# STUDII PRIVIND INFLUENŢA ATMOSFEREI MODIFICATE ÎN DIOXID DE CARBON ASUPRA PĂSTRĂRII DE SCURTĂ DURATĂ A FRUCTELOR DE ZMEUR
# STUDIES ON THE INFLUENCE OF CARBON DIOXIDE MODIFIED ATMOSPHERE ON SHORT TERM STORAGE IN RASPBERRY FRUIT

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**Abstarct**

**The storage of fruits in modified atmosphere rich in carbon dioxide slows down the aging and the action of pathogens. Research has shown that loss decreases with increasing carbon dioxide concentration and duration of treatment. The percentage of fruit affected by pathogens is very small, the best option is 20% $CO_2$ atmosphere maintained for two days at a temperature of 2° C. Weight loss had the lowest values at increased $CO_2$ concentration and conservation time. The appearance of the fruits varied very little, and the taste varied between parameters: very good and acceptable.**

**Cuvinte cheie** : fructe de zmeur, dioxid de carbon,păstrare
**Keywords**: raspberry fruit, carbon dioxide, storage

## 1. Introduction

Using gas inhibitory effect on the metabolic activity of the product and the pathogens during transport has been studied by many researchers. Following experiments they showed that both the low level of $O_2$ and the high concentration of $CO_2$ reduced respiration rate (Beaudry, 1999; Cameron, 1989; Joles, Cameron, Shirazi, 1994).

Earlier results also indicated that transportation of strawberries, raspberries and cherries, in modified atmospheres using carbon dioxide concentrations of 20-25% had relevance to transport over long distances. (Marcellin, 1974).

All models used in the experiments requires knowledge of the rate of $O_2$ consumption and $CO_2$ evolution on the rate of respiration which are based on the composition of $O_2$ and $CO_2$ in the environment (Beaudry, Cameron, Shirazi and Dostal-Lange, 1992).

There have been numerous efforts to create the necessary gas mixture around the fruits and to establish the mathematical equations for calculating the concentration of $O_2$ and $CO_2$ from the microatmosphere in a polymeric film for packaging (Jurin and Karel, 1963). It was used computerized methods to solve the mathematical equations for calculating the gas concentration in the packaging system for transportation (Henig and Gilbert, 1975).

All the above mentioned models require the knowledge of the $O_2$ consumption rate and $CO_2$ evolution concerning the respiration rate, which are based on $O_2$ and $CO_2$ composition from medium.

Laboratory tests with fruit raspberry were made to create the possibility of substantiating their behavior in different modified atmospheres, rich in carbon dioxide (10% $CO_2$, 20% $CO_2$ and 30% $CO_2$) and determining whether these atmospheres can be used to transport these fruits.

The purpose of these measurements was to determine the usefulness and optimal percentage of carbon dioxide of modified atmospheres, to transport in fresh and short storage of the fruit, possibility in which the attack of pathogens to be the lowest, and the fruit to retain the original properties.

## 2. Material and methods

Researches have been conducted on raspberry fruits (mixture of species), using equipment such as:

- hermetically sealed container for maintaining the tested carbon dioxide concentration;
- climate chamber TBV - 2000; INFRALIT fan gas analyzer ($CO_2$ measurement range 0-50%);
- Ryan recording thermometer;
- Solomos maintained thermohygrographic probe and display;
- weighing with 0,001 kg accuracy.

The research method consisted of analytical and comparative analysis on the behavior of raspberry fruit in normal atmosphere and modified atmosphere with carbon dioxide at cold (in climate chamber at a temperature of approx. 2°C) and hot (in laboratory at a temperature of approx. 25° C).

We achieved the following treatments:

- $V_{02}$ - Control - normal atmosphere in exsicator, period of maintenance 6 days
- $V_7$ - Modified atmosphere $CO_2$ concentration of 10% for 1 day and 6 days period maintenance
- $V_8$ - Modified atmosphere $CO_2$ concentration of 20% for 1 day and 6 days period maintenance
- $V_9$ -Modified atmosphere $CO_2$ concentration of 30% for 1 day and 6 days period maintenance
- $V_{10}$ -Modified atmosphere $CO_2$ concentration of 10% for 2 days and 6 days period maintenance
- $V_{11}$ -Modified atmosphere $CO_2$ concentration of 20% for 2 days and 6 days period maintenance
- $V_{12}$ -Modified atmosphere $CO_2$ concentration of 30% for 2 days and 6 days period maintenance

There have been observations and determinations in dynamics with respect to:

- the appearance of the fruit;
- firmness;
- organoleptic analyses;
- weight loss;
- the phytosanitary state of the fruit.

Raspberry (different varieties) was harvested directly into casseroles.

For each variant were introduced in the climate chamber three repetitions at a temperature of $2^0$ C. There were followed the experiences with a maintenance period of six days because this is the length of an average transport in Europe. During experience within a day or 2 days, was removed the carbon dioxide through the vent with a compressor. After the containers and the fruit exsicators were removed, the organoleptic analysis was done, which has been repeated after 2 days. Also during the inspection it was determined the evolution of weight loss.

## 3. Results and discussions

The value of losses in Raspberry is presented in the table 1. It may be noted that weight loss decreases with increasing carbon dioxide concentration and with increasing duration of treatment. In the 10% $CO_2$ treatment appeared an infection with botrytis cinerea. After removing samples from the climate chamber the first test of organoleptic quality controls was performed. After two days a new test was carried out. Assessment of organoleptic qualities (appearance, firmness and taste) is shown in tables 2 and 3.

