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THE INFLUENCE OF THE GROWTH REGULATOR AKM ON THE BIOCHEMICAL COMPOSITION OF TOMATOES AND ITS CHANGE DURING THEIR STORAGE

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Rezumat. Scopul principal al cercetării a fost studierea influenței stimulatorului de creștere AKM asupra cantității de substanțe nutritive și de substanțe fiziologic active și asupra duratei de păstrare a tomatelor (soiurile Eleonora și Klondike), în condiții de stepă uscată. Soluția apoasă de AKM (substanța activă $3 \cdot 10^{-5}$ g/l) a fost utilizată pentru înmuierea semințelor înainte de plantare și pentru stropirea plantelor de tomate în perioada de vegetație. Cercetarea demonstrează că odată cu aplicarea preparatului AKM a crescut cantitatea de substanță uscată (cu 0,44%), de zahăruri (0,32%), de acid ascorbic și de β -caroten (7,5 – 11,3%) în tomate. Durata de păstrare a tomatelor s-a mărit cu 7-10 zile. De asemenea, s-a redus pierderea substanțelor nutritive și a substanțelor biologic active, ceea ce a făcut posibilă păstrarea produselor pentru un termen de 30 de zile și menținerea calității lor normale.

Cuvinte cheie: *Lycopersicon esculentum*; Regulator de creștere; Tomate; Compoziție chimică; Capacitate de păstrare

Abstract. The main aim of our research was to study the influence of the growth stimulator AKM on the amount of nutrients and physiologically active substances and the shelf life of tomatoes (varieties Eleonora and Klondike) in dry steppe conditions. Water solution of AKM (active substance $3 \cdot 10^{-5}$ g/l) was used for soaking the seeds before planting and for spraying the vegetating tomato plants. The research proves that the application of AKM increased the amount of dry matter (by 0.44%), sugars (0.32%), ascorbic acid and β -carotene (7.5-11.3%) in the fruits, improved their shelf life and increased the fruit storage period by 7-10 days. The decay of nutrients and biologically active substances decreased, which makes it possible to store the products for 30 days and keep their normal quality.

Key words: *Lycopersicon esculentum*; Growth regulator; Tomatoes; Chemical composition; Shelf life

INTRODUCTION

The biological value of tomatoes is due to the presence of easily digestible sugars, organic acids, mineral substances and the complex of physiologically active substances of stress protector type (phenols, carotenoid, pectin and ascorbic acid) in the fruit (Dvornikov, V.N. 2005; Kravchenko, V.A., Prylipka, O.V. 2007). These features are determined by variety genotype, but the external conditions can influence a lot the content of physiologically active substances in tomatoes. The application of growth regulators (Reastim, Biolan, iodine humate, Crezatsin) for soaking seeds before planting and spraying the vegetating plants contributed to the accumulation of soluble dry matter, sugars and ascorbic acid (Gavris, I.L. 2007; Fedurina, O.N., Soromotina, T.V., 2012). Undoubtedly, the effect of exogenous growth regulators on the chemical composition of tomatoes depends on water and climatic conditions, growth regulator type, method of its application, as well as on other factors. However, there is not enough systematic research on this subject and the obtained results are contradictory.

The main aim of our research was to study the influence of AKM growth stimulator on the amount of nutrients and physiologically active substances and the shelf life of tomatoes in dry Steppe conditions.

MATERIAL AND METHODS

The experiments were held at Akimomka testing station of NAAS of Ukraine and in the laboratory of plant physiology and biochemistry of SRI of agrotechnology and ecology of Tavria State Agrotechnological University in 2010-2011. The objects of our research were tomato varieties Eleonora and Klondike (List of plant varieties ... 2007).

Tomato plants were cultivated via the seedling method using the intensive technology (DSTUI SO 874-2002). Water solution of AKM growth regulator (active substance $3 \cdot 10^{-5}$ g/liter) was used in the research variants for soaking seeds before planting and for spraying the vegetating plants (List of pesticides ... 2010). The seeds and plants in the control variants were processed by water.

Tomato fruits were collected by hand every 4-5 days, without allowing them to become over mature and were sorted according to DSTU 3246-95. The yield was determined for every area with recalculation for 1 ha.

The storage of tomatoes was done in the experimental and productive storage center of TSAU at the temperature of 6-8°C according to DSTU ISO 5524-2002. Sample selection and preparation for the analysis was done according to DSTU ISO 847-2002.

Biochemical composition of fruits was done according to the standard methods: amount of dry matter – thermogravimetric method (Gorodniy, M.M., Melnichuk, S.D., Gonchar, O.V. et al. 2006), sugar concentration – DSTU 4954:2002, titrated acids – GOST 22555.0-82, ascorbic acid – using Tillman's reagent.

