Bioanalysis ISSN:1757-6199 VOLUME 16, ISSUE 6 page 326-333
Journal link: https://bioanalysisjournal.com/
Abstract Link: https://bioanalysisjournal.com/abstract-326-333
25 MAY 2024

Consequences of amaranth flour and quinoa on the aesthetic appeal of cakes that conatin zero content of gluten

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Abstract:
Background: A typical gastrointestinal condition known as gluten-sensitive enteropathy is celiac disease. Disorders in nutrition absorption, loss of weight, condition of diarrhea, anemia, weariness, iron poor blood, and osteoporosis are all signs of this illness.
Materials and Methods: The quinoa, amaranth, and wheat Moisture content, ash, fiber, and protein were used to characterize the flour. AACC technique was used.
Results: Depending on the growing environment and genotype, the quantity of protein and composition of amino acid vary. In terms of protein content, quinoa is comparable to wheat and oats and has a greator amount than corn, rice, and barley. The modification of the gluten network and a porous texture are the causes of the 20% quinoa cake's reduced hardness. The majority of the participants preferred the quinoa-flour bread over the control.
Conclusion: This study shows that making products that are free of gluten is achievable for a group of people with special needs, like celiac disease, gluten intolerance, diabetes, or both.
Keywords: enteropathy, celiac disease, Trypsin inhibitors, Maillard process.

Introduction:

A typical gastrointestinal condition known as gluten-sensitive enteropathy is celiac disease. Patients' immune systems react by attacking the tissue in the nutrient-absorbing villi of the gut [1,2]. Disorders in nutrition absorption, loss of weight, situation of diarrhea, anemia, weariness, iron poor blood, and osteoporosis are all signs of this illness. Avoiding foods that contain gluten is the only way to treat celiac disease. As a result, patients should cut out all gluten-containing foods from their diets. Products that are gluten-free are typically prepared from pseudocereal flour and are less nutrient-dense than those that contain gluten [3,4]. A few of its technical flaws are its unpleasant texture, low specific volume, early staleness, low color, and awful flavor. Though less robust and elastic, the gluten-free dough is more adherent. The pseudocereal quinoa, which originated in Latin America and is now popular throughout the world, was first consumed there. It improves the nutritional value of bread goods by using the proper components [5,6]. Amaranth (Amaranthus hypochondriacus), which has a high protein content and a composition that is well-balanced in key amino acids, outperforms cereal grains in terms of nutrition.

Amaranth protein has large amounts of lysine, which is sometimes lacking in grains. Phytic acid, phytate, and trypsin inhibitors are some of the antinutritional ingredients found in amaranth. Trypsin inhibitors with low concentrations don't jeopardize a person's nutritional status [7,8].

Materials and methods:

Materials. We bought wheat flour from Atlas. (Isfahan, Iran). After being planted, the seeds of quinoa and amaranth were carried from a shop, and the flour was 5 mm sieve was used. Oil, sugar and salt from different Companies, was purchased. We bought all of our chemicals from Merck. composition of flour. The quinoa, amaranth, and wheat Moisture content, ash, fiber, and protein were used to characterize the flour. Cake Manufacturing. Amaranth flour and quinoa were combined in a replacement ratio of 0, 10, or 20 with wheat flour. 20, and 30%. For five minutes, sugar (30%) and eggs (40%) were combined and stirred. Baking powder (3%), after combined with oil (8%). Physico-chemical traits. This particular book was obtained using the AACC technique. With a 16 mm-diameter probe, a texture analyzer (Brookfield, USA) was used to examine the texture. 500 N was chosen as the force, and The 20 mm/min probe speed was chosen. Hardness was estimated as the maximal force. HunterLab was owned to examine the variations in color' L, a, and b values. Fatty acids were evaluated using gas chromatography, acid methyl ester, and a FID detector after they were produced. The methylation procedure required 50 mL of the sample, 100 mL of 0.5 sodium methoxide, and 1 mL of hexane, and it took place for 15 minutes at room temperature. Twenty untrained panelists evaluated overall acceptability on a 5-point hedonic scale based on taste, sight, color, and odor. The samples that were used were pre-programmed samples. Analytical Statistics. Each experiment had a completely randomized design with three replications.

