

Original Research Article

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Development and Sensory Evaluation of Quinoa Based Sweet and Salt cookies

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ABSTRACT

Gluten, a visco elastic protein present in the wheat causes damage to the small intestine and as a result the microvilli of the small intestine gets atrophied. This situation leads to abdominal discomfort and malabsorption of many vital vitamins. This condition is called as Gluten Sensitivity or Celiac Disease, following a gluten free diet is most suitable treatment. Gluten free cereals can be used in diet, but they can't replace wheat in bakery products. The present study was conducted to develop gluten free cookies with quinoa, a nutrient dense pseudocereal. Three different types of cookies using two different types of quinoa flour were prepared. Sensory evaluation and nutritive value of the cookies revealed that Quinoa cookies have excellent sensory attributes and also they are high in nutritive value. Among all cookies made corn flake cookies (C1) cookies are much more appreciated than cinnamon cookies (C2) and salt cookies (C3).

Keywords

Wheat, barley,
lipids, calcium,
iron, folate

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Introduction

Celiac disease is a chronic gastrointestinal disease which affects genetically predisposed persons and causes damage to the lining of the small intestine as a result of a protein called "gluten" found in grains such as wheat, barley, and rye. The gut is damaged, making it difficult for the body to absorb nutrients such as lipids, calcium, iron, and folate (Porcel *et al.*, 2017). However, for those who suffer from this condition, a gluten-free diet is the

only standard therapy (Eunice *et al.*, 2020). But following gluten free diet is not easy as it sounds because most of daily consumed biscuits, cookies, bread and wheat based products depends on viscoelastic nature of the gluten, which is a structure-forming protein present in various grains that influences the elastic qualities of dough and adds to the overall aesthetic and crumb structure of many baked goods. Cereal-based cookies, crackers, and breakfast cereals and cereal products are foods that provide a significant amount of

energy to individuals. Cookies are widely accepted and consumed in many countries because they offer a diverse variety of snack options with a long shelf life and low cost. Texture, flavour, and appearance are the three primary factors that influence cookie quality. Another essential component of developing cookies with enhanced nutritional status is maintaining the product's sensory qualities, because customer acceptance is still the most significant factor in determining whether or not a newly produced product will be successful. The undissolved sugar gradually dissolves while baking, contributing to cookie spread. Cookie hardness, crispness, colour, and volume are all impacted by the sugar content of the recipe.

Following gluten free diet can cause micronutrient deficiency due to deficiency of nutrients in traditionally consumed gluten free cereals such as Rice, Ragi, Sorghum, jowar. The other problems include lack of dietary fibre and excess of transfat making the gluten free cereals unfit for nutritious and tasty cookies for gluten free population.

To overcome these problems, people now a days are giving lot of priority to food grains with nutrient dense and Quinoa turned out to be excellent substitute for gluten free cereals.

Quinoa is usually referred to as a pseudo-cereal since it is not a member of the Graminae family but it produces seeds that can be milled in to flour and used as a cereal crop. It is highly resistant to weather, climate, and soil conditions (Valencia, 2011). It is called as 'golden grain' because of its ability where it can grow in adverse conditions like cold, drought and salt and can adopt to high temperature (Hinojosa, 2018). It can grow in a place with annual rainfall within a range of 200-400 mm and even at high precipitated countries like Chile with 3000 mm precipitation factor (Angeli, 2020).

With its ability to withstand to weather and soil conditions, Quinoa can provide food security where malnutrition is prevalent making it one of the most demandable pseudo cereal. Quinoa has not only excellent nutrients but also adding taste and variety to the meal.

The present study was planned with the aim of development and sensory evaluation of value added gluten free cookies which can be welcomed by general population where they can enjoy cookies along with a cup of tea over breakfast.

