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Rheological, Physical Properties and Sensory Evaluation of Biscuits Enriched with Chia Seed Powder

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ABSTRACT

Biscuits enriched with Chia seed powder (CSP) are a kind of nutritional and functional bakery product. The aim of this research is to evaluate the supplement of wheat flour by chia seed powder at different levels (5, 7, 10 and 15%) in the manufacture of biscuit. The antioxidant capacity, phenolic compounds, physical analysis, texture, rheological properties (farinography, extensography tests) and sensory evaluation of the dough samples were evaluated. The results showed that chia seed powder had a potential antioxidant capacity because it contains phenolic compounds. Withregard to farinography and extensography tests, it was observed that increasing the level of substitution with chia seed powder, the time to reach the maximum consistency of the dough reduced. Also the extensibility of the dough decreased significantly, which represents the possibility of using chia seed powder in biscuits with replacement level up to 15% without any negative effect on the rheological properties of the dough. Determining the physical properties of biscuit samples showed a decrease in biscuit size, and the results of the texture profile analysis showed an increase in hardness and cohesiveness by adding chia seed powder. Overall acceptance of biscuits did not differ significantly up to the 7% substitution level, Therefore, nutritional and functional improvement of products using chia is a very promising concept, and recommended to use chia seed powder in the production of biscuits and other baking products for contains to its antioxidants and other nutrients.

Keywords: Chia seed Powder, Biscuits, Rheological, Physical, Sensory Properties

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INTRODUCTION

Chia seed (*Salvia hispanica L.*) is an oil seed plant grown commercially in many countries, including southern Mexico, Guatemala, Australia, and the United States. Its seeds are widely recognized as nutrient dense addition to healthy diets. Chia seeds are full of nutrients and becoming a part of human nutrition. So, many researchers focused on the utilization of from chia seeds in preparing some untraditional diets, because they seed contains many natural nutrients including protein, fiber, vitamins, minerals and other important constituent's i.e., omega-3 fatty acid, phytosterols and antioxidants, as tocopherols, carotenoids and phenolic compounds, which considered a useful nutrients (***Knez Hrnčič, Maša, et al., 2020 and Muñoz-González et al., 2019*****).** Chia seed powder can be a source of bioactive components and natural antioxidants that can reduce the incidence of certain diseases such as cardiovascular diseases, inhibition of rancidity of unsaturated fatty acids, and higher antioxidant activity due to the presence of phenolic compounds in the seeds **(Reyes-Caudillo *et al.*, 2008 and Marineli *et al.*, 2014).**

Biscuits are widely consumed processed food products as they enjoy wide popularity as a ready-to-eat food available in the market, have good nutritional quality, are inexpensive, cater to all different tastes, and have a longer shelf life **(Agama-Acevedo et al. 2012)**

Recently, consumers around the world are getting more attention in formulating functional bakery products such as gluten-free products such as those containing chia, which reduce biscuits saturated fat intake by increasing intake of ω-3 fatty acids which essential to the human diet due to their efficacy and prevention of chronic diseases **(Dinçoğlu and Yeşildemir, 2019).**

The farinograph method is still the leading standard tool in assessment of the rheological and technological behavior of wheat flours containing health promoting additives during the bread dough develop end and mixing processes. This has been demonstrated in numerous publications **(Ahmad *et al.,* 2016; Bigne *et al.,* 2016 and Nicolae *et al.,* 2016).**

The aim of this work is to evaluate the addition of chia seeds powder by different levels to wheat flour in the manufacture of biscuits and its effect on physical, rheological analysis and sensory evaluation of Biscuits.

MATERIALS AND METHODS

. **Raw material:**

Chia seeds were obtained from Agricultural Research Center, Giza, Egypt, while, wheat flour (72% extraction), sugar, butter, fresh eggs, active dry yeast, vanilla, salt, baking powder and corn oil were purshased from a local market in Giza.

