I should think, tend to obviate any objection against the use of small quantities of magnesia in bread, from the fear of its accumulation in the system, on account of its supposed insolubility. As cold water readily dissolves the new magnesian salt formed in the bread, the fluids of the stomach, it may be presumed, will be much more effectual solvents of that substance.

There is one circumstance that deserves mention, and with the notice of which I shall close the present communication. I think I have ascertained the existence of the prussic acid in bread made from the new flour*. My opinion rests on the fact, that in the preceding experiments, when the strong sulphuric acid was added to infusions of the bread evaporated to dryness, or nearly so, the peculiar peach-blossom odour of the prussic acid became more or less perceptible on a gentle application of heat. I do not conceive the appearance of this acid can be referred to any changes effected in the vegetable matter by the agency of the sulphuric acid, as the prussic odour was clearly perceived in cases when the sulphuric acid was in a very diluted state.

* From an experiment I made with bread made from good old flour, I am inclined to believe it also contained the prussic acid, but in much smaller quantity than the bread from new flour.

Should further experiments confirm the existence of the prussic acid in bread made from the new flour, the fact would in some measure serve to account for the injurious effects that have been attributed to it, especially when freely used by children.

Cork, Jan. 20, 1817. EDMUND DAVY.

XLI. *On alloying Iron with Manganese.* By DAVID MUSHET, *Esq. of Coleford, Forest of Dean.*

To Mr. Tilloch.

DEAR SIR,—THE general result of my two last communications showed that there existed a difficulty in combining to any considerable amount the metal of manganese with that of iron, either by the fusion of cast-iron with the ore of manganese, or by the fusion of the ores of both metals. Nothing favourable to a practical result in the blast-furnace could be inferred, particularly if it were necessary to unite manganese to the extent of 20 or 30 per cent. with the metal of iron for any particular object of manufacture. It was however remarked, that while the metallic results or buttons were obedient to the magnet, some minute spherules of metal were obtained, over which it had no influence. I therefore concluded that the difficulty arose from a defective mode of operation, and that those circumstances necessary to produce de-oxidation and reduction in ores of iron were not sufficient to produce a similar effect when an ore of manganese was operated upon. In the blast-furnace as well as in the assay-furnace previous de-oxidation is necessary to metallic reduction. In the former this is completely effected by a process of cementation which takes place in the upper regions of the furnace. In the latter, the fusion being more rapid, the effect is generally produced by the presence of a quantity of carbonaceous matter in the mixture. If the crucible is formed of a mixture of clay and this latter substance, the fusion will admit of a more rapid progress, and the oxidation and reduction will be more completely effected. Hence in the reduction of ores of iron in crucibles formed of clay and blacklead, metallic masses of iron may be obtained so highly saturated with carburet of iron as to destroy metallic weight and compactness: under such circumstances the most perfect de-oxidation takes place; no vestige of iron remains unrevived, or the slightest trace of its oxide in the glass. Considering the use of such crucibles favourable to the reduction of manganese, I determined on attempting the alloy of this metal with iron to a greater extent than