Statistical analysis of the results was done using the dispersion analysis method (Dosphehov, B.A. 1985).

RESULTS AND DISCUSSIONS

Earlier we had proven (Karpenko, K.M. 2011) that the application of AKM growth regulator on seeds and vegetating plants stimulates the growth of both vegetative and generative organs and increases fruit yield by 21-26% compared to the control plants. The output of standard products was 3.9–4.6% higher (abs.).

Researches prove that seeds soak and non-root application of AKM had a positive effect on the biochemical composition of matured fruits (Tab. 1). Fruits of both varieties had increased the amount of dry matter by 0.44%. O.N. Fedurina and T.V. Soromatina observed the similar effect of growth regulators on the amount of dry matter in fruits (Fedurina, O.N., Soromatina, T.V. 2012).

The variety Klondike has more sugars, fact which is determined by the variety genotype. The application of AKM on the seeds and plants increased the amount of sugars in both researched varieties. However, the variety Eleonora had a higher increase (0.32%).

Table 1. Biochemical composition of tomatoes depending on the application of AKM growth regulator (2010-2011)

Index	Variety				SVD 05
	Eleonora		Klondike		
	without GR	with AKM	without GR	with AKM	
Dry matter, %	5,39	5,83	4,89	5,32	0,23
total sugar, %	3,04	3,36	3,43	3,67	0,15
Titrateable acidity, %	0,66	0,70	0,51	0,58	0,03
Ascorbic acid, mg/100g	15,44	16,21	14,06	14,75	0,36
β - carotene, mg/100g	1,42	1,58	3,18	3,42	0,12

AKM application led to the increase of titrateable acidity in both varieties, but the reaction was less in the Eleonora variety. Thus, the sugar-acid index had the tendency to increase in Eleonora variety due to the influence of AKM, while in Klondike variety it decreased. It should be mentioned that tomatoes cultivated in stress conditions of dry Steppe, accumulated more organic acids, compared to fruits cultivated in the zone of enough humidity (Sveshnichova, E.V. 2009).

High temperatures and low relative air humidity in the dry Steppe leads to greater use of ascorbic acid in the system of tissues protection against oxidative damages. Thus, the amount of ascorbic acid was low in both varieties, but due to the influence of AKM preparation the amount of ascorbic acid increased in both cases. The obtained data is similar to the specialized literature data (Fedurina, O.N., Soromatina, T.V. 2012), fact which proves that the synthesis and accumulation of ascorbic acid goes better when applying anti-stress growth regulators.

β -carotene holds an important place in the system of antioxidant protection, its amount in orange tomatoes (Klondike) is 2.2 times higher than in the red tomatoes (Eleonora). The application of AKM preparation to the seeds and plants increased the amount of β -carotene in the fruits by 11.3% for the variety Eleonora and by 7.5% for the variety Klondike. Thus, due to the influence of AKM, tomatoes formed a more effective system of antioxidant cell protection, which proves the anti-stress features of AKM growth regulator.

The application of AKM preparation in tomato cultivation increased the storage period of fruits up to 32-40 days, which is 7-10 days longer compared to the control variant. The decay of nutrients and biologically active substances decreased; fact which allowed to get products of normal quality after 30 days of storage (Figures 1-5). The most intensive decrease in the amount of dry matter was observed during the 10th – 20th days of storage, which is caused by climatic increase of breathing (Fedurina, O.N., Soromotina, T.V. 2012). In total, the decrease of dry matter amount in tomatoes grown with AKM preparation, after 30 days of storage was of 0.76-0.87% compared to 0.92% as for the control variant (Fig. 1).

