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Effect of replacement of wheat by amaranth and quinoa blend ratio on sensory, nutritional and keeping quality of instant paratha

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Abstract
The effect of replacing wheat flour (WR) by amaranth and quinoa blend ratios (A:Q) at various levels (0, 30 40 and 50 g/100 g) and particle size of multigrain flour blends (MGB) were assessed for their suitability in instant North Indian *paratha* making. Sensory and nutritional qualities of prepared *paratha* from these blends were studied. Among various blends tested, the MGB having WR (40%) by A: Q:: 2:2 blend ratio was rated the best for colour (8.12), taste (8.14), texture (8.16), aroma (8.22) with an overall acceptability of 8.29 on a 9-point hedonic rating sensory scale. Further the selected MGB flour having particle size of 300µm was found to be most acceptable over 420 and 180µm for colour (8.35), taste (8.12), texture (8.73), aroma (8.18) and overall acceptability (8.35) on a 9-point hedonic rating sensory scale. The nutritional composition of *paratha* revealed that addition of 40% A:Q::2:2 had increased the protein and minerals content of *paratha* to the tune of 15.0 and 12.75% and 1.66 and 2.33% in MGB and WF, respectively. MGB flour *paratha* without preservatives could be stored well for 15 days under freezer temperature of -18 °C with lower scores for colour, taste, texture, aroma and overall acceptability but still had acceptance in the liked range.

Keywords: Multigrain, amaranth, quinoa, instant *paratha*, unleavened flatbread

1. Introduction
Consumers across the world are gravitating toward foods that are simple to make and require little work. As a result, quick meal items are expanding in popularity and acceptability throughout the world since they are pre-cooked and hence less time to prepare. Nowadays, every supermarket shelf is filled with instant food products. Since ancient time, amaranth and quinoa flour have been used as an alternative option of cereals. These crops come under the category of pseudo cereals because these seeds are eatable as cereal grains but these does not belong to grass family. Grain amaranth and quinoa are dicotyledonous plants that belong to *Amaranthaceae* family. Wheat is a major cereal crop of India. Currently, India is the second largest producer of wheat in the world with about 12% share in total world wheat production. More than 80% of wheat produced in India is consumed in the form of traditional products such as *chapati*, *roti*, *paratha* and *poori*. *Paratha* is one of the most popular unleavened shallow fried flat bread. *Paratha* is a staple breakfast item in North Indian cuisine & is eaten daily alongside various dishes. Multigrain flour is a brilliant ingredient option to develop *paratha* because it renders many health benefits to it. The concept of adding different grains to our diet is age-old as it gives the body access to different nutrients and is a key to good health. Frozen *paratha* offers minimal preparation; a brief heating prior to serving to save time and ease of consumption. However, this product is easily exposed to deterioration and microbial growth, which adversely affects the product's shelf life. Numerous studies on *paratha* were focused on nutritional value, rheological characteristic and microstructure, quality of wheat flour, influence of enzymes, seed powder, whey protein concentrate, surfactant, and additives (Indrani and Venkateswara Rao, 2000; 2003; 2007; Indrani *et al*., 2000; 2007; 2010; 2011; Prabhasankar *et al*., 2004; Bhargava *et al*., 2012) [5, 3, 10, 3]. Limited scientific studies however are available on frozen *paratha* storage. Therefore, the objectives of the present work were to formulate instant frozen *paratha* from multigrain flour by replacing wheat flour with amaranth and quinoa in different blend ratios and study effect of particle size of MGB and evaluate the sensory, nutritional and keeping quality of *paratha*.

2. Materials and Methods

2.1 Food and packaging material

Good quality wheat (*Triticum aestivum*), amaranth (*Amaranthus*), quinoa (*Chenopodium quinoa*), salt (Tata iodized salt), refined oil and spices were procured from local market of Pantnagar, Uttarakhand, India. HDPE pouches (60 µm, 21×15 cm) were procured from the local market of Rudrapur, Uttarakhand, India.

