Asian Jr. of Microbiol. Biotech. Env. Sc. Vol. 25, No. (4) : 2023 : 777-781

ISSN-0972-3005

DOI No.: http://doi.org/10.53550/AJMBES.2023.v25i04.032

SENSORY EVALUATION AND NUTRIENT COMPOSITION OF 'MUFFIN' PREPARED BY GERMINATED QUINOA FLOUR (*CHENOPODIUM QUINOA* WILD), SESAME SEED AND OATS

IRA ANJALI TIRKEY[1] AND VIRGINIA PAUL*[2]

Department of Food Nutrition and Public Health, Ethelind College of Community Science, SHUATS, Prayagraj 211 007, U.P., India,

(Received 27 July, 2023; Accepted 15 September, 2023)

Key words : *Germinated Quinoa Flour, Quinoa Muffin, Quinoa, Oats, Sesame seeds.*

Abstract– Germination is a widely used technique for increasing the nutritional value of cereals and grains. Germination has long been thought to be a low-cost and effective way to boost antioxidant capacity and increase the bioavailability of essential minerals and vitamins. Quinoa is high in fiber, vitamins, and minerals. Unlike cereals, quinoa seeds contain all essential amino acids and has high biological value. The process to obtain Germinated Quinoa flour was done by soaking and germinating methods.The grains wereproperly washed and soaked in water for 12 h then germinated foranother 24h in fresh water after washing the soaked seeds properly to drain out the saponins and other antinutritional factors. This study was conducted to examine the effects on sensory properties, nutrient and antioxidant content of *Muffin* prepared by incorporation of Germinated Quinoa flour, Sesame seeds and Oats in different proportion. Three different types of treatments were prepared by incorporating Germinated Quinoa Flour ranging from 20g, 30g and 40g, Oats flour ranging from 15g, 20g, 25g, and 2g of Sesame seed was also incorporated which remained constant in all three treatments along with control made of 100g of Whole Wheat flour. The products were evaluated for sensory attributes based on 9 Point Hedonic Score. The results suggested that *Muffin* incorporated in the ratio of (50:30:20:2) T_2 was liked very much. Whereas, *Muffin* incorporated in the ratio of (65:20:15:2) T_1 was liked moderately and *Muffin* incorporated in the ratio of (35:40:25:2) T_3 was liked the least and resulted in decreased mean score of Overall Acceptability. The data obtained for Proximate Analysis, Mineral and Antioxidant content was done by using AOAC methods. Differences among the Sensory Score and nutrient content of the developed food product was done by using various Statistical Analysis methods like ANOVA, CD and 't' test. The nutritional composition of the best treatment (T_2) resulted to be higher than that of control (T_0). The best treatment of Quinoa Muffin had the moisture content of 26.6%, and ash content of 1.8 g per 100 g and protein content of 18.8g per 100g. Fat content was 30.6g per 100g, fiber content was 5.2g per 100g, carbohydrate content as 165.46g per 100g and the energy content was 1012.44 Kcal. Quinoa Muffin also contained 118.01mg of Calcium per 100g and 7.3mg of Iron per 100g. The cost of the dry ingredients for preparing Quinoa Muffin per 100g were Rs.35.42 for T_0, Rs.60.98 for T_1, Rs.66.83 for T_2 and Rs.72.72 for T_3. Thus, it can be concluded that incorporation of Germinated Quinoa Flour, Oats and Sesame Seeds can be utilized for preparation of different food products which enhances the Nutritional Content and improves Sensory Acceptability.

INTRODUCTION

Pseudocereals are defined as fruits or seeds of non-grass species that are consumed in very similar way as cereals having nutritive value very much competitive to conventional crop, in most cases even better. Quinoa is a pseudo cereal belongs to (Chenopodiaceae) family. Quinoa fruits are achenes, comprised of a single seed enclosed by an outer pericarp (FAO, 2011). Quinoa has been traditionally used by several indigenous peoples of South America (Bhargava and Srivastava, 2013). The seeds have been consumed similarly to rice, prepared in soup, puffed to make breakfast cereal, or ground to flour to produce toasted and baked goods (Cookies, breads, biscuits, noodles, flakes, tortillas, pancakes) (Bhargava *et al.*, 2006).

