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Quality and Shelf Life of Processed Pineapple by Different Edible Coatings

Nguyen Phuoc Minh[1,*], Tran Thi Yen Nhi[2], Duong Ngoc Hue[3], Danh Thi Thu Ha[4], Vo Minh Chien[5]
[1]*Faculty of Chemical Engineering and Food Technology, Nguyen Tat Thanh University, Ho Chi Minh, Vietnam*
[2]*NTT Hi-Tech Institute, Nguyen Tat Thanh University, Ho Chi Minh City, Vietnam*
[3]*Mekong University, Vinh Long Province, Vietnam*
[4]*Kien Giang University, Kien Giang Province, Vietnam*
[5]*Can Tho University, Can Tho City, Vietnam*

Abstract.
Pineapple (*Ananas comosus*) is one of the most important commercial fruit crops with several health benefits. Processed pineapple (*Ananas comosus*) fresh cut ripen and soften rapidly due to injuries from cutting operations, which cause break of the cell membrane**.** Consequently, respiration rate, ethylene production, and tissue softening are accelerated, making the commercialization of highquality, fresh-cut fruits difficult. Besides, injured fruits become more susceptible to microbial spoilage, mainly by foodborne pathogens. The current research aimed to evaluate the quality and shelf life of processed pineapple by various edible coating on the storage. Pineapples pieces were dipped into five coating agents: without coating (control) A, chitosan (B), sodium alginate (C), modified starch (D), xanthan gum (E) under the same concentration (0.25%) with the presence of 0.3% citric acid, 0.1% potassium sorbate, 1.5% calcium chlorite in all samples. All samples were preserved in refrigerator at 8±0.5°C and 75-80% relative humidity for 21 days. The analyzed parameters were based on weight loss (%), firmness (N), total soluble solids (^{o}Brix), total titratable acidity (%), vitamin C (mg/100g), catalase ($U.g^{-1}.min^{-1}$), microbial quality (TPC, cfu/g) and sensory score. Result revealed that 0.25% sodium alginate with 0.3% citric acid, 0.1% potassium sorbate, 1.5% calcium chlorite was appropriated for coating processed pineapple pieces. The use of edible coatings has emerged as an effective and environmentally-friendly alternative to extend their shelf life and protect them from harmful environmental effects.

Keywords: *Pineapple, coating, shelf life, chitosan, sodium alginate, modified starch, xanthan gum*

I. INTRODUCTION

Pineapple (Ananas comosus L.) belongs to Bromeliaceae. Pineapple (Ananas comosus) is the world‟s most popular non-citrus tropical and subtropical fruit. It has cylindrical shape, square shoulders, an intense orange-yellow shell colour and a medium to large size (1.3 to2.5g), and stands out for its excellent quality and sensory characteristics. Due to its excellent flavour and taste, pineapple is known as the queen of fruits (Silva DIS et al., 2013). The flesh is clear yellow, very sweet, compact and fibrous and has a high ascorbic acid content but low total acidity. The fresh pineapple fruit contains 60% edible portion and the moisture content ranges from 80-85%. The fruit contains 12-15% sugars, 0.6% acid, 0.4% protein, 0.5% ash (mainly K), 0.1% fat, fibre, vitamin A, C and βcarotene and antioxidants mainly flavonoids, citric and ascorbic acid (Offia Olua BI, Edide RO., 2013). The mature fruit contains a proteolytic digestive enzyme, Bromelin, which when taken with meals proves to aid in digesting protein by breaking proteins to amino acids. Bromelain is a complex mixture of substances that can be extracted from the stem and core fruit of the pineapple and has serious impact on health and medicinal benefits. The fruit can be consumed fresh or may be processed into squash, syrup, jelly, vinegar, citric acid to name a few (Tanmay Sarkar et al., 2018). Generally, the matured pineapple fruit is consumed fresh and juice as source of many essential minerals and vitamins but can also be processed to produce different pineapple based products. Fresh pineapples are rich in bromelain which is used as anti-inflammatory agent as well as reduces swelling in inflammatory conditions such as acute sinusitis, sore throat, arthritis, gout (Tanmay Sarkar et al., 2018).

