# Ribosome

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## Introduction

Ribosomes are small granular structure presen in cytoplasm of cell.Sometimes they are found attached to endoplasmic reticulum**.** Ribosomes are first observed by George Palade(1953)in animal cell and Robinson andBrown(1953) in plant cell. .Ribosomes are organelle without membrenes.The number,size and shape of ribosomes are variable from cell to cell and species to species.

## Ultrastructure:-

Ribosomes are smallest and most abundant organelles of a cell. Each ribosome is porous, hydrated and composed of two unequal sub-units, larger one dome- shaped and the smaller one oblate – ellipsoid. The large subunit has a protuberance, a ridge and a stalk. The smaller subunit has a platform, cleft, head and base. It is about half the size of larger subunit. The smaller subunit fits over the larger one at one end like a cap

The larger sub units are found to adhere to the membrane of endoplasmic reticulum. The cleft separating the two sub units lies parallel and remain attached to the membrane of endoplasmic reticulum.

(i)**Larger subunit** -It is dome shaped. It has a protuberance, ridge and stalk.

(ii)**Smaller subunit** -It is oblate-ellipsoidal in shape. It has a platform, cleft, head and base. It is about half the size of large subunit. The smaller subunit fit over the larger on at one end like a cap.

Each ribosome has four sites for specific functions in protein synthesis.

(a)m-RNA binding site in smaller subunit.(receive m RNA)

(b)A-site or amino acyl-tRNA site: – acceptor site for t- RNA

(c)P-site or peptidyl-tRNA site : -site for growing polypeptide chain.

(d)E-site or exit site :- to which uncharged t-RNA come before leaving the ribosome.

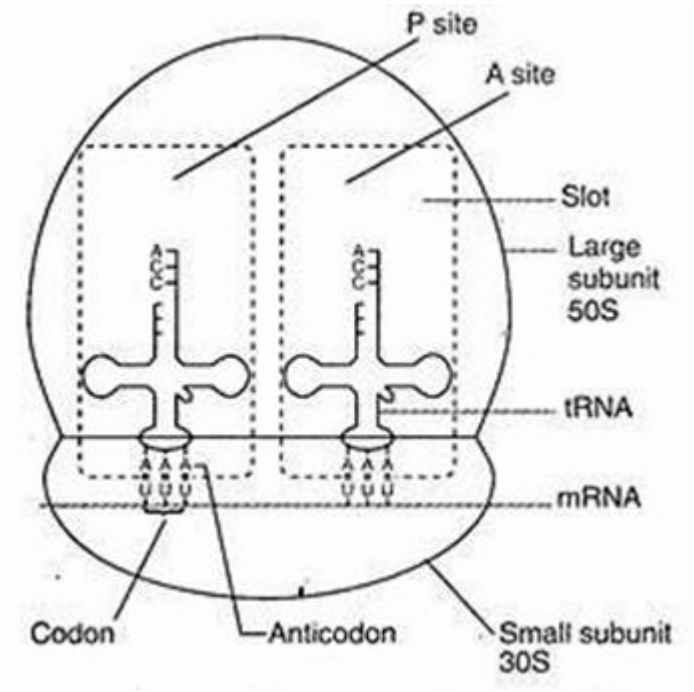
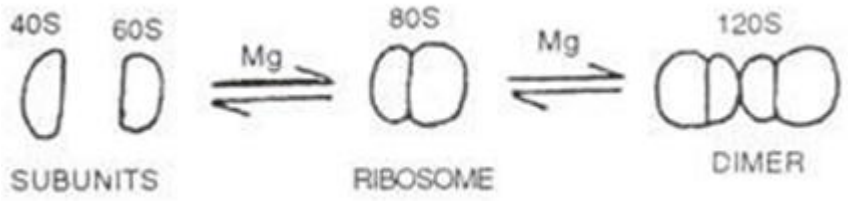



**Fig.I.Ribosome:Diagram to depict the attachment of small subunit to large subunit and position of m RNA and r RNA** molecules of these subunits

