Unusual compartmentalisation of mouse U7 small nuclear transcripts in Xenopus oocytes.

PHILIP C. TURNER and STEPHEN C. PHILLIPS*

Department of Biochemistry, University of Liverpool, P. O. Box 147, Liverpool, L69 3BX, U. K.

Small nuclear RNAs are generally transcribed as precursors in the eukaryotic nucleus which then rapidly enter the cytoplasm. In the cytoplasm the precursors undergo RNA processing events and they also associate with specific proteins to form RNP particles or snRNPs. The RNA processing events include: (a) the addition of a tri-methyl G cap, the precursor being synthesized with the normal mono-methyl G cap of polymerase II transcripts and (b) the removal of the short 3' extension of about 8 nucleotides[1]. The association of snRNAs with the common snRNP proteins requires the Sm antigen binding site, 5'-PuA(U)nGPu-3', to be present in a single stranded region in the RNA molecule. When some or all of the snRNP proteins have bound to the snRNA a nuclear targeting signal is probably unmasked permitting the snRNP to localize in the nucleus where it can carry out its biochemical function[1,2].

Experiments injecting Xenopus oocytes with sea urchin U7 snRNA or sea urchin U7 genes have shown that the sea urchin U7 snRNA can presumably form a snRNP using endogenous Xenopus proteins, enter the nucleus, and then process target histone pre-mRNA transcripts[3]. We have recently isolated the mouse U7 snRNA gene[4] and shown it to be efficiently transcribed in Xenopus oocytes. However, attempts to demonstrate that it can form a functional snRNP particle have so far failed. In an effort to understand this lack of function we looked at the cellular distribution of the mouse U7 snRNA transcripts following injection of the gene into Xenopus oocytes and incubating for 24 hours.

Figure 1 shows that the bulk of the mature mouse U7 transcripts are located in the cytoplasm. Upon longer exposure the precursors are also seen to be cytoplasmically located with some mature product being detected in the nuclear fraction. However, the latter could easily have resulted from some cytoplasmic contamination of the dissected nuclei. The cytoplasmic localisation of the majority of the mouse U7 snRNA means that even if it was assembled into a functional snRNP particle it could not participate in the histone pre-mRNA 3' processing reaction which is nuclear and is a prerequisite for the export of histone transcripts from the nucleus[5].

These results suggest that there is some feature of the mouse U7 transcript that prevents nuclear localisation in Xenopus. It could be directly or indirectly related to its sequence and may have implications with regard to assembly, processing and nuclear import.

The use of a number of mutant Xenopus U2 transcripts has shown that binding of snRNP proteins, although necessary, is not sufficient for nuclear import of the resulting snRNP particle [6]. As a result, it has been suggested that certain conformational changes are required, as a result of protein-RNA interactions, to unmask the nuclear targeting signal(s). Therefore, the mouse U7 snRNA may not allow the unmasking of nuclear targeting signal(s) in Xenopus oocytes.

It will be interesting to carry out domain swapping experiments to see what parts of the mouse U7 snRNA prevent assembly/localization in Xenopus oocytes.

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