Practical Manual
B. Sc. Agriculture
Processing Technology of Cereals
Course No.: ASFE2201
Credit: 3(1+2)
Semester: 6th

Centurion UNIVERSITY
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B. Sc. Agriculture
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Course No.: ASFE2201 Credit: 3(2+1) Semester: 4th

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Certificate

Certified that this is a bonafide record of practical work done by

Mr./ Ms. _____

Regd. No. _____ in B. Sc. (Hons.) Agriculture degree programme, Course No. ASFE2201 entitled "Processing Technology of Cereals" during 4thsemester of the academic year 2019-20.

Date:Faculty In charge

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Practical No: 1

Problem Session on physical properties of cereals

1. Length, breadth and thickness of a rice kernel was measured to be 6.5, 3.2 and 1.8 mm respectively. Determine its sphericity.

2. The bulk density and particle density of wheat sample was determined to be 650 and 800 kg/m^3 respectively. Find the porosity and voids ratio.

3. Volume of a pea was found to be 2700 mm3 by liquid displacement method. Find out its equivalent diameter. Determine the roundness if projected area was measured to be 200mm^2. Determine its sphericity if the radius of the minimum circumscribed circle is 9mm.

4. 25 kg of grain occupied 0.05m^3 space. If the porosity is 60%, determine bulk density and particle density the grain mass.

5. What would be the volume and surface area of a carrot having base and apex diameters 25 and 5 mm, and height of 8 cm?

6. The weight of an apple is 115g. After waxing with a thickness of 1.2mm, the weight was increased to 122g. Determine the surface area of the apple.

Practical No: 2

To determine the physical & frictional properties of cereals

Aim – To determine the bulk density, true density, angle of friction and angle of repose.

Requirement - MeasuringCylinder, Electronic Weighing Balance, Toluene, Grain Samples, Weights

Theory –

1) Bulk Density

The bulk density (ρb) considered as the ratio of the weight of the grain in kg to its total volume in m3.The bulk density of the food grains changes with the change in the moisture content.

Procedure:

1. Weight the grains about 100 g with the help of Electronic Weighing Balance
2. Fill the grains in the measuring cylinder and note down the reading of volume (v1).
3. The bulk density can be calculated using the following formula.

$$\rho_b = \frac{W_s}{V_s}$$

Where,
ρb = bulk density, kg/m3,
Ws = weight of sample, kg and
Vs = volume of the sample i.e., 1000 cc or 10-3 m3

2) True Density

The true density (ρt) defined as the ratio of mass of the sample (W) to its true volume. The true density (ρt) is determined using a (Oil displacement method). Multivolume Pycnometer's oil displacement method provides a rapid means for

precisely determining the true volume of pores, porous materials, and irregularly shaped food grains.

The true density of the grains is found to be decreased with an increase in moisture content as the increase in true volume of the grains is higher compared to the increase in moisture content of the grains. Since, the true density varies with the moisture content of the food grains, the moisture content of the food grains also to be reported.

Procedure:

1. Weight the grains about 100 g.
2. Fill the grains in the measuring cylinder and note down the reading of volume (v1).
3. Afterwards add the sufficient amount of oil in the measuring cylinder due to which the volume get increased then note down the reading of increased volume (v2).
4. The difference between initial and final volume gives the value of displaces volume (v2- v1).
5. Repeat the procedure for three times and take the observations.
6. The average value of all the replications is the actual true density of the materials
7. True density can be calculated using following formula.

$$\rho_t = \frac{W}{V_2 - V_1}$$

Where,

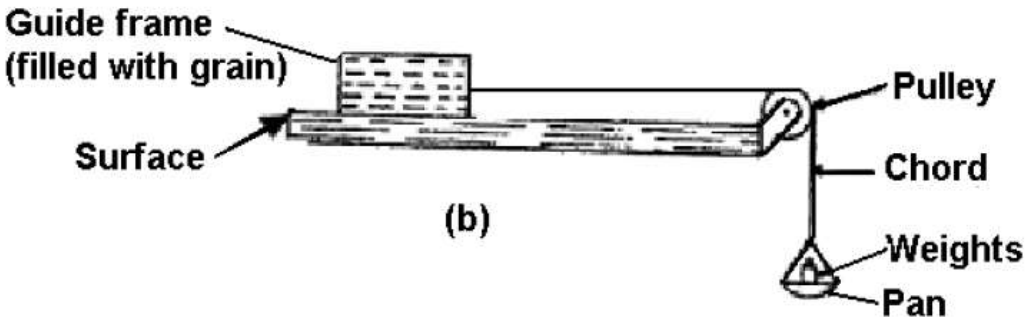
ρ_t =True Density

W=Weight of Grains

$V_2 - V_1$=Volume displaced

3) Coefficient of friction

The ratio of frictional force, parallel to the surface of contact, that opposes the motion of a body which is sliding or rolling over another, to the force normal to the surface of contact, with which the bodies press against each other.

