

## HALF-FINISHED VEGETABLE PRODUCTS OF HIGH READINESS

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### Abstract

Quality of production is of great importance in application of new technologies in catering enterprises. Foodstuff changes during preparation of food products take place. The perspective storage method for food is packaging in vacuum or modified gas atmosphere. Modified atmosphere packaging is the method to prolong storage time by days or even weeks, preserving high quality, original taste and texture appearance of the foodstuff, and improving overall cost-effectiveness. Packaged products have been stored in a chilled room in light at different temperatures. Qualitative changes of vegetables during storage have been investigated with instrumental methods. Regimes of storage time are determined, taking into account their influence on the structure-mechanical properties of the product. Elements of HACCP system are used.

**Key words:** vegetables, packaging, modified atmosphere, half-finished products.

### Introduction

Quality of fresh vegetables is influenced by several factors:

1. internal factors (chemical content of food products, active acidity pH of the medium, water activity  $a_w$ , contamination level of raw material with micro-organisms);
2. external factors (pre-treatment and processing technologies, storage temperature, type and material of packaging, atmosphere in the package) (Soroka, 1995).

The most significant factor, characterising where and what food products consumer buys, is the safety and quality of the product which is provided by adequate packaging.

To comply with the current market demands, packaging has to provide: harmlessness, quality permanence of the food product, prolonged storage time, protection against mechanical and other external damages, protection against subordinate contamination, information availability about the packaged product and, the most important, it has to arouse consumer's interest. Packaging by use of modified atmosphere medium – MAP or vacuum is considered as potential methods in storage of food products without using preservatives (Hotchkiiss, 1999).

Therefore in order to determine the optimum type of packaging for salad mixes, the following objective is proposed: to investigate quality changes of fresh vegetable salad mixes during storage in packages with protective gasses – modified medium by applying HACCP principles.

### Materials and Methods

Four different types of vegetable salad mixes from the farm “Ezerkaulini” are used in the research:

- red cabbage salad mix;
- kale salad mix;
- lettuce salad mix;
- cauliflower-celery salad mix.

Fresh vegetable salad mixes are used with the aim to estimate their quality and storage possibilities in the commercial network where their storage temperature changes from +2 °C to +6 °C, with the shelf-life of 7 days. Mixes are packed in a polypropylene box 190×140×50 mm, surrounded by a polypropylene bag of the size 260×190 mm, thickness 38 micrometers, applying gas mix: O<sub>2</sub> 10%:CO<sub>2</sub> 10%:N<sub>2</sub> 80%. Polypropylene packaging is mechanically more durable and safeguards the packaged product against mechanical deformation, as well as its thermo stability from -30 °C to +140...+160 °C insures warming up of ready-made packed foodstuff for nutrition without removing it from the package. Net weight of the package is

300±0.5 g. All salad mixes are stored for 11 days at two different temperatures +2±1 °C and +6±1 °C, experiments carried out in three repetitions.

The following items are determined during storage:

1. Mass changes by using electronic scales *ACCULAB IV-600*;
2. Changes in active acidity pH level of the medium by using *INOLAB SELECTA pH 720 pH-meter*;
3. Determination of breathing intensity influence on the composition of protective gasses in the package during storage by using the analyzer *OXYBABY<sup>®</sup>V O<sub>2</sub>/CO<sub>2</sub>*;
4. Colour changes by using the „ColorTecPCM/PSM" equipment in colour system CIE L\*a\*b\*;
5. Content of ascorbic acid (vitamin C) in salads (mg 100 g<sup>-1</sup>) is determined by iodine method (T-138-15-01:2002);
6. The total number of micro-organisms is determined according to *LVS ISO 4833:2003* with the method of dilution and sowings on Petri dishes.

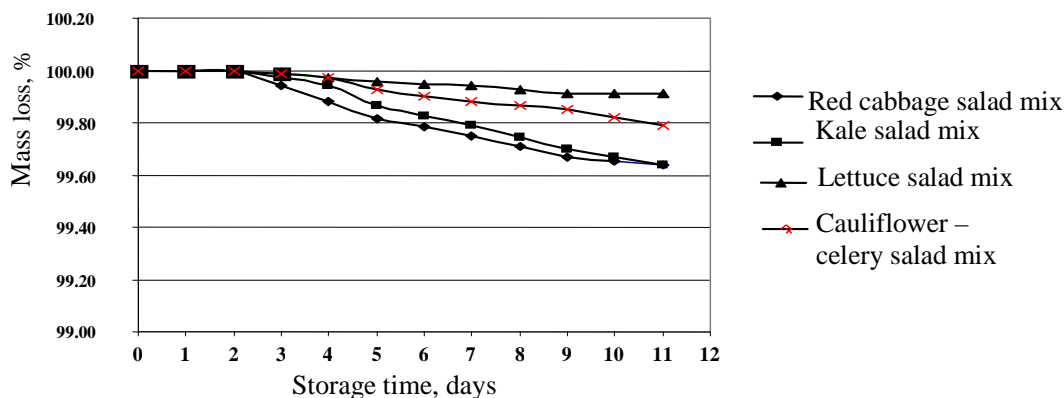
Research is carried out at the research laboratories of Microbiology and Packaging material qualities at the Faculty of Food Technology, Latvia University of Agriculture.

