

Quality Prerequisites of Fruits for Storage and Marketing

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Abstract

Quality is a major component that attracts consumers of all ages. If the consumers like it, they are ready to pay a premium price. India is the second largest producer of fruits in the world. However, quality of the produce is not up to the world standard level. There may be many reasons for this, but one of the main reasons is lack of knowledge. Most producers are small and marginal farmers and they are not much aware about quality. Country's current distribution system of fresh produce is also inefficient in maintaining quality in the long supply chain between producers and consumers. With the amendment in the policy of Agricultural Produce Market Committee, recently a few reputed companies entered into fruit business on small, medium, and large-scale. These firms increased quality bars of Indian fruits as only quality fruits are purchased and sold by these firms.

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INTRODUCTION

Quality of fresh fruits is based on both chemical and physical attributes. Quality fruits if possess external defects or disease infection is regarded as inferior quality fruits. Quality also depends on the purpose for which it is sold and purchased. More sweetness, crisp and juicy is good quality parameter for immediate consumption but not for storage. Less sweet and more firm fruits are good for storage. Quality depends on both maturation and ripening and affects the storage life of many horticultural products. Both ripening and maturity can have a considerable influence on the quality of the fruits as well as the storage potential and the occurrence of many storage disorders (Siddiqui and Dhua, 2010). Postharvest treatments and storage conditions are equally important for quality

maintenance during storage (Pal et al., 2004; Ahmad et al., 2005).

India is the second largest producer of fruits in the world, only next to China. As per the NHB (2011-12) report, the production of fruits is 76.42 million metric tons. However, quality of the produce is not up to the standard of many developed and developing countries and also there are many malpractices are prevalent in Indian fruit markets. Most producers are small and marginal farmers and they are not much aware about quality production and postharvest management. They sold their produce to mostly local traders. Faulty packing, cheap packing materials, faulty loading and unloading, long distribution channels, ambient transportation and lack of basic infra structures, all affects quality adversely. Entry of organized retail shops and few medium and large-scale back end

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fruits based companies in fruit business automatically raised the quality standards of fruits. Due to retail chain's demand of quality fresh produce, farmers also raising their quality bar as only quality produce are sold by organized retail chains. Singh and Singla (2010) also reported that retail chains have raised quality consciousness among farmers, introduced grading (in primary processing), and have helped in cost - cutting through extension and training on input use for better yield and quality. Companies like Adani Agrifresh Ltd., Reliance fresh, Big Bazaar etc appointed scientists and experts to train the farmers about quality production and management. The important brands of modern formats currently operating in India are Reliance Fresh, Choupal Fresh, More, Food World, Big apple, Easy Day etc. promoted by different companies are emerging very rapidly in medium and large towns in the country, and they are very strict about quality. The important companies entered in Fruits and vegetables retailing are Reliance Industries (Reliance Fresh and Ranger Farms, Bharti- Wal-Mart (Easy Day), ITC, Food World., Spencer, Godrej, Future group (Big Bazaar and Food Bazaar), Aditya Birla Group are reputed firms (Abid Hussain, 2009). Similarly, few important companies such as Adani Agrifresh Ltd., Fresh and Healthy enterprises, Harshana naturals, entered into wholesale marketing of fresh fruits. Generalized quality standards of fruits with prevalent malpractices are listed below.

Quality standards of Apple

In the fruit and vegetable markets (mandi), apples are graded in three grades. These grades are A, B, and C. The quality parameters are described below

Peel Color (%) The peel color plays many important roles in Indian apple business starting from maturity to consumption. It is one of the most important quality parameter of apple and accordingly price is fixed

either in auction sale or in retailing. Color of A grade apple varies between 70-100%, B grade 50-70% and C-grade 0-100% respectively. In other countries also, colour is an important parameter that decides sale price. The price of Fuji apple from China varies according to number of layers of red blush per pack. Three layer blushes per pack is more costly than two-layer blush per pack. Change in peel color is a combination of red blush and the background (BG) colour of the peel. Initially apple is green in color and changes take place as the fruit reaches towards maturation and ripening stage. Peel color also acts as a maturity index for some cultivars of apple and can be used to determine the maturity of the fruit (Huybrechts et al., 2003). Peel color is used to grade the fruit in almost all countries before storage and marketing (Watkins, 2003).

In Indian apple business, color mixing is a common mal practice in fruit mandi. For example, in A and B grade apple boxes, the inner most two layers possess less color and top two layers is full of red color apples. During packing, less color fruits are packed in lower layers and full color apples were packed on the upper top layers. Growers, loaders, sub wholesalers, and even mashakhors (seller of small lots or one box at a time) follow this practice. The buyers try to see the inner layers of the boxes before offering any price.

