The effect of mild heat treatment on inactivation of pathogenic *Enterococcus faecalis* in model nutrition medium and chicken breast

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Introduction

Sous vide is a well-established minimal processing technology that use cooking of vacuum packaged meat at precisely controlled time and temperature parameters (Baldwin, 2012). This technology has been proved to have positive effect on increasing juiciness, improve tenderness and decrease lipid oxidation of meat (Bıyıklı et.al. 2020). However, the microbial safety is a challenge when it comes to selection of proper temperature and time parameters in sous vide technology. Many recipes found on internet use temperatures in the range of 42-60 °C at different time durations to cook different types of foods (Stringer et.al. 2012). On the other hand, new sous vide techniques have been tested recently by researchers that include temperatures of 45-50 °C as pre-step temperatures to cook different types of meat (Hasani et.al. 2022; Yang et.al. 2020). Therefore, it is necessary to test the efficiency of these new sous vide techniques for pasteurization of meat. In this study, we used pathogenic *Enterococcus faecalis* to validate the sous vide treatments that use temperatures of 50 and 60 °C. The experiments were conducted in model nutrition medium and chicken breast.

Materials and Methods

The experimental work was conducted in the Department of Food Microbiology, Hygiene and Safety, Institute of Food Science and Technology, Hungarian University of Agriculture and Life Sciences. NCAIM B.01312 strain of *Enterococcus faecalis* was used to determine the efficiency of different time and temperature treatment combinations (Table 1) in model nutrition medium and vacuum packaged chicken breast.

For studying the heat resistance of *E. faecalis* in model medium,0.5 McFarland suspension was prepared from pure culture and adjusted to a final concentration of 10^6 / ml. The samples were heated in water bath and *E. faecalis* counts were determined using TSA (Trypton-Soya Agar).

Table 1. Combination of temperature and time durations treatments used in the experiment.

Treatments	S1 -Time at temperature of 50°C (min)	S2 - Time at temperature of 60 °C (min)	Treatment time ratio (S1:S2)	Total treatment time (min)
T1	0	180	0:1	180
T2	60	120	1:2	180
T3	90	90	1:1	180
T4	120	60	2:1	180

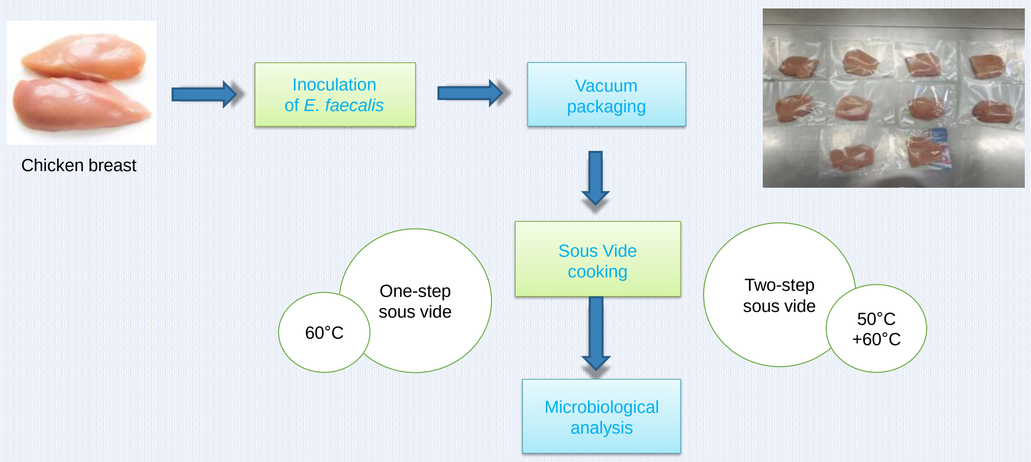

Figure 1. Challenge test of *E. faecalis* in sous vide treated chicken breast

Chicken breast was aseptically trimmed from fat and connective tissues. About 10 g of sample was taken and inoculated with *E. faecalis* suspension obtaining a final concentration of 10^6 cfu/g. Inoculated samples were vacuum packaged and treated under different time-temperature conditions in a thermostatic water bath. Enumeration of *E. faecalis* was carried out before and after treatments, using MRD diluent for homogenization and serial dilutions. The homogenate was plate out onto the selective media CATC Agar and incubated at 37°C for 24-48h.

