

# THE INFLUENCE OF TEMPERATURE AND AIR FLOW RATE ON DRYING KINETICS OF APPLE CHIPS

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Apple is an ideal fruit for snacks according to its high nutritional content. Dried apple slices have a good market potential as a raw material in many processed foods and can be an alternative to deep fat fried chips for health-conscious consumers. The purpose of this research was to study the effect of the temperature and air flow rate on convective drying of 1 mm apple slices. A laboratory-scale drying system was used as a conventional drying method. Greeny Smith apple slices were dried in an experimental dryer at different air flow rates (3.5; 4 and 4.5 m/s) and different temperatures (60, 65 and 70°C). The samples were withdrawn for moisture content estimation at an interval of 5 min. The results showed that the optimal parameters are a temperature of 65°C and air flow velocity of 4 m/s, at which the change in mass of the sample is most uniform and constant over time. Considering organoleptic quality the determined optimal parameters are suggested parameters for drying of apple slices.

## EXPERIMENTAL

Apples. For the experiments was used an apple of the "Greeny Smith" variety (Delta Agrar DOO, Belgrade). Apples are cut into slices with a special knife. The dimensions of the apple slices were 35 × 55 × 1 mm. Apple slices were immersed in a 2.5% aqueous solution of citric acid for 5 minutes. The apple slices are taken out of the solution and arranged on a drying rack. The total mass of untreated samples was measured and then the samples were subjected to drying.

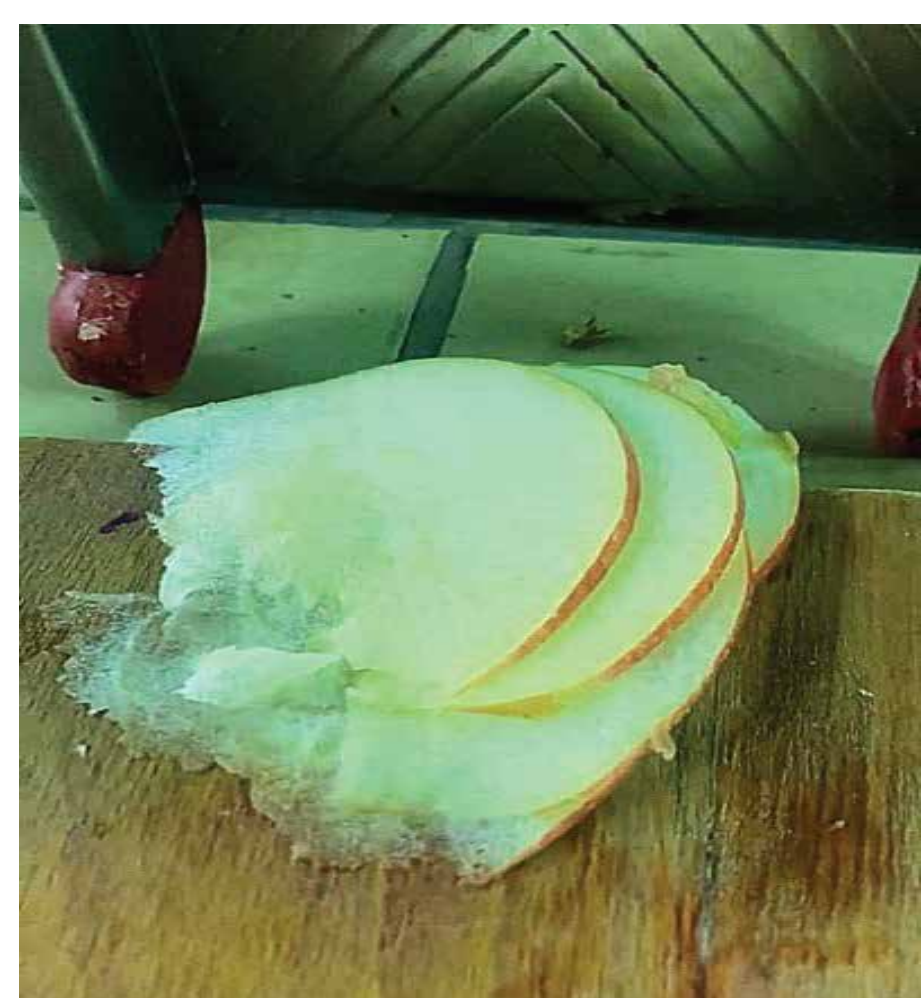


Fig 1. Apple slices



Fig 2. Apple slices on digital scale

Sample	Air flow rate (m/s)	Temperature of the air (°C)	Relative humidity (%)
Greeny Smith	3.5	65	2.5 - 5.1
Greeny Smith	4	60	2.5 - 5.1
Greeny Smith	4	65	2.5 - 5.1
Greeny Smith	4	70	2.5 - 5.1
Greeny Smith	4.5	65	2.5 - 5.1