Weight

Weight is another important factor upon which price is fixed. In general, more weight fetches more price and vice versa in Indian fruit business. The SKU large, medium and small apple from Himachal Pradesh weight (Net Wt.) is 23 kg and ES and 240 counts weight (Net Wt.) is above 24 kg is tagged as a good lot but quality is not same in all layers of the box as quality appears in the top layers. The weight (Net Wt.) of imported apple boxes are only 20

kg and buyers are fully satisfied. This is because every fruit in imported apple box is good and of the same quality. The tendency of packing above 20 kg is totally absent in imported apple and this is why pressure marks and touching in imported apple is very less or nil. The weight of J & K apple varies between 14 to 17 Kg. They use both wooden boxes and CFB boxes of same capacity i.e. 14-17 Kg. They use straw as

cushioning material but Himachal and Uttarakhand farmer uses CFB boxes of 20 Kg. capacities with trays.

Maturity Quality

It depends on maturity standards of apple (For storage in CA or normal cold store) On commercial scale quality standards of apple is judged by two methods in India

Table 1: Different SKUs of Himachal Apple

S.No.	SKU	No. of layers/ Box	No. of fruits/ Layer	Total no. fruits/box	Remarks
1	Extra-Large (EL)	4	20	80	
2	Large (L)	5	20	100	Large, medium and small SKUs are sold in the same price.
3	Medium (M)	5	25	125	
4	Small (S)	5	30	150	
5	Extra small (ES)	5	35	175	
6	Extra-Extra small (EES)	6	35	200	
7	Extra-Extra small (EES)	6	40	240	Also called as heavy pack with trays. Packed with separators also
8	Loose packaging with separators			300/310	Boxed packed with separators only

1) By measuring flesh Firmness There are two major methods used on commercial scale for accurate maturity determination before Controlled Atmosphere (CA) storage.

a) By Pressure tester/ Penetrometer)

This method is a recent entry on commercial scale in fruit business sector with the entry of private companies in India. Flesh firmness (FF) is the most important quality measurement of apples that has been used to determine optimal storage maturity by private companies. But it varies among the cultivars (Watkins, 2003). In Himachal Pradesh, Red and Royal Delicious are two most firm cultivars while Golden Delicious is the least. While in J & K, Kullu Delicious and Delicion are two firm cultivars. Flesh firmness has successfully been used to measure the harvest maturity of

‘Delicious’ apples. Similar to TSS, FF is a useful measure of consumer acceptance of apples as textural qualities of apples are often reported by consumers to be amongst the top requirements for acceptability (Harker et al., 2003). Fruit firmness is directly related to consumer’s acceptance and storage quality. It is important parameter for edible quality, postharvest handling and market value of apples (De-Ell et al., 2001; Siddiqui, 2008). Fruit firmness, also depends on total soluble solids (TSS) contents as well as the texture of apple fruit (Weibel et al., 2004; Peck et al., 2006). Thus, the loss of fruit firmness before storage and during storage is a serious concern as it results in quality loss (Kov et al., 2005) leading to soft and mealy fruit and hence less consumers acceptance. Fruits having pressure less than 14 are not suitable for storage. The

fruit firmness varied significantly with cultivars.

Table 2. Quality grades of Himachal apple

Parameters	Apple grades			Remarks
	Grade -A	Grade -B	Grade -C	
Color (%)	75-100	50-70	0-100	5% variation/box may be allowed
Weight (Net) Kg	23 (LMS)	23 (LMS)	23-24	In case of Es & 240 counts, wt. may be above 24 Kg
Note: - Private Companies like Adani Agrifresh Ltd. uses 20 Kg as standard weight in Grade A similar to imported fruits. Grade B and C is little higher. Fruits get very less or no pressure marks damage. It is necessary for long distance transportation especially for south Indian markets (Hyderabad, Vijayawada, Chennai, Bangalore, etc.)				
Firmness (lb)	16 and above	14-15	Not fixed	Grade C also includes droppings
Russeting	Below one Rupee coin	Below one Rupee coin but 10-15 fruits/box is allowed	No limit	Russeting decreases market value but not quality
Shape	Well formed	Well formed but 10-20% Deshaped fruits/box is allowed	No limit	Lambotra shape is more preferred in grade A
Hail damage	Nil to 3%/box (minor 1-2 hailed hail spots)	10-20%/box (Minor healed hail spots)	No limit	As we move from top layer to bottom layer no. of hail damage fruits increases. This is a malpractice very common in Indian apple boxes
Sun burn	0-3%	10-20%	No limit	Mild Sun burn is difficult to judged at the Time of Packing, thus can be found in A-grade also
Skin puncture	NIL	10-20%	No limit	Skin Puncture is not allowed in A-Grade
Pressure marks	1-2%	10-20%	No limit	Only hard pressure marks are allowed in grade- A. As we move from top layer to bottom layer Pressure marks fruits increases in B-grades.
Fly specs	1-2%	10-20%	No limit	Not a major problem
Sooty blotch	NIL	5-10%	No limit	Fruits having sooty blotch are not preferred for storage.
Shriveling	NIL	10-20%	No limit	
Bruising	NIL	10-20%	No limit	
Scab	NIL	10-20%	No limit	Minor spot of scale in B-grade may be allowed but not in A-grade
Insect damage	NIL	10-20%	No limit	

b) By Starch Iodine Taste This method is also a new entry with the entry of using pressure tester by private companies. The apple used for pressure test is also used for starch iodine test. After measuring pressure, the fruit is cut in the middle and pedicel end is immersed in the solution

kept in a Petri dish and left on the table for 1-2 minutes for color development. As soon as the color develops, it is compared with the color chart. A reading of 2.5 is ideal for CA storage. The same reading is also ideal for cold storage. A little fluctuation is also considered. If reading is

more towards 3, this can also be stored but as low pressure stock and its early (better one month storage) removal from the store is compulsory. A reading beyond 3 is not advisable to put in cold or CA store and should be sent immediately to market without any further delay.

