Development and quality evaluation of basil leaf incorporated papad

Akshatha, D Shobha, R Shekhara Naik, BS Chethana and AR Brundha

Abstract
Present study was conducted to develop papad by incorporating basil leaves (Ocimum basilicum). The basil leaves were evaluated for its nutritional, functional and anti-nutritional parameters. The basil leaves were incorporated into foxtail millet papad at different levels and developed papad was analyzed for their physical, sensory and storage qualities. The nutritional composition of basil leaves incorporated papad indicated that it contained 3.12 grams of protein, fiber (5 g/100 g), iron (5.88 mg/100g) and calcium (60.12 mg/100 g) along with flavonoids (148 µg) total phenols (73 mg) and antioxidants (94.05 %). Basil leaves incorporated papad with 15 g level incorporation were found to be acceptable with an overall acceptability score of 7.56 on a nine point hedonic scale compared to other variations tested. The nutritional quality of developed basil papad showed significantly higher protein (19 g/100 g), ash (7.2 g/100 g), iron (11.58 mg/100 g), fiber (4 g/100 g), zinc (7.99 mg/100 g) and functional parameters such as flavonoids (143 µg), total phenol (73 mg) and antioxidant (94 %) content; whereas anti-nutrients such as tannins were significantly high (25.25 mg) in basil leaves incorporated papads compared to phytic acid. The storage studies of basil leaves incorporated papad indicated that developed papad was found to be stable up to one month when stored in LDPE covers.

Keywords: Basil leaf, storage studies, flavonoids, total phenols, antioxidant, LDPE, papad

Introduction
Basil plant (Ocimum basilicum L) belongs to genus Ocimum of Lamiaceae family consisting of 50 to 150 herbs and shrubs. Normally basil which is also known as “Sweet basil” is used for both unani and ayurvedic medicine. Leaves, parts of basil has tonic, antiseptic and insecticidal properties, hence used to treat cough, inflammations, dyspepsia, aches and pains (Muralidharan et al., 2004) [17]. Foxtail millet (Setaria italica) is one of the major millet in terms of worldwide production and sixth highest yielding grain (Saleh, 2013) [25] which belongs to Poaceae family also known as Italian, German, Hungarian or Siberian millet. Foxtail millet contains high amounts of protein and minerals. Simple processing methods like dehulling, soaking and cooking were reported to significantly reduce the anti-nutrient content and improves the bioavailability of minerals like iron and zinc and protein digestibility improvement (Gulia et al., 2007).

Papads are popular snack food of India, which is eaten as roasted/fried product or as a combination with vegetable soups and curries. A wide variety of papads are available in India, produced from wide diversifying ingredients (Chowdhury et al., 2008). They are usually made from blends of pulse and cereal flour with added salt, spices, edible oil, alkaline and mucilaginous additives. Literature and market survey revealed that spiced papads are usually prepared from blend of black gram, green gram, corn flour and gelatinized starch with salt and spices (Kulkarni et al., 1989) [15]. Various papads with different combination of cereals, millets and pulses were developed by others workers using various combinations of cereals, millets, pulses by applying different methods in preparation. Papads from sorghum and black gram dhal by Nanzi, (2010) [18]. Nere happala millets at three to seven days of soaking (Kamat, 2012) and even varities of sorghum papads were developed by Prabhakar et al., (2017) [4]. However, papads by incorporation of basil leaves to the foxtail millet in order to tap the nutritional and medicinal advantages of millet and basil is untapped yet. This research is open for exploration. Hence the present study was conducted to standardize the basil leaves incorporated papad and evaluate its nutritional, anti-nutritional and storage quality of developed papads

Materials and Methods
Raw material like foxtail millet, papad Khara and other ingredients such as green gram dhal
and masala were procured from local market in single a lot and refrigerated until further use. The fresh basil leaves (Thai basil leaves) were harvested in medicinal garden of ZARS, V. C. farm Mandya.

**Standardization of papad**

Papads were standardized by incorporating basil leaves at 10, 15 and 20 grams along with other ingredients like foxtail millet, green gram dhal added in different combinations in order to select the acceptable ratio (Table 1).

Table 1: Formulation of papads with incorporation of basil leaves.