Preparation of Chia seed powder

Chia seeds were cleaned free of any impurities and then ground with a Moulinex grinder (French, Model MC300132, 180W, Capacity: 80g), then this powder was taken and fine-tuned to pass through a standard 40-mesh sieve. This method corresponds to **Mihafu *et al.,* (2020)**, the method of grinding chia seeds in (Moulinex grinder, AR11, China) to obtaincompletechiapowder

Determination of antioxidants in Chia seed powder
Analysis of antioxidant capacity by DPPH

Chia seed powder was analyzed for its radical scavenging activities using 2,2-diphenyl-1-picrylhydrazyl (DPPH) as an antioxidant assay according to the method reported by **Yen and Chen, (1995)**
Analysis of the total phenolic content

Total phenol contents (TPC) of Chia seeds powder were determinned by using the Folin-Ciocalteau reagent method according the method reported by **Ameer *et al.,* (2017).** A spectrophotometer (UV-1800, Shimadzu Inst. Co., Ltd, Kyoto, Japan) was used and all measurements were recorded at 765 nm and the results expressed as gallic acid equivalent (mg GAE)/ 100 mg dry weight (DW).

Preparation of Biscuit and Biscuit formulas

The ingredients used in preparing the biscuits (wheat flour, chia seed powder with different replacement ratios (5, 7, 10 and 15%), eggs, vanilla, water, butter, sugar, baking powder, salt and milk powder were weighed as shown in Table (1).

The biscuits were made by gently mashing the butter with a fork, then adding the eggs and whisking with a wooden spoon until a light and fluffy mixture was obtained, while using a rubber spatula to constantly scrape the mixture from the bowl. The rest of the ingredients (wheat flour, chia seed powder, vanilla, water, sugar, baking powder, salt, and powdered milk) was added to the mixing bowl. The mixture was mixed well to obtain a dough. Biscuit pieces were formed in a circular shape using a stainless-steel circular cutter with a diameter of 5 cm and a thickness of 2 mm. After obtaining forty pieces of biscuits, they were baked at 190 °C / 20 minutes in a conventional oven (Memmert UNE 400 Germany) according to **Chelladurai *et al.*, (2019).**

Rheological Characteristics of dough:

Farinograph test:

The Farinograph instrument (Brabender Duis Bur G, type 810105001 No. 941026, Germany) was used to determine the water absorption and mixing properties of the dough prepared from the different mixtures to be studied by replacing wheat flour with chia powder in proportions of 5, 7, 10 and 15%. The Farinogram parameters (i.e., arrival time (AT), dough development time (DDT), Stability (ST), and degree of softening
(DS) were obtained from the Farinograms except for the percentage of water absorption (WA) which It was recorded directly from the Farinograph burette as described by **AACC, (2010).**

Extensograph test:

Extensograph tests were performed on wheat flour dough as well as mixtures with different substitution ratios of flour and chia powder according to the method described in **AACC, (2010)** using an Extensograph (Brabender Duis Bur G, type 860001, No. 946003, Germany), to obtain the maximum resistance of the dough to stretching. (R, elasticity), dough expansion (E), Proportional Number (P.N) and dough forming energy (E).

Physical properties of biscuits

The physical properties of the biscuits were measured after cooling to determine width and height according to the method described by **AACC (2010)** where the biscuit sample was placed edge-to-edge and the width was measured, it was then rotated 90° and re-measured to obtain the average diameter (Width, W). Then, they were stacked on top of each other and the thickness (height) was measured, reassembled in different order, and re-measured, to obtain the average thickness (T).

Spread ratio was calculated according to the following equation as described by **Salama (2002)**. The average weight of five biscuits was measured in g.

