Effect of Edible Organic Coatings on the Physicochemical Characteristics of Fruit and Vegetable Products in Their Commercial Maturation and Its Impact on the Marketing Price

Diego Cajamarca[1], Danilo Fernández[2],Javier Briones[3], Carla Haro[4]
[1]Diego Ivan Cajamarca Carrazco, Master in Integrated Management Systems (Quality, Environment, and Safety),
School of Zootechnical Engineering, Morona Santiago Headquarters,
Polytechnic School of Chimborazo.
http://orcid.org/0000-0001-6619-0490.
[2] Danilo Fernando FernándezVinueza.Engineer in Business Administration, Master in Business Management, danilo.
http://orcid.org/0000-0003-4929-9325
[3] Javier Ignacio BrionesGarcía, Engineer in Biotechnology,
Master in food products of vegetable origin, Morona Santiago Headquarters,
School of Zootechnical Engineering, Polytechnic School of Chimborazo. Javier.
http://orcid.org/0000-0002-2675-3495
[4] Carla VivianaHaroVelastegui, Chemical Engineer,
Master in Applied Chemical Engineering, Polytechnic School of Chimborazo.
http://orcid.org/0000-0001-5598-9600
[1] diego.cajamarca@espoch.edu.ec,[2] fernandez@espoch.edu.ec,
[3] briones@espoch.edu.ec,[4] carlav.haro@espoch.edu.ec

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Abstract

The present bibliographic review aims to know the effect of edible organic coatings on the physicochemical characteristics of fruit and vegetable products in their commercial maturation. Reviewing studies by several researchers supported by scientific journals and higher education repositories, the best results of each researcher are compared, obtaining evidence that the coating based on gelatin 3%, glycerin 0.75%, carboxyl methyl cellulose 0.75%, and chloride of Calcium maintains the quality in the strawberry up to 10 days of storage. Likewise, the edible coating made with 0.5% carboxyl methyl cellulose, 1.5% glycerol, 1% tween 80, and 1% eucalyptus oil maintains the physicochemical properties of papaya. Such is the case, for the cucumber that preserves the quality of its physical-chemical properties with an edible film based on% cassava starch, 1% chitosan, 1% essential oil, and 0.15% cinnamaldehyde.

In addition, the application of alginates from brown algae was evidenced that can be applied in the formulation of edible coatings that improve physical-chemical characteristics such as soluble solids content, titratable acidity, and ascorbic acid content. Therefore, it is concluded that edible coatings form a mechanical barrier that delays respiratory metabolism and consequently decreases the enzymatic activity of fruit and vegetable products, thus extending the useful life of the food and maintaining its physicochemical characteristics. Finally, the search for microbial and sensory determination of edible coatings is recommended.

Keywords Inhibitors, commercial ripening, ethylene, organic coatings, Physical-chemical characteristics.

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INTRODUCTION

The growing interest of consumers towards healthy, nutritious, organic, and health-friendly products has guided and motivated research towards the development of sustainable edible films and coatings applied to fruit and vegetable products, as an alternative to meet these real needs of the world population (Daybelis F, & Silvia B et al, 2015) . The same can be defined as a continuous transparent matrix, edible and thin that is structured around a portion of food through immersion in a solution to form a barrier against the transmission of gases, water vapor, and other substances (Natalia F & Diana C et al, 2017).

Therefore, vegetables and fruits are very perishable agricultural products due to their water content and metabolic activity that continues even after harvesting. Fresh fruit and vegetable losses are one of the main sources of losses in organic food. It is estimated that post-harvest losses that occur in the world exceed 20%, due to microbiological, (Racines M & Gabriela C et al, 2012)physical and physiological deterioration, as a result of technological factors such as inadequate harvesting process, inappropriate packaging, and insufficient routes for transportation, among others, which translates into a short storage period (Almeida, A & Reis, J.D et al, 2011).

Indeed, the implementation of this technology is a promising field not yet fully explored and involves the search for products with the potential to become part of the structural matrix of this type of coatings that can be made from a wide variety of polysaccharides, proteins, and lipids, alone or in combinations that manage to take advantage of each group (Ribeiro et al, 2007).

Polysaccharides and proteins are useful materials for the formation of coatings, as they show excellent mechanical and structural properties, but have a (Chambi H & Grosso C, 2006)low barrier capacity against moisture, this problem is not found in lipids given their hydrophobic properties, especially in those with high melting points such as beeswax and carnauba wax. (Morillon V & Debeaufort, F et al, 2002)Each type of coating has its characteristics defined by its composition, this is how carbohydrates are excellent sources of biopolymers, in addition, its low price and accessibility arouses great interest worldwide, reflected in various investigations that have proven its effectiveness, among them, cassava starch has been very well received because it looks good, It is not sticky, it is a resource of high availability in various parts of the world, it is bright and transparent, it improves the visual appearance of the fruit and can be removed with a natural source such as water, which represents a potential alternative to be used in the conservation of fruits and vegetables with natural products that contribute to achieving the 2030 Sustainable Development Goals(Bengtsson, M, 2003).

