# EFFECT OF DIFFERENT PACKING MATERIALS ON PHYSICOCHEMICAL PROPERTIES OF CARROT AND POTATO

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## Abstract

Potato (*Solanum tuberosum L.*) and carrot (*Daucus carota* subsp. *sativus* Hoffm.*)* are one of the most popular and most used vegetables around the world. Both the vegetables are thoroughly used in Europe but in these rapidly changing times the present-day consumer want ready to prepare (RTP) or ready to eat (RTE) foods or ingredients. To produce the ready to prepare food its skin must be removed. But this removal of skin reduces the shelf life, sensory characteristics and causes nutrient loss. RTP vegetables can be packed in Polyethylene (PE) packaging but it's one of the most prominent polluter in the world. We used packing material made up of Polylactic Acid (PLA) as our biodegradable packing.

In our experiments, we used three treatments for packing, control (without packing), PE and PLA.

The samples were kept at room temperature for 5 days and we measured weight change, moisture content, color parameters and Total Polyphenol Content (TPC) every day.

## Introduction

Potato is the 5$^{th}$ most cultivated agricultural commodity in the world. In the year 2020, 359 MT potato was produced [1]. European countries are second in production of potato, Asia remains the first. The potato tuber is a subterranean swollen stem which evolved to survive from season to season as a dormant storage organ. Starch is the primary form of energy in potato. Thus, potatoes are the major source of energy in the diets of masses across the world. Potatoes contain only about 2% protein on fresh weight basis, but their bioavailability is 90% [2]. They also contain considerable amounts of vitamin B1, B6, B9 and C, calcium, phosphorus, potassium, magnesium, zinc and iron, carotenoids, and tocopherols. Potatoes have better nutrient to price ratio than many other vegetables [1].

Carrot is one of the popular root vegetables grown throughout the world and is the most important source of dietary carotenoids in Western countries. Carrots are multi-nutritional vegetables. It is well known by its high β-carotene content, but its root also contains carotenoids, phenolic compounds, vitamin C, dietary fiber and polyacetylenes [3]. The utilization of carrot and its products is expanding relentlessly due to its recognition as an important source of natural antioxidants having anticancer activity [4]. Total worldwide production of carrot in 2019 was 44.77MT including turnips [1].

Modern consumer is always running out of time and need something which is easier and ready to prepare (RTP). Thus, there is need of RTP of vegetables so that the demand can be satisfied. But conversion into RTP make the vegetables more prone to deterioration, less shelf life and loss of nutrients. Hence, they need to be packed to keep all the characteristics and a significant shelf life.

The PE are mainly produced from fossil fuels and may take thousands of years to biodegrade. Plastics are a menace to the environment and are hurdle in the sustainable development. PLA

can be synthesized from renewable bio-derived monomers, and it is an alternative to conventional petroleum-based polymers [5].
So, we use two types of packing materials simple packing (polyethylene) and biodegradable (polylactic acid) and compared packed vegetables samples with the unpacked ones.

## Experimental

Good quality fresh potato and carrot were brought from a supermarket in Budapest. They were peeled using a hand peeler and diced. After dicing they were washed thoroughly in potable running water. Afterwards, the vegetable dices were divided in three different batches. No packing was used for the first batch of vegetable samples it was called Control (C). The other two were packed with polyethylene (PE) and biodegradable polylactic acid (PLA). The measurements were taken daily from all the three batched for a span of 5 days.

**Percentage weight loss**

Weight loss was determined and expressed as percentage weight loss using the following formulae:

Weight loss (%) = $(W_i - W_f)/W_i * 100$

Where, $W_i$ is the initial weight (g) on day 1 and $W_f$ is the measured weight (g) of each sample on particular day of analysis during storage period.

**Moisture content**

Moisture content was performed using a moisture content examining machine.

**Total Polyphenolic Content**

Extraction: 5 g of sample was dissolved in 20 mL of solution containing 80% methanol and 20% distilled water. The mixture was allowed to rest for one hour at room temperature. After the resting period, the mixture was filtered using filter papers and liquid solution was obtained to perform further analysis.

