International Journal of Agricultural Technology 2026 Vol. 22(6):2939-2956
DOI: https://doi.org/10.63369/ijat.2026.22.6.2939-2956
Available online http://www.ijat-aatsea.com
ISSN 2630-0192 (Online)

Effectiveness of konjac glucomannan coatings in preserving siamese orange quality

Suriati, L.[1*], Singapurwa, N. M. A. S.[1], Janurianti, N. M. D.[1], Chindrawati, A. A. S. M.[1], Selamet, K.[2], Putri, K. S. P.[1] and Jelita, N. P. A. B.[1]

[1]Food Technology and Agriculture Product, Faculty of Agriculture, Warmadewa University, Denpasar, Indonesia; [2] Management Program Study, Economic Faculty, Warmadewa University, Denpasar, Indonesia.

Suriati, L., Singapurwa, N. M. A. S., Janurianti, N. M. D., Chindrawati, A. A. S. M., Selamet, K., Putri, K. S. P. and Jelita, N. P. A. B. (2026). Effectiveness of konjac glucomannan coatings in preserving siamese orange quality. International Journal of Agricultural Technology 22(6):2939-2956.

Abstract Results indicated that the application of konjac glucomannan-based nano-coatings was more effective in maintaining the quality of Siam oranges compared to using non-nano konjac glucomannan coatings or no coating. Comparisons between treatments highlighted the superiority of the nano-coating, particularly in suppressing weight loss, slowing skin color changes, and preserving vitamin C content during storage. These findings suggested that nanoscale modification facilitated the formation of a more uniform and compact film, thereby acting as a superior barrier against gas exchange and moisture loss. Such conditions are minimized post-harvest quality degradation, ultimately contributing to the stability of the product's physical and chemical characteristics. The study demonstrated that applying a 50% concentration of konjac glucomannan nano-coating for two minutes is represented the optimal condition for the post-harvest handling of Siam oranges. The shelf life of the oranges can be extended by up to 15 days. Successfully extending shelf life is found to be the potential to reduce the risk of quality deterioration during distribution and storage while ensuring consistent quality at the time of consumption. Implementing nano-coating is expected to enhance consumer satisfaction through a fresher appearance, reduced weight loss, and better preservation of vitamin C content. A nano-coating-based quality control strategy also holds the potential to boost the market competitiveness of Siam oranges and increase their commercial value.

Keywords: Siamese orange, Fruit quality, Nanocoating, Konjac, Shelf-life

Introduction (All the cited references must be listed in references)

The consumption of fruit is currently on the rise. This phenomenon can be attributed, at least in part, to heightened public health awareness, which has led to an increased demand for high-quality fruits (Suriati *et al*., 2023). Fruits are available in a wide array of shapes, sizes, flavors, and textures (Suriati, 2022). One of the most popular fruits with high economic value is the Siamese orange

[*]**Corresponding Author:** Suriati, L.; **Email:** suriati@warmadewa.ac.id

(*Citrus nobilis* var. L.) (Gullo *et al*., 2021). Siamese oranges are characterized by a pleasant taste and the presence of phenolic bioactive compounds, carotenoids, vitamins, minerals, and fibre (Ferreira *et al*., 2021). The Siamese orange is distinguished by its thin skin (approximately 2 mm), smooth surface, and adherence to the pulp, characterized by a shiny appearance. A short neck and a serrated crown distinguish the fruit body. The fruit stalks, measuring approximately 3 centimeters in length and 2.6 millimeters in width, are relatively short. The flesh is characterized by a soft texture and a sweet and aromatic flavour. Notably, the fruit is high-yielding, with a mean weight of approximately 75 g per fruit.

The harvesting period typically extends from May to August, with an average yield of 6 grams per fruit (Suriati, 2023). According to Aini *et al*. (2022), a multitude of bioactive phenolic components, organic acids, vitamins, carotenoids, and fibre have been demonstrated to possess significant health benefits. Beyond their palatability, Siamese oranges have been shown to possess antioxidant, antineoplastic, and anti-inflammatory properties. These properties contribute to the regulation of digestion, the management of obesity, and the enhancement of immunity (Strano *et al*., 2021).

The enhanced yield of Siamese oranges has been linked to elevated post-harvest losses, attributable to inadequate management during distribution and storage. The reduction in the quality of Siamese oranges due to mechanical damage is between 15 and 20%, manifesting as skin damage and decay due to microbial contamination, such as fungi, mould, and bacteria. This, in turn, reduces the shelf life (Gao *et al*., 2018). The quality of orange fruit intended for marketing is contingent upon several factors, including uniformity in type and size (i.e., diameter and weight), as well as the fruit's maturity level, total solids, total acidity, and vitamin C content (Zacarías-García *et al*., 2022). To mitigate the deterioration of Siamese oranges, it is imperative to store them in an optimal manner post-harvest, thereby enhancing their shelf life (Strano *et al*., 2021). Consequently, there is a necessity for research to ensure the maintenance of the quality of orange fruits during storage. The employment of coating methodologies is imperative to ensure the delivery of products that meet consumers' expectations (Suriati *et al*., 2022; Gu *et al*., 2024).

