

**Nutritional and quality analysis of quinoa seed flour fortified wheat biscuits****Shruti Puri<sup>1</sup>, Loveleen Kaur Sarao<sup>2\*</sup>, Kulveer Kaur<sup>1</sup>, Ananya Talwar<sup>1</sup>**<sup>1</sup>*Department of Food Science, MCM DAV College for Women, Chandigarh, India*<sup>2</sup>*Department of Microbiology, Punjab Agricultural University, Ludhiana, Punjab, India*

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**ABSTRACT**

Improvisation towards a healthy lifestyle is a necessity of today. Quinoa is a pseudo cereal and its seed is rich in essential amino acids such as methionine, threonine and lysine which are limiting in most other cereals. It also contains large amounts of minerals like calcium, iron, zinc and copper. Hence, it can be used in preparation of fortified products. The influence of fortification of wheat flour with quinoa seed flour in different ratios (90:10), (80:20), (70:30) and (60:40) were studied. The proximate analysis, sensory analysis and physical properties of samples were analysed. On the basis of nutritional value, biscuits with ratio (60:40) were acceptable as it contains high fibre content and high ash content as compared to other samples. On the basis of sensory evaluation, whole wheat flour biscuits and 10% fortified biscuits scored highest among all samples. Fortified quinoa seed flour biscuits were found to be highly nutritious.

**Key words:** Quinoa, quinoa seed flour, biscuits, fortified products.

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**INTRODUCTION**

Quinoa (*Chenopodium quinoa* Wild.) is a pseudocereal native to the Andean regions of South America. [1] Quinoa is one of the oldest crops of the American continent. Foreign crops like wheat and barley were grown instead of traditional food natives. Subsequently, it was based on the morphological types of the plant. For practical reasons, quinoa, like maize, has been classified as a race. Quinoa collected in Ecuador, Peru, and Bolivia has been classified into 17 races, however, more races may exist. Quinoa is known as a “complete food”. [2] Quinoa has been replaced with rice as it is rich source of fibre and protein. It is mainly boiled in hot water to cook infant cereal food. A high amount of health-beneficial phytochemicals including saponins, phytosterols and phytoecdysteroids were present in quinoa. It is known that quinoa has considerably positive effects on metabolic, cardiovascular, and gastrointestinal health in humans. People even enjoy seeds as popcorn. Quinoa seeds are grinded and mixed with maize or wheat flour.

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Various studies reported utilization of quinoa flour for fortification in products such as bread (10-13% Quinoa flour), noodles and pasta (30-40%) and sweet biscuits (60%) (Valencia – Chamorro, 2003). Bakery products are used as a vehicle for incorporation of different nutritionally rich ingredients. [3] Biscuit are a healthy item for consumption. It has replaced a lot much junk from the society. Hence its fortification increases its nutritional value and a give a definite flavour to it. Quinoa has gained an increasing interest due to its nutritional value as well as its vitamins (B1, B2, B3 and E) content. Fortification is basically adding nutrients to foods regardless of whether or not the nutrients were originally present in the food. Fortification is a means of improving the nutritional status of a population (or potentially a sub-population). Some foods are fortified by law (e.g. white bread), others voluntarily (e.g. breakfast cereals, fat spreads). Safety and technical considerations are taken into account when deciding which foods to fortify and to what level. Quinoa possesses many sensory properties. Food texture refers to those qualities of a food that can be felt with the fingers, tongue, palate, or teeth. [4] Texture is one of most significant properties of food products. Quinoa has unique texture – creamy, smooth and a little crunchy (James, 2009). The seed

composition was recently reviewed by Wu (2014).<sup>[8]</sup> In order to conclude the high nutritional value of quinoa arises from its high protein content, complete and balanced essential amino acids, high proportion of unsaturated fatty acids, high concentrations of vitamin B complex, vitamin E, and minerals, and high phenolic and betalain content. That is why it is chosen for fortification. As Quinoa has gained importance due to its high nutrition value, aim of this study was to develop a new product via fortification with quinoa flour, thus improving the trend of traditional biscuits. Main objective of this study were - • Preparation of wheat flour biscuits. • Grinding and preparation of Quinoa seed flour • Fortification of Quinoa seed flour with wheat flour in different ratios (WF:QF - 90:10, 80:20,70:30,60:40) • Proximate comparative analysis of all the above ratios. • Comparative study of physical parameters such as Length : Breadth ratio , Spread ratio, Break strength . • Sensory evaluation of native and fortified biscuits

## MATERIAL AND METHODS

### Sample Procurement

Quinoa seeds were obtained from Sector-37 market, Chandigarh, while other ingredients. Wheat flour, desi ghee, milk, sugar were obtained from a local market in Boha, Punjab.

### Production of Quinoa Seed Flour

Quinoa seeds were washed properly under running water until there is no foam formation. This is done to remove saponins from outer layers because it imparts bitter taste. After all the water drained, these seeds are dried by sun drying method. These quinoa seeds were grinded in a clean electrical stainless steel grinder to get a fine powder and sifted through 60 mesh. This quinoa seed flour was used in required quantities for preparation of biscuits with varied ratios.

