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Abstract

Sterilisation/Pasteurisation by high pressure: the inventor – a scientific point-of view

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In 1899, Hite subjected milk to high hydrostatic pressure instead of high temperature to prevent it from turning sour [1]. His attempt was inspired by the sensorial shortcomings of heat-sterilized milk that had a “cooked” taste and recent discoveries by researchers in the field of marine ecology that microorganisms are affected by pressure. Hite achieved a 4-log reduction in the microbial count in milk by a 10-minute treatment with approximately 700 MPa at room temperature. Treatment for 30 minutes at 400 MPa successfully preserved grape juice, cider, peaches, and pears without destroying the fresh flavour. The finding that, below 200 MPa, the lethal effect of pressure was strongly reduced was in agreement with the findings of Chlopin and Tammann (1903)[2]. They found that bacterial spores were resistant to hydrostatic pressure. This finding was later proven by Larson et al. (1918) [3], who found that even an applied pressure of 1200 MPa was not sufficient to kill *Bacillus subtilis* spores.

Thermal processing is still the foundation of the processed food industry. This story of success dates back to the early 1920s when Bigelow and colleagues introduced a scientifically based method and calculation procedure for the heat sterilization of food [4;5]. These authors proved the effectiveness of heat treatment by quantifying the death of bacterial spores that are responsible for product deterioration or foodborne intoxication. Based on these calculations, the food industry developed clear processing rules that accounted for the transient nature of heat transfer. The production of shelf-stable food was (and it still is) the goal of the canning industry, and it became clear that the resistance of spores to hydrostatic pressure impaired the quality-retaining benefits of this alternative treatment. For much of the 20th century, the food industry focused on the optimization of thermal preservation. In fact, the development of rotary retort systems, high-temperature–short-time treatment, aseptic processing, and novel packaging systems substantially improved the quality characteristics of thermally processed foods. However, heat treatment still has its shortcomings. It is the aim of this contribution to explore ways in which high pressure can be used to control pathogenic microbes or spores in foods in which conventional thermal processing fails to obtain competitive, high-quality products [6,7].

References

1. Hite, B. H. 1899. The effect of pressure in the preservation of milk - A preliminary report. West Virginia Agr. Exp. Stat. Bull., 58, 15-35.
2. Chlopin, G. W. and Tammann, G. 1903. Über den Einfluß hoher Drücke auf Mikroorganismen. Z. Hygiene Infektionskrankheiten, 45, 171-204.
3. Larson, W. P., Hartzell, T. B. and Diehl, H. S. 1918. The effect of high pressures of bacteria. Journal of Infectious Diseases, 22, 271-279.
4. Bigelow, W. D., Bohart, G. S., Richardson, A. C. and Ball, C. O. 1920. Heat penetration in processing canned foods. National Canners Association Bulletin, 16-L, 128.
5. Bigelow, W. D. 1921. The logarithmic nature of thermal death time curves. Journal of Infectious Diseases, 29, 528-536.
6. Knorr, D. and Heinz, V. 2001. Development of nonthermal methods for microbial control. In *Disinfection, sterilization, and preservation* (S. S. Block, Ed.). Lippincott Williams & Wilkins, Philadelphia, pp. 853-877.
7. Hendrickx, M.E.G. and Knorr, D. 2002. Ultra High Pressure Treatments of Foods. Kluwer Academic/Plenum Publishers, New York.