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DEPENDENCE OF DRIED CHIVE *(ALLIUM SCHOENOPRASUM)* QUALITY UPON THE DRYING METHOD AND STORAGE PERIOD

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ABSTRACT

Two methods of drying were applied: air-drying (temp.50 ^{o}C, time 5h) and freeze drying. The content of water in dried chive was about 3%. The quality of chive was tested before and immediately after drying and than after 3, 6, 9 and 12-months storage. Compared with air-drying, the freeze-drying method allows the production of dried chive characterized by more favourable organoleptic traits and chemical composition, although the organoleptic quality of air-dried chive may be regarded as fairly good. After 12-months storage of chive dried by these two

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methods the content of dry matter, total sugars, total nitrogen, ash, beta-carotene, and total chlorophylls and the degree of active acidity and ash alkalinity were not statistically different. During the drying procedure and the storing of dried chive losses of 24-34% concerned vitamin C, of 11-18% beta-carotene, of 19-21% - chlorophylls, and of 47-82% - volatile oils, always being greater in the air-dried product. On the other hand, the content of nitrates and total acids increased by 80-111% and 52-65%, respectively, with a greater increase in air-dried chive.

Key words: chive, drying, storage, chemical components, organoleptic traits

INTRODUCTION

Chive is regarded as a valuable seasoning herb. Fresh leaves are available on the market only for a few months in the year, even if forced greenhouse production is taken into consideration. Also freezing may prolong the consumption of this vegetable [11], although in practice the best preservation method is drying. The drying of horticultural products as a conservation method has long been known. In recent years it has been revived owing to the developing industry of food concentrates and ready-cooked meals such as pizzas or gratin dishes, prepared in small restaurants and at home. The increasing scale of drying fruit and, especially, seasoning herbs is demonstrated by the value of these products on the European market, amounting to 260 million USD [19].

In spite of numerous drying methods [13, 16], air-drying with forced air current is the one most frequently used in the Polish industry, with freeze-drying method being much less popular. The former procedure is recommended on account of low costs and good productivity, while its drawback is the poorer quality of obtained dried herbs. With the latter method the drying of frozen materials occurs at low temperatures and in airtight chambers, as Leino [14] and Karathanos et al. [9] claim, the obtained products being characterized by a distinctly higher quality.

The aim of the present work is to compare the quality of dried chive of similar water content, obtained using the methods of air-drying and freeze-drying. The chemical composition and organoleptic traits were taken as criteria of quality evaluation.

MATERIALS AND METHODS

The investigated materials were fresh and dried and then stored leaves of chive-Erfurcki Olbrzymi cv. The raw material was obtained from a 2-year commercial plantation in the Krakow region. The vegetable was grown on loamy soil with mineral fertilizing adjusted to the requirements of the crop, i.e. N 80 kg/ha, P_2O_5 70 kg/ha, and K_2O 110 kg/ha per year, of these doses N 30 kg/ha, P_2O_5 20 kg/ha, and K_2O 30 kg/ha being applied in spring. The raw material was evaluated, and the drying was carried out about 4-5 h after harvest. Very small, yellowish, and bolting leaves were discarded and the fresh material was cut into sections about 0.5 cm in length.

A type S-3 Zelmed chamber drier with forced air current was used for the air-drying of chive at 50°C. The charge of leaves calculated per 1 m^2 of the sieve was 5 kg. The position of sieves was changed every hour during the first 4h, and later every 30 min. to eliminate encrusting of the raw material during the initial phase of drying and its browning towards the end. The time of drying to the limit of 3% water content was 5h.

Before freeze-drying the cut leaves were placed on trays of the lyophilizing cabinet, weighted with 300 g/cm^3, and frozen. The layers of material did not exceed 30 mm in thickness. The freezing was carried out at -35^{o}C in a 3101-01 Feutron blast freezer with forced air current. Freezing to -25^o C took 60 min. In freeze-drying the German 05 LGM lyophilizing cabinet was used. The drying began at the initial temperature of about -25^o C, its termination being determined on the basis of preliminary tests which had shown that the 3% water content was obtained when the temperature in the cabinet reached 20^{o}C in conditions of 20 Pa pressure, this corresponding to 28 h of drying. The material from different portions was mixed for each drying method separately, dried chive being stored in airtight glass jars of twist-off type, in a dark store at 10^{o}C.