Table 1. Values of parameters used in experiments

A laboratory-scale drying system was used as a conventional drying method which consisted of a drying chamber, air duct system with associated control elements and air heaters. This drying system has adjustable air recirculation and the possibility of controlling all relevant process parameters, as well as their monitoring during the entire period of the drying process. The mass of the samples was constantly measured and recorded at precise time intervals of 5 minutes, with a digital scale, with an accuracy of ± 0.01 kg. Apple samples were periodically rotated to dry evenly.



Fig 3. Photo of experimental convective dryer

## RESULTS AND DISCUSSION

The influence of temperature on drying kinetics of apple chips

On the Figure 4. we can see that the highest temperature of 70°C has the fastest drop in mass of the sample, which means that the kinetics of the process is the fastest. If we compare the stationary drying time for all three temperatures, we can notice that the stationary drying time for a temperature of 60°C is 75 minutes, for a temperature of 65°C the stationary drying time is established in 70 minutes and for a temperature of 70°C, the time is 80 minutes. The "stationary drying time" is the time after which the changes in the mass of the sample are very small and the drying process is almost complete. It is evident that the optimal drying temperature is 65°C.

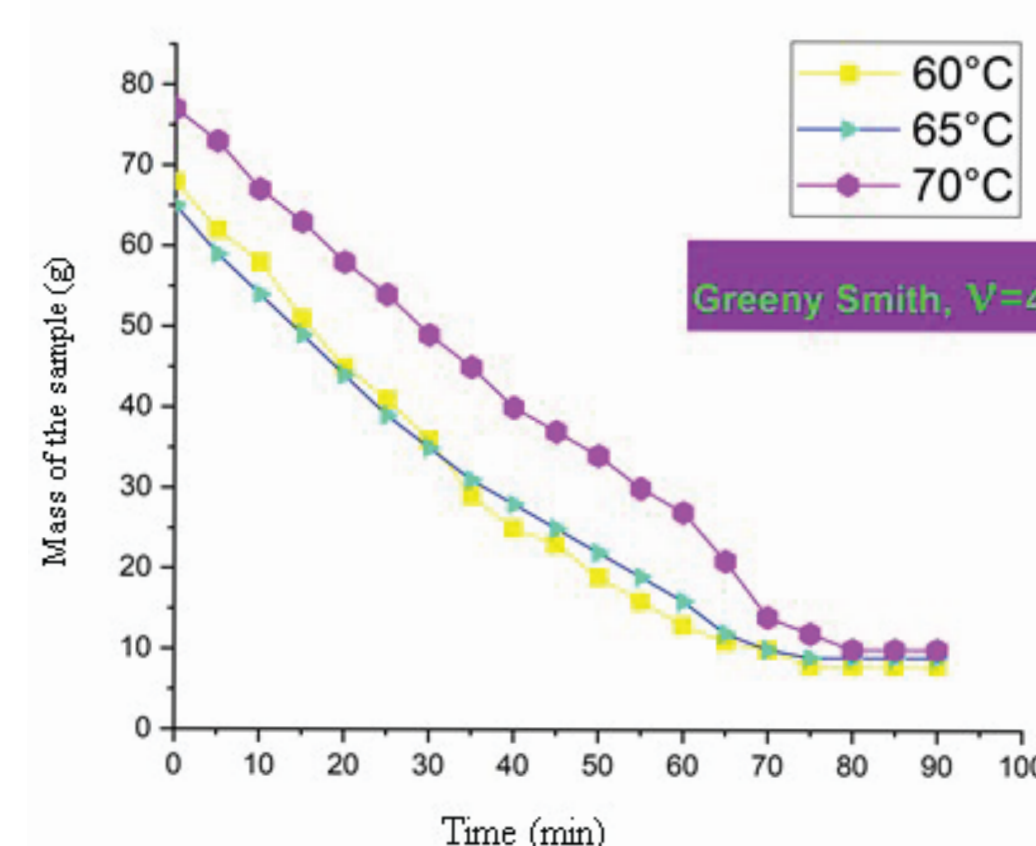


Fig 4. Change in the mass of apple chips depending on the time at different drying temperatures

