## LETTERS TO THE EDITORS

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## The Flavour of Porridge

NOWADAYS, porridge is often insipid and lacking in its traditional flavour and aroma. Possibly one reason for this is that, in England at least, sugar is usually added, and the sweetish taste, while it does not mask any true porridge flavour, is sufficient for most people. In Scotland, on the other hand, the majority add salt—precisely why, despite many inquiries, we have been unable to ascertain—so that the porridge flavour is more important. In any event there is a traditional flavour, often described as 'nutty', associated with Scotch porridge, and it is the view of many that if this flavour were more general the consumption of porridge would increase.

Any flavour in porridge meal or flakes is developed during the initial kilning process. This is not a standard operation. The whole oats are dried down from a moisture content in the range 14-20 per cent (but usually about 17 per cent) to a final moisture content of 4–8 per cent, after which they are shelled and ground into meal. The source of heat may be coke or anthracite, and in the past oat husk was often thrown on the fire presumably with the object of producing some volatile product which then gave the kilned oat its flavour. The conditions of heating are not, however, constant as from one kiln to another, or in one operation within a single kiln. Broadly speaking, if the kilning is carried out at low temperatures (not exceeding about 80° C.) the resulting meal or flakes have no distinctive taste, whereas if the temperature is sufficiently high the meal will have a caramel-like bitterness or even a burnt flavour.

As part of a programme of research for the Oatmeal Millers of England and Scotland, we are investigating the physics of kilning, and inevitably we have also considered the problem of flavour. The full results will be published elsewhere; but meanwhile it is of interest to record that we have consistently produced the desirable porridge flavour by careful control of the conditions of kilning. The furnace gases, despite traditional belief, play no part, and the same flavour is obtained when the air is heated in an electric furnace. The optimum conditions correspond to the gentle drying of the oats down to an intermediate moisture content of about 8 per cent followed by a short toasting for twenty minutes in a current of air at 150° C. These conditions are, of course, not absolutely rigid, and a slight increase in the temperature can be compensated by a corresponding decrease in the time of toasting. The use of high air temperatures at the surface of the partly dried grain to obtain a short but severe heat treatment at the final stage of kilning is the essential feature. On crushing the grain the pleasant aroma is immediately apparent. It soon evaporates from exposed meal; but the flavour is associated with less volatile material and accordingly more persistent.

The work of Baker, Parker and Fortmann<sup>1</sup> has indicated that the aroma and flavour of bread are due largely to numerous organic substances produced in the crust at temperatures around 150°C. The substances thus produced range from the more volatile aldehydes like furfural and pyruvic aldehyde to the melanoidins associated with the browning reactions occurring in the crust. Similar reactions will occur in the kilning of oats, since the outer portions of the grain reach about the same temperature and also undergo slight browning. However, there would appear to be other substances produced which are responsible for the unique flavour of oatmeal. Thus, in laboratory tests we have found that the optimum conditions of heating to produce flavour in oats also apply to groats, albeit there is less tolerance to overtreatment and a tendency for a slight rancid flavour to be produced due to the absence of the protective husk. On the other hand, we have failed to produce the same characteristic nutty oatmeal flavour in wheat when it is submitted to similar treatment.

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<sup>1</sup> Baker, J. C., Parker, H. K., and Fortmann, K. L., Cereal Chem., 30, 22 (1953).

## Sweetness and Configuration in Rhamnose

The ordinary form of most reducing sugars, such as  $\alpha$ -glucose,  $\beta$ -fructose and  $\alpha$ -galactose, becomes gradually less sweet after dissolution, and in the meantime the sweetness reaches a constant value, since the ordinary form is converted in part into the less sweet isomer, and finally an equilibrium is attained between the two isomers :  $\alpha \rightleftharpoons \beta$ .

Several years ago, one of us<sup>1</sup> pointed out that the sweeter form of these reducing sugars always has cis-hydroxyl groups on the carbonyl and adjacent carbon atom, while in the less sweet isomer the hydroxyls on the two carbon atoms are trans; this was confirmed<sup>1,2</sup> by isolating and testing the  $\alpha$ - and  $\beta$ -anomers with respect to sweetness.

From this rule it would be expected that in L-rhamnose the ordinary form (I) would be less sweet than the  $\beta$ -form (II), because the hydroxyls on C<sub>1</sub> and C<sub>2</sub> of the latter are *cis*. It has now been found that this is so.



Three tasters compared the sweetness of a 4.29 per cent (calc. as anhydrous) solution of  $\alpha$ -L-rhamnose  $([\alpha]_{D}^{23} - 13^{\circ} \rightarrow + 8.6^{\circ})$  with that of a 3.86 per cent solution of  $\beta$ -L-rhamnose  $([\alpha]_{D}^{23} + 41^{\circ} \rightarrow + 8.8^{\circ})$ . Immediately after dissolution the  $\beta$ -rhamnose solution was, in spite of its lower concentration, much sweeter than the  $\alpha$ -rhamnose solution; but with time the sweetness of the two solutions became closer, and after the lapse of fifteen minutes they were found equal in sweetness. After a further interval, the positions were reversed, the latter being distinctly sweeter than