Evaluation, Flowering behavior Physico-chemical and Keeping quality of Custard apple :A Review

ABSTRACT

Custard apple (*Annona squamosa* L.), also known as Sitaphalor Sharifais an important dry land fruit crop in India. Flower solitary or in short lateral clusters of 2.4 to 2.5 cm long, greenish-yellow on a hairy, slender 2 cm long stalk. Each carpel containing a single, hard, smooth, shiny, dark-brown or black, glossy seed, oblong, smooth, less than 1.3 to 1.6 cm long. The fruit of custard apple (*Annona squamosa*) has delicious whitish pulp, and is popular in tropical markets. The fruits composed of loosely cohering carpels forming a squamose or tuberculated surface. This pulp is white-tinged yellow, edible and sweetly aromatic.It has a thick, creamy-white layer of custard like, somewhat granular, flesh beneath the skin surrounding the concolorous moderately juicy segments. Actual seed counts have been found 55 to 60. It is full of vitamin C anti-oxidants, which helps to combat many diseases and also enhances the immune system. Eating custard apple is helpful in curing many diseases and disorders. The fruit is good for heart, skin and bone and maintains blood pressure. The is a helpful in curing of boils, ulcers and gum related problems. The evolution of custard apple through natural and human selection in diverse elevation zones and under different cropping systems with involvement of honey bees being the carrier of cross pollination has resulted in a wide variety of locally adapted landraces. Till date no systematic collection and evaluation of custard apple cultivars has been carried out in States. Thus, there is an urgent need for collection, characterization and evaluation of high-yielding strains/lines which can be successfully grown on commercial scale in Chhattisgarh. Hence, based up on this objective basically this paper custard apple would get evaluation of genotypes, flower behavior and physico-chemical charactersfor improved that farmers can satisfy from the production.

Key words:evaluation, flower behavior, physico-chemical, custard apple

INTRODUCTION

Custard apple (*Annona squamosa* L.), also belongs to family ‘Annonaceae’ having chromosome number 2n = 14. The nutritional and medicinal qualities of dietary importance

were realized, there has been considerable awareness about the consumption of custard apple in the world. The immature fruits, seeds, leaves and roots are of considerable medicinal values both in Aurvedic and Yunani systems of medicine. Custard apple is full of vitamin C anti-oxidants, which helps to combat many diseases and also enhances the immune system. Eating custard apple is helpful in curing many diseases and disorders. The fruit is good for heart, skin and bone and maintains blood pressure. Custard apple is also helpful in curing of boils, ulcers and gum related problems. The leaves of this fruit work against cancer, bark can be used in case of toothache, and gum pain. However, the most important advantages of custard apple are healthy heart, beneficial in pregnancy, improve eye vision, cure arthritis, fighting fatigue and protects against anaemia. The edible portion or pulp is creamy or custard like, granular, with a good blend of sweetness, possessing pleasant flavor and mild aroma have a universal liking, being rich in carbohydrates 23.0 g per100 g fruits. The fruit is reported to have moisture 70.5 g, protein 1.6 g, fat 0.4 g, minerals 0.9 g, fiber 3.1 g, calcium 17.0 mg, phosphorous 47.1 mg, iron 1.5 mg, thiamine 0.07 mg, riboflavin 0.17 mg, niacin 1.30 mg, Vitamin C 37.0 mg and energy 104Kcal Gopalan *et al*., (1987) and Singh, (1995).Shedding off leaves during stress conditions is another associated escape mechanism which offers ample scope for cultivation of custard apple in arid regions. There is no well organized orcharding of this crop. Hence, the custard apple fruits yield is a complex character and therefore, the knowledge of association and cause and effect relationship of yield component traits with yield would help in formulation of effective selection schemes (Baskaran and Muthiah, 2007). Grouping of genotypes based on the inherent genetic diversity is also helpful to find out the linkage of association. Diverse genotypes are always used to exploit heterosis in plant breeding programme.It is cultivated in Maharashtra, Gujarat, Madhya Pradesh, Andhra Pradesh, Chhattisgarh, Karnataka, Bihar, Orissa, Assam and Tamil Nadu. Besides India, it is common in China, Phillippines, Egypt and Central Africa. In India, it is presently grown in an area of about 29.87 thousand hectares with a production of 228.37 MT and the average productivity is 765 q/ha and it ranges from 673 q/ha in Andhra Pradesh to 685 q/ha in Maharashtra (2014-15). Chhattisgarh and Maharashtra occupies 55.74 per cent of the total area in the country. Whereas Gujarat covered 5.34 thousand hectare and the average productivity is 768 q/ha (Chandra, 2010). Chhattisgarh, state of India occupies an area of approximately 7.990 thousand hectare with an annual production of 39.73 metric tones having the productivity of 497.25 q/ha under custard apple. In the range of forest scattered across Jagdalpur, Beejapur,

