Sea Water Consumption by Two Strains of Mice

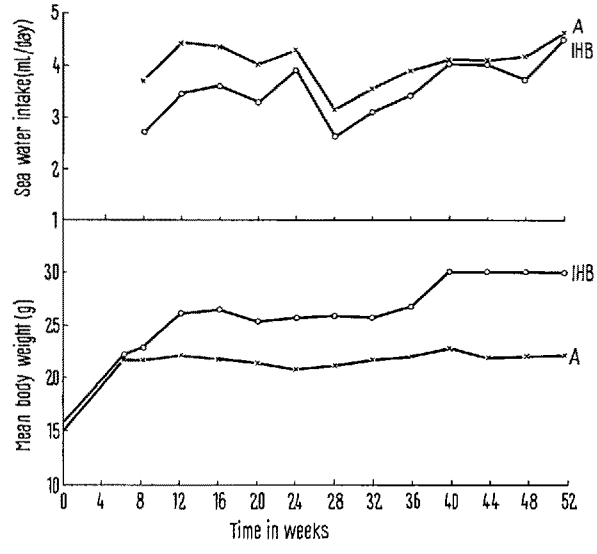
The high degree of urine concentrating ability of 2 strains of mice suggested that they could handle the urinary electrolyte excretion load imposed by the ingestion of sea water. One strain (IHB) is capable of surviving on a diet of dry laboratory chow and a solution of 4% NaCl to drink, while the second strain (A) produces, under conditions of dehydration, a urine more concentrated in sodium and potassium than sea water[1-2]. Since only a few land mammals can tolerate the ingestion of sea water[3], we were interested to learn if these 2 strains of mice could survive on a diet of dry laboratory chow and sea water. The following study was carried out in order to examine this possibility.

Eight male and 2 female IHB mice, 45 days of age, and 4 male and 7 female A mice, 46–79 days of age, were fed dry laboratory chow (10% moisture) and sea water ad libitum. The sea water was obtained from the Gulf of Mexico several miles offshore. After 6 weeks on this diet, the mice were placed in individual cages and body weights and fluid consumption were recorded weekly. The Figure illustrates the rate of growth and fluid intake for the 2 strains of mice under the experimental conditions described. Previous studies[1-2] and personal observations have shown the body weight of IHB mice on a diet of laboratory chow and tap water to progress from 16 g at 42 days of age to 37 g at 1 year. Corresponding figures for the A strain were 15 and 31 g. Under these conditions, the average daily consumption of tap water was found to be 6 ml for IHB and 5 ml for A mice. When these values are compared with those of the Figure, it can be seen that both strains on the experimental diet drank less fluid and gained less weight than mice of the same 2 strains drinking tap water. However, most of the mice appeared to be in good condition throughout the experiment.

Three females of the A strain died, 1 during the 6th week, 1 during the 28th week and the other from spontaneous mammary tumor during the 25th week. This death rate would not be unusual in a colony of these mice on a normal diet. One female of the A strain gave birth to 5 pups during the 8th week (conception occurred prior to separation of the mice into individual cages). The mother survived, but the pups lived for only 5 days and died in an emaciated condition. No deaths occurred among the IHB mice and there was no indication of diarrhea among either strain at any time during the test period. Diarrhea, which results in the loss of additional water, commonly occurs in many mammals following the ingestion of sea water[4].

The consumption of sea water by marine mammals is uncertain and among land mammals only the kangaroo rat, until now, has been reported to be able to drink sea water and survive on a dry diet[3]. The cat and the white rat can utilize sea water in order to survive on a diet of partially desiccated salmon (approximately 43% moisture)[4]. However, ADOLPH[5] has shown that sea water will not maintain white rats on diets containing 2 or 10% moisture. A number of desert rodents have urine concentrating abilities which should allow them to drink sea water[6] and some can tolerate drinking solution containing up to 10% sodium chloride[7], but we are not aware of experiments to test these animals on sea water. Thus, the IHB and A strains of mice are among the small number of mammals shown to be not only tolerant of sea water, but capable of utilizing it as the principal source of water.

During the 38th and 50th weeks of the test diet, urine was collected from each mouse from 08.00–12.00. This was accomplished by placing the mouse in a small cage with a large mesh screen floor which was supported above a piece of wax paper. Urine was collected from the wax paper immediately after each voiding and stored temporarily in small plastic vials. Urine osmolality was determined by the freezing point depression technique described by PROSSER et al.[8]. Sodium concentration was measured by standard flame photometric methods. The data obtained from the 2 intervals showed no marked differences and, therefore, they were combined. These data are presented in the Table. Since the total osmolality of



Mean volumes of sea water ingested and mean body weights of IHB and A strains of mice on a diet of laboratory chow (10% water) and sea water ad libitum.

