Uluslararası Tarım Araştırmalarında Yenilikçi Yaklaşımlar Dergisi
International Journal of Innovative Approaches in Agricultural Research 2023, Vol. 7 (1), 135-147
https://doi.org/10.29329/ijiaar.2023.536.10


Original article

# Evaluation the Effects of Chia Supplementation on Basisa Functional Properties

Wedad Muhammad Abu Manjil [a], Muna Abdulsalam Ilowefah [b, *] & Hanen Bin Ismail [c]

[a] Department of Home Economics, Faculty of Agriculture, University of Tripoli, Libya
[b] Department of Food Technology, Faculty of Food Sciences, Sebha University, Libya
[c] Department of Agri-Food Industrial, University of Carthage, Tunisia

**Abstract**

Bassissa is one of the traditional Arabian foods and characterized by high nutritional value and health benefits. However, its preparation procedures could negatively influence its nutritional components. Accordingly, the objectives of this research was to supplement bassissa with chia powder by 5 and 10% and evaluate its effects on bassissa nutritional and sensory attributes. Three types of bassissa were prepared according to their original areas in Libya. Then, dietary fiber, omega 6, omega 3, bioactive compounds (ascorbic acid, riboflavin, thiamine and pyridoxine), minerals and sensory properties of bassissa samples were measured. The results indicated that addition of chia by 5 or 10% to all bassissa samples significantly increased total dietary fiber. Furthermore, adding chia by 5 or 10% caused a significant ($p < 0.05$) elevation in the content of ascorbic acid, riboflavin, thiamine and pyridoxine. Moreover, chia-fortified bassissa significantly recorded higher values of the studied minerals and omega 3 and 6. The sensory properties of chia-fortified samples had higher grades compared to the controls. Chia powder can be used as a functional ingredient and as an improver of the sensory and nutritional properties of bassissa.

**Keywords:** Bassissa; Chia; Polyunsaturated Fatty Acids; Minerals; Vitamins; Dietary Fibers.

**Received:** 06 December 2022 * **Accepted:** 13 March 2023 * **DOI:** https://doi.org/10.29329/ijiaar.2023.536.10

* **Corresponding author:**

Muna Abdulsalam Ilowefah is a faculty member at department of Food Technology, Faculty of Food Sciences, Sebha University. Her research interests include functional foods. She lives in Sebha city, Libya.
Email: mona.milad2005@mail.com

## INTRODUCTION

Food supplementation is one of the most important way to obtain healthy manufactured foods. Micronutrients, such as vitamins, minerals and omega 3 and 6 are the common components that used to enhance food products nutritional value (El Ati-Hellal and Hellal, 2021; Aguirre et al., 2021). Improving the quality of food products by providing benefits to consumers and decreasing risks is the goal of food scientists and food organizations. According to the Food and agriculture organization (FAO) the most fortified foods are cereals and their products, milk and dairy products, fat and oil products (FAO / WHO 2006).

Sufficient nutrition is a significant element in preventing several civilization-related diseases, like cardiovascular diseases, obesity, diabetes and cancers. Progressively, an essential health supporting role is attributed to the bioactive food constituents. The bioactive components have been defined as nutritional substances or non-nutritional components naturally existed in the raw material or generated in the product due to technological processes that might enhance, prevent or modify physiological and metabolic functions in the human body (Biesalski et al., 2009). These bioactive components include dietary fibre, vitamins, polyphenols, probiotics, carotenoids, fatty acids, phytoestrogens, bioactive peptides, prebiotics and sterols (Knez Hrnčič et al,. 2019).

There are some popular foods known in the Arab world rich in their nutritional value. Bassissa, zumita, Bazin, and Asida are the most popular cereal-based products in the Maghreb Union region (Gharbi Yahyaoui et al., 2017). These foods are water based porridges and beverages that are known with their high nutrition values. Nevertheless, there are few scientific studies regarding their chemical composition and their health effects. Bassissa is an aromatized cereal fine powder, principally composed of cereals, leguminous and dried herbs. It is considered one of the popular foods famous in the Maghreb region (Gharbi Yahyaoui et al., 2017). The components of bassissa and the procedures of preparing it differ from one region to another throughout the Maghreb Countries (Sayed-Ahmad et al., 2018).

