Use of high pressure homogenization for the production of natural antimicrobial based nanoemulsions to prolong the safety and shelf-life of apple juice

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INTRODUCTION

In these last two decades, essential oils (EOs) and their components have gained much attention from researcher because gifted of several properties such antimicrobial, antioxidant and anticancer activities (Patrignani et al., 2015). Despite the strong antimicrobial activity against foodborne pathogens and spoilage microorganisms shown by EOs, their practical application is currently limited due to their strong impact and changes they cause in food products. Moreover, they are subjected to a fast degradation. In this view, nanoencapsulation of bioactive compounds or EOs represents a viable and efficient approach to increasing the physical stability of the active substances, protecting them from the interactions with the food ingredients and, because of the subcellular size, increasing their bioactivity.

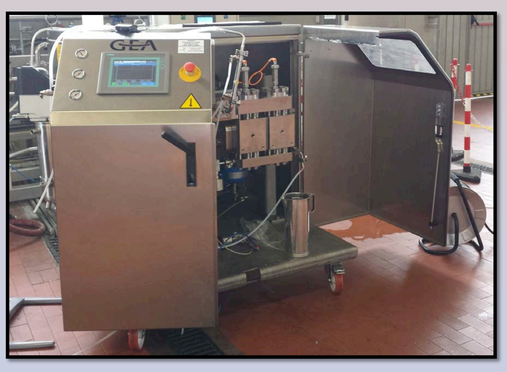
MATERIALS AND METHODS

The nanoemulsions were produced at Gea (Parma, Italy) according to the method proposed by Donsì et al (2011) by using ultra high pressure at 400 MPa. The nanoemulsions were used in apple juice at concentration of 20 and 100 ppm for E(2)-hexenal and hexanal, respectively. The juice was also inoculated with a mix of pathogenic (*L. monocytogenes, E.coli*) and spoilage microorganisms (*S. cerevisiae, Lb. plantarum*), at level of about 4 log cfu/ml, and treated by high pressure homogenization with a Panda homogenizer at lab level at 100 MPa for 1,2,3 cycles and 200 MPa for 1 cycle. As control, the juice treated only at high homogenization pressure without the presence of encapsulated natural antimicrobials was used. In addition to microbiological analyses, also the colour and quality parameters were evaluated.

AIM OF THE RESEARCH

Main aim of this research was to prolong the shelf-life of apple juice by using nanoemulsions of hexanal and E(2)-hexenal produced by high pressure homogenization at 400 MPa.

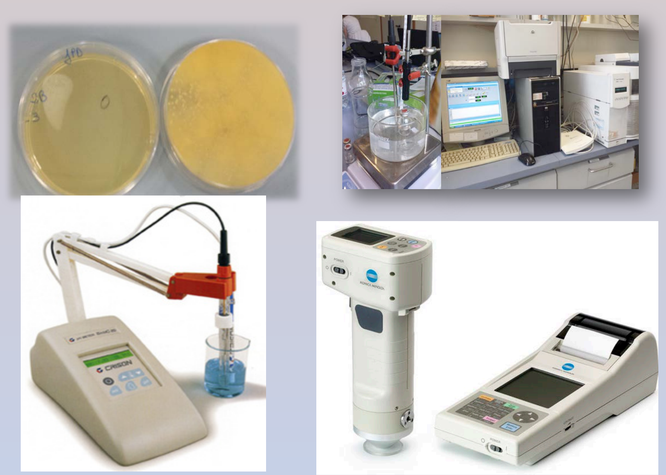
EXPERIMENTAL PLAN



Production of antimicrobial based nano emulsions by UHPH at 400 MPa

Production of apple juice added of hexanal and E(2) hexenal nano emulsions and inoculated with pathogenic and spoilage microorganisms

