Physio-chemical and sensory analysis of noodles fortified with cowpea and pomegranate peel powder

Asmita V Thorat, Nilesh B Kardile and Rahul P Wagh

Abstract
Noodles gain popularity due to its low glycemic index (GI) and ready to eat convenience. Effects of fortification on noodles with the combination of dehulled cowpea flour and pomegranate peel powder were studied. Nutritional, cooking and sensory qualities of noodles were analyzed. The fortification of whole wheat flour noodles was done by the combinations of cowpea flour and pomegranate peel powder (5% and 10%) and (5% and 7%) respectively. The results showed that, increase in whole wheat flour proportion increases cooking loss. The resultant product is found to be highly nutritious because of its fibers, phenolic compounds, antioxidants and proteins. Sensory and cooking quality results showed that, noodles containing 10% dehulled cowpea flour and 7% pomegranate peel powder was more acceptable.

Keywords: noodles, cowpea, pomegranate peel, fortification, cooking quality

Introduction
In today’s world health, nutrition and convenience are the three major factors essential for development of breakfast snack and other variety of products. One of the great challenges for today’s food industry is to develop inexpensive foods which are nutritionally rich and should contain all essential nutrients which are required for human health. Pasta, whether it is in the form of noodles, macaroni or spaghetti, it is consumed worldwide (Baskaran et al., 2011) [4]. It is also economical, very easy for preparation, longer shelf life and can be prepared in different varieties. It is acceptable for consumption among people of all socioeconomic and age groups. Noodles and other type of pasta are rich source of carbohydrates but they are deficient in other essential nutrients. While preparation of semolina, bran and germ of wheat grain is removed and only the endosperm of wheat grain is used which lacks nutrients such as vitamins and minerals. Hence in the present study whole wheat flour is used instead of semolina and fortified with dehulled cowpea (Vigna unguiculata) flour and pomegranate (Punica granatum) peel powder for enhancing the nutritional value and make noodles as a complete protein source by balancing the indispensable and dispensable amino acids such as lysine, tryptophan and threonine.

Wheat or bread wheat (Triticum aestivum) is mostly cultivated in the world. Wheat is a major source of dietary energy and protein for people whom daily diet is composed of cereal products. It is the world’s most important crop in terms of production and consumption. More than 60% of the total daily requirements of protein and calories are met through wheat (Zuzana et al., 2009) [15] and it is cheapest source of protein and calories in the diet (Eman et al., 2012) [7]. Legumes contain relatively high amount of protein than other plant foodstuffs. Legume proteins are mainly used in food formulations to complement the protein in cereal grains because of their chemical and nutritional characteristics. Being in the class of legume, they are often referred to as “poor man’s meat” owning to their use as primary protein sources. They represent one of the dietary staples in many parts of the world. Cowpeas is of considerable importance in Nigeria and in many African countries as a nutritious leguminous crop providing an alternative source to animal protein (Khalid and Iharadallou, 2014) [8]. Cowpeas, like most other grain legume, contain anti nutritional factors (ANF’s) such as trypsin inhibitors, lectins and tannins, which decrease protein digestibility and reduce protein quality (Khalid and Iharadallou, 2014; Nielsen and Sumner, 1980; Nell and Siebrits, 1992) [8, 9, 10]. So that while preparation of cowpea flour, hull (seed coat) is removed to eliminate the anti-nutritional factors which results in better digestion and it also helps to improve the appearance
of the flour, because the seed coat has the black colored eye spot on it.
Pomegranate (*Punica granatum*) is very popular for its functional and nutritional properties which can be used as the pharmaceutical agent such as antimicrobial, antiviral, anticancer, antioxidant and antimitogenic activities (Ahmed, 2014) [3]. The pomegranate peels having good antioxidant activity as compared to the pulp and seed portion of fruit. Pomegranate fruits peel is an inedible part obtained during processing of pomegranate juice. Pomegranate peel is a rich source of tannins, flavonoids and other phenolic compounds (Rowayshed et al., 2013; Ullah et al., 2012) [12, 14]. The objective of this study is physio-chemical and sensory analysis of noodles fortified with cowpea flour and pomegranate peel powder.

**Materials and Methods**

**Procurement of raw materials**

Wheat flour, cowpea flour, pomegranate peel powder, salt and guar gum for noodles preparation were purchased from local market of Nashik, Maharashtra, India.

