Development of Standardized and Modified Process Technology for Making Sorgo Papad (Sandoli and Bibadi)

P.A. Borkar1*, M.R. Rajput2, R.P. Murumkar3 and M.M. Dange3

1Research Engineer, 2Senior Research Assistant, 3Assistant Research Engineer, AICRP on Post Harvest Technology, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola-444 104 (M.S.), India.

* Corresponding Author: P.A. Borkar
Email: paborkar@rediffmail.com

Abstract
The traditional products like Sorghum papad such as Sandoli and Bibadi are very popular in Maharashtra and other part of India, however, preparation of these products is tedious and skill-specific. Thus, urban kitchens are mostly away from these products, and younger generation is deprived of these traditional products as it is not available in the market. In the near future the local art and skill may vanish. Therefore, it is necessary to standardize the local processes, art and skill to develop a process technology for preparation of these products on larger scale to meet the need of urban population. The fast moving life of human, demands convenience in food production, preparation and product consumption. Hence process technology for sorgo papad viz. Sandoli and Bibadi was standardized and modified. Water bath was used for hot water soaking of sorghum at 90 °C. Papad cutter was developed for cutting of papad in convenient sizes for providing convenience in packaging, handling, transportation, as well as consumption of sorgo papad. The total time required for preparation of Sandoli and Bibadi by traditional methods was 8 days and 9 days respectively. It was reduced 2 days for Sandoli and 3 days for Bibadi in the developed process technology. The maximum shelf life of Sorgo papad Viz. Sandoli and Bibadi was estimated to be 210 and 220 days respectively at 30 °C under saturated conditions while packed in HDPE (Thickness = 0.036mm). The sorghum utilization can be increased by popularizing indigenous products like Sorgo papad, which would increase the crop value in the market.

Key words: Sorghum Variety SPV-669, sorgo papad, papad cutter, modified process technology.

Introduction

India stands first for area under cultivation of sorghum, but in production, it ranks third in the world (Anonymous, 2005). Sorghum (Sorghum bicolor L. Moench) belongs to Gramineae family and is the third most important cereal grain after rice and wheat in India (ICRISAT, 1999). In India Maharashtra, Karnataka and Andhra Pradesh shared 75 to 85 per cent of country’s sorghum (Jambamma et al., 2011). The near-record sorghum production in India is 6.4 million tons (Anonymous, 2013).

However, Sorghum has still remained a low valued crop as it is merely used as a food grains, in the low income sector and industrial products are not yet derived. Owing to its fodder value, it is being cultivated over a larger area every year. This necessitates the utilization of grains in the main food chain by developing various value added products. Varieties of traditional soughum based products are prepared and consumed in different forms, namely thin or thick fermented porridge, unleavened bread, dumpling (madde), chapati or roti, malted sorghum, popped sorghum, ambil and boiled rice (anam/bana) specially in festival times (Thorat et al., 1988; Sankarapandian, 2000; Borkar et al., 2014). The local products like Sorghum Papad are very popular in west Vidharbha and east Kandesh region of Maharashtra, however, preparation of these products is tedious and skillful. Thus, urban kitchens are mostly away from these products, and younger generation is deprived of these traditional products as it is not available in the market. In the near future the local art

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and skill may vanish therefore, it is necessary to standardize the local processes, art and skill to develop a process technology for preparation of these products on larger scale to meet the need of urban population.

Hence, this study was undertaken for standardization and modification of process technology for preparation of Sorgo papads and to study shelf life of these products. The sorghum utilization can be increased by popularizing these indigenous products, which would increase the crop value. Due to modified process technology, size reduction, packaging, handling and bulk transportation of Sorgo papads can be possible in India and worldwide.

Material and Methods

Standardization of Process Technology for Sorgo Papad

The existing process was identified for preparation of sorgo papad (Sandoli and Bibadi). The housewives were interviewed for knowing the traditional process technology for preparation of these products.

