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# Preparation and optimization of ready to serve non-dairy quinoa milk

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**Abstract**
In order to create RTS beverages has the same texture, particle size, and mouthfeel as dairy products, soaked and cooked Quinoa seeds are combined with an enzyme treatment, and xanthan gum; which are studied in this article. A ready-to-drink non-dairy beverage made from quinoa, is a healthy, calorie-free drink that will be quench thirst and give a booster of energy. Quinoa is advantageous for those who are lactose intolerant, and it is healthy, gluten-free product that is suitable for all demographics. Sterilization results in a lower microbial load and a longer shelf life, allowing for longer storage times. Both necessary fatty acids and protein are abundant in quinoa. The final product is kept for sensory assessment using the nine-point hedonic scale and proximate analysis. In this article, discussed about the analysis for two evaluation processes namely, as sensory and physio-chemical processes done by the mathematical and statistical techniques as ANOVA and CRD models. From the sensory evaluation processes, performance of formulation $T_1$ give acceptable response on sensory basis as well as nutritional values.

**Keywords:** Quinoa milk, RTS beverage, intolerance, sensory evaluation, xanthum gum, valerian extract. ANOVA, CRD

## Introduction
In the amaranth family, Quinoa (Chenopodium quinoa) is a flowering plant. It is an annual herbaceous plant that is mostly grown for its edible seeds, which are higher in protein, fiber, B vitamins, and nutritional minerals than many cereals [1]. India is still the world's top producer and consumer of dairy products obtained from animals. Plant-based milks including oat, soy, and almond milk have made encouraging strides with Indian consumers. Plant-based dairy in India is estimated to be worth $21 million, compared to the $140 billion animal-derived dairy business, and is expected to expand at a CAGR of 20.7 percent to reach $63.9 million by 2024. Lactose malabsorption with gastrointestinal symptoms is the definition of lactose intolerance. Additionally, "Not all consumed lactose was digested and that some has reached the large intestine" is the definition of lactose malabsorption. The majority of milk consumed worldwide is produced by cows, with buffalo, goat, sheep, and camel milk being the least popular [2]. Almond milk, oat milk, coconut milk, cashew milk, and rice milk are a few substitutes that can be used in place of cow's milk. However, there are debates about whether to refer to various varieties of milk as "milk" or "beverages, juice, or drinks" [3]. Even yet, since these substitutes don't contain lactose but nevertheless have a comparable Flavour and texture, lactose intolerance sufferers can safely consume them.
The primary justifications given by consumers for purchasing plant-based milk are those related to health and wellbeing. About 65 to 70 percent of adults worldwide, or adults, are lactose intolerant. Regional differences in lactose intolerance rates range from less than 10% in Northern Europe to up to 95% in Asia and Africa. After weaning, other mammals typically lose the capacity to digest lactose [4]. Many people are unaware that over 60% of Indians have a milk intolerance. Bloating, diarrhea, nausea, borborygmi, and stomach pain are common symptoms of lactose maldigestion. There is a risk of incorrect diagnosis because the terms "LI" and "cow's milk allergy" (CMA) are frequently used interchangeably [5].

## The protein-and-calcium myth
According to a Stanford researcher who recently talked about the "fats" in milk and its facts. Although milk is a good source of calcium, it is not often the most important element for bone and health. Despite consuming a lot of calcium, American women have some of the highest incidences of osteoporosis in the world [6, 7]. According to scientific research, milk may actually increase women's chance of developing osteoporosis rather than avoiding it.

Those who drank two or more glasses of milk per day had a higher risk of fractured hips and arms than those who drank one glass or fewer per day, according to a Harvard Nurses' Study of more than 77,000 women aged 34 to 59.

**Environmental Destruction**

Dairy cows and their faces release greenhouse gases that fuel climate change. Local water supplies may be harmed by improper manure and fertilizer handling. Additionally, unsustainable dairy farming and feed production can result in the destruction of forests, wetlands, and other ecologically significant habitats like grasslands.

