Chemical Composition of *Broa*, a Portuguese Traditional Sourdough Bread

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INTRODUCTION

The earliest method of obtaining reliable leavens was to keep back a piece of fermenting dough to be used later in subsequent batches; the piece of dough kept for the next production is called the sour ferment. One type bread that is still manufactured via such ancient manufacturing procedures, at the farm level only, is *Broa*.

From an economic point of view, *Broa* has a great importance in Portugal, due to the significant number of small farmers who are involved in their production. Such artisanal farmers are encompassed by the directives of the Common Agriculture Policy, as long as they contribute to the protection of the environment. Such traditional product has also a social function, via helping the fixation of people in rural areas, and hence stopping the desertification phenomenon which has become more and more noticed in Portugal. Finally, consumption of this product has a major potential for increase as nowadays consumers tend to prefer natural foods.

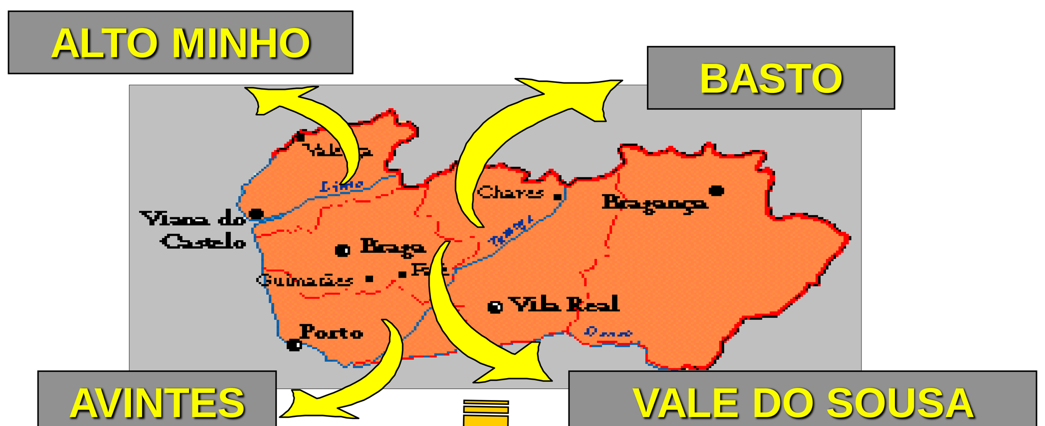
However, preservation of *Broa* in the open market will require a greater quality, and a more constant set of characteristics of the product. This quality can only be legally guaranteed via certification, which might occur via definition of Appélation d'Origine Protegée (AOP) regions.

To this goal, chemical characterization is one of the most crucial steps. Several chemical analyse were performed on samples of maize and rye flours, as well as of *Broa* made available by traditional producers in two several distinct periods and from several distinct geographical locations.

Our study has shown that samples of *Broa*, as well as maize and rye flours, from the various regions are undistinguishable by their chemical characteristics, and that only slight variations are perceived between different periods for every producer.

EXPERIMENTAL METHODS

Moisture content (NP-515), **Ashes at 550ºC** (NP-518), **pH** (potenciometry method), **Total titratable acidity** (NP-2967), **Chlorides** (Mohr process), **Total sugars** (Munson & Walker method), **Total dietary fiber** (Weende method), **Total proteins** (NP-1996) and **Total lipids** (NP-4168) were determined in samples of **maize flour** (*m*), **rye flour** (*r*) and ***Broa*** (*b*), obtained from producers in different geografical locations (*I*, *II*,...,*XV*) and in two different periods, the cold (*c*) and warm (*w*) seasons:



4 SUB-REGIONS

2 ZONES/sub-region

2 PRODUCERS/zone

RESULTS

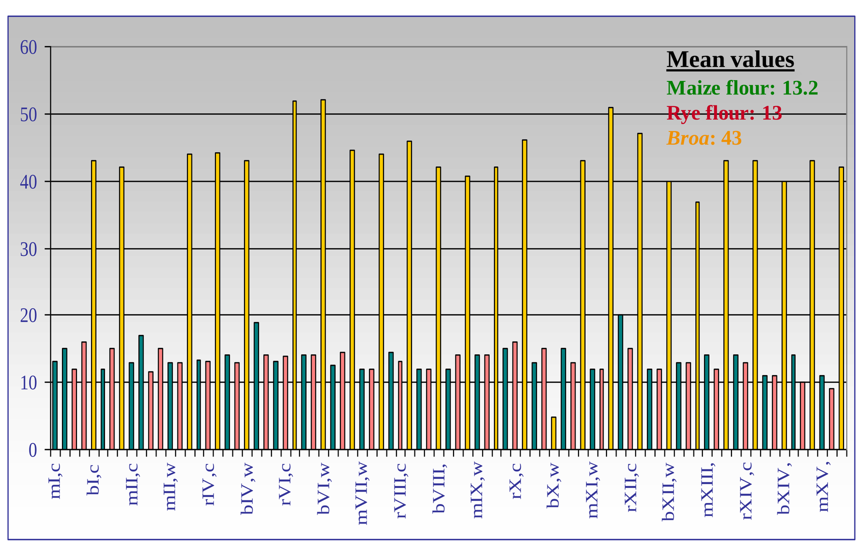


Figure 1 - Percent Moisture in samples of maize and rye flours, and of *broa*, obtained from different producers in two different periods.

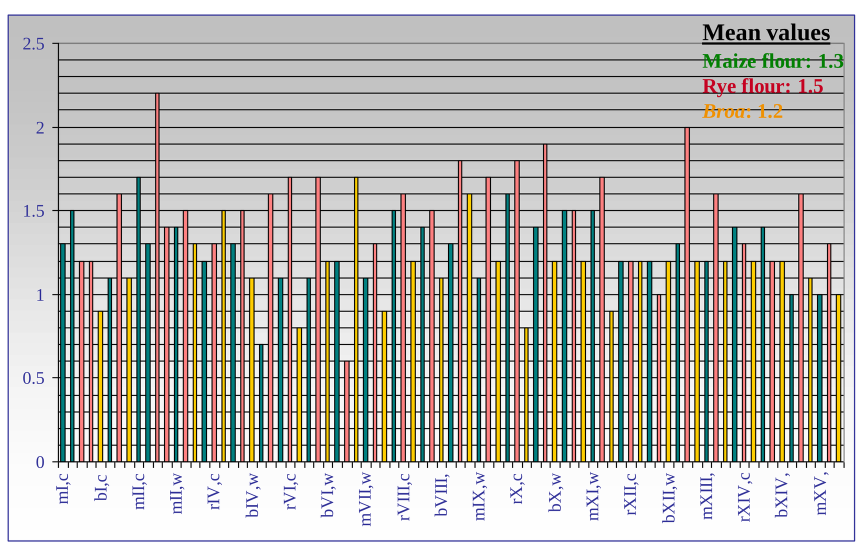


Figure 2 - Percent Ash content in samples of maize and rye flours, and of *broa*, obtained from different producers in two different periods.

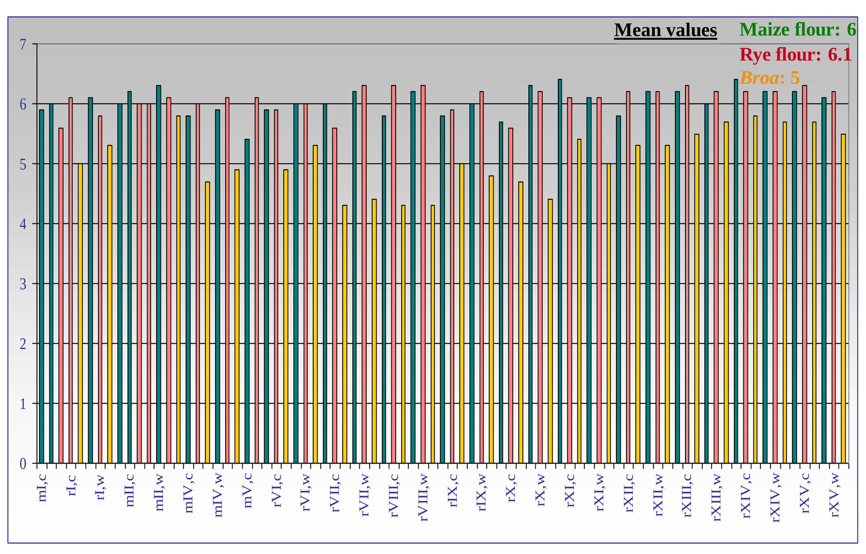


Figure 3 - pH in samples of maize and rye flours, and of *broa*, obtained from different producers in two different periods.

