Effects of different packages on broccoli integrity and quality: A scientific approach

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ABSTRACT

Broccoli, as it is a vegetable rich in moisture, is extremely perishable and its commercialization faces problems due to this short shelf life. Packaging and coatings become great allies in the conservation of this product for a longer period. Thus, the present study aimed to evaluate the influence of the use of different types of packaging and edible coating on the conservation and quality of broccoli. The vegetables were arranged in plastic film and parchment paper packages and, for another treatment, a starch-based coating was produced. The treatments were evaluated on day 0 and also on day 7 in terms of mass loss and also in relation to color. The data were analyzed using Tukey's mean test of 5% probability. The results showed the lowest percentage of mass loss for broccoli packed with plastic wrap and the highest average was found for vegetables that were coated with starch solution. Regarding the color parameters, no significant differences were detected for the treatments. However, visually, the broccoli submitted to starch coating showed less color variation. Finally, it was concluded that more satisfactory results were found for vegetables packed with plastic film, as they presented less mass loss. On the other hand, visually, starch-coated broccoli has greater conservation in the color of the product. Therefore, it is suggested to combine both treatments to obtain more advantageous results.

Keywords: Broccoli, Conservation, Packaging.

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INTRODUCTION

Horticulture involves a variety of products of great importance in human food, meeting the demands arising from population growth. Broccoli (*Brassica oleracea*) of the branch type is cultivated in all regions of Brazil. It has stems with smaller diameter and lateral branches, its commercialization takes place in bunches. The inflorescence has flower buds that are less compact, more open and larger (LUENGO and CALBO, 2009).

The start of the broccoli harvest occurs about 90 days after sowing and, depending on weather conditions, the cultivar cycle can be shorter or longer. The harvest takes place manually and certain care is essential to obtain a good quality in the product. Therefore, the ideal is to be harvested in the cooler periods of the day (ALMEIDA, 2019).

Broccoli is a highly perishable vegetable, with a higher respiratory rate among the others, requiring greater care in marketing. Post-harvest losses pose a significant challenge. Deterioration during storage and transportation can lead to loss of quality and food waste (VALERO and SERRANO, 2010).

A limiting cause in the post-harvest storage of broccoli includes the loss of fresh mass associated with firmness (wilting) and the loss of green coloration, as a result of yellowing of the florets. Its senescence helps in the physiological changes initiated soon after harvest; due to the high ethylene production and respiratory rate, with the use of technologies it can extend its useful life (GIOPPO, *et al*, 2011).

To address this issue, the development of effective conservation technologies is needed. Good post-harvest practices are indispensable for offering quality vegetables to the consumer market, having access to fresh and high quality products. Edible packaging and coatings are promising technologies to reduce post-harvest losses in vegetables. Packaging offers physical protection against mechanical damage and contamination, while edible coatings, such as cornstarch, have demonstrated the ability to reduce moisture loss and minimize oxidation (ROJAS-GRAÜ, RAYBAUDI-MASSILIA and MARTÍN-BELLOSO, 2008). With this, it maintains the quality of the product by reducing water loss, delays deterioration, change in color and firmness.

Recently, there has been an increase in interest in the application of these innovative technologies in vegetables. This is because edible packaging and coatings are a sustainable approach to preserving the quality and extending the shelf life of these highly perishable products. These technologies have the potential to positively impact the food industry and sustainability by reducing food waste and environmental impacts. Therefore, this study aims to evaluate the influence of the use of different types of packaging and edible coating on the conservation and quality of branch broccoli.

MATERIAL AND METHODS

In the conduction of the experiment, 24 experimental units of broccoli, with an average weight of 100 g, from the region of Rio Paranaíba, Minas Gerais, were used. The broccoli was selected based on quality criteria, such as color, size, and absence of physical damage. These were divided into four treatments, the control (without any packaging), wrapped in parchment paper, wrapped in plastic film and coated with 3% m/v starch coating. For all experimental units, a Styrofoam tray was used.

The preparation of the edible starch coating was carried out according to the method described by Rojas-Graü, Raybaudi-Massilia and Martín-Belloso (2008). The concentration of corn starch used was 3% mass/volume. 60 g of corn starch was weighed and transferred to a 2 L beaker, then 1940 g of water was added to the beaker under stirring for homogenization. The starch solution was heated on a heating plate and under constant agitation until it reached a temperature of 70 °C. The solution was kept at 70 °C for 5 minutes, after the heating time the solution was cooled until it reached an ambient temperature of 32°C. The coating was applied by immersing the broccoli in the solution and placed to dry in Styrofoam trays.

All experimental units were stored in a refrigerator for a period of one week. Mass loss was evaluated by the difference in mass on the first day and the 7th day after storage in the refrigerator; the color change using a tristimulus colorimeter, Delta Vista model. The parameters L*, a* and b* were determined.

The data were submitted to ANOVA and the means were compared using Tukey's test, with a significance level of 5%. The software used was Speed Stat version 3.2.

RESULTS AND DISCUSSION

The means for the percentage of mass loss observed for each treatment in relation to the analysis time are presented in Table 1.

Table 1: Mean Percentage of Mass Loss for Each Treatment

Treatments	Medium
Starch	39.72a
Control	29.49ab
Parchment paper	23.21b
Plastic film	6.55c

Means followed by different letters differ from each other by Tukey's test at 5% probability of error.

