Cooking and textural qualities of carrot incorporated instant noodles

Shere PD, Devkatte AN and Pawar VN

Abstract
The objective of this study was to explore the possibility of adding carrot puree in preparation of vegetable noodles. Carrot puree was added at 0, 10, 20, 30, 40 and 50 g per 100 g of wheat flour. Noodles were prepared by cold extrusion process and were studied for its sensory, cooking and textural qualities. The results indicated that carrot puree can be incorporated in wheat flour up to 40 g per 100 g of wheat flour without significant changes in its qualities. The sensory score for colour of carrot noodles was preferred the most. Cooking weight and water absorption were found to be increased with increase in level of carrot puree in noodles. Whereas, cooking loss and swelling index decreased with increase in carrot puree incorporation in noodles. The textural studies denoted decrease in values of hardness, springiness, cohesiveness and adhesiveness with increase in level of carrot puree addition in instant noodles.

Keywords: Carrot puree, noodles, cooking qualities, textural

Introduction
Noodles are very thin form mostly made of wheat flour, water, egg and salt. Noodles have been increasingly important food commodity worldwide. 97.5 billion servings of instant noodles were eaten in 2016, by simple arithmetic as many as 270 millions servings are eaten every day (World Instant Noodle Association, 2016). The consumption level of noodles has become one of the fastest growing sectors in Asian countries, due to their ease of cooking and long shelf life. Traditional noodles are claimed to lack dietary fiber, vitamins and minerals. Over the last decades consumer food demands have changed considerably. For these reason foods today are not only intended to satisfy the hunger and necessary nutrients, but also to prevent nutritional related diseases and enhance physical and mental well being of consumer Betoret et al. (2011) [3]. In this regard functional foods offer an outstanding opportunity to improve the quality of the product. Noodles in particular are an important basic food widely consumed across the world and is among first food to be authorized by food and drug administration as a good vehicle for addition of bioactive compounds. However, noodles enriched with bioactive compounds of vegetable origin is still limited Rekha et al. (2013) and Deep et al., (2014) [11]. Worldwide, people’s lifestyle is continuously changing and with respect to eating habits, it is changing in an unhealthy direction. Caballero, (2007) [5]. Both developed and developing countries are experiencing a nutrition transition. This phenomenon is characterized by a decrease in physical activity and a too low consumption of vegetables and grains. Eating habits are now characterized by an increase in the consumption of high energy-dense foods, i.e. foods with a high amount of calories per gram of food. This lifestyle is one of the factors for the development of diseases such as obesity, which is now acknowledged as a global epidemic. In turn, obesity has been linked to the development of other chronic diseases such as type II diabetes, hypertension, coronary heart disease and several types of cancer. When it comes to childhood obesity, concerns increase, since there are strong indications that it will persist into adulthood. Wang et al. (2010) [28]. One of the most effective strategies to fight this problem involves the combination of physical activity and the consumption of low energy-dense foods, such as vegetables, at an early age. A hurdle for implementing this strategy is the fact that children often dislike vegetables. Vegetables are known to have health benefits but are often non-appealing to children/adolescents due to their bitterness, undesired texture, and their low satiating capacity. Zeinstra et al. (2010) [30]. One of the possible solutions to increase vegetable intake by children is to incorporate vegetables in a food matrix that they do like. Several studies have shown that noodles are very much appreciated by children, making it an ideal candidate for the development of vegetable-enriched foods. Carrot is one of the important vegetable rich in beta carotene, minerals and antioxidants.
Beta carotene may prevent cancer and certain chronic diseases Sies and Krinsky (1995) [25]. Several research work has been carried on instant noodles in terms of Carbohydrate, protein and fiber improvement. However, no efforts have been made to deliberately improve the vitamin and fiber content of noodles using carrot puree. Addition of fresh carrot puree gives the advantage of homogenous mixing, intensifying the color and distribution of pigments in dough over the addition of dried carrot powder. Therefore, this work aims to enrich instant noodles with dietary fiber and vitamins to meet nutritional requirements of children.