Bassissa often consists of chickpeas, lentils, beans, barley and wheat in certain proportions according to the geographical area (Gharbi Yahiaoui et al., 2018). In addition to some optional spices, like turmeric, fennel, thyme, wreath and coriander. Bassissa is prepared by cleaning those materials and roasting cereal grains through hot sand. After that, all the ingredients are mixed and milled to a fine flour, which consumed by mixing it with water or olive oil, some consumers prefer it sweetened with sugar or honey (Gharbi Yahiaoui et al., 2018).

Bassissa should contain most of the nutrients found in grains, legumes and spices utilized to prepare it. Meanwhile, the manufacturing processes that take place during preparation could negativity affect those nutrients. For example, grinding process leads to a loss in vitamins and minerals (Kumar et al., 2011). Roasting enhances flavor, and therefore improve sensory properties. However, it contributes on certain undesirable alterations decreasing nutritional value, such as Maillard reaction products and some toxic compounds like furfural, hydroxymethylfurfural and glucosylisomaltol (Rufián-Henares et al., 2009).

Chia seeds (*Salvia hispanica*) is an annual herbaceous belongs to the family of Lamiaceae, and it grown in tropical and subtropical areas. It is well-known as a food ingredient, specifically in terms of its health properties (Fernandez et al., 2008; Kulczy´nski et al., 2019). Chia seeds are an example of a raw material having considerable technological and nutritional properties that utilized as food ingredients in many foodstuffs, such as baked products, dairy drinks, salads and as thickeners in soups and sauces (Steffolani et al., 2015). Chia seeds contain high amount of oil (30%), and it has been reported that chia oil the richest source of alpha-linolenic acid (up to 67%) in comparison to the other food sources of alpha-linolenic acid (Nadeem et al., 2017). It is also a rich source of protein (19-27%). This content of protein is greater than that of other typical food crops, including wheat, maize and rice (Knez Hrnčič et al., 2019). Ash in chia seeds represents 4 to 5%; moreover, it is rich in fiber content (18-30%) (Heshe et al., 2016). Besides, chia seeds contain a high amount of phenolic compounds and antioxidants, including chlorogenic acid, caffeic acids, quercetin and kaempferol (Nadeem et al., 2017).

Introducing chia seeds as food additives can help the digestive system function well, as well as lower cholesterol and blood glucose levels (Parker et al., 2018). European Food Safety Authority has reported that chia is a safe new food ingredient, which would encourage its use to enhance food products nutritional value. Chia seeds were previously added to eggs and gluten-free bread (Parker et al., 2020). Moreover, introducing chia into rats diet increased the density of LDL and omega-3 fatty acids, and decreased triglyceride levels in the serum of rats (Ayerza and Coates, 2009). It has also been reported that the use of ground chia seeds can be more beneficial to obtain the potential benefits of its bioactive compounds such as fatty acids and fiber (Muñoz et al., 2012; Ullah et al., 2016). Also, bassissa could lack of some nutrients such as omega-3, 6 and some vitamins, which need to be enhanced. Consequently, the objectives of this study were to evaluate nutritional properties including dietary fiber, vitamins, omega 3, 6 and minerals for three different bassissa samples prepared according to their original place in Libya before and after supplementation of chia powder supplementation.

## MATERIALS and METHODS

### Materials

Wheat, lentils, fenugreek, chickpeas, turmeric, cumin and chia were purchased from the local supermarkets in Tripoli. These raw materials were used to prepare bassissa samples. The used chemicals in this study, which included sulfuric acid, nitric acid, sodium hydroxid, boric acid, petroleum ether, chloroform, methanol, standraded of vitamins, minerals and omega 3, 6 were purchased from Sigma.

