Communication to the Editor
Involvement of Sulfhydryl Peptides in the Improver Reaction

Dear Sir:

The term "improver effect" or "improver reaction" is used to denote the remarkable changes in dough properties caused by the addition of oxidizing reagents (improvers). Chemists have long sought the explanation of the improver effect, but little is known about the phenomenon other than that sulfhydryl (SH) groups are involved.

Studies in this laboratory have shown that several low-molecular-weight (MW) peptides in wheat flour react with improvers. The direct involvement in flour of low-MW SH peptides in the improver reaction is readily seen by observing the reactions of flour extracts with the improver reagent iodoacetic acid. This is illustrated in Fig. 1, which shows an ion-exchange chromatographic analysis combined with simultaneous radioactivity monitoring (1) of a water-extract prepared from a slurry obtained by adding flour to an iodoacetic acid-2-^{14}C solution. Five radioactive peaks, I, II, III, IV, and V, are shown in Fig. 1. Peaks I and II are due to

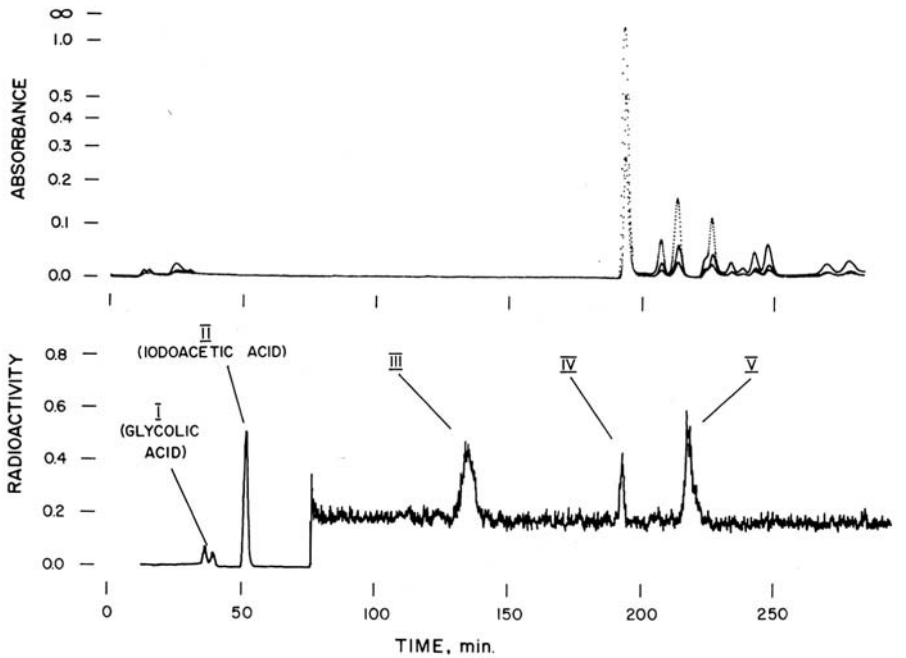

Fig. 1. Ion-exchange chromatographic analysis of a flour extract prepared from flour treated with iodoacetic acid-2-^{14}C solution. The ninhydrin-positive profile (upper curve) and the radioactivity profile (lower curve) were obtained by analyzing a sample equivalent to 0.33 g. flour. The rise in the base line for the radioactivity curve at 80 min. is due to a change to a higher sensitivity on the radioactivity monitor.

glycolic acid-2-^{14}C (a hydrolysis product of iodoacetic acid-2-^{14}C) and excess unreacted iodoacetic acid-2-^{14}C. Peaks III and V have been identified as S-carboxymethyl-2-^{14}C derivatives of glutathione and cysteinylglycine. Peak IV has

not yet been identified. Previous (unpublished) work had shown that the highest concentration of the SH peptides was found in wheat germ, and it was from this source that the two peptides, cysteinylglycine and glutathione, were isolated and identified. During this work cysteinylglycine was isolated from a natural source for the first time; glutathione has been found previously in many substances, including wheat germ (2).

