CHANGES IN RESPIRATION, COMPOSITION AND SENSORY CHARACTERISTICS OF RAMBUTAN PACKED WITH PLASTIC FILMS DURING STORAGE AT LOW TEMPERATURE.

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Abstract

Rambutan were held in sealed propropylene, polyethylene film bags and unpacked at 10 ±1 ^{o}C and 90-95% RH for 12 days. Physico-chemical, sensory changes and CO_2 Evolved were observed after 2, 4, 6, 8, 10 and 12 days. Packing fruit in plastic bags reduced declining quality by means of weigh loss, moisture content, reduction sugars content and vitamin C. Packed fruit showed low respiration rate, low browning rate and high retaining total phenol in rambutan skin. Treated fruit also indicated better attributes associated with eating quality than control fruit. Polypropelene plastic bags showed the best result in all changes quality occurring during storage at low temperature observed.

INTRODUCTION

Rambutan (*Nephelium lappaceum* L) is a climacteric fruit grown in most tropical countries such as Indonesia with national production being about 270690 ton in 1990 and increases significantly about 446890 ton in 1995 (BPS, 1995). Export rambutan from Indonesia increased every years. 33761 kg fresh rambutan was exported in 1989 and worth US $43,306 and by 1990 export rambutan was 108827 kg worth US $88,302. During harvesting season the production of rambutan is about 1.0 – 1.5 ton/weeks.

Rambutan is only fresh for two up to three days, after that part of hairy and the peel will be wilt accompany by darker peel, although the flesh is still good. Once the fruit stays at that quality, the selling value decrease significantly. Postharvest methods to extend the storage life as well as to maintain fruit quality are needed.

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The use of low temperature storage on rambutan was reported by Brown, Wong & Watson, (1985), high RH (Landrigan. Morris & Mc. Glasson, 1996), the use of CO_2 (Muhidin, 1989), SO_2 and $CaCl_2$ under vacuum pressure (Mohamed & Othman, 1989) etc. Although little information on the changes of fruit quality after being stored under low temperature at different RH. This paper reports on respiration production, physico-chemical composition and sensory characteristics of rambutan packaged by plastic film during storage at 10 ^{o}C for 12 days and transferring at elevated temperatures of 27 and 30 ^{o}C.

MATERIALS AND METHODS

Rambutan Lebak Bulus was picked from Pasirharjo Village, Kecamatan Talun Kabupaten Blitar, at a commercial maturity stage. Fruit was sorted on the basis of uniform colour, weigh and size, after 24 hours were transported by car to Ilmu Pangan laboratory Brawijaya University. Fruit was dipped in 500 ppm benlate at 52 ±1 ^{o}C for 3 minutes. Selected fruit were allowed to dry prior to sealed in PP and PE

film bags (0.03 mm Thickness) of the same size (27 X 15 cm). Control fruit were placed in an opened air without packaging. Randomized Blocked Design was used in this experiment and each treatment was replicated three times, containing 10 fruit per treatment. Fruit were stored at 10 ±1 ^{o}C and 90-95% RH for 12 days. Respiration production was determined as carbon dioxide evolved every 2, 4, 6, 8 10 and 12 days and was calculated as described by Sandra (1998). Physico-chemical characteristics were assessed at similar interval times as aboved. Weigh loss was determined as described by Sandra (1998), Flesh texture was determined with penetrometer PNR-6 (Sandra, 1998), TSS with refractometer (Sandra, 1998), Total acidity was measured by titration method (Ranganna, 1977), Vitamin C by Yodium method (Sudarmadji *et al*., 1984), reduction sugars by Nelson- Somogyi method (Sudarmadji *et al*., 1984), Total Phenol at rambutan skin was with spectrophotometer method (Landrigan *et al*., 1996).

Data obtained in this study for each characteristics were statistically analysed using Microsof-Exel measured for analysis of varians and the least significant different at P = 0.05 was calculated to examine differences between means.