Methodology
Preparation of carrot puree
Fresh local red carrot variety was procured from local market of Pune city (India). Carrots were washed thoroughly to remove extraneous matte, shredded, steam cooked for 15 minutes and finely ground to pass through muslin cloth to obtain homogenous carrot puree.

Flow sheet for preparation of carrot puree

![Flow sheet for preparation of carrot puree](image)

Table 1: Formulation of instant noodles with carrot puree

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>C0</th>
<th>C10</th>
<th>C20</th>
<th>C30</th>
<th>C40</th>
<th>C50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat flour (g)</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Carrot puree (g)</td>
<td>0</td>
<td>10</td>
<td>20</td>
<td>30</td>
<td>40</td>
<td>50</td>
</tr>
<tr>
<td>Whole egg (g)</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Water (g)</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>25</td>
<td>20</td>
</tr>
<tr>
<td>Salt (g)</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

C0 – Control- 100% wheat flour noodles  
C10 - 10g carrot puree in 100g flour  
C20 - 20g carrot puree in 100g flour  
C30 - 30g carrot puree in 100g flour  
C40 - 40g carrot puree in 100g flour  
C50 - 50g carrot puree in 100g flour

Chemical Analysis
All the chemicals used in the present research work were of analytical grade. The proximate composition (Moisture, crude fat, crude protein, total ash and fiber) were analyzed using AOAC (2000) [1] methods. The total carbohydrates were determined by difference method.

Sensory Evaluation
All dried noodles samples were prepared for sensory evaluation by cooking before testing. The cooking was carried for optimum cooking time and served hot for 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 centre of noodles become transparent.

**Cooking Loss**
Cooking loss was determined by measuring the amount of solid substance lost to cooking water. 10 g noodle sample of was placed into 300 ml boiling distilled water in a 500 ml beaker. Cooking water was collected in an aluminum petri dish and placed in oven at 105°C and evaporated to dryness. The residue was weighed and reported as a percentage of starting material.

\[
\text{Cooking Loss} = \frac{\text{Dried residue in cooking water}}{\text{Noodle weight before cooking}} \times 100
\]

**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 (2005) \[2\].

\[
\text{Water absorption} = \frac{\text{Weight of cooked noodles} - \text{weight of raw noodles}}{\text{Weight of raw noodles}} \times 100
\]

**Swelling index**
The swelling index of cooked noodles was determined according to the procedure described by Cleary and Brennan (2006) \[8\]. The Swelling index was expressed as weight of cooked noodle,

\[
\text{Swelling Index} = \frac{\text{Weight of cooked noodles} - \text{weight of noodles after drying}}{\text{Weight of noodles after drying}}
\]

**Texture profile analysis of noodles**
30g carrot noodles were cooked in 300ml in water using controlled hot plate for 8 minutes. The cooked noodles were drained and cooled for 3 minute in a sieve. Noodle strands of 50mm length were used for Texture profile analysis using Texture analyzer (TA-XT PLUS, Stable micro system limited, Godalamin, UK). The test conditions used were as follows: pretest speed- 1mm/sec, test speed- 1mm/sec, post test speed- 5mm/sec, 80% strain and 20g trigger force. The parameters calculated were hardness, adhesiveness, springiness, cohesiveness and gumminess. The measurements were replicated 10 times for each treatment.

**Statistical analysis**
The data obtained from the laboratory experiment was analyzed using completely randomized design and appropriately interpreted as per the methods described in” Statistical methods for agricultural workers” by Panse and Sukhatme (1985) \[21\]. Appropriate standard error (S.E) and critical differences (C.D.) at 5% level were worked out as and when necessary and used for data interpretation.