Dantewada, Kanker, Dhamtari,Rajnandgaon, Durg, Jashpur, Surguja and Bilaspur districts, only Kanker district is blessed with natural biodiversity of the custard apple. Its wild land races are found distributed all along as a natural stand over an area of about 7.20 thousand hectare with an annual production of 35.60 MT having the productivity of 494.45 q/ha (Anon., 2013).The evolution of custard apple through natural and human selection in diverse elevation zones and under different cropping systems with involvement of honey bees being the carrier of cross pollination has resulted in a wide variety of locally adapted landraces. These landraces have evolved over years to fit into local cropping patterns and diverse end uses and represent a wide range of patterns of crop diversity. The knowledge of patterns of genetic variation of a crop species in any given region or country is very important for planning future germplasm exploration missions and thereafter it's efficient utilization in crop improvement programme. Assessment of genetic variability for yield and its components is useful to predict the extent of improvement possible for fruits yield and other important characters.

Literatures in relation to evaluation of genotypes, flower behavior and physico-chemical characters. **This review and literature on Evaluation, Flowering behavior Physico-chemical and Keeping quality of Custard apple.**In this chapter, an attempt has been made to present the review of available literatures in following heads:

1. Evaluation of genotypes

2. Flowering behavior

3. Physico-chemical characters of fruits

4. Keeping quality (Shelf life)

1. Evaluation of genotypes

The objectives broadly aimed at developing new high-yielding commercial varieties with such characters as desired tree height and spreading of canopy (dwarf / semi dwarf canopy), fruit weight (450-500g), fruit size with higher pulp-seed ratio and lower number of seed (30-35), seeded pericarp, seedless pericarp, keeping quality, resistance / tolerance to biotic (mealy bug) and abiotic stress (fruit cracking, moisture stress and climate changes). Literature pertaining to the evaluation of genotypes relevant to the present investigation has been reviewed.

Concluded that the mean marketable yields of custard apple (*Annona squamosa* X *A. cherimola*) cv. African Pride were 18.7 t/ha on cherimoya (*A. cherimola*) rootstock and 9.2 t/ha on sugar apple (*A. squamosa*) rootstock. Comparative yields for cv. Pinks Mammoth were 7.2 and 6.2 t/ha, respectively. The trial showed that satisfactory yields could be obtained with African Pride without hand pollination. Sugar apple rootstock exhibited dwarfing characteristics but could not be recommended owing to susceptibility to *Pseudomonas solanacearum*(George and Nissen, 2000b). Found that the cherimoya cultivar AP introduced to China in 1981 is precocious and productive in the Guangzhou area of Guangdong; yields from 3 to 5 year-old trees are 337.5% higher than yields from other cultivars. The trees are hardy, withstanding temperatures of 2.7 ºC without injury. Average fruit weight (250 g) is twice that of other cultivars and the flesh has high soluble solids content (Xie *et al.*1999). evaluated that the moderate drought (Psi L=-1.5 MPa) reduced shoot growth by 20-30% and increased the number of flowers per lateral by about 40% compared with well-watered controls due to reduced apical dominance and increased lateral branching. Overall fruit set was not adversely affected by drought. Drought also increased the number of fruits harvested per tree by 47% compared with well-watered controls. This response was mainly due to the increase in number of flower per tree. Drought reduced average fruit size by 11% possibly due to effects on cell division in the first 4-6 weeks after fruit set or on net carbon assimilation. In summary, mild to moderate drought during the flowering period and fruit set increased flowering without adversely affecting fruit set, but decreased fruit size of the custard apple cv. African Pride in subtropical Australia (George and Nissen 2002a).revealed that the five methods of controlling tree size, *viz.*, growth retardant (foliar-sprayed and trunk-injected paclobutrazol), root-restriction bags, cherimoya rootstock and sugar apple (*Annona squamosa*) interstock, were evaluated for their effects on growth, yield and fruit quality of custard apple (*Annona spp.* hybrid cv. African Pride) in subtropical Australia (Queensland). Compared with trees on their own roots, sugar apple interstock was highly effective in dwarfing 'African Pride' trees, reducing tree canopy volume by 72-90%. Root-restriction bags (woven fiber glass) proved to be only partially effective in controlling tree size due to growth of major roots through the seams. Compared with trees on their own roots, cherimoya rootstock alone and sugar apple interstock increased fruit weight per unit canopy volume by a maximum of 3 and 5 fold, respectively. Sugar apple interstock reduced the severity of fruit disorders 'woodiness' and 'brown pulp' by about 75 and 50%, respectively