Organoleptic assessment was made by an 8-member panel on samples from fruit at interval times as described aboved. For each evaluation, each panellist was asked to assess presented samples for browning rate using a score 1 (no traces of browning rate and 5 full browning rate), the whole fruit appearance, flesh appearance, flavour, taste and acceptability as described by Lawless and Heymann (1998). Score 1 up to 7 were used to judged the rate of likeness where 1, extremely dislike and 7, extremely like). Data collected from sensory measurements were calculated using Friedman Test (Steel and Torry, 1993).

RESULT AND DISCUSSION

Respiration rate during storage

Figure 1 shows that respiration rate of rambutan was 65.36 mg CO2/kg/hr and tended to decrease during storage at 10 ±1 ^{o}C and 90-95% RH for 12 days. This is due to low temperature storage and rambutan is non-climacteric fruit. In accordance to Broto (1993) stated that non-climacteric commodity showed CO_2 evolved was low and decreased gradually during storage. Respiration rate of fruit stored in PP bags were lower and significantly different than PE bags at 8 and 10 days storage (Table 1). Kader *et al*., (1989) mentioned that permeability of PP bags towards O_2, was lower (1300-6400 ml O_2/mm/m^2/days than PE bags (3900 – 13000 ml O_2/mm/m^2/days).

Physical Characteristics

Weigh loss

Although Paine and Paine (1992) reported the rate of water vapour exchange into PE bags was higher (16-24 g/m^2/days) than PP bags (11 g/m^2/days) at 38 ^{o}C and 90% RH particularly for plastic films with 0.025 mm in thickness, but weigh loss of fruit stored in PP and PE bags were not significantly different at P=0.05 (Table 1). Over the periode of 12 days storage at 10 ±1 ^{o}C, weigh loss of control fruit was higher and significantly different. Therefore packaging reduced significantly the weigh loss during fruit storage.

Flesh Texture

Flesh texture was not affected by packaging technique, although Table 1 showed that flesh texture increased during storage. This is in relation to flesh texture became soft during storage due to

enzymatic breakdown, especially PE and PG enzymes (Pantastico *et al*., 1989).

Chemical Characteristics

Water Content

Water content of control fruit was lower than treated fruit (Table1), this is due to weigh loss of control fruit was higher than treated fruit. Taufikurrahman (1998) reported weigh loss of control fruit was higher than fruit packed with plastic films, therefore water content of treated fruit were higher than control fruit.

Total Soluble Solids

Contrary to climacteric fruit, TSS of non-climacteric fruit decreased gradually during storage. TSS of rambutan decreased from 22.40 ^{o} Brix to 16.45 – 17.10 ^{o} Brix (Table 1). TSS of fruit is used for fuel of respiration process during fruit storage (Crisosto *et al*., 1993). Packaging did not influence TSS content of fruit.

Reduction Sugars

Packaging did not influence reduction sugars content of fruit. Similar pattern likes TSS fruit content was found on reduction sugar content of fruit due to packaging treatments (Table 1). Data on reduction sugars were closely related to TSS content of fruit. Wills *et al.*, (1981) stated that increasing and decreasing sugars content primarily depend on TSS content of fruit.

Vitamin C

Vitamin C of rambutan decreased during storage and effected by treatment of packaging after 8 days storage. Treated fruit showed higher Vitamin C content than control fruit (Table 1). This is due to O_2 can not penetrate into the packaging films and can not diffuse into the flesh. Vitamin C is vulnarable toward oxygen, since vitamin C is a reducing agent (Fennema, 1976).

Total Phenol and Browning rate

Total phenol of rambutan skin decreased from 625.43 mg/g (d.b) to 268,61 mg/g d.b. over 12 days storage. In general, total phenol content decreased gradually during storage (Table 2). Metlitskii *et al.,* (1983) revealed that at low temperature storage, polyphenoloxidase activity will activate dehydrogenase enzyme and phenolic substances will be oxidised with the production of browning substances. The fruit becomes darker than unoxidised fruit and this process is irreversible.

Treated fruit showed lower and significantly different compared to control fruit aboved 4 dyas storage (Table 2). Landrigan *et al*., (1996) claimed that fruit stored at high RH can restore its total phenol content, therefore fruit packed in plastic films showed higher total phenol content than fruit stored unpack.

