

POSSIBILITY OF USAGE OF SELECTIVE MEMBRANES FOR VEGETABLE PRODUCTS STORAGE

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Abstract: The article considered possibility of vegetable products storage in modules with modified gaseous atmosphere by usage of selective membranes. Results of experimental investigations by storage of apples in cameras of commercial refrigerating equipment are stipulated here.

Key words: module, modified gaseous atmosphere, selective membranes.

Increase of vegetable products storage times is one of the key components of food safety. Resolution of a problem of food safety is impossible without improvement of food stock storage methods. Stoppage of spoilage processes is used on practice; with this aim optimal methods of technological treatment, package, storage and transportation of food products are worked out.

On the basis of carried out analysis it was determined that during some last decennaries the most widespread in world is usage of hermetic packages with modified gaseous atmosphere by refrigeratory storage of both vegetable and other products.

Main objective of work was to determine possibility of usage of modified gaseous atmosphere for storage of vegetables and fruits. In order to achieve mentioned goal compact module with semi-permeable membranes was used in this work. Because of selective gas penetrability of polymeric materials self-regulated gas exchange between modified gaseous atmosphere inside limited volume and air environment of refrigerator camera takes place in this module. Estimation of efficiency of module's work was made on the basis of experimental data about kinetics of apples quality spoilage (content of vitamin C, hardness) and composition of gaseous atmosphere (content of ethylene, O₂, CO₂ and N₂) in process of storage.

There were examined two main methods of barrier mechanism creation by penetration of gas atmosphere through membranes. In first case membranes from continuous films were used. In such membranes diffusion of CO₂ and O₂ is carried out through surface. In second case perforated films with small holes were used as gas exchange transport net. It was determined that character of membranes' penetrability depends upon choice of molecular structure of membrane's material, its thickness and surface area, and also on temperature gradients and gaseous atmosphere pressure. Penetrability of CO₂ and O₂ for continuous films is increased with temperature rise, while gas diffusion through perforated holes is practically independent of temperature changes.

Main indices of polymeric membranes which were used in experiments: - diameter of working area – 23,0 ± 0,5 mm; - thickness of membrane – 0,120 ± 0,020 mm; - area of membrane – 4,15 cm; - capillary diameter of membrane – 5.....25 μm.

Investigation of dynamics of apples' quality degradation process by refrigeratory storage was made with usage of three alternative variants:

- placing of apples in isolated hermetic module from plastic (module with closed top);
- placing of apples in hermetic modules with selective membrane;

- placing of apples in open module from plastic (with opened top);

Apples of variety “Renet Semyrenko” were chosen as object of investigation.

All lot of apples selected for placement met requirements to first rate. Primary indices: content of vitamin C – 13,1%; hardness – 170 kg/cm²; ethylene content – 53 mg/kg; O₂ = 9,9%, N₂ = 85,2%, CO₂ = 3,6%. By carrying out of investigations temperature was maintained on level $t = 2-3^{\circ}\text{C}$, and relative humidity of air was not less than $\varphi = 95\%$.

Impoverishment limit of O₂ for apples “Renet Semyrenko” was set on level – 2%, because at lower concentrations anaerobiosis processes became stronger.

Measurements of gaseous composition were made on gas chromatograph “Цбер 5000”. In accordance with technical characteristics of device measurements error did not exceed $\pm 0,5\%$.

Storage of apples in modules with modified gaseous atmosphere allowed slowing down processes of ripening and continuation of storage times without decreasing good quality.

Increasing of content of CO₂ and decreasing of O₂ slows down vital activity processes, preventing spoilage processes (flesh darkening, etc).

It is confirmed that increasing of ethylene concentration in packages by apples storage is one of factors which has negative influence upon storage duration. Investigations showed that by active ventilating of loading area selective properties of membranes permit to decrease considerably such influence.

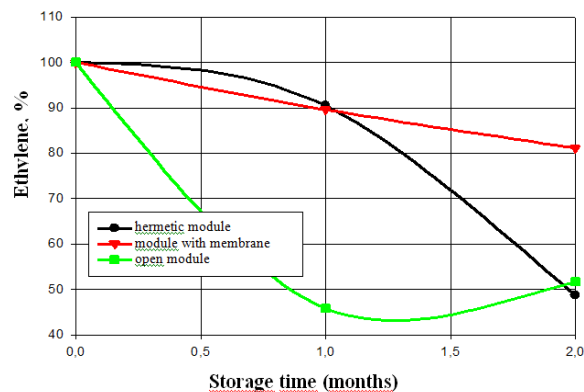


Fig. 1. Decreasing of ethylene concentration depending on storage time

Made investigations showed that by use of hermetic packages with selective membranes, parameters of atmosphere in packages correspond to requirements for optimal storage of apples and permit to continue storage time.

On fig. 2 there is change of Vitamin C content in process of storage of apples in module with modified gaseous atmosphere. Change of content of Vitamin C in apples in first two months practically does not depend on storage technology. Henceforth rates of decreasing of mentioned quality measure by storage in module with membrane slow down and remain practically unchanged till storage times ending.

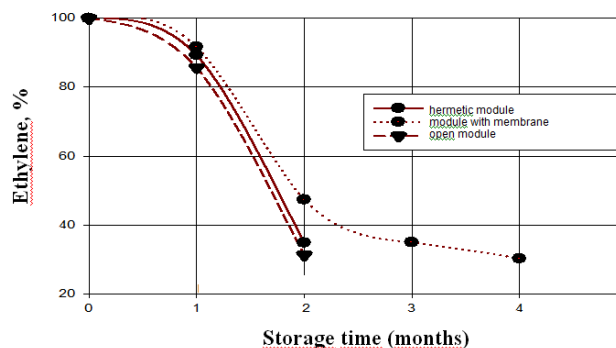


Fig. 2. Change of Vitamin C content in apples by refrigeratory storage

Under results of carried work following conclusions can be made:

- technologies of controlled and modified atmospheres are the most effective method of increasing of duration of vegetable products storage times;

- observations which were conducted during 120 days, showed that usage of modules with selective membranes as method of management with content of gaseous atmosphere saves quality of apples and increases durability of storage time in 2-3 times.

- for effective use of modules with modified gaseous atmosphere for the purpose of continuation of high-quality storage of apples and other production it is necessary irrespective of production type to select membranes according to selectivity indices which secure maintenance of technologically admissible level of CO₂ and O₂ inside packages for this type of cargo, and ablation of ethylene to environment.

Hereafter it is planned to make investigations with use of modules and polymeric membranes for determination of effectiveness of vegetable production storage.

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