In the raw material and in the dried product directly after drying and then after 3, 6, 9 and 12 month storage the following constituents were determined using methods given in AOAC [1]: the level of dry matter (32.019), total sugars (32.041), total nitrogen (2.058), total acids (32.043), active acidity (32.041), total ash (32.027), alkalinity of ash (32.028), total chlorophylls and chlorophylls a and b (3.138), and volatile oils (30.020). The content of L-ascorbic acid and vitamin C was determined using the ISO/6557-2 [6] methods, nitrates and nitrites ISO /6635 [7], and beta-carotene according to Davies [3]. The ability of water absorption by dried leaves was determined using the following procedure: a weighed 10 g portion of the dried material was transferred to a 400 ml beaker with 250 cm^3 of water at 20 ^{o}C, covered with a watch glass, and left for 24 h at room temperature. The content of the beaker was then filtered through fluted filter paper 12.5 cm in diameter, to a dry cylinder 250 cm^3 in volume. During the filtering the funnel with the filter paper was covered with a watch glass. Within 30 min of filtering the amount of the filtered fluid was recorded. All the analyses were carried out in 4 determinations.

In statistical analyses the Snedecor F and the Student t tests were used. The least significant difference for the chemical composition was calculated at the probability level of $p=0.01$ and for the capability of water absorption at the probability level of $p=0.05$. Moreover, a descriptive organoleptic evaluation was carried out permitting determination of changes due to the drying treatment, in relation to the fresh material.

RESULTS AND DISCUSSION

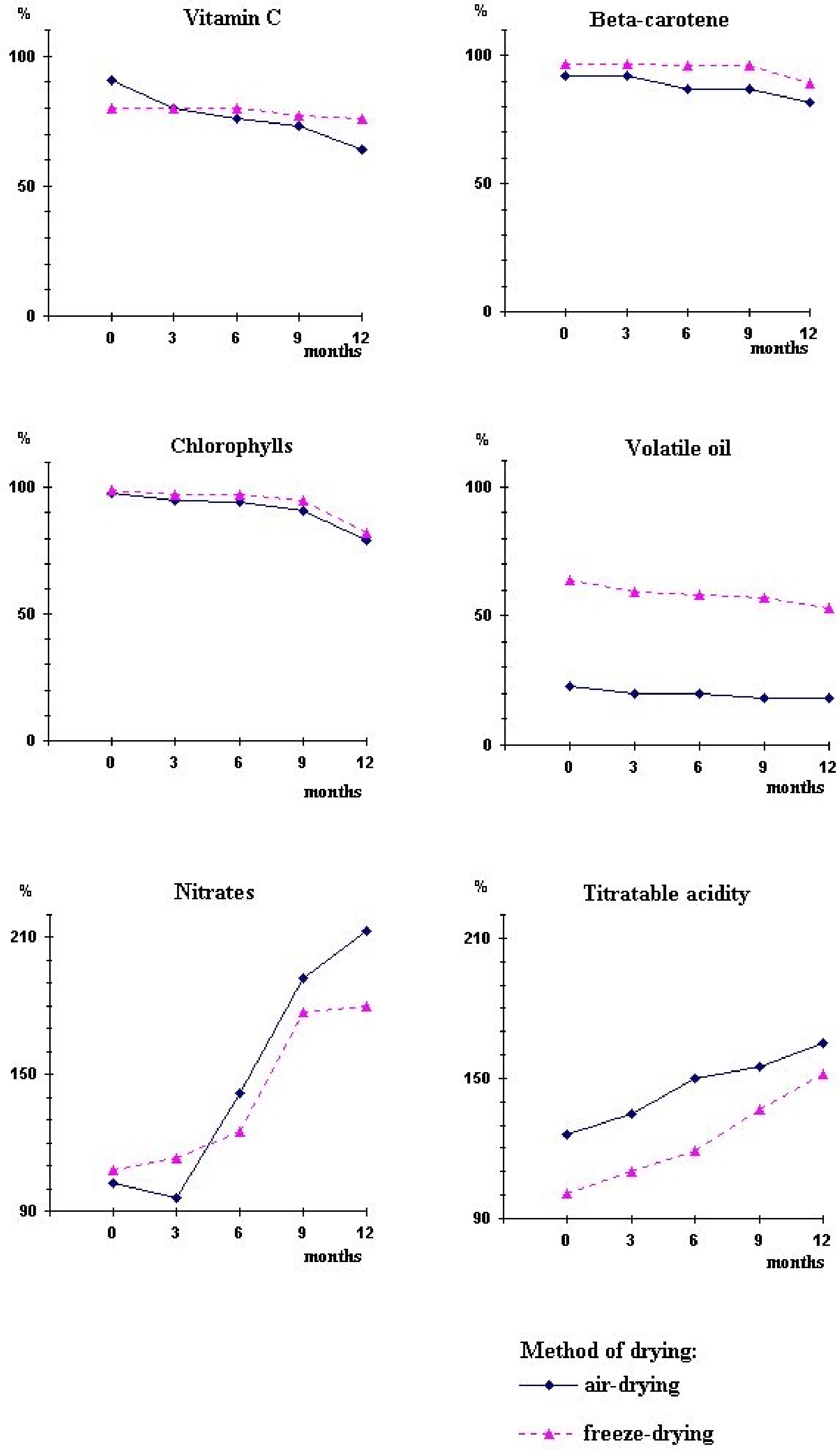
The content of water in the products obtained using the two drying procedures was similar. In the case of air-drying it was 3.3% and in the freeze-dried material 3.0%, this level was maintained throughout the investigation period. Since the content of water was distinctly similar and the storage conditions identical, it is possible that the differences in the quality of the dried products depended solely upon the drying method and the time of storage. These factors did not significantly affect the level of total sugars, total nitrogen, active acidity (pH), ash and its alkalinity (Table 1). Bąkowski & Michalik [2] evidenced a different behaviour of sugars in the dried leaves of dill, parsley, and celery. Depending on species the above, authors observed a decrease in the content of sugars of 4-52% during the air-drying while a stable level of these constituents was maintained during the storage period. No content of nitrites was recorded in the raw material or in the dried products (Table 1) in spite of an increase in their content during the drying of parsley leaves evidenced by Kmiecik et al. [10] Also Flemmig [5] postulated that dried vegetables contain considerable amounts of nitrites.