(George and Nissen2002b). Observed that the temperature affects the growth, pollination and fruit development of *Annona spp*. The optimum temperature for growth and fruiting of cv. African Pride is 17-22 ºC and growth is retarded if the temperature decreases to 4-5 ºC. *Annona cherimola* is suitable for cooler tropical regions (Liu and Chen 2002). Identified high-yielding cultivars in custard apple (*Annona squamosa* L.) with quality and shelf life. Under an *Annona* improvement programme, six existing promising hybrids were evaluated at the Fruit Research Station, Sangareddy. Hybrid-1 (17/4 Atemoya x Balanagar) was earliest to mature. Maximum fruit weight (250 g) was recorded in Hybrid-1 (17/4 Atemoya x Balanagar) followed by Hybrid-6 (15/3 Red Sitaphal x Atemoya) (225 g) and Hybrid-4 (1/6 British Guinea x Atemoya) (220 g). Among all the hybrids, maximum number of fruits per tree (94) was recorded in Hybrid-1 (17/4 Atemoya x Balanagar) followed by Hybrid-6 (15/3 Red Sitaphal x Atemoya) (67). The TSS ranged from 22 to 28 º Brix and was found to be maximum in Hybrid-2 (15/2 Red Sitaphal x Pond apple), while the seed content per fruit was also minimum (20) in this hybrid. Based on overall performance, the Hybrid-1 (17/4 Atemoya x Balanagar) and Hybrid-3 (15/3 Red *Sitaphal x Atemoya*) and Hybrid-2 (15/2 Red Sitaphal x Pond apple) were found to be excellent in quality with pleasant aroma, smooth pulp texture with less seed, good sugar acid blend and shelf life (Girwani*et al.*2011). Reported that during 1991-92, the effects of cultural methods (irrigation or mulching) and gibberellins (50 or 100 ppm), NAA (20 or 30 ppm) or 2,4-D (15 or 30 ppm) on the yield and quality of custard apples (*Annona reticulata*) were investigated in Rahuri, (M.S.). In terms of average fruit weight, the best results were obtained using irrigation (148.0 g), followed by mulching (138.8 g) and controls (137.0 g). Fruit composition was not significantly affected by the treatments (Kulkarni *et al.*1997). revealed that the six traits were evaluated in the first cropping season (mean number of seeds per fruit, mean weight of the pericarp, pulp, pedicel, seeds per fruit and the whole fruit), while five traits were evaluated in the first three cropping seasons (mean fruit length and width, total number of fruits ha^{-1}, mean fruit weight (in both types of analyses), and fruit yield in kg ha^{-1}. (Keny *et al.* 2010). evaluated at Agricultural Research Communication Centre, Karnal (Haryana) and reported the suitability of custard apple (*Annona squamosa* L.) fruits for organized farming on the basis of different physical and chemical characteristics such as fruit weight, number of seeds, seed weight, rind yield and pulp yield, TSS, pH, acidity, total sugar and ascorbic acid. The results revealed that custard apple

growth in organized orchards resulted in comparatively higher pulp yield and better chemical properties, justifying its suitability for commercial exploitation (Hashmi and Pawar 2012).

