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RESEARCH ARTICLE

Effect of Storage Conditions on Quality and Shelf Life of Minimally Processed Precut Banana Pseudostem

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ABSTRACT

Minimal processing techniques should provide the market with fresh- like appearance. Fresh-cut vegetables are consumed widely and it is a healthy, nutritional and convenient option. The present study aimed to standardize and develop the minimally processed precut pseudostem. Two banana varieties were selected viz., ottuvazhai (syn Mupaddai) (V_1), vayalvazhai (V_2) for developing minimally processed product.To prevent browning, different pretreatments such as lemon juice, turmeric powder, curd, salt, water, citric acid, and vinegar were used at 1 to 5 % concentration. Two different packaging materials, viz., aluminum foil (P_1) and low-density polypropylene (P_2) were used.The chemical composition of banana pseudostem was analyzed. The moisture, browning index, color value and microbial study of the precut pseudostem were analyzed using standard procedures. The quality of minimally processed precut pseudostem was evaluated from the initial day to 9 days at ambient and refrigerated storage conditions. Among the pretreatments, citric acid pretreated precut pseudostem had an effective role against browning reaction. During storage conditions, a minimum changes were observed in Mupaddai variety (V_1) precut pseudostem sample. At refrigerated condition, the minimally processed product (V_1) from aluminum foil was good upto 9 days of storage condition.

Keywords: *Minimal processing; Pseudostem; Polyphenol oxidase; Citric acid; Fresh-cut vegetables*

INTRODUCTION

Banana plant is the largest herbaceous flowering plant which is tall and fairly sturdy (Nelson *et al*., 2006). In India, the production of banana has witnessed an increasing trend because of higher profit as compared to other cultivation. After harvesting of the fruit, the banana plant produces a huge level of biomass in the form of pseudostem, leaves, sucker etc.(Patil and Kolambe, 2011). Biomass of banana plants, such as pseudo stem, leaves and tillers, generate as much as 11.20 t/ha of dry matter (Rochana *et al*., 2017).

Now a day's people lifestyle patterns is changed that lead to an increase the demand for fresh-cut vegetables. Currently, people did not have time to prepare vegetables at home as well as in hostels. For this reason, the demand for minimally processed products increased (Allende *et al*., 2006). Several factors may influence the fresh-cut produce, including farm locations, storage temperature or time, and transport conditions (James *et al*., 2010). In fresh-cut processing, surface darkening is one of the main physiological effect and leads to the loss in quality of fresh-cut produce due to oxidation of phenolic compounds, by polyphenol oxidase (PPO) enzymes (Francis *et al*., 2012). Shelf life could be extended by preservation techniques such as low-temperature storage, controlled atmosphere, hypobaric and modified atmosphere packaging methods (Loizzo *et al*., 2012).

Banana pseudostem has many medicinal properties. It is more fibrous and is helpful in weight loss programme. The tender core is rich in potassium and vitamin B6, which helps inproduction of insulin and hemoglobin. It controls the blood pressure level. The juice from pseudostem is used as a diuretic and it helps in detoxifying the body. By consuming tender core juice, it dissolvies the kidney stones and also maintains the fluid balance. The tender core helps to alleviate stomach disorder and diabetes. Daily intake of this tender core fiber deprives the obesity and detoxification (Mahesh *et al*.,2019). For increasing of daily vegetable intake, fresh-cut vegetables are consumed widely and it is healthy, nutritional and convenient option (Xylia *et al*., 2019).

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MATERIAL AND METHODS

Two variety of banana pseudostem was selected for preparation of minimally processed precut pseudostem, i.e. Ottuvazhai (synMupaddai) (V_1) and vayalvazhai (V_2). Banana pseudostem was procured from Kovilpappakudi and Thathakkoundampatti, Madurai district, Tamil Nadu, India.

Standardization and development of minimally processed precut pseudostem

The collected banana pseudostems were washed thoroughly, the center core was cut and fiber was removed. The pseudostem was chopped into a small cube shape (5 mm thickness size). Since exposure to air renders the pseudo stem to browning. To prevent browning, different pretreatments such as lemon juice, turmeric powder, curd, salt, water, citric acid, vinegar were used at 1 to 5 % concentration.Among the different pretreatments, citric acid pretreatment had an effective role against browning reaction. The 2 % citric acid (2% CA) treated sample was subjected to further studies.

