RESEARCH PAPER

Nutritional Profiling and Sensory Evaluation of Multigrain Flour Based Indigenous Fermented Food

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Abstract

Fermented foods are the important components of the diets of many parts of the world since time immemorial as it increase the nutritive value, organoleptic characteristics, decreases the cooking time and enhance the shelf-life. Hence, a study was undertaken with the objective to develop fermented food (Idli) using multigrain flour mixture and to assess its organoleptic and nutritional properties. Standard recipe (Idli) served as a Control (T0). Along with control; four variations of Idli were prepared by replacing rice with different ratio of multigrain flour mixture which was referred to as T1, T2, T3 and T4, respectively. They were tested for different sensory attributes. Proximate analysis was used to determine the nutritional composition of Idli. Appropriate statistical technique was adopted for the analysis. The result revealed that the T2 (8.30±0.14) was found to be the most acceptable with regards to its overall acceptability followed by T1 (8.22±0.81), T0 (8.11±0.29), T3 (7.44±0.54) and T4 (6.66±0.81), respectively. Nutrients content was significantly increased in treatments as compared to control. Thus it can be concluded that value added fermented multigrain product has good organoleptic and nutritional quality.

Keywords: Fermented foods, shelf-life, multigrain flour, organoleptic, nutritional properties

Fermentation is regarded as one of the oldest technique of food preservation and processing. Use of microbes for preparation of food products were well-known for thousands of years and globally, a wide range of fermented foods and beverages contributed significantly to the diets of many people. In traditional fermented food preparations, microbes are used to prepare and preserve food products, adding to their nutritive value, the flavour and other sensory quality attributes (Achi, 2005). The requirement of fermentation is fuelled attributing to the production of organic acids, nutritional enrichment, reduction of endogenous toxins and reduction in duration of cooking (Sekar and Kandavel, 2002). These processes are characterized by their limited need for energy input, allowing microbial fermentations to proceed without external heat sources. Idli is a traditional naturally fermented steamed product with a soft and spongy texture which is highly popular and widely consumed as a food item in India (Agarwal et al., 2000). It makes an important contribution to the diet as a source of protein, calories and vitamins, especially B-complex vitamins, compared to the raw unfermented ingredients (Srilakshmi, 2003). It is a favourite breakfast food in south India with spongy texture, attractive appearance, appetizing taste and flavour to get with its easy digestibility and good nutritive value contribute to its increasing popularity in all parts of India and also in other countries (Manay and Shadaksharaswamy, 2001).

The soybean (Glycine max) has good quantity of isoflavones, genistein and daidzein, (phytoestrogen)
which act as a hypocholesterolemic. This legume is a native of East Asia, which is widely grown and has numerous health benefits (Ridges et al., 2001). Barley (Hordeum vulgare L.), contains β–glucan which reduces the serum cholesterol. It belongs to the family of grass and one of the first cultivated and widely grown cereal grains (Shimizu et al., 2008). Flaxseed (Linum usitatissimum) contains significant quantities of dietary fiber as well as high concentrations of linolenic acids (omega-3) and lignins. Sesame seed contains good amount of manganese, calcium, copper, iron, phosphorus, vitamin B, zinc and dietary fiber and also good quantity of water-soluble antioxidants. Traditionally, curry leaves (Murraya koenigii Linn) was used as antiemetic, anti diarrhoeal and blood purifier. It was found to be a potent antioxidant, antidiabetic, antibacterial, antihypertensive and cytotoxic.

The present study was designed to utilize soy flour, sesame seed, whole wheat flour, flaxseed, barley and carrot to develop a low fat and nutrient rich traditionally fermented food which acts as an important functional food in food industries as well as to evaluate the feasibility of substituting rice Idli with other cheap and healthy plant based food materials to enhance its organoleptic and nutritional qualities. The results obtained are described here.

**MATERIALS AND METHODS**

The present investigation was carried out in the Food and Nutrition Research Laboratory of the Department of Food Nutrition and Public Health, Sam Higginbottom University of Agriculture, Technology and Sciences Allahabad, U.P.

**Raw materials**

All Basic ingredients for preparation were purchased from the local market of Allahabad.