Results and Discussion:

Depending on the growing environment and genotype, the quantity of protein and amino acid composition vary [9]. In comparison to wheat flour, quinoa and amaranth flours included more hydration, protein, fat, ash, and fiber (p 0:05). The quantity of protein in quinoa and amaranth flours was previously determined to be 13.1-21.5%, 8-22%, and 18.2-25.3%, respectively. In terms of protein content, quinoa is comparable to wheat as well as oats and has a higher amount than the protein content in corn, rice, and barley [10,11]. Mineral and dietary fiber dense foods include amaranth and quinoa. Amaranth's greater levels of protein and fat content are due to its relative higher fiber content when compared to other cereals like maize and wheat. Pseudocereal flour was used to create gluten-free cakes, which had greater ash, fat, protein, and fiber contents than the control sample (p 0:05). One of the ideal characteristics of a cake is its moisture content, which over time causes the cake to become soft [12,13]. The gluten-free cakes' moisture content did not meet the Iranian national requirement. It may be claimed that the inclusion of hygroscopic substances, such as fiber, in the composition of quinoa and amaranth flour led to a rise in the final product's moisture content. The high fiber content keeps water from evaporating while heating and keeps food moist. According to some research, bran bread has a high level of moisture content and a less hardness during preservation, which is understandable given bran's excellent capacity to hold onto moisture [14]. Determined volume is essential for consumer approval since cakes with larger determined volumes are frequently put forward. Each sample of cake had its own volume, which ranged from 2.30 to 2.88 cm3/g. Because there is more fiber present, adding quinoa and amaranth flour to the cake recipe causes the samples' moisture level to increase hardness [15,16]. The lowest and highest degrees of hardness, respectively, were seen in the samples containing 20% and 10% quinoa flour (p 0:05). Each cake sample had its own volume, which ranged from 2.30 to 2.88 cm3/g. 20% of quinoa flour was present in the sample with the largest determined volume (p 0:05).

Table 1: Approaching configuration of raw materials

%	Quinoa flour	Amaranth flour	Wheat flour
Moisture	2.39 ± 0.04[b]	12.71 ± 0.04[a]	11.40 ± 0.07[c]
Protein	17.01 ± 0.10[a]	17.42 ± 0.50[a]	12.49 ± 0.1[b]
Fat	6.59 ± 0.20[a]	6.49± 0.02[b]	1.00 ± 0.05[c]
Ash	2.59 ± 0.04[b]	2.78 ± 0.05[a]	0.49 ± 0.02[c]
Fiber	15.42 ± 2.90[a]	14.19 ± 0.60[a]	3.89 ± 0.1[b]

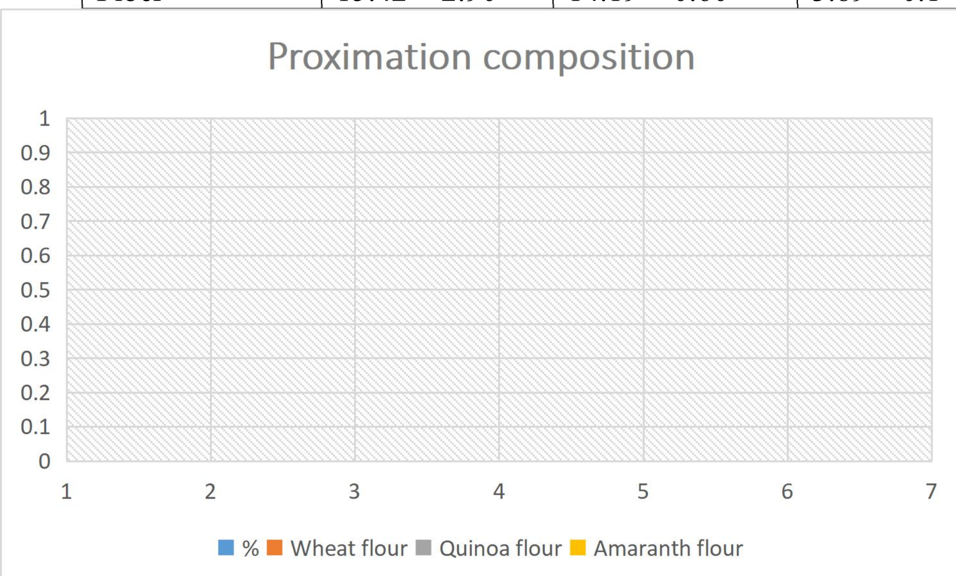
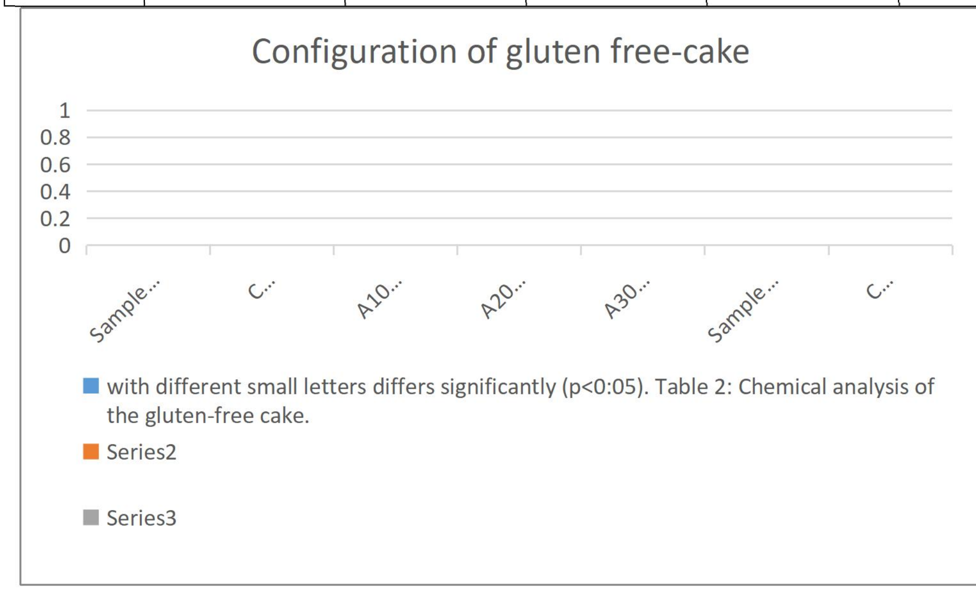