Minimal processing of fresh-cut fruits, which involves grading, washing, sorting, peeling, slicing and packaging, can affect the integrity of the fruits and cause biochemical changes and microbial spoilage that may result in degradation of the colour, texture and flavour of fruits (Watada & Qi, 1999). The removal of the natural protective skin of fruits causes leakage of juices and sugars from the damaged tissue resulting in the fruits being highly susceptible to microbial spoilage (Oms-Oliu et al., 2010). An edible coating can be used as an alternative to modified atmosphere packaging to improve the shelf life of fresh-cut fruits (Rojas-Grau et al., 2009). Moreover, coatings are effective barriers to water loss, provide good appearance and brightness, making fruits and vegetables more attractive to the market (Lemos et al., 2007, Vila et al., 2007).

Chitosan, which may be used as a biofilm, by itself or associated to other compounds, was very effective in inhibiting microorganisms during the postharvest life of vegetables and fruits, and also in minimally processed food (Liu et al., 2007). Chitosan is a biopolymer of high potential to be used as an edible coating and active package, because it is non-toxic, able to form biodegradable films and prevents antimicrobial activity. Among edible coatings, chitosan, also has long been known to protect perishable produce from deterioration by reducing transpiration, respiration and maintaining the textural quality (Mona A. Elabd, 2018).

Alginate is a natural polysaccharide extracted from brown sea algae (Phaeophyceae), and it is composed of two uronic acids: β-D-mannuronic acid and α-L-guluronic acid. Sodium alginate is composed of block polymers of sodium poly(L-guluronate), sodium poly(D-mannuronate) and alternating sequences of both sugars (Huertas M. Díaz-Mula et al., 2012). Alginate is known as a hydrophilic biopolymer that has a coating function because of its well-studied unique colloidal properties, which include its use for thickening, suspension forming, gel forming and emulsion stabilising. Sodium alginate has been effective on maintaining postharvest quality of tomato (Zapata et al. 2008) and peach (Maftoonazad et al. 2008).

Starch-based coatings are colourless and have an oil-free appearance, and can be used to increase the shelf life of fruits, vegetables and other products, although due to their hydrophilic nature, they are highly water sensitive and exhibit low water vapour barrier capacity (Mayra Sapper and Amparo Chiralt, 2018). Other components, such as plasticizers and emulsifiers (or surfactants), may be added to the polymer matrix to improve the flexibility, extensibility and/or the stability of the polymer matrix structure. Blending (with other hydrophobic compounds to limit the hygroscopicity of starch-based materials has become an economical and versatile way to obtain new materials with better properties (Cazón, P. et al., 2017).

Xanthan gum, synthesized as an exopolysaccharide by *Xanthomonas campestris* under unfavorable conditions, is used as a stabilizer, thickener or emulsifier. It forms a highly viscous solution in cold or hot water at low concentration with excellent stability over a wide range of pH and temperature and it is also resistant to enzymatic degradation. Moreover, it facilitates the suspension of particulates, even in complex formulations for a long time (Sonu Sharma, T.V. Ramana Rao, 2015). Most recently, the effect of xanthan gum coating was studied on minimally processed prickly pear (Mohamed et al., 2013) and fresh-cut apples (Freitas et al., 2013; Zambrano-Zaragoza et al., 2014).

