Osteophagia in the Cape porcupine *Hystrix africaeaustralis*

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Two groups of porcupines (*Hystrix africaeaustralis*) were maintained for a period of 23 weeks on a diet containing high levels of Ca2+ and PO4. Parallel to this another two groups were maintained on a diet containing low levels of these minerals. All groups were provided with defatted bovine bones during weeks 18 to 23 of the experiment. Plasma Ca2+ and PO4 levels were determined at intervals throughout the experiment. The amount of osteophagia that occurred was determined by weighing the bones at two-weekly intervals. No significant differences in the plasma Ca2+ and PO4 levels of the porcupines on the high diet and those on the low diet were detected. Osteophagia by porcupines on the low diet was twice that of porcupines on the high diet.


Two groups of ystervarke (*Hystrix africaeaustralis*) is vir 23 weke 'n dieet bevattende hoër vlakke Ca2+ en PO4 gevoer en twee ander groepe 'n dieet bevattende lae vlakke Ca2+ en PO4. Tydens weke 18 tot 23 van die eksperiment is alle groepe van ontvette beeëerbene voorsien. Plasma Ca2+ en PO4 is op verskeie stadiums in die verloop van die eksperiment vasgestel. Die hoeveelheid osteofagie wat plaasgevind het is elke twee weke bepaal deur die bene te weeg. Geen betekenisvolle verskille in die plasma Ca2+ of PO4-vlakke van die ystervarke op die hoër dieet en die op die lae dieet is gevind nie. Ystervarke op die lae dieet het twee keer soveel osteofagie getoon as ystervarke op die hoër dieet.


Cape porcupines *Hystrix africaeaustralis* have long been known to accumulate bones in their lairs in certain regions and to practise osteophagia as evidenced by gnawing marks on these bones (Pitman in Shortridge 1934). These behaviours are important palaeontologically and were described by Maguire (1976) and Brain (1981). The reasons for osteophagia in porcupines, however, remain obscure and a subject of some speculation. De Graaff (1981), for example, states that it is the need to hone the incisor teeth that induces porcupines to gnaw bones while Kingdon (1974) and Skinner, Davis & Ilani (1980) believe that bones are gnawed for the minerals, particularly calcium and phosphorus, which they contain.

The former explanation for osteophagia can be discounted as attrition of the open-rooted incisors of rodents occurs naturally when the upper incisors rub against the lower pair (De Blasé & Martin 1982). Furthermore Skinner *et al.* (1980) note that osteophagic behaviour in porcupines is unique amongst species similar in size and mass and with similarly structured incisor teeth.

The porcupine diet consists of roots, bulbs, tubers, rhizomes and fruit (De Graaff 1981). These plant parts are known to be poor sources of calcium and phosphorus (McDonald, Edwards & Greenhalgh 1973). Thus it is possible that unless their digestive systems are adapted to extract adequate quantities of these minerals, porcupines may experience deficiencies in calcium and phosphorus and as a consequence, resort to osteophagia.

The objective of the present study was to investigate the relationship between dietary levels of calcium and phosphorus, and the incidence of osteophagia.

**Materials and Methods**

Four groups of adult porcupines were constituted as follows;

High diet groups — four males and four females

Low diet groups — two groups of one male and three females.

The mean body masses of these groups were the same.

The porcupines were housed in pens with cement floors. Half of this area was under cover and the rest exposed to sunlight. Two daily rations containing approximately the same amounts of crude protein (45 g and 42 g) but different amounts of Ca2+ (4 g and 0,2 g) and phosphorus (1,75 g and 0,8 g) were formulated using 0,45 kg calf starter pellets [Epol (Pty) Ltd, Johannesburg] and 2,0 kg potatoes (Table 1). Drinking water was provided *ad libitum*.

Plasma was collected from animals immobilized following van Aarde (1985) at intervals over 19 weeks. These samples were analysed for PO4 following Henry, Cannon & Winkelman (1974) and for Ca2+ by absorption spectropho-
tometry according to the Varian-Techtron manual (1972).

Defatted bovine bones were provided to all the experimental groups during weeks 18 - 23 after drying at 80°C for 4 h and mass determination. New bones were provided every two weeks and the old bones removed and weighed after scrubbing and drying as above.

The results were analysed using Student's t test.

Results and Discussion
The effects of growth, old age, pregnancy and lactation on calcium and phosphorus absorption were excluded from the experiment. For practical reasons sex did not apply.

Protein levels of the two diets were similar while calcium and phosphorus levels of the high diet exceeded those of the low diet by factors of 20 and 2,18, respectively. The fibre and fat content of the high diet were, respectively, two and three times those in the low diet. Fat only affects calcium absorption in cases of steatorrhea (Agnew & Holdsworth 1971).

The blood plasma Ca\(^{2+}\) levels (Figure 1) of both the high and low groups varied but remained within the range of 9 - 11 mg 100 ml\(^{-1}\) which is 'normal' for most animals (Martin 1976). PO\(_4\) plasma levels (Figure 1) were inclined to vary more widely but remained close to levels for humans of 2.4 - 4.4 mg 100 ml\(^{-1}\) (Vaughan 1975). Differences between the values of the high and low groups were not significant for the duration of the experiment ($P \leq 0.05$).

Although differences were significant, conclusions from these results are compromised by shortcomings in the diet constitution which did not take into consideration differences in protein quality, calorific content or volume of ration. They do, however, indicate that $H.\:$africanaeaurstralis will osteophagia even when dietary calcium levels are high. Here cognizance should be taken of the fact that porcupines are Africa's largest rodents which like other rodent species probably have an innate tendency to collect and gnaw objects of any size and description (Alexander 1956; Maguire 1976; Brain 1981).

That such large percentages of natural porcupine accumulations should comprise bones (e.g. 94% in the Nossob lair, Brain 1981) could be related to their relative availability, portability and colour attraction as compared to other objects in the environment.

References