From the results found, it is noted that the lowest mass loss was observed for broccoli packed with plastic film, differing statistically from the other treatments. Broccoli that was only coated with starch showed the greatest loss of mass, proving that, for this requirement, the best conservation of

this food is due to packaging that surrounds the product and serves as a barrier mainly to water loss, which is aggravated by the cooled environment in which this vegetable is commonly stored.

Padula *et. al*. (2006) when evaluating the influence of different types of packaging on the physicochemical characteristics and gaseous composition of broccoli, they found that polypropylene packages had an average mass loss of 0.92%, samples packed in acrylic with open channels was 0.55% and those packed in sealed acrylic was 0.26%. The same behavior can be observed between the study presented and the one carried out in this work, since the more sealed and impermeable the packaging, the lower the tendency for mass loss, since there will be a lower gradient of water potential.

Carvalho and Clemente (2004) used a bioriented polypropylene polymeric film to evaluate the postharvest quality of broccoli in the control treatment, which did not have packaging. In this way, the film acted as a barrier, reducing the exchange of gases between the product and the atmosphere and extending its useful life.

The means for the variation of parameters L, a* and b* between the 7 days of analysis are shown in Table 2. L represents luminosity, ranging from 100 (white) to 0 (black) a* defines the transition from green (-a*) to red (+a*) and b* represents the transition from blue (-b*) to yellow (+b).

Table 2: Means of the variations of the L, a* and b* parameters between the days of analysis

Treatments	Parameter averages		
	L	the*	b*
Starch	-1.84a	3.92a	-0.31a
Control	-4.27a	3.44a	2.68a
Parchment paper	-11.09a	2.55a	11.35a
Plastic film	-9.06a	2.42a	11,12a

Means followed by different letters differ from each other by Tukey's test at 5% probability of error.

Regarding color analysis, it was observed that it was not possible to detect significant differences in any of the three parameters. However, it is worth noting that in the parameter b*, where +b indicates the yellow color, there was a positive variation mainly for broccoli packed with plastic wrap and parchment paper, and these, also visually, presented a more yellowish color than in the other treatments. Similarly, broccoli that was coated with starch solution visually showed greater conservation of green color (parameter b-).

By performing a pigment analysis of broccoli leaves, flowers and stalks, Padula *et. al.* (2006) observed in their experiments a degradation of chlorophyll *A* and *B* during the entire storage period, with greater decreases in values in the packages that had greater interaction with the external environment. And despite such a decline, in most cases the statistical analyses did not show significant differences, as is the case of the present study.

Gioppo (2011), when evaluating different environments and regulators in the postharvest of broccoli, found that the treatments did not obtain significant differences in the color analyses performed. This factor was explained due to the low temperatures, since cold storage provides less metabolic activity and consequently, less degradation of chlorophyll.

Finally, it can be inferred that for more satisfactory results, it would be interesting to combine the two different treatments that stood out in the analyses carried out: plastic film, in the case of less mass loss and starch coating, in the case of greater color conservation. Thus, the association of both treatments would become an alternative for better conservation of broccoli in relation to its metabolic activity, in addition to becoming more attractive to consumers for a longer period of time.

CONCLUSION

The use of plastic film proved to be more efficient in the conservation of broccoli, since it showed a lower percentage of mass loss when compared to the other treatments. Regarding the color analysis, it was not possible to find statistical differences between the treatments, however, the starch coating presented, visually, good results for the color conservation of the vegetable. It is therefore suggested, for future studies, the combination of these two treatments, as an alternative to obtain even more satisfactory results.

REFERENCES

1. Almeida, S. V. (2019). *Desempenho operacional e econômico de transplante mecanizado de mudas de brócolis em dois tipos de preparo de solo* (Tese de doutorado). Faculdade de Ciências Agronômicas, Unesp Câmpus de Botucatu, Botucatu.

2. Carvalho, P. T., & Clemente, E. (2004). The influence of the broccoli (*Brassica oleracea var. itálica*) fill weight on postharvest quality. *Ciência e Tecnologia de Alimentos*, 646-651.

3. Gioppo, M. (2011). *Pós-colheita de brócolis, repolho roxo e alface sobre diferentes ambientes e reguladores* (Dissertação de mestrado). Universidade Estadual de Ponta Grossa, Ponta Grossa.

4. Luengo, R. F. A., & Calbo, A. G. (Eds.). (2009). *Embalagens para comercialização de hortaliças e frutas no Brasil*. Brasília, DF: Embrapa Hortaliças.

5. Padula, M. L., et al. (2006). Influência de diferentes tipos de embalagens nas características físico-químicas e composição gasosa de brócolis (*Brassica oleracea L. var Itálica*) orgânicos minimamente processados e armazenados sob refrigeração. *Brazilian Journal of Food and Nutrition, 17*(3), 259-268.

6. Rojas-Graü, M., Raybaudi-Massilia, R., & Martín-Belloso, O. (2008). Edible coatings for fresh produce: A review. *Trends in Food Science & Technology, 19*(11), 613-624.

7. Valero, J. M., & Serrano, M. (2010). Effect of storage conditions on the quality of broccoli florets. *Journal of Food Science, 75*(5), M291-M296.