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STUDIES REGARDING THE STORAGE CAPACITY AND ECONOMIC EFFICIENCY OF SOME SWEET POTATO VARIETIES CULTIVATED IN ROMANIA, IN THE CONTEXT OF THE EXPANSION IN CULTIVATION AS A CONSEQUENCE OF GLOBAL WARMING

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Abstract

Sweet potato consumption worldwide, but particularly in some African and South-East Asian countries, is second only to the potato as an important source of food for the population. Additionally, given the soil and climate requirements and the ongoing impacts of climate change, including global warming, sweet potato is a crop expected to increase in cultivation. This paper discusses the findings from studies on post-harvest management and the economic assessment of sweet potato cultivars in the marketing process. The duration of the quality keeping depends of the environmental conditions during storage, mainly temperature and relative humidity levels. The shelf-life was extended when stored at 13°C and 90% relative humidity (climatic room), lasting between 180 and 192 days, depending on the variety. In contrast, under ambient conditions of 18°C and 60% relative humidity, the shelf-life was shorter, ranging from 115 to 130 days, also depending on the variety. Overall losses at the end of storage were lower in the climatic chamber, ranging from 16% for Koretta to 23% for RO-CH-M.
It was also ascertained that over 98% of the output of the sweet potato cultivars correspond to the specific quality standard and the tubers production have a homogenous structure by quality categories, the value of quality category coefficient (Q) having values between 2.56 and 2.65.

Key words**:** *postharvest, storage period, weight losses, quality keeping, quality coefficient*

INTRODUCTION

Sweet potato (Ipomoea batatas) is a tropical tuber crop grown in warm seasons, ranking as the second most economically significant tuber crop worldwide, after the potato. It is a key food crop in numerous countries, mainly in Africa and Sud East Asia [6, 9, 13]. Sweet potato's ability to thrive in marginal environments, its role in enhancing household food security, and its adaptability in mixed farming systems make it a vital livelihood strategy for smallholder farmers. Sweet potato takes only a short period to maturity making it possible to produce food in areas with short rainfall seasons, aspect very important in the actual context of climate changes and global warming [1, 2, 3]. The sweet potato cultivar, growing conditions, maturity and storage conditions have a big influence on the nutrient composition and production [12].

Although the roots are mostly consumed soon after harvest, a properly cured sweet potato held under optimal temperature and relative humidity conditions can be stored for many months. Various types of sweet potatoes are planted in the world. Skin color, flesh color, dry matter, sweetness, and flavor differ among cultivars. However, the postharvest care and handling recommendations are identical for all types. Numerous pre-harvest factors influence the potential storage life of sweet potatoes. Heavy rainfall and saturated soil conditions prior to harvest may cause root fermentation and storage decay, especially if the vines have been removed before harvest. The amount of pre-harvest disease and insect pressure also influences postharvest life [7, 8].

Sweet potatoes do not mature as fruits do but continue to grow as long as conditions allow. Harvest time is determined by market price, expected total yield, and root size. Sweet potatoes should be harvested when most of the roots have attained the desired size for the target market. This typically requires between 3 to 3.5 months from the time of transplanting. After harvest, the storage of tubers may occur in short time, in order to have a good quality preservation of the product [4, 5].

The sweet potatoes should be kept in a separate well-insulated storage room at 13 °C ± 1 °C and 90 to 95 percent RH. Under these conditions, a storage life of 6 to 10 months is expected, although sprouting may begin after approximately 6 months, depending on the cultivar. Temperatures above 15°C lead to more rapid sprouting and weight loss. Roots can be stored up to a year without sprouting under optimal conditions [10,11].

In this context, the purpose of the paper is to present the results of the studies carried out regarding the post-harvest management process and the economic characterization of the sweet potato cultivars in the marketing process.

MATERIALS AND METHODS

Sweet potato tubers of the varieties Hayanmi, RO-CH-M, Dabu 23 and Koretta were harvested at the beginning of October 2023, from the experimental field of Research Station for Crop Culture on Sands (SCDCPN) Dăbuleni, Dolj County, Romania.

After harvesting, the tubers were kept in the laboratory of Horticultural Products Technology - Faculty of Horticulture Bucharest, under different environmental conditions, which constituted the 2 experimental variants:

V1 - T = 13°C and RH 90%, using climatic chamber (Photo 1, Photo 2).

