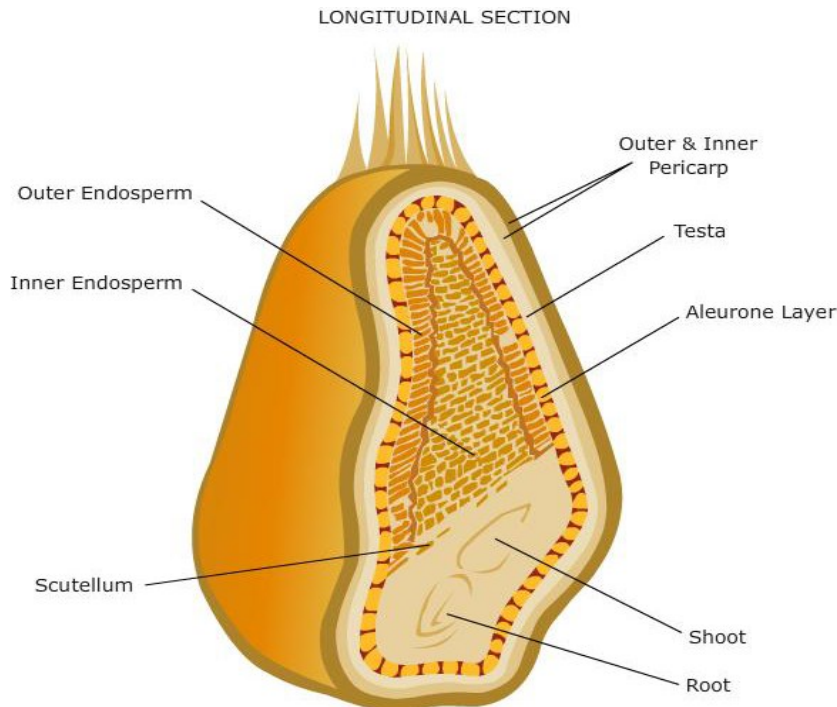


# Session 4.3 – Wheat, Corn, Oats Milling

# Wheat Milling



Wheat structure

## Introduction

Genus : *Triticum* of the grass family

Gramneae

Major wheat variety: Common wheat (*Triticum aestivum*) and durum wheat (*Triticum durum*)

Wheat is classified into two groups: hard and soft.

## Wheat Processing

**Storage** : Moisture 20% before harvesting and then storage at >12.5%

## Milling

Objective is to grind cleaned and tempered wheat by separating husk and endosperm

