In S. cerevisiae, there are five genes that encode alcohol dehydrogenases involved in ethanol metabolism, ADH1 to ADH5. Four of these enzymes, Adh1p, Adh3p, Adh4p, and Adh5p, reduce acetaldehyde to ethanol during glucose fermentation, while Adh2p catalyzes the reverse reaction of oxidizing ethanol to acetaldehyde.The five ethanol dehydrogenasesas well as the bifunctional enzyme Sfa1p are also involved in the production of fusel alcohols during fermentation. Fusel alcohols are end products of amino acid catabolismvia the Ehrlich pathway and contribute to the flavor and aroma of yeast-fermented foods and beverages. They may also have physiological roles. For example, exposing cells to isoamyl alcohol, derived from catabolism of leucine, stimulates filamentous growth. Similarly, other fusel alcohols also stimulate filamentous growth in S. cerevisiae and biofilm formation in the pathogens Candida albicans and Candida dubliniensis.The cytosolic ADH1 gene product is the major enzyme responsible for converting acetaldehyde to ethanol. Adh1p functions as a tetramer of four identical subunits with each subunit containing two zinc ions; one zinc atom is essential for catalysis and the other is important for the structure of the protein. Although originally thought to be expressed constitutively, ADH1 transcription is repressed when cells are grown on a non-fermentable carbon source such as ethanol or glycerol. S. cerevisiae cells lacking Adh1p activity grow poorly on glucose under anaerobic conditions and treatment of these cells with a respiratory inhibitor blocks growth completely. Overexpression of ADH1 is able to enhance the formaldehyde resistance of yeast cells.About the medium-chain dehydrogenase/reductasefamily Medium-chain dehydrogenase/reductases, sometimes referred to as long-chain dehydrogenases, constitute an ancient and widespread enzyme superfamily with members found in Bacteria, Archaea, and Eukaryota. Many MDR members are basic metabolic enzymes acting on alcohols or aldehydes, and thus these enzymes may have roles in detoxifying alcohols and related compounds, protecting against environmental stresses such as osmotic shock, reduced or elevated temperatures, or oxidative stress. The family also includes the mammalian zeta-crystallin lens protein, which may protect the lens against oxidative damage and enzymes which produce lignocellulose in plants. MDR enzymes typically have subunits of about 350 aa residues and are two-domain proteins, with a catalytic domain and a second domain for binding to the nicotinamide cofactor, either NADor NADP. They contain 0, 1, or 2 zinc atoms. When zinc is present, it is involved in catalysis at the active site. Based on phylogenetic and sequence analysis, the members of the MDR superfamily can be further divided into more closely related subgroups. In families which are widespread from prokaryotes to eukaryotes, some members appear conserved across all species, while others appear to be due to lineage specific duplications. Some subgroups are only found in certain taxa. S. cerevisiae contains fifteenor twenty-onemembers of the MDR superfamily, listed below. The difference in number is due to six sequences that were included as members of the quinone oxidoreductase family by Riveros-Rosas et al.but not by Nordling et al.. Zinc-containing enzyme groups: - PDH; \"polyol\" dehydrogenase family - BDH1, BDH2, SOR1, SOR2, XYL2 - ADH; class III alcohol dehydrogenase family - SFA1 - Y-ADH; \"yeast\" alcohol dehydrogenase family - ADH1, ADH2, ADH3, ADH5 - CADH; cinnamyl alcohol dehydrogenase family - ADH6, ADH7 Non-zinc-containing enzyme groups: - NRBP; nuclear receptor binding proteinor MRF; mitochondrial respiratory functionfamily - ETR1 - QOR; quinone oxidoreductase family - ZTA1, AST1, AST2, YCR102C, YLR460C, YMR152W, YNL134C- LTD; leukotriene B4 dehydrogenases - YML131W - ER; enoyl reductasesor ACR; acyl-CoA reductasefamily - no members in S. cerevisiae