INVESTIGATION OF THE PROCESS OF STORING PACKAGED PUMPKIN IN MODIFIED ATMOSPHERE

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Abstract: *The article presents experimental studies with packaged in modified atmosphere and stored refrigerated grated pumpkin and chopped pumpkin. We have used three types of gas environment: 30% CO_2 / 70% N; 100%CO_2 and vacuum. We have drawn up time temperature curves during refrigerator storage. We have defined the variation of CO_2 in the packages during storage. On the base of microanalysis we have defined the shelf life.*

Keywords: *modified atmosphere, cold storage, shelf life, pumpkin*

1. Introduction

Fruits and vegetables are still alive after being harvested. Their shelf-life is defined by several factors, such as harvest ripeness, store temperature, content of the gas environment, type and material of the packaging, availability of microorganisms and others [1, 2, 3, 4]. Their storing in refrigeration units increase the possibility of longer quality lasting periods of the products. The packaging in modified atmosphere is one of the ways for additional increase the shelf-life (1) or allows their storing at higher temperature.
The defining of shelf-life of a product is a complex investigation of the store temperature, the gas environment content and microflora.
The aim of the present work is to define the most suitable out of the three gas environment types for storing of grated pumping and chopped pumpkin at same refrigeration temperature.

2. Materials and methods

For packaging of grated pumpkin and intact pieces of pumpkin is used semi automatic packaging machine Tray sealer Fibosa with two trays – Fig. 1.

Figure 1. Chamber of the packaging machine with packaging trays

Figure 2. Control desk of the packaging machine

Polypropylene (PP) trays with dimensions 130 x 215 mm (fig. 3) are used for packaging.

The upper foil, which seals the tray has high stoppage effect on gases and vapours. It is multi ply Lintop PP DAN. This is a foil, which has very high stoppage effect on oxygen, carbon dioxide and water vapours. The values of oxygen permeability are under 15 cm^3/m^2.24h.bar at 23°C and RH 0% according to ASTM D 3965, the values of carbon dioxide permeability are under 75 cm^3/m^2.24h.bar at 23°C and RH 0% according to ASTM D 3965 and the values of water vapours permeability is under 3 g/m^2.24h.bar at 23°C and RH 85% according to ISO 2528.

The foil thickness is 50 μm and the basis weight is 46 g/m^2. The strength characteristics are defined according to ASTM D882. The sealing temperature of the upper oil to the base, which can be PP as well as PE, is 170 °C.

Figure 3. Packaging tray

Figure 4. Upper foil Lintop PP DAN

The grated pumpkin and intact pieces pumpkin is packed in three different packages in condition of each gas environment, as the sealing seams are visually inspected. One of them is put aside for microbiological analysis as a control sample and the rest are put in a refrigerator „Liebherr" CT2841and are stored in refrigeration conditions. The reading and registration of the temperature is done by R.I.C.S. (Remote Integrated Control System) EVCO ITALY, which has 5 separate temperature probes – Pt, placed as it is shown on Fig. 5.

During storage the gas environment content is measured by portable gas analyzer PBi Dansenzor „CheckPoint".

After expiration of the 5 days set storage period of the pumpkin, we separate the microbiological availability by the following methods:

- BDS EN ISO 4833:2004 Microbiology of food and animal feeding stuffs - Horizontal method for the enumeration of microorganisms - Colony-count technique at 30 degrees C ;
- BDS EN ISO *7954*:2002 Microbiology -- General guidance for enumeration of yeasts and moulds -- Colony count technique at 25 degrees C *yeasts and molds;*

The reading and registration of the temperature is done by the temperature probes of R.I.C.S. which are located in the following zones (Fig. 5)

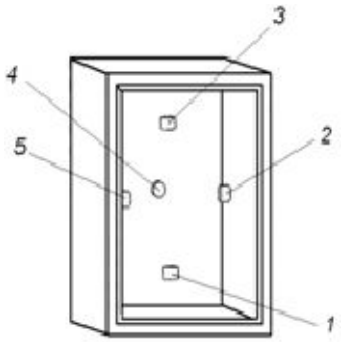

Figure 5. Location of the temperature probes
1 lower part; 2,4,5 central part;
3 in the room.

