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Innovative approaches for the development and performance evaluation of new frying mixtures through physical, chemical, and sensory analyses

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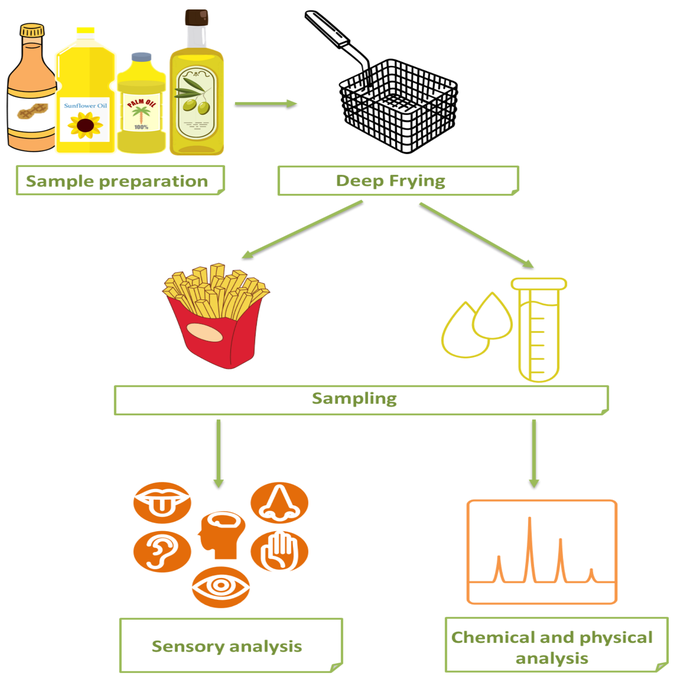
State-of-the-Art

In recent years, increased consumer demand for healthier and higher-quality foods has drawn significant attention to the selection of optimal cooking methods, as these can substantially influence the nutritional and sensory properties of the final product. One popular, convenient and quick method for food preparation is the deep-frying technique. Despite the negative attitude towards fried foods due to their calories and fat content, deep-frying is a method that provides foods with good texture, taste, colour and palatability (Nikzad *et al*., 2021). Deep-frying involves immersing food in edible oil or fat heated to temperatures between 170°C and 180°C. Although deep-frying is one of the most convenient and simple cooking methods, understanding the chemical and physical changes that occur is more challenging. Oxidation and hydrolysis are the most common degradations that occur in oils during frying, while starch gelatinization, protein denaturation and Maillard reaction take place in the fried products. Moreover, if frying conditions are not properly monitored, they can lead to the production of potentially harmful substances deriving from the Maillard reaction (such as acrylamide and heterocyclic amines) and from oxidation (such as acrolein and phytosterol oxides). In particular, lipid oxidation is accelerated by the presence of unsaturated fatty acids, which can lead to the formation of volatile compounds due to the fragmentation of the fatty acid radicals, thus contributing to rancidity development. On the other hand, the use of highly saturated frying oils can have an impact on human health, as they can increase the risk of cardiovascular diseases (Anushree *et al*., 2017). Consequently, the best choice would be to use monounsaturated oils for frying, from technological and health standpoints. For these reasons, the agronomical selection of oilseed crops rich in monounsaturated fatty acids has enabled the improvement of the nutritional value of the oil, thus providing important functional properties required by the food industry. In addition, recent studies are focusing on the potential use of plant extracts as natural antioxidants to improve the oxidative stability of frying oils, aiming to reduce the production of harmful substances and preserve the colour and flavour of fried foods. However, the type and dosage of plant extracts used, processing times and temperatures, oil composition, and the type of food subjected to frying significantly influence the antioxidant activity of these extracts (Li *et al.,* 2023). Thus, analytical and instrumental techniques are crucial for monitoring and optimizing the frying process. These techniques can help identifying the most effective natural extracts and determining the oils and fats with the best performance, in order to ensure compliance with legislative and technological requirements of the food industry. To achieve a thorough characterization of frying oils and fats, it is crucial to combine chemical and physical analyses with sensory evaluation of both the oils and the fried foods. Sensory analysis is essential for evaluating the profile of frying oils, as their quality directly impacts the fried product. If the taste and flavour of the oil are unacceptable, the fried products will not be considered suitable by consumers. Therefore, it is necessary to conduct consumer tests to determine the taste characteristics, preferences, and acceptability of fried foods. However, despite the importance of sensory analysis, there are still few studies that support the sensory information provided on labels for frying oils/blends and fried products.

PhD Thesis Objectives and Milestones

This PhD thesis research project aims to assess the frying performance of seed oils and oil blends through an integrated approach based on the correlation of data from chemical, physical, and sensory analyses. In addition, this research project seeks to achieve a complete characterization of pre-selected oils and foods, focusing on the rancid defect in oil blends and fried foods and the positive attribute of "crispiness" in fried foods.



Gantt diagram for this PhD thesis project

Activity	Months	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
A1)	***Bibliographic research***																								
A2)	***Setting up of the experimental design***																								
	1) Selection of the oils, oil blends, and products for frying																								
	2) Definition of frying conditions																								
A3)	***Sampling of oils and food during frying***																								
A4)	***Chemical and physical analysis of frying blends and fried foods***																								
A5)	***Sensory analysis of frying blends and fried foods***																								
	1) Descriptive tests																								
	2) Consumer Test																								
A6)	***Data processing and correlation***																								
A7)	***Thesis and paper preparation***																								

Selected References

1. Anushree S, André M, Guillaume D, Frédéric F (2017) Stearic sunflower oil as a sustainable and healthy alternative to palm oil. A review. Agron Sustain Dev 37: 1-10.
2. Li C, Chen L, McClements DJ, Liu W, Long J, Qiu C, Wang Y, Yang Z, Xu Z, Meng M, Jin Z (2023) Utilization of plant extracts to control the safety and quality of fried foods—A review. Compr Rev Food Sci Food Saf 22(3): 2310-2345.
3. Nikzad N, Ghavami M, Seyedain-Ardabili M, Akbari-Adergani B, Azizinezhad R (2021) Effect of deep frying process using sesame oil, canola and frying oil on the level of bioactive compounds in onion and potato and assessment of their antioxidant activity. Food Sci Technol 41: 545-555.