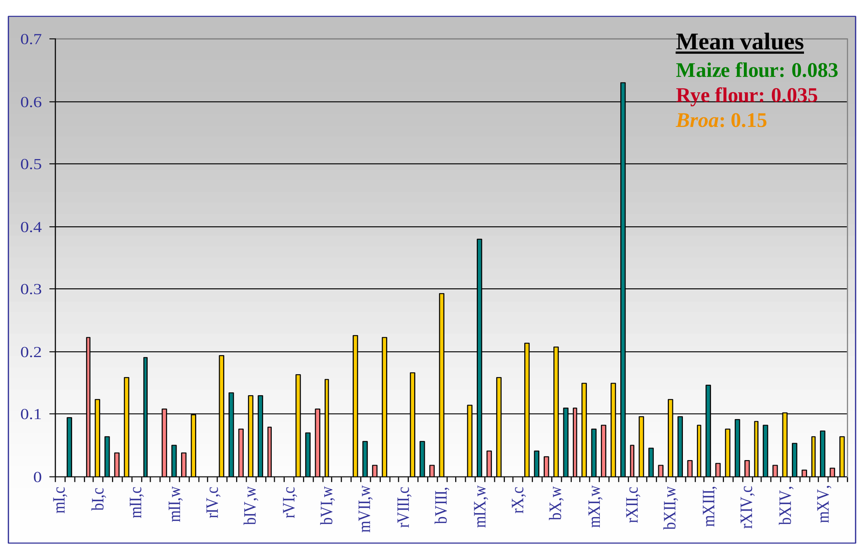


Figure 4 - Percent Total Titratable Acidity ($g_{H2SO4}/100g_{sample}$) in samples of maize and rye flours and of *broa*, obtained from different producers and in two different periods.

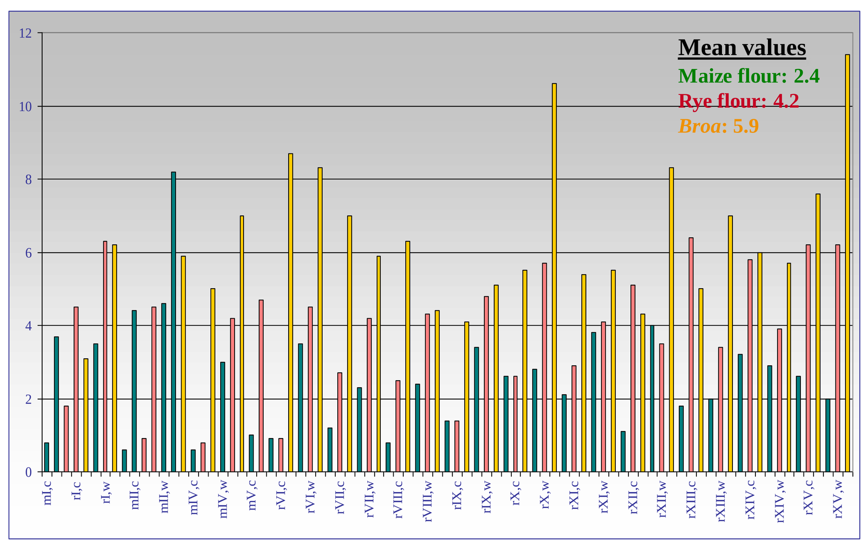


Figure 5 - Percent Total Sugar content in samples of maize and rye flours, and of *broa*, obtained from different producers in two different periods.

