2025 10th International Conference
on Energy Efficiency and Agricultural Engineering
5-7 November 2025, Starozagorski Bani, Bulgaria

Effect of alginate and propolis-based edible coating on moisture loss and microbial status of raspberries cherries and blueberries during storage

Darina Georgieva, Stanka Damyanova

University of Ruse "Angel Kanchev", Branch-Razgrad,7200 Razgrad, Bulgaria, dsgeorgieva@uni-ruse.bg

GOAL OF THE STUDY

The present study aims to evaluate the effect of an alginate-based edible coating, as well as its combined application with a glycerol extract of propolis, on moisture retention and microbial stability in raspberries, strawberries, and cherries stored at room temperature (26.4 – 27.4°C) over a period of 168 h.

METHODOLOGY OF THE INVESTIGATION

Materials and methods

The study utilized fresh soft fruits – cherries (Prunus avium L.), blueberries (Vaccinium corymbosum L.), and raspberries (Rubus idaeus L.) – all classified as Class I and sourced from the Bulgarian commercial market. Fruits were purchased in polyethylene terephthalate (PET) containers. Sodium alginate (plant-derived, E401, batch No 0253, France) was used as the base material for the edible coatings. A local Bulgarian manufacturer supplied Glycerol (99% purity).
The propolis used in the present study for the preparation of the glycerine extract was sourced from central Bulgaria and underwent chemical characterization to determine its antioxidant and antimicrobial properties. Microbiological assessment of the raw propolis indicated the presence of mesophilic bacteria, while yeasts and moulds were not detected. Phytochemical analysis identified a diverse range of compounds, with flavanones and flavones being predominant, followed by hydrocinnamic acids and esters, monosaccharides, benzoic acids, alcohols, fatty acids, and various organic acids. The corresponding tincture prepared from this sample was found to contain 18.48 mg GAE/g of total phenolic compounds, confirming its functional potential for incorporation into edible coatings.

Sample Preparation

Nine experimental groups were prepared (three per fruit type), as follows: untreated (control); coated with 0.5% sodium alginate; coated with alginate + 5% 1:10 propolis extract. Fruits were dipped into their respective coating solutions for 30 s, allowed to drain for 1 h on a grid at room temperature (26–27°C), and then weighed to determine coating mass retention. Moisture loss was monitored at 24-h intervals over 168 h. After the storage period, all samples were subjected to microbiological analysis to determine the total viable count (TVC), following ISO 4833-1, targeting aerobic mesophilic and facultative anaerobic
microorganisms incubated at 30°C.

MAIN RESULTS FROM THE STUDY

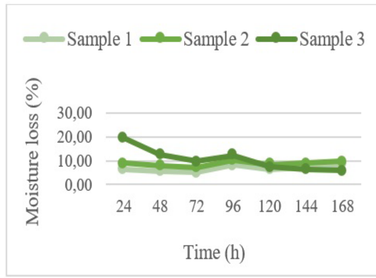

Fig.1. Moisture loss of raspberries during storage

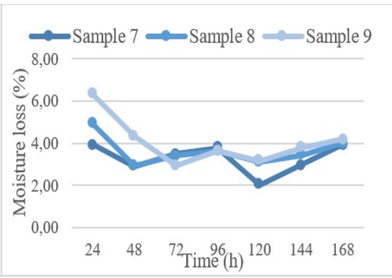

Fig. 2. Moisture loss of blueberries during storage

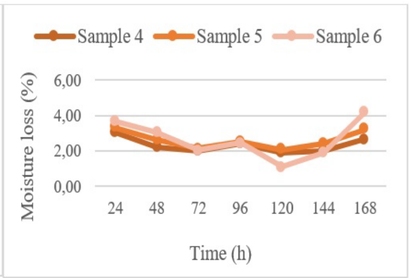

Fig. 3. Moisture loss of cherries during storage

Results showed that samples with propolis extract lost moisture faster than untreated or alginate-only samples, especially within the first 48 h. A sharp drop occurred at 72 h, followed by increases at 96 h. For raspberries, moisture loss stabilized after 96 h, while blueberries and cherries showed a dip at 120 h and another peak at 144–168 h. The highest losses were seen in coated raspberries with propolis; the lowest in untreated fruits. Raspberries exhibited the highest cumulative moisture loss (up to 73.64%), while cherries showed the least (16.33–18.4%).

Table 1. Results from laboratory investigation for TCM in CFU/g

	Natural fruit	Fruit with alginate coating	Fruit with alginate coating with propolis extract
Raspberries	$5.1x10^7$	$6.1x10^6$	$9.6x10^6$
Cherries	10	$1.x10^3$	$21.8x10^3$
Blueberries	$3.3x10^2$	$5x10^3$	9

After 168 h, all samples underwent microbiological analysis. Results presented in Table 1. revealed significant variation in total viable counts.

The coating enriched with propolis extract exhibited potential antimicrobial effects, particularly in raspberries and blueberries.

CONCLUSIONS

The use of sodium alginate-based edible coatings did not significantly reduce moisture loss in soft fruits stored at room temperature. Moreover, the incorporation of glycerin-based propolis extract appeared to accelerate the rate of moisture evaporation. While propolis extract may enhance the antimicrobial efficacy of the coating, higher concentrations adversely affected the sensory properties of the film. It is also important to consider the method of coating application and the structural characteristics of the fruit, as excessive coating accumulation can lead to increased surface moisture retention.
Despite these limitations, biopolymer-based edible coatings remain a promising and sustainable strategy for extending the shelf life of perishable fruits under ambient storage conditions.
Future studies will optimize coating application methods and alginate concentrations across different fruit types to account for surface characteristics and enhance preservation efficiency.