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Evaluation of papaya genotypes for latex yield under Kerala condition

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Abstract
A study was undertaken at College of Agriculture, Kerala Agricultural University, Thrissur, Kerala in July 2021 to evaluate latex content of different genotypes under Kerala condition. The experiment was laid out in randomized block design with twenty-four genotypes replicated thrice, planted at a spacing of 2 m x 2 m. The results revealed that quantity of fresh papaya latex ranged from 2.39 g-23.54 g. The maximum dry latex per fruit (4.11g) was observed in CO2 (T_{20}) which was on par with CO1 (T_{19}-3.60 g). Likewise, maximum dry latex per percent of fruit weight was recorded by Red Lady (0.30%), which was on par with CO2 (0.27%). Furthermore, the colour of shade-dried latex appeared to be pale yellow compared to the dark brown coloured sundried latex. Therefore, from the results it was concluded that the variety CO2 is best suited to the humid tropical condition of Kerala and shade dried latex is superior to sundried ones in terms of colour and quality.

Keywords: Papaya latex, Papain, Genotype, CO2, Fresh latex, Dried latex, Sun dried, Shade dried

1. Introduction

Papaya (*Carica papaya* L.) is an evergreen herbaceous tropical fruit crop belonging to the family Caricaceae. The nutritional and economic potential of papaya has made it a popular fruit and vegetable among people. The fruit of papaya is botanically a berry that develops from a syncarpous superior ovary with parietal placentation (Kochhar, 1986) [8]. It is a rich source of vitamin A and C along with thiamine, riboflavin, calcium, iron, potassium, sodium and magnesium in modest amounts (Oloyede, 2005; Wall, 2006) [11, 13]. Even though papaya is mainly valued for its ripe fruits, the latex extracted from unripe papaya is a rich source of papain. The proteolytic enzyme papain has a wide range of applications in leather, meat, textile, pharmaceutical and cosmetic industry. In meat and brewing industries, it is used to tenderize meat and to prepare ‘chill proof’ beer respectively. It is also used in chewing gum manufacturing industry and to degum natural silk (Lewis and Woodward, 1950; Morton, 1987; Arvind *et al*., 2013) [9, 10, 2]. Cosmetically, it is used in shampoos, face-lifting operations and also to treat freckles and burns. In humans, the use of papain helps to reduce blood pressure, dyspepsia, diarrhea, bleeding hemorrhoids and whooping cough apart from its action as an anthelmintics (Arvind *et al*., 2013) [2]. These diversified end-use areas indicate a strong export demand for papain. The papain-rich crude papaya latex obtained from green papayas is highly priced in the market. Hence papain extraction can be a profitable business even for the small-scale farmers.

The non-seasonality and early production of papaya make its cultivation easier. However, the yield of papaya latex depends on several factors like genotype, season and time of fruit tapping. Kerala being a humid tropic is congenial for papaya cultivation and evaluation of different genotypes will help to find out the best latex yielders. Hence, this study was carried out to evaluate the latex yield of different genotypes collected from various research stations and local collections in order to find out the most suitable ones under humid tropical conditions.

2. Materials and Methods

The experiment was conducted at the College of Agriculture, Kerala Agricultural University, Vellanikkara, Thrissur (Kerala), India during July 2021 to evaluate the performance of different genotypes for latex content under Kerala conditions. The experimental plot was situated in Vellanikkara, the central zone of Thrissur located at an altitude of 22.25 meters above MSL at 10°56’ north latitude and 76 º 28’ east longitude with warm humid tropical condition. The location details of genotypes used in the study are given in table 1.

Table 1: Location details of genotypes used in this study

Genotype no.	Variety/ Accession	Location
T_1	Local accession	NBPGR, Vellanikkara
T_2	Local accession	Ernakulum
T_3	Local accession	Ernakulum
T_4	Local accession	Malappuram
T_5	Local accession	Malappuram
T_6	Local accession	Kottayam
T_7	Local accession	Kottayam
T_8	Local accession	Kottayam
T_9	Local accession	Kottayam
T_{10}	Local accession	Palakkad
T_{11}	Local accession	Kottayam
T_{12}	Local accession	Thrissur
T_{13}	Local accession	Thrissur
T_{14}	Local accession	Thrissur
T_{15}	Local accession	Ernakulum
T_{16}	Local accession	Thrissur
T_{17}	Arka Prabhath	IIHR, Bangalore
T_{18}	Red Lady	Taiwan
T_{19}	CO 1	TNAU, Coimbatore
T_{20}	CO 2	TNAU, Coimbatore
T_{21}	CO 3	TNAU, Coimbatore
T_{22}	CO 4	TNAU, Coimbatore
T_{23}	CO 6	TNAU, Coimbatore
T_{24}	CO 7	TNAU, Coimbatore

