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Effectively Reducing Acrylamide by Maximizing Enzymatic Activity of Asparaginase in Applications with Lower Water Content

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Abstract

Consumers and manufacturers are increasingly focusing on food safety and eventual food safety incidents receive intense media attention. The formation of acrylamide in a variety of processed foods is part of this discussion and is a growing health concern. Generally, processed foods (like baked products, breakfast cereals, various snacks, and roasted products) are mentioned as products to watch closely. Acrylamide is formed when food is processed at high temperatures. Such processes include baking, frying, grilling, toasting and roasting, both in commercial-scale manufacturing of food products as well as in home cooking. Acrylamide formation is closely related to the desired browning effect; the Maillard reaction. This occurs between reducing sugars (such as glucose, fructose or lactose) and free amino acids. When the amino acid is free asparagine, a minor side-reaction occurs leading to the formation of acrylamide. Asparaginases are enzymes which are commonly added to food items to prevent the formation of acrylamide. Enzymes need time, specific temperature, substrate and a certain amount of water to be effective. Low water content applications like for instance biscuits, cookies, breakfast cereals and snacks represent an especially tough challenge.

DOE studies were carried out on asparaginases in rotary cookie dough compositions to measure detectable conversions between 10 and 90%. These compositions were carefully chosen to optimize reliability of the model to cover a relevant range of ingredients compromising flour, fat, sugar, water, sodium bicarbonate (SBC). Many recipes were compared to determine the maximum and minimum percentage of each ingredient that was found in real recipes. This resulted in a model that covered virtually all existing recipes. Enzyme activities in dough compositions are analysed by asparagine (substrate) and aspartic acid (product) concentrations (dose-response curves), Confocal Laser Scanning Microscopy (CLSM), Fluorescein isothiocyanate microscopy (FITC), pH, water activity, dough temperature, Analysis of variance (ANOVA)

Using analytical methods, like Fluorescein isothiocyanate microscopy and measuring asparagine and aspartic acid concentrations, a better understanding on enzymatic activity of asparaginases in low water content cookie dough can be made. Using this data will help in the selection of the right type of asparaginase for acrylamide reduction in more challenging applications.

PRESENTER BIOGRAPHY: KEES VEEKE

Kees Veeke is a Technical Service Manager for Baking & Confectionery at DSM Food & Beverage in the Netherlands. In his daily role, he works alongside R&D scientists, product developers and bakers to find new solutions for improving baked goods of all types – from reducing gluten, fats and acrylamide, to improving the taste, texture and shelf life of bread and baked products. Kees holds a Bachelor of Science degree in Food Technology from the College of Agrarian Technology Delft and has more than twenty years' experience in product development in the baking industry. Before joining DSM in 2009, he developed products for the B2B ingredient industry – with a focus on ingredients and solutions for bakery, cereal and snack products.