**Development of cowpea flour**

Cowpea

Sorting and grading

Soaking (overnight)

Dehulling

Drying (60°C for 4 to 5 h)

Grinding

Sieving (60 mesh size)

Store in dry place

**Development of pomegranate peel powder**

Mature pomegranate

Washing

Cutting

Separate the peels and other portion

Cut the peels into small pieces

Drying (60°C for 6-7 hours)

Grinding

Sieving (60 mesh size)

Packed in HDPE bags

Store at ambient room temperature

**Table 1: Sample formulations for 1 kg production of noodles**

<table>
<thead>
<tr>
<th>Sample</th>
<th><em>WWF</em></th>
<th><em>DCF</em></th>
<th><em>PPP</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>850 gm</td>
<td>100 gm</td>
<td>50 gm</td>
</tr>
<tr>
<td>B</td>
<td>900 gm</td>
<td>50 gm</td>
<td>50 gm</td>
</tr>
<tr>
<td>C</td>
<td>830gm</td>
<td>100 gm</td>
<td>70 gm</td>
</tr>
</tbody>
</table>

*WWF- Whole Wheat Flour* DCF-Dehulled Cowpea Flour*PPP-Pomegranate Peel Powder

Each sample contains 5gm of guar gum and 20 gm of salt for 1 kg production of noodles.

**Preparation of Noodles**

Whole wheat flour + Dehulled cowpea flour + Pomegranate peel powder + Salt

* Mixing

Addition of Guar gum (Premixed in hot water)

Preparation of dough (by adding required quantity of water)

Dough passed through Noodle extruder (Single screw extruder)

Cutting into required length

Drying (in tray dryer at 62°C for 4 hours)

Packaging (in HDPE bags)

**Chemical Composition**

Moisture, ash, fat and protein content were determined according to AOAC (2000) [1] methods. Protein content was obtained by using conversion factor of 6.25. Dietary fiber was determined by (IS: 11062). Total carbohydrate content was determined by using Anthrone method AOAC (1990) [2]. The measurement of total phenolics (TPs) content was conducted according to the modified Folin–Ciocalteu colorimetric method (Singleton et al., 1999) [13].

**Physical characteristics of noodles**

**Cooking Time**

Optimum cooking time of noodles was determined according to method of Baskaran et al., (2011) [4]. The noodle sample was boiled in a bowl at 100 °C temperature and time was recorded. One strip of noodle was crushed in every 1-minute interval for checking the cooking time.

**Cooking Loss**

Cooking loss was calculated according to Bahmassey et al. (1986) [5]. Cooking loss was determined by collecting the cooking and rinse water in a preweight Erlenmeyer glass beaker, which was then placed in an air oven at 100 °C and the water evaporated to dryness. The residue was weighed and reported as a percentage of dry noodles.
Weight Increase
Weight increase was evaluated according to Ozkaya and Kahveci (1990) [11]. After cooked and drained noodles were rested for 5 minutes, the weight was recorded and percent weight increase was calculated on the basis of difference between the weight of cooked and uncooked noodles.

Sensory Evaluation
Sensory evaluation of noodle samples was performed by 30 semi trained panelists, who are regularly consuming noodles. The 9-point hedonic scale and composite scoring tests were used to carry out sensory evaluation. They were assessed noodles in terms of appearance, texture and taste properties.

Table 2: Proximate composition of Ingredients

<table>
<thead>
<tr>
<th>Composition</th>
<th>Wheat flour</th>
<th>Dehulled cowpea</th>
<th>Pomegranate peel powder</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protein (%)</td>
<td>9.2 ± 0.02</td>
<td>23.12 ± 0.03</td>
<td>3.10 ± 0.05</td>
</tr>
<tr>
<td>Fat (%)</td>
<td>2.01 ± 0.10</td>
<td>1.62 ± 0.09</td>
<td>1.73 ± 0.12</td>
</tr>
<tr>
<td>Carbohydrates (%)</td>
<td>68.0 ± 0.13</td>
<td>62.86 ± 0.14</td>
<td>80.50 ± 0.10</td>
</tr>
<tr>
<td>Dietary Fibers (%)</td>
<td>10.4 ± 0.11</td>
<td>0.48 ± 0.17</td>
<td>11.22 ± 0.12</td>
</tr>
<tr>
<td>Ash (%)</td>
<td>1.8 ± 0.01</td>
<td>1.03 ± 0.01</td>
<td>2.12 ± 0.01</td>
</tr>
<tr>
<td>Total Phenolics (%)</td>
<td>-</td>
<td>-</td>
<td>27.92 ± 0.02</td>
</tr>
</tbody>
</table>

The noodles samples prepared using different proportion of wheat flour, dehulled cowpea flour and pomegranate peel powder is shown in Table 2. The dehulled cowpea was rich in protein content 23.12 % as compare to wheat flour and pomegranate peel powder. The pomegranate peel powder had highest dietary fiber (11.22 %) than wheat flour and dehulled cowpea. The pomegranate peel powder contains total phenolics 27.92 %.