([1]Research Scholar, [2]Professor)

Post harvesting and prior to marketing, grains undergo industrial processing, mainly the process of dehulling or decortications, to remove the outer layers of the grain. Dehulling is known to improve grain quality by lowering the content of antinutrients and enhancing the sensory parameters, hence the acceptance and palatability of the grain. Despite these benefits of dehulling, it reported to cause loss of nutrients from grains. Thus, to minimize loss nutrients and increase bioavailability of nutrients, researchers recommend use of common traditional domestic processing methods for grains. Soaking and germination are the commonly used methods for domestic processing of seed (Srujana *et al.*, 2019). The heat application to quinoa has shown reduction of antinutritional factors in Chenopodium quinoa seeds (Silva *et al.*, 2015).

Cakes are popular and frequently consumed by almost all levels of society for their desirable sensory properties and convenience. They differentiate mainly by their porous structure and high moisture content from the commonly consumed baked products such as bread, biscuits, etc. Muffins belong to the greasy cakes group rather than foam-type cakes and prepared as individual-sized portions that are smaller than cakes with no need to cut into slices. They are obtained by preparing a batter from wheat flour, sugar, oil, egg, milk and aroma products. The current market trend for muffins is increasing in parallel to the interest in customizable bakery, though consumers highly expect affordable and healthier options at the same time. Overall cake quality is mostly related to volume besides a flexible, smooth and soft texture. Moreover, generally cakes enable the corporation of different ingredients into their formulations when one or more sources of dietary fibres are added.Attempts for use of dietary fibre in food products have both health and nutrition standpoints (Hamzacebi *et al.*, 2021).

Although, Oat flour and/or fibre has been used in numerous studies as a dietary fibre source for cakes or muffins. The use of quinoa flour in combination with oat flour has been proposed as a method for improving functionality (Inglett *et al.*, 2015).

MATERIALS AND METHODS

Procurement of Raw Material: The raw materials like Quinoa seeds of "Swechha" brand and pumpkin, melon and sunflower seeds of "Wonderland Foods" were purchased online from amazon website. Oats, Sesame seeds, Jaggery, Ghee and other ingredients was purchased from the local market of Prayagraj.

Processing of Germinated Quinoa flour: The process to obtain Germinated Quinoa flour was done by soaking and germinating the grains according to the procedure used by Elgi *et al.*, 2002**.** About 100 seeds were soaked in 500 ml water for 12 h in the dark at 25 °C. Seeds were germinated for 24 h, in the dark at 25 °C. They were rinsed with water twice daily Thakur *et al.*, 2021. Then germinated seed were dehydrated in hot air oven at 60 ^{0}C for 5 hrs. Then they were processed fine in kitchen mixer grinder the the obtained flour was stored in sealed vacuumed packets at 4°C in refrigerator.

Standardization and Preparation of Quinoa Muffin: Preparation of food product namely '*Quinoa Muffin'* was done by incorporating Germinated Quinoa Flour, Sesame seeds, Oats, Gram Flour and jaggery as main ingredients for preparing three experimental treatments (T_1, T_2, and T_3) and control (T_0) was prepared with whole wheat flour and sugar. Other ingredients like egg, banana, cinnamon, honey, butter, vanilla essence was added to the experimental treatments to enrich the nutritional quality and flavour of experimental Muffin.

Details of Control and Treatments of *Quinoa Muffin*

(T0) (Control): the product was prepared using only 100g of whole wheat flour.
(T1) (Treatment): the product was prepared using 65g of whole wheat flour, 20g of quinoa flour, 15g of oats flour, and 2g of sesame seeds.
(T2)(Treatment): the product was prepared using 50g of whole wheat flour, 30g of quinoa flour, 20g of oats flour, and 2g of sesame seeds.
(T3)(Treatment): the product was prepared using 35g of whole wheat flour, 40g of quinoa flour, 25g of oats flour, and 2g of sesame seeds.

Pre-heat oven (180!). Roast Oats in low flame and fine grind. Mix all the dry ingredients together in a bowl (Germinated quinoa flour, oats flour, whole wheat flour, baking powder, cinnamon, salt). Mix wet ingredients together in another bowl (Mashed ripe banana, honey, powdered jaggery). Add egg, oil/butter, vanilla essence into the wet ingredient bowl and whisk. Combine wet and dry ingredients together. Transfer in greased muffin mold, sprinkle Sesame Seed and bake in hot air oven 180 ^{o}C for 20 mins.

Sensory Evaluation of Quinoa Muffin: Sensory evaluation of the food products for their acceptability was done with the help of a score card based on the 9-point Hedonic Scale such on the basis of attributes like Color and Appearance, Body and Texture, Taste and Flavor and Overall Acceptability. The mean scores for each product and each treatment were then calculated (Srilakshami, 2018).

