ABSTRACT OF Ph.D THESIS

ENTITLED

TRANSLATIONAL CONTROL IN BARLEY EMBRYOS

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The existence of stored mRNA in higher plants has been well established (Payne, 1976). The stored mRNAs, synthesised during embryogenesis, are utilised only during germination. The suppression of translation of some mRNAs at certain stages of development which is found in both animal and plant systems, requires a mechanism of regulation at the translational level. Some proposals that have been put forth with regard to the translational control of the stored messages in developmental systems are: 1. The stored mRNAs are unprocessed and therefore are not translatable, 2. The lack of some essential rate limiting factors involved in translation, leading to suppression of mRNA utilization, and 3. The presence of protein synthesis inhibitors as a mechanism of conservation of mRNA.

In barley (Hordeum vulgare, Hull-less variety, IB65) embryos, the first possibility does not hold true because poly(A)RNA has been isolated and successfully translated in vitro (Sopory et al., 1980). The second and the third possibilities have been investigated in this research project.

The activity of eIF-2 (a factor required at the first step in initiation of protein synthesis) at different stages of development in barley embryos has been
studied. eIF-2 activity has been assayed by the method of Siekierka et al. (1982). It has been observed that the activity of this important factor was fairly high in dry embryos. The amount of eIF-2 activity during the early stages of embryogenesis (0-25 days) was very low, but it increased rapidly after 30 days of fertilization. The developing seed reached a maximum weight 30 days after fertilization, after which dehydration began and was completed by the 40th day. This high activity decreases steadily during germination and reaches a level that can sustain a good rate of protein synthesis. Therefore, in barley embryos, lack of eIF-2 is very unlikely to be the reason for suppression of stored messages.

Dry embryos contain monosomes which, soon after imbibition, are incorporated into polysomes to support protein synthesis. Therefore, besides the mRNA and ribosomes, other components of the translation machinery (e.g. initiation and elongation factors) should be conserved. The large stock of eIF-2, observed in dry embryos, is synthesized during embryogenesis as a preparation for germination. But eIF-2 activity was not detected till the onset of desiccation. This suppression of eIF-2 activity could be a mechanism by which newly synthesized eIF-2 is stored during the metabolic phase of embryogenesis, to be used during germination.
A small molecular weight RNA has been shown to be present in barley embryos which inhibits translation. Most of the properties of the inhibitor RNA matches well with that of the animal systems (Fuhr and Natta, 1972; Bogdanovsky et al., 1973; Dionne et al., 1982; Arnold et al., 1978; McCarthy et al., 1983; Winkler et al., 1983). It is important to stress the fact that this is the first report of an RNA translational inhibitor from a plant system. The 255,000Xg supernatant of the embryo extract is the source of the RNA. It is sensitive to alkali and pancreatic RNase treatment, indicating that it is an RNA macromolecular and is single stranded. It does not have long stretches of poly(A) because it does not bind to oligo(dT) cellulose. By urea-PAGE it has been observed that the inhibitor RNA was smaller than 4S in size. It is a potent inhibitor of translation in rabbit reticulocyte cell-free system. It has been categorically shown to inhibit specifically at the level of initiation, like some of the other inhibitor RNAs described earlier (Arnold et al., 1978; Dionne et al., 1982; McCarthy et al., 1983; Winkler et al., 1983).

It is thus believed that the mechanism of conservation of mRNA in barley embryos is due to the presence of the RNA translational inhibitor. Furthermore, a protein inhibitor, which is a cAMP-independent protein kinase, has also been reported in this system.
(Reddy et al., 1984). But the molecular mechanism of the action of these inhibitors is yet unknown. Further research in this direction would definitely be helpful for better understanding of the mechanism of translational control of conserved mRNA in plant seeds.

REFERENCES


