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# Effect of Addition of quinoa Flour on Cooking and Sensorial qualities of Noodles

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**ABSTRACT: The objective of this study was to explore the possibility of adding quinoa flour in the preparation of noodles. Quinoa flour was added at 20, 40, 60 and 80g in different proportion of refined wheat flour. Noodles were prepared by cold extrusion process and were studied for its sensory, cooking and colour qualities. The results indicated that quinoa flour can be incorporated in refined wheat flour up to 40g per 60g of wheat flour without significant changes in its qualities. The sensory score for colour of quinoa flour noodles was preferred the most. Cooking weight and water absorption were found to be increased with increase in level of quinoa flour in noodles and also increase in cooking loss with an increase in the level of quinoa flour incorporation in noodles. The studies on color estimation revealed that red and yellow color of the product was slightly increased during cooking of noodles.**

**Keywords:** Quinoa, Noodles, Cooking qualities, Sensory, Colour.

## INTRODUCTION

Noodles have been consumed for thousands of years in many Asian countries as a traditional staple dish. It is gaining popularity in the world due to its convenience, low cost and availability of desirable sensory properties such as a variety of tastes and textures, good nutrition and a long shelf life. It's one of the most common carbohydrate-based dishes and it is usually made with wheat flour. Wheat noodles are only second to bread in terms of global consumption (Ding & Zheng, 1991; Shin & Kim, 2003).

Instant noodles are a fast-growing section of the noodle industry that is widely consumed around the world. Noodles are made from unleavened dough that is stretched, extruded or rolled flat and shaped into different forms and it is a common meal in many cultures around the world (Okoye *et al*., 2008).

Instant noodles are handy, simple to prepare, inexpensive and have a long shelf life. Wheat flour, which is commonly used to produce quick noodles, is low in fiber and protein, as well as lysine, an important amino acid. The major basic component is hard wheat flour (*Triticum aestivum* L.*)* and alkaline salts can assist in reinforcing the structure and so increasing the hardness of the finished product (Fu, 2008; Hou & Kruk, 1998).

Noodles are one of the staple foods since ancient times in many countries all over the world. These cereal products are still increasingly popular worldwide for their convenience, nutritional properties, special flavour and taste. Pasta and noodles are essentially the same type of food but differ in their raw materials and shaping process, as well as the people and regions in the world consuming them. Many additives have been developed and are being used today in pasta and noodle products for various purposes. Various natural additives used in the noodles are starch, edible gums, enzymes, organic acids, natural polyols, phytochemicals, protein concentrates etc. (Li *et al.,* 2014).

Consumers are very demanding with quality requirements and do not easily accept its variability in the product; there by, it is necessary to address the compositional and functional traits of the raw material (Tyl *et al.,* 2020). In this respect, the use of quinoa (*Chenopodium quinoa Willd*.) in human nutrition has been recognized by the FAO as an important food crop, whose grains are highly nutritional as a protein source, particularly rich in essential amino acids, like lysine and methionine. In general, quinoa has better nutritional and functional quality compared to cereal grains like corn, oats, wheat and rice (FAO, 2013).

Because of the high quality and nutritional worth of its protein, the quinoa grain has gained popularity as a novel food source. It is primarily high in lysine, making its protein more complete than other vegetables, with an amino acid composition that is similar to milk and near to the ideal protein balance and suggested by the Food and Agriculture Organization's (FAO). This grain is an amylaceous raw material with high carbohydrate content, mostly starch and a little amount of sugars (Maradini-Filho, 2017).

The quinoa is an excellent example of 'functional food' that aims at lowering the risk of various diseases. Functional properties are given also by minerals, vitamins, fatty acids and antioxidants that can make a strong contribution to human nutrition, particularly to protect cell membranes, with proven good results in brain neuronal functions (Mohammad *et al.*, 2017).

Hence, the objective of this project was to obtain extruded noodles by reducing the refined wheat flour by quinoa flour to evaluate its effect on the sensorial, cooking and colour characteristics.

## MATERIALS AND METHODS

The present investigation was carried out in the Department of Food Process Technology, College of Food Technology and College of Horticulture, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra.

**Materials.** The raw material such as refined wheat flour was obtained from local market of Parbhani, Maharashtra. Good quality quinoa seeds were procured from Seed Technology Research Unit, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani.

**Preparation of quinoa seed flour.** Selection of good quality quinoa grains is carried out. The grain cleaned to remove the unwanted material such as dust, dirt, stone, mud particles, leaf etc. The cleaned grain soaked in sodium bicarbonate solution or citric acid solution for 6 hours (for removing bitterness of seed due to presence of saponin). Soaked and drained grains was washed with running tap water and then allowed to dry. After drying the dried grain was finely milled to obtain a quinoa seed flour.

