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Development and characterization of some vegan spreadable desserts without added sugar, enriched with essential oils

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Abstract

Raw vegan desserts without added sugar have become very popular among consumers in recent years, as they keep vitamins, enzymes and other heat-labile substances intact, while also bringing energy, vitality and contributing to good health. This work aimed to obtain two varieties of raw vegan desserts, without added sugar, using avocado pulp, banana pulp and dates as raw materials: one with added cocoa powder and nutmeg essential oil (SRVD1), and the second, allergen-free, containing carob powder and black pepper essential oil (SRVD2). For both raw materials and finished products, the total polyphenol content was determined by the Folin-Ciocalteu assay, DPPH free radical scavenging activity, proximate composition, as well as sensory characteristics (5-point hedonic scale method). From the raw materials, cocoa powder stood out with the highest TPC (10.15±0.14 mg GAE/g) and the strongest 2,2-diphenyl-1-picrylhydrazyl free radical scavenging activity (95.21±0.34%), followed by carob powder (7.02±0.06 mg GAE/g, respectively 90.31±0.27%). In terms of finished products, the SRVD1 assortment had the highest TPC and the best antiradical activity (2.07±0.03 mg GAE/g.12±0.33%). The two varieties of spreadable raw vegan desserts had very similar values of the proximate composition, SRVD2 assortment being slightly richer in total carbohydrates, sugars and dietary fiber. The sensory evaluation of the products resulted in very good scores for all the characteristics analyzed.

Keywords: raw vegan desserts, polyphenols, antioxidant activity, proximate composition, essential oils.

1. Introduction

Nowadays, raw-vegan, sugar-free desserts are gaining more and more popularity among consumers, satisfying their sweet tooth, providing the body with high quality carbohydrates, fats and proteins, as well as enzymes, vitamins, minerals, polyphenols, natural pigments. They also eliminate the health risks associated with frequent consumption of products high in refined sugar, animal fats, cholesterol [1,2]. Vegan diets are usually richer in dietary fiber, magnesium, folic acid, vitamins C and E, iron and phytochemicals, and tend to be lower in calories, saturated fat and cholesterol, long-chain n-3 fatty acids (omega-3), vitamin D, calcium, zinc and vitamin B-12. In general, vegans usually enjoy a lower risk of cardiovascular disease (CVD), obesity, type 2 diabetes and some cancers. A vegan diet

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appears to be useful for increasing intake of protective nutrients and minimizing intake of dietary factors implicated in several chronic diseases [3-5]. In the development of the food industry, there is a trend to create new innovative technologies to the production of healthy and functional foods for different population groups. As confectionery products are popular around the world, there have been advances in the development of alternative, updated desserts: gluten-free, lactose-free and with natural sugar substitutes. These desserts are of vegan origin [6-9]. As raw materials for obtaining these vegan desserts, a variety of dried fruits are used, such as: figs, dates, raisins, goji berries, but also fresh ones: bananas, apples, pears, mangoes, pineapples, which provide a sweet taste, without the need for additional sugar or other sweeteners. Avocado tree, native to Mexico and Central America, belongs to the family *Lauraceae*, genus *Persea* and comprises two subgenera: *Persea* and *Eriodaphne*. Avocados grown for agricultural purposes belong to two species of the genus *Persea* [10]. Fruits of different avocado varieties vary in moisture and oil content, from less than 5% to more than 30% oil [11]. Avocado's high nutritional value and the usefulness of its unsaturated oils in promoting heart and circulatory health are expected to attract interest from ageing populations in much of the world. Beneficial effects have also been found in relieving physiological stress [12]. Several preclinical studies conducted over the past decades emphasize the unique nutritional and phytochemical characteristics of avocado fruit and their potential in the treatment and prevention of various diseases. Avocado fruit has cumulative effects in preventing and treating oxidative stress and age-related degenerative diseases, being rich in polyphenols and carotenoids, compounds with powerful antioxidant action [13]. The date palm known as *Phoenix dactylifera* is one of the oldest (5500-3000 BC) cultivated cultivars of palm trees, with nutritional, ecological, economic and ornamental properties [14]. Dates contain 6.5-11.5% total dietary fiber (of which 84-94% insoluble and 6-16% soluble), about 1% fat, 2% protein, 2% ash and are also a rich source of phenolic antioxidants (1-2%). There are many health benefits of dates, as this fruit is rich in natural fiber in addition to vitamins and minerals. Dates help protect against many chronic diseases, including cancer and heart disease. Many studies have reported that date fruit extract is also helpful in reducing blood cholesterol levels [15]. Banana is the fruit of evergreen monocotyledonous, perennial, giant herb, exclusively subtropical belonging to the genus *Musa* from the family *Musaceae*. Bananas are an important source of phytonutrients including phenolic compounds and vitamins, dietary fiber, minerals, especially potassium, phosphorus, calcium, zinc, manganese, iron, magnesium, copper [16]. Beyond its nutritional value, the banana fruit has various medicinal properties being known for its antidiarrheal, antimicrobial, healing, anticarcinogenic, antiulcer, antiulcerigenic, antilitic, hypoglycemic and antioxidant actions [17]. The cocoa tree (*Theobroma cacao* L.) is among the crops of major economic interest in several countries. Cocoa powder is made from cocoa beans that have been refined, shelled and roasted [18]. Cocoa bean products are a highly nutritious food for all types of people, rich in protein, vitamins, minerals, carbohydrates, quality fats and a rich source of polyphenols with comparatively higher antioxidant activity than teas and red wines [19]. The carob tree (*Ceratonia siliqua* L.) belongs to the *Leguminosae* family and is widely cultivated in the Mediterranean area, where it is considered an important component of vegetation for economic and environmental purposes [20]. Carob powder contains a variety of nutrients, including fiber, sugar and various polyphenols; many minerals and amino acids are also present. Numerous phytochemical compounds with anti-tumor, anti-proliferative and pro-apoptotic properties have been identified in carob powder [21]. Known since antiquity for their antiseptic properties, i.e. bactericidal, virucidal and fungicidal, for their medicinal properties and for their fragrance, essential oils have gained particular interest in recent years, especially for their pharmaceutical and food uses which have become increasingly widespread as alternatives to synthetic chemicals to protect the ecological balance [22]. Nutmeg essential oil has various therapeutic applications, such as antioxidant, antimicrobial, anticancer, and others. Black pepper essential oil constitutes approximately 0.4-7% of the dry weight of the peppercorns and is a powerful antioxidant, beneficial for managing rheumatism, colds, fatigue, muscle pain and infections [23].