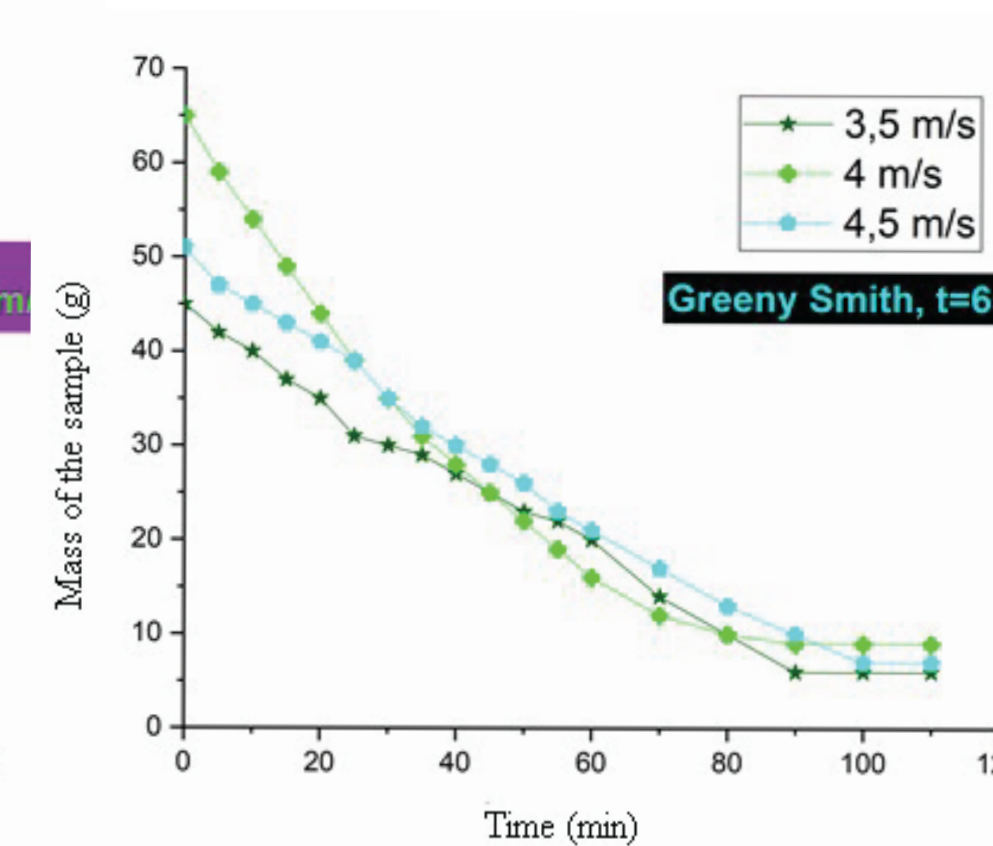


Fig 5. Change in the mass of apple chips depending on the time at different air flow rate

The influence of air flow rate on drying kinetics of apple chips

On the Figure 5. we can see that at the optimal temperature of 65°C and air flow rate of 4 m/s, the stationary drying time is established in 80 minutes, for a flow rate of 3.5 m/s that time is 90 minutes, and for a flow rate of 4.5 m/s, the steady-state is established after 100 minutes of the drying process. The optimal air flow rate is 4 m/s.

The optimal air flow rate is 4 m/s.

## CONCLUSION

- The optimal parameters are a temperature of 65°C and air flow velocity of 4 m/s, at which the change in mass of the sample is most uniform and constant over time.
- The drying process itself is shorter compared to other examined parameters of the convective drying process.
- Considering organoleptic quality the determined optimal parameters are suggested parameters for drying of apple slices.
- The results of experiments also showed that high-quality dried apple chips are provided due to less browning and a brighter appearance.

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