### Results and Discussion

Evaluating the technological process of making salad according to the requirements of HACCP system principles, as the possible stages in emergence of potential risk reasons turn out to be pre-treatment of vegetables, their storage before and after packaging and the very procedure of packaging. In all these stages of technological process the most important is the microbiological risk reason, but in the process of vegetable pre-treatment also the physical risk reason.

In order to prevent emergence of potential risk reasons, principles of good hygiene practice and principles of good production practice have to be strictly observed. Therefore attention was paid to the quality of drinking water used in the pre-treatment process, air pollution in the cooling chamber of the product, harmlessness of the packaging material and the very process of packaging.

As the storage process of packaged vegetables is one of the most important, changes of physical and microbiological quality indices are determined just in this stage of technological process.

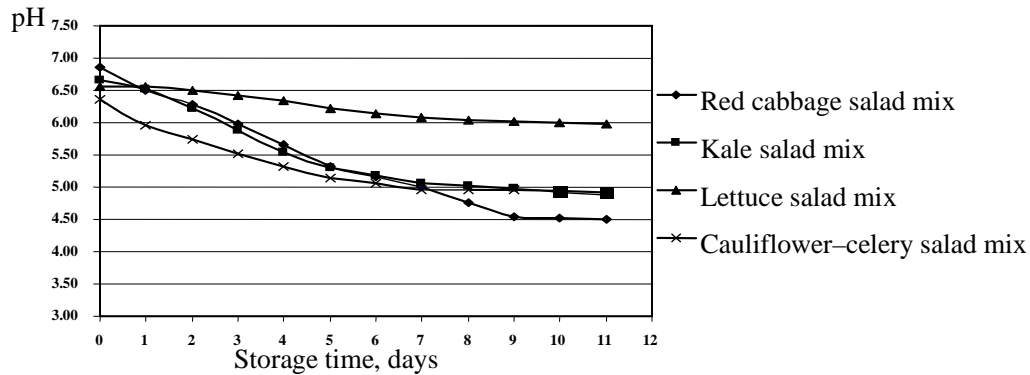


**Figure 1. Changes of mass in salads during storage at the temperature 2±1 °C**

Water vapour migration through the chosen packaging material is insignificant; during storage it provides slight mass loss. The packaged mass almost does not change till the third day of storage, mass loss ranges between 0.01–0.03% in comparison with the initial gross weight of the package.

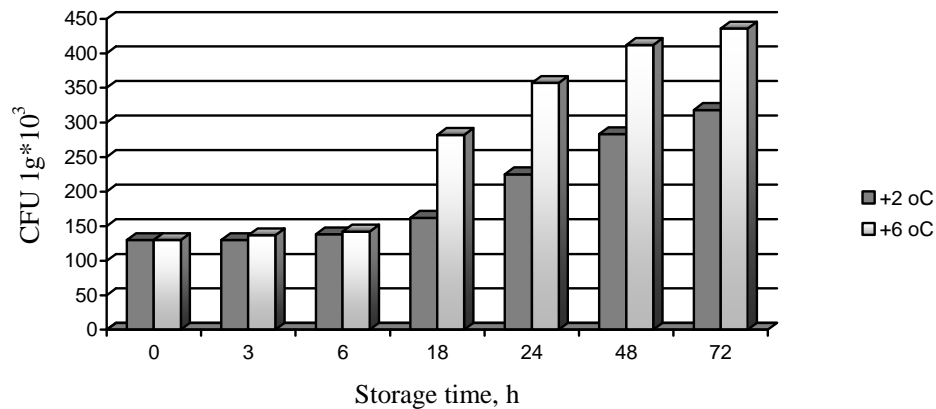
The active acidity pH of vegetable cell sap essentially affects micro-organisms cell metabolism because bio-catalytic agents – enzymes of metabolism have pH interval of certain

activity. In sour medium, characteristic to the prepared salad mixes, cell sap prevents development of proteolytic bacteria, but facilitates development of yeast and mould.



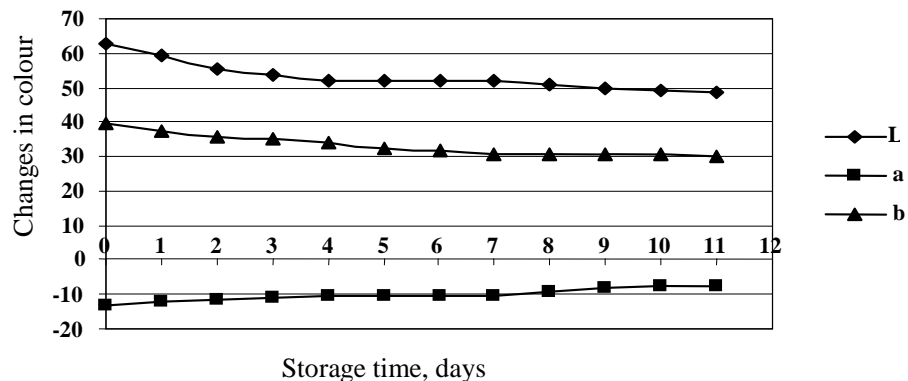
**Figure 2. Changes in pH level during storage at the temperature 2±1 °C**

Changes in active acidity pH indicate the development of micro-organisms and activity in the package during storage (Baumgart, 1993).