**Preparation of sample**

Bassissa was prepared using the previous ingredients in different proportions (Table 1). The ingredients were cleaned and wheat, fenugreek and chickpeas grains were roasted. Then, all the ingredients were mixed according to the methods of its preparation in three Libyan regions (Gharyan, Zintan and Tripoli) to obtain three bassissa samples with different quantities of the used ingredients. Then, bassissa samples were milled and sieved through 4 µm sieve to attain a fine flour, chia powder was added to all bassissa samples by 5% and 10%. The samples were kept refrigerated in plastic bags until use.

**Dietary fiber measurement**

The amount of dietary fiber was estimated by using Fibertec 1023 according to the enzymatic methods approved by (AOAC 2005).

**Ascorbic acid, riboflavin, thiamine and pyridoxine determinations**

Ascorbic acid, riboflavin, thiamine and pyridoxine contents was estimated by using HPLC (Agilent 1260 Infinity II Prime, LC System China) as described by Shahid et al. (2020).

**Omega 3, 6 fatty acids measurements**

Folch method (chloroform:methanol 2:1v/v) was used to determine omega levels using gas chromatography (Agilent 6890, Agilent Technology, china) equipped with capillary column (30m per 0.25mm ID, 0.25 um film thickness) and flam ionization detector (FLD) (Thermo Tr-5, Thermo Fisher Scientific). The instrument used helium (He) as the carrier gas with 0.2 ml/min, experiment was conducted according to the method suggested by El-Yazbi and El-Hawiet (2017).

**Determination of minerals**

Minerals were determined by an ATOMIC Absorption spectrophotometer (A, A8600, 1998, Australia), following the method of AOAC (2005).

**Sensory evaluation**

Sensory properties, which included color, favor, taste and texture, were evaluated by fiftheen panelists in the field of food science and technology from Department of Food Sciences, Faculty of Agriculture, University of Tripoli. The bassissa samples were mixed with olive oil in a plastic cup and were given to each panelists, who evaluated three samples for every type of bassissa at a time. The used scale was from 1-9, where 1-3 points “like slightly”, 4-6 points “like moderately” and 7-9 points “like very much”. Accordingly, the mean score for each property was calculated.

### Statistical analysis

Data obtained were subjected to analysis of variance (ANOVA), while Duncan's test with a confidant interval of 95% were used to report the significant differences between the treatment means using SPSS 16 (USA 2016).

## RESULTS AND DISCUSSION

### Total dietary fiber

The amount of dietary fiber is an indicator of the nutritional and functional values of a food product, as it is a great component in maintaining health and preventing diseases. The dietary fiber contents in the control bassissa samples were significantly different as shown in Table (2). Tripoli sample recorded the highest amount (4.30g/100g), while Zintan sample recorded the lowest value (2.54 g/100g). In general, adding chia by 5 or 10% to all bassissa samples significantly increased total dietary fiber. Nevertheless, there was significant differences between the studied samples ($p < 0.05$). Zintan sample recorded the lowest value (6.30 g/100g) and the highest amount was found in Tripoli sample (9.40g/100g), when chia was added by 5 and 10%. The difference in total fiber in the samples could be related to the differences in the used ingredient proportions. It can be seen that Tripoli sample contain higher amount of cumin (Table 2) which may explain the higher dietary fiber content. Seeds of chia have almost 30–34g dietary fiber of which the insoluble fraction is dominating (85-93%). It is suggested that the amount of dietary fiber in chia seeds overdo their contents in dried fruits, cereals or nuts (Marineli et al., 2015; Reyes-Caudillo et al., 2008). Oliveira et al. (2015) reported that pasta having chia seeds significantly recorded higher nutritive value represented in minerals, protein, and dietary fiber contents compared to the control.

