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Effects of transglutaminase on health properties of food products

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Nowadays, food manufacturers try to develop new products with unique functional characteristics; however, these products have not always been to the benefit of the consumer and in some cases have led to consumer's health problems. The use of transglutaminase (TG) in the food industry is very common. Transglutaminase catalyzes covalent bond between lysine and glutamine in peptides and protein to achieve a more stable, rigid and complex product. From the health point of view, TG can reduce allergy, control energy intake from foods and act as mediator in wound healing. Besides all these benefits, evidences have suggested that transglutaminase (mTG) action in food products might cause autoantigen in celiac disease (CD) population. Microbial transglutaminase cross-linked gluten may be hazardous for CD since the enzymes can deamidate gluten and thus, mimic endogenous tissue transglutaminase (tTG). On the other hand, numerous studies indicated that transglutaminase is responsible for some neurodegenerative diseases such as Alzheimer disease and Huntington disease (HD). In the present article, recent achievements on health aspects of transglutaminase in food products are reviewed.

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Introduction

Transglutaminase is an enzyme capable of catalyzing acyl transfer reactions introducing covalent cross-links between proteins as well as peptides and various primary amines. When the ε-amino groups of lysine residues in proteins act as an acyl acceptor, ε-(γ-Glu)-Lys bonds are formed both intros- and inter-molecularly [1]. The transglutaminase-catalyzed reactions are shown below:

$$\text{R-Glu-CO-NH}_2 + \text{H}_2\text{N-R}' \rightarrow \text{R-Glu-CO-NHR}' + \text{NH}_3$$

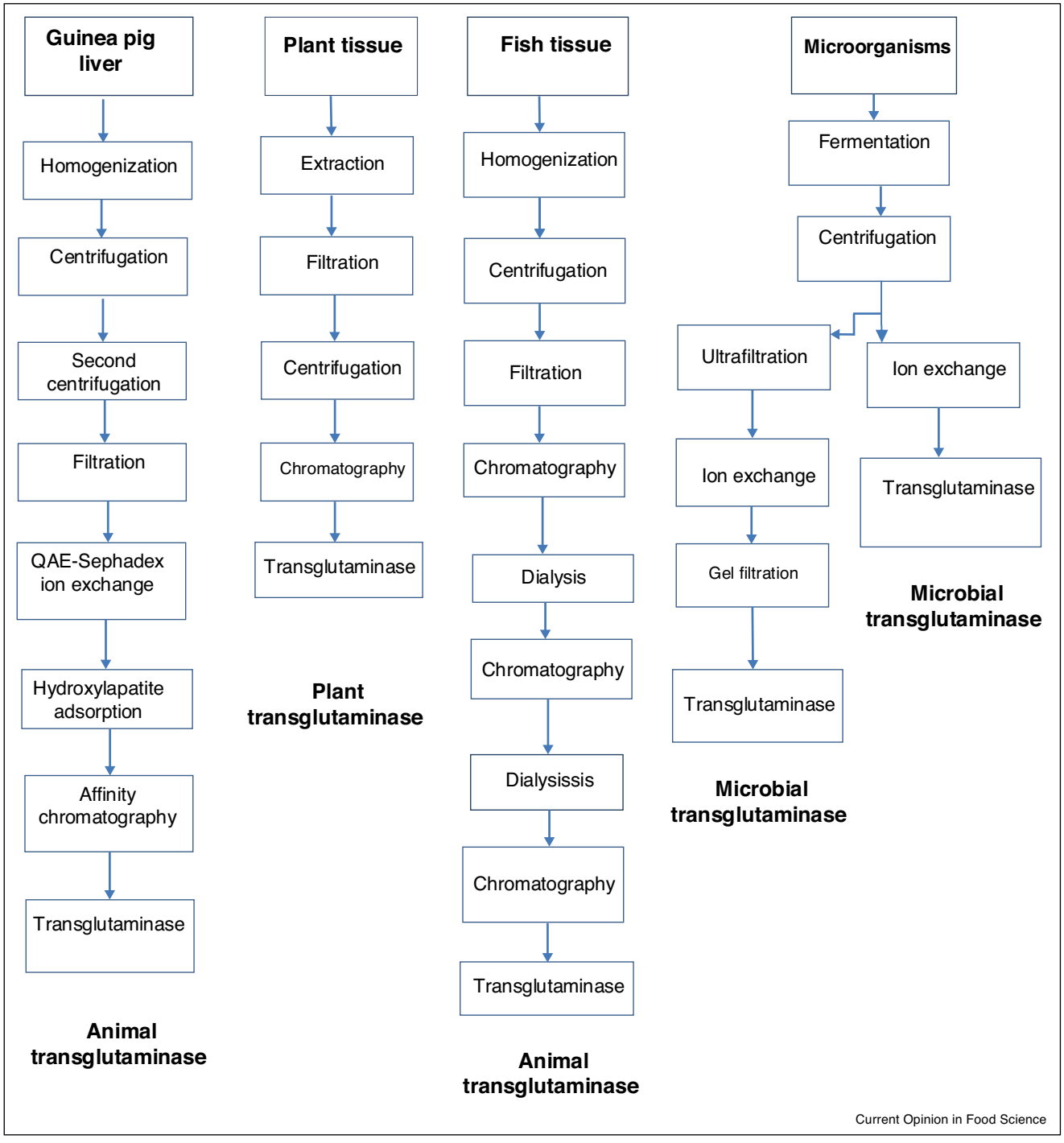
$$\text{R-Glu-CO-NH}_2 + \text{H}_2\text{N-Lys-R}' \rightarrow \text{R-Glu-CO-NH-Lys-R}' + \text{NH}_3$$

$$\text{R-Glu-CO-NH}_2 + \text{H}_2\text{O} \rightarrow \text{R-Glu-CO-OH} + \text{NH}_3$$

Preliminary studies on the applications of transglutaminase (TG) in food have attracted much attention in guinea pig liver [2]. This animal had the most available molecular form of the transglutaminases (TG). The function of transglutaminase is explained by fact that this enzyme acts as a catalyst for reactions that happen in the active system. When these reactions cannot happen, TG enzyme leads to reaction occurrence in normal rate. In many years later, studies showed that transglutaminases can be found in nature [3], in animal tissues [4], in microbial cells [5] even in plants such as fodder beet, soy tissue or a type of apple [6••] (Figure 1). Furthermore, this enzyme is involved in many processes like as coagulation, photosynthesis and antibacterial immune reactions [3].

In some foods, enzymes are effective in increasing the overall quality [7]. Animal and plant transglutaminase

Figure 1



Process chart of transglutaminase from different sources.

enzymes are similar to microbial transglutaminase [8]. The role of animal transglutaminase in physiological processes such as blood coagulation is significant [6••]. Plant transglutaminase plays an important role in the growth and development of plants [9]. Transglutaminase from microbial sources is more effective than others. The TG enzyme isolated from microbial sources has facilitated the processes and resulted in saving more energy. In recent years, most studies have been done on the physical characteristics, different sources of transglutaminase or role of this enzyme in food processing. The aim of this