POLISH JOURNAL OF FOOD AND NUTRITION SCIENCES

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Pol. J. Food Nutr. Sci.
2007, Vol. 57, No. 2(A), pp. 141-146

TEMPERATURE CHANGES DURING VACUUM DRYING OF DEFROSTED AND OSMOTICALLY DEHYDRATED STRAWBERRIES

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Key words: vacuum drying, temperature, pressure, defrosting, osmotic dehydration, strawberries

The aim of this work was to examine the influence of drying parameters on temperature changes during vacuum drying of defrosted and osmotically dehydrated strawberries.

This work presents curves of temperature above fruits, temperature of fruits' surfaces and internal temperature of strawberries' flesh during 8 h of drying. The increase of the setting temperature of drying from 40 to 60°C was observed to affect the samples' surface and the internal temperature (to a greater extent in the case of defrosted strawberries than osmotically dehydrated strawberries) and the temperature above fruits (to the same degree in the case of defrosted strawberries and osmotically dehydrated strawberries). Furthermore, the pressure decrease from 20 to 4 kPa had an influence on the declining samples' surface and internal temperature as well as on the temperature above fruits (to a greater extent in the case of defrosted strawberries than in the case of osmotically dehydrated strawberries). During vacuum drying, the temperatures of fruits' surface or tissue and above fruits were lower in the case of defrosted strawberries than in the case of osmotically dehydrated strawberries.

NOTATIONS

Abbreviations and units: P – Pressure (kPa); t – Time (min); T – Temperature (°C); X – Moisture content (kg water / kg d.b.), (d.b. = dry basis); X/Xo – Dimensionless moisture content (-).

Codes for material preparation and pretreatments: DF – defrosted strawberries; OD – osmotically dehydrated strawberries

INTRODUCTION

In Poland fresh strawberries are available for a relatively short period, while processed strawberries are offered on the market all year long as: jams, pure, juices, compotes, concentrates and additives to other products.

Substances sensitive to high temperatures can be dried under a lower pressure in relation to the atmospheric pressure. This approach permits to decrease the drying temperature and manufacture products that have superior quality in comparison to those manufactured with the use of convective drying under atmospheric pressure [Krokida & Maroulis, 1997]. Due to reduced contact time with air harmful effects of oxygen on raw material components (bioflavinoid, β-carotene, pigments) can be avoided. However, air- and vacuum-dried fruits and vegetables had stronger structure than the freeze-dried ones and kept their viscoelastic characteristics during rehydration close to those of dried materials [Krokida & Philippopoulos, 2005].

Research on vacuum contact drying kinetics of a model system applying nonporous glass spheres focused on the influence of effects of jacket temperature, head-space pressure, particle bed depth, chamber dimensions, and particle size [Kohout *et al.*, 2005]. Published results of tests where vacuum drying is applied promote application of this technology, especially in drying such materials as fruits, vegetables and thick coat seeds [Białobrzewski & Misiak, 1997; Madamba & Liboon, 2001; Borkowska *et al.*, 2003; Arévalo-Pinedo & Murr, 2006]. Application of lower pressures with additional sources of energy enables obtaining new dried products in a shorter time [Beaudry *et al.*, 2004; Devahastin *et al.*, 2004; Piotrowski & Figiel, 2005].

The objective of this study was to examine the influence of drying parameters on temperature changes during vacuum drying of defrosted and osmotically dehydrated strawberries.

MATERIAL AND METHODS

The experimental material were not disintegrated frozen strawberries of Senga Sengana variety with a diameter of 30-35 mm, produced in accordance with the Polish Standard [PN A--78652:1997] by the refrigerating plant RUN from Włoclawek. Until being used in the experiment the raw material was stored at a temperature of about -18°C in closed plastic film bags. Before vacuum drying the frozen fruits were exposed only to defrosting (DF) or osmotic dehydration (OD).

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Defrosting (thawing) the strawberries was effected in the ambient temperature for 3 h that were necessary to obtain a temperature above +16°C inside fruits.

The osmotic dehydration was carried out in a 61.5% sucrose solution (with mass proportion between the raw material and the solution equal to 1:4) at a temperature of approx. 30°C for 20 h in a water bath with application of delicate oscillations of the shaker.