Total Polyphenol Content (TPC) was determined using the method by Singleton and Rossi. The samples were measured at 760 nm and the results were given in mg gallic acid equivalent 100 $g^{-1}$ (mg GAE 100 $g^{-1}$) [6].

**Color values**

Color measurements were performed by CIE Lab Color Measuring System with Konica Minolta CR 410 manual digital color meter.

## Results and discussion

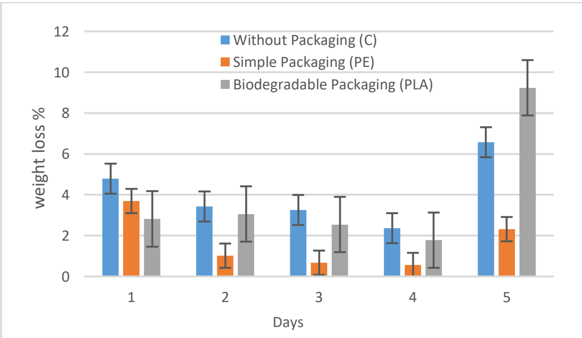


Figure 1a- Rate of weight loss in potato samples

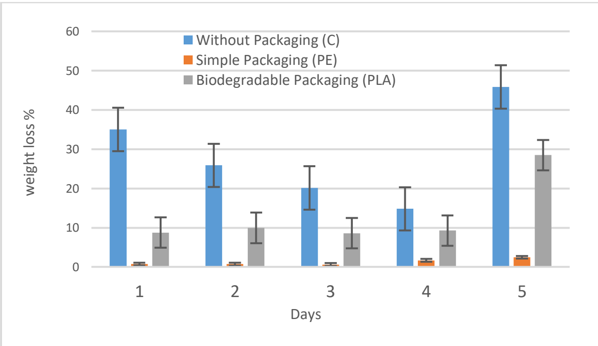


Figure 1b- Rate of weight loss in carrot samples

For weight change PE packing was significantly better than PLA and without packing for potato. In case of carrots, the samples which were kept in PE packing had almost no weight loss. Throughout the storage period the samples kept without packing lost most weight. The least weight loss was seen in the carrot at 0.64% on 3rd day of storage. In their studies [7], [8] used vaccum drying and PE for packing of potato and carrot. They found similar results and same trend.

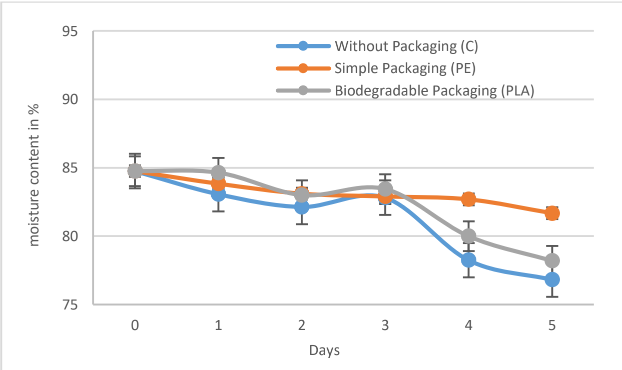


Figure 2a- Change in moisture content of potato samples

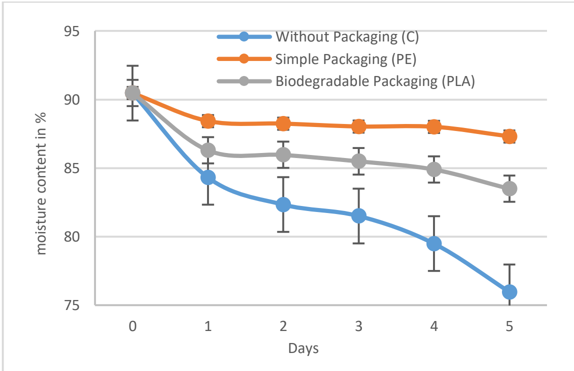


Figure 2b- Change in moisture content of carrot samples

The highest moisture content was seen in the samples with PE packing followed by PLA and then samples without packing. This trend was same in potatoes and carrots and the content of moisture reduced every day. By the end of of storage period samples packaging had around 76% moisture content compared to more than 85 and 90 % on day 1. Our results were in accordance with the experiments of [9].