The precut pseudostem immersed in 2% citric acid for 10 mins prevented browning reaction. The

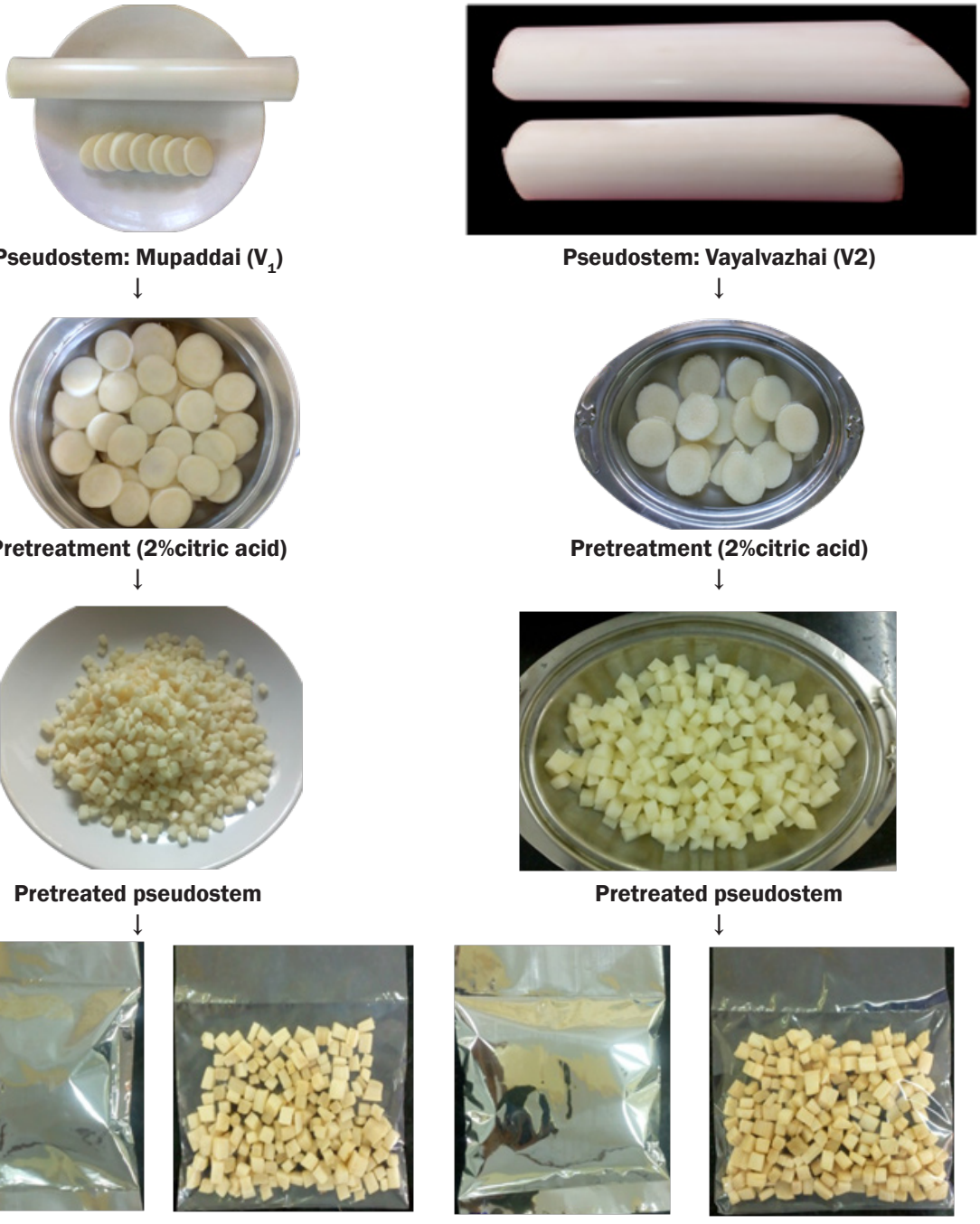

Figure 1.Minimal processing of precut banana pseudostem

pretreated pseudostem (2% CA) was surface dried for 1 hour, then the dried pseudostems were packed in two different packaging materials viz aluminum foil (P_1) and low-density polypropylene (P_2) were stored at ambient and refrigerated condition. The minimal processed precut pseudostem is presented in Figure1.