Drying the strawberries was carried out in a laboratory vacuum dryer, type SPT-200 (Conbest, Krakow), with the balance using an inductivity transducer of force (Mensor, Warszawa) [Piotrowski & Lenart, 2002] for 8 h at two levels of drying temperature (T) 40 and 60°C and under pressure (P) of 4 and 20 kPa. During drying light-gauge wire thermocouples of "K" type (Czaki, Raszyn) were used for measurement of temperatures above fruits, temperature of fruit surfaces and internal temperature of strawberries flesh. A PC class computer with procedures elaborated in VisiDAQ software package (Advantech, Cincinnati) was used for process control and data registration. Water content was determined using vacuum drying at 70°C for *ca.* 18 h.

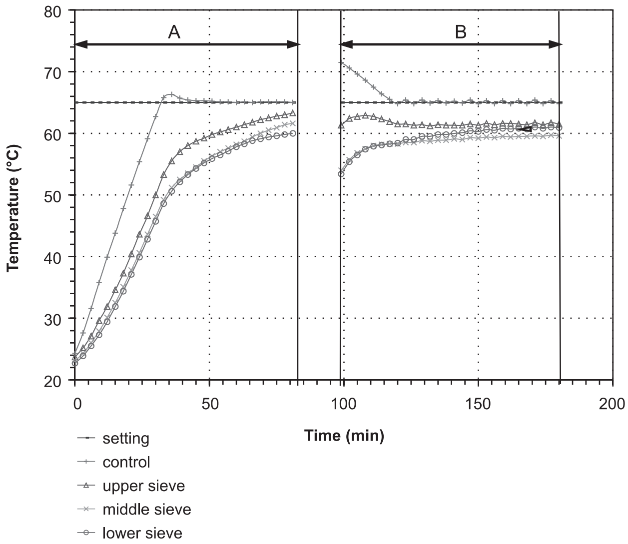

Figure 1. Temperature distribution inside the vacuum dryer chamber. Setting temperature – T65 (°C), pressure – P4 (kPa); A – the period ending at the moment of reaching over the sieve the temperature by 5°C lower from the settled one; B – the period starting from closing the dryer after the interruption until the moment of stabilizing the temperature at a constant level.

RESULTS AND DISCUSSION

Temperature distribution in the vacuum dryer

The analysis of the heating process of the 42 dm^3 drying chamber at the setting temperature of 65°C showed (Figure 1) that temperature registered by the control thermocouple, localised near the wall of the dryer, raised above the value of the setting temperature to the level of 66.5°C after *ca*. 36 min of the "A" period.

Subsequently, it was lowered to the set level during the following 20 min. The temperatures registered above all sieves in the drying chamber were increasing systematically until they reached their maximum levels in the final minutes of the period "A". As a result, above the upper sieve a temperature of 62.3°C was obtained, being lower by 2.7°C than the setting temperature, whereas above the middle sieve – the temperature was lower by 3.4°C and above the lower sieve – by 5°C. During the "B" period, certain similarity in distribution of temperature was registered as well. A decrease in the temperature measured by the control thermocouple was observed from 71.5°C to 65°C during the first 20 min of the "B" period, in the setting temperature of 65°C. Also the temperature above the upper sieve increased during the first 9 min of the "B" period from 61.3°C to the value higher by 1.6°C than the setting temperature and then during the following 15 min it decreased to the constant level of 61.5°C. The temperature above the middle and lower sieves increased during the first 60 min of the "B" period and reached stable levels: above the lower sieve – by approx. 59.5°C and above the middle sieve – by approx. 60.8°C. The final differences between the setting temperature and the temperature registered above each sieve reached lower levels: about 3.5°C above the upper sieve, about 5.5°C above the middle sieve, and about 4.2°C above the lower sieve.

Temperature distribution in the vacuum dryer is required for pilot plant stand identification. Temperature distribution in the investigated chamber was stable and approved for technological experiments. During vacuum drying also Białobrzewski & Misiak [1997] as well as Białobrzewski & Markowski [2000] checked and considered the range of temperature distribution and measurement errors including that of an electronic balance.

Analysis of the course of temperature curves

The influence of temperature, pressure defrosting (DF) and osmotic dehydration (OD) on vacuum drying of strawberries was analysed on the basis of temperature curves: temperature on the surface, the internal temperature of flesh and above strawberries without additional pretreatment or pretreated in osmotic solutions measured during vacuum drying experiments carried out for 480 min at two levels of temperature (T): 40°C and 60°C and at two levels of pressure (P): 4 kPa and 20 kPa in the vacuum chamber (Figures 2-5).

