cal ultracentrifuge, it contained the 2nd satellite DNA besides the rDNA satellite (figure 3). 3rd CsCl-centrifugation completely separated the second satellite DNA from rDNA satellite[7]. The appearance of satellite DNA (II) by this method establishes its existence. This satellite DNA has a buoyant density 1.710 g/cm^3 in CsCl, corresponding to 50% GC content.

It is difficult to explain why this DNA did not appear in the earlier experiments of Patterson and Stafford[3]. It may, however, be pointed out that these authors isolated DNA from frozen sperms. It is not unlikely that during thawing of frozen sperms, some nuclease may become active and degrade the DNA. The present author has experienced considerable difficulty in isolating a high mol.wt DNA from frozen and preserved sperms.

It would require a large scale purification of the 2nd satellite DNA before its function can be determined. Nevertheless, 2 important characteristic features of the 2nd satellite DNA justify some comments upon its possible function. 1. By looking at the area under the peak (figure 1), it may be suggested that the amount of this DNA may come up to 0.8% of the total amount of DNA of the sea urchin sperm. This amount of DNA is required to encode the histone genes and their associated spacer DNA (Birnstiel et al., 1974; cited by Elgin and Wintraub[8]). 2. The buoyant density of the 2nd satellite DNA suggests that its GC-content is 50%. The GC-content of histone mRNA vary from 51 to 58% (Grunstein et al., 1973; cited by Elgin and Wintraub[8]). Histone genes are repetitious and it is held that they contain AT-rich regions designated as spacer DNA. Assuming that the region of histone DNA, which corresponds to translatable histone mRNA, is conservative, the variation in the AT-rich spacer DNA (Birnstiel et al., 1974; Farquhar and McCarthy, 1973; cited by Elgin and Wintraub[8]) could account for some differences in the overall GC composition of this gene present in different genera of sea urchin.

The data presented in this paper simply point to the existence of a second heavy satellite DNA in *Lytechinus variegatus*. Further characterization of this DNA is required to establish its function.

1 Acknowledgment. This work was carried out in the laboratory of Dr D.W. Stafford, Department of Zoology, University of North Carolina, Chapel Hill, N.C., USA. I thank him for his help and cooperation.
2 D.W. Stafford and W.R. Guild, Exp. Cell. Res. *55*, 347 (1969).
3 J.B. Patterson and D.W. Stafford, Biochemistry *9*, 1278 (1970).
4 K.S. Kirby, E. Fox-Carter and M. Guest, Biochem. J. *104*, 258 (1967).
5 P.A. Albertsson, Partition of cell particles and molecules. John Wiley and Sons, New York 1961.
6 M.L. Birnstiel, M. Chipchase and J. Spiers, Prog. Nuc. Acid R. *11*, 351 (1971).
7 N.K. Mishra, Ph.D. thesis, University of North Carolina, Chapel Hill (1973).
8 S.C.R. Elgin and H. Wintraub, A. Rev. Biochem. *44*, 725 (1975).

Influence of seed size and composition on the dry matter yield of *Cenchrus ciliaris*

S. Kathju, A.N. Lahiri and K.A. Shankarnarayan[1]

Central Arid Zone Research Institute, Jodhpur 342 001 (India), 3 January 1978

Summary. Higher food reserve in larger seeds of *Cenchrus ciliaris* contributed towards greater forage production, as compared to that of the small seeds, only during the 1st year of establishment.

Large and heavier seeds of a given genotype, having a higher protein content[2,3], has been found to have a higher germination percentage as compared to smaller and lighter seeds[4], and plants obtained from the larger seeds have been reported to have greater seedling vigour[3,5-7] and growth and yield potentialities[8,9] as compared to plants obtained from the small seeds with a lower protein reserve. In *Cenchrus ciliaris*, a prominent fodder grass of the Indian arid zone, seed dimorphism has been found to be associated with significant differences in the growth of the seedlings obtained from them[4]. This report relates the differences in chemical composition of these 2 types of seeds of *C. ciliaris* (CAZRI 358) and describes the results of field performance of plants obtained from them.