3. Results and Discussion

The temperature variation in the refrigerator CT 2841 Liebherr has been followed for the whole store period and we

have presented data for only two days (48 hours), because during the next days the temperature has no variations(Fig.3 and 4)

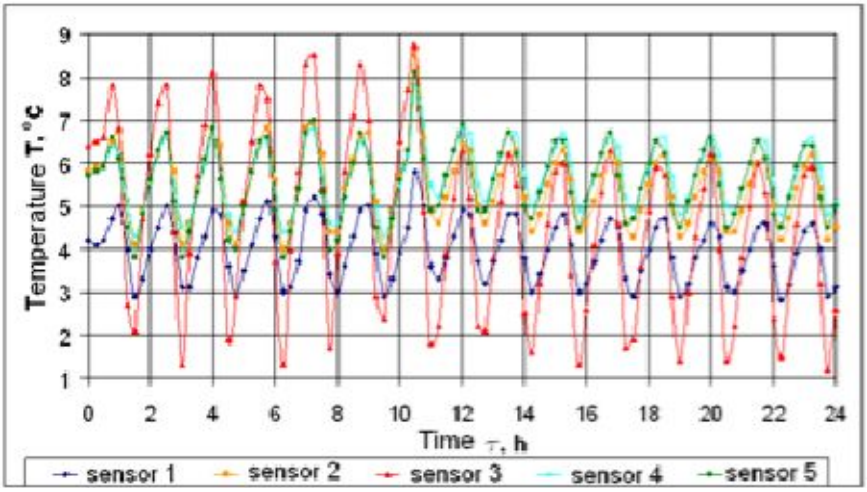

Figure 6.Store temperatures during the first day

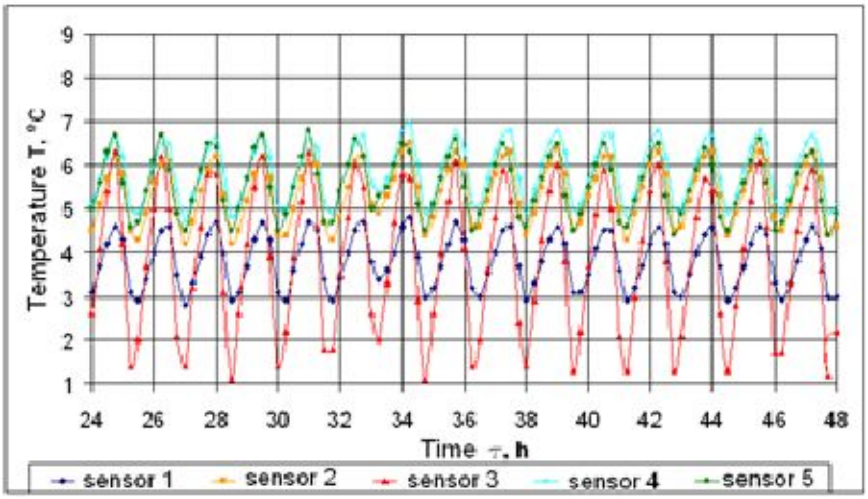

Figure 7.Store temperatures during thesecond day

The packaged pumpkin is stored in the central zone of the refrigerator (sensor 2, 4 and 5). We can see on fig. 6 that the upper part of the refrigerator (sensor 3) has the highest temperature variation. This is observed only during the first 10 hours, until the input packages are cooled down. The average temperature of the stored pumpkin for the whole period is 5.5 ^{o}C, but the shelf life is defined by the maximal temperature of 6.5 ^{o}C.

The breathing of fruits and vegetables is a biochemical process, related to evolving heat and carbon dioxide. The higher store temperature is related with more intensive breathing of the packaged fruits. This means reduction of O_2 quantity and increasing the CO_2 quantity in packages, made of high barrier property materials.

Using the gas analyzer we reported the CO_2 content of each sample during the separate days of the refrigerator storage (5,5 ± 1^{o}C). You can see the results for the CO_2 content in Table 1.

Fig. 8 and Fig.9 graphic of CO_2 content at storing in vacuum packaging of intact and grated pumpkin.

