LETTER TO THE EDITOR

A LIM Motif Is Present in a Pollen-Specific Protein

We have recently described a sunflower cDNA sequence coding for a pollen-specific protein (SF3) with putative zinc finger domains (Baltz et al., 1992). In a more recent analysis we have found that these domains correspond to the conserved LIM motif identified so far only in a family of metal binding, cysteine-rich proteins from animals. This motif, ~55 amino acids long, is characterized by a unique organization of cysteine and histidine residues into two adjacent putative zinc fingers. LIM motif–containing proteins include developmental regulators such as the rat insulin gene enhancer binding protein ISL-1 (Karlsson et al., 1990), the *Caenorhabditis elegans* proteins LIN-11 (Freyd et al., 1990) and MEC-3 (Way and Chalfie, 1988), the Drosophila APTEROUS protein (Cohen et al., 1992), the Xenopus XLIM-1 protein (Taira et al., 1992), and the mammalian oncoproteins TTG-1 and TTG-2 (also known as RHOM-2) of the rhombotin family (McGuire et al., 1989; Boehm et al., 1990, 1991; Royer-Pokora et al., 1991). The mammalian cysteine-rich proteins CRIP (Birkenmeyer and Gordon, 1986), hCRP (Liebhaber et al., 1990; Wang et al., 1992), and ESP-1 (Nalik et al., 1989), all of which are of yet unknown function, also contain LIM motifs. LIM motifs are found either alone (in CRIP, TTG-1, TTG-2, ESP-1, and hCRP) or in association with a homeodomain (in MEC-3, ISL-1, LIM-11, XLIM-1, and APTEROUS).

Figure 1 shows an alignment of the LIM motifs of the pollen-specific protein SF3 with those of the animal LIM proteins. Conserved residues are shown in bold type. A close examination of a number of semi-conserved positions (see boxed residues) shows evidence for the existence of two subfamilies of LIM proteins: subfamily A, which includes SF3, hCRP, CRIP and ESP-1, and subfamily B, which comprises the seven other proteins.

The most frequently occurring metal-chelating residues in the potential zinc fingers are cysteines and histidines. However, in the majority of the LIM proteins, aspartate (D) is the last residue in the second finger (position 57). This is not necessarily surprising because aspartate has been identified as a metal-chelating residue in zinc-containing enzymes (Vallee and Auld, 1990).

As potential zinc finger domains, the LIM motifs could be directly involved in DNA binding, although a possible role in protein–protein interactions has been

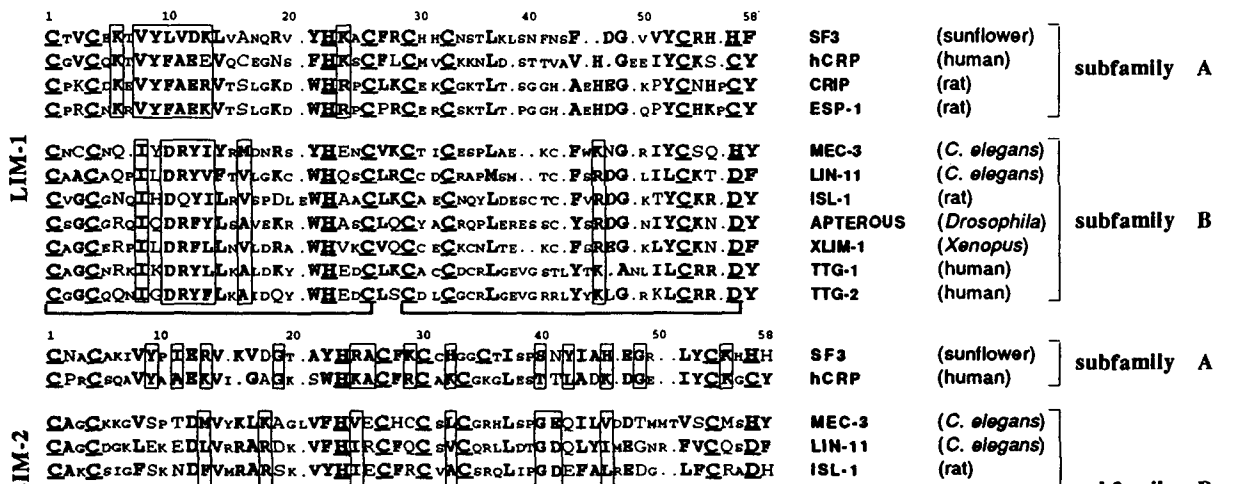

Figure 1. Alignment of the SF3 LIM Motifs with Other LIM Sequences.

Bold type letters indicate conserved and semiconserved residues. Unconserved residues are in standard type. Putative zinc fingers in the LIM domains are delimited by horizontal brackets. Potential metal-chelating residues are underlined. LIM subfamily–specific residues are boxed. CRIP and ESP-1 have only one LIM motif, whereas all of the other proteins have two LIM motifs. CRIP and ESP-1 are highly related, as are TTG-1 and TTG-2 (which is identical to RHOM-2).

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proposed (Boehm et al., 1990). The observation that LIM motifs and DNA binding homeodomains can coexist in the same protein does not preclude the LIM motif from also being a DNA binding domain. Together with the homeodomain, the LIM domain could bind to the regulatory regions of developmentally controlled genes, as has been proposed for the paired box, a conserved sequence motif first identified in the paired (PRD) and gooseberry (GSB) homeodomain proteins from Drosophila (Treisman et al., 1991). The PRD box is also able to bind DNA in the absence of the homeodomain.

The LIM region of the LIN-11 protein is an iron-, sulfur-, and zinc-containing metallodomain (Li et al., 1991). It has been proposed that LIM proteins containing iron–sulfur clusters might act as redox-sensitive transcriptional regulators, modulating their activity in response to a redox signal such as the level of oxygen or another redox-active molecule.

It is possible that the SF3 protein is involved in controlling pollen-specific processes such as male gamete maturation, pollen tube formation, or even fertilization. However, it is also possible that this protein plays another, yet unknown, biological function. Further experiments should clarify this point.

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