**Figure 3. Changes in total number of micro-organisms in Lettuce salad during storage**

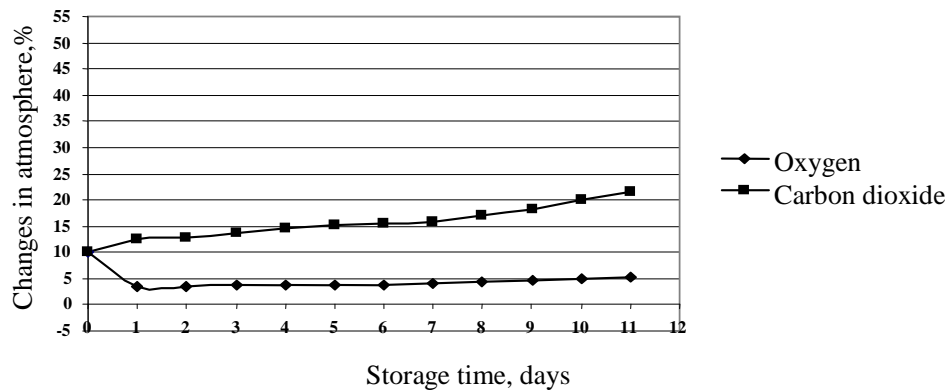
By carrying out research it was ascertained that aerobic spore formers – bacteria of *Bacillus* family, were dominating. (These bacteria split organic compounds. The presence of *E. coli* form bacteria was not found in any of the prepared salad samples. The total number of bacteria starts to increase much faster after 24 hour long storage and during storage increases twice.



**Figure 4. Changes in colour of „Lettuce salad mix” during storage at the temperature +2±1 °C**

By estimating changes in colour of fresh salad mix with three-stimulus colorimeter, three quantities  $L$ ,  $a$  and  $b$  are obtained. The quantity  $L$  denotes colour intensity,  $a$  – amount of red and green colour,  $b$  – amount of yellow and blue colour. Colour changes in package are estimated at two different temperatures. By comparing influence of temperature on stability of colour, it is observed that in higher temperature tissue colouring is faster, because during more intensive breathing process water vapour forms faster facilitating this process.

While storing lettuce salad mix at the temperature  $+2\pm 1$  °C it is observed that quantity  $L$  of colour intensity has changed from 62 to 49 at the end of the storage. During the first four days changes taking place are the fastest. Quantity  $a$  also changes from -14 to +2 and quantity  $b$  decreases from 40 to 30 at the end of storage. Similar results are obtained by storage of salad mix at the temperature  $+6\pm 1$  °C. Decrease of colour intensity could be explained by degradation of chlorophyll, which is facilitated by decrease of medium active acidity pH level (Zariņš, 2002).



**Figure 5. Changes of modified medium in the package during storage of Lettuce salad mix at  $+2\pm 1$  °C**

Packaging is suitable for storage of Lettuce salad mix because composition of protective gasses changes slightly – carbon dioxide from 10% to 21% and oxygen from 10% to 6.2%. Oxygen concentration is sufficient to prevent anaerobic metabolism processes. The natural aroma of the product is well maintained during storage.

### Discussion

Environmental temperature has an essential impact on number of products bacteria packed in modified medium because by increasing the temperature solubility of carbon dioxide decreases in the liquid stage of products wherewith it does not have so strong abilities to suppress micro-organisms.

Quality of products in modified atmosphere packaging is significantly influenced by temperature. The preferable storage temperature is in the range between  $0\pm 1$  °C and  $+4\pm 1$  °C. The natural freshness of vegetables and storage period are influenced by characteristic properties of the product as well as external factors. Thus the external factors influencing quality are the following: temperature; sanitary and hygienic conditions; gas atmosphere; production methods. The factors mentioned have crucial significance during the production and storage of the product.

### Conclusions

1. The packaging used provides minimal mass losses.
2. Numerical quantity of pH decreases during storage what ascertains the fact that splitting of carbohydrates takes place and organic acids are formed.
3. The packaging material used for lettuce salad mix is suitable for storing salad up to 3 days because during storage changes in content of protective gasses  $O_2$  are minimal, as well as

changes in total sum of micro-organisms taking place after 72 h storage period are admissible: from 10–6.2% and CO<sub>2</sub> from 10–21.6%.

4. The total number of bacteria increases for 2.2 times, when salads are stored for 72 hours at the temperature 2 °C, but for 3.2 times if stored at 6 °C.
5. When determining colour changes it is ascertained that colour intensity changes the most in Red cabbage and Cauliflower-celery salad mixes, but minimal changes take place in Kale and Lettuce salad mixes.

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