Lipid-based coatings are efficient in reducing product dehydration due to their low polarity and poor water vapor permeability. These coatings have some limitations such as poor mechanical properties and sometimes poor appearance (García et al., 2000); That is why lipids are mixed with other substances such as polysaccharides, as these combinations provide the coating with greater stability (Kester, & Fennema, O, 1986)(Koelsch, C, 1994). According to, (Garcia, M & Martino, M et al, 2000)reported that by mixing sunflower oil (Helianthus annus L.) and cornstarch (Zea mays L.) with glycerol and sorbitol as a plasticizer, they obtained a coating, with good mechanical properties to adhere to the carrot (Daucus carota L.) and reduced the loss of water vapor three times more above the control (Cabezas-Heredia et al., 2021).

The difference between a film and an edible coating is the way they are made and applied to the food, or a film is a thin layer of edible material, formed separately and placed on a level surface for later use. A coating is applied to the surface of a food, either by immersion in a solution or by spraying. The films are made up of three components: the polymer, the solvent, and finally the plasticizer (Barrera y Molina-Granja, 2016). The techniques commonly used for the elaboration of edible films and coatings are the application (Sharma, S. & Rao, T. R., 2015)(Arredondo-Ochoa, T., 2012)of spray covers, rubbing with compressed air and application by casting(Solano L, 2020).

These coatings, by controlling the transfer of moisture, gases, and volatile compounds, have demonstrated the ability to improve the integrity and quality of food and prolong its storage life by ensuring a sustainable economy model (Granda et al., 2022). However; When coating a fruit or vegetable to slow the loss of moisture, it is necessary that there is a certain permeability to oxygen and carbon dioxide to avoid anaerobic respiration that could induce physiological and physical disorders and a rapid loss of the quality and life of shelf in them (Falguera V, Quinteros P & Jimenes J et al, 2011).

Therefore, the purpose of this research is to know the different types and techniques of edible coatings based on biopolymers most used for the fruit industry, identifying the physicochemical and microbiological effects of the use of coatings in the life of several fruits and vegetables (Molina-Granja et al., 2022).

Finally, the research seeks to determine the costs through the use of the ABC method, because it is the method that most fits agricultural production and if its incidence on production costs (Direct Raw Material MPD, Direct Labor MOD, and Indirect Manufacturing Costs CIF) and the fixing of the retail price PVP.

METHODOLOGY

The research was carried out through a system of a systematic review of documents of scientific societies dedicated to physics, chemistry, sustainable development, and food sovereignty, as well as indexed journals and university repositories supported by the search strategy.

First, a Google Scholar search was carried out for documents and guides on edible coatings applied in fruit and vegetable products published in different repositories of higher education cloisters and professional virtual libraries. Subsequently, a search of systematic reviews of the scientific literature was carried out in repositories Scielo, Scopus, and SpringerOpen without a date limit.

2.1 Data inclusion, exclusion, and extraction criteria

In the analysis of the literature, all kinds of data provided by several authors were included, and concerning systematic reviews and scientific studies, it was applied as inclusion criteria to the research carried out on fruits such as strawberry *Fragaria chiloensis L,* papaya *carica potato* L and pickle or cucumber Cucumis *sativus L.* The main inclusion criterion integrates the following descriptors: "ethylene", "biofilm", "respiration rate", "commercial ripening", "strawberry", "papaya", "cucumber", "sustainable development", physical and chemical characteristics" in addition to excluding and articles do not contribute Information on edible coatings applied in the aforementioned variables. In addition, 96 studies were located from data extraction, although 35 that were not relevant to the objective of this literature review were excluded. Finally, for the final structure of results, 13 researchers were selected, including international journals, from which the materials used with their respective treatments were considered. Finally, a cost evaluation and awareness matrix for cost operationalization are structured.

DEVELOPMENT AND DISCUSSION

3.1 Evaluation of the influence of sustainable inhibitors on the physicochemical characteristics of strawberries

The physicochemical parameters are a determining factor to consider in the quality of food, especially strawberries which are perishable foods due to a large amount of water and that makes it susceptible to changes in the process of its metabolism after harvest. Therefore, their importance lies in maintaining their physicochemical characteristics to extend their shelf life of the same, and in this way, they are considered acceptable foods by consumers.

Table 1. Evaluation of the physicochemical characteristics of the organic strawberry.

