

Physico-chemical analysis of cookies by using chia seeds (*Salvia hispanica* L.)

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Abstract

The present study was carried out to prepare cookies by using chia seeds and to evaluate the physico-chemical analysis of the final cookies. Cookies are baked goods that typically have the following three ingredients: flour, sugar, and fat. These three ingredients are combined with other minor ingredients to produce dough. *Salvia hispanica* L., sometimes known as chia, is a plant that the Mayans and Aztecs have long used for food and medicine. It produces a dry, inelastic fruit that is generally referred to as a seed. The plant's seeds have received more recent attention due to their potential health advantages and culinary applications. Following physico-chemical examination, it was also discovered that the treatments varied significantly at the 0.05 level of significance for total energy (%), carbohydrate (%), and protein (%). It was discovered that there is no significant difference between the treatments T₀ and T₁ in the study of total fat (%). Additionally, it was discovered that the treatment combinations T₁ vs. T₂ and T₂ vs. T₃ are not significant in the study of ash (%). At the 0.05 level of significance, it was discovered that there is no difference between the treatments for and moisture (%) content.

Keywords: cookies, *Salvia hispanica* L, physico-chemical analysis, energy (%), carbohydrate (%), and protein

Introduction

Cookies are baked goods that typically have the following three ingredients: flour, sugar, and fat. These three ingredients are combined with other minor ingredients to produce dough. Wheat is primarily employed in baking items because of its valued rheological properties. The main structural ingredient in most batter and dough products is wheat flour. As a result of the gluten presence, which enables air cell expansion and provides rigidity after baking, it can carry out these textural duties. However, compared to oilseeds and pulses, wheat protein is weak in some key amino acids and has a lower protein content (Kulkarni *et al.* 2013 and Murugkar 2014).

Chia, or Salvia hispanica L., is an annual herb that is native to southern Mexico and northern Guatemala. It belongs to the Salvia genus, Labiate mint family, and Nepetoideae subfamily of the Lamiales order. There are roughly 900 species of the genus Salvia, which has existed for thousands of years in many different parts of the world, such as Southern Africa, Central America, North and South America, and South-East Asia.

Because of their nutritional benefits and therapeutic uses, chia seeds have recently become one of the most well-known foods in the world (Ullah *et al.*, 2016; Das 2017; Mohd *et al.*, 2012; de *et al.*, 2017; Silva *et al.*, 2016) [7, 2, 12, 3, 6]. According to Coorey *et al.* (2012) [1], Chia is a great component because it has the highest known concentration of -linolenic acid and is simple to incorporate into processed foods. Numerous studies have suggested that chia seeds may be essential for good health, antioxidant activity, and antibacterial activity because of the high percentage of fatty acids they contain.

In a recent study, chia seeds were used to make cookies, and the physico-chemical analysis of the finished cookies was assessed.

Materials and Methods

Procurement of raw material

The ingredients for the quinoa flour cookies were all purchased from Pryagraj's neighbourhood market: wheat flour, sugar, oil, chia seeds, and baking powder.

Treatment combination

T₀= Wheat Flour (100%) + Chia seeds (0 %) Baking at 150°C for 20 Mins

T₁= Wheat Flour (90%) + Chia seeds (10 %) + Baking at 150°C for 20 Mins

T₂= Wheat Flour (80%) + Chia seeds (20 %) + Baking at 150°C for 20 Mins

T₃= Wheat Flour (70%) + Chia seeds (30 %) + Baking at 150°C for 20 Mins

Results and Discussion

Table 1: Table showing the total energy content (kcal/100gm) of final prepared cookies.

Treatments	T ₀	T ₁	T ₂	T ₃
mean	416.0800	435.5800	439.9900	457.4100
Sample std.dev.	0.0755	0.0656	0.0917	0.1311
std. Error	0.0436	0.0379	0.0529	0.0757

Figure 1 showed the findings of the total energy (kcal/100gm) content of cookies baking at 150° c for 20 mins. It was found that mean value of total energy (kcal/100gm) of treatment combination (t₀ to t₄) are 416.0800 (± 0.0436^a), 435.5800 (± 0.0379^b), 439.9900 (± 0.0529^c) and 457.4100 (± 0.0757^d) respectively.