Chemical analysis

The chemical composition of banana pseudostem such as moisture (%),total carbohydrate (%), protein (%), fat (%), and were analyzed. Crude fiber (%),Ash(%), Total dietary fiber (%), Phenols (mgGAE), Flavonoids (mgCE), Tannins (mg) and pH.The stored samples were analyzed for 9 days in-between days. During storage conditions, changes in moisture content, browning index, color value and microbial load of the minimally processed precut pseudo stem were analyzed.The moisture and total dietary fiber content were determined as given by Horwitz and Latimer (2006). The total carbohydrate, protein, fat,crude fiber, ash,phenols and tannins were determined as per the prorocolsgiven by Sadasivam and Manickam (2008) and flavonoids analyzed as given by Cernisev (2010). The browning index was determined as given by Kamtekar (2014).

Table 1. Chemical composition of banana pseudostem

Chemical composition	V_1	V_2
Moisture (%)	91.20 ± 0.15	91.60 ± 0.09
Total carbohydrate (%)	57.30 ± 0.70	58.70 ± 0.96
Protein (%)	3.50 ± 0.02	3.30 ± 0.008
Fat (%)	1.25 ± 0.03	0.60 ± 0.007
Crude fiber (%)	18.41 ± 0.26	18.79 ± 0.53
Ash (%)	10.74 ± 0.22	10.21± 0.07
Total dietary fiber (%)	62.13 ± 1.39	61.95 ± 0.47
Phenols (mgGAE)	181.00 ± 2.04	173.00 ± 0.50
Flavonoids (mgCE)	76.00 ± 0.62	70.00 ± 1.11
Tannins (mg)	7.21± 0.15	7.05 ± 0.08
PH	6.05 ± 0.07	6.11 ± 0.06

V_1- ottuvazhai (syn Mupaddai) V_2- vayalvazhai (V_2)

Microbial Analysis

The quality of the developed precut banana pseudostem was analyzed based on the number and kind of microorganisms present, which was determined by the total plate count method. Commonly used media for enumeration of bacteria and fungi was plate count agar and potato dextrose agar media. The total plate count was determined by observing the colonies, especially bacteria and fungi (Ranganna, 2000).

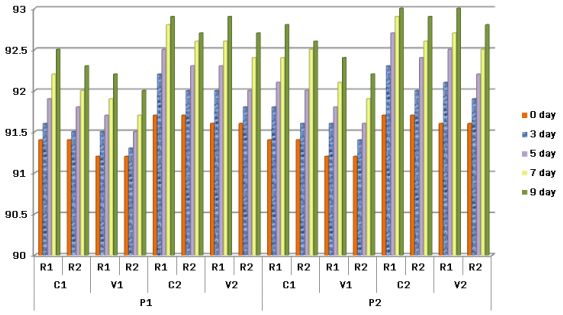

Figure 2.Changes in moisture content (%) of minimally processed precut pseudostem during storage

Statistical Analysis

The results of the chemical analysis were analyzed statistically by ANOVA using computer-aided AGRES (software) statistical analysis package to evaluate the significance at $P<0.05$. All the obtained data from the test was triplicate and it was subjected to the single factorial completely randomized design AGRES software.

RESULT AND DISCUSSION

Chemical Composition

Table 1 showed the chemical composition of the selected banana pseudostem. The moisture (%) content of the pseudostem from ottuvazhai (synMupaddai) (V_1) and vayalvazhai (V_2) that had 91.2 and 91.6%, respectively. The total carbohydrate (%) content of the V_1 and V_2 sample was 57.3 and 58.7, respectively. The protein (%) content of the V_1 and V_2 sample was 3.50 and 3.30 and the fat (%) content of the V_1 and V_2 sample was 1.25 and 0.60, respectively. The crude fiber (%) content of the V_1 and V_2 sample was 18.41 and 18.79 and total dietary fiber (%) content of the V_1 and V_2 sample was 62.13 and 61.95, respectively. The ash (%) content of the V_1 and V_2 sample was 10.74 and 10.21, respectively.