	Weight loss (%)		Total soluble solids (°Brix)		pH		Titratable acidity (%)		Variety	Rf.
	Control	Treatment	Control	Treatment	Control	Treatment	Control	Treatment		
Days	T0	T1	T0	T1	T0	T1	T0	T1		
2	2,74	2.35 [to]	7,55	7,55	3,30	3,3	0,94	0,94	Albion	Oñate (2018)
16	18.46 [d]	13.86 [ab]	11.60 [to]	11.25 [a]	3.13 [a]	3.19 [a]	1.15 [to]	1.18 [a]		
Days	T0	T2	T0	T2	T0	T2	T0	T2		
1	2,4	0,6	8,1	8	3,51	3,5	0,829	3,828	Albion	Ferrer (2020)
10	26.6 [e]	13.6 [to]	11,8	9.05 [to]	3,72	3.56 [a]	0.971 [to]	0.968 [to]		
Days	T0	T3	T0	T3	T0	T3	T0	T3		
1	1.35 [to]	0.77 [b]	6.73 [a]	6.77 [to]	3.39 [a]	3.39 [a]	0.93 [to]	0.97 [to]	Albion	Cup (2017)
10	28.34 [a]	14.81 [b]	7.31 [a]	7.27 [a]	3.68 [a]	3.66 [a]	0.68 [to]	0.69 [to]		
Days	T0	T4	T0	T4	T0	T4	T0	T4		
1	2.75 [a]	3.47 [a]	6.92 [to]	6.92 [to]	3.48 [a]	3.48 [a]	0.87 [to]	0.87 [to]	Big Bear	Falconí (2016)
12	43.43 [abc]	41.27 [b]	9.69 [a]	8.29 [bc]	3.71 [b]	3.70 [b]	0.57 [to]	0.56 [to]		
Days			T0	T5	T0	T5	T0	T5		
1			10.60	9.73	3,43	3,50	0,77	0,70	Big Bear	Quilo (2016)
13			8.73	7.77	3,70	3,51	0,63	0.89		

T0. Control**; T1**. Chinese potato starch 2 %, at 4°C, immersion 10 min; **T2**. Cidrayote starch 2 %, at 4°C, immersion 10 min; **T3**. Gelatin 3%, Glycerin 0.75%, CMC, 0.75, and the application of 1% Calcium Chloride; **T4**. Pectin 3%, Glycerin 0.75%, CMC, 0.75, and T5. Propolis extract dosage 15% + Ambient storage temperature at 0ºC.

* All this data is in milling cutters with refrigeration.

3.1.1 Weight loss

Table N°1 shows the weight loss (%) of strawberries according to Oñate (2018) the strawberry of variety Albion, treated with an edible coating based on Chinese potato starch 2%, at 4 ° C, in an immersion of 10 minutes; depending on the storage time (16 days), presented values in the control of (2, 74 to 18.46) and Q1 (2.35 to 13.86). Both the control and the treatment presented weight loss during storage, this is because the strawberry has very thin skin which makes it susceptible to rapid water loss (Hernández et al., 2008). The greatest loss was in the control which shows that the coating fulfills a protective function avoiding the loss of water and volatile substances. This weight loss is explained by the physiological processes of respiration and perspiration that occur in the fruit (Sora et al., 2006), which demonstrates its high respiration rate and as a consequence the general decay of the fruit.

This is corroborated by Ferrer (2020) who with a strawberry of the Albión variety, was treated with CR based on 2% citrodonete starch, at 4 ° C, for a 10-minute immersion in refrigeration; depending on the storage time (10 days) presenting values as in the control of (2.4 to 26.6), and in the T2 of (0.6 to 13.6). This shows that the coating fulfills a protective barrier function in the strawberry and prevents the loss of water preventing a loss of the quality and appearance (wilting) of the fruit, and also preventing the loss of oxygen and volatile substances. According to Rico et al. (2012), weight loss is due to the processes related to the physiological reactions of respiration and perspiration that occurs in the postharvest life of the fruit. It is known that losses of 3% in weight are enough for the fruit to lose its characteristic shine and present a wrinkled appearance, being therefore 6%, the maximum weight loss advisable for this fruit during marketing.

Copa (2017), with a CR based on gelatin 3%, Glycerin 0.75%, CMC, 0.75 and the application of 1% of Calcium Chloride, for a storage time of (10 days) reached a control of (1.35 to 28.34), and in T3 of (0.77 to 18.41), the same author explains that which coatings preserve the quality in fruits is because they create a physical barrier to gases, producing a modified atmosphere as they reduce the availability of O2 and increase the concentration of CO2 (Guerrero & Vázquez, 2013). Other authors have also reported lower weight losses in coated strawberries than in uncoated strawberries, such as Restrepo and Aristizábal (2010) who applied coatings based on aloe vera gel and carnauba wax in strawberries, which presented losses 40% less compared to the control. Hernández et al. (2008) evidenced, after six days of storage at 10 °C, weight losses of 19.2 and 14.6 % in strawberries coated with chitosan at 1 and 1.5 %, respectively; compared to 28.7% of uncoated strawberries. Colla et al. (2006) applied a coating based on *Amaranthus cruentus* flour and stearic acid on strawberries, presenting weight loss of 23% after 18 days at 7 °C; compared to the control that presented losses of more than 35%.