Table 1. Content of selected ingredients in fresh and dried chive[a]

Ingredient	Raw material		Dried material				LSD p=0.01 concerns content in dry matter
	in fresh matter	in dry matter	just after drying		12th month after		
			air drying	freeze-drying	air drying	freeze-drying	
			in dry matter				
dry matter, g/100 g	11.91	100	100	100	100	100	
total sugar, g/100 g	4.01	33.7	29.8	31.9	30.2	32.3	Femp< Ft
total nitrogen, g/100 g	0.37	3.11	3.07	3.12	3.10	3.11	Femp< Ft
total acidity, $cm^3$0,1M NaOH/100 g	2.17	18.2	22.9	18.3	30.1	27.7	2,30
active acidity, pH	5.29	5.29	5.22	5.28	5.02	5.02	Femp< Ft
ash, g/100 g	0.91	7.64	7.67	7.70	7.71	7.68	Femp < Ft
alkalinity of ash, $cm^3$0,1M HCl/100 g	62,8	527	531	532	534	536	Femp < Ft
L-ascorbic acid, mg/100 g	99	831	637	702	502	635	40.1
vitamin C, mg/100 g	108	907	826	726	603	693	39.7
chlorophyll a, mg/100 g	55.5	466	458	459	356	372	18.6
chlorophyll b, mg/100 g	15.0	126	125	125	110	109	4.9
total chlorophylls, mg/100 g	70.5	592	583	584	466	481	18.3
beta-carotene, mg/100 g	3.54	29.7	27.2	28.9	24.4	26.4	2.15
valatile oil, cm^3/1000 g	0.23	1.93	0,45	1.25	0.35	1.03	0.081
$N\text{-}NO_3$, mg/1000 g	48.0	403	409	430	851	727	56.8
$N\text{-}NO_2$,mg/1000g	0.00	0.0	0.0	0.0	0.0	0.0	-

[a] - from four determinations

In the case of the remaining constituents given in Table 1 for which statistically significant differences were found between their content in the raw material and in the dried chive after 12-month storage, the pattern of changes in their content at 3-month intervals was presented in a graph form. The content of the given compound in the dry matter of the raw chive was accepted as 100% (Fig. 1).



Immediately after the treatment the content of vitamin C was higher in the product obtained by air-drying than in that from the freeze-drying procedure. This level of vitamin C may have been effected by the cumulated losses of the vitamin during freezing and drying. The level of vitamin C, however, was already equalized after 3-months storage and towards the end of this period it was 15% higher in the freeze-dried chive. The better preservation of vitamin C in freeze-dried products was also evidenced by Jaworska [8] in dried parsley, and by Michalik & Dobrzański [15] in dried dill, celery, and parsley. The share of dehydroascorbic acid varied from 3-23% in dried chive, always being higher in air-dried products.

