Lipid rich detergent-resistant membranes from all non-mammalian sources – a bibliography

The companion OptiPrep™ Mini-Review MS06 "Lipid rich detergent-resistant membranes from mammalian cells and tissues" contains a brief summary of the methodology for the isolation of these plasma membrane domains in addition to the complete reference list of the published papers. Strategies used for invertebrate cells, plant cells, algae, fungi and protozoa are broadly similar. This Mini-Review is thus confined to the provision of a bibliography of published papers concerned with this diverse group of organisms.

A detailed description of the OptiPrep™ methodology (see Application Sheet S32) can be found on the OptiPrep™ Applications flash-drive or on the following website: www.axis-shield-density-gradient-media.com (click on "Methodology", then "Organelles and Subcellular Membranes") and scroll down the Index.

Papers have been divided into **organism or cell type** and additionally, when required, into **research topic**. Within each group papers are listed alphabetically according to **first author**. When a paper reports the study of more than one cell type, reference to that paper will appear under multiple cell headings. A paper may also appear under two or more research topic headings.

♦ Part(s) of the titles are highlighted in blue to facilitate identification of particular research topic(s)

1. Amphibia

Bates, R.C., Fees, C.P., Holland, W.L., Winger, C.C., Batbayar, K., Ancar, R., Bergren, T., Petcoff, D. and Stith, B.J. (2014) *Activation of Src and release of intracellular calcium by phosphatidic acid during Xenopus laevis fertilization* Dev. Biol., **386**, 165-180

2. Bacteria

Borrelia burgdorferi

Coleman, J.L., Toledo, A. and Benach, J.L. (2016) *Borrelia burgdorferi HtrA: evidence for twofold proteolysis of outer membrane protein p66* Mol. Microbiol., **99**, 135–150

LaRocca, T.J., Crowley, J.T., Cusack, B.J., Pathak, P., et al (2010) *Cholesterol lipids of Borrelia burgdorferi form lipid rafts and are required for the bactericidal activity of a complement-independent antibody* Cell Host Microbe **8**, 331–342

Toledo, A., Crowley, J.T., Coleman, J.L., LaRocca, T.J., et al (2014) *Selective association of outer surface lipoproteins with the lipid rafts of Borrelia burgdorferi* mBio, **5**: e00899-14

Toledo, A., Pérez, A., Coleman, J.L. and Benach, J. L. (2015) *The lipid raft proteome of Borrelia burgdorferi* Proteomics, **15**, 3662–3675

3. Chicken embryo

Long, J., Tokhunts, R., Old, W.M., Houel, S., Rodgriguez-Blanco, J., Singh, S., Schilling, N., Capobianco, A.J., Ahn, N.G. and Robbins, D.J. (2015) *Identification of a family of fatty-acid-speciated sonic hedgehog proteins, whose members display differential biological properties* Cell Rep., **10**, 1280–1287

4. Coccolithoviruses

Rose, S.L., Fulton, J.M., Brown, C.M., Natale, F., Van Mooy, B.A.S. and Bidle, K.D. (2014) *Isolation and characterization of lipid rafts in Emiliania huxleyi: a role for membrane microdomains in host–virus interactions* Environ. Microbiol., **16**, 1150–1166

5. *Drosophila melanogaster*

Eroglu, C., Brügger, B., Wieland, F. and Sinning, I. (2003) *Glutamate-binding affinity of Drosophila metabotropic glutamate receptor is modulated by association with lipid rafts* Proc. Natl. Acad. Sci. USA, **100**, 10219-10224

Fernandez-Funez, P., Casas-Tinto, S., Zhang, Y., Gómez-Velazquez, M., et al (2009) *In vivo generation of neurotoxic prion protein: role for Hsp70 in accumulation of misfolded isoforms* PLoS One, **5**:e1000507

Hebbar, S., Lee, E., Manna, M., Steinert, S., et al (2008) *A fluorescent sphingolipid binding domain peptide probe interacts with sphingolipids and cholesterol-dependent raft domains* J. Lipid Res. 49, 1077-1089**Hoehne,**

M., de Couet, H.G., Stuermer, C.A.O. and Fischbach, K-F. (2005) *Loss- and gain-of-function analysis of the lipid raft proteins reggie/flotillin in Drosphilia: they are posttranslationally regulated, and misexpression interferes with wing and eye development* Mol. Cell. Neurosci., **30**, 326-338
Rietveld, A., Neutz, S., Simons, K. and Eaton, S. (1999) *Association of sterol- and glycosylphosphatidyl-inositol-linked proteins with Drosophilia raft lipid microdomains* J. Biol. Chem., **274**, 12049-12054
Sanxaradis, P.D., Cronin, M.A., Rawat, S.S., Waro, G., et al (2007) *Light-induced recruitment of INAD-signaling complexes to detergent-resistant lipid rafts in Drosophila receptors* Mol Cell. Neurosci., **36**, 36-46
Zhai, L., Chaturvedi, D. and Cumberledge, S. (2004) *Drosophila Wnt-1 undergoes a hydrophobic modification and is targeted to lipid rafts, a process that requires porcupine* J. Biol. Chem., **279**, 33220-33227

