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INFLUENCE OF THE PRELIMINARY PREPARATION OF PARSLEY CUBES ON THE PROCESS OF DRYING THEM IN A MICROWAVE AT REDUCED PRESSURES

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Abstract. The results for the drying of parsley cubes at reduced pressures are presented in this paper. The range of the pressures applied was between 6-8 kPa. Parsley without any preliminary preparation, blanched parsley and parsley preliminarily osmotically dehydrated in sodium chloride at concentrations of 10% and 30% were used during the experiment. The course of drying was described with a linear equation for the constant drying rate and exponential functions for the sub-period changes in the drying rate defining the values of the hydration of the material at critical points.

Keywords: Drying, parsley, microwaves, lower pressure, preliminary preparation

INTRODUCTION

The application of reduced pressure in microwave heating has a very positive influence on the quality of the material being dried. Microwaves heat the material inside its own volume which prevents the structures from hardening or forming a crust. This in turn causes dehydration difficulties with the consequent lowering of product quality [3]. Accelerating the drying process by applying microwaves shortens the time of contact with oxygen at higher temperatures and therefore lowers the negative effects of any biochemical changes, for example, the oxidization of lipids [1]. Additionally, acceleration of the drying time is gained by lowering the pressure. The above-mentioned features mean that dried material obtained in this way is of much better quality than material produced by other methods.

The correct preliminary preparation of material before drying will give a higher quality end product. The positive effects of the preliminary preparation of

a product by blanching and osmotic dehydration are known [2]. Applying osmotic dehydration improves the features of many foods by using suitable raw materials from which some osmotically active substances penetrate the dehydrated material.

THE AIM OF THE WORK

The aim of the experiment was a description of the influence of the preliminary preparation of parsley on the course of microwave drying at lower pressures.

MATERIAL AND METHODS

The experiment to dry cubes of parsley in a microwave using lower pressures was conducted on an experimental stand designed by the Agricultural University [4].

The 'Berlinska' variety of parsley was used in the examination. This was cut into small cubes (each side about 7 mm). Samples weighing about 60 g (to an accuracy of 0.01 g) were placed inside the drying container. The container was connected to low pressure microwave equipment which was then switched on thus rotating the chamber. The examination paused after 3, 6, 9, 12, 15, 18, 21 and 24 minutes. In each experiment, the power of the microwaves amounted 480 W and the pressure was changed within the range of 6 kPa to 8 kPa.

The initial and final humidity of the samples was obtained by a method which allowed the following points of the drying axis to be described.

Four different kinds of material were used during the examination:

- parsley cubes without any preliminary preparation,
- parsley cubes blanched in water at a temperature of 90°C for 5 minutes,
- parsley cubes with preliminary osmotic dehydration in a 10% sodium chloride solution for 24 hours,
- parsley cubes with preliminary osmotic dehydration in a 30% sodium chloride solution for 24 hours.

RESULTS

The results of the experiment to dry parsley in a microwave at lower pressures is shown in the graph (figs. 1-4). The minimum pressure was 6 kPa and the maximum 8 kPa. During the constant kinetic period, drying took place and is described by a linear equation. The changing drying rates are described by an exponential equation. The critical point u_k, which divides the course into periods, was marked.

Figure 1 shows the drying curve of parsley cubes. No preliminary preparation was made.

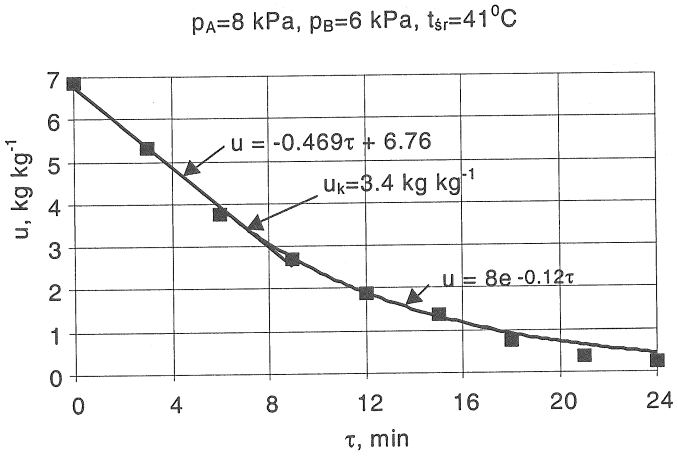

Fig. 1. Course of the changes of water content in the parsley cubes during microwave drying at lower pressures. Parsley not preliminarily prepared

Figure 2 shows the drying curve of the parsley cubes. Before drying, the cubes had been blanched in water at a temperature of 90°C for 5 minutes.

