Development of Macaroni from Blends of Wheat (*Triticum aestivum*), Barley (*Hordeum vulgare L.*) and Soybean (*Glycine max*) Flours

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1. Introduction

- Macaroni and Pasta are the major processed cereal products used by most of the communities.
- Soybean is a very rich source of essential nutrients and one of the most versatile food stuffs.
- The soy protein is highly digestible and contains all the essential amino acids except methionine.
Introduction......Cont’d

• Addition of soy protein is acceptable in almost all diets due to no cholesterol and absence of lactase.

• Barley flour has concentrated amount of glucan which is 3 to 4 times more than the naturally occurring level.

• Barley provides an excellent source of soluble dietary fiber for attenuating blood glucose and reducing low density lipoprotein cholesterols.
2. Objectives

• The **general objective** of this study was to evaluate the effects of blending ratio of durum wheat, barley and soybean flours on functional, proximate and sensorial properties of macaroni.

**Specific objectives**

• To develop macaroni from durum wheat, barley and soybean flour blends
• To determine the proximate compositions of macaroni
• To evaluate the functional properties of the developed macaroni
• To conduct sensorial characteristics
3. Materials and Methods

3.1. Sample collection and preparation

- Durum wheat flour was taken from Kality Food Complex Share Company.

- Barley was purchased from local market. Barely flours were developed following (Hussein et al. 2006) procedures with minor modification.
Barley → Cleaning debries → Washing with tape water

Winnowing ← Dehusking ← Sun drying

Milling → Sieving (500 um) and flour
• Soybean crops were collected from Hawassa agricultural research center.

• The samples were cleaned and soaked in cold water for 2 hrs.

• Then it was drained, blanched and dried so as to minimize anti-nutritional factors.
3.3. Development of Macaroni

• Macaroni development process was done following four critical steps. These are dough preparation, extrusion, cutting and drying.

• The dough was prepared using 5 blending proportions (Blend 1 = 100% wheat flour (WF) (control), Blend 2 = 80% WF+15%barley flour (BF) +5% soybean flour (SF), Blend 3 = 70% WF + 20% BF + 10% SF, Blend 4=70% WF + 10% BF+20% SF and Blend 5=60% WF+30% BF + 10% SF).
Weighing ingredients (28 ml water/100 g flour)

Mixing

Kneading

Extruding

Cutting

Oven drying (70 °C, 12 hr)

Packaging
3.5. Determination of functional properties

- Cooking quality was determined by quantifying
  - water absorption capacity and
  - cooking loss

after cooking the macaroni. 100 gram of macaroni was cooked by 1000 ml for 10 minutes to do those functional properties using a slight modification of Marconi et al., 2000.
3.6. Proximate Analysis

Moisture content, crude protein, total crude fibers and total ash were analyzed according to (AOAC, 2000) standard procedures.
3.7. Sensory Evaluation

• The sensory evaluation of macaroni was carried out on the basis of appearance, color, odor, taste, stickiness and overall acceptability.

• A five point hedonic scale was used for evaluation of the product acceptability.

• Fifteen panelists were used for the sensorial evaluation.
3.7. Experimental design and data analysis

• Randomized Complete Block Design (RCBD) was used to investigate the effect of level of soybean and barley on sensorial characteristics of macaroni.

• Complete Randomized Design (CRD) was carried out to study the blending effect on proximate composition and functional properties of macaroni. Statistical software package of SAS version 9.01 was used.
4. Results and Discussions

4.1. Functional Properties

<table>
<thead>
<tr>
<th>Blends</th>
<th>Water absorption (ml/100g)</th>
<th>Cooking loss (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blend 1</td>
<td>160.30±4.38&lt;sup&gt;b&lt;/sup&gt;</td>
<td>7.45±1.55&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>Blend 2</td>
<td>182.70±3.82&lt;sup&gt;a&lt;/sup&gt;</td>
<td>11.04±0.7&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Blend 3</td>
<td>149.80±6.36&lt;sup&gt;b&lt;/sup&gt;</td>
<td>13.15±0.46&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
<tr>
<td>Blend 4</td>
<td>177.30±3.82&lt;sup&gt;a&lt;/sup&gt;</td>
<td>15.41±1.29&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Blend 5</td>
<td>172.65±6.86&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>14.89±0.64&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

Values are mean ± SD and those bearing different letter within a columns are significantly different (P<0.05)
• Water absorption capacity of blend 2 was higher compared to other treatments. This might be due to the fact that low amount of soybean (5%) incorporation on blend 2 than the other blends.

