Gluten

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gluten gliadin zonulin intestinal permeability

1. Introduction

Gluten proteins have long been of interest to the food industry due to their high impact on the baking quality of wheat flours[1][2]. More specifically, gluten proteins are responsible for the high water absorption capacity and unique viscoelastic properties of wheat dough[1][2]. From a chemical perspective, gluten has been defined as the proteinaceous mass that remains when wheat dough is washed with water and consists primarily of the prolamin and glutelin fractions of the storage proteins of wheat[3][4]. The terms prolamin and glutelin originate from the classification of grain proteins into four fractions according to their solubility properties (Osborne fractions)[5]. Prolamins are insoluble in water but soluble in alcohol, whereas glutelins are insoluble in both water and alcohol[6]. The terms gliadin and glutenin account for the prolamin and glutelin fractions of wheat, whereas the terms secalin, hordein and avenin describe the prolamin fraction of rye, barley and oats, respectively[6]. Likewise, the glutelin fractions of rye and barley are commonly described as secalinin and hordenin, however, similar terminology does not apply for oat glutelins[4]. Furthermore, prolamins are commonly grouped into fractions (α, γ, ω) characterized by different electrophoretic mobilities, whereas glutelins are classified into subunits on the background of their molecular weight[4]. Codex Alimentarius has defined gluten as “a protein fraction from wheat, rye, barley, oats or their crossbred varieties and derivatives thereof, to which some persons are intolerant and that is insoluble in water and 0.5M NaCl”[7]. As a result, gluten is nowadays considered to be a common term for the prolamin and glutelin fractions of wheat, rye, barley and, in some cases, oats.

2. Influences

Gluten proteins contain repetitive sequence sections that are rich in the amino acids proline and glutamine[6][8]. Such sections cannot be fully degraded by the human gastrointestinal enzymes[2][5], resulting in the presence of relatively long gluten peptides in the small intestine. In patients with CD, such gluten peptides trigger an inflammatory reaction, however, their presence in the small intestine of most healthy individuals is believed to be rather unproblematic. In vitro studies using caco-2 cell lines[9][10] as well as ex vivo studies on human biopsy explants from both CD patients and healthy controls (HCs)[10][11], suggest that exposure to gliadin disrupts the integrity of the intestinal epithelium. The effect of gliadin on intestinal permeability is believed to be mediated through the secretion of the protein zonulin[12]. Zonulin has been identified as prehaptoglobin-2[13] and serum zonulin is often used as a marker of intestinal permeability. Levels of zonulin have been found to be elevated in autoimmune diseases[14][15][16][17], however, widely used ELISA kits cross-react with proteins, such as properdin and complement C3[18][19], which shows why caution should be practiced when interpreting data on this topic. In addition, several publications using different methods have illustrated that gliadins can affect the intestinal permeability in non-genetically modified mice[20][21][22] , however, the mechanism of action is rather unclear as mice do not have the haptoglobin-2 allele and therefore cannot express zonulin[23] .

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