**Results and Discussion**
The proximate composition of refined wheat flour, carrot puree and egg is shown in table no.2.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Moisture (%)</th>
<th>Fat (%)</th>
<th>Protein (%)</th>
<th>Carbohydrate (%)</th>
<th>Fibre (%)</th>
<th>Ash (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Refined wheat flour</td>
<td>10.86</td>
<td>1.56</td>
<td>11.6</td>
<td>71.38</td>
<td>1.67</td>
<td>0.59</td>
</tr>
<tr>
<td>Carrot puree</td>
<td>91.6</td>
<td>0.20</td>
<td>0.65</td>
<td>4.95</td>
<td>1.00</td>
<td>1.40</td>
</tr>
<tr>
<td>Egg</td>
<td>73.30</td>
<td>11.20</td>
<td>12.5</td>
<td>0.20</td>
<td>Trace</td>
<td>2.8</td>
</tr>
<tr>
<td>SE ±</td>
<td>0.5151</td>
<td>0.1056</td>
<td>0.5172</td>
<td>0.3865</td>
<td>0.1155</td>
<td>0.1007</td>
</tr>
<tr>
<td>CD at 5%</td>
<td>1.6798</td>
<td>0.3444</td>
<td>1.6867</td>
<td>1.2604</td>
<td>0.3997</td>
<td>0.3284</td>
</tr>
</tbody>
</table>

The wheat flour contained 10.86% moisture, 1.56% crude fat, 11.6% protein, 1.67% fibre and 0.59% ash. Carrot was rich in moisture (91.6%), ash (1.40%), fibre (1.00%) and fat (0.20%). Egg was also rich in fat, protein and ash. The results are in agreement with several workers.

**Sensory evaluation of carrot puree added noodles**
Results pertaining to the sensory qualities of noodles added with carrot puree are presented in fig.1

Significance differences were found among various parameters. The colour is the first quality parameter for consumer identification of food. Due to addition of carrot puree colour of the carrot noodle improved with attractive yellow-orange colour to the product. The sample C40 scored maximum as compared to control. Flavour, taste and texture were also significantly improved with addition carrot puree in sample C40. Sample C40 scored maximum on overall
acceptability however, flavor scores showed non-significant difference compared to control. Similar results with respect to color were reported by Rekha et al., (2013). Similar results of increasing in sensory parameters with reference to appearance were reported by Keyimu (2013) [15] with addition of sea weed in noodles up to 3 % level.

### Cooking qualities

Cooking qualities as affected by addition of carrot puree in noodles are presented in table no.3.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Cooking time (min)</th>
<th>Cooking weight (%)</th>
<th>Cooking loss (%)</th>
<th>Swelling index (ml/g)</th>
<th>Water absorption (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>6.24</td>
<td>215.20</td>
<td>14.33</td>
<td>2.55</td>
<td>125.30</td>
</tr>
<tr>
<td>C$_{10}$</td>
<td>5.42</td>
<td>221.0</td>
<td>13.92</td>
<td>2.36</td>
<td>128.10</td>
</tr>
<tr>
<td>C$_{20}$</td>
<td>5.31</td>
<td>232.7</td>
<td>9.99</td>
<td>1.40</td>
<td>130.90</td>
</tr>
<tr>
<td>C$_{30}$</td>
<td>4.57</td>
<td>245.4</td>
<td>8.87</td>
<td>1.44</td>
<td>158.50</td>
</tr>
<tr>
<td>C$_{40}$</td>
<td>4.50</td>
<td>250.5</td>
<td>8.74</td>
<td>1.98</td>
<td>176.20</td>
</tr>
<tr>
<td>C$_{50}$</td>
<td>4.35</td>
<td>259.7</td>
<td>5.07</td>
<td>2.24</td>
<td>185.30</td>
</tr>
<tr>
<td>SE ±</td>
<td>0.2714</td>
<td>1.8058</td>
<td>0.4128</td>
<td>0.2932</td>
<td>7.8036</td>
</tr>
<tr>
<td>CD at 5%</td>
<td>0.8363</td>
<td>5.5647</td>
<td>1.2721</td>
<td>NS</td>
<td>24.0557</td>
</tr>
</tbody>
</table>

C$_{0}$ - Control 100% wheat flour noodles  
C$_{10}$ - 10 g carrot puree in 100g flour  
C$_{20}$ - 20 g carrot puree in 100g flour  
C$_{30}$ - 30 g carrot puree in 100g flour  
C$_{40}$ - 40 g carrot puree in 100g flour  
C$_{50}$ - 50 g carrot puree in 100g flour