2. Flowering behaviour

Flowering behavior is very important for fruit setting in custard apple because *Annona* is a cross-pollinated due to protogyny and flowering occurs in last week of June and up-to last week of July. The flower has numerous stamens carpel's and pollinated by nitidulid beetles.

Reported that the custard apple plants, cv. Sahebganj were observed to flower from March to August, the maximum flowering being in April and May. Buds developed into flowers in 35 days. Fruit set was low (8%) and started in August, when the climatic conditions were optimal. Maximum anthesis was between 5.30 p.m. and 5.30 a.m. and dehiscence was maximum between 11.30 a.m. and 2.30 p.m. The highest pollen germination (16-25%) was obtained in 20% sucrose-agar solution (Kumar *et al.*1977). Found that in custard apple, the flowering season commences in February and continued up to September. The flowers are borne mostly in new flushes after shedding of older leaves. Anthesis occurred from 02.30 hr to 18.30 hr with a peak period between 05.30 and 06.30 hr. Dehiscence of pollen began 10 hours after flower opening and continued for only 2 hours. The stigmas were receptive from one day prior to anthesis till 2-3 days after anthesis indicating a protogynous condition. The pollen grains were round to ovate in shape. Very little variation was recorded in flowering behavior of green and red fruited types (Sahoo *et al.*2000a).investigated the custard apple (*Annona squamosa* L.) pollen morphology, pollination and fruit set under the northeast climatic conditions and results observed that the average pollen grain size from March to August ranged between 53.15 and 53.82 micro m in the green type and between 47.82 and 48.26 micro m in red type. The maximum pollen grain diameter was observed in July in both types. The viability of pollens varied from 42.30 to 93.33% in the green type and 45.10 to 93.75% in the red type. The highest pollen viability was recorded from June to August in both varieties. Fruit set by open pollination was ~3.33% and fruit set by controlled self pollination was only 0.75% (Sahoo *et al*. 2000b). Studied the low natural pollination rates which produce few and poorly formed fruits in commercial orchards of the custard apple (*Annona squamosa* x *A. cherimola*) cultivar *Hillary White* on the Atherton Tablelands, North Queensland, Australia. Supplementary pollination, using either pollen type, significantly increased overall fruit production and fruit quality above natural levels. However,

pollen source from cv. African Pride trees produced significantly larger and more symmetrical fruits than pollen from cv. *Hillary White*. Increased quality was not at the expense of quantity. There was no difference in mean fruit yield between flowers treated with pollen from either variety. These results indicated that using cv. African Pride pollen had greater economic returns for growers through the production of a higher proportion of 'best' quality fruits (Pritchard and Edwards 2006).

3. Physico-chemical characters of fruits

Custard apple is no longer poor man's fruit as it fetches an even higher price than several other fruit because the fruits are very sweets, nutritious, very perishable in nature and other all parts are used as a medicine purposes.

compared two types of fruit of custard apple (*Annona squamosa*)with regard to berry weight, specific gravity, acidity and the content of total, reducing and non-reducing sugars and also that seeded berries were larger and had a higher sugar content (Mazumdar 1977). Assessed changes in the fruit size of *Annona squamosa*, at an intervals from 20th August to 18th November, and on the physical characteristics and chemical composition of mature fruits and reported that ascorbic acid content was 1.10 mg/100 g (Singh *et al*. 1977).Reported that the number of fruits per tree, number of seeds per fruit, specific gravity and total sugar content were significantly higher, and the peel weight was lower, with 240 g/plant of each fertilizer in custard apple. Both rates of fertilizer caused a significant increase in the diameter, DM percentage, TSS, vitamin C and reducing sugar percentage, compared with the control (Chattopadhyay and Mandal 1993). Studied fruit ripening after harvesting in cherimoya and demonstrated a respiratory climacteric associated with rapid ethylene production. The increase in ethylene production was caused by an increase in the activities of ACC-synthase and ethylene-forming enzyme (EFE), which were very low in the freshly picked fruits, but increased rapidly over the second day e=reaching a maximum on the third day. During the climacteric there was also a low amount of I-aminocyclopropane-I-carboxylic acid (ACC) in its conjugated form. Rind browning increased after harvesting, but this was not related to decrease in chlorophyll, since the chlorophyll level remained stable throughout the entire post harvest period. The level of browning correlated well with the Hunter L Value. The onset of ethylene production, starch degradation, loss of firmness and acceleration of total sugar all coincide (Martinez *et al.* 1993). observed that the fruit growth