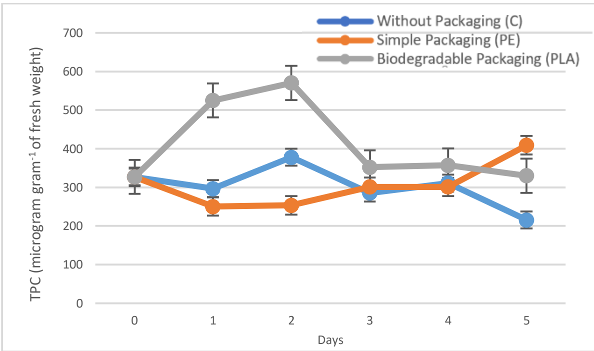


Figure 3a- TPC of Potato samples

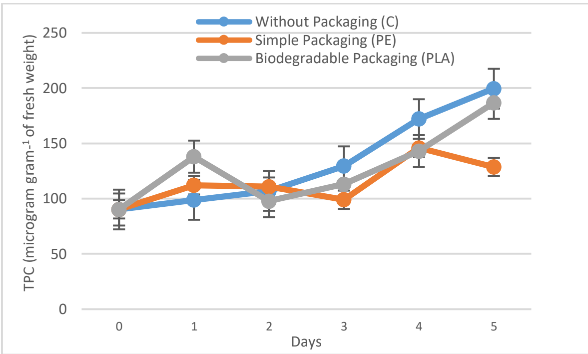


Figure 3b- TPC of Carrot samples

TPC for potato was lowest in PE packed samples while highest in samples without packaging. For carrots initially the TPC was highest in PLA packed samples but by the end of storage period PE packed samples contained most TPC. In all the samples the TPC increased as the storage period increased. Initially the TPC was low for carrot, but it increased with storage time. On the first day it was 90.13 $\mu g\ g^{-1}$ FW for carrot and 326.91 $\mu g\ g^{-1}$ FW for potato. Opposite trend was seen in the potato samples. Our results also showed that TPC of potato was more than carrot, but these results are in accordance with the literature. Some studies also received similar results in their experiments [10, 11].

There was no significant effect of packing material on color parameters of both the vegetable samples.