The aim of this work was to obtain two types of spreadable dessert without added sugar, using avocado pulp, banana pulp and dates as raw materials: one with the addition of cocoa powder and nutmeg essential oil (SRVD1) and the second, allergen-free, with carob powder and black pepper essential oil (SRVD2). The desserts obtained were characterized in terms of total polyphenol content, antioxidant activity, proximate composition and organoleptic properties.

2. Materials and method

To obtain the raw vegan spreadable desserts without added sugar, the following raw and auxiliary materials (purchased from the Romanian market) were used: bananas, avocados, dates, cocoa powder, carob powder, nutmeg and black pepper essential oils (therapeutic grade - from Young Living).

2.1.Raw vegan spreadable desserts preparation

Two raw vegan spreadable dessert varieties were prepared: SRVD1 and SRVD2 using the recipes in Table 1.

Table 1. Recipes used to make the raw vegan spreadable desserts

Dessert assortment	SRVD1	SRVD2
Banana pulp (%)	36	36
Avocado pulp (%)	42	42
Dates (%)	17	17
Cocoa powder (%)	4.6	-
Carob powder (%)	-	4.6
Nutmeg essential oil (%)	0.4	-
Black pepper essential oil (%)	-	0.4

The technology for obtaining these desserts is simple and environmentally friendly: first the bananas were peeled, then the avocado pulp was removed, all the ingredients were weighed and blended with a Bosch MSM14500 appliance, until a fine paste was obtained. The essential oils were incorporated at the end. The creams obtained were packaged in glass jars, then labeled and stored in the refrigerator. Samples were then taken for physicochemical and sensory analysis from each type of product. The finished products are shown in Figure 1.

2.2.Assessment of total polyphenol content, antioxidant activity and sensory analysis

Assessment of total polyphenol content (TPC) in raw materials and finished products by Folin-Ciocalteu assay, as well as the sensory evaluation of the raw vegan spreadable desserts by the 5-point hedonic scale method, were carried out according to those presented by Dumbrava *et al*., (2020) [24]. The evaluation of the DPPH free radical scavenging activity (RSA) was carried out by the method described by Dumbrava *et al*., (2022) [25].

SRVD 1 SRVD 2

Figure 1. – The raw vegan spreadable deserts

2.3.Assessment of proximate composition and energy value

In order to determine the approximate composition and energy value for the two raw vegan spreadable dessert varieties, the USDA Nutritional Database was used.

2.4.Statistical analysis

For TPC and RSA the mean values and standard deviations of all replicates were calculated using Excel software (Microsoft Office 2010).

3. Results and discussions

3.1. Total polyphenol content

The experimental results regarding the total polyphenol content of the raw materials and finished products are presented in Table 2.

