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DEVELOPMENT OF FUNCTIONAL BREADSTICK ENRICHED BY EXTRACTS FROM ARTICHOKE INDUSTRIAL WASTES AS SOURCE OF BIOACTIVE PHENOLIC COMPOUNDS

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INTRODUCTION

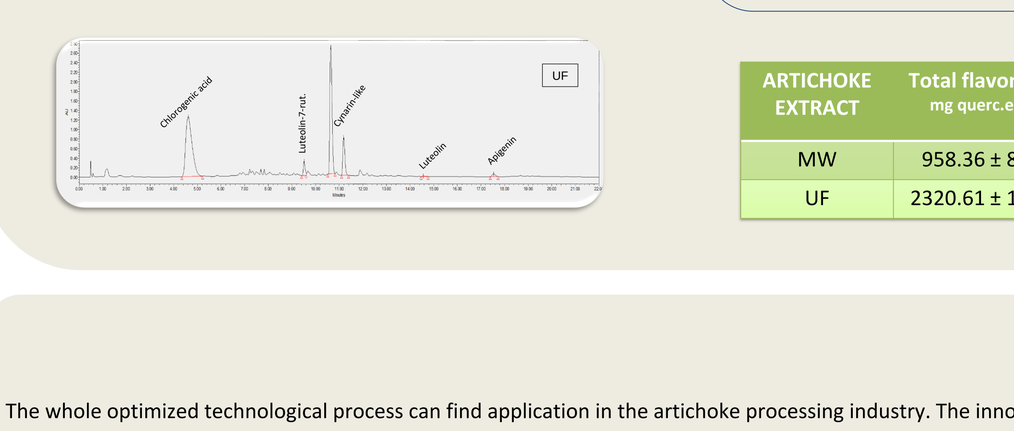
The agro-food industry produces millions of tons of fruit and vegetable waste every year, causing environmental and economic problems. In addition, there is a strong change in the cultural consumers attitude, with an increased focus on sustainability issues and a greater willingness to change their lifestyles according to this interest. Therefore, different strategies have been studied to valorise fruit and vegetable waste (FVW) by recovering the huge amount of biomass and valuable nutrients in order to obtain products with high added value [1]. The artichoke (*Cynara scolymus*), among them, besides being a particularly popular vegetable in Mediterranean gastronomic culture, possesses health-promoting properties (hepatoprotective effect and ability to reduce blood cholesterol levels) due to its high levels of bioactive molecules, antioxidants, minerals and fibres (soluble and insoluble). The huge amount of artichokes by-products (bracts, leaves and stems) of field harvesting and industrial processing constitutes about 80-85% of the total plant biomass and represents a massive loss of its valuable resources. This waste material is nowadays left directly in the field during harvesting and/or is used as animal feed. As the recovery of these valuable molecules is suitable for the production of food supplements and food additives, the valorisation of plant processing waste represents an opportunity for companies in the sector to develop new products and help increase economic and environmental sustainability. By transferring the know-how acquired within the EU-funded projects Medismart and Agro2Circular (PRIMA and Horizon 2020), extracts rich in beneficial bioactive molecules could be produced from industrial processing waste, through processing/extraction techniques that do not involve the use of organic solvents.

OBJECTIVES

The aim of this work was to develop a functional food aimed at meeting the latest consumer demands for well-being and environmental sustainability by recovering the bioactive molecules in artichokes industrial processing waste and incorporating them into a new functionally enriched product following a micro-encapsulation process. While these compounds are undoubtedly healthy, their supplementation in food can affect the sensory properties leading to unpleasant effects, namely bitter taste and astringency perception. In addition, the great reactivity and lack of chemical stability make necessary to deliver these compounds in encapsulated forms . The project consisted of 3 phases: a) MICROWAVE ASSISTED EXTRACTION; b) MICRO-INCAPSULATION; c) NEW PRODUCT DEVELOPMENT.