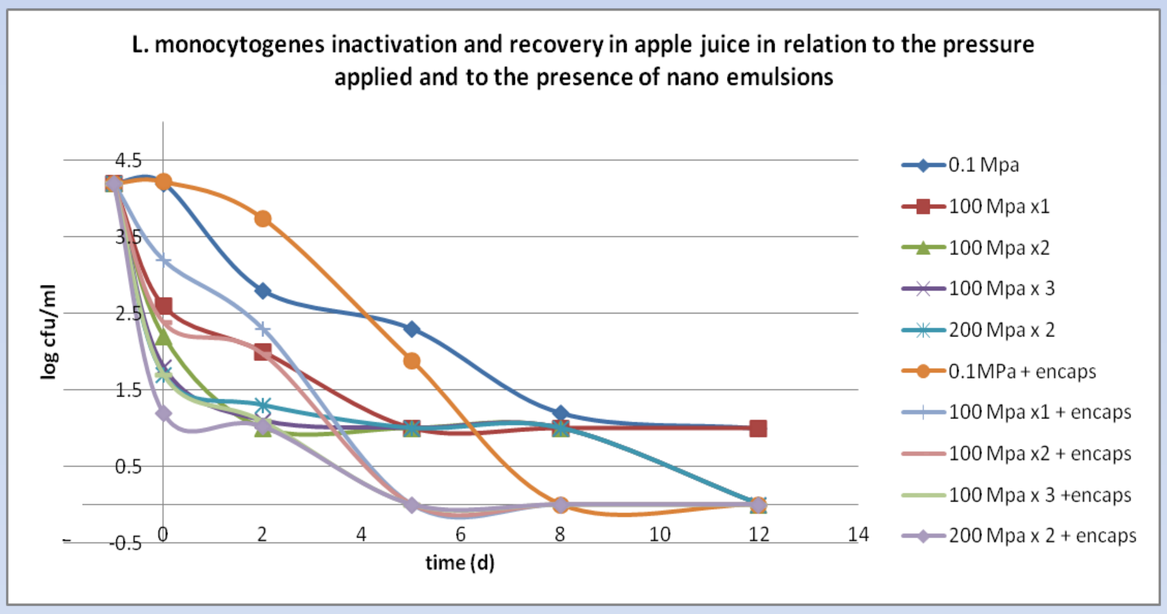
Treatment of the juice at 100 MPa for 1,2,3 cycles and 200 MPa for 2 cycles