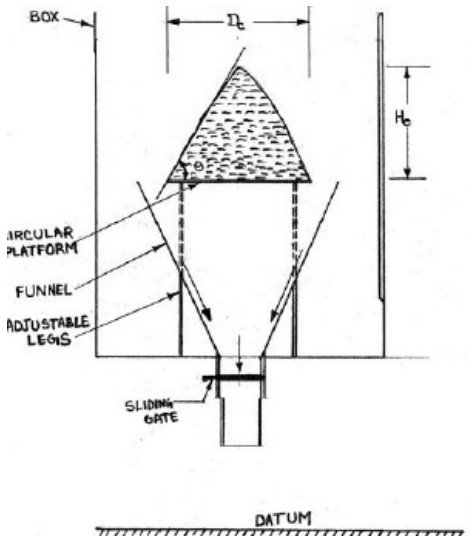


EXPERIMENTAL SETUP FOR COEFFICIENT OF FRICTION

4) Angle of Repose

When a granular material is allowed to flow freely from a point into a pile, the angle which the side of the pile makes with the horizontal plane is called the angle of repose.

The angle of repose is influenced by size, shape, moisture content ad orientation of the particles.



$$\theta = \tan^{-1}\left(\frac{2H_c}{D_c}\right)$$

where,

H_c = height of cone formed measured with depth gauge

D_c = diameter of the platform on which the cone formed

Results -

Bulk density, true density, coefficient of friction, angle of repose of cereals.

Sl. No	Bulk Density	True Density	Coefficient of Friction	Angle of repose
1				
2				
3				
4				
5				
6				

Conclusion –

Practical No: 3

Determination of moisture content of grain by hot air oven method

Aim:-

To calculate the moisture content of food materials by hot air oven.

Requirement: - Food sample, Hot air oven, Empty sample boxes, Weighing balance, Desiccators.

Theory:-

Moisture content:

The weight of water present in the grain expressed in percentage is called as moisture content.

Moisture content determination by oven dried method

Procedure for ground samples of grain:

1) Weighing the empty sample box (W1).
2) Weighing the empty sample box + grains (2-3 grams) (W2).
3) After weighing the samples of grains is placed in an air-oven at 130oC for 1-2 hours.
4) Afterwards, the sample is taken out and placed in desiccators to cool down to room temperature.
5) Weighing the sample after drying (W3).

Procedure for ungrounded samples of grain:

1) Weighing the empty sample box (W1).
2) Weighing the empty sample box + grains (25-30 grams) (W2)
3) After weighing the samples of grains is placed in an air-oven at 100oC for 72-96 hours.
4) Afterwards, the sample is taken out and placed in desiccators to cool down to room temperature.
5) Weighing the sample after drying (W3).

$$\% \text{ Moisture content} = \frac{W_2 - W_1}{W_3 - W_1} \text{ X } 100$$

Moisture content can be represented by two methods:

1) Wet basis moisture content (w. b.)
2) Dry basis moisture content (d. b.)

1) Wet basis moisture content:

The moisture content in this method is represented by the following expression,

$$\% \text{ Moisture content (wb)} = \frac{\text{weight of water in product}}{\text{Weight of product sample}} \times 100$$

2) Dry basis moisture content:

It is represented on the basis of dry weight of product. The dry basis moisture content determined by the following expression,

$$\% \text{ Moisture content (db)} = \frac{\text{weight of water in product}}{\text{Weight of dry matter of product sample}} \times 100$$

The value of dry basis moisture content is always more than the wet basis moisture content.

Results-

Moisture content of grain samples:

Sl. No	Grain Samples	% Moisture Content	% Moisture Content (wb)	% Moisture Content (db)
1				
2				
3				
4				
5				

Conclusion -

Practical No: 4

To study about Parboiling of Paddy

Aim:-

To study parboiling of paddy

Requirement: - Parboiling unit, Paddy

Theory:-

Parboiling:Parboiling is a hydrothermal treatment followed by drying before milling for theproduction of milled parboiled grain. The three major steps in parboiling are soaking, steaming and drying.