The utilization of natural coatings has emerged as a preferred alternative to synthetic preservatives. Glucomannan, a polysaccharide, is a primary component in the synthesis of nanocoatings (Azeredo *et al*., 2022). Konjac (*Amorphophallus muelleri* Blume) has been identified as a potential source of glucomannan. Konjac tubers contain high levels of glucomannan, a water-soluble fibre, with a content of 79%. The tuber's composition has been found to contain 91% glucomannan (Bintoro *et al*., 2024). Glucomannan from Konjac exhibits several

advantageous characteristics. It is biodegradable, has antioxidant properties, is low in toxicity, and is inexpensive and easy to obtain (Tripetch *et al*., 2023; Zhang *et al*., 2020). Glucomannan functions as an emulsifier or thickener, a property that has led to its frequent utilization within the food industry. The ability of glucomannan to form a gel with a relatively high viscosity in water has made it a valuable component in numerous food products (Suriati *et al*., 2020). Glucomannan from konjac is characterized by its ability to undergo a phase transition resulting in the formation of crystals and fine fibrous structures. These structural changes have been shown to enhance the coating properties of the material (Zhang *et al*., 2020).

The coating's strength is contingent upon the dimensions of its constituent particles and the composition of the chemical substances utilized in its formulation (Chinchkar *et al*., 2025) the presence of (nano) particles has been demonstrated to result in an augmentation of the surface area, consequently leading to an increase in solubility, the release of active compounds, absorption, and adhesion (Onyeaka *et al*., 2022). Nanocoating is defined as a thin, nano-sized layer that can be combined with active additives, including antioxidants, anti-ageing, and antimicrobial agents (Correa-Pacheco *et al*., 2021). The utilization of nanocoating derived from natural materials is imperative to enhance the aesthetic appeal and preserve the integrity of the material (Mohammed *et al*., 2024), the objective of this study is to support a green economy, thereby improving the livelihood and social justice of the Siamese orange growing community and significantly reducing the risk of environmental damage. The utilization of nanocoating confers several advantages, including its antimicrobial potency, barrier, and mechanical properties, the stability of the emulsion system, and adhesion (Butler *et al*., 2024). The utilization of nanocoating on orange fruits is a subject that has yet to be extensively researched.

Nanocoating functions as a barrier against chemical, physical, and biological changes. (Ghosh *et al*., 2021). The utilization of nanocoating has been demonstrated to enhance the aesthetic appeal of products, preserve moisture, mitigate weight reduction, and function as an antimicrobial agent (Gago *et al*., 2020)(Gunam *et al*., 2021). According to (Basaglia *et al*., 2021), Nanocoating has been demonstrated to contribute to the maintenance of product quality and the prolongation of shelf life. According to (Suriati & Utama, 2019), and Correa-Pacheco *et al.* (2021), Nanocoating has been demonstrated to preserve the physical, chemical, and microbiological characteristics of food, thereby enhancing its quality, safety, and shelf life. However, a comprehensive study that systematically compares the impact of coating, coating application, and nanocoating application on the shelf life of Siamese orange is lacking. The objective was to assess the efficacy of konjac-based nanocoating in prolonging

the shelf life of Siamese orange fruits and to ascertain the impact of konjac nanocoating application on the shelf life of Siamese orange fruits.

Materials and methods

Tools and materials

The following equipment was utilized in the study: a refractometer, a spectrophotometer CS-280, a viscometer NDJ8S, a pH meter, an oven, a sonicator Q125 mesonic USA, a scanning electron microscope (SEM), a spectrometer UV Vis Libra S60, a homogenizer, and a tissue analyzer. The ensuing research results were the konjac (*Amorphophallus muelleri* Blume), which collected at six months after the start of the study. Siamese orange (*Citrus nobilis* Tan.) was collected eight months after the start of the study. Both fruits were collected from the Catur village, which is located in the Kintamani district of Bangli district, Bali province. The following criteria were used to identify Siamese orange as the fruit is soft to the touch, the colour is uniformly yellow, and the sugar content is 10%. The additions of NaCl, Ca $(OH)_2$, and glycerol were obtained from UD. Bharata Chemical Denpasar. This study was conducted in the Food Statistics Center, Faculty of Agriculture, Warmadewa University, Denpasar.

Research implementation

Quality testing of Siamese oranges was conducted according to established protocols, with fruit samples categorized based on their optimal maturity stage—specifically, 28 weeks after flowering. Each study site comprised 30 plots, and the research employed a randomized block design with three replications. The first factor involved postharvest treatments, consisting of three options: no coating, konjac coating (non-nano), and nano-konjac coating. The second factor was storage duration (0, 5, 10, and 15 weeks). Parameters observed included weight loss, number of damaged fruits, color, texture, acidity, total soluble solids, moisture content, vitamin C content, and microbial colony count (plate count). The obtained data were analyzed using analysis of variance (ANOVA) via SPSS software, followed by Duncan's Multiple Range Test to identify significant differences.

Preparation of konjac flour

The process of making konjac flour, the main coating ingredient, and konjac nanocoating started with the separation of the konjac and its subsequent

slicing to remove the skin. This is followed by a washing step, after which the slicing procedure is carried out, maintaining a thickness of 5 mm. The konjac pieces were then soaked in a 15% salt solution for half an hour and subsequently rinsed well to eliminate any residual salt. The next step was soaked for 20 minutes in a 15% Ca $(OH)_2$ solution, after which cognac is added. The drying process, which took place at 50°C for around 24 hours, followed by crushing and sieving the dried konjac slices through a 50-mesh sieve to produce konjac flour, which is used as a basis for nanocoating.

Formulation coating-konjac and nanocoating-konjac

The preparation of konjac coating entailed the dissolution of 1% konjac flour in water. A 1% glycerol emulsifier is then incorporated, and the homogenization process was carried out for 10 minutes. This process is involved heating at a temperature of 70°C ± 1°C for 5 minutes, followed by cooling. Once these steps are completed, the Konjac coating is deemed ready for utilization. The preparation of konjac nanocoating entailed the dissolution of 1% konjac flour in water, followed by the incorporation of 1% glycerol and thorough mixing for 10 minutes. This process is utilized a Q125 sonicate model to generate nanoparticles with a size range of 200-500 nm. The nanoparticle size is then measured using a UV-Vis WG spectrometer. The heating process was conducted at a temperature of 70±1°C for 5 minutes, followed by cooling. Once cooled, the nano-coated konjac was deemed ready for utilization.