Apple growers and traders never use this test either for maturity determination or for storage purpose. Only private firms in India using this test for storage purpose and their officers regularly visit to grower's field with quality checking kits that includes Penetrometer and reagents for starch iodine test.

Table 3. Quality grades of Kashmir apple

Parameters	A (Ex-Fancy)	B (Fancy)	C	Remarks
Color (%)	>75	50-70%	0-100%	Quality variation/box in A & B should not exceed 5%
Count	4-layer, 5-layer and Roll (6-layers)	4-layer, 5-layer and Roll (6-layers)	Loose packing	Number of layers per box. Loose packing have no layers
Note In 4-layer boxes 60-68 counts, 5-layer boxes 110-112 counts, rolls 170-180 fruits (4-layers means Ex-large and large, 5-layers means- medium and small and roll means of Ex-small and pittu)				
Firmness	Firmed(pressure- 15 lb or above)	Firmed (pressure- 12-14 lb or above)	Firmed but also includes droppings (pressure-8 to 14 lb)	All fruits in C-grade are defective
Note Pressure Judged by pressing thumbs on apple, no pressure meter used in mandi. Pressure value of Kashmir apple are less than Shimla apple but more sweeter than Shimla apple				
Russeting	Below one rupee coin	Below one rupee coin, 5-10 fruits/box above one	No any criteria	In Kashmir apple, Russeting is not a problem
Note In general russeting is not a problem in Kashmir apple. Naturally very less russeting is found (<50 paisa coin) at higher elevation in the district of Sophian and Pulwama. Apple from sopore district possess russeting and also dull color				
Shape	Well formed (Lambotra shape)	Deshaped up to 10-20%	Mainly de shaped Fruits (50-100%)	Grade A also include 2-5% slightly Deshaped fruits.
Hail damage	Nil to 3% (fruits with single healed hail is allowed up to 3% in a single pack)	Up to 5 -10% (fruits with single and double healed hails are allowed up to 10% in a single pack)	No limit	As we move from top layer to bottom layer no. of hail damage fruits increases. This is a malpractice very prevalent in Kashmir apple
Sun burn	2-3% on surface are and not more than 3% in a box	5-10% note more than a one rupee coin size 10 % in a box	No limit	Mild Sun burn is difficult to judged at the Time of Packing, thus it can be found in A-grade also. Sun burn apples are not suitable for storage, as deterioration starts from sun burn portion
Skin Puncture	NIL	10-20% %	No limit	Skin Puncture is not allowed in A-Grade .

Pressure marks	1-2%	10-20%	No limit	As we move from top layer to bottom layer Pressure marks fruits increases in B-grades.
Fly specs	2-3%	20-30 %	No limit	
Sooty blotch	NIL	5-10%	No limit	Fruits having sooty blotch are not preferred for storage
Shriveling	NIL	10-20 %	No limit	As we move from top layer to bottom layer quality decreases in A & B-grades.
Bruising	NIL	10-20%	No limit	
Scab	Nil	5-10%	No limit	In Himachal Apple generally is scab free or miner scab.
Insect damage	Nil	5-10%	No limit	

Table 4. Quality grades of Premium quality apple

S.No.	parameters	Premium quality
1.	Colour	Fruits having colour on >75% surface area (Characteristic to the variety). Fruits which do not meet this criteria shall not exceed 5% per box
2.	Shape	Characteristic to the varieties/fairly well formed
3.	Count	4 layer box-60-68 counts and 5 layer box- 110-112 count
4.	Firmness	Average- 14 lb and not more than 10% fruits with pressure 12 to 13 lb
5.	Hail damage	Fruits with single healed hail mark may be allowed up to 2% of the total count
6.	Sun burn	Fruits with sunburn on 2% surface area should not exceed 2% fruits by count per box
7.	Russeting	Russeting up to shoulders allowed only 3% of fruits per pack
8.	Skin Puncture	Free of skin puncture
9.	Fly Speck	Free of skin puncture
10.	Sooty blotch	Not allowed
11.	Pressure marks	Not exceed 50 paisa coin size allowed in 3% fruits per pack
12.	Shrivelling	Not allowed
13.	Soft patch	Not allowed

Table 5. Finger length and diameter (mm) of commercial varieties of banana

S.No.	Name of Verities	Finger Length (mm)	Finger Diameter (mm)	Remarks
1	Robusta	> 220	> 35	Used for table purpose
2	Rasthali	> 140	> 40	Used for table purpose
3	Poovan	> 120	> 30	Used for table purpose
4	Nendran	> 200	> 40	Suitable for chips
5	Dwarf Cavendish	> 180	> 35	Used for table purpose

