Hansenula polymorpha Pex11p is important for peroxisome proliferation and inheritance

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Peroxisomes are morphological simple organelles that are present in almost all eukaryotic cells, where they play a role in various important metabolic processes. We use the yeast Hansenula polymorpha as a model organism to study peroxisomes. In this yeast peroxisomes are massively induced when cells are grown on methanol.

Peroxisomes have long been thought to be formed by growth and division of pre-existing ones [1]. However, recent observations suggest that peroxisomes may also form from the endoplasmic reticulum (ER) [2]. Pex11p is a peroxisomal membrane protein that has been suggested to play a role in peroxisome fission [3]. We have cloned and characterized the H. polymorpha PEX11 gene. Fluorescence microscopy studies using a strain producing H. polymorpha Pex11p fused to Green Fluorescent Protein (GFP), confirmed the cloned gene encoded a peroxisomal protein.

Fluorescence microscopy analysis of a constructed H. polymorpha PEX11 overexpression strain producing GFP containing a Peroxisomal Targeting Sequence 1 (GFP-PTS1) revealed a strong increase in peroxisome number, indicating that enhanced levels of H. polymorpha Pex11p stimulate peroxisome proliferation. Conversely, cells of a constructed PEX11 deletion strain (designated pex11) contained reduced numbers of peroxisomes. The latter was observed by confocal laser scanning microscopy (CLSM) using pex11 and WT cells producing GFP-PTS1. These studies revealed that methanol-grown pex11 cells generally contain a single peroxisome per cell, whereas WT control cells contain 2-3 peroxisomes per cell.

Live cell imaging by CLSM showed that in budding H. polymorpha pex11 cells inheritance of peroxisomes to newly developing buds was altered relative to WT controls. In WT cells peroxisomes are carefully partitioned over mother cell and bud during cell division. In H. polymorpha pex11 cells grown at peroxisome repressing growth conditions (glucose), most of the mother cells failed to retain a peroxisome and the single peroxisome originally present in the mother cell migrated into the bud. The opposite process was observed at peroxisome inducing conditions (growth on methanol). In these cells most buds failed to inherit the peroxisome from the mother cell. After prolonged cultivation, however, new peroxisomes arose in these buds. Possibly these organelles are newly formed from the ER.

Our data suggest that H. polymorpha Pex11p is involved in regulating peroxisome numbers and is also required for proper organelle inheritance.