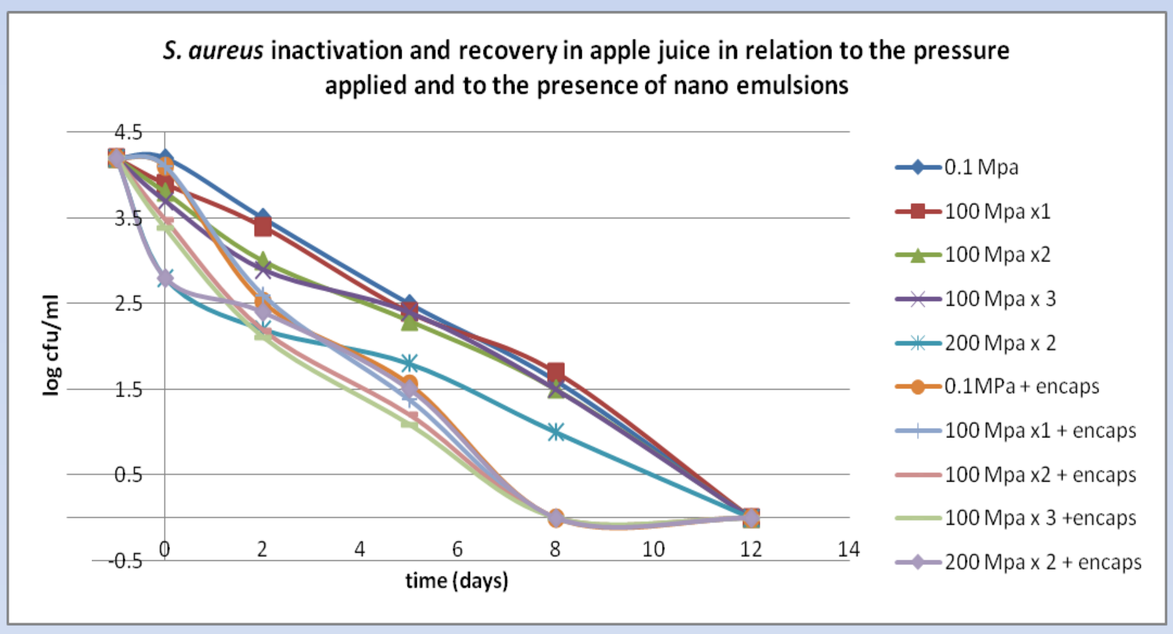


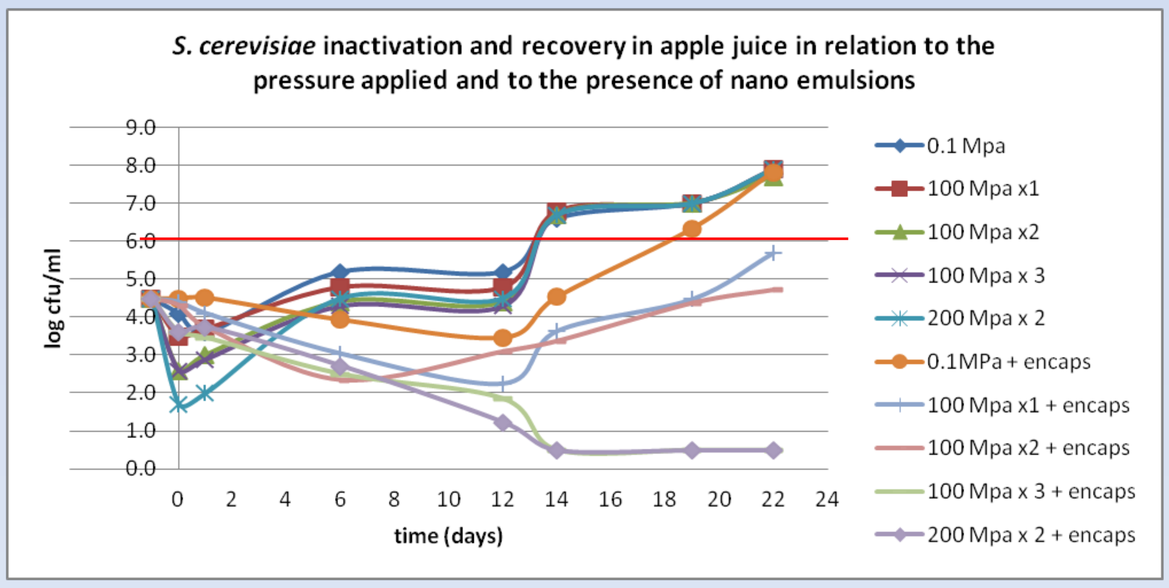
Microbiological, colour, pH and volatile propile analyses on treated juice

RESULTS

The data showed that the major reduction of pathogenic (*L. monocytogenes, S.aureus*) microorganisms were in presence of encapsulated natural antimicrobials at 100 MPa for 3 cycles and 200 MPa for 2 cycles. A very interesting result was achieved for S. cerevisiae. In fact, this spoilage species was not able to recover and reach the spoilage threshold (6 log cfu/ml) when inoculated in juice in presence of nano emulsions and treated at 100 MPa for 3 cycles or 200 MPa for 2 cycles. The analysis concerning the colour showed a major stability of juice samples containing antimicrobial nanoemulsions processed at the highest homogenization treatment.







FINAL REMARKS

The results obtained have showed the potential of natural antimicrobial based nanoemulsion and high pressure homogenization in the sector of fruit juices representing also an innovative solution to prolong the product safety and shelf-life. In addition the exploitation of this approach can result in a replacement/reduction of thermal treatment and consequently of the damages related to it.

REFERENCES

Patrignani et al (2015). Trends in Food Science 46, 311-319.
Donsì et al (2011). LWT 44, 1908-1914.