• However, addition of barley flour increases water absorption capacity because of high amount of fiber found on barley flour than soybean and wheat flours.
• Macaroni made from 100% durum wheat (B1) had lower percentage of cooking loss.

• Increasing the amount of soybean and barley flour increases the amount of solid loss (7.45% to 14.89%). This might be due to low gluten amount on barley and soybean flours compared to durum wheat flour.
### 4.2. Proximate compositions

<table>
<thead>
<tr>
<th>Products</th>
<th>Moisture (%)</th>
<th>Crude protein (%)</th>
<th>Total ash (%)</th>
<th>Crude fiber (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blend 1</td>
<td>9.32±0.14\textsuperscript{a}</td>
<td>9.61±0.12\textsuperscript{d}</td>
<td>0.28±0.20\textsuperscript{a}</td>
<td>0.16±0.10\textsuperscript{d}</td>
</tr>
<tr>
<td>Blend 2</td>
<td>8.58±0.25\textsuperscript{b}</td>
<td>9.94±0.19\textsuperscript{c}</td>
<td>0.35±0.14\textsuperscript{d}</td>
<td>0.24±0.21\textsuperscript{c}</td>
</tr>
<tr>
<td>Blend 3</td>
<td>8.40±0.18\textsuperscript{c}</td>
<td>10.41±0.20\textsuperscript{b}</td>
<td>0.58±0.21\textsuperscript{b}</td>
<td>0.31±0.16\textsuperscript{b}</td>
</tr>
<tr>
<td>Blend 4</td>
<td>8.65±0.32\textsuperscript{b}</td>
<td>11.51±0.16\textsuperscript{a}</td>
<td>0.49±0.34\textsuperscript{c}</td>
<td>0.29±0.11\textsuperscript{c}</td>
</tr>
<tr>
<td>Blend 5</td>
<td>7.94±0.17\textsuperscript{d}</td>
<td>10.54±0.18\textsuperscript{b}</td>
<td>0.74±0.19\textsuperscript{a}</td>
<td>0.35±0.28\textsuperscript{a}</td>
</tr>
</tbody>
</table>

Values are mean ± SD and those bearing different letter within a columns are significantly different (P<0.05)
### 4.3. Sensory characteristics

#### Table 3. Sensory characteristics of macaroni prepared from blends of wheat, barley and soybean flours

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Blend 1</th>
<th>Blend 2</th>
<th>Blend 3</th>
<th>Blend 4</th>
<th>Blend 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color</td>
<td>4.62±0.53a</td>
<td>3.93±0.69b</td>
<td>3.22±0.74c</td>
<td>3.82±0.68b</td>
<td>2.44±0.78d</td>
</tr>
<tr>
<td>Odor</td>
<td>4.56±0.5a</td>
<td>4.08±0.63b</td>
<td>3.76±0.6c</td>
<td>3.78±0.7c</td>
<td>2.82±0.91d</td>
</tr>
<tr>
<td>Appearance</td>
<td>4.38±0.58a</td>
<td>3.76±0.43b</td>
<td>3.67±0.6b</td>
<td>3.04±0.74c</td>
<td>3.10±0.86c</td>
</tr>
<tr>
<td>Stickiness</td>
<td>4.67±0.48a</td>
<td>3.64±0.71b</td>
<td>3.49±0.66b</td>
<td>3.81±0.66b</td>
<td>3.02±0.97c</td>
</tr>
<tr>
<td>Taste</td>
<td>4.8±0.4a</td>
<td>3.73±0.58b</td>
<td>3.38±0.61cd</td>
<td>3.44±0.59c</td>
<td>3.80±0.86d</td>
</tr>
<tr>
<td>Overall acceptability</td>
<td>4.89±0.32a</td>
<td>4.04±0.3b</td>
<td>3.87±0.40c</td>
<td>3.69±0.47d</td>
<td>3.13±0.84e</td>
</tr>
</tbody>
</table>

Values are mean ± standard deviation. Means followed by different superscript letter within the raw indicate significant difference (p<0.05).
Conclusions and Recommendations

• Incorporation of barley and soybean flour increases the water absorption capacity due to higher fiber content of barley compared to the control.

• However, increasing the amount of soybean and barley flour also increases the amount of solid loss due to lower protein quality found in barley and soybean flours.
• Addition of barley and soybean flours on durum wheat flour during macaroni preparation increases crude protein, fiber and ash contents while reducing the moisture contents.

• The macaroni prepared from blends of 15% barley, 5% soybean and 80% durum wheat flour have scored better sensorial acceptability.
Acknowledgement

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Thank You!