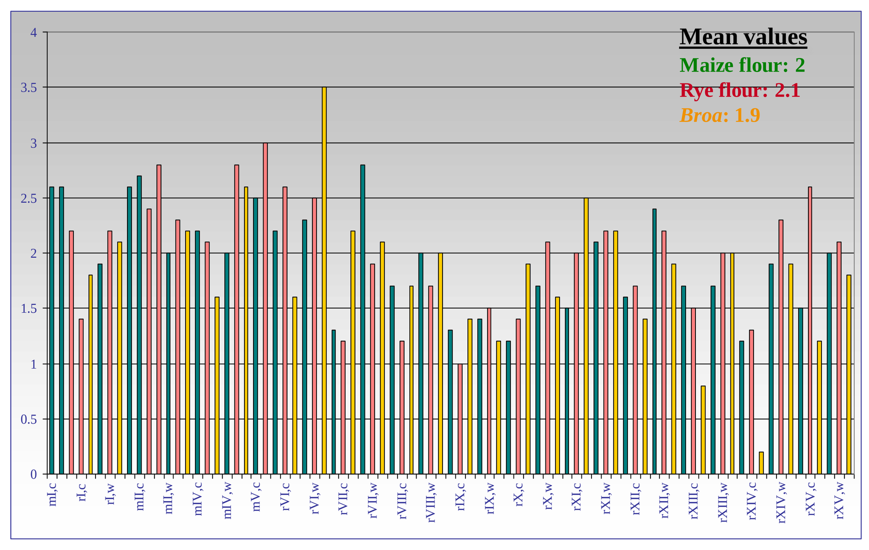


Figure 6 - Percente Total Dietary Fiber content in samples of maize and rye flours, and of *broa*, obtained from different producers in two different periods.

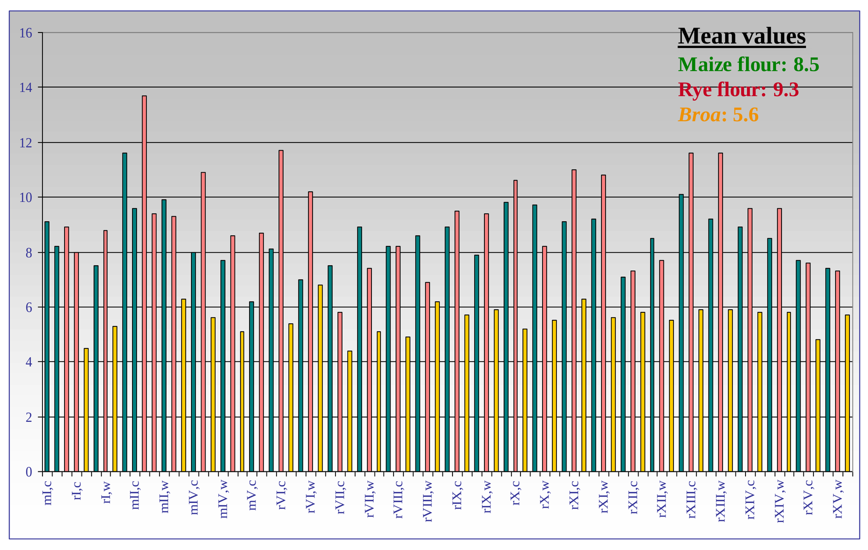


Figure 7 - Percent Total Proteins content in samples of maize and rye flours, and of *broa*, obtained from different producers and in two different periods.

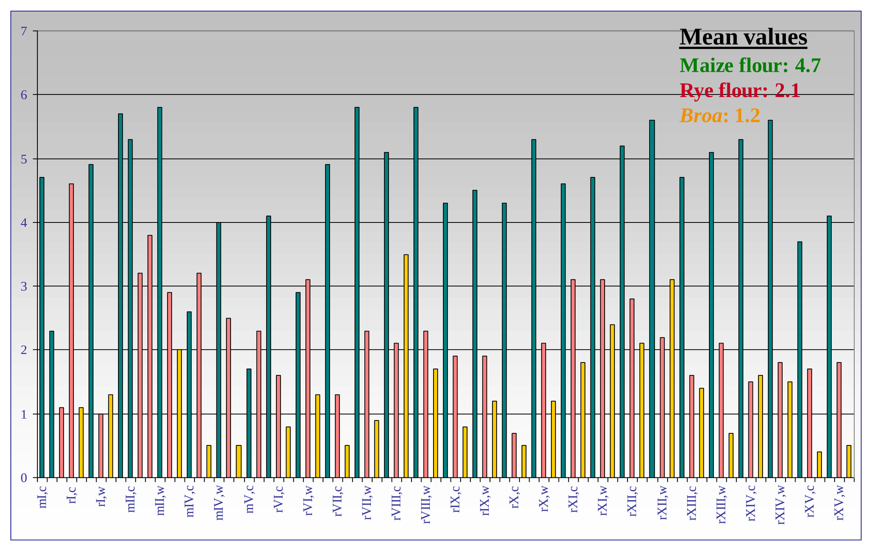


Figure 8 - Percent Total Lipid content in samples of maize and rye flours and of *broa*, obtained from different producers in two different periods.

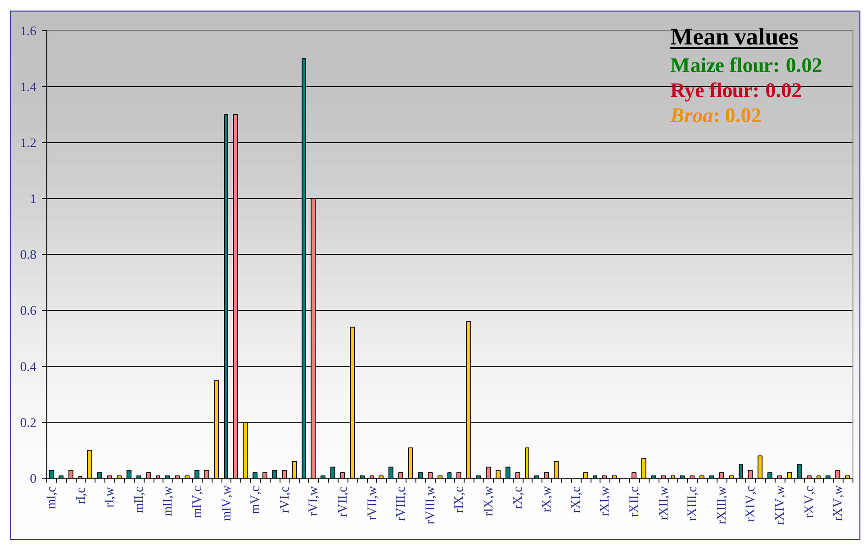


Figure 9 - Percent Chloride content in samples of maize and rye flours, and of *broa*, obtained from different producers in two different periods.

STATISTICAL TREAMENT and CONCLUSIONS

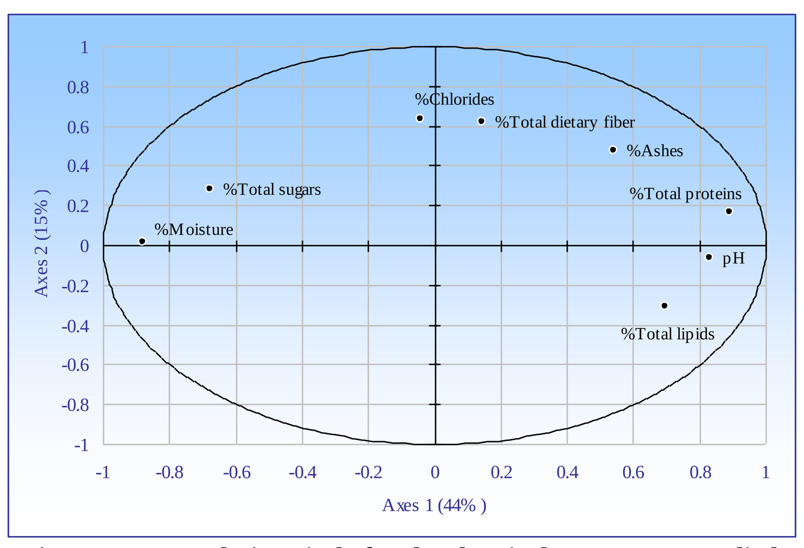


Figure 10 - Correlation circle for the chemical parameters studied, in terms of the principal components 1 and 2.

- The first Principal Component (PC1) explains 44% of the variance in the initial matrix, whereas PC2 explains 15%
- PC1 and PC2 together hence describe 59% of the total variance in the initial matrix
- The three first PC's explain 72% of the variance: it was thus possible to reduce the 8 initial variables to only 3, with marginal loss of information
- Some clusters can be defined from the correlation circle plotted on axes 1 and 2 (or loading plot), *e. g.*:

  = pH with Proteins (53% correlation), with Lipids (53%), with Moisture (-75%), or with Sugars (-40%)

  = Proteins with Ashes (65%)

  = Moisture with Sugars (53%), or with Proteins (-73%)

  = Sugars with Lipids (-54%)

- Variables from each cluster (with high positive or negative correlations) do not allow a good distinction for the objects studied (chemical parameters in samples of Maize and Rye flours and of *Broa*.
- Proteins, pH, Lipids and Ashes are the parameters with more positive contributions for PC1, and Moisture and Sugars are close with more negative ones
- Chlorides and Fibers have the most positive contribution for PC2, and Lipids the most negative one
- Variables with low mutual correlation, *e. g.* pH with Fiber (6%), Moisture with Chlorides (-0.7%), or Ashes with Lipids (9%), could be the preferential axis for differentiation amoung the objects studied

- Can be concluded that:

  = samples from the same geographical zone can not be separated by their chemical characteristics; and

  = there is a slight diversity in samples from the same producer, but obtained in different periods

- However, it is obvious that clustering exists for some samples:

  = **Maize flour** (4th quadrant) with highest Lipids values

  = **Maize flour** (1st quadrant) with highest Ashes values, and with highest Sugars values (when compared with Maize flour)

  = ***Broa*** (semi-negative PC1 axis) with highest Moisture and Sugars values, due to water addition during the breadmaking process; the enzymatic and microbial activity (that uses the flours as substrate) can explain the increase of total sugars content in *Broa*. The final product has the lowest values in Proteins and Lipids, which can be explained by the proteolytic and lipidic activities of the prevailing microflora, complemented by the thermal acceleration of said processes during baking

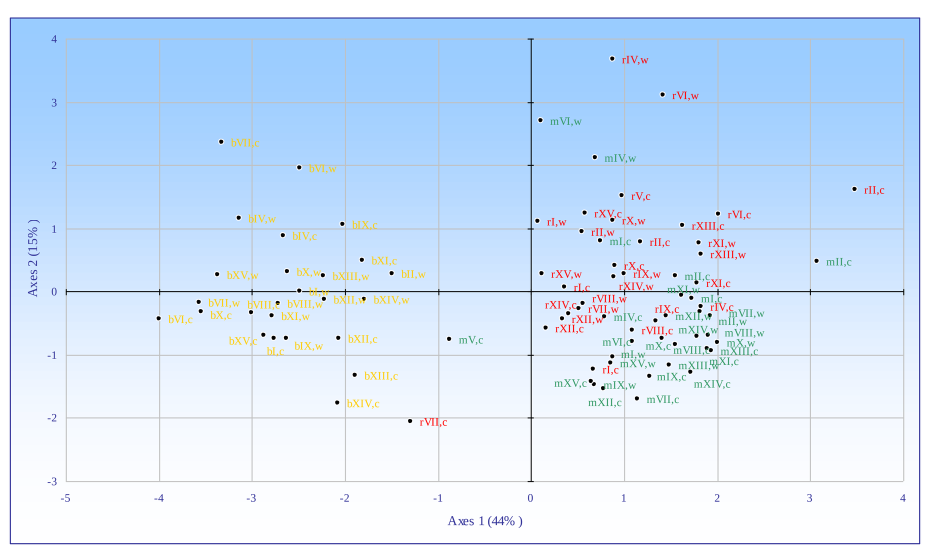


Figure 11 - Observations on principal components 1 and 2.

The results produced also indicate that:

- Rye flour has a stranges contribution for the ashes content in *Broa*. Increasing Ash content increases the acidity and the volatile compound content in dough and in bread. The amino acid content is also increased by the ash content
- pH decreases in *Broa*, as a result of the fermentation process, when compared with the flours. Acidity has the reverse behaviour, as expected
- Lipids, Ashes and Sugars are the best parameters do differenciate between Maize and Rye flours

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