V2 - T = 18°C and RH 60%, under ambient conditions, in a space away from light and heat.

Sweet potato tubers were weighed both before and after storage to assess weight loss. After harvest, only tubers in excellent phytosanitary condition were selected for storage. At the end of the storage period, the quality degradation (such as spoilage or sprouting) was evaluated. The SUS content of the tubers was measured using an Atago electronic refractometer at both harvest and the end of storage. The shelf-life was also determined, with the end of storage marked as the point when the sweet potato tubers lost their commercial value.

Photo 1.The temperature of climate chamber
Source: Photo taken by authors (Own source).

Fig. 2. Relative humidity of the climate chamber
Source: Photo taken by authors (Own source).

The economic efficiency of sweet potato valorization was determined by establishing the structure of production by quality categories (Q) using the formula:

Q = Kq/100, where K= 3 for extra quality; 2 for 1st quality; 1 for 2nd quality and 0 for that

intended for industrialization, and q is the percentage of the quality category.

According to American Standard No 51.1600/2005, sweet potato tubers are classified into quality classes according to physical parameters as follows:

- *Extra quality*: tuber length 7.5 - 23 cm, maximum diameter 8.2 cm, minimum diameter 4.5 cm and maximum weight 0.51 kg.
- *Grade 1*: tuber length between 7.5 - 23 cm, maximum diameter 9 cm, minimum diameter 4.5 cm and maximum weight 0.56 kg.
- *2nd quality*: tuber length between 7.5 - 18 cm, diameter between 3.8 and 5.7 cm.

RESULTS AND DISCUSSIONS

From the values presented in Table 1 , the following results were highlighted:

Soluble dry matter (SDM) content

At harvest, SDM content values ranged from 8.3% for Dabu 23 to 14.4% for Hayanmi. Koretta and RO-CH-M had intermediate values of 12.6% and 14.2% respectively. During storage, both due to further hydrolyzation of starch and its conversion into soluble carbohydrates and loss of water through transpiration (concentration), the SDM content increased.

Table 1. Behavior of sweet potato varieties during storage according to storage conditions

Variety	Storage variant	SDM (at harvest) %	SDM (end of storage) %	Storage period days	Weight loss %	Qualitative loss %	TOTAL LOSS %
HAYANMI	V1	14.4	15.2	192	11	7	18
	V2	14.4	15.8	130	16	10	26
RO-CH-M	V1	14.2	15.0	185	14	9	23
	V2	14.2	15.4	120	18	12	30
DABU 23	V1	8.3	9.0	185	14	7	21
	V2	8.3	9.6	125	20	10	30
KORETTA	V1	12.6	13.2	180	10	6	16
	V2	12.6	13.7	115	16	9	25

Source: Own results. V1 – T=13° C; UR= 90% V2 – T = 18° C; UR = 60%

Thus, under V1 conditions, the determined values ranged from 9% for Dabu 23 (Photo 3), 13.2% for Koretta (Photo 4), 15% for RO-CH-M (Photo 5), and 15.2% for Hayanmi (Photo 6).

Photo 3. Dabu variety - 23 SUS 9%
Source: Authors' s source.

Photo 4. Koretta variety - SUS 13.2%
Source: Authors' source.

Photo 5. RO - CH - M variety - SUS 15%
Source: Authors' s source.

Photo 6. Hayanmi variety - SUS 15.2 %
Source: Authors' source.

In sweet potato tubers stored at a higher temperature and lower relative humidity (V2), metabolic activity was more intense, so that SUS values at the end of storage were higher compared to V1. They ranged from 9.6% in Dabu 23, 13.7% in Koretta, 15.4% in RO-CH-M and 15.8% in Hayanmi, respectively.

Storage duration

Sweet potato tubers stored under the two experimental variants showed different behavior depending on variety and storage conditions. It was observed, as expected, that the longest storage period was observed at V1, practically under the environmental conditions recommended in the literature. Thus, the storage time under V1 conditions ranged from 180 days for Koretta variety, 185 days for Dabu 23 and RO-CH-M varieties and 192 days for Hayanmi variety, respectively.

Under ambient storage conditions (V2), the shelf-life was reduced compared to V1 by 60-65 days. The results obtained showed a storage life of 115 days for Koretta, 120 days for RO-CH-M, 125 days for Dabu 23 and 130 days for Hayanmi.