### Product Development

Biscuit sample were prepared using the following method. The ingredients used in preparation of biscuits were composite of wheat flour, quinoa seed flour, desi ghee (450g/kg), milk (550ml/kg) and sugar (550-600g/kg) according to taste. Biscuits were prepared from different blends of wheat flour and quinoa seed flour in the respective ratios of 100:0, 90:10, 80:20, 70:30 and 60:40. 100:0 biscuits were considered as control. Biscuits dough was prepared manually and rolled into a thin sheet and cut into desired shape using mould. The cut pieces were baked at 220-226<sup>o</sup>C in a pre-heated oven for 6-8 minutes. After baking biscuits were cooled and stored in air tight containers.

### Formulations

- A – 100g wheat flour, 0g quinoa seed flour (100:0)
- B – 90g wheat flour, 10g quinoa seed flour (90:10)
- C – 80g wheat flour, 20g quinoa seed flour (80:20)
- D – 70g wheat flour, 30g quinoa seed flour (70:30)
- E – 60g wheat flour, 40g quinoa seed flour (60:40)

### Proximate Analysis

#### Moisture Content

The moisture content in the biscuit samples was determined by the Hot Air Oven Single Stage Method (AOAC 2000)

#### Fat Content

For the estimation of crude fat content, Soxhlet method (AOAC 2000) was used<sup>[5]</sup>

#### Ash Content

Sample (5 g) was taken in a previously weighed crucible. Crucibles were then placed in a muffle furnace at 550<sup>o</sup>C for 4 hours or until light grey ash resulted (AOAC 2000).

#### Crude Fiber Content

Crude fiber is defined as loss on ignition of dried residue remaining after digestion of sample with 1.25% Sulphuric acid and 1.25% Sodium Hydroxide solution under specific conditions. <sup>[5]</sup>

#### Protein Content

Protein content was estimated by using Micro-Kjeldahl method (AOAC 2000).

#### Carbohydrate Content

The values of moisture content, protein, fat, crude fiber and ash were added and subtracted from 100 (AOAC 2000)

#### Physical Parameters

Various parameters such as width, spread ratio and weight was calculated. a) Width:- The width of biscuits was determined by taking the average of the 3 values of width from various sites of biscuit. b) Spread Ratio:- It was calculated by taking the ratio of width and height. c) Weight:- It was calculated by weighing the biscuit using weighing balance.

#### Sensory Evaluation

The sensory evaluation of all biscuit samples was done 25 semi-trained panel lists. The analysis was performed at MCM DAV College for Women, in Chandigarh, India, in a stable temperature and light. The evaluation was done by using 9-point hedonic scale. Samples were scored using a nine-point hedonic scale, where 1 is dislike extremely, 2 is dislike very much, 3 is dislike like moderately, 4 is dislike slightly, 5 is neither dislike nor like, 6 is like slightly, 7 is like moderately, 8 is like very much and 9 is like extremely according to the appearance/colour, body/texture, mouth feel, flavour and overall desirability.

**RESULTS AND DISCUSSION****Table 1 : The results of physical parameters**

Physical parameters	Sample A (control) s	Sample B	Sample C	Sample D	Sample E
Width	2.85	2.93	2.68	2.29	2.08
Diameter	11.84	11.15	10.97	10.76	10.61
Spread ratio	4.15	3.8	4.09	4.69	5.1

**Table 2: The results of sensory evaluation**

Samples	Sample A (control)	Sample B	Sample C	Sample D	Sample E
Appearance	7.75	8	7.20	7.75	6.83
Texture	7.87	7.83	7.12	7.54	6.08
Mouth feel	7.62	7.66	6.58	7.16	5.58
Flavour	7.91	7.58	6.75	6.83	5.70
Overall acceptability	7.79	7.77	6.91	7.3	6.05

**Table 3:Moisture content of all the samples**

Sample	Moisture Content (%)
A	4.85
B	5.55
C	6.34
D	6.45
E	8.77

**Table 4:Ash content of all the samples**

Sample	Ash content (%)
A	0.87
B	1.03
C	1.17
D	1.29
E	1.46

**Table 5: Crude fiber content of all the samples**

Sample	Crude fiber content (%)
A	0.24
B	0.37
C	0.6
D	1.13
E	1.16

**Table 6 : Fat content of all samples**

Sample	Fat content (%)
A	23.13
B	22
C	20.58
D	19.98
E	18.29

**Table 7: Protein content of all samples**

Sample	Protein content (%)
A	8.74
B	10.49
C	12.25
D	17.06
E	25.37

**Table 8: Carbohydrate content of all samples**

Sample	Carbohydrate content (%)
A	62.17
B	60.56
C	59.06
D	54.06
E	44.95

**Physical parameter analysis**

A very minute difference was found in the results of physical parameters like weight, width and spread ratio. As we can see in table no. 1. The weight was decreased with increase in fortification but with a very minute difference. The height had also a decreasing trend with increase in fortification but with a very minute difference. The spread ratio had an increasing trend with increase in fortification with a minute difference. The diameter was decreased with increase in fortification. It was found that the decrease in the physical properties with increase in fortification is because the gluten content of biscuits was decreased and hardness increased with increase in fortification. [7]