**Preparation of quinoa seed flour**

Quinoa seeds
↓
Cleaning
↓
Soaking in sodium bicarbonate/citric acid solution
↓
Washing in water
↓
Drying
(45°C for 12 hrs.)
↓
Grinding
↓
Quinoa seed flour

**Quinoa seed flour.**

**Preparation of noodles:** Noodles were formulated according to a method depicted by (Inglett *et al*., 2003) and Jarnsuwan & Thongngam (2012) with some modifications. The noodles were made in an automatic laboratory Kent noodle maker. Dry ingredients were first mixed for about 5 minutes, followed by addition of quinoa flour, salt and water to form a crumbly mass and then extruded through a die with 12 outlets of 0.8 mm in diameter. The noodles were cut and cooked in steam for 5 minutes and dried at 45°C for 3 hours and packed in HDPE pouches. The noodles produced from different blends of quinoa flour with wheat flour are shown in Table 1.

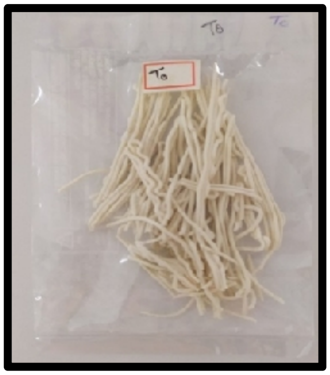
**Table 1: Formulation of noodles.**

| Ingredient | $T_0$ | $T_1$ | $T_2$ | $T_3$ | $T_4$ |
|---|---|---|---|---|---|
| Refined wheat flour (g) | 100 | 80 | 60 | 40 | 20 |
| Quinoa flour (g) | 00 | 20 | 40 | 60 | 80 |
| Salt (g) | 1 | 1 | 1 | 1 | 1 |
| Water (ml) | 38 | 38 | 38 | 38 | 38 |

**$T_0$ –** Control- 100% refined wheat flour noodles
**$T_1$**- 20g quinoa flour in 80g refined wheat flour
**$T_2$** - 40 g quinoa flour in 60g refined wheat flour
**$T_3$** - 60 g quinoa flour in 40g refined wheat flour
**$T_4$** - 80 g quinoa flour in 20g refined wheat flour

**Preparation of instant noodles**

Refined wheat flour
↓
Addition of quinoa flour
↓
Mixing of ingredients
↓
Addition of water
↓
Mixing and kneading
↓
Extrusion (automatic single screw)
↓
Steaming of noodles
↓
Drying (at 45-50°C for 2-3 hours)
↓
Dried noodles
↓
Packaging in HDPE



**$T_0$**

**$T_1$**

**$T_2$**

**$T_3$**

**$T_4$**

**Formulation of noodles:** The noodles are prepared by using quinoa seed flour at the different levels of 0, 20, 40, 60 and 80 g with refined wheat flour.

**Sensory evaluation:** All dried noodles samples were prepared for sensory evaluation by boiling it with salt and oil and cooked in soya sauce and chili sauce before testing. The cooking was carried for optimum cooking time and served the hot for the panel members to evaluate for its colour, flavour texture and overall acceptability using 10 semi trained panel members with 9- point hedonic rating where 9= like extremely and 1= dislike extremely.

**Cooking characteristics:**

**Optimum cooking time.** To determine optimum cooking time, 250 g of noodles were dispersed in 250ml boiling water. For every 30 seconds, a piece of noodle was held between a plastic paper and pressed gently until the white color of noodle at central portion of strand disappears. Optimum cooking time was achieved when the center of noodles become transparent.

**Cooking loss.** The cooking qualities of the dried noodles were evaluated with respect to cooking time and cooking loss according to (Gatade and Sahoo, 2015). Optimal cooking time was evaluated by observing the time of disappearance of the core of the noodle strand during cooking (every 30 s) by squeezing the noodles between two transparent glass slides. The cooking loss was determined by measuring the amount of solid substance lost to cooking water. A 10 g sample of noodles was placed into 300 ml of boiling distilled water in a 500 ml beaker. Cooking water was collected in an aluminum dish which was placed in hot air oven at 105°C and evaporated to dryness. The residue was weighed and reported as a percentage of the starting material. For each optimal cooking time and cooking loss value, three determinations were performed to obtain the mean values

$$\text{Cooking loss (\%)} = \frac{\text{Dried residue in cooking water}}{\text{Noodle weight before cookng}} \times 100$$

