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Producing dietary functional halva for diabetic people using Stevia Plant, bio-sweetener, oats, and wheat bran flour

Abstract

Background and objective: in addition to common nutritional specifications, functional foods provide healthy values for consumers, and these foods have pharmaceutical value besides their nutritional properties. Moreover, functional foods effectively reduce the risk of acute and chronic diseases. This research is an empirical study that is conducted by reviewing the revenant papers and texts and using oat flour, wheat bran flour, stevia leaf (sugar substitute), whey, vegetable oil, and some seasonings such as saffron, cardamon, and cinnamon. Halva was produced in three forms: 100% oat flour (whole-oat flour), 100% wheat bran flour (whole-wheat flour), 50% oat flour, and 50% wheat bran flour, and kruskal-wallis analysis was used for statistical assessments of quality and sensitive analysis. The applied purpose of this study is to produce dietary products for individuals with cardiovascular, hypertension, non-insulin-dependent diabetes, obesity, etc. In this research, we sought to prepare a versatile food with high nutritional value that meets the needs of diabetics, a food that has health-giving properties for these people in addition to conventional nutritional properties. The stevia plant is a very strong sweetener and a very suitable alternative to refined sugars. Wheat bran and oat flour are the richest food sources of fiber and plant fibers, which include high amounts of protein, carbohydrates and mineral salts, which play a significant role in the diet of diabetics have.

Keywords: *Stevia, Oat, Wheat Bran, Whey, Diabetes, Functional*

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Materials and methods:

This is an empirical study conducted by reviewing the relevant papers and studies using kitchen appliances available at home. First, the relevant studies and suitable research methods were selected by searching through Google Scholar, and then the (free-sugar) halva was cooked for diabetic patients, using the materials and methods used in these studies.

Introduction and necessity of the project:

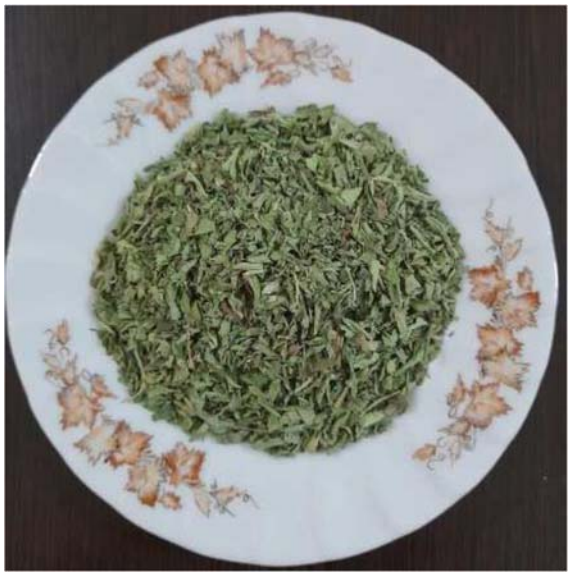
Consumers' demands for foodstuff have considerably changed compared to past decades, so most of them believe that foods directly affect their health. The new viewpoints on the effect of food compounds on physiological performance and health have led to the spread of functional foods, and more understanding of the nutrition-health link has resulted in the popularity of functional foods to achieve desired health and reduce the risk of diseases [20]. The industry of functional foods production was created by adding or condensing the beneficial ingredients and deleting the ineffective or harmful materials, and the production-consumption market of these products was rapidly developed. Functional foods provide healthy values in addition to their nutritional properties. This term is usually used for modified or synthesized foods for improving health or decreasing the risk of diseases. However, these foods may include any kind of material that organically contains compounds with pharmaceutical actions. Consumers can control their health if they know and choose functional food or beverages. High-quality functional foods are not easily achieved. In addition to its active role in physiology, the product must be prepared based on the consumer's needs in terms of appearance and taste [3]. Functional food products can be classified based on different aspects. According to one type of classification, functional foods are divided into three categories: the first group includes those products that improve the health level of individuals; for instance, they are used to improve regulatory functions of the intestine and stomach (pre and probiotic) or improve the life of children supporting their abilities and learning behaviors. Another group includes functional foods used to reduce the risk of some diseases such as high cholesterol, or only for removing hunger and providing people with their essential nutrients. These foods are also used to prevent nutrition-related diseases and improve the physical-psychological situation of consumers so functional foods play a vital role in this case [22]. Higher costs of treatment, increased life expectancy, and individuals' willingness to improve the quality of old age have led to higher demand for such foods [18]. Diabetes is a metabolic disorder in the body through which, insulin cannot be made or the body becomes resistant to insulin, and therefore, the produced insulin cannot do its natural function. In this disease, many tissues such as the pancreas, kidney, liver, brain, and heart are affected [24]. The liver is an insulin-dependent organ its function depends on the blood insulin level and the liver's rate of sensitivity to inulin [9]. On the other hand, diabetes may intensify the risk of some liver diseases. Improper blood sugar control would increase the risk of fatty liver. The other complications caused by improper control in diabetes, including obesity and high cholesterol may increase the probability of fatty liver incidence. Since liver cirrhosis and diabetes are interconnected, people with diabetes

