Trends in Food Science & Technology 56 (2016) 149–157

Contents lists available at ScienceDirect

Trends in Food Science & Technology

journal homepage: http://www.journals.elsevier.com/trends-in-food-science-and-technology

Review

Technological benefits of inulin-type fructans application in gluten-free products – A review

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ARTICLE INFO

Article history:
Received 25 April 2016
Received in revised form
25 August 2016
Accepted 27 August 2016
Available online 29 August 2016

Keywords:
Inulin
Fructooligosaccharides
Gluten-free products
Bread
Technological properties
Sensory quality

ABSTRACT

Background: Although cereals are used extensively in food products, ingestion of gluten-containing food has been associated with gluten-related disorders in susceptible individuals. Recently, the gluten-free (GF) products are one of the most dynamically growing branches of the food industry. However, many commercially available GF products provide lower level of proteins, dietary fibre, vitamins and minerals, compared with wheat products. To meet the growing demands of GF food consumers, efforts have been made to improve the overall quality of these products. Recently, inulin-type fructans (ITFs) were proposed as the beneficial ingredients of GF products.

Scope and approach: Over the last decade, the application of ITFs in GF products has been widely explored. Therefore, the aim of this review is to present the current application of ITFs as components of GF products by summarising the existing data concerning their effect on the technological properties and sensory quality of these products in the light of their physicochemical characteristics.

Key findings and conclusions: ITFs added to the GF products interact with other ingredients and additives. Generally, they have the potential to improve the technological properties and sensory perception of obtained products. The presented facts may provide an inspiration for further intensive work on the improvement of the quality of GF products for the growing number of people struggling with the problem of gluten intolerance.

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1. Introduction

Cereals (wheat, rye and barley) are used extensively in food products. Their role in the everyday diet is emphasized in dietary guidelines as a source of well-balanced macro- and micronutrients. Cereal proteins comprise up to 80% of gluten proteins which play an important role in the baking industry. Gluten is composed of two main protein fractions: gliadins, which contribute essentially to the viscosity of the dough, and glutenins, which are responsible for dough elasticity (Wieser, 2007). Therefore, it provides cohesiveness to dough during processing, retains leavening gases, sets the crumb structure and imparts elasticity to the bread texture (Delcour et al., 2011).

Nevertheless, a significant portion of the global population must avoid the consumption of cereals because they do not tolerate gluten proteins. A gluten-free (GF) diet is therefore a recommended or even fundamental method of treatment for a wide spectrum of gluten-related disorders, among which the best known are coeliac disease (CD) and wheat allergy (WA) (Fig. 1). The prevalence of CD, the immune-mediated enteropathy caused by the ingestion of wheat gluten (and rye secalin and barley hordein) affecting genetically predisposed individuals, has increased two- to four-fold over the last 50 y (Lohi, Mustalahti, Kaukinen & Laurila, 2007; Rubio-Tapia, Kyle, Kaplan, Johnson, & Page, 2009). Western countries show an estimated CD prevalence of approximately 1% of the population (Guandalini & Assiri, 2014; Mustalahti et al. 2010). Apart from CD and WA, various adverse reactions to wheat are classified as non-coeliac gluten sensitivity (NCGS) (Biesiekierski & Iven, 2015; Scherf, Kohler, & Wieser, 2016). It is suspected that the NCGS prevalence in the general population could well be higher than that of CD (Catassi et al., 2013). The characteristic of main gluten related disorders is presented in Table 1 (Czaja-Bulsa, 2015; Krupa-Kozak, 2014, 2016; Scherf et al., 2016). In response to a rapidly increasing demand for GF products, GF food production is one of the most dynamically growing branches of the food industry