Materials and Methods

Procurement of raw materials and processing of flour

The Quinoa seeds were purchased from a authorized dealer, the other ingredients such as oasts, cornflour, sugar, butter etc were purchased from local markets. Two types of flours i'e: RQS flour (dry roasting for 5-6 minutes) Quinoa seeds flour as well as URQS flour (Soaking in water for 4-5 hrs).

Method of preparation

Corn Flake Cookies / Cinnamon Cookies (C2)

Fat and sugar was creamed together till lightly and puffy.

Vanilla essence was added and mixed thoroughly.

The flour was added to cream and mixed into smooth dough using milk.

Cornflakes/Cinnamon Powder was added to the dough and mixed once again.

The dough was divided into round balls using wet hands.

The round balls were placed on greased and dusted baking trays and crushed cornflakes* were sprinkled on the top of surface and baked at 200°C for 20 minutes.

Salt Cookies (C3)

Butter was creamed light and puffy.

Quinoa flour, oats flour and corn flours were taken in a bowl.

Salt and butter were added to the flours and mixed thoroughly and made into a smooth dough using water.

The dough was divided into round balls using wet hands.

The round balls were placed on greased and dusted baking trays and pressed slightly and baked at 200°C for 20 minutes.

Sensory Analysis

After preparation of cookies, Sensory evaluation was conducted using 9-point Hedonic Rating Scale, judges were asked to rate the samples on appearance, colour, texture, flavour, taste, and overall acceptability.

The expression "liked very much" was given at 9 score, "neither like nor dislike" was given 5 score, and "disliked extremely" was given 1 score (Schumacher *et al.*, 2010).

Statistical Analysis

Mean and standard deviation for twenty parallel observations was calculated. Paired t test was used to test the difference between samples prepared with RQS flour and URQS flour. Paired t test was applied between RQS flour and URQS flour based products.

Results and Discussion

Organoleptic scores of Quinoa Cookies

The organoleptic scores of the Quinoa cookies were analyzed and presented in the tables(1).

Appearance

The foremost important attribute which appeases the acceptance of food was its appearance. Appearance of C1 cookies made with both RQS flour and URQS flour was much delighted with a similar score of 8.3 ± 0.80 and 8.3 ± 0.86 followed by C2 cookies with 7.65 ± 0.81 and 7.55 ± 0.88 and C3 cookies with similar score of 7.5 ± 0.67 and 7.65 ± 0.74 .

Colour

The brownish cinnamon cookies (C2) was less appreciated with RQS flour based cookies scoring 7.6 ± 0.75 and URQS flour based cookies comparatively scoring 7.5 ± 0.76 than much lighter salt cookies (C3) with 7.6 ± 0.59 , 7.7 ± 0.80 and where as golden coloured corn flake cookies (C1) with 8.55 ± 0.82 , 8.25 ± 0.85 tops in the colour. Except in salt cookies, RQS based cookies scored better than URQS based products.

Taste

The salt cookies (C3) made with RQ flour was least scored with 7.3 ± 0.65 in taste because of its slight bitter taste. The cinnamon cookies (C2) and salt cookies (C3) made with URQS flour was similar in scores with 7.7 ± 0.97 , 7.8 ± 0.95 and 7.8 ± 0.69 . The taste of corn flake cookies (C1) was given similar high scores of 8.35 ± 0.87 in both RQS and URQS flour based products. Except corn flakes cookies, the taste of URQS based cookies is much liked than RQS based cookies.

Texture

The combination of Texture and flavour forms the sensory image and consider crucial in sensory characteristics of cookies. Score of RQS cinnamon cookies (C2) texture was slightly lesser URQS cinnamon cookies (C2) with 7.4 ± 1.14 , 7.6 ± 0.88 , the similar pattern was observed in salt cookies (C3) with 7.65 ± 0.58 , 7.75 ± 0.71 . The texture of corn flake cookies (C1) varies between RQ (8.05 ± 0.94) and URQ (8.3 ± 0.80). URQS based products has better texture than RQS based cookies.