Application of coating and nanocoating-konjac on Siamese orange fruit

The konjac nanocoating was applied after the processing of Siamese orange fruits and the preparation of the experimental section. Each experimental section was filled with 20 oranges, with a weight range of 150 to 200 grams. The dyeing process was conducted with a nanocoating concentration of 50% and a duration of 2 minutes. Following the dyeing process, the samples were subjected to drying method involving air circulation for 10 minutes. Subsequently, the samples were maintained at ambient temperature. Observations were made at 0, 5, 10, and 15 days post-dyeing, encompassing weight loss, number of broken fruits, color, texture, acidity, total soluble solids, water content, vitamin C, and total plate number.

Results

Weight loss

The findings indicated that the coating application exerted a substantial impact on the weight reduction of Siamese orange fruits. However, the storage duration and the interaction effect of the treatment did not demonstrate any significant differences. The maximum weight reduction of 33.10% was observed in the non-treated and treated groups on the 15th day, as presented in Table 1.

Table 1. Weight loss of the Siam orange

Storage time (day)	Without coating	Coating application	Nanocoating application
0	00.00	00.00	00.00
5	28.73	18.47	12.47
10	29.70	25.73	23.57
15	33.10	29.27	26.70

Number of damaged fruits

The findings indicated that the application of coating, storage duration, and the interaction between these factors exerted considerable influence on the incidence of fruit damage in Siamese orange. The highest percentage of damaged fruits, 21%, was observed in the untreated control group. From the tenth day of storage, no damage was detected in any of the treated groups (Figure 1).

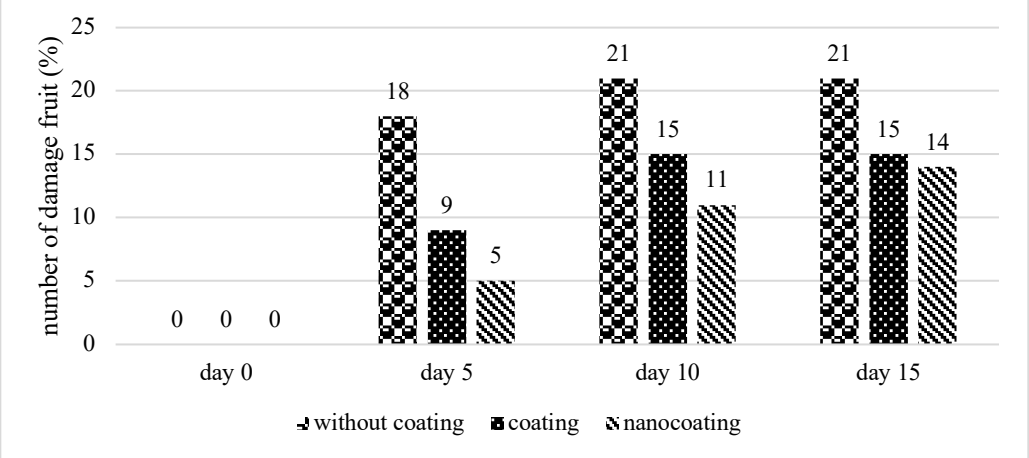


Figure 1. Number of damages of the Siamese orange fruit (%)

Color

Colour is a pivotal factor in the selection and acceptance of food items, exerting an influence on taste thresholds, perception, and preferences. The findings of the study demonstrated that the application of the coating and the duration of storage significantly influenced the colour of Siamese orange. However, the interaction effect was found to be non-significant. The mean colour of Siamese orange ranged from 65.23 to 89. 06, as shown in Table 2.

Table 2. Colour of Siamese orange

Storage time (day)	Without coating	Coating application	Nanocoating application
0	68.71	65.67	65.23
5	78.44	77.16	86.48
10	88.51	76.64	83.77
15	89.06	74.16	85.60

Texture

The data indicated that several factors, including the application of the coating, the storage time, and the interaction between these variables, influenced the feel of Siamese orange fruit. A texture analyzer was employed to measure the texture at a distance of 20 mm and a speed of 5 mm/s. The orange fruit treated with coating and nanocoating showed a reduced texture value, whereas the uncoated treatment's texture value increased by 18.25 to 25.09 N. It suggested that the surface of uncoated orange peel dries more rapidly and exhibited greater resistance to punctures by a tissue analyzer, thereby enhancing the yield (Figure 2).

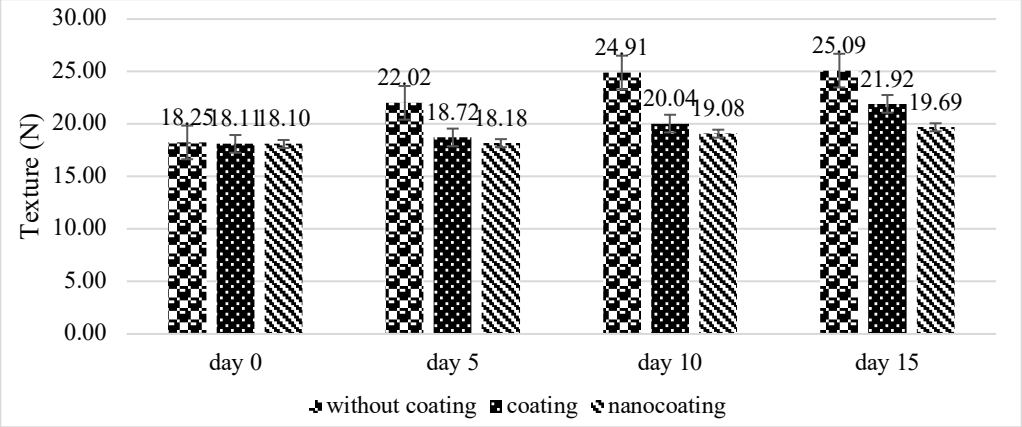


Figure 2. Texture of Siamese orange

Acidity

Acidity is a critical factor in determining the quality of Siamese oranges. The findings of the study demonstrated that the application of the coating, the storage duration, and their interaction had a substantial influence on the acidity of Siamese orange. The acidity levels of Siamese orange fruits exhibited a decline on the tenth day of storage, followed by an uptick on the fifteenth day, with variations in the range of 4.47–4. 81, as demonstrated in Figure 3.

