Zeszyty Problemowe Postępów Nauk Rolniczych
nr 597, 2019, 41–51
DOI 10.22630/ZPPNR.2019.597.11

THE IMPACT OF DIFFERENT DRYING METHODS ON QUALITY OF RADISH SPROUTS

Artur Wiktor[1]✉, Katarzyna Wasilewska[1], Francisco J. Barba[2], Magdalena Dadan[1], Mohamed Koubaa[3], Shahin Roohinejad[4], Małgorzata Nowacka[1], Dorota Witrowa-Rajchert[1]

[1] WULS-SGGW, Faculty of Food Sciences

[2] University of Valencia, Faculty of Pharmacy, Nutrition and Food Science Area

[3] Sorbonne Universities, University of Technology of Compiègne, Integrated Transformations of Renewable Matter Laboratory

[4] Shiraz University of Medical Sciences, Division of Food and Nutrition, Burn and Wound Healing Research Center

Summary. In the latest years people's attention focus on the consumption of products characterised by abundance in bioactive compounds. One of the products rich in the bioactive compounds is radish sprouts, which are generally consumed raw or slightly cooked. However, in recent years the problems connected with foodborne illness in sprouts were noticed. One of the possibilities to resist this problem is to use drying as the traditional method used for food preservation. Moreover, the set up right parameters of the process and methods of drying might influence on the sensory quality of plant products. During drying the water decrease because of evaporation and water activity reduce and inhibition of microbial activity occurs. Furthermore, the enzymatic and chemical reactions rate reduce what has influenced the quality of the food matrix. Thus, the aim of presented work was to assess the nutritional and quality losses such as DPPH scavenging activity, total phenolic compounds content, colour and rehydration properties, of the dried radish sprouts obtained by different drying techniques (convective drying – CD, microwave-assisted convective

Artur Wiktor http://orcid.org/0000-0003-4058-6010; Francisco J. Barba https://orcid.org/0000-0002-5630-3989; Magdalena Dadan https://orcid.org/0000-0001-7647-0592; Mohamed Koubaa https://orcid.org/0000-0002-2063-7450; Shahin Roohinejad https://orcid.org/0000-0002-1524-2534; Małgorzata Nowacka https://orcid.org/0000-0003-4689-6909; Dorota Witrowa-Rajchert https://orcid.org/0000-0002-0937-3204

✉artur_wiktor@sggw.pl

drying – MV-CD and infrared-assisted convective drying – IR-CD). In the case of convective drying, process was carried out with the air velocity of 1 $m \cdot s^{-1}$ and at the temperature of 60°C. In infrared-assisted convective drying was used the power of infrared emitter equal 7.875 $kW \cdot m^{-2}$, and air velocity equal to 1 $m \cdot s^{-1}$. For microwave-assisted convective drying the starting microwave power was equal to 200 W, the air velocity was 1 $m \cdot s^{-1}$ in the temperature of 30°C. The DPPH scavenging activity and total phenolic compounds content were measured using spectrophotometric methods. The colour was measured in CIE L*a*b* system and rehydration properties were express as the soluble solids loss ratio and relative water content. After the drying process, the loss of total phenolic content and antioxidant capacity were observed. However, the methods of drying not differentiate the antioxidant capacity and the total phenolic content was significantly higher when infrared-assisted convective drying was applied. The colour after drying was altered and differences between the dried samples were noticed. Moreover, the analysis of rehydration properties shows that the fastest kinetics of water absorption was characteristic for infrared assisted convective dried sprouts. On the research basis, it can be indicated that analysed drying methods allow shaping the final quality of dried radish sprouts allowing to manufacture of products characterised by certain properties.

Key words: sprouts, radish, microwave drying, infrared drying, antioxidants, polyphenols, rehydration

INTRODUCTION

In recent years, the consumption of radish sprouts has received people's attention because of their abundance in bioactive compounds [Li et al. 2016]. Radish sprouts are commonly consumed raw or slightly cooked in many countries [Robertson et al. 2002]. However, sprouts have been associated with numerous foodborne outbreaks worldwide and due to their high water activity they are perishable [Frank et al. 2011]. Due to these problems there is a need to improve the quality of sprouts, limiting their contamination and preserve all healthy valuable compounds [Zhang et al. 2016].