The seeds of papaya genotypes were collected from IIHR, TNAU and several homesteads in Kerala. The experiment was laid out in a randomized block design with twenty-four genotypes replicated thrice. The seedlings were raised, transplanted and fertilized according to the package of practice recommendation of Kerala Agricultural University. The seedlings were planted at a spacing of 2 m x 2 m. The latex was extracted from uniform sized unripe but almost mature fruits of 90 to 100 days old by giving 3-4 longitudinal cuts of 3 mm depth (Fig 1). The incision was made from top to bottom of the fruit using a stainless-steel razor or sharp bamboo splinter during the early morning. The practice of making incisions on the untapped fruit surface is repeated three to four times over a period of 9 to 12 days at 3 to 4 days intervals. The latex oozing out of the fruits was collected in polythene trays, as metals may react with the papain enzyme present in the latex. The flow ceases within 4 to 5 min and the latex may get solidified on the fruit surface. This is scrapped off and added to the earlier collected latex. The fresh weight of the latex was recorded. It was shade dried for about 24 hr until it can be removed from the tray as flakes. The difference in the colour of latex in shade dried and sundried conditions were also evaluated. Commercially, the colour of these crude unrefined flakes varies from off-white to dark brown depending upon the mode of drying (Hinkel, 1951) [7]. The fruit weight, fresh and dry weight of latex along with the percentage moisture content were recorded and average values were subjected to statistical analysis. The colour difference between the shade dried and sundried samples was also recorded.

3. Result and Discussion

The experimental data pertaining to the latex yield shows a significant difference among the genotypes (Table 2). The highest moisture percent of 97.78% was recorded for the local accession from Thrissur (T_{16}) whereas the lowest moisture percent was observed in the variety CO2(T_{19}). The amount of fresh papaya latex ranged from 2.39 g in local accession collected from NBPGR, Vellanikkara (T_1) to 23.54 g in Red Lady (T_{18}). The difference in fresh weight among the genotypes was due to the difference in dilution of latex by water which was in agreement with the findings of Balls and Thompson (1940) [4]. The highest per fruit dry latex yield of 4.11g was noted in CO2 (T_{20}) and the lowest was recorded in T_{16} (0.35 g), a local accession collected from Thrissur. The variety CO2 is a dual-purpose papaya variety released from TNAU, Coimbatore, commercially recommended for latex extraction. It was on par with CO1 (T_{19}-3.60 g) for dry latex yield which was followed by Red Lady (T_{18}-2.69 g). Similarly, separate experiments were carried out by Chovatia *et al.* (2010) [5] and Davamani *et al.* (2013) [6] on papaya latex extraction using CO2 variety and observed per fruit papaya latex yield as 1.96 g and 7.83g respectively. On comparing the dry latex per percent of fruit weight of different genotypes, it was noted that Red Lady (0.30%) had maximum dry latex per fruit weight, which was on par with CO2 (0.27%). Meanwhile, minimum dry latex per percent fruit weight was recorded by the local accession T_{16} (0.03%). So, it can be concluded that the average yield of dried latex of papaya was approximately about 0.10 percent of the weight of the tapped fruit, regardless of the amount of wet latex obtained. Similar results were obtained by Balls and Thompson (1940) [4], where they had observed a constant proportion in weight of dried latex, which was about 0.10 percent of the weight of the fruit.

In the experiment, colour of shade dried latex appeared to be pale yellow (Fig 2) whereas the latex dried in direct sunlight was brown to dark brown in colour (Fig 3). Baines *et al.* (1979) [3]; Sanders and Robertson (1944) [12] also reported that sundried latex was red-brown in colour compared to other methods of drying. Since colour is one of the indications of papain quality, the sundried latex will be of inferior quality than the shade dried sample. The decreased papain activity of sundried latex was due to the sensitive nature of histidine residue (required for enzyme activity) in papain to ultraviolet light (Arnon, 1970) [1]. Hence, light coloured latex is mostly accepted in the market than dark-coloured latex. Therefore, the quality of shade dried latex is better than sun-dried ones, even though the time taken for drying by the former is more than the latter.

Table 2: Latex yield of different genotypes under Kerala condition

Genotype no.	Weight of fruit (g)	Fresh latex per fruit (g)	Fresh latex, per cent of fruit weight	Dry latex per fruit (g)	Dry latex, per cent of fruit weight	Moisture content (%)
T1	1234.54^{d}	2.39^{q}	0.19^{m}	0.51^{lm}	0.05^{jk}	78.98^{f}
T2	1112.41^{de}	16.68^{b}	1.51^{b}	1.92^{cde}	0.17^{cde}	88.48^{bcd}
T3	780.01^{ij}	10.63^{i}	1.36^{cd}	0.97^{ijk}	0.12^{fgh}	90.87^{b}
T4	736.14^{j}	9.12^{jk}	1.24^{de}	0.78^{jkl}	0.11^{gh}	91.41^{b}
T5	1149.76^{d}	14.19^{e}	1.23^{def}	2.15^{c}	0.19^{c}	84.86^{e}
T6	1.13^{d}	14.79^{d}	1.31^{cd}	1.63^{ef}	0.14^{ef}	89.01^{bcd}
T7	0.99^{ef}	14.19^{e}	1.43^{bc}	1.50^{fg}	0.15^{def}	89.45^{bc}

