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VARIABILITY OF RAMBUTAN (*NEPHELIUM LAPPACEUM* LINN.) IN EAST SIANG DISTRICT OF ARUNACHAL PRADESH

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Key words: Rambutan, Sweet type, Acid type, SDS-PAGE analysis

Abstract

A survey was conducted in the Ayeng, Balak and Silay villages under the East Siang district of Arunachal Pradesh, India during the period 2013-2015 for the documentation on the variability of Rambutan **(***Nephelium lappaceum Linn.*) in this region. These plants are found in wild in the region and in this investigation two types of morphotypes could be identified endemic to this region. The two morphotypes have one contrasting character i.e. having sweet taste (dull red colour fruit) and another having acidic taste (red colour fruit). Flowering period of both the types occur during February - March and the fruits ripe during April - May. Study on its different physical and quality parameters was evaluated to identify the better genotype. It was found that the sweet types are smaller in size (6 × 3.2 cm) having the TSS of 16.8^{o} Brix and better pulp (10.1 g/fruit) whereas the acidic types are bigger in size (6.2 × 3.5 cm) having the TSS of 13.4^{o} Brix but lesser pulp content (6.5 g/fruit). However, SDS-PAGE analysis revealed that there is monomorphic band in between the two morphotypes which needs further analysis through molecular marker for confirmation in future.

Introduction

Rambutan (*Nephelium lappaceum* Linn.) belongs to Sapindaceae and is one of the important underexploited fruits of the south and South East Asia. The globalization of the economy, increased ethnic diversity, and a greater demand for healthy and more diverse food products have opened a window of opportunity for the commercial production and marketing of non-traditional subtropical fruit crops like rambutan as reported by Ricardo and David (2011). Rambutan is a medium sized evergreen tree with an open structure growing 12 - 15 m high, is a native of the Malaysian-Indonesian region. It produces clusters of 15 - 20 ellipsoidal fruits. Fruits weigh 40 -50 g each and resemble litchi but because of long, thick, soft hairs or spines on the surface these are known as rambutan (in Malay 'rambut' stands for hair). The hairy outgrowth has eye-catching red and yellow colours and it imparts a distinctive exotic appearance to its fruits as reported by Chadha (2003). Twenty two *Nephelium* species have been recorded in Myanmar, Thailand and Indo-China, 13 in peninsular Malaysia, 16 in Borneo, four in the Philippines and three in western Java (Tindall 1994). The primary centre of production of rambutan is in Malaysia and from there it spreads westward to other countries, such as Thailand, Myanmar, Sri Lanka, India and eastward to Vietnam, Philippines, Indonesia and Hawaii as reported by Bose *et al*. (2002). Chadha (2003) also reported that it is mostly confined to South-East Asia especially Indonesia, Malaysia and Thailand and the fruit has spread to other humid tropical regions of the world including India. They are grown mainly for fruits in which the juicy, white, translucent, sub acid-sweet flavoured aril is the edible flesh. The sweet fruits are consumed fresh whereas the sour ones are eaten stewed. It can also be canned or made into jam but loses its flavour after heating. Its appearance is different from litchi by having red and soft spines (hair) covering the whole surface