2.2 Preparation of multigrain flour blends (MGB)

Based on the preliminary trials, MGB were prepared with different percentage of wheat flour replaced by three amaranth to quinoa blend ratios (A:Q::1:2, A:Q::2:2 and A:Q::3:2) along with other ingredients as shown in Table 1 by keeping carom seeds (1%), nigella seeds (1%), salt (2%), oil (7ml) and water (75 ml) constant. The grains were dry milled in a mini stainless steel (SS) dry grinder mill and passed through different sieves to get a fine MGB flour of particle size 355 µm. A control *paratha* was prepared with 100% wheat flour. In order to select the best quality *paratha* among four different combination of treatments (standardization purpose) the *parathas* (Figure 1) of treatments (C, WR30%, WR40% and WR50%) were reheated and the coded samples were served for sensory evaluation by semi-trained panel members using nine point hedonic rating scale. The judges were asked to evaluate the noodles based on colour, taste, texture, aroma and over all acceptability. Based on sensory evaluation results, MGB having WR (40%) by A:Q::2:2 blend ratio was rated as the best in terms of *paratha* quality (Table 2). Best *paratha* was selected to continue further experiments and analysis.

For selecting the best particle size of selected MGB flour treatment i.e. WR (40%) by A:Q::2:2 blend ratio, to prepare instant *paratha*, the milled grains were passed through different sieves to get fine MGB flours of 420, 300 and 180 µm and coded *paratha* samples thus prepared (Figure 1) were subjected to sensory evaluation. Based on sensory evaluation results, MGB having WR (40%) by A:Q::2:2 blend ratio with particle size of 300 µm was rated as the best in terms of *paratha* quality (Table 3). Best *paratha* was selected to continue further experiments and analysis.

Table 1: Formulations with different levels of wheat flour replaced by amaranth to quinoa ratios incorporation into the *parathas*

Ingredients[1]	C	WR 30%	WR 40%	WR 50%
WR	0	30 g	40 g	50 g
A:Q::1:2	–	10 g, 20 g	13g, 27g	17g, 33g
A:Q::2:2	–	15g, 15g	20 g, 20 g	25g, 25g
A:Q::3:2	–	18g,12g	24g, 16g	30 g, 20 g
Carom seeds	1	1	1	1
Nigella seeds	1	1	1	1
Salt	2	2	2	2
Oil	7	7 ml	7 ml	7 ml
Water	7.5	75 ml	75 ml	75 ml

[1]T= Treatments; C=Control (100%wheat flour); WR=Wheat replacement (%); A:Q=Amaranth:Quinoa blend ratio

2.3 Preparation of frozen *paratha*

The flow chart of preparing instant *paratha* has been shown in Figure 1. Multigrain flour blend was sieved through different sieves and weighed quantity of multigrain flour was kneaded into dough. Weighed quantity of salt was dissolved in measured quantity of water in a stainless steel vessel and added to the flour while kneading dough. Required quantity of the refined oil was added to the dough and all the ingredients were thoroughly mixed to obtain desired consistency. Dough was set aside for about 10min at room temperature (25±1 degree Celsius) for conditioning and mixed again for about 5 min. The dough was removed from the vessel and divided into round balls of 32.4 g each. The dough was pressed into flattened circular sheet at 0.3 cm thickness and packed in HDPE pouches. Each packed contained 4 parathas having butter paper lining in between each pair and labeled accordingly before stored in a deep freezer at -18 °C till further analysis.

Instant *paratha* were baked on an electric hot plate. When one side was baked, the instant *paratha* were reversed with the help of flat ladle and oil was applied on both side of *paratha* till it attained a crispy and flaky appearance. The temperature during cooking was maintained at around 220-230 °C.

2.4 Sensory evaluation

Samples at -18 °C were subjected to thawing followed by heating for min prior to sensory evaluation which was carried out at Foods and Nutrition department to select attribute that best described the *paratha*. Samples were pan-fried prior to sensory analysis, coded with 3-digit random numbers and balanced ordered testing to keep samples anonymous and avoid bias (Lawless and Heymann, 2010) [7]. Sensory attributes; colour, taste, aroma, appearance, texture and overall acceptability, were evaluated by 10 semi-trained panelists, using 9-point hedonic scale with 1 representing the least score and 9 representing the highest score.The 10 panelists were chosen from students and staff of the department.

2.5 Chemical analysis

Moisture, protein, fat, crude fiber and total ash were determined using standard methods of AOAC (2011) and carbohydrate by difference by calculation.

2.6 Keeping quality of instant *paratha* under frozen storage

Four *parathas* without any preservative were packed in HDPE pouches (60 µm, 21×15 cm) and sealed immediately using an impulse heat sealing machine and stored in freezer (-18 °C) for a period of 15 days. One pouch of each packaging was opened at an interval of three days and used for evaluation of keeping quality of *paratha* on the basis of sensory evaluation.