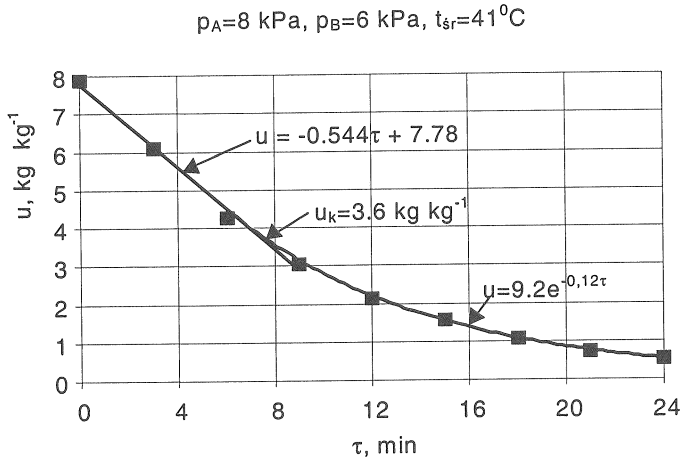

Fig. 2. Course of the changes of water content in parsley cubes during microwave drying at lower pressures. Parsley blanched before drying

Figure 3 shows the drying curve of parsley cubes. Before drying, the cubes had been osmotically dehydrated in a 10% sodium chloride solution for 24 hours.

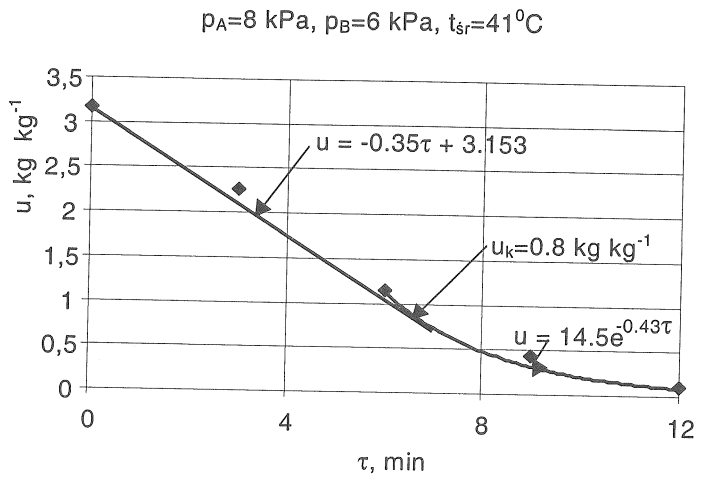

Fig. 3. Course of the changes of water content in parsley cubes during microwave drying at lower pressures. Parsley preliminarily osmotically dehydrated for 24 hours in a 10% sodium chloride solution

Figure 4 shows the drying curve of parsley cubes. Before drying, the cubes had been osmotically dehydrated in a 30% sodium chloride solution for 24 hours.

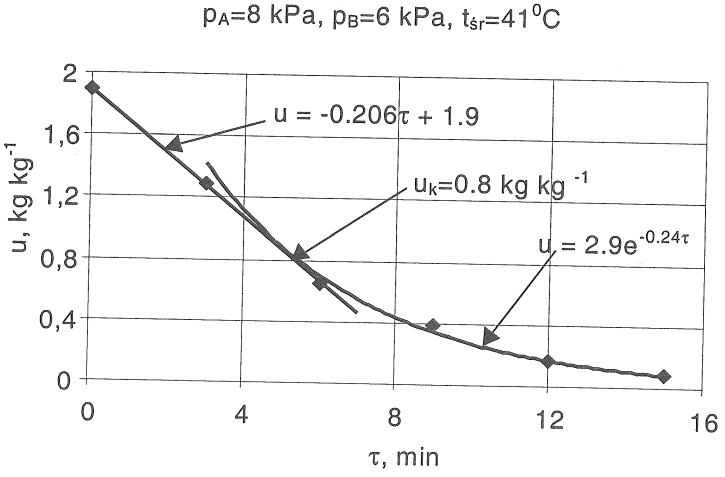

Fig. 4. Course of the changes of water content in parsley cubes during microwave drying at lower pressures. Parsley preliminarily osmotically dehydrated in a 30% sodium chloride solution for 24 hours

