Glycomics and Lipidopics

Extended Abstract

Biotechnological method for decreasing hazardous compound (acrylamide) formation during phyto food product processing.

Othmani-Mecif K

Abstract:
Acrylamide is a toxicant and defined as a suspected human carcinogen by the International Agency for Research on Cancer. In 2002, a research group showed that acrylamide is found in a range of cooked foods, with the highest content range in carbohydrate-rich foods, 50-4000 µg Kg-1, and a range of 5-50 µg Kg-1 in protein-rich foods. The outcome of this review was that the main acrylamide containing food groups were identified as cereal-based products and potatobased products. Acrylamide in foods is formed in Maillard reaction pathway, which is a synthesis of asparagine, as an amino group, and a reducing sugar such as glucose and fructose. This reaction affects the development of flavor and color. This chemical reaction mainly occurs at high temperatures (>120°C) and low moisture conditions. Meanwhile, the relationship between these reactants and final product (acrylamide) is surprisingly complicated. Addition of the enzyme asparaginase, obtained from microbial sources has been reported as a method to reduce the formation of acrylamide since it results in the hydrolysis of asparagine to aspartic acid and ammonia. Acrylamide is a toxicant and defined as a suspected human carcinogen by the International Agency for Research on Cancer. In 2002, a research group showed that acrylamide is found in a range of cooked foods, with the highest content range in carbohydrate-rich foods, 50-4000 µg Kg^{-1}, and a range of 5-50 µg Kg^{-1} in protein-rich foods. The outcome of this review was that the main acrylamide containing food groups were identified as cereal-based products and potatobased products. Acrylamide in foods is formed in Maillard reaction pathway, which is a synthesis of asparagine, as an amino group, and a reducing sugar such as glucose and fructose. This reaction affects the development of flavor and color. This chemical reaction mainly occurs at high temperatures (>120°C) and low moisture condition. Meanwhile, the relationship between these reactants and final product (acrylamide) is surprisingly complicated. Addition of the enzyme asparaginase, obtained from microbial sources has been reported as a method to reduce the formation of acrylamide since it results in the hydrolysis of asparagine to aspartic acid and ammonia. Added asparaginase in bread making showed a reducing effect on acrylamide formation ($P \leq 0.0001$). Baking temperature significantly increased the acrylamide content in bread ($P \leq 0.0001$). A strong correlation was found between the baking temperature and acrylamide formation. Baking time and its interaction with asparaginase had a low but significant reducing effect on acrylamide content in bread ($P \leq 0.0001$). Three parameters: cooking temperature, cooking time and enzyme concentration(U Kg^{-1}) have been optimized using response surface methodology, their values obtained 245.71°C, 14.55 min and 752.15 U Kg^{-1}, respectively. Potato has high levels of acrylamide precursors; hence, at the presence of high temperatures acrylamide is generated. This toxic substance can have concentrations of even more than 4000 µg/kg in potato products. Further supports the finding that addition of the enzyme asparaginase is a method to reduce the formation of acrylamide since it results in the hydrolysis of the critical precursor (asparagine) for acrylamide formation in bread and potato products. The main aim is to compare the reduction of acrylamide in potato crisps using two kinds of asparaginase enzyme; the first enzyme is commercial but the second is an enzyme made from Candida utilize specifically for food treatment. Before frying, samples were treated in one of following ways: Washing in distilled water (control I); Blanching in hot water; Immersion in commercial asparaginase (asparaginase of Candida utilis) solution; Both blanching in hot water and immersion in commercial asparaginase (asparaginase of Candida utilis) solution; Blanching in hot water plus immersion in medium temperature water (control II). While commercial asparaginase reduces acrylamide formation by 39%, asparaginase obtained from Candida utilize makes a higher reduction of 58% in potato crisps. However, both enzymes in combination with blanching inhibit much higher amount of acrylamide formation. The maximum reduction of acrylamide is 95% caused by commercial treatment plus blanching. For conclusion, enzymatic process could be suggested as a safe and convenient method for preventing acrylamide formation in bread making and potato products processing.

Othmani-Mecif K
Laboratory of Cellular and Molecular Biology, Team of ECM Remodeling Biochemistry, Faculty of Biological Sciences, University of Sciences and Technology Houari Boumediene, Algiers, Algeria

Particularly Acrylamide cannot detect in unheated or boiled food. Acrylamide in meals may be shape at some point of excessive temperature cooking via numerous mechanisms, i.e. formation via acrylic acids, formation due to dehydration/ decarboxylation of natural acids WHO. A series of nonenzymatic reactions among free amino acids and reducing sugars that is accountable for the taste and color are generated at some points of baking . This will provide an explanation for the formation of acrylamide in cooked food wealthy in asparagine, e.g. in cereals and potatoes.

In reality, the awareness of decreasing sugars in meals the number one determinant of acrylamide formation in comparison to asparagine content. Then highest amount of acrylamide is present in fried, roasted, toasted, broiled and baked foods that have heated at a temperature more than 120 °C. In the next step, a chemical reaction happens called the "Maillard reaction" which involves sugar such as glucose, fructose, water, heat and asparagine content (amino acid). These mixtures cause the formation of acrylamide. Swedish studies in 2002 introduce high level of acrylamide produced during frying or baking of potato and cereal products. An essential associated reaction is the Strecker's degradation of amino acids by means of those intermediates where the amino acid decarboxylate and de-aminate to form an aldehyde. It was investigated whether this reaction provide a probable path to acrylamide. The amino acid, asparagine should be especially suitable reactant because it already has an amide group connected to a certain sequence of carbon atoms. They therefore performed a sequence of Maillard reactions between glucose and asparagine; in addition, they used different amino acids that do not have an appropriate carbon backbone for acrylamide. The large quantities of acrylamide (221mg per mole of amino acid) have discovered in equimolar mixture of asparagine and glucose that reacted at 185 °C in phosphate buffer in a sealed glass tube. Then temperature dependency of acrylamide formation from asparagine indicates that is favored above 100 °C and very high temperature is not important. In order to investigate the role of oxidation in acrylamide formation they studied the consequences of exogenous phenolic antioxidants extracted from cranberry and oregano from Maillard reaction in fried potato slices having the capacity of antioxidant pastime. The extensive study on acrylamide highlights it as a harmful chemical in animals and humans as in having its major effects being carcinogenic, genotoxin and neurotoxin along with its minor effects in reproduction. Its most common use in industries makes it a serious chemical of concern that is causing potential damage to humans and environment along with its hundreds of benefits. Children are a most common victim of acrylamide nowadays. Research on acrylamide showed that the reduction in the weight of newborn is due to the acrylamide food consumption by the pregnant women and is a key factor that points the future health of the baby. As in comparison to adult children, they consume twice the amount of acrylamide due to their small size and weight. According to a research survey the sudden deaths of patients with cancer were increased to 33% in between the year 2005 ad 2015. Research studies conducted on mice and rats showed that a long-term exposure or intake to acrylamide results in various types of cancers e.g. pancreatic, prostate, breast, ovarian, and endometrial cancer. In human and animals, acrylamide get metabolize to an epoxide metabolite called as Glycinamide (GA), by means of an enzyme referred to asCYP2E1 that leads to mutations and disrupts the DNA.

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