Fresh pineapple possesses a thick inedible peel and a large crown which takes up storage space and results in higher transportation cost. Value addition by processing into a ready-to-eat product is an attractive alternative since consumers will spend less time on food preparation (Rocculi et al., 2009). However, fruit peeling and cutting increase metabolic activities such as respiration rate and delocalisation of enzymes and substrates leading to quality deterioration such as browning, softening, off-flavour and microbial growth, resulting in a short shelf life (Montero-Calderon et al., 2008). There were several researches mentioned to using of edible coating for storage of pineapple. The effect of an edible coating, Semperfresh™ (sucrose-fatty acid ester), on postharvest quality of pineapple fruit during cold storage was studied and compared with a commercial coating material, Sta-fresh 7055 (paraffin-polyethylene wax). Coating with 2% Semperfresh™ and 10% Sta-fresh 7055 reduced internal browning and maintained higher ascorbic acid content compared to that of 1% Semperfresh™ coated fruit and control. Coating treatments extended storage life of pineapple fruit up to 5 weeks, whereas the control fruit had a storage life of only 28 days (H. Nimitkeatkai et al., 2006). A research aimed to develop an edible coating incorporated with mint essential oil, evaluate its effectiveness in inhibiting in vitro microbial development, and improve both quality and shelf-life of fresh-cut pineapple (Raphaela Gabri Bitencourt et al., 2014). A study was conducted to investigate the effects of gamma irradiated and un-irradiated chitosan coating on different quality parameters (ripening, biochemical and organoleptic) and shelf life extension of pineapple over a storage period of 18 days at ambient environment (30 ± 1°C /75 ± 5% RH) (Sayka M. Ibrahim et al., 2014). Impact of packaging materials on quality of fresh cut pineapple using biopreservative to ensure safety was examined (G. Sindumathi et al., 2017). A study focused on examining the effect of wax application on the ripening and storage quality of the fruit. An optimized waxing treatment (65 g L^{-1} for 1 min) could effectively control fruit ripening by delaying fruit color change, decreasing the respiration rate and ethylene production, decreasing content of organic acids and relieving the symptoms of internal browning of pineapple fruit. Waxing enhanced the relative level of pentose phosphate pathway of respiration and affected the enzymes involved in organic acid metabolism (Xueping Li et al., 2018). Fresh cut fruits and vegetables with the advantage of health, convenience, high nutrition and flavour while still maintaining freshness, have gained great popularity among customers worldwide. This has led to a global trend of increased consumption and research investment of fresh cut fruits and vegetables in recent years (Oliveira et al., 2015, Siddiq Sogi and Dolan, 2013).

The currently applied sanitizing and washing treatments for industrial applications do not guarantee the entire elimination of microorganisms. Edible coatings have been developed as an alternative technology that may reduce the gas exchange rates and water loss from fruits and vegetables, as well as incorporate additives to control reactions that are detrimental to their quality (OMS-OLIU et al., 2008). Application of edible coating could be considered as a useful approach to maintain its product quality during preservation. Ojective of the present study focused on the effect of various coating agents on some physicochemical, microbial and sensory characteristics of processed pineapple pieces during storage.

II. Materials And Method

2.1 Material

Pineapple fruits were collected in Hau Giang province, Vietnam. They must be cultivated following VietGAP to ensure food safety. After harvesting, they must be conveyed to laboratory within 8 hours for experiments. Fruits were thoroughly rolled to remove dirt, dust and adhered unwanted material. Besides pineapple fruits we also used other materials during the research such as chitosan, sodium alginate, modified starch, xanthan gum, distilled water, NaOH, 2,6-dichlorophenolindophenol**,** Petrifilm - 3M, citric acid, potassium sorbate, peracetic acid, PVC bag. Lab utensils and equipments included incubator, colony counter, refrigerator, pH meter, refractometer, spectrophotometer, digital balance, grinder, centrifugator, biuret.

Figure 1. Pineapple (*Ananas comosus*)

2.2 Researching procedure

2.2.1 Sample preparation

Pineapple fruit harvested at commercial maturity was obtained from farms in Hau Giang province, Vietnam. Good quality fruit was selected for uniformity of size and colour. Fruit was washed and cut into pieces. The pineapple pieces were dipped in peracetic acid water (25 ppm) for 30 seconds and drained for 5 min. This was followed by air drying for 2 min, and randomly divided into five groups, which corresponded to four coating treatments, and one water dipped control.