Soaking of paddy is done at or below the gelatinisation temperature. The lower the temperaturethe slower is the process of soaking and vice versa.Soaking time can be reduced by subjecting the paddy to vacuum before soakingand or soaking under pressure in hot water. Steaming helps in the gelatinisation of starchin the paddy. The higher the temperature of steam and longer the steaming time, theharder is the rice and darker the colour. Drying of parboiled paddy may be done in theshade, in the sun, or with hot air. Shade drying takes a longer time but results in excellentmilling quality. Rapid drying in the sun or with hot air causes higher breakage duringmilling. In continuous drying, breakage starts as the moisture content reaches about 18per cent and increases rapidly with further drying. Hence the recommended practicewould be to dry in two passes with a tempering in between at about a moisture content of20 per cent. Normally, the varieties of paddy which are more brittle are preferred forparboiling. The long and slender varieties which are more fragile compared with shortand medium length grains are usually parboiled. Scented and tiny varieties which havegood milling quality are generally not parboiled.

Procedure:-

Paddy

↓

Cleaning

↓

Soaking in hot water for 3 h (70 ^{0} C)

↓

Draining the water

↓

Steaming

↓

Shade drying (2-4 h)

↓

Dried paddy (15 % moisture)

After drying the moisture content in paddy was measured using hot air oven method.

Result:-

Sl. No	Weight of grain taken for parboiling	Weight of grain before drying	Weight of grain after drying	Moisture content (%)

Conclusion -

Practical No: 5

To study the cooking quality of rice

Aim:-

To study the cooking quality of rice

Requirement: - White rice, Beaker, Stirring rod, Hot plate

Theory :-

Water Uptake Ratio :

This was determined by cooking 2.0 g of whole rice kernels from each treatment in 20 ml distilled water for a minimum cooking time in a boiling water bath and draining the superficial water from the cooked rice. The cooked samples were then weighed accurately and the water uptake ratio was calculated as the ratio of final cooked weight to uncooked weight. Water uptake ratio = (weight of cooked rice) / (weight of uncooked rice sample).

Solids in Cooking Water :

This was determined by drying an aliquot of the cooking water in a tarred evaporating dish to evaporate the water as steam. The weight of the empty Petri dish was measured and recorded (W_1). This was followed by measuring the weight of the Petri dish and aliquot (W_2). The weight of the Petri dish and the dry aliquot was measured (W_3). The amount of solid in cooking water was now calculated as: $W_3 - W_{1;}$ where W_1 = weight of empty Petri dish, W_2 = weight of empty dish + dry aliquot (W_3).

Cooking time :

This was determined by boiling 2.0 g of whole rice kernels from each treatment in 20 ml distilled water, removing a few kernels at different time intervals during cooking and pressing them between two glass plates until no white core was left. Optimum cooking time was taken as the established cooking time plus two (2) additional minutes.

Grain Elongation during Cooking :

This was determined by first measuring the initial grain length (L_0) before cooking. The final length (L_0) after cooking was then measured. The grain elongation during cooking was then calculated as: $L_1 – L_0$, where L_0 = initial grain length before cooking, L_1 = final length after cooking.

Results :-

Weight of cooked rice	Weight of uncooked rice sample	Water uptake ratio

Solids in Cooking Water =$W_3 – W_1$=

$W_1 = W_2 = W_3$ =

Cooking time =

Grain Elongation= $L_1 – L_0$

$L_0 = L_1$ =

Conclusion :-

Practical No: 6

Production of popcorn using microwave heating

Aim:-

To study the popping characteristics of corn using microwave heating

Requirement: - Microwave, Petridish, Corn, Oil

Theory :-

Each kernel of popcorn contains a certain amount of moisture and oil. Unlike most other grains, the outer hull of the popcorn kernel is both strong and impervious to moisture and the starch inside consists almost entirely of a hard type. As the oil and water within the kernel are heated, they turn the moisture in the kernel into pressurized steam. Under these conditions, the starch inside the kernel gelatinizes, softens, and becomes pliable. The internal pressure of the entrapped steam continues to increase until the breaking point of the hull is reached: a pressure of approximately 135 psi (930 kPa) and a temperature of 180 °C (356 °F). The hull thereupon ruptures rapidly and explodes, causing a sudden drop in pressure inside the kernel and a corresponding rapid expansion of the steam, which expands the starch and proteins of the endosperm into airy foam. As the foam rapidly cools, the starch and protein polymers set into the familiar crispy puff.

Procedure:-

1) Take three samples of 8 gms weight.
2) Place the samples in microwave in time intervals of 60, 90, 120 secs.
3) Take the weight of fully popped, semi-popped and unpopped samples.
4) Calculate the popping yield.