Nutritional Analysis of Quinoa Muffin: Nutritional analysis was conducted following procedures to determine the nutritional composition of the developed food products, including moisture, ash, fibre by AOAC (2012), total carbohydrates (difference method), fat (Soxhlet method), protein (Lowery's method), calcium (titration method), iron (colorimetric method), and total energy (Kcal/100g) = (4 X Protein) % + (9 X fat) % + (4 X CHO) %. Additionally, the antioxidant activity of the food products was assessed using the DPPH (2,2-diphenyl-1-picrylhydrazyl) method, which measures their ability to scavenge free radicals and protect against oxidative stress.

Cost Evaluation of Quinoa Muffin: The price of each individual raw ingredient used in the preparation of food products as well as the prevailing market price were taken into account when calculating the cost of the prepared food product.

Statistical Analysis: The data was analysed using analysis of variance technique (ANOVA) to get the difference between the variables. Critical Difference and 't' test and other appropriate statistical analysis methods was used to interpret the data (Gacula and Singh, 2008).

RESULTS AND DISCUSSION

Sensory Evaluation of Quinoa Muffin

The mean sensory scores of Quinoa Muffins in relation to Colour and Appearance indicates that T_2 had the highest score 8.1 followed by T_1 (7.1), T_0 (7.0), T_3 (6.7) respectively. It is quite obvious from Figure 1 that treatment T_2 containing 50g whole wheat flour, 30g quinoa, 20g oats, 2g sesame seeds was liked very much, T_1, T_2 and T_3 were liked moderately. It was observed that all three experimental treatments of quinoa muffin showed increased intensity of colour because of the addition of jaggery and quinoa flour in increasing proportion which gave the experimental muffin treatments brown colour in comparison to control T_0which included white sugar and all-purpose flour giving light golden-brown colour to the muffin. In a study conducted to observe the influence of jaggery and sugar on pasting properties of wheat flour it was observed that the redness of the jaggery muffins crust and crumb increased with increased proportion of jaggery and the lightness value decreased and there was not much change in the yellowness of the muffin crumb compared to sugar muffins (Khabeer *et al.*, 2018).

The Statistical Analysis was carried out in relation to Colour and Appearance the calculated value of 'f' (20.3) due to treatment was greater than tabulated value of F (4.7) on 3,6 degree of freedom at 5 per-cent probability level. Hence, the difference was significant. On comparing the average score for Colour and Appearance against critical difference value (C.D.) the result was significant because the difference in mean value of (T_0 T_2), (T_1 T_2), (T_2 T_3)was greater the CD, i.e. (0.44).

The mean sensory scores of Quinoa Muffins in relation to Body and Texture indicates that T_2 had the highest score 8.4 followed by T_1 (7.2), T_2 (7.1), T_3 (7.0) respectively. It is quite obvious from Fugure 1 that treatment T_2 containing 50 g whole wheat flour, 30g quinoa, 20g oats, 2g sesame seeds was liked very much, T_1, T_2 and T_3 were liked in moderation. It was observed that all three experimental treatments of quinoa muffin showed improved and acceptable texture because of the addition of quinoa flour in increasing proportion along with the decreasing proportions of whole wheat flour. The softness of muffins was observed to increase with an increase in jaggery and egg. This may be due to foaming, coagulation, emulsifying and binding properties of egg (Murugkar *et al.*, 2016). Fat increases the volume and softness of muffins by disrupting the gluten network structure of wheat flour and by establishing the air bubbles due to their surface activity

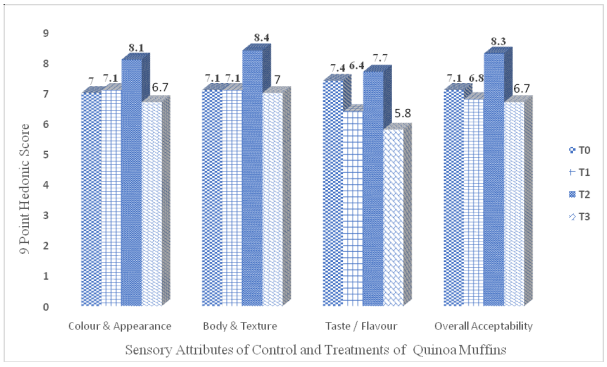

Fig. 1. Sensory Attributes of Control and Treatments of developed Quinoa Muffin

properties (Harastani *et al.,* 2021).

The Statistical Analysis was carried out in relation to Body and Texture the calculated value of 'f' (59.40) due to treatment was greater than tabulated value of F (4.7) on 3,6 degree of freedom at 5 per-cent probability level. Hence, the difference was significant. On comparing the average score for Body and Texture against critical difference value (C.D.) the result was significant because the difference in mean value of (T_0 T_2), (T_1 T_2), (T_2 T_3) was greater the CD i.e (0.27).

