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Comparative morphometric analysis of vermilion border epithelium and lip epidermis

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Abstract. A comparative morphometric study of lip epithelia in cattle, rats, and humans was undertaken using stereological techniques. Vermilion border and skin specimens of cattle, rats and humans were processed under standardized conditions for light microscopic observation. Stereological techniques were employed to obtain volumetric densities of each epithelial layer. The results obtained show that although the absolute volume of each epithelial stratum of the vermilion border and of the skin varies markedly in the different species studied, the relative volume of these strata in relation to the entire epithelium is similar in all epithelia.

Introduction

The oral epithelium has peculiar characteristics according to its location in the oral cavity. The morphologic features of the vermilion border epithelium differ from those of the epithelia of the adjacent skin and mucosa. Several authors [Schroeder and Munzel-Pedrazzoli 1970; Hashimoto 1971; Sauter and Weibel 1971; de Rey and Klein-Szanto 1972; Amakiri 1973; Landay and Schroeder 1973; Meyer and Schroeder 1975; Sauter and Loud Alden 1975] have used morphometric methods to describe the oral mucosa and the skin in different areas. However, quantitative data on the epithelium of the vermilion border are not available. The aim of this study was the quantitative characterization of the vermilion border epithelium in several species using stereologic techniques, and to

comparatively study the histoarchitecture of this epithelium with that of the epidermis of the adjacent lip skin. Three different species of mammals, in which the morphologic characteristics of these tissues differ considerably, i.e. rat, cow and man, were used to compare the various layers of these epithelia.

Materials and methods

Ten lips of cows and adult Wistar rats as well as ten human lips were prepared for this study. All samples were fixed in 20% formaldehyde and embedded in paraffin. Sections of approximately 7 μ m were stained with hematoxylin and eosin. The application of stereological principles permits the evaluation of volume densities (V_v) of the structures observed in tissue sections.

The general principles for the correct use of this parameter have been extensively described by Weibel *et al.* [1966]. The morphometric measurements were done by surveying contiguous microscopic fields, covering

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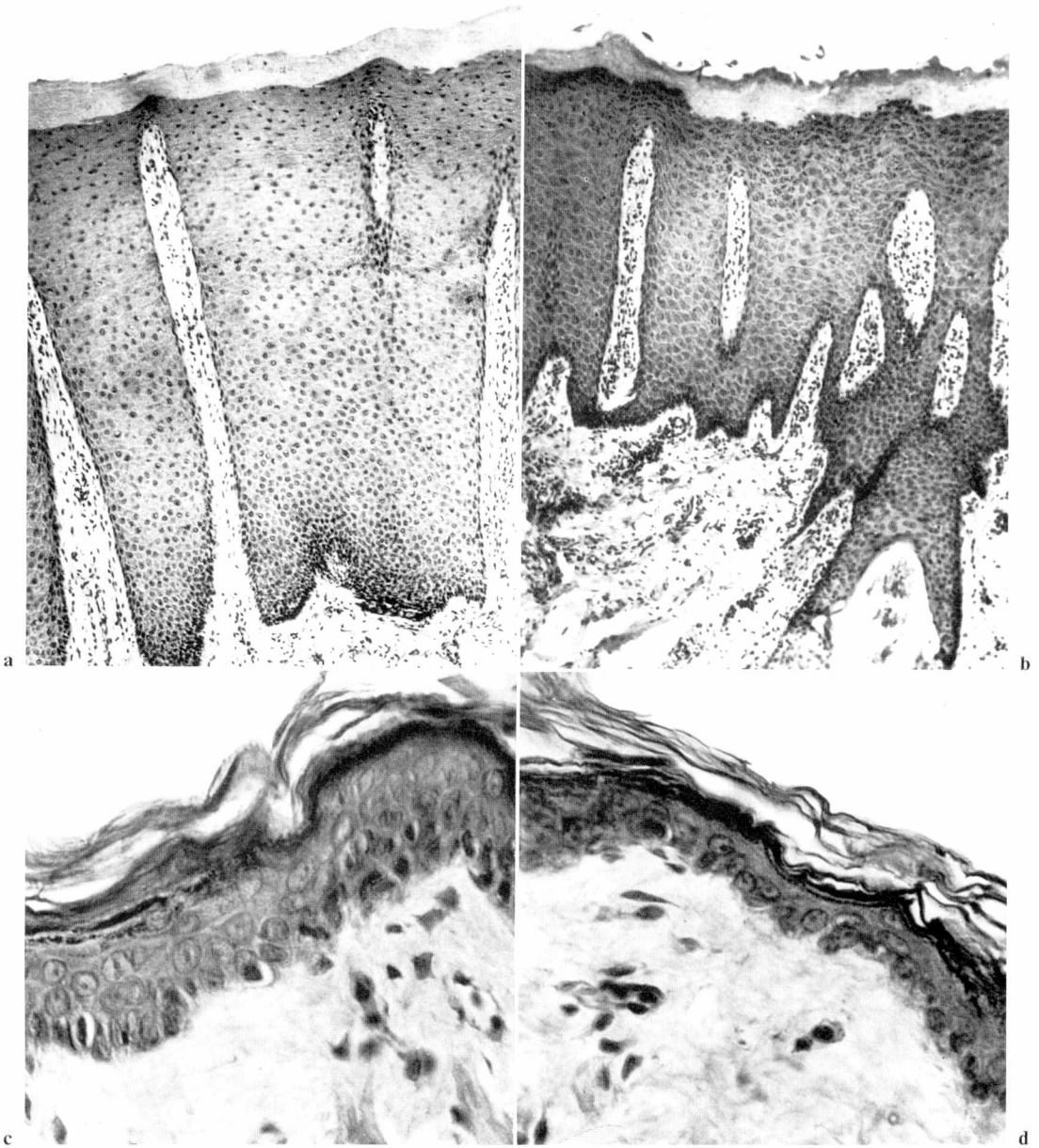