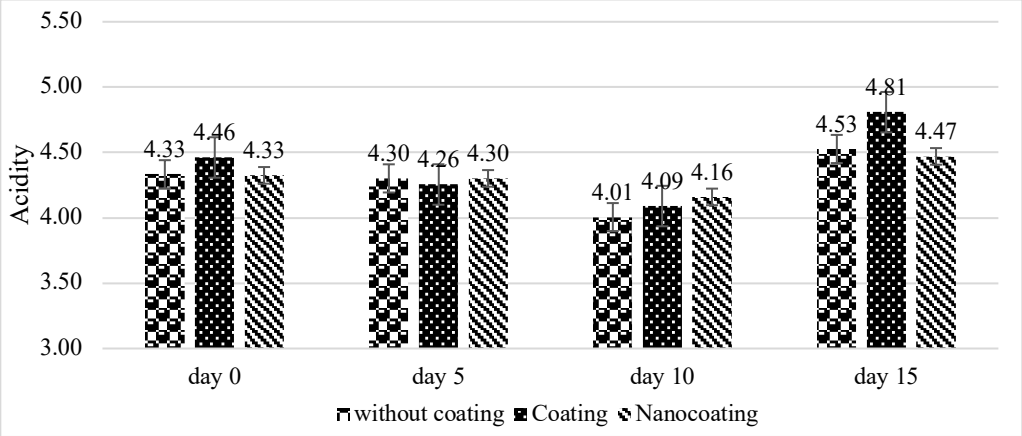


Figure 3. The acidity of the Siamese orange fruit

Total soluble solids

The findings indicated that the implementation of a coating, the duration of storage, and the interaction among these factors exerted a substantial impact on the total soluble solids of Siamese orange fruit. The total soluble solids of Siamese orange fruit without coating exhibited an initial increase until the 10th day, followed by a subsequent decrease on the 15th day. Conversely, the nanocoating-konjac treatment exhibited a sustained increasing in total soluble solids, reaching a maximum of 17.23°Brix by the 15th day (Figure 4).

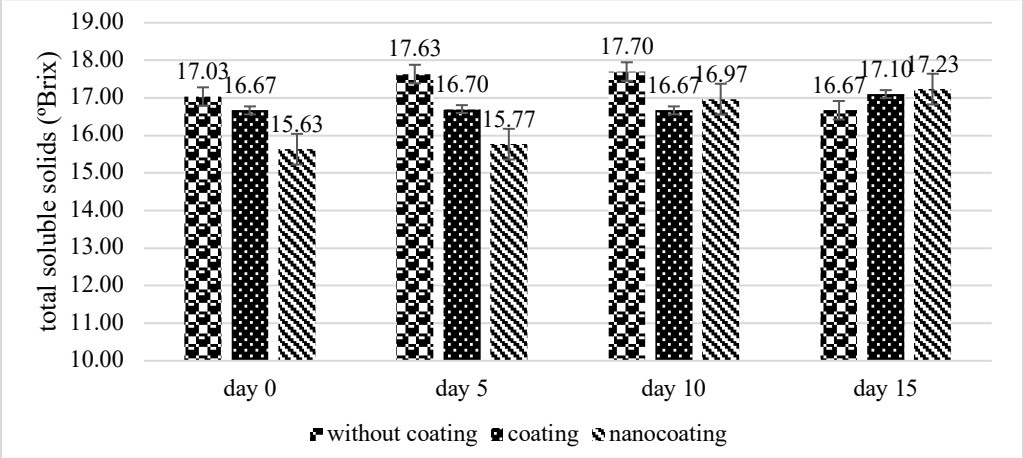


Figure 4. Total soluble solids (ºBrix) of Siamese orange fruit

Water content

The moisture content of Siamese oranges is a critical factor that impacts their quality. The findings demonstrated that the application of coating, storage duration, and the interaction between these two factors exerted a substantial influence on the moisture content of Siamese orange fruits. The findings revealed a general increase in the water content of Siamese orange fruits during the initial five days of storage, followed by a subsequent decrease until the 15th day of storage (see Figure 5).