2.7 Statistical analysis

Each analysis was carried out in triplicates. Two sample t-test was used to find out the significant difference between

nutritional composition of control and the selected developed product. All the samples were compared using a complete randomize design (CRD). One- and two- way analysis of variance (ANOVA) was performed and comparisons of means were carried out using Duncan's multiple range test (DMRT) with differences considered to be significant where $p<0.05$.

3. Result and Discussion

3.1 Effect of replacement of wheat flour and amaranth to quinoa ratio blends on sensory qualities of instant *paratha*

The mean scores of the sensory attributes perceived in each sample and the statistical significance of the effects of wheat replacement, amaranth & quinoa ratio blend, and their interaction on color, taste, texture, aroma and overall acceptability are shown in Table 2. There was a significant effect of wheat replacement on color, taste, texture, aroma and overall acceptability of the samples. Whereas the amaranth & quinoa ratio blend affected texture of *parathas* significantly. Significant interactive effect of wheat replacement and amaranth & quinoa ratio blend on aroma and overall acceptability, indicating that wheat replacement behaved differently in different sample, with regard to reactions leading to these characteristics.

The mean score for overall acceptability varied from 7.35 to 8.40. The maximum value corresponded to the sample prepared with a replacement level of 40% of wheat flour which was having score of 8.29, while the sample prepared with a replacement level of 50% of wheat flour scored the minimum (7.72). It was observed that the minimum replacement level of 40% of wheat flour with amaranth and quinoa blend was more accepted and scored high. The liking for *paratha* samples prepared with replacement level beyond 40% was gradually decreased with increase in replacement level as they were found inferior in appearance, taste, flavor, color and texture. The sensory score for taste decreased after 40% wheat replacement with amaranth and quinoa ratio blend. This may be due to bitter aftertaste of amaranth flour. This was contradicting with the result reported by Sindhuja *et al.* (2005) [12] which revealed that the cookies containing 25% amaranth seed flour was found to be most acceptable by the panelists.

Table 2: Effect of replacement of wheat flour and amaranth to quinoa ratio blends on sensory qualities of instant *paratha*

Sample[1]	WR				Interaction effect
A:Q Blend Ratio	WR30%	WR40%	WR50%	GM[2]	WR x A:Q (Level of significance)
Colour					
A:Q::1:2	8.31	8.13	7.47	7.97^{x}	NS
A:Q::2:2	7.96	8.23	7.38	7.86^{x}	
A:Q::3:2	7.88	7.98	7.37	7.74^{x}	
GM[3]	8.05^{a}	8.12^{a}	7.41^{b}	-	
Taste					
A:Q::1:2	8.23	8.03	7.42	7.90^{x}	NS
A:Q::2:2	7.96	8.33	7.38	7.89^{x}	
A:Q::3:2	7.85	8.04	7.27	7.72^{x}	
GM[3]	8.01^{a}	8.14^{a}	7.36^{b}	-	
Texture					
A:Q::1:2	8.33	8.18	7.47	8.00^{x}	NS
A:Q::2:2	7.96	8.25	7.36	7.86^{x}	
A:Q::3:2	7.63	8.04	7.03	7.57^{y}	
GM[3]	7.97^{a}	8.16^{a}	7.29^{b}	-	
Aroma					
A:Q::1:2	8.33	8.18	7.48	8.00^{x}	0.00001
A:Q::2:2	7.86	8.30	7.17	7.78^{x}	
A:Q::3:2	7.63	8.17	8.27	8.02^{x}	
GM[3]	7.94^{b}	8.22^{a}	7.64^{c}	-	
Overall Acceptability					
A:Q::1:2	8.25	8.13	7.61	8.00^{x}	0.0001
A:Q::2:2	7.98	8.40	7.35	7.91^{x}	
A:Q::3:2	7.59	8.33	8.18	8.03^{x}	
GM	7.94^{b}	8.29^{a}	7.72^{b}		

1 WR=Wheat replacement (%); A:Q=Amaranth:Quinoa blend ratio; WR x A:Q= Interaction effect; GM[2]= Gross mean of WR; GM[3]= Gross mean of A:Q

Values are presented as means (n = 10).

Means bearing different superscripts a to c differ significantly ($p<0.05$) in a column for particular sensory characteristics.

Means bearing different superscripts x and y differ significantly ($p<0.05$) in a row for particular sensory characteristics.