Drying has been traditionally used for food preservation and to improve the sensory quality of agricultural products [Barba et al. 2015, Fijalkowska et al. 2016]. As it is well known, drying of foods is a key tool to enhance the competitiveness of developing countries as it can be used as a component of convenience foods (tertiary processed foods), which is ready-to-cook or ready-to-eat and because it promotes crop surplus utilisation [Barba et al. 2015]. Therefore, drying could be used for both reduction of production costs and promote the protection of the environment, thereby addressing sustainable development issues.

The application of microwave and infrared processing technologies might be useful in regards to the retention of thermolabile healthy compounds found in radish sprouts. Apart from developing drying protocols to reduce processing time, it is also of paramount importance to assess the nutritional and quality loss after the different processes. For instance, antioxidant tests (e.g. DPPH scavenging activity), total phenolic compounds, and colour could be viewed as fast indicators of quality deterioration after processing (e.g. drying) and subsequent storage [Touati et al. 2016]. Therefore, the aims of the present work were to dry radish sprouts with different drying techniques as convective drying (CD), microwave-assisted convective drying (MW-CD) and infrared-assisted convective drying (IR-CD), and to assess the nutritional and quality losses of the obtained dried samples (DPPH scavenging activity, total phenolic compounds content and colour).

MATERIAL AND METHODS

Radish (*Raphanus sativus* var. *sativus*) seeds originated from Poland were purchased at a local market in Warsaw Sprouting was conducted for four days in a special sprouting vessel (Bio-natura, Poland) with drainage channels, siphons and the overflow tank. The sprouts were irrigated twice a day by pouring 500 cm^3 water in the first sprouting dish. These conditions were selected according to preliminary studies (unpublished data). On the fourth day, sprouts were harvested. Dry matter of all samples were determined according to AOAC method 920.15 [Horwitz 2002].

DRYING PROCESSES

The convective drying (CD) was conducted in a prototype dryer using hot air in temperature 60°C and a parallel air velocity set at 1 $m \cdot s^{-1}$. The dryer was loaded with 0.5 $kg \cdot m^{-2}$. This prototype dryer was equipped with nine lamps emitting the infrared radiation and infrared assisted convective drying (IR-CD) was conducted. The total power of infrared emitter was 7.875 $kW \cdot m^{-2}$. The distance between the infrared source and the material was equal to 20 cm and drying was conducted at room temperature (20 ±2°C). Other parameters (air velocity and mass of samples) were the same as in the CD. The microwave-assisted convective drying (MV-CD) was conducted in prototype dryer (Promis-Tech, Wrocław) with starting microwave power set up to 200 W, temperature on 30 ±2°C and perpendicular air velocity set to 1 $m \cdot s^{-1}$. The dryer was loaded with 0.673 $kg \cdot m^{-2}$. Different sieve load used for MV-CD in comparison to CD and IR-CD was related to the construction limits of the dryers and specificity of the sprouts. All drying experiments were done at least in duplicate. Dried material was packed into a laminate packaging (BOPA/PE 1540 FF) with vacuum (30% of air).

Total phenolic content (*TPC*) and DPPH assay scavenging activity

Phenolic compounds were extracted from the plant material with 80% ethanol solution, as previously described by Nowacka et al. [2014]. The extracts were prepared in duplicate for each type of material and were used for total phenolic content and free radical scavenging activity determinations. Total phenolic content (*TPC*) was determined according to Folin-Ciocalteu (FC) methodology [Nowacka et al. 2014]. For this purpose, 30 cm^3 of distilled water, 1.5 cm^3 of extract, and 2.5 cm^3 of FC reagent were mixed in a flask. After 3 min 5 cm^3 of 1.7M sodium carbonate was added. The mixtures were well stirred, and the volume was made up to 50 cm^3 with distilled water, and then kept under darkness for 1 h. Afterwards, the absorbance was measured against a blank (without extract) at 750 nm using Heλios gamma spectrophotometer (Thermo Electron Corporation, USA). Total phenolic content was expressed as gallic acid equivalents (*GAE*). The determination was repeated twice for each extract.

In order to determine the antioxidant properties of the extracts, the free radical scavenging activity was assessed as proposed by Wu et al. [2006], with some modifications. In this method DPPH was used as a free radical scavenger. Sample's extract (300 μg), prepared as aforementioned, was added into 3.9 cm^3 of DPPH methanol solution prepared by mixing 1.2 mg with 50 cm^3 of 99% methanol. Mixtures were stirred then kept for 30 min in the darkness before reading the absorbance at 515 nm (Heλios gamma, Thermo Electron Corporation, USA) against a blank (the extract was replaced by 300 μg of 99% methanol solution). The measurements were conducted in triplicate for each extract. The antioxidant activity (*AA*) was expressed according to equation:

$$AA = \frac{A_b - A_m}{A_b} 100 \quad (1)$$

where:
AA – antioxidant activity [%];
A_b – absorbance of the blank sample;
A_m – absorbance of the analysed extract.