Hand grinding, grinding stones, mortal and pestle, millstones, metal rollers

Cleaning

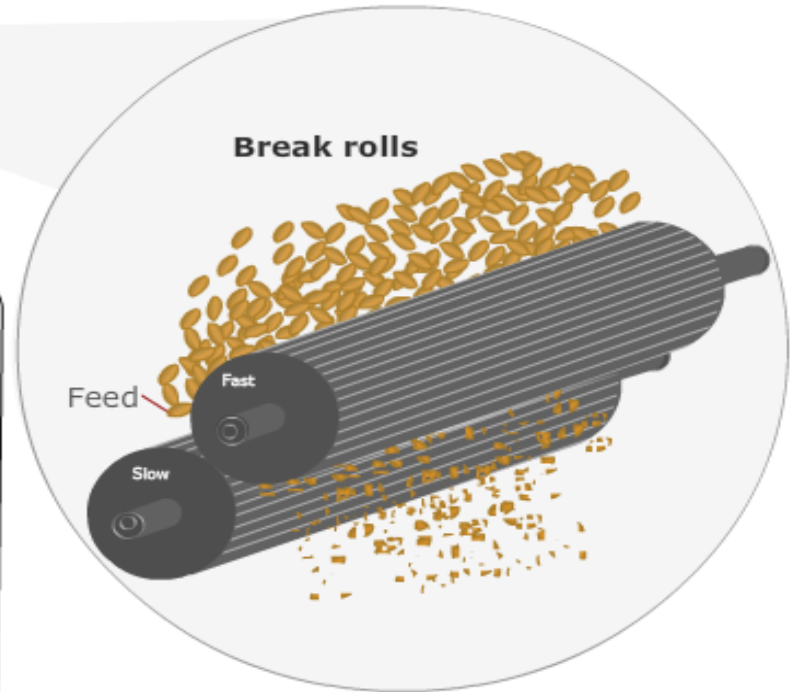
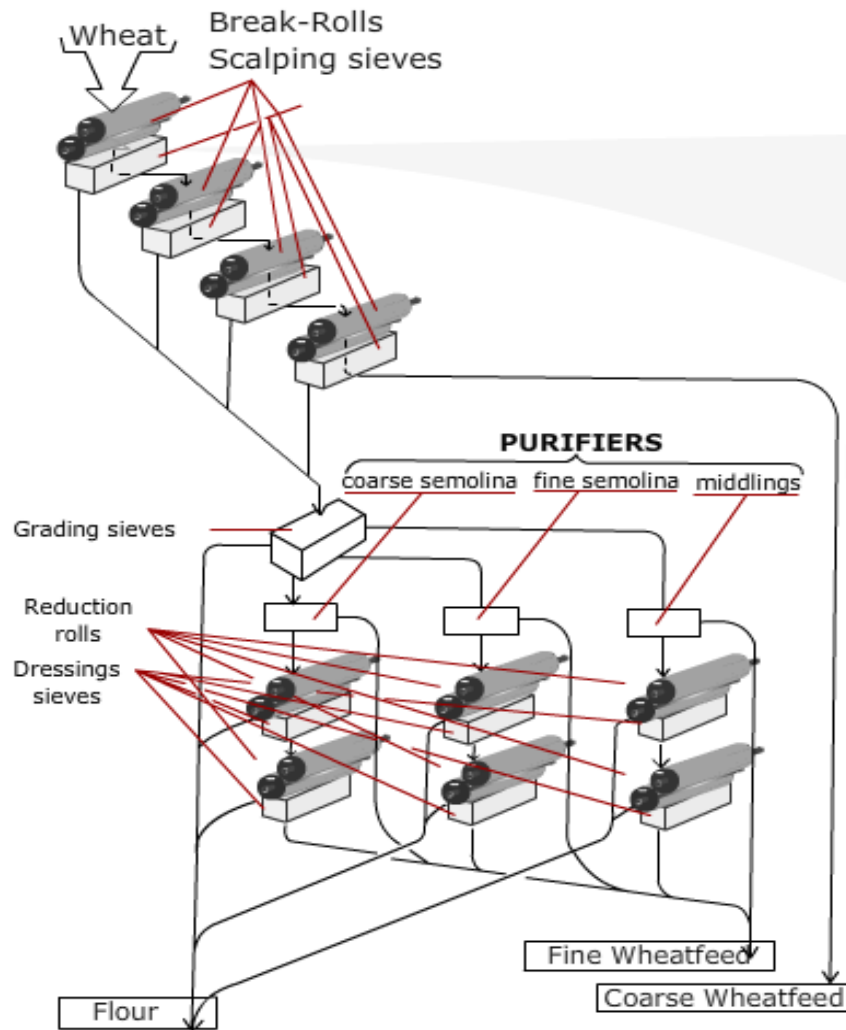
Conditioning/Tempering

Milling/separation of flour

# Flour Milling

- The objective of modern flour milling is to obtain the maximum amount of white flour from the wheat endosperm without any bran or germ content.
- Wheat consists of bran (12%), germ (3%), and endosperm (85%).
- Milling of wheat into flour essentially involves a series of grinding and sifting operations with in between purification of granular endosperm particles
- Modern flour milling consists of seven steps: (1) receiving, drying, and storage of wheat; (2) cleaning; (3) conditioning; (4) milling into flour and by-products; (5) packaging and storage of finished products; (6) blending; and (7) milling by-products.

## Wheat Milling



# Components of a Wheat Mill

- **Break Roll** – Break roll consists of twin pairs of corrugated steel rolls. One roll of a pair revolves faster than the other, differential speed being in the proportion of 2.5 to 1.
- **Break Sifting System** – This can be divided into two parts—plan sifter and purifier.
  - Plan sifter* – Plan sifter is a scalping system removing large bran pieces adhering with endosperm at the top. The next series, which are finer, remove the bran and germ. The next layer of still finer sieve removes the endosperm middling and the bottom rough flow.
  - Purifier* – The middling containing finer bran particles are removed by the purifier before they move to reduction roll.
- **Reduction Roll** – The reduction roll comprises two smooth rolls. The rolls in the reduction system are further divided into coarse and fine rolls, depending on the clearance between the rollers.