**Water absorption:** The water absorption was determined by the ratio of the weight of cooked noodles to the weight of noodles before cooking as described by AACC method (AACC 2005).

$$\text{Water absorption (\%)} = \frac{\text{Weight of cooked noodles} - \text{Weight of raw noodles}}{\text{Weight of raw noodles}} \times 100$$

**Swelling index:** The swelling index of cooked noodles was determined according to the procedure described by Cleary and Brennan (2006). The Swelling index was expressed as weight of cooked noodle,

$$\text{Swelling Index} = \frac{\text{Weight of cooked noodles} - \text{Weight of noodles after dreying}}{\text{Weight of noodles after drying}}$$

**Colour measurement of noodles.** Colour of noodles incorporated with quinoa flour was measured by using hunter lab colorimeter (Model No. Colour Flex EZ) in the Department of Horticulture, College of Horticulture, VNMKV, Parbhani. Hunter lab colorimeter measured the color in terms of the value L* (0=black, 100=white), a* (+value=red, -value=green) and b* (+value=yellow, -value=blue) with a standard white tile/board for setting the instrument with illuminant (Rajiv *et al*., 2015).

## RESULTS AND DISCUSSION

**Sensory evaluation.** Data presented in Table 2 shows that greater overall acceptance score was for sample $T_0$ (7.9) compared to the other samples, followed by control $T_2$ (7.8) and $T_1$ (7.6). There was a large variance amongst samples in terms of general acceptability. The highest colour score for quinoa flour noodles was for sample $T_0$ (7.8) & the lowest score for sample T4 (6.0). The highest rating for flavour is for sample $T_0$ (8). The lowest score was recorded in the case of sample $T_4$ (6.2). All $T_1$, $T_2$, $T_3$, $T_4$ and $T_0$ samples had a suitable flavour. Formulation T2 had the highest texture value (8). The mean taste score was between (8.2) to (6.1). For taste highest score for sample $T_0$ was found (8.2) followed by $T_2$(7.8), $T_1$ (7.5) $T_3$ (6.5) and $T_4$ were shown Table 2.

**Table 2: Sensory evaluation of quinoa flour incorporated noodles.**

| Sample | Sensory attributes | | | | |
|---|---|---|---|---|---|
| | Colour | Flavor | Taste | Texture | Overall acceptability |
| $T_0$ | 7.8 | 8 | 8.2 | 7.9 | 7.9 |
| $T_1$ | 7.5 | 7.8 | 7.5 | 7.7 | 7.6 |
| $T_2$ | 7.8 | 7.9 | 7.8 | 8 | 7.8 |
| $T_3$ | 6.5 | 6.8 | 6.5 | 6.8 | 6.6 |
| $T_4$ | 6.0 | 6.2 | 6.1 | 6.3 | 6.2 |
| SE± | 0.0109 | 0.0172 | 0.0133 | 0.0218 | 0.0589 |
| CD at 5% | 0.0319 | 0.0505 | 0.0391 | 0.0639 | 0.1727 |

*Each value is a average of three determinations

**Cooking qualities:** Cooking quality is important for determination of quality of the noodles. Cooking quality of the noodles includes cooking time, cooking loss, cooked weight and water uptake.

The data presented in Table 3 indicated that the highest cooking time was obtained for sample $T_4$ (8.27 min). The cooking time values for samples $T_1$, $T_2$ and $T_3$were 6.23, 7.25 and 7.53 min respectively. The lowest cooking time was observed for control sample (5.43 min). The cooking time of the noodles gradually increased with the addition of quinoa seed flour. Optimal cooking time of the noodles is generally influenced by the rate of water movement in noodles and subsequent starch gelatinization (Sozer & Kaya, 2008).

The results showed less cooking loss in $T_0$ sample (6.41 per cent) noodle sample. The cooking loss was highest in $T_4$ sample was (10.28 per cent). The increase in the cooking loss with quinoa flour noodles for $T_1$, $T_2$ to $T_3$ ranged from (7.24 per cent), (8.46 per cent) and (9.52 per cent). The cooking loss rises because the starch polymers are reduced in the matrix due to the lack of a network of gluten, therefore preventing excessive swelling of starch granules and the dispersion of components in the kitchen water (Olga *et al.*, 2021). Increase in cooking loss was also observed by (Caratini and Rosentrator 2019).