Colour measurement

The colour of each sample was measured using a Konica-Minolta CM-5 (Osaka, Japan) Chroma Meter. Samples were placed in a special Petri dish (d = 30 mm), which acted as a bulk sample holder. Such approach allowed the light beam to reflect. The CIE Standard Illuminate D65, di: 8° (diffuse illumination/8° viewing angle), CIE: 2° Standard Observer, and the 30 mm measuring area were used. The measurement was done in 12 repetitions. Before each measurement, the device was calibrated according to the manufacturer instructions. Based on the CIE L*a*b* measurement total colour difference (*TCD*) was calculated using following formula:

$$TCD = \sqrt{(\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2} \quad (2)$$

where ΔL^*, $\Delta a^*$and Δb^* is the difference in specific chromametric coordinate between dried and fresh material.

Rehydration properties

In order to determine the rehydration properties of the dried radish sprouts, 2 g of the dried material was placed in a beaker and then filled with 100 mL of distilled water (20 ±2°C). Samples were rehydrated for 0, 5, 15, 20, and 30 min period and subsequently withdrawn from the beaker and separated from water by a domestic fine mesh sieve.

Afterwards, samples were blotted on a filter paper and the mass was recorded once again. Beside of mass measurement, the dry matter content (AOAC method 920.15) was analysed after each rehydration time. Each experiment was performed in triplicate. The rehydration properties of the dried sprouts were expressed according to following equations:

$$SSL = \frac{m_\tau dm_\tau}{m_d dm_d} \tag{3}$$

where:
SSL – soluble solids loss ratio;
m_τ – mass of the material after τ time [kg];
dm_τ – dry matter content of the material after τ time of rehydration [$kg \cdot kg^{-1}$];
m_d – mass of the material before the rehydration [kg];
dm_d – dry matter content of the material before rehydration [$kg \cdot kg^{-1}$].

$$X = \frac{X_\tau}{X_0} \tag{4}$$

where:
X_τ – water content of the rehydrated sprouts after τ time of rehydration [$kg \cdot kg^{-1}$];
X_0 – initial water content of the rehydrated sprouts [$kg \cdot kg^{-1}$].

The rehydration kinetics was described with Peleg's model according to the methodology previously reported by Nowacka et al. [2012].

Statistical analyses

ANOVA analysis was conduct to verify the significance of differences between the properties of dried materials ($p < 0.05$). Two-way ANOVA was applied in order to verify whether the differences were significant on the variability of the relative water content (*X*) taking into account rehydration times and drying methods. Tukey's test was applied to indicate the samples between which there were relevant differences. All statistical analyses were performed using SPSS software v22 (IBM® SPSS® Statistics, USA).

RESULTS AND DISCUSSION

The required time to obtain dried radish sprouts ($MR = 0.0014$) was in the range from 92 to 152 min. The CD was the shortest process and last 92 min. The innovative methods of drying resulted in longer drying time and were equal to 127 min for IR-CD and 152 min for MV-CD. This results was probably linked with the specific morphology and structure of the radish sprouts and different power load that were linked to the processing parameters of each drying method.

Determination of fast predictive quality and nutritional indicators

Significant loss in TPC was found after drying independently of the applied treatment, compared to the fresh samples (Fig. 1). However, IR-CD retained the highest amount of TPC compared to CD and MW-CD. These results are in close agreement with those found by Si et al. [2016] when they compared the effect of different conventional and innovative drying methods on TPC from raspberry powders. They observed an improved retention of TPC when they applied IR- and MW-assisted drying. In addition, other authors also reported a higher retention in polyphenols of raspberries when they applied combined hot air/microwave vacuum drying methods compared to conventional drying [Mejia-Meza et al. 2010]. There are three possible explanations: (i) tissue disruption after IR-CD and MW-CD, thus facilitating the extraction of polyphenols; (ii) modifications in other compounds which can be converted into polyphenols [Oliviero et al. 2014] and (iii) better inactivation of enzyme-degrading polyphenols (i.e. polyphenol oxidase). However, another factor that should be taken into account considering TPC is a low selectivity of the Folin-Ciocalteu reagent which can react with, for example, products of browning reactions [Polovka et al. 2003]. Such behaviour can explain partially the highest polyphonol content of IR dried sprouts, which were the darkness at the same time. The antioxidant capacity of dried material did not confirmed changes between different dried radish sprouts (the table). All dried materials characterised by lower antioxidant activity in comparison to fresh materials.