T8	1.43^{bc}	12.12^{fg}	0.84^{ij}	1.76^{def}	0.12^{fgh}	85.47^{de}
T9	0.94^{fgh}	9.55^{j}	1.01^{gh}	1.24^{ghi}	0.13^{fg}	86.97^{cde}
T10	1.24^{d}	11.65^{gh}	0.97^{hi}	1.66^{ef}	0.13^{fg}	85.75^{de}
T11	0.95^{fg}	11.97^{gh}	1.27^{d}	1.13^{hi}	0.12^{fgh}	90.54^{b}
T12	1.14^{d}	12.57^{f}	1.11^{fg}	1.44^{fgh}	0.12^{fgh}	88.61^{bcd}
T13	0.82^{ghij}	11.49^{h}	1.42^{bc}	1.02^{ijk}	0.12^{fgh}	91.12^{b}
T14	1.15^{d}	8.72^{kl}	0.77^{j}	2.07^{cd}	0.18^{cd}	76.22^{f}
T15	0.79^{ij}	8.32^{l}	1.06^{gh}	0.73^{kl}	0.09^{hi}	91.25^{b}
T16	1.19^{d}	15.77^{c}	1.33^{cd}	0.35^{m}	0.03^{k}	97.78^{a}
T17	0.81^{hij}	2.22^{q}	0.27^{lm}	0.75j^{kl}	0.09^{hi}	66.44^{gh}
T18	1.54^{ab}	23.54^{a}	2.68^{a}	2.69^{c}	0.30^{a}	88.60^{bcd}
T19	1.40^{c}	11.52^{h}	0.75^{j}	3.60^{b}	0.23^{b}	68.68^{g}
T20	1.59^{a}	6.44^{m}	0.46^{k}	4.11^{a}	0.27^{a}	40.0^{i}
T21	0.96^{f}	3.40^{p}	0.22^{m}	1.09^{ij}	0.07^{ij}	67.95^{g}
T22	1.49^{abc}	10.71^{i}	1.12^{efg}	2.18^{c}	0.23^{b}	79.68^{f}
T23	1.51^{abc}	5.73^{n}	0.39^{kl}	0.69^{klm}	0.05^{jk}	88.05^{bcde}
T24	0.88^{fghi}	4.73^{o}	0.31^{lm}	1.69^{ef}	0.11^{gh}	64.19^{h}
S.Em±	46.44	0.26	0.05	0.12	0.01	1.25
CD (P=0.05)	132.19	0.53	0.13	0.35	0.03	3.57

Fig 1: Papaya latex extraction- a) Polythene tray b) Bamboo splinter c) Tapping of papaya fruit d) Fresh papaya latex

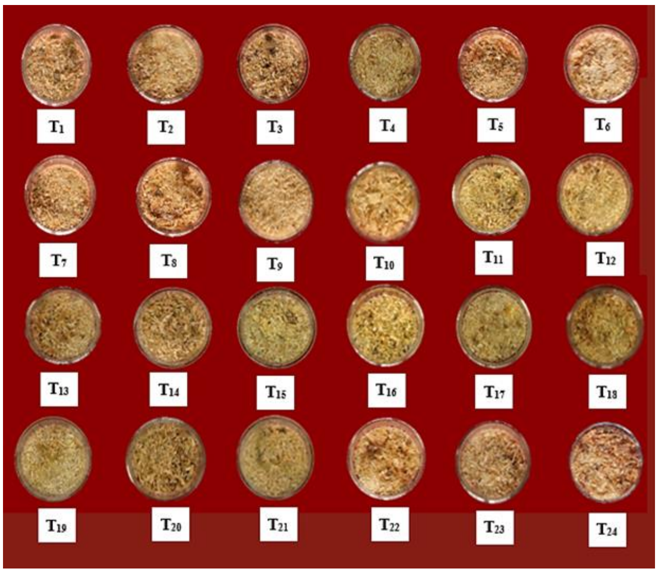

Fig 2: Dried latex of different papaya genotypes

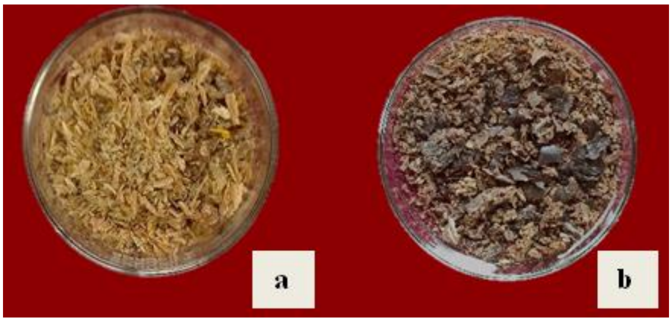

Fig 3: Colour difference of dried latex - a) shade dried b) sundried latex

4. Conclusion

The results from the present study indicated that there was a significant difference in the latex content among the genotypes. Although the quality analysis was not carried out for the above shade dried and sundried samples, the colour of dried latex indicated that the quality of dark coloured latex was inferior to pale yellow coloured ones. Hence from the experimental data, it can be concluded that among the treatments the TNAU variety CO2 was the best latex yielder under the humid tropical condition of Kerala and the quality of shade dried latex was better than sundried ones, although inferior to other methods of drying.

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