The processes were observed and studied in laboratory systematically with respect to quantity of ingredients and process-time. The process parameters were specified, quantified and the processes were standardized. The processes were repeated (seven times) in laboratory until identical products were obtained. The hardness of the sorghum grain at various processing stages was measured on texture analyzer (Model: Texture Expert, Make: Stable Micro System Limited, UK). The viscosity of the dough at various stages was measured using Brookfield Dial Viscometer (Model- RV, Make: Brookfield Engineering Laboratories, USA). The flow chart for standardized traditional process for preparation of Sandoli and Bibadi are shown in Fig 2 and Fig 3, respectively. The flow chart for modified process technology for Sandoli and Bibadi are shown in Fig 4 and Fig 5, respectively.

Modified Process Technology for Sorgo Papad

The sorghum of variety SPV-669 was used for preparation of sorgo papads (Sandoli and Bibadi). It was observed that the major time period was required in soaking of sorghum (6 days) during traditional process. Efforts were made to minimize the soaking period of sorghum by soaking the sorghum in hot water at 90 ºC temperature (close to boiling–as mentioned by Afolayan et al., 2010). Water bath (Model No: 6130409, Make: Lab Hosp Corporation, Mumbai) was used for hot water soaking of sorghum. Soaking of sorghum in hot water will certainly help to replace some processing steps and time required.

The fast moving life of human, demands convenience in food production, preparation and product consumption. The Ready to Cook (RTC) foods are becoming very popular in this fast moving world. Considering the difficulties in packaging, handling and storage of traditionally prepared Sandoli and Bibadi due to its uneven shape and low bulk density, papad cutter (Fig 1) was developed to cut small size square shape (25 x 25 mm) sorgo papad (Sandoli and Bibadi). Other than square different shapes of sorgo papad observed during testing are Viz. rhombus, triangular, etc.

Biochemical Analysis

The biochemical analysis of Sandoli and Bibadi prepared by traditional and improved process technology was carried out for various parameters viz., crude protein, crude fat, carbohydrate, crude fiber, phosphorus, thymine, riboflavin, ascorbic acid, protease inhibitor and pH.

Shelf Life Study

The storage of Sandoli and Bibadi prepared by standardized process technology was undertaken under accelerated storage condition (45±2 ºC temperature and 95±2 % relative humidity). The commonly available packaging material like HDPE (thickness = 0.036mm) was used this study. Ten gram sample of both sandoli and bibadi were packed in HDPE packet of 10 cm x 7 cm size. The permeability of packaging material was determined by standard method (Pardeshi, 2008). The sorption study was also undertaken by standard method for determination of the critical water activity (a_w*) and critical moisture content (M_i). The shelf life of the products (Sandoli and Bibadi) θ days i.e. the period required for the moisture content to reach from an initial value M_i to its critical value M_i (g water/g dry method) where it lost its hardness can be determined by the following formula (Das, 2005).

\[ θ = \frac{W_i}{P_i K_{iA} \int_{M_i}^{M_f} \frac{dM}{RH - a_w}} \]  (1)

Where,
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M.C. – 8.2 % ± 0.78
Hardness - 14.95 kg ± 3.81

M.C. – 47.80 % ± 1.57
Hardness – 1.061 kg ± 0.436

M.C. – 12.60 % ± 1.29
Hardness – 3.42 kg ± 1.38

Alum (6 g)
(Hydrated potassium aluminum sulfate)
Salt (100 g)
as per requirement

M.C. of dough – 56.53 % ± 0.15

Initial viscosity – 12,400 P
Final viscosity – 39,320 P
M.C. of dough – 56.53 % ± 1.31

Gum water

M.C. – 6.61 % ± 0.15
Hardness – 0.729 kg ± 0.31

Sorghum (3 kg)

Soaking in water
(till softening of grains)
(6 days)
Sun drying (1 day)

Dry sorghum

Rice (200 g)
Dried powder of Wheat paste (200 g)

Fine grinding (Burr mill)
(Flour - 3.7 kg)

Sieve (Sieve - 400 μ)

Over size (6.06 % ± 0.42)

Fine flour (92.94 % ± 1.02)
Sesamum (65 g)

Boiling water (6 lit.)

