

**EFFECT OF STAGE OF MATURITY AT HARVEST ON THE
POSTHARVEST QUALITY OF DRAGON FRUIT**

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Introduction

Dragon fruit (*Hylocereus undatus*) was introduced to Sri Lanka around 1999 as a small scale crop. It is a fast return perennial fruit crop within two years after planting and full production can be achieved within five years. Furthermore, it could be grown organically using locally available organic manures and composts. Organically produced dragon fruits have a high demand as a health fruit (Pushpakumara *et al*, 2006). As dragon fruit is a non-climacteric fruit (Nerd *et al.*, 1999) it does not continue to ripen after harvesting. Therefore, the fruits have to be harvested at maximum sugar levels and acidity. At peak ripeness, the fruits become pink-red, although the scales remain green. The fruit of dragon fruit reaches its peak stage about 40- 50 days after flowering. If the harvesting time is delayed the fruit becomes sweeter and heavier. The fruits harvested after 50 days have been reported to be 50% heavier (480g) than those harvested early (340g) (Chang and Yen, 1997). However, over ripening of fruits causes lower shelf life and splitting of fruits. This reveals the importance of harvesting of fruits at the correct time. Furthermore, if fruits are picked for the overseas market, proper storage is required. As regard the storage studies, most of them have been done to explore the storage conditions of fruits which are closed to full peel colour stage. According to Arevalo and Ortiuz (2004), storage temperature for the fresh market should be 15 °C - 2°C at 85-90% RH. However, dragon fruit is a new fruit crop to Sri Lanka, sufficient information is not available to identify the most suitable stage for harvesting of dragon fruit and detail studies have not been carried out to assess the post harvest quality of the fruits under different storage conditions.

Therefore this study was conducted with the objective of identifying the most suitable harvesting stage for dragon fruit and assess the postharvest quality of the fruits harvested at different maturity stages.

Methodology

The study was conducted in two steps, i.e. as a field experiment and a laboratory experiment at Regional Agriculture Research and development Centre (RARDC), Makandura (located in the agro-ecological zone IL₁) from June to September, 2008. The experiment was laid out as a Completely Randomized Design (CRD) with three replicates. In the field experiment twenty four dragon fruit plants at their full blooming stage were randomly selected for the study. Colour bands were painted to differentiate plants in each treatment. The fruits were harvested at different as given below.

Treatment 1(T1) - This is the first picking stage(Initial Ripening stage).Fruit reaches this ripening stages 27 days after flowering.

Treatment 2 (T2) - Second picking stage. (28 days after flowering.)

- Treatment 3 (T3)** - Third picking stage (29days after flowering).
- Treatment 4 (T4)** - Fourth picking stage. (30 days after flowering).
- Treatment 5 (T5)** - Fifth picking stage. (31 days after flowering) - (control)
- Treatment 6 (T6)** - Six picking stage.(32 days after flowering).
- Treatment7 (T7)** - Seventh picking stage. (33 days after flowering).
- Treatment 8(T8)** - Eight picking stage. (34 days after flowering).

In the laboratory experiment, quantitative and qualitative evaluations of harvested fruits were done by using 05 fruits from each plant which were harvested at different time intervals (27-35 days after flowering). Then samples were stored at ambient temperature and subjected to qualitative, quantitative, visual and sensory evaluations at different storage time intervals. i.e. 1st, 3rd, 5th, 7th and 9th days. Data were tabulated and analyzed by using Analysis of Variance (ANOVA) procedure of Statistical Analysis System (SAS). Duncan's New Multiple Range Test (DNMRT) was used to compare differences among the means at P=0.05.

Results and Findings

Data were analyzed by using Statistical Analysis System (SAS) according to the above mentioned combined category. According to the analyzed data, as shown in Table 1, it was revealed that the lowest R² value was in plant dry weight (0.397) but it was not significant (P>0.05). Results of the analysis in respect to each characteristic are summarized in the table (Table 1). According to the findings of this experiment significant differences of fruit length, fruit girth could be observed within treatment1-5.

Table 1 Quantitative measurements of the fruits just after harvesting

Treatments different maturity stage)	Fruit length(cm)	Fruit girth(cm)	Fruit weight(g)
T2	12.00 ^{ab}	9.16 ^{bc}	516.67 ^{bc}
T2	11.16 ^b	8.16 ^{cd}	470.00 ^{bc}
T3	12.00 ^{ab}	9.43 ^b	484.33 ^{bc}
T4	11.83 ^a	9.00 ^{bc}	460.33 ^{bc}
T5 (control)	11.66 ^b	9.33 ^b	564.33 ^b
T6	11.33 ^b	9.00 ^{bc}	463.67 ^{bc}
T7	11.60 ^b	7.76 ^d	420.00 ^{cc}
T8	13.60 ^a	10.06 ^a	739.67 ^a
LSD	1.80	1.109	116.54

Note : Means with same letters along the columns are not significantly different at $p>0.05$. Measurements are the means of three Replications.

When correlation analysis was performed on quantitative and qualitative parameters of the dragon fruit, pH value showed a highly significant ($p<0.001$) positive correlation with Brix value (Table 2). The values of the correlations coefficients of the above linear relationships are 73%, 81% and 95% respectively. On the other hand, fruit weight, fruit girth and fruit length showed the non significant difference ($p = 0.05$) with pH and Brix values.

