mammalian tissues has previously been reported only in animals which have been heavily dosed with this compound[10]. Vitamin A_2 is, however, the preponderant retinoid in fresh-water vertebrates[7], and its biological activity is considered to be about half that of retinol[11].

It is conceivable that dehydroretinol, like retinol, is a normally occurring retinoid in human epidermis, although its exact nature in unhydrolyzed skin has not yet been determined. Under certain conditions of hyperkeratosis changes in the retinoid metabolism may possibly lead to an accumulation of dehydroretinol. In this context reference should be made to the work of Wolfe et al.[12] demonstrating the accumulation of retinoyl complexes in the brains of patients with inherited Batten disease. Also, anhydroretinol (i.e. retinol lacking the terminal hydroxyl group) has recently been reported in transformed, but not in normal mouse fibroblasts incubated in vitro with retinol[13]. Thus, several independent observations have been made of a disturbed retinoid metabolism in relation to genetically determined cellular diseases. Whether such variations in retinoid metabolism may actually cause symptoms of a disease remains to be established.

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Effect of crustacean eyestalk extracts on carbohydrate levels in the South Indian scorpion *Heterometrus fulvipes* (Koch)

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Summary. Injection of eyestalk extracts of freshwater crab and marine prawn caused elevation of haemolymph sugar level, and decrease in free sugar and glycogen levels, in the hepatopancreas of the scorpion.

The chemical nature, mode and site of action of crustacean hyperglycemic hormone are well known[1–4]. A hyperglycemic principle has been identified in the cephalothoracic ganglionic mass of the scorpion *Heterometrus fulvipes*[5–7]. Some information is available on the interspecific action of crustacean hormones[8–10]. The present report examines the effects of eyestalk principles of the freshwater crab *Oziotelphusa (Paratelphusa) Senex senex* and the marine prawn *Penaeus monodon* on carbohydrate levels in the haemolymph and the hepatopancreas of the South Indian scorpion *Heterometrus fulvipes*.

Material and methods. Collection and maintenance of scorpions have been described earlier[11]. Scorpions normally fed daily with cockroaches were starved for 24 h prior to experimentation. Eyestalks from intermoult crabs and prawns were used. Prawn eyestalks were collected from the Kakinada area of Andhra Pradesh. Hyperglycemic principle was extracted from the eyestalks into 80% ethanol in the

Effect of injection of crustacean eyestalk extracts on free sugar and glycogen levels of hepatopancreas, and total sugar level of haemolymph, in the scorpion *Heterometrus fulvipes*

Tissue/component	Normal	Scorpion Ringer injected	Eyestalk extract injected	
			O. Senex senex	*P. monodon*
Haemolymph				
Total sugars	37.67 ± 8.41	37.20 ± 7.03	120.29 ± 10.18	85.86 ± 4.44
		−1.25%	+219.33%	+127.93%
		NS	$p < 0.001$	$p < 0.001$
Hepatopancreas				
Glycogen	0.9053 ± 0.0727	0.8757 ± 0.1059	0.6220 ± 0.1155	0.6170 ± 0.0604
		−3.27%	−31.29%	−31.85%
		NS	$p < 0.001$	$p < 0.001$
Free sugars	12.04 ± 1.74	11.96 ± 2.47	5.99 ± 0.81	7.17 ± 1.22
		−1.66%	−50.25%	−40.45%
		NS	$p < 0.001$	$p < 0.001$

Values are means (mg of glucose, g wet weight of tissue^{-1}, mg of glucose/100 ml of haemolymph) ± SD of 6 estimations. % change, 'p' calculated for normal-injected.

cold. The extracts were centrifuged and the supernatants were dried. The residue was resuspended in scorpion ringer[12]. Each scorpion received by injection 50 µl of the extract (2 eyestalk equivalents of crab hormone or 1 eyestalk equivalent of prawn hormone); 1 batch of scorpions was injected with ringer solution to serve as a control. 2 h after injection the scorpions were sacrificed for the estimation of total sugar in the haemolymph, and free sugar and glycogen[13] in the hepatopancreas. The data were subjected to Student's t-test.

Results and discussion. Administration of eyestalk extracts from freshwater crab and marine prawn caused significant elevation of haemolymph sugar in the scorpion (table) indicating that the scorpion tissues respond to crustacean hyperglycemic principles. Crab eyestalk extract elicited a greater response than the prawn eyestalk extract. A parallel decrease in the free sugar and glycogen levels in the hepatopancreas were observed, suggesting the possible mobilization of sugar from hepatopancreas to haemolymph. It has been established that the crustacean hyperglycemic hormone is glycogenolytic through activation of the phosphorylase system, leading to the elevation of tissue free glucose. This glucose leaks into the haemolymph, causing hyperglycemia[2,4,14,15].

The hyperglycemic principles of the scorpion neuroendocrine system do not enhance the activity of the phosphorylase system[6]. However, the crustacean hormone molecule, when introduced into the scorpion, acts through the same mechanism as in crustaceans. Although the scorpion has a hyperglycemic hormone of a different nature, the tissues do respond to crustacean hormone. The findings of the present investigation unequivocally prove the interspecific action of crustacean hyperglycemic hormone and throw light on the parallel evolution of hormonal mechanisms in invertebrates.

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Amino acid transport by small and large intestine of newborn pig

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Summary. Unidirectional fluxes of different amino acids have been determined across newborn pig small intestine and colon. The systems responsible for amino acid transport are present in the same proportion in both tissues. Colonic transport of amino acids appears to represent a transient overspill function of the small intestine.

The presence of at least 2 separate mechanisms for neutral amino acid entry into rabbit ileal mucosa has been established recently through the combined use of 3 different types of experimental approach. The first consists of mutual competition experiments, where it is found that serine is unable to inhibit fully the uptake of other neutral amino acids[1]. The range of apparent affinities of other amino acids for this serine-sensitive system varies from 0.3 to 3.7 mM. The characteristics of the amino uptake system resistant to serine inhibition cannot be determined from this type of experiment. Computer analysis of a 2nd series of uptake and inhibition experiments, involving the simultaneous fitting of 83 data points for 3 neutral amino acids to a 2-system model, leads to the generation of a similar series of high affinity constants for neutral amino acids (0.4–6.3 mM), together with a 2nd set of low affinity constants (22, 91 and 2931 mM for methionine, alanine and serine respectively)[2]. Subsequent work has shown this 2nd low affinity system to be present in the absence of sodium (23, 75 and 89 mM for methionine, alanine and serine respectively)[3]. The low affinity system for serine shows most apparent variation due to its close resemblance to diffusion. Inhibition experiments with methionine show, however, that the diffusion of serine into this tissue is small or non-existent[2]. Similar mechanisms for amino acid entry have been described for the proximal colon of the newborn pig, but in this case the relative proportions of the 2 systems appear to differ from those reported for the rabbit[4]. These results are interesting, but it is not known whether the difference arises because of the developmental state of the animal, whether it represents a true difference between species or whether the amino acid transport characteristics of the large intestine are normally different from those found higher up the gastrointestinal tract. The present work was initiated to answer some of these questions by directly comparing the transport of different neutral amino acids across the small and large intestine of the newborn pig.

Short-term measurements of amino acid uptake generally provide the best means of analysing intestinal transport mechanisms. Endocytosis of immunoglobulins by newborn pig intestine makes this method of analysis unsuitable in the present case. For this reason, it was decided to measure