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## Chia seeds as a novel food

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### 1. Summary

One of today's popular products is the seed of *Salvia hispanica*, more commonly known as chia seeds. Its popularity stems from its high nutrient content, and also from the beneficial health effects associated with its consumption. *Salvia hispanica* was one of the staple crops of the Aztec and Mayan civilizations and, in addition to being consumed as a food, it was also used in medicine because of its special nutrient content. These days chia seed consumption is experiencing a renaissance again, for example, in the USA, Canada and Australia, it has been used for more than eight years as a food ingredient, because of its potentially beneficial health effects. The protein, essential fatty acid and fiber contents of chia seed are outstanding, and it is an excellent natural source of antioxidants. Chia seeds are classified as a "novel food" in the European Union, so there are strict conditions for its marketing and use for business purposes. The use of chia seeds as a food ingredient was approved by the Directorate-General For Health and Food Safety (DG SANTE) in 2009, the conditions of which were modified in 2013, 2014 and 2015. However, consumption of more than 15 grams a day can cause gastrointestinal malfunctions, therefore, in the European Union, consumers have to be warned about this. In addition, its potential allergizing effect also has to be taken into consideration when consuming it. Today, the positive effects of chia seed consumption have not yet been proved, and further research is needed regarding its future role played in the food industry.

### 2. Introduction

One of today's popular products is the seed of *Salvia hispanica*, more commonly known as chia seeds. Its popularity stems from its high nutrient content, and also from the beneficial health effects associated with its consumption. At websites promoting a healthy diet, one can almost read about its healing powers. It became an essential part of weight-loss diets. But is its popularity justified? In this article we seek to find the answer to the question whether its consumption has beneficial health effects, or whether it has any potential adverse effects.

### 2. General characteristics of the chia plant

*Salvia hispanica* L. is an annual plant belonging to the order *Lamiales*, family *Lamiaceae*, native to southern Mexico and northern Guatemala [19].

*Salvia hispanica* one of the staple crops of the Aztec and Mayan civilizations, since it served as a useful source of energy and nutrients, due to its nutrient content. After corn and beans, it was their third most important crop, and was used both in foods and for medicinal purposes [14]. According to some historical sources, payments were made in chia seeds in the Aztec Empire, and it was also an important element of certain religious ceremonies [17]. However, after the Spanish colonization, its cultivation started to decline. Flowers of the chia plant can be of different colors, ranging from very light to dark blue or purple. The tiny seeds of the plant can be white or dark in color, but most of the chia seeds cultivated today for commercial purposes are dark colored. They have an oval shape and, generally, white seeds are larger than dark ones [17].

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## 2.1. Possible uses of the chia seed

Potential uses of the chia seed in healthy nutrition and therapeutic options are less well known, but according to literature data, its application as a feedstock may provide a great future perspective, and it could be useful in the food and pharmaceutical sectors as well. It is largely popular, and is used as a food ingredient in certain parts of Mexico, Argentina, Chile, the USA, Canada, Japan, New Zealand and Australia. The use of chia seeds as a food ingredient was approved by the Directorate-General For Health and Food Safety (DG SANTE) in 2009, and this was extended in 2013 and 2014. Currently, in Europe it can be used in pastries, breakfast cereals and fruit, stone fruit and seed mixes in amounts up to 10%, and the (pasteurized) seed can be used in fruit juices and fruit drink mixes in a crushed or ground form in amounts up to 15 g/450 ml. Outside Europe, it is used in the manufacture of dietary supplements, in salads as sprouts, and processed in beverages and cereal-based foods, for example, in the USA. In Mexico, Australia and Asia, it is primarily used as an ingredient of dietary supplements and cereal-based foods [5].

## 2.2. The chia seed market in European countries

Approximately 3.5 thousand tons of chia seed (with a value of 5.9 million Euros) was imported into Europe in 2012, while in 2015 the amount was already 12 thousand tons (with a value of 26 million Euros). The three largest suppliers of chia seed are Paraguay (34%), Argentina (23%) and Bolivia (21%). The biggest chia seed importer in Europe is Germany, followed by the Netherlands, the United Kingdom and Spain. The chia seed consumption of the above-mentioned four importing countries is not proportional to the amounts imported, because they sell not only on their own markets, but frequently export the product further to other European countries [8].

The increasing popularity of chia seed is due to the fact that consumers wish to eat "healthier". Thanks to its nutritional values, chia seed meets these aspirations of consumers, and it also fits the „free from" trend. Chia seed consumption provides an excellent opportunity to people following a vegetarian or vegan diet, and it is also suitable for people suffering from celiac disease.

