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TEMASEK LIFESCIENCES LABORATORY

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The Auditorium (Level 1)
Hosted by: Dr Naqvi Naweed Isaak

RNAi-mediated centromere evolution

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Kaustuv Sanyal obtained Masters of Science in Biotechnology from Madurai Kamaraj University, the PhD degree from Bose Institute (Kolkata) and a postdoctoral fellowship at the University of California, Santa Barbara, USA. He joined JNCASR, Bangalore in late 2005 as Assistant Professor and promoted to Associate Professor in 2011. Since his graduate studies, the major focus of his research is to understand the mechanism of chromosome segregation using various yeasts, both pathogenic and non-pathogenic, as model systems. He has contributed significantly in his research area by publishing several papers and reviews. He has been invited in many international meetings as a session chair, plenary speaker, mentor, guest lecturer or for delivering research seminars. He has been awarded the National Bioscience Award by the Department of Biotechnology (India), is an elected fellow of the National Academy of Sciences (India) and a member of the Faculty of 1000 (F1000Prime), UK. Currently, he leads a group of 12 members consisting of graduate students and postdoctoral researchers and actively collaborates with many research groups across the world.

Each eukaryotic chromosome carries a centromere, a unique DNA locus, which is essential for faithful transmission of the genetic information during mitosis and meiosis. Despite playing this conserved function, the centromere DNA sequence is rapidly changing across all forms of eukaryotic life. Moreover, the length of the centromere varies widely ranging from < 200 bp in the budding yeast *Saccahromyces cerevisiae* up to several megabases in humans. One of the challenges in centromere biology is to identify the determinants that shape centromere DNA organization. Many centromeres show the presence of repeats and/or transposable elements that are proposed to play an important role in centromere evolution. In this study, using ChIP-seq with conserved kinetochore proteins, we identified centromeres in the *Cryptococcus* species complex belonging to the Basidiomycota phylum of fungi. We observed that *Cryptococcus deuterogattii* possesses significantly shorter centromeres (8 to 18 kb) than those of two other closely related species, *C. neoformans* (29 to 65 kb) and *C. deneoformans* (29 to 110 kb). All three species have a large number of retrotransposons at their centromeres but in *C. deuterogattii*, fewer and truncated forms of retroelements are present. We extended our investigation to another closely related species complex in the Basidiomycota: *Ustilago maydis* is found to have significantly shorter putative centromeres (8 to 25 kb) compared to *Ustilago hordei* (28 to 45 kb). Incidentally, *C. deuterogattii* and *U. maydis*, having shorter centromeres, lack key components of the RNAi silencing machinery, such as Argonaute, Dicer and RNA-dependent RNA polymerase, whereas the species with larger centromeres possess a fully functional RNAi system. This correlation found in two independent species complexes leads us to propose that the loss of RNAi led to transposon attrition resulting in a reduced centromere length in these RNAi-deficient species. Overall, our results suggest that RNAi may be a critical determinant of centromere organization in fungi with potential implications for centromere structure and function in other eukaryotes.

Recent Publications:

1. Gautam Chatterjee, Sundar Ram Sankaranarayanan, Yogitha Thattikota, Krishnendu Guin, Sreedevi Padmanabhan, Rahul Siddharthan, and **Kaustuv Sanyal (2016)** Repeat associated fission yeast-like centromeres in the budding yeast Candida tropicalis, a human pathogen. PLoS Genetics 12: e1005839
2. Sabyasachi Sutradhar, Vikas Yadav, Shreays Sridhar, Lakshmi Sreekumar, Dibyendu Bhattacharyya, Santanu Kumar Ghosh, Raja Paul and **Kaustuv Sanyal (2015)** A comprehensive model to predict mitosis division in budding yeasts. Mol. Biol Cell 26: 3954-3965 Journal Cover article
3. Sreyoshi Mitra, Jonathan Gómez-Raja, Germán Larriba, Dharani Dhar Dubey and **Kaustuv Sanyal (2014)** Rad51-Rad52 mediated maintenance of centromeric chromatin in Candida albicans. PLoS Genetics 10: e1004344