The cooked weight found to be lowest in $T_0$ sample (197.66 per cent) and it increased from $T_1$ to $T_4$ ranged from (201.53 per cent) to (218.22 per cent). The water uptake of control sample was (152.78 per cent) and the water uptake of noodles incorporated with quinoa flour was (159.56 per cent) in $T_1$, (165.67 per cent) in $T_2$, (170.34 per cent) in $T_3$ and (177.22 per cent) in $T_4$ sample. Results reported are in close agreement with (Olga *et al.*, 2021).

**Table 3: Cooking qualities of noodles incorporated with quinoa flour.**

| Sample | Cooking time (min) | Cooking loss (%) | Cooking weight (%) | Water uptake (%) |
|---|---|---|---|---|
| $T_0$ | 5.43 | 6.41 | 197.66 | 152.78 |
| $T_1$ | 6.23 | 7.24 | 201.53 | 159.56 |
| $T_2$ | 7.25 | 8.46 | 207.11 | 165.67 |
| $T_3$ | 7.53 | 9.52 | 213.31 | 170.34 |
| $T_4$ | 8.27 | 10.28 | 218.22 | 177.22 |
| SE | 0.0430 | 0.0267 | 0.0695 | 0.0544 |
| CD at 5% | 0.1261 | 0.0783 | 0.2039 | 0.1597 |

*Each value is a average of three determinations

**Colour characteristics:** Data presented in Table 4 indicate that quinoa flour addition had a statistically significant effect on L* value of raw and cooked noodles. The L* value of raw control sample was (82.91). The raw $T_1$ sample showed highest L* value (70.29) L* value of raw noodles decline gradually from (70.29 to 56.71).The cooked control noodle had L* value (80.41) and when addition level of quinoa flour increased, L* values of cooked noodles decreased from (64.29 to 51.38). The results were found more or less similar with (Isabelle *et al.*, 2015)

The a* value, which indicates the redness/greenness component of the colour. The a* (-a* =greeness) value of raw and cooked noodles found the highest in $T_4$ noodle sample (5.91) and (6.79) respectively and the raw and cooked noodles found the lowest a* value in control sample (1.70) and (1.03) respectively. The a* value was significantly ($P$< 0.05) increased in raw and cooked noodles from control to $T_4$ (1.70 to 5.91) and (1.03 to 6.79) respectively. The similar results were noted by (Mohammad, 2019).

The b* value of raw noodles significantly increased with increased proportion of quinoa flour in noodles it was found the lowest in raw $T_0$ sample (14.14) and the highest in $T_4$ sample (20.63). The 'b' value of cooked noodles found lowest in control sample (13.57) and highest in $T_4$ sample (23.77) and it was found to increase due to increase in the proportion of quinoa flour in noodles. The similar results were found by (Olga *et al.,* 2021).

**Table 4: Colour characteristics of raw and cooked quinoa flour noodles.**

| Sample | L* | | a* | | b* | |
|---|---|---|---|---|---|---|
| | Raw | Cooked | Raw | Cooked | Raw | Cooked |
| $T_0$ | 82.97 | 80.41 | 1.70 | 1.03 | 14.14 | 13.57 |
| $T_1$ | 70.29 | 64.29 | 3.88 | 4.44 | 16.94 | 19.45 |
| $T_2$ | 65.04 | 59.71 | 4.77 | 5.45 | 19.15 | 20.38 |
| $T_3$ | 60.91 | 55.25 | 5.54 | 6.02 | 20.45 | 22.40 |
| $T_4$ | 56.71 | 51.38 | 5.91 | 6.79 | 20.63 | 23.77 |
| SE ± | 0.1448 | 0.0315 | 0.0573 | 0.0612 | 0.0325 | 0.0344 |
| CD at 5% | 0.4247 | 0.0924 | 0.1680 | 0.1795 | 0.0954 | 0.1009 |

*Each value is a average of three determinations

**Colour flex EZ hunter colour lab.**

## CONCLUSION

On the basis of obtained results, it could be concluded that increasing concentration of quinoa flour in noodles increases cooking losses while, cooking time, cooked weight and water uptake increased with increasing concentration of quinoa flour in noodles. As per the results of colour analysis of raw and cooked noodles it shows slight decrease in L* value and increase in a* and b* value after cooking. Therefore, incorporation of quinoa flour in noodles results in good sensorial, cooking and colour characteristics.

## FUTURE SCOPE

There is need to enhance the intake of quinoa seeds by combining it into the varied extruded product like noodles, which are enjoyed by the all age group people. Because of the changing way of life and food propensities for individuals need food things which require less an ideal opportunity for cooking and helpful for planning and attributable to dietary prevalence of quinoa seeds, there is a need to create quinoa based prepared food sources like noodles.

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**Conflict of Interest.** Nil

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