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Advances in Grading of Fruits

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ABSTRACT

Grading agricultural products, especially fruits, has become essential to trade across borders. Most fruit growers in India grade the fruit manually. The trained operators performed manual grading, they considered several grading factors and differentiated the fruit as maintained by their physical attribute. Manually grading is expensive and the grading process is affected by lack of labor during peak periods. Human operations might be unstable, less effective and slow. As noted by the World Trade Organization (WTO), new trends in marketing request high quality produces. Farmers look forward to having an adequate agricultural product-grading machine to reduce labor shortages, save time and improve the quality of graded produce. Fruit grading is a very important operation because it gives the grower a high price and improves the packaging, management and overall development in the marketing system. Fruits are usually graded based on size and graded fruits are more comfortable in the export market. Grading can reduce maintenance risks during transport. The need to respond to market demand places greater emphasis on quality assessment, resultant in better and more accurate grading and sorting methods.

INTRODUCTION

Agriculture is one of the major sectors and a main supplier to the financial growth of the country. Fruit production is one of its applications in this sector. Since olden eras, fruits have continuously contributed to the nutritional needs of man, which are very important for sustainable health. Fruits are processed to produce fruit-based products such as fruit juice,

candies, medicines and industrial chemicals, and hence fruit quality is significant in the fruit processing industries. Fruit grading can be seen as a method of classifying fruits based on physical characteristics such as size, color, weight and texture to get better market value. In other words, fruit grading is a tool that affects quality control in fruit processing, and to implement this quality, certain visual characteristics of the fruit can be used as a

standard for its classification. Classification of fruits is required to check whether the products meet farm quality standards and consequently increase market value.

Grading: The quality separation of food product is called as grading. The term ‘quality’ has different situations for various agricultural commodities and relative importance of the constituent material properties. In fact, grading includes a balanced valuation of all the properties of a material, which affects its acceptance as a food produce and as a working material for the processor. Most often, grading involves the concurrent evaluation of multiple attributes, which can cause complexity in mechanical grading, and therefore prioritize manual grading. The separation is based on shape, size and color of the food product, which is made to produce different characteristics.

Agricultural products, especially vegetables and fruits, are a significant share of trade countrywide and worldwide. Grading plays a vital part in the removal of undesirable or foreign matter from the harvested crops, as applicable during the harvesting of vegetables and fruits. Grading means classifying or categorizing vegetables and fruits into different grades as maintained by shape, color, size and volume to obtain the maximum worth in the market. In addition to grading, other pre-cooling products, harvesting treatments, and packaging, such as pre-cooling, to eliminate heat from the farm, are also dangerous to marketing success.

The product transported in various markets frequently has variable properties and can occasionally be imperfectly distributed or contain shaken, injured and rotten products. Delivering such products usually leads to cheaper prices. Therefore, systematic grading is essential for effective marketing of fruits. Wounded, injured and ill-shaped products would be graded and graded healthy vegetables or fruits according to their size, shape, color, weight and maturity. Fruits can be graded in additional fancy, larger and class I, II and III or

standard grades respectively. The several benefits of grading are given below:

Benefits of grading methods:

Graded products get a good price on the marketplace.

Grading supports build greater trust among buyers and growers.

Increase marketing efficiency by procurement and vending a product without personal choice.

You can avoid the huge marketing cost of packing and shipping by grading.

Increasing distributors’ incomes.

Grading improves uniform in a product in a specific grade and is the basis for price.

Criteria for grading of materials: Grading is completed by means of accurate equipment for each product of the product category. It is constructed on the criterion set out in the table below.

Table 1: Criteria for grading of materials

S. No	Group	Criteria
1.	Physical criterion	Weight, size and shape
2.	Technological criterion	Processing suitability or compatibility to existing equipment
3.	Organoleptic	Color, taste, texture, aroma, ripeness or freshness
4.	Commercial	Tradition, attractiveness, utility, variety and price

Most of the mechanical graders depend on the size of the materials, but some devices use differences in the shape, density and surface properties of the products to be sorted.

Graders and sorters classification: The different types of sorters and graders are

classified in the following table based on their grading principle.