6. Echinoderms

Loza-Huerta, A., Vera-Estrella, R., Darszon, A. and Beltrána, C. (2013) *Certain Strongylocentrotus purpuratus sperm mitochondrial proteins co-purify with low density detergent-insoluble membranes and are PKA or PKC-substrates possibly involved in sperm motility regulation* Biochim. Biophys. Acta, **1830**, 5305–5315
Vacquier, V.D., Loza-Huerta, A., García-Rincón, J., Darszon, A. and Beltrán, C. (2014) S*oluble adenylyl cyclase of sea urchin spermatozoa* Biochim. Biophys. Acta, **1842**, 2621–2628

7. Fish and fish embryo

Adachi, T., Sato, C. and Kitajima, K. (2007) *Membrane microdomain formation in crucial in epiboly during gastrulation of medaka* Biochem. Biophys. Res. Commun., **358**, 848-853
Adachi, T., Sato, C., Kishi, Y., Totani, K., et al, (2009) *Membrane microdomains from early gastrula embryos of medaka, Oryzias latipes, are a platform of E-cadherin- and carbohydrate-mediated cell–cell interactions during epiboly* Glycoconj. J. **26**, 285–299
Zehmer, J.K. and Hazel, J.R. (2003) *Plasma membrane rafts of rainbow trout are subject to thermal acclimation* J. Exp. Biol., **206**, 1657-1667

8. Fungi

8a *Candida albicans*

Aeed, P.A., Sperry, A.E., Young, C.L., Nagiec, M.M., et al (2004) *Effect of membrane perturbants on the activity and phase distribution of inositol phosphorylceramide synthase; development of a novel assay* Biochemistry, **43**, 8483-8493
Insenser, M., Nombela, C., Molero, G. and Gil, C. (2006) *Proteomic analysis of detergent-resistant membranes from Candida albicans* Proteomics, **6,** Suppl. **1**., S74-S81
Martin, S.W. and Konopka, J.B. (2004) *Lipid raft polarization contributes to hyphal growth in Candida albicans* Eukary. Cell, **3**, 675-684
Ragni, E., Calderon, J., Fascio, U., Sipiczki, M., et al (2011) *Phr1p, a glycosylphosphatidylinsitol-anchored β(1,3)-glucanosyltransferase critical for hyphal wall formation, localizes to the apical growth sites and septa in Candida albicans* Fungal Genet. Biol., **48**, 793–805
Wang, L., Jia, Y., Tang, R-J., Xu, Z., Cao, Y-B., Jia, X-M. and Jiang, Y-Y. (2012) *Proteomic analysis of Rta2p-dependent raft-association of detergent-resistant membranes in Candida albicans* PLoS One, **7**: e37768

8b *Saccharomyces cerevisiae*

ABC transporters

Rockwell, N.C., Wolfger, H., Kuchler, K. and Thorner, J. (2009) *ABC transporter Pdr10 regulates the membrane microenvironment of Pdr12 in Saccharomyces cerevisiae* J Membr. Biol., **229**, 27–52

Acyl chains

Gaigg, B., Toulmay, A. and Scheiter, R. (2006) *Very long-chain fatty acid-containing lipids rather than sphingolipids per se are required for raft association and stable surface transport of newly synthesized plasma membrane ATPase in yeast* J. Biol. Chem., **281**, 34135-34145
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Tatzer, V., Zellnig, G., Kohlwein, S.D. and Schneiter, R. (2002) *Lipid-dependent subcellular relocalization of the acyl chain desaturase in yeast* Mol. Biol. Cell, **13**, 4429-4442

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Germann, M., Swain, E., Bergman, L. and Nickels, Jr. J.T. (2005) *Characterizing the sphingolipid signaling pathway that remediates defects associated with loss of the yeast amphiphysin-like orthologs, Rvs161p and Rvs167p* J. Biol. Chem., **280**, 4270-4278
Kishimoto, T., Yamamoto, T. and Tanaka, K. (2005) *Defects in structural integrity of ergosterol and the Cdc50p-Drs2p putative phospholipid translocase cause accumulation of endocytic membranes, onto which actin patches are assembled in yeast* Mol. Biol. Cell, **16**, 5592-5609
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Amino acid transport
Lauwers, E., Grossmann, G. and André, B. (2007) *Evidence for coupled biogenesis of yeast Gap1 permease and sphingolipids: essential role in transport activity and normal control by ubiqutination* Mol. Biol. Cell **18**, 3068-3080