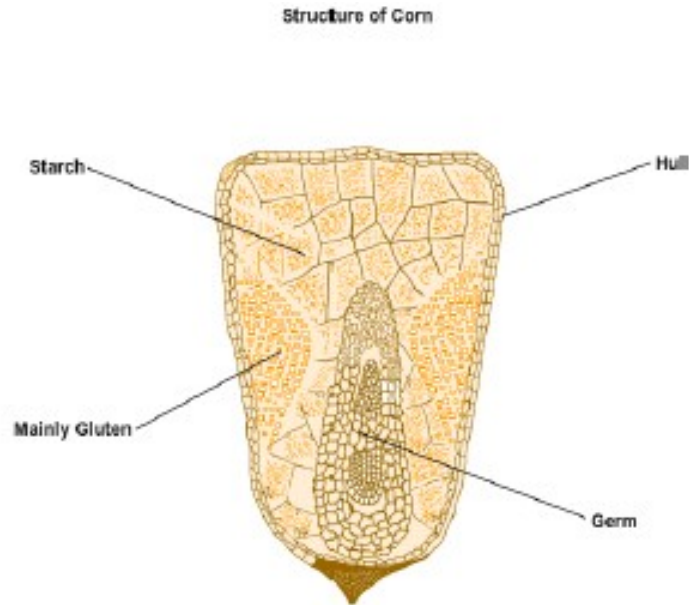
- **Reduction Sifting System** – The same plan sifting system is used here. After each reduction, the product is separated by plan sifters where the finished flour is sifted by 120 mesh sieve (silk) and removed and oversized material is sent back to the reduction rolls for further processing
- **Scratch System** – If the mill is functioning properly, i.e., a good release of endosperm is obtained on the break rolls, the scratch system can be bypassed; if not, the scratch system is employed to maintain proper release of endosperm from bran. The scratch system is an extension of the break system and thus used as a standby system only

# Corn Milling

- Corn is one of the world's most versatile seed crops. Botanically named *Zea mays*, corn is used as food and feed. Corn can be processed into various food and feed ingredients, industrial products, and alcoholic beverages.
- Two modern methods of milling of corn: **dry milling, and wet milling**
- Besides germ for corn oil extraction and hull and deoiled germ, etc., for feed, grits (mainly used for breakfast cereals) are the main products of corn dry milling, whereas pure starch, germ, and feed are the major products of wet milling

# Corn composition and structure

- The mature corn kernel is composed of four major parts: (1) endosperm (82%); (2) germ (12%); (3) pericarp (5%); and (4) tip cap (1%).





