

REVOLUTION IN FRYING: NEW TECHNOLOGY TO SIGNIFICANTLY REDUCE ACRYLAMIDE FORMATION

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ABSTRACT

The **Agricultural Chemistry Research Group** at the **University of Alicante** has developed additives that, when incorporated into frying oil used for cooking carbohydrate-rich foods, enable a significant reduction in the formation of acrylamide.

This technology represents an innovative and sustainable solution for the food industry, offering multiple benefits for both producers and consumers, ensuring a safer, healthier, and higher-quality product without compromising flavour or texture. Furthermore, its ease of implementation and versatility make it a valuable tool to comply with current regulations and adapt to market demands.

The technology, protected by a patent application, has been developed at a laboratory scale. Companies interested in its commercial exploitation are being sought.



INTRODUCTION

Acrylamide is a chemical compound potentially harmful to human health and has been identified as probably carcinogenic by the International Agency for Research on Cancer (IARC) since 1994. This compound is naturally formed in carbohydrate-rich foods when subjected to temperatures above 120°C, such as during frying or baking. This process is linked to the Maillard reaction, which is responsible for the characteristic flavour and colour of golden or toasted foods but also results in the formation of acrylamide and other harmful by-products.

Acrylamide is present in a wide range of foods, including potato products, biscuits, bread, coffee, and cereals, leading to the adoption of specific regulations in various regions, such as the European Union and the United States, to limit its presence. These regulations are mandatory for food companies, driving the development of strategies to reduce its concentration, especially in potato-based products.

Proposed solutions include selecting potato varieties, adjusting slice thickness, controlling storage conditions, and modifying cooking methods. Pre-treatments such as washing, blanching, fermentation with antioxidants and plant extracts, or advanced technologies like ionizing radiation and ultrasonic waves have also been implemented. Although these strategies have reduced acrylamide levels, they have significant limitations, such as variability in potato composition, high implementation costs, and negative impacts on the product's flavour and texture.

In this context, compounds formed by monosaccharide molecules linked in a ring structure offer an innovative and promising solution. These natural molecules, derived from sugars, form complexes with other compounds to improve their stability and solubility. Since the 1970s, they have been used in the food industry to protect sensitive compounds, eliminate unwanted odours and flavours, and enhance the sensory properties of foods. Additionally, they help stabilize vitamins and essential oils against physical or chemical changes and enrich foods with antioxidants and other nutrients.

Recognized as safe by the FDA since 1998 and regulated in Europe as food additives, these encapsulating agents have been

successfully applied in various areas of the food industry. However, their use in reducing acrylamide has been limited due to challenges such as cost, industrial scaling difficulties, and the degradation of certain heat-sensitive compounds during processing.

The invention presented here addresses these challenges by encapsulating essential oils to achieve an effective reduction of acrylamide in fried potatoes, even below regulatory limits. This approach combines innovation and industrial feasibility, offering an efficient alternative.

TECHNICAL DESCRIPTION

To address the aforementioned issues, the **Agricultural Chemistry** Research Group at the **University of Alicante** has developed a synthesis process for enriched or additive-enhanced vegetable oils that, when used in frying carbohydrate-rich foods, **reduce the acrylamide concentration** in the **fried food** by at least **77%** compared to acrylamide produced during frying with non-enriched vegetable oils.

The vegetable oil in question is a commercial oil that is homogeneously enriched or additive-enhanced with encapsulated essential oil.

The main advantages of the synthesis method are its **low economic cost**, **scalability**, and ease of **use in the industry**. Furthermore, it preserves the physicochemical properties of the encapsulated additive since **no heat is applied during its production**.

Thus, by not applying heat, the characteristics of heat-sensitive compounds are preserved, maintaining the biological activity of the essential oil due to minimal heat exposure. This is a **versatile process in terms of formulation and suitable for a wide range of molecules**.

ADVANTAGES AND INNOVATIVE ASPECTS

ADVANTAGES OF THE TECHNOLOGY

The described technology offers numerous advantages, making it a practical and effective solution for reducing acrylamide in fried potatoes:

- **Regulatory compliance and food safety:** The technology enables the reduction of acrylamide concentrations below the limits established by the latest regulatory standards and recommendations from regulatory bodies.
- **Universal versatility:** It is compatible with any type of potato, regardless of its origin, variety, or cut shape.
- **Independence from the type of oil:** Its effectiveness is not affected by the chemical properties of the frying oil used.
- **Energy efficiency:** It does not require adjustments to cooking temperature or time, avoiding increases in energy consumption and maintaining the original characteristics of the potatoes.
- **Minimization of losses:** As it is unnecessary to lower the cooking temperature, production losses during the process are avoided.
- **Same flavour and texture:** It preserves the organoleptic characteristics of the product, preventing potential consumer rejection.
- **Controlled costs:** The reagents used are economical, contributing to minimal impact on production costs.
- **Ease of industrial implementation:** The technology can be easily integrated into industrial processes without incurring high costs or facing scaling difficulties.
- **Increased competitiveness:** It offers a differentiated, high-quality product that meets the demands of a market increasingly focused on safety and health.
- **Wide range of applications:** It is applicable to a variety of fried products beyond potatoes, expanding business opportunities.

INNOVATIVE ASPECTS OF THE TECHNOLOGY

The primary innovative aspect of the technology is the development of new vegetable oils enriched with encapsulated essential oils for use in frying processes, representing a novel approach in the food industry. Although these molecules are already known for their ability to stabilize compounds, their specific application in encapsulating essential oils to reduce acrylamide represents a unique solution.

CURRENT STATE OF DEVELOPMENT

The technology has been developed at a **laboratory scale**.

MARKET APPLICATIONS

The described enriched or additive-enhanced vegetable oil enables the reduction of acrylamide concentration during the frying of carbohydrate-rich foods, such as frying potatoes in slices or sticks, in a pan or fryer, applicable to both restaurants and industrial plants.

Thus, this technology could also be used for:

- The production of other carbohydrate-rich fried snacks;
- Restaurants and fast-food services;
- Processing of pre-fried frozen foods; etc.

COLLABORATION SOUGHT

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

- Patent licensing agreements.
- R&D collaboration agreements to develop the technology according to company needs.
- Scientific-technical advisory services.

Types of companies sought:

- Industrial manufacturers of snacks and fried foods.
- Suppliers of oils for the food industry.
- Producers of frozen or pre-cooked foods.

INTELLECTUAL PROPERTY RIGHTS

This technology is protected by two **patent applications**:

- *Patent application title 1: "Procedimiento de obtención de un aceite vegetal enriquecido de fritura de alimentos ricos en carbohidratos".*
- *Application number 1: P202431090*
- *Application date 1: December 23, 2024*
- *Patent application title 2: "Procedimiento de obtención de un aceite vegetal aditivado de fritura de alimentos ricos en carbohidratos".*
- *Application number 2: P202431091*
- *Application date: December 23, 2024*

MARKET APPLICATION (2)

Agri-food and Fisheries
Chemical Technology