Constant values occurring in the description of the constant rate of drying periods described by the following equation are shown in the table 1.

$$u = a\tau - b \quad (1)$$

Constant coefficients of exponential equations describing periods of the changing rate of drying were also presented:

$$u = Ae^{-B\tau} \quad (2)$$

Table 1. Values of constant coefficients in equations 1 and 2

No.	Kind of preliminary preparation	I Period		u_k	II Period	
		a	b	(kg kg^{-1})	A	B
1	Without preliminary preparation	–0.47	6.76	3.4	8.0	–0.12
2	Blanching	–0.54	7.78	3.6	9.2	–0.12
3	Osmosis 10%	–0.35	3.15	0.8	14.5	–0.43
4	Osmosis 30%	–0.21	1.90	0.8	2.9	–0.24

DISCUSSION

Preliminary preparation caused changes in the dried material. Blanching caused an increase in the preliminary water content of about 1kg H_2O (kg d.m.)$^{-1}$ as opposed to the fresh material. The increase of the preliminary water content meant that during the constant drying rate period, the slope of the straight for this period lowered from –0.47 – fresh parsley to –0.54 – blanched parsley. During the changeable rate of drying, the indices in the exponential equation were similar. The critical point of the water content also had similar values in both cases.

Applying a 10% sodium chloride solution to the osmotic dehydration caused a lowering of the preliminary water content from about 6.8 kg kg^{-1} – fresh material to 3.2 kg kg^{-1}. Using a 30% solution, a reduction in initial water content to about 1.9 kg kg^{-1} was caused. The result of this was an increase in the slope of the straight line which described the period of the constant rate of drying from –0.35 for dehydrated material in a 10% solution to a value of –0.21 when using the 30% solution. The critical water content in both cases amounted to about 0.8 kg kg^{-1}. The B index in the degree equation describing the period of the changeable rate of drying increased from 0.43 – dehydrated material in the 10% solution to a value of –0.24 when using the 30% solution. This proves that water diffusion in less

preliminarily dehydrated material was faster than in material with a lower initial water content.

CONCLUSION

1. The kinetics of the drying of fresh parsley, pre-cooked and then osmotically dehydrated in a 10% and 30% solution of sodium chloride was divided by the constant drying rate period, described with a linear equation and the period of variable velocity, described with an exponential equation.
2. Blanching the parsley before drying causes an increase in its initial water content in relation to fresh material. The outcome was an increase in the drying rate during the constant drying rate period.
3. The preliminary blanching of parsley before drying did not cause any changes of the B value in the exponential equation describing the period of the changeable drying rate. This proves that blanching does not cause any changes in the water diffusion coefficient.
4. Using a concentrate of the osmoactive solution has a significant influence on the initial value of the humidity of the material. This also means that the course of drying in the constant and changeable rate periods is diverse.

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WPŁYW WSTĘPNEGO PRZYGOTOWANIA PIETRUSZKI NA PROCES MIKROFALOWEGO SUSZENIA PRZY OBNIŻONYM CIŚNIENIU

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Streszczenie. W pracy przedstawiono wyniki badań suszenia kostki pietruszki w warunkach mikrofalowo-podciśnieniowych. Zakres stosowanych ciśnień zawierał się pomiędzy 6-8 kPa. Do badań użyto pietruszki bez obróbki wstępnej, pietruszki blanszowanej oraz pietruszki wstępnie odwadnianej osmotycznie w roztworze chlorku sodu o stężeniu 10 i 30%. Przebieg suszenia opisano równaniami liniowymi dla okresu stałej szybkości suszenia oraz wykładniczymi dla okresu zmiennej szybkości suszenia, określając wartości uwodnienia materiału w punktach krytycznych.

Słowa kluczowe: suszenie, pietruszka, mikrofale, podciśnienie, obróbka wstępna