

Influence of rare sugar syrup on quality attributes of sour bread

(Received September 1, 2025)

(Accepted December 7, 2025)

Ha Chi Vu, Haoto Kawabe, Masahiro Ogawa

Department of Applied Biological and Rare Sugar Sciences, Graduate School of Agriculture, Kagawa University

Abstract

Rare sugar syrup (RSS), developed through alkaline isomerization of high-fructose corn syrup (HFCS), contains rare sugars such as D-allulose, which are associated with anti-obesity and anti-diabetic effects. This study investigated the effects of RSS on the physicochemical properties, fermentation behavior, staling rate, and volatile compound profile of sour bread, in comparison with breads made using sucrose (Suc) and without added sugar (Blk). The addition of 5°Bx RSS resulted in a greater loaf volume compared with the 5°Bx Suc and Blk samples, likely due to improved gas retention capacity. Volatile compound analysis showed moderate concentrations of alcohols and higher levels of esters, furans, and alkadienes, reflecting the distinct flavor and aroma of RSS-bread compared to the others. RSS-bread exhibited a significantly lower staling rate and retained a softer texture during storage at 25 °C. Furthermore, RSS-bread demonstrated the most effective mold growth suppression, extending storage period to 17 ± 5 days, compared with 6 ± 0 days for Blk-bread and 7 ± 1 days for Suc-bread. These results suggest that RSS can serve as a functional sugar alternative in sour bread, enhancing shelf life and texture without compromising fermentation performance.

Keywords : sourdough fermentation, D-allulose, shelf life, lactic acid bacteria, yeast

I Introduction

The bread and bakery industry is a dynamic and ever-evolving sector that supplies food to millions of consumers on a daily basis. Bread, one of the oldest and most widely consumed foods globally, plays a central role in the human diet and holds significant cultural meaning in many regions¹⁾. As it is consumed daily by a vast number of people around the world, the bread and bakery industry has become a cornerstone of dietary habits and even an indispensable good in numerous countries. Within this vast industry, various types of bread have emerged, with sour bread gaining particular attention in recent years due to its traditional fermentation process and perceived health benefits.

Sour bread, also referred to as “fermented bread” or “wild-yeasted bread,” is made through a natural fermentation process that dates back thousands of years²⁾. This method involves combining flour and water and allowing the mixture to rest in a warm environment, where it undergoes spontaneous fermentation. Naturally occurring microorganisms, including

wild yeasts and lactic acid bacteria (LAB), which are present in the environment and in the flour (especially wheat and rye), begin to multiply and interact, eventually producing a sourdough starter. This starter serves as a natural leavening agent in bread-making, replacing commercial baker’s yeast. Compared to conventional bread that is typically leavened with baker’s yeast, sour bread is considered a healthier alternative. It is known for its distinctive tangy flavor, enhanced aroma, and chewy texture. Moreover, it is easier to digest due to the breakdown of gluten and phytic acid during fermentation, and it helps reduce the glycemic index by slowing the rate of starch digestion, primarily through the formation of organic acids that delay starch absorption^{3, 4)}. These characteristics have made sour bread especially appealing to health-conscious consumers and those with mild gluten sensitivity. The sourdough process is particularly important in rye bread production. Unlike wheat flour, rye flour contains little to no gluten, which means it cannot develop the same elastic network that traps gas and gives bread its airy texture. In rye dough, this function is instead performed by pentosans - complex polysaccharides