Popping yield = $(W_{fpg}) / (W_{fpg} + W_{spg} + W_{upg}) * 100$

Where,

W_{fpg}= weight of fully popped corn

W_{spg} =weight of semi popped corn

W_{upg}=weight of un popped corn

Tabulation :-

Sl. No	Weight of samples	Microwave Power	Time of Treatment	W_{fpg}	W_{spg}	W_{upg}	Popping Yield
1							
2							
3							

Conclusion:-

Practical No: 7

Preparation of puffed rice and flaked rice

Aim:-

To prepare puffed and flaked rice

Requirement: - Paddy, White Rice, Distilled water, Pan, Sand, Rice Flaker

Theory:-

Puffed rice popularly known as “murmuralu” is an Indian snack rich in protein, fiber, vitamins and minerals. It is free from fat & sodium and low in calories. Puffed rice is used in snack foods and breakfast cereals, and is also a popular street food in some parts of the world. It is an ingredient of bhelpuri, a popular Indian chaat item. It is also used in temples and gurudwaras as prasad. A traditional puffed rice called muri is made by heating rice in a sand filled oven. Muri is to rice as popcorn is to corn.

Flaked rice popularly known as “poha”. Rice flakes are produced in largequantities, both on a cottage industrial scale and on a commercial scale in India. Rice flake is a precooked product and can be readily reconstituted by soaking in warm water for 20 minutes. It is widely used in India for the preparation of snacks.

Procedure:-

Paddy is soaked in water to increase the moisture content to about 20%. The moist paddy is puffed by subjecting to sudden heat treatment at 250-270^{0}C for 30-40 sec. The husk splits off and the rice is puffed.

The paddy is soaked in hot water at 70-80^{0}C for about 20 minutes.The water is drained off. The soaked paddy is toasted in a pan at about 250-275^{0}C till afew grains start puffing. The toasted paddy is immediately subjected to flaking by eitherpounding with a heavy iron pestle or with a heavy iron roller. The husk is

pulverizedduring the flaking process. Rice flake is a precooked product and can be readily reconstituted by soaking in warm water for 20 minutes.

Results:-

Conclusion:-

Practical No: 8

Preparation of sorghum flakes

Aim:-

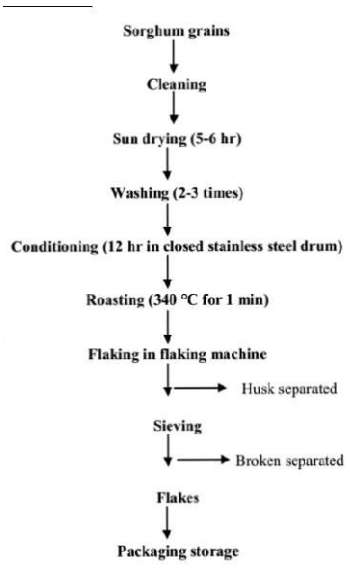
To prepare flaked sorghum

Requirement: -Sorghum, Distilled water for conditioning, Roasting machine, Flake making machine, Sieve

Theory:-

Sorghum (*Sorghum bicolour*L. Moench) is one of the major cereal crop consumed in India after rice and wheat. Sorghum is commonly called as jowar or great millet. The crop is primarily produced in Maharashtra, Karnataka and Andhra Pradesh. 100 g of Sorghum gives 349 Kcal energy, 9.6 per cent protein, 3.8 per cent fat, 73.2 per cent carbohydrates, 2.4 per cent ash and 11 per cent moisture content.Sorghum is totally free from gluten, contains more fibre and micronutrients.Processed food products of sorghum for human consumption are emerging such as *flakes, pasta, vermicelli, semolina* etc. Ready to eat products like *flakes* are very popular being crisp and friable in texture. Cereal *flakes* are one of the most popular type of ready to eat cereals. Therefore, suitable processing techniques are required to produce *flakes* from sorghum.

Procedure:-



Calculation:-

1. **Flakes (%):**

$$Flakes(\%) = \frac{Amount\ of\ flakes}{Total\ amount\ of\ clean\ sorghum} \times 100$$

2. **Broken (%)**

$$Broken(\%) = \frac{Amount\ of\ broken}{Total\ amount\ of\ clean\ sorghum} \times 100$$

3. **Husk (%)**

$$Husk\ (\%) = \frac{Amount\ of\ husk}{Total\ amount\ of\ clean\ sorghum} \times 100$$

Tabulation:-

Sl. no	*Flakes* (%)	Broken (%)	Husk (%)
1			
2			
3			
4			

Results:-

Conclusion:-

Practical No: 9

Estimation of milling qualities and milling efficiency in a rice mill

Aim:-

To estimate milling quality and efficiency of rice mill

Requirement: -Paddy, Rubber Roll Sheller, Weighing Balance

Theory:-

The objective of a rice milling system is to remove the husk and the bran layers from paddy rice to produce whole white rice kernels that are sufficiently milled, free of impurities and contain a minimum number of broken kernels.