In the case of defrosted (DF) strawberries dried under the pressure of 4 kPa, a short decrease was observed in the measured temperature both during the processes carried out at the temperature of 40°C and 60°C (Figures 2b, c). At 40°C, the temperature above strawberries first reached the level of 25.4°C, and next had a tendency to decrease by about 1°C, whereas at a temperature higher by 20°C the following decrease from the initial value of 37.1°C was even bigger – about 5°C. In both cases these phenomena were related to a decrease in moisture content of fruits to about 8.2 kg water/kg d.b. The initial values of the temperature on the surface and internal temperature of flesh in the drying at 40°C were equal to 26.3 and 24.3°C. For moisture content of approx. 5 kg water/kg d.b., the temperature registered above fruits accounted for 27.1°C (Figure 2a), the temperature on the surface – for 13.4°C and the internal temperature of strawberries flesh – for 15.8°C (Figures 2b, c). In the case of drying at 60°C, higher values of the considered temperatures were registered at the indicated moisture content and were higher by about: 36, 56 and 10%, respectively.

The dependencies presented above appeared also in the case of defrosted (DF) strawberries dried under the pressure of 20 kPa (Figures 2a, b, c). During drying the fruits at 40°C, the initial

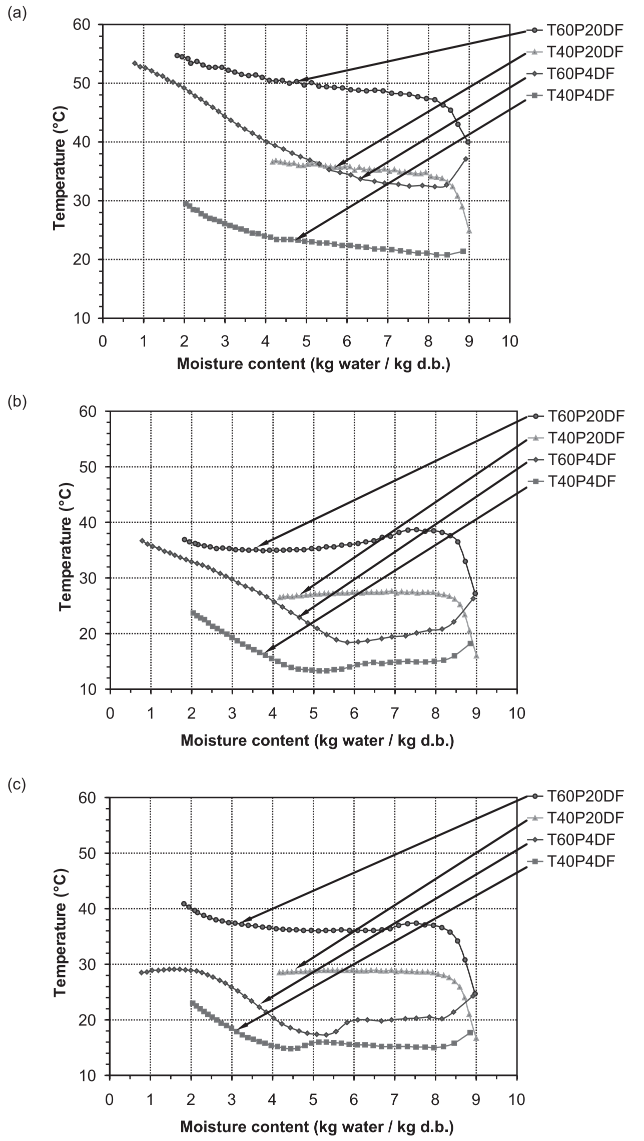

FIGURE 2. Temperature curves of defrosted (DF) strawberries during vacuum drying. Parameters: drying temperature T60 (°C), pressure P4 (kPa). Measured temperatures: (a) above fruits, (b) on sample surfaces, (c) internal of strawberries flash.