2.2.2 Coating procedure of pineapple fruit pieces

Pineapple piece samples were dipped for 30 secons in antibrowning solution composed of a mixture of 0.3% citric acid and 0.1% potassium sorbate. The excess liquid was gently removed by drying for 2 min using a fan to ensure dryness. This was followed by dipping in 1.5% calcium chloride solution as solidifying agent. The pieces were immersed in different coating solutions for 30 seconds and dried. The pieces then were stored in refrigerator at 8°C and relative humidity 75-80%, for 21 days. The pineapple pieces were analyzed on day zero and every 7 days interval, during storage period of 21 days.

2.3 Physico-chemical, microbial and sensory evaluation

Weight loss (%) was measured as percentage of weight loss from the initial weight of pieces (AOAC 2000). Total soluble solid (^{o}Brix) was determined in the juices by refractometer. Firmness (N) of the fruit pieces was measured using a hand dynamometer. Total titratable acidity (%) of the juices was determined by titration as described in the AOAC (2000). Ascorbic acid (mg/ 100g) was determined using 2,6 dichlorophenolindophenol titration as described in the AOAC (2000). Catalase activity ($U.g^{-1}.min^{-1}$) was determined spectrophotometrically method. The total plate count (cfu/g) was enumerated during the storage period by Petrifilm - 3M. The sensory attributes such as visual appearance, color, taste, flavor and acceptability was carried out by selected panel of judges (9 members) rated on a 9-point hedonic scale.

2.4 Statistical analysis

The experiments were run in triplicate with three different lots of samples. Data were subjected to analysis of variance (ANOVA) and mean comparison was carried out using Duncan's multiple range test (DMRT). Statistical analysis was performed by the Statgraphics Centurion XVI.

III. RESULT & DISCUSSION

3.1 Weight loss (%) of processed pineapple pieces by edible coatings

Application of all coating treatments significantly decreased the weight loss of processed pineapple pieces. Loss weight in fresh fruit and vegetable is mainly due to the loss of water caused by transpiration and respiration processes (Zhu et al., 2008). Chitosan coating forms a layer of semi-transparent to smooth the pericarp surface (Dong et al., 2004).

3.2 Total soluble sodid (^{o}Brix) of processed pineapple pieces by edible coatings

The control sample had a decrease in the **total soluble sodid** values during the experiment, while the coated treatments were significantly more effective in controlling the sugar content until the end of storage period.

The chemical changes in N36 and Gandul pineapples stored at 10 ± 1 °C; 85–88% RH and the effects of various surface coatings (palm oil, liquid paraffn, *Semperfresh*) were examined by monitoring fruit total soluble solids (TSS), titratable acidity (TA), sugar-acid ratios (TSS:TA), pH and individual sugars (glucose, fructose and sucrose). Palm oil was effective in reducing ascorbic acid loses of N36 pineapple. All surface treatments signifcantly (p <0.05) reduced the TSS value in all pineapple cultivars except for N36 pineapple treated with palm oil. In N36 pineapple, the palm oil caused an increase in the TSS during storage (O. Zaulia et al., 2007).

3.3 Firmness (N) of processed pineapple pieces by edible coatings

Antimicrobial coatings delayed pieces softening and exhibited significant differences during storage. The maintenance of firmness in the coated samples with antimicrobial coatings could be due to covering of the cuticle and lenticels and their higher antifungal activity thereby reducing respiration, other ripening processes and infection during storage (Krishna& Sudhakar 2014).

Table 1. Weight loss (%) of processed pineapple pieces by edible coatings in 0.25% concentration

Storage (days)	*Control*	*Chitosan*	*Sodium alginate*	*Modified starch*	*Xanthan gum*
0	0^a	0^a	0^a	0^a	0^a
7	$1.45±0.01^a$	$0.73±0.03^{bc}$	$0.57±0.02^c$	$0.98±0.00^b$	$1.11±0.02^{ab}$
14	$2.46±0.03^a$	$0.97±0.01^{bc}$	$0.64±0.01^c$	$1.14±0.02^b$	$1.49±0.03^{ab}$
21	$3.55±0.00^a$	$1.18±0.02^{bc}$	$0.83±0.03^c$	$1.43±0.01^b$	$1.95±0.00^{ab}$

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%).