3.1.2Total soluble solids (°Brix) (TSS)

Table N°1 shows the total soluble solids (%) of the strawberry according to Oñate (2018) the strawberry of the Albion variety treated with an edible coating based on Chinese potato starch 2%, at 4°C, in a 10-minute immersion; depending on the storage time (16 days), it presented values in the control of (7.55 to 11.60), and T1 (7.55 to 11.25). Here it can be seen that TSS is one of the parameters that present less variation during the post-harvest period of the strawberry (Escalante, 2015). This is corroborated by Ferrer (2020) who with a strawberry of Albion variety was treated with CR based on 2 cidrayota starch, at 4 ° C, for a 10-minute immersion in refrigeration; depending on the storage time (10 days) presenting values as in the control of (8.1 to 11.8), and in T2 of (8 to 9.05), having a variation of OSH in the treatments minimal compared to the variability of the control. Copa (2017), with a CR based on gelatin of 3%, Glycerin 0.75%, CMC, 0.75 and the application of 1% of Calcium Chloride, for a storage time of (10 days) reached a control (6.73 to 7.31), and in T3 of (6.77 to 7.27), there was also the increase of soluble solids over the days, it is because the loss of water caused by the transpiration of the strawberry caused the concentration of sugars, in addition to this the transformation of organic acids into sugars during maturation caused the progressive increase of soluble solids (Alcántara, 2009). Quilco (2016) on the other hand found a slight decrease in soluble solids in T5 of (9.73 to 7.7), concerning the control, was (10.60 to 8.63), this is because this treatment does not contain the coating therefore the respiratory intensity increases, since part of the sugars is being used in the respiratory process; however, it should be noted that many times the synthesis of sugars is greater than the amount spent on respiration (León, & Soto, 2002).

On the other hand, Falconí (2016) tried a treatment based on 3% pectin and beeswax; 0.5% in strawberries large bear variety, for a storage time of (12 days) resulting in a control of (6.92 to 9.69) and based on CR treatments with pectin (3%) gave a value of (6.92 to 8.29) these data are within the optimal values of TSS. The determination of the brix degrees shows the degree of maturity of the fruit this correlates with weight loss and the increase of soluble solids that are usually organic acids from sugars which in turn causes the decrease in pH.

3.1.3pH

Table N°1 shows the total soluble solids (%) of strawberries according to Oñate (2018) strawberry of variety Albion treated with an edible coating based on Chinese potato starch 2%, at 4°C, in a 10-minute immersion; depending on the storage time (16 days), it presented values as in the control of (3.30 to 3.13), and in T1 of (3.30 to 3.19). Here you can see a slight decrease in pH both in the control and in the treatment this is due to the conversion of starch present in the fruit to sugars, as a result of physiological changes during storage Figueroa et al. (2017). This is corroborated by Ferrer (2020) who with a strawberry of the Albión variety, was treated with CR based on 2% cidrayota starch, at 4 ° C, for a 10-minute immersion in refrigeration; depending on the storage time (10 days) presenting values such as control (3.51 to 3.72) and T2 (3.50 to 3.56). On the other hand, Copa (2017), with a CR based on gelatin of 3%, Glycerin of 0.75%, CMC, 0.75 and the application of 1% of Calcium Chloride, for a storage time of (10 days) reached a control (3.39 to 3.68), T3 (3.39 to 3.66), here there was a slight increase and can be attributed to the fact that during maturation organic acids are transformed into sugars or are used during respiration, which causes a decrease in the acidity of the medium and with it an increase in pH (Hernández, *et al.* 2012). Quilco (2016) mentions that the control treatment resulted (in 3.43 to 3.70) this same author explains that they have a slight tendency to increase the pH in the control because the fruits became less acidic over time because organic acids are used as a respiratory substrate and for the synthesis of new compounds during ripening and strawberries with T5 was (3, 50 to 3.51) there is no increase. On the other hand, Falconí (2016) who tried a treatment based on 3% pectin and beeswax; 0.5% in strawberries variety large bear, for a storage time of (12 days) pectin helped to form a protective layer preventing the entry of oxygen slowing down the activity of fungi and bacteria, which keeps the pH stable in the fruit.

3.1.4Titratable acidity

Table N°1 shows the titratable acidity of the strawberry according to Oñate (2018) the strawberry of the Albion variety treated with an edible coating based on Chinese potato starch 2%, at 4°C, in a 10-minute immersion; depending on the storage time (16 days), it presented values such as control (0.94 to 1.15), T1 (0.94 to 1.18). It should be noted that the initial amount of citric acid is different and evolves independently and that the main factor for its increase is the high content of CO2 (Beltrán, 2010). This is corroborated by Ferrer (2020) who with a strawberry of the Albión variety, was treated with CR based on 2% cidrayota starch, at 4 ° C, for a 10-minute immersion in refrigeration; depending on the storage time (10 days) presenting values such as control (0.82 to 0.97), T2 (3.28 to 0.96). Copa (2017), with a CR based on gelatin of 3%, Glycerin 0.75%, CMC, 0.75 and the application of 1% of Calcium Chloride, for a storage time of (10 days) reached a control (0.93 to 0.68), T3 (0.97 to 0.69), the decrease in titratable acidity both in control and treatment is related to an increase in pH since the pH value depends on the number of organic acids present in the fruit, which decrease during ripening due to the use of these during respiration or their conversion to sugars (Rojas, 2006). Quilco (2016) mentions that the control treatment resulted (in 0.77 to 0.63) this same author explains that they present a slight tendency of decrease due to the reduction in the content of organic acids that occurs because they are used in respiration or converted into sugars and strawberries with T5 was (0, 70 to 0.89).

