

Vacuum Frying: Novel Technology for Preservation of Fruits and Vegetables

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Introduction

Frying is a complex unit operation in which food is immersed in an oil bath at a temperature above the boiling point of water. This results in counter flow of water vapour (bubbles) and oil at the surface of the product. It can be considered as a method of preservation by dehydration of food. Frying is thought to have first appeared in the kitchens of Asian countries around 2500 BC. The earliest evidence of frying technique in the western world was traced from a 17th century painting depicting an elderly lady frying an egg, which demonstrates the birth of frying. Since then, it has been regularly used in the western food industry.

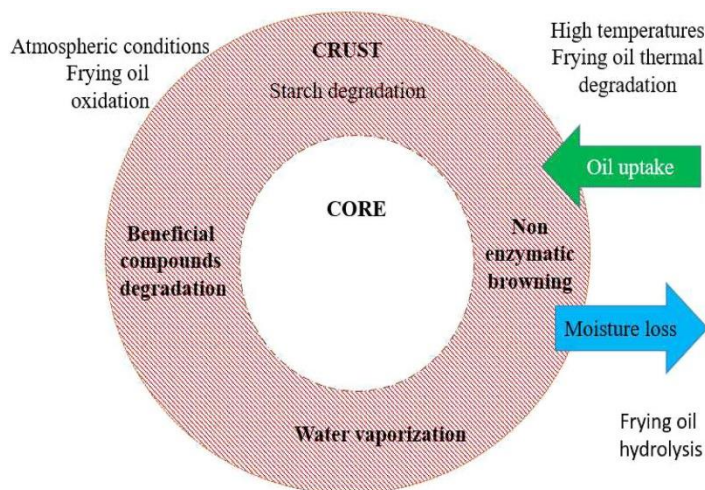


Fig. 1: Quality changes in fried food during frying process

Types of frying

In general, there are 3 types of frying methods as follow:

Deep fat frying

The process of cooking food materials partially or fully immersing in oil at some point or total duration of cooking at atmospheric pressure (760 mm Hg) is termed as deep fat frying. Final product is generally golden – brown in color having oil content varying from 8% to 25%. Frying temperature normally ranges from 160 to 190 C.

Problems associated with deep fat frying in atmospheric condition:

- ✓ High oil absorption
- ✓ Oxidation of oil and pigments
- ✓ Burning of food
- ✓ Browning of product
- ✓ Production of toxic compound

Air frying

Air frying technology does not produce toxic compounds and also retains the sensory characteristics of the final product similar to deep fat frying.

A major limitation of this technique is the compromised physical properties such as texture, colour, flavour, moisture content in the final food.

Vacuum frying

Vacuum frying is a frying process below atmospheric pressure (-100 kpa). At reduced pressure, the boiling point of oil and water is lower compared to atmospheric pressure. Due to lower frying temperature, vacuum frying better preserves the nutritional value, aroma, and color of fried product compared to atmospheric frying. Most of the benefits of this technology are the result of the low temperatures employed and minimal exposure to oxygen.

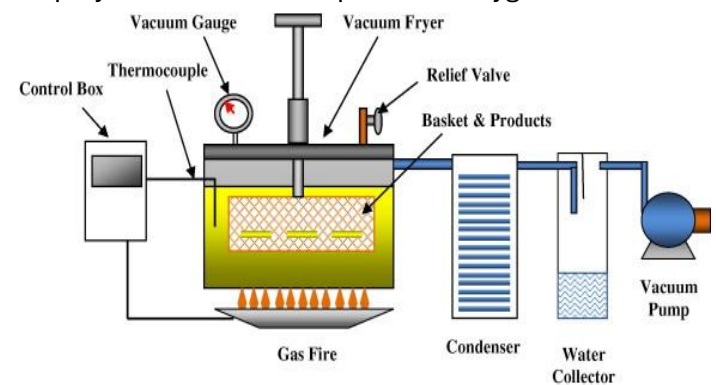


Fig. 2: Vacuum Fryer set up

Advantages of vacuum frying

- Oil uptake in vacuum fried apple chips is lower compared frying at atmospheric pressure.
- Carotenoid retention was higher in vacuum fried mango compared to atmospheric frying.
- Preservation of natural colour and flavours

- Color of vacuum fried mango was lighter compared to atmospheric frying.
- Decreased acrylamide content
- Preservation of nutritional compounds
- Reduce fat content in product

Table 1. Comparison between Vacuum frying and Atmospheric frying

Vacuum Frying	Atmospheric Frying
Frying happens at low temperature i.e. 80- 120 °C, so there is no burning of any ingredients	Frying happens at high temperature of about 130-190 °C, at this temperature burning of ingredients happens
Maximum retention of nutrients and vitamins	Nutrients and vitamins get destroyed by more than 50 %
The absorption of oil is reduced by 50 % in vacuum as compared to atmospheric frying	Absorbs higher amount of oil (generally 25 % to 45 % on weight basis).
There is authenticity of the taste.	There is no originality in taste.
No oxygen so no oxidation of oils and pigments	Oxygen in atmosphere is responsible for oxidation

Disadvantages of vacuum frying

- Comparative high investment and operating cost
- Requires skilled operating person
- Takes little longer time

Conclusion

Frying is a versatile and ancient cooking technique that has evolved significantly over time. While deep fat frying remains popular for its flavor and texture, it poses challenges such as high oil absorption and the formation of unhealthy compounds. Alternatives like air frying offer healthier options but may compromise on certain sensory attributes. Vacuum frying, on the other hand, presents a promising solution by preserving nutritional value, reducing oil uptake, and maintaining natural flavours and colours due to its lower temperature and pressure conditions. However, the higher costs and need for skilled operation are notable drawbacks. As technology advances, optimizing frying methods to balance health benefits, cost-effectiveness, and product quality continues to be a critical area of research and development in the food industry.