are also at risk of liver cirrhosis [9]. Some therapeutical supplements such as herbal supplements can effectively alleviate diabetes and its complications [11]. Plants and herbs have been used almost in all countries in the past to treat diseases [14, 26]. Because these plants have minimum side effects, are inexpensive, and are available, they have gradually become substitutes for chemical drugs [21, 23]. In Persian (Iranian) traditional medicine, medicinal plants are used to treat various diseases, such as neural and inflammatory diseases, hypertension, blood fat, and blood sugar in particular [25].

The stevia rebaudiana is a plant from the Stevia species of the family Asteraceae that grows in South America. Stevia is full of substantial herbal compounds that provide properties for reducing blood cholesterol, blood pressure (hypertension), and blood sugar (hypoglycemia), as well as anti-bacterial specifications [16].

The sweetening compounds include Stevioside, Rebaudioside, Steviolbioside, And dolcoside A [16]. According to previous studies, the compounds available in this plant do not increase blood sugar and it can be used as a natural sweetener in food products [28].

Stevia contains various vitamins, especially vitamins A and C, as well as many elements such as selenium, cobalt, and chromium that are antioxidant elements. Stevia also contains protein, fiber, carbohydrates, phosphor, iron, calcium, and sodium [27]. In a study conducted on patients with hyperlipidemia, stevia plants could considerably decrease the blood fat of the patients [12]. Moreover, the powerful antimicrobial specifications of Stevia rebaudiana have been confirmed [29]. Hence, the Stevia rebaudiana plant is now used as an organic sweetener in food products particularly for people with diabetes [8, 16].



Statement of problem:

Diabetes is one of the most prevalent and costly chronic diseases around the world, which causes many complications, such as vascular and renal failures, blindness, amputation, and neuropathy. The numerous complications of diabetes severely affect the quality of life of patients imposing many costs on the patient and society causing premature disability and death gradually. Lack of accurate control and monitoring of the disease would lead to many complications in the future. Stevia plant is a strong sweetener and a suitable substitute for refined sugar. Regarding the antioxidant and sweetening power of this plant, its use is useful for patients to reduce their blood sugar and subsequent complications [7]. Natural sweeteners, called Steviol glycosides, are d-terpenes extracted from the leaves of Stevia rebaudiana Bertoni with a sweetening power that is 250-300 times greater than saccharose. These sweeteners provide many therapeutical properties. These calorie-free sweeteners can be used in most food products, particularly for people with diabetes and obesity. Due to the non-textualizing feature of the sweetener extracted from the Stevia plant and its high sweetening potential, this additive of food products is more used in alcohol-free beverages. This sweetener can be integrated with saccharose to reduce the calories of the product and produce foods that are useful for people with diabetes and obesity. However, the bitter taste is one of the challenges and problems that occur when stevia is used in food products which can be somewhat solved by mixing it with other sweeteners [5]. Since no study has examined the different parts of the stevia plant, this study aims to separate the bitter part of Stevia rebaudiana that is detected with a bitter taste sense and lacks the sweetening compounds of this plant [2].

Importance and necessity of research:

Nutrition is one of the most critical parts of diabetes treatment. A diabetic patient can eat anything if they have a healthy diet and control their blood sugar. Most delicious foods with attractive appearances around us contain carbohydrates that are harmful to diabetic patients because these macros increase the blood sugar of these patients.

This research aims to prepare a functional food with high nutritional value which is what diabetic patients like. A food that not only has conventional nutritional properties but also is healthy, so they can use it freely.