On the other hand, Falconí (2016) tried a treatment based on 3% pectin and beeswax; 0.5% in strawberries large bear variety, for a storage time of (12 days) resulting in a control of (0.87 to 0.57) and based on CR treatments with pectin (3%) gave a value of (0.87 to 0.56), this decrease in values of the control and treatments exposes the author due to the conservation effect provided by low temperatures such as coatings that create a layer protective in the fruit that retains volatile compounds and slows down its senescence process, stabilizing organic acids for longer (ELIKA, 2010).*3.2 Evaluation of the physicochemical characteristics of organic* papaya

Table No. 2 shows the result of the analysis of the literature of five different authors who report the physical-chemical analysis of papaya with their respective treatments according to several authors. Of which the initial value of the treatment in the first days is evidenced, as well as the final value at the end of the period of the experimental research.

Table 1. Evaluation of the physicochemical characteristics of organic papaya

Time	pH		Acidity		Degrees Brix		Firmness		Weight loss		Authors
	Control	Treatment	Control	Treatment	Control	Treatment	Control	Treatment	Control	Treatment	
Days 0 12	T0 5.2 7.15	T1 5.58 6.00	T0 0.43 0.36	T1 0.44 0.39	T0 5.4 7.3	T1 5.7 6.4	T0 7.9 5.5	T1 7.8 6.6	T0 14.93 %	T1 4.04 %	(Gustavo H, 2019)
Days 0 10	T0 5.75 5.93	T2 5.75 5.98	T0 0.05 0.03	T2 0.05 0.04	T0 8.5 10.00	T2 8.5 9.60	T0 10.53 5.41	T2 10.53 7.52	T0 1.51 %	T2 1.14 %	(Marcho S, 2018)
Days 0 12	T0 4.64 4.62	T3 4.45 4.09	T0 0.15 0.35	T3 0.16 0.13	T0 10.90 11.30	T3 10.90 11.00	-	-	T0 5.10%	T3 1.13%	(Angelica J, 2017)
Days	-	T4 5.29	-	T4 0.09	-	T4 9.77	T0 12.38	T4 12.39	-	T4 T0	(Dora C, Katterin

1 **13**		5.50		0.11		11.53	0.28	2.47			e S & Silvio M et al, 2018)
Day s **0** **14**	-	T5 5, 63a 7.20 cd	-	T5 0.35 d 0.09 to	-	T5 10.10 c 7.09 a	-	T5	-	T5	(Cyntia E, Diana S & Jaime V et al, 2020)

Source: Franklin L & Luis A

T0. Control; **T1.** Cmc 0.5 %, glycerol 1.5 %, tween 80 1%, Eucalyptus oil 1 %. **T2*.** Sodium alginate 2 g, glycerol 1.5, sunflower oil 0.025 **T3**. Glycerol 1.5%, Pectin 2.0, tween 80 0.1%, Calcium chloride 0.5%, ascorbic acid 0.3%, aloe vera 70%. **T4.** Cassava starch 4%, glycerol 2%, at 75 °C, tween 80 0.1%, oregano oil 250 mg. **T5.** Cocoa mucilage 5%. *100 ml.

3.2.1 Ph

Table No. 2 shows the analysis of the pH evaluated in the different varieties of papaya for which each researcher reports their respective results, according to (Gustavo H, 2019) the papaya evaluated with an edible coating based on carboxymethyl cellulose 0.5%, glycerol 1.5%, tween 80 and eucalyptus oil at 1%; depending on the storage time (12 days), it presents pH values for control treatment of 5.2 on day 0 and a significant increase with a value of 7.15 for day 12. And about the T1 treatment, the pH increase is 5.58 on day 0 and 6.00 on day 12, so the greatest increase in hydrogen potential presents control. The differences between the treatments indicate an increase in values, due to the decrease in the content of organic acids, which are converted into sugars, as maturation progresses. These values are similar to the study conducted by, who evaluated in his study a treatment based on sodium alginate 2 g(Hernadéz M, Barrera J & Melgarejo L, 2010)(Marcho S, 2018); glycerol 1,5; sunflower oil 0.025 obtaining an initial pH of 5.75 on day 0 and for day 12 a pH of 5.98 and treatment control a change in pH from 5.75 to 5.98.