**Cow suffers dairy farms**

On dairy farms in the United States, there are more than 9 million cows, which is almost a 12 million decrease from 1950 [8]. However, milk output has gone risen, from 116 billion pounds in 1950 to 215 billion pounds in 2017 [9]. Additionally, because their natural diet of grass wouldn't provide enough nutrients, cows are given unnatural, high-protein diets that can contain chicken feathers and fish

**Materials and Methods**

White Chenopodium quinoa grains were procured from Satara, Maharashtra, India for the study. Basic process for preparation of raw, soaked, cooked and blend quinoa beverages was followed step by step see figure 1. Used ingredients for these processes, i.e., Quinoa seeds, Valerian extract, Vanilla essence, Sweetener, and Additives with the ratio of amount, can see figure 2.

The researcher recommends using a traditional domestic method for preparing Quinoa Milk RTS beverages- soak, cook, and blend. The heating process has been found to reduce the anti-nutritional factors of [10]. The process of making the quinoa milk is further described in the fig below with the help of flow chart method. In this process, applied alpha enzyme at 0.2g/100 of cooked seeds to hydrolyses the starch for better palatability, as well as also added xanthum gum for stabilizing and thickening the Quinoa milk. Treatment of valerian extract is given just to enhance the nutritional value of the RTS Quinoa milk in very small amount discussed in table below.