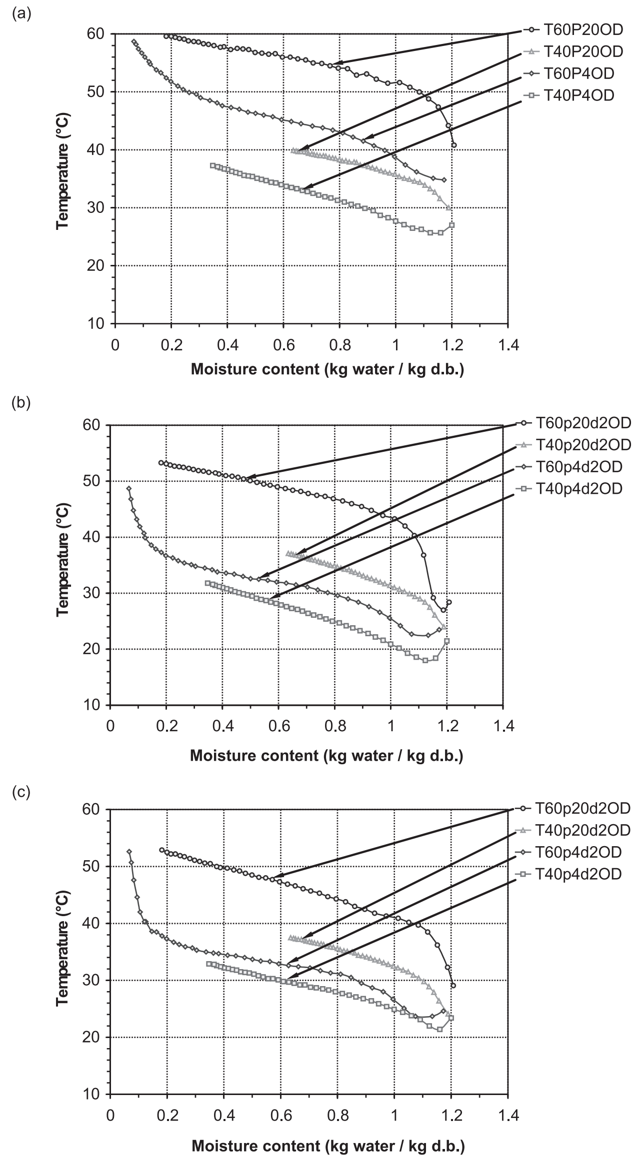

FIGURE 3. Temperature curves of osmotically dehydrated (OD) strawberries during vacuum drying. Parameters: drying temperature T60 (°C), pressure P4 (kPa). Measured temperatures: (a) above fruits, (b) on sample surfaces, (c) internal of strawberries flash.

temperature above fruits reached the level of 24.9°C, whereas on their surface – the level of 16.0°C, and the internal temperature of flesh was 16.7°C. The rise in process temperature caused that the considered temperatures increased by about: 60, 48 and 70%, respectively. Along with a decrease in moisture content of the strawberries to *ca*. 5 kg water/kg d.b., an increase was registered in the measured temperatures. The temperature above fruits during drying at 40°C reached the level of 36°C, and at 60°C it was about 40% higher (Figure 2a), while a systematic increase of the measured temperature by about 30% (Figures 2b, c) occurred on the strawberries surface and internal temperature of flesh.

In the case of osmotically dehydrated (OD) strawberries dried under the pressure of 4 kPa and at the temperature of 40°C, the initial temperature was equal to 27°C above fruit, to 21.5°C on the surface and to 23.4°C in the case of internal temperature of flesh, whereas in the case of drying at 60°C these values were higher by about: 30, 9 and 5%, respectively (Figures 3a, b, c). In the case of moisture content of approx. 0.7 kg water/kg d.b., the temperature gained higher values than at the beginning of the process and at the temperature of 40°C it reached the level of 32.5°C above strawberries, 26.4°C on their surface and 28.8°C for the internal temperature of flesh. In the case of drying at 60°C, higher values of temperature were observed at the above-indicated points, *i.e*. by 40, 17 and 12%, respectively.

In the case of the drying process under the pressure of 20 kPa, higher initial temperatures were also observed in the instance of osmotically dehydrated (OD) strawberries. The registered temperatures were higher in the case of drying at 60°C than at 40°C, *e.g.* about 36% above strawberries, about 18% on the surface and about 20% in the case of internal temperature of flesh, and were equal to 40.8, 28.4 and 29.1°C, respectively (Figures 3a, b, c). After the decrease of moisture content to about 0.7 kg water/kg d.b., the registered temperature reached higher values in the case of drying at 40°C: 39.3°C above osmotically dehydrated strawberries, 36.3°C on the surface and 36.8°C in the case of internal temperature of flesh. In the case of drying at 60°C, we observed increases in the respective temperatures by approx. 30% (Figures 3a, b, c).