The mean sensory scores of Quinoa Muffins in relation to Taste and Flavour indicates that T_2 had the highest score 7.7 followed by T_0 (7.4), T_1(6.4), T_3 (5.8) respectively. It is quite obvious from the Figure 1 that treatment T_2 containing 50g whole wheat flour, 30g quinoa, 20g oats, 2g sesame seeds was liked moderately and T_1, was also liked moderately, T_0 was liked slightly whereas T_3 was neither liked or disliked. It was observed that all three experimental treatments of quinoa muffin showed variance in taste and flavour because of the incorporation of quinoa flour, oats flour and sesame seeds in varying proportions. Addition of banana, jaggery powder and cinnamon powder balanced the slight bitter taste of quinoa. Jaggery is a natural sweetener and has winey fragrance flavour. It has heady aroma and delicious flavour. It is an important item of diet and is consumed directly or as sweetening agent for sweet preparations (Hirpara *et al.,* 2020).

The Statistical Analysis was carried out in relation to Taste and Flavour the calculated value of 'f' (59.40) due to treatment was greater than tabulated value of F (4.7) on 3,6 degree of freedom at 5 per-cent probability level. Hence, the difference was significant. On comparing the average score for Tate and Flavour against critical difference value (C.D.) the result was significant because the difference in mean value of (T_0 T_1), (T_0 T_3), (T_1 T_2) , (T_1 T_3),(T_2 T_3) was greater the CD, i.e (0.59).

The mean sensory scores of Quinoa Muffins in relation to overall acceptability indicates that T_2 had the highest score 8.4 followed by T_0 (7.1), T_1 (6.8), T_3 (6.7) respectively. It is quite obvious from the Figure **1** that treatment T_2 containing , 50g whole wheat flour, 30g quinoa, 20g oats, 2g sesame seeds was liked very much, T_0 was liked moderately whereas T_1 , T_3 was liked slightly. The muffins with jaggery shows more acceptability as it shows wholesome taste and perceptible jaggery flavour even when stored for duration of about 21 days (Lamdande *et al.,* 2018). Colour plays an important role towards the consumer's perception to the acceptability of the product. The original intrinsic colour due to the individual ingredients are affected by the interaction between the ingredients themselves during baking of the products, which is likely to the increased Mallard browning reaction in the product (Bhaduri, 2013).

The Statistical Analysis was carried out in relation to Overall Acceptability the calculated value of 'f' (93.2) due to treatment was greater than tabulated value of F (4.7) on 3,6 degree of freedom at 5 per-cent probability level. Hence, the difference was significant. On comparing the average score for Overall Acceptability against critical difference value (C.D.) the result was significant because the difference in mean value of (T_0 T_1) , (T_0 T_2), (T_0 T_3), (T_1 T_2) , (T_2 T_3)was greater the CD, i.e (0.19).

Table 1. Nutrient Composition of control and best treatment of "*Quinoa Muffins*" by using t-test per 100g.

Particulars	T_0	T_2	(Difference)(T_2 - T_0)	t.cal.	t.tab.	S.A
Proximate Analysis						
Moisture (%)	30	26.6	3.4	7.81	2.447	S*
Ash (g)	1.2	1.8	0.6	7.78	2.447	S*
Protein (g)	18.3	18.8	0.5	4.7	2.447	S*
Fat (g)	27.1	30.6	3.5	6.28	2.447	S*
Fiber (g)	1.9	5.2	3.3	15.34	2.447	S*
Carbohydrate (g)	126.24	165.46	39.22	121.05	2.447	S*
Energy (g)	822.06	1012.44	190.38	37.78	2.447	S*
Minerals						
Calcium (g)	70	118.01	48	88.91	2.447	S*
Iron (g)	5.36	7.3	1.94	11.97	2.447	S*
Antioxidant Activity						
DPPH radical scavenging activity(%)	29.7	96.9	67.2	45.77	2.447	S*

S * = Significant , NS* *= Non-Significant, S.A = Statistical Analysis

Nutritional composition of Quinoa Muffin

The data depicted in Table 1 indicates a significant difference between the nutrient content of the control (T_0) and the best treatment (T_2) as the calculated value of "t" of all the parameters was found to be higher than the tabulated value of "t" which is 2.447 at 5 percent probability level. All the parameters showed slight increase in nutrient content and this concludes that incorporation of germinated quinoa improvs the nutritional composition. Carbohydrate and energy levels showed the most amount of increase because of the addition of jaggery and butter which are high in calorie content.