6	Hill Banana	> 130	> 30	Suitable for cooking
7	Red Banana	> 180	> 40	Used for table purpose

2) Total soluble Solids Total soluble solids (TSS) are a quality component of apples that has also been used to measure fruit maturity and quality. Total soluble solids are a measure of the soluble compounds (such as carbohydrates, salts and acids) in the cell, which increases during ripening, primarily from the conversion of starch into sugar (Watkins, 2003; Siddiqui et al., 2013). During apple maturation, sugars become the primary component of the soluble solids and consequently the TSS gives a measurement of the sweetness of the fruit. Because of this, TSS is often used as a quality component before storage and export markets. The concentration of acids and the ratio of TSS to acid is also an important constituents for development of flavour.

The other quality characteristics for storage and marketing are described below

Size/SKU The common Stock Keeping Unit (SKU) of apple in the market is Extra large (EL), Large (L), Medium (M), Small (S), Extra small (ES), Extra-Extra Small (EES) and loose. These SKUs are followed in Himachal Pradesh and Uttarakhand but not in J & K. The common counts are described in Table-1.

Shape Generally good shape characteristics to varieties are packed. In A and B grades apple, 5-10% shape variation per box is allowed.

Physical Characteristics It includes common defects of apple such as Hail damage, Sun burn, Skin puncture, pressure marks, shriveling, Bruising and insect pest damages. All defects with grades are mentioned in the Table – 2

Diseased and insect The most common diseases affects apple quality is Scab and Sooty blotch. Scab badly affects the

appearance of apple and priced very low in wholesale and retail markets. Apples from Himachal Pradesh are almost free from this disease but Kashmir apple is highly infested. Sooty blotch, another fungal disease affects quality badly but upon rubbing with cloths, the black spots or patches on apple disappears. The apple lot infested with sooty blotch is not suitable for storage because during storage, pressure (Firmness) reduces rapidly and these apples easily gets damaged during transportation. All quality parameters of Himachal apple with defects are summarized in Table – 2

Note In India, generally grading is not done on the basis of pressure. It is done mainly based on color, size, disease, and external defects

Quality Specifications of Kashmir Apple

Quality of Kashmir apple and Shimla apple are almost same. However, little differences in the form of grade name and others are listed in the Table-3

Grade A is also called as Premium quality. This quality fetches highest price. The quality criteria may vary from buyer to buyer. Premium quality is summarized and listed in Table -4.

Quality standards of Banana

In general, banana is not restricted strictly within a season, but available in almost all season. However, during the winter season, availability in the market reduces drastically. South India is the main producer centre of Banana. Tamil Nadu, Andhra Pradesh, and Maharashtra are three leading states and supplier of main modern formats and North Indian states.

There are two commercial qualities of banana, first green stage quality, and second

ripe stage quality. The green stage quality is important because, it decides final quality of ripened fruit and transportation ability to distant market, whereas, ripe stage quality determines shelf life and consumer satisfaction. Banana from South to North is transported at mature green stage. Ripening treatment is given at the sub wholesaler or retailer end. Whatever be the quality, it depends upon the harvesting stage. Every fruit will develop its full characteristic flavour, taste and colour during ripening and storage if it is picked during an optimum maturity stage. Fruits harvested at an early stage of maturity are more susceptible to shrivelling and mechanical damage and are of poor quality upon ripening. On the other hand, harvesting at an advanced stage of maturity is unsuitable for fruits intended for long distance transportation due to their shorter storage life. Banana generally not stored in cold storage but just for few days (less than a week) at green stage.

The hands are graded based on the number and size of fingers in each hand. Overripe and injured fruits are discarded at this stage. Major criteria for quality are based on lobe size in terms of wt. and no. of fingers. Grading is done on the basis of fruit length and diameter of the fingers. Bruised marks, cuts, Crack, Misshaped, Double, Natural browning, Mechanical damage, Sun burn and pressure damage are considered as defects.

General characteristics

Banana fingers shall be free from rotting, fungal infection, insect and disease infestation, bruises, spots, sun burn and chilling injury symptoms, cuts/cracks, misshape or double, rupture skin and any type of damage caused during handling. The fruit should be clean, firm and mature and shall have shape characteristics of the variety. Stalk and crown portion of the banana hands shall not be black and damaged and shall be free from rotting or

fungal infection. Important varieties with finger length and diameter are listed in Table-5.

Defect & size tolerance (by weight) in every consignment, there is a tolerance level indicated by the consigner and accepted by consignee. It may vary from buyer to buyer or place to place. Here defect tolerance level for banana is listed in Table- 6

Quality standards of Grapes

Traditionally, grape quality is judged all over world by visual, taste, total soluble solids (TSS) and acidity (Krstic et al., 2003). The most commonly used parameters in India are visual, total soluble solids (TSS) and taste. The best combination of all parameters give good quality assessment, and it is not possible to assess quality adequately by taste alone (Cozzolino et al., 2006). Commercially important varieties are Thompson seedless, Sonaka, Black Thompson, Black Sonaka, Bangalore Blue, Anab-a-shahi and Flame seedless. Among these, Thompson seedless is widely grown and marketed in our country and exported from India. This is also the best variety suitable for storage. Other varieties stored for short periods are Sonaka, Black Thompson and Red Globe. Red Globe is an exotic variety but many farmers adopted this cultivar in Nasik and highest price is paid to this variety.

