VITAMIN REQUIREMENTS OF DOLPHINS

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Summary

A review of the literature emphasized the absence of detailed knowledge of specific requirements of individual vitamins for dolphin species. Apart from the B group, where studies have been reported, basic work is still required for the assessment of normal blood levels relating to healthy animals.

The techniques of vitamin estimation still vary with the worker and it is not advisable to look at individual levels without reference to the total vitamin spectrum.

Introduction

Before the establishment of the Zoological Society of London's Water Mammal Exhibit at Whipsnade, which was built in 1972 and designed to display bottle-nosed dolphins *(Tursiops truncatus)* in the first instance, advice was sought from many dolphinaria in the United Kingdom and in Europe on satisfactory and suitable diets for the animals. It was expected that enough experience would have been obtained already to enable all the necessary minerals and vitamins for the maintenance of health to be included in the diet but it was discovered that no two collections fed exactly the same diets. RIDGWAY's „Mammals of the Sea" lacks essential information on the normal level of any vitamin needed for the maintenance of health and does not quote levels found in wild caught stock. The first step in constructing diets is to obtain information from the wild but unfortunately even GERACI (1974) cannot quote any detailed investigations of vitamin A requirements. STEFFENS and KARST (1972) report levels in fish flesh and bearing in mind that the total diet of dolphins in the wild is whole fish, this is a reasonable starting point for calculation.

ENGELHARDT (1973) found about 5 micrograms of vitamin A per 100 ml of plasma in a bottle-nosed dolphin which was not receiving any dietary supplement. He has found that tissue concentrations of vitamin A in marine mammals occur particularly in the liver and the blubber with a concentration in these last two sites at least three times higher than in other tissues. Soon after the Society imported bottle-nosed dolphins in May 1972, a young female died. Post mortem examination of her liver failed to reveal any traces of vitamin A. Since the animal was healthy when caught in the wild and had fed well in the short acclimatisation period in the United States, it is reasonable to assume that on arrival her vitamin A status was satisfactory. Nevertheless within eight days of arrival no vitamin A was detectable in her liver, despite the fact that she, like all the animals, was receiving additional levels of arond 25,000 i.u. of vitamin A per day as a supplement

to the diet. Further investigations with increased levels of supplementation failed to reveal a concurrent rise in blood levels. A check was then made with other establishments in the country and random blood samples taken which yielded an an average figure of 127 i.u. per 100 ml plasma. In these cases supplementation to the diet was only of the order of 10,000 i.u. per day.

The levels of supplemental vitamin A fed in captive situations are found to vary from place to place but in any case the total vitamin received by the animal must be related to the method of feeding the fish. So many public displays utilise small pieces of gutted fish as rewards that in these situations at least the vitamin A content must be reduced considerably. Many collections feed what is described as a „multi-vitamin tablet" but there are few reports of the composition of these tablets let alone the chemical nature of the individual vitamins included in them. Vitamin A alcohol (retinol) is unstable and breaks down rapidly; the commercial form available is usually one of the esters (retinol acetate or retinol palmitate) and this is much more stable. It is also the natural form in which vitamin A is stored in the liver. Many factors affect the absorption rate of vitamin A from the gut. Provided the levels of vitamin A and E are properly balanced (DICKS et al 1959), since vitamin E is a natural fat soluble anti-oxidant, an adequate supply of the latter will increase the effectiveness of absorption and will prolong the storage life of vitamin A. The presence of adsorbing substances such as bentonite and soft phosphates may inhibit absorption (BRIGGS, 1956 and ERWIN, 1958). Protein deficiencey will reduce vitamin A storage and under conditions of an intensive protein supply vitamin A requirements are increased (OLSEN et al 1959). The absorption of the esters is reduced in animals showing fibrosis of the pancreas (RIND, 1955 and SOBEL, 1952). The same happens in diseases of the intestinal mucosa. In chronic nephritis (MOORE, 1957) the blood level may fall to 10% of the normal and a smaller decrease will occur in pyrexia. Any disease with an impaired fat absorption will depress absorption of the fat solube vitamins. It is not known, at least for the dolphin, how quickly normal liver levels of vitamin A can be depleted under conditions of stress. In some mammals depletion takes place in a period of days rather than in months while in others the depletion takes place over a longer period of several weeks or months. A recent survey of different laboratories produced levels between 13 and 30 i.u. per 100 ml. and at this concentration in the blood both figures should be accepted as within the normal range. McCANCE and WIDDOWSON (1960) estimated the vitamin A content of mackerel and herring to be in the region of 150 i.u. per 100 grams and on this basis most dolphins would receive 6,000 i.u. per day if they were fed on whole fish without supplemental feeding. As mentioned above the levels of supplemental feeding vary from one establishment to another and levels of between 1,000 i.u. per day and 150,000 i.u. per day recorded. It seems, however, as though the average levels fed to prevent signs of deficiency is in the order of 40 to 50,000 i.u. per day.

