Dough Properties and Proof Times of Yeasted Doughs Affected by Surfactants[1]

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ABSTRACT

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Surfactants used to study effects on dough properties and proof times of yeasted doughs included diacetyl tartaric acid esters of monoglycerides and diglycerides (DATA), sodium stearoyl-2-lactylate (SSL), calcium stearoyl-2-lactylate (CSL), succinylated monoglycerides, monoglycerides, sucrose monopalmitate, polysorbate 60 (Poly-60), and ethoxylated monoglycerides (EMG). Absorption did not differ markedly among the dough samples containing 0.5% of any of the eight surfactants studied. However, SSL, CSL, or EMG delayed developing time, and SSL, CSL, or DATA increased stability. The other surfactants had only minor effects on developing time and stability. When a yeasted dough, processed by either a straight-dough or sponge-dough method, was proofed in a baking pan placed in a fermentation cabinet, proof times varied with different surfactants: DATA, SSL, and CSL shortened whereas sucrose monopalmitate, Poly-60, and EMG prolonged proof time. Such effects of surfactants were also observed on the gassing power of yeast with flour-water doughs: DATA, SSL, and CSL promoted and Poly-60 and EMG inhibited gas production significantly.

We have studied the use of various surfactants in bakery foods, especially in protein-enriched products to alleviate the adverse effects of supplements such as soy flour (Tsen 1978; Tsen and Hoover 1973; Tsen and Tang 1971; Tsen et al 1971, 1975). During those studies, we have observed differences in proof times of doughs containing different surfactants, whether the doughs were processed by a straight-dough or a sponge-dough method. The observation prompted us to study the effects of commonly used surfactants on proof times of doughs processed by the above two methods. In this study, we substantiated and explained the observations by studying the surfactants' effects on farinograms and on the gas production of yeasted flour-water doughs.

MATERIALS AND METHODS

Flour

The flour was milled in the pilot mill of the Department of Grain Science and Industry, Kansas State University, from a composite of hard red winter wheats grown in 1978. It contained 12.8% moisture, 11.5% protein (N × 5.7), 0.40% ash, and 1.0% fat, determined by AACC methods 44-15A, 46-11, 08-01, and 30-25, respectively.

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Surfactants

Surfactants were diacetyl tartaric acid (DATA) ester of monoglycerides and diglycerides (Panodan AB 90) from Grindsted Products, Inc., Kansas City, MO; sodium stearoyl-2-lactylate (SSL), calcium stearoyl-2-lactylate (CSL), and ethoxylated monoglycerides (EMG) from the C. J. Patterson Co., Kansas City, MO; monoglycerides (MG) and succinylated monoglycerides (SMG) from the Eastman Chemical Co., Kingsport, TN; polysorbate 60 (Poly-60) from ICI Americas Inc., Wilmington, DE; and sucrose monopalmitate (SMP) from the Dai-Nippon Sugar Mfg. Co., Tokyo, Japan. The required amount (0.5% of flour weight) was suspended in water at 55°C before use.

Yeast

Fresh yeast (compressed) was supplied weekly by Universal Foods Corp., Milwaukee, WI.

Farinograms

Farinograms were obtained by the constant-dough weight method (AACC method 54-21) with 50 g of sample.

Proof-Time Measurements

Dough samples were formulated according to the ingredients listed in a modified straight-dough method (Tsen and Tang 1971) without soy flour added and in a modified sponge-dough method (Tsen et al 1971), with 0.5% SSL or other surfactant added in both methods. Absorptions of the yeasted doughs treated with a given surfactant at the 0.5% level were estimated from their respective farinograph absorptions plus 4% additional water. Dough samples were mixed optimally and processed by the two methods. They were proofed to 1.5 cm above the standard one-pound loaf pan in a

TABLE I
Farinogram Properties of Doughs Containing 0.5% Surfactant

Surfactant[a]	Absorption (%)	Developing Time (min)	Stability (min)
Control	60.4	8.50	14.40
DATA	59.8	8.75	18.40
SSL	60.6	15.75	36.25
CSL	60.4	12.50	31.40
SMG	61.2	7.25	15.60
MG	61.0	7.00	14.80
SMP	62.4	9.00	14.30
Poly-60	61.2	7.25	16.25
EMG	61.6	11.25	14.60

[a] DATA = diacetyl tartaric acid ester of monoglycerides and diglycerides, SSL = sodium stearoyl-2-lactylate, CSL = calcium stearoyl-2-lactylate, SMG = succinylated monoglycerides, MG = monoglycerides, SMP = sucrose monopalmitate, Poly-60 = polysorbate 60, EMG = ethoxylated monoglycerides.

fermentation cabinet at 92% rh and at 36.5° C for straight-dough samples and 37.8° C for sponge-dough samples.

Gassing Power

Gassing power was determined by the pressure-meter method (AACC method 22-11) for a diastatic activity of flour-water dough or of a Difco dextrose broth medium (1 g/33 ml).

