Asian Jr. of Microbiol. Biotech. Env. Sc. Vol. 24, No. (1) : 2022 : 81-85

ISSN-0972-3005

http://doi.org/10.53550/AJMBES.2022.v24i01.015

DEVELOPMENT AND STANDARDIZATION OF QUINOA BASED NUTRI-BAR

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(Received 25 November, 2021; Accepted 22 December, 2021)

Key word: *Quinoa, Nutri-bar, Sensory evaluation, Proximate analysis.*

Abstract–This study was carried out at College of Food Science and Technology, Rudrur, Telangana and the main objective of this study was to develop a nutritive, low cost and stable nutri-bars for stout people (obese people). The Nutri-bars were developed and standardization from different ingredients in four different formulations. Present era food habits have changed the desire for healthy and functional foods are also increasing at the same time. The quinoa plays an important role in the highly nutritious foods. Quinoa is an annual grain crop and in recent years people attracted renewed interest for its high nutritional value, which make it a unique food product for health-conscious consumers. The study is to develop a nutri-bar using Quinoa with Flax seed, chia seeds, nuts and dried fruits. Four bar prototypes were designed and evaluated in a consumer acceptance test where the attributes flavor, sweetness, texture and appearance were assessed. The prototype (F4) with the highest acceptance scores had the following composition: 25% Quinoa; 6% Flax seeds; 6% Chia seeds; 14% Almonds; 13% Jaggery; 11% dried cranberry; 1% Salt; 3% Ghee; 18% honey; 1% agar-agar. Quinoa nutria-bars were packed in low density polyethylene, stored under ambient conditions for shelf-life evaluation in fifteen days of interval. In Proximate analysis of F4 sample contained 17.88% protein, 13.5% fat, 18.35% Fibre, 5.05% Moisture, 1.99% Ash, 30.99mg Calcium. Sensory parameters were observed a stability study over a period of 60 days in the time interval of 15 days at ambient temperature. Hardness of the bar decreased significantly during storage. Proximate composition of F4 sample increases significantly as compared to control and other two samples. Finally, the F4 sample was having high nutritive values in proximate and during storage and proved as a formulation in sensory evaluation.

INTRODUCTION

Quinoa is referred as a pseudo-cereal; Quinoa is one of the most versatile super foods which we can eat. Super foods are natural, unprocessed foods that are low in calories and also high in nutrients. They help the body to fight against disease and provide it with what it needs to be in excellent health. That means it contains all the essential Amino acids your body needs so, it's a great plant-based way to get your protein. It also full of Antioxidants and minerals, like manganese, folate, Zinc and Iron.

The demand for healthy, nutritious and safe food is growing worldwide. Intake of balanced food diet is the correct way to prevent or even remedy health problems, such as obesity, diabetes, malnutrition, cardiovascular and others, which largely originate from dietary mistakes

Quinoa provides balanced number of fatty acids such as omega 3, 6 and 9, fiber, vitamins (B2 and E) and mineralssuch as calcium and iron. Now-a-days food industry has developed a considerable number of quinoa-based edible products that are available on the global market. Among these are flours,soups, chips, tortillas, puffed quinoa (quinoa pop) and drinks. Quinoa is light, tasty, and easy to digest.

In the present study, quinoa has been used as one of the ingredients due to its high nutritional value along with the other ingredients viz. Flax seeds, Chia seeds, Dried fruits and nuts etc. for the preparation of Quinoa nutri-bar and evaluated for its stability by packing them in Low density

polyethylene, storing them at ambient conditions the resultant product which had better physico-chemical and sensory quality throughout the storage period**.**

MATERIALS AND METHODS

Raw materials

The required raw material viz., Quinoa, Flax seed and Chia seeds, Amaranth, Dried cranberries, Coconut powder, Almonds Honey, Ghee, jaggery, agar-agar and salt were purchased from the local market Bodhan. Packaging materials used was Low Density Polyethylene (200 gauge). The Equipment used grinder, Induction stove, Laminar air flow, Autoclave, Incubator, Weighing balance, Hot air oven, Soxhlet apparatus, Muffle furnace.