Table 2: Composition of the cake free of gluten.

Sample	Protein (%)	Fat (%)	Ash (%)	Fiber (%)	Moisture (%)
C	3.50 ± 0.13[d]	6.41 ± 0:08[d]	1:31 ± 1.27c	15.33± 0.90d	41.19 ± 1.27[e]
A10	3.89 ± 0.18[bc]	7.71 ± 0.11[bc]	1.48 ± 0.04[ab]	17.41 ± 0.11[c]	41.49 ± 1.09[e]
A20	4.20 ± 0.08[b]	7.89 ± 0.41[b]	1.52 ± 1.04[ab]	18.20 ± 0.55[b]	43.89 ± 2.03[d]
A30	4.42 ± 0.24[a]	7.01 ± 0.43[bc]	1.71 ± 1.04[a]	18.82 ± 0.25[a]	43.87 ± 1.11[d]

Q10	3.80 ± 0.06^{c}	7.10 ± 0.04^{cd}	1.52 ± 1.14^{b}	17.30 ± 0.21^{c}	45.10 ± 0.89^{c}
Q20	3.69 ± 0.09^{c}	6.49 ± 0.12^{c}	1.51 ± 0.04^{b}	18.32 ± 0.15^{b}	46.61 ± 1.19^{b}
Q30	4.42 ± 0.33^{a}	8.71 ± 0.56^{a}	1.72 ± 0.04^{a}	18.69 ± 0.25^{a}	47.41 ± 0.99^{a}



The modification of the permeable appearance and gluten network are the causes of the 20% quinoa cake's reduced hardness [17]. With the substitution of quinoa and amaranth flour, the amount of gluten dropped and caused a unattached network, making the dough weak and making it harder. Additionally, it appears that the fat and hydrocolloids in quinoa and amaranth flour were unable to make up for the hardness brought on by the loss of gluten [18]. The high fat content of the flours from quinoa and amaranth retains air bubbles, increasing porosity and hardness. Color. According to the color examination, the L parameter's range was 72.09 to 79.09 [19]. Cakes without gluten often had a deeper hue. This is due to the fiber components included in quinoa and amaranth flours as well as their capacity to retain moisture. Quinoa and amaranth flour samples were those that had higher a and b values; as a result, these samples had a bright red and yellow color [20]. The natural pigments in the flours of amaranth and quinoa may be the cause of the variation in color parameters. The Maillard process and caramelization have an impact on the cakes' color. Due to its ability to bind water, amaranth and quinoa flour can change color when used in little amounts, and when used in large amounts, their colors play a larger role [21]. The gluten-free sample containing 10% amaranth and quinoa flour obtained the highest evaluations for flavor, smell, color, appearance, and overall acceptability because of the fiber's excellent ability to hold onto moisture when cooking. Iglesias-Puig et al. claim that adding quinoa to bread increased the nutritional content of the bread by introducing minerals including calcium, iron, and zinc. the sensory qualities of cake [22].