Fig.1. Light micrograph of a paraffin-embedded section stained with hematoxylin and eosin. **a** Lip vermilion border (cattle). $\times 80$. **b** Lip skin (cattle). $\times 80$. **c** Lip vermilion border (rat). $\times 400$. **d** Lip skin (rat). $\times 400$.

the skin section at a magnification of $\times 1,000$ for rats and humans and $\times 80$ for cattle. A rectangular grid of 200 points was superimposed always with the same orientation on each field by means of an ocular reticle. In each section the whole epithelium and a portion of the underlying connective tissue were scanned. The total number of such points (P_{skin}) and the number of those points overlying different strata were recorded and then used to calculate the volume fraction or volume density (V_v) of each of these strata.

The volume density (V_v) can be estimated by counting the points of a test system projected on the different structures (in this case epithelial layers, P_i) in relation to the total number of points (P_t) projected on the whole epithelium:

$$V_v \text{ estratum} = \frac{P \text{ stratum}}{P \text{ skin}}.$$

The following data expressed in mm^3/cm^3 were finally collected:

	Volume density of:
$V_v D$	dermis portion
$V_v B$	basal layer
$V_v S$	spinous layer
$V_v G$	granulose layer
$V_v C$	horny layer

The entire tissue under study was:

$$V_v D + V_v B + V_v S + V_v G + V_v C = 1,000 \text{ mm}^3 / 1 \text{ cm}^3.$$

Based upon the classical stereological principles the bidimensional test system of points corresponds to a tridimensional prism of 0.5 mm^3 .

The knowledge of this volume and of the volume fractions of the epithelial layers yields, by performing simple calculations, the following parameters:

(1) The volume of each stratum relative to the total volume of the test system (prism)

$$V \text{ relat stratum} = V_v \text{ stratum} \times \text{test system volume.}$$

(2) The absolute height (thickness) of each stratum

$$h \text{ stratum} = \frac{V \text{ relat. stratum}}{\text{test system area}}.$$

(3) The percentage of each stratum relative to the total epithelium.

Results

Histologic characteristics of the analyzed epithelia can be observed in figure 1.

The epithelial layers of cattle exhibit significantly higher values than those of rats and humans. Table I shows the volume density of the epithelial layers of the vermilion border and of the skin of the studied species. A one-way analysis of variance contrasting the media of the strata volume density showed significant difference among these values ($p \geq 0.99$).

Figure 2 represents the thickness of the different epithelial layers of the skin and of the vermilion border of the three studied species. As can be seen, the vermilion border of cattle

Table I. Volume density (V_v) evaluation of vermilion border epithelium and skin epithelium in lips of cattle, rats and humans

Strata	Vermilion border epithelium ¹			Skin epithelium ¹		
	cattle	rats	humans	cattle	rats	humans
	$\bar{x} \pm \text{SD}$	$\bar{x} \pm \text{SD}$	$\bar{x} \pm \text{SD}$	$\bar{x} \pm \text{SD}$	$\bar{x} \pm \text{SD}$	$\bar{x} \pm \text{SD}$
Corneum	93 ± 14	14 ± 2	16