SNS COLLEGE OF TECHNOLOGY
AN AUTONOMOUS INSTITUTION

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DEPARTMENT OF FOOD TECHNOLOGY

Unit - 1

PHYSICAL PROPERTIES OF FOODS

TOPIC : Methods of estimation of Shape, Size

INTRODUCTION

PHYSICAL CHARACTERISTICS

1.Size
2. Shape
3. Weight
4. Volume
5. Density
6. Porosity
7. Specific Gravity
8. Surface area

APPLICATION

•The geometric characteristics of size, shape, volume, surface area, density, and porosity are important in Design of specific machine or analysis of product behaviour during handling and processing operations.

•Separation of seeds and grains from undesirable material. (shape, size, density)

•Fruits and vegetables are usually graded depending on size, shape, and density. Impurities in food materials are separated by density differences between impurities and foods.

• Conveying of solid materials (density, size,shape)

•Knowledge of the bulk density of food materials is necessary to estimate floor space during storage and transportation.

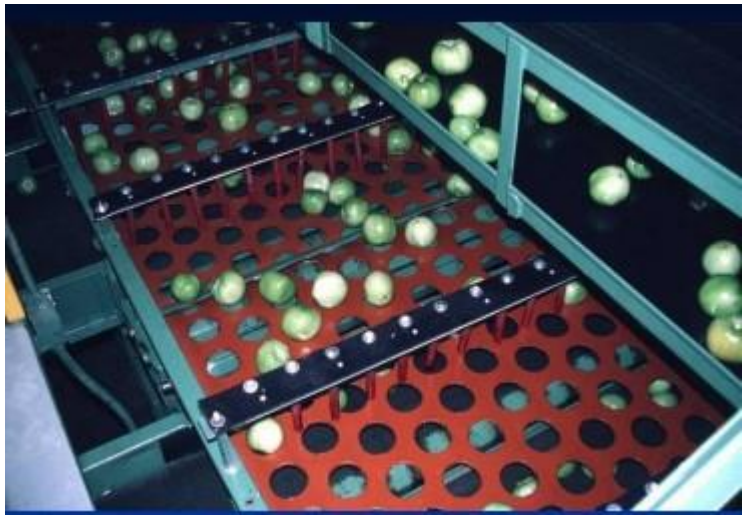
APPLICATION

•Sorting, grading and for capacity determination of machines and during storage.

• When mixing, transportation, storing and packaging particulate matter, it is important to know the properties of bulk material.

•Surface areas of fruits and vegetables are important in investigations related to spray coverage, removal of residues, respiration rate, light reflectance, and color evaluation, as well as in heat transfer studies in heating and cooling processes. In many physical and chemical processes, the rate of reaction is proportional to the surface area; thus, it is often desirable to maximize the surface area.

•Density and porosity have a direct effect on the other physical properties. Volume change and porosity are important parameters in estimating the diffusion coefficient of shrinking systems.

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SIZE

•Size is an important physical attribute of foods used in screening solids to separate foreign materials, grading of fruits and vegetables, and evaluating the quality of food materials.

• In fluid flow, and heat and mass transfer calculations, it is necessary to know the size of the sample. Size of the particulate foods is also critical as it affects the viscosity and dispersibility and stability of the product.

•Sort the various agro produces into size groups for fresh market. This is helps in assigning market and price differentials of large and small produce, to match consumer preferences and to allow pattern packing

•Determine produce surface area.

•Mandatory for modern or on-line fruit/ vegetables/ grain/spices density sorting, for which two size-related parameters, volume and weight, are required.

Methods of measurement

Projected method:

•Photographic enlarger

•Micrometer method: Micrometer and slide calipers

•Electronic devices: Image analysis (Precise method)

Precise methods incorporating optical, light, or lasers in machine vision systems exist to define shape and size of irregular-shape objects.

These systems are costly; their use is warranted in applications of high value materials more commonly found in highly processed, final products rather than raw, unprocessed materials.

- **Cont….**

•The size of spherical particles like peas is easily defined by a single characteristic such as its diameter.
•The size of non-spherical objects like wheat kernels, pears may be described by multiple length measurements.
•The longest diameter (major) and shorter diameter/s (minor) will adequately describe the size of an ellipsoidal object such as grain kernel or potato.
• The two/three dimensions are usually measured perpendicular to one another.
•The size of pear-shaped objects such as okra, pears, carrots, or beets can be expressed by diameter or circumference of the largest part and an overall length in the direction of the stem.
• The size of irregular-shaped materials like bananas, requires more extensive considerations. May be given in overall length and diameter.