This halva was made after examining the chemical, physical, and sensory properties of Stevia, oat flour, wheat bran flour, and whey. We used stevia which is a calorie-free sweetener and a good sugar substitute to make this halva. This plant is known as a bio-sweetener without calory [15].

This study found that Stervinoline is the most common compound available in the alcoholic extract of the bitter part of the stevia plant.

A study has shown that Stervinoline applies its antioxidant and anti-inflammatory properties either by removing the free radicals or preventing the production of nitrogen oxide and pro-inflammatory cytokines [17].

This halva is made of wheat bran flour and oat flour. Wheat bran and oat flour are the richest nutritional sources of fiber and plant fibers contain high amounts of protein, carbohydrates, minerals, and vitamins of groups B and E playing an important role in the diet of diabetic patients [19].

Wheat and oat bran are complex carbohydrates and good substitutes for simple carbohydrates (sugar and starch materials). The human body can digest carbohydrates simply through fast interactions and sugar transfer in blood flow. Therefore, we can reduce the glyceride and cholesterol of diabetic patients by using wheat bran and oats [6].

Whey is a thin and watery liquid with yellow-green or sometimes yellow-blue colors. This valuable liquid that makes a large volume of byproducts of cheese and casein-producing industry is mainly poured away as waste. One of the major problems in developing countries is the lack of some micronutrients, including Vitamin A. Enriching foods with Vitamin A is one of the solutions to this problem. This nutrient (vitamin A) is abundant in whey [4]. Therefore, it is expected that the nutritional value of foods in terms of vitamins increases by adding whey to them.

Now, the prevalence of diabetes has made a suitable diet one of the main concerns among these patients thinking of using those foods that do not raise their hypoglycemia. In this research, after the sugar-free halva was made using stevia, oat flour, wheat bran flour, and whey, it was tested in terms of physical, chemical, and sensory properties. In the cooking process, this halva was cooked by deleting the sugar and instead using stevia as the sweetener of this halva, so its sugar became zero. Therefore, this product can be a suitable dietary snack for obese people and those who suffer from diabetes, and sweet foods raise their blood sugar. According to sensory evaluations, this sugar-free halva is welcomed and accepted. Diabetic patients can eat this halva without raising blood sugar but this food is rich in some minerals, such as calcium, magnesium, iron, potassium, sodium, etc. that are useful for patients with diabetes.

Objectives:

The purpose of this study is to produce dietary (sugar-free) functional halva for diabetic people using stevia plant, a bio-sweetener, oats, and wheat bran flour to keep healthy diet and health conditions of these patients.

Background:

Seyed Mahmoodzade (2019) expresses that it is vital to use calorie-free and low-calory substitutes in the production of foods with decreased carbohydrate and fat levels. In this research, the best formulation was determined for chocolate dairy dessert using stevia as a sugar substitute and inulin as a fat substitute. The practical purpose of this study is to produce dietary products for people with cardiovascular diseases, hypoglycemia, insulin-independent diabetes, obesity, etc. [1].

Falah Shojaee et al. (2017) evaluated the antioxidant activity of the methanol extract of Stevia in dairy desserts and the possible substitution of sugar with stevia plant in the dessert's formulation. The results showed that stevia extract can be used as a sugar substitute in dairy desserts, so dairy desserts containing stevia indicated high levels of free radical scavenging activity and increased shelf life [13].

Assaei et al. (2016) indicated that consumption of 400mg per body weight of stevia extract for 28 days significantly reduces FBS and triglyceride in diabetic Sprague-Dawley rats. In another study, it was shown that 250 and 500mg stevia extract per body weight for 30 days led to a significant reduction in glucose and triglyceride in diabetic rats despite the decline in Omentin [10].

Project implementation specifications:

A: type of study, method, and project implementation

Stevia extraction

This is an empirical study that was conducted through a review of authentic relevant articles. In the first phase, stevia leaves were cleaned and powdered. The plant powder was mixed in the aquatic solvent at 30°C temperature and kept for 24 hours at room temperature. The mixture was stirred for 3 minutes at different hours during the 24 hours. After the watering phase, the walls of the mixture container (aquatic solvent and plant powder) were affected by ultrasound waves by a home ultrasound device (massager) with 20kHz frequency and 10w power for 20 minutes. In the next phase, the mixture was filtered within two steps using a cloth-made filter to remove plant debris then the mixture was passed through a Whatman with a 10-micron mash size and a blue-colored filtration paper with 2-3-micron size to remove contaminations. After the filtration phase, the condensation phase was done through evaporation in which, the clear solution obtained from the filtration phase was poured into a proper container and put on a low heat to reach evaporation without any boiling and seeing bubbles just observing the steam rising.