Table 1
Pumpkin, packaged with upper foil Lintop

Packaging environment content	Condition of the pumpkin	№ of sample	CO_2, content %	
			Third day	Fourth day
Air	grated	1	2,4	2,9
Vacuum	intact	2	2,6	3,3
	intact	3	2,5	3,1
	grated	4	3	3,2
	intact	5	3,1	4,4
	intact	6	2,9	3,7
	intact	7	2,5	2,8
30% CO_2 :70% N_2	intact	8	3,7	4,6
	intact	9	11,1	10,6
	grated	10	14,8	13,5
	intact	11	4,5	5,8
100% CO_2	intact	12	7,6	7,2
	grated	13	43,6	39,3
	intact	14	39,7	31,5
	intact	15	7,8	4,0
	intact	16	10,7	9,6
	intact	17	9,3	8,9

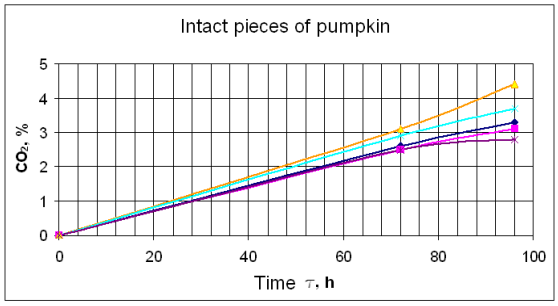

Figure 8. CO_2 content in packages with intact pieces of pumpkin (upper foil Lintop) packaged in vacuum

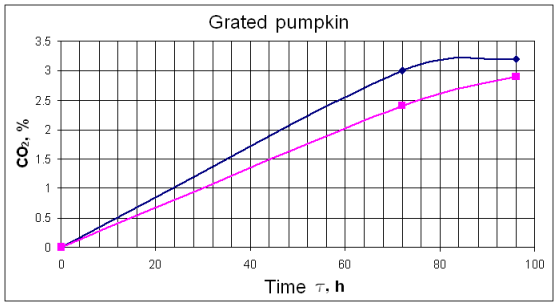

Figure 9. CO_2 content in packages with grated pumpkin (upper foil Lintop) packaged in vacuum

During storage in vacuum in grated condition as well as intact pieces condition of the pumpkin we observer similar CO_2 content variation. The breathing is an aerobic process which is sopped in case of oxygen absence it is stopped. In our case the process is due to the incoming through the foil oxygen and even the bigger surface of the grated pumpkin has no effect.

On Fig. 10 and 11 we can see a graphic of the CO_2 content of packages with gas environment of grated and intact pieces of pumpkin.

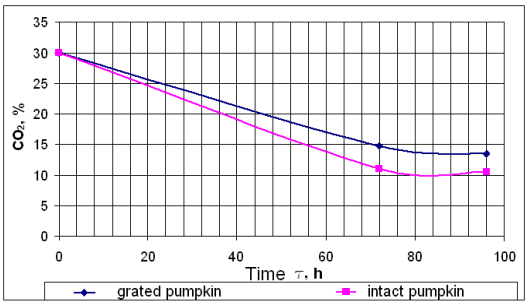

Figure 10. CO_2 content in packages of pumpkin (upper foil Lintop) Packaged in gas environment 30% CO_2 :70% N_2

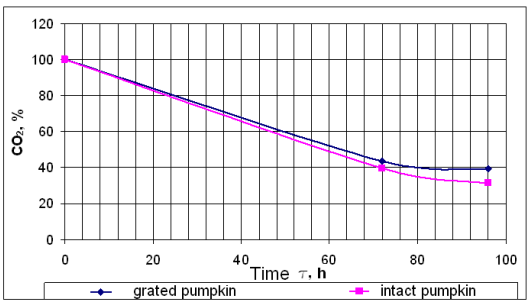

Figure 11. CO_2 content in packages of pumpkin (upper foil Lintop)Packaged in gas environment 100% CO_2

On the graphics of Fig 10 and 11 we can see the decreasing CO_2 in the packages, as in the case with the grated pumpkin the breathing process is more intensive and the CO_2 content is higher in the end of the storage period.

When storing fruits and vegetables, for better quality of the end product it is necessary to observe the microbiological pollution as well as the maintaining of low temperature.