## 3. Nutritional aspects of the chia seed

### 3.1. Nutrient content

The nutrient content of the chia seed varies widely. According to one of the sources cited, the protein, fat, carbohydrate and fiber contents of the chia seed are in the range of 15-25%, 30-33%, 26-41% and 18-30%, respectively [13]. Its dry matter content is

90-93%, the ash content is 4-5%. Of the nutritional values of the chia seed, the carbohydrate, protein, omega-3 fatty acid, fiber, antioxidant and calcium contents can be highlighted. The typical composition of *Salvia hispanica* is presented in **Table 1**.

Chia seeds can become part of a healthy diet mainly because of their protein and fatty acid contents. Due to their nearly 20% protein content and significant essential amino acid content, they can be suitable for the prevention and recovery of protein-energy malnutrition. However, their protein content is significantly influenced by environmental and agronomic factors.

#### 3.1.1. Fatty acid content

Chia is one of those plants that contain essential fatty acids in higher concentrations. Cardioprotective effects are attributed to chia oil consumption, due to its omega-3, omega-6 and larger polyunsaturated fatty acid contents [15]. The oil of the chia seed is used in the manufacture of omega-3 containing dietary supplements, and its pressed oil is used as an ingredient of fats and oils, in amounts up to 10% [4]. Its higher omega-3 fatty acid content can help in the recovery from dyslipidemia, therefore, it can be suitable for use in the diet of people suffering from cardiovascular diseases [5].

#### 3.1.2. Fiber content

Fiber is a particularly important plant component due to its positive effects on human health. The dietary fiber content of the chia seed is 18-30%. When absorbing water, the seeds swell significantly to a gelatinous consistency, because of the water binding ability of the water-soluble anionic heteropolysaccharide (with a molecular weight of 800–2000 kDa), making up 4 to 6% of the mass of the seed. This polysaccharide is the source of the soluble fibers found in the husk of the seed [9], [19]. Its fiber content is higher than the fiber content of quinoa and amaranth. According to the results of certain epidemiological studies, this high fiber content can play a role in the prevention of diabetes [5], however, excessive consumption can lead to gastrointestinal problems, therefore, it is not recommended to consume more than 15 grams a day.

#### 3.1.3. Phytochemicals in the chia seed

Chia seed is an excellent source of antioxidants, the total polyphenol content of the seed extract is 8.8%. The occurrence of caffeic acid, chlorogenic acid and quercetin could correlate to the higher amounts of phenols [16]. Anticarcinogenic, antihypertensive and neuron protective effects are attributed to these antioxidants. The *in vitro* antioxidant activity of the chia seed was examined in several studies, and the results consistently showed that the free radical scavenging

abilities of the polyphenols found in the chia seed is larger, compared to other sources of natural antioxidants [5], [19]. The potential peroxidation inhibiting effects of the polyphenols found in the chia seed are supported by the results of Tepe [18].

### 3.1.4. Potential allergenic effect of the chia seed

In 2005, the European Food safety Authority (EFSA) drew attention to the possible allergenic effect of the chia seed [10], particularly in the case of people sensitive to sesame seeds and mustard. Because of the allergy risk, further studies are still warranted, and it is recommended to indicate the allergen content on the labels of products containing chia seed [11].

### 3.1.5. Human studies investigating the health effects of the chia seed

There is only a limited amount of source materials available about human studies regarding the health effects of the chia seed [7]. Most of these studies investigate the role of chia seed consumption in weight reduction, or its effects on the immune system or in the treatment of people suffering from type two diabetes mellitus. In a research involving 100 men and women (between the ages of 21 and 65), the role of chia seed consumption in strengthening the immune system was investigated. Participants were divided into four groups and they consumed breakfasts containing different amounts of chia seeds. Breakfasts containing 2.5 g of chia seeds were consumed each day by the first group for four weeks, while the breakfasts of the second and third group contained 5 g of chia seeds and 10 g of chia seeds, respectively. 4 g of sunflower seeds was consumed by the fourth group, the control group, each day. When testing the health effects of the chia seed, blood samples of the participants were analyzed before and after the experiment (lipid profile, lymphocytes), which was accompanied by the registration of anthropometric data, as well as the filling out of a questionnaire on lifestyle and food consumption. No relevant health effect was demonstrated by the results even in the case of the largest dose (10 g) chia seed consumption [1]. In another study, involving a small number of people suffering from type two diabetes mellitus, the chia seed intake was 25 g/1000 kcal for 12 weeks. After the test period, a decrease in the systolic blood pressure was observed among the patients, compared to the control group. However, there was no significant difference in terms of blood lipid parameters, liver enzymes or renal functions [21].