<table>
<thead>
<tr>
<th>Test material</th>
<th>Control</th>
<th>BFP1</th>
<th>BFP2</th>
<th>BFP3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foxtail millet (g)</td>
<td>100</td>
<td>90</td>
<td>80</td>
<td>70</td>
</tr>
<tr>
<td>Green gram whole (g)</td>
<td>-</td>
<td>10</td>
<td>20</td>
<td>30</td>
</tr>
<tr>
<td>Masala (g)</td>
<td>16</td>
<td>16</td>
<td>16</td>
<td>16</td>
</tr>
<tr>
<td>Basil leaves (g)</td>
<td>-</td>
<td>20</td>
<td>15</td>
<td>10</td>
</tr>
<tr>
<td>Water (ml)</td>
<td>120</td>
<td>120</td>
<td>120</td>
<td>120</td>
</tr>
</tbody>
</table>

*BFP- Basil papad varying in basil leaves (10, 15 and 20 g)

Sensory evaluation of papad

Sensory evaluation of developed papad was evaluated by 25 semi-trained panelists of ZARS, V.C. farm Mandya using nine point hedonic scale. Scores were given based on the appearance, colour, crispness, flavour, taste and overall acceptability as per Chavan et al., (2015) [10].

**Nutritional composition of basil leaves incorporated papad**

Nutritional composition of leaves as well as papad were analysed as per standard procedure. The proximate composition such as moisture, crude protein, crude fat, crude fiber, total ash, carbohydrates were estimated as per AOAC (1980) [3] and minerals such as iron and zinc by atomic absorption spectrophotometric (spectra 240AA model 200 series AA, Aglient Technologies) method according to Page et al., (1992) and calcium by Piper (1966).

Functional parameters of basil leaves incorporated papads

Functional parameters such as flavonoids were determined by calorimetric assay as gallic acid equivalent in mg (GAE) g⁻¹, while total phenols were determined by Folin Ciocalteu assay as quercetin equivalent in µg (QE) g⁻¹ and antioxidants were determined by DDPH method expressed as % inhibition (James et al., 2016) [14].

Anti-nutrient composition basil leaves incorporated papads

Phytic acid content was determined by titration method while tannin content was by calorimetric method according to Shuaib et al., (2015) [24].

Physical characteristics of papad

Physical quality attributes of papads such as diameter (cm), unit weight (g), oil absorption (ml), thickness (mm) and expansion ratio (%) were determined as per Vidyavati et al., (2004) [26].

Storage studies of basil leaves incorporated papads

Papads stored in LDPE (low density polythene) covers were periodically assessed for its moisture, free fatty acid, peroxide value and alcohol acidity as per AACC (2000) [1]. Microbial analysis of papad was carried out using standard plate count method according to Ranganna, (2010) [21].

Statistical analysis

All the data were analyzed statistically for mean and standard deviation.

**Result and Discussion**

**Sensory analysis of papad**

The sensory evaluation of basil incorporated papad with different levels of basil leaves incorporation is shown in Fig 1. Among the four variations tested, 15 g basil leaves incorporated papad received higher score for overall acceptability (7.56), appearance (7.55), colour (7.54), flavour (7.61), crispness (7.57) and taste (7.54) on nine point hedonic scale when compared to other variation tested.

**Nutritional composition of basil leaves incorporated papads**

Nutritional composition of basil leaves incorporated papad is depicted in Table 2. Basil leaves incorporated (15 g) papad showed higher protein (19 g/ 100 g), fiber (4 g/ 100 g), ash (7.2 g/100 g), iron (11.58 mg/100 g) and zinc (7.99 mg/100 g) compared to basil leaves. Similar analysis were conducted on 24 varieties of basilicum species Bernardo et al., (2013) [3] and Zahid et al., (2011) [27] on basil leaves showed that it contained moisture (86.35 %), crude protein (4.2 %), crude fat (0.2 %) and ash (2.1 %). Even the study conducted by Prabhakar et al., (2017) [24] on sorghum papad indicated moisture ranged from (12 to 13.9 %), fat (3.8 to 4.71 %), protein (9.8 to 15.08 %), carbohydrates (65.8 to 70.52 %) and ash (1.89 to 2.06 %).