Table 1 indicates that the reducing sugar and soluble carbohydrates were relatively more in the small seeds as compared to the large seeds. But the level of starch and extractable protein in the large seeds were very much more than those found in the small seeds. The nitrogen and phosphorus contents of the 2 types of seeds also showed a sharp contrast, but the potassium concentration was slightly more in the small seeds and the difference in the absolute quantities (µg/seed) between the large and small seeds was also small. However, the over-all difference in the nutritional reserve in the 2 types of seeds obviously contributed towards the disparity of early seedling vigour noted earlier[4].

In a perennial grass, like *C. ciliaris*, it was necessary to examine whether this difference in seedling vigour has any relevance with the forage production under field conditions. It is possible that commencement of photosynthesis and equal availability of nutrients may level off the initial differences in growth, as has been observed in relation to

Table 1. Compositional differences in small and large seeds of *C. ciliaris*

Seed size	1000 seed weight (mg)	Reducing sugar (µg/seed)	Soluble carbohydrates (µg/seed)	Starch (µg/seed)	Extractable protein (µg/seed)	Nitrogen (µg/seed)	Phosphorus (µg/seed)	Potassium (µg/seed)
Small	303.00	3.30	26.00	150.00	1.10	3.99	1.40	0.26
		(1.09)*	(8.68)	(49.60)	(0.38)	(1.32)	(0.47)	(0.089)
Large	676.00	2.00	22.00	399.00	4.80	20.76	3.90	0.51
		(0.30)	(3.37)	(58.70)	(0.71)	(3.07)	(0.58)	(0.075)

* Concentration in mg/100 mg dry seed.

the yield behaviour of certain cereals[10]. In view of this, plants obtained from the large and small seeds of *C. ciliaris* were raised during July 1976 in field plots (gross plot size was 5.25 M×4.50 M where space between the plants was 75 cm) with 3 levels of nitrogen (0, 20, 40 kg N/ha applied as ammonium sulphate and with a dressing of 20 kg P/ha as superphosphate in all the plots) in loamy sand soil of Central Research Farm of this Institute at Jodhpur which contains about 0.15% of organic carbon, 8 kg/ha of available P_2O_5 and 180 kg/ha of available K_2O. A factorial design was adopted with 5 replications of each treatment. The growth of this grass is normally restricted to between June-July and September-October under the rainfed conditions of the Indian arid zone.

During the 2nd year (i.e. 1977) the plots received similar fertilizer treatment, as mentioned above, at the beginning of the monsoon showers in July and the dry matter production was assessed from a single cut, close to the ground level, during October in both the year 1976 (rainfall: 639.7 mm) and 1977 (rainfall: 353.1 mm).

Table 2. Effect of parent seed size on the dry matter production (q/ha) in *C. ciliaris*

Treatments (nitrogen)		1976 Small	Large	Mean	1977 Small	Large	Mean
0 kg/ha		2.23	3.87	3.05	9.24	11.73	10.49
20 kg/ha		4.60	6.91	5.76	22.22	21.51	21.87
40 kg/ha		5.04	7.69	6.37	25.07	26.58	25.83
Mean		3.95	6.41	5.18	18.84	19.94	19.39
Seed size	±SEM		0.46			0.14	
CD	5%		1.36			NS	
	1%		1.85			NS	
Nitrogen							
dose	±SEM		0.56			0.19	
CD	5%		1.65			0.56	
	1%		2.24			0.76	

Table 2 indicates that the dry forage production during the 1st year of establishment (i.e. 1976) was significantly higher in plants obtained from the large seeds as compared to that of the small seeds. Increasing level of nitrogen increased the dry matter production in both the cases, but the yields from the plants raised from large seeds were consistently higher at all levels of nitrogen treatment. The interaction between seed size and nitrogen treatment was not significant. In general the dry matter yield was relatively higher in the 2nd year of the growth (1977). However, the effect of seed size on dry matter production was not significant during this year, although the nitrogen levels had a significant effect.