**Preparation of Idli**

Nutritious fermented food (Idli) was developed by using wheat flour, Soy flour, Flaxseed, Barley flour, gingelly seed and curry leaves powder. The basic recipes were standardized and served as control (T₀). Along with the control T₀, on the basis of acceptability rice and black gram dhali mix was replaced by other flour mixture and was referred to as T₁, T₂, T₃ and T₄ respectively. The prepared of Idli was served to panel of five experienced members for the organoleptic analysis. Panel members were asked to rate the product for various sensory attributes (colour and appearance, body and texture, taste and flavour and overall acceptability on the help of Nine Points Hedonic Scale (Srilakshmi, 2007).

**Treatments and Replications of Developed fermented food**

The basic recipes were standardized and served as a control (T₀). Each product was prepared in triplicate. The combination of different ingredients used for the preparation of different treatment were as follows:

- T₁: 25 percent Black Gram Dhal + 75 percent Rice (Mix)
- T₂: 40 percent Mix + 30 percent Soybean flour + 5 percent Flaxseed flour + 10 percent Barley flour + 10 percent Gingelly seed powder + 5 percent Curry leaves
- T₃: 30 percent Mix + 35 percent Soybean flour + 10 percent Flaxseed flour + 10 percent Barley flour + 10 percent Gingelly seed powder + 5 percent Curry leaves
- T₄: 20 percent Mix + 40 percent Soybean flour + 15 percent Flaxseed flour + 10 percent Barley flour + 10 percent Gingelly seed powder + 5 percent Curry leaves
- T₅: 10 percent Mix + 45 percent Soybean flour + 20 percent Flaxseed flour + 10 percent Barley flour + 10 percent Gingelly seed powder + 5 percent Curry leaves

**Analysis**

The nutritional composition (energy protein, fat, carbohydrate, calcium and iron) of fermented food was carried by using standard procedure described by AOAC (2005). The soxhlet method was used for total fat determination using ether for oil extraction. Protein content was determined by Micro Kjeldahl
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method and Carbohydrate was calculated by difference method and energy was calculated. Calcium estimation was done by potassium permanganate titration and iron estimation was done by AAS (Atomic Absorption Spectroscopy).

Statistical analysis
The data obtained from sensory evaluation were statistically analysed by using ANOVA and t test (Banerjee, 2013).

RESULTS AND DISCUSSION

Organoleptic analysis of developed fermented food
The mean scores of Idli in relation to various sensory attributes (colour and appearance, body and texture, taste and flavour and overall acceptability) are shown in Table 1.

<table>
<thead>
<tr>
<th>Sensory Attributes</th>
<th>Colour and Appearance</th>
<th>Body and Texture</th>
<th>Taste and Flavour</th>
<th>Overall Acceptability</th>
</tr>
</thead>
<tbody>
<tr>
<td>T₀ (M ± SE)</td>
<td>8.33±0.55</td>
<td>8.0±0.28</td>
<td>8.0±0.29</td>
<td>8.11±0.29</td>
</tr>
<tr>
<td>T₁ (M ± SE)</td>
<td>8.66±0.45</td>
<td>7.0±0.00</td>
<td>9.0±0.00</td>
<td>8.22±0.81</td>
</tr>
<tr>
<td>T₂ (M ± SE)</td>
<td>8.0±0.00</td>
<td>7.9±0.99</td>
<td>9.0±0.24</td>
<td>8.30 ± 0.14</td>
</tr>
<tr>
<td>T₃ (M ± SE)</td>
<td>7.33±0.24</td>
<td>7.0±0.00</td>
<td>8.0±0.00</td>
<td>7.44±0.54</td>
</tr>
<tr>
<td>T₄ (M ± SE)</td>
<td>6.0±0.00</td>
<td>5.33±0.28</td>
<td>7.0±0.45</td>
<td>6.66±0.81</td>
</tr>
<tr>
<td>Fₐₑ (5%)</td>
<td>18.93</td>
<td>20.93</td>
<td>17.73</td>
<td>8.03</td>
</tr>
<tr>
<td>CD (5%)</td>
<td>0.36</td>
<td>0.34</td>
<td>0.24</td>
<td>0.38</td>
</tr>
</tbody>
</table>

