Extended cardinal parameter growth and growth boundary model for non-proteolytic Clostridium botulibum – effect of ten environmental factors

Koukou, Ioulia; Devitt, Tina Dahl; Janionis, Juoazas; Mejholm, Ole; Dalgaard, Paw

Publication date:
2019

Document Version
Publisher's PDF, also known as Version of record

EXTENDED CARDINAL PARAMETER GROWTH AND GROWTH BOUNDARY MODEL FOR NON-PROTEOLYTIC *CLOSTRIDIUM BOTULINUM* – EFFECT OF TEN ENVIRONMENTAL FACTORS

Ioulia Koukou, Tina Dahl Devitt, Juoazas Janionis, Ole Mejlholm and Paw Dalgaard

National Food Institute (DTU Food) Technical University of Denmark, Kemitorvet building 204, DK-2800 Kgs. Lyngby, Denmark

Introduction: Growth and toxin formation by non-proteolytic *Clostridium botulinum* in chilled seafood can be managed with ≥ 3.5% water phase salt (WPS). However, recent dietary recommendations suggest reduced salt intake due to negative health effects of sodium and therefore, other environmental factors should be used to prevent growth of *C. botulinum*. The aim of this study was to expand an available growth and growth boundary model for non-proteolytic *C. botulinum* with terms for CO_2 and smoke components (phenol) to predict growth responses and facilitate product development as well as documentation of food safety for MAP smoked seafood.

Methodology: Four nontoxigenic *C. botulinum* group II isolates were studied and cardinal parameter values for CO_2 (CO_{2max} in equilibrium = 280.75%) and phenol (P_{max} = 27.52 ppm) were determined in seafood challenge studies and used to expand an available model. The new model included the effect of ten environmental factors (temperature, pH, a_w, acetic, benzoic, citric, lactic and sorbic acids, CO_2 and phenol).

Results: Evaluation of the new model by comparison of observed and predicted μ_{max}-values for 56 growth curves in seafood resulted in bias factor of 1.12 and accuracy factor of 1.40. Interestingly, smoke components (phenol) in hot-smoked fish, opposed to cold-smoked fish, had no inhibitory effect on growth of non-proteolytic *C. botulinum.*

Conclusions and relevance: The new and expanded model can be used to facilitate product development for a wide range of chilled seafood. As an example for chilled (7°C) cold-smoked halibut with pH 6.3, 15 ppm phenol and 3500 ppm acetic and 7000 ppm lactic acids: Reducing WPS from 3.5% to 1.5% resulted in predicted growth (ψ-value = 0.69). However, with 5500 ppm acetic and 9000 lactic acids at pH 6.0 growth of non-proteolytic *C. botulinum* was prevented (ψ-value = 1.56). For vacuum-packed cold-smoked salmon at 5°C, with pH 6.2, 7000 ppm lactic acid and 10 ppm phenol: When WPS was reduced from 3.5% to 1.5%, growth was predicted (ψ-value = 0.63). When using MAP with 50% CO_2 in equilibrium, 3000 ppm acetic acid and pH 5.8 growth was prevented (ψ-value > 2) as for 3.5 %WPS.

Keywords:

phenol; low salt; carbon dioxide; MAP; chilled seafood