Pre-treatments for quinoa

Soaking

Soaking is ideally done to enhance the nutritional value as well as the flavor of the soaked Food. Here quinoa seeds were soaked for two hours to reduce the anti-nutritional factors like Saponins, protease inhibitors, phytic acid.

Roasting

Roasting of the quinoa was done as per the method given by Florence and Asna (2014). The grains were roasted in an open pan for 10 minutes at 200 f˜°C on low flame cooled to room Temperature, seal packed and further used.

Puffing

Here quinoa seeds were puffed where the initial moisture content of the seeds was brought to 19 % by adding water externally then these seeds were kept in close container for 4 hr Prior to puffing. Conditioned seeds were puffed in an iron pan. The temperature was maintained at 270 °C. Puffing induces significant changes in the structure and physical properties of the Starch and an increased water holding capacity of the seeds.

Puffing Yield

Puffing yield measured the quantity of grains fully puffed out of raw grains taken for Puffing. The grains were considered fully puffed only when the grain has expanded or bulged Endosperm structure with a disintegrated hull. The mixture containing both puffed and unpuffed Quinoa was separated into fractions by hand picking and the weight of fractions was recorded.

Puffing yield was calculated using the following formula

$$\text{Puffing yield (\%)} = \frac{\text{Weight of puffed grains (g)}}{\text{Weight of puffed grains + Weight of unpuffed grains}} \times 100$$

Expansion Ratio

Volume expansion ratio determined the degree of expansion of grains during puffing and it has a positive correlation with profit on sales. The popped grains were filled in 100 ml graduated Cylinder and volume was measured after tapping it 12 times. The expansion ratio can be expressed as follows

$$\text{Expansion volume} = \frac{\text{Volume of puffed grains}}{\text{Volume of raw grains}}$$

Flake Size

Flake size also called puff size was a measure of final average puffed volume for individual Puffed grain. The volume of 100 fully popped grains was recorded. It was calculated as follows

$$\text{Flake size} = \frac{\text{Volume of puffed grains}}{\text{Number of puffed grains}}$$

Bulk Density

Bulk density measured the degree of lightness of the puffed product. It was measured by the tapping method. The following formula was used for its calculation,

$$\text{Bulk density} = \frac{\text{Mass of puffed grains}}{\text{Volume of puffed grains}}$$

Quinoa Nutri-bar production process:

Standardized the Nutri-bar with three different formulations along with control sample taken Namely Formulation-1, Formulation-2, Formulation-3 were assumed.

Preparation of Nutri-bar

Initially, dry ingredients (quinoa 25%, flax seeds 6%, chia seeds 6%, dried cranberries 11%, almonds 14% and dehydrated grated coconut 2%) were weighed and mixed. In a next step, Ghee 3%, jaggery 13%, honey 18% and salt 1%, agar agar 1% were Mixed and heated up to 70-80 °C with constant stirring until an elastic mass was obtained. At this Point, the dry ingredients were added and mixed thoroughly. The mass was immediately Transferred into a mold

S.No	Ingredients	F1(Control)	F2	F3	F4
1.	Quinoa	23+8	23	24	25
2.	Flaxseeds	-	8	7	6
3.	Chias eeds	6	6	6	6
4.	Almonds	14	14	14	14
5.	Honey	18	18	18	18
6.	Jaggery	13	13	13	13
7.	Ghee	3	3	3	3
8.	Dried cranberries	11	11	11	11
9.	Desiccated coconut	2	2	2	2
10.	Salt	1	1	1	1
11.	Agaragar	1	1	1	1

Cleaning(to remove dust / dirt)

⇩

Puffing(quinoa)

⇩

Cutting (almonds, dried cranberries)

⇩

Preparation of syrup mixture(75 brix)

⇩

Addition of ingredients

⇩

Mix all the ingredients with syrup and heat

⇩

Mould and cool (30 min)

⇩

Unmold and cut

⇩

Packaging & storage

and cooled down to room temperature. Finally, the bar was removed from the mold, cut into pieces.