Score pattern: 9-Liked extremely, 8-Liked very much, 7-Liked moderately, 6- Liked slightly, 5-Neither liked

3.2 Effect of particle size on sensory qualities of *paratha* made from selected MGB flour

The separation of the flour into different fractions based on particle size has high commercial significance due to its impact on various quality parameters including appearance, taste, texture and stability of final product. Sensory evaluation of *paratha* as influenced by particle size distribution for selected MGB flour is given in Table 3. Instant *paratha* made with MGB flour of different particle size *viz*. 420, 300 and 180 µm were evaluated on a 9- point hedonic scale for their sensory quality showed that flour of particle size 300µm earned the greatest score when compared to the others. The 300µm fraction showed higher scores for the overall acceptability than 180 µm. The *paratha* was soft with distinct layers for 300µm fraction. Similar to our study, the South Indian *parottas* from finer fractions (>150 µm) showed

significantly higher sensory scores for colour, texture, mouthfeel and overall quality score than the coarser fractions (Sakhare *et al.* 2014) [11].

Table 3: Effect of particle size on sensory qualities of *paratha* made from WR40% with A:Q::2:2 blend ratio

Parameters	Particle size of selected MGB flour		
	420µm	300µm	180µm
Colour	7.96[a]	8.35[a]	7.38[b]
Taste	8.06[a]	8.12[a]	7.38[b]
Texture	7.96 [a]	8.73[a]	7.36[b]
Aroma	7.86 [a]	8.18[a]	7.17[b]
Overall acceptability	7.98[a]	8.35[a]	7.35[b]

Score pattern: 9-Liked extremely, 8-Liked very much, 7-Liked moderately, 6- Liked slightly, 5-Neither liked nor disliked, 4-Disliked slightly, 3- Disliked moderately, 2-Disliked very much, 1-Disliked extremely

3.3 Nutritional quality of selected MGB flour instant paratha

The results of the proximate analysis of the *paratha* samples of selected MGB flour were found to be containing moisture 19.73%, ash 2.31%, protein 15.01%, fat 9.52%, total carbohydrate 73.16% on dry weight basis. The calorific value was in the range of 363 to 384 kcal/100 g. The protein, fat and mineral content of the both *paratha* were significantly different. The nutritional composition of *paratha* revealed that addition of 40% A:Q::2:2 had increased the protein and minerals content of *paratha* to the tune of 15.0 and 12.75% and 2.31 and 1.66% in MGB and WF, respectively. Increase in protein content of the *paratha* could be due to amaranth and quinoa flour blending. Moreover, protein takes longer time to digest and thus provide satiety to an individual for longer time and thus contributing in management of diabetes. A study by Goyat *et al*. (2019) [4] a very high content of crude protein (18.69%) was reported in quinoa based ready to eat porridge mix.

The crude fibre content of the *paratha* increased in the range of 1.66 to 6.28% as the percentage of amaranth and quinoa flour blend added however difference was non-significant. Fibre is essential in human diet as it improves the stool bulk by acting as a vehicle for fecal fluid. It improves the health of the gastro-intestinal system and metabolic system in human (Atobatele *et al*., 2016) [9]. The increased fibre and lower carbohydrate contents of paratha have several health benefits, as it will aid digestion in the colon and reduce constipation often associated with products from refined grain flours (Elleuch *et al*., 2011; Slavin, 2005) [8].

The ash content of the *paratha* increased from 1.66 to 2.31% as the percentage of amaranth and quinoa flour blend added. Ash content is a representation of mineral content, samples with high ash content are expected to have a relatively high mineral content (Olapade *et al*., 2014) [1].

3.4 Keeping quality of instant *paratha* under frozen storage

Sensory evaluations of instant *paratha* were carried out using a 9 point hedonic scale and overall acceptability score of 6 was taken as the unacceptable. Based on this criterion the samples remained stable and acceptable throughout the storage period of 15 days. The overall acceptability score of instant *paratha* decreased significantly from 9.48 to 7.55 after 15 days of storage and the details are given in Table 5.

Similar idea was opined in previous studies by Balestra *et al*. (2011) [2] who suggested that infusion of spices could result to the least sensory acceptability and significantly enhanced pungency taste. However, a significant color variation was observed.

