

COMMUNICATION TO THE EDITOR

Semisynthetic Model System for Study of Browning during Baking

DEAR SIR:

Most of the model systems of sugars and amino acids described in literature were studied in an aqueous medium. Several reports deal with browning of dry mixtures of proteins and reducing sugars (1,2) or of amino acids and reducing sugars (3). Studies were made by Stenberg and Geddes (4) on browning in buffered starch suspensions containing various bread ingredients and stored for up to 25 days at 75°C. Rothe and Voigt (5) attempted to duplicate baking conditions by heating sand coated with amino acids and xylose, at 130°C. The authors had previously reported on the effects of various sugars on browning of cookies (6), and on effects of sugars and certain free amino acids on bread characteristics (7). A number of components present in wheat flour and unrelated to its nitrogenous or free sugar moieties might accelerate or inhibit browning (8).

This communication reports studies of the effects of sugars and free amino acids on browning of a dough prepared and baked under conditions simulating breadmaking but substituting a starch mixture for the wheat flour used previously. The basic dough contained 20 g. commercial pregelatinized wheat starch, 80 g. native wheat starch, 2 g. sucrose, 1.5 g. salt, 3 g. shortening, 2 g. yeast, and optimum amount of water from the standpoint of mechanical handling properties (about 72 ml.). The dough was mixed, punched, and panned in the usual manner. Fermentation was for 3 hr. at 30°C. Baking time was 24 min. at 218°. Crust color was measured with a Photovolt Reflectometer,¹ Model 610, equipped with a green filter; the higher the reading, the less the color. Results reported are averages of three measurements, each from two bakes, rounded to the nearest 0.5 unit.

Results obtained are summarized in Table I. Crust colors of the

TABLE I
CRUST COLOR OF STARCH DOUGHS BAKED WITH EQUIMOLAR CONCENTRATIONS OF
AMINO ACIDS AND SUGARS ADDED TO THE BASIC FORMULA

SUGAR	SUGAR LEVEL	AMINO ACID	AMINO ACID LEVEL	TOP CRUST COLOR
	g.		g.	
Basic formula	0	none	0	58.0
Arabinose	1.67	none	0	43.5***
Sucrose	2.00	none	0	60.0
Galactose	2.00	none	0	58.0
Arabinose	1.67	glycine	0.200	48.0***
Arabinose	1.67	lysine	0.486	45.0***
Arabinose	1.67	glutamic acid	0.489	50.0***
Sucrose	2.00	glycine	0.200	57.5
Sucrose	2.00	lysine	0.486	57.5
Sucrose	2.00	glutamic acid	0.489	61.0
Galactose	2.00	glycine	0.200	53.5*
Galactose	2.00	lysine	0.486	53.0**
Galactose	2.00	glutamic acid	0.489	56.5
None	0	glycine	0.200	59.0
None	0	lysine	0.486	58.0
None	0	glutamic acid	0.489	60.0

starch doughs baked with arabinose alone or arabinose-amino acid mixtures, or galactose and lysine or glycine, were significantly darker than crust colors of starch doughs baked with sucrose alone, with amino acids alone, with sucrose-amino acid mixtures, or without amino acid and sugar. The least significant difference at the 5% level was 3.51, at the 1% level 4.92, and at the 0.1% level 6.95.

¹Mention of firm or trade product does not imply its endorsement by the U.S. Department of Agriculture over similar products or companies not named.

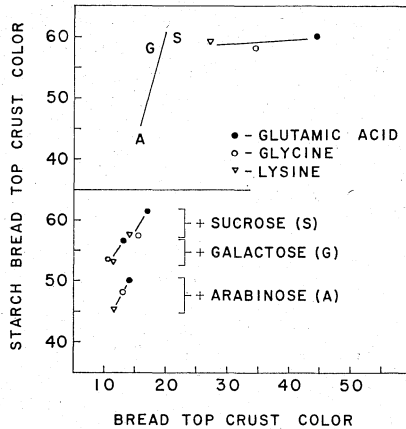


Fig. 1. Comparison of top crust color of wheat flour bread and starch bread baked with equimolar concentrations of amino acids and sugars added singly (upper) and in combination (lower) to the basic formula. The greater the reflectometer reading, the less the color.

Figure 1 compares top crust color of baked starch doughs with previously reported (7) bread crust color. The crust color of bread was consistently darker than the color of baked starch doughs. The three amino acids did not differ in their effect on crust color of baked starch doughs but differed materially in their effect on crust color of baked wheat flour doughs. This difference seems to result not from the browning effect of the amino acids alone, but from the interaction between amino acids added and available sugars or other compounds present in flour but not in starch.

Sucrose, galactose, and arabinose differed materially more in their effects on the top crust color of starch bread than on that of wheat flour bread. The effects of mixtures of amino acids and sugars on crust color are similar to those of the sugars alone, and both are better differentiated in starch bread than in wheat flour bread.

It would seem, therefore, that the starch dough system enables one to evaluate the effects of amino acids on crust browning, independently of sugars or other compounds present in wheat flour.

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