Table 1.1: One-way ANOVA of treatments:

source	SS	degrees of freedom	MS	F statistic	p-value
treatment	2,594.6703	3	864.8901	97,178.6634	1.1102e-16
error	0.0712	8	0.0089		
total	2,594.7415	11			

The p-value corresponding to the F-statistic of one-way ANOVA is higher than 0.05, suggesting that the treatments

are significantly different for that level of significance.

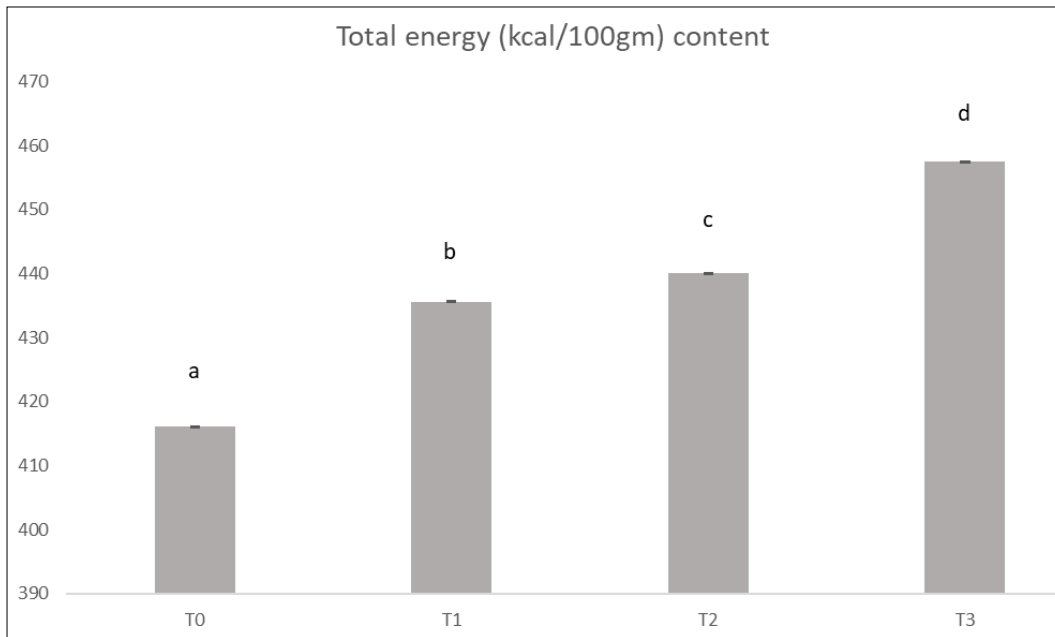


Fig 1: Graphical representation of Peroxide Value (miliequ/1000gm) of Tray Dryer T₃ of different treatments. (All the samples were evaluated in triplicate. In the similar column, different superscript alphabet showed significant difference).

Table 2: Table showing the total carbohydrates content (%) of final prepared cookies.

Treatments	T ₀	T ₁	T ₂	T ₃
mean	40.8600	40.4500	41.3200	42.7633
Sample std.dev.	0.0755	0.0656	0.1054	0.0493
std. Error	0.0436	0.0379	0.0608	0.0285

Table 2.1: One-way ANOVA of treatments:

source	SS	degrees of freedom	MS	F statistic	p-value
treatment	9.1455	3	3.0485	518.1586	1.6878e-09
error	0.0471	8	0.0059		
total	9.1926	11			

Figure 2 showed the findings of the total carbohydrate (%) content of cookies baking at 150° c for 20 mins. It was found that mean value of total carbohydrates (%) of treatment combination (t₀ to t₄) are 40.8600 (± 0.0436^a), 40.4500 (± 0.0379^b), 41.3200 (± 0.0608^c) and 42.7633 (± 0.0285^d) respectively.