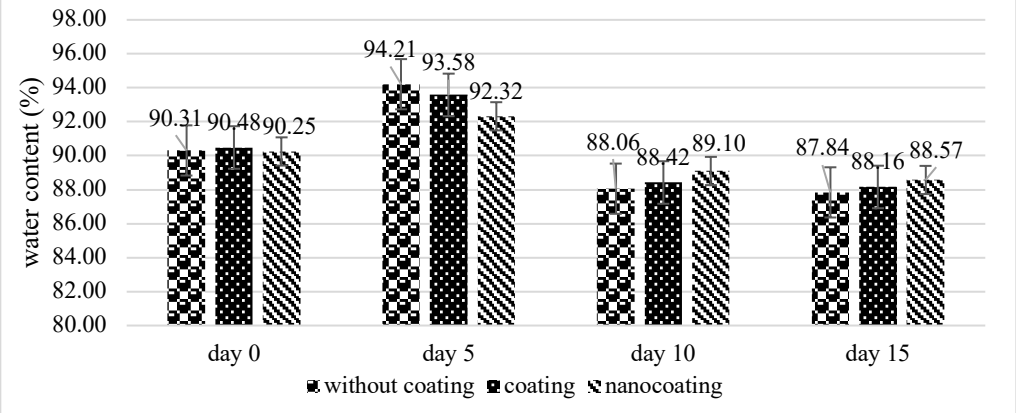


Figure 5. Water content (%) Siamese orange fruit

Vitamin C

The findings indicated that the storage duration exerted a substantial impact on vitamin C levels in Siamese orange fruits, while the incorporation of nanocoating and its subsequent interactions demonstrated minimal influence. The nanocoating-konjac treatment yielded the highest vitamin C content in Siamese orange fruits, with a value of 73.46 mg/100g, as depicted in Figure 6.

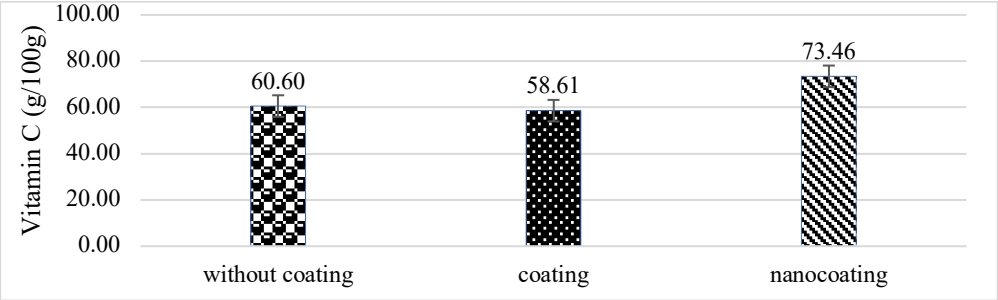


Figure 6. Vitamin C (g/100g) of the Siamese orange fruit

Total plate count

The findings indicated the existence of statistically significant relationships among the total plate count of Siamese orange fruits, the application of coating, the duration of storage, and the interaction between these factors. The nanocoating-konjac application treatment exhibited the lowest total plate count value of 6.89 log cfu/gram, while the uncoated treatment, stored for 15 days, demonstrated the highest at 6.89 log cfu/gram, as illustrated in Figure 7.

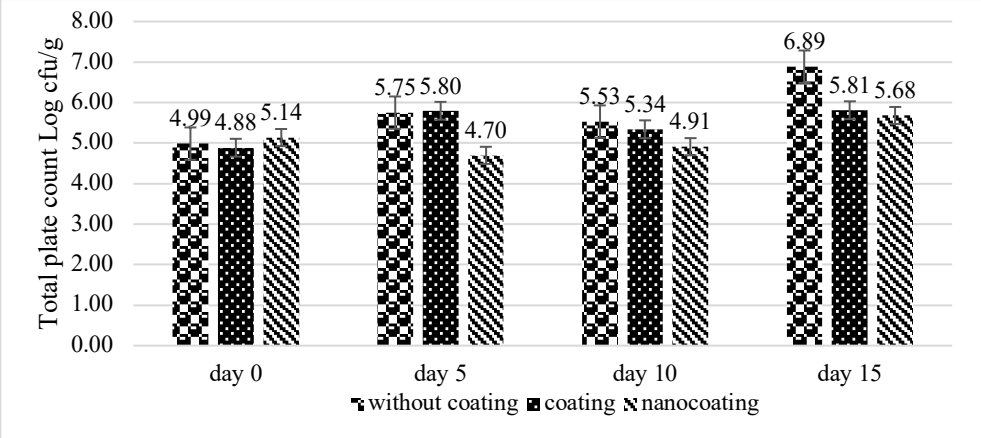


Figure 7. Total plate count (Log cfu/gram) of Siamese orange fruit



Figure 8. Kintamani Siamese Orange and Nanocoating Konjac

Discussion

The application of konjac was found to be effective in reducing weight loss in orange fruits. The finding suggested that the konjac nanocoating treatment is more effective in reducing the weight loss of orange fruits. According to Xiao *et al*. (2022), Samples that were sealed with a konjac nanocoating demonstrated a loss in weight. This phenomenon can be attributed to the enhanced water-repellent properties of the konjac nanocoating. Given its non-toxic nature and high tensile strength, konjac nanocoating is promising material for commercial storage applications.

The konjac nanocoating application exhibited the lowest number of damaged fruits compared to the konjac nanocoating treatment and the absence of coating. The finding indicated that the konjac nanocoating treatment is found to be more effective in suppressing orange damage as a report of Díaz-Montes and Castro-Muñoz (2021). The konjac glucomannan coating is demonstrated to preserve the quality of freshly cut lotus root. Phenol, a polysaccharide found in konjac glucomannan which exhibited considerable promise as a sustainable packaging ingredient, particularly in the form of food coatings (Dao *et al*., 2023).

The colour of the fruits increased within 15 days of storage. It suggested that the shift in colour from green to yellow is attributable to the ripening process. The nanocoating treatment of konjac produced, the least color change compared to the coated konjac without coating treatment. The application of konjac nanocoating is demonstrated to retard the deterioration of the quality of Siamese orange fruits, and to extend their shelf life. The properties of konjac glucomannan

is allowed for the formation of crystals and fine granular structures (Zhou *et al*., 2018). Furthermore, glucomannan is possed an elastic property, enhancing konjac's coating properties (Zhang *et al*., 2020).

