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Study on the Performance of Thyme and Lavender Essential Oils Incorporated in Edible Coatings for Ensuring the Antifungal Protection of Strawberries During the Storage Period

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Abstract

Thyme and lavender essential oils 0,2 %, in nanoparticle form have been incorporated into sodium alginate edible solution to limit the releasing effect of the oils. The solutions were used to cover the strawberry fruits and the antifungal effect was monitored while preserving the quality indicators during the controlled storage period. In our case, the incorporation of thyme essential oil provided better antifungal protection and kept the strawberries firm for up to 6 days compared to other coatings variants.

• Introduction

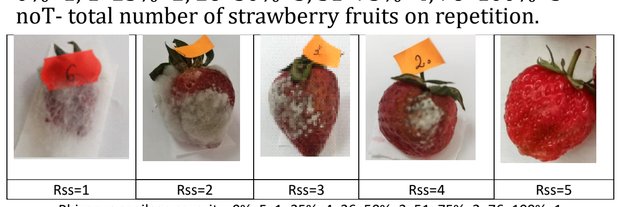
Fresh fruits are a valuable nutritional resource for humans. Thanks to their pleasant aroma and taste, Strawberries are preferably consumed fresh, thus bringing a significant supply of nutrients, vitamins and minerals easily assimilated by the human body. Alginate is a natural compound extracted from brown algae with gelling, emulsifying, stable, and non-toxic properties which is included in the generally recognized as safe category (GRAS), having the approval of the Food and Drug Administration and European Commission (Palou, Ali and Fallik, 2016). Used in the form of sodium salt, it can be used in edible coatings of fruits and vegetables minimizing water loss, gas transfer, and delaying ripening.
The strategy of using essential oils is based on the properties of biodegradability, friendly to the environment, and without overdose effects(De Almeida et al., 2010). Their direct use in practice is limited by the smell and the strong taste, low solubility in water, rapid degradation and volatilization properties (Yammine et al., 2022),(Redondo-Blanco et al., 2020).
Recent studies suggest the need to use essential oils in the form of vapors, but this implies shortcomings related to their dosage, the volatilization potential being different depending on the origin (Střelková et al., 2021), (Paris et al., 2020).
In the last decade, interest in using essential oils has grown in the agricultural sphere, they being seen as an alternative in plant protection due to their antimicrobial properties in limiting the spread of phytopathogenic agents or minimizing post-harvest losses through spoilage.
This research aimed to evaluate an edible coating formulated with alginate with lavender and thymus essential oils nanoemulsions on *Rhizopus stolonifer* incidence on the quality parameters of strawberries during storage at 10 Celsius degree, 50% humidity for 9 days of storage.

• Material and method

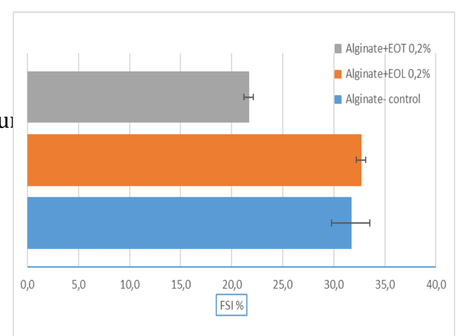
Strawberries of local origin, obtained under grow-protected conditions, harvested at technological maturity, chosen whole, uniformly in size and ripeness, without obvious signs of deterioration, were used. In total, 6 casseroles and approximately 3 kg of strawberries, Magic variety, were used in the experience.
The working variants were V1- coating sodium alginate solution, V2 coating with sodium alginate + lavender essential oil, EOL 0.2%; V3 - coating with sodium alginate + thyme essential oil, EOT 0.2%. After the disinfection of strawberries, an artificial inoculation was made with sporal suspension $5x10^5$ /mL *Rhizopus stolonifer*. The fruit boxes (2 repetitions/variant) were kept for 9 days in the dark, 10^0 C and 60% humidity, monitoring the moment of mycelium appearance and determining the quality indicators: fungal spoilage index (FSI%, day 6), fruit weight (WL%, day 6 and 9), firmness and soluble sugar content (TSS%, day 6).

