# Crop quality

**Lecture-3**

# The physical & chemical characteristics of wheat and its relationship to qualitative characteristics

# 1-Test Weight

- Is a measure of the volume of grain per unit. It is usually expressed as kilograms per hectoliter and is a good indication the integrity of the grain.

-This test is one of the most important and simplest common physical tests for evaluating the quality of grains and the possibility of using it as an approximate indicator of the amount of flour produced after grinding wheat, and it is expressed in units of kg/ hectoliter

-The grains damaged(un full) or infected with insects or as a result of unsuitable climatic conditions give low test weight values, which reduces the amount of flour produced

- **The test weight is also a measure of “the safety of wheat, as healthy wheat is full, complete and free from the broken grain. Therefore, there is a positive relationship between the test weight and the yield of the flour, and that the values of the test weight are affected by a number of measures such as the size and shape of the grain, temperature, dryness, freezing and diseases .**
- **However, the lower values of the test weight may be due to the inappropriate time of harvesting.**

## TABLE 2 TYPICAL GRAIN BULK DENSITIES PER CUBIC METRE

| GRAIN | BULK DENSITY (t/m³)* |
|---|---|
| Wheat | 0.80 |
| Canola | 0.67 |
| Barley | 0.68 |
| Triticale | 0.62 |
| Sorghum | 0.73 |
| Maize | 0.72 |
| Lupins | 0.80 |
| Mung beans | 0.75 |
| Sunflower seed | 0.42 |
| Cotton seed | 0.40 |

* Note: Vary according to moisture content and variety.

Source: Kondinin Group

# 2-1000 grain Weight (TGW)

-Thousand **grain** weight (TGW) is an important parameter for the evaluation of grain yield. The traditional measurement method relies on manual steps: counting and weighing

-The weight rates of a thousand grains express the density of the grains and are measured (in grams).

-Usually the grains with high weight and density contain higher rates of endosperm and other structural components than in the low-weight grains.

-The weight of a thousand grains is one of the approved and important measures that accompany the test weight of grains.

-The small grain size gives Less yield compared to the large grain because the ratio of the endosperm to the bran is low.

**-This test is also an indication of the size, shape and purity of the grain, as well as a measure of grain density.**

**-It was found that good and appropriate environmental conditions for the growth of the crop positively affect the growth of a crop with full grain and high density.**

**- The weight of a thousand grains is negatively related with the height of the plant while it is positively correlated with the period of filling of the grain.**

# 3-The degree of hardness of the grain kg $cm^{-2}$

- The method of measuring the degree of hardness usually includes measuring the pressure required to break the grain and it is measured in (kg / cm2) .

- Many measures are related to the hardness of the grain as the percentage of the resulting broken starch and the absorption of water increases with the increase in the degree of hardness of the grain and this affects the characteristics of the dough and the quality of the final product.

