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Monitoring storage shelf life for chilled fresh pork using enzymatic time-temperature indicator

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中文摘要:

为了更为便捷的指示记录食品在冷链运输过程中的品质变化情况，该文选择冷鲜猪肉的挥发性盐基氮作为其品质监控的指标，通过试验研究贮藏过程中冷鲜猪肉的品质变化动力学特性并应用本课题组研制的新型碱性脂肪酶型时间温度指示器（TTI）设计相匹配的TTI体系配方；在此基础上，分别在5种恒温模型（0、3、10、15和20℃）及4种变温模型（TP1: 3℃ 3 d，15℃ 1 d，20℃ 0.5 d，23℃ 0.5 d，10℃ 2 d，以此循环；TP2: 23℃ 0.5 d，10℃ 2.5 d，以此循环；TP3: 23℃ 0.5 d，20℃ 0.5 d，10℃ 2 d，以此循环；TP4: 23℃ 0.5 d，10℃ 2 d，3℃ 3 d，以此循环）条件下对设计的TTI以及冷鲜猪肉进行贮藏试验，评估该TTI对贮藏过程中冷鲜猪肉品质变化的指示特性。结果表明，通过分析冷鲜肉的动力学特性，得出动力学参数，进而通过活化能匹配原则可以选择出最优TTI；并且该TTI在恒温和变温条件下最终的显色带扩散值的极差分别为1.86、2.13，表明其显色变化具有良好的稳定性及其与冷鲜猪肉品质变化的高度匹配性，该TTI在恒温和变温条件下，可有效指示冷鲜猪肉在贮藏过程中基于挥发性盐基氮的品质变化历程。

英文摘要:

Abstract: The temperature in a cold chain is the key factor for the quality of food that relies on low temperature in its distribution, as it may cause safety problems and economic losses. The Time-Temperature Indicator (TTI) is more and more important in the application of food stored and transported in a cold chain as a simple, inexpensive and user-friendly quality record device that overcomes the shortage of traditional open shelf-life and has experienced a deep development in the past few decades. The developed TTI is based on the diffusion and reaction between solidified alkaline lipase and three acetic acid glycerol ester that reduces the pH of the system and emerges as a yellow band moves forward to indicate the quality change of the food. Furthermore, chilled fresh pork was chosen to evaluate the applicability of the TTI. First, the dynamic characteristics of the quality change of chilled fresh pork based on TVB-N (Total Volatile Basic Nitrogen) value was studied by a storage experiment at 5 different isothermal temperatures. Then the Ea of the pork was attained by an Arrhenius model and a suitable TTI with specific ingredients was developed according to it at the base of the principle of Ea matching. Moreover, several storage experiments of both TTI and chilled fresh pork was conducted at an identical 5 different isothermal temperatures and 4 different non-isothermal conditions to evaluate the indicating characteristics of the TTI. In the research of the dynamic characteristics of the quality change of chilled fresh pork based on TVB-N value, the result shows that in the same level of temperature the longer the time, the higher the TVB-N value of chilled fresh pork; and as the temperature rises, the TVB-N value increases fast. Based on the Arrhenius Equation, the activation energy Ea of the chilled fresh pork was 51.346 kJ/mol, the pre-exponential factor k0 was 6.224×108 d-1. The TTI which matching the chilled fresh pork was selected as the basis of the Ea of the chilled fresh pork and the ingredients of the TTI are that the glycine - NaOH buffer dosage was 3.5 mL, the enzyme concentration was 20.0 g/mL, the alkaline lipase solution dosage was 0.5 mL, the glycerol triacetate dosage was 2.0 mL and the activation energy was 51.604 kJ/mol. In the research of reliability between TTI and chilled fresh pork, the results indicated that the color change of TTI was steady in both isothermal and non-isothermal conditions that were proved by the little difference between the final diffusion values. In non-isothermal conditions, the deterioration rate of the chilled fresh pork increases with the rising storage temperature. In addition, the deteriorating times of the pork in the 4 different non-isothermal conditions (TP1, TP2, TP3, TP4) are 4.8 d, 3.4 d, 3.3 d and 5.3 d respectively.The results also indicate that the TTI which was chosen by the base of the principle of Ea matching corresponded to the change of chilled fresh pork in both isothermal and non-isothermal conditions, which means that the TTI could be well used in the quality indication of chilled fresh pork based on TVB-N value. In addition, this TTI can be used to monitor the shelf life of chilled fresh pork during cold chain storage.

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