Cooking
(continuous stirring)
for dough formation
(Time – 4 min)

Rolling of Sandoli
(54 g) on metallic flat surface
(Total nos. of wet Sandoli – 163)

Rolling of Bibadi
(200 g) on metallic flat surface
(Total nos. of wet Bibadi – 163)

M.C. – 47.80 % ± 1.57
Hardness – 1.061 kg ± 0.436

M.C. – 12.60 % ± 1.29
Hardness – 3.42 kg ± 1.38

M.C. – 8.2 % ± 0.78
Hardness - 14.95 kg ± 3.81

To make
Sandoli

To make
Bibadi

Fig 2: Flow chart for standardized traditional process of Sandoli preparation

ือ = shelf life, days

\[ W_i = \text{dry matter in the product, kg} \]

\[ P^* = \text{saturation vapour pressure of water at } T°C (Pa) \]

\[ P^* = \frac{23.060}{1 + 0.01 \times RH} \]

\[ RH = \text{relative humidity in which package is placed (fraction)} \]

\[ a_w = \text{water activity (fraction of the product at } T°C = f (M) \]

\[ M = \text{moisture content of the product (kg water per kg dm)} \]

\[ i \text{ and } c = \text{are the suffix for initial and critical conditions, respectively} \]

Results and Discussion

The total time required for preparing Sandoli and Bibadi by traditional method was 8 days and 9 days, respectively (Table 1 and 2). After modified process technology the time of preparing was reduced to 2 days for Sandoli (Table 1) and 3 days for Bibadi (Table 2).

The traditional circular or uneven shape of the Sandoli and Bibadi was one of the hindrances in packaging of the product, its transportation and storage space. Hence, Sorgo papads were cut in to square pieces which were easy for packing (in bulk), handling and transportation. Also the small size (25×25 mm) of Sorgo papad is convenient for consumption after roasting or frying.

Due to uneven shape of traditional Sandoli and Bibadi (Fig 6 and 8) the bulk densities were low i.e. 0.040 ± 0.006 g/cc and 0.117 ± 0.006 g/cc, respectively. In modified process technology, due to reduce size and regular shape of Sandoli and Bibadi (Fig 7 and 9), the bulk densities were increased to 0.21±0.019 g/cc and 0.24±0.011 g/cc, respectively. Hence, the bulk densities of Sorgo papads after modified process technology were increased over traditional process i.e. 5 times more in Sandoli and 2 times more in Bibadi.
Table 3 shows the mean values of sensory score imparted by judges (BIS, 1971) for Sandoli prepared by traditional and modified method. The data with respect to colour, flavor and appearance shows non-significant difference. However, the numerical values with respect to flavor and appearance were slightly higher for Sandoli prepared by modified method. The Sandoli prepared by traditional method was found better only in case of texture as compared to improved method. Sandoli prepared by modified method was having slightly higher thickness and was slightly harder (1.027 kg ± 0.42) than that prepared by traditional method (0.729 kg ± 0.31). The sensory score received for Sandoli prepared by modified method with respect to texture was high enough i.e. 8.00.
The data of mean values of sensory attributes in respect of Bibadi prepared by traditional and modified method is also shown in Table 3. Colour, flavor and appearance followed trend similar to that of Sandoli. However, score received by texture of Bibadi prepared by modified method is still high i.e. 8.00. It was having high hardness (0.92 kg ± 0.26) than Bibadi prepared by traditional method (0.331 kg ± 0.042). Moreover, the higher hardness before frying or roasting is good property for better packaging, handling, transportation and storage for long period. Thus Sorgo papad prepared by modified process technology thereby saving time and labour can be preferred as compared to traditional method.