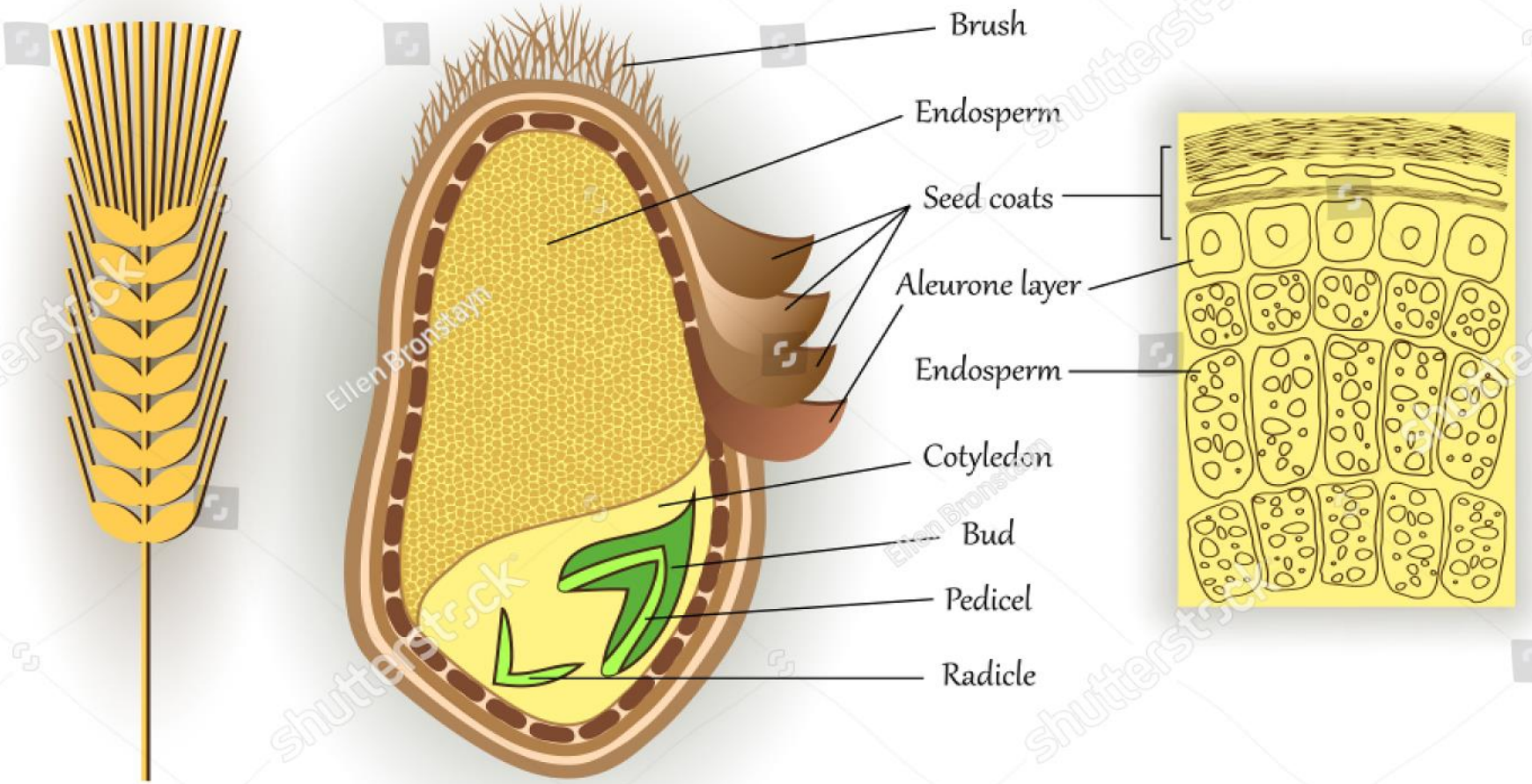
- In addition, the moisture content of the grain affects the measurement of the degree of hardness, as the degree of hardness decreases with an increase in the moisture content of the grain.

-The degree of hardness determines whether the wheat is of the soft or hard type.

-Usually, the higher types of wheat have a higher degree of hardness, higher water absorption.

-The hardness depends on the strength of bonding between the starch and protein grains.

# STRUCTURE OF WHEAT GRAIN



# 4–Vitreousness

- **Vitreousness a characteristic of distinguishing wheat grains by their hardness and shiny appearance.**
- **The reason for the Vitreousness of the grains may be due to the rapid thickening of the cell wall and the prevention of the leakage of starch granules into the aleurone layer.**
- **It is usually related to the protein content. The decrease in Vitreousness is accompanied by a -decrease in the protein content.**
- **The darkness of the grains is due to the presence of free starch. grains in the Aleurone layer outside the endosperm tissue.**
- **Also, part of the grain may be Vitreousness and the other part is not Vitreousness.**

- **-The Vitreousness of the grain increases when nutrients are available to the plant during the period of filling the grain and indicates a high percentage of protein in the grain, and as a result, the grain has a hard endosperm.**

# 5-Grains color

-Color is one of the quality factors associated with the consumer's choice of the final product.

-Instruments were used to measure color and determine color values.

-Recently used a computer compared to common and traditional devices that cannot identify or distinguish dark spots that affect consumer acceptance of the final product.