RESULTS AND DISCUSSION

Effect of Surfactants on Dough Properties

The effects of surfactants on dough farinograms are shown in Table I. Absorption did not differ markedly among the eight surfactants studied. However, SSL, CSL, or EMG delayed developing time. Dough stability was increased most by SSL and CSL and next by DATA and Poly-60. The other surfactants had relatively little effect on either developing time or dough stability.

Effects of Surfactants on Proof Times

Proof times of yeasted doughs containing the different surfactants varied significantly (Table II). DATA, SSL, and CSL significantly shortened proof time for yeasted dough processed by either the straight-dough or the sponge-dough method. On the other hand, SMP, Poly-60, and EMG prolonged proof time. The prolonged effect was significant with SMP for the doughs processed by the straight-dough method and with Poly-60 and EMG for the doughs processed by the sponge-dough method. SMG and MG did not significantly affect proof times of doughs processed by either method.

Effects of Surfactants on Gas Production

Table III shows the gas production in millimeters of Hg at the fifth hour of fermentation for yeasted flour-water doughs containing the various surfactants. DATA, SSL, and CSL promoted and Poly-60 and EMG inhibited gas production significantly. Increased gas production for flour-water doughs containing DATA, SSL, and CSL may be responsible for the shortened proof times of similar doughs processed by the straight-dough or sponge-dough methods (Table II).

When wheat flour was replaced by a medium of dextrose broth, gas production by surfactants showed no marked differences (results not shown). This suggested that gas production was not directly affected by surfactants but was indirectly affected by some complex interactions among flour components and surfactants. Among the eight surfactants studied, three (DATA, SSL, and CSL) increased dough stability (Table I), shortened proof times (Table II), and accelerated gas production (Table III). Although the exact mode of action is not clearly understood, these combined effects of the three surfactants might be due, at least in part, to their similar abilities to interact with components of wheat flour to give dough a better structure with which to form gas cells and to retain gas for expansion.

TABLE II
Proof Times of Yeasted Dough Containing 0.5% Surfactant Processed by Straight-Dough and Sponge-Dough Methods

Surfactant[a]	Mean Proof Time (min)[b] Straight-Dough	Sponge-Dough
Control	64.3 bc	68.1 cd
DATA	58.6 d	61.1 e
SSL	58.3 d	59.7 e
CSL	59.3 d	59.7 e
SMG	62.8 c	69.2 bcd
MG	63.5 bc	67.5 d
SMP	67.6 a	71.0 c
Poly-60	66.2 ab	71.8 b
EMG	65.7 abc	76.4 a

[a] DATA = diacetyl tartaric acid ester of monoglycerides and diglycerides, SSL = sodium stearoyl-2-lactylate, CSL = calcium stearoyl-2-lactylate, SMG = succinylated monoglycerides, MG = monoglycerides, SMP = sucrose monopalmitate, Poly-60 = polysorbate 60, EMG = ethoxylated monoglycerides.

[b] Mean of three observations. Means followed by the same letter under each column do not differ significantly ($P<0.05$) by Duncan's multiple range test.

TABLE III
Gas Production of Yeasted Flour-Water Doughs Containing 0.5% Surfactant

Surfactant[a]	Mean Gas Pressure[b] (mm)
Control	443 c
DATA	477 a
SSL	467 ab
CSL	467 ab
SMG	455 bc
MG	435 c
SMP	435 c
Poly-60	415 d
EMG	398 d

[a] DATA = diacetyl tartaric acid ester of monoglycerides and dialycerides, SSL = sodium stearoyl-2-lactylate, CSL = calcium stearoyl-2-lactylate, SMG = succinylated monoglycerides, MG = monoglycerides, SMP = sucrose monopalmitate, Poly-60 = polysorbate 60, EMG = ethoxylated monoglycerides.

[b] Mean of three observations. Means followed by the same letter do not differ significantly ($P<0.05$).

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LITERATURE CITED

AMERICAN ASSOCIATION OF CEREAL CHEMISTS. 1962. Approved Methods of the AACC. Method 08-01, approved April 1961; Method 22-11, approved April 1961; Method 30-25, first approved April 1961, revised October 1976; Method 44-15A, first approved April 1967; Method 46-11, approved October 1976; and Method 54-21, approved April 1961. The Association: St. Paul, MN.

TSEN, C. C. 1978. Soy flour and protein used in bread and pasta products. Page 95 in: Proceedings of International Soya Protein Food Conference, Singapore. American Soybean Association: St. Louis, MO.

TSEN, C. C., FARRELL, E. P., HOOVER, W. J., and CROWLEY, P. R. 1975. Extruded soy products from whole and dehulled soybeans cooked at various temperatures for bread and cookie fortifications. Cereal Foods World 20:413.

TSEN, C. C., and HOOVER, W. J. 1973. High-protein bread from wheat flour fortified with full-fat soy flour. Cereal Chem. 50:7.

TSEN, C. C., HOOVER, W. J., and PHILLIPS, D. 1971. High-protein breads: Use of sodium stearoyl-2-lactylate and calcium stearoyl-2-lactylate in their production. Bakers Dig. 45(2):20.

TSEN, C. C., and TANG, R. T. 1971. K-State process for making high-protein breads. I. Soy flour bread. Bakers Dig. 45(5):26.

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