Quinoa bread provides more magnesium, calcium, iron, and zinc than wheat bread, claim El-Sohaimy et al. Quinoa and amaranth boost the grain products' nutritional value. According to Ballester-Sánchez et al., quinoa increases the quantities of iron and zinc in bread as well as polyunsaturated fatty acids (linoleic acid), dietary fiber, and oleic and linolenic acids [23,24].

Table 3: Configuration of the formulated gluten-free cake.

Nutrients	Quinoa cake	Amaranth cake	Wheat cake
Linoleic acid (%)	1.5	2.8	1.6
Linolenic acid (%)	0.23	0.41	0.31
Iron (mg/kg)	109	2.4	0.57
Calcium (mg/kg)	20.4	12.4	0.52
Zinc (mg/kg)	35.8	1.9	0.10
Oleic acid (%)	1.1	1.8	0.89

Quinoa flour reportedly significantly enhanced the flavor of bread, according to Xu et al. The majority of the participants preferred the quinoa-flour bread over the control, according to El-Sohaimy et al. 25% quinoa flour obtained the highest sensory score in gluten-free bread with favorable characteristics, according to Azizi et al. According to the research done by Nasir et al., bread baked using alternatives for amaranth flour between 5% and 10% is up to the mark [25, 26].

Conclusion:

The research demonstrates that making gluten-free things is feasible for a number of people with exceptional requirements, like celiac disease, gluten intolerance, diabetes, or both. Additionally, it makes up new path for the gluten-free bakery industry. Cake samples made from quinoa and amaranth have higher quantities of protein, fat, ash, and fiber, improving their nutritional profile. Gluten-free cake demonstrated more particular volume, less hardness, and better color comparative to conventional cake.

Conflict of interest:

There is no conflict of interests.

References:

1. Hamzehpour, R., & Dastgerdi, A. A. (2023). The Effects of Quinoa and Amaranth Flour on the Qualitative Characteristics of Gluten-Free Cakes. *International Journal of Food Science*, *2023*.
2. Wanniarachchi, P. C., Pavalakumar, D., & Jayasinghe, M. A. (2023). Pseudocereals: Nutrition, Health Benefits, and Potential Applications in Gluten-free Food Product Developments. *Current Nutrition & Food Science*, *19*(4), 377-385.
3. Kaur, S. (2023). Disorders related with gluten and sources for gluten-free diet. *benefits (Joshi et al., 2018, 2019)*, *48*, 19.
4. Azizi, S., & Azizi, M. H. (2023). Evaluation of producing gluten-free bread by utilizing amaranth and lipase and protease enzymes. *Journal of Food Science and Technology*, 1-10.

