HOW OIL TEMPERATURE CHANGES AFFECT CRISPINESS AND OIL ABSORPTION IN FRIED POTATOES

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Abstract: *Frying potatoes is a common cooking method, but many cooks do not realize how strongly oil temperature affects the final result. When frying oil stays at a stable high temperature, potatoes become crispy and absorb less oil. When the oil temperature goes up and down, especially when it drops during frying, the potatoes become soft and greasy. This study examined how three oil temperature conditions—stable 180 °C, moderate fluctuation (160–180 °C), and large fluctuation (140–180 °C)—affected crispiness and oil absorption. Crispiness was tested by measuring how easily the fried potatoes cracked, and oil absorption was measured by comparing their weight before and after frying. The results showed that potatoes fried at a stable temperature were the crispiest and absorbed the least oil, while potatoes fried under large temperature drops absorbed almost twice as much oil. This study explains the frying process in simple language for cooks and shows why temperature stability is essential for high-quality fried potatoes.*

Keywords: *Frying temperature; crispiness; oil absorption; potato frying; thermal stability; steam barrier; crust formation; culinary science; deep-fat frying; food texture*

INTRODUCTION

Even though frying potatoes is a routine task in kitchens, the process is influenced by complex changes in heat and moisture. When potatoes are placed in hot oil, the water inside them quickly turns into steam. This escaping steam helps push oil away from the potato surface, which reduces oil absorption and helps form a crispy crust. Research in food science confirms that strong steam production is one of the main reasons crispy fried foods absorb less oil (Aguilera, 1997). When the oil temperature is high and stable, steam forms continuously, moisture escapes quickly, and the potato surface hardens into a crisp layer.

Problems arise when oil temperature drops, which often happens when the fryer is overloaded or when there is not enough oil in the pan. When the temperature falls, steam production slows down and the crust does not form quickly. This gives oil more time to enter the potato. Several studies have shown that temperature drops lead to higher oil absorption and softer textures in fried potatoes (Mirzaei et al., 2015; Liu et al., 2021). Mathematical models also show that when the oil temperature repeatedly rises and falls, the potato absorbs more oil because moisture escapes unevenly (Dehghannya et al., 2025). Understanding these basic processes helps cooks see why good temperature control is essential for producing consistently crispy fries.

2. Materials and Methods

Fresh potatoes (Solanum tuberosum) were peeled and cut into uniform strips similar to French fries. All potatoes were cut to the same size to ensure even cooking. Refined sunflower oil was used because it is common in kitchens and has a stable frying

performance. A digital deep fryer with a thermostat was used to control temperature, and a thermometer was used to verify actual values.

Three oil temperature conditions were tested. In the first condition, the oil was kept at a stable 180 °C throughout frying. In the second condition, the oil temperature fluctuated between 160 and 180 °C, similar to what happens in a busy kitchen where the fryer recovers heat slowly. In the third condition, the temperature dropped sharply from 180 °C to 140 °C whenever potatoes were added, representing an overloaded fryer.

Each batch of potatoes was fried for six minutes. To measure crispiness, a small device pressed down on fried potatoes until the crust cracked. The amount of pressure needed showed how crispy the crust was, similar to the method used in previous studies on fried food texture (Krokida et al., 2000). Oil absorption was measured by weighing the potatoes before frying and after frying and draining. The difference in weight indicated how much oil had entered the potatoes, following methods described in earlier fried potato research (Aguilera, 1997).

3. Results

The potatoes fried at a stable temperature of 180 °C were the crispest. They broke easily when tested, showing that the crust was firm and well developed. This agrees with existing research, which states that high, steady temperatures create strong crust formation (Liu et al., 2021). Potatoes fried under moderate temperature fluctuation had less crisp crusts, and those fried under large temperature drops were the softest, bending instead of snapping during texture testing.

Oil absorption followed the same pattern. Potatoes fried at a stable temperature absorbed around 9–10% oil. When the temperature fluctuated moderately, oil absorption increased to around 13%, and when the temperature dropped heavily to around 140 °C, the potatoes absorbed almost 19% oil. This matches earlier findings showing that lower frying temperatures lead to significantly higher oil uptake in fried potato products (Mirzaei et al., 2015). Observations during frying also supported these results. In the stable-temperature condition, strong bubbling occurred throughout frying, showing continuous steam release. In the fluctuating conditions, bubbling slowed or stopped when the temperature dropped, indicating less steam and more opportunity for oil to enter the potato.

4. Discussion

The results of this study confirm what many cooks experience in real kitchens: when the oil temperature stays high and constant, fried potatoes come out crispy and light, but when the temperature drops, the potatoes become soft and oily. Stable temperature allows the surface of the potato to heat quickly, push out moisture, and form a crust. This crust acts like a barrier, limiting how much oil can enter the potato. Similar explanations have been given in previous studies of frying physics, which emphasize rapid crust formation as a key factor in reducing oil uptake (Mellema, 2003).

On the other hand, when oil temperature falls, the potato surface stays wet for longer, giving oil more time to be absorbed. Large temperature drops weaken the steam barrier—the main force that normally pushes oil away. Studies on fried food structure support this idea, showing that weaker steam pressure and slower crust formation allow oil to soak into

the food more easily (Ziaiifar et al., 2008). This study's results, therefore, match both scientific research and everyday kitchen observations.

For cooks, the message is simple and practical. Avoiding overcrowding, allowing the oil to reheat between batches, and using enough oil to prevent large temperature drops can dramatically improve fry quality. Consistent temperature is one of the most important steps in making fries that are crisp on the outside and tender on the inside, without being overly oily.

5. Conclusion

This study shows in clear and simple terms that oil temperature stability is essential for making good fried potatoes. When oil stays at a steady 180 °C, potatoes develop a crispy crust and absorb only a small amount of oil. When the oil temperature drops, especially to around 140 °C, potatoes become soft and absorb almost twice as much oil. These findings demonstrate that temperature control is one of the most important factors for cooks who want to produce high-quality fried potatoes. Stable temperatures lead to fries that are crisp, flavorful, and much less oily.

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