DOI : 10.5958/0974-0112.2019.00030.6

Indian J. Hort. 76(1), March 2019: 195-197

Short communication

Ripening behaviour of papaya at different temperature regimes

Harminder Singh*, S. K. Jawandha and Anita Arora

Department of Fruit Science, Punjab Agricultural University, Ludhiana 141004, Punjab

ABSTRACT

Papaya cv. Red Lady-786 is grown successfully in Punjab under net-house conditions. But, its fruit fails to ripe with the onset of winter. In view of this, physiological mature fruits were harvested at colour break stage and kept at 20, 25, 30°C and also at ambient conditions and analysed for quality parameters such as sensory quality, firmness, pulp colour, PLW, spoilage, TSS and acidity after 48, 72 and 96 h of ripening. Fruits kept at 20°C and ambient conditions failed to develop the desirable quality. Fruit ripening was observed at 25 and 30°C, but quality of fruits ripened at 25°C was superior.

Key words: *Carica papaya*, fruit quality, ripening, temperature.

In sub-tropics of northern India winter frost and low temperature is the major hurdle in papaya cultivation. Protected cultivation alleviates climatic stresses and Papaya cv. Red Lady-786 can be grown successfully in Punjab under net-house conditions. But, its fruit fails to ripe with the onset of winter. There is an alternative to ripe the mature fruits after harvesting. Ripening of fruits with temperature management is the safest method of chemical-free ripening. Mango fruits of *cv.* Langra can be ripened in 4 days at 25°C (Gill *et al.* 4). Keeping this in view, the present investigation was planned to study the effect of controlled temperature conditions on ripening of papaya *cv.* Red Lady-786 fruits.

Papaya plants of cv. Red Lady-786 were grown under net-house conditions at Fruit Research Farm, PAU, Ludhiana during the year 2015-16. Physiological mature fruits were harvested at colour break stage in first week of December.

Fruits were kept at different controlled temperatures (20, 25 and 30°C) & also at ambient conditions and observed after 48, 72 and 96 h for various quality characteristics. Fruits were evaluated by a panel of judges for sensory quality (SQ) evaluation by following a Hedonic scale (Amerine *et al.* 1). Fruit firmness and total soluble solids were measured with penetrometer and refractometer respectively. The pulp colour parameters of papaya were assessed by using Colour Flex meter (Hunter Lab Color Flex, Hunter Associates Inc., Reston, VA, USA). The per cent loss in weight was calculated. Total acidity of fruits was estimated by following the AOAC (2) method. The two factor experiment (factors: temperature and ripening period) was laid out in Completely Randomized Design (Factorial) with three replications. Data were analysed for analysis of Variance (ANOVA) using Fischer's LSD ($p<0.05$) for significant difference test.

Sensory quality of fruits improved with the advancement of ripening period at 20, 25°C and ambient conditions, but at 30°C this improvement was recorded only up to 72 h afterwards a decline was noticed (Table 1). Reduction in sensory quality with time at high temperature (30°C) might be due to low retention of fruit firmness and high physiological loss in weight. Fruits kept at 25°C scored the maximum sensory quality rating after 96 h of ripening, whereas fruits kept a 30°C scored the highest sensory rating after 48 h. Quality of fruits obtained after 48 h at 30°C was lower than those kept for 96 h at 25°C. At moderate temperature (25°C) fruits ripened with high quality and at 20°C & ambient conditions fruits failed to ripe properly. Gill et al. (4) also reported that Mango fruits cv. Langra developed the optimum sensory quality at 25°C. Fruits firmness decreased with increase in temperature and time of ripening (Table 1). Reduction of fruit firmness was rapid at 30°C than at 25°C. However, fruits kept at ambient conditions and 20°C failed to develop the desirable texture. After 96 h of ripening period at 30°C, over softening of fruits was observed, hence firmness could not be recorded. Similarly, Jason *et al.* (5) reported that temperature strongly influenced both the initiation and rate of fruit softening in apples.

During ripening both a^* and b^* values for papaya pulp colour were increased in all the treatments, but at 30°C increase in b^* value was recorded only up to 72 h of ripening (Table 1). Fruit pulp colour values a^* and b^* at 30°C also showed that after 96 h of ripening intensity of redness increased and yellowness decreased. But at 25°C, an increase in

*Corresponding author's Email: harminder@pau.edu

Table 1: Effect of ripening temperatures on sensory quality, firmness and pulp colour of papaya.

Temperature	Sensory quality (1-9)				Firmness (lbf)			
	Ripening period (h)				Ripening period (h)			
	48	72	96	Mean	48	72	96	Mean
20°C	5.16	5.31	5.73	5.40	22.81	20.60	19.50	20.97
25°C	5.93	6.96	8.33	7.07	18.30	9.80	2.80	10.30
30°C	6.73	7.43	7.12	7.09	11.20	2.20	0.00	4.47
Ambient	4.72	5.03	5.25	5.00	23.20	21.40	19.20	21.27
Mean	5.64	6.18	6.61		18.88	13.50	10.38	
LSD (P<0.05)	Temperature (T) = 0.10, Ripening period (RP) = 0.12, T × RP = 0.18				Temperature (T) = 1.06, Ripening period (RP) = 0.92, T × RP = 1.84			
Temperature	Pulp colour (a* value)				Pulp colour (b* value)			
	Ripening period (h)				Ripening period (h)			
	48	72	96	Mean	48	72	96	Mean
20°C	13.12	14.62	14.88	14.21	34.39	34.47	35.12	34.66
25°C	15.84	19.81	25.70	20.45	35.86	40.50	41.73	39.36
30°C	18.75	26.10	28.12	24.32	37.41	41.88	39.82	39.70
Ambient	12.72	13.64	14.13	13.50	34.28	34.38	35.08	34.58
Mean	15.11	18.54	20.71		35.49	37.81	37.94	
LSD (P<0.05)	Temperature (T) = 1.13, Ripening period (RP) = 0.98, T × RP = 1.97				Temperature (T) = 1.17, Ripening period (RP) = 1.01, T × RP = 2.03			

Table 2: Effect of ripening temperatures on PLW, spoilage, TSS and acidity of papaya.

