Faculty of Engineering
Department of Mechanical Engineering

8th INTERNATIONAL SCIENTIFIC CONFERENCE ON ADVANCES IN MECHANICAL ENGINEERING (ISCAME 2022)

10-11 November, 2022 Debrecen, Hungary

CONFERENCE PROCEEDINGS (BOOK OF EXTENDED ABSTRACTS)

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CONTENTS

CHANGES IN PHYSICAL AND MECHANICAL PROPERTIES OF DRIED SWEET POTATOES DURING STORAGE

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Keywords: sweet potato, combined drying, color, texture, vacuum packaging, storage.

Dehydration is one of the oldest techniques for extending food shelf life. The food industry faces a constant challenge to meet rapidly changing consumer tastes and the demand for healthier foods with a longer shelf life, free from traditional chemical preservatives [1]. Raw sweet potatoes have a relatively high water content and are very susceptible to microbial spoilage and enzymatic browning, so dehydration and proper storage are essential [2]. The color as physical characteristic is an important quality factors of dehydrated foods, as it affects consumer acceptability [3]. Modifications in mechanical characteristics are related to the textural attributes of the food. Hence, it is important to determine the texture of the dried products [4]. Rehydration is the process of wetting dry material. If drying does not cause any damage to the material, rehydration can be treated as a process that can be reversed by dehydration [5].
The aim of the research is to determine the effect of shelf life on the physical and mechanical properties of the product. In addition, to find out which of the different drying solutions gives the least variation in color, texture and rehydration.

MATERIAL AND METHODS

The sweet potato material (*Ipomoea batatas* L.) was dried by various drying methods, i.e., lyophilization (FD), vacuum pre-drying and freeze post-drying (VD-FD), mid-infrared freeze-drying (MIR-FD) and hot-air pre-drying and freeze post-drying (HAD-FD). The following parameters were used for drying: FD (T=-25 - 20°C, p=50-80 Pa, dt=23 h), VD-FD (pre-drying: T=60°C, p=7 kPa, dt=3 h; post-drying: T=-25 - 20°C, p=50-80 Pa, dt=12 h), MIR-FD (pre-drying: T=60°C, p= 1 bar, dt=5 min; post-drying: T=-25 - 20°C, p=50-80 Pa, dt=12 h) and HAD-FD (pre-drying: T=60°C, p= 1 bar, dt=3 h; post-drying: T=-25 - 20°C, p=50-80 Pa, dt=11 h), respectively. The drying was carried out to a constant weight of the material. The moisture content of the samples at the end of the drying process: FD – 2,41% (w.b.), 3hVD-FD – 2,39% (w.b.), 5minMIR-FD – 2,69% (w.b.) and 3hHAD-FD – 2,07% (w.b.), respectively. Moisture content of the dried sweet potato dices was determined by the gravimetric method (LP306, LaborMIM, Hungary). For each drying method, 50-50 g samples were used. Weighing was performed on a digital balance (JKH-500, Jadever Co., Taiwan). The raw samples used in the experiment are cube-shaped – smooth surface – with an average of 10 mm each.
The dried materials were placed in vacuum packaging (Laica VT3112, LAICA, Italy). The packs were stored at room temperature (t=20-22 °C) for 3 months and the color difference (ΔE) (ColorLite sph900 spectrophotometer, ColorLite GmbH, Katlenburg-Lindau, Germany), hardness (compression test using CT3-4500 texture analyzer, Brookfield Engineering Laboratories, Middleboro, USA) and rehydration (in distilled water at 30 °C for 10 minutes) of the finished product were measured weekly. All tests were repeated three times.

RESULTS

Figure 1 shows the value of rehydration rate (RR) of the dried sweet potatoes placed in vacuum packaging during the investigated period, i.e. the storage time (12 weeks).

