

# CO-INOCULATION OF DEBARYOMYCES HANSENI AND LACTIC ACID BACTERIA: A STRATEGY TO IMPROVE THE TASTE AND ODOUR PROFILES OF DRY SAUSAGES

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## I. INTRODUCTION

Traditional dry sausage is a naturally fermented meat product that is well-known in China for its distinctive flavour and texture. During the sausage fermentation, lactic acid bacteria and yeasts contribute to complex biochemical changes and have gradually been found to have great potential for taste and odour formation [1]. The aim of this study was to investigate the effect of *Debaryomyces hansenii* separately co-inoculated with *Lactobacillus sakei*, *Lactobacillus plantarum* and *Lactobacillus curvatus* on the taste compounds, odour compounds and sensory characteristics of dry sausages.

## II. MATERIALS AND METHODS

Dry sausages were prepared according to Wen et al. [2]. A control treatment was non-inoculated with the starter cultures, and the other four treatments were inoculated with strains (each strain was  $10^6$  CFU/g meat): (i) single inoculated with *D. hansenii* (Dh), (ii) co-inoculated with *D. hansenii* and *L. plantarum* (Dh + Lp), (iii) co-inoculated with *D. hansenii* and *L. sakei* (Dh + Ls) and (iv) co-inoculated with *D. hansenii* and *L. curvatus* (Dh + Lc). The taste and odour profiles of dry sausages were analysed using the TS-5000Z E-tongue instrument and E-nose system PEN3. The sensory analysis of the dry sausages was evaluated by a well-trained panel consisting of 20 assessors using quantitative descriptive analysis. Data were analysed using the General Linear Models method of variance (ANOVA) and Tukey's multiple comparison to determine the significance of the treatment effects ( $P < 0.05$ ) using the Statistix 8.1 software package.

## III. RESULTS AND DISCUSSION

As shown in Fig. 1A, The Dh sausage had higher umami and saltiness responses and a lower sourness response than the control sausage ( $P < 0.05$ ). Umami compounds could increase the saltiness intensities in food products [3]. It was also noted that the co-inoculated sausages yielded a higher umami response and a lower aftertaste-B (aftertaste-bitterness) response than the control sausage and that the Dh + Ls sausage had the lowest bitterness response ( $P < 0.05$ ). As shown in Fig. 1B, compared with the single inoculation of Dh, the co-inoculation of Dh + Ls increased the responses of the W1C, W5S and W1S sensors ( $P < 0.05$ ), and the co-inoculation of Dh + Lc increased the responses of the W1C and W2S sensors ( $P < 0.05$ ). These differences may result from the formation of volatile compounds in the sausages co-inoculated with Dh and lactic acid bacteria. As shown in Fig. 2, There were no significant differences between the salty and umami tastes of the Dh and co-inoculated sausages ( $P > 0.05$ ), the scores of umami, salty and sour tastes obtained from the sensory evaluation confirmed the results of the E-tongue analysis. With regard to the odour attributes, high scores of fermented, floral and fruity odours were observed in the inoculated sausages. Overall, the results of electronic tongue, electronic nose and sensory evaluation demonstrated that compared with the Dh sausage, the sour taste and floral odour increased and the fatty odour decreased in the Dh + Ls sausage; this was more favourable for the development of a desirable flavour in sausages.

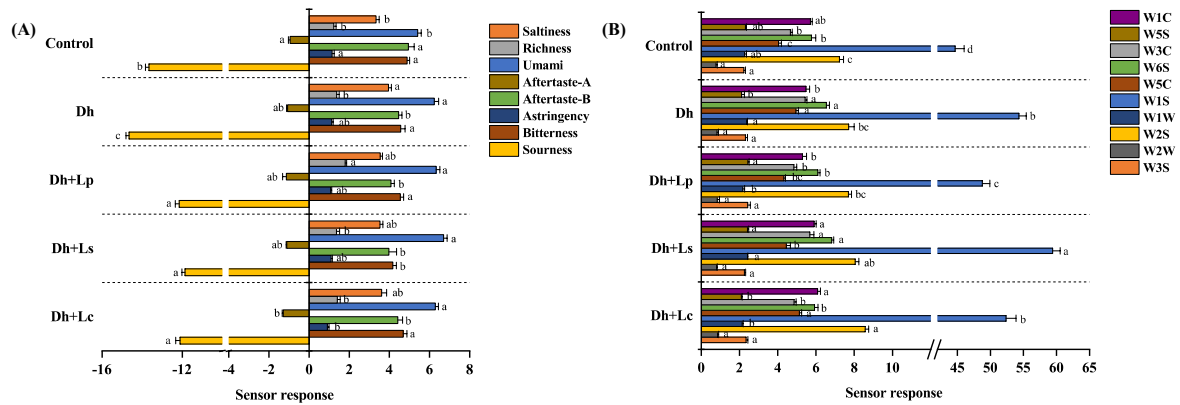


Figure 1. The electronic tongue (A) and electronic nose (B) sensor responses of non-inoculated dry sausage and dry sausages inoculated with the starter cultures. <sup>a-d</sup> Refers to the significant differences among the different sausages ( $P < 0.05$ ). Control: non-inoculated with starter cultures; Dh: *D. hansenii*; Dh + Lp: *D. hansenii* + *L. plantarum*; Dh + Ls: *D. hansenii* + *L. sakei*; Dh + Lc: *D. hansenii* + *L. curvatus*.

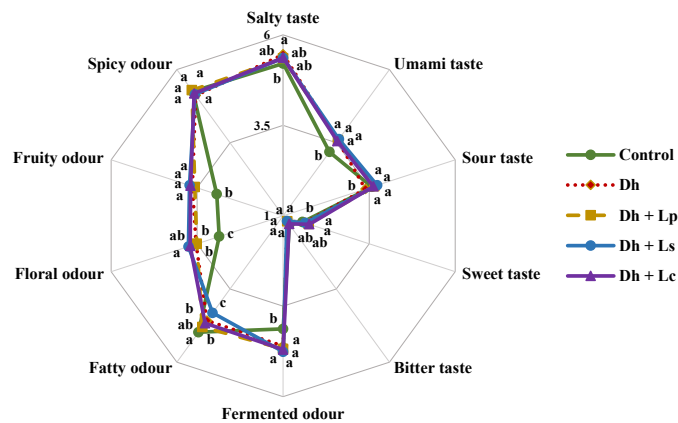


Figure 2. Radar plot of sensory evaluation of non-inoculated dry sausage and dry sausages inoculated with the starter cultures. <sup>a-c</sup> Refers to the significant differences among the different sausages ( $P < 0.05$ ). Control: non-inoculated with starter cultures; Dh: *D. hansenii*; Dh + Lp: *D. hansenii* + *L. plantarum*; Dh + Ls: *D. hansenii* + *L. sakei*; Dh + Lc: *D. hansenii* + *L. curvatus*.

#### IV. CONCLUSION

The results showed that the inoculation of *D. hansenii* and mixed starter cultures can change the flavour profile of dry sausages, and co-inoculation of *D. hansenii* and *L. sakei* more positively impacted the taste and odour profiles of dry sausages than the single inoculation of *D. hansenii*.

#### ACKNOWLEDGEMENTS

This study was funded by the National Natural Science Foundation of China (U22A20547 and 32172232) and the Major Science and Technology Projects of Heilongjiang Province (2021ZX12B05).

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