Concerning the colour of the dried radish sprouts (the table), with the different drying treatments applied, the CIE b* value, which indicates "–b*" for blueness and "+b*" for

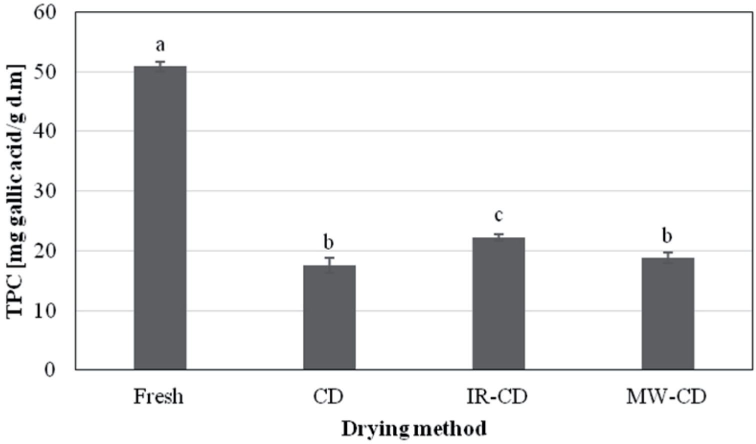

Fig. 1. Total phenolic content (*TPC*) changes after applying different drying techniques: CD – convective drying, IR-CD – infrared-assisted convective drying, MW-CD – microwave-assisted convective drying

Rys. 1. Zmiana zawartości polifenoli ogółem (*TPC*) po zastosowaniu różnych metod suszenia: CD – suszenie konwekcyjne, IR-CD – suszenie promiennikowo-konwekcyjne, MW--CD – suszenie mikrofalowo-konwekcyjne yellowness [Fijałkowska et al. 2015] decreased significantly ($p < 0.05$) for all the drying processes applied compared to the untreated radish sprouts, with the lowest b* value appearing when IR-CD was used (the table).

Table. Colour and antioxidant capacity (DPPH values) of fresh and dried radish sprouts

Tabela. Barwa oraz aktywność przeciwutleniająca (DPPH) świeżych oraz suszonych kiełków rzodkiewki

Sample Próbka	DPPH [% inhibition] [% wygaszania]	CIE a*	CIE b*	CIE L*	*TCD*
Fresh – Świeże	91.1 ±0.5[a]	–0.72 ±1.52[a]	25.99 ±1.72[a]	49.18 ±1.74[a]	–
CD	60.7 ±3.1[b]	2.41 ±0.81[b]	24.57 ±1.49[b]	47.08 ±1.34[b]	4.0
IR-CD	63.2 ±6.0[b]	1.28 ±0.45[c]	19.85 ±0.81[c]	40.72 ±1.69[c]	10.6
MW-CD	59.2 ±1.2[b]	3.87 ±0.44[d]	23.78 ±0.74[b]	43.34 ±1.10[d]	7.8

[a-d] Different lowercase letters in the same column indicate significant differences ($p < 0.05$) as a function of the applied treatment: CD – convective drying, IR-CD –infrared-assisted convective drying, MW-CD – microwave--assisted convective drying.

[a-d] Różne małe litery w tej samej kolumnie wskazują na statystycznie istotne różnice w odniesieniu do różnych metod suszenia: CD – suszenie konwekcyjne, IR-CD – suszenie promiennikowo-konwekcyjne, MW-CD – suszenie mikrofalowo-konwekcyjne.

The CIE a* values (–a* means greenness, +a* means redness) [Fijałkowska et al. 2015] of radish sprouts increased when the drying processes were applied, observing the highest increase in CIE a* after MW-CD. Thus, a colour shift toward negative b* and positive a* directions indicate less intensive yellow colour and less green in dried samples. The results obtained for the CIE L* of radish sprouts indicating that the luminance decreased significantly ($p < 0.05$) after drying compared to the fresh samples, independently of the treatment applied, obtaining the highest decrease after IR-CD.