Cooking time refers to the time in minutes to gelatinize the starch marked by dis appearance of central white core in the noodles strand De pilli et al., (2013) [10]. The results indicated that there were significance differences (P< 0.05) in time required to cook the noodles. The cooking time varied from 6.24 min (control) to 4.35 min (C50). This might be due to dilution of gluten in dough. Gluten is primarily responsible for the development of starch/protein complex; which in term determines the noodles structure and cooking properties. The dilution of these constitutents might be reducing the coking time. The results are in agreement with those described by (Petitot et al. 2010) [23] and Kuchtowa et al. 2016 for supplementation of wheat flour in pasta with faba bean flour and pumpkin powder. Reduction in cooking time was also observed by Padalino et al. (2017) [20] by fortification of tomato peel powder in pasta.

Cooking weight was significantly increased with increase in quantity of carrot puree in wheat flour. It was increased from 215% (control) to 259.7% (C50). This may be due to high fibre content in the formulation which might cause higher water binding as fiber have greater affinity to water.

### Cooking loss

Cooking loss is amount of solids that dissolve in water during cooking and may be an indicator of noodles structure integrity during cooking Li et al. (2015) [18]. Cooking loss is commonly used as predictor of overall noodle cooking performance Tudorica et al. (2002) [26]. Type of ingredients added directly affect the loss of soluble and solids during cooking and has been reported that a compact texture of noodles often results in less cooking loss than the loose textured noodle Krishnan et al., (2012) [15]. From the results it can be clearly seen that cooking loss was maximum (14.33%) in control. There was a progressive reduction in cooking loss with increasing level of carrot puree in formulation. This could be due to better binding of starch granules with added vegetable puree in gluten matrix. Rekha et al. (2013) also reported decrease in gruel loss for vegetable paste incorporated pasta.

### Water Absorption

Water absorption is an indication of quantity of water absorbed by the noodles during cooking, an important characteristic in deciding the cooking quality Li et al. (2015) [18]. Results indicated that, there was slight and progressive increase in water absorption with increase in carrot puree in noodles. The water absorption for control was least and with increase in carrot puree in formulation, water absorption progressively increased from 125.30% (control) to 185.30% (C50). The addition of vegetable puree enhances the interaction between starch granules and protein matrix resulting in better quality noodles. Since, vegetables have greater water holding capacity therefore carrot puree added noodle samples had more water absorption as compared to control. Vegetable noodles had higher fiber content than control noodles, which resulted in higher water absorption due to strong water binding ability of fibers Chen et al. (1988) [6].

### Swelling Index

Concerning swelling index the noodles samples with carrot puree recorded slightly lower values as compared with control samples. The results can be interpreted in terms of competition between fiber and starch for water absorption means that starch components might have absorbed less water at optimum cooking time giving rise to lower swelling indices. Therefore increasing the amount of fiber generally results in lower swelling of starch and lower swelling index. Padalino et al. (2017) [20] also reported lower swelling index in spaghetti incorporated with tomato peel flour.

### Textural qualities of carrot puree noodles

Textural properties in terms of hardnes, springiness, gumminess and adhesiveness are main criteria are main criteria for assessing the overall quality of cooked noodles that determines its consumer acceptance. The textural quality parameters analysis is shown in table no.4.

### Table 3: Cooking qualities of carrot puree added noodles

<table>
<thead>
<tr>
<th>Sample</th>
<th>Cooking time (min)</th>
<th>Cooking weight (%)</th>
<th>Cooking loss (%)</th>
<th>Swelling index (ml/g)</th>
<th>Water absorption (%)</th>
</tr>
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<tr>
<td>CD at 5%</td>
<td>0.8363</td>
<td>5.5647</td>
<td>1.2721</td>
<td>NS</td>
<td>24.0557</td>
</tr>
</tbody>
</table>