Jaggery is a traditional concentrated cane sugar consumed in Asia, Africa and some countries in America. It is rich in minerals mainly iron but it also has traces of other mineral salts. It activates digestive enzymes ultimately reducing strain on the intestines and the digestive tract. Because of its nutritional and medicinal value, it is being highly recommended by health experts in food application too (Shrivastva *et al.,* 2016).

The predominance of unsaturatedfatty acids in quinoa seeds is well known, and therefore, the greater lipid content in bakery productsmade with quinoa could help to improve the saturated/ unsaturated fatty acids ratio in diet and hence, improve the omega 3/omega 6 fatty acid relationship (Ballester-Sánchez *et al.,* 2019).

Cost of the Control and Treatments of prepared Quinoa Muffin

The cost of the raw materials for preparing "Quinoa Laddu per 100g were Rs. 32.42 for T_0, Rs. 60.98 for T_1, Rs. 66.83 for T_2, and Rs. 72.72 for T_3 . It is therefore concluded that T_3 had the highest cost of production followed by T_2, T_1, and T_0 being the cheapest among all the treatments because of the incorporation level of Germinated Quinoa flour, Oats and Sesame seeds as they increased the price marginally.

CONCLUSION

Processing of quinoa results in easy digestion and absorption of protein, reduction of antinutritional contents like saponins, phytates, and tannins and increased bio availability of minerals due to the application of processing techniques. Pseudo cereal like quinoa needs attention of consumers because of its superior nutritious quality in terms of protein, essential amino acids and minerals such as calcium and iron which lends itself a gluten free nutritious alternative for routine dietary alternative. This study concludes that Quinoa can be incorporated in the form of flour into muffins and other baked food products and the acceptability of quinoa flour for about 50 % incorporation resulted the best.

REFERENCES

AOAC, 2012. *Official Method of Analysis: Association of Official Analytical Chemistry*. Ed. 19th, Washington D.C.

Bhargava, A., Shukla, S. and Ohri, D. 2006. Chenopodium quinoa-An Indian perspective. *International Journal of Industrial Crops and Products.* 23:73-87.

Bhargava, A. and Srivastava, S. 2013. Quinoa, Botany, Production and Uses. Boston, MA: CABI.

Egli, L., Davidsson, M.A., Juillerat, D., Barclay, R.F. and Hurrell, 2002. The Influence of Soaking and Germination on the Phytase Activity and Phytic Acid Content of Grains and Seeds Potentially Useful for Complementary Feeding: *Journal of Food Science.* 67: 9.

FAO, 2011. Quinoa: An ancient crop to contribute to world food security. Regional Office for Latin America and the Caribbean.

Gacula Jr., Singh, 2008. *Statistical Method in Food and Consumer Research.* Publication: Acedimic. 234-312.

Hamzacebi, O. and Tacer-Caba, Z. 2021. Date Seed, Oat Bran and Quinoa Flours as Elements of Overall Muffin Quality. *Current Research in Nutrition and Food Science*. 9(1).

Inglett, G.E., Chen, D. and Liu, S.X. 2015. Pasting and rheological properties of quinoa oat composites. *International Journal of Food Science and Technology.* 50(4): 878-884.

Lamdande, A.G., Khabeer, S.T., Kulathooran, R. and Dasappa, I. 2018. Effect of replacement of sugar with jaggery on pasting properties of wheat flour, physico-sensory and storage characteristics of muffins. *Journal of Food Science and Technology*. 55(8): 3144-3153.

Srujana, N.S., Kumari, M.A., B. Jessie Suneetha, W. and Prathyusha, P. 2019. Processing technologies and health benefits of quinoa. *The Pharma Innovation Journal.* 8(5): 155-160.

Hirpara, P., Thakare, N., Kele, V.D. and Patel, D. 2020. Jaggery: A natural sweetener. *Journal of Pharmacognosy and Phytochemistry.* 9(5): 3145-3148.

Shrivastva, P., Verma, A.K., Walia, R., Parveen, R. and Singh, A.K. 2016. Jaggery: A revolution in the field of natural sweetness. *European Journal of Pharmaceutical and Medical Research*. 3(3):198-202.

Silva, J.A., Pompeu, G., Olavo, C., Gonçalves, D.B. and Spehar, C.R. 2015. The importance of heat against antinutritional factors from *Chenopodium quinoa* seeds. *Food Science and Technology.* 35(1): 74-82.