The condensation phase was continued based on the evaporation technique until the solution concentration reached 70%. In the next phase, active carbon filtration was used to treat and improve the solution (color, smell, and taste). In this phase, the solution was treated in a vertical column (active

carbon sterile gas- active carbon sterile gas- sterile gas) with two repetitions. Now, the sweet solution is ready.

It is worth noting that to reach the sweet powder of this plant, the sweet solution was heated based on the evaporation technique after the treatment phase until it reached 90% condensation. Finally, the 90% compensated solution was poured into a suitable plate and kept at room temperature so its remaining water evaporated. Therefore, the sweet powder of the stevia plant is obtained and is easily soluble in different beverages.

(1) (2) (3)

Data collecting instrument:

Data collecting was done by searching through Google Scholar studying the relevant topics and papers, and consulting with food experts.

Statistical society:

According to the presented model, this step was done in a familial ceremony by the family. The general acceptance of cooked halva was determined based on a ranking test technique by five members of the family. These evaluators were randomly selected based on their interests and understanding abilities. They had experience cooking halva at home and became aware of how to fill out the form before the evaluation phase.

Sample size:

Five members

Sampling method:

Ranking test technique

Data analysis technique:

A) Physical and chemical specifications

It was not possible to measure the amount of sugar, carbohydrate, and protein in the laboratory because this study was done during COVID-19 and schools' closure, so nutrition facts were reported by referring to the authenticate papers and considering specifications of stevia, whey oat flour, and wheat bran flour. Stevia content of this halva distinguishes it from other types, so diabetic patients can eat it without any worry. Moreover, the high-qualified properties of whey, oat four, and wheat bran flour would enrich the halva with minerals.

Table 1. Nutrition facts about halva

Nutrition value	Oats per 100g	Wheat bran per 100g	Whey per 100g	Stevia liquid per 100g
Energy	210kcal	216kcal	27kcal	*
Calcium	115mg	73mg	51mg	722.0mg
Iron	2.30mg	10.57mg	5mg	31.1g
Carbohydrate	66.3g	64.51g	1	11.3g
Fiber	10.6g	42.80g	*	*
Sugar	*	0.41g	0.53mg	11.3g
Cholesterol	*	*	3	2.7g
Magnesium	24mg	611mg	9mg	*
Sodium	388mg	2mg	57mg	32.7mg
Protein	16.8mg	15.55mg	11mg	12.0g
Potassium	124.000mg	1182.00mg	169mg	839mg

Findings:

Table 1 reports the ingredients of considered halva, which confirms that the final product is functional. Moreover, stevia is a natural sweetener that plays a significant role in producing innovative products. The results reported in the table confirm the suitable quality of the product for diabetic patients.

B) Sensory evaluation:

In terms of sensory evaluation of halva, 5 evaluators (interested in halva) were selected. The five-point hedonic scale was used for sensory evaluation in which, 1 indicates the lowest score while 5 indicates the highest score. First, all three types of halva were prepared then the sensory indicators, including appearance, color, taste, smell, texture, and overall acceptance of each sample were evaluated.

Table 2. Tasting test of functional halva

Evaluator	**1**			**2**			**3**			**4**			**5**		
Sample code / Factors	**A_1**	**A_2**	**A_3**	**A_1**	**A_2**	**A_3**	**A_1**	**A_2**	**A_3**	**A_1**	**A_2**	**A_3**	**A_1**	**A_2**	**A_3**
Color	4	3	5	4	4	5	3	3	5	4	4	5	3	4	5
Smell	4	4	5	3	3	5	4	3	5	3	4	5	4	3	5
Taste	4	3	5	4	3	5	4	4	5	4	4	5	4	4	5
Mouthfeel	3	4	5	3	4	5	4	4	5	4	3	5	4	4	5
Texture	3	3	5	4	4	5	4	4	5	4	4	5	4	4	5
Overall acceptance (1-5)	4	3	5	4	4	5	4	4	5	4	4	5	4	4	5

Ranking scale: 1) very bad 2) bad 3) moderate 4) good 5) very good

Halva A_1: 100% oat flour halva A_2: 100% wheat bran flour halva A_3: 50% wheat bran flour and 50% oat flour

Limitations:

1. Not testing on diabetic patients
2. Access to laboratory measurement devices

Ethical considerations:

1. Considering the production of a product that is affordable for most households.
2. Lack of testing on diabetic patients.