Temperature	PLW (%)				Spoilage (%)			
	Ripening period (h)				Ripening period (h)			
	48	72	96	Mean	48	72	96	Mean
20°C	1.56	2.41	3.48	2.48	-	-	-	-
25°C	1.98	3.30	4.12	3.13	-	-	-	-
30°C	3.41	6.19	7.42	5.67	-	1.35	3.75	1.7
Ambient	1.35	2.17	3.37	2.30	-	-	-	-
Mean	2.08	3.52	4.60		-	0.34	0.94	
LSD (P<0.05)	Temperature (T) = 0.12, Ripening period (RP) = 0.13, T × RP = 0.24				Temperature (T) = 0.24, Ripening period (RP) = 0.28, T × RP = 0.46			
Temperature	TSS (%)				Acidity (%)			
	Ripening period (h)				Ripening period (h)			
	48	72	96	Mean	48	72	96	Mean
20°C	5.70	5.81	6.07	5.86	0.22	0.22	0.20	0.21
25°C	6.12	7.80	8.20	**7.37**	0.18	0.12	0.10	0.13
30°C	7.08	8.33	8.40	7.94	0.17	0.11	0.08	0.12
Ambient	5.50	5.66	5.71	5.62	0.22	0.22	0.21	0.22
Mean	6.10	6.90	7.10		0.20	0.17	0.15	
LSD (P<0.05)	Temperature (T) = 0.04, Ripening period (RP) = 0.05, T × RP = 0.11				Temperature (T) = 0.006, Ripening period (RP) = 0.007, T × RP = 0.02			

a^* and b^* fruit pulp colour values was recorded up to the 96 h of ripening period. Increase in a^*values of mesocarp was indicative of shift from greenness with the progression of ripening and might be attributed to an increase in carotenoid content in mango pulp (Ribeiro *et al.*, 7).

Physiological loss in weight (PLW) of fruits increased with the increase in ripening period and temperature (Table 2). Minimum physiological loss in weight was recorded in the fruits kept at ambient conditions and the maximum was registered at 30°C. Similar results were also reported by Jawandha *et al.* (6) in guava fruits. High temperature during ripening led to the fruit spoilage. Maximum spoilage was recorded at 30°C whereas no spoilage was noticed during ripening at ambient conditions, 20 and 25°C (Table 2). Spoilage at high temperature might be due to the adverse effect of high temperature on papaya fruits.

Both ripening temperature and time significantly influenced the TSS content of fruits (Table 2). After 96 h of ripening, highest TSS was recorded in fruits kept at 30°C, followed by fruits kept at 25°C. Rate of TSS increase was also greater at higher temperatures than at lower temperatures. These results were supported by findings of Baloch and Bibi (3) who observed more TSS at higher storage temperature. As the ripening period and temperature increased fruit acidity decreased. Maximum acidity was recorded in fruits kept at ambient conditions, where as minimum was retained by the fruits kept at 30°C (Table 2). These results correspond with observations of Gill *et al.* (4) who reported constant decrease in acid content of mango fruits during ripening.

It can be concluded from the results that physiologically mature fruits of papaya cv. Red Lady 786 harvested at colour break stage paper can be ripened at 25°C in 72-96 hrs.

REFERENCES

1. Amerine, M.A., Pangborn, R.M. and Roessler, E.B. 1965. Principle of sensory evaluation of food. **In**: *Food and Technology Monographs*, Academic Press, London, pp. 338-39.
2. AOAC 1990. *Official methods of analysis.* Association of Official Analytical Chemists Washington DC, USA.
3. Baloch, M.K. and Bibi, F. 2012. Effect of harvesting and storage conditions on the post harvest quality and shelf life of mango (*Mangifera indica* L.) fruit. *South African J. Bot.* **83**: 109-16.
4. Gill, P.P.S., Jawandha, S.K., Singh, N.P., Kaur, N. and Verma, A. 2015. Changes in quality attributes of mango in response to different ripening temperature regimes. *Ecol. Env. Cons.* **21** (Suppl.): 79-83.
5. Jason, J.W., Hewett, E.W., Hertog, M.L.A.T.M. and Harker, F.R. 2002. Temperature and ethylene affect induction of rapid softening in 'Granny Smith' and 'Pacific Rose™' apple cultivars. *Postharvest Biol. Tech.* **25**: 257-64.
6. Jawandha, S.K., Gill, M.I.S., Singh, H. and Arora, A. 2015. Influence of temperature on ripening of winter guava. *Ecol. Env. Cons.* **21**(Suppl): 255-59.
7. Ribeiro, S.M.R., De Queiroz, J.H., De Queiroz, M.E.L.R., Campos, F.M. and Sant'Ana, H.M.P. 2007. Antioxidant in mango (*Mangifera indica* L.) pulp. *Plant Foods Hum. Nutr.* **62**: 13-17.

Received : June, 2017; Revised : January, 2019;
Accepted : February, 2019