### Table 4: Textural qualities of carrot puree noodles

<table>
<thead>
<tr>
<th>Sample</th>
<th>Hardness (kg)</th>
<th>Springiness</th>
<th>Cohesiveness</th>
<th>Gumminess (kg)</th>
<th>Adhesiveness (-kg.sec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>10.320</td>
<td>5.304</td>
<td>0.812</td>
<td>8.377</td>
<td>-0.065</td>
</tr>
<tr>
<td>C$_{10}$</td>
<td>9.090</td>
<td>1.118</td>
<td>0.811</td>
<td>7.371</td>
<td>-0.062</td>
</tr>
<tr>
<td>C$_{20}$</td>
<td>8.724</td>
<td>1.071</td>
<td>0.808</td>
<td>7.048</td>
<td>-0.060</td>
</tr>
</tbody>
</table>
The hardness of the peak force of the first compression cycle Brennan (2004) [10]. In this study hardness of cooked noodles was reduced significantly with increase in proportion of carrot puree in noodles. The hardness of control (10.320) was highest and progressively decreased with addition of carrot puree in formulation. This may be due to presence of sugars and fibers in carrot puree. Both sugar and fibers are known to have high affinity for water and therefore water was partially available for gluten network Chinachoti (1993) [11], Wang et al., (2002) [12]. This may also due to the dilution of gluten content. Addition of carrot puree in formulation disturbs the gluten matrix which leads to the weakening of noodles structure. Similar results for decrease in firmness values were reported by Baik, et al. (2001) [13] in fortified pasta with ginger powder. Krishnan and Prabhanskark (2014) also reported decrease in firmness of noodles prepared by incorporation of green banana flour. The springiness which indicates recovery percentage was found to be decreased significantly with increase in amount of carrot puree in noodles. The decline in springiness and cohesiveness was thought to be due to corresponding decrease in amount of gluten in blend. Gluten is primarily responsible for giving elastic structure to the noodles. Lee et al., (1998) [14] also reported decrease in springiness and cohesiveness by substitution of garbanzo bean in wheat flour. The high ash content in vegetables and low gluten content might have reduced the cohesiveness of noodles Park and Baik, (2009)[15]. Adhesiveness is defined as negative area under the curve when probe lifts up from the sample. The degree of stickiness of noodles is measure of adhesiveness in the TPA profile is very important parameter of noodles. Stickiness of noodles is considered as undesirable property. The adhesiveness was slightly decreased with in increase in proportion of carrot puree in noodle. The decrease in adhesiveness is a desirable property from quality point of view Hou, (2001) [16]. In general by addition of carrot puree firmness, springiness, cohesiveness and adhesiveness were decreased progressively and constantly with slight increase in gumminess.

**Conclusion**

The experiment concluded instant noodles as a good carrier medium for incorporated carrot puree. The level of carrot puree incorporation was found to be acceptable up to 40 g per 100 g wheat flour without affecting the sensorial qualities of the instant noodles. Carrot puree being rich in dietary fibres affected the cooking and textural quality parameters of instant noodles. Cooking time and cooking loss decreased while water absorption and swelling index increased with level of addition of carrot puree in noodles. Hardness, springiness, cohesiveness and adhesiveness of noodles were found to be decreased with progressive increase in level of carrot puree.

### Table 1: Effect of carrot puree incorporation in wheat flour noodle on texture properties

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Hardness (N)</th>
<th>Springiness</th>
<th>Cohesiveness</th>
<th>Adhesiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td>C00</td>
<td>8.134</td>
<td>1.092</td>
<td>0.807</td>
<td>-6.569</td>
</tr>
<tr>
<td>C50</td>
<td>7.527</td>
<td>1.072</td>
<td>0.806</td>
<td>6.066</td>
</tr>
<tr>
<td>C150</td>
<td>5.763</td>
<td>1.083</td>
<td>0.805</td>
<td>4.639</td>
</tr>
<tr>
<td>SE ±</td>
<td>0.1558</td>
<td>0.0259</td>
<td>0.822</td>
<td>0.822</td>
</tr>
<tr>
<td>CD at 5%</td>
<td>0.4801</td>
<td>0.0798</td>
<td>0.2533</td>
<td>0.2533</td>
</tr>
</tbody>
</table>

Reference:


