Rheologic effect of selected acrylamide reducing agents from plant extracts in wheat and rye bread

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Abstract:

The objective of this work was to assess the rheologic (texture and color) effect on two types of bread formulas (wheat and rye) that the addition of acrylamide (AA) reducing agents from vegetable extracts (oregano, fennel, lemongrass, pear Rocha peel) may generate. Thirty-four batches of bread dough were prepared, with the extracts (liquid and dried). AA reductions were registered with all the extracts; oregano and fennel in wheat bread gave the best results. Toughness was only affected in wheat bread by lemongrass extracts; cohesiveness was related to the type of oven; Extracts didn't influence elasticity of breads neither caused changes in the color.

Fig 1- Some aspects of the preparation of bread (A) division of units; (B) cooking in the Convection oven; (C) collecting of samples for analysis.

Introduction:

Bread is a staple food worldwide with an annual intake recommended by the WHO of 60kg / capita (Cipriano, 2009). AA is largely formed by the reaction between an amino acid, asparagine, and a reducing sugar, glucose or fructose and therefore, common in products containing cereals. Many studies demonstrated a positive correlation between AA mitigation and the application of herbs extracts, spices and antioxidants (eg. Li et al., 2012). The reduction process based on these additives depends on their origin but is more affordable than using the asparaginase enzyme, which represents an expensive solution. More natural sources of AA mitigants should be investigated making sure they should not interfere in food properties perceived by the consumers.

Materials and Methods:

- Vegetable extracts (oregano, fennel, lemongrass, pear (Rocha peel), liquid (liq) and dried (dr).
- Thirty-four batches of bread dough were prepared, with the extracts (liquid and dried) as follows (Fig 1; Fig. 2):

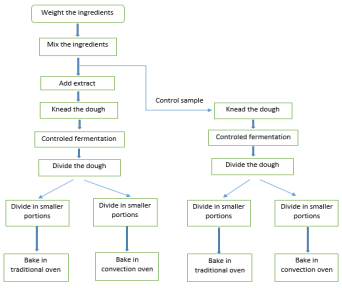

Fig. 2 Diagram for bread production. Each batch: one control sample and 5 replicates added with extracts. Formulas were mixed followed by: controlled fermentation, division of units; cooking in traditional oven (TO) and convection oven (CO), 8 of wheat and 9 of rye for each oven. All variables were defined and controlled (fermentation and cooking time, cooking temperature, homogeneity of premixes

- Extracts were obtained as described by Naczk & Shahidi, 2004 and Jesus, 2016.
- Acrylamide was determined according to Jesus et al. (2018).
- A Texture Profile Analysis (TPA) assay was performed Six parameters of bread texture profile were determined: toughness; springiness; cohesiveness; gumminess; chewiness; Objective color measurement was calculated by the determination of colorimetric coordinates in the CIE L * a * b * color space. L * C * H° were also determined. (Bourne, 2002, Szczesniak, 2002).

Results:

The following **reduction values** were obtained: oregano in rye bread 17.7% (CO), in wheat bread 31.6% (TO) and 21.7% (CO); lemongrass in rye bread 27.5% (TO) and 7.8% (CO); fennel in wheat bread 33.5% (TO) and 41.5% (O2); peel of Rocha pear in rye bread 27.3% (CO), in wheat bread 19.2% (TO) and 12.5% (CO).

Extracts didn't influence **elasticity** of breads neither cause changes in the **color** (Fig 3)

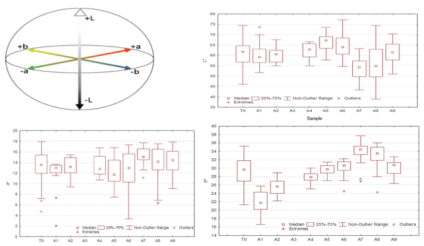

Fig 3. Colorimetric coordinates obtained for whey bread in TO, as an example; T0 and C0 – control; A1 - Lemon grass (dr); A2 - Lemon grass (lq); A3 - Oregano (dr); A4 - Oregano (lq); A5 - Fennel (dr); A6 - Fennel (lq); A7 - 70/30 Fennel; A8 - Pear bark (dr); A9 - Pear peel lq).

Regarding to **toughness**, in wheat flour, the addition of the extracts of lemongrass (dry and aqueous) and fennel (dried) made the bread softer (Fig 4).

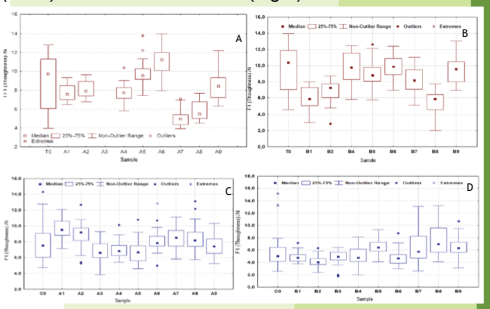

Fig 4. Toughness in bread made with (A) wheat flour in TO; (B) wheat four in CO; (C) rye flour in TO and (D) rye flour in CO. T0 and C0 - control; A/B1 - Lemon grass (dr); A/B2 - Lemon grass (lq); A/B3 - Oregano (dr); A/B4 - Oregano (lq); A/B5 - Fennel (dr); A/B/B7 - 70/30 Fennel; A/B8 - Pear bark (dr); A/B9 - Pear peel lq).

There were changes in **cohesiveness** related to the type of oven (Fig 5).

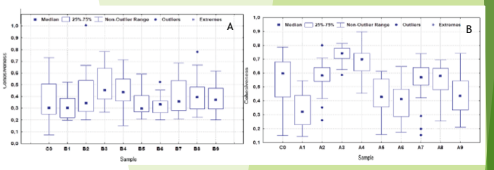

Fig 5. Cohesiveness in bread made with rye flour in (A) CO and (B) TO. T0 and C0 - control; A/B1 - Lemon grass (dr); A/B2 - Lemon grass (lq); A/B3 - Oregano (dr); A/B4- Oregano (lq); A/B5 - Fennel (dr); A/B/B7 - 70/30 Fennel; A/B8 - Pear bark (dr); A/B9 - Pear peel lq).

Conclusions:

- Crossing the acrylamide mitigation effects, and the rheological results will enable the election of the best baking process according to the varieties of bread (process ongoing).

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Project financed within MISAGE: Mitigation strategies of acrylamide and advanced glycation end-products in bread - LISBOA-01-0145-FEDER-024172

Cofinanciado por:
COMPETE 2020 PORTUGAL 2020 UNIÃO EUROPEIA Fundo Europeu de Desenvolvimento Regional