**Sensory evaluation (on the basis of overall acceptability (average))**

The sensory evaluation of all the samples after preparation was done. Samples (A, B, C, D and E) showed an overall acceptability of 7.79, 7.77, 6.91, 7.3 and 6.05 respectively out of 9 (Table 2). This showed that on increasing the amount of quinoa seed concentration, the overall acceptability of the samples decreased except Sample D. As observed, the Sample A and Sample B was the most accepted and in the fortified samples, the sample fortified with 30% quinoa seed was satisfactory. The mean scores were lower due to increase in hardness in texture because gluten content decreased, because quinoa seeds were gluten free, increased dullness and biscuits with increase in fortification are more dried than the control sample. [7]

**Proximate analysis****Moisture Content (%)**

Moisture content of all the samples after preparation was evaluated. Samples (A, B, C, D, E) showed moisture content of 4.85%, 5.55%, 6.34%, 6.45% and

8.77% respectively (Table 3). This showed that on increasing the amount of quinoa seed concentration, moisture content also increased. This showed that on storage, moisture was gained by the product. This may be due to high water binding and high hydration power of quinoa seeds.

**Ash Content**

The ash content of all the samples was evaluated. Samples (A, B, C, D and E) showed ash content of 0.87%, 1.03%, 1.17%, 1.29% and 1.46% respectively (Table 4). This showed that on increasing the amount of quinoa seed concentration, ash content also increased. This may be due to high mineral content of quinoa seed flour. In a study done on fortification of cookies with chia seed flour, it was reported that the ash content increases with the increase in mineral content and quinoa has slightly more ash content than wheat flour. [6]

**Crude Fibre Content**

The crude fibre content of all the samples was evaluated. Samples (A, B, C, D and E) showed crude fibre content of 0.24%, 0.37%, 0.6%, 1.13% and 1.16% respectively (Table 5). This showed that on increasing the amount of quinoa seed concentration, crude fibre content also increased. This may be due to increase in lipid content present in quinoa seed flour as PUFA. A study reported by Michala Jancurova *et al.*, (2009) [6] showed that the crude fibre content of biscuits fortified with quinoa seed flour showed an increasing trend with addition of quinoa. This was due to the increase in lipid content present in chia flour as PUFA.

**Fat Content**

The fat content of all samples was evaluated. Samples (A, B, C, D and E) showed fat content of 23.13%, 22%, 20.58%, 19.98% and 18.29% respectively (Table 6).

This showed that on increasing the amount of quinoa seed concentration, the fat content decreased. This may be due to an increase in the free fatty acid content and might be due to the high retention ability of quinoa seed flour.

#### Protein Content

Protein content of all samples was evaluated. The samples (A, B, C, D and E) showed protein content of 8.74%, 10.49%, 12.25%, 17.06 and 25.37% respectively (Table 7). This showed that on increasing the amount of quinoa seed concentration, protein content also increased. The study of Michala Jancurova *et al.*, (2009) showed that quinoa seeds has 16.5% protein content, so due high content of proteins in quinoa seed flour protein content of biscuits increased as fortification level increased.

#### Carbohydrate Content

The carbohydrate content of all samples was evaluated. Samples (A, B, C, D and E) showed carbohydrate content of 62.17%, 60.56%, 59.06%, 54.09 and 44.95% respectively (Table 8). This showed that on increasing the amount of quinoa seed concentration, carbohydrate content decreased. Because quinoa has low carbohydrate content than wheat flour. <sup>[6]</sup>

#### CONCLUSION

Composite flour prepared from quinoa seed flour considerably affected the physicochemical, sensory and nutritional properties of biscuits. The present study was conducted to compare the effect of fortification on the chemical and sensory attributes of biscuits. Quinoa seeds flour had significant effect on the functional properties of the flour blends. The present study was conducted to compare the effect of fortification on the chemical and sensory attributes of biscuits. Replacement of wheat flour with quinoa seed flour at 10 % , 20%, 30% and 40% levels was done. It showed an increase in total proteins, fiber and ash contents. Blending quinoa seed flour with wheat flour at 40% level produced samples can be used for production of bakery goods with improved functional properties. Because 40% fortified biscuits had highest ash content (1.46%), crude fiber content (1.16%), protein content (25.37%) and lowest carbohydrate content (44.95%) among all other samples. But it had highest moisture content (8.77%) and lowest fat content (18.29%) among all other samples. On the basis of sensory

evaluation, biscuits of ratio (100:0), (90:10) and (70:30) of wheat flour and quinoa seed flour was organoleptically highly acceptable than other fortified biscuits. In physical examination analysis sample with highest fortification showed the maximum spread ratio (5.1) but had lowest width (2.08 cm), weight (5.44 g) and diameter (10.61 cm) among all the samples. The results obtained could be very valuable in decision making for industries that want to take nutritional advantage of quinoa seed flour as alternative or supplement to cereal flours. Quinoa seed flour could be useful in the manufacture of highly nutritious biscuits.

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