Quadrant II – Notes

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Name of the Presenter: Arati K. Talauliker

Ribosomes are small, dense, rounded and granular particles of the ribonucleo protein. They occur either freely in the matrix of mitochondria, chloroplast and cytoplasm or remain attached with the membranes of the Endoplasmic reticulum and nucleus. The ribosomes occur in all prokaryotic and eukaryotic cells. Ribosomes are used by the cell for protein synthesis the process by which amino acids are assembled in a definite sequence to produce the polypeptide chain.

The ribosomes were first noted by Robinson and Brown (1953) in plant cells and by Palade (1955) in animal cells. Palade isolated the ribosomes and detected the RNA in them in 1956 and coined the term of ribosome.

Occurrence and Distribution

Occur in both prokaryotic and eukaryotic cells. In Prokaryotic cells - occur freely in the cytoplasm (Free ribosomes). In Eukaryotic cells - either occur freely in the cytoplasm or remain attached to the endoplasmic reticulum and nucleus (Bounded ribosomes).

Number

The number of ribosomes in a cell differs greatly. Bacterial cell - an average of about 10,000 ribosomes. Plant cells - upto 5,00,000 ribosomes. Number depends upon the physiological ability of cell to produce proteins.

Occur singly – monosomes or in cluster – polysomes. At the time of protein synthesis 6 – 8 ribosomes temporarily join with a mRNA to form a cluster called polysome.

Sedimentation coeficient

Ribosomes are of two basic types- 70S and 80S ribosomes. The 'S' refers to Svedberg units.This is a sedimentation coefficient shows at what rate cell organelle sediments in an ultracentrifuge.

Types of Ribosomes

According to the sedimentation coefficient(S) two types of ribosomes have been recognised

- 70S
- 80S

Structure of Prokaryotic Ribosomes

All prokaryotes have 70S ribosomes. It occurs in the prokaryotic cells of the blue green algae and bacteria and also in mitochondria and chloroplast of eukaryotic cells.

70S Ribosomes

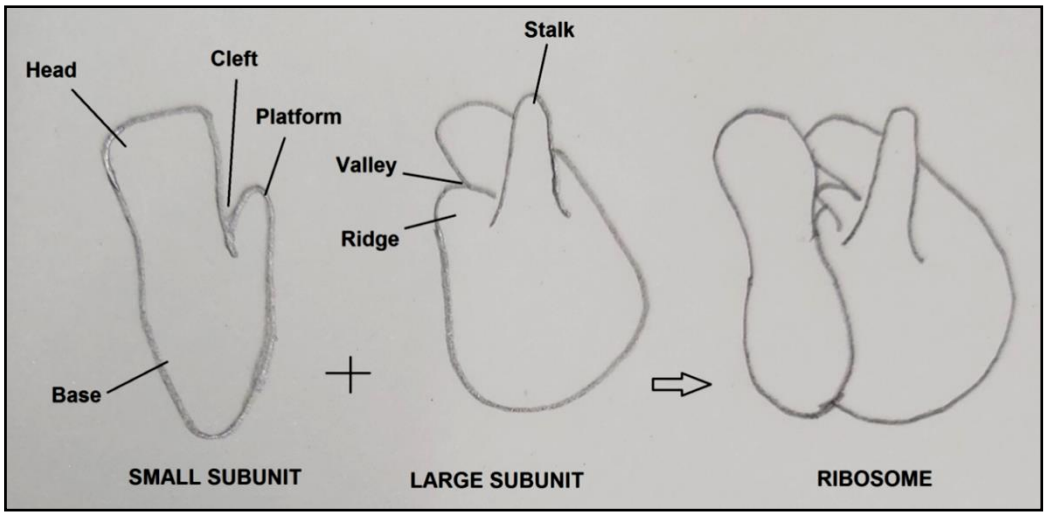
Ribosome is porous, hydrated and composed of two subunits.
Larger subunit - 50S.
Small subunit - 30S.
The subunits join together - process of protein synthesis. 30S subunit remains attached with larger 50S subunit like a cap. The RNA and proteins are interwined and arranged in a complex manner in the two subunits.

Smaller subunit – Asymmetrical

An indentation divides the subunit into two unequal parts head and body. The platform separates head from the base with the help of a cleft.

Larger subunit - Asymmetrical

Ridge, a central protuberance and a stalk. The ridge and the central protuberance are separated with the help of a valley.



Prokaryotic Ribosome

The function of the ribosome is to take the actual message and the charged aminoacyl-tRNA complex to generate the protein. The mRNA passes through a tunnel between the two subunits. Between the two subunits is a groove or channel through which the newly formed polypeptide chain comes out. Association and dissociation of subunits depends on Mg^{++} ion concentration. The subunits of the ribosome are synthesized by the nucleolus. Ribosomes along with a tRNA, helps to translate the protein coding genes in mRNA to protein.

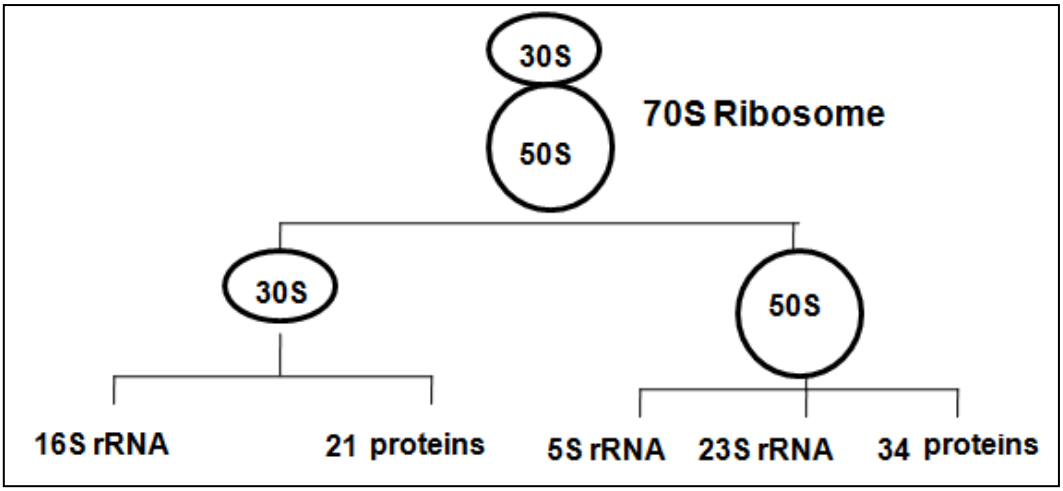
To do so, they have three binding sites.

- One is for the mRNA; the other two are for the tRNA.
- The binding sites for tRNA are the A site (acceptor site), which receives the amino acyl-tRNA complex.
- The P site (peptidyl or donor site), which binds the growing polypeptidyl – tRNA.

Chemical composition

Ribosomes are composed of RNA, proteins and certain divalent metallic ions.

The RNA / protein ratio is 2:1 in the 70S ribosome. It contains more rRNA (60 to 40%) than the proteins (36 to 37%).



Components of the 70S ribosome

Metal ions

The most important low molecular weight components of ribosomes are the divalent metallic ions - Mg^{++}, Ca^{++}, Mn^{++}. Mg^{++} Play an important role in holding the two subunits together.