Quinoa nutri-bar

Formulation of Nutri-bar

Nutritional evaluation of Quinoa nutri-bar

A. Organoleptic evaluation

Organoleptic evaluation of Quino anutri-barswas done by selected panel members in the institute using 5-pointhedonicscale.

B. Chemical and nutritional properties

The chemical and nutritional properties of the Quino anutri-bar were studied using standard procedures. Estimation of Moisture present in the food sample was determined by using standard methods, given by AOAC (2005).

C. Estimation of Crude Fat

The amount of fat was determined by using Soxhlet apparatus method by AOAC (2012).

D. Estimation of Total Ash

The total ash content of given food sample was determined by using AOAC (2012) method.

A. Protein estimation by micro-kjeldahl method:

Nitrogen is the major element next to carbon, hydrogen and oxygen found in living things given by AOAC (2005).

B. Estimation of crude fiber

The acid and subsequent alkali treatment, oxidative hydrolytic degradation of the native cellulose and considerable degradation of lignin occur. The residue obtained after final filtration is weighed, incinerated, cooled and weighed again. The loss in weight gives the crude fiber content. (Maynard A J).

C. Estimation of Calcium

Calcium was precipitated as calcium oxalate. The precipitate was dissolved in hot dilute HSO and titrated against standard potassium permanganate (Ranganna, 2010).

Table. Puffing characteristics of quinoa

Particulars	Quinoa
Puffing yelid	64.03%
Expansion ratio	2.54%
Flake size	6.66mm^3
Bulk density	0.45g/ml

RESULTS AND DISCUSSION

In ready to eat products, just like nutir-bar low moisture content was exploited an advantage for better quality to store longer period without using preservatives. This technique was very effective against developing rancidity even after several months in the product.

The quinoa seeds can be processed into a crispy, cellular-structured and expanded whole-grain snack product by low capital cost involving traditional puffing method. The study aims to statistically optimize the processing conditions for puffing of quinoa. It was found that measured response parameters like puffing yield, expansion ratio, flax size and overall acceptability of puffed quinoa.

Sensory Analysis

Mean sensory scores for color varied non-significantly for all the samples whereas flavor, taste, texture and overall acceptability show a significant difference. Formulation F4was rankedby the judges to have the highest color score (4.26), flavor (4.12) taste (4.25), texture (4.5) and overall acceptability (4.27). The formulation F3 was observed to closely relate with formulation F4 with non-significant differences for the parameters studied such as color (4.25), taste (3.87), flavor (3.75), texture (4.12) and overall acceptability (3.96).

Whereas, formulation F1and F2 received the lowest score for almost all attributes except color which did not differ significantly with formulation F3 and F4.

Sensory evaluation of Nutri-bars

The highest score was given to formulation F3 and F4 by the panelist for flavor, texture, taste and overall acceptability; this may be because of the presence of nuts, cranberries, almonds and puffed quinoa in high concentration. These ingredients were responsible for crisp nature and crunchy texture of quinoa nutri-bar, in addition to providing better taste and fruitful flavor to the final product. Based on microbiological analysis of TMC and TBC count we have evaluated the shelf life studies.

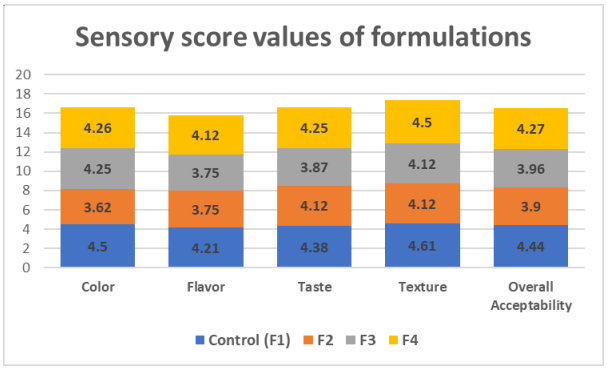

Fig: Sensory score of different formulations of Quinova Nutri-bar

Table: Total Bacterial and fungal count of (CFU/g) for all the four formulations

Formulation	Bacteria10^{-3}	Fungi10^{-2}
F1	5×10^2	5×10
F2	8×10^2	9×10
F3	2×10^2	6×10
F4	7×10^2	8×10