Table 2. Total soluble sodid (°Brix) of processed pineapple pieces by edible coatings in 0.25% concentration

Storage (days)	*Control*	*Chitosan*	*Sodium alginate*	*Modified starch*	*Xanthan gum*
0	10.38±0.02^{a}	10.38±0.02^{a}	**10.38±0.02^{a}**	10.38±0.02^{a}	10.38±0.02^{a}
7	10.40±0.03^{c}	10.65±0.03^{ab}	**10.89±0.00^{a}**	10.59±0.03^{b}	10.45±0.01^{bc}
14	10.47±0.00^{c}	10.98±0.03^{ab}	**11.45±0.01^{a}**	10.79±0.01^{b}	10.63±0.00^{bc}
21	10.63±0.01^{c}	11.40±0.01^{ab}	**12.59±0.02^{a}**	10.95±0.00^{b}	10.81±0.03^{bc}

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%).

Table 3. Firmness (N) of processed pineapple pieces by edible coatings in 0.25% concentration

Storage (days)	*Control*	*Chitosan*	*Sodium alginate*	*Modified starch*	*Xanthan gum*
0	3.60±0.01^{a}	3.60±0.01^{a}	3.60±0.01^{a}	3.60±0.01^{a}	3.60±0.01^{a}
7	3.49±0.03^{c}	3.57±0.03^{ab}	3.58±0.00^{a}	3.55±0.00^{b}	3.53±0.03^{bc}
14	3.40±0.02^{c}	3.55±0.01^{ab}	3.57±0.02^{a}	3.53±0.03^{b}	3.52±0.00^{bc}
21	3.32±0.01^{c}	3.52±0.02^{ab}	3.55±0.03^{a}	3.50±0.01^{b}	3.47±0.02^{bc}

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%).

Table 4. Total titratable acidity (%) of processed pineapple pieces by edible coatings in 0.25% concentration

Storage (days)	*Control*	*Chitosan*	*Sodium alginate*	*Modified starch*	*Xanthan gum*
0	0.36±0.00^{a}	0.36±0.00^{a}	0.36±0.00^{a}	0.36±0.00^{a}	0.36±0.00^{a}
7	0.31±0.03^{c}	0.34±0.01^{ab}	0.35±0.02^{a}	0.33±0.03^{b}	0.32±0.02^{bc}
14	0.28±0.00^{c}	0.32±0.01^{ab}	0.33±0.02^{a}	0.31±0.02^{b}	0.30±0.01^{bc}
21	0.25±0.03^{c}	0.30±0.02^{ab}	0.31±0.01^{a}	0.29±0.00^{b}	0.28±0.03^{bc}

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%).

Table 5. Ascorbic acid (mg/ 100g) of processed pineapple pieces by edible coatings in 0.25% concentration

Storage (days)	*Control*	*Chitosan*	*Sodium alginate*	*Modified starch*	*Xanthan gum*
0	94.75±0.01^{a}	94.75±0.01^{a}	94.75±0.01^{a}	94.75±0.01^{a}	94.75±0.01^{a}
7	94.40±0.03^{c}	94.70±0.02^{ab}	94.72±0.02^{a}	94.64±0.03^{b}	94.57±0.02^{bc}
14	94.21±0.01^{c}	94.63±0.00^{ab}	94.70±0.01^{a}	94.53±0.03^{b}	94.44±0.00^{bc}
21	94.03±0.03^{c}	94.59±0.03^{ab}	94.67±0.02^{a}	94.41±0.00^{b}	94.35±0.02^{bc}

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%).