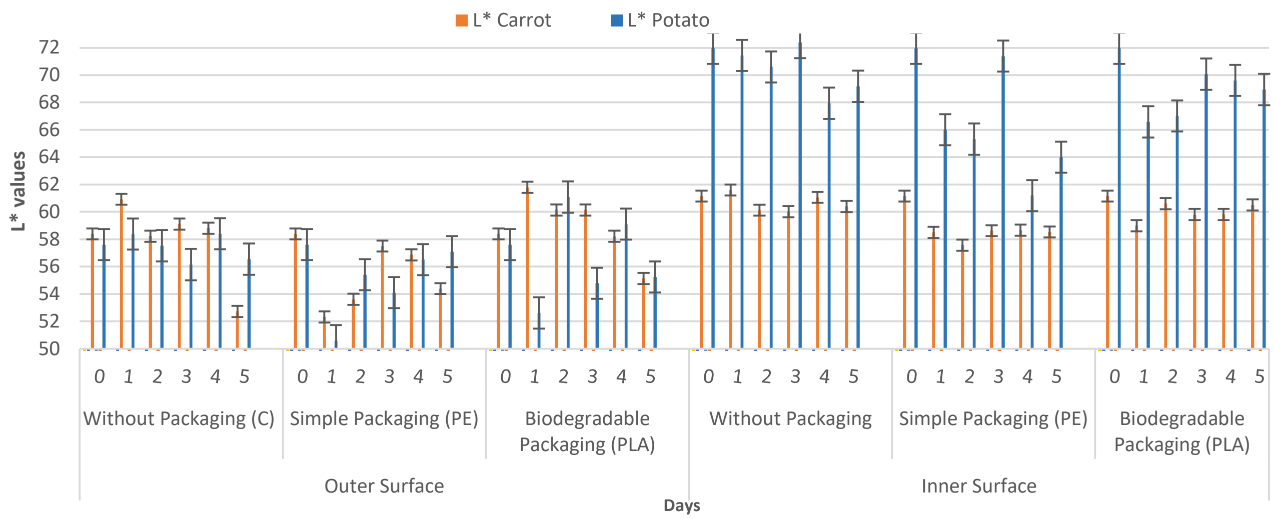


Figure 4a- L* values of potato and carrot samples in different packings

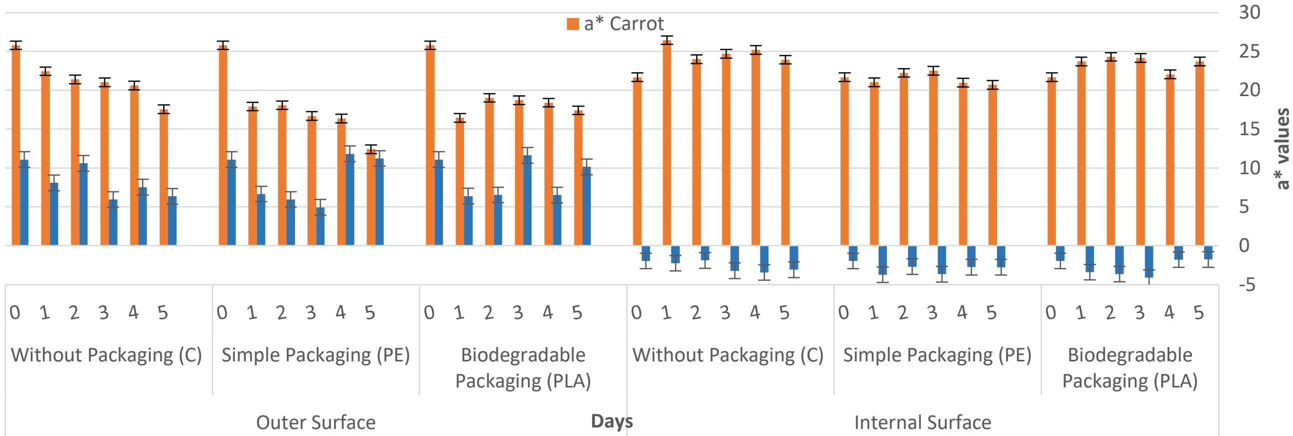


Figure 4b- a* values of potato and carrot samples in different packings

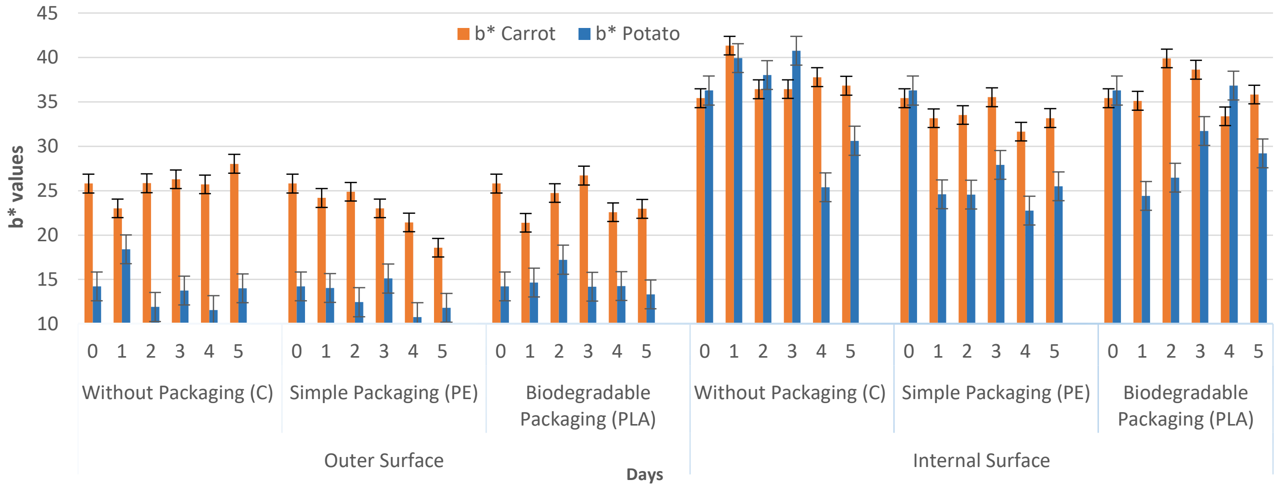


Figure 4c- b* values of potato and carrot samples in different packings

**Conclusion**

Based on our results we can say that vegetables samples kept in packing performed better than samples without packing in every test. Between the normal (PE) packing and biodegradable (PLA) packing, the PE packing performed better in case of retaining moisture and inhibiting weight loss. The samples kept in PLA packing showed higher TPC values than PE, but this could be due to the more weight loss in PLA packed samples. Eventually PE was found to be a better packing material than PLA in our experiments.

**Acknowledgements**

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**References**

[1] FAO STAT. https://www.fao.org/faostat/en/

[2] M. Friedman, "Nutritional Value of Proteins from Different Food Sources. A Review," J Agric Food Chem, vol. 44, no. 1, pp. 6–29, Jan. 1996, doi: 10.1021/jf9400167.

[3] S. KRIVOKAPIC, T. PEJATOVIC, and S. PEROVIC, "CHEMICAL CHARACTERIZATION, NUTRITIONAL BENEFITS AND SOME PROCESSED PRODUCTS FROM CARROT (Daucus carota L.)," The Journal "Agriculture and Forestry," vol. 66, no. 2, Jun. 2020, doi: 10.17707/AgricultForest.66.2.18.

[4] K. D. Sharma, S. Karki, N. S. Thakur, and S. Attri, "Chemical composition, functional properties and processing of carrot—a review," J Food Sci Technol, vol. 49, no. 1, pp. 22–32, Feb. 2012, doi: 10.1007/s13197-011-0310-7.