### Ascorbic acid, riboflavin, thiamine and pyridoxine

Chia is a good source of many vitamins, specifically vitamin B complex. Addition of chia by 5 or 10% led to a significant increase in the content of riboflavin, thiamine, pyridoxine and ascorbic acid in all samples, as shown in Table (3). Gharyan bassissa recorded the highest value of ascorbic acid, when chia powder was added by 10%. The greatest increase in the B vitamins was in B6 with Gharyan sample recording the highest value, followed by vitamin B1 with Tripoli sample had the highest proportion, when chia was added by 10%. In general, supplementation of bassissa sample with chia by 10% caused a remarkable increase in all measured vitamins compered to its addition by 5%. Previous research reported the presence of several vitamins in chia seeds mostly vitamin B1, B2, and niacin (USDA 2019; Jin et al., 2012). It can be seen that there are significant variations in the vitamin contents between bassissa samples ($p < 0.05$). The variations in vitamin contents in bassissa samples are mainly due to the differences in their ingredients quantity, like cumin, Fenugreek and chickpea. The differences in the nutritional value between bassissa samples may give an idea of choosing the best ingredients and their quantity for preparing this type of food. Moreover, this variation coube be used as an indication about the best type of bassissa, which can be used as a basis for improving the quality of this food during manufacturing.

**Omega -3 and Omega - 6**

Omega 3 and Omega 6 fatty acids are important component in terms of nutritional point of view. It has been pointed out that theses types of fats play a part in the preventing of diabetes, cardiovascular disease, inflammation, hypertension, cancer, neural function, renal disorders, and improve immune system (Ponnampalam et al., 2021). The difference in the contents of omega 3 in the control samples were not significant. Addition of chia by 5 and 10% significantly increased this component in the fortified samples. Gharyan sample recorded the highest value of alpha-linolenic acid (omega 3) and Tripoli samples had the greatest proportion of Eicosapentaenoic acid (omega 3) ($p < 0.05$), when chia was added by 5% and 10% (Table 4).

In general, there was not significant differences in the omega 6 fatty acid contents in the control samples. Nevertheless, addition of chia led to a noticeable increase in the omega 6 and there were significant differences ($p < 0.05$) between the samples (Table 4). For example, Gharyan and Tripoli samples recorded the highest value of linolenic acid, arachidonic acid and Gamma Linolenic with no significant variation between them. However, they significantly differed with the values presented by Zintan sample, when chia was supplemented by 10%. An investigation pointed out that baked goods fortified with chia had higher amount of omega-3 acids in comparison to the control (Munoz et al., 2012). Chia seeds have great amount of omega fatty acids, which was reflected in the fortified bassissa samples. It is also reported that chia seeds contain higher quantity of omega-3 acids than flaxseed (Villanueva-Bermejo et al., 2019). Accordingly, chia seeds can be utilized as a food ingredient in bassissa preparation to enhance its nutritional properties.

**Minerals**

Table 5 shows the mineral contents of bassissa samples. Sodium was the dominant mineral, followed by Potassium; while, Selenium was the lowest. Supplementation of bassissa with chia powder caused a remarkable elevation in the Zn, Fe, Mg, Ca, Se, Na and K content of the fortified samples (Table 5). In addition, there were significant differences between the samples ($p \leq 0.05$). The same trend can be observed for the mineral content as that of the vitamins and omega fatty acids, since 10% of chia powder led to higher increase compared to 5% for the all studied minerals. Chia seeds contain numerous minerals, mainly phosphorus, calcium, potassium and magnesium, which are found in high amounts (USDA 2019; Jin et al., 2012). It was previously highlighted that pasta-containing chia seeds considerably showed greater amounts of minerals in comparison to its counterpart (Oliveira et al., 2015). Tripoli sample recorded the greatest value of potassium, sodium and calcium, when chia was added by

10%. The reason might be because of the higher amount of cumin (Table 2). In fact, it was found that cumin is a good source of f iron, sodium, potassium, calcium, zinc and phosphorous (Sultan et al. 2009).

**Sensory evaluation**

The obtained results (Table 6) reported that there were significant differences ($p \leq 0.05$) in the sensory properties of bassissa. Chia-powder fortified bassissa had higher grades in the all measured properties. Tripoli sample color was more appreciated in comparison to the other samples; when, chia was added by 5 or 10%. It can be observed that chia-fortified samples had higher acceptance by consumers compared to their counterparts and addition of 10% chia powder improved most of the studied sensory properties. A previous study revealed that fortification of wheat bread with chia seeds up to 6% did not negatively affect bread sensory properties (Romankiewicz et al., 2017). Moreover, an other research reported that there were no significant alterations between the chia flour fortified-bread and the control in terms of the overall acceptability, with chia-breads having better texture (Steffolani et al., 2015).