Packaging treatment also affects the rate of browning. The effect clearly show up after 6 days storage. The intensity of browning rate closely related to total phenol content. (Table 2).

Sensory Characteristics

Table 3 presents organoleptic panel assessment of whole fruit appearance, flesh appearance, flavour, taste and acceptability of rambutan after 2 – 12 days storage at 10 ±1 ^{o}C and 90-95% RH. All quality attributes decreased as the degree of skin colour decreased and tended to turn dark brown after 12 days storage was attained.

Whole skin appearance of control fruit tended to wilt, curl and hairy skin turn brown. While treated fruit seem to be more fresh than control fruit. Muhidin (1989) reported that packed fruit with plastic film retained the freshness quality of rambutan.

After 4 days storage the effect of packaging significantly effected the flesh fruit appearance, where the flesh appearance score of packed fruit was higher

than unpacked fruit. Similar data were also shown for the fruit flavour and overall acceptibility, especially after 4, 6, 8, 10 and 12 days storage (Table 3). Packaging rambutan with plastic films inhibit water loss due to transpiration rate. Therefore the moisture content of flesh were significantly higher than unpacked fruit (Table 1). Brown *et al*., (1985) reported that the flesh appearance of packed rambutan was better than control fruit, while fruit flavour was also better as well as the overall acceptability (Muhidin, 1989).

CONCLUSION

Packaging of rambutan slowed down declining physico-chemical characteristics during storage fruit at at 10 ±1 ^{o}C and 90-95% RH for 12 days. Polypropilene (PP) plastic films as packaging material was suitable and better than polyethylene (PE) for storing rambutan at low temperature storage over 12 days storage.

Unpacked fruit shown lower quality for any attributes associated with physico-chemical characteristics observed compared to treated fruit. Rambutan which was packed with PP bags had respiration rate 22.65 mg/CO_2/kg/hr, 2.02% weigh loss, 27.42 mm/100g/sec. of flesh texture, 79.22% moisture content, 17.10 ^{o}Brix TSS, 4.59% reduction sugars, 47.21 mg/100 g vitamin C, 440.70 mg/g db of total phenol, 1.50 of browning rate, 5.89 whole fruit appearance score, 6.12 flesh score, 6,73 flavour score, 6.93 of taste score, and overall acceptability 5.90 after 12 days storage at low temperature storage.

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Table 1.
Means of respiration rate (mg CO_2/kg/hr), weigh loss (%), flesh texture (mm/100g/sec.), water content (%), TSS (^oBrix), reduction sugars (%), vitamin C (mg/100g) of rambutan during storage at 10 ±1 ^oC after 2 – 12 days

Days at	Treat-ment	CO_2 Evolved (mg CO2/kg/ hr)	Weigh loss (%)	Texture (mm/ 100g/ sec.	Water Content (%)	TSS (^{o}Brix)	Reduc-tion sugars (%)	Vitamin C (mg/ 100g)
2	Control	63.04 b	5.38 b	22.44	81.73 a	20.10	6.70	55.88
	PP	59.09 a	0.99 a	21.30	83.54 b	20.20	6.48	57.33
	PE	59.45 a	1.09 a	20.60	84.08 b	20.50	6.89	54.69
	LSD 0.05	1.69	0.68		1.22			
4	Control	58.54 c	5.80 b	22.83	80.63 a	19.95	6.21	51.13
	PP	53.67 b	1.12 a	22.38	82.92 b	19.05	6.23	54.67
	PE	49.46 a	1.25 a	23.12	83.48 b	19.00	6.60	53.16
	LSD 0.05	2.34	0.54		1.62			
6	Control	54.93 b	13.24 b	25.37	80.14 a	19.45	5.94	47.34
	PP	42.06 a	1.26 a	24.21	82.09 b	18.65	5.84	51.61
	PE	43.68 a	1.40 a	24.52	82.35 b	18.10	6.10	50.86
	LSD 0.05	4.30	1.68		1.50			
8	Control	49.64 c	16.95 b	25.89	78.26 a	18.35	5.04	44.93 a
	PP	32.99 a	1.35 a	25.23	81.01 b	18.50	5.82	49.24 ab
	PE	36.31 a	1.50 a	25.44	81.52 b	17.50	5.51	51.08 b
	LSD 0.05	3.01	2.11		1.83			4.50
10	Control	44.23 c	21.22 b	26.95	77.55 a	17.20	4.67	39.90 a
	PP	26.39 a	1.42 a	24.75	79.70 b	17.75	5.18	48.78 ab
	PE	29.72 b	1.63 a	26.54	79.56 b	17.10	4.86	48.73 b
	LSD 0.05	2.30	0.87		1.62			4.57
12	Control	42.00 b	24.10 b	28.08	75.30 a	16.60	3.66 a	38.14 a
	PP	22.65 a	2.02 a	27.42	79.22 b	17.10	4.59 b	47.21 b
	PE	22.58 a	1.76 a	27.89	79.41 b	16.45	4.48 b	47.48 b
	LSD 0.05	3.12	1.08		0.82		0.77	2.22