3. Technical characteristics of project result:

1. Using ultrasound waves:

Ultrasound waves with low intensity break the cell structure as a non-destructive process then extract the bioactive compounds in the plant matrix and improve the yield trend.

2. Filtration: the purpose is to remove debris, environmental contaminations, heavy metals, microbial and fungal contamination

3. Condensation:

The purpose is sterilizing the solution, evaporating the solution, and condensing the considered solution

4. Treatment with active carbon; purpose: improving the color, taste, and condensate solution.

A: Specification of final product:

In this halva, stevia (sugar substitute), oat flour, and wheat bran flour are used which contain high polyphenols and fibers. The fiber-containing foods improve blood sugar and prevent some diseases, such as diabetes, heart disease, and digestive disorders because fiber contained in the food helps slow digestion. It means that glucose is gradually absorbed into the blood, so adjusts the blood sugar. Diabetic patients can use this halva as a useful snack without any worry.

B: How to ensure achieving the final result and project ending required professions

(1)

(2)

(3)

According to sensory evaluation and overall acceptance, halva (3) obtained the highest score in terms of appearance, color, smell, taste, mouthfeel, and texture.

5. Project Implementation

A) Ingredients:

Ingredients of the halva included oat flour, wheat bran flour, stevia (sugar substitute), vegetable oil, whey, rosewater, saffron, and cardamom. The whey was traditionally extracted from cheese making it in the home. Stevia plant was used instead of sugar in this halva, and the stevia was extracted as a liquid using an evaporation technique to use its best version in cooking halva.

Table 3. The ingredients used in the formulation of functional halva (%)

Halva	Oat flour	Wheat bran flour	Stevia	Oil	Cardamom	Rosewater	Whey
A_1	39.34	-	40.98	16.39	0.81	0.81	1.63
A_2	-	39.34	40.98	16.39	0.81	0.81	1.63
A_3	19.67	19.67	40.98	16.39	0.81	0.81	1.63

With three repetitions

How to make halva

First, oat flour was heated for 5 minutes then the bran flour was added and fried for 10 minutes, and a little vegetable oil was added and fried for 5-10 minutes then the salt-free whey was added and mixed well. After 5 minutes, stevia liquid was added and mixed until the liquid and flour were mixed and halva became soft. Based on the taste, a little saffron or cardamom is ground and added to halva and mixed then it is ready after 10 minutes. It is worth noting that halva was cooked in three forms. In the first recipe, 100% oat flour was used, while 100% wheat bran flour was used in the second recipe, and 50% wheat bran flour and 50% oat flour were used in the first form.

How to select and prepare ingredients

- The following ingredients were used to cook green halva for diabetic patients:
- To prepare oat flour:

Oat was bought from a popular store in Shiraz, then the oats were cleaned and washed to use in cooking halva.

- To prepare wheat bran flour:

Wheat bran flour was prepared from high-quality wheat purchased from popular farmers in Bavanat County, and then the wheat bran was prepared with a traditional and hygienic technique.

- To prepare stevia, the plant was purchased in clean packs from a traditional herb store in Shiraz then was purified under the supervision of laboratory sciences and used by the food expert.

Conclusions:

Because carbohydrate is one of the most important sources of increasing calories and diabetes has become prevalent in the world, many food industries have paid attention to reducing this important source and replacing it with calorie-free or low-calorie sweeteners. In this case, the stevia plant has received great attention as a calory-free bio-sweetener that is a good sugar substitute. For this purpose, the functional halva was cooked using stevia extract, wheat bran flour, and oat flour with percentages mentioned in Table 3. The made halva was evaluated by presenting the sensory evaluation based on a five-point hedonic scale inserted in Table 2. The highest score was given to taste assessment factors of halva A3 that had higher acceptance than other samples in terms of sensory, physical, and chemical features.

conflict of interest financial support and ethical statements

We do not have a conflict of interest in this article, because we did not destroy anyone's rights and did not copy from anywhere, we did not cause any profit or loss to anyone, and the four names mentioned in the article are also aware of it, and no body or place helped us as we wanted Thank them.

Conflict of interest:

None.

Financial support:

None.

Ethics statement:

None.

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