The rise in drying temperature within the range of 40-60°C was shown to have a comparable influence on the increase in the temperature above strawberries that were defrosted (DF) or osmotically dehydrated (OD). The same change of the drying temperature influenced, in a greater degree, the increase in the temperature measured on the surface of defrosted fruits than osmotically dehydrated ones. In the analysed 480-min experiments, the value of drying temperature was reached only above strawberries, while both temperatures on the surface and internal of flesh reached lower values than the drying one.

Białobrzewski & Markowski's [2000] results and approach to modelling drying under air pressure and vacuum showed that pressure in the drying chamber had a dominating influence on the final water content of the dried celery discs. Among their assumptions there was that one: in the set of experiments the temperature differences under the surface of a sample and in the middle of disc thickness remained within the limits of measuring errors. For vacuum dried discs three temperature change phases had been distinguished, including warming-up the material or the third phase with an increase in the value of the material temperature up to the value approximating the temperature applied in the drying chamber. In contrasts to temperature changes obtained for whole strawberries, the second phase of temperature curves for celery discs represented a slow temperature decrease (by several Celsius degrees) spanning for a long period. This difference may be due to a difference in temperature distribution near the samples during the heating process in the compared vacuum stands.

Influence of pressure on strawberries temperature during vacuum drying

For separate points of measurement of temperature curves, the initial value of temperature was running at a similar level. Differences in the course of temperature curves in the case of drying experiments on defrosted (DF) strawberries were observed during the first minutes of the processes (Figures 2, 3). During drying under the pressure of 4 kPa, a decrease by about 1-2°C was registered in relation to the period with initial transitory temperature and in the further course of the process we observed an increase of temperatures along with a decrease in moisture content in the dried product. However, with the moisture content of approx. 5 kg water/kg d.m. and under 5-times higher pressure (20 kPa), the measured temperatures were higher than those assayed under the lower pressure by 50% above strawberries (36.2°C), by over 200% on the surface (27.1°C) and over 80% in the case of flesh (28.8°C), (Figures 2b, c).

In the case of drying at 60°C, the increase of pressure was also found to elevate the measured temperatures (Figures 2b, c). In these datasets, drying under the pressure of 4 kPa proceeded with a slight decrease of temperature at the beginning of the processes. After removing moisture from strawberries to approx. 5 kg water/kg d.m., the measured temperatures were noticed to increase. Their values were higher under the pressure of 20 kPa than under that of 4 kPa, by about approx. 35% over fruits (49.7°C), by about 70% on the surface and by about 100% in the case of flesh. Along with lowering the moisture content in the dried material, a smaller influence of pressure increase was observed on temperature value on the surface, in the flesh or above fruits (Figures 2b, c).

The influence of the pressure level on the measured temperatures was observed also in the case of osmotically dehydrated (OD) strawberries (Figures 3b, c). It was lower than in the above discussed experiments, especially at the temperature of 40°C. During the drying at 40°C and under the pressure of 4 kPa in the case of moisture content of approx. 0.7 kg water/kg d.m., temperatures on the surface reached approx. 26°C and in the case of flesh – approx. 29°C. A pressure increase to 20 kPa resulted in a temperature rise by about 40 and 30% respectively, to the levels of 28.8 and 26.4°C (Figures 3b, c).

The influence of pressure on the measured levels of temperatures could also be observed in the case of drying at 60°C (Figures 3b, c). Lower values were registered under the pressure of 4 kPa and at the same moisture content and were equal to 31.1°C on the surface and 32.2°C in the case of flesh. In the case of a higher pressure (20 kPa), the considered values increased by about 41 and 54%, respectively.

In none of the considered drying processes did the temperature on the surface or in the case of flesh of the osmotically dehydrated fruits tend to have a period of constant temperature. The temperatures increased along with a decrease in moisture content of the product.

Depending on the pressure level set up in the vacuum dryer's chamber, different courses were obtained for the first part of temperature curves (Figures 2b, c, 3b, c). Cooling down the material and its environment was observed at this stage under the pressure of 4 kPa, whereas under pressure of 20 kPa the temperature of both material and its environment was found to increase. We did not notice any constant differences in the character of the course of the second stage of temperature curves due to the pressure difference. However, we observed the presence of the third period of temperature changes *versus* time in the case of defrosted strawberries or osmotically dehydrated strawberries and dried only under pressure of 4 kPa.

Lowering the pressure in the drying chamber affects also an increase in the measured temperature. We observed a greater influence of pressure drop on temperature rise of the material in the case of defrosted (DF) strawberries (from approx. 70 to 110% on the surface and from approx. 80 to 130% in the case of flesh) than in the case of osmotically dehydrated (OD) strawberries (from approx. 30 to 50% on the surface and in the case of flesh).