**Conclusion**

It can be concluded that chia-fortified bassissa, specifically by 10% were a great source of dietary fiber, vitamins, omega 3, the measured minerals and bioactive compounds. Also, addition of chia powder improved the sensory properties of bassissa. There were variations in the all measured nutritional attributes in the bassissa samples, which could be associated with the differences in their ingredient quantities. Tripoli sample had the highest value of vitamin B1, dietary fiber, calcium, sodium, and potassium, when chia was added by 5 or 10%. More studies are needed to inestigate higher quantity of chia addition on this type of food nutritional value. Also the oxidative stability and ability of chia-fortified bassissa need to be explored.

**Acknowledgements:** The authors appreciate and thank the Center for Industrial Research and the Center for Food Control and the Food Analysis Laboratory in Carthage/ Tunis for their assistance in performing the necessary analysis and accomplishing the research.

**Conflict of interest**

The authors declare that the work is original and has not been published before in any form; also, it is not under consideration for publication elsewhere, all authors have read and approved the work. The authors declare that have no conflict of interest.

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**Table 1**. Proportions of basisa ingredients according to the areas of their origin (Kg)

| **Ingredient** | **Area** | | |
|---|---|---|---|
| | **Gharyan** | **Zintan** | **Tripoli** |
| Wheat | 4.00 | 4.00 | 4.00 |
| Chickpea | 2.00 | 2.00 | 1.50 |
| Lentils | 2.00 | - | 2.00 |
| Fenugreek | 0.10 | 0.10 | 0.05 |
| Turmeric | 0.05 | 0.05 | 0.05 |
| Cumin | 0.10 | 0.10 | 1.50 |
| Sugar | 0.25 | 0.25 | 0.25 |

**Table 2**. Dietary fiber content of control and chia-fortified basisa (g/100g**)**

| **Sample** | **Chia ratio** | | |
|---|---|---|---|
| | 0% | 5% | 10% |
| Gharyan | 3.50±0.06[b] | 8.62±0.34[b] | 8.40±0.21[c] |
| Zintan | 2.54±0.22[c] | 6.30±0.22[c] | 10.16±0.30[b] |
| Tripoli | 4.30±0.06[a] | 9.40±0.23[a] | 12.15±0.20[a] |

Tabular value are means ± standard error, the means with similar letters in a column have no significant differences at 5% probability level.

**Table 3**. Vitamin Contents of control and chia-fortified basisa (mg/100g)

| **Sample** | **Chia ratio** | **Gharyan** | **Zintan** | **Tripoli** |
|---|---|---|---|---|
| Ascorbic acid | 0% | 4.01±0.01[a] | 4.23±0.01[a] | 3.66±0.01[b] |
| | 5% | 17.06±0.01[a] | 16.60±0.01[b] | 17.55±0.03[a] |
| | 10% | 21.47±0.02[a] | 19.51±0.01[c] | 20.35±0.03[b] |
| B6 (pyridoxine) | 0% | 0.07±0.01[b] | 0.10±0.00[a] | 0.10±0.01[a] |
| | 5% | 5.10±0.17[a] | 4.30±0.01[b] | 3.20±0.02[c] |
| | 10% | 8.10±0.03[a] | 7.30±0.02[b] | 6.23±0.01[c] |
| B3 (niacin) | 0% | 0.39±0.03[b] | 0.42±0.01[a] | 0.43±0.01[a] |
| | 5% | 4.01±0.17[a] | 3.20±0.07[b] | 3.83±0.02[b] |
| | 10% | 6.20±0.01[a] | 5.40±0.05[b] | 5.60±0.03[b] |
| B2 (riboflavin) | 0% | 0.09±0.03[b] | 0.40±0.03[a] | 0.43±0.01[a] |
| | 5% | 3.99±0.04[b] | 4.01±0.04[a] | 3.33±0.02[b] |
| | 10% | 5.30±0.03[b] | 6.03±0.03[a] | 5.30±0.01[b] |
| B1 (thiamine) | 0% | 0.18±0.00[b] | 0.43±0.00[a] | 0.02±0.01[b] |
| | 5% | 2.63±0.27[b] | 3.01±0.05[c] | 5.01±0.01[a] |
| | 10% | 6.10±0.03[b] | 6.03±0.05[b] | 8.05±0.01[a] |