## 4. Legal regulation of chia seed distribution in the European Union

In the European Union, chia seed is considered novel food. Novel foods are foods that had not been consumed in the European Union in significant amounts before May 15, 1997, and fall under one of the categories of paragraph (2) of Article 1, of regulation

(EC) No 258/97 [6]. Authorization of novel foods is performed by the Directorate-General For Health and Food Safety (DG SANTE), in close cooperation with member states. The first request for the marketing of chia seed and ground seed as a novel food ingredient was submitted to the relevant authority of the United Kingdom (Food Standard Agency, FSA) in 2003. The primary safety assessment was performed by the FSA in 2004, and it was forwarded by the European Commission to member states for delivering their opinions. A justified safety objection was raised by the member states against the marketing of the product, therefore, the request was sent by the Commission to EFSA for a further evaluation. In the absence of the necessary information, no conclusion regarding the safety was drawn by EFSA, and further information was requested from the applicant. A second opinion was issued in 2009 about the safety of *Salvia hispanica* and ground seed as a food ingredient, in which it was confirmed that the use of *Salvia hispanica* in bakery products, under the conditions listed in the request for authorization, is not likely to have adverse effects on human health. Based on the opinion of EFSA, in agreement with the member states, the marketing of *Salvia hispanica* as a novel food ingredient in bakery products, with a *Salvia hispanica* content of no more than 5%, was authorized by the European Commission in Commission Decision 2009/827/EC [2]. In 2011, an application for the extension of chia seed use was submitted to EFSA by another applicant, about which Commission Decision 2013/50/EU was born in 2013. It allowed the use of chia seed in a broader product range (in breakfast cereals, as well as fruit, stone fruit and seed mixes, in addition to bakery products) in larger proportions (10%). It also allowed direct selling of chia seed exclusively in a pre-packaged form, with the condition that the label should contain the information for consumers that the daily intake cannot exceed 15 grams (first extension of possible applications). In 2014, with Commission Decision 2014/890/EU the use of chia oil as a novel food ingredient was authorized, and in 2015 the possible applications of *Salvia hispanica* were extended to a new product range. Under strict special measures (pasteurization, microbiological control system, information about how to report potential allergic reactions, processing technologies and packaging methods eliminating choking hazards), the use of *Salvia hispanica* in fruit juices and fruit drink mixes was authorized [3], [4], [12].

### 4.1. Conditions for the marketing of chia seed and for its use for business purposes

Novel food authorization decisions issued by the European Commission in accordance with Regulation (EC) No 258/97 are in the name of the applicant, so only those possessing a decision issued by the Commission, a member state authorization decision (in the case if there is no safety objection regarding the request), or who are on the notification list of the Commission, can place chia seeds or chia-



containing products on the market within the European Union. In accordance with the decisions, it is among the conditions for the marketing of chia seed as a novel food ingredient and for its use for business purposes that *Salvia hispanica* can be sold to consumers exclusively in a pre-packaged form, sales in a bulk form are not permitted. The recommended daily intake, which cannot exceed 15 grams, has to be indicated on the label of the product containing *Salvia hispanica*. In addition, the product label should include the name *Salvia hispanica*, and it should be indicated, using this name, in the list of ingredients in descending order of weight. *Salvia hispanica* can be used as a food ingredient in the following products: bakery products, breakfast cereals, and fruit, stone fruit and seed mixes. These products can contain no more than 10% of chia seeds by weight. Whole chia seeds can be added to fruit juices and fruit drink mixes in a crushed or ground form in amounts not exceeding 15 g/450 ml [3], [12].

**Table 2** lists the chia seed containing foods available on the European Union market, grouped according to their authorization status.

### 5. Summary and future perspectives

The beneficial health effects of chia seed consumption are mainly attributed to its high protein and essential fatty acid contents. In most cases, no demonstrable health effects were confirmed by human studies of these effects. Consequently, for comprehensive confirmation of the beneficial health effects, further studies are warranted, as well as in the case of foods enriched with chia seeds.



A kép illusztráció / Picture is for illustration only  
Fotó/Photo: Tolokán Adrienn

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