During drying and storage of dried chive beta-carotene and chlorophylls were fairly stable components, their preservation being slightly more efficient in freeze-dried products, though the differences were non-significant. Decreases in the content of these compounds were recorded only after 9 months, except for beta-carotene in air-dried chive where the losses began earlier and were more uniform. Beta-carotene was also stable in spinach, dill, celery, and parsley subjected both to air-drying and to freeze-drying [4, 8, 15]. Ranganath & Dubash [18] stress that higher losses of beta-carotene are associated with higher drying temperatures, while Kon & Shimba [12] showed that greater losses of this compound are also observed in dried vegetable stored at higher temperatures. Both the total chlorophyll content and the ratio of chlorophyll a to b changed only slightly towards the end of the storage period, from 3.7 in the raw material to 3.2 in air-dried chive and 3.4 in that subjected to freeze-drying.

The greatest losses induced by drying were noted in the content of volatile oils. Immediately after treatment 23% of these compounds in air-dried and 65% in the freeze-dried chive were preserved. The results obtained confirmed those reported by Leino [14] who demonstrated that for volatile compounds the air-drying treatment was the most destructive whereas freezing was less, and freeze-drying the least detrimental method of treatment.

The drying treatment did not affect the level of nitrate, though during storage they gradually increased up to a double content in air-dried and to an almost double one in freeze-dried products. Similarly, Jaworska [8] recorded constant increases in nitrate content in dried parsley leaves irrespective of the method of drying. According to Kmiecik et al. [10], air-drying of parsley induced a decrease in nitrate content irrespective of the temperature used in drying, while during storage an increase was noted initially after which the content of the discussed compounds varied.

The freeze-drying method did not cause any changes in the total content of acids, while in air-drying their level increased by 26% in relation to raw chive. The storage of dried products caused a constant increase in acidity. Freeze-dried chive contained significantly less acids than the air-dried one, though a difference of only 8% was found between these products with reference to the content of acids.

An important utility trait of dried vegetable is their capacity to absorb water. The statistical differentiation of this trait was assessed in favour of freeze-dried samples (Table 2). Non-significant changes were observed in the rehydration during the storage of dried vegetables. Also in dill and celery Michalik & Dobrzański [15] found a higher rehydration of freeze-dried than of air-dried products. Contrary to the results reported by Jaworska [8], the above authors observed an identical capability of water absorption in air-dried and freeze-dried leaves of parsley.

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Table 2. Changes in absorption of water ability in stored dried chive[a], cm^3/100 g

Method of	Storage time in months				
drying	0	3	6	9	12
air drying freeze-drying	792 873	779 869	774 869	752 851	743 846
LSD p=0.05	55.8				

[a] - from four determination

Organoleptic traits of dried chive are given in Table 3. The freeze-dried product was characterized by a better preservation of shape and did not shrink, as shown by its double volume with the same weight in comparison with that of air-dried chive. On the other hand, owing to a greater access of the air (no storage in neutral gas being used), the quality of freeze-dried chive might have deteriorated, hence the difference in the organoleptic quality of the dried products was slight. Analogically to the above data, Poulsen & Nielsen [17] reported that the colour of chive subjected to rapid freezing and low pressure drying was lighter than that of the chive dried under higher pressure. In air-dried chive the smell of hay was perceptible, this confirming the results of Leino [14] who evidenced that the greatest amounts of compounds characterized by the smell of hay occurred in air-dried chive.

Table 3. Organoleptic characteristics of dried chive after 12-months storage

Trait	Method of drying	
	air-drying	freeze drying
Appearance	cut leaves uniform, distinctly flattened and shrivelled as compared with fresh chive	cut leaves uniform, and the tubular shape of fresh chive almost perfectly preserved
Colour	uniform vivid green with a slight olive shade	very uniform, paler than air-dried material, with a silver-white coat
Smell	medium typical and medium intense, with a slight smell of hay	very intense, very typical
Consistency	fragile	fragile
Taste	typical, not very spicy with palatable bitterness	very typical, spicy, intense

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Compared with air-drying, the freeze-drying method allows the production of dried chive characterized by more favourable organoleptic traits and chemical composition, although the organoleptic quality of air-dried chive may be regarded as fairly good. After 12-month storage of chive dried by these two methods the content of dry matter, total sugars, total nitrogen, ash, beta-carotene, and total chlorophylls and the degree of active acidity and ash alkalinity were not statistically different. During the drying procedure and the storing of dried chive losses of 24-34% concerned vitamin C, of 11-18% beta-carotene of, 19-21%-chlorophylls, and of 47-82% - volatile oils, always being greater in the air-dried product. On the other hand, the content of nitrates and total acids increased by 80-111% and 52-65%, respectively, with a greater increase in air-dried chive.