Table 2. Total polyphenols content of juices and finished products

Sample	TPC (mg GAE/g)
Banana pulp	0.86±0.03
Avocado pulp	0.29±0.03
Dates	1.62±0.06
Cocoa powder	10.15±0.14
Carob powder	7.02±0.06
SRVD1	2.07±0.03
SRVD2	1.58±0.02

Among the raw materials, cocoa powder had the highest TPC (10.15±0.14 mg GAE/g), followed by carob powder (7.02±0.06 mg GAE/g), and the SRVD1 dessert had a 31%

higher content of these compounds (2.07±0.03 mg GAE/g) than SRVD2. Bashmil *et al*., (2021) [26] found in the pulp of bananas of different varieties a TPC ranging between 0.38±0.01 and 1.28±0.03 mg GAE/g, the results determined in the present work falling within this range. For avocado pulp of different varieties, Liu *et al*., (2023) [27] reported a TPC ranging between 0.20±0.01 and 0.28±0.01 mg GAE/g, the results from our study being slightly above the upper limit of this range. Regarding TPC in dates, the results in this work are within the range found by Khairuddin et al., (2017) [28]: 1.51 and 5.62 mg GAE/g. For cocoa powder, Alash *et al*., (2020) [29] determined a higher content of total polyphenols: 16.75 ± 0.25 mg GAE/g, while Ioannou *et al*., (2023) [30] reported lower TPC values for carob powder: between 1.06 and 2.25 mg GAE/g.

3.2.Antioxidant properties analysis

DPPH free radical scavenging activity (RSA) determined to express the antioxidant activity of raw materials and finished products, led to the results presented in Table 3.

Table 3.- RSA for raw materials and finished products

Sample	Dilution	RSA (%)
Banana pulp	1:10	86.36±0.23
Avocado pulp	1:10	87.51±0.21
Dates	1:10	84.42±0.22
Cocoa powder	1:10	95.21±0.34
Carob powder	1:10	90.31±0.27
SRVD1	1:10	90.12±0.33
SRVD2	1:10	89.08±0.32

From the analysis of the results regarding the DPPH free radical scavenging activity for the extracts (1:10) in 70% ethanol, it is noted that, among the raw materials, cocoa powder had the strongest RSA: 95.21±0.34%, followed by carob powder 90.31±0.27%, the lowest value being recorded in the case of dates: 84.42±0.22%. In the case of finished products, both were distinguished by high antioxidant activity, the SRVD1 assortment had an RSA of 90.12±0.33%, slightly higher than SRVD2: 89.08±0.32%

3.3.Proximate composition and energy value

Calculations regarding the proximate composition and energy value of the two finished products, using the USDA Nutritional Database, led to the results shown in Figures 2 and 3.

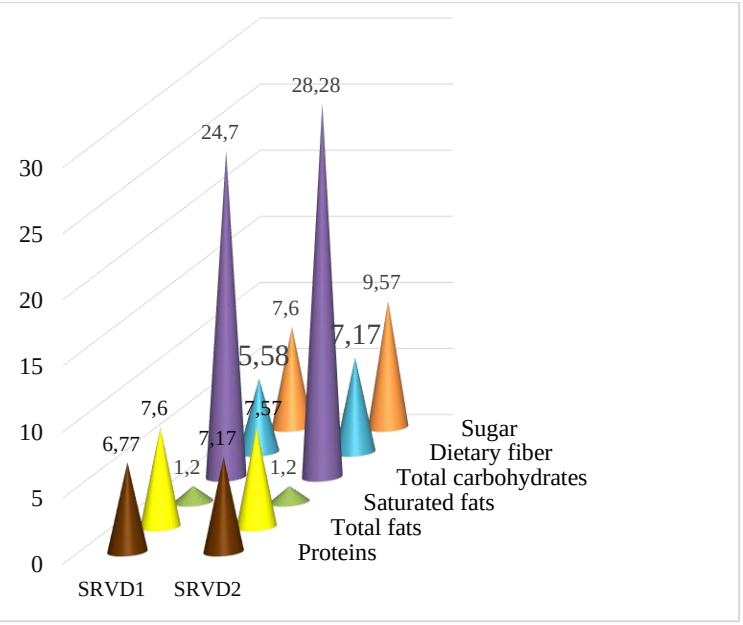

Figure 2. Proximate composition of spreadable raw vegan desserts (g/100g)