M ± SE =Mean ± standard error, Fₐₑ = 3.84, *Significant difference

For colour and appearance Tₐ (8.66) has obtained the highest score followed by T₃ (8.33), T₂ (8.0), T₁ (7.33) and T₄ (6.0) respectively. A significant difference between treatments regarding the colour and appearance was observed which indicates that the addition of different proportions of soybean flour and flaxseed affects the colour and appearance of the prepared products, the colour and appearance becomes darker as the amount of incorporation increases. Similarly, T₀ (8.0) had the highest score for body and texture followed by T₄ (7.9), T₁ (7.0), T₃ (7.0) and T₄ (5.33) respectively.

There was significant difference between the body and texture of control and treatments which indicates that the addition of different proportions of soybean and flaxseed affects the body and texture of the prepared products. The body and texture becomes softer as the amount of incorporation increases. The highest score for taste and flavour was awarded to T₅ (9.0) and T₄ (9.0) followed by T₀ (8.0), T₁ (8.0) and T₃ (7.0), respectively. The taste and flavor score increased till T₄ after that the score decreased as the amount of soybean flour and flaxseed powder increased. The mean score for overall acceptability was the highest in T₂ (8.30) followed by T₅ (8.22), T₀ (8.11), T₃ (7.44) and T₄ (6.66) respectively. Thus, it is clearly shown that the average sensory scores of T₀ was liked very much by the panel of judges followed by T₅, T₆, T₄ and T₃ respectively. There was a significant difference between the control and different treatments regarding the overall acceptability of multigrain fermented idli as the calculated value of F is greater than the tabulated value of F at 5% probability level. This revealed that the addition of different proportions of soybean flour and flaxseed powder affect the overall acceptability of the prepared products. It is therefore, concluded that the average score for various sensory attributes of Idli differed significantly, which may be ascribed to different ratios of soybean flour and flaxseed powder in Idli. Similar study was conducted which shows that incorporation of soybean at 20 percent was the most acceptable (Dhanashree et al., 2015). According to the Khatoon et al., (2011) idli prepared with 4 percent incorporation of dehydrated curry leaves obtained highest score for taste and flavor (8.52).

Nutritional composition of fermented idli
The average nutrient content in treatments and control of Idli/100 gm was shown in Table 2. The result revealed that highest energy was found T₄ (763 Kcal) followed by T₅ (758 Kcal), T₀ (744 Kcal), T₃ (737 Kcal) and T₄ (682 Kcal) per 100 g respectively. It was observed that the energy content decreases as the
incorporation level of soybean flour and flaxseed powder increases.

**Table 2:** Average nutrients content in control and different treatments of *Idli* per 100 g

<table>
<thead>
<tr>
<th>Nutrients</th>
<th>Control</th>
<th>T₀</th>
<th>T₁</th>
<th>T₂</th>
<th>T₃</th>
<th>T₄</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy (kcal)</td>
<td>682</td>
<td>737</td>
<td>744</td>
<td>758</td>
<td>763</td>
<td></td>
</tr>
<tr>
<td>Carbohydrate (g)</td>
<td>124.8</td>
<td>114.25</td>
<td>110.2</td>
<td>106.5</td>
<td>98.4</td>
<td></td>
</tr>
<tr>
<td>Protein (g)</td>
<td>19.8</td>
<td>23.25</td>
<td>24.9</td>
<td>25.5</td>
<td>26.1</td>
<td></td>
</tr>
<tr>
<td>Fat (g)</td>
<td>6.3</td>
<td>7.2</td>
<td>7.4</td>
<td>7.5</td>
<td>7.8</td>
<td></td>
</tr>
<tr>
<td>Iron (mg)</td>
<td>5.3</td>
<td>6.7</td>
<td>6.8</td>
<td>6.9</td>
<td>7.8</td>
<td></td>
</tr>
<tr>
<td>Calcium (mg)</td>
<td>74</td>
<td>92</td>
<td>93.4</td>
<td>94.5</td>
<td>95.2</td>
<td></td>
</tr>
</tbody>
</table>

Protein content was highest in T₄ (26.1 g) followed by T₁ (25.5 g), T₂ (24.9 g), T₃ (23.25 g) and T₀ (19.8 g) per 100 g respectively. The protein content was increases as the incorporation level of soybean flour and flaxseed powder increases. Gopalan *et al.* (1989) reported that the soybean and flaxseed contains good amount of Protein (43.2 g and 20.3 g per 100 g) in comparison to wheat flour.