Properties of Food Powders

•Food powder properties contribute to the understanding of operations like grinding, filtration, sedimentation, centrifugation, spray or freeze-drying, conveying, dosing, hopper storage, mixing etc.

•Particle size is used in sieve separation of foreign materials or grading (i.e., grouping into size categories).

•Particle size is particularly important in grinding operations to determine the condition of the final product and determines the required power to reduce the particle's size

•Small irregular-shaped objects can be sized with sieves by expressing particle size as the smallest sieve opening through which the particle passes

• The size of larger objects may be expressed only in terms of its largest diameter or circumference.

•SI units for particle size are micrometers (or microns) or millimeters depending on the size range.

• Cont…

•More important than individual size is the size distribution among the particles.

•Particle size distribution is directly related to material behavior and/or physical properties of products. Bulk density, compressibility, and flowability of a food powder are highly dependent on particle size and its distribution.

• In quality control or system property description, measurement of the particle size distribution in food powders becomes paramount.

•Different types of methods such as sieving, microscope counting techniques, sedimentation, and stream scanning are available for measuring particle size distribution.

• Fineness modulus from sieve analysis is the common measurement.

SHAPE

•Shape describes the object in terms of ageometrical body.

•Shape is also important in heat and mass transfer calculations, screening solids to separate foreign materials, grading of fruits and vegetables, and evaluating the quality of food materials.

•The shape of a food material is usually expressed in terms of its

•Roundness,

•Sphericity,

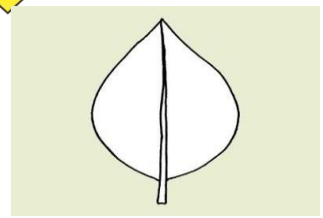
•Aspect ratio,

•Ellipsoid ratio and

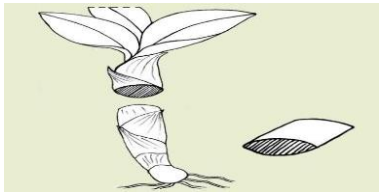
• Slenderness ratio.

SHAPE AND DESCRIPTION OF VARIOUS AGRO COMMODITIES

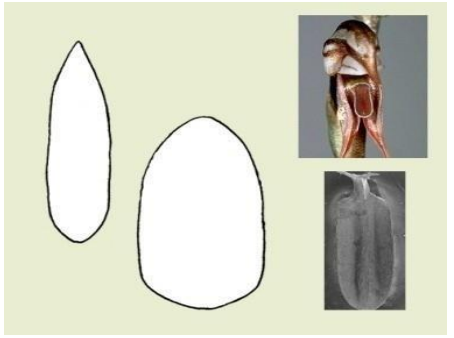
Shape	Description	Examples
Round	Approaching Spheroid	sapota, cherry tomato, pea
Oblate	Flattened at the stem end and apex	orange, pumpkin
Prolate	Elongated along a line	Lemon, grape
Oblong	Vertical diameter greater than horizontal diameter	some apple varieties, capsicum, brinjal, rice, wheat
Conic	Tapered towered the apex	ladies finger, carrot, reddish
Ovate	Egg shaped & broad at stem end	Brinjal, apple and guava.
Oblique	Axis connecting stem and apex slated	some apple varieties, tomato.
Obovate	Inverted ovate-broad at apex	Mango, papaya
Elliptical	Approaching ellipsoid	rice, wheat, pointed guard etc
Truncate	Having both hand squared or flattened	capsicum
Unequal	One half larger than the other	mango
Ribbed:	In cross section, sides are more or less angular	plantain, ladies finger
Regular	Horizontal section approaches a circle	orange, apple, guava etc
Irregular	Horizontal section dearth materially from a circle	mango, ladies finger, capsicum



