SURVEY OF ENZYMES KNOWN IN THE FIELD OF FOOD INTOLERANCE

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REVIEW ARTICLE

Abstract

According to people's own admission and according to popular belief, nowadays there are more and more people suffering from digestive problems caused by food intolerance, including lactose intolerance or enzyme deficiency. The purpose of this study is to review the scope of the food allergy-food intolerance issue, focusing on a small group sample to assess whether the problem exists among the respondents, whether it is necessary to enter enzymes in the organizer to break down the nutrients, and which foods are a problem. The results confirm that special dietary needs lead to special product offerings. Where the question arises, is it really (also) the distant future that the market for milk sugar, gluten and egg-free products is growing, or in terms of product development, is it possible to innovate such that our former products are effective in a given location, with a given operational provider do they contain enzymes or tolerating factors? Based on the yellow data, the study mentions certain diets and the use of special diets. He just keeps in mind that an unnecessary restrictive diet is a psychological problem, a deterioration in the quality of life, or even a lack of it.

Keywords: *product development, innovation, enzyme, food intolerance, diet*

INTRODUCTION

"Giving the customer what they want is not as difficult as figuring out what they want." (Amenda Bannett source: Topár, 2005). In business activities, the goal of development is to satisfy needs and make a profit. At the same time, 21st century consumers are making new and new demands on food, driven partly by health awareness and partly by environmental awareness. Among other things, the product should be healthy, easy to store and easy to prepare with the smallest possible ecological footprint, have a clear list of ingredients, be made using an ethical production process, and not cause health problems for the consumer.

Today, nearly 80% of the value of every product produced is given by the invested intellectual capital, while the value of raw materials is less than 20%, and this is also the case for intolerant products. This relationship is well illustrated by the so-called "food-friendly" concept created by the founder of Acer, Stan Shih. "industrial smile curve", which shows the contribution of each phase of the value chain to the added value of the product (Rekettye, 2016).

WHAT IS THE DIFFERENCE BETWEEN A FOOD ALLERGY (FA) AND A FOOD INTOLERANCE?

Food allergy is a pathological immune reaction that causes adverse symptoms triggered by a food component. In the case of an allergen, various general symptoms (inflammation) appear immediately or within a short time (24–48 hours) due to the overproduction of immunoglobulin E (IgE) (Pálfi, 2019).

The precise determination of the occurrence of food allergy faces various concerns, as the adverse symptoms and reactions that occur may also occur in other cases (e.g. infection, toxic/psychiatric/metabolic reaction), i.e. the symptoms of food allergy are not specific to the given allergen. Furthermore, estimates may be influenced by the definition of allergy, study populations, methods, geographical differences, age, dietary exposure and other factors (Sicherer–Sampson, 2018).

However, it is estimated that allergic diseases are not rare on Earth, but the majority of people can consume all kinds of food without any problems: Food allergies in childhood have a prevalence of 5–8%, and the number of adult food allergies is estimated to be around 1–2% in Europe (Sicherer–Sampson, 2018, Pónyai, 2015).

Vegetables and fruits that cross-react with pollen can cause unpleasant symptoms, mainly in asthmatic and allergic rhinitis patients. We use the name pollen food allergy syndrome (PFAS) for this, based on an internationally accepted proposal. It is based on the structural similarity between pollen and

food allergen molecules (Solymosi et al., 2020, Carlson, 2019).

If both parents are allergic, the unborn child has a 70% chance of being allergic, while in the case of one allergic parent, the chance of the unborn child is reduced to 33% (Kjellman, 1977).

It is estimated that 15-20% of the world's population suffers from some kind of allergy or intolerance. The latest data show that the number of people suffering from food allergies and intolerances is increasing worldwide, although experts and doctors are making great efforts for prevention and effective treatment.

A 2018 study of 50,000 households found that IgE-mediated food allergies affect approximately one in ten adults and one in twelve children in the United States. However, the respondents did not meet the strict criteria for a "conclusive" food allergy, so their symptoms could also be related to tolerance (Warren et al., 2020).

The previous statement is also supported by a survey conducted in Hungary in 2020, in which 406 people were examined and what is behind the frequency of adverse food reactions. Namely, 10–20% of the adult population experiences such complaints. They think it is a food allergy at first, but the results of the study also prove, based on the sample, that the relevant IgE-mediated food allergy was confirmed in 6 patients out of 406 cases (1.5%). According to their data, biogenamine intolerance is very common in the background of food-related reactions by patients, but the number of food allergies is overestimated.