Data in each column followed by the same letter were not significantly different at P =0.05.

Table 2.
Means of total phenol in rambutan skin (mg/g d.b) and browning rate of rambutan during storage at 10 ±1 ^{o}C after 2 – 12 days

Days at	Treatment	Total phenol of rambutan skin (mg/g d.b)	Browning rate
2	Control (Unpacked)	553.69 a	1.03
	PP	645.67 b	1.00
	PE	625.16 ab	1.00
	LSD 0.05	73.78	
4	Control (Unpacked)	463.25 a	1.10
	PP	587.97 b	1.00
	PE	591.88 b	1.00
	LSD 0.05	34.86	
6	Control (Unpacked)	385.79 a	1.38
	PP	563.73 b	1.13
	PE	559.17 b	1.07
	LSD 0.05	58.14	
8	Control (Unpacked)	352.69 a	1.66
	PP	556.45 b	1.16
	PE	536.64 b	1.22
	LSD 0.05	45.19	
10	Control (Unpacked)	302.14 a	2.44
	PP	493.38 b	1.50
	PE	495.83 b	1.47
	LSD 0.05	52.22	
12	Control (Unpacked)	268.61 a	3.04
	PP	440.70 b	1.50
	PE	439.22 b	1.54
	LSD 0.05	81.47	

Data in each column followed by the same letter were not significantly different at P =0.05.
Browning rate: score 1 (none) – 5 (100% browning)

Table 3.
Means of whole fruit appearance, flesh appearance, flavour, tase and acceptability of rambutan after 2 – 12 days storage at 10 ±1 ^{o}C.

Dyas at	Treatment	Whole Fruit Appearance	Flesh Appearance	Flavour	Taste	Acceptability
2	Control	6.76	6.88	6.87	6.88	6.80
	PP	6.90	6.95	6.95	6.95	6.90
	PE	6.92	6.95	6.93	6.95	6.92
4	Control	5.93	6.59	6.75	6.93	6.28
	PP	6.63	6.82	6.90	6.95	6.68
	PE	6.68	6.88	6.95	7.00	6.73
6	Control	5.57	6.15	6.55	6.85	5.80
	PP	6.23	6.68	6.85	6.85	6.27
	PE	6.27	6.75	6.85	7.00	6.22
8	Control	5.17	5.77	6.41	6.77	5.36
	PP	6.05	6.45	6.92	6.93	6.02
	PE	6.03	6.59	6.88	6.95	6.07
10	Control	4.50	5.18	5.78	6.54	4.84
	PP	5.99	6.22	6.75	6.87	5.89
	PE	5.95	6.24	6.75	6.88	5.95
12	Control	3.72	4.61	5.61	6.63	4.14
	PP	5.89	6.11	6.73	6.93	5.90
	PE	5.91	6.10	6.78	6.88	5.95

Data taken from 8 times measurement
Score 1 means extremely dislike and 7 means extremely like