General characteristics

Grape berries shall be fresh, clean, mature and firm and shall have shape and color true to its variety. Berries shall be firmly attached and evenly spaced on the stalk and shall have intact in the bunch. Berries shall be free from discoloration, brown stem and stalk, bruising, holes, natural brown marks and any type of damage caused by pressure, mechanical and other means. Berries should not be immature, over ripe, shriveled, misshape and soft/pulpy. Grape bunches

shall be compact and well formed and shall not have loose/single berries. Berries shall be sound and free from rotting, fungal infection, insect and disease infestation.

The grape production is mainly concentrated in Nashik, Sangli and Solapur districts of Maharashtra and Bijapur district of Karnataka. Grapes are also produced in Theni (Tamilnadu) and Cuddapa (Andhra Pradesh). Quality standards of grapes also depend on varietal characteristics. Thompson seedless can be kept in store but not flame seedless, Tas-A- Ganesh or Anabesahi. Black Thompson seedless and Sonaka cannot be stored for more than one month because the bunch stem/stalk dries. Only Thompson seedless and up to some extent Sonaka can be stored in cold store after sorting grading and pre cooling. Thompson seedless can be stored for 2-3 months.

The quality of grape is judged based on following parameters:-

Berry Size Berry size should be greater than 15 mm for Thompson and 18 mm for Sonaka both for domestic as well as for Dubai market. A variation of 2-5% per bunch is allowed.

Sugar content (TSS) Sugar content should be equal to or greater than 17 degree brix ($^{\circ}$ B) measured by Refractometer (Hand Refractometer)

Diseases Two major disease of grapes have commercial importance, one is Powdery mildew (Fungal disease), easily identified with the presence of powder like substance on the peel and stalk of berries. The second is mealy bug (Insect attack) can be identified easily with the presence of honey or dew like substance on berry and on fruit stalk. This disease spreads very fast in the field. It is better not to purchase mealy bug infested orchard. Grapes infected with either of these two diseases are not suitable for storage. Both spreads during storage and

infection may spread to other healthy boxes also. For European Union export, grape bunch should be free from all diseases.

Tightly held Berries Best quality grapes should have tightly held berries. One berry can hold the full weight of bunch. This test is very common among growers and buyers. This is a good measure of berry droppings during storage and long distance transportation. This also gives an idea about berry dropping during storage and marketing.

Physiological disorders There are few physiological disorders of grapes strictly prohibited for storage and export. Physiological disorders are pink berry, hard berries (Karak money), water berries (Puchka), yellow berries (Sun burn). Pink berries, water berries and sun burn berries get spoiled during storage. Hard berries and water berries taste sour, not desirable and also not suitable for storage. The water berries are identified easily by dark green color of berry.

Water berries, pink berries, hard berries, discoloration in the bunch are not allowed for export but in some cases, it is allowed for Middle East countries as per the allowed tolerance limits. During sorting or cleaning of bunches, all defected berries are removed before packing and pre cooling. The sorted and packed boxes are palletized and pre cooled. For storage purpose, grape is either packed in perforated plastic crates with new paper as lining material with grape gourd or CFB boxes with perforated pouches of 500 - 600gm each with grape gourd. One plastic box contain 18-20 Kg approx. whereas, One CFB box mainly contains 8-9 poly pouches gives about 4.5Kg (net wt.).

Total soluble solids (TSS)

TSS shall be 16-22% depends upon varieties. For Bangalore blue and Anab-a-Shahi variety, minimum TSS should be 13%. TSS is judged by hand refractometer.

Irrigation before harvesting decreases TSS but increases bunch weight.

Grades

There shall be three Grades for Grapes viz., Grade-A, Grade-B and Grade-C. The size requirement for grape varieties are listed in Table- 7

Grades and tolerant limits

Similar to any other fruit, the defects and tolerance limit of all grades are listed in Table-8

Quality standards of Mandarin

Mandarin is a group name for a class of oranges with loosely attached peel with segments. It is a citrus fruit of the species *Citrus reticulata*. It is distinguished from

other citrus species by the relatively loose skin or peel of the fruits and the relative ease with which the segments can be separated. The maturity of harvested fruits has an important role on shelf life, quality and market price. Hence, certain standards of maturity must be kept in mind while harvesting the fruits. However, the most commonly used measures to assess maturity for harvesting the Mandarin is peel colour. Fruits are considered mature, if they have a yellow orange colour on 25% or more of the fruit surface. Fruit quality for harvesting depends upon TSS (Total soluble solids contents), sugar and acidity of the juice. The juice should have a TSS of 8.5% or higher. TSS content is determined by squeezing a few drops of juice on a hand-held refractometer.