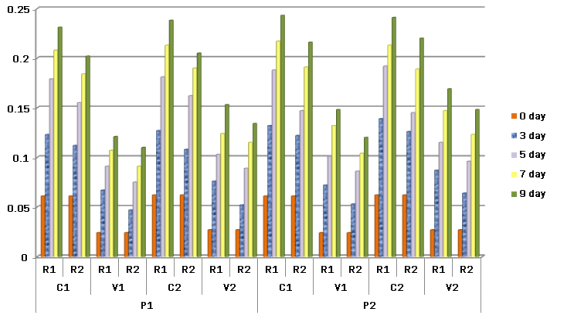

Figure 3.Changes in browning index of minimally processed precut pseudostem during storage

The phenol (mgGAE/100g) content of the V_1 and V_2 sample was 181 and 173 and the flavonoids (mgCE/100g) content of the V_1 and V_2 sample was 76.14 and 70.52, respectively. The tannin (mg/100g) content of the V_1 and V_2 sample was

7.21 and 7.05, respectively. The pH content of the V_1 and V_2 sample was 6.05 and 6.11, respectively. The obtained result was similar to Dayod and Abat (2016), who selected otel variety banana pseudo stems had 93.22% moisture content. Similarly, Aziz *et al*. (2011) reported that the total carbohydrate (%), fat (%) and protein (%) content of the banana pseudostem flour was 57.58, 0.24 and 0.89, respectively. Bhaskar *et al*.(2012) reported that the soluble and insoluble dietary fiber (%) of the banana pseudostem was 1.4 and 27.4 and the ash (%) content of banana pseudostem was 0.3. Ramu *et al*.(2017) reported that the phenols and flavonoids (mg/100g) content of the banana pseudostem was 188.64 and 78.60. The tannins (mg/100g) levels of pseudostem were 7.86.

Table 2. Effect of pretreatment on colour value of minimally processed precut pseudostem during (AF) storage condition

Storage period (Days)	C_1						V_1					
	R_1			R_2			R_1			R_2		
	L*	a*	b*	L*	a*	b*	L*	a*	b*	L*	a*	b*
0	71.20	1.98	25.82	71.20	1.98	25.82	79.41	1.54	26.02	79.41	1.54	26.02
3	65.14	2.76	18.24	68.81	2.23	20.14	70.11	2.27	20.78	77.13	1.91	24.32
5	52.81	3.27	15.81	54.18	2.92	18.02	62.93	3.49	17.88	75.64	2.10	21.15
7	46.32	3.82	14.02	48.61	3.20	15.78	56.50	3.61	16.79	74.98	2.24	19.45
9	43.54	3.98	13.98	46.04	3.62	14.03	51.45	3.78	15.48	72.12	2.43	19.04
Storage period (Days)	C_2						V_2					
	R_1			R_2			R_1			R_2		
	L*	a*	b*	L*	a*	b*	L*	a*	b*	L*	a*	b*
0	70.14	1.87	24.89	70.14	1.87	24.89	77.08	1.37	24.63	77.08	1.37	24.63
3	64.56	2.61	18.03	67.92	2.63	20.93	70.49	1.91	21.06	75.82	1.75	23.16
5	51.87	3.05	15.17	54.32	2.92	18.43	65.31	2.54	18.58	73.51	2.19	21.77
7	47.32	3.74	13.92	47.16	3.18	14.94	57.60	3.05	16.92	71.96	2.57	20.26
9	44.09	3.93	13.01	45.02	3.78	14.06	51.44	3.27	15.64	70.08	3.01	19.09

C_1 - Contol 1 C_2- Control 2 V_1 -Ottuvazhai (synMupaddai) V_2 - Vayalvazhai R_1- Ambient conditionR_2 - Refrigerated condition

Changes in moisture content of minimally processed precut pseudostem during storage