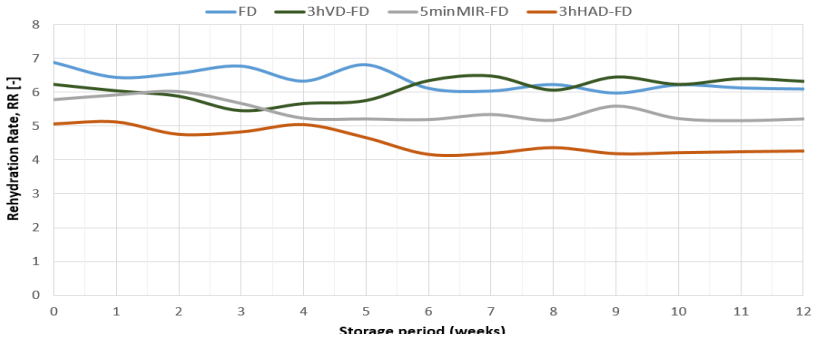

Figure 1 Change in rehydration value of the dried product under storage

From the rehydration rate curves (Fig. 1), it can be observed that the RR value of the product dried by different methods fluctuated slightly from week to week, and was stable by the end of the examination. Only the RR of the material produced by the VD-FD method increased at the end of the storage test.
Table 1 provides information on the results of the color and hardness test of dried sweet potatoes placed in vacuum packaging over a period of 12 weeks.

Table 1 Changes in color and texture during the storage period

Designation	0-12 weeks												
Color difference ΔE	0	1	2	3	4	5	6	7	8	9	10	11	12
FD	-*	1.34	1.55	2.12	1.55	3.55	4.69	3.26	4.89	5.22	5.83	5.22	5.34
3hVD-FD	4.36	4.55	5.78	6.22	5.99	6.84	7.23	7.15	8.22	9.11	8.46	8.26	8.48
5minMIR-FD	7.11	6.65	7.33	7.62	8.22	8.03	9.56	10.33	10.16	9.77	10.33	10.88	10.77
3hHAD-FD	9.22	10.26	10.66	11.25	11.05	10.82	12.09	11.86	12.34	12.97	13.44	13.73	13.88
Texture, N	0-12 weeks												
FD	1.21	1.02	1.30	1.65	1.39	1.87	1.22	1.38	1.88	2.04	2.18	2.16	2.20
3hVD-FD	4.98	5.22	4.67	4.78	4.77	5.28	5.89	5.16	4.36	4.92	5.06	4.55	4.62
5minMIR-FD	3.82	3.33	3.58	4.02	4.44	4.48	4.88	4.19	4.56	4.83	4.45	4.79	4.56
3hHAD-FD	6.50	6.23	6.77	7.21	7.76	8.14	8.05	8.27	8.43	8.21	8.38	8.24	8.49

*Freeze-dried (FD) samples are the standard.
„0" data include the value of the dried product before packaging.

The color difference (ΔE) of the samples in vacuum packs shows an increase during the storage period (Table 1). This was mainly due to fading of the product (increase of the L* parameter). For samples dried by combined methods (VD-FD, MIR-FD and HAD-FD), the ΔE increased slightly over the 12 weeks, but increased 4-fold for lyophilized material (FD). The color difference between the MIR-FD and HAD-FD samples is already in the range of significant deviation [6].
The texture of the packaged products also shows a slight increase, mostly negligible, except for VD-FD sweet potatoes (stable texture). The increase in texture of the product means that the material becomes harder (increase in resistance of the material, N). The largest change - negative - in texture is observed for the HAD-FD product.

CONCLUSIONS

Freeze-dried and combined dried sweet potato cubes were vacuum packed at room temperature and the color, rehydration and texture of the product were monitored week by week over a 12-week storage period. It was found that vacuum packaging was suitable for packaging lyophilized and hybrid dried product with hygroscopic characteristics. During the storage test, the product with the most favorable physical and mechanical properties was prepared by the vacuum pre- and freeze post-drying methods (3hVD-FD).

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