Carbohydrate content was found to be highest in T₀ (124.8 g) followed by T₁ (114.25 g), T₂ (110.2 g), T₃ (106.5 g) and T₄ (98.4 g) per 100 g respectively. The carbohydrate content decreased as the incorporation level of soybean flour and flaxseed powder increases. Gopalan *et al.* (1989) reported that the carbohydrate content of soybean flour and flaxseed powder (20.9 g and 28.9 g per 100 g) were lower than the wheat flour (69.4 g per 100 g) so as the wheat flour was replaced with soybean flour and flaxseed powder, the carbohydrate content was decreased. Fat content of mixture was highest in T₄ (7.8 g) followed by T₃ (7.5 g), T₂ (7.4 g), T₁ (7.2 g) and T₀ (6.3 g) per 100 g, respectively. It was observed that the fat content increases as the incorporation level of soybean flour and flaxseed powder increases.

Fat content of mixture was highest in T₄ (7.8 g) followed by T₃ (7.5 g), T₂ (7.4 g), T₁ (7.2 g) and T₀ (6.3 g) per 100 g respectively. It was observed that the fat content increases as the incorporation level of soybean flour and flaxseed powder increases. Gopalan *et al.* (1989) reported that the soybean and flaxseed contains good amount of fat (19.5 g and 37.1 g per 100 g, respectively) in comparison to wheat flour.

Comparison of Average nutrients content of control (T₀) and best treatments (T₄) of *Idli* per 100 g on applying the t test (at 5% level of significance) whereas a non-significant difference was observed for fat and iron content of control and best treatment.

**Table 3:** Comparison of Average nutrients content in control (T₀) and best treatments (T₄) of *Idli* per 100 g

<table>
<thead>
<tr>
<th>Nutrients</th>
<th>Control (T₀)</th>
<th>T₄</th>
<th>Difference (t₀-t₄=D)</th>
<th>T (Calculated)</th>
<th>T (Tabulated)</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy (kcal)</td>
<td>682</td>
<td>744</td>
<td>-62</td>
<td>19.6</td>
<td>4.30</td>
<td>S</td>
</tr>
<tr>
<td>Carbohydrate (g)</td>
<td>124.8</td>
<td>110.2</td>
<td>14.6</td>
<td>29.3</td>
<td>4.30</td>
<td>S</td>
</tr>
<tr>
<td>Protein (g)</td>
<td>19.8</td>
<td>24.9</td>
<td>-5.1</td>
<td>11.45</td>
<td>4.30</td>
<td>S</td>
</tr>
<tr>
<td>Fat (g)</td>
<td>6.3</td>
<td>7.4</td>
<td>-1.1</td>
<td>2.29</td>
<td>4.30</td>
<td>NS</td>
</tr>
<tr>
<td>Iron (mg)</td>
<td>5.3</td>
<td>6.8</td>
<td>-1.5</td>
<td>2.34</td>
<td>4.30</td>
<td>NS</td>
</tr>
<tr>
<td>Calcium (mg)</td>
<td>74</td>
<td>93.4</td>
<td>-19.4</td>
<td>34.6</td>
<td>4.30</td>
<td>S</td>
</tr>
</tbody>
</table>
CONCLUSION

Among all the treatments $T_2$ was liked very much by the panel of judges on the basis of sensory attributes followed by $T_1$, $T_3$, $T_0$ and $T_4$ respectively. The ratio of most acceptable treatments ($T_2$) was 30:35:10:10:5 (Mix, Soybean flour, Flaxseed, Barley flour, Gingelly seed powder and Curry leaves). Nutritional composition was significantly increased by the addition of fermented soy based multigrain flour. The active ingredients from soya bean, flaxseed, barley, sesame seed and curry leaves can be extracted and utilized in various food products including other indigenous and traditional fermented foods also.

REFERENCES