Spread ratio = width (W) / thickness (T)

The volume of biscuits was measured in cm^3 by rapeseed displacement. Specific volume (cm^3/ g) was calculated by dividing the volume (in cm^3) by the weight (in g) and the water activity of biscuits was measured at 25 °C with using chloride sodium and potassium nitrate according to the method described by an AquaLAB CX-2 (Decagon Devices Inc., Pullmand, WA, USA) as described by **Mesías et al., (2023)**.

Texture analysis of biscuit mixes

Biscuit mixes prepared by adding chia seed powder with different substitution ratios were screened and their properties were for texture profile (TP) were evaluated using a Brookfield CT3 instrument (Brookfield Engineering Laboratories, Inc., MA 02346-1031, USA) using a TA-JTPB AACC-compatible probe, **(AACC, 2010)**, in which a sample of biscuit, about 2 mm thick, was placed under a three-point bender and a TA7 blade was used to assemble the mass probe and the following characteristics were determined:

Hardness (N) (average of cycle 1 and cycle 2), adhesiveness (MJ), fracturability (N), cohesiveness, gumminess (N) and chewiness (MJ), as described in the operating instruction manual, were the most capable factors to distinguish the texture of the dough is the hardness, adhesion, and cohesion as described by **Abd-El-Khalek, M.H. (2012)**.

Sensory evaluation

Sensory evaluation of biscuit samples was performed by ten judges trained at the Food Technology Research Institute (FTRI) to assess the overall acceptability of the biscuit, its appearance, texture, taste, color and odor. He used a 9-point hedonic scale with corresponding values ranging from 1 (very disliked) to 9 (very liked) as described by **Meilgaard *et al.*, (2016).**

Statistical analysis

Data obtained from different tests were expressed as the Mean±SE and they were analyzed statistically using the one-way analysis of variance ANOVA followed by Duncan's test. In all cases $p \leq 0.05$ was used as the criterion of statistical significance by SAS program **SAS, (2003)**.

RESULTS AND DISCUSSION

Antioxidants in chia seeds powder

Total phenolic content and antioxidant scavenging by DPPH was determined in chia seed powder and the results are listed in **Table (2),** which show, that chia seed powder is a good source of total phenols, as it recorded 1.85 (mg GAE/g), while the free radical scavenging activity was high, reaching 24.26 %. These results are consistent with those obtained by **Oliveira-Alves *et al.*, (2017).** According to the results, chia seed powder can be a source of bioactive components and natural antioxidants that have the ability to reduce the incidence of certain diseases such as cardiovascular diseases, inhibition of rancidity of unsaturated fatty acids and higher antioxidant activity due to the presence of phenolic compounds in the seed powder **(Reyes-Caudillo et al., 2008 and Marineli *et al.*, 2014).**

Rheological properties of biscuit dough samples:
Farinograph characteristics:

Afarinograph curve gives two important physical properties of flour: water absorption, the amount of water required for a dough to reach a defined consistency and a general profile of the mixing behavior, mixing time and mixing stability of dough.

The effect of supplemented wheat flour with chia seed powder at different levels on the properties of the dough farinograph (Table 3) showed an increase in the water absorption percentage with an increase in the percentages of chia seed powder in the biscuit dough. The water absorption rate (WAR) (%) was from 64.0 up to 66.0% for control, 5%, 7%, 10% and 15% replacement, respectively. This can be attributed to the high fiber content which is a defining feature of chia seed powder.

In addition, it can be seen that the arrival time (AT) (min.) increased with increasing the percentage of chia seed powder in biscuit dough, and the highest arrival time was 3.5 minutes at 10% replacement, then decreased after that to one min at 15% replacement.

Also, the results in the same table showed that, by increasing the percentage of chia powder in the biscuit dough, the dough development time (DDT) (min.) decreases. This is probably due to the increased amount of fat in the chia powder which reached to 30% as illustrated by **(Sudha *et al.*, 2007 and Marta et al., 2016).** The stability time (ST) of the dough decreased with the increase content percentages of chia seeds powder in the biscuit dough compared to the control sample, but it was equally decreasing at (5%, 7%) and (10%, 15%). This is due to the weakness of the gluten network, which led to a decrease in its stability. These results were in agreement with the results of **Abd-El-Khalek and Youssif, (2018).**

On the other hand, an increase in the softness of biscuit dough samples was observed with an increase in the proportions of chia seed powder in biscuit dough samples, expressed in Barbander units, compared to the control sample.