The changes in moisture content (%) of minimally processed precut pseudostem during storage was given in figure 2. The moisture content (%) of the V_1 sample on initial day of the packaging was 91. 2%. During storage conditions, there was no significant ($P<0.05$) difference noticed. In aluminum foil packaging (P1) V_1 moisture content was increased to 92.2% and 92.0% at ambient and refrigerated conditions, respectively. In polypropylene packaging (P_2), moisture content of V_1 was increased to 92.4% and 92.2% at ambient and refrigerated conditions, respectively. Meagre changes were observed in V_1 sample.The moisture content (%) of the V_2 sample on initial day of the packaging was 91. 6%. There was no significant ($P<0.05$) difference noticed during storage conditions. In aluminum foil packaging (P_1), moisture content of V_2 was increased to 92.9% and 92.7% at ambient and refrigerated condition. Moisture content of V_2 in polypropylene packaging (P_2) was increased to 93.0% and 92.8% at ambient and refrigerated conditions, respectively. Comparing the two packaging material (P_1 and P_2), the aluminum foil packed cut pseudo stem (V_1) had low changes in moisture content.

Similarly, Ruthra priya *et al*.(2014) reported that the minimally processed banana center core sample on initial day moisture content was 93%. On the eighth day of storage, moisture content was increased to 97% at both ambient and refrigerated conditions. The moisture content of product was increased during the storage condition.

Changes in browning index of minimally processed precut pseudostem during storage

The changes in browning index of minimally processed precut pseudostem during storage was given in figure 3. The browning index of the V_1 sample on initial day of the packaging was 0.024. During the storage conditions, no significant ($P< 0.05$) difference was noticed. In aluminum foil packaging (P_1), browning index of V_1 was increased to 0.121 and 0.110 at ambient and refrigerated conditions.

In polypropylene packaging (P_2), browning index of V_1 was increased to 0.148 and 0.120 at ambient and refrigerated conditions. V_1 sample had negligible changes. The browning index of the V_2 sample on initial day of the packaging was 0.027. During storage conditions, no significant ($P< 0.05$) changes were noticed. In aluminum foil packaging (P_1), browning index of V_2 was increased to 0.153 and 0.134 at ambient and refrigerated conditions, resepctively. In polypropylene packaging (P_2), browning index of V_2 was increased to 0.169 and 0.148 at ambient and refrigerated conditions. Comparing the two packaging material (P_1 and P_2), the aluminum foil packed cut pseudostem (V_1) had moderate browning index changes.

Table 3. Effect of pretreatment on colour value of minimally processed precut pseudostem during (LDPE) storage condition

Storage period (Days)	C_1						V_1					
	R_1			R_2			R_1			R_2		
	L*	a*	b*	L*	a*	b*	L*	a*	b*	L*	a*	b*
0	70.91	1.69	24.17	70.91	1.69	24.17	74.92	1.61	25.87	74.92	1.61	25.87
3	63.14	2.98	18.56	66.39	2.47	19.62	69.80	2.55	19.03	72.31	1.99	23.64
5	55.63	3.01	14.09	58.21	2.91	17.02	60.94	3.50	16.98	70.88	2.41	21.01
7	48.42	3.72	13.61	50.04	3.40	14.78	54.03	3.84	15.76	69.01	2.73	18.63
9	44.02	3.90	13.64	48.92	3.71	13.71	50.65	3.91	13.89	68.82	2.98	18.31
Storage period (Days)	C_2						V_2					
	R_1			R_2			R_1			R_2		
	L*	a*	b*	L*	a*	b*	L*	a*	b*	L*	a*	b*
0	70.03	1.57	23.89	70.03	1.57	23.89	75.33	1.40	24.12	75.33	1.40	24.12
3	64.53	2.76	19.02	67.03	1.90	21.97	70.04	2.34	20.04	72.92	1.79	22.01
5	56.84	2.97	16.95	61.96	2.53	19.52	64.26	2.97	17.45	70.64	2.13	21.63
7	51.13	3.19	15.92	58.17	2.95	18.93	55.82	3.31	15.91	69.03	2.78	19.94
9	45.02	3.78	14.03	51.83	3.26	16.24	50.31	3.56	13.20	67.87	3.14	18.05

C_1 - Contol1 C_2- Control 2 V_1 -Ottuvazhai (syn Mupaddai) V_2 - Vayalvazhai R_1- Ambient condition R_2 - Refrigerated condition

Sommano *et al*.(2011) examined that the browning index of the longan sample on 2nd,4th and 6th day of storage condition was 1.62, 1.89, 1.72, 2.38. Browning index of the sample was increased with time.