Table 6. Defects tolerance limit of banana grades

Defect tolerance	Grade-A	Grade-B	Grade-C
Minor defects	10%	20%	100%
Major defects	Up to 2%	10%	50%
Serious defects	0%	2-5%	5-20%

Table 7. Quality characteristics of grapes of different commercial varieties

Varieties	Color	Berry shape	Berry size (mm)	Bunch weight (gm)
Thompson Seedless	Yellowish green/ Golden yellow	Oblong	12-15	> 200
Tas-a-ganesh	Yellowish green/ Golden yellow	Elongated	12-15	> 200
Black seedless	Black/purplish Black	Oblong	12-15	> 200
Black seedless	Black/purplish Black	Elongated	12-15	> 200
Sonaka Seedless	Yellowish green/ Golden yellow	Elongated	12-15	> 200
Bangalore blue	Dark blue/ Purplish Black	Oblong	15-23	> 250
Anab-a-shahi	Pale green	Elongated	Min. 20	> 500

Table 8. Defects and tolerance level in different grades of grapes grown in India

Defects	Levels of defects in grapes			
	Grade-A	Grade-B	Grade-C	Remarks
Overripe	Not allowed (1-3 berries/bunch may be allowed)	Not allowed (10-20 berries/bunch may be allowed)	Allowed	Over ripe berries also include yellow berries turned on exposure to sun light
Discoloration/Pigmentation	Not allowed	Not allowed (2-5 berries/bunch may be allowed)	Allowed	Pink berries are good example of pigmentation. These are sweet in taste but no commercial value hence not desirable.
Brown stalk	Not allowed	Not allowed (10-15% fruit stalk may turn brown upon dehydration /bunch may be allowed)	Allowed	Turning of fruit stalk/stem into brown color is an indication of shelf life of harvested bunch and also indicate when it is harvested
Insect damage	Not allowed	Not allowed (5-10% fruit/box may be infected but not severe.	Allowed	Mealy bug is the most important pest of grape. Infected bunch is not advisable for storage. During storage also it spreads from one to another bunch
Bruising	Not allowed (such berries must be trimmed out)	Not allowed (5-10% fruit/box may be allowed with slightly bruised fruits.	Allowed	Bruised and damaged berries must be trimmed out. These berries spoils quickly

Table 9. Classification of Orange grades with respect to size tolerance (Nagpur orange)

	Grade-A	Grade-B	Grade-C
Diameter (mm)	>65	55-65	Any size

Note: The diameter is measured from the stem end to the blossom end.

Table 10. Classification of Orange with respect to size (Nagpur orange)

Extra Large	Large	Medium	Small	Extra Small
75-80 mm	65-75 mm	55-65 mm	50-55 mm	40-50 mm

Table 11. Fruit Maturity Criteria of Orange (Nagpur orange)

TSS	Not less than 8 % brix
Acidity	0.6 to 0.7%
TSS : Acid ratio	TSS/acid ratio-not less than 14 & not more than 20
Juice content	Minimum 38% to 40%.
Colour	More than 50% of the surface should be yellow-orange

Table 12. Classification of Mandarin (Nagpur) sold in domestic markets

Count (Dana)	Size of fruit in diameter (mm)	No. of fruits/Kg	Wt/Fruit (gm)	Remarks
141	70-74	6-7	145-164	Always on high demand
171	66-69	7-8	125-144	Always on high demand
191	60-65	8-9	105-124	More demand in Bihar, W.B and NE- states
205	56-59	10-11	85-104	
225	51-54	12-13	65-84	

Table 13. Defects and tolerance level in different grades of Nagpur Mandarin grown in India

	Grade-A	Grade-B	Grade-C
Misshape	Slight misshape (up to 5%) per pack	Allowed (up to 20%/pack)	No limit
Green color	Allowed if matured (During start of the season it is not a defect)	Allowed (up to 20%/pack)	No limit
Rough/thick skin	>20% surface area	>50% surface area	No limit
Bruises	1-3 sq. cm. surface area	5-10% surface area	No limit
Loose jacket	Allowed	Allowed	No limit
Black/brown spots on skin	5-10% surface area	10-20% surface area	No limit
Punctured skin	Allowed if no juice seepage	Allowed	No limit
Sunburn	1-3 sq. cm surface area	5-10% surface area	No limit
Cut/ Crack	Deep cut/ crack \leq 2 cm. long	Deep cut/ crack 2-6 cm. long	No limit
Hollow stem end	Allowed	Allowed	No limit
Pressure damage	5-10% surface area	10-25% surface area	No limit
Shriveling	\leq 20% surface area	>20% surface area	No limit
Rotting/ fungal infected	Not allowed	Not allowed	No limit

Note:

1. Percentage of defects allowed or disallowed in a particular grade will be determined based on weight in a sample lot.
2. More than one defect in an individual piece will be considered as major defect.
3. Extent of defect not covered in minor, major & serious categories of Grade A, B & C, means it is allowed in that particular grade.

