Identification and Characterization of Gamete Adhesion Factor *FUS1* Orthologs in Isogamous *Yamagishiella* and Anisogamous *Eudorina*

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Abstract:

Anisogamy, which exhibits the fusion of a large female gamete and a small male gamete (sperm), has evolved from isogamous ancestors several times in independent eukaryotic lineages. To understand the mechanistic change of gamete fusion event associated with the isogamy-anisogamy transition, we focus on the two closely related volvocine algae, isogamous *Yamagishiella unicocca* and anisogamous *Eudorina* sp. Based on our whole-genome sequencing project of these algae, we identified orthologous genes of *FUS1*, an isogametic adhesion factor gene previously reported in *Chlamydomonas reinhardtii* (Ferris et al. 1996; Misamore et al. 2003) and *Gonium pectorale* (Hamaji et al. 2016). The *FUS1* orthologs of *Y. unicocca* (*YuFUS1*) and *Eudorina FUS1* (*EuFUS1*) were exclusively encoded in the *plus* and female mating-type locus, respectively. The deduced protein sequences of YuFUS1 and EuFUS1 contain a signal peptide, immunoglobulin-like sequences, and a transmembrane domain, in common with the other isogamous FUS1 proteins. In *Y. unicocca*, the *YuFUS1* gene was specifically expressed in is the *plus* gametes. In *Eudorina* sp., the *EuFUS1* expression was significantly up-regulated after mixing with sperm, indicating that enhancement of the *EuFUS1* expression may require some interaction to the male derived factor(s), comparable to the *FUS1* enrichment through the gamete activation treatment in isogamous species (Ning et al. 2013; Hamaji et al. 2016). These results suggest that isogamy and anisogamy in volvocine algae share the FUS1-mediated gamete adhesion mechanism on *plus*/female gametes. In oogamous *Volvox carteri*, no *FUS1* ortholog was found (Ferris et al. 2010). It seems that a substantial mechanistic shift in gamete fusion/fertilization might have occurred in the ancestor of *V. carteri*.

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