Extensoghraph characteristics:

Extensograph provides information on the viscoelastic behavior of such dough's **(Rosell *et al.*, 2001**) as it measures the dough elasticity and resistance to stretching. The combination of elasticity and extensibility is a determining factor for the quality of bakery products **(Walker and Hazelton, 1996).**

Table (4) presents the results obtained regarding the extensoghraph characteristics of the biscuit dough, where wheat flour was replaced with different levels of chia seed powder (CSP) and the stretching resistance (elasticity) depends on the amount of glutenin in the dough. The results showed that elasticity increases with the increase in the proportion of chia powder substitution, while the control sample made of wheat dough showed a low elasticity value (490 B.U) compared to the dough samples with a substitution rate of 15% chia seed powder. Tensile of dough is the ability of the dough to stretch and depends on the gliadin protein in the dough. The extensibility of the dough decreases with the increase in the percentage of replacing wheat flour with chia seed powder. Overall, in this study chia seed powder had little effect on elasticity and extensibility. This represents the possibility of using chia seed powder in biscuits, which constitutes a substitution level of up to 15% without any negative effect on the rheological properties of the dough. These obtained results are consistent with those of **Aguirre *et al.,* (2021) and Bölek (2021).**

Physical properties of biscuit samples:

Table (5) shows the analysis of biscuit samples in terms of water activity, weight, diameter, height volume and spreading percentage. The results showed that both water activity and weight did not differ significantly ($p \leq 0.05$) for all replacement ratios from the control sample, but in terms of diameter, there were significant differences ($p \leq 0.05$) at the replacement ratios 7%, 10%, 15%, while at the replacement rate of 5% there was no significant difference ($p \leq 0.05$) compared to the control sample. Similar observation was reported by **Kumar *et al.,* (2015)** who found that diameter of the biscuit containing chia seeds decreased from 62.3 mm to 57.4 mm and for the height there was a significant decrease in both the replacement percentage 7%, 15% compared to the control.

With regard to biscuit volume, all replacement levels had no significant differences ($p \leq 0.05$) compared to the control sample, except for the 15% replacement percentage that showed a significant decrease compared to the control sample. This might be attributed to the dilution of gluten (as a result of replacement with chia seed powder) which lead by its turn to a decrease in biscuit volume as mentioned by **Aguirre *et al.,* (2021)**. For the spread ratio, there were no significant differences ($p \leq 0.05$) for all replacement levels compared to the control sample, except for the 15% replacement rate, which an increase in the spread ratio had compared to the control sample terms of the spread factor the results were in agreement with **Song et al., (2019)**.

Where led The replacement of wheat flour with chia seeds significantly decreased water activity of the biscuits as compared with the control sample ($p < 0.05$), were observed (Table 5) biscuits fortified by 15% CSP has decreased water activity , this means that with an increase in the replacement ratio of chia powder , (WA) decreases , due to the absorption of a large amount of water by the chia fiber and these values of water activity that obtained in our study agreement with the results of **Mesías et al., (2023)**.

Texture profile analysis of biscuit samples supplemented with different percentages of chia seeds powder:

The results of texture profile analysis (TPA) of biscuits made with chia seed powder are presented in Table (6). In general, some substitution ratios showed clear differences in the coefficients of hardness (N), adhesion (MJ), refraction (N), cohesion, mucilage (N), and chewability (MJ). Where the results showed that there was an increase in each of the following parameters: hardness, Adhesiveness, Fracturability, Cohesiveness and Gumminess as a result of an increase in the replacement percentage of 15% added from chia powder, while a decrease in the chewing property occurred with an increase in the replacement percentage of chia powder, compared to the control sample. Where, whether the increase or decrease that occurred in the biscuit samples, it became clear as a result of the percentage of fat, sugar, and the amount of water added, as the biscuit is thin and easy to break and this is result to the high percentage of fat in chia powder, and These results are consistent with those of ***Jan et al.,2022***.