Weight loss

Due to the metabolic activity of sweet potato tubers but mainly due to water loss by transpiration during storage, weight losses were higher under ambient storage (V2) compared to cold storage (V1).

Weight losses, even after a longer storage period were lower in V1 compared to V2. Thus, under V1 conditions, losses were 10% for Koretta, 11% for Hayamni and 14% for RO-CH-M and Dabu 23. In tubers stored under ambient conditions (V2), weight losses were 16% for Hayanmi and Koretta, 18% for RO-CH-M and 20% for Dabu 23, respectively.

On a monthly average basis, weight losses under V1 storage conditions ranged from 1.66% to 2.33% depending on the variety, and from 2.66% to 3.33% for V2, also depending on the variety.

Quality scores

Quality downgrading caused by microbiological spoilage or sprouting of tubers was higher in sweet potato tubers stored under ambient conditions (V2) than in the climatic chamber (V1).

The values obtained under V1 conditions ranged from 6% for Koretta, 7% for Hayanmi and Dabu 23 and 9% for RO-CH-M.

The highest values recorded for tubers stored under V2 conditions ranged from 9% for Koretta, 10% for Dabu 23 and Hayamni and 12% for RO-CH-M.

It should be noted that in Dabu 23 and Hayanmi, at the end of storage under ambient conditions (V2), the tubers showed sprouting (Photo 7 and 8).

Photo 7. Dabu 23 variety, sproute
Source: Authors' s source.

Photo 8.Hayanmi variety, sprouted
Source: Authors' source.

Total losses

The total losses resulting from the sum of weight losses and quality downgrades were higher in the environmental storage conditions (V2) than in the climatic chamber (V1).

Thus, under V1 conditions, the values recorded were 16% for Koretta, 18% for Hayanmi, 21% for Dabu 23 and 23% for RO-CH-M, respectively.

The higher values recorded for tubers kept in the climate chamber (V2) ranged from 25% for Koretta, 26% for Hayanmi, 30% for Dabu 23 and RO-CH-M, respectively.

Economic efficiency of sweet potato tubers valorization

The structure by quality categories of sweet potato varieties cultivated in the experimental field of SCDCPN Dăbuleni is presented in Table 2.

It results that 98 - 99.3% of the total production of all varieties meet the requirements of the quality standard for fresh sweet potatoes.

The coefficient of the quality categories, which characterizes the homogeneity of the variety from the qualitative point of view, in the three cropping systems ranged between 2.56 and 2.65. The close values of this coefficient indicate the qualitative homogeneity of the cultivated varieties.

Table 2. The quality structure of sweet potato, in the valorization process

Variety	Quality structure - %-				Total according quality standard	The coefficient of the quality category
	Extra class	First quality class	Second quality class	Industry class		
HAYANMI	75.0	13.0	10.8	1.2	98.8	2.62
RO-CH-M	74.5	9.4	14.2	1.9	98.1	2.56
DABU 23	76.2	10.8	12.3	0.7	99.3	2.65
KORETTA	73.8	12.6	11.6	2.0	98.0	2.58

Source: Own results.

CONCLUSIONS

The optimal storage conditions recommended for the storage of sweet potato tubers are: temperature of 13°C and RH of 90%.

SUS content at harvest ranged from 8.3% in Dabu 23 variety to 14.4% in Hayanmi variety.

At the end of storage, the values were higher than at harvest, ranging from 9% - 15.2% (V1) and 9.6-15.8% (V2), respectively, depending on the variety.

The shelf-life was longer under storage conditions in climatic chamber V1, with values of 180-192 days, depending on the variety, and

lower values under ambient conditions (V2), ranging from 115 to 130 days, also depending on the variety.

The total losses at the end of storage were lower in the climatic chamber (V1), where they ranged from 16% for Koretta to 23% for RO-CH-M.

When stored under ambient conditions (V2), the highest values of total losses ranged from 25% for Koretta to 30% for Dabu 23 and RO-CH-M.

Analyzing the results as a whole, it can be seen that the best keeping capacity (shelf life correlated with total losses) was shown by the Hayanmi variety and the lowest by the Koretta variety.

Economic quality indicators of sweet potato varieties show that:

- 98 - 99.3% of the total production falls within the quality standard specific to the valorization of fresh sweet potato tubers,
- the coefficient of the quality categories (Q) had values between 2.56 and 2.65, which indicates the homogeneity of the quality structure of all 4 studied varieties

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