Table 3: Proximate composition of noodle samples

<table>
<thead>
<tr>
<th>Sample</th>
<th>Protein (%)</th>
<th>Carbohydrates (%)</th>
<th>Fats (%)</th>
<th>Fibers (%)</th>
<th>Ash (%)</th>
<th>Total phenolics (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>10.01 ±0.05</td>
<td>68.08 ± 0.12</td>
<td>1.94 ± 0.02</td>
<td>9.03 ± 0.21</td>
<td>1.79 ± 0.01</td>
<td>12.56 ± 0.03</td>
</tr>
<tr>
<td>B</td>
<td>9.55 ± 0.07</td>
<td>68.34 ± 0.15</td>
<td>1.97 ± 0.06</td>
<td>8.94 ± 0.23</td>
<td>1.83 ± 0.01</td>
<td>11.74 ± 0.04</td>
</tr>
<tr>
<td>C</td>
<td>10.14 ±0.05</td>
<td>68.35 ± 0.14</td>
<td>1.94 ± 0.03</td>
<td>9.46 ± 0.22</td>
<td>2.82 ± 0.02</td>
<td>15.24 ± 0.04</td>
</tr>
</tbody>
</table>

Physical characteristics of noodles
Physical characteristics of noodles consist of cooking time, cooking loss and weight increase. The result of cooking time (Table 4) show that Sample C has less cooking time as compare to other two samples Table. This is due to increase in proportion of cowpea and pomegranate peel powder does not affect much cooking time.

Table 4: Physical characteristics of noodles

<table>
<thead>
<tr>
<th>Sample</th>
<th>Cooking time (minute)</th>
<th>Cooking loss %</th>
<th>Weight before cooking</th>
<th>Weight after cooking</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>10:48 ± 0.26</td>
<td>5.4 ± 0.31</td>
<td>10 gm</td>
<td>27.1 gm</td>
</tr>
<tr>
<td>B</td>
<td>10:27 ± 0.35</td>
<td>5.0 ± 0.26</td>
<td>10gm</td>
<td>28.2 gm</td>
</tr>
<tr>
<td>C</td>
<td>9.33 ± 0.42</td>
<td>2.7 ± 0.27</td>
<td>10gm</td>
<td>26.8 gm</td>
</tr>
</tbody>
</table>

Cooking loss is indicated by the loss of solid materials contained in noodle during cooking. The results of cooking loss (Table 4) shows that loss of solids or leaching of solids increases as the proportion of whole wheat flour increases. It is because of the starch, as it is easily leach out while cooking. Sample C was required lesser time than sample A and sample B.

Weight Increase
Table 4 showed weight increase after cooking. Cooking yield is depending on the ability of noodle to absorb water during cooking. The water absorption is depending upon particle size of ingredients. Sample A and B had more weight increase than sample C.

Sensory Analysis

<table>
<thead>
<tr>
<th>Sample</th>
<th>Color</th>
<th>Texture</th>
<th>Taste</th>
<th>Overall acceptability</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>5.9 ± 0.18</td>
<td>5.8 ± 0.34</td>
<td>6.53 ± 0.28</td>
<td>6.07 ± 0.25</td>
</tr>
<tr>
<td>B</td>
<td>7.4 ± 0.21</td>
<td>7.73 ± 0.21</td>
<td>7.43 ± 0.27</td>
<td>7.52 ± 0.24</td>
</tr>
<tr>
<td>C</td>
<td>7.8 ± 0.28</td>
<td>7.58 ± 0.32</td>
<td>7.65 ± 0.27</td>
<td>7.67 ± 0.29</td>
</tr>
</tbody>
</table>
The sensory analysis of noodles was carried out using 9th point hedonic scale. The results of sensory evaluation show that, ‘Sample C’ was more acceptable as compare to sample A and sample B. In composite score test sample B had high score in textural property but sample C had high scores in color and flavor attributes, therefor overall acceptability of Sample C was more compare to other two samples. The sensory analysis result also shows that, as the proportion of wheat flour increases acceptability decreases because it gives grainy texture. Sample C also had higher proportion of pomegranate peel powder i.e. 70 gm for 1 kg production of noodles and it does not affect any sensory characteristics.

Conclusion
The results of present study suggest that dehulled cowpea flour and pomegranate peel powder incorporation into whole wheat flour noodles up to level of 10% and 7% respectively, seems acceptable in terms of physicochemical and sensory attributes. Fortified noodles are inexpensive, highly nutritious and complete protein source, which can help to eliminate the major nutritional problem in developing and underdeveloped countries i.e. protein calorie malnutrition. Fortified noodles will improve the nutritional quality of diets and health of people. To reduce the cooking loss and cooking time of fortified noodles are the subjects of further investigation.

References