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An HSF2-like factor is present in the invertebrates: characterization and purification in sea urchin embryos and its localization in primary mesenchime cells

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The cells respond to environmental, pathological and physiological stresses by inducing the synthesis of the heat shock proteins (HSP) which are highly conserved among all the organisms.[1] The stress response is a common cellular defence mechanism against extracellular stress stimuli. The responsible for the stress-regulated synthesis is the transcription factors (HSF) which activate the transcription of the heat shock genes with a rapid synthesis of their encoded proteins (HSPs). The heat shock proteins are classified into different families on the basis of molecular mass, and one the most conserved during the evolution is HSP70 that is the most abundant and the most reacting HSP to both physiological and environmental stresses. The HSP70 and their cognate proteins (HSCs) function as molecular chaperones to protect cells by binding to partially denatured proteins and dissociating protein aggregates.[2] Single genes for HSF have been cloned from yeast,[3] fruit flies (*Drosophila*),[4] and frogs functionally homologous to mammalian HSF1. Four HSFs have been identified in mammalian and of these, HSF1 and HSF2, are ubiquitously expressed and conserved.[5] HSF1 functions as a classical stress-responsive factor, HSF2 is active during specific development processes and it has been proposed to have a role in developmental processes. Although HSFs are best known as stress- inducible transcriptional regulators, they are also important for physiological processes. HSF functions are from the heat shock response to development, metabolism, disease, especially cancer and neurodegenerative disorders.[6] HSFs contribute to multiple normal physiological processes and pathologies through direct regulation of their target genes. Since reproduction, the immune response and aging are the processes that are affected by the HSF activities an hypothesis would be that these new functions have been recruited during evolution in order to coordinate these processes.[6] In order to verified this hypothesis we investigated whether HSF2-like factor in addition to HSF1 is present in one invertebrate which precedes chordates in evolution. To this aim we demonstrated that in sea urchin *Paracentrotus lividus* embryos are present HSF1 and also HSF2. After characterization and purification we found two HSF2 isoforms located both in the nucleus and in the cytoplasm. α and β sea urchin isoforms seems to be similar to those present in mouse and their expression pattern varies during embryo development, similarly to those of the mammalian HSFs, which are developmentally regulated in a stage-specific manner. In sea urchin the β isoform has greater DNA-binding activity than the α isoform. Moreover, in non-stress conditions the HSE-HSF complex present in early developmental stage embryos is composed predominantly of HSF2, whereas the late developmental stage binding activity is due to HSF1. Studies on territorial localization demonstrate that sea urchin HSF2 is maternal and that during embryo development, until gastrula, is more concentrated in primary mesenchyme cells (PMCs) (Figure 1). Interestingly, Hsp70 distribution shows no spatial correlation with HSF2 expression in non stressed conditions. However, in sea urchin embryos the particular HSF2 localization does not seem to be related to development, because the block of its function, by anti-HSF2 antibody microinjection in eggs, does not disturb the morphogenetic processes after fertilization. It is possible that at its appearance HSF2 did not have any role related to development and this may have been achieved later in evolution.

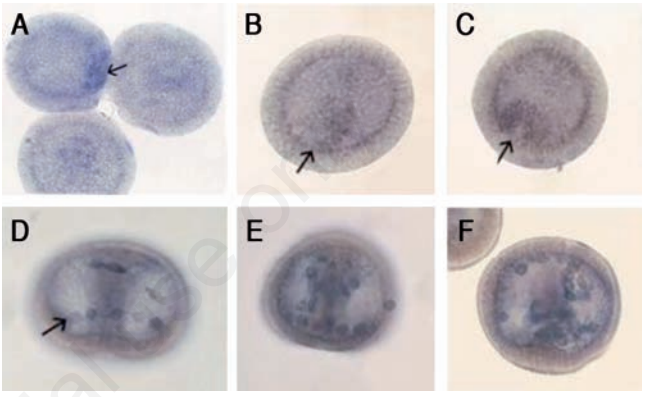

Figure 1. HSF2 localization during embryo development. A-C) Blastula embryos (arrows indicate the ingressing cells); D-F) Gastrula embryos (arrow indicates the primary mesenchyme cell).

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