Changes in colour value of minimally processed precut pseudostem during storage

Effect of pretreatment on colour value of minimally processed precut pseudostem during (AF) storage condition

In storage conditions of minimally processed pseudostem, L* value and b* was significantly decreased. At storage conditions, a* value was significantly increased. The effect of pretreatment on colour value of minimally processed precut pseudostem during (AF) storage condition is presented in table 2.

The significant ($P<0.05$) difference was observed on L* value of V_1 sample during storage conditions. The L* value of V_1 sample was significantly ($P<0.05$) decreased with increased storage periods. Initially the L* value of V_1 sample was recorded as 79.41. On 9th day of ambient storage conditions, L* value was decreased to 51.45. At refrigerated conditions, L* value of V_1 sample was mostly maintained from the initial day. So, the L* value of refrigerated sample was 72.12 on 9th day. The a* value of V_1 sample was significantly ($P< 0.05$) increased with increased storage periods. Initially the a* value of V_1 sample was recorded as 1.54. On 9th day a* value was increased to 3.78 and 2.43 at ambient and refrigerated conditions. The b* value of V_1 sample was significantly ($P< 0.05$) decreased with increased storage periods. Initially the b* value of V_1 sample was recorded as 26.02. The maximum significant difference was noticed in ambient condition and slight difference was noticed in refrigerated condition. On 9th day of storage conditions, b* value was 15.48 and 19.04.

Significant ($P< 0.05$) difference was present on the L* value of V_2 sample during storage conditions.

The L* value of V_2 sample was significantly (P< 0.05) decreased with increased storage periods. Initially the L* value of V_2 sample was recorded as 77.08. On 9th day of ambient storage conditions, L* value was decreased to 51.44. At refrigerated conditions, L* value of V_2 sample was mostly maintained from the initial day. At the end of 9th day, L* value of refrigerated sample was 70.08. The a* value of V_2 sample was significantly (P< 0.05) increased with increased storage periods. Initially the a* value of V_2 sample was recorded as 1.37. On 9th day a* value was increased to 3.27 and 3.01 at ambient and refrigerated condition. The b* value of V_2 sample was significantly (P< 0.05) decreased with increased storage periods. Initially the b* value of V_2 sample was recorded as 24.63. The maximum significant difference was noticed in ambient condition and slight difference was noticed in refrigerated condition. On 9th day of storage conditions, b* value was 15.64 and 19.09.

Table 5. Effects of a storage period on microbial (bacterial) growth for minimally processed precut pseudostem

	P_1															
Storage period (Days)	Bacteria (10^{-5} CFU/g)								Bacteria (10^{-7} CFU/g)							
	C1		V1		C2		V2		C1		V1		C2		V2	
	R1	R2	R1	R2	R1	R2	R1	R2	R1	R2	R1	R2	R1	R2	R1	R2
0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	1.81	0.90	-	-	2.27	1.81	-	-	0.45	-	-	-	-	-	-	-
7	2.72	1.36	0.45	-	3.18	2.27	0.90	-	0.90	-	-	-	1.36	-	-	-
9	*	*	0.90	-	*	*	1.36	0.45	*	0.45	0.90	-	*	0.45	0.45	-
	P_2															
Storage period (Days)	Bacteria (10^{-5} CFU/g)								Bacteria (10^{-7} CFU/g)							
	C_1		V_1		C_2		V_2		C_1		V_1		C_2		V_2	
	R_1	R_2	R_1	R_2	R_1	R_2	R_1	R_2	R_1	R_2	R_1	R_2	R_1	R_2	R_1	R_2
0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	2.72	1.81	-	-	2.27	0.90	-	-	1.36	-	-	-	-	-	-	-
7	3.18	2.27	1.36	-	3.63	1.81	1.36	-	0.90	-	-	-	0.90	-	-	-
9	*	*	0.90	-	*	*	0.90	0.45	*	0.90	0.45	-	*	0.45	0.90	-