The chemical composition of Sandoli and Bibadi (Table 4) prepared by traditional and modified method indicates that, the product prepared by traditional method exhibited slightly higher protein content as compared to modified method. The crude fat and fibre content of Sandoli and Bibadi prepared by both the
methods did not show marked difference. The carbohydrates of prepared product varied among both the products however, method of preparation did not cause marked variations. This low calorie high fibrous Sorgo papad will certainly attract consumer and will increase the crop value in market.

The sorgo papad viz Sandoli and Bibadi were found to have initial moisture content of (Mᵢ) of 0.1199 kg/kg dm and 0.068 kg/kg dm and water activity of 0.395 and 0.376, respectively. Using standard method, the critical water activity (aₑₑ) was determined and found to be 0.599 at critical moisture content (Mₑₑ) of 0.1339 kg/kg dm for Sandoli. Similarly for Bibadi, the critical water
activity was found to be 0.592 at critical moisture content of 0.0947 kg/kg dm.

Using equation as given in methodology, the shelf life in given packaging material at various temperatures is calculated to be as given in Table 5. The Sandoli and Bibadi were found to have shelf life of 210 and 220 days (about 7 months) if kept at 30 °C and 92 and 97 days (about 3 months) if kept at 45 °C and at saturated conditions while packed in HDPE (Thickness = 0.036mm). The above prepared Sandoli and Bibadi in regular rectangular shape can be converted into ready-to-eat material using frying technique or using hot air puffing.

**Conclusions**

Process technology for sorgo papad viz., Sandoli and Bibadi was identified, standardized and modified. The total time required for preparation of Sandoli and
Bibadi by traditional methods was 8 days and 9 days, respectively. It was reduced to 2 days for Sandoli and 3 days for Bibadi in modern process technology. The shelf life of Sorgo papad viz., Sandoli and Bibadi was observed to be 210 and 220 days, respectively at 30°C under saturated conditions while packed in HDPE (Thickness = 0.036mm).

Table 2: Time required for traditional and modified method for Bibadi preparation

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Traditional method</th>
<th>Time</th>
<th>Modified method</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soaking of Sorghum grains</td>
<td>Natural Soaking (under shade)</td>
<td>6 days</td>
<td>Soaking in water bath at 90°C</td>
<td>90 min.</td>
</tr>
<tr>
<td>Drying</td>
<td>Sun drying</td>
<td>30-60 min.</td>
<td>Sun drying of soaked sorghum</td>
<td>3 h</td>
</tr>
<tr>
<td>Water application</td>
<td>√</td>
<td>60 min.</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Conditioning in cloth</td>
<td>√</td>
<td>120 min.</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Grinding</td>
<td>Grinding (Burr mill -2HP)</td>
<td>15 min.</td>
<td>Grinding (Burr mill -2HP)</td>
<td>15 min.</td>
</tr>
<tr>
<td>Sieving</td>
<td></td>
<td>30 min.</td>
<td></td>
<td>30 min.</td>
</tr>
<tr>
<td>Flour soaking overnight</td>
<td>√</td>
<td>12 h</td>
<td></td>
<td>10 min</td>
</tr>
<tr>
<td>Papad making</td>
<td>√</td>
<td>1 day</td>
<td></td>
<td>3 h</td>
</tr>
<tr>
<td>Papad drying</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(upto moisture content of 7.85% ± 0.71 wb)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Papad warming</td>
<td>√</td>
<td>1 day</td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>Papad cutting</td>
<td></td>
<td></td>
<td>Semidried Bibadi cutting by using papad cutter</td>
<td>4 h</td>
</tr>
<tr>
<td>Papad drying</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(upto moisture content of 6.37% ± 0.65 wb)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total time required</td>
<td>8 days 16 h 45 min. 9 days</td>
<td>≈ 3 days</td>
<td>≈ 3 days 23 h 25 min.</td>
<td>3 days</td>
</tr>
</tbody>
</table>