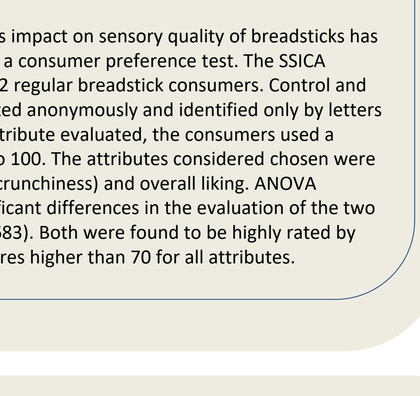
MATERIALS AND METHODS

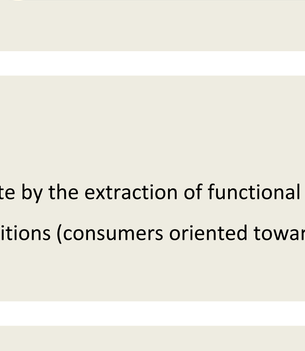
PHASE 1. The extraction step had been optimized for different vegetable species in the international MEDISMART and A2C projects, using MAE (Microwave Assisted Extraction) technology. Figure represents the extraction and purification processes.



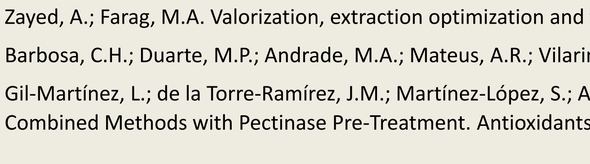
PHASE 2. In order to preserve the characteristics of the bioactive substances (mainly chlorogenic ac., cynarins, luteolin) and allow their preservation in food matrices, it is necessary to protect them from oxidation caused by, e.g., high T (cooking and/or stabilization), changes in humidity during storage, exposure to oxygen, etc. In addition, the possible presence of off-flavors (i.e. bitterness) and off-odors (burnt, cooked smell) could affect consumer acceptability. To overcome these drawbacks, the extracts have been micro-encapsulated and used in a dried form. Following indications from market surveys, breadstick with artichoke extracts were prototyped and proposed for sensory panel evaluations.

PHASE 3. Results obtained in the survey conducted in previous experiments were used for product development. Functional snacks have been prepared with an added amount of flavonoids (equal to about 200mg/100g of snacks) which represents a dietary supplement corresponding to 1/5 of daily maximum intake (recommended by Italian Ministry of Health).





RESULTS



EXTRACT CHARACTERIZATION
Among the identified and quantified phenolic compounds, 42.2% was chlorogenic acid, 44.4% cynarin-related compounds, 4.5% apigenin, 7.8% free luteolin or luteolin bound to sugar groups, and <1% other phenolic or carboxylic acids such as ferulic acid, vanillic acid and coumaric acid.

ARTICHOKE EXTRACT	Total flavonoids mg querc.eq/L
MW	958.36 ± 83.2
UF	2320.61 ± 145.4

SENSORY EVALUATION
The two snacks (functional and control) were assessed by triangle test (ISO 4120:2021) and liking test to determine whether the beads addition was perceived by consumers and the contribution to overall liking.
TRIANGLE TEST : The results obtained confirm that micro-encapsulated polyphenols added to snacks (breadsticks) do not modify sensory perception.
CONSUMER TEST : The beads impact on sensory quality of breadsticks has been evaluated by means of a consumer preference test. The SSICA sensory panel consisted of 32 regular breadstick consumers. Control and Beads samples were presented anonymously and identified only by letters A and B. For each sensory attribute evaluated, the consumers used a linear graphic scale from 0 to 100. The attributes considered chosen were appearance, taste, texture (crunchiness) and overall liking. ANOVA showed no statistically significant differences in the evaluation of the two products considered (p=0.1683). Both were found to be highly rated by the panel, with averages scores higher than 70 for all attributes.

CONCLUSIONS

The whole optimized technological process can find application in the artichoke processing industry. The innovation offers, on the one hand, an alternative solution to the disposal of the industry's waste by the extraction of functional molecules from the bracts, leaves, and stems coming from the industrial plants, on the other hand, represents an opportunity aimed at its expansive and commercial grow. The new products developed respond to changing market conditions (consumers oriented toward healthy and sustainable choices) with the aim of creating new niches commodities and leading the whole supply chain towards new consumers.

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