Additional evidence for the reaction of low-MW SH peptides with improvers was shown by analysis of an extract prepared from a mixture obtained by adding iodoacetic acid-2-^{14}C to a slurry of flour and potassium iodate solution. The results from an analysis of this extract are shown in Fig. 2 and it is seen that, besides a

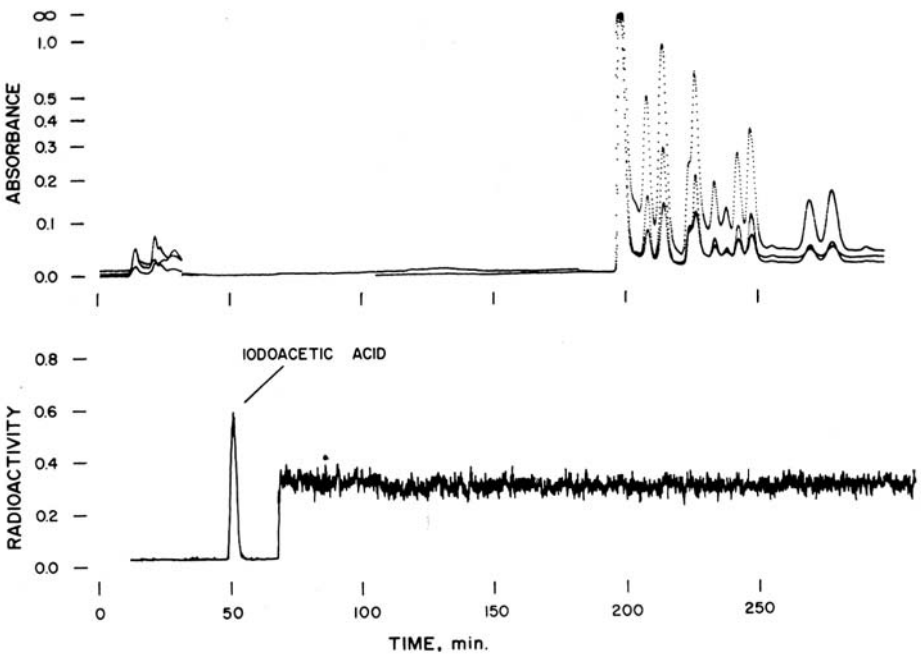

Fig. 2. Chromatographic analysis of a flour extract prepared from flour treated first with potassium iodate solution and then with iodoacetic acid-2-^{14}C solution. The ninhydrin-positive profile (upper curve) and radioactivity profile (lower curve) were obtained by analyzing a sample equivalent to 2.0 g. of flour.

peak due to unreacted iodoacetic acid-2-^{14}C, no other radioactive peaks are present. These results indicate that potassium iodate has reacted with the SH peptides, making the peptides unavailable for reaction with iodoacetic acid-2-^{14}C.

The involvement of low-MW (and therefore very mobile) SH peptides in dough chemistry affords convenient SH entities for the SH/S–S interchange theory that is often proposed as operating in dough. Hitherto, suggestions that protein SH is involved in SH/S–S interchange have not always been plausible because of the immobile nature of many of the proteins in dough.

It is also interesting that the total amount of SH peptides which react with iodoacetic acid-2-^{14}C in flour is approximately 0.1 micromole per g. protein (N X 5.7), and that the maximum beneficial improving effect on bread baked from

dough treated with iodoacetic acid is obtained by addition of approximately 0.1 to 0.2 micromoles iodoacetic acid per g. protein. (The latter finding is in good agreement with the report by Sullivan (3) that approximately 0.2 to 0.4 micromoles iodoacetate per g. protein produces a beneficial effect in dough.) These observations suggest that the beneficial effects of improvers in bread may be due to their reactions with low-MW SH peptides; however, further work (which is in progress) is necessary to substantiate this claim.

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Literature Cited

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