Table 2 Linear correlation coefficients between Fruit Length(FL), Fruit Girth(FG), Fruit Weight(FW), Brix Value(BV) and pH value(pH).

	FL	FG	FW	BV	pH
FL	-	0.7289*	0.8771 ^{ns}	0.2628 ^{ns}	0.2427 ^{ns}
FG	-	-	0.7789*	0.2336 ^{ns}	0.1211 ^{ns}
FW	-	-	-	0.1949 ^{ns}	0.2892 ^{ns}
BV	-	-	-	-	0.9484**
pH	-	-	-	-	-

Note : ns- non Significant at $p=0.05$; * Significant at $p = 0.05$; **Significant at $p= 0.01$

According to the study findings, significant differences between Brix and pH values could be observed among differently matured fruits (Table 3). The fruits harvested at 30 days after flowering or 3 days after initial ripening stage possessed higher sweetness. But it is impossible to decide the maturity stage based on the sweetness or Brix value as the fruit maturity depends on several other fruit characteristics.

Table 3 Brix value and pH value of dragon fruit harvested at different maturity stages.

Maturity Stage of fruits at harvest	Brix value	pH value
T1	12.07 ^d	3.20 ^d
T2	12.07 ^d	3.56 ^c
T3	12.90 ^c	3.56 ^c
T4	13.67 ^b	4.13 ^b
T5(control)	13.80 ^{ab}	4.26 ^{ab}
T6	13.90 ^{ab}	4.23 ^{ab}
T7	14.08 ^a	4.20 ^{ab}
T8	13.97 ^b	4.36 ^a
LSD	0.36	0.18

Note : Means with same letters along the columns are not significantly different at $p>0.05$. Measurements are the means of three replications.

The results of appearance of fruit, bracts and stem, fruit taste and fruit odour are summarized in table 4. The analyzed sum of ranks were given in relation to the maturity of the fruits. There is no possibility to compare all possible treatments by this type of analysis .But these sum of ranks show the highest and the lowest values of the ranks which are related to taste. According to the results of the analysis, the maturity stage of the fruit was not affected on the appearance of the fruit, bracts and stem. But the maturity stage significantly affected the fruit taste and the odour.

Table 4 Visual and sensory evaluation of fruits at harvest

Maturity stage of fruits at harvest	Sum of ranks			
	Appearance of fruit	Appearance of bracts & stem.	Fruit taste	Fruit odour
T1	135.00	143.50	145.00	95.50
T2	135.00	143.50	145.00	145.50
T3	135.00	143.50	145.00	151.50
T4	135.00	143.50	155.00	155.50
T5	135.00	143.50	161.00	155.50
T6	135.00	135.50	117.00	151.50
T7	135.00	119.50	93.00	115.50
T8	135.00	107.50	105.00	99.50
Grand median	9.000	5.000	6.250	6.875
Probability	1.000	0.374	0.000	0.000

Note: Pr- 0 = highly significant

According to table 5, the first day category showed the colour of differently matured fruits at harvest. In other words, it clearly explained the pattern of colour change of dragon fruits with ripening. Twenty seven days after flowering (T1), peel colour of the fruits turned red and 29 days after flowering it turned red - purple (T4). As regard the colour change of dragon fruits in each storage period category distinguished colour variations could not be observed under storage conditions. The colour intensity slightly varied within the red–purple group during the storage period.

Table 5 Peel colour at different storage periods

Matutity stage of fruits at harvest	Peel colour at different storage period (days)									
	1 st day		2 nd day		5 th day		7 th day		9 th day	
T1	47C	(R.g)	61C	(R.p)	63A	(R.p)	65A	(R.p)	63A	(R.p)
T2	47B	(R.g)	61C	(R.p)	60C	(R.p)	61B	(R.p)	61B	(R.p)
T3	58B	(R.p)	58A	(R.p)	60C	(R.p)	58A	(R.p)	59C	(R.p)
T4	59C	(R.p)	61B	(R.p)	61B	(R.p)	61B	(R.p)	61B	(R.p)
T5(Control)	58A	(R.p)	58A	(R.p)	59A	(R.p)	60C	(R.p)	59C	(R.p)
T6	61B	(R.p)	61B	(R.p)	60B	(R.p)	60B	(R.p)	60A	(R.p)
T7	59C	(R.p)	58A	(R.p)	59C	(R.p)	60C	(R.p)	60C	(R.p)
T8	59C	(R.p)	60C	(R.p)	60C	(R.p)	60C	(R.p)	60C	(R.p)

A,B,C- Represent colour code in RHS colour chart; Rp - Red group; Rg -Red purple

Conclusions and Recommendations

The results of this study clearly showed that the dragon fruits harvested at 30 days after anthesis (T4) or three days after the initial ripening stage possessed not only the highest brix value and pH values but also the highest taste and characteristic odour. Furthermore, the correlation analysis performed on quantitative and qualitative parameters of the dragon fruit showed a significant ($p < 0.01$) positive correlation with Brix value and pH. However, significant changes of colour intensity of red purple group could not be

observed during the storage of fruits showing non-climacteric nature of the fruits. According to the assessment of postharvest quality, the fruits harvested at 30-31 days after anthesis (T4 and T5) exhibited significantly high postharvest life during storage. Postharvest diseases were not observed during the storage period. Hence, the dragon fruits harvested at 30-31 days after anthesis could be proposed as the most suitable stage for harvesting dragon fruits for storage purposes.

References

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