The tissues of some species of fish contain enzymes that destroy thiamine. JESSE WHITE (1970) reports a case of thiamine deficiency in a dolphin fed a diet of raw fish (mainly herring). The animal's symptoms were alleviated by the parenteral administration of 1000 mgms. of thiamine hydrochloride for five days followed by 500 mgms. dialy. This was in addition to the normal supplemention with thiamine of the diet. On the basis of this one animal WHITE recommends that all mammals

fed on raw fish should be supplemented wih 250 mgms. of thiamine hydrochloride over and above „their daily multi-vitamin as a preventative measure". The level of thiamine in this was taken as approximately 10 mgms. per day. GERACI (1968) reported on the theoretical assumption that addition of 177 mgms. of thiamine was required to the daily diet of an animal eating 15 lbs. of raw whole smelt which contained enough of the anti-thiamine enzyme in one gram to destroy 44 μgrams of thiamine. Analysis of mackerel and herring shows that whole fish would yield between 0.01 and 0.13 mgms. and 0.09 mgms. per 100 grams respectively. Presumably the fish fed in the case of thiamine deficiency referred to above by WHITE was also ingesting a certain amount of B vitamins although all the fish fed to this animal were gutted.

Both BRAEKKAN (1948) and SLIJPER (1962) found only negligible levels of vitamin D in the livers of whales and the latter assumes that at least these cetaceans are unable to store large quantities in the liver or other tissues and must, therefore, obtain all requirements of this vitamin from their food intake. Recommended levels in the dolphin vary from 400 to 1,000 i.u. per day. DUDOK VAN HEEL (1972) points out the importance of adding vitamin C to the diet because of its anti-oxidant properties. The levels being fed are again extremely variable but are in the region of between 200 and 1,000 mgms. per day.

Conclusion

Once again in the field of non domestic animal medicine a long and detailed search of the literature and communication with workers in this field has failed to reveal adequate knowledge of basic normal dietary requirements and the author wishes to plead for more record keeping to try and elucidate some of the normal levels based on the successes and failures of the establishment concerned.

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REMARKS ON THE COMPOSITION OF WATER FOR DOLPHINS IN INLAND DOLPHINARIUMS

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Summary

In the Dolfinarium Harderwijk the original imported dolphins have been alive for nearly ten years. However, evidence has accumulated that artificial seawater with sodium chloride as the only salt present is insufficient for maintaining dolphins over a long period of time. A number of minerals and trace elements have been added and the results after 6 months are distinctly positive. It may also be more favourable for marine fungi, but this drawback has to be accepted.

Introduction

For years we have realized that in feeding deep frozen fish, even of the best quality, losses in quality occur and ought to be corrected. Therefore we add vit. B_1 to counteract thiaminase developing in dead fish. Other vitamins which feature in diets nowadays are in particular Vit. A, E, C and K.
The vitamin tablets usually contain minerals and sometimes trace elements. Interviewing colleagues about this matter I learned that they did not give much attention to this matter. Generally speaking it is assumed that the animals get enough minerals and trace elements from the fish supplemented from the daily tablets.

Over the years Dolphinaria or Oceanaria gather a lot of background information part of which is found in bloodvalues and postmortems. Evertytime one has a casualty, in particular if it is fatal, it is good practice to go through the records and see whether it is possible to learn from the addition of new data. These persusals lead us to believe that extra attention to minerals was badly needed. In our case even more so because the water in our systems is not oceanwater, but an artificial mixture.