Table 4: Nutritional composition (proximate composition, carbohydrate profile and physiological energy) of control (WF) and selected MGB flour instant paratha (DW per 100 g, (n=3)

S.No.	Parameters	Instant paratha		T-value
		WF	MGB	
A. Proximate composition (%)				
	Moisture	19.00±1	19.73±0.65 (+3.8%)	1.07
	Crude fat	8.83±0.89	9.52±0.18	NS
	Crude protein	12.75±0.22	15.01±0.25 (+18%)	11.50
	Crude fiber	1.65±0.11	6.28±0.15	NS
	Total ash	1.66±0.11	2.31±0.12 (+1.4x)	6.62
B. Carbohydrate profile				
	Total carbohydrate by difference (g)	76.76±2.1	73.16±1.1 (-7.5%)	3.11
	Available carbohydrate (g)	63.38 ±2.08	54.37±1.1 (-10.7%)	3.11
C. Physiological energy (Kcal)		384±1	363±2 (-0.5%)	1.27

Table 5: Storage study of instant *paratha* on the basis of sensory evaluation

Parameters	Days					
	0	3	6	9	12	15
Colour	9.71[a]	9.21[b]	8.58[c]	8.48[d]	8.34[e]	7.78[f]
Taste	9.51[a]	9.30[b]	8.46[c]	8.26[d]	7.99[e]	7.31[f]
Aroma	9.2[a]	8.94[b]	8.54[c]	8.43[d]	8.21[e]	7.72[f]
Texture	9.38[a]	9.11[b]	8.48[c]	8.16[d]	8.07[e]	7.58[f]
Overall acceptability	9.48[a]	9.24[b]	8.59[c]	8.26[d]	8.14[e]	7.55[f]

Score pattern: 9-Liked extremely, 8-Liked very much, 7-Liked moderately, 6- Liked slightly, 5-Neither liked nor disliked, 4-Disliked slightly, 3-Disliked moderately, 2-Disliked very much, 1-Disliked extremely

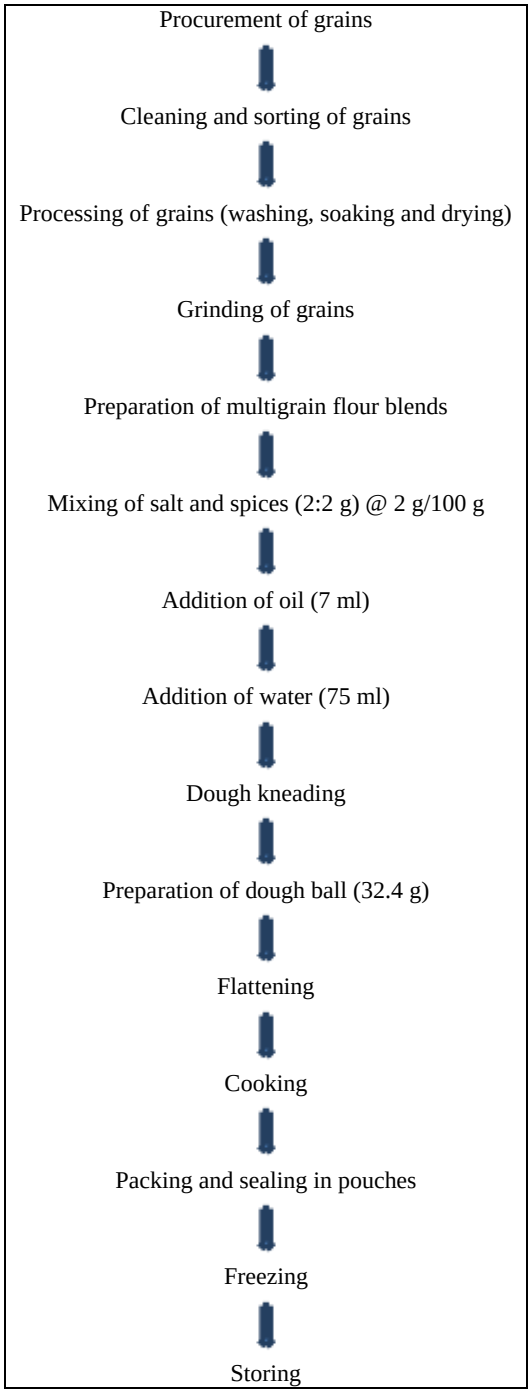

Fig 1: Flow chart for preparation of instant frozen *paratha* (without preservative)

Conclusion

It is evident from the study a traditional food product like *paratha* which is perishable in nature, could be preserved without use of preservative using freezing process at -18 degree Celsius. The product remained stable and acceptable even after a storage period of 15 days. Incorporation of amaranth and quinoa flour made *paratha* nutritious and flavorful. The product could be used during breakfast, lunch, dinner, or any other occasion.

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