TOWARDS SUSTAINABLE MEDITERRANEAN BAKERY PRODUCTS – TESTING FORMULATIONS WITH SUNDRIED CAROB PULP AND SEED FLOUR
(*Ceratonia siliqua* L.)
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Water – Food – Energy nexus is the key to sustainable development

Mediterranean resources:
- Rich agrobiodiversity / well adapted plants
- Mediterranean Diet (healthy and sustainable food pattern, crafts and lifestyle)
- Ancient wisdom – Sun drying


http://www.fao.org/3/AC911E/ac911e05.htm

https://www.unenvironment.org/resources/emissions-gap-report-2019
The carob tree
(Ceratonia Siliqua)

Fabacea family

Rich in sugars, fibers and minerals
Rich in polyphenols
(health-promoting phytochemicals)

Innovative, sustainable bread & bakery products by blending carob flour with wheat flour
Carob
- Sorting & selection
  - Sun drying (open air)
  - Shelling
  - Separation

Carob seed
- Grinding
- Sieving
- Storage
- Carob Seed flour ($\Phi 200\mu m$)

Carob pod
- Grinding
- Sieving
- Storage
- Carob Pod flour $\Phi 200\mu m$

Ambient temperature for several days
Analysis:

Humidity (AACC Approved Method 44–15.02)
Alveographic properties of dough (AACC 54-30, ICC 121, NF EN-ISO 27971, GOST 51415-99)
Instrumental analysis of colour and texture
Ash (minerals), gluten content
Aroma profile (GC-MS)
Hedonic studies

Measuring colour and texture
## Some Results

<table>
<thead>
<tr>
<th>Samples</th>
<th>H (%)</th>
<th>P (mm)</th>
<th>L (mm)</th>
<th>G (cm³)</th>
<th>W (10⁻⁴J)</th>
<th>P/L</th>
<th>Ie (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>White flour</td>
<td>14.8</td>
<td>71.2</td>
<td>60.6</td>
<td>17.08</td>
<td>152</td>
<td>1.288</td>
<td>47.9</td>
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<tr>
<td>Carob pods powder C100%</td>
<td>13.53</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Carob pods powder C30%</td>
<td>13.4</td>
<td>69.0</td>
<td>20.2</td>
<td>9.96</td>
<td>58</td>
<td>3.556</td>
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<td>Carob pods powder C20</td>
<td>13.5</td>
<td>89.6</td>
<td>30.8</td>
<td>12.28</td>
<td>119.4</td>
<td>2.82</td>
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<td>Carob pods powder C10</td>
<td>13.7</td>
<td>55.4</td>
<td>53.4</td>
<td>16.18</td>
<td>103.6</td>
<td>1.05</td>
<td>41.12</td>
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<tr>
<td>Carob pods powder C5%</td>
<td>14.3</td>
<td>67.4</td>
<td>38.2</td>
<td>13.7</td>
<td>104.4</td>
<td>1.782</td>
<td>ND</td>
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<tr>
<td>Carob seed powder G100%</td>
<td>5.9</td>
<td></td>
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<tr>
<td>Carob seed powder G10%</td>
<td>14.0</td>
<td>276.7</td>
<td>15.75</td>
<td>8.8</td>
<td>186.7</td>
<td>17.57</td>
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<tr>
<td>Carob seed powder G5%</td>
<td>14.2</td>
<td>134.6</td>
<td>30.8</td>
<td>12.26</td>
<td>178.2</td>
<td>4.45</td>
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<tr>
<td>Mixture WF x C x CS M1</td>
<td>13.6</td>
<td>253.4</td>
<td>14.8</td>
<td>8.54</td>
<td>160.4</td>
<td>17.15</td>
<td>ND</td>
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<tr>
<td>Mixture WF x C x CS M2</td>
<td>13.2</td>
<td>164</td>
<td>14.4</td>
<td>8.4</td>
<td>97.2</td>
<td>12.63</td>
<td>ND</td>
</tr>
</tbody>
</table>

*No rheological proprieties of carob pods flour*

*No rheological proprieties of carob seed flour*
**Aromatic composition of carob (pod) flour**

- Hexanoic acid; 15.7

**Aromatic composition of carob seed flour**

- n-heptane; 14.7
- Isobutyric acid; 8.3
- Isocetane; 13

**Aromatic composition of wheat flour**

- 3-ethyl-1-hexanol; 18.9
- Limonene; 19.4
Hedonic evaluation
In Conclusion,

Blending wheat flour with sun dried carob flour for sustainable and healthy bread and pastries

- Less use of energy to produce flour and hence lower C footprint of bread and pastries
- Higher anti-oxidant and free-radical scavenging activity
- Reduced gluten content and darker colour of bread are relevant for some niche markets
- Less furanic contaminants (from Maillard reactions) than those observed with white wheat flour

The result of the hedonic study showed that the “tasters” liked very much the pastry products made from carob (the carob pulp cake (C100%) and the carob seed cake (G100%)

To crown the whole, carob is a typical Mediterranean product that enables the formulation of a wide diversity of sustainable foodstuffs of high nutritive value, low carbon footprint, safe, healthy, tasty and affordable, all at once.