Arévalo-Pinedo & Murr [2000] showed that application of lower pressures and higher temperatures in the vacuum drying chamber caused drying time reduction for carrot. The authors suggested using a temperature above vapour saturation temperature correspondent to the pressure inside the chamber (*i.e*. 70°C and 28 kPa), and underlined that the generated temperature gradient within the product had a positive influence on drying rate. Generally, in literature considering vacuum drying, the process of kinetics is most often graphically represented by drying curves. The above-mentioned authors [Arévalo-Pinedo & Murr, 2000; 2006] discussed also drying curves without presenting temperature distribution.

Influence of osmotic dehydration on strawberries temperature during vacuum drying

Higher values of temperature were observed in the case of osmotically dehydrated (OD) strawberries than in the case of strawberries (DF) not subjected to this process (Figures 4, 5) in the majority of the analysed and presented curves *versus* dimensionless moisture content X/Xo. This relationship was noticed both at the beginning of the drying and after a decrease of the dimensionless moisture content X/Xo to approx. 0.6.

In the case of strawberries with a diameter of 30-35 mm, we observed an influence of osmotic dehydration on the measured temperature of fruits. Depending on the other process parameters, the measured temperatures were higher by about 4-50% in the case of dehydrated fruits. In the case of defrosted strawberries dried under the pressure of 4 kPa and at the temperature of 40°C (Figures 4a, b), initial values of temperature were equal to 18.2°C on the surface and 17.7° in the case of flesh, whereas in the case of dehydrated fruits they were higher by, respectively, about 18 and 32% and were equal to 21.5 and 23.4°C. With the decrease of the dimensionless moisture content these differences increased. For dimensionless moisture content of approx. 0.6, in the case of osmotically dehydrated strawberries the temperatures were equal to 26.1°C on the surface and 28.7°C in the case of flesh and were higher by about 96% and 80%, respectively, than those measured in the case of defrosted strawberries. Analogical dependence was observed in the case of strawberries dried at the temperature of 60°C (Figures. 5a, b). After a decrease of the dimensionless moisture content to approx. 0.6, the temperature registered in the case of defrosted strawberries amounted to 19.8°C on the surface and 17.3°C in the case of flesh, whereas in the case of osmotically dehydrated strawberries these values were higher by about 57 and 86% and were equal to 31.1 and 32.2°C, respectively.

For strawberries dried under the pressure of 20 kPa and at a temperature of 40 and 60°C (Figures 4, 5), higher temperatures were also observed in the case of strawberries subjected to dehydration before drying *versus* dimensionless moisture content X/Xo.

This phenomenon does not have so negative influence on the dried product because of the initial moisture content that is substantially higher before drying in defrosted (DF) than osmotically dehydrated (OD) strawberries. Removal of water from initially dehydrated strawberries took place at the temperature of a dehydration solution to the moisture content of approx. 1.2 to 1 kg water/kg d.b. Due to the initial pretreatment, the drying of osmotically dehydrated strawberries (Figure 3) was always carried out at lower temperatures than in the case of defrosted strawberries (Figure 2) with respect to the same moisture content.

Selection of a pretreatment such as steam blanching for celery [Madamba & Liboon, 2001] may be a technological starting point for optimisation of independent variables (operating vacuum pressure, drying temperature and slice thickness) affecting several quality attributes of the product during vacuum dehydration. Arévalo-Pinedo & Murr [2006] observed that the applied pre-treatments influenced favourably the vacuum drying kinetics, however freezing and thawing of pumpkin slabs showed greater influence than blanching. This form of presentation of the applied pretreatments in comparison to pumpkin "in nature" before vacuum drying and data calculated for

