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The influence of storage conditions on quality parameters of head cabbage with conical heads

INTRODUCTION

White head cabbage (*Brassica oleracea* L. var. *capitata* f. *alba*) is a popular vegetable crop grown in temperate climate regions. In Poland, consumption per capita of this vegetable is relatively the highest among all vegetable crops. Most of head cabbage cultivars form big heads of oval shape, but recently vegetable breeders obtained cultivars with heads of conical shape and smaller, quite loose heads. Conical cabbage is grown on a limited scale yet, mainly in West Europe. These cultivars are generally aimed at fresh market and are consumed during vegetation season, in summer. However, in order to extend the consumption period there is a need to store the crop with keeping its good quality.

The objective of the study was to determine the influence of storage of the conical cabbage on chosen quality parameters of the heads in relation to storage conditions – regular cold store with normal atmosphere and cold store with controlled atmosphere. The practical aspect of the study was aimed to answer if the CA storage would be useful as a method to keep better quality of this vegetable during medium-long storage period. As the quality indices, overall sensory quality and consumer acceptance were also taken into account in the evaluation.

MATERIAL AND METHODS

Cultivars of conical cabbage used for the experiment were 'Caraflex F1' and 'Bejo 2654' (Bejo Zaden, Holland). They are recommended for cultivation in spring or autumn. Plant material was obtained from experimental field of WULS. Cabbage heads were harvested on 10th October and then were stored for 3 months at following conditions:

- regular cold store (NA),
  temperature 0-1°C, 95 RH, normal atmosphere
- controlled atmosphere storage (CA),
  temperature 0-1°C, 95 RH, 5% CO_2 + 3% O_2, the reminder gas – N_2

At the harvest time and after 3-month storage the following parameters were determined: dry matter content in the heads, soluble solids content, nitrate (V) content, vitamin C content, as well as colour of outer leaves of the heads in the CIE L*a*b* system. Weight losses resulting from heads respiration and transpiration were determined additionally after the storage. After the storage sensory evaluation was performed. The evaluation was carried out at the sensory laboratory, with quantitative descriptive analysis method. The trained panel, consisting of 12 persons, carried out the evaluation. The same panel was used for semi-consumer test of overall liking of the cabbage samples. Overall quality and liking were scored in 0-10 point nonstructural scale, on a computer.

RESULTS

Table 1. Natural weight losses of conical cabbage heads during storage (%)

Cultivar	After storage at NA	After storage at CA	Means for cultivars
Caraflex	6.02	5.82	5.92 a
Bejo 2654	8.00	6.10	7.05 b
Means for storage	7.01 b	5.96 a	

Note to Tab. 1 – 10: Means marked with different letters differ at P = 0.05

Table 2. Mass percentage of marketable conical cabbage heads after storage (%)

Cultivar	After storage at NA	After storage at CA	Means for cultivars
Caraflex	78.6	82.0	80.3 a
Bejo 2654	79.9	88.2	84.1 b
Means for storage	79.3 a	85.1 b	

Table 3. Dry matter of conical cabbage heads (%)

Cultivar	Before storage	After storage at NA	After storage at CA	Means for cultivars
Caraflex	21.1	22.3	22.5	22.0 b
Bejo 2654	20.3	20.6	21.2	20.7 a
Means for storage	20.7 a	21.5 b	21.9 b	

Table 4. Soluble solids content in conical cabbage heads (%)

Cultivar	Before storage	After storage at NA	After storage at CA	Means for cultivars
Caraflex	5.4	6.0	5.9	5.8 a
Bejo 2654	5.7	5.3	5.8	5.6 a
Means for storage	5.6 a	5.7 a	5.9 b	

Table 5. Vitamin C content in conical cabbage heads (mg 100 g^{-1} fw.)

Cultivar	Before storage	After storage at NA	After storage at CA	Means for cultivars
Caraflex	25.9	17.5	24.0	22.5 b
Bejo 2654	21.3	16.7	21.9	20.0 a
Means for storage	23.6 b	17.1 a	23.0 b	

Table 6. Nitrate(V) content in conical cabbage heads (mg NO_3 kg^{-1} f.w.)

Cultivar	Before storage	After storage at NA	After storage at CA	Means for cultivars
Caraflex	510	621	514	548 a
Bejo 2654	542	562	498	534 a
Means for storage	526 a	592 a	506 a	

Table 7. The L* value (lightness) for conical cabbage heads in CIE L*a*b* system

Cultivar	Before storage	After storage at NA	After storage at CA	Means for cultivars
Caraflex	65.3	69.8	67.1	67.4 a
Bejo 2654	68.9	73.2	69.5	70.5 b
Means for storage	67.1 a	71.5 c	68.3 b	

Table 8. The a* value (green color) for conical cabbage heads in CIE L*a*b* system

Cultivar	Before storage	After storage at NA	After storage at CA	Means for cultivars
Caraflex	-8.4	-4.3	-7.2	-6.6 b
Bejo 2654	-8.0	-3.7	-6.5	-6.1 a
Means for storage	-8.2 c	-4.0 a	-6.9 b	

Table 9. The b* value (yellow color) for conical cabbage heads in CIE L*a*b* system

Cultivar	Before storage	After storage at NA	After storage at CA	Means for cultivars
Caraflex	24.1	26.8	25.2	25.4 a
Bejo 2654	25.2	28.1	26.7	26.7 b
Means for storage	24.7 a	27.5 c	26.0 b	

Table 10. Results of sensory evaluation of conical cabbage heads – overall sensory quality and consumer liking (score 0-10)

Cultivar	Means for factors	Scores for	
		Overall quality	Overall liking
Caraflex	NA	6.55	6.37
Bejo 2654	NA	6.51	6.20
Caraflex	CA	6.82	6.54
Bejo 2654	CA	6.38	7.27
Means	NA	6.53 a	6.29 a
	CA	6.60 a	6.91 b
	Caraflex F_1	6.69 a	6.46 a
	Bejo 2654	6.45 a	6.74 a

CONCLUSIONS

1. **Controlled atmosphere (CA) conditions decreased quality changes, which occurred during 3-month storage of heads of the conical cabbage.**
2. **The storage under CA conditions resulted also in smaller changes of CIE colour parameters of the heads, related to the tissue senescence, in comparison with the storage under normal atmosphere.**
3. **Therefore, storage of cabbage heads in CA store, with gas composition of atmosphere of 5% CO_2 + 3% O_2, seems to be a better alternative for storage of the heads than storage in a regular cold store, i.e. under normal atmosphere conditions.**

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