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ASCORBIC ACID AND AN OXIDIZING AGENT IN CONTINUOUS BREAD PROCESS

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This application is a continuation-in-part application of our application, U.S. Serial No. 402,346, filed October 7, 1964, and now abandoned.

The present invention relates to the use of the ascorbic acid isomers (l-ascorbic acid and d-araboascorbic acid) to reduce the mixing speed requirements of a dough in the production of bread, buns, and similar yeast leavened bakery products by the continuous dough process. In this disclosure the generic term ascorbic acid will be used to cover both isomers when specific identification of a given isomer is not necessary to properly disclose the invention since we have found the two isomers to be substantially equivalent in reducing dough mixing requirements in the continuous dough process.

The continuous dough process employing machinery manufactured by Wallace & Tiernan, Inc. and American Machine and Foundry Company is being widely used in the U.S.A. for the production of white pan bread, a general description of such processes being found in Chapter 17 of Bakery Technology and Engineering (1960), edited by Samuel A. Matz. It has been estimated 25% to 30% of the white pan bread made in 1964, and that over 30% of the white pan bread will be made in 1965 by the continuous dough process. The chief attraction of this process is the lower operating cost compared to other conventional processes. The savings are achieved by rapid dough development so that over 7,000 loaves per hour can be produced with a standard compact machine.

The flour used in the continuous dough process must be capable of forming a dough very rapidly with a minimal mixing speed requirement. Millers are constantly experimenting with blends of spring, winter, and soft wheat flours to produce a satisfactory dough; but many doughs require such a high mixing speed that optimum production rates cannot be maintained, and the baker's cost of production consequently increases. Various expedients have been tried to reduce the mixing speed requirement of flours with only partial success. One approach is to maintain a high level of acidity in the fermented broth which is used to leaven the dough. For example lactic acid, acetic acid and monocalcium phosphates are frequently added to the fermented broth to reduce the mixing speed requirement of a given flour. However, even at relatively high levels such acids conventionally used are not very effective in reducing the required mixing speed, and at high levels such acids have a deleterious effect on the bread quality. Frequently the broth is fermented for several hours to produce a high level of fermentation acids such as lactic, acetic, malic, and tartaric. Cysteine is also used to reduce dough mixing requirements.

We found that l-ascorbic acid (vitamin C) or d-araboascorbic acid exert a wholly unexpected effect on the mixing speed requirement of a wide variety of flours. Even at the very low level of 10 p.p.m. (based on the flour), these ascorbic acid isomers reduce the mixing speed requirement of a given flour by about 10%. The unexpected nature of this effect is emphasized by the fact that when lactic acid or other fermentation acids are used at over three times this level, they have no

significant effect on the mixing speed requirement of a given flour.

Accordingly, we have discovered that the use of ascorbic acid in amounts ranging from 10 to 200 p.p.m. or more results in a marked reduction in the mixing speed requirements of continuous process doughs. The use of l-ascorbic acid as a flour and bread improver has been known for many years. Jorgenson obtained U.S. Patent 2,149,687 on March 7, 1939, covering the use of l-ascorbic acid in amounts up to 50 p.p.m. as a flour and bread improver in conventional (non-continuous) dough processes. His work, as well as that of others, revealed the improving effect of l-ascorbic acid as similar to that of potassium bromate in increasing loaf volume and in improving the internal characteristics of the loaf by producing a finer grain than loaves made from an untreated control flour. It is generally agreed today that this improving effect of l-ascorbic acid is oxidative in effect through dehydroascorbic acid which is produced in doughs from ascorbic acid by enzymic oxidation. On the other hand d-araboascorbic acid does not show an improving effect in conventional (non-continuous) dough processes, presumably since it is not oxidized to dehydroascorbic acid in the dough by enzymic action. This was shown by Feaster and Cathcart, Cereal Chemistry, volume 18, page 201, March 1941.

In our studies of the effect of ascorbic acid upon the dough and the bread produced by the continuous dough process, we found effects markedly different from the effect produced by potassium bromate. We discovered that in using levels of ascorbic acid of 10 to 200 p.p.m. that a very significant decrease in mixing speed requirements for continuous dough processes was effected without lowering the score of the produced bread below normally commercially acceptable levels; and that at higher levels the mixing speed requirements for such processes are reduced even though for some flours the bread score falls below normally commercially accepted levels. This effect is not due to oxidation of dough constituents by ascorbic acid since it is not produced by known oxidizing agents such as potassium bromate and potassium iodate. The effect appears to be due to the ability of ascorbic acid to act as a reducing agent under certain conditions. However, when ascorbic acid is used as a replacement for potassium bromate or potassium iodate in continuous dough processes, bread having inferior internal characteristics is produced. It is only when ascorbic acid is used in combination with known edible oxidizing agents such as potassium bromate and potassium iodate that its effect of reducing the mixing speed requirement of dough can be realized while producing bread of acceptable quality. This is the novel and unexpected feature of the phenomena we have discovered.

A specific object of this invention is to provide a variety of flours for continuous dough applications which contain added ascorbic acid at a level of 10 to 200 p.p.m. to provide flours with minimal mixing speed requirements.

It is a further object of this invention to provide for reducing the mixing speed requirement of a given flour through the addition of ascorbic acid to the flour, to the fermentation broth or oxidant solution used in the continuous dough process at about 10 p.p.m. and above.

Other and further objects are those inherent in the invention herein illustrated, described and claimed, and will be apparent as the description proceeds.

To the accomplishment of the foregoing and related ends, this invention then comprises the features hereinafter fully described and particularly pointed out in the claims, the following description setting forth in detail certain illustrative embodiments of the invention, these