Microbial Analysis

Proximate analysis of different formulations

Analysis of proximate composition of quinoa nutri-bar indicated the moisture content of 5.05%, crude fat 13.5%, crude protein 10.09% and fiber 18.35% and also bar contained 1.99% total ash and calcium 30.09 mg/100g.

Using flax seeds and chia seeds make a

Table: Sensory evaluation of different formulations of Quinova Nutribar

Sl. No.	Parameters	Sensory score values of formulations			
		Control(F1)	F2	F3	F4
1.	Color	4.50	3.62	4.25	4.26
2.	Flavor	4.21	3.75	3.75	4.12
3.	Taste	4.38	4.12	3.87	4.25
4.	Texture	4.61	4.12	4.12	4.5
5.	Overall Acceptability	4.44	3.90	3.96	4.27

S. No.	Parameter	Nutrient composition of formulations (100g)			
		Control(F1)	F2	F3	F4
1.	Moisture content (%)	5.12	5.09	5.10	5.05
2.	Proteins (%)	8.10	8.9	9.8	10.09
3.	Calcium mg/100g	26.03	28.86	27.06	30.09
4.	Fat (%)	12.1	15.3	14.05	13.5
5.	Ash (%)	1.07	1.77	1.59	1.99
6.	Crude fiber (%)	16.98	17.03	17.92	18.35

complimentary combination to improve the omega-3fatty acid and also protein quantity and quality in nutri-bar product. In addition to these, it may be a good source of limiting amino acids such as lysine, arginine, and sulfur-containing amino acid cysteine.

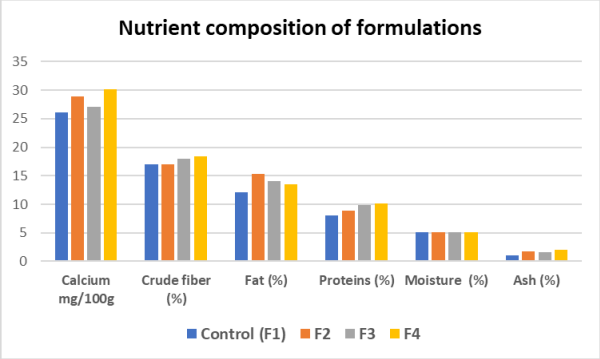

Fig. Nutrient composition of Quinoa nutri-bar in all formulations

In this nutri-bar the composition of fibers and unsaturated fatty acids is ideal for the patients suffering from obesity, higher weights, and elevated blood pressure. Similar health benefits can be achieved by using nuts as was practiced in this research to prepare thenutri-bar.

The fiber content provided by these ingredients also help to control cholesterol levels in blood thus minimize the occurrence of heart-related problems. Some of the ingredients used in nutri-bar development were meant for energy purposes. Apart from energy provision, these were also imparting favorable conditions to improve functional properties of the final product.

CONCLUSION

A highly nutritious bar was prepared with quinoa and the incorporation of flax seeds to enhance its fiber and protein quality. Quinoa nutri-bars were packed in low density polyethylene, stored under ambient conditions for shelf-life evaluation. Packing in low density polyethylene was found beneficial in extending the shelf life of the bar. Even though bar remained chemically, sensorily and microbiologically safe during the entire storage period, Sensory parameters were observed a stability study over a period of 60 days in the time interval of 15 days at ambient temperature. Hardness of the bar decreased significantly during storage. Proximate composition of F4 sample increases significantly as compared to control and other two samples.

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