The application of konjac nanocoating is provided a stable texture for up to 15 days of storage, from 18. 10-19. 69N. The konjac nanocoating exhibited the capacity to preserve the texture of Siamese orange fruits during storage. Polysaccharide-based food coatings have been investigated as safe and environmentally friendly food packaging materials (Mohammed *et al*., 2024). The findings suggested that the coating can be utilized to impede oxidation (Butler *et al*., 2024). The enhanced water barrier properties can be attributed to increase in diffusion of water vapour molecules throughout the coating layer. Consequently, the coating is demonstrated to considerable promise for utilization in product packaging (Chinchkar *et al*., 2025).

The utilization of organic acids as a means to regulate respiration is a crucial factor in this context. Despite the nano-coating of the orange colour, the respiration process persists, albeit to a lesser extent. Siamese oranges are notable for their pleasant taste and bioactive compounds, including phenolates, carotenoids, vitamins, minerals, and fibre (Ferreira *et al*., 2021). The quality of an orange is determined by factors such as acidity, varietal uniformity, size, ripeness, firmness level, total soluble solids, and vitamin C content (Gao *et al.*, 2018; Saberi *et al.*, 2018). The maintenance of characteristics, including acidity titratable, total solids soluble, fruit rigidity, ascorbic acid, and colour of the skin, shows that coating application is an efficient technique for preserving fruit quality (Zhao *et al*., 2021).

Conversely, the nanocoating-konjac treatment exhibited a sustained increase in total soluble solids. This finding is indicated that the nanocoating-konjac treatment exhibited the capacity to counteract the respiratory rate, thereby impeding the process of starch conversion into simple sugars. Consequently, the ripening and deterioration of the quality of Siamese orange fruits can be prevented. Consequently, the quality of Siamese orange fruits can be maintained, and the ripening and deterioration of these fruits can be prevented, as posited by Zhao *et al*. (2021) The application of coating treatments during post-harvest storage can facilitate the maintenance of total dissolved solids, thereby suppressing the development of diseases and preserving the natural properties of the fruit. This assertion is further corroborated by the findings of Suriati *et al*. (2020), which demonstrated that the application of a coating can effectively prolong the shelf life of fresh produce.

The water content of Siamese orange fruits during the initial five days of storage, followed by a subsequent decrease until the 15th day of storage. This finding is suggested that the shift of starches into less complex parts and water is

responsible for the rise in Siamese orange juice. It is crucial to remember that moisture content has a big impact on how fresh materials are and how resistant to microbial attacks through post-harvest handling *(*Xu *et al*., 2022). According to Shi *et al*. (2019) stated that the utilization of konjac coatings in the domain of fruit packaging holds considerable promise. Konjac glucomannan, a polysaccharide, is extensively utilized in the fabrication of edible coatings due to its exceptional film-forming capabilities (Xiao *et al.*, 2022). However, glucomannan konjac can help to preserve the integrity of tissue cells, assertiveness is also strongly correlated with moisture content (Ma *et al*., 2021). This is suggested that glucomannan konjac can preserve the quality of fresh-cut fruits.

The konjac nanocoating technique may retain the vitamin C concentrations from Siamese orange fruits throughout a 15-day storage period. These findings demonstrated the efficacy of the konjac nanocoating treatment in maintaining vitamin C content in Siamese oranges. Gu *et al*. (2024) who demonstrated that an edible coating/film derived from glucomannan konjac holds considerable promise in extending the shelf life of fresh kiwifruit. This coating treatment is showed to preserve fruit quality parameters, including acidity, ascorbic acid content, and skin colour (Shah and Hashmi, 2020).

The rise in total microorganisms in the fifth week was caused by the growth of bacteria that presented in the orange fruits and did not come from the external environment. In a related finding of Chen *et al*. (2021) who reported that konjac-based coatings exerted a more substantial and favourable impact on the quality of ginger during storage. This finding is underscored the potential of konjac coatings as a promising solution for enhancing the shelf-life of ginger (Xiao *et al.*, 2022) and following the assertion posited by Li *et al*. (2021) and Harsojuwono *et al*., (2022). The results showed that polysaccharide-based coatings play an important role in protecting the quality of chayote fruits.

The research finding was examined how nanocoating is affected the quality of Siamese oranges. The study is observed weight loss, the number of damaged fruits, color, texture, acidity, total soluble solids, water content, vitamin C, and plate count. The study findings showed that using nanocoating-konjac is improved the shelf life of Siamese orange fruits. The findings demonstrated that the application of nanocoating-konjac at a rate of 50% in conjunction with a 2-minute dyeing procedure can prolong the shelf life of Siamese oranges up to the 15th day.

Acknowledgments

The writer is thankful to the Ministry of Education and Culture, Research and Technology of Higher Education of the Republic of Indonesia for its financial assistance. Furthermore, the

author would like to express his sincere thanks to the Rector of Warmadewa University and all colleagues for their important cooperation in performing this research.

Conflicts of interest

The authors declare no conflict of interest.

References

Aini, N., Dwiyanti, H., Setyawati, R., Handayani, I., Septiana, A. T., Sustriawan, B. and Aena, D. A. Q. (2022). Siam orange (*Citrus nobilis* L.) nectar characteristics with variations in stabilizer and sucrose level. Food Research, 6:315-323. https://doi.org/10.26656/fr.2017.6(3).386

Azeredo, H. M. C., Otoni, C. G. and Mattoso, L. H. C. (2022). Edible films and coatings – Not just packaging materials. Current Research in Food Science, 5:1590-1595. https://doi.org/10.1016/j.crfs.2022.09.008

Basaglia, R. R., Pizato, S., Santiago, N. G., Maciel de Almeida, M. M., Pinedo, R. A. and Cortez-Vega, W. R. (2021). Effect of edible chitosan and cinnamon essential oil coatings on the shelf life of minimally processed pineapple (*Smooth cayenne*). Food Bioscience, 41.

Bintoro, V. P., Dwiloka, B., Ekaputri, H. and Kamil, R. Z. (2024). The effect of gelatin and konjac glucomannan concentrations on moisture content, water activity, texture, density, and protein content in synbiotic marshmallows. Food Research, 8:409-419. https://doi.org/10.26656/fr.2017.8(4).623

Butler, J., Morgan, S., Jones, L., Upton, M. and Besinis, A. (2024). Evaluating the antibacterial efficacy of a silver nanocomposite surface coating against nosocomial pathogens as an antibiofilm strategy to prevent hospital infections. Nanotoxicology, 18:410-436. https://doi.org/10.1080/17435390.2024.2379809

Chen, M., Meenu, M. and Xu, B. (2021). Effect of konjac glucomannan and chitosan-based film coatings on the quality of fresh sea bass (*Lateolabrax maculatus*) under refrigerated condition. Journal of Future Foods, 1:187-195. https://doi.org/10.1016/j.jfutfo.2022.01.008

Chinchkar, A. V., Singh, A., Singh, S. V., Mazumder, K., Bishnoi, M. and Kamble, M. G. (2025). Application and toxicological study of polyvinyl acetate (PVAc) coating on lemon (*Citrus limon* L.) fruit to extend the shelf life. Journal of Future Foods, 5:145-152. https://doi.org/10.1016/j.jfutfo.2024.05.003

Correa-Pacheco, Z. N., Corona-Rangel, M. L., Bautista-Baños, S. and Ventura-Aguilar, R. I.

(2021). Application of natural-based nanocoatings for extending the shelf life of green bell pepper fruit. Journal of Food Science, 86:95-102. https://doi.org/10.1111/1750-3841.15542

Dao, L., Chen, S., Sun, X., Pang, W., Zhang, H., Liao, J., Yan, J. and Pang, J. (2023). Construction and sustained release of konjac glucomannan/naringin composite gel spheres. Frontiers in Nutrition, 9:1-11. https://doi.org/10.3389/fnut.2022.1123494

Díaz-Montes, E. and Castro-Muñoz, R. (2021). Edible films and coatings as food-quality preservers: An overview. https://doi.org/10.3390/foods10020249

Ferreira, T. H. B., Rodrigues Basaglia, R., Marques Paes da Cunha, T. and Faria Freitas, M. L. (2021). Production and Physical, Chemical, Microbiological, and Sensory Characterization of Extra Fruit Jam. Journal of Culinary Science and Technology, 00:1-10. https://doi.org/10.1080/15428052.2020.1862009

Gago, C., Antão, R., Dores, C., Guerreiro, A., Miguel, M. G., Faleiro, M. L., Figueiredo, A. C. and Antunes, M. D. (2020). The effect of nanocoatings enriched with essential oils on "Rocha" pear long storage. Foods, 9:1-15. https://doi.org/10.3390/foods9020240

Gao, Y., Kan, C., Wan, C., Chen, C., Chen, M. and Chen, J. (2018). Quality and biochemical changes of navel orange fruits during storage as affected by cinnamaldehyde -chitosan coating. Scientia Horticulturae, 239:80-86. https://doi.org/10.1016/j.scienta.2018.05.012

Ghosh, T., Nakano, K., Mulchandani, N. and Katiyar, V. (2021). Curcumin loaded iron functionalized biopolymeric nanofibre reinforced edible nanocoatings for improved shelf life of cut pineapples. Food Packaging and Shelf Life, 28:100658. https://doi.org/10.1016/j.fpsl.2021.100658

Gu, X., Li, J., Yang, L., Liu, L., Li, T., Zhang, H., Gao, Y. and Xiao, L. (2024). Comparative study on the different edible coatings loaded with fennel essential oil/β-cyclodextrin microcapsules for blueberry preservation. Journal of Horticultural Science and Biotechnology, 99:584-596. https://doi.org/10.1080/14620316.2024.2318569

Gullo, G., Dattola, A., Vonella, V. and Zappia, R. (2021). Performance of the Brasiliano 92 orange cultivar with six trifoliate rootstocks. AIMS Agriculture and Food, 6:203-215. https://doi.org/10.3934/AGRFOOD.2021013

Gunam, I. B. W., Sujana, I. G. A., Wijaya, I. M. M., Setiyo, Y., Putra, I. W. W. P. and Suriati, L. (2021). Isolation and selection of amylase-producing microbes isolated from ragi tape and cassava tape available on the markets. IOP Conference Series: Earth and Environmental Science, 913:012041. https://doi.org/10.1088/1755-1315/913/1/012041

Harsojuwono, B. A., Arnata, I. W., Hartiati, A., Setiyo, Y., Hatiningsih, S. and Suriati, L. (2022). The Improvement of the Modified Starch—Glucomannan—Polyvinyl Alcohol Biothermoplastic Composite Characteristics With Polycaprolactone and Anhydride Maleic Acid. Frontiers in Sustainable Food Systems, 6:1-13. https://doi.org/10.3389/fsufs.2022.844485

Li, L., Yi, P., Li, C., Xin, M., Sun, J., He, X., Sheng, J., Zhou, Z., Fengjin Zheng, |, Li, J., Liu, G., Ling, D., Tang, J., Li, Z., Yang, Y. and Tang, Y. (2021). Influence of polysaccharide-based edible coatings on enzymatic browning and oxidative senescence of fresh-cut lettuce. https://doi.org/10.1002/fsn3.2052

Ma, S., Zheng, Y., Zhou, R. and Ma, M. (2021). Characterization of Chitosan Films Incorporated with Different. Coatings, 11:1-16.

Mohammed, M., Alqahtani, N. K. and Ali, S. A. (2024). Development, RSM-based modeling, and process optimization of an ultrasonic coating system for extending the storage life of fresh fruits. Frontiers in Sustainable Food Systems, 8. https://doi.org/10.3389/fsufs.2024.1403164

Onyeaka, H., Passaretti, P., Miri, T. and Al-Sharify, Z. T. (2022). The safety of nanomaterials in food production and packaging. Current Research in Food Science, 5:763-774. https://doi.org/10.1016/j.crfs.2022.04.005

Saberi, B., Golding, J. B., Marques, J. R., Pristijono, P., Chockchaisawasdee, S., Scarlett, C. J. and Stathopoulos, C. E. (2018). Application of biocomposite edible coatings based on pea starch and guar gum on quality, storability and shelf life of 'Valencia' oranges. Postharvest Biology and Technology, 137:9-20.

Shah, S. and Hashmi, M. S. (2020). Chitosan–aloe vera gel coating delays postharvest decay of mango fruit. Horticulture Environment and Biotechnology, 61:279-289. https://doi.org/10.1007/s13580-019-00224-7

Shi, X. D., Yin, J. Y., Zhang, L. J., Huang, X. J. and Nie, S. P. (2019). Studies on O-acetyl-glucomannans from Amorphophallus species: Comparison of physicochemical properties and primary structures. Food Hydrocolloids, 89:503-511. https://doi.org/10.1016/J.FOODHYD.2018.11.013

Strano, M. C., Restuccia, C., De Leo, R., Mangiameli, S., Bedin, E., Allegra, M., Quartieri, A., Cirvilleri, G. and Pulvirenti, A. (2021). Efficacy of an antifungal edible coating for the quality maintenance of Tarocco orange fruit during cold storage. Crop Protection, 148:105719. https://doi.org/10.1016/j.cropro.2021.105719

Suriati, L., Utama, I. M. S., Harsojuwono, B. A. and Gunam, I. B. W. (2020). Ecogel incorporated with nano-additives to increase shelf-life of fresh-cut mango. Journal of Applied Horticulture, 22:189-195. https://doi.org/10.37855/jah.2020.v22i03.34

Suriati, L. and Utama, I. M. S. (2019). Characteristic fillet of aloe vera gel as edible coating. Journal of Physics: Conference Series, 1402(6). https://doi.org/10.1088/1742-6596/1402/6/066021

Suriati, L., Mangku, I. G. P., Datrini, L. K., Hidalgo, H. A., Red, J., Wunda, S., Cindrawat, A. A. S. M. and Damayanti, N. L. P. S. D. (2023). The effect of maltodextrin and drying temperature on the characteristics of Aloe-bignay instant drink. Applied Food Research, 3:100359. https://doi.org/10.1016/J.AFRES.2023.100359

Suriati, L., Utama, I. M. S., Harsojuwono, B. A. and Gunam, I. B. W. (2022). Effect of Additives on Surface Tension, Viscosity, Transparency, and Morphology Structure of Aloe vera Gel-Based Coating. Frontiers in Sustainable Food Systems, 6:1-9. https://doi.org/10.3389/fsufs.2022.831671

Tripetch, P., Lekhavat, S., Devahastin, S., Chiewchan, N. and Borompichaichartkul, C. (2023). Antioxidant activities of konjac glucomannan hydrolysates of different molecular weights at different values of pH. Foods, 12:1-11. https://doi.org/10.3390/foods12183406

Xiao, M., Luo, L., Tang, B., Qin, J., Wu, K. and Jiang, F. (2022). Physical, structural, and water barrier properties of emulsified blend film based on konjac glucomannan/agar/gum Arabic incorporating virgin coconut oil. Lwt, 154:112683. https://doi.org/10.1016/j.lwt.2021.112683

Xu, W., Jia, Y., Wei, J., Ning, Y., Sun, H., Jiang, L., Chai, L., Luo, D., Cao, S. and Shah, B. R. (2022). Characterization and antibacterial behavior of an edible konjac glucomannan/soluble black tea powder hybrid film with ultraviolet absorption. RSC Advances, 12:32061-32069. https://doi.org/10.1039/d2ra05030g

Zacarías-García, J., Cronje, P. J., Diretto, G., Zacarías, L. and Rodrigo, M. J. (2022). A comprehensive analysis of carotenoid metabolism in two red-fleshed mutants of Navel and Valencia sweet oranges (*Citrus sinensis*). Frontiers in Plant Science, 13:1-24. https://doi.org/10.3389/fpls.2022.1034204

Zhang, K., Yang, W., Ge, F., Xu, B., Chen, Y., Yin, X., Liu, Y. and Zuo, H. (2020). A self-curing konjac glucomannan/CaCO3 coating for corrosion protection of AA5052 aluminum alloy in NaCl solution. International Journal of Biological Macromolecules, 151:691-701. https://doi.org/10.1016/j.ijbiomac.2020.02.223

Zhao, Y., Li, B., Li, C., Xu, Y., Luo, Y., Liang, D. and Huang, C. (2021). Comprehensive review of polysaccharide-based materials in edible packaging: A sustainable approach. Foods, 10. https://doi.org/10.3390/FOODS10081845

Zhou, D., Huang, Y. and Tu, K. (2018). Effect of konjac glucomannan coating on antioxidant capacity and phenolic metabolism in fresh-cut lotus roots. Journal of Food Processing and Preservation, 42:1-9. https://doi.org/10.1111/jfpp.13759

(Received: 6 March 2025, Revised: 9 July 2026, Accepted: 13 September 2026)