It seems therefore that the higher food reserve of the large seeds has a sustained effect on the maintenance of a higher growth of plants only during the 1st year of their establishment. It is tentatively concluded that the advantages provided by the large seeds, such as higher germination, greater seedling vigour and larger dry matter production in the 1st year of establishment, provide ample scope for improving forage production in the arid areas.

1 Acknowledgment. Thanks are due to Dr H.S. Mann, Director of this Institute for providing facilities. Technical support provided by Mr M. Ram is duly acknowledged.
2 L.E. Evans and G.M. Bhatt, Can. J. Pl. Sci. *57*, 929 (1977).
3 S.K. Ries, G. Ayers, V. Wert and E.H. Everson, Can. J. Pl. Sci. *56*, 823 (1976).
4 A.N. Lahiri and B.C. Kharabanda, Sci. Cult. *27*, 448 (1961).
5 S.K. Ries, O. Moreno, W.F. Meggitt, C.J. Schweizer and S.A. Ashkar, Agron. J. *62*, 746 (1970).
6 S.K. Ries, J. Proc. Am. hort. Soc. *96*, 557 (1971).
7 C.M. Mckell, in: The Biology and Utilization of Grasses, p. 74. Ed. V.B. Younger and C.M. Mckell. Academic Press, New York 1972.
8 C.J. Schweizer and S.K. Ries, Science *165*, 73 (1969).
9 M.J. Pinthus and R. Osher, Israel J. agr. Res. *16*, 53 (1966).
10 R.W. Welch, J. agric. Sci. *88*, 119 (1977).

Isoelectric focusing study of radiation damage to dry conalbumin[1]

P. Cavatorta, P.R. Crippa and A.M. Tosi

Unità di Biofisica Molecolare CNR-GNCB, Istituto di Fisica dell'Università, I-43100 Parma (Italy), 28 November 1977

Summary. The effect of γ-rays on iron-free conalbumin was studied by isoelectric focusing technique. The results obtained can be interpreted on the basis of radiation-induced conformational changes of the macromolecules through a cleavage of disulphide bridges. Treatments with reagents acting on disulphide bridges lead to isoelectric focusing patterns that confirm this hypothesis.

The separation and the identification of chemically modified molecules after X- or γ-irradiation of proteins was performed in recent years, using the most advanced methods of analytical biochemistry. In particular, proteins irradiated in aqueous solution were investigated, but considerable interest was also devoted to the study of irradiated dry enzymes after the works of Jung and Schüssler[2,3] and Haskill and Hunt[4-6] on ribonuclease. Up to now however, no general picture can be outlined for clarifying all the phenomena involved in the chemical modification of irradiated dry enzymes leading to their biological inactivation. Several theories are at present debated, including damage of amino acids in the active site, conformational changes, and the intervention of oxygen leading to the formation of peroxide groupings[7].

In the present note, we report the results of a preliminary study of the radiation damage to dry iron-free conalbumin performed by the isoelectric focusing technique on column, a method based on the separation of proteins according to differences in their isoelectric points. Thin-layer isoelectric focusing was used in radiation biochemistry, first by Delincée and Radola[8,9] in their study on irradiated horse-radish peroxidase. The isoelectric focusing technique has the advantage of giving information only on amino acids bearing charges and, indirectly, on conformational changes causing a different exposure to the solvent of the charged residues. Free radical formation on dry chicken egg conalbumin was studied in the past in our laboratory[10]. The present work was performed with the aim of obtaining some inferences on charge modification of such a protein, taking advantage by a convenient pH value of its isoelectric focusing patterns.

Chicken egg conalbumin (iron free) and dithioerythritol were obtained from Sigma Chemical Co. St. Louis, USA, 'Ampholine' carrier ampholites (pH range 5-8) from LKB, Bromma, Sweden. All other chemicals were of analytical