and development of 10 year old*Annona squamosa* trees (cultivars Barbadose Seedling and Washington-97), grown at Hessaraghatta Experimental Station (Karnataka, India), was monitored at 15 days intervals from flowering to harvest maturity (120+or-5 days after flowering) and physiological maturity (2-5 days after harvest maturity). Fruits showed a double sigmoid growth curve and exhibited climacteric respiration. Changes in fruit weight and size, the pulp-peel ratio, DM accumulation, TSS, insoluble solids, sucrose, glucose, fructose, citric acid and peel chlorophyll and vitamin and mineral contents were observed. The sugar-acid ratio and the appearance of a yellow colour in the edible pulp appeared to be reliable harvest criteria of custard apple (Pal and Kumar 1995). Evaluated the custard apple (*Annona squamosa*) fruits harvested at the normal time or 2 or 5 days earlier and then stored at 25-33 degrees C and 85-90% RH. The soluble solids content, total acids and vitamin C content of stored fruits were determined. The results showed that for immediate consumption, the best harvest date was when the fruit soluble solids content reached 15-20%. Otherwise, the harvesting should take place 2-3 days earlier, when the fruit soluble solids content reached around 10% (Chen WeiHui1999). Conductedphysico-chemical studies of 4 year old grafted trees of custard apple (*Annona reticulata*) cultivars Atemoya, Balanagar, Chance Seedling, Iceland Gem, Washington, and Jargham Local in West Bengal, India during the year 2000. Balanagar exhibited the highest fruit weight (300 g), fruit length (8.3 cm), fruit diameter (9.0 cm), number of seeds per fruit (35), earliest maturity date i.e. October and content of total soluble solids (27.0 º Brix), reducing sugar (11.8%), non-reducing sugar (4.7%), total sugar (16.7%) and ascorbic acid (54.4 mg/100 g pulp). Atemoya and Chance Seedling exhibited the highest acidity (0.32%) content and number of seedless berries per fruit (48), respectively (Ghosh *et al.*2001). reported that they identified high-yielding cultivars of custard apple (*Annona squamosa* L.) with quality and shelf life. Six existing promising hybrids were evaluated at the Fruit Research Station, Sangareddy. Among all the hybrids, maximum TSS ranged from 22 to 28 degrees B and was found to be maximum in Hybrid-2 (15/2 Red Sitaphal x Pond apple), while the seed content per fruit was also minimum (20) in this hybrid. Based on overall performance, the Hybrid-1 (17/4 Atemoya x Balanagar) and Hybrid-3 (15/3 Red Sitaphal x Atemoya') and Hybrid-2 (15/2 Red Sitaphal x Pond apple) were found to be excellent in quality with pleasant aroma, smooth pulp texture with less seed, good sugar acid blend and shelf life (Girwani*et al.*2011).

4. Keeping quality (Shelf life)

Custard apples are mostly consumed as table fruits. They are also used in ice creams and other milk products and preserved as jam, jelly or other products on limited scale. Edible portion or pulp is creamy or custard like, granular with a good blend of sweetness and acidity which vary with the species. The pleasant flavour and mild aroma have a universal liking. Custard apple fruit is nutritional rich and largely valued for its taste.