C_1 - Contol 1 C_2- Control 2 V_1 - Ottuvazhai (synMupaddai) V_2 - Vayalvazhai P_1- Aluminum foil P_2- Polypropylene R_1- Ambient condition R_2 - Refrigerated condition
- : Nil colony formation , * : sample got spoiled

Effect of pretreatment on colour value of minimally processed pseudostem during (LDPE) storage condition

The effect of pretreatment on colour value of minimally processed precut pseudostem during (LDPE) storage condition is given in table 3. The significant (P<0.05) difference was observed on L*value of V_1 sample from P_2 during storage conditions. The L* value of V_1 sample was significantly (P<0.05) decreased with increased storage periods. Initially the L* value of V_1 sample was recorded as 74.92. On 9th day of ambient storage conditions, L* value was decreased to 50.65. At refrigerated conditions, L* value of V_1 sample was mostly maintained from the initial day. So, the L* value of refrigerated sample was 68.82. The a* value of V_1 sample was significantly (P< 0.05) increased with increased storage periods. Initially thea* value of V_1 sample was recorded as 1.61. On 9th day a* value was increased to 3.91 and 2.98 at ambient and refrigerated condition. The b* value of V_1 sample was significantly (P< 0.05) decreased with increased storage periods. Initially the b* value of V_1 sample was recorded as 25.87. The maximum significant difference was noticed in ambient condition and slight difference was noticed in refrigerated condition. On 7th and 9th day of refrigerated conditions, b* value was decreased to 18.63 and 18.31.

Significant (P< 0.05) difference was present on the L* value of V_2 sample from P_2 during storage conditions. The L* value of V_2 sample was significantly (P< 0.05) decreased with increased

storage periods. Initially the L* value of V_2 sample was recorded as 75.33. On 9th day of ambient storage conditions, L* value was decreased to 50.31. At refrigerated condition, L* value of $_{V2}$ sample was mostly maintained from the initial day. At end of the 9th day, L* value of refrigerated sample was 67.87.The a* value of V_2 sample was significantly (P< 0.05) increased with increased storage periods. Initially the a* value of V_2 sample was recorded as 1.40. On 9th day a* value was increased to 3.56 and 3.14 at ambient and refrigerated conditions. The b* value of V_2 sample was significantly (P< 0.05) decreased with increased storage periods. Initially the b* value of V_2 sample was recorded as 24.12. The maximum significant difference was noticed in ambient condition and slight difference was noticed in refrigerated condition. On 9th day of refrigerated storage conditions, b* value was decreased to 18.05.

Table 6: Effects of Storage period on microbial (fungi) growth for minimally processed precut pseudostem

	P_1															
Storage period (Days)	Bacteria (10^{-2} CFU/g)								Bacteria (10^{-4} CFU/g)							
	C_1		V_1		C_2		V_2		C_1		V_1		C_2		V_2	
	R_1	R_2	R_1	R_2	R_1	R_2	R_1	R_2	R_1	R_2	R_1	R_2	R_1	R_2	R_1	R_2
0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	1.81	0.90	-	-	2.27	1.81	-	-	0.45	-	-	-	-	-	-	-
7	2.72	1.36	0.45	-	3.18	2.27	0.90	-	0.90	-	-	-	1.36	-	-	-
9	*	*	0.90	-	*	*	1.36	0.45	*	0.45	0.90	-	*	0.45	0.45	-
	P_2															
Storage period (Days)	Bacteria (10^{-2} CFU/g)								Bacteria (10^{-4} CFU/g)							
	C_1		V_1		C_2		V_2		C_1		V_1		C_2		V_2	
	R_1	R_2	R_1	R_2	R_1	R_2	R_1	R_2	R_1	R_2	R_1	R_2	R_1	R_2	R_1	R_2
0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	2.72	1.81	-	-	2.27	0.90	-	-	1.36	-	-	-	-	-	-	-
7	3.18	2.27	1.36	-	3.63	1.81	1.36	-	0.90	-	-	-	0.90	-	-	-
9	*	*	0.90	-	*	*	0.90	0.45	*	0.90	0.45	-	*	0.45	0.90	-