The p-value corresponding to the F-statistic of one-way ANOVA is higher than 0.05, suggesting that the treatments are significantly different for that level of significance.

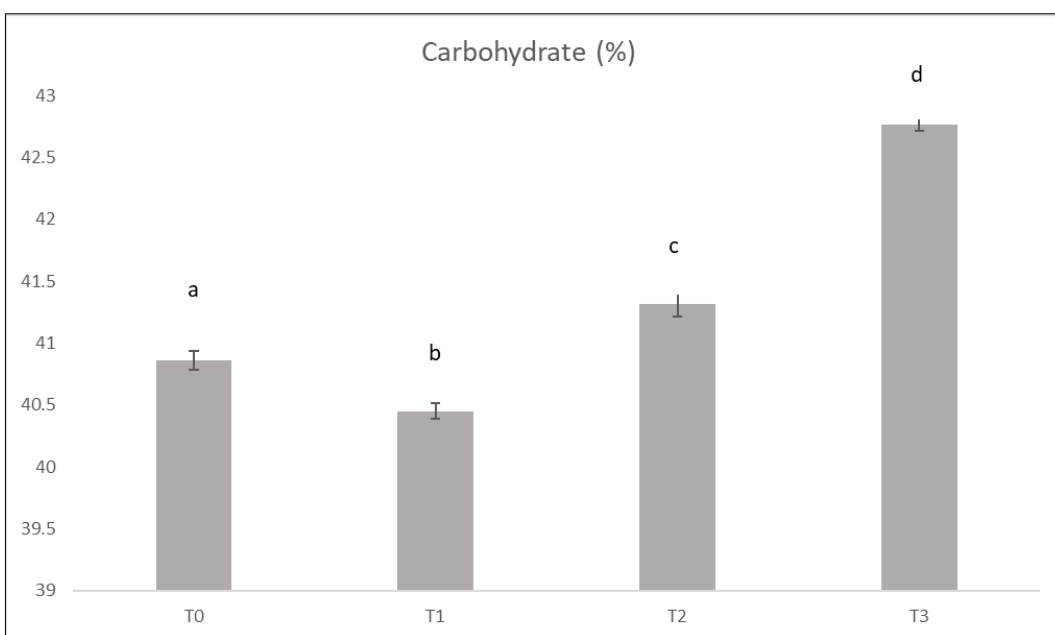


Fig 2: Graphical representation of Peroxide Value (miliequ/1000gm) of Tray Dryer T₃ of different treatments. (All the samples were evaluated in triplicate. In the similar column, different superscript alphabet showed significant difference).

Table 3: Table showing the total protein content (%) of final prepared cookies.

Treatments	T ₀	T ₁	T ₂	T ₃
mean	5.5300	5.6100	5.6200	5.7600
Sample std.dev.	0.0721	0.1136	0.0954	0.1323
std. Error	0.0416	0.0656	0.0551	0.0764

Figure 3 showed the findings of the total protein (%) content of cookies baking at 150° c for 20 mins. It was found that mean value of total protein (%) of treatment combination (t₀ to t₄) are 5.5300 (± 0.0416^a), 5.6100 (± 0.0656^b), 5.6200 (± 0.0551^c) and 5.7600 (± 0.0764^d) respectively.