Revealed that the *Annonasquamosa* fruits ripened normally in storage at 15 to 30 ºC although fruits were susceptible to fungal attack at >25 ºC. Ripening was enhanced by removal of CO_2 and by addition of O_2 to the storage atmosphere and delayed by addition of CO_2 and removal of O_2. Ethylene had no apparent effect on ripening. Fruits stored at low RH ripened faster than those at high RH. Dipping the fruits in IAA at 10^{-4} to 10^{-2} M accelerated ripening. Levels of both ascorbic acid and glucose increased to a maximum at the climacteric, but decreased as the fruits became overripe. The stage of eating ripeness occurred at the climacteric. Recommended conditions for storing custard apple are: temperatures between 15 and 20 ºC, low oxygen and ethylene tensions coupled with 10% CO_2 and 85-90% RH (Broughton 1979). reported that the organoleptic evaluation is overall acceptability methods for quality evaluation of fruits and vegetable in which nine point Hedonic rating test is adopted for pulp, juice, Ready to Serve (RTS), nectar, jam, jelly and vegetable products fresh or in different interval of storages by the panel of five judges (Ranganna1986). Concluded that the processed products were evaluated for colour, appearance, aroma, taste and overall acceptability. The product with score of '7' (like moderately) or above for overall acceptability was considered acceptable (Rabbani and Singh 1988). Observed that custard apple ripened most quickly and with good flavor at 28°C while ripening was slower and the quality impaired at 32°C. Fruit stored at 4°C and high humidity developed symptoms of chilling injury after 2 days, although even after 5 days at 4°C fruits ripened at 20°C with very good flavor. Fruits withstood 5 days at 8°C without detectable deterioration in appearance or flavor, but the total post harvest life of 9 days hardly better than at 12°C (8.5 days). At 12°C, fruits deteriorated in appearance after >6 days, although the flavor remained very good up to 10 days. The maximum TPHL achieved without significant damage to fruit was 9.4 days, with 6 days at 12°C followed by ripening at 20°C or 9.1 days, with 5 days at 8°C. This compares with a ripening time of 4.8 days at 20°C (Batten 1990).Observed that the most effective treatments for prolonging the shelf life of fruits were; brown paper wrapping, followed by dipping in gibberellic acid (GA) and polyethylene bagging + KMnO4.

Ethrel (ethephon) and hot water treatment enhanced ripening of fruits compared to the control and other treatments. The lowest fruit weight losses were recorded in polyethylene bagging + KMnO4, perforated polyethylene bagging and brown paper wrapping treatments. GA (100 or 200 ppm), brown paper wrapping and polyethylene bagging + KMnO4 also maintained high sugar and ascorbic acid contents and low acidity during storage for up to 10 days at 32 ºC and 70-75% RH, after a variety of treatments. Some fruits were also stored at 10 ºC and 85-90% RH (Bhadra and Sen 1997).Reported that the ripening of fruits was observed on 4, 6 and 9 days of storage at 25, 20, and 15 ºC, respectively. The colour of the pulp, texture, taste and flavour of ripe fruits held at 25 and 20 ºC were superior, followed by fruits stored at 15 ºC. At 10 ºC, the fruits became hard with surface blackening, messy pulp and less sweetness. The major changes during ripening were a continuous decrease in fruit firmness and starch content and a continuous increase in TSS and sugars, the changes being more rapid at 25 and 20 ºC than at 15 and 10 ºC. Custard apple fruits stored at 25 and 20ºC had a clear climacteric peak whereas those stored at 15 and 10 ºC did not show any distinct rise in respiration rate. Ethylene peak (2.40 micro kg^{-1} h^{-1}) coincided with the respiratory climacteric at 25ºC storage, corresponding with the peaks in TSS, sugars, ascorbic acid and acidity (Prasanna *et al*. 2000).revealed that fruits such as papaya, banana, ber (*Zizyphusmauritiana*), guava, mango, sapota (*Manilkara zapota*), citrus fruits, custard apple (*Annona reticulata*) and pomegranate can be stored safely for certain period under ambient temperature as well as in cold storage with the help of postharvest treatment with certain ripening retardants such as fruit coating resin (Waxol), gibberellic acid (GA_3, $CaCl_2$, $KMnO_4$ and Cycocel (chlormequat) at their appropriate concentration. Ripening retardants prolong shelf life of fruits, reduce weight loss, spoilage and maintain higher percentage of marketable quality fruits up to a certain period of time thereby overcome glut in markets during peak season and give higher returns to growers and traders (Singh,2003).Reported that the Custard apple (*Annona squamosa* L.) is delicious fruit of the tropics and has been naturalized in the Deccan plateau due to its hardy nature.Under an *Annona* improvement programme, six existing promising hybrids were evaluated for different horticultural traits from 2001 to 2006 at the Fruit Research Station, Sangareddy. All the hybrids varied in fruit shape (round, conical and cordate), fruit colour (yellowish-green, grayish-green, light green and red), pulp colour (creamy white, light pink and white), areole shape (tuberculate, hexagonal) and texture (course, soft and meaty). Time of fruit maturity varied from September 2nd fortnight and lasted till the end of December. Hybrid-1

