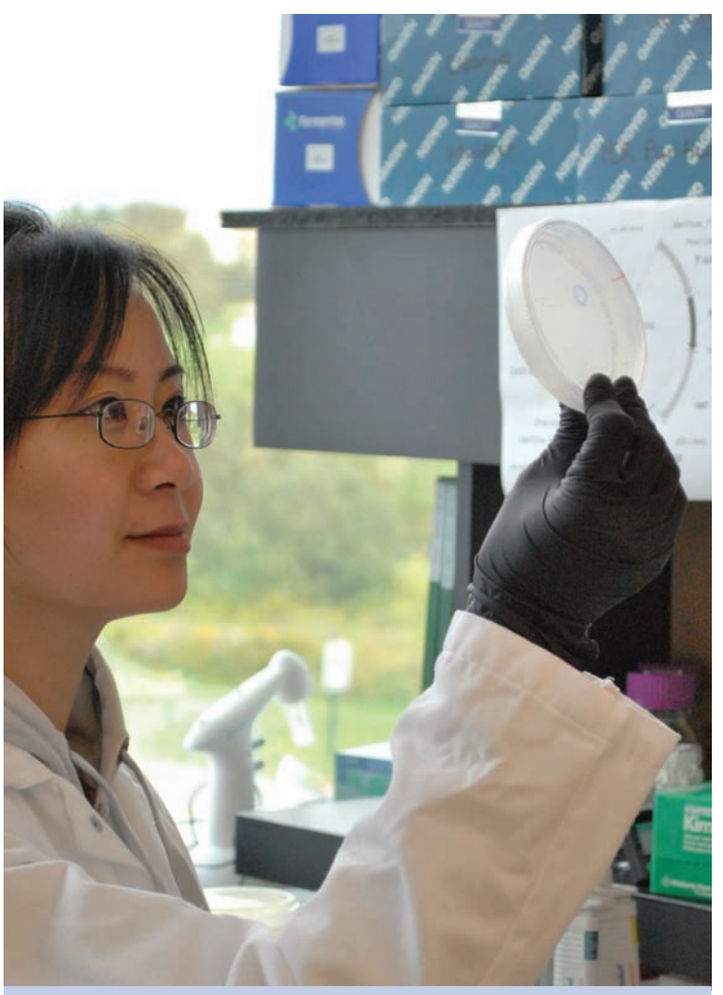
BAKERY

Reducing Acrylamide

Use baker's yeast to reduce acrylamide formation in food.

BY ALINE CHHUN, MOLECULAR BIOLOGY SUPERVISOR AND JOHN HUSNIK, SENIOR RESEARCH SCIENTIST, FUNCTIONAL TECHNOLOGIES CORP



One yeast strain was found to consume asparagine to undetectable levels after a four-hour test.

Acrylamide is a colorless and odorless chemical compound that was in the industry spotlight in 2002 when the Swedish National Food Administration and the University of Stockholm reported considerably high levels of this World Health Organisation (WHO) Group 2A carcinogen in commonly consumed food such as bread, coffee, potato chips, fries and infant food products. Prior to this discovery, acrylamide was commonly known as an industrial chemical used as an intermediate for polyacrylamide production.

Laboratory studies had provided clear evidence on carcinogenic and genotoxic effects of acrylamide and its metabolite glycidamide, although epidemiological studies on human exposure through food have not been clear. The review of the data has convinced numerous scientific committees and regulatory agencies worldwide that human exposure to acrylamide should be minimized. The substance was added to the State of California's Proposition 65 list of carcinogens in 1990. In March 2010, the European Chemical Agency added acrylamide to its list of substances of very high concern.

The formation of acrylamide in food occurs when amino acid asparagine and reducing sugars such as glucose or fructose are heated together above 120°C. Since asparagine is the limiting precursor for acrylamide and is present in carbohydrate-rich food such as grains and potatoes, reducing its content in food prior to heating will significantly reduce acrylamide levels.

Metabolizing asparagine

Many approaches have attempted to reduce acrylamide formation in food. However, no method has yet been accepted as the ideal solution due to drawbacks such as cost, impact on the organoleptic properties (such as taste, color, odor and feel) of food, and ineffective acrylamide reduction under typical food production/processing conditions. But yeast has been found to present a low-cost solution to the acrylamide problem.

Using the natural ability of baker's yeast to metabolize asparagine, Phyterra Yeast, a subsidiary of Functional Technologies Corp

R&D is being conducted to enable AR yeast to be applied to heat-treated food such as potato products, biscuits, crackers, and baked snacks.

developed bread yeast strains with enhanced asparagine degradation properties. Initial tests showed that these proprietary strains can rapidly reduce asparagine in media and food matrices, thereby dramatically limiting acrylamide formation after heating.

- **Research**

Various yeast strains belonging to Functional Technologies were tested for acrylamide-reducing (AR) capabilities. They were first screened in liquid media for their ability to take asparagine from the test media. Equal cell numbers of each strain were inoculated into separate test tubes containing yeast extract and glucose (YEG) broth that was spiked with 0.5 g/L of asparagine. An 'aliquot' was taken every hour, as asparagine concentration was determined using an enzymatic kit called Megazyme, K-ASNAM. Three of the AR strains showed enhanced asparagine degradation under the test conditions. In particular, one strain consumed asparagine to undetectable levels after four hours. In comparison, the commercial bread yeast strain reduced asparagine by only 11% in the same time period and test conditions.

After determining their ability to reduce asparagine in liquid media, the strains were tested in bread dough. Both the AR and commercial bread-yeast strains were cultivated simultaneously in two separate fermenters, and the cells were harvested the following day for dough and baking trials. Asparagine was added to the dough in order to monitor asparagine consumption using enzymatic analysis.

- **99% reduction in asparagine levels**

Once the AR yeast was mixed into the dough, the asparagine levels were found to decrease immediately. In contrast, there was no noticeable decline in asparagine using the control strain (data not shown). After the dough was formed, samples were taken every 30 minutes (from the time the yeast was added) to test for the level of asparagine concentration. This experiment was performed twice. After three hours, the AR strain was shown to reduce asparagine concentration in the dough by 99.2%. Conversely, the control strain reduced the asparagine by just 18.5%.

The dough from this experiment, which contained higher levels of asparagines, was also used to prepare a baked bread sample in order to determine the acrylamide concentration in the final product. Acrylamide results from this experiment, revealed that the AR baker's yeast strain produced bread with approximately 10 times less acrylamide than the control baker's yeast (under the same conditions tested). This result is consistent with the asparagine reduction found in the dough analysis.

Conclusion

To reduce acrylamide in food, manufacturers face the challenge of changing their processes and/or product parameters without compromising on the taste, texture and appearance of their products. In the latest bread trial, research chefs made various breads using the AR yeast and the commercial bread yeast control. The final products showed no difference in color, size or texture. Importantly, no changes were required in the baking process in order to achieve reductions in acrylamide formation in bread.

More work is underway to create more strains and to further enhance the performance of existing strains. The AR yeast technology is not limited to bread products, as R&D is being conducted to enable this technology to be applied to other types of heat-treated food such as potato products, biscuits, crackers, and baked snacks. ■