**Functional parameter of basil leaves incorporated papads**

Functional parameter such as flavonoids, total phenols and antioxidant content of basil leaves were found to be 148 µg, 73 mg and 94.05 % respectively (Table 3). Similar species of basil family Ocimum gratissimum had showed antioxidants (51.2 %) and total phenols (3.6 g) as reported by Ganiyu et al., (2010) [11] and Camila et al., (2017) [27] on Ocimum basilicum species. Whereas basil leaves incorporated papad had flavonoids (110 µg) total phenols (42.5 mg) and antioxidant (22.94 %) respectively.

**Anti-nutrient of basil leaves incorporated papads**

Anti-nutrient such as tannins (1.34 mg) and phytic acids (0.29 mg) of basil leaves as shown in Table 4. Even the study conducted by Shuaib et al., (2015) [24] observed the presence tannin in Ocimum basilicum species and also Ganiyu et al., (2010) [11] also noticed presence of anti-nutrients in Ocimum gratissimum species. Tannins content of basil papad were higher (25.25 mg) compared to control sample (4.48 mg) whereas phytic acid in control sample was 0.20 mg and basil papad 0.52 mg/100 g respectively.

**Physical parameter of papad**

Physical characteristic of basil leaves incorporated papad had higher value for diameter before and after frying (8.92 and 9.5 cm) but unit weight before and after frying was 6.53 and 9.2 g respectively. As per Hadimani et al., (1993) [13] in nere hoppala papad varied in terms of total yield, unit weight, number and diameter because of reliable property of starch, chemical composition, nature, characteristic shape, size and cooking parameter. Oil absorption, thickness and expansion of basil leaves papad was 10 ml, 0.38 mm and 6.1 % respectively. According to Chandrashekar et al., (1991) [8] the developed nere hoppala consists of more expansion percentage compared to reported values in this study which
can be due to the presence of chemical structure such as amylose and the gluten structure would be responsible for expansion percentage in this study millet had lesser expansion percentage compared to wheat and rice papad.

### Storage studies of basil leaves incorporated papads

The storage studies of any products which determine its wholesomeness during definite period of time (Shobha et al., 2011) [22]. The developed papad were stored in LDPE cover showed moisture content ranged from 6.58 to 5.50 % during first to four months of storage. Peroxide value (PV) of basil papad initially was 12.2 meq/kg of fat and increased to 40 meq/kg of fat whereas free fatty acid (FFA) of basil papad initially was 0.57 % and at end of storage period increased to 1.25 % and alcohol acidity (AA) was 0.04 % which increased to 0.34 % as shown in Figure 2. Increase in values observed in the study can due to the formation of volatile compounds such as aldehydes, ketones and esters. As per Codex, (201) [6] PV should not exceed 15 meq/kg and FFA 5 % and 0.3 % in crude palm oil and refined palm oil, also (Kirik and Sawyer, 1991) [8] reported increase in FFA levels not exceed more than 1.5 % and 20-40 meq/kg of fat peroxide values leads to noticeable rancidity. According to this basil leaves incorporated papad were acceptable up to one month.

### Microbial analysis of papad

The perusal of Table 5 depicted that papads were safe for consumption, without any fungal and bacterial growth during initial period. However, as the storage period progressed bacterial growth (3×10 \(^{-3}\) and 2×10 \(^{-4}\) cfu/ml) and fungal growth (4×10 \(^{-3}\) and 5×10 \(^{-4}\) cfu/ml), increased this can be due to contamination of product during the storage period and use of LDPE covers with low gauge capacity. Similar results were reported in sorghum papad wherein the sorghum papad can be kept safe up to three months, without any noticeable microbial growth as reported by Chavan et al., (2015) [9].

### Conclusion

Thus the study indicated that the basil leaves are found to contain flavonoids, total phenols and antioxidant content (148 µg, 73 mg and 94.05 %), hence the papads developed by incorporation of 15 g basil leaves along with other ingredients scored between good to very good (7.56) in overall acceptability on nine point hedonic scale. The nutritional composition of basil leaves incorporated papad were good in term of protein (19 g), ash (7.2 %) and iron (11.58 mg), flavonoids (110 µg), total phenols (42.5 mg) and antioxidant (22.94 %) content. But the keeping quality of papad was good up to one month due to high rancidity of foxtail millet.