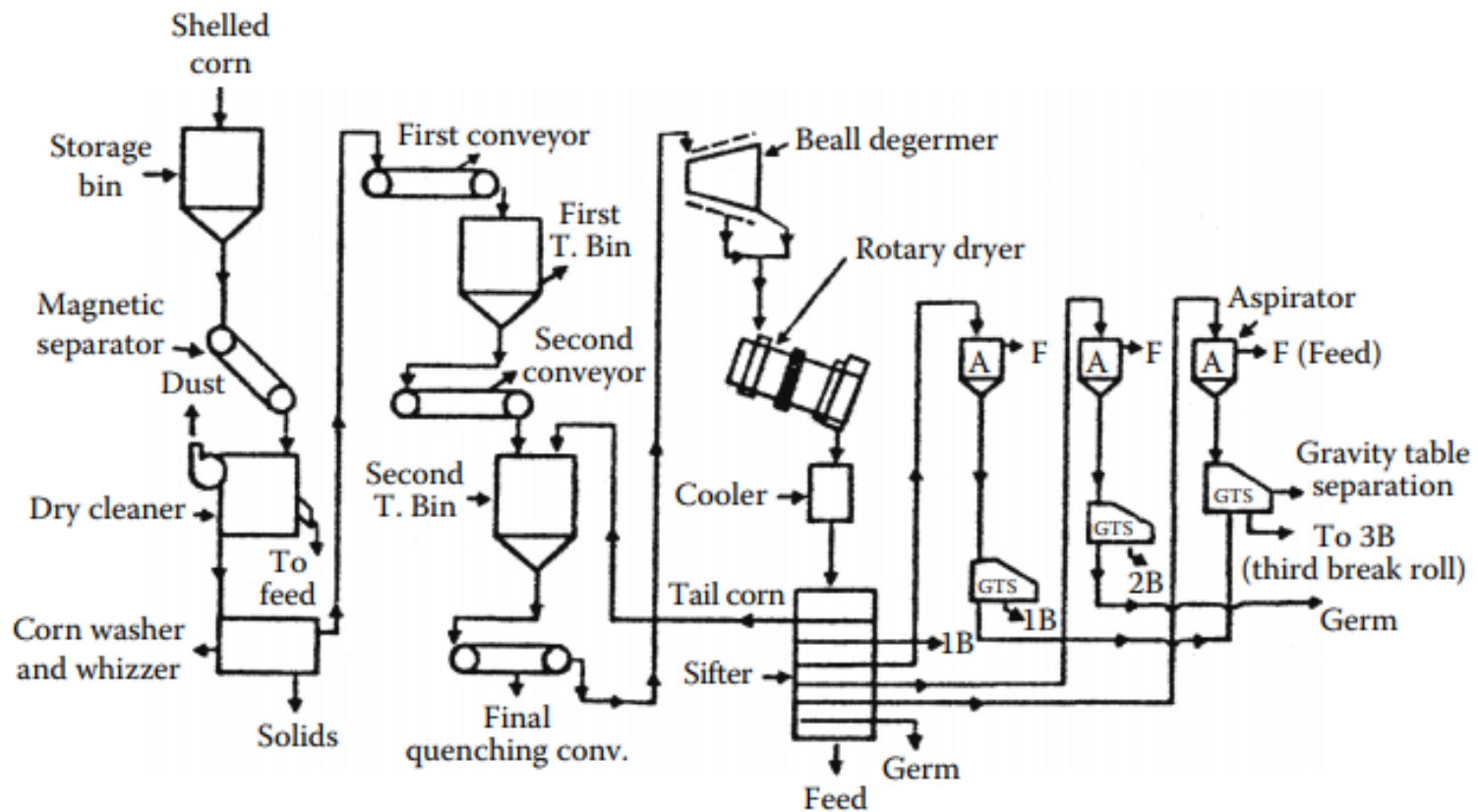
# Corn Dry Milling

- Tempering–Degerming (TD) Method of Dry Milling

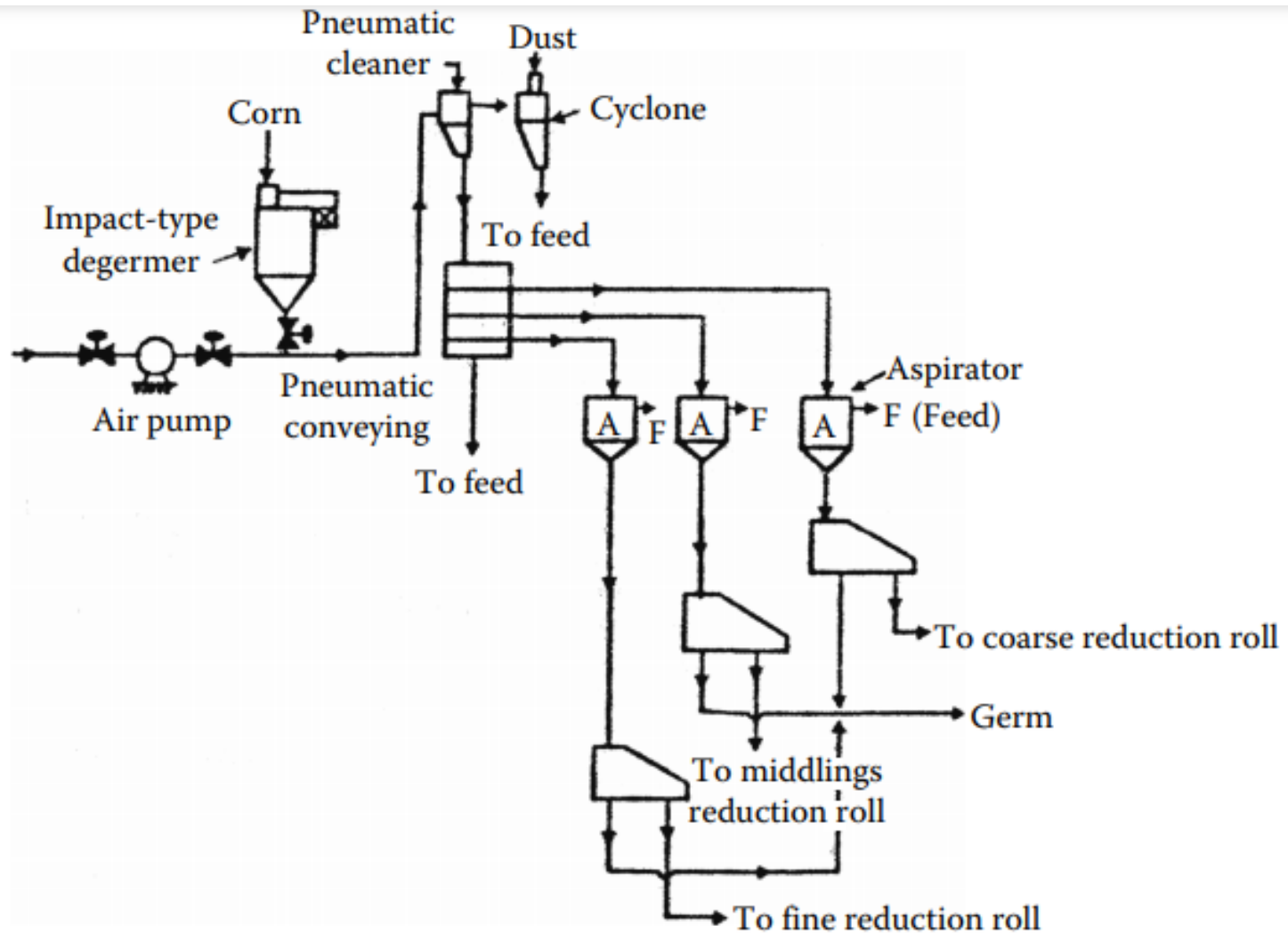
The major objectives of this method are (a) to remove essentially all germ and hull so that endosperm contains as low fat and fiber as possible, (b) to recover a maximum amount of the endosperm as large clean grits without any dark speck, and (c) to recover a maximum amount of germ as large and pure particles.

# Steps in TD method

- Cleaning of the corn
- Conditioning of the corn by addition of control amount of moisture either at ordinary temperature or at an elevated temperature to toughen the germ and husk and facilitate their removal from the endosperm
- Releasing hull, germ, and tip cap from the endosperm in a degermer
- Drying and cooling the degermer products obtained from the degermer
- Fractionating degermer stock by multistep milling through a series of machines, namely, roller mills, sifters, aspirators, gravity table separators, and purifiers, to separate and recover the various products
- Further drying of the products as and when necessary
- Blending and packaging of products



