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Acrylamide Concentration in Cakes with Different Caloric Sweeteners

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Abstract : Acrylamide, a probable carcinogen, is formed in high-temperature processed food (>120ºC) when the free amino acid asparagine reacts with reducing sugars, mainly glucose and fructose. Cane juices' repeated heating would potentially form acrylamide during brown sugar production. This study aims to determine if using panela in yogurt cake preparation increases acrylamide formation. A secondary aim is to analyze the acrylamide concentration in four cake confections with different caloric sweetener ingredients: beet sugar (BS), cane sugar (CS), panela (P), and a panela and chocolate mix (PC). The doughs were obtained by combining ingredients in a planetary mixer. A model system made up of flour (25%), caloric sweeteners (25 %), eggs (23%), yogurt (15.7%), sunflower oil (9.4%), and brewer's yeast (2 %) was applied to BS, CS and P cakes. The ingredients of PC cakes varied: flour (21.5 %), panela chocolate (21.5 %), eggs (25.9 %), yogurt (18 %), sunflower oil (10.8 %), and brewer's yeast (2.3 %). The preparations were baked for 45' at 180 ºC. Moisture was estimated by AOAC. Protein was determined by the Kjeldahl method. Ash percentage was calculated by weight loss after pyrolysis (≈ 600 °C). Fat content was measured using liquid-solid extraction in hydrolyzed raw ingredients and final confections. Carbohydrates were determined by difference and total sugars by the Luff-Schoorl method, based on the iodometric determination of copper ions. Finally, acrylamide content was determined by LC-MS by the isocratic system (phase A: 97.5 % water with 0.1% formic acid; phase B: 2.5 % methanol), using a standard internal procedure. Statistical analysis was performed using SPSS v.23. One-way variance analysis determined differences between acrylamide content and compositional analysis, with caloric sweeteners as fixed effect. Significance levels were determined by applying Duncan's t-test ($p<0.05$). P cakes showed a lower energy value than the other baked products; sugar content was similar to BS and CS, with 6.1 % mean crude protein. Acrylamide content in caloric sweeteners was similar to previously reported values. However, P and PC showed significantly higher concentrations, probably explained by the applied procedure. Acrylamide formation depends on both reducing sugars and asparagine concentration and availability. Beet sugar samples did not present acrylamide concentrations within the detection and quantification limit. However, the highest acrylamide content was measured in the BS. This may be due to the higher concentration of reducing sugars and asparagine in other raw ingredients. The cakes made with panela, cane sugar, or panela with chocolate did not differ in acrylamide content. The lack of asparagine measures constitutes a limitation. Cakes made with panela showed lower acrylamide formation than products elaborated with beet or cane sugar.

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