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**Table 2: Nutritional composition of basil leaves incorporated papad per 100 g**

<table>
<thead>
<tr>
<th>Nutrients</th>
<th>BL</th>
<th>FP1</th>
<th>BFP3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture (%)</td>
<td>80±0.08</td>
<td>6.58±0.26</td>
<td>5.41±0.51</td>
</tr>
<tr>
<td>Energy (kcal)</td>
<td>46.5±0.25</td>
<td>354.1±0.97</td>
<td>351.06±0.36</td>
</tr>
<tr>
<td>Carbohydrates (g)</td>
<td>6.48±0.37</td>
<td>64.4±0.78</td>
<td>60.89±0.45</td>
</tr>
<tr>
<td>Protein (g)</td>
<td>3.12±0.34</td>
<td>14±0.25</td>
<td>19±0.16</td>
</tr>
<tr>
<td>Fat (g)</td>
<td>0.9±0.29</td>
<td>4.5±0.18</td>
<td>3.5±0.58</td>
</tr>
<tr>
<td>Crude fiber (g)</td>
<td>5±0.56</td>
<td>3.92±0.78</td>
<td>4±0.39</td>
</tr>
<tr>
<td>Ash (%)</td>
<td>4.5±0.0</td>
<td>6.6±0.52</td>
<td>7.2±0.28</td>
</tr>
<tr>
<td>Calcium (mg)</td>
<td>60.12±0.58</td>
<td>20.06±0.74</td>
<td>30.06±0.58</td>
</tr>
<tr>
<td>Iron (mg)</td>
<td>5.88±0.21</td>
<td>6.75±0.58</td>
<td>11.58±0.44</td>
</tr>
<tr>
<td>Zinc (mg)</td>
<td>5.92±0.19</td>
<td>9.52±0.0</td>
<td>7.99±0.0</td>
</tr>
</tbody>
</table>

Values are mean of three replications ± SD *FP1- Foxtail papad, BFP3- Basil papad, BL- Basil leaf
Table 3: Functional parameters of basil leaves incorporated papads

<table>
<thead>
<tr>
<th>Products</th>
<th>Flavonoids (mg/100g)</th>
<th>Total phenol (mg/100g)</th>
<th>Antioxidant (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BL</td>
<td>148</td>
<td>73</td>
<td>94.05</td>
</tr>
<tr>
<td>FP1</td>
<td>130</td>
<td>50.75</td>
<td>13.12</td>
</tr>
<tr>
<td>BFP3</td>
<td>110</td>
<td>42.5</td>
<td>22.94</td>
</tr>
</tbody>
</table>

(n=3)*FP1- Foxtail papad, BFP3- Basil papad, BL-Basil leaf

Table 4: Anti-nutritional content of basil leaves incorporated papads

<table>
<thead>
<tr>
<th>Products</th>
<th>Phytic acid (mg/100g)</th>
<th>Tannins (mg/100g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BL</td>
<td>0.29</td>
<td>1.34</td>
</tr>
<tr>
<td>FP1</td>
<td>0.20</td>
<td>4.48</td>
</tr>
<tr>
<td>BFP3</td>
<td>0.52</td>
<td>25.25</td>
</tr>
</tbody>
</table>

(n=3)*FP1- Foxtail papad, BFP3- Basil papad, BL-Basil leaves

Table 5: Microbial analysis of papads

<table>
<thead>
<tr>
<th>Microbial cfu/ml</th>
<th>0</th>
<th>2</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FP1</td>
<td>BFP3</td>
<td>FP1</td>
</tr>
<tr>
<td>Bacteria</td>
<td>10^-1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>10^-2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Fungi</td>
<td>10^-1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>10^-2</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

(n=3)*FP1- Foxtail papad, BFP3- Basil papad

Fig 3: Storage studies of basil leaves incorporated papads

Plate 1: Papads incorporated with basil leaves

Plate 2: Storage study of basil leaves incorporated papads in LDPE covers

Reference
7. Camila MGR, Oliveira S, Paula F, Maria FML, Jonathaline AD, Aline AB et al. Evaluation of basil
extract (Ocimum basilicum L.) on oxidative, anti-