

Enzymes for meat and meat processing industry: current trends, technological development, and future prospects

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2.1 Introduction

Enzymes have been a part of human society from prehistoric times, even before history was written. Numerous traditional foods, including bread, cheese, wine, and beer, have been prepared with the help of enzymes (Verma et al., 2018). The modern period makes extensive use of enzymes, particularly in the food processing industry, in order to produce high-quality food products (Mandeep et al., 2020; Tantamacharik et al., 2018; Verma et al., 2019). People have developed a greater awareness of the quality of food products, and as a result, the meat industry is experiencing significant transformation in order to fulfill and satisfy customer demand (Verma et al., 2021a,b). However, there is a problem with beef products during postmortem muscle modifications, when enzymes play a significant role in degrading their texture, particularly their softness (Mandeep et al., 2020; Pang et al., 2021). Enzymes are responsible for the postmortem transformations of beef products. The glycolytic cycle consumes glycogen, which produces lactic acid and lowers the muscle's pH. The quality of the meat is highly dependent on how the animal was cared for before slaughter, that is, preslaughter animal care. When the pH of the muscle decreases, the other membranes, the sarcoplasm, the sarcolemma, and the muscle fibers also change as a result of the depleted energy (Ramanathan et al., 2020).

Additionally, muscular protein complexes, namely, actin and myosin, become permanently linked, resulting in the hardening of the muscles and the formation of rigor mortis. Pre- or postslaughter conditions have a significant effect on meat tenderness (Pathare & Roskilly, 2016). Soft meat can be obtained either naturally or by the use of exogenous enzymes. Thus the use of enzymes assists meat companies in improving the quality of low-graded meat while also streamlining the production process. For customers, the most significant meat quality parameter is meat softness, which can be achieved in two ways: by tenderizing tough cuts and by remodeling low-grade meat pieces into higher-graded ones. To soften hard and tough beef slices, an external supply of enzymes is required. Lysosomal enzymes, cathepsins, and other enzymatic components have been postulated in this run; however, their precise functions remain unclear and require additional exploration. Additionally, the functionality of several fruits and vegetables has been investigated, as they contain protease, which can enhance the softness of meat cuts. Numerous research studies have demonstrated the tenderizing effects of microbial enzymes and plant proteases such as papain, zingibain, and ficin (Gagaoua et al., 2021; Zhao et al., 2020). Additionally, proteases have been proven to promote carcass efficiency and bind together small pieces of meat to raise their market value. Transglutaminases, a kind of protein cross-linking enzyme, have been used to improve the texture of a range of meals. By catalyzing the cross-linking of glutamine and lysine residues, the enzymes help ensure uniform shapes and sizes in raw beef products (Miwa, 2020; Yang & Zhang, 2019). Additionally, enzymes serve as flavor enhancers throughout the aging process of meat products (Dong et al., 2019).