Table 6. Catalase activity ($U.g^{-1}.min^{-1}$) of processed pineapple pieces by edible coatings in 0.25% concentration

Storage (days)	*Control*	*Chitosan*	*Sodium alginate*	*Modified starch*	*Xanthan gum*
0	30.24±0.02^{a}	30.24±0.02^{a}	30.24±0.02^{a}	30.24±0.02^{a}	30.24±0.02^{a}
7	30.12±0.00^{c}	30.20±0.01^{ab}	30.22±0.01^{a}	30.19±0.03^{b}	30.16±0.00^{bc}
14	30.05±0.00^{c}	30.17±0.02^{ab}	30.21±0.00^{a}	30.15±0.01^{b}	30.13±0.01^{bc}
21	30.00±0.01^{c}	30.13±0.03^{ab}	30.18±0.01^{a}	30.11±0.01^{b}	30.09±0.00^{bc}

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%).

Table 7. The total plate count (cfu/g) of processed pineapple pieces by edible coatings in 0.25% concentration

Storage (days)	*Control*	*Chitosan*	*Sodium alginate*	*Modified starch*	*Xanthan gum*
0	$1.2x10^{1}$±0.02^{a}	$1.2x10^{1}$±0.02^{a}	$1.2x10^{1}$±0.02^{a}	$1.2x10^{1}$±0.02^{a}	$1.2x10^{1}$±0.02^{a}
7	$1.9x10^{1}$±0.01^{a}	$0.8x10^{1}$±0.03^{b}	$1.3x10^{1}$±0.01^{ab}	$1.3x10^{1}$±0.01^{ab}	$1.3x10^{1}$±0.00^{ab}
14	$3.7x10^{1}$±0.02^{a}	$0.5x10^{1}$±0.00^{c}	$1.3x10^{1}$±0.02^{bc}	$1.4x10^{1}$±0.02^{b}	$1.5x10^{1}$±0.02^{ab}
21	$4.5x10^{1}$±0.03^{a}	$0.2x10^{1}$±0.01^{c}	$1.3x10^{1}$±0.01^{b}	$1.5x10^{1}$±0.03^{ab}	$1.5x10^{1}$±0.01^{ab}

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%).

Table 8. Sensory score of processed pineapple pieces by edible coatings in 0.25% concentration

Storage (days)	*Control*	*Chitosan*	*Sodium alginate*	*Modified starch*	*Xanthan gum*
0	8.13±0.02^{a}	8.13±0.02^{a}	8.13±0.02^{a}	8.13±0.02^{a}	8.13±0.02^{a}
7	7.02±0.03^{c}	8.10±0.01^{a}	8.11±0.01^{a}	8.06±0.00^{ab}	8.04±0.03^{b}
14	6.31±0.00^{c}	8.05±0.00^{ab}	8.08±0.01^{a}	8.02±0.03^{b}	8.0±0.00^{b}
21	5.02±0.00^{c}	8.01±0.03^{ab}	8.05±0.03^{a}	7.97±0.01^{ab}	7.93±0.01^{b}

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%).

A study was conducted to investigate the effects of gamma irradiated and un-irradiated chitosan coating on different quality parameters (ripening, biochemical and organoleptic) and shelf life extension of pineapple over a storage period of 18 days at ambient environment (30 ± 1°C /75 ± 5% RH). Preserved fruits maintained their eating quality during whole storage period without visual fungal growth. Dry matter content, total soluble solids, titratable acidity, reducing sugar, moisture content and ascorbic acid were also observed. All of the results were analyzed statistically and found to be significantly different (Sayka M. Ibrahim et al., 2014).

3.4 Total titratable acidity (%) of processed pineapple pieces by edible coatings

Citric acid is the major organic acid in pineapple fruit. The total titratable acidity (%) was relatively high at begining and then it decreased during storage period which is a natural phenomenon. This might be due to rapid utilization of acids in guava fruits during the respiration process as a substrate (Gupta et al., 1979)

3.5 Ascorbic acid (mg/ 100g) of processed pineapple pieces by edible coatings

Ascorbic acid (mg/ 100g) in processed pineapple pieces gradually decreased during storage, and this reduction was effectively inhibited by edible coatings.