Flavour

The flavour of salt cookies (C3) were lower than other cookies but both RQ and URQ has similar scores with 7.55 ± 0.51 and 7.45 ± 0.60 . flavour of URQ Cinnamon cookies (C2) was better scored than RQ Cinnamon cookies (C2) ($7.8 \pm 0.69 > 7.4 \pm 0.75$). the scores revealed that corn flake cookies (C1) flavour higher than both cinnamon and salt cookies with URQS

cookies flavour (8.25 ± 0.85) is more acceptable than RQS cookies (8.1 ± 1.02). Flavour of RQS based corn flake and cinnamon cookies were much liked than URQS based cookies.

Overall Acceptability

The overall acceptability of cookies didn't varied between RQ and URQ rather the difference more evident in cookies with corn flake cookies (C1) scoring high overall acceptability score of 8.35 ± 0.87 , 8.3 ± 0.80 followed by cinnamon cookies (C2) (7.75 ± 0.71 and 7.5 ± 0.76) and Salt cookies (C3) (7.65 ± 0.67 and 7.55 ± 0.68). The quinoa cookies were highly accepted with overall acceptability score ranges from 7.55 ± 0.68 to 8.35 ± 0.87 on 9 point hedonic scale means they were liked moderately to liked very much. C1 Cookies were very much liked in all aspects of sensory evaluation with all scores more than 8 which interpretes that they were liked very much to liked extremely on the hedonic scale.

Table.1 Raw materials

Name of ingredients	Corn flake Cookies (C1)	Cinnamon cookies (C2)	Salt cookies (C3)
1. Quinoa flour	22g	22g	35g
2. Oats flour	13g	13g	13g
3. Corn flour	8.5g	8.5g	20g
4.Sugar	25g	25g	-
5.Butter	17g	17g	19g
6.cornflakes/cinnamon powder/salt	5g (Cornflakes)	5g (cinnamon powder)	1g (salt)
7.Milk/ Water	10ml	10ml	10ml

Table.2 Scores based on Sensory Evaluation of Quinoa Cookies (Plain cookies, Cinnamon cookies (C2) and Salt cookies (C3))

S. No.	Parameters	RQC2	URQC2	Tvalue	RQCC2	URQCC 2	t-value	RQSC	URQSC	t-value
1	Appearance	8.3±0.80	8.3±0.86	0 NS	7.65±0.81	7.55±0.88	0.48 NS	7.5±0.67	7.65±0.74	0.71^{NS}
2	Colour	8.55±0.82	8.25±0.85	1.55 NS	7.6±0.75	7.5±0.76	0.56 NS	7.6±0.59	7.7±0.80	0.46 NS
3	Taste	8.35±0.87	8.35±0.87	0 NS	7.7±0.97	7.8±0.95	0 NS	7.3±0.65	7.8±0.69	2.36*
4	Texture	8.05±0.94	8.3±0.80	1.09 NS	7.4±1.14	7.6±0.88	0.67 NS	7.65±0.58	7.75±0.71	0.39 NS
5	Flavour	8.1±1.02	8.25±0.85	0.61 NS	7.4±0.75	7.8±0.69	1.70 NS	7.55±0.51	7.45±0.60	0.62 NS
6	Overall Acceptability	8.35±0.87	8.3±0.80	0.25 NS	7.5±0.76	7.75±0.71	1.31 NS	7.65±0.67	7.55±0.68	0.49 NS

Table.3 Nutritive value of Quinoa Cookies

	Plain Cookies	Cinnamon cookies (C2)	Salt cookies (C3)
Energy	337.95	318.95	303.07
Fat	8.93	8.88	9.89
Protein	4.56	4.23	6.2
Carbohydrates	58.96	54.61	46.91
Fibre	4.15	4.02	6.43
Vitamin A	12.97	7.97	7.04
Vitamin E	0.46	0.46	0.71
Vitamin K	0.44	0.44	0.7
Thiamine	4.73	4.68	0.29
Riboflavin	12.8	12.74	0.07
Niacin	11.63	10.97	0.59
Pyridoxine	0.12	0.04	0.07
Calcium	58.14	58.14	67.2
Zinc	0.72	0.72	1.15
Iron	2.69	1.81	0.88