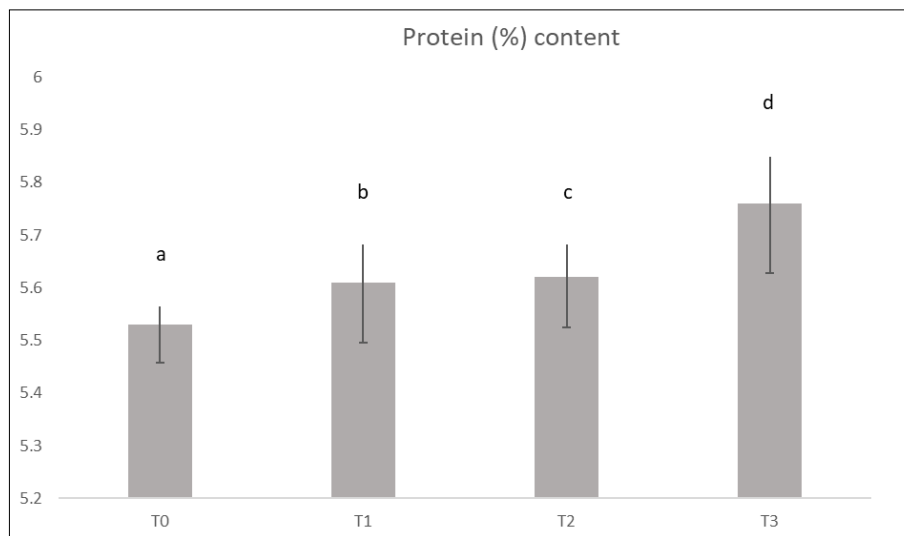


Fig 3: Graphical representation of Peroxide Value (miliequ/1000gm) of Tray Dryer T₃ of different treatments. (All the samples were evaluated in triplicate. In the similar column, different superscript alphabet showed significant difference).

Table 4: Table showing the total fat content (%) of final prepared cookies.

Treatments	T ₀	T ₁	T ₂	T ₃
mean	27.7800	27.8400	28.3500	29.2300
Sample std.dev.	0.1249	0.0500	0.0755	0.1058
std. Error	0.0721	0.0289	0.0436	0.0611

Figure 4 showed the findings of the total fat (%) content of cookies baking at 150° c for 20 mins. It was found that mean value of total fat (%) of treatment combination (t₀ to t₄) are 27.7800 (± 0.0721^a), 27.8400 (± 0.0289^b), 28.3500 (± 0.0436^c) and 29.2300 (± 0.0611^d) respectively.

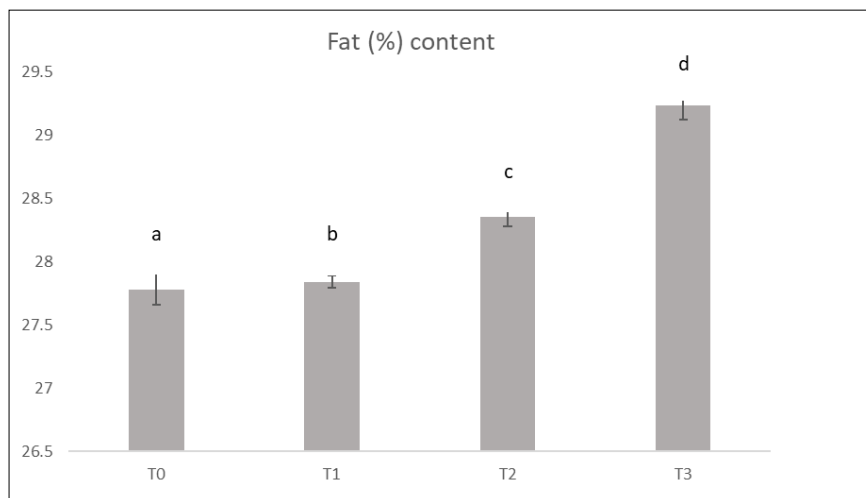


Fig 4: Graphical representation of Peroxide Value (miliequ/1000gm) of Tray Dryer T₃ of different treatments. (All the samples were evaluated in triplicate. In the similar column, different superscript alphabet showed significant difference).

Table 3.1: One-way ANOVA of treatments:

source	SS	degrees of freedom	MS	F statistic	p-value
treatment	0.0822	3	0.0274	2.4519	0.1381
error	0.0894	8	0.0112		
total	0.1716	11			

The p-value corresponding to the F-statistic of one-way ANOVA is higher than 0.05, suggesting that the treatments are not significantly different for that level of significance.

