

I'm not a bot



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Page for 5S ribosomal RNA at Rfam 5SData Archived 2010-04-27 at the Wayback Machine 5S+Ribosomal+rRNA at the U.S. National Library of Medicine Medical Subject Headings (MeSH) 5S rRNA human gene location in the UCSC Genome Browser. Halococcus morrhuae (archaeobacterium) 5S rRNA Retrieved from " 3RNA component of the large subunit of the ribosome RNA family 5S ribosomal RNAPredicted secondary structure and sequence conservation of 5S ribosomal RNALdentifiersSymbo5S rRNARfamRF00001 CL00113Other dataRNA typeGene: rRNADomain(s)EukaryotaGO:0005840 GO:0003735SOSO:0000652PDB structuresPDBe The 5S ribosomal RNA (5S rRNA) is an approximately 120 nucleotide-long ribosomal RNA molecule with a mass of 40 kDa. It is a structural and functional component of the large subunit of the ribosome in all domains of life (bacteria, archaea, and eukaryotes), with the exception of mitochondrial ribosomes of fungi and animals. The designation 5S refers to the molecule's sedimentation coefficient in an ultracentrifuge, which is measured in Svedberg units (S).[1] Figure 1: A 3D representation of a 5S rRNA molecule. This structure is is of the 5S rRNA from the Escherichia coli 50S ribosomal subunit and is based on a cryo-electron microscopic reconstruction.[2] In prokaryotes, the 5S rRNA gene is typically located in the rRNA operons downstream of the small and the large subunit rRNA, and co-transcribed into a polycistronic precursor.[3] A particularity of eukaryotic nuclear genomes is the occurrence of multiple 5S rRNA gene copies (5S rDNA) clustered in tandem repeats, with copy number varying from species to species.[4][5] Eukaryotic 5S rRNA is synthesized by RNA polymerase III, whereas other eukaryotic rRNAs are cleaved from a 45S precursor transcribed by RNA polymerase I. In Xenopus oocytes, it has been shown that fingers 4–7 of the nine-zinc finger transcription factor TFHIA can bind to the central region of 5S rRNA.[6][7] Binding between 5S rRNA and TFHIA serves to both repress further transcription of the 5S rRNA gene and stabilize the 5S rRNA transcript until it is required for ribosome assembly.[8] The secondary structure of 5S rRNA consists of five helices (denoted I–V in roman numerals), four loops (B–E), and one hinge (A), which form together a Y-like structure. Loops C and D and E are terminal hairpins and loops B and E are internal.[4] According to phylogenetic studies, helices I and III are likely ancestral.[9] Helix III includes two highly conserved adenosines.[10] Helix V, with its hairpin structure, is thought to interact with TFHIIA.[4] Figure 2: Atomic 3D structure of the 50S subunit from Haloarcula marismortui, PDB 1FFK. Proteins are shown in blue, 23S rRNA in orange and 5S rRNA in yellow.[11] 5S rRNA together with the ribosomal proteins L5 and L18 and the domain V of 23S rRNA constitute the bulk of the central protuberance (CP). Using a variety of molecular techniques, including immuno-electron microscopy, cryo-electron microscopy, intermolecular chemical cross-linking, and X-ray crystallography, the location of the 5S rRNA within the large ribosomal subunit has been determined to great precision. In bacteria and archaea, the large ribosomal subunit (LSU) itself is composed of two RNA moieties, the 5S rRNA and another larger RNA known as 23S rRNA, along with numerous associated proteins.[3][11]2 In eukaryotes, the LSU contains 5S, 5.8S, and 28S rRNAs and even more proteins.[13][14] The structure of LSU in 3-dimensions shows one relatively smooth surface and the opposite surface having three projections, notably the L1 protuberance, the central protuberance (CP), and the L7/L12 stalk. The L1 protuberance and L7/L12 stalk are arranged laterally surrounding CP. The 5S rRNA is located in the CP and participates in formation and structure of this projection. The other major constituents of the central protuberance include the 23S rRNA (or alternatively 28S in eukaryotes) and several proteins including L5, L18, L25, and L27.