Fig.1 RQS Corn flake cookies (C1)



Fig.2 URQS Corn flake Cookies (C1)



Fig.3 RQS Cinnamon cookies (C2)



Fig.4 URQS Cinnamon Cookies (C2)



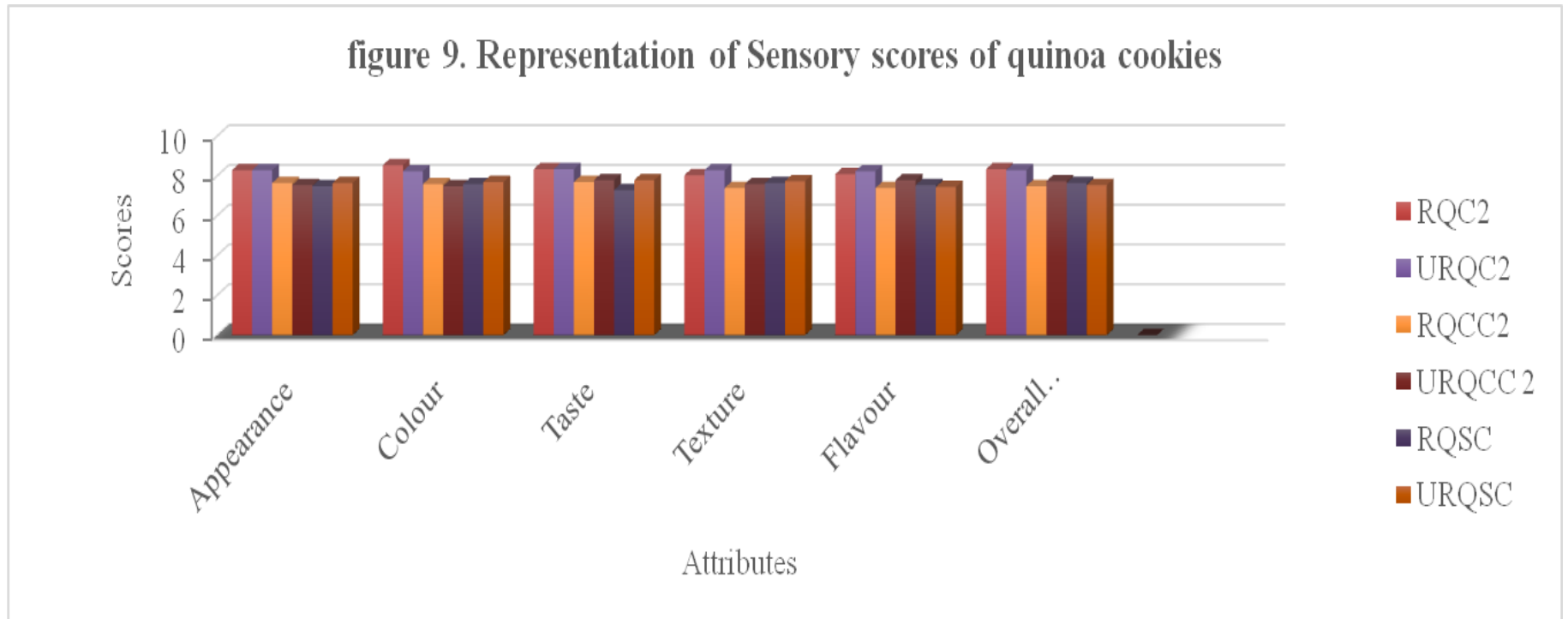
Fig.5 RQS Salt Cookies (C3)



Fig.6 URQS Salt Cookies (C3)



Fig.7



The Significant difference at 5% level of significance was found only in taste (t - value: 2.36) attribute of salt cookies (C3). The results were higher when compared to Sukmandeep (2016) where cookies made with quinoa, oats and rice flour in the proportion of 10:45:45 ratio which got overall acceptability score of 7.46 ± 0.45 . Bhatkal (2016) prepared gluten free products with 100% quinoa flour and organoleptic scores were like 8.10, 8.0, 7.70, 8.00, 7.90 and overall acceptability score of 7.94 which was more than the cookies in the control i.e., 7.28.