Sensory evaluation of biscuits samples supplemented with different percentages of chia seeds powder:

Table (7) shows that there were significant differences between biscuit samples at ($p \leq 0.05$) in terms of color, where these results showed that the color tones became significantly darker with an increase in the level of substitution of wheat flour used in manufacturing with chia seed powder. The same observation has been found by **Syed-Ahmed *et al.,* (2018)** and can be clearly seen in **Fig. (1)**.

In addition, the biscuit samples obtained significantly lower organoleptical scores only at the higher levels of replacement with chia seed powder (i.e., 10 a nd 15%), when compared to the control sample in other sensory attributes (appearance, texture and flavor). However, the overall acceptability of the biscuit samples did not differ significantly, up to 7% substitution level. These results are consistent with those of **Goswami and Awasthi (2022).**

Figures and Table:

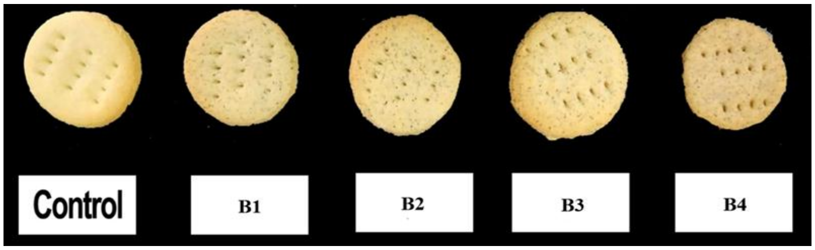

Figure (1): Biscuit samples enriched by different percentages of chia seeds powder versus control sample without chia seeds powder.

Table (1): Biscuit Ingredients (g)

Ingredients	Control	A (5%)	B (7%)	C (10%)	D (15%)
Wheat flour	200.00	190.00	186.00	180.00	170.00
Chia seeds	00.00	10.00	14.00	20.00	30.00
Sugar	36.00	36.00	36.00	36.00	36,00
Water	30.00	30.00	30.00	30.00	30.00
Butter	33.00	33.00	33.00	33.00	33.00
Fresh eggs	20.00	20.00	20.00	20.00	20.00
Baking	0.30	0.30	0.30	0.30	0.30
Salt	1.00	1.00	1.00	1.00	1.00
Milk powder	4.00	4.00	4.00	4.00	4.00

Table (2): Antioxidant power of chia seeds powder

Components	**Value** (mean ± SE)
Total Phenols (mg GAE/g)	1.85 ± 0.07
Scavenging activity **(%)**	24.06 ± 0.04

Table (3): Farinograph characteristics of biscuit dough samples supplemented with different percentages of chia seeds powder.

Biscuit dough samples	Water Absorption Rat (WAR) (%)	Arrival Time (AT) (min)	Dough Development Time (DDT) (min)	Stability (ST) (min)	Degree of Softening (DS) (B.U)
Control (Wheat flour 72%)	64.0	1.0	9.5	15	40
Wheat flour (72%) with 5% CSP	65.0	1.0	9.5	13	70
Wheat flour (72%) with 7% CSP	65.0	2.0	9.0	13	90
Wheat flour (72%) with 10% CSP	66.0	3.5	8.5	10	100
Wheat flour (72%) with 15% CSP	66.0	1.0	7.0	10	110

Where: CSP means Chia seed powder, B.U = Brabender Unit.

Table (4): Extensograph characteristics of biscuit dough samples supplemented with different percentages of chia seeds powder.