Table 4.1: One-way ANOVA of treatments:

source	SS	degrees of freedom	MS	F statistic	p-value
treatment	4.0482	3	1.3494	154.2171	2.0403e-07
error	0.0700	8	0.0087		
total	4.1182	11			

The p-value corresponding to the F-statistic of one-way ANOVA is lower than 0.05, suggesting that the treatment T₀ and T₁ are not significantly different.

Table 5: Table showing the total ash content (%) of final prepared cookies.

Treatments	T ₀	T ₁	T ₂	T ₃
mean	1.3400	1.5500	1.6400	1.8500
Sample std.dev.	0.0500	0.1054	0.0700	0.1114
std. Error	0.0289	0.0608	0.0404	0.0643

Figure 5 showed the findings of the total ash (%) content of cookies baking at 150° c for 20 mins. It was found that mean value of total ash (%) of treatment combination (t₀ to t₄) are 1.3400 (± 0.0289^a), 1.5500 (± 0.0608^b), 1.6400 (± 0.0404^c) and 1.8500 (± 0.0643^d) respectively.

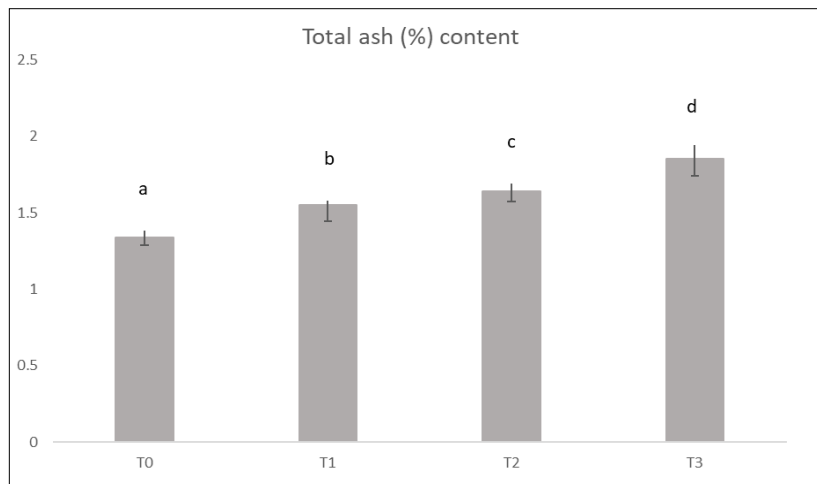


Fig 5: Graphical representation of Peroxide Value (miliequ/1000gm) of Tray Dryer T₃ of different treatments. (All the samples were evaluated in triplicate. In the similar column, different superscript alphabet showed significant difference).

Table 6: Table showing the total moisture content (%) of final prepared cookies.

Treatments	T ₀	T ₁	T ₂	T ₃
mean	0.4300	0.6900	0.8800	0.9000
Sample std.dev.	0.1114	0.0721	0.0700	0.0436
std. Error	0.0643	0.0416	0.0404	0.0252

Figure 6 showed the findings of the total moisture (%) content of cookies baking at 150° c for 20 mins. It was found that mean value of total moisture (%) of treatment combination (t₀ to t₄) are 0.4300 (± 0.0643^a), 0.6900 (± 0.0416^b), 0.8800 (± 0.0404^c) and 0.9000 (± 0.0252^d) respectively.