As can be seen from tables 2 and 3 the variant that has the highest score is $V_{11}$ (20% $CO_2$ and 2 days treatment) followed by $V_8$ and $V_7$. The appearance varies slightly, and only between Nice and very nice. Firmness has values between good and very good, with two exceptions: $V_{02}$ and $V_{12}$. The taste has the highest value to the Control, close to very good; variants, $V_7$, $V_8$, $V_{10}$, $V_{11}$ have values between good and very good; $V_9$ and $V_{12}$ variants approaching acceptable rating.

Raspberry fruits raised no issues of phytosanitary nature. After keeping the 5 days at a temperature of 20° C and high relative humidity (approx. 90%) a grey and white mycelium of Botrytis cinerea grew only to Control variants with 10% carbon dioxide (table 4).

## 4. Conclusions

In experiments with raspberries, the conclusions drawn are:

- weight loss decreases with increasing $CO_2$ concentration and maintenance period of treatment;
- weight loss are lower by 60% in variants with modified atmospheres compared to the Control variants;
- organoleptic qualities of fruits raspberries are appreciated with the highest scores at variant with 20% $CO_2$ and 2 days treatment;
- the percentage of fruit affected by pathogens is very small and only appeared in Control and variants with 10% $CO_2$;

For raspberries, optimal treatment option for transport is considered to be 20% $CO_2$ atmosphere maintained for 2 days and a temperature of 2° C.

## References

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**Tables and figures**

**Table 1. Losses occurred in experiments on raspberry fruit behavior after a treatment with $CO_2$ for 6 days maintenance period**

| Variant | Symbol | Total losses | | Of which | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Weight loss | | Losses devaluations by soaking | | Losses (depreciations) by Mildewed | |
| | | 1 day | 2 days | 1 day | 2 days | 1 day | 2 days | 1 day | 2 days |
| Control | $V_{02}$ | - | 24.92 | - | 3.5 | - | 20.2 | - | 1.22 |
| Modified atmosphere with CO2 at a concentration of 10% | $V_7$ | 10.95 | - | 1.6 | | 9.35 | - | - | - |
| | $V_{10}$ | - | 9.67 | - | 1.4 | - | 8.25 | - | 0.22 |
| Modified atmosphere with CO2 at a concentration of 20% | $V_8$ | 9.96 | - | 1.20 | | 8.7 | - | - | - |
| | $V_{11}$ | - | 9.0 | - | 1.2 | - | 7.8 | - | - |
| Modified atmosphere with CO2 at a concentration of 30% | $V_9$ | 9.34 | - | 1.23 | - | 8.11 | - | - | - |
| | $V_{12}$ | - | 8.71 | - | 1.2 | - | 7.51 | - | - |

**Table 2. The assessments of organoleptic qualities of raspberry fruit after 6 days storage in modified atmosphere**

| Organoleptic qualities / treatment | $V_{02}$ | $V_7$ | $V_8$ | $V_9$ | $V_{10}$ | $V_{11}$ | $V_{12}$ |
|---|---|---|---|---|---|---|---|
| Appearance | 11.2 | 11.2 | 13 | 12 | 13 | 14.4 | 11.2 |
| Firmness | 26.2 | 29.4 | 29.4 | 28 | 28 | 29.4 | 26.6 |
| Taste | 40.0 | 36.66 | 38 | 34.66 | 38.33 | 38 | 34.33 |
| Total | 77.4 | 77.26 | 80.4 | 74.66 | 79.33 | 81.8 | 72.13 |
| **Classification** | **4** | **5** | **2** | **6** | **3** | **1** | **7** |

**Table 3. The assessments of organoleptic qualities of raspberry fruit after 6 days storage in modified atmosphere and two days in normal atmosphere**

| Organoleptic qualities / treatment | $V_{02}$ | $V_7$ | $V_8$ | $V_9$ | $V_{10}$ | $V_{11}$ | $V_{12}$ |
|---|---|---|---|---|---|---|---|
| Appearance | 13.5 | 13 | 14.5 | 12 | 14 | 14.5 | 13.5 |
| Firmness | 28.66 | 30.66 | 32.33 | 32.66 | 31.5 | 35 | 32.33 |
| Taste | 46.0 | 44.66 | 46.33 | 35 | 42 | 42.66 | 29 |
| Total | 88.13 | 88.32 | 91.16 | 79.66 | 87.5 | 92.16 | 74.83 |
| **Classification** | **4** | **3** | **2** | **6** | **5** | **1** | **7** |

**Table 4. Phytosanitary state of raspberry fruit maintained in modified atmosphere with carbon dioxide**

| **INFECTED FRUIT WITH PATHOGENS AFTER FOLLOWING TREATMENT WITH CO2 FOR ONE DAY AND 6 DAYS STORAGE (%)** | | | | |
|---|---|---|---|---|
| **Initial** | **Control $V_{02}$** | **$V_7$** | **$V_8$** | **$V_9$** |
| 0 | 12.5 Botrytis Penicillium | 6.4 Botrytis | 0 | 0 |
| **INFECTED FRUIT PATHOGENS FOLLOWING TREATMENT WITH CO2 FOR TWO DAY AND 6 DAYS STORAGE (%)** | | | | |
| **Initial** | **Control $V_{02}$** | **$V_{10}$** | **$V_{11}$** | **$V_{12}$** |
| | 12.5 Botrytis Penicillium | 2.1 Botrytis | 0 | 0 |