Mayra (2018) prepared gluten free cookies using Rice flour (RF), Corn flour (CF) and Quinoa flour (QF) in three different formulations, Formulation 1, 2 and 3 consists of RF, CF and QF in the proportion of 60:30:10 and 70:10:20 and 60:10:30 and concluded that Formulation 3 was not accepted due to its poor organoleptic scores.

Brito *et al.*, (2015) Gluten-free quinoa cookies with 30% quinoa flour, 25% quinoa chips and 45 % corn starch. In comparison to the control batch, these cookies were high in essential amino acids, linolenic acid, minerals, and dietary fibre and The overall acceptability of the optimised quinoa-based cookie received an average score of 6.8, which corresponds to "liked." Pagamunici *et al.*, (2014) produced gluten-free cookies using rice and quinoa flour in proportions of 15, 26, and 36% quinoa flour.

According to 80 non-trained customer panelists, the formulation of 36.0 percent quinoa flour had as well as outstanding sensory characteristics. The cookies were highly received since the acceptance percentage was greater than 70%.

Nutritive Value of Quinoa Cookies

Table(2) represents the calculated nutritive value of quinoa cookies based on the weight

of raw ingredients mentioned in Indian Food Composition Table (2017). From the table, it is evident that quinoa cookies are not only tasty but also nutritious.

Salt cookies (C3) provide less carbohydrates(46.91g) and energy(303.07 k.cal), high fibre (6.43g) than sweet cookies i.e., Corn flake cookies (C1) and Cinnamon cookies (C2) (C3) (54.61g and 58.96 g, 318.95 k.cal and 337.95 K.Cal, 4.02 g and 4.15 g) per 100g of quinoa cookies which can be helpful in weight reduction. Even though the nutrient content differs from salt cookies (C3) but it's nutritive value is cannot be ignored. Using FAO/WHO recommendation(2003) of fibre intake (25 to 30 g of fibre per day) for adults to help avoid diet-related chronic illnesses, four quinoa cookies (as cooked) would provide approximately 25% of the minimum daily required fibre intake.

Protein (4.23g, 4.56g and 6.2g) and fat (8.83g, 8.88g and 9.89g) are present in moderant quantities which makes quinoa as excellent substitute for wheat in bakery products. Quinoa is one of very few grains that consists of all essential amino acids and considering the amount of protein even without egg explains the importance of quinoa. The fat is present in quinoa is majorly made up of polyunsaturated fatty acids, monounsaturated fatty acids and less transfat. 100g quinoa cookies(Corn flake Cookies) can provide 4.73 mg, 12.8 mg and 11.63 mg of Thiamine, Riboflavin and Niacin which are important vitamins in energy and protein metabolism. The calculated values were higher than recommended RDA of these nutrients for reference man and woman (RDA, 2020) which implies the health benefits of quinoa cookies. The other important minerals that is present in cookies are calcium (58.14, 58.14 and 64.4), Zinc (0.72, 1.15) and Iron (0.88, 1.18 and 2.69) These minerals have critical roles in maintaining health, cell growth and

proliferation, metabolism, development, and immune function.

The results of sensory evaluation and calculated nutritive value of quinoa cookies proved that Quinoa cookies presents both health benefits and taste. These results indicate that quinoa (processed into flour) might be used as a gluten-free bakery ingredient in combination with maize flour and oat flour, especially in cookies for the gluten sensitive people who suffers from lack of nutrients.

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