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Application of the hurdle concept: acidification and/or addition of antimicrobials to reduce the required thermal treatments of foods

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Two hurdle approaches were studied to replace thermal sterilization processes: 1) a mild heat treatment after acidification to a pH of 4.5 and 2) a mild heat treatment after moderate acidification in combination with the addition of nisin. The impact of acidification on the taste of a typical chicken broth and Alfredo-Sauce was evaluated. Acidification of the chicken broth to a pH of 4.5 was found not to be acceptable (preliminary tests with three panellists). A mild acidification to pH of 5-5.5 with the addition of nisin was a viable option. Preliminary tests with Alfredo-Sauce showed that acidification to a pH 4.5 could be feasible if a mild acid like GDL or lactic acid was used. A ranking test showed that panellists (30) were able to discriminate sauces acidified to pH of 5 with lactic acid or GDL from the reference, but that the impact on the taste was mild. An accelerated shelf-life test demonstrated the effectiveness of nisin to prevent the spoilage of Alfredo-Sauce, when used in combination with a mild heat treatment (30 min 86°C). The effectiveness of nisin was enhanced by a moderate acidification to a pH 5. Samples containing 1000 IU / g did not spoil after 40 days. A methodology was proposed to predict the acidification kinetics of solid food particles. It is based on the Fickian 2nd law of mass diffusion assuming that the difference in acid concentration determines the mass flux. The acid uptake was related to particle pH by a 2nd degree or a 3rd degree polynomial. The model allowed some good predictions of the average particle pH of cooked pork using lactic or acetic acid as a function of time with the following limitations. Expansion of cooked pork meat pieces became important the organic acid solution of a pH < 2.9 and titration measurements of the solution were slightly influenced by the buffering effect of the product solutes at pH 3.1. The model allows rough estimations of t_{min}. If more accurate predictions of t_{min} are required the centre pH and the centre, acid concentration must be measured. For fast acidification of meat and potato (< 30 min.), high acid concentrations (>> 0.07 M), temperatures above room temperature (e.g. 42-67°C) and small food particles (< 1 cm) should be used.