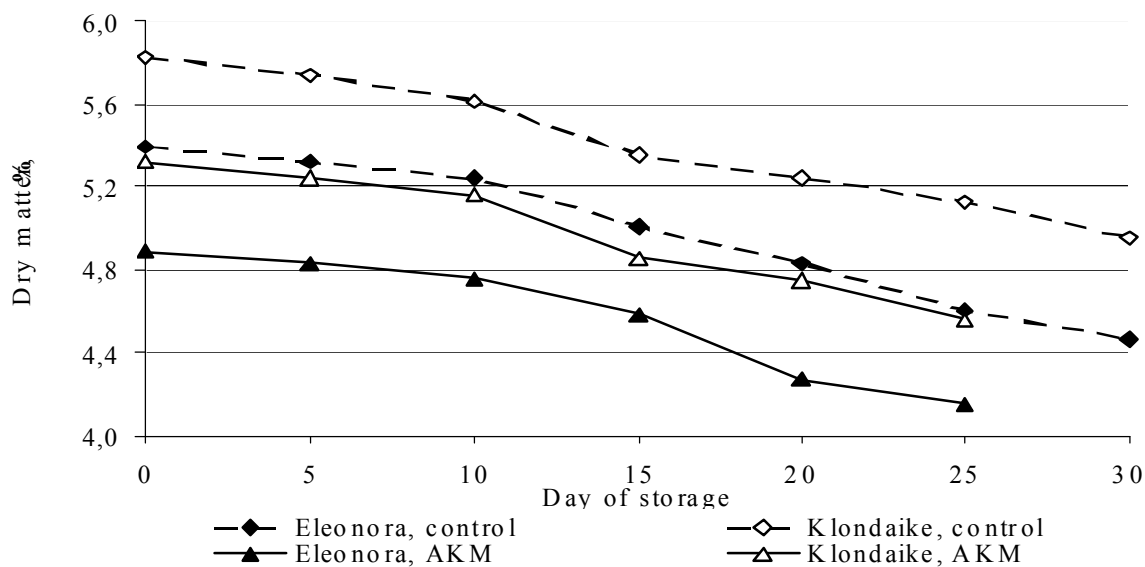


Figure 1. Dynamics of dry matter amount in tomatoes during the storage (2010-2011)

The most intense process that took place was the oxidation of organic acids. Regardless of genotype and method of growing tomato plants, the reduction in the amount of titratable acids after 30 days of storage was of 0,24-0,27% compared to the initial value of this parameter 0,51-0,7% (Fig. 2).

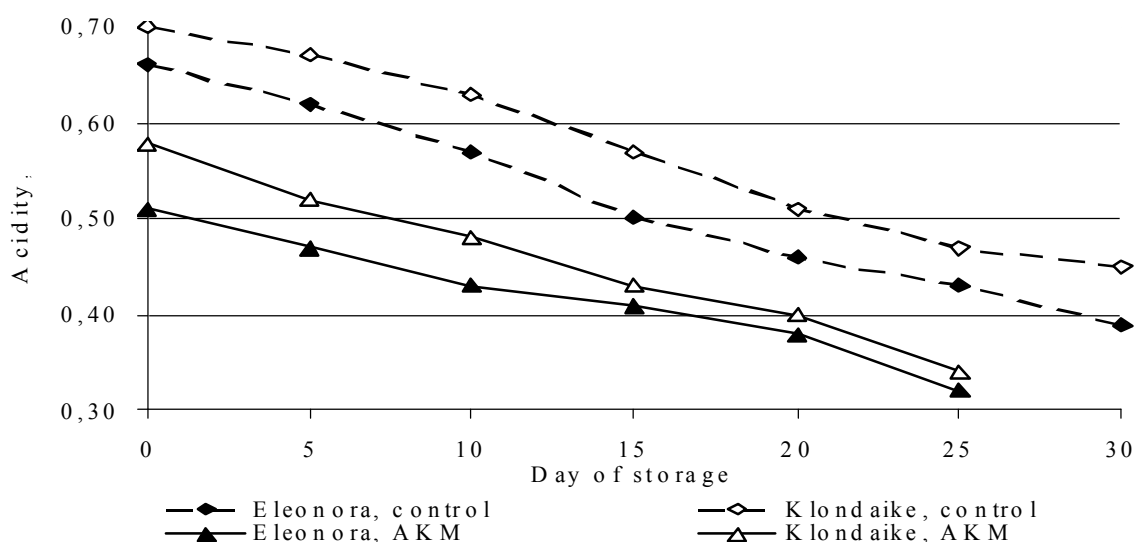


Figure 2. Dynamics of titratable acids amount in tomatoes during the storage (2010-2011)

At the same time, the process of sugars' oxidation in the tomatoes grown with AKM application was more intensive and therefore the decrease of sugars amount after 30 days of storage was of 18% (rel.) and 14% in the control variant (Fig. 3).