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of the fruits thus, the synonymous name hairy litchi is ascertained. The aril of rambutan is very nutritive and rich in sugar, vitamin and mineral content as reported by Vishal *et al*. (2009). The thin, leathery fruit skin is easily peeled away, revealing a pearly white, gelatinous, juicy pulp (aril) surrounding a large seed. The pulp tends to be attached to the seed in some varieties while in others, it can be readily separated. The translucent pulp is sweet or sub-acid with a refreshing flavour and is akin in many ways to litchi pulp as reported by Chadha (2003). The fruits are astringent, stomachin and anthelmintic. The roots are used in decoctions for treating fever and the bark is astringent for disease of the tongue. The leaves are used in poultices and headache. The fruits also contain toxic secondary metabolite, saponin which is dried and used as a medicine in java. The young shoot is used as a green dye for silk. The seed kernel is used for the production of rambutan fallow, a solid fat similar to carcass butter which is used for soaps and candle and also edible. The bitter and narcotic seeds are also taken after roasting and the tree gives aesthetic look during fruiting (Vishal *et al*. 2009). Many phytochemical found in fruits act as powerful antioxidants that give them color, flavor, odor and protection against human diseases. Rambutan fruit contains diverse nutrients but in modest amounts, with only manganese having moderate content at 16% of the daily value per 100 g consumed. Rambutan rind displays diverse phenolic acids, such as syringic, coumaric, gallic, caffeic and ellagic acids having antioxidant activity *in vitro* as reported by Thitilertdecha *et al*. (2010) and Sun *et al*. (2012). Rambutan seeds contain equal proportions of saturated and unsaturated fatty acids, where arachidic (34%) and oleic (42%) acids, respectively are highest in fat content (Manaf *et al*. 2013). It is used in a number of treatments which include diabetes, hypertension, sex tonic and various other ailments. One of the main compounds of rambutan is gallic acid. This compound behaves like a free radical scavenger that protects our body from oxidative damage and is particularly helpful to fight cancer. The pleasant fragrance of rambutan fruit derives from numerous volatile organic compounds, including beta-damascenone, vanillin, phenylacetic acid and cinnamic acid (Ong *et al*. 1998). However, there is no scientific study on the antimicrobial activity of the extracts of the rambutan fruits as reported by Sunanta *et al.* (2003). Besides, there are reports of antimicrobial potential of rambutan fruit against human pathogens and showed the inhibitory activity of fungal activity from the fruit sap (Malini and Maheshkumar 2013). During the survey, there is no report of using this fruit as ethnomedicinal value for curing the diseases by the local people "*Adi tribe*" in the East Siang district of Arunachal Pradesh. However, this fruit is used as desert fruit during the off season in April-May as wild litchi or *Adi* litchi or *jungle* litchi before the available of litchi fruit in the market. Because of its beautiful leaves, flower and colourful fruits it is also grown as ornamental tree in landscape and homestead garden. In some parts of subtropical region of Arunachal Pradesh, it is grown as underutilized fruit crop without knowing its medicinal and nutritive value in the wild forest region. But, now adays due to its medicinal and nutritive value, people started giving emphasis in this unexploited crop. However, still now there is no report of research for this crop from Arunachal Pradesh. Therefore, the present investigation was undertaken to identify the superior genotype of rambutan which is successfully growing in some pockets of hilly sites in East Siang district of Arunachal Pradesh, will be useful for the farmer to get the superior genotype as planting materials.

Materials and methods

The study was carried out by randomly selecting the fruits from different sites of East Siang district *viz.*, Ayeng, Balak and Silay villages of Arunachal Pradesh. These villages are inhabited by the *Adi* tribal community. The average altitude of the sites are about 155 m MSL and represent a typical subtropical zone with short cool, dry and windy winter, a hot summer and a heavy monsoon season. The climate of Arunachal Pradesh varies with topography and elevation. Study

site represents a subtropical, hot and humid climate; in the lower valleys, summer temperatures in June, July and August typically rise to about 30°C, while winter temperatures in December, January and February usually drops to 13°C. Annual rainfall in the state averages 3,300 mm, falling mostly between April and September in the centre of the state.

Fig. 1. Site of study, East Siang district, Arunachal Pradesh, India.

Results and Discussion

According to earlier investigations, 22 *Nephelium* species have been recorded, including in Myanmar, Thailand and Indo-China, 13 in peninsular Malaysia, 16 in Borneo, four in the Philippines and three in western Java (Tindall 1994). The other *Nephelium* species other than rambutan are *Nephelium chryseum* L., mountain rambutan growing wild; *Nephelium topengii* L., Hainan rambutan growing wild locally in Hainan*; Nephelium malaiense* L., the Malay longan; *Nephelium obovatum* L., the vin longan; *Nephelium bassocense* L.; *Nephelium eriopetalum* L.*; Nephelium glabruam* L.; *Nephelium hypoleucum* L., the white under- leaf rambutam of Thailand; *Nephelium rimosum* L.*; Nephelium xerospermoides* L. (Bose *et al.* 2002). In Arunachal Pradesh, still now there is no report about the variability of rambutan which is growing in a few pockets of East Siang district of Arunachal Pradesh. During the present survey, it is observed that two types of rambutan morphotype are found in this region *viz.*, acidic (red colour peel) and sweet (dull red colour peel) based on the fruit morphology (Fig. 2a, b) but same morphological leaf character (Fig. 2e). Inside the fruits a big seed is surrounded by pearl-white aril (flesh) which is juicy in acidic type but in sweet type seed size is smaller and flesh is slightly pigmented with red pigment (Fig. 2c, d) but the taste is rather flat or insipid as compared with the litchi. The fruit sizes of sour type are larger as compared to sweet type and their characteristic features are given in Table 1.