Table 2: Graders and sorters classification based on their grading principle

S. No	The basis of grading	Graders and Sorters
1.	Shape and size	Disc and indented cylinder separator, spiral separator and Trommel
2.	Surface roughness	Velvet roll separator, inclined drapper
3.	Aerodynamic properties	Fluidized bed separator, cyclone separator and pneumatic/aspirator separator,
4.	Magnetic properties	Magnetic separator
5.	Specific gravity	Destoner, specific gravity separator
6.	Optical properties	Colour sorter

Grade factors: The grade factors applicable to all products produced on the farm in different combinations are as follows:

1. Physical features like moisture content, colour, foreign matter, unit size, texture and shape
2. Chemical features like rancidity, free fatty acid index (for fat containing material), odour and flavour and analysis (composition)
3. Biological features like bacterial count, germination, type and amount of insect damage and type and amount of mould damage

Grading machinery: Grading will be completed manually or by automatic grading lines. Sizing grading is subjective (visually) with the usage of standard size gauges. Round product elements can be simply graded with sizing rings. Fruit grading plays a significant part in the national and export marketing of fruits.

Grading of the minor fruits is considered very important because it can be costly to the breeder. Improves grading packaging, handling and other harvesting activities. Grading basically divides the material into different homogeneous groups according to its exact features based on shape, size, color and quality. This saves the time and energy on different processing performances and decreases maintenance losses throughout shipment. Usually fruits are categorized manually in the country. Grading has altered very slightly in the period of last fifty years. Although, the grading procedure is purely mechanical. A basic mechanical grader consists of a chain conveyor belt and a bag at the end. Smaller products fall through the chain, simplifying the grading method.

Grading of quantity and quality is important for marketing of fruits and vegetables. Sizing machines can be divided into weight and diameter. Machines vary according to article, grade, design and size. This yields more than machine grade by the weight. Roller feed conveyor are used for quality sorting of fruits.

There are various methods of grading based on methods or standards, of which size grading is the oldest standard for designing graders.

Grading methods: Grading of fruits is usually based on physical appearances such as size, specific gravity, color, weight, shape, and freedom from diseases. For the latest marketing, familiar methods of fruit and vegetable are manual and machine grading. In both methods, the product is classified based on the size. Though, electronic grading systems are gaining momentum in the horticulture sector and have been widely used in pilot scale studies. The grading method is completely mechanical, but in India it is still completed manually. The basic process behind mechanical grading consists of a conveyor belt with a bag at the end, in which small products make the grading process less extensive through the chain. Fruits are generally classified based on the state, central and international values. Each country has its own set of different classes to

suit the needs of the market. However, there are three classes for the international market: class I, class II and Extra class.

Extra Class: Extra class produces greater quality shapes and color and affects the inherent texture and taste without any internal defect. 5 percent tolerance for defects is allowed. This should be carefully considered considering the uniformity of product in the quantity, color and condition of product in the package, the quality and appearance of the packing or pre-packing material.

Class I: It is having an almost identical quality except 10% tolerance is to similar extra class. A minor defect in individual fruit shape, color and minor skin defects is allowed, which does not affect the overall appearance of the symptoms.

Class II: This class of produce exhibits some internal or external defects that are suitable for use when they are up to date. This class is best suited to short or local distance markets. This group can meet the desires of the most demanding customers and worth is more important than quality.

In general, the characteristics that determine the quality of a food product may be size, shape, maturity, taste, texture, color and contaminants.

Grading can be completed manually or with the help of special machines, which are discussed below:

Manual grading: Most of the grading of fruits, vegetables, eggs or any such food product is performed manually. Grader forms a balanced judgment of overall quality and divides food into quality groups. Apples can be graded using color cards that perform different grades in relations of surface proportions displaying fruit color, corrosion, surface defects etc. Cherries are related to models made of plastic spheres which is fitted with nylon stems. The eggs are manually grade by candle. This stands the destructive test of the egg content. In this type of test, the translucent shell of the egg rotates in a dark booth in front of powerful light. The

appearance of each egg is automatic and the candling operator can separate several thousand eggs in 3-4 grades in one hour.

