Effect of fermentation on total phenolic content and antioxidant activity of sourdough from Calabria (Italy)

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ABSTRACT
Sourdough is a combination of cereal flowers and water fermented by a mixture of lactic acid bacteria (LAB) and yeasts. The microbiological composition of the sourdough can vary according to type of flour, ingredients and production technology [1]. The LAB and yeasts coexistence gives the bread peculiar organoleptic characteristics. Many traditional Italian breads use sourdough as natural starter and some of them have the label either of Protected Designation of Origin (PDO) or the Protected Geographical Indication (PGI) [2]. In Calabria different traditional sourdoughs are produced (Figure 1) but until now they have not been studied in detail. It is well known that the use of sourdough leads to improve aroma, texture, and shelf-life of bread [3]. Other than these characteristics, consumers are conscious and pay attention to food health aspects. Efforts are being made to stabilize bakery products towards oxidation also using synthetic antioxidants [4]. It was reported the possible use of sourdough fermented wheat germ to reduce white bread oxidation [5]. Whole grain cereals are known to produce health benefits due not only to the vitamins, minerals, fibres, but also to other phytochemicals such as phenolic compounds [6,7] which show radical scavenging capacities. The aim of the present work was to study the effect of fermentation in sourdoughs from Calabria (Italy) on phenolic content and antioxidant activity.

MATERIALS AND METHODS
Four sourdoughs were collected from bakeries located in two Calabrian provinces: Catanzaro (PF1, PF2, and PF4) and Reggio Calabria (PF5) together with a dough for white bread (produced in Reggio Calabria using only Saccharomyces cerevisiae) used as control. The samples (Figure 2) were tested for lactic acid content by HPLC [8], total phenols by Folin-Ciocalteu [9], and antioxidant activity by using the 2,2-diphenyl-1-picyrhydrazyl radical (DPPH) [10]. For the microbiological analyses, each sourdough sample was homogenized, serially diluted, and plated in MRS and SDB for LAB [8] and in YPD for yeasts [11].

RESULTS AND DISCUSSION
The LAB load ranged from 6.50 to 9.05 Log CFU/g in MRS, and from 6.59 to 9.03 Log CFU/g in SDB. The load of yeasts detected ranged from 5.41 to 8.27 Log CFU/g. Compared to the control dough, the highest lactic acid content (4.892 mg/g) was found in PF1 while PF2 exhibited the lowest value (0.329 mg/g). The highest antioxidant activity expressed as percentage of inhibition was found in PF5 (22.7%), whereas the minimum activity was found in PF2 (19.27%). The control dough exhibited a value of 17.77%. The total phenolic content (expressed as mg of gallic acid/g of sourdough) ranged from 48.929 (PF2) to 92.089 (PF4) and in the control dough the content was 35.405.

Phenols exhibit radical scavenging capacities and the increase of phenolic compounds during sourdough fermentation was previously shown [12]. The control sample and the sourdoughs differed for the concentration of total phenols. The total phenols content was lower in the control sample and in the PF2; this was predictable because the first one is fermented prevalently by yeasts while the second one is a peculiar Calabrian sourdough (named Pitta) characterized by lower pH than the other Calabrian sourdoughs. The same trend it was observed for the DPPH activity. As previously reported [12] the increase of total antioxidant could be related also to the acidification that facilitates the phenolic compounds extractability.

Our results shown that the microflora responsible for the sourdough fermentation determines an increase in the phenolic content and antioxidant activity; so, this could be useful to produce sourdough bread with improved characteristics of healthiness and shelf-life. LAB and yeasts technological analyses will be carried out to select the best strains to use as starter.

Table 1 - Values of lactic acid, DPPH, and total phenols of the sourdoughs.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Lactic acid a</th>
<th>DPPH b</th>
<th>Total phenols c</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>0.195 ± 0.01</td>
<td>17.77 ± 0.23</td>
<td>35.405 ± 0.00</td>
</tr>
<tr>
<td>PF1 - pane tradizionale</td>
<td>4.892 ± 0.04</td>
<td>20.38 ± 1.91</td>
<td>86.935 ± 0.00</td>
</tr>
<tr>
<td>PF2 - Pitta</td>
<td>0.329 ± 0.05</td>
<td>19.27 ± 0.83</td>
<td>48.929 ± 0.02</td>
</tr>
<tr>
<td>PF4 - pane tradizionale</td>
<td>3.399 ± 0.00</td>
<td>21.17 ± 1.29</td>
<td>92.089 ± 0.00</td>
</tr>
<tr>
<td>PF5 - pane tradizionale</td>
<td>3.423 ± 0.16</td>
<td>22.27 ± 0.61</td>
<td>52.205 ± 0.01</td>
</tr>
</tbody>
</table>

a mg of lactic acid/g of sourdough  
b % of inhibition  
c mg of gallic acid/g of sourdough

REFERENCES

This work was supported by PROGETTO PON03PE_00909_1 Innovazione di prodotto e di processo nella filiera dei prodotti da forno e dolciari