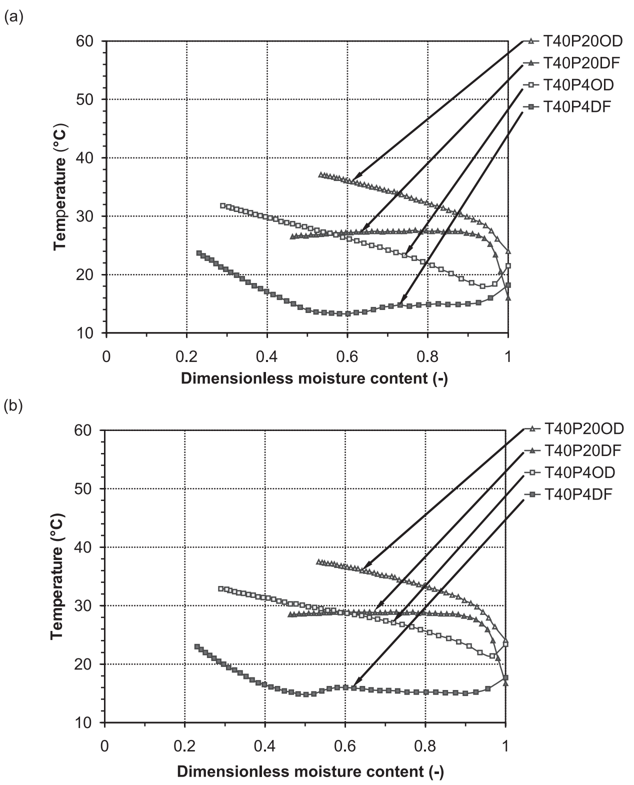

Figure 4. Temperature curves of defrosted (DF) and osmotically dehydrated (OD) strawberries during vacuum drying. Parameters: drying temperature T40 (°C), pressure P4 and P20 (kPa). Measured temperatures: (a) on sample surfaces and (b) internal of strawberries flash.

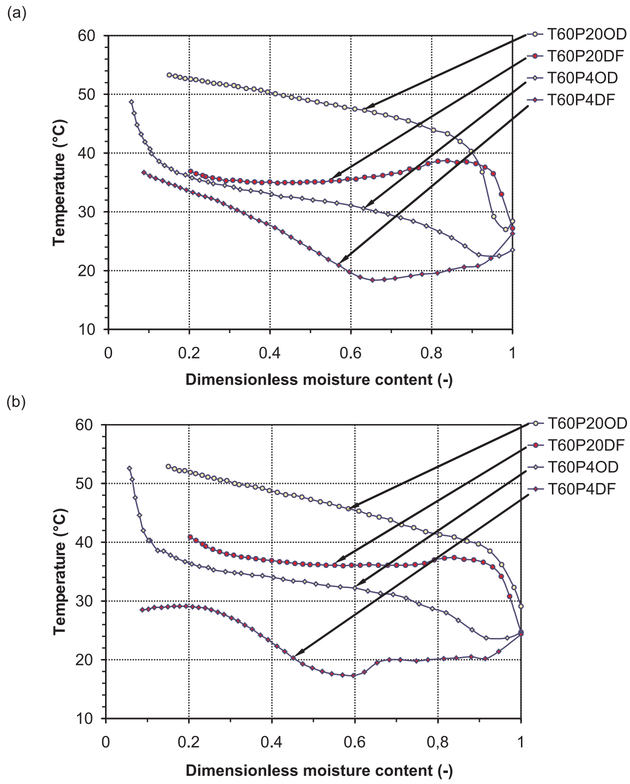

FIGURE 5. Temperature curves of defrosted (DF) and osmotically dehydrated (OD) strawberries during vacuum drying. Parameters: drying temperature T60 (°C), pressure P4 and P20 (kPa). Measured temperatures: (a) on sample surfaces and (b) internal of strawberries flash.

interpretation of water balance and moisture diffusivity, even without presentation of material temperature, are worth citing as a valuable approach. Interpretation of changes in water and drying rates for particular drying methods may be more convenient. For microwave/air drying higher drying rates were obtained for strawberries which were only defrosted in the dryer and not initially dehydrated osmotically as compared to the osmotically dehydrated ones [Piotrowski *et al.*, 2004].

CONCLUSIONS

1. Three significantly different phases of temperature changes during strawberries vacuum drying were observed: (1) a period of cooling down the material and its environment (at 4 kPa) or heating up (at 20 kPa), (2) a period of constant (in the case of defrosted fruits) or increasing (in the case of osmotically dehydrated fruits) temperature of material and its environment, and (3) a period of heating up the material and its environment.

2. The increase in drying temperature from 40 to 60°C in the case of defrosted strawberries was found to affect an increase in the temperature on the surface and inside the samples to a greater extent than in the case of osmotically dehydrated ones.

3. The decrease of pressure from 20 to 4 kPa affected a decline in the temperature on the surface and inside the samples as well as in the temperature above defrosted fruits to a greater extent than in the case of the osmotically dehydrated ones.