There are some drawbacks of manual grading: This is a laborious task; it needs a lot of effort to grade fruits and vegetables. Most of the fruit grading is done manually in India, such as mangoes, oranges, kinnow and vegetables.

Machine grading: Separate grading machines are accessible for whole grains and fruits and vegetables. Two types of machine grading for whole grains like Spiral separator and rotary screen grain cleaner and grader.

Grading machines for fruits: Four types of grading machines for fruits. They are roller grader, screens, weight grader and diving belt grader.

Screens: There is variety of fruits which are graded with the help of vibrating screens made up of plastic, stainless steel and copper, which do not respond chemically with the products. The material to be graded is passed over to the rotary screen or vibrating screen. At the end of the screen, the smallest material passes from the beginning to the middle and finally the largest. In this way, it makes dissimilar classes of fruits such as orange, apple, kinnow, and vegetables like tomato and potato. You can re-create the material that goes to the top of the screen and get new fractions.

Roller grader: This type of graders is fast, precise and reasons little damage to fruit. These are widely used in the fruit industry. Each roller rotates in a counter clockwise direction. The fruit is continuously rotated so that each piece has a chance to record its lowest dimension with the space in the grader. Roller conveyers with fixed space among the rolls are used for eliminating small fruit, twigs and leaves.

Diverging belt grader: It is extensively used grader, which contains of two belts. These belts diverge as they move. The fruit is passed on and between the belts. Subsequently the distance between two belts rises regularly and

systematically, the smaller parts will drop among the belts at the beginning of travel while the larger parts will be carried more and will be dropped later.

Weight grader: The grading is completed based on the weight of product. This technique is precise, fast and there is least damage to fruits. This is also used for large size products like oranges, apples, potato kinnow, mango, eggs, tomato etc. These are especially adapted for sorting material, which cannot be handled by other procedures, due to their shape or texture. The material to be graded is positioned in individual cups by automatic feed, which is then passed through the sorter, where it is indexed with the help of spring-loaded trips. The spring tension is gradually weakened from the start to the end of the movement. Initially a large portion is the discharge whereas the lighter fraction is the next and the lighter at the end. This kind of grading does not depend on their size and shape of the material.

Mechanical grading of fruits: Mechanical fruit graders are categorized by their working principles as weight grader, fruit color grader and fruit color, size grader and weight grader which categorizes fruit by their color and size. Fruit grading through their color and size is the innovative technology of the post-harvest fruit handling currently in the world. Its working principle is a combination of color grading and automatic size grading. First, fruit size grading is done on the conveyor belt with adjustable apertures. The fruits coming down from the belt are irradiated by lamps under the conveyor belt and the yield reflex. Then the reflex signal was sent to the computer and received different grade fruits according to different reflex signals like as whole green, half-green and half red and red under each conveyor belt. Lastly, the graded fruit was transported through various conveyor belts.

Weight grading:

- A multi-fruit grader that can grade fruits by four grades (A, B, C and D) based on weight. Grade A (> 200 g),

Grade B (150-200 g), Grade C (100-150 g) and Grade D (<100 g). Grader's performance is evaluated at several speeds (5, 10, 15, 20, 25 and 30 r min⁻¹) [Omre and Saxena (2003)].

- The capacity of the apple grading product line range reaches 15 to 20 tons per hour (Haisheng Gao et al., 2002, 2003; Miller B. K., 1989). The near-infrared (NIR) transmittance spectrum of peaches from various regions of the wavelength range from 730 to 900 nm has been studied to evaluate peach maturation in terms of sugar content and viscosity. Apple image information was collected using CCD (Charge Coupled Device) and Apple was sorted based on their size, color and texture. Picking robots and conveyors were developed based on the machine vision system and a hardware and software system for cucumber grading.
- A computerized grading machine was developed and evaluated for grade alfonso mangoes on a weight basis in five grades. Logistic software was developed to run the grader. Grader's performance is assessed at four speeds, four microprocessor settings, and their impact on five grades of mango, grade I (326-375 g), grade II (276-325 g), grade III (226- 275 g for single lane), grade IV (176-225 g) and Grade V (<175> 376 g) [Badhe, Singh and Bhatt (2011)].