[15] The exact function of 5S rRNA is not yet clear. In Escherichia coli, 5S rRNA gene deletions reduce the protein synthesis rate and have a more profound detrimental effect on cell fitness than deletions of a comparable number of copies of other (16S and 23S) rRNA genes.[16] Crystallographic studies indicate that 5S rRNA-binding proteins and other proteins of the central protuberance of the LSU plays a role in binding rRNAs.[15] Also, the topographical and physical proximity between 5S rRNA and 23S rRNA, which forms the peptidyl transferase and GTPase-associating center, suggests that 5S rRNA acts as a mediator between the two functional centers of the ribosome by forming, together with 5S rRNA-binding proteins and other components of the central protuberance, intersubunit bridges and tRNA-binding sites.[15] In eukaryotes, the cytosolic ribosome is assembled from four rRNAs and over 80 proteins.[14][17] Once transcribed, the 3' ends of 5S rRNA can only be trimmed to mature length by functional homologues of RNase T, for example Rix1p in Saccharomyces cerevisiae.[18] The 60S and 40S ribosomal subunits are exported from the nucleus to the cytoplasm where they join to form the mature and translation-competent 80S ribosome. When exactly 5S rRNA is integrated into the ribosome remains controversial.[4] but it is generally accepted that 5S rRNA is incorporated into the 90S particle, which is a precursor to 60S particle, as part of a small ribosome-independent RNP complex formed by 5S rRNA and ribosomal protein L5.[17] Several important proteins which interact with 5S rRNA are listed below. Interaction of 5S rRNA with the La protein prevents the RNA from degradation by exonucleases in the cell.[19] La protein is found in the nucleus in all eukaryotic organisms and associates with several types of RNAs transcribed by RNA pol III. La protein interacts with these RNAs (including the 5S rRNA) through their 3' oligo-uridine tract, aiding stability and folding of the RNA.[4][20] In eukaryotic cells, ribosomal protein L5 associates and stabilizes the 5S rRNA forming a pre-ribosomal ribonucleoprotein particle (RNP) that is found in both cytosol and the nucleus. L5 deficiency prevents transport of 5S rRNA to the nucleus and results in decreased ribosomal assembly.[4] In prokaryotes the 5S rRNA binds to the L5, L18 and L25 ribosomal proteins, whereas in eukaryotes 5S rRNA is only known to bind the L5 ribosomal protein.[21] In T. brucei, the causative agent of sleeping sickness, 5S rRNA interacts with two closely related RNA-binding proteins, P34 and P37, whose loss results in a lower global level of 5S rRNA.[4] 14] RNA family Permutated mitochondrial genome encoded 5S rRNALentifiersSymbo1mPermu5S rRNADomain(s)EukaryotaGO:0005840 GO:0003735SOSO:000652PDB structuresPDBe Figure 3: Consensus secondary structure models of 5S rRNA based on the pronounced sequence composition bias and structural variation.[24] This analysis pinpointed additional 5S rRNA genes not only in mitochondrial genomes of most protist lineages, but also in genomes of certain apicoplasts (non-photosynthetic plastids of pathogenic protozoa such as Toxoplasma gondii and Eimeria tenella). Figure 4: Comparison of the conventional and permuted secondary structure models of 5S rRNA. Mitochondrial 5S rRNAs consist of five helices (denoted I–V in roman numerals), four loops (B–E), and one hinge (A). Mitochondrial 5S rRNAs in brown algae represent the most unconventional case, where the closing helix i, which otherwise brings together the molecule's 5' and 3' ends, is replaced by a (closed) hairpin resulting in an open three-way junction. Current evidence indicates that mitochondrial DNA of only a few groups, notably animals, fungi, alveolates and euglenozoans lacks the gene.[24] The central protuberance, otherwise occupied by 5S rRNA and its associated proteins (see Figure 2), was remodelled in various ways. 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