(17/4 Atemoya x Balanagar) was earliest to mature. Maximum fruit weight (250 g) was recorded in Hybrid-1 (17/4 Atemoya x Balanagar) followed by Hybrid-6 (15/3 Red Sitaphal x Atemoya) (225 g) and Hybrid-4 (1/6 British Guinea x Atemoya) (220 g). Among all the hybrids, maximum number of fruits per tree (94) was recorded in Hybrid-1 (17/4 Atemoya x Balanagar) followed by Hybrid-6 (15/3 Red Sitaphal x Atemoya) (67). The TSS ranged from 22 to 28 degrees B and was found to be maximum in Hybrid-2 (15/2 Red Sitaphal x Pondapple), while the seed content per fruit was also minimum (20) in this hybrid. Based on overall performance, the Hybrid-1 (17/4 Atemoya x Balanagar) and Hybrid-3 (15/3 Red Sitaphal x Atemoya) and Hybrid-2 (15/2 Red Sitaphal x Pondapple) were found to be excellent in quality with pleasant aroma, smooth pulp texture with less seed, good sugar acid blend and shelf life (Girwani*et al.*2011). conducted an experiment with custard apple (*Annona squamosa*) fruits dipped in cold water for 5 min, $CaCl_2$ at 2% for 10 min, $KMnO_4$ at 4% for 10 min and smeared with mustard oil, then placed in polyethylene bags (150 and 200 gauge) with (0.5%) or without ventilation. Untreated fruits served as the control. Data were recorded on fruit specific gravity, storage life, physiological losses in weight, taste, colour, flavour and acceptability (Nagaraja 2011).revealed that the custard apple fruits treated with NAA 100 ppm as well as GA_3 50 ppm were found most effective in extending the shelf-life, respectively over control (by 1.75 and 1.42 days), while they helped in maintaining the marketability and tended to reduce the fruit weight loss. The level of acidity and ascorbic acid decreased, while reducing and total sugars increased with advancement of storage period. Application of NAA 100 ppm was more economical than other no chemicals (Nilam *et al.*2011).Conducted an experiment during 2006-07 to assess the effect of different packages and storage systems for enhancing shelf life of custard apple fruits. They reported that the shelf life of custard apple fruits was 6 days in ventilated polyethylene package and it was 8 days in silicon membrane and diffusion channel systems at 20 ºC. In 15 ºC, the storage life was increased 8 days in ventilated polyethylene followed by 10 days in silicon membrane and diffusion channel systems. The shelf life of custard apple fruits under ambient temperature in ventilated polyethylene package was 4 days and in silicon membrane and diffusion channel systems, it was 6 days compared to control which could be kept well for only 2 days under ambient temperature (Mallikarjuna *et al*. 2012). evaluated the postharvest quality of custard apple (*Annona squamosa* L.) fruits under different treatments *i.e.,* unpacked (control), individually packed in polyvinyl chloride (PVC) film, or packed in expanded polystyrene trays enveloped in PVC film and tested

during five periods of storage (0, 4, 8, 12, and 16 days) at 10ºC. Data of mass loss, pulp hardness, soluble solids, titratable acidity, pH, vitamin C and water activity were recorded at harvest and every 4 days over the storage period. Custard apple fruits stored at 10ºC and packed in PVC film had reduced mass loss. The modified atmosphere packaging also resulted in decreased loss of firmness, providing about a 12 days postharvest life. Soluble solids and total titratable acidity concentrations did not increase significantly during storage. The modified atmosphere allowed for a shelf life of 12 days at 10ºC (Silva *et al*. 2012).

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