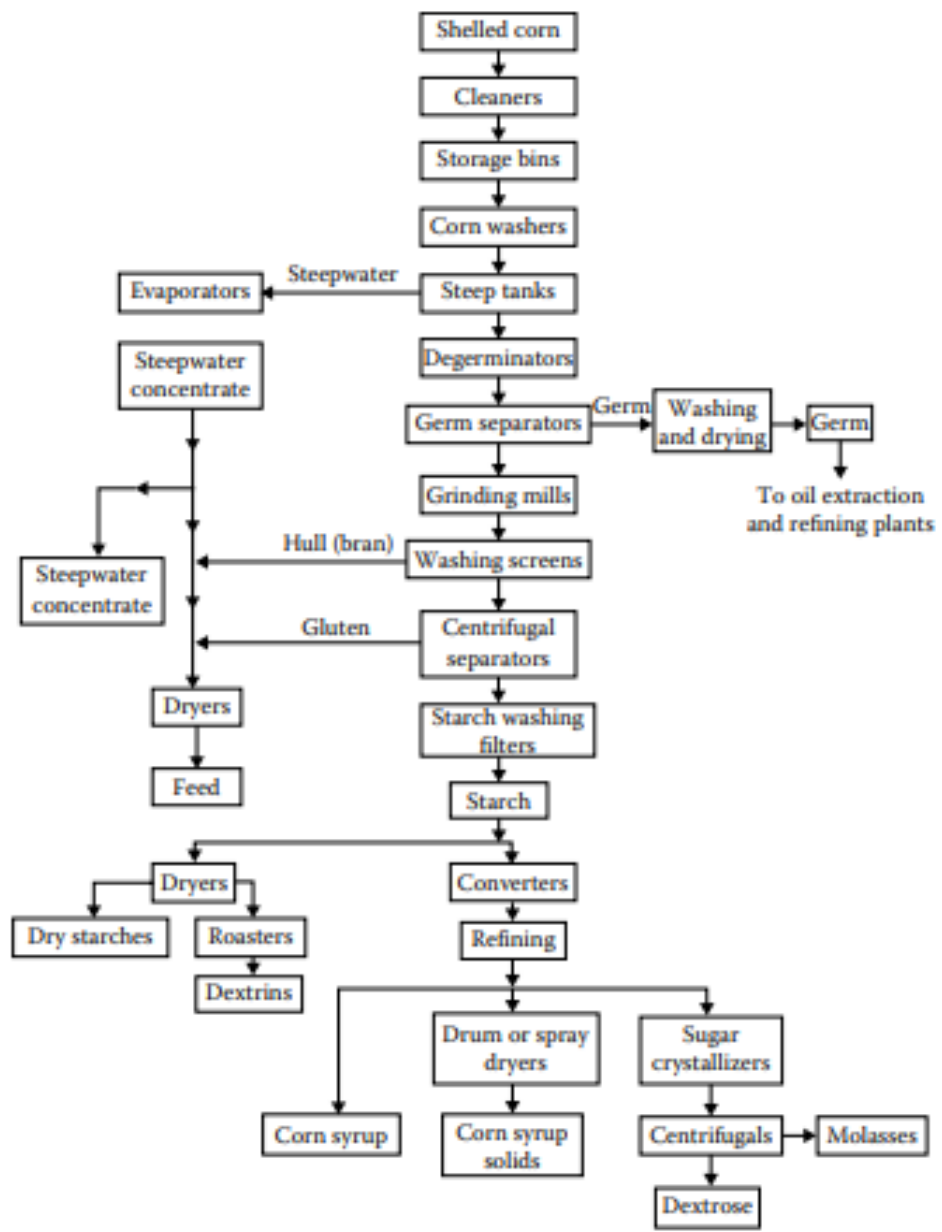
Flow diagram for TD-type corn mill.



**Flow diagram for Miag process.**

# Corn Wet Milling

- The raw corn for wet milling should contain 15%–16% moisture and it should be physically sound
- The wet milling process consists of the following steps: (a) cleaning; (b) steeping; (c) germ separation and recovery; (d) grinding and hull recovery; and (e) separation of starch and gluten.



Flow diagram of corn wet milling and refining processes.

# Oat Milling

- The whole oat usually consists of 65%–75% caryopsis and 25%–35% hull. An oat kernel contains about 56%–68% starchy endosperm.
- After separation of hulls, the oats are called groats, which apparently resemble wheat kernels. The oat groats are characterized by their high fat and protein contents. These also contain an active lipase enzyme that is to be denatured or inactivated; otherwise, rancidity in the milled products may develop as they have a short shelf life.
- The operations carried out for milling of oats are (i) cleaning; (ii) drying and cooling; (iii) hulling; and (iv) cutting and flaking.

- The clean oats are heat treated and partially dried by indirectly heating the oats with steam at about 90°C–95°C for about 1 h in large open pans to bring down their moisture to a level of 7%–10% and the dried products are then cooled. The heat treatment imparts a desirable roasted flavor to the oats, inactivates lipase, as well as makes it easy to remove the hull.
- The treated oats are then separated by size with the help of disk separators. These are dehulled using an impact type of huller.
- The groats are separated from the unhulled ones by using disk and paddy separators.
- Steamed groats are allowed to pass through the rolls rotating at 250–450 rpm in order to roll into flakes for the production of old-fashioned rolled groats or thin flakes.
- The steamed cut groats are ground with impact-type hammer mill and the ground products are then sifted to have the desired oat flour