

NOTE

Aspects of general antimicrobial properties of skin secretions in the common seal *Phoca vitulina*

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ABSTRACT: Considerable amounts of several saccharide residues (α -D-Man, β -D-GlcNAc, α -D-GalNAc, β -D-Gal, α -D-Gal, α -L-Fuc, NeuNAc) are demonstrated by lectin histochemistry in the sections of the sebaceous glands, and, particularly, the apocrine tubular glands of the common seal. These sugars may be liberated on the skin surface by microbial activities and, then, represent a general antimicrobial protection mechanism of the skin because of their ability to inhibit the adherence of different bacteria and fungi to the epidermis.

KEY WORDS: Skin secretions · Free sugars · Antimicrobial protection · Seal

The skin surface of most animals is a biotope for numerous micro-organisms. This is also true of marine mammals, where a variety of bacteria and fungi can be found. The composition of this microflora, however, may vary according to internal and external circumstances (Sweeney et al. 1976, Polglase et al. 1986, Ushakova & Abramova 1989). In pinnipeds, several skin diseases have been recognized that are primarily of infectious etiology. Bacterial conditions included dermatophilosis, streptococcosis, mycobacteriosis, staphylococcosis and others. Fungal conditions were mainly related to dermatophytosis, candidiasis, and *Fusarium* spp. mycosis (Montali et al. 1981, Dunn et al. 1984, Beckmen et al. 1997). Many of the microbial species involved are opportunistic invaders, i.e. inoffensive commensals that become dangerous when the normal skin biology is disturbed by polluted water, other diseases, skin injuries, decreased immunocompetence, etc. In the common seal, for example, this development is often initiated by severe chemical and mechanical hazards to which the ventral body regions

are frequently exposed, due to sliding and creeping movements on different types of ground (Meyer 1997). Independent of these influences, however, seasonal integumental variations such as the moulting process also seem to be of importance (Montali et al. 1981).

Using lectin histochemistry to demonstrate specific aspects of complex carbohydrates, the present study was designed to provide initial information on possible general integumental mechanisms for controlling microbial activity which are related to the normal structural and functional attributes of the skin, and which respond before specific immunobiological properties of epidermal cells (Bos 1997, Schroeder 1999) are necessary.

Skin specimens were excised from different body regions (back, abdomen, forefoot, hindfoot) of 4 juvenile and 4 adult freshly dead seals of both sexes. The specimens were fixed in Bouin's fluid, embedded in paraffin, and stained for the determination and differentiation of glycoconjugates by applying peroxidase (PO)-labelled lectins (E.Y./Sunbio; Sigma, see also Table 1). This methodical approach used is described in detail elsewhere, including specific control procedures (Meyer et al. 1993, Brooks et al. 1997).

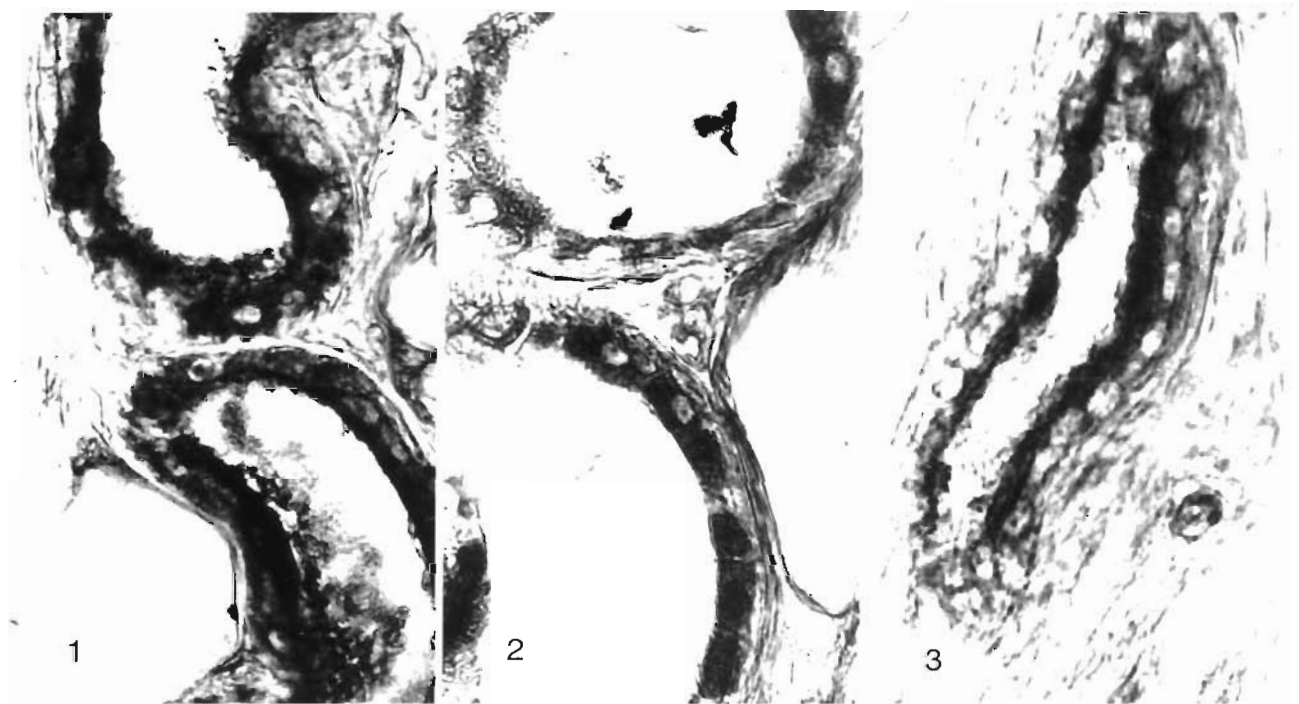
The results obtained are summarized in Table 1 and Figs. 1 to 3, which illustrate varying distribution patterns of different terminal sugars mainly in the skin glands of all seals studied. The apocrine tubular glands showed a rather distinct reaction staining of the secretory cells and the luminal secretions for most of the lectins, especially in the apical apocrine protrusions, where very strong reactions were visible for Con A, BPA, PNA, UEA-I, and LFA. In the sebaceous glands the reaction staining was weaker in all of the structures examined.