Results and discussion

The obtained results for log inactivation of *E. faecalis* achieved after mild heat treatment processing in model nutrition medium and vacuum packaged chicken breast are presented in Table 2 and Table 3.

Table 2. Thermal inactivation of *Enterococcus faecalis* in model nutrition medium

Treatments	Inactivation in S1 ($\log(N/N_0)$)	Inactivation in S2 ($\log(N/N_0)$)
T1	0	ND
T2	1.40	5.53
T3	1.61	4.93
T4	0.61	4.10

According to our results, higher log reductions of *Enterococcus faecalis* were demonstrated in model nutrition medium compared to chicken breast in all treatments. In case of one-step mild heat treatment, *E. faecalis* was not detected in both model nutrition medium and vacuum packaged chicken breasts.

None of the two-step mild heat treatments (T2-T4) did not achieve 6 log reduction of *E. faecalis* which is considered as pasteurization performance for pathogenic bacteria (NACMCF, 2006). The highest log inactivation (5.53) in model nutrition medium was observed in T2 treatment.

Table 3. Thermal inactivation of *Enterococcus faecalis in sous vide cooked chicken breasts*

Treatments	Inactivation in S1 ($\log(N/N_0)$)	Inactivation in S2 ($\log(N/N_0)$)
T1	0	ND
T2	1.18	4.48
T3	1.88	3.48
T4	0.78	2.93

From Table 3 it can be seen that the range of log inactivation of *E. faecalis* after sous vide processing of chicken breast was between 2.93 and 4.48. Two-step sous vide treatment efficiency on *E. faecalis* inactivation depends on the treatment time ratio between the first step temperature and final step temperature. The log inactivation of *E. faecalis* after first step treatment at 50 °C of chicken breasts was less than 2 . Similar outcome was ovserved in case of log inactivation of *E. faecalis* in model nutrition medium.

Conclusions

This preliminary study showed that *Enterococcus faecalis* was less heat-resistant in model nutrition medium compared to chicken breast in all treatments. The difference of log inactivation between model nutrition media and chicken breast were 1.15-1.45. The pasteurization performance was achieved in one-step mild heat treatment both in media and chicken breast. T2 mild heat treatment was the most efficient in inactivation of *E. faeacalis* among two step treatments, both in medium (5.53) and chicken breast (4.48).

References

Baldwin D. E. (2012). Sous vide cooking: A review. International Journal of Gastronomy and Food Science, 1(1), pp.15-30.

Bıyıklı M., Akoğlu A., Kurhan Ş., Akoğlu İ. T. (2020). Effect of Different Sous Vide Cooking Temperature-Time Combinations on the Physicochemical, Microbiological, and Sensory Properties of Turkey Cutlet. International Journal of Gastronomy and Food Science, 20, 100204.

Stringer S. C., Fernandes M. A., Metris A. (2012). Safety of sous - vide foods: feasibility of extending combase to describe the growth / survival / death response of bacterial foodborne pathogens between 40 °C and 60 °C. Final report on FSA project FS102028.

Hasani, E., Csehi, B., Darnay, L., Ladányi, M., Dalmadi, I., & Kenesei, G. (2022). Effect of Combination of Time and Temperature on Quality Characteristics of Sous Vide Chicken Breast. Foods, 11(4), 521.

Yang, X., Wang, H., Badoni, M., Zawadski, S., McLeod, B., Holman, D., & Uttaro, B. (2020). Effects of a novel three-step sous-vide cooking and subsequent chilled storage on the microbiota of beef steaks. Meat science, 159, 107938.

NACMCF (2006). Requisite scientific parameters for establishing the equivalence of alternative methods of pasteurization. Journal of Food Protection, 69(5), 1190.

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