

# VALORISATION OF PINEAPPLE AGRO-FOOD BY-PRODUCTS TO OBTAIN BIOACTIVE COMPOUNDS AND THEIR INCORPORATION INTO POLYMERS FOR FOOD PACKAGING

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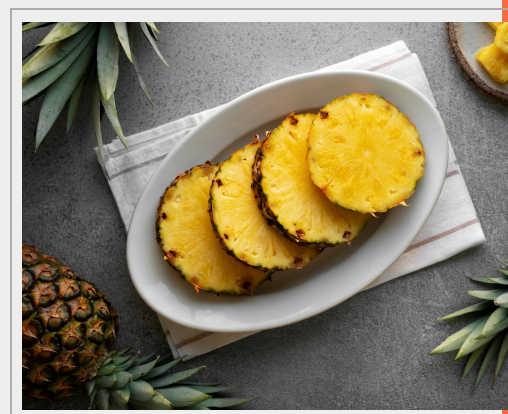
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## ABSTRACT

The research team of the VALPIPACK project, from the Department of Analytical Chemistry, Nutrition and Food Sciences, has developed an analytical methodology that makes it possible to add value to the waste and by-products derived from pineapple processing.

More specifically, the procedure developed consists of the extraction on a semi-industrial scale of different active compounds (antioxidant compounds, colouring agents, etc.) of interest, present in pineapple waste, a by-product that has not been used for these purposes to date. This procedure is characterised by being sustainable, simple and fast, as well as being easily scalable to an industrial environment. Finally, natural additives with different functionalities are obtained, which can be presented in solution or in fine powder form, for different applications, including incorporation into packaging materials for food applications.

Companies interested in acquiring this technology for its commercial exploitation are being sought.



## INTRODUCTION

Global food waste is estimated at 1.3 billion tonnes per year. Such food loss limits society's ability to sustainably feed a growing population and wastes resources on a large scale. In addition, the production of food intended for human consumption but not consumed accounts for 8% of anthropogenic greenhouse gas emissions, 20% of freshwater consumption and 30% of global agricultural land use.

Pineapple can be consumed fresh, transformed into juice or packaged in different formats such as pineapple in juice, slices, natural, etc. During pineapple processing, around 60% by weight of by-products (435,000 tonnes) such as pineapple crown, peel and core are generated, representing around 360,000,000 € of economic losses. Traditionally, to avoid a negative impact of waste on the environment, these pineapple by-products are used for animal feed, disposed of as waste in landfills or burned for energy production. However, these by-products are a potential source of valuable substances with high added value, including phenolic compounds with high antioxidant capacity. However, most of the scientific developments related to their revalorisation have focused only on the reuse of proteolytic enzymes such as bromelain, the extraction of pectin from peel or the use of juice to produce vinegar.

On the other hand, different factors influence the quality and shelf life of foods such as temperature, the presence of oxygen, endogenous enzymes, humidity and exposure to light. In this sense, the main causes of quality loss are oxidative degradation of

the fat fraction and the growth of microorganisms that limit the sensory shelf life of the product. For these reasons, the shelf life of certain foods such as fresh meat is very limited, ranging from 4 to 10 days depending on the specific type of meat and storage conditions. In order to solve this problem, an increase in the shelf life of these foods would help to reduce losses due to product deterioration during storage and marketing, to better rationalise production and stock control, and at the same time to extend the distribution area, increase sales, provide greater added value to the product and differentiate it in the market compared to the product of the competition. In line with this, the traditional methodology to maximise the preservation of perishable foods is the combination of different technologies such as low temperatures and modified atmosphere packaging (MAP). This implies the use of packaging materials with complex structures, which makes their recyclability difficult. In addition, MAP packaging has related limitations, one of the most relevant being that its preservative effect is lost once the package is opened.

This fact, together with the reluctance of consumers to add preservatives or other types of additives directly to fresh food, has led to a special interest in the development of active packaging, i.e. packaging with a specific technical functionality (antioxidant, antimicrobial, moisture absorption, CO<sub>2</sub> emitters, ethylene absorbers, etc.) that is capable of interacting positively with the food it contains.

## TECHNICAL DESCRIPTION

Taking into account the limitations described above, the present invention describes an economical, simple, rapid and sustainable analytical methodology to obtain bioactive compounds from pineapple by-products, an agricultural waste not used for such purposes to date.

The procedure for the synthesis of active compounds from pineapple by-products comprises the following **steps**:

1. characterisation and initial preparation of the pineapple by-product.
2. Extraction on a semi-industrial scale using rapid and sustainable technologies of the active compounds of interest present in the pineapple by-product.
3. Purification of the active compounds obtained.
4. Characterisation of the active compounds obtained, including stability studies to define the most appropriate conservation method.

Through this procedure, active compounds with well-known properties are obtained.

## TECHNOLOGY ADVANTAGES AND INNOVATIVE ASPECTS

### TECHNOLOGY ADVANTAGES

- It is an economical, sustainable, fast and simple methodology.
- It allows natural compounds with known functional properties to be obtained.
- It allows the transformation of waste from the pineapple processing industry into products with high added value for different industrial applications.
- The extraction process can be applied to mixtures of different agri-food by-products.
- It is easily scalable to an industrial environment.
- In food packaging applications, the active component (extract from pineapple waste) can be incorporated into the same packaging structure so that separate devices are not necessary.
- In food packaging applications, the concentration of active substance to be incorporated into the packaging material can be adjusted and optimised and its release into the food can be controlled to avoid toxicity problems.
- In food packaging applications, the protection provided through the packaging will be maintained even after the first opening of the packaging.

### TECHNOLOGY INNOVATIVE ASPECTS

- Use of by-products from the pineapple processing industry to obtain natural compounds of interest for different industrial applications.
- Extending the shelf life of perishable foods by incorporating active compounds from pineapple by-products into food packaging materials.
- Simplification of multilayer structures in food packaging by incorporating functional additives from pineapple by-products.
- Adjustment of processing parameters and techniques, as well as a correct selection of the materials in which the active extract is incorporated to avoid losses in the incorporation processes and thus optimise the functionality of the final packaging material.
- Development of an active packaging designed to meet the specific requirements of the selected foodstuffs.

## CURRENT STATE OF DEVELOPMENT

In order to bring the technology closer to the market and, based on the laboratory prototype obtained previously, the technology is currently in the process of industrial scaling up through the VALPIPAC project (Valorisation of pineapple (*Ananas comosus* (L.) Merrill) to obtain antioxidant compounds and their subsequent incorporation into polymers for active packaging applications for food) funded by the Valencian Innovation Agency (AVI) through the Valuation and transfer of R&D&I results programme in 2022.

## MARKET APPLICATIONS

The active compounds of interest obtained by means of the methodology described are suitable for certain industrial applications, such as the **food packaging** sector, among others, as they have certain properties that can help to extend the shelf life of perishable packaged foodstuffs.

## COLLABORATION SOUGHT

Companies interested in acquiring this technology for **commercial exploitation** are sought:

- Patent licensing agreements.
- Search for funding opportunities to develop new applications, adapt it to the company's specific needs, etc.
- Technology and knowledge transfer agreements.

## INTELLECTUAL PROPERTY RIGHTS

This technology is protected by **patent application**:

- *Patent title: "Extracto, material de envasado que contiene dicho extracto, su procedimiento de fabricación y uso del mismo".*
- *Application number: P202430298*
- *Application date: 16 April 2024*

## MARKET APPLICATION (4)

Agri-food and Fisheries  
Pollution and Environmental Impact  
Materials and Nanotechnology  
Chemical Technology