C_1 - Contol1 C_2- Control 2 V_1 - Ottuvazhai (synMupaddai) V_2 - Vayalvazhai P_1- Aluminum foil P_2- Polypropylene R_1- Ambient condition R_2 - Refrigerated condition
- : Nil colony formation , * : sample got spoiled

Preetha *et al*.(2015) reported that the initial L* value of sample was 70.34 and then L* value was increased to 72.54 for ascorbic acid and 73.56 for KMS. L* value was decreased during storage condition due to enzymatic browning. The ascorbic treated samples had less l* value (57.58 in LDPE). Under refrigerated condition, KMS pretreated samples had l* value 70.41.

Effect of a storage period on bacterialgrowth of minimally processed precut pseudostem [AF & LDPE]

The effects of a storage period on bacterial growth of minimally processed precut pseudostem is given in table 5. At initial day of storage condition, there was no bacterial growth observed in the sample. From 5th day onwards, bacterial colony forming unit (CFU) was observed on control samples. On 5th day P_1 control (C_1) had 1.81×10^{-5} and 0.90×10^{-5} bacterial population at R_1 and R_2 storage condition. Then, P_2 Control (C_1) had 2.72×10^{-5} and 1.81×10^{-5} bacterial population at R_1 and R_2 storage condition. There was no bacterial population was observed on control 10^{-7} dilution. From 9th day of storage the control got spoiled. On 9th day, P_1 & P_2 sample from V_1 had 0.90×10^{-5} bacterial population at R_1 storage condition. So, there was no bacterial population was observed on V_1 sample from 10^{-5} dilution at R_2 storage condition. Then V_2 sample from P_1 had 1.36×10^{-5}, 0.45×10^{-5} and P_2 had 0.90×10^{-5}, 0.45×10^{-5} bacterial population at R_1 & R_2 storage condition.

Effect of a storage period on fungi growth of minimally processed precut pseudostem [AF & LDPE]

The effects of storage period on microbial (fungi) growth of minimally processed precut pseudostem is given in table 6. Initially, there was no fungal growth

on minimally processed precut banana pseudostem. From 5th day onwards, fungal colony forming unit (CFU) was observed. On 5th day P_1 control (C_1) had 0.90× 10^{-2} and 0.45× 10^{-2} fungal population at R_1 and R^2 storage condition. Then, P_2 control (C_1) had 1.36 × 10^{-2} and 0.90× 10^{-2} fungal population at R_1 and R_2 storage condition. There was no fungal population observed on control 10^{-4} dilution. The samples were spoiled on the 9th day of storage. On 9th day, P_1 & P_2 sample from V_1 had 1.36× 10^{-2} and 0.45 × 10^{-2} fungal population at R_1 and R_2 storage condition. On 9th day, P_1 & P_2 sample from V_2 had 0.9 × 10^{-2} and 0.45 × 10^{-2} fungal population at R_1 and R_2 storage condition. It was under the acceptable limit. V_1 and V_2 sample from P_1 & P_2 does not have any fungal population on 10^{-4} dilution at R_2 storage condition. Then, the minimum level of fungal population was observed on the V_1 sample from 10^{-4} dilution at R_2 storage condition.

Preetha *et al.*(2015) reported that the initially the bacterial count of fresh cut pseudo stem was 6.12× 10^{-5} CFU/g and fungal population was 4.3 × 10^{-3} CFU/g. After pre-treating (1% KMS, 1% AA) the samples, it did not have any bacterial and fungal growth. Later stage, slight microbial growth was observed.

CONCLUSION

Now a days significant changes have happened in our life style and consumption pattern also changed.The different pretreatments for minimal processing of banana pseudostem were given to prevent browning. Among the pretreatments, citric acid pretreatment had effective role against browning reaction.During storage conditions of minimally processed precut pseudostem product, a minimum changes were observed in Mupaddai variety (V_1) sample. Comparing the two packaging material, the aluminum foil (P_1) packed cut pseudostem from Mupaddai variety (V_1) had low moisture content, browning index changes and it had minimum microbial load. At refrigerated condition, the minimally processed product (V_1) from aluminum foil was good upto 9 days of storage condition.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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