The selectivities of the PO-lectins revealed, thus, that the following saccharide residues were clearly

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Table 1 *Phoca vitulina*. Lectin histochemical reaction intensities in the sebaceous glands and the apocrine tubular glands of the common seal. 0 = no reaction, 1 = very weak, 2 = weak, 3 = moderate, 4 = strong, 5 = very strong

Lectins	Sebaceous glands				Secretory cells	Apocrine glands			Inhibitory sugar
	Peri- pheral cells	Central cells	Sebum	Excre- tory duct cells		Luminal secre- tion	Myoepi- thelial cells	Excre- tory duct cells	
PO-Con A-DAB	1–3	1	2	1	2–5	2–4	1–2	3–4	α -D-Man; α -D-Glc
PO-WGA-DAB	1–3	2–3	1–3	1–3	2–4	1–3	1–3	1–3	β -D-GlcNAc>Neu NAc
PO-GSA-II-DAB	1–3	1–2	1–3	1–2	1–2	1	1–2	1–2	α - β -D-GlcNAc
PO-DBA-DAB	1–3	1–3	1–3	1–3	2–3	2	1–2	2–3	α -D-GalNAc
PO-SBA-DAB	1–2	1–2	1–2	1–2	3–4	3–4	1	1–2	α -D-GalNAc> α -D-Gal
PO-MPA-DAB	1–2	1	1–2	1	1–4	1–3	1	1–4	α -D-Gal; α -D-GalNAc
PO-GSA-I-DAB	1–2	1–2	1–3	1–2	2–4	1	1	1–2	α -D-Gal; α -D-GalNAc
PO-BPA-DAB	1–3	1–2	1–3	1–2	4	1–3	1–2	1–3	β -D-Gal; β -D-GalNAc
PO-PNA-DAB	1–2	1–2	1–3	1–2	3–5	1–3	1–2	1–4	β -D-Gal; β -D-GalNAc
PO-UEA-I-DAB	1–3	1–2	1–3	1–2	3–5	1–2	1–2	1–2	α -L-Fuc
PO-LFA-DAB	1–3	1–2	1–3	1–2	3–5	1–2	1–2	1–3	NeuNAc = NeuNGc



Figs. 1 to 3. *Phoca vitulina*. Strong lectin histochemical reactions in secretory cells of the apocrine tubular skin glands of the common seal. Fig. 1. BPA (β -D-galactose). Fig. 2. UEA-I (L -D-fucose). Fig. 3. LFA (N-acetylneuraminic acid). All $\times 625$

present, particularly in the secretions of the apocrine tubular skin glands: α -D-mannose, β -D-N-acetylglucosamine, α -D-N-acetylgalactosamine, β -D-galactose, α -D-galactose, α -L-fucose, and N-acetylneuraminic acid. All of these sugars that are liberated on the skin surface from their glycoprotein or glycolipid bases by microbial activities (Noble 1993) have the ability to inhibit the adherence of different bacteria (Sharon et al. 1981, Romero-Steiner et al. 1990, McGavin et al.

1993) and fungi (Critchley & Douglas 1987, Ollert et al. 1993) to the mammalian epidermis. In this way the concentration of free sugars to a considerable degree may impede the attack of normal skin micro-inhabitants against epidermal integrity, and a general biological protection mechanism becomes obvious. It should be emphasized in this connection that in terrestrial mammals the secretions of the skin glands also contain such terminal sugars, but these sugars are not as con-

centrated as in the seal (Tsukise & Meyer 1983, Meyer & Tsukise 1989, Meyer et al. 1993). The results of this study indicate that further research is warranted, provided that it is possible to obtain fresh skin material from healthy or diseased marine mammals for relevant carbohydrate histochemical processing.

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