Table 3: Sensory evaluation of Sorgo papad prepared by traditional and modified process technology

<table>
<thead>
<tr>
<th></th>
<th>Sandoli (Traditional)</th>
<th>Bibadi (Modified)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colour</td>
<td>8.0</td>
<td>7.6</td>
</tr>
<tr>
<td>Flavour</td>
<td>8.1</td>
<td>8.0</td>
</tr>
<tr>
<td>Texture</td>
<td>9.0</td>
<td>8.0</td>
</tr>
<tr>
<td>Appearance</td>
<td>7.5</td>
<td>8.0</td>
</tr>
<tr>
<td>Colour</td>
<td>8.1</td>
<td>8.0</td>
</tr>
<tr>
<td>Flavour</td>
<td>8.1</td>
<td>8.0</td>
</tr>
<tr>
<td>Texture</td>
<td>9.0</td>
<td>8.0</td>
</tr>
<tr>
<td>Appearance</td>
<td>7.6</td>
<td>8.0</td>
</tr>
<tr>
<td>t Stat</td>
<td>0.6882</td>
<td>-0.4472</td>
</tr>
<tr>
<td>t Critical two-tail</td>
<td>2.1009</td>
<td>2.1098</td>
</tr>
</tbody>
</table>

Table 4: Biochemical analysis of Sorgo papad prepared by traditional and modified process technology

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Parameter</th>
<th>Sandoli (Traditional)</th>
<th>Modified</th>
<th>Bibadi (Traditional)</th>
<th>Modified</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Total protein (crude), g/100g</td>
<td>7.1</td>
<td>6.9</td>
<td>9.3</td>
<td>9.1</td>
</tr>
<tr>
<td>2</td>
<td>Crude fibre, %</td>
<td>3.2</td>
<td>3.2</td>
<td>3.4</td>
<td>3.5</td>
</tr>
<tr>
<td>3</td>
<td>Crude fat, %</td>
<td>2.5</td>
<td>2.60</td>
<td>2.6</td>
<td>2.80</td>
</tr>
<tr>
<td>4</td>
<td>Carbohydrates, g/100 g</td>
<td>73.2</td>
<td>73.3</td>
<td>70.7</td>
<td>70.6</td>
</tr>
<tr>
<td>5</td>
<td>Phosphorus, g/100 g</td>
<td>1.5</td>
<td>1.3</td>
<td>0.8</td>
<td>0.8</td>
</tr>
<tr>
<td>6</td>
<td>Iron, g/100 g</td>
<td>0.22</td>
<td>0.25</td>
<td>0.23</td>
<td>0.20</td>
</tr>
<tr>
<td>7</td>
<td>Thymin, μg/100 g</td>
<td>11.76</td>
<td>11.425</td>
<td>9.42</td>
<td>11.11</td>
</tr>
<tr>
<td>8</td>
<td>Niacin, mg/100 g</td>
<td>42</td>
<td>45</td>
<td>41</td>
<td>40</td>
</tr>
</tbody>
</table>
Table 5: Shelf life of Sorgo papad at various storage temperatures

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Storage temperature at saturation condition</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>30°C</td>
</tr>
<tr>
<td>Saturation pressure, P* (Pa)</td>
<td>4162.67</td>
</tr>
<tr>
<td>Permeability of packaging</td>
<td></td>
</tr>
<tr>
<td>film Ka (kg water/day.m².Pa)</td>
<td>4.5076x10⁻⁷</td>
</tr>
<tr>
<td>Shelf life (days)</td>
<td>Sandoli</td>
</tr>
<tr>
<td></td>
<td>210</td>
</tr>
<tr>
<td></td>
<td>220</td>
</tr>
</tbody>
</table>

References