Pineapple were minimally processed in the form of slices and treated with 0.04mg of nisin packed in thermocol, arecanut sheath, aluminium foil and polypropylene stored at room and refrigeration temperatures. Changes in physiological loss of weight, firmness, TSS, pH, ascorbic acid, β-carotene, total antioxidant activity, sensory quality and microbial growth were evaluated over a time. For all the packaging materials polypropylene allowed conservation of fresh cut pineapples treated with nisin without undesirable changes up to 3 days in room temperature and 12 days in refrigerated temperature in all parameters. Packaging materials used in this study are beneficial to food industry and consumers since they can extend the lag-period and reduce the growth rate of microorganism to prolong shelf life of fresh cut pineapple to maintain food safety (G. Sindumathi et al., 2017).

3.6 Catalase activity ($U.g^{-1}.min^{-1}$) of processed pineapple pieces by edible coatings

Catalase activity ($U.g^{-1}.min^{-1}$) in all samples decreased during storage period. The coating samples delayed the decrease of catalase activity ($U.g^{-1}.min^{-1}$).

3.7 The total plate count (cfu/g) of processed pineapple pieces by edible coatings

Edible films can be used to protect perishable food products from deterioration by retarding dehydration, providing a selective barrier to moisture, oxygen and carbon dioxide, suppressing respiration, improving textural quality, helping retain volatile flavour compounds and reducing microbial growth (Lee et al., 2003). Impact of coatings and storage time was significant ($P<0.05$) on the total bacterial count.

A research aimed to develop an edible coating incorporated with mint essential oil, evaluate its effectiveness in inhibiting in vitro microbial development, and improve both quality and shelf-life of fresh-cut pineapple. Mint essential oil-containing edible coatings showed in vitro antimicrobial efficiency against ***Escherichia coli*** and ***Salmonella*** *Enteritidis*. Titratable acidity, pH, and texture were not affected ($P>0.05$) by coating or storage time. Mass loss was not higher than 1.0% after the 6th day of storage. No effect of storage time and coating on total soluble solids was observed. Mint essential oil-containing coatings inhibited the growth of yeasts and molds in fresh-cut pineapple. Compared to uncoated and controlcoated samples, mint essential oil-containing coatings lessened psychrotrophic bacteria counts throughout storage. Counts of thermotolerant *coliforms* were not higher than 3.0MPN·g-1 in all treatments, whereas no ***Salmonella*** sp. was detected during the 6-day storage (**Raphaela Gabri Bitencourt et al., 2014**).

3.8 Sensory score of processed pineapple pieces by edible coatings

The results indicated that no significant differences in sensory score were recorded among uncoated and coated samples at zero time. After that, significant differences were noted between coated and uncoated pieces. Uncoated samples (control) showed significant loss of quality at 21st days of storage.

IV. CONCLUSION

Pineapple is one of the most relished fruits with ample amount of bioactive compounds present in it. The world pineapple demand has been increasing rapidly. Therefore pineapple and pineapple based products will be of a great demand in recent future not only because of its taste but also a principal compound in terms of health healing in different manner. Pineapple fruit has a relatively short postharvest life, since it remains as living tissues up until the time they are used for consumption and are prone to physiological and biochemical changes, which can also have physical or pathological origins, leading to important economic losses. It looses weight during postharvest handling and storage by transpiration, resulting in textural changes and surface shrinkage that affects their shelf life. On the other hand, softening of fruit during storage is also attributed to the deterioration of the cell wall components, mainly pectin, due to the activity of various enzymes. The use of edible coatings was efficient to maintain the physico-chemical, microbial and sensory characteristics of processed pineapple pieces during storage. This will be an alternative approach to prolong processed pineapple piece shelf-life during post-harvest. The use of an edible coating is a good way to increase fruit shelf-life.

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