The *TCD* values of dried sprouts varied between 4.0 and 10.6. What is interesting, air dried material exhibited the lowest values. It means that the colour difference between convective dried sprouts and fresh material was the least noticeable.

Rehydration properties

Rehydration properties belong to one of the most important features of dried products especially if the product has to be consumed as an ingredient of ready-to-eat meals, in which the preparation includes water immersion. In such case, it is desirable that the reconstitution of the dried samples would proceed very quickly and the rehydrated material would be as similar as possible to the fresh tissue. In turn, if the product has to be eaten directly as dried, moisture adsorption should be limited [Lewicki 2006].

Rehydration properties of radish sprouts dried by different methods expressed by the changes of relative water content during rehydration (Fig. 2). On the basis of the obtained results, it can be stated that sprouts dried by the means of IR-CD were characterised by the highest rate of rehydration. For instance, after 30 min immersion in water, the relative water content of IR-CD samples was equal to 0.764 and for CD and MW-CD it was equal to 0.672 and 0.674, respectively. It is worth emphasising that the difference between IR-CD and the other samples was statistically relevant ($p < 0.05$). It should also be noted that the reconstitution behaviour of CD and MW-CD expressed by the changes of relative water content did not differ significantly ($p > 0.05$) at any time of rehydration, except at the beginning of the process (5 min). Two-way ANOVA revealed that both rehydration times and drying methods had significant ($p < 0.05$) impact on variability of the relative water content *X*. In turn, an interaction between these two parameters did not affect significantly the values of *X* ($p > 0.05$).

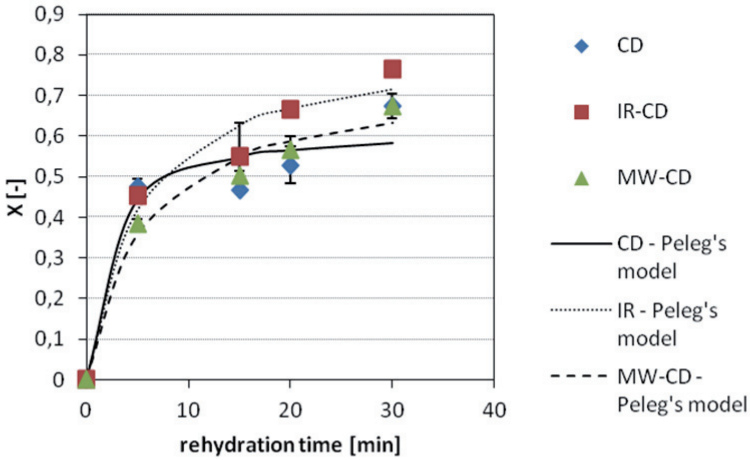

Fig. 2. Changes in a relative water content (*X*) of sprouts during rehydration. The points represent the experimental values whereas lines represent the theoretical course obtained based on Peleg's model

Rys. 2. Zmiana względnej zawartości wody (*X*) kiełków podczas rehydracji. Punkty reprezentują dane otrzymane eksperymentalnie, a linie wskazują dane teoretyczne otrzymane na podstawie modelu Pelega

During rehydration, the soluble solid content of the investigated samples was also altered (Fig. 3). Almost along the whole rehydration process, the lowest soluble solid loss values were observed in MW-CD dried sprouts. Depending on rehydration time, this parameter for MW-CD material varied from 0.810 (5 min) to 0.665 (30 min). Radish sprouts processed by the means of only hot air drying (CD) lost the smallest amount of soluble solids (*SSL* = 0.917–0.794). Sprouts obtained by the IR-CD were characterised by intermediate soluble solid losses. However, statistical analyses proved that the differences between all the investigated samples regardless of the rehydration time were not significant ($p > 0.05$). Nevertheless, concerning the results of two-way ANOVA, it can be stated that, similarly to the changes of relative water content, the *SSL* variability is also shaped relevantly by rehydration time and drying method, although one-way ANOVA did not differentiate these samples.