The physical and physiochemical properties of the two morphotype of rambutan viz. spine length, peel colour and thickness, aril thickness, aroma, adherence of aril to the seed, vitamin C content, TSS, reducing sugar % etc. are presented in Tables 1 and 2. Among this two morphotype of rambutan found in this region, there are significant differences in their characters like seed weight, seed length, seed breadth, fruit length, fruit breadth, juice content, spine length, TSS and reducing sugar. In case of acidity content, acid type have slight higher acid content in the fruit however, there is no significant difference in them. The fruit pulps are firmly attached to the seed

Table 2. Physical parameters of sweet and sour types of rambutan (*N. lappaceum*).

Location	Fruit weight (g)	Peel weight (g)	Seed weight (g)	Pulp weight (g)	Peel thickness (cm)	Spine length (cm)	Seed length (cm)	Seed breadth (cm)	Juice (ml)	Fruit length (cm)	Fruit breadth (cm)
R_1L_1	53.20	35.20	9.60	9.40	0.50	0.50	3.50	2.50	10.10	6.60	3.50
R_2L_1	50.70	30.10	12.90	7.70	0.60	0.50	3.50	2.50	9.20	6.50	3.55
R_3L_1	45.50	29.20	12.90	3.40	0.70	0.45	3.60	2.30	9.60	6.40	3.60
R_1L_2	48.73	30.49	9.60	6.80	0.65	0.50	3.70	2.40	11.00	6.00	3.40
R_2L_2	39.00	37.00	12.90	5.00	0.55	0.50	3.40	2.60	10.40	6.10	3.50
R_3L_2	37.80	38.20	12.90	6.40	0.55	0.45	3.30	2.40	12.00	5.80	3.60
R_1L_3	39.80	30.20	6.00	110	0.50	0.60	2.50	2.00	6.10	6.00	3.33
R_2L_3	51.20	22.00	6.10	8.70	0.50	0.70	2.50	2.10	7.30	6.10	3.21
R_3L_3	51.00	23.00	6.20	10.70	0.60	0.70	2.30	2.00	7.20	5.80	3.10
Mean	46.32	30.59	9.90	7.67	0.57	0.54	3.14	2.31	9.21	6.14	3.42
SEM±	-	-	0.52	-	-	0.01	0.06	0.03	0.34	0.03	0.05
CD @ 5%	NS	NS	2.38	NS	NS	0.07	0.31	0.15	1.56	0.15	0.23

L_1 = Balak site, L_2 = Ayeng site, L_3 = Sillay site.

in both the morphotypes having bigger size in acid type (Fig. 2d) but the inner layer peels of the sweet type are red in colour while the sour types are white in colour (Fig. 2c). Chadha (2003) also reported that the pulp tends to be attached to the seed in some varieties while in other it can readily separate.

Table 1. Morphological characteristics features of acid and sweet types of rambutan (*N. lappaceum*).

Characters	Acid type	Sweet type
Fruit shape	Elongated and larger size	Round and smaller size
Fruit colour	Dark red colour	Dull red colour
Flesh attachment	Tightly attached to seed	Same
Seed colour	Pinkish colour	Yellowish colour
Fruit length (cm)	6.2[a]	6.0[a]
Fruit breadth "	3.5[a]	3.2[a]
Fruit weight (g)	47.3[a]	45.8[a]
Peel weight "	6.5[a]	10.1[a]
Peel thickness "	0.6[a]	0.5[a]
Spine length (cm)	0.5[a]	0.7[a]
Seed length "	2.5[a]	2[a]
Seed breadth "	2.5[a]	2[a]
Pulp weight (g)	10.1[a]	6.5[a]

[a]All data of this column represent average value.

Table 3. Quality parameters of sweet and sour types of rambutan (*N. lappaceum*).

Location	TSS (^{0} Brix)	Acidity (%)	Reducing sugar (%)	Vitamin C	Phenol (%)	Shelf life (No. of days)
R_1L_1	13.50	1.20	4.06	0.10	1.02	4.00
R_2L_1	14.00	1.10	4.01	0.12	1.04	4.00
R_3L_1	14.00	1.00	4.00	0.10	1.01	5.00
R_1L_2	13.00	1.00	4.03	0.11	1.00	4.00
R_2L_2	12.00	1.30	4.00	0.101	1.02	4.00
R_3L_2	14.00	1.00	4.05	0.10	1.03	3.00
R_1L_3	17.00	0.85	4.32	0.12	1.06	3.00
R_2L_3	16.50	0.70	4.20	0.10	1.05	3.00
R_3L_3	17.00	0.70	4.25	0.12	1.04	3.00
Mean	14.55	0.98	4.10	0.10	1.03	3.66
SEM±	0.28	-	0.02	-	-	-
CD @ 5%	1.28	NS	0.11	NS	NS	NS

L_1 = Balak site, L_2 = Ayeng site, L_3 = Sillay site.