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Ana, B., Chen, Y., Li, B., Qin, G. and Tian, S. (2014) *Ca^{2+}–CaM regulating viability of Candida guilliermondii under oxidative stress by acting on detergent resistant membrane proteins* J. Proteom., **109**, 38–49

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Souza, C.M., Schwabe, T.M.E., Pichler, H., Ploier, B., et al (2011) *A stable yeast strain efficiently producing cholesterol instead of ergosterol is functional for tryptophan uptake, but not weak organic acid resistance* Metab. Eng., **13**, 555–569

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Kashiwazaki, J., Yamasaki, Y., Itadani, A., Teraguchi, E., et al (2011) *Endocytosis is essential for dynamic translocation of a syntaxin 1 orthologue during fission yeast meiosis* Mol. Biol. Cell, **22**, 3658-3670

Ergosterol
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Glycophospholipids

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Eisenkolb, M., Zenzmaier, C., Leitner, E., and Schneiter, R. (2002) *A specific structural requirement for ergosterol in long-chain fatty acid synthesis mutants important for maintaining raft domains in yeast* Mol. Biol. Cell, **13**, 4414-4428
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Okamoto, M., Yoko-o, T., Umemura, M., Nakayama, K-i., et al (2006) *Glycosylphosphatidyl-inositol-anchored proteins are required for the transport of detergent-resistant microdomain-associated membrane proteins Tat2p and Fur4p* J. Biol. Chem., **281**, 4013-4023
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Growth properties

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Claret, S., Roumanie, O., Prouzet-Mauleon, V., Lefebvre, F., et al (2011) *Evidence for functional links between theRgd1-Rho3RhoGAPGTPasemodule and Tos2, a protein involved in polarized growth in Saccharomyces cerevisiae* FEMS Yeast Res., **11**, 179–191
Tani, M., Khara, A. and Igarashi, Y. (2006) *Rescue of cell growth by sphingosine with disruption of lipid microdomain formation in Saccharomyces cerevisiae deficient in sphingolipid biosynthesis* Biochem. J., **394**, 237-242

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Bagnat, M., Chang, A. and Simons, K. (2001) *Plasma membrane proton ATPase Pma1p requires raft association for surface delivery in yeast* Mol. Biol. Cell, **12**, 4129-4138
Czyz, O., Bitew, T., Cuesta-Marban, A., McMaster, C.R., et al (2013) *Alteration of plasma membrane organization by an anticancer lysophosphatidylcholine analogue induces intracellular acidification and internalization of plasma membrane transporters in yeast* J. Biol. Chem., **288**, 8419–8432
Gaigg, B., Toulmay, A. and Scheiter, R. (2006) *Very long-chain fatty acid-containing lipids rather than sphingolipids per se are required for raft association and stable surface transport of newly synthesized plasma membrane ATPase in yeast* J. Biol. Chem., **281**, 34135-34145
Lee, M.C., Hamamoto, S. and Schekman, R. (2002) *Ceramide biosynthesis is required for the formation of the oligomeric H^+ -ATPase Pma1p in the yeast endoplasmic reticulum* J. Biol. Chem., **277**, 23395-23401
Liu, Y. and Chang, A. (2006) *Quality control of a mutant plasma membrane ATPase: ubiquitylation prevents cell-surface stability* J. Cell Sci., **119**, 360-369
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Morphogenesis

Rolli, E., Ragni, E., Calderon, J., Porello, S., et al (2009) *Immobilization of the glycosylphosphatidylinositol-anchored Gas1 protein into the chitin ring and septum is required for proper morphogenesis in yeast* Mol. Biol. Cell, **20**, 4856–4870

Na^+/H^+ antiport

Mitsui, K., Hatakeyama, K., Matsushita, M. and Kanazawa, H. (2009) *Saccharomyces cerevisiae Na^+/H^+ antiporter Nha1p associates with lipid rafts and requires sphingolipid for stable localization to the plasma membrane* J. Biochem., **145**, 709–720

Oxidative stress

Ana, B., Chen, Y., Li, B., Qin, G., et al (2014) *Ca^{2+}–CaM regulating viability of Candida guilliermondii under oxidative stress by acting on detergent resistant membrane proteins* J. Proteom., **109**, 38–49

Phospholipids

Cuesta-Marbán, A., Botet, J., Czyz, O., Cacharro, L.M., et al (2013) *Drug uptake, lipid rafts, and vesicle trafficking modulate resistance to an anticancer lysophosphatidyl-choline analogue in yeast* J. Biol. Chem., **288**, 8405–8418
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Kato, U., Emoto, K., Fredriksson, C., Nakamura, H., et al (2002) *A novel membrane protein, Ros3p, is required for phospholipid translocation across the plasma membrane in Saccharomyces cerevisiae* J. Biol. Chem., **277**, 37855-37862
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Sphingolipids

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