Biscuit dough samples	Elasticity (B.U)	Extensibility (mm)	Proportional Number (P. N)	Energy (cm^2)
Control (Wheat flour 72%)	490	190	2.57	190
Wheat flour (72%) with 5% CSP p	520	195	2.66	185
Wheat flour (72%) with 7% CSP	560	160	3.5	165
Wheat flour (72%) with 10% CSP	500	140	3.57	150
Wheat flour (72%) with 15% CSP	590	130	4.53	95

Where: CSP means Chia seed powder, B.U = Brabender Unit. P.N means Proportional Number of dough's

Table (5): Physical analysis of biscuit samples supplemented with different percentages of chia seeds powder.

Property	Biscuits				
	B_0	B_1	B_2	B_3	B_4
Water activity	$0.329^{a}\pm0.08$	$0.366^{a}\pm0.006$	$0.343^{a}\pm0.002$	$0.309^{a}\pm0.008$	$0.263^{a}\pm0.002$
Weight (g)	$7.2^{a}\pm0.21$	$7.9^{a}\pm0.2$	$7.13^{a}\pm0.4$	$7.4^{a}\pm0.3$	$7.01^{a}\pm0.5$
Diameter (m)	$5.1^{ab}\pm0.1$	$5.1^{a}\pm0.04$	$4.8^{c}\pm0.05$	$4.9^{bc}\pm0.1$	$4.6^{d}\pm0.01$
Height (cm)	$0.7^{a}\pm0.033$	$0.7^{a}\pm0.02$	$0.6^{ab}\pm0.01$	$0.6^{a}\pm0.03$	$0.5^{b}\pm0.03$
Volume (cm^3)	$5.3^{a}\pm0.31$	$5.4^{a}\pm0.24$	$4.7^{a}\pm0.1$	$5.1^{a}\pm0.3$	$3.8^{b}\pm0.2$
Spread Ratio	$7.6^{ab}\pm0.33$	$7.6^{ab}\pm0.30$	$7.8^{ab}\pm0.1$	$7.4^{b}\pm0.3$	$8.7^{a}\pm0.5$

Data are mean ± SE, n=3, Different uppercase superscript letters in the same lines represent statistically significant data at 5%. Control: B0 without chia seeds powder (0%), B1: with chia seeds powder (5%), B2: with chia seeds powder (7%), B3: with chia seeds powder (10%) and B4: with chia seeds powder (15%)

Table (6): Texture profile analysis of biscuit samples supplemented with different percentages of chia seeds powder.

Parameter	**Biscuits**				
	B_0	B_1	B_2	B_3	B_4
Hardness (N)	35.45	35.44	40.63	50.97	54.77
Adhesiveness (MJ)	0.10	0.10	0.20	0.25	0.30
Fracturability (N)	34.36	35.44	40.63	50.97	52.10
Cohesiveness	0.70	0.68	0.65	0.66	0.91
Gumminess (N)	46.72	34.83	67.49	26.76	68.50
Chewiness (MJ)	194.3	133.4	132.2	102.2	98.12

Control: B0 without chia seeds powder (0%), B1: with chia seeds powder (5%), B2: with chia seeds powder (7%), B3: with chia seeds powder (10%) and B4: with chia seeds powder (15%). N= is meaning of force, MJ = is a measure of energy

Table (7): Sensory evaluation of biscuit samples supplemented with different percentages of chia seeds powder versus control sample without chia seeds powder.