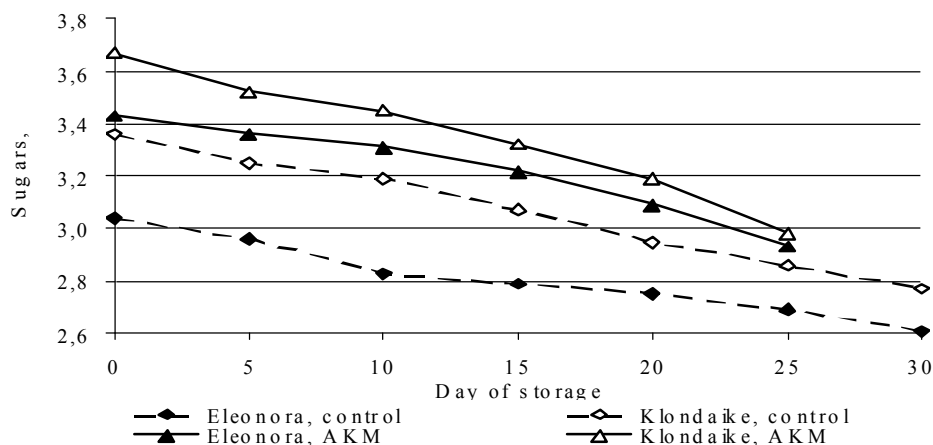


Figure 3. Dynamics of sugars amount in tomatoes during the storage (2010-2011)

Tomato storage was accompanied by the decrease of the ascorbic acid (Fig. 4) and β -carotene (Fig. 5) amount, which prevented the oxidative damage of membranes and the occurrence of physiological diseases in fruits. However, shelf life of these substances was much higher in the tomato variety Klondaïke compared to the variety Eleonora. AKM preparation had a valid effect on the shelf life of β -carotene and had little effect on the shelf life of ascorbic acid.

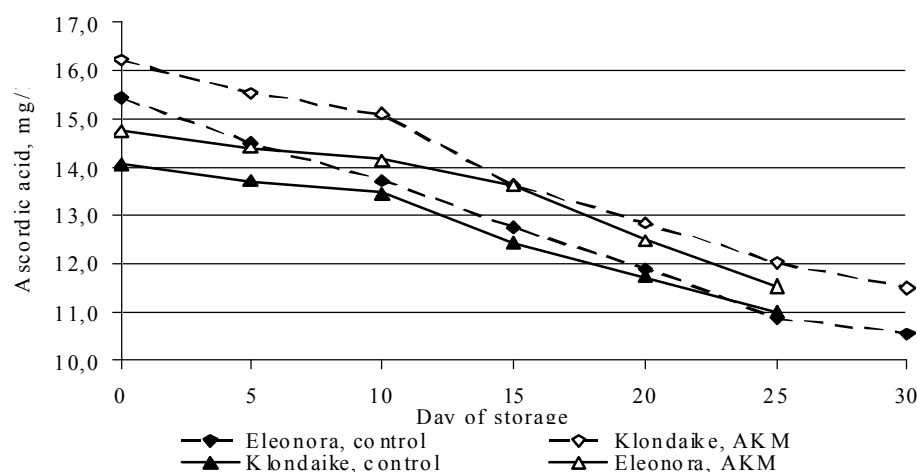


Figure 4. Dynamics of ascorbic acid amount in tomatoes during the storage (2010-2011)

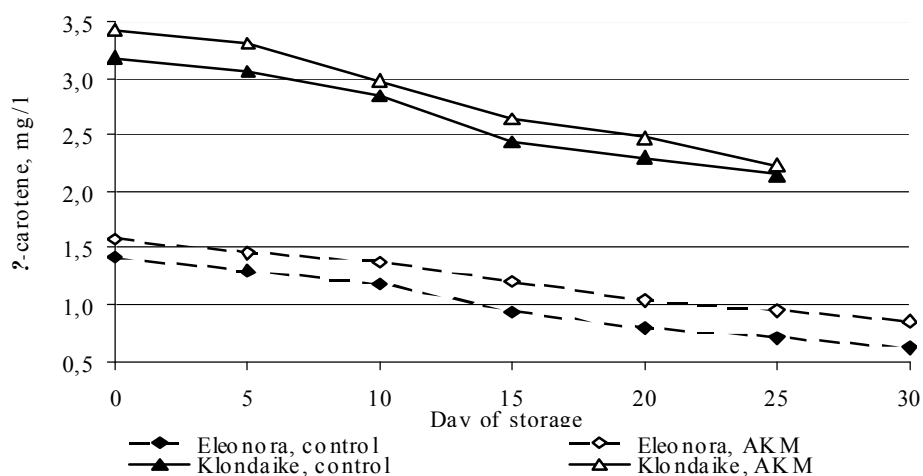


Figure 5. Dynamics of β -carotene amount in tomatoes during the storage (2010-2011)

CONCLUSIONS

Our study showed the effect of AKM preparation application in tomato cultivation under stress conditions of open field. Its application in soaking seeds before planting and foliar spraying of the vegetating plants increased the amount of dry matter, sugars, ascorbic acid and β -carotene in the fruits, improved their shelf life and increased the fruit storage period by 7-10 days.

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