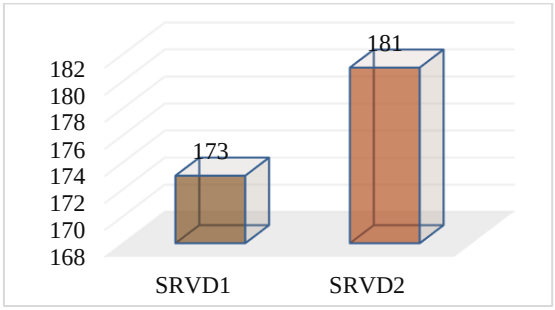

Figure 3. Energy values (kcal/100g) of finished products

As can be seen from Figure 2, the proximate composition of the two finished product varieties is very similar, SRVD2 being slightly richer in proteins, total carbohydrates, dietary fiber and sugars than SRVD1. Also, the energy value of SRVD2 (181 kcal/100g) was 4.6% higher than SRVD1 (173 kcal/100g). Both in SRVD1 and SRVD2, the relatively low content of lipids, total carbohydrates and sugars (7.60, 24,70, 7.60, respectively: 7.57, 28.28 and 9.57 g/100g) for the spreadable cream dessert category is noted, but also the fairly high content of fiber and protein (5.58 and 6.77, respectively 7.17 and also 7.17 g/100g).

3.4.Sensory analysis

Organoleptic evaluation of the two raw vegan spreadable dessert varieties developed in this work, carried out by 20 panelists aged between 21-57 years, led to the results presented in

Figures 4 and 5.

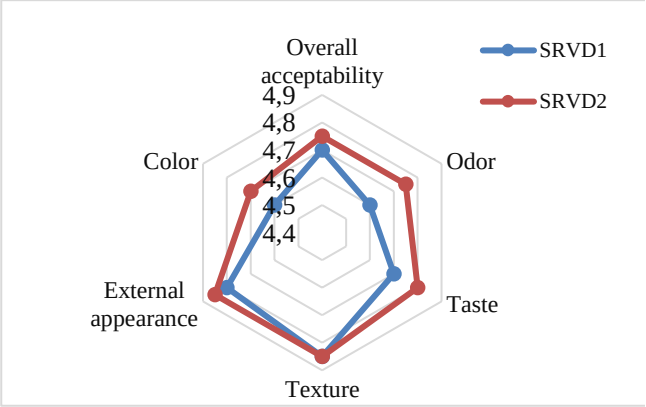

Figure 4. Global values of the developed desserts organoleptic evaluation

Both varieties of raw-vegan spreadable desserts were very well accepted by the tasters, obtaining scores from 4.6 to 4.85 for the analyzed organoleptic characteristics. Except for texture, where both products obtained the same score (4.85), in the other sensory characteristics, the SRVD2 assortment with carob powder and black pepper essential oil obtained higher ratings than SRVD1.

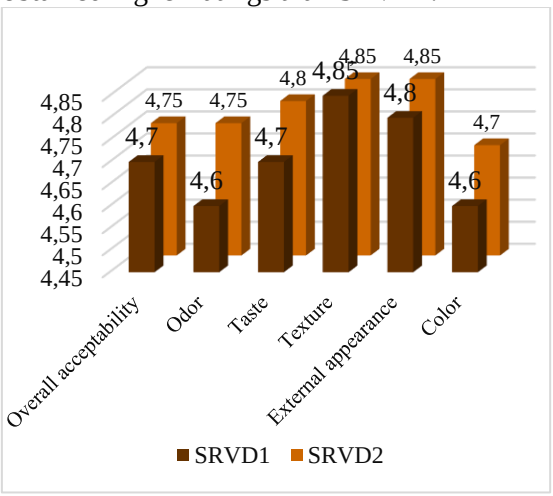

Figure 5. Organoleptic characteristics of jellies

4. Conclusions

As a response to the growing consumer demand for healthy desserts that do not contain added sugar, provide extra vitamins and other bioactive substances, and can also be eaten by diabetics or people with various food allergies, two varieties of innovative spreadable raw-vegan dessert creams without added sugar have been developed in this work, in view of a future technology transfer. The raw materials used for both assortments were banana pulp, avocado pulp and dates, one of the products being made with added cocoa powder and nutmeg essential oil, while the second was allergen-free using carob powder and black pepper essential oil. This kind of desserts, obtained through a simple and environmentally friendly technology, constitute a much healthier alternative to the sugary, thermally processed and additive-laden dessert creams that exist on the market. The products developed in this work are very rich in polyphenolic compounds, have a very good antioxidant activity, are not thermally processed - thus keeping the thermolabile bioactive compounds intact, do not contain added sugar - thus being suitable for people with restrictions in sugar consumption, do not contain animal products - which makes them suitable for vegans, and their organoleptic properties are very good.

Compliance with Ethics Requirements

Author declares that he respects the journal's ethics requirements. Author declares no conflict of interest.

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