REFERENCES

1. Arévalo-Pinedo A., Murr F.E.X., A diffusion model with concentration dependent effective diffusivity during the vacuum drying carrot. 2000, *in:* Proceedings of the 12th International Drying Symposium – IDS2000. Amsterdam, The Netherlands: Elsevier Science B.V., CD-ROM, Paper No. 138, pp. 1-9.
2. Arévalo-Pinedo A., Murr F.E.X., Kinetics of vacuum drying of pumpkin (*Cucurbita maxima*): Modeling with shrinkage. J. Food Eng., 2006, 76, 562-567.
3. Beaudry C., Raghavan G.S.V., Ratti C., Rennie T.J., Effect of four drying methods on the quality of osmotically dehydrated cranberries. Drying Technol., 2004, 22, 521-539.
4. Białobrzewski I., Markowski M., The effect of selected parameters on celery drying kinetics. 2000, *in:* Proceedings of the 12th International Drying Symposium – IDS2000. Amsterdam, The Netherlands: Elsevier Science B.V. CD-ROM, Paper No. 324, 2000, pp.1-10.
5. Białobrzewski I., Misiak W., A stand for investigation of vacuum-drying kinetics – short report. Pol. J. Food Nutr. Sci., 1997, 6/47, 133-138.
6. Borkowska O., Piotrowski D., Lenart A., Impact of selected parameters on vacuum drying kinetics of osmotically dehydrated strawberries. Inż. Roln., 2003, 7, 203-210 (in Polish).
7. Devahastin S., Suvarnakuta P., Soponronnarit S., Mujumdar A.S., A comparative study of low-pressure superheated steam and vacuum drying of a heat-sensitive material. Drying Technol., 2004, 22, 1845-1867.
8. Kohout M., Collier A.P., Stepanek F., Vacuum contact drying kinetics: an experimental parametric study. Drying Technol., 2005, 23, 1825-1839.
9. Krokida M.K., Maroulis, Z.B., Effect of drying method on shrinkage and porosity. Drying Technol., 1997, 15, 2441-2458.
10. Krokida M.K., Philippopoulos C., Rehydration of dehydrated foods. Drying Technol., 2005, 23, 799-830.
11. Madamba P.S., Liboon F.A., Optimization of the vacuum dehydration of celery (*Apium graveolens*) using the response surface methodology. Drying Technol., 2001, 19, 611-626.
12. Piotrowski D., Lenart L. Operating parameters of computerised stand for drying fruits under lowered pressure. Inży. Roln., 2002, 6, 283-290 (in Polish).
13. Piotrowski D., Figiel A., Influence of vacuum microwave drying on productivity and quality of preserved fruits and vegetables. Przem. Ferment. Owoc.-Warz., 2005, 49, 22-24 (in Polish).
14. Piotrowski D., Lenart A. Wardzynski A., Influence of osmotic dehydration on microwave-convective drying of frozen strawberries. J. Food Eng., 2004, 65, 519-525.
15. Polish Standard, PN A-78652:1997. Frozen strawberries (in Polish).

ZMIANY TEMPERATURY PODCZAS SUSZENIA ROZMROŻONYCH I OSMOTYCZNIE ODWADNIANYCH TRUSKAWEK

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Celem pracy było zbadanie wpływu parametrów suszenie na zmiany temperatury podczas suszenie próżniowego rozmrożonych i osmotycznie odwadnianych truskawek.

W pracy tej przedstawiono krzywe temperatury nad owocami, temperatury powierzchni owoców i wewnętrznej temperatury miąższu truskawek podczas 8 godzinnego suszenia. Obserwowano wpływ wzrostu zadanej temperatury suszenie od 40 do 60°C na temperaturę powierzchni owoców i w ich wnętrzu (w większym stopniu w wypadku rozmrożonych truskawek niż osmotycznie odwadnianych truskawek) i na temperaturę nad owocami (w porównywalnym stopniu w wypadku rozmrożonych i osmotycznie odwodnionych truskawek). Ponadto, ciśnienie zmieniające się od 20 do 4 kPa miało wpływ na obniżenie temperatury powierzchni próbek i w ich wnętrzu, jak również na temperaturę nad owocami (w większej mierze w przypadku rozmrożonych niż osmotycznie odwodnionych truskawek). Podczas suszenia próżniowego temperatura powierzchni owoców albo tkanki oraz nad owocami była niższa w przypadku rozmrożonych truskawek niż dla osmotycznie odwadnianych.