Table 14. Defects and tolerance level in different grades of Mango grown in India

Defects	GRADE-A	GRADE-B	GRADE-C
Bruised marks	5-10% surface area	10-20% surface area	No limit
Latex spots	5-20% surface area	Allowed	No limit
Shrivelled	Not allowed	Slight shriveled	No limit
Discoloration	Not allowed	Slight discoloration	No limit
Watery patches	Not allowed	20-30% surface area	No limit
Misshape	Slight misshape allowed	Allowed	No limit
Pressure damage	Not allowed	10-20% surface area	No limit
Cut		Deep cut (30-50 mm long)	No limit
Mechanical damage	\leq 2sq. cm surface area	2-4 sq. cm surface area	No limit
Spongy tissue (in case of Alphonso)	Not allowed	Allowed	No limit

Table 15. Grade wise standard weight of Mango varieties

Varieties	Grade-A (gms)	Grade-B (gm)	Grade-C
Mango Banganpalli	>300	200-300	Any weight
Mango Alphanso	>180	130-180	
Mango Chousa	> 250	180-250	
Mango Dashehari	>180	120-180	
Mango Langra	>220	150-220	
Mango Malgoa	>250	180-250	
Mango Mallika	>300	200-300	
Mango Neelum	>220	150-220	
Mango Pairi	>220	150-220	
Mango Raspuri	>250	180-250	
Mango Sindhuri	>200	150-200	
Mango Totapuri	>350	250-350	
Mango Rumani	>200	120-200	

Table 16. Defects and tolerance level in different grades of Pomegranate grown in India

Defects	Grade-A	Grade-B	Grade-C
Dry skin	Not allowed	Allowed 10-20%	No limit
Bruises	≤1sq. cm surface area/1-2 fruits/pack (Nt.wt. 4-5 Kg)	20-50% surface area	No limit
Natural brown marks on surface	>10% surface area/2-5 fruits /pack (Nt.wt. 4-5 Kg)	30-50% surface area	No limit
Pressure damage	Not allowed	10-20% surface area	No limit
Cut/crack	Deep cut/crack >2cm. long.	Deep cut/crack 2-4 cm long	No limit
Holes	≤2 holes (if no juice seepage)	Allowed	No limit
Mechanical damage	Not allowed	> 2 sq. cm. surface area	No limit
Diseased	≤1% in a lot	≤2% in a lot	No limit
Misshape	Slightly misshape	Allowed	No limit
Immature (dark green)	Not allowed	Up to 15%	No limit
Black spots on surface	5-10% surface area	10-20% surface area	No limit
Insect damage	Not allowed	Up to 10%	No limit
Rotting/ fungal infected	Not allowed	≤2% in a lot	No limit

Table 17. Export quality of grapes for Middle East countries

General description	Fruits should be wholesome of specified variety/ cultivar with good appearance and within permissible limit of sign of spots on the peel/ bruising/ scratches/pressure damage/ rusting etc. It shall be round shaped, mature, firm, free from diseases, pest infestation & significant calyx damage and able to meet the specified export quality requirements.			
Color	Yellowish Orange to Red/ saffron			
Fruit weight (gm)	9 count	12 count	15 count	18 count
	350-450	270-350	200-270	170-200
° Brix	12-16 (Average of 6 fruits)			
Taste	Sweet Taste			
Net wt./box	3.5 kg			
Quality attributes				

S. No.	Major Defects	Max. Permissible Limit (%)
1	Soft and black arils/ seeds	1
2	Cracked fruit/ surface	0.5
3	Superficial Fungal/ bacterial spots	1
4	Fruit borer infestation	NIL
5	Mites attack on fruit-rusting	NIL
6	Fruits with Chilling injury Symptoms	NIL
S.No.	Minor Defects	Max. Permissible Limit (%)
1	Minor variation in surface color	10
2	Minor Sun burn spots	5
3	All types of superficial blemishes (bruises, scratches)	5
4	Minor thrip [#] marks	10
5	Fruit weight less than specified	5
Critical Rejection Criteria		
1	Produce not matching the general requirement/description or not being fresh and wholesome.	
2	Presence of any critical foreign matter including glass, metal, filth, poisonous plant or insect etc.	
Mode of Transportation		Sea Shipment
Storage		At Temp. & RH of 5 to 7°C and 92 ± 2%
Packing		In CFB (Carton)
1	No. of Fruits Per Box	9 -12 or 15 Or as Specified
2	Bubble sheet + Separator or Tray	
3	Net fruit weight per box	3.5 Kg.± 5% of net wt.
Remarks	Container Capacity - 15400 kg	

General characteristics

Orange shall be mature, firm, juicy, well formed and shall have similar Varietal characteristics. Orange shall be free from black/ brown spots, sunburn, cut/crack, shriveling bird-punctured skin, hollow

stem, nodes on surface and any type of mechanical, pressure and packing damage. Orange shall have tight and smooth skin (no granulation) with intact Pericarp (stem end). Orange shall have minimum 75% yellow/ orange color. Orange shall be free from internal shrivelling caused by frost. Orange shall be sound and free from rotting (moldy rot or any other rot), insects, and disease infestation. Orange shall not have any foreign taste and/or smell. Mrig season orange (Feb-Mar i.e. 25th Jan-10th April) is suitable for storage. Oranges are very prone to fungal disease and weight

loss during storage. Therefore, it is highly advisable to monitor quality at weekly basis.