Sensory attributes	Biscuits blends				
	B_0	B_1	B_2	B_3	B_4
Appearance	$8.9^{a}\pm0.1$	$8.7^{ab}\pm0.15$	$8.6^{ab}\pm0.16$	$8.2^{b}\pm0.24$	$7.2^{c}\pm0.35$
Texture	$8.6^{a}\pm0.22$	$8.5^{a}\pm0.22$	$8.2^{ab}\pm0.20$	$8.2^{ab}\pm0.24$	$7.8^{b}\pm0.24$
Color	$8.7^{a}\pm0.21$	$8.1^{ab}\pm0.17$	$8.1^{ab}\pm0.17$	$7.8^{b}\pm0.29$	$6.7^{c}\pm0.33$
Taste	$8.5^{a}\pm0.26$	$8.4^{a}\pm0.26$	$8.1^{a}\pm0.23$	$8.1^{a}\pm0.31$	$8^{a}\pm0.39$
Odor	$8.7^{a}\pm0.21$	$8.2^{ab}\pm0.20$	$8.3^{ab}\pm0.26$	$8.1^{ab}\pm0.23$	$8^{b}\pm0.25$
Overall	$8.8^{a}\pm0.13$	$8.2^{b}\pm0.13$	$8.3^{ab}\pm0.26$	$8.1^{b}\pm0.17$	$7.8^{b}\pm0.24$

Data are mean ± SE, n=10, Different uppercase superscript letters in the same lines represent statistically significant data at 5%., Control: B0 without chia seeds powder (0%), B1: with chia seeds powder (5%), B2: with chia seeds powder (7%), B3: with c

CONCLUSION

Based on the aforementioned results, it can be concluded that partial supplementation of chia seed powder with wheat flour improved the nutritional value and quality of the biscuits. Organoleptic properties showed that biscuits with up to 15% chia seed powder are acceptable. Biscuits made from chia seed powder showed good physical properties, texture, and good physical properties. Therefore, some functional bakery products can be prepared using chia seed powder with high quality and organoleptic properties.

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الخصائص الريولوجية, الفيزيائية والتقييم الحسي للبسكويت المعزز بمسحوق بذور الشيا

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الملخص الـــعربى

تعزيز البسكويت بمسحوق بذور الشيا (CSP) هو نوع من منتجات المخابز الوظيفية والتغذوية. الهدف من هذا البحث هو تدعيم دقيق القمح المستخدم في صناعة البسكويت بمسحوق بذور الشيا بنسب مختلفة (5، 7، 10 و 15٪). تم تقييم القدرة المضادة للأكسدة، المركبات الفينولية، القوام، الخواص الفيزيائية، الخصائص الريولوجية (الفارينوجراف، الأكستنسوجراف) لعينات العجين والتقييم الحسي للبسكويت. أظهرت النتائج أن مسحوق بذور الشيا له قدرة محتملة كمضاد للأكسدة لاحتوائه على مركبات فينولية. فيما يتعلق باختبارات الفارينوجراف والأكستنسوجراف ، فقد لوحظ أن زيادة نسبة الاستبدال بمسحوق بذور الشيا ، قلل من الوقت للوصول إلى أقصى قدر من الثبات للعجين ، كما أن قابلية التمدد للعجين انخفضت بشكل كبير ، مما يمثل إمكانية استخدام مسحوق بذور الشيا في البسكويت يصل إلى 15٪ من مستوى الاستبدال دون أي تأثير سلبي على الخواص الريولوجية للعجين. أثناء تحديد الخصائص الفيزيائية لعينات البسكويت أظهرت انخفاضاً في حجم البسكويت ، وأظهرت نتائج تحليل صفات القوام زيادة في الصلابة والتماسك بإضافة مسحوق بذور الشيا. لم يختلف مستوى القبول العام للبسكويت بشكل كبير حتى مستوى الاستبدال 7٪، ولكن لوحظ أن 15٪ من البسكويت المضاف بدقيق بذور الشيا كان له فرق كبير مقارنة بالعينة الضابطة. لذلك، يعد التحسين التغذوي والوظيفي للمنتجات باستخدام الشيا مفهوماً واعداً للغاية ويوصى باستخدام مسحوق بذور الشيا في إنتاج البسكويت ومنتجات الخبز الأخرى لما يحتويه من مضادات الأكسدة والعناصر المغذية الأخرى.