[5] I. S. M. A. Tawakkal, M. J. Cran, J. Miltz, and S. W. Bigger, "A Review of PolyLactic Acid)-Based Materials for Antimicrobial Packaging," J Food Sci, vol. 79, no. 8, pp. R1477–R1490, Aug. 2014, doi: 10.1111/1750-3841.12534.

[6] Singleton, V. L., Rossi, J. A. "Colorimetry of Total Phenolics with Phosphomolybdic-Phosphotungstic Acid Reagents", American Journal of Enology and Viticulture, 16(3), pp. 144–158, 1965.

[7] N. Aharoni, V. Rodov, E. Fallik, R. Porat, E. Pesis, and S. Lurie, "Controlling humidity improves efficacy of modified atmosphere packaging of fruits and vegetables," Acta Hortic, no. 804, pp. 121–128, Dec. 2008, doi: 10.17660/ActaHortic.2008.804.14.

[8] A. M. C. N. Rocha, E. C. Coulon, and A. M. M. B. Morais, "Effects of vacuum packaging on the physical quality of minimally processed potatoes," Food Service Technology, vol. 3, no. 2, pp. 81–88, Jun. 2003, doi: 10.1046/j.1471-5740.2003.00068.x.

[9] A. Asgar, "Effect of storage temperature and type of packaging on physical and chemical quality of carrot," IOP Conf Ser Earth Environ Sci, vol. 443, no. 1, p. 012002, Feb. 2020, doi: 10.1088/1755-1315/443/1/012002.

[10] S. H. Lee et al., "Antioxidant Contents and Antioxidant Activities of White and Colored Potatoes (Solanum tuberosum L.)," Prev Nutr Food Sci, vol. 21, no. 2, pp. 110–116, Jun. 2016, doi: 10.3746/pnf.2016.21.2.110.

[11] C. Kaur and H. C. Kapoor, "Anti-oxidant activity and total phenolic content of some Asian vegetables," Int J Food Sci Technol, vol. 37, no. 2, pp. 153–161, Feb. 2002, doi: 10.1046/j.1365-2621.2002.00552.x.