Tabular values are means ± standard error, the means with similar letters in a raw have no significant differences at 5% probability level.

**Table 4**. Omega-3and omega-6 fatty acids in the control and chia-fortified basisa

| **Omega 3 (g/100g)** | | | | |
|---|---|---|---|---|
| **Sample** | **Chia ratio** | **Gharyan** | **Zintan** | **Tripoli** |
| Alpha Linolenic | 0% | 0.02±0.00[a] | 0.01±0.00[a] | 0.01±0.00[a] |
| | 5% | 2.00±0.01[a] | 1.85±0.03[b] | 1.87±0.03[b] |
| | 10% | 4.13±0.00[a] | 2.85±0.01[b] | 2.95±0.02[b] |
| Eicosapentaenoic | 0% | 0.01±0.00[a] | 0.01±0.00[a] | 0.01±0.00[a] |
| | 5% | 2.69±0.02[b] | 2.72±0.05[b] | 3.02±0.01[a] |
| | 10% | 4.55±0.05[b] | 5.01±0.05[a] | 5.04±0.03[a] |
| Docosahexaenoic acid | 0% | 0.02±0.00[a] | 0.02±0.00[a] | 0.01±0.00[a] |
| | 5% | 3.10±0.02[a] | 2.55±0.02[b] | 2.90±0.03[b] |
| | 10% | 6.13±0.03[a] | 5.82±0.02[b] | 5.72±0.03[b] |
| Omega 6 (g/100g) | | | | |
| linolenic acid | 0% | 0.02±0.00[a] | 0.02±0.00[a] | 0.01±0.00[a] |
| | 5% | 2.35±0.02[b] | 1.88±0.01[c] | 3.16±0.00[a] |
| | 10% | 4.35±0.02[a] | 2.8±0.00[b] | 4.19±0.01[a] |
| Arachidonic | 0% | 0.02±0.00[a] | 0.01±0.00[a] | 0.03±0.00[a] |
| | 5% | 3.82±0.02[a] | 2.78±0.01[b] | 3.87±0.01[a] |
| | 10% | 5.35±0.02[a] | 4.25±0.01[b] | 5.45±0.02[a] |
| Gamma Linolenic | 0% | 0.01±0.00[a] | 0.01±0.00[a] | 0.01±0.00[a] |
| | 5% | 3.37±0.02[a] | 2.71±0.02[b] | 3.96±0.02[a] |
| | 10% | 5.44±0.01[a] | 4.90±0.02[b] | 5.85±0.02[a] |

Tabular values are means ± standard error, the means with similar letters in a raw have no significant differences at 5% probability level.