Electronic color grading and reflectance grading:

- A single lane firmness sorting system, which transmits fruit at a constant speed (76.6 cm⁻¹) and they affect the surface of the solid surface. About 74% of the peaches were sorted into correct firmness range [Delwiche, Tang and Mehlschau (1989)]. Citrus grading by automation measures the amount of light reflected from normal fruit

surfaces and from skin defects. In studies on the light reflectance properties of citrus fruits with a double beam recording spectrometer and reflections attachment, minimum of 15% reflectivity difference among defective and normal fruit surfaces has been recorded. Each fruit type has a single wavelength bond, which can be used to distinguish between different defects and normal fruit surfaces [Gaffney (1973)].

Grade designation and fruit quality:

The minimum necessities of fruits are listed below:

1. Fresh in appearance, free of pests
2. Clean, rounded, free from visible foreign materials
3. Free from damage produced by pests and diseases
4. Without any foreign smell or taste

Various fruits and vegetable classes as indicated by the directorate of marketing and inspection (DMI): Directorate of marketing and inspection (DMI) under ministry of agriculture and farmers welfare, Government of India was set up in the year 1935 to frame the grade values in a scientific manner. The various grades used in some important fruits with respect to weight, length or diameter as valid are given as under. For grading information on other fruits, following site i.e. www.dmi.gov.in can be accessed.

1. Mangoes

S.no	Grade	Weight of fruit (g)	Maximum allowable difference between fruits in packages (g)
1.	A	100-200	50
2.	B	201-350	75
3.	C	351-550	100
4.	D	551-800	125

2. Grapes

S.no	Grade	The size of the berries	
		Small bunch weight (g)	Large bunch weight (g)
1.	Extra class	150	200
2.	Class I	100	150
3.	Class II	75	100

3. Kinnow

S.no	Grade	Fruit size (diameter, mm)	Number of fruits in 10kg pack
1.	A	60-64	84
2.	B	65-69	72
3.	C	70-72	60
4.	D	72-74	54
5.	E	75-79	51
6.	F	80-85	45

4. Pomegranate

S.no	Grade	Weight of fruit (g)	Fruit diameter (mm)
1.	A	400	90
2.	B	350	80
3.	C	300	70
4.	D	250	60
5.	E	200	50

5. Guava

S.no	Grade	Weight of fruit (g)	Fruit diameter (mm)
1.	A	> 350	> 95
2.	B	251-350	86-95
3.	C	201-250	76-85
4.	D	151-200	66-75
5.	E	101-150	54-65
6.	F	61-100	43-53

6. Apple

S.no	Grade	Weight of fruit (g)	Fruit diameter (mm)
1.	A	> 341	> 80
2.	B	211-240	76-80
3.	C	181-210	71-75
4.	D	151-180	66-70
5.	E	121-150	61-65
6.	F	91-120	56-60

7. Pear

S.no	Grade	Fruit diameter (mm)
1.	Extra class	60
2.	Class I	55
3.	Class II	50

8. Litchi

S.no	Grade	Fruit diameter (mm)
1.	Extra class	33
2.	Class I	28
3.	Class II	23

CONCLUSION:

Usually fruits in India are manually graded. Manual grading is expensive, laborious and inefficient. Fruit grading is an important process that affects the quality, management and storage of products. Grading arrangements give us a wide variety of information such as size, shape, color, defect and internal quality. This size and color have many significant features for the accurate arrangement and or sorting of citrus, such as lemons, tangerines and oranges. Screen grader is fit for rotating fruits such as ber, lemon and aonla. Citrus grading is usually accomplished on the basis of exterior appearance criteria including fruit shape, size and color. Other methods of grading are grading based on size, which is easy and inexpensive and is used for grading onion, potato, apple, tomato etc. Fruit weight grading based on its specific gravity and density. Electronic color grading is done for high perishable fruits. This

method is expensive but with high precision of grading.

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