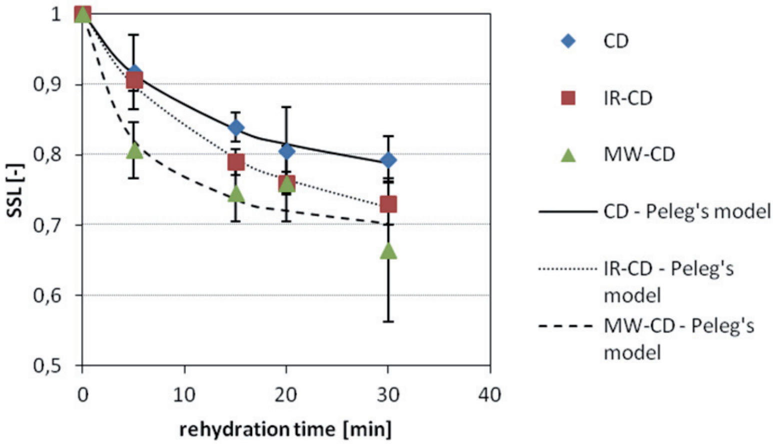

Fig. 3. Changes in a soluble solid loss (*SSL*) of sprouts during rehydration. The points represent the experimental values whereas lines represent the theoretical course obtained based on Peleg's model

Rys. 3. Zmiana ubytku suchej substancji rozpuszczalnej w wodzie (*SSL*) w kiełkach podczas rehydracji. Punkty reprezentują dane otrzymane eksperymentalnie, a linie wskazują dane teoretyczne otrzymane na podstawie modelu Pelega

Despite the fact that in many publications, MW-assisted drying is listed as one of the best methods of drying [Dev et al. 2011], the obtained results, next to the drying kinetics, indicate that this method is not efficient in the case of radish sprout drying.

CONCLUSIONS

1. All the technologies had a significant effect on antioxidant capacity, total phenolic compounds, and colour compared to fresh samples, although IR-CD preserved better the TPC compared to the CD and MW-CD.
2. The analysis of rehydration properties shows that depending on the further application of drying sprouts different drying techniques should be used. The fastest kinetics of water absorption was characteristic for infrared assisted convective dried sprouts.
3. Obtained results indicate that analysed drying methods allow shaping the final quality of dried radish sprouts allowing to manufacture product characterised by certain properties.

Acknowledgements

This work was funded by a statutory activity subsidy of the Polish Ministry of Science and Higher Education for the Faculty of Food Sciences of Warsaw University of Life Sciences – SGGW. Francisco J. Barba was supported from the Union by a postdoctoral Marie Curie Intra-European Fellowship (Marie Curie IEF) within the 7th European Community

Framework Programme (project number 626524 – HPBIOACTIVE – Mechanistic modeling of the formation of bioactive compounds in high pressure processed seedlings of Brussels sprouts for effective solution to preserve healthy compounds in vegetables). Shahin Roohinejad would like to acknowledge the Alexander von Humboldt Foundation for his postdoctoral research fellowship award.

REFERENCES

Barba F.J., Parniakov O., Pereira S.A., Wiktor A., Grimi N., Boussetta N., Saraiva J.A., Raso J., Martin-Belloso O., Witrowa-Rajchert D., Vorobiev E., 2015. Current applications and new opportunities for the use of pulsed electric fields in food science and industry. Food Res. Int. 77(4), 773–798.

Dev S.R.S., Geetha P., Orsat V., Gariépy Y., Raghavan G.S.V., 2011. Effects of microwave-assisted hot air drying and conventional hot air drying on the drying kinetics, color, rehydration, and volatiles of *Moringa oleifera*. Dry. Technol. 29(12), 1452–1458.

Fijalkowska A., Nowacka M., Wiktor A., Sledz M., Witrowa-Rajchert D., 2016. Ultrasound as a pretreatment method to improve drying kinetics and sensory properties of dried apple. J. Food Process Eng. 39(3), 256–265.

Fijałkowska A., Nowacka M., Witrowa-Rajchert D., 2015. Wpływ obróbki wstępnej ultradźwiękami na przebieg suszenia oraz barwę i zawartość betalain w buraku ćwikłowym [The influence of ultrasound pre-treatment on drying kinetics and the colour and betalains content in beetroot]. ZPPNR 581, 11–20.

Frank C., Werber D., Cramer J.P., Askar M., Faber M., an der Heiden M., Bernard H., Fruth A., Prager R., Spode A., Wadl M., Zoufaly A., Jordan S., Kemper M.J., Follin P., Müller L., King L.A., Rosner B., Buchholz U., Stark K., Krause G., HUS Investigation Team, 2011. Epidemic profile of Shiga-toxin-producing *Escherichia coli* O104:H4 outbreak in Germany. N. Engl. J. Med. 365(19), 1771–1780.