**Table 5**. Mineral Content of control basisa and chia fortified Basisa (mg/kg).

| Sample | Chia ratio | Gharyan | Zintan | Tripoli |
|---|---|---|---|---|
| Zn | 0% | 1.56±0.20$^{a}$ | 1.35±0.01$^{a}$ | 1.56±0.02$^{a}$ |
| | 5% | .294± 0.04$^{a}$ | 2.15±0.01$^{a}$ | 2.61±0.03$^{a}$ |
| | 10% | 4.85±0.02$^{a}$ | 4.25±0.06$^{a}$ | 4.66±0.02$^{a}$ |
| Fe | 0% | 1.54±0.20$^{b}$ | 2.35±0.01$^{a}$ | 2.18±0.01$^{a}$ |
| | 5% | 3.24±0.01$^{a}$ | 3.22±0.06$^{a}$ | 3.36±0.02$^{a}$ |
| | 10% | 3.00±0.02$^{a}$ | 3.35±0.01$^{a}$ | 3.45±0.02$^{a}$ |
| Mg | 0% | 2.08± 0.03$^{a}$ | 1.18±0.04$^{b}$ | 2.08± 0.05$^{a}$ |
| | 5% | 3.08± 0.03$^{a}$ | 2.27±0.02$^{b}$ | 2.14± 0.02$^{b}$ |
| | 10% | 5.03±0.03$^{a}$ | 4.27±0.02$^{b}$ | 4.10±0.01$^{b}$ |
| Ca | 0% | 2.09±0.01$^{b}$ | 3.13±0.06$^{a}$ | 2.56±0.02$^{b}$ |
| | 5% | 4.10± 0.02$^{a}$ | 3.42±0.01$^{b}$ | 4.03± 0.29$^{a}$ |
| | 10% | 6.10±0.02$^{a}$ | 5.83±0.01$^{b}$ | 6.23±0.02$^{a}$ |
| Se | 0% | 0.18± 0.01$^{a}$ | 0.13±0.01$^{a}$ | 0.11±0.02$^{a}$ |
| | 5% | 2.10± 0.01$^{a}$ | 1.15± 0.02$^{b}$ | 1.20± 0.01$^{b}$ |
| | 10% | 4.04±0.01$^{a}$ | 3.30±0.02$^{b}$ | 3.23±0.02$^{b}$ |
| Na | 0% | 27.02±0.0$^{b}$ | 27.36±0.0$^{b}$ | 29.07±0.0$^{a}$ |
| | 5% | 32.73±0.03$^{b}$ | 32.67±0.06$^{b}$ | 40.02±0.04$^{a}$ |
| | 10% | 35.10±0.02$^{b}$ | 35.23±0.01$^{b}$ | 42.10±0.03$^{a}$ |
| K | 0% | 20.10±0.05$^{c}$ | 21.7± 0.01$^{b}$ | 23.00±0.07$^{a}$ |
| | 5% | 22.10±0.04$^{c}$ | 24.04±0.03$^{b}$ | 29.06±0.03$^{a}$ |
| | 10% | 25.17±0.02$^{c}$ | 26.20±0.03$^{b}$ | 31.05±0.03$^{a}$ |

Tabular values are means ± standard error, the means with similar letters in a raw have no significant differences at 5% probability level.

**Table 6**. Sensory properties of control and chia-fortified basisa

| Property | Chia ratio | Gharyan | Zintan | Tripoli |
|---|---|---|---|---|
| Taste | 0% | 7.20±0.0[b] | 7.20±0.0[b] | 8.50±0.0[a] |
| | 5% | 7.50±0.1[b] | 7.60±0.1[b] | 8.10±0.1[a] |
| | 10% | 8.30±0.1[a] | 8.60±0.1[a] | 8.10±0.1[a] |
| Texture | 0% | 8.60±0.0[a] | 8.80±0.0[a] | 8.30±0.0[a] |
| | 5% | 8.90±0.1[a] | 8.90±0.1[a] | 8.80±0.1[a] |
| | 10% | 9.50±0.1[a] | 9.10±0.1[a] | 9.30±0.1[a] |
| Color | 0% | 7.60±0.0[b] | 7.80±0.0[b] | 9.10±0.0[a] |
| | 5% | 7.80±0.1[c] | 8.00±0.1[b] | 9.60±0.1[a] |
| | 10% | 8.91±0.1[b] | 8.10±0.1[b] | 9.30±0.1[a] |
| Flavor | 0% | 6.60±0.0[b] | 6.40±0.0[b] | 7.60±0.0[a] |
| | 5% | 7.00±0.1[b] | 6.91±0.1[c] | 8.01±0.1[a] |
| | 10% | 8.50±0.1[a] | 8.80±0.1[a] | 8.20±0.1[a] |

Tabular values are means ± standard error, the means with similar letters in a raw have no significant differences at 5% probability level.