CONCLUSION

It is suggested by the negligible differences in the organoleptic evaluation of chive dried using the two methods, and also after 12-month storage by the differences in the content of vitamin C by 15%, of beta-carotene by 8%, chlorophylls by 3%, and nitrates by 15% in favour of the freeze-drying method, with a pronounced difference in volatile oils (194%), that the much more expensive freeze-drying method may only be recommended if the dried product is used in food whose distinct chive smell be obtained.

REFERENCES

1. AOAC (1984). Official methods of analysis, 14th ed. Association of Official Analytical Chemists. Arlington, USA.
2. Bąkowski, J., Michalik, H. (1986). Przydatność niektórych gatunków warzyw do produkcji suszu. Biul.Warzywn., 29, 191-211 (English summary).
3. Davies, B.H. (1965). Chemistry and biochemistry of plant pigments. Ed T.W. Goodwin. Academic Press. London and New York.
4. Denise, M.R., Rodriguez-Amaya, R.B. (1993). Avaliacao das perdas de carotenoides e valor de vitamina a durante desidratacao e liofilizacao industrial de espinafre. Agr.Biol.Technol. 36, 1, 83-94.
5. Flemmig, R. (1983). Nitratgehalt von Gewuerzmischungen und anderen pflanzlichen Zutaten. Fleischwirstschaft, 63, 6, 1046-1050.
6. ISO/6557/2. (1984). Fruits, vegetables and derived products - Determination of ascorbic acid content. Part 2: Routine methods.
7. ISO/6635. (1984). Fruits, vegetables and derived products - Determination of nitrite and nitrate content - Molecular absorption spectrometric method.
8. Jaworska, G. (1998). Wpływ sposobu suszenia i czasu przechowywania suszów z liści pietruszki na ich cechy jakościowe. Zeszt. Nauk. AR w Krakowie, s. Technol. Żyw. 10, 23-29 (English summary).
9. Karathanos, V.T., Kanellopoulos, N.K., & Belessiotis, V.G. (1996). Development of porous structure during air drying of agricultural plant products. J.Food Eng., 29, 2, 167-183.
10. Kmiecik, W., Lisiewska, Z., Jaworska, G. (1995). Zawartość azotanów i azotynów w suszach z liści pietruszki w zależności od jej typu, warunków suszenia i okresu przechowywania. Bromat. Chem. Toksykol., 28, 4, 339-343.(English summary).
11. Kmiecik, W., Lisiewska, Z. (1998). Effect of pretreatment and conditions and period of storage on some quality indices of frozen chive (*Allium schoenoprasum L.*). Food Chem., 61, 4.
12. Kon, M., Shimba, R. (1989). Changes in carotenoid composition during preparation and storage of frozen and freeze-dried squash. J.Japanese Soc.Food Sci. Technol., 36, 8, 619-624.
13. Lenart, A. (1996). Osmo-convective drying of fruit and vegetables: technology and application. Drying Technol., 14, 2, 391-413.
14. Leino, M.E. (1992). Effect of freezing, freeze-drying, and air-drying on odor of chive characterized by headspace gas chromatography and sensory analyses. J.Agric.Food Chem., 40, 1379-1384.
15. Michalik, H., Dobrzański, W. (1987). Jakość liści warzyw suszonych metodą owiewową i sublimacyjną. Przem.Ferm.i Ow-Warzywn., 6, 30-32.
16. Nijhuis, H,H., Torringa, E., Luyten, H., Rene, F., Jones, P., Funebo, T., & Ohlsson, T. (1996). Research needs and opportunities in the dry conservation of fruit and vegetables. Drying Technol., 14, 6, 1429-1457.

PRINT

17. Poulsen, K. P., Nielsen, P. (1979). Freeze-drying of chives and parsley - optimization attempts. Bul.Inst.Intern. Froid, 59, 4, 1118-1119.
18. Ranganath, D.R., Dubash, P. J. (1981). Loss of colour and vitamins on dehydration of vegetables. Indian Food Packer, 35, 4, 4-10.
19. Tuley, L. (1996). Swell time for dehydrated vegetables. Intern. Food Ingred., 4, 23-27.

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