In terms of food intolerances, the most common food intolerances in Hungary are lactose sensitivity and gluten sensitivity (Biesiekierski, 2017). The latter, i.e. celiac disease, is a systemic autoimmune process. Lactose intolerance is a digestive disorder caused by an enzyme deficiency, in which lactose is partially or not digested at all in the small intestine due to a lack of the lactase enzyme, and then passes on to the large intestine where it is broken down by the microbiome. The frequency of celiac disease among Hungarians is approx. 0.5%. In Europe, the number of people with lactose intolerance is between 10-30%, in Hungary it is approx. 14%.

Overall, we distinguish between food allergy with an immunological background, non-immune mediated food intolerance, food aversion based on psychological factors, and a group that includes pathological conditions that cause symptoms similar to food allergy or food intolerance. The latter typically show symptoms of gastroenterological diseases or inflammatory foci (dental, ENT, gynecological, urological). Another group of adverse reactions can be categorized as symptoms caused by toxins (food poisoning caused by bacterial toxins, aflatoxin poisoning, etc.) (Solymosi, 2023).

CAUSES, SYMPTOMS

Among the environmental factors that are most often cited as the cause of the increase in allergies are environmental pollution, changes in diet and lifestyle. According to recent research, changes in the microbiome, i.e. the natural intestinal flora, may also play a role in the increase in allergic diseases. This may be due to low dietary fiber consumption (few vegetables and fruits) and excessive fat and sugar consumption.

We know of more than 170 food allergens, but milk, eggs, peanuts, soy, wheat, fish, shellfish and seafood are the most common causes of allergic reactions caused by foods.

The most common symptoms of food allergies are hives, redness and itching. When consuming vegetables and fruits that cross-react with pollen, the patient may show all the signs of allergic rhinitis: runny nose, sneezing, nasal congestion and tingling of the oral mucosa. We will not discuss this further. Food allergies are hypersensitivity reactions that, in the most severe cases, can even lead to anaphylactic shock (low blood pressure, fainting, shortness of breath). In the case of lactose intolerance, in the absence of the lactase enzyme, the lactose content of dairy products is broken down by bacteria in the microbiome in the large intestine. In the process, various digestive metabolic products are produced. These cause bloating, abdominal discomfort and diarrhea. In 65% of people, lactase production irreversibly decreases with age (it is highest during breastfeeding), thus reducing the breakdown of milk sugar in the body. The ability to digest milk sugar, i.e. the individual tolerance level, varies (Lomer, 2015). In the case of food intolerance, which affects a very large part of the adult population, about 20%, the non-immunologically based response is triggered by a food or food component consumed in an amount that is tolerable for most people.

TREATMENT

The "simplest" solution is to eliminate the food that causes allergic symptoms from the

diet, but its implementation is not so simple. It imposes additional activity on the consumer, as he or she must constantly monitor the product composition and, when preparing food at home, also prevent cross-contamination. This is because even a small amount of the allergen can lead to severe reactions. A solution may be taking an antihistamine in the case of skin symptoms, using a bronchodilator when wheezing, or administering a corticosteroid. In the case of anaphylactic shock, an adrenaline injection is administered. It is interesting that the latest studies also recommend dietary changes, the essence of which is that it works similarly to immunotherapy (Soltész, et al., 2023). Since food allergens are proteinaceous substances, consuming the allergen in a minimally heat-treated form (Burks et al., 2001) results in the appearance of blocking IgG4 molecules, which reduces the severity of the allergic reaction by reducing the IgE level. In the case of home implementation, this could mean baking milk and eggs into patties and consuming small amounts to accustom the body to them (Hidvégi, 2024).

Food processing (Zsótér–Bagi, 2020) and - in addition to production - kitchen technology can also change the allergenic properties of food proteins. This also affects the prescriptions of diet therapies, since a strict avoidance diet is required in the case of heat-stable allergens, while in the case of heat-labile allergens, heat-treated (baked, cooked at a given temperature, for a given time) foods can be consumed in the diet (Pálfi, 2019).

Previous studies have shown that patients with more food allergies reported a lower quality of life than their counterparts with fewer food allergies - probably due to the fact that a greater degree of vigilance is required to avoid the allergen (Howe et al., 2014). Consumer vigilance is particularly important, but it cannot be ignored that service providers in tourism and hospitality must also be vigilant (Zsótér, 2006) (Zsótér, 2007).

In addition to their effects on physical and psychological health, food allergies and intolerances also pose a significant economic burden to individuals and society. In a 2013 study, Gupta et al. estimated the annual economic cost of food allergies at $24.8 billion, which is approximately $4,184 per child per year (Warren, 2020). Lactose intolerance (LI) can contribute to the development of osteoporosis, be associated with tumors, and affect quality of life (Buzás, 2015; Wilt et al., 2010).