Size and Grades

There shall be three Grades for Orange viz., Grade-A, Grade-B and Grade-C. On the basis of domestic market, grading of Nagpur mandarin is done on dimension basis. Fruits generally vary from 40 to 80 mm in diameter. Grades and size (mm) are listed in Table 9 and 10 respectively.

The maturity standards of Nagpur mandarin is listed in Table - 11

Mandarin are sold in the market on count basis (No. of fruits per box) as listed Table-12

Grades and criteria for checking: - Price fixation or procurement is done on the basis of defects present in a particular lot or box. The following grades with their

permissible defects are listed in Table-13. This can be a criterion for acceptance or rejection of any lot or box.

Quality standards of Mango

Mango quality are judged at two stage, First before transportation and second before retailing. For the first stage, Mango should be developed, mature, hard, clean and shall have olive green color with whitish waxy layer (bloom) and should sink in 3% salt solution. Fully developed but not ripened Mangoes should have swollen shoulder (fullness of chiks); whose blades shall be either in line with stem end or overgrown. Mangoes shall be free from black/ brown spots, bruises, cuts, watery patches, internal spongy tissue and any type of damage caused by hail, packing, pressure and mechanical means. Mangoes shall be sound and free from rotting (stem end rot or lateral rot, or any other rot), fungal infection, insect and disease infestation.

For the second stage i.e. before retailing (ripened mango) It should be firm and ripe and shall have shape and color characteristics of the variety. Mangoes shall be free from black/brown spots, bruised marks, cuts, watery patches, internal spongy tissue, and any type of damage caused by hail, packing, pressure and mechanical means. Mangoes shall not be soft, overripe, misshape and shriveled. Mangoes shall be free from rotting (lateral rot or stem end rot or any other rot), fungal infection, insect and disease infestation. Mangoes shall be free from abnormal external moisture, foreign smell and/or taste. The permissible defects with grade wise are enumerated in Table- 14

Mango shall be free from black/brown spots, bruised marks, cuts, watery patches, internal spongy tissue, and any type of damage caused by hail, packing, and mechanical means.

Mangoes should not be soft, overripe, misshape and shrivelled, must be free from rotting (lateral rot or stem end rot or any other rot), fungal infection, and insect and disease infestation. Fruits should also be free from abnormal external moisture, foreign smell and/or taste, latex (sap) brownish/ blackish spots. Standard weight (gm) of mango fruits with premium quality is summarized below with Table-15

Quality standards of Pomegranate

Pomegranate shall be clean, firm, fresh, and mature and shall have color and shape characteristics of variety. Pomegranate shall be free from cut/crack, holes, bruises and natural brown/black spots. Pomegranate shall not be soft, misshaped and shall be free from damage caused by birds, packing, handling and mechanical means. Pomegranate shall be sound and free from rotting, fungal infection, insect and disease infestation. Outer rind of pomegranate shall have fresh with shiny look. Grades and criteria for checking quality is listed in Table-16

Main Varieties in Demand

- Bhagwa: Attractive, shine and redish orange colour in skin and fruit is red in colour. This is also called Kesar. Aril color is pink
- Arakta/Mirdula: Attractive and Blood red colour in skin and fruit is red in color. Aril colr is blood red
- Ganesh: Pinkish yellow skin and fruit is pinkish white. Aril color is whitish pink

Packing and pack size

The fruit is packed in cartoons called (Karandi) and to avoid damage, paper cuttings are used as cushioning. The weight of box and cutting paper is approximately 0.5 kg to 1.0 kg. Pomegranate marketing is based on number of fruits/box popularly called as

counts or Dana. The prevalent counts in mandi are 9,12,15,18,22,24,27, 30,36,40, 45,48, 60 and loose. Counts 9,12,15,18 dana comes in single layer and mainly comes from Sholapur (Maharashtra). The packing from Nasik is in two layers which consists mainly 12,14,16,18,22,24,30 Dana The packing comes in following sizes.

Export Quality: - Export quality Pomegranate is packed in CFB boxes only with trays and cushioning materials. It varies from country to country and buyer to buyer. Export quality for Middle East countries are listed below in Table-17

CONCLUSION

Customers' acceptance is directly related to the eating quality of fruits like crispy, crunchy, free from external defects, and sweet in taste. However, it varies from fruit to fruit. In mango and strawberry, flavour is also included among quality parameters. Quality for storage is however, different and varies from fruit to fruit. The most important quality for storage is flesh firmness and extent of conversion of starch into sugar for apple, TSS and berry size for grapes, TSS, and acid ratio for orange and so on. India is leader in fruit production but not in quality fruit production. However, the situation is changing day by day with the entry of few reputed firms like Reliance Fresh, MORE, Big Bazaar etc. The quality produce also is spoiled in the absence of infrastructure, lack of knowledge and poor postharvest management. Domestic demand for quality produce is also on increasing trend. The rapid growth of organized retail shops is an authentic proves of quality fruit's demand created by people of all age groups.

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