

Vacuum frying

Identification

Key words	vacuum, frying, fat reduction, acrylamide reduction, deep fat frying
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How does it work?

Primary objective	This is a technology where food products are deep fried under vacuum or near vacuum conditions to reduce the fat content compared to normal deep-frying.
Working principle	<p>Vacuum frying is a method when a food product is deep-fried under vacuum (no pressure) or near vacuum conditions. The general method is as follows. The foodstuff is enclosed into a specialised pressure vessel containing a deep fryer. The vessel is connected to a vacuum pump. After this the vessel depressurizes. The foodstuff is immersed into frying oil within the vessel, fried for the required time, and then lifted up from the oil. Finally the vessel is re-pressurized again (1,3). The re-pressurization should be done quickly (5). A centrifugation step can also be inserted for removal of excess frying oil after the frying step before the pressurization (1).</p> <p>This technique has shown to reduce the amount of fat in the fried product (1,3). This might be because of the lower temperature that is needed to boil water and oil under vacuum conditions. The removal of excess fat has shown to be important. A report shows that the optimal time for removal is just after the frying but before the re-pressurization step (centrifuged within the pressure vessel) (1). Also the fast re-pressurization has been shown to be a key factor in reducing the fat content (5). Although the fat content is reduced, the quality is still maintained and even superior to normal deep-frying in some cases. It should be stated that some reports show an increase in fat content, although these are fewer than those who show the opposite effect.</p>
Images	
Additional effects	<p>Apart from the fat reducing ability, the lowered temperature in vacuum frying may also reduce the formation of acrylamide: Acrylamide is a possible carcinogenic compound that is produced when protein and reducing sugars are heated above 150°C (7).</p> <p>Preservation of natural colour and favours (2,3).</p> <p>The colour of the finished product is lighter than if the product is fried at atmospheric pressure (6).</p> <p>As the vessel in which the product is vacuum fried needs time for pressurising and depressurising, the process will take longer time.</p> <p>The pressurisation step is also energy consuming and an increase in energy consumption is therefore expected.</p>
Important process parameters	<p>Time, temperature, pressure, type of frying oil, time of breakage of vacuum (faster is better), de-oiling before pressurisation.</p> <p>Oil absorption rate is related to the moisture loss rate during the vacuum frying process. The oil absorption rate can be increased by higher oil temperatures and lower vacuum pressures (6).</p>

Important product parameters

What can it be used for?

Products	Potato chips, apple slices, vegetable based snacks. Also, this technology is probably suited for products that are already suitable for normal (at atmospheric pressure) deep-frying; however this needs to be evaluated.
Operations	Deep-frying at vacuum pressure.
Solutions for short comings	Deep-fried food is a large part of the food industry. The big problem with it is the high fat content that deep fried products have. A technology that reduces the fat content without compromising the edible quality (and according to reports increases the quality) has therefore a large industrial potential today. The only obstacle is the economy, both for the industry (purchase and increased operating costs) and for the consumer (increased price due to the increased industrial costs).

What can it NOT be used for?

Products	This technology is not suited for food products that are already not suited for normal (at atmospheric pressure) deep-frying.
Operations	This technology can only be used for deep-frying in vacuum.
Other limitations	Only usable for vacuum-frying.
Risks or hazards	There are always risks when handling vessels with an internal pressure other than the atmospheric pressure (the bigger difference in pressure the bigger risk).

Implementation

Maturity	This technology exists today in lab scale, but reduced pressure frying (closely related to vacuum frying) is used today at industrial scale in southeast Asia.
Modularity /Implementation	There may be problems inserting this technology into existing production lines since existing frying equipment either has to be replaced or inserted into pressurised vessels.
Consumer aspects	Generally positive as fat is reduced and the quality unchanged. Some negative effects are expected because of the increased energy consumption of this technology.
Legal aspects	Not known.
Environmental aspects	A probable increase in energy consumption is expected with this novel technology compared to existing frying methods.

Facilities that might be interesting for you

Title	Institute/company
Auditorium IRTA	IRTA
Clean room - Histocell	Noray
Video observation system for market research and product development tasks - Keki	NAIK EKI

Further Information

Institutes University of Zaragoza, Texas A&M University

Companies BMA Group

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