Osmolality and sodium concentration of 4-h urine samples from mice after 38–50 weeks on the sea water regimen

Strain	No. of samples	Urine osmolality (osm) mean ± S.E.	Urine sodium (meq/l) mean ± S.E.
IHB	20	2.65 ± 0.13	550 ± 40
A	16	2.51 ± 0.12	648 ± 33

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sea water is approximately 1.07 osm[9] and the sodium concentration of the Gulf sample used was found to be 480 meq/l, it can be seen that these animals can produce a urine more concentrated than sea water in terms of both osmolality and sodium concentration. Even while drinking tap water the IHB mice produced urine of greater osmolality than sea water. Twenty-four h urine samples were collected from 8 IHB mice drinking tap water and were found to have mean osmolality and sodium concentration values of 1.47 ± 0.26 osm and 196 ± 23 meq/l respectively. These findings support those of THUNG[10], who reported high concentrations of nitrogenous materials in the urine of mice.

Although several water conservation mechanisms must be utilized by these animals, the extensive urine concentrating capacity of their kidneys appears to be the most significant factor in their survival on the test diet. Lack of diarrhea also must be considered as an important factor[11,12].

Résumé. Deux espèces de souris (IHB et A) vécurent 1 an avec un régime d'eau de mer ad libitum et d'aliments secs. La haute osmolarité urinaire, la capacité élevée de concentrer le sodium et l'absence de diarrhée furent des facteurs qui leur permirent de supporter ce régime expérimental.

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[12] This study was supported by grants No. AM 07257-03 and No. NB 01147-09 from the U.S. Public Health Service.
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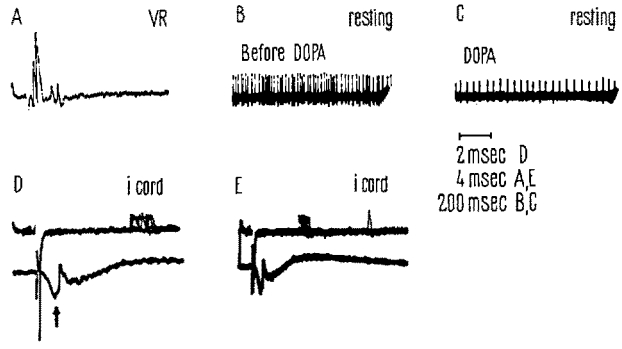
Monosynaptic Control of Static γ-Motoneurones from the Lower Brain Stem

The lower brain stem exerts monosynaptic excitatory control on one group of spinal γ-motoneurones while another group is not influenced[1]. This investigation has been undertaken to show whether this division is identical with the known subdivision in dynamic and static γ-motoneurones[2].

The experiments have been carried out on anaemically decorticated, unanaesthetized cats. Single γ-efferents were isolated in peripheral nerve filaments to flexor muscles in the hindlimb as described in a previous paper[3]. The lower thoracic cord was transected and the dorsal columns removed. The ipsilateral ventrolateral funicle was dissected and mounted for stimulation as well as ipsi- and contralateral nerves.

The γ-efferents were identified as dynamic or static by their difference in reflex behaviour and spontaneous activity before and after an i.v. injection of DOPA[3,4] which modifies the spinal reflex patterns[5,6] presumably by liberating NA from the terminals of descending noradrenergic fibres. Dynamic γ-motoneurones are spontaneously active before DOPA[3,4,7] but either not, or less active after[3,4]. On the contrary, static γ-motoneurones increase their resting activity after DOPA[3,4,8].

In the Figure 2 γ-efferents in 1 filament to the tenuissimus muscle are shown identified as conducting within the γ-range (A) on stimulation of the intact ventral root. The larger diphasic unit is spontaneously active before DOPA (B) but not after (C) and is thus a dynamic γ-motoneurone[3,4]. The smaller clubbed fibre is spontaneously active only after DOPA (C) and thus of the static type[3,4]. By stimulation of the ipsilateral ventrolateral funicle (D, E) the static γ-motoneurone can be activated with short latency but not the dynamic. The segmental latency is calculated by subtracting the peripheral conduction time in the efferent from the latency measured from the onset of negativity of the descending volley (arrow) recorded on cord dorsum (lower trace in D); it is in this case 1.2 msec. This latency is of course of longer duration than the one obtained by intracellular recording which is



Activation of a static γ-motoneurone after stimulation of the ipsilateral ventrolateral funicle of the spinal cord. Upper traces are recordings from a filament to the tenuissimus muscle containing 2 γ-efferents, identified as conducting within the γ-range by stimulation of the intact ventral root of L6. L7 and S1 ventral roots are cut. Spontaneous activity is illustrated in B before and in C 15 min after an i.v. injection of DOPA (100 mg/kg). Only the larger, diphasic unit is spontaneously active before DOPA (B), and only the smaller, clubbed one (static) after (C). D and E show the effect of single shock stimulation of the ipsilateral, ventrolateral funicle at lower thoracic level, recorded at 2 different sweep speeds (superimposed traces). Lower traces in D and E are from the cord dorsum at L6 segmental level. The onset of negativity in the descending volley is indicated by an arrow in D. Only the small unit is activated at a short latency by this stimulation.

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