Pharmaceutical preparations containing the lactase enzyme can be found in pharmacies either as medicines or as nutritional supplements. Tablets, chewable tablets, capsules, drops, or powder containing the lactase enzyme should be taken before meals and the amount should be adjusted to the amount of lactose you want to consume. The product box usually states how many grams of lactose or how many deciliters of milk each unit is needed to break down, and the dosage should be calculated accordingly.

MATERIAL AND METHOD

The primary research was prepared for the Science Fair scientific exhibition of the Hungarian Student Labs Association and the Kaposvári Táncsics Mihály High School, Selye János Student Lab Network. The topic of my students' research was the examination of digestive enzymes. For this, we asked the respondents about their digestive enzymes in the framework of a questionnaire survey. The aim of the research was to see whether the respondents had enzymatic problems related to their nutrition.

The online form was edited as a questionnaire on the Google Forms website, and then the link generated by the system was published among the students of the Németh László High School, Elementary School and their relatives, sharing the link to the questionnaire. In the fall of 2024, a total of 81 questionnaires were completed.

The structure of the questionnaire and the types of questions were carefully planned, as we have read in other studies (Újvári et al., 2021) (Meszlényi–Hampel, 2024). Before filling it out, we also used a test question (Simonyi et al., 2013). The questionnaire consisted of fourteen questions, two of which related to demographic data. The questionnaire did not contain any open-ended questions. The filling out was voluntary and completely anonymous.

RESULTS OF THE QUESTIONNAIRE SURVEY

Regarding the age group of the respondents, the age of the respondents was between 13 and 60 years. We chose this interval as the lower age limit because we thought that 7th grade students, in accordance with the school profile, could have already heard about the functioning of enzymes in biology classes within the natural science curriculum.

Regarding the respondents, the gender ratio shifted towards women, 65.4% of the respondents were women, 34.6% were men.

It turned out that 14% of the respondents needed to take some kind of enzyme to break down the nutrients they consumed. Fortunately, however, the majority of the respondents did not have such a problem.

Among the reactions based on non-allergic mechanisms, we looked for diseases related to enzyme defects and malabsorption in the survey. These include lactose intolerance, fructose intolerance, glucose-galactose malabsorption, pancreatic insufficiency and other diseases associated with chronic malabsorption (Nowak-Wegrzyn et al., 2017).

Based on the answers, most of the respondents reported taking the enzyme lactase, which breaks down milk sugar, or taking a pancreatic enzyme complex.

As for the foods causing problems, it is not surprising that milk and dairy products cause the most problems among the respondents. Lactose intolerance is a common disease in which the activity of the lactase enzyme in the brush border of the small intestine is reduced, so lactose is not broken down into its two components, glucose and galactose (Juhász, 2005, Szokolay et al., 2014).

8.8% of the respondents eat food several times a day that requires taking an enzyme tablet.

Among the tablets, there are prescription-only ones, over-the-counter preparations sold in pharmacies, and numerous dietary supplements containing lactase enzymes. One of these is the Lactase chewable tablet and Comfort drops, which contain the acid-resistant lactase enzyme extracted from the Aspergillus species as their active ingredient. It reduces the symptoms of lactose intolerance (Buzás Gy., 2015; Novinszky, 2022). The respondents experience the following symptoms without taking the tablet: most of them experience bloating (30%), abdominal cramps (28%), and diarrhea (27%).

7.4% of the respondents know the causes behind their problem as genetic, 43.2% do not know what could be behind the problem.

CURRENT AND FUTURE STUDIES IN THE FOOD INDUSTRY

Based on the data obtained in the survey, we wondered how big the market for lactose-free products is in the world. In global terms, one of the largest markets for lactose-free milk and dairy products is in the USA (Balsa-Budai, Szakály, 2021).

There are many approaches to defining innovation. Economics, management and marketing use the concept of innovation differently. The former uses the interpretation of J. Schumpeter, where we can distinguish five types of innovation with professional development and in terms of the industrial application of scientific results. These are the following: the novel production of goods not yet known to the consumer (product innovation); the introduction of a new production technology or commercial process (process innovation); the exploration/opening of new markets (market innovation); the search for new sources of supply of raw materials (purchasing innovation); industrial reorganization (organizational innovation) (Vágási, 2001, Fleischer, 2006).

From a food industry product development perspective, further research, testing and follow-up studies may be worthwhile. Dóra Solymosi Based on the analysis of the medical history and test results of 664 adult patients with suspected food allergies examined at the Allergology Outpatient Clinic of the Department of Dermatology, Venereology and Dermatological Oncology of Semmelweis University, the effect of preservation techniques on food allergies may be worth investigating. According to Solymosi's results, smoking and pickling are frequent triggers for mediator intolerance in the area of adverse reactions (Solymosi, 2023).

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