• Results and discussion

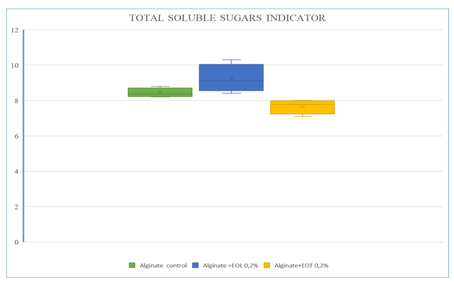
The FSI was established for each repetition with the formula:
FSI (%) = [(noRs x Rss / noT) x 100]-100
Where:
noRs- the number of strawberry fruits affected by Rhizopus fu
Rss- Rhizopus spoilage severity:
0%=1; 1–25%=2; 26–50%=3; 51–75%=4; 76–100%=5
noT- total number of strawberry fruits on repetition.

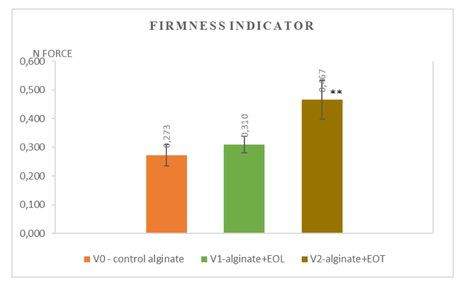


Rhizopus spoilage severity: 0%=5; 1–25%=4; 26–50%=3; 51–75%=2; 76–100%=1

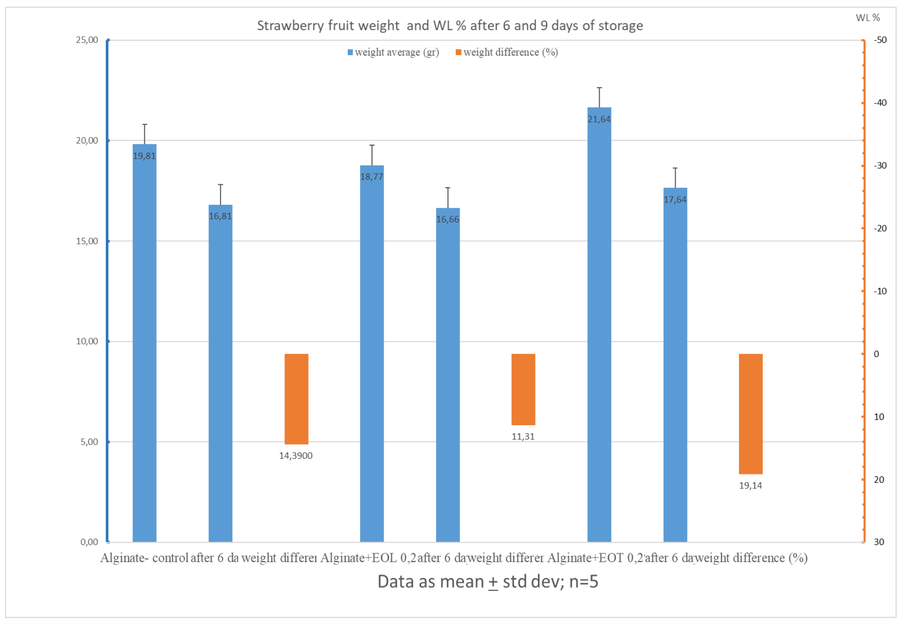


The lowest FSI values were provided, in the 9 th days by the V3 treatment (EOT) of 21.7%, while the control -V1 treatment and V2 with EOL recorded values of 31.7% and 32.7%, respectively.





The results for firmness revealed an increased firmness, above the control value in the case of V3 alginate + EOT 0.2%, the differences being statistically assured. Also, for V3, the lowest mean value of the fungal alteration indicator (FSI) of 21.7% was determined, while the mean V1 and the mean V2 had higher values of 31.7% and 32.7%, respectively. The weight indicator recorded decreases in values for all variants studied, the differences being in the order V2<V1<V3 after 6 days and after 9 days V1 <V3< V2. Weight loss is due to the respiratory process of fruits, resulting in water and sugar loss. The total soluble sugar content was decreased in all variants in order V2< V1< V3, but the differences are statistically unassured



Conclusions

Sodium alginate is a viable edible fruit coating that can be augmented by essential oil addition. In our case, the incorporation of **thyme essential oil provided better antifungal protection** and kept the strawberries firm for up to 6 days compared to other coatings variants.
In the future, new determinations are necessary regarding sensory and taste analysis of strawberries preserved by the essential oil addition.

Acknowledgement:

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