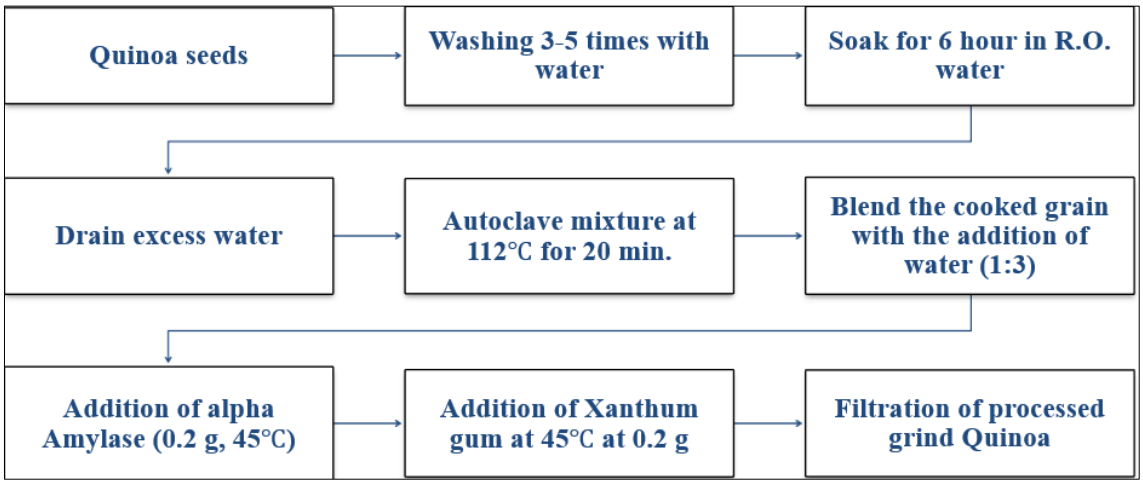


**Fig 1:** Flow Chart for Processing of Quinoa Milk

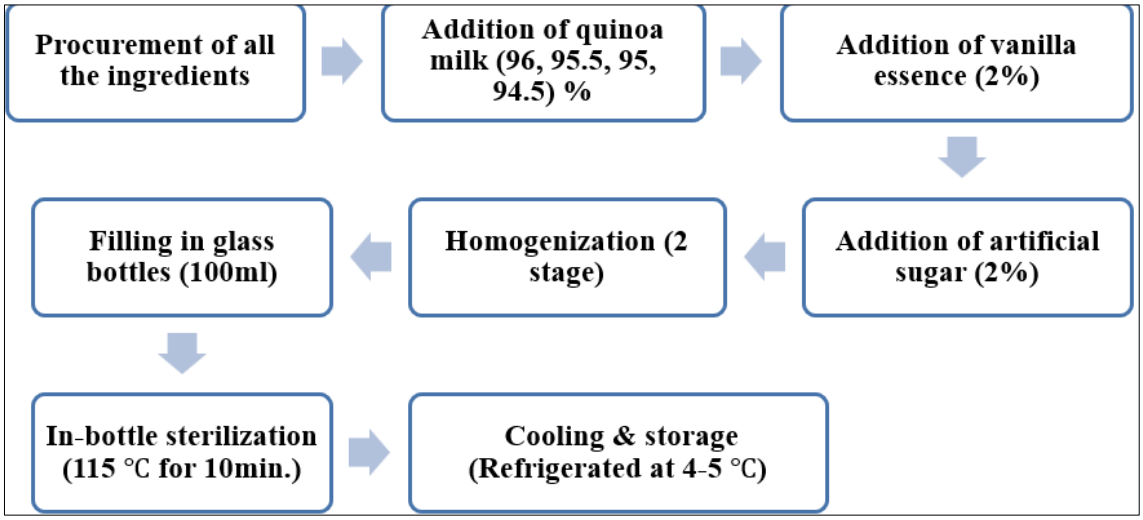


**Fig 2:** Preparation of Quinoa Milk

**Statistical analysis**

All experimental analyses (physio-chemical and sensory evaluation) were compared in MS. Excel using 2-way ANOVA, by CRD model.

**Experimental model**

In this section, apply the proposed experimental model i.e., CRD to use for analysis of different nutritional parameter average value obtained from the physio-chemical analysis of RTS non-dairy Quinoa Milk. Completely randomized design

(CRD) model applied on different method on forecasted stock index data set [11].

Firstly, the definition of completely randomized design (CRD) as when the homogenous data are taken into a single group and $\sum_{i=1}^{n} r_i = n$. Any treatment occurs more than one in the design [12]. The CRD model is define as,

$z_{ij} = \gamma + \beta_i + s_{ij}$

Proposed hypothesis of the observational data for different methods,

Null hypotheses, H0: all the methods used in literature are equal vs

Alternative hypothesis, H1: some methods used are in literature are not equal.

**For the analysis considered treatments define as**

$T_0$ - Control prepared from quinoa water (100%).

$T_1$ - Experimental sample prepared from quinoa water, valerian root oil, alpha-amylase, xanthum gum, vanilla essence, sweetener (95.5.:0.5:0.2:0.2:2.0:2.0)

$T_2$ - Experimental sample prepared from quinoa water, valerian root oil, alpha-amylase, xanthum gum, vanilla essence, sweetener (95.0:1.0: 0.2:0.2:2.0:2.0).

$T_3$ - Experimental sample prepared from quinoa water, valerian root oil, alpha-amylase, xanthum gum, vanilla essence, sweetener (94.5:1.5:0.2:0.2:2.0:2.0).

**Observation data of different methods is as follows**

**Table 1:** Raw Data of observation

| Ingredients | $T_0$ | $T_1$ | $T_2$ | $T_3$ |
|---|---|---|---|---|
| Quinoa Milk (ml) | 100 | 100 | 100 | 100 |
| Valerian extract (g) | 00 | 00.50 | 01.00 | 01.50 |
| Vanilla essence (g) | 02.00 | 02.00 | 02.00 | 02.00 |
| Sweetener (g) | 02.00 | 02.00 | 02.00 | 02.00 |
| Enzyme (g) | 00.20 | 00.20 | 00.20 | 00.20 |
| Xanthum Gum(g) | 00.20 | 00.20 | 00.20 | 00.20 |

$C.F. = G^2/n$

Different source of variation is obtained as,

$RSS = \sum Y_{ij}^2$

$TSS = RSS - C.F.$

$SST_r = \frac{\sum T^2}{r_i} - C.F.$

$SSE = TSS - SST_r$

**Physical and chemical composition**

The Association of Official Agricultural Chemists (AOAC) recommended procedures were used to determine the amount of fat and carbohydrates [13]. The Kjeldahl method was used to estimate the nitrogen content in order to measure the protein content. [14]. According to the procedure used by Welsh *et al*. [15], quinoa beverages were evaluated for organoleptic acceptance using a 9-point hedonic scale, from strongly dislike too extremely like.

**Results and Discussion**

Quinoa based ready to serve non-dairy beverage from different mixtures of Quinoa milk, valerian extract & additives is subjected to sensory and Physico-chemical evaluation and result are recorded on different parameters are presented below in table 2 and table 3.