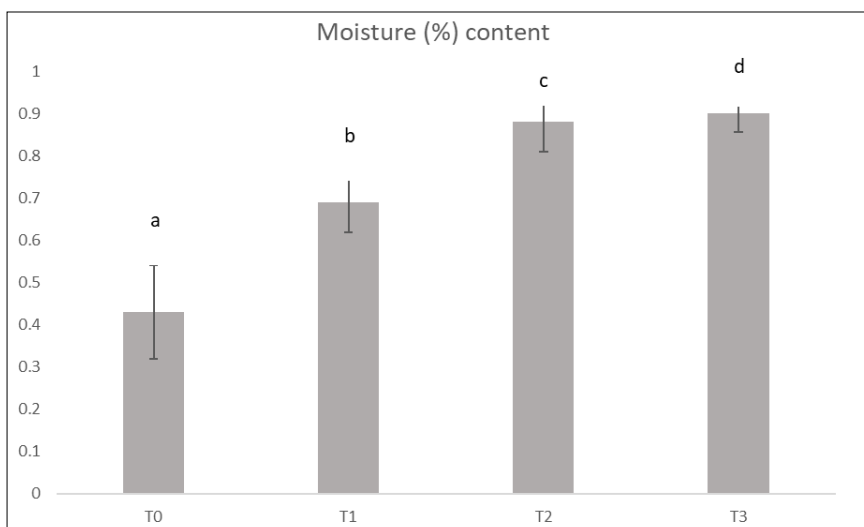


Fig 6: Graphical representation of Peroxide Value (miliequ/1000gm) of Tray Dryer T₃ of different treatments. (All the samples were evaluated in triplicate. In the similar column, different superscript alphabet showed significant difference).

Table 5.1: One-way ANOVA of treatments:

source	SS	degrees of freedom	MS	F statistic	p-value
treatment	0.4023	3	0.1341	17.3592	0.0007
error	0.0618	8	0.0077		
total	0.4641	11			

The p-value corresponding to the F-statistic of one-way ANOVA is lower than 0.05, suggesting that the treatment combinations T₀ vs T₁, T₁ vs T₂ and T₂ vs T₃ are insignificant.

Table 6.1: One-way ANOVA of treatments:

source	SS	degrees of freedom	MS	F statistic	p-value
treatment	0.4287	3	0.1429	23.4262	0.0003
error	0.0488	8	0.0061		
total	0.4775	11			

The p-value corresponding to the F-statistic of one-way ANOVA is lower than 0.05, suggesting that the treatment combinations T₁ vs T₂ and T₂ vs T₃ are insignificant.

Conclusion

According to the results of the physico-chemical study, the mean total energy values for the treatment combinations (T0 to T4) are 416.0800 ($\pm 0.0436^a$), 435.5800 ($\pm 0.0379^b$), 439.9900 ($\pm 0.0529^c$), and 457.4100 ($\pm 0.0757^d$), respectively. The mean total carbohydrate percentages for the treatment combinations (T0 to T4) are, respectively, 40.8600 ($\pm 0.0436^a$), 40.4500 ($\pm 0.0379^b$), 41.3200 ($\pm 0.0608^c$), and 42.7633 ($\pm 0.0285^d$). The mean total protein (%) values for the various treatment combinations (T0 to T4) are, respectively, 5.5300 ($\pm 0.0416^a$), 5.6100 ($\pm 0.0656^b$), 5.6200 ($\pm 0.0551^c$), and 5.7600 ($\pm 0.0764^d$). The average percentage of total fat in each treatment group (T0-T4) is 27.7800 ($\pm 0.0721^a$), 27.8400 ($\pm 0.0289^b$), 28.3500 ($\pm 0.0436^c$), and 29.2300 ($\pm 0.0611^d$), respectively. The mean value of total ash (%) of treatment combination (t₀ to t₄) are 1.3400 ($\pm 0.0289^a$), 1.5500 ($\pm 0.0608^b$), 1.6400 ($\pm 0.0404^c$) and 1.8500 ($\pm 0.0643^d$) respectively. The mean value of total moisture (%) of treatment combination (t₀ to t₄) are 0.4300 ($\pm 0.0643^a$), 0.6900 ($\pm 0.0416^b$), 0.8800 ($\pm 0.0404^c$) and 0.9000 ($\pm 0.0252^d$) respectively. After analysis of physico-chemical analysis it was also found that for total energy (%), carbohydrate (%) and protein (%) the treatments are significantly different at 0.05 level of significance. In case of analysis of total fat (%) it was found that the treatment T0 and T1 are not significantly different. And in case of analysis of ash (%) it was also found that the treatment combinations T₁ vs T₂ and T₂ vs T₃ are insignificant. In case of and moisture (%) content it was found that treatments are insignificant difference at 0.05 level of significance.

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