We can see on table 2 experimental results from microflora of pumpkin (grated and intact) packaged in different gas environment: 100% CO_2, 70:30% N_2: CO_2 and vacuumed after 5 days storing in refrigerator (5,5 ± 1°C).

Table 2.Packaging of pumpkin

	Grated pumpkin		Intact pumpkin	
	Total microbial counts, CFU/g	**Yeasts and molds, CFU/g**	**Total microbial counts, CFU/g**	**Yeasts and molds, CFU/g**
100% CO_2	7,7. 10^3	over 10	1,87. 10^3	over 10
30% CO_2 / 70% N_2	3,1. 10^4	10	7,5. 10^4	over 10
Vacuum	1,6. 10^4	over 20	over 10^4	over 10

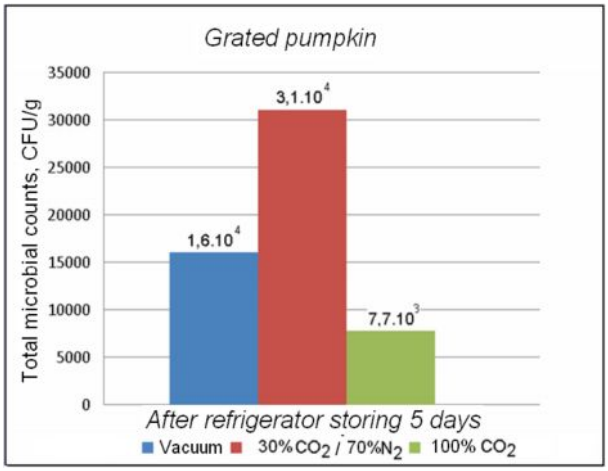

Figure 12.Total microbial counts in grated pumpkin after refrigerator storing(5,5±1°C) 5 days

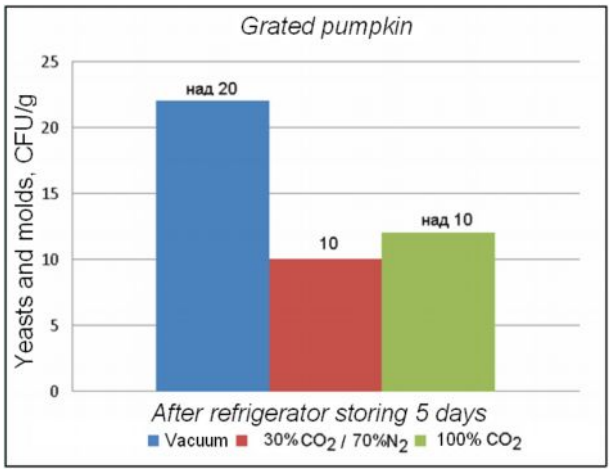

Figure 13. Yeasts and molds content in grated pumpkin after refrigerator storing(5,5±1°C) 5 days

On table 2 and Fig. 12 and 14 we can see that gas environment containing 100% CO_2, is more suitable for packaging grated pumpkin or intact pumpkin pieces, because the CO_2 itself has antimicrobial effect. When it is mixed with N_2 its effect is being reduced. The less suitable for such products with high aqua activity aw is packaging in vacuum – Fig. 13

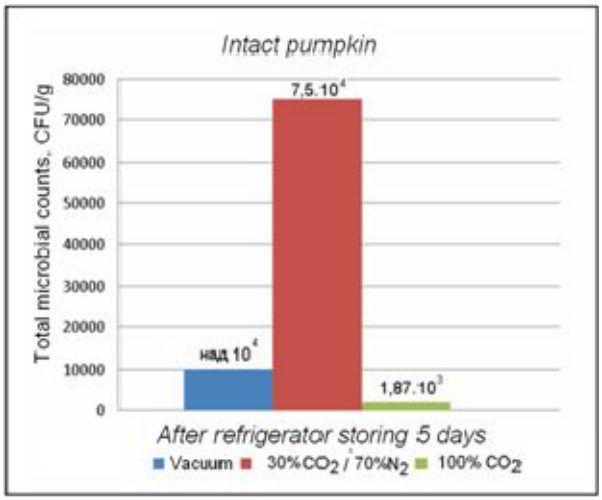

Figure 14. Total microbial counts in intact pumpkin pieces after refrigerator storing (5,5 ± 1°C) 5 days

4. References

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