**Table 2:** Sensory Analysis of four Quinoa milk based on non-dairy beverage

| Treatments | $T_0$ | $T_1$ | $T_2$ | $T_3$ |
|---|---|---|---|---|
| Colour and appearance | 7.8 | 8.1 | 7.74 | 7.7 |
| Flavour and taste | 8 | 8.2 | 7.5 | 7.1 |
| Texture and sediment | 7.6 | 8 | 7.5 | 7 |
| Mouthfeel | 7.8 | 8.2 | 7.2 | 7 |
| Overall acceptability | 7.8 | 8.1 | 7.48 | 7.2 |

**Table 3:** ANOVA table for analysis of sensory evaluation of RTS Quinoa Milk

| Source of Variation | SS | df | MS | F-Cal. | F tab 5% |
|---|---|---|---|---|---|
| Rows | 0.24948 | 4 | 0.06237 | 2.167883 | 3.259167 |
| Columns | 2.36726 | 3 | 0.789087 | 27.42741 | 3.490295 |
| Error | 0.34524 | 12 | 0.02877 | | |
| Total | 2.96198 | 19 | | | |

Applied CRD methods on the data of sensory evaluation in the case of row, the F-calculated value is 2.16 which is less than the F-Tab value i.e., 3.25 so the null hypothesis is accepted and in case of column the, the F-calculated value is 27.42 which is greater than the F-Tab value i.e., 3.49 so the null hypothesis is rejected at 5% level of significance. Shown in table 4.

From the figure 3, the overall acceptability of RTS non-dairy Quinoa milk is maximum in the treatment of $T_1$(8.1), followed by $T_1$(7.8), $T_2$(7.48) and minimum acceptability in case of $T_3$ (7.2) due to presence of strong essence of valerian extract.

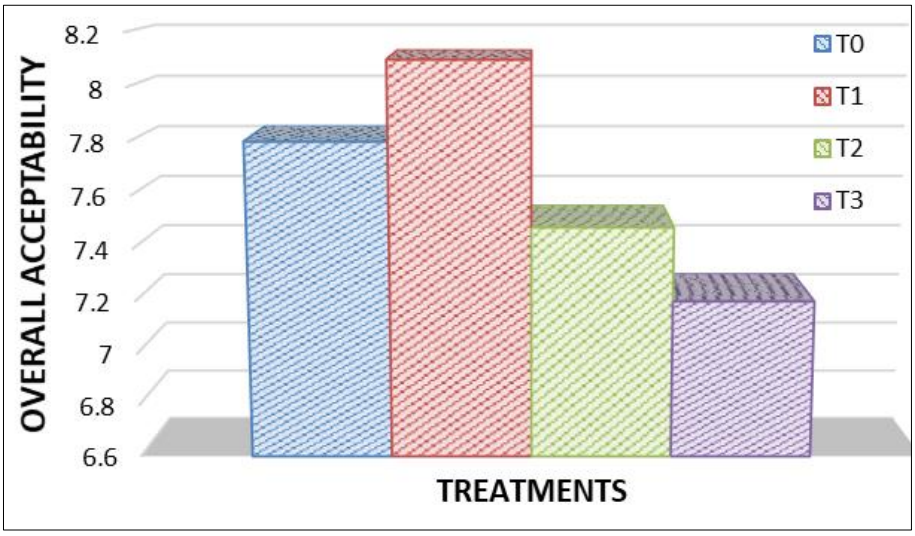


**Fig 3:** Sensory Analysis of four Quinoa milk based on non-dairy beverage

**Table 4:** Physico-chemical analysis of four Quinoa milk based on non-dairy beverage

| Treatments | $T_0$ | $T_1$ | $T_2$ | $T_3$ |
|---|---|---|---|---|
| Carbohydrate | 11.4 | 11.7 | 11.72 | 11.76 |
| Protein | 1.43 | 1.82 | 1.87 | 1.94 |
| Fat | 2.5 | 2.4 | 2.3 | 2 |
| Iron | 0.00052 | 0.00054 | 0.00057 | 0.00057 |
| Antioxidants | 24 | 26 | 27 | 31 |
| Saponin | 0.38 | 0.34 | 0.32 | 0.3 |

**Table 5:** ANOVA Analysis of nutritional value of RTS Quinoa Milk

| Source of Variation | SS | df | MS | F cal. | F Tab. |
|---|---|---|---|---|---|
| Rows | 2257.214 | 5 | 451.4429 | 310.4224 | 2.901295 |
| Columns | 4.568013 | 3 | 1.522671 | 1.047023 | 3.287382 |
| Error | 21.81429 | 15 | 1.454286 | | |
| Total | 2283.597 | 23 | | | |

From the above ANOVA table 6, When we applied CRD methods on the data of sensory evaluation in the case of row, the F-calculated value is 310.42 which is greater than the F-Tab value i.e., 2.90 so the null hypothesis is rejected and in case of column the, the F-calculated value is 1.047 which is less than the F-Tab value i.e., 3.28 so the null hypothesis is accepted at 5% level of significance.