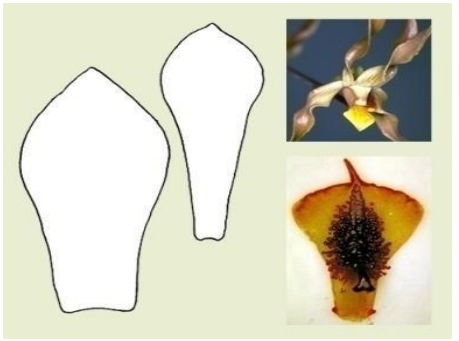
Ovate



ellipsoid



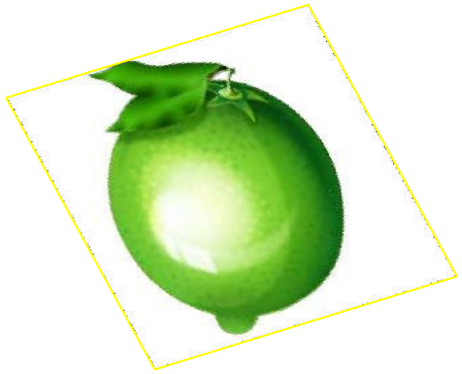
Oblong



obovate

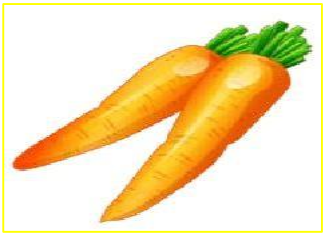
obovoid

Oblate

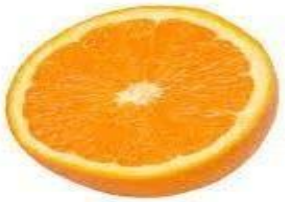


Prolate

Oblique

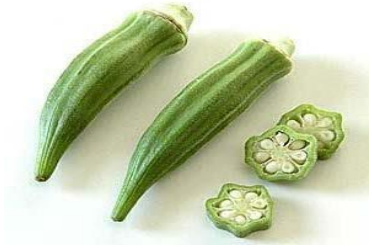


Conic



Regular

Truncate



Ribbed

Unequal

Elliptical

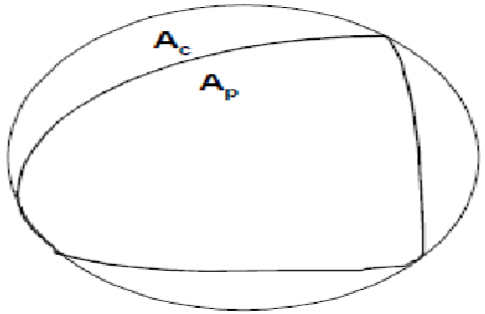
Roundness

Roundness is a measure of the sharpness of the corners of the solid.

1. **Roundness** = Ap/Ac

where: *Ap* = largest projected area of object in natural rest position

Ac = area of smallest circumscribing circle

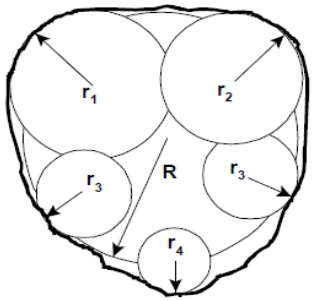


2. **Roundness** = *Σr* / NRi

where: *r* = radius of curvature as defined in figure

Ri = radius of maximum inscribed circle

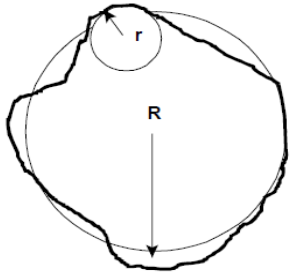
N = total number of corners summed in numerator



Roundness = Σ r / NR

3. Roundness Ratio = Radius of curvature of the sharpest corner / Mean radius of the particle

= r/R_m, where $R_m = \sum r/n$



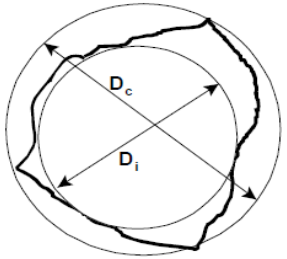
The use of the radius of curvature of a single corner determines the roundness or flatness of an object

Sphericity expresses the characteristic shape of a solid object relative to that of a sphere of the same volume.

1. **Sphericity** = *De/Dc*
2. **Sphericity** = *Di/Dc*

where: *De* = diameter of a sphere of the same volume as the object
Di = diameter of largest inscribed circle
Dc = diameter of smallest circumscribed circle

3. **Sphericity = $(Vo / Vc)^{1/3}$ = $(lwt)^{1/3}$**



Sphericity = D_i / D_c

i.e. Ratio of Geometric mean diameter to major diameter

Vo= Volume of object
Vc= Volume of smallest circumscribed sphere
l = longest intercept
w = longest intercept normal to l
t = longest intercept normal to a and w Note: Vo = [(π/6) lwt] and Vc = [(π/6) l^3]

Slenderness ratio= Ratio of length of rice to width of rice**.** usually used for grading of rice.

Aspect ratio= The **aspect ratio** of ageometric shape is the ratio of its sizes in different dimensions.
Rectangle is the ratio of its longer side to its shorter side
Ellipse, the ratio of the major axis to the minor axis.

Ellipsoid ratio =Major diameter : minor diameter
Flattening (**oblateness**)is a measure of the compression of a circle or sphere along a diameter to form an ellipse or an ellipsoid of revolution **.**
It is the ratio of difference of the major and minor semi-axes to major semi axis

THANK YOU...