## Association and Dissociation of Ribosomal subunits

Magnesium ion is essential for the binding of the ribosome sub units. $Mg^{+2}$ form ionic bond with phosphate groups of rRNA of two sub units. Minimum 0.001 M $Mg^{+2}$ concentration is required for structural formation of ribosome. At the time of protein synthesis several ribosomes become attached to m-RNA with the help of smaller subunits. This structure is called polyribosome or polysome or ergosome. Ribosomes move along the m-RNA like beads on a string, during protein synthesis.If the concentration of Mg is increased two ribosomes combine to form **dimer** and if Mg concentration is lowered below 0.001 M,

the ribosome dissociated into two subunits




**Types of Ribosomes:-**

(1)**Eukaryotic ribosomes**:- 80s occur in cytoplasm of eukaryotic cell.

(2)**Prokaryotic ribosome:-** 70s occur in cytoplasm of prokaryotic cell ,also present in mitochondria and chloroplast of eukaryotes.

(S=Svedberg unit refers to sedimentation coefficient which shows how fast a cell organelles sediments in an ultracentrifuge.The heavier a structure the more is its sedimentation coefficient.)

They have a typical binary and constricted structure with the two units being unequal in size. The prokaryotic and eukaryotic ribosomes are differentiated on the basis of the sedimentation coefficient

Each ribosome composed of two sub units i.e.larger and smaller subunits.

80s=60s+40s Size of 300-340A°

70s=50s+30s Size of 200-290A°

## Chemical composition :

"Chemically ribosomal," subunit consists of highly folded ribosomal RNA (rRNA) and many attached proteins.Proteins form the periphery and RNA lies in the interior remaining interwined within the two subunits. The protein and RNA molecules are probably held together by forming magnesium complex . The ratio of rRNA to protein in prokaryotic and eukaryotic ribosomes is 60:40 and 50:50 by weight respectively. The ribosomal proteins may be basic, structural or enzymatic in function. The larger subunit of ribosome contains an important enzyme – peptidyl transferase, which brings about the formation of peptide bond. Inside the ribosome, the rRNA remains fully covered with proteins. The ribosomes are therefore, ribonucleoprotein particles (RNP).

70s - 60% rRNA +40% proteins; 70s- synthesized in cytoplasm.

80s - 40%rRNA+60% proteins ; 80S- synthesized inside the nucleolus

## Biogenesis of Ribosome.:-

In bacteria the ribosomes are formed inside the cytoplasm because of the absence of nucleolus. The rRNA originates from specific codon of the genome or the ribosomal DNA.

In eukaryotic cells the origin of ribosomes take place inside the nucleolus. Nucleoli disappear during mitosis, new nucleoli are formed at specific chromosomal sites called nucleolar organizers located in secondary constriction on the chromosome. This site contains ribosomal DNA. This r DNA transcribes 45 S nucleolar RNA molecule is a precursor of both 28 s and r RNA.

The 45 s nucleolar RNA molecules are first methylated, then splits into 32 s and 18 SRNA through several intermediate steps.

The protein synthesis of ribosomal protein takes place in the molecules and the protein synthesized in cytoplasm are assembled in the nucleolus. This is evidenced by the fact that 45 s RNA is associated with the protein forming 80 s ribonucleo-protein particles.

FUNCTION:

- **As proten factories** :The ribosomes are the site of protein synthesis and also provide necessary enzymes for the same. Hence these are called "protein factories".
- **Enzymes**;-Ribosomes provide enzymes –peptidyl transferase and factors for consideration of amino acids to form polypeptide
- **r-RNA**:-Ribosome contains rRNA for providing attachment points to mRNA and tRNA.
- **m-RNA**:-Ribosomes have tunnel for m-RNA so that it can be translated properly.
- **Protection**:-Anewly synthesized polypeptide is provided protection from cytoplasmic enzymes by enclosing it in the groove of larger subunits of ribosome till it attains secondary structure.

- **Free ribosomes** synthesis structural and enzymatic proteins for use inside the cell. The attached ribosomes synthesize proteins for transport (i.e. transport proteins).l

- A newly synthesized polypeptide is provided protection from cytoplasmic enzymes by enclosing it in the groove of larger subunit of ribosome till it attains secondary structure