From the figure 4, the nutritional value of RTS non-dairy Quinoa milk is vary from treatment to treatment i.e., in case of carbohydrate the maximum amount is found in $T_3$(11.76) followed by $T_2$ (11.72), $T_1$(11.7) and minimum in $T_0$(11.4). Same trend followed in case of Iron and protein as well as in antioxidant due presence of valerian extract. While in case of fat and saponin the maximum value in $T_0$ and minimum in case of $T_3$.

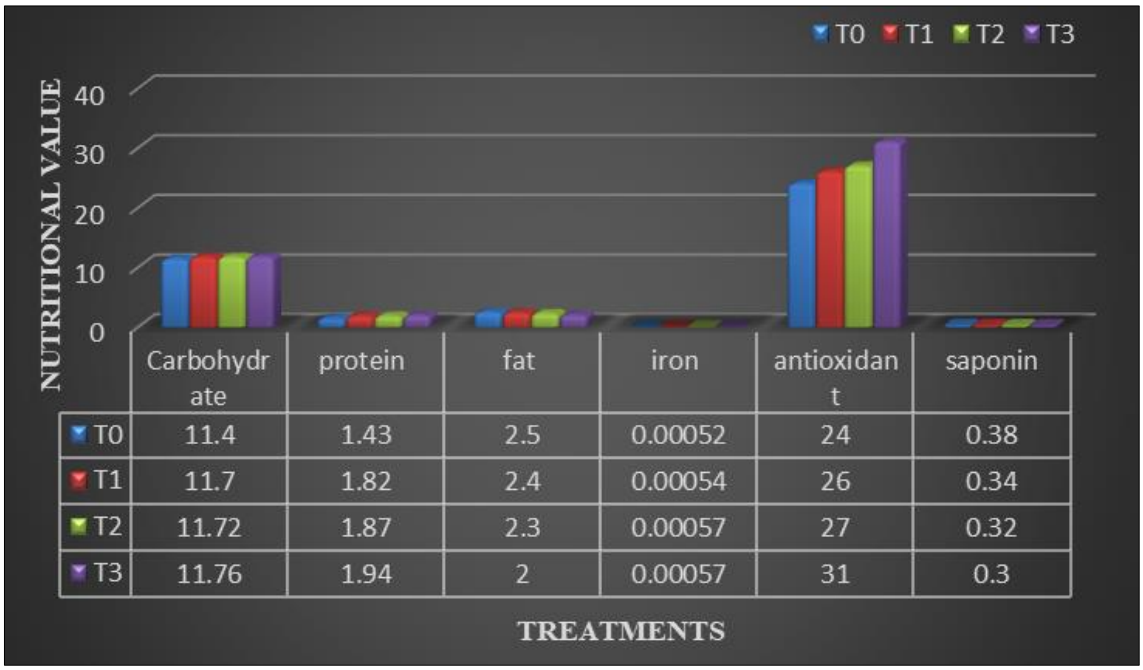


**Fig 4:** Physico-chemical analysis of four Quinoa milk based on non-dairy beverage

## Conclusion

From the above results we observed that the sample 2 which is treatment $T_1$ (8.1) has maximum acceptability in case of sensory evaluation and overall good quantity of nutritional value. In case of nutritional value carbohydrate content in $T_3$ (11.76) has maximum while in case of $T_0$(11.40) has

minimum carbohydrate, same pattern followed in case of protein and antioxidants, while in case of fat and saponin the treatments $T_0$ has highest nutritional value and $T_3$ has lowest nutritional value. Antioxidants in case of $T_3$ (31) due to the treatment of valerian extract and in $T_0$ no treatment is given so that antioxidants value is lesser in 1st sample. The results infer that the Quinoa milk based on non-dairy beverage could be included as a part of the diet in effective dietary management for lactose intolerance and hypertension. As the RTS of Quinoa Milk added valerian extract which help in a relaxing and sleep-promoting as well as to treat insomnia and blood circulation, and mental disorders. The optimum amount of valerian extract and quinoa milk that can be used in the process of preparation of quinoa based RTS non-dairy beverage is up to 1g and 95g respect. It is gluten free RTS beverage.

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