# Qualitative and chemical tests for grains

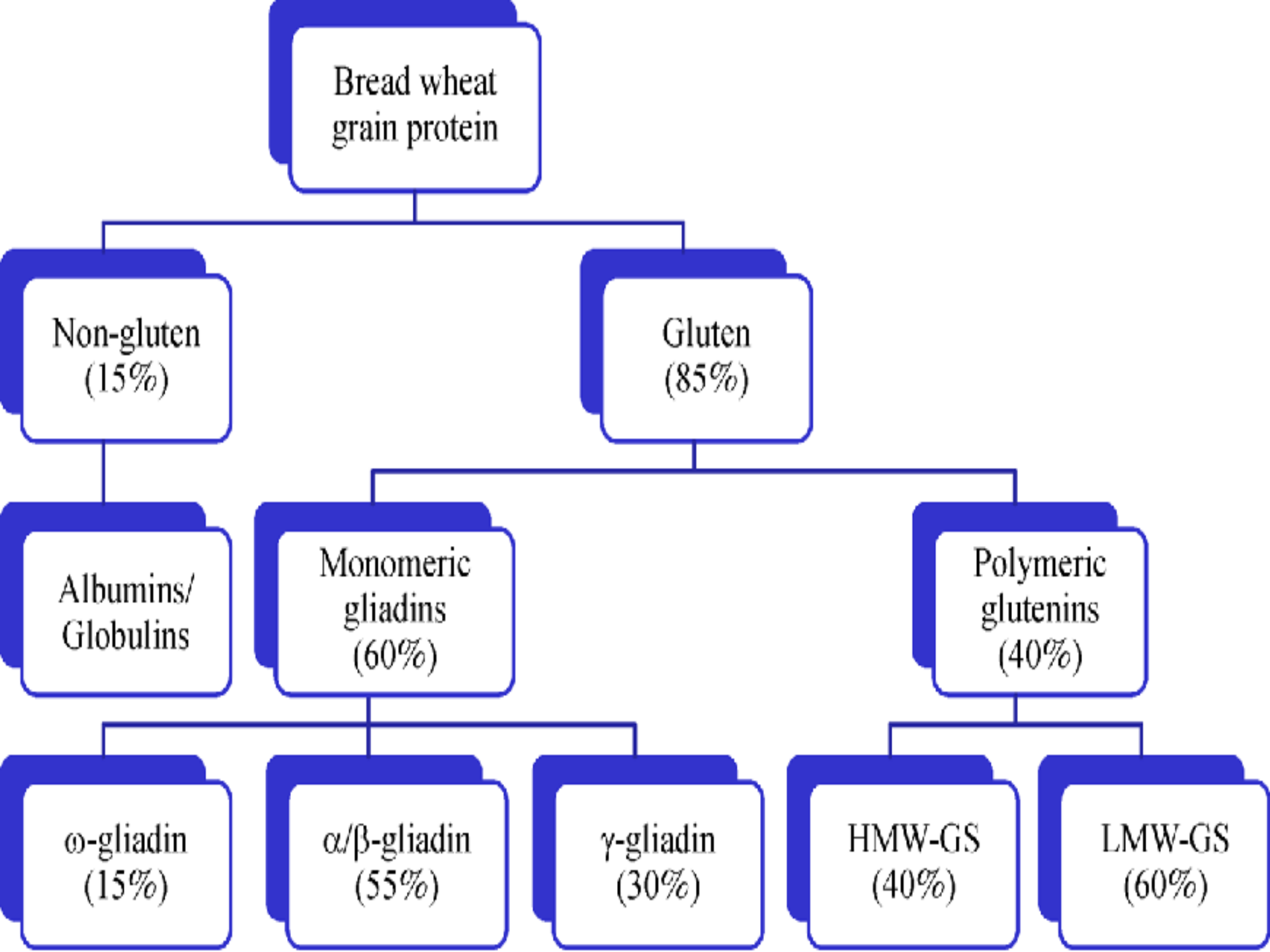
**The quality of grain has become an important factor in the global grain trade. Therefore, plant breeders have increased their interest in improving the desirable quality characteristics of grain varieties, in addition to improving the varieties for resistance to agricultural pests and environmental conditions.**

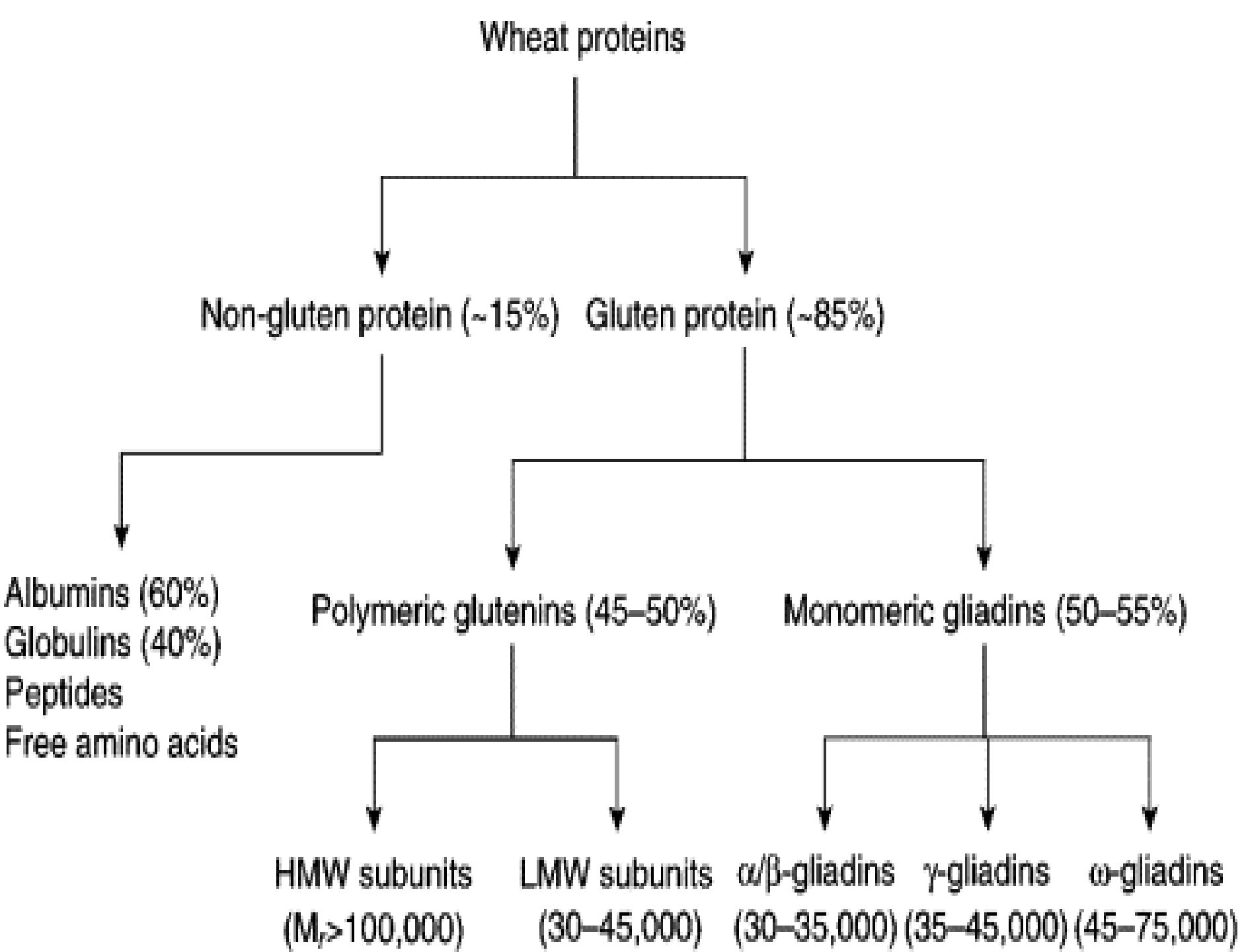
- **The qualitative tests for grain include the use of several tests for a large number of samples, which results in a large amount of results. Therefore, the use of the computer has become an essential basis in the analysis, as several systems have been developed for the purpose of conducting qualitative tests for wheat.**
- **-In recent years, the Near Infrared reflectance spectroscopy (NIRS) was used, and it is one of the devices used to measure protein content, moisture, and color.**
- **It is one of the quick method that can carry out several examinations without using chemicals. When comparing the results with traditional methods, it was found that the standard error was very little.**

# 1-Total protein

- -Most of the studies showed that the percentage of total protein in wheat depends on the variety, order, and environmental conditions as well as on agricultural operations during the growing season.
- -Rainfall during the maturity period of the grain leads to a decrease in the percentage of total protein.
- -As for high temperatures and drought during the maturity period of the grain leads to a high percentage of protein.

- **The content and quality of protein are important in determining the importance of wheat varieties and their uses.**
- **The main component of protein in wheat is gluten, which consists of glutinin and gliadin. The first gives the dough elasticity and strength, while the second gives viscosity.**
- **Environmental conditions play a greater role than genetic changes in influencing protein content.**
- **Among the environmental factors that affect protein content are soil quality and the Crop rotation to increase soil fertility, especially the use of legumes and nitrogen fertilizer, as well as rain, heat and drought, as we mentioned previously.**


Bread wheat grain protein
Non-gluten (15%)
Gluten (85%)
Albumins/ Globulins
Monomeric gliadins (60%)
Polymeric glutenins (40%)
ω-gliadin (15%)
α/β-gliadin (55%)
γ-gliadin (30%)
HMW-GS (40%)
LMW-GS (60%)


Wheat proteins
Non-gluten protein (~15%)
Gluten protein (~85%)
Albumins (60%)
Globulins (40%)
Peptides
Free amino acids
Polymeric glutenins (45–50%)
Monomeric gliadins (50–55%)
HMW subunits
(Mr>100,000)
LMW subunits
(30–45,000)
α/β-gliadins
(30–35,000)
γ-gliadins
(35–45,000)
ω-gliadins
(45–75,000)

# 2-The ratio of wet and dry gluten

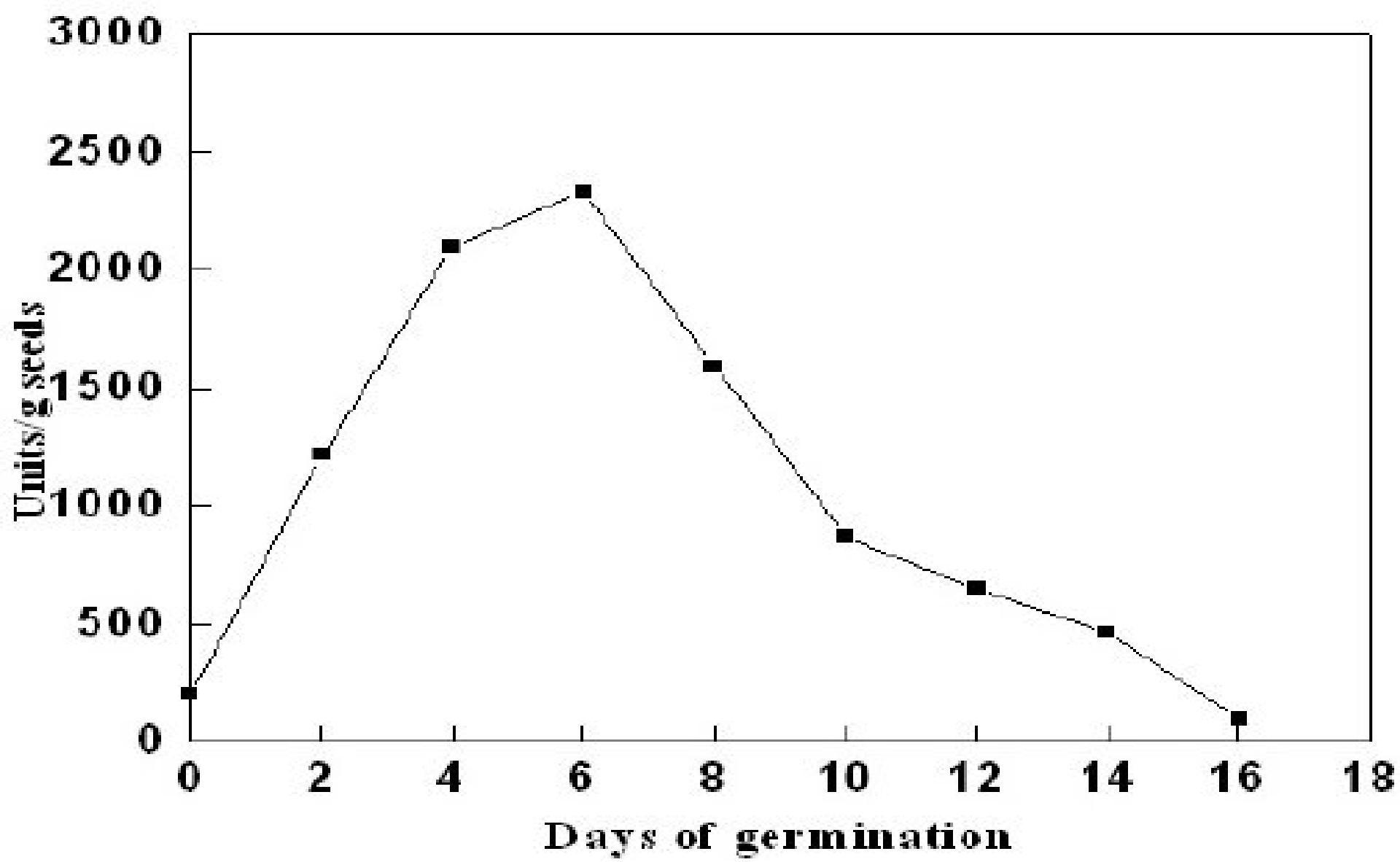
- The percentage of gluten is 85% of wheat proteins and it is of great importance in determining the nature of the gluten.
- Gluten consists of **compounds of large molecular weight, glutenin**, and its characteristics are that it is resistant to expansion and low viscosity, and **compounds of low molecular weight are gliadin**, and its characteristics are elastic and high viscosity.
- The amount of gluten in flour is an indicator of its protein content, and the amount of both wet and dry gluten increases with an increase in the protein content in the flour.
- It is not only the quantity of gluten that is important, but its quality as well, as they are the determinants of the quality of the dough.

- It was found that the date of planting affects the quality of gluten through the temperature during the period of filling the grain.
- Delaying the date of planting makes the period of filling the grain at high temperatures that reach above 32 $C^0$, so the percentage of gluten increases and its effect is direct on the quality of gluten 15 days before maturity
- It was found that high temperatures during the period of filling the grain directly affect the formation of chains of high molecular weight protein units and their interconnection with each other and with units with low molecular weight leading to an increase in the strength of the dough.
- -An increasing the number of units with high molecular weight increases the strength and flexibility Gluten increases the ratio of glutenin to glidin, while lower temperatures do the opposite.

# 3- α –amylase Activity

- The grains contain a large number of enzymes that increase with the beginning of the growth of the seed.
- The endosperm layer percentage 82% of the weight of the grain . Therefore, it contains high concentrations of these enzymes.
- These enzymes are less in the outer layers of the grain, while the embryo is rich in various enzymes, which Helps accelerate germination and seed growth.
- The most important enzymes found in the grain of wheat are the starch-analysis enzymes, which are α-amylase, and its percentage is small in the healthy grain of wheat, and β-amylase.

- **Amylograph is used to determine the activity of the enzyme α-amylase.**
- **If the grains contain a large percentage of the enzyme α-amylase, it works on a greater decomposition of starch and a rise in its viscosity.**
- **One of the studies showed the important role of the α-amylase enzyme on the characteristics of the dough, as it appeared that the increase of this enzyme led to a decrease in the complex starch molecules.**
- **It was also found that the high percentage of gluten and its strength worked to reduce the effectiveness of the α-amylase enzyme.**
- **The activity of starch degrading enzymes is higher in hard wheat compared to soft wheat.**




á -Amylase activity during germination of wheat seeds

# THANK YOU