5. Jan, N., Hussain, S. Z., Naseer, B., & Bhat, T. A. (2023). Amaranth and quinoa as potential nutraceuticals: a review of anti-nutritional factors, health benefits and their applications in food, medicinal and cosmetic sectors. *Food Chemistry: X*, 100687.
6. Mu, H., Xue, S., Sun, Q., Shi, J., Zhang, D., Wang, D., & Wei, J. (2023). Research Progress of Quinoa Seeds (Chenopodium quinoa Wild.): Nutritional Components, Technological Treatment, and Application. *Foods*, *12*(10), 2087.
7. Göncü, A., Kuzumoğlu, Y., Vardin, A. Y., Çelik, İ., & Karaman, A. D. Evaluation of Physicochemical and Sensorial Properties of Gluten-Free Boza Formulated with Chia and Quinoa Flours. *Cereal Chemistry*.
8. Yaseen, E. G. (2023). Effect of Utilizing of Quinoa, Rice and Corn Flours on Physicochemical Properties and Sensory Characteristics of Gluten Free Cupcake. *Annals of Agricultural Science, Moshtohor*, *61*(1), 119-126.
9. Malik, M., Sindhu, R., Dhull, S. B., Bou-Mitri, C., Singh, Y., Panwar, S., & Khatkar, B. S. (2023). Nutritional Composition, Functionality, and Processing Technologies for Amaranth. *Journal of Food Processing and Preservation*, *2023*.
10. Siminiuc, R., & Ţurcanu, D. (2023). Technological approaches applied in the design of gluten-free bakery products. *Czech Journal of Food Sciences*.
11. Siminiuc, R., & Ţurcanu, D. (2023). Technological approaches applied in the design of gluten-free bakery products. *Czech Journal of Food Sciences*.
12. Yeşil, S., & Levent, H. (2022). The influence of fermented buckwheat, quinoa and amaranth flour on gluten-free bread quality. *LWT*, *160*, 113301.
13. Yeşil, S., & Levent, H. (2022). The effects of emulsifiers on quality and staling characteristics of gluten-free bread containing fermented buckwheat, quinoa, and amaranth. *Journal of Food Processing and Preservation*, *46*(7), e16668.
14. Punia Bangar, S., Sharma, N., Singh, A., Phimolsiripol, Y., & Brennan, C. S. (2022). Glycaemic response of pseudocereal-based gluten-free food products: a review. *International Journal of Food Science & Technology*, *57*(8), 4936-4944.
15. Punia Bangar, S., Sharma, N., Singh, A., Phimolsiripol, Y., & Brennan, C. S. (2022). Glycaemic response of pseudocereal-based gluten-free food products: a review. *International Journal of Food Science & Technology*, *57*(8), 4936-4944.
16. Turk Aslan, S., & Isik, F. (2022). Effects of pseudocereal flours addition on chemical and physical properties of gluten-free crackers. *Food Science and Technology*, *42*, e52521.
17. Wanniarachchi, P. C., Pavalakumar, D., & Jayasinghe, M. A. (2023). Pseudocereals: Nutrition, Health Benefits, and Potential Applications in Gluten-free Food Product Developments. *Current Nutrition & Food Science*, *19*(4), 377-385.
18. Bozdogan, N., Ormanli, E., Kumcuoglu, S., & Tavman, S. (2022). Pear pomace powder added quinoa-based gluten-free cake formulations: effect on pasting properties, rheology, and product quality. *Food Science and Technology*, *42*, e39121.
19. Alizadeh-Bahaabadi, G., Lakzadeh, L., Forootanfar, H., & Akhavan, H. R. (2022). Optimization of gluten-free bread production with low aflatoxin level based on quinoa flour containing xanthan gum and laccase enzyme. *International Journal of Biological Macromolecules*, *200*, 61-76.

20. Aguiar, E. V., Santos, F. G., Centeno, A. C. L. S., & Capriles, V. D. (2022). Defining amaranth, buckwheat and quinoa flour levels in gluten-free bread: A simultaneous improvement on physical properties, acceptability and nutrient composition through mixture design. *Foods*, *11*(6), 848.
21. Hamzehpour, R., & Dastgerdi, A. A. (2023). The Effects of Quinoa and Amaranth Flour on the Qualitative Characteristics of Gluten-Free Cakes. *International Journal of Food Science*, *2023*.
22. Yeşil, S., & Levent, H. (2022). The influence of fermented buckwheat, quinoa and amaranth flour on gluten-free bread quality. *LWT*, *160*, 113301.
23. Miranda-Ramos, K. C., & Haros, C. M. (2020). Combined effect of chia, quinoa and amaranth incorporation on the physico-chemical, nutritional and functional quality of fresh bread. *Foods*, *9*(12), 1859.
24. Arslan-Tontul, S., Candal Uslu, C., Mutlu, C., & Erbaş, M. (2021). Expected glycemic impact and probiotic stimulating effects of whole grain flours of buckwheat, quinoa, amaranth and chia. *Journal of Food Science and Technology*, 1-8.
25. Valerio, F., Bavaro, A. R., Di Biase, M., Lonigro, S. L., Logrieco, A. F., & Lavermicocca, P. (2020). Effect of amaranth and quinoa flours on exopolysaccharide production and protein profile of liquid sourdough fermented by Weissella cibaria and Lactobacillus plantarum. *Frontiers in microbiology*, *11*, 967.
26. Muchekeza, J. T., Jombo, T. Z., Magogo, C., Mugari, A., Manjeru, P., & Manhokwe, S. (2021). Proximate, physico-chemical, functional and sensory properties OF quinoa and amaranth flour AS potential binders in beef sausages. *Food Chemistry*, *365*, 130619.