“Vitamin D Mysteries”? Secretions and Sloughings from Skin and Oral-Gastrointestinal Mucosa Contain Hormone

Regarding the questions raised in a recent article about the puzzle of transfer of vitamin D activity to the D(−) animal kept in the cage below a D(+) animal, it is stated to appear unlikely that feces from irradiated D(+) animals could show significant antirachitic activity and that “an alternate possibility—activity of grease from irradiated fur—deserves investigation” (Carpenter and Zhao 1999). Data published in the literature during the past 20 y offer an additional explanation: Sloughings and secretions of the skin together with sloughings and secretions of naso-oral (salivary) and gastrointestinal mucosal lining are likely to contribute hormone and metabolites as active contaminants (Stumpf 1995).

The skin contains specific binding sites for 1,25 dihydroxycholecalciferol and analogs in keratinocytes of the epidermis, the hair sheaths, the holokrine sebaceous glands and the sweat glands (Perez-Delgado et al. 1999, Stumpf et al. 1979, 1993, 1995) with additional storage capacity in intercellular secretory products and sebum. Because of the high turnover of target cells and secretions of the skin, followed by grooming and licking, active hormone and metabolites become available to the surface of hairs and fur and are released continuously. We have visualized specific vitamin D receptor binding also in the layers of epithelium of the mouth cavity and esophagus, in certain elements of the nasal mucosa (esp. vomeronasal organ), the Harderian gland of the eye, and the salivary glands, from all of which active compound may be contributed. Furthermore, radiolabeled compound is seen in glandular ducts, and steroids are known to be excreted into the saliva. Additionally, epithelial cells of the intestine exhibit strong nuclear binding of 1,25-dihydroxycholecalciferol. These cells are characterized by a high turnover and continuous sloughing.

Since these epithelial sloughings from both the entire small and large intestine are excreted with the feces, they may constitute an important source of active hormone. Clearly, skin and some of its appendices, oral-nasal mucosa and salivary gland as well as alimentary tract discharges need to be considered as sources of the maybe not so “mysterious” vitamin D transfer.

The comprehensive amounts of the bodily discharges of vitamin D, albeit considered low in the experiments reviewed by Carpenter and Zhao, may provide evidence regarding the minimum amounts of vitamin D metabolite needed by rats to prevent vitamin D deficiency-related pathologies. The latter might be of interest even for the design of new experimental strategies.

Walter E. Stumpf
International Institute of Drug Distribution, Cytopharmacology and Cytotoxicology
Chapel Hill, NC 27516
and Institute for Neuroanatomy
University of Duesseldorf
40225 Duesseldorf, Germany

LITERATURE CITED


1 To whom correspondence should be addressed.
Vitamin D Mysteries: A Response to Stumpf and Bidmon

Dear Dr. Suttie,

We have appreciated the opportunity of seeing Stumpf and Bidmon’s letter. We are sorry not to have known of their papers when preparing ours (Carpenter and Zhao 1999). Their work gives reason to expect that molecules with vitamin D activity will be present on the skin and fur of rats that have an adequate supply of the vitamin (Stumpf 1995).

Where, in Steenbock’s work, an irradiated rat conferred protection from rickets on a nonirradiated cage mate (Steenbock and Black 1924), the presence of active molecules on the coat of the former could certainly have been the source of the latter’s protection. Also when one cage of irradiated rats was placed on top of a control cage (Nelson and Steenbock 1925a), it could again have been particles of skin and fur falling down and being eaten by the animals below that protected them, although the potency of these fragments would have had to be surprisingly high.

However, in further experiments by Steenbock’s group, the wire screens on the floors of cages previously occupied by nonirradiated rats were a source of vitamin D activity when they were irradiated in the absence of rats (Nelson and Steenbock 1925b). It appeared, therefore, that whatever had come onto the screens from the rats was only a precursor that needed to be irradiated before it displayed vitamin D activity. The two possible sources of such precursor(s) appear to be grease from the fur, or from fecal pellets.

We join Drs. Stumpf and Bidmon in hoping that workers with the necessary facilities and experience will soon put the hypotheses to a direct test, and explain what has remained a mystery for so long.

Kenneth J. Carpenter
Ling Zhao
Department of Nutritional Sciences
University of California
Berkeley, CA 94720-3104

LITERATURE CITED