Horwitz W. (Ed.), 2002. Method 920.15. In: Official Methods of Analysis of AOAC International. 17th ed. AOAC International, Gaithersburg, Md.

Lewicki P.P., 2006. Design of hot air drying for better foods. Trends Food Sci. Technol. 17(4), 153–163.

Li R., Song D., Vriesekoop F., Cheng L., Yuan Q., Liang H., 2016. Glucoraphenin, sulforaphene, and antiproliferative capacity of radish sprouts in germinating and thermal processes. Eur. Food Res. Technol. 243(4), 1–8.

Mejia-Meza E.I., Yáñez J.A., Remsberg C.M., Takemoto J.K., Davies N.M., Rasco B., Clary C., 2010. Effect of dehydration on raspberries: polyphenol and anthocyanin retention, antioxidant capacity and antiadipogenic activity. J. Food Sci. 75(1), 5–12.

Nowacka M., Śledź M., Wiktor A., Witrowa-Rajchert D., 2014. Changes of radical scavenging activity and polyphenols content during storage of dried apples. Int. J. Food Prop. 17(6), 1317–1331.

Nowacka M., Wiktor A., Śledź M., Jurek N., Witrowa-Rajchert D., 2012. Drying of ultrasound pretreated apple and its selected physical properties. J. Food Eng. 113(3), 427–433.

Oliviero T., Verkerk R., van Boekel M.A.J.S., Dekker M., 2014. Effect of water content and temperature on inactivation kinetics of myrosinase in broccoli (*Brassica oleracea* var. *italica*). Food Chem. 163, 197–201.

Polovka M., Brezová V., Staško A., 2003. Antioxidant properties of tea investigated by EPR spectroscopy. Biophys. Chem. 106(1), 39–56.

Robertson L.J., Johannessen G.S., Gjerde B.K., Loncarevic S., 2002. Microbiological analysis of seed sprouts in Norway. Int. J. Food Microbiol. 75(1), 119–126.
Si X., Chen Q., Bi J., Wu X., Yi J., Zhou L., Li Z., 2016. Comparison of different drying methods on the physical properties, bioactive compounds and antioxidant activity of raspberry powders. J. Sci. Food Agr. 96(6), 2055–2062.
Touati N., Barba F.J., Louaileche H., Frigola A., Esteve M.J., 2016. Effect of storage time and temperature on the quality of fruit nectars: Determination of nutritional loss indicators. J. Food Qual. 39(3), 209–217.
Wu L., Hsu H.-W., Chen Y.-C., Chiu C.-C., Lin Y.-I., Ho J.A., 2006. Antioxidant and antiproliferative activities of red pitaya. Food Chem. 95(2), 319–327.
Zhang C., Cao W., Hung Y.-C., Li B., 2016. Application of electrolyzed oxidizing water in production of radish sprouts to reduce natural microbiota. Food Control 67, 177–182.

WPŁYW RÓŻNYCH METOD SUSZENIA NA JAKOŚĆ KIEŁKÓW RZODKIEWKI

Streszczenie. Celem badań było określenie wpływu zastosowania różnych metod suszenia (konwekcyjne, mikrofalowo-konwekcyjne i promiennikowo-konwekcyjne) na jakość kiełków rzodkiewki określaną na podstawie zawartości związków fenolowych, pojemności przeciwutleniającej, zmian barwy i właściwości rehydracyjnych. Po suszeniu nastąpiło zmniejszenie zawartości polifenoli i aktywności antyoksydacyjnej, przy czym zastosowane do tego metody nie zróżnicowały zdolności przeciwutleniającej suszonych kiełków rzodkiewki. Jednocześnie odnotowano większą zawartość polifenoli w kiełkach suszonych metodą promiennikowo-konwekcyjną oraz najszybszą absorpcję wody podczas rehydracji. Ponadto zaobserwowano zmiany barwy w wyniku zastosowania różnych metod suszenia. Na podstawie przeprowadzonych badań można stwierdzić, że analizowane metody suszenia pozwalają na kształtowanie ostatecznej jakości suszonych kiełków rzodkiewki, umożliwiając wytwarzanie produktów o określonych właściwościach.

Słowa kluczowe: kiełki, rzodkiewka, suszenie mikrofalowe, suszenie promiennikowe, antyoksydanty, polifenole, rehydracja