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http://dx.doi.org/10.1016/j.tifs.2016.08.015
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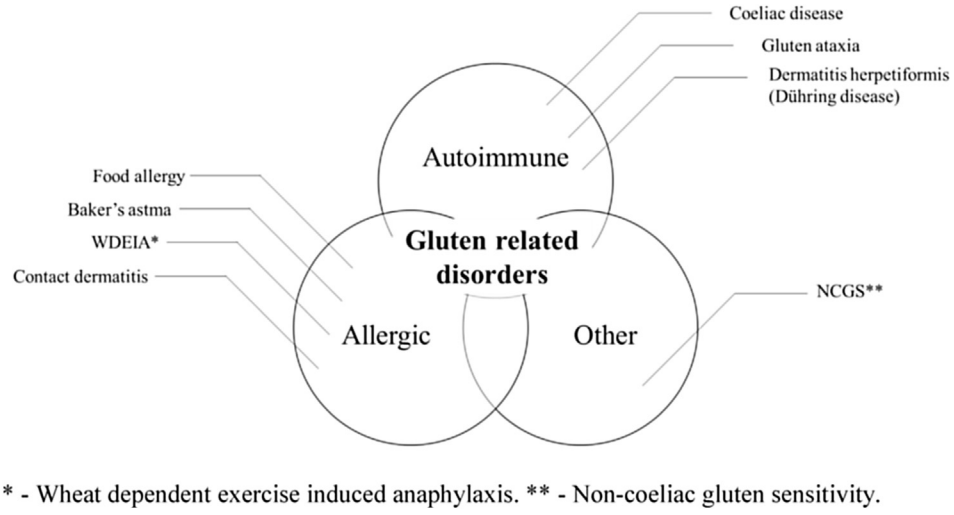

Fig. 1. Gluten-related disorders.

Table 1
Characteristic of main gluten-related disorders.

Characteristic	CD[a]	WA[b]	NCGS[c]
Definition	Immune-mediated enteropathy triggered by the ingestion of gluten in genetically susceptible individuals	Adverse immunologic reaction to wheat proteins	Gluten sensitivity with negative immunoallergy tests to wheat or negative CD serology with normal duodenal histopathology
Morbidity	≈1%	≈1%	Unknown
Genetic background	HLA-DQ2/DQ8[d]	Atopy	HLA-DQ2/DQ8?
Triggering proteins	Gluten	Gluten/nongluten	Gluten/nongluten
Symptoms	Intestinal and extraintestinal	Intestinal and extraintestinal	Intestinal and extraintestinal
Diagnosis	CD symptoms, positive CD serology, determination of HLA-DQ2/DQ8, small-intestine biopsy	Specific skin prck tests, wheat specific serum IgE assays, gluten challenge	Exclusion criteria for CD and WA, gluten challenge
Serology	IgA/IgG[e]	IgE	IgG?
Histology (Marsh classification)	II–IV	0	0–I
Atrophy of duodenal villi	Present	May be present	Absent
Treatment	Gluten-free diet	Wheat-free diet	Wheat-/gluten-free or reduced diet
Time of diet duration	Lifelong	The average of 6 years, individual. Lifelong in anaphylaxis	Unknown

[a] CD – coeliac disease.
[b] WA – wheat allergy.
[c] NCGS – Non-coeliac gluten sensitivity.
[d] HLA – human leukocyte antigen.
[e] Ig – immunoglobin.

(Miranda, Lasa, Bustamante, Churruca, & Simon, 2014). According to a report of the Transparency Market Research, the global GF food market was valued at 2.84 billion dollars in 2014 and is projected to reach 4.89 billion dollars by 2021 (Transparency Market Research, 2015).

The compliance with a strict GF diet is not easy, as GF products are generally not widely available, are more expensive and have lower palatability and nutritional value than their gluten-containing counterparts. GF cereal goods provide a lower level of B vitamins (thiamine, riboflavin, niacin), folate, iron and dietary fibre (Thompson, 1999; 2000) than a gluten-containing counterparts. The consumers expect continuous improvement of the nutritional and sensory quality of GF foods. They wish for the products resembling gluten-containing counterpart, maintaining the same flavour and texture. Additionally, they have also been paying more attention to the innovative GF products possibly because of the growing awareness about health benefits of GF food. Fortunately, this market requirements contribute to the growing number of studies on the development of new GF products with increased nutritional and functional properties.

Over the last decade, the application of inulin-type fructans (ITFs) as ingredients in GF products has been widely explored. Therefore, the aim of this manuscript is to present the current application of ITFs as ingredients of GF products by reviewing the existing data concerning their effect on the technological properties and sensory quality of these products in light of their physicochemical characteristics.

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