The pre-stained ladder of having three-colour protein standard with 12 pre-stained proteins covering a wide range molecular weights from 10 to 245 KDa was used for screening the variability of rambutan germplasm using SDS-PAGE using tris-glycine buffer. The protein form different strains of rambutan sweet and sour type are loaded at 5 µl/lane and compared with 245 KDa ladder for it variability. From the investigation, it is confirmed that the sweet and sour types

have same composition of protein having monomorphic band (Fig. 3). In future application of DNA based molecular marker can be used for further identification of variable genotypes of rambutan at the seedling stage before it reaches the bearing stage of the plants.

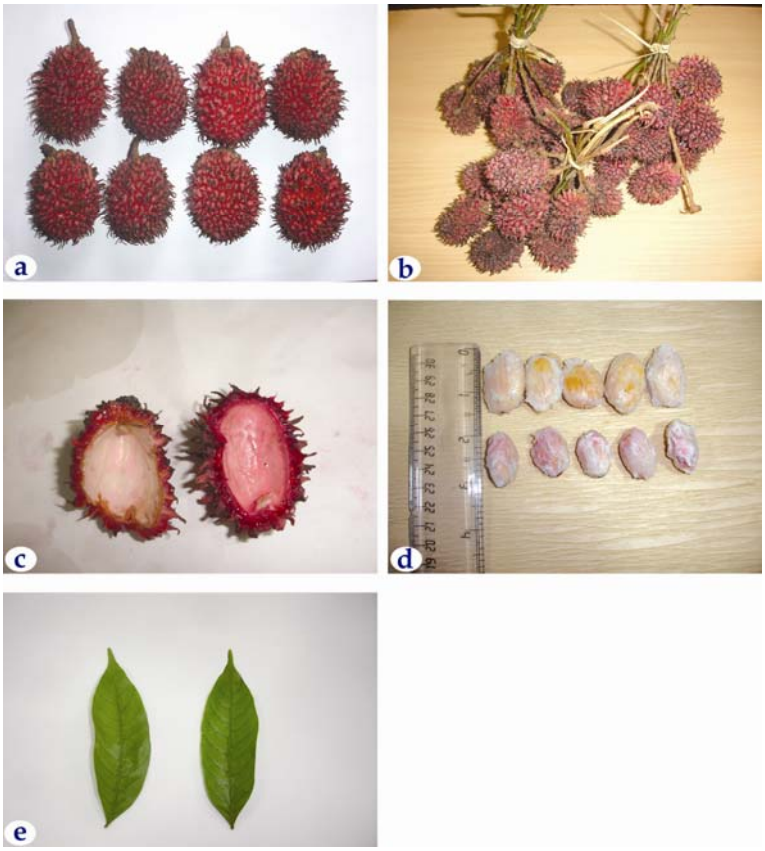

Fig. 2. (a) Sour type, (b) sweet type, (c) inner layer peel of sour and sweet types, (d) seeds of sour and sweet types and (e) leaves of sour and sweet types.

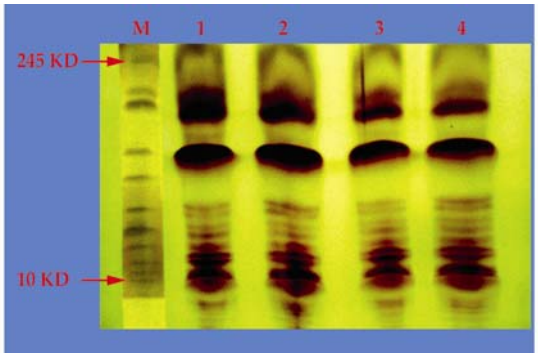

Fig. 3. SDS-PAGE analysis indicating monomorphic bands (M: Ladder of 245 KD; Sweet type - 1, 2; Sour type - 3,4).

Rambutan is minor fruit crop in Arunachal Pradesh but it occupies a respectable position mainly during the off season of May for available fruit in Pasighat, East Siang district of Arunachal Pradesh. Attempts have been made to commercialize this crop through identification of superior genotypes for it. During the investigation it is observed that there are two types of rambutan *viz.*, sweet and sour types based on taste and fruit morphology. Still now there is lacking of identification of superior genotype of it. Application of molecular marker will be suitable for the identification of superior genotype for the future.

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