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Optimization of alkaline protease production from *Bacillus licheniformis* D5 in submerged fermentation

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Enzymes are important raw material for the detergent industry. In order to develop enzymes for detergents, *Bacillus licheniformis* D5, a strain with high alkaline protease production, was screened in this study. The alkaline protease production was optimized using response surface methodology (RSM). The optimized fermentation medium (*w/v*) consisted of soybean cake flour (4.0%), peanut cake flour (2.69%), beef paste (0.95%), maltodextrin (4.0%), glucose (2.23%), KCl (0.1%), KH_2PO_4 (0.2%), $K_2HPO_4 \cdot 12H_2O$ (0.40%), $CaCl_2$ (0.04%), $MgSO_4 \cdot 7H_2O$ (0.04%), Tween-80 (0.05%) and serine (0.05%). The fermentation level increased by 2.12-fold compared with the control. The culture temperature was 33°C, and the initial pH was 10. The fed-batch fermentation was performed in a 30 L fermenter. The fermentation level was increased by 47.4% (from 43,587 U/mL to 60,830 U/mL), and the fermentation time was shortened from 78 h to 54 h. The results demonstrated significantly improved fermentation level, reduced fermentation cost, simplified large-scale production of alkaline protease, and thereby promote application of alkaline protease in detergent industry.