Rice milling can be undertaken as:

- A one step milling process where the husk and the bran are removed in one pass and white rice is produced directly from the paddy.
- A two-step process where the husk and the bran are removed separately, and brown rice is produced as an intermediate product.
- A multistage process where rice passes through a number of different operations and machines from paddy to white rice.

Procedure :-

1) Take approx. 100 gms of paddy.
2) Mill the paddy in dehuller/ sheller.
3) Take the weight of unhulled& hulled paddy, weight of husk by weighing balance.

Calculations :-

1. Foreign matter, % $= \frac{\text{weight of foreign matter}}{\text{total weight of paddy}} \times 100$

2. Grass and weed seed, % $= \frac{\text{weight of grasses and weed seeds}}{\text{total weight of paddy}} \times 100$

3. Dead and immature grain, % $= \frac{\text{weight of dead and immature grains}}{\text{total weight of paddy}} \times 100$

4. Broken grains, % $= \frac{\text{weight of brokens}}{\text{weight of paddy}} \times 100$

5. Husked rice, % $= \frac{\text{husked grains}}{\text{total weight of paddy}} \times 100$

6. Milling recovery, % $= \frac{\text{weight of total rice}}{\text{total weight of paddy}} \times 100$

7. Head rice, % $= \frac{\text{weight of head rice}}{\text{weight of milled rice}} \times 100$

8. Broken rice, % $= \frac{\text{weight of broken rice}}{\text{weight of milled rice}} \times 100$

Milling efficiency, % = Coefficient of hulling × coefficient of wholeness of kernel × 100

Coefficient of hulling $= \frac{\text{weight of brown rice}}{\text{weight of paddy fed to machine}} \times 100$

Coefficient of wholeness $= \frac{\text{weight of brown head rice}}{\text{weight of total brown rice}} \times 100$

Results :-

Conclusion :-

Practical No: 10

Preparation of noodles

Aim:-

To prepare noodles using general flour

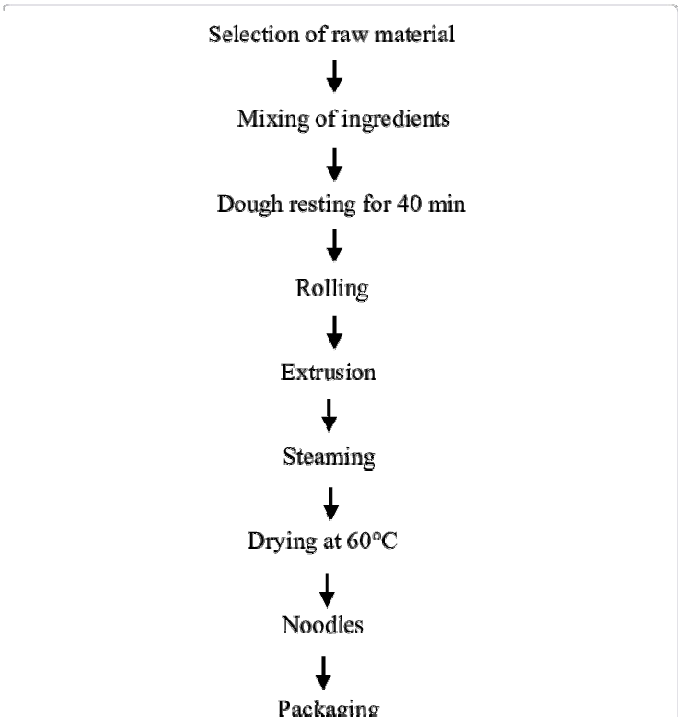
Requirement :-Water, Flour, Roller, Knife, Oven

Theory :-

Noodles are a type of food made from unleavened dough which is rolled flat and cut, stretched or extruded, into long strips or strings. Noodles can be refrigerated for short-term storage or dried and stored for future use.

Noodles are usually cooked in boiling water, sometimes with cooking oil or salt added. They are also often pan-fried or deep-fried. Noodle dishes can include a sauce or noodles can be put into soup. The material composition and geocultural origin is specific to each type of a wide variety of noodles. Noodles are a staple food in many cultures

Procedure :-



Results:-

Conclusion:-