According to him, in his research he makes a coating based on (Angelica J, 2017) glycerol 1.5%, pectin 2.0; tween 80 to 0.1 %, calcium chloride 0.5%, ascorbic acid 0.3%, and aloe vera 70% in 12 days determines the pH change in the fruit with values of 4.45 on the first day and a pH 4.09 at the end of his research. And concerning the control treatment, it reports 4.64 on day 0 and 4.62 at the end of the work. This result is contrary to research conducted by, which reports a pH of(Dora C, Katterine S & Silvio M et al, 2018) 5.29 on day 0 and 5.50 on day 12. Likewise, they report significant differences between treatments. pH is important from the sensory point of view of fruits, when pH increases the perception of sweetness also does so. The values of this work follow the traditional behavior of pH for papaya, the increase in organic acids caused by the hydrolysis of maturation is presented, but not constant. The fluctuation in the values was possibly caused by differences in the maturity of the fruits, although they were classified according to a single characteristic, the ripening of the fruits is not always homogeneous and the incidence of light and soil can influence this aspect. In addition, it establishes that there is generally an increase in pH during the ripening and storage process of the fruit, mainly referred to the decrease of organic acids that are used as substrates for enzymatic reactions during respiration (glycolysis, Krebs cycle, and the electron transport system) or are simply converted into sugars.(Cyntia E, Diana S & Jaime V et al, 2020)(Concha, J., Guevara, A., & Araujo, M., 2002)(Ayón-R, Tamayo L & ME López et al, 2008)

3.2.2 Acidity

An important parameter during the storage of fruits is the loss of titratable acidity, so table N°2 shows the results reported by, registering a slight decrease in the percentage of acidity at the end of the investigation, because T1, T2, and T3, between days 0 and 12 decreased their percentages, According to, (Angelica J, 2017)(Gustavo H, 2019)(Marcho S, 2018)they propose that the decrease in the acidity of the fruit is probably due to the reduction of metabolic activity and likewise the organic acids used as a substrate of respiration, are depleted during this period. These results are superior to the research conducted by, those who made a coating based on (Miranda, A., Alvis, A., & Arrázola, G., 2014)(Dora C, Katterine S & Silvio M et al, 2018)Cassava Starch 4%, glycerol 2%, at 75 ° C, tween 80 to 0.1%, oregano oil 250 mg and in contrast to the control treatment obtain an increase in acidity from 0.09 to 0, 11 the increase in the percentage, possibly due to the delay in the volatilization of organic acids, thus allowing the fruits to remain more acidic thus decreasing the synthesis of organic acids, due to the alteration of respiration in the production of CO2.

3.2.3 Total soluble solids

Concerning the sugars present in fruits, their importance lies in the control of its ripening process since it increases the concentration of dissolved solids, which are mostly formed by sugars; However, when the fruit begins to overripen the sugar content decreases because they are used for the respiration of the fruit and starch reserves are depleted. Therefore, when processing the fruits, they must have an adequate maturity for consumption, on the other hand, the damage caused to the fruits that you have cut increases their breathing speed requiring greater energy consumption (sugars) to carry out the different metabolic reactions. These sugars (glucose, fructose, and, to a lesser extent, sucrose) represent, finally, between (Fuchs Y, Pesis & E, Zauberman, 1980)(López-López ME, 2010)1.5 and 2% of the total weight of the fruit, they are called generic soluble solids and their concentration varies from one fruit to another. Therefore, it is worth mentioning the studies carried out by, which report values of (5.4-7.3); (8.5-10.00) and (10.90-11.30) in the control samples evaluated in 12 days show an increase in sugars that have been metabolized in papaya. However, in the treatments evaluated with edible coatings, they have a lower concentration of sugars in the fruit. These values are similar to the study conducted by the person who used the T4 treatment (Agustí M., 2000)(Angelica J, 2017)(Marcho S, 2018)(Gustavo H, 2019)(Dora C, Katterine S & Silvio M et al, 2018) to cassava starch 4%, glycerol 2%, tween 80 to 0.1%, and 250 mg of oregano oil as the basis for the coating; reporting values of 9.77 ° Brix on day zero and 11.53 ° Brix at the end of the investigation. Likewise, its studies evaluated with (Cyntia E, Diana S & Jaime V *et al*, 2020)5% cocoa mill, reports significant differences between treatments. So you can see the effect of the protective barrier that helps improve the quality of fruits since it prevents the passage of oxygen and the slowdown in the synthesis of ethylene which is the hormone responsible for metabolic changes in fruits and vegetables. Thus, sugars are of great importance because they represent the physiological state and quality of the fruit since its flavor and palatability depend on the number of sugars, organic acids, salts, and other soluble compounds present in the structural parts of the fruit.

3.2.4 Firmness

Among the parameters to be considered in the quality criteria of fruits is their firmness, which depends exclusively on the time of maturity of consumption, once it has been removed from the plant. Therefore, Table No. 1 shows the results obtained by several authors with their respective treatments; According to what he evaluated in his research the effect of coating based on CMC 0.5%, (Gustavo H, 2019)glycerol 1.5%, tween 80 to 1 %, eucalyptus oil 1% in 12 days reports a firmness of 7.8 to 6.6 N. In addition to these data, the studies evaluated, and performed (Marcho S, 2018) a coating based on sodium alginate 2 g, glycerol 1.5, and sunflower oil 0.025 presented values of 10.53 N firmness on day 0 and 7.52 N at the end of the treatment period. And concerning the control sample I present a value of 5.4 N. These values are similar to the study conducted by, with a coating based on (Dora C, Katterine S & Silvio M et al, 2018)cassava starch 4%, glycerol 2%, at 75 °C, tween 80 at 0.1%, oregano oil 250 mg obtained a firmness of 0.28 N in the control treatment and 2.47 N for T1. These results could be explained by the degradation processes of wall polymers involved in cell adhesion (insoluble protections) to peptic acids and more soluble pectins are affected by CR decreasing their metabolic processes. The loss of firmness can be influenced by extracellular and vascular air loss, the degradation of the cell wall, the consequent loss of water by the breakdown of the cells, and senescence itself. (Del Valle, D., Hernández, P., Guarda, A., & Galotto, M., 2005)

3.2.5 Weight loss

Weight loss is a relevant factor in the visual perception of the consumer, the respiration of the fruits generates the decrease of the water present inside it; Therefore, it reports a weight(Gustavo H, 2019)loss of 4.04% in papaya evaluated with a coating based on C MC 0.5%, glycerol 1.5%, Tween 80 to 1 %, eucalyptus oil 1%. These results are superior to the study of & who report a weight loss of 1.14(Marcho S, 2018)(Angelica J, 2017)% and 1.13%.

3.3 Evaluation of physic-chemical characteristics in organic cucumber

Table N°3 reports the results of the physicochemical properties as a characteristic of food to be accepted by consumers, however, its importance lies in the correct evaluation and compliance with the standards established in food to improve food security in this way and thereby be able to achieve objective 2 of the sustainable development agenda "Zero Hunger".

Table N°3. Evaluation of the physicochemical characteristics of the cucumber.

Time	pH		Acidity		Degrees Brix		Firmness		Weight loss		Authors
	Control	Treatment	Control	Treatment	Control	Treatment	Control	Treatment	Control	Treatment	
Days 1	T0 5.00 to	T1 5.10 a	T0 0.05 to	T1 0.05 to	T0 3.00 to	T1 3.00 to	T0 17.51 a	T1 17.51 a	T0	T1	(Linen C, 2017)
		5.2 b							16.78a	6.06e	
21	6.08 b		0.66 d	0.52 to	6.63 d	5.5 c	4.48 a	13.84 e			
Days 0	T0 5.2 c	T2 5.2 ab	T0 0,08	T2 0,08	T0 3,1	T2 3,1	T0 3.5 to	T2 3.5 to	T0	T2	(Maria L, Alexsandra A
	5.2 c	5.1 ab	0.08	0,089	3.5	3.2 a		3.8 to	15 b	15 b	

24			1 to		to		4.0 to				& Rene P, 2020)
Days 1	T0 5,36	T3 5,87	T0	T3	T0 1,96	T3 1,96	T0 54,00	T3 54,00	T0	T3	(Eliza M, Henry
15	5,42	5,98	1,11	0,66	2,36	2,14	48,00	53,00	6.00 ab	2.89 b	García & Rodríguez L, 2017)

Source: Franklin L & Luis A

T0. Control; **T1.** Cassava starch 1%, chitosan 1%, essential oil 1%, cinnamaldehyde 0.15%, 10 °c, **T2.** Latex, calcium oxide 50 ppm, **T3.** Wax 25%, mineral oil 25%, emulsifier 0.5%, 85% RH.

3.3.1 pH

Table No. 3 shows the result of the physical-chemical analysis evaluated in the cucumber by several authors with their respective treatments, in their study performs an edible coating based on cassava starch 1%, chitosan 1%, essential oil 1%, and cinnamaldehyde 0.15%, at a temperature of 20 ° C; for which it establishes in its research that there are no significant differences between T1 and control treatment. In addition, it is observed that the control sample evidences the highest pH value unlike T1 which showed a lower increase in pH during the 21 days of storage. These results are contrary to the study conducted, which made an edible coating with latex, and calcium oxide 50 ppm; thus reporting that there are no significant differences between treatments. In the control and analysis samples, they maintained the same pH during the 24 days of storage. In addition to these data, through its research carried out with wax 25%, mineral oil 25%, and emulsifier 0.5% (Linen C, 2017)(Maria L, Alexsandra A & Rene P, 2020)(Eliza M, Henry García & Rodríguez L, 2017) and 85% RH reports an increase in pH. According to him, he associates high pH values as an indicator of better fruit quality, (Sabir FK, & Agar It, 2010)sinc a drop in pH values in coated fruits indicates stress due to a modified atmosphere, resulting in a greater speed of fruit deterioration.

With the results obtained in this work, it can be inferred that the coatings influenced the treated fruits to present the highest pH values, while the uncoated ones had the lowest values. reported in three cucumber cultivars a pH range of 5.6-6.0(Moreno D, Garcia E & Ibañez A et al, 2013); in which no coatings were used and the change was attributed to breathing.

3.3.2. Acidity

Acidity is a determining factor in food that is determined by titration also known as titration. The result is expressed in the index of the predominant acidity in the material, and its importance lies in the sensation for the palate of consumers. Therefore, through the literature review, table No. 3 shows the results of several authors; develop a coating based on cassava starch 1%, chitosan 1%, essential oil 1%, cinnamaldehyde 0.15% (Linen C, 2017) at a temperature of 10 ° C and observed significant difference (0.05ª- 0.66 [d]) in the sample control and comparison with the samples of the treatments in the 21 days of storage it is established that there is no significant difference (0.05 to - 0.52 a). In addition, it also reports that there are significant differences between the control treatment(Eliza M, Henry García & Rodríguez L, 2017) (1.11) and the sample evaluated with the coating since they have a value of 0.66. These values are contrary to the research, which developed a coating with latex and calcium oxide 50 ppm and establishes that there are no significant differences between the control sample and T2. The increased acidity in the treatments could be explained due to the concentration of organic acids present in the cucumber due to the weight loss that takes place in storage. Similar behavior was found, which associates this behavior to the modified atm(Maria L, Alexsandra A & Rene P, 2020)(Silvia V & Jenny T, 2016)or sphere generated by the coatings.

3.3.3 degrees Brix

The results obtained from the sugar present in cucumbers according to several authors are expressed in degrees brix, (Linen C, 2017), which applies cassava starch reports that there are significant differences between the control sample and the other treatments. Likewise, for its research, I develop an edible coating based on wax 25%, mineral oil 25%, and emulsifier 0.5%(Eliza M, Henry García & Rodríguez L, 2017) reports a value of 2.36 ° brix in the control sample and 2.14 ° brix in the treatment evaluated, demonstrating that there are significant differences between treatments. These results are different from the study (Maria L, Alexsandra A & Rene P, 2020) which states that there is no significant difference between the treatments since it presents values of 3.5 and 3.2 between both variables. What states that the most important physiological process that affects the deterioration of strawberries during the postharvest stage is the loss of water, which dissipates in the form of water vapor as a result of respiration, this process results in the loss of firmness and accelerates the general decay of the fruit.

3.3.4 Firmness

Table 3 presents the result according to several authors; In his study evaluated with cassava starch 1%, chitosan 1%, essential oil 1%, and cinnamaldehyde 0.15%, 10 ° C determines that there are significant differences between the control sample and treatments. In addition, it establishes that the coating allows for maintaining the firmness of the cucumber. These results are similar to the study evaluated, which reports cucumber firmness on day 1 (54 N) and 53 (N) on day 15. However, the control fruit was (Linen C, 2017)(Eliza M, Henry García & Rodríguez L, 2017)significantly softer compared to the discovered fruit and by day 15 the firmness value for the control fruit was 48 N respectively. According to what has been reported in the literature, this "firming" effect is due to the phenomenon of cross-linking, which helps reduce juice loss. In addition, bilayer RCs form a mechanical barrier that delays respiratory metabolism and consequently decreases enzyme activity (e.g., polyphenol oxidase), which is related to fruit softening. (Brazil IM, Gomes C, & Puerta-Gomez A et al, 2010)

3.3.5 Weight loss

The loss of water in fruit and vegetable products is the main cause of weight loss, therefore the control of this parameter is one of the main objectives of CR technology. As shown in the figure, as reported in his research that there are significant differences between the control treatment and T1. These results are similar to the study conducted, which states that there are significant differences between treatments. (Linen C, 2017)(Eliza M, Henry García & Rodríguez L, 2017)The efficiency of RCs to decrease weight loss may be because these materials form a polymeric barrier on the surface of the fruit, which reduces the transmission of water vapor and therefore weight loss (Sipahi RE et al, 2013).

CONCLUSIONS

The scientific literature analyzed allows us to know the organic and somehow sustainable edible coatings based on proteins, carbohydrates, and lipids that are used in the conservation of strawberries, and based on the results and physicochemical values it is concluded that the best formulation to be applied is treatment 3, which is constituted based on gelatin 3%, glycerin 0.75%, carboxyl methyl cellulose 0.75% and calcium chloride that allows maintaining the quality in the milling cutter until 10 days of storage because it creates a physical barrier to the gases, producing a modified atmosphere and reducing the availability of O_2 and increasing the concentration of CO2.

The application of natural edible coatings is known to preserve in a better way the physicochemical characteristics of the organic papaya, being the best treatment the study carried out with carboxyl methyl cellulose 0.5%, glycerol 1.5%, tween 80 to 1%, and eucalyptus oil 1% that help maintain the physicochemical properties of papaya in a storage period of 12 days; So you can check the effect of the protective barrier that helps improve the quality of fruits, preventing the passage of oxygen and slowing down the synthesis of ethylene which is the hormone responsible for metabolic changes in fruits and vegetables.

Through the studies carried out by several authors, the natural edible coatings applied in the conservation of the shelf life of organic cucumber are known, concluding that the best treatment that manages to preserve its physicochemical properties is the edible coating Based on cassava starch, chitosan 1%, essential oil 1% and cinnamaldehyde 0.15% as they influence the change of respiration of the vegetable.

The percentage of loss surrounds 14% and 13% approximately from 12 days, for the cause of weight loss by filtration of liquids and natural oils, this loss directly influences the sale price and there is a reduction of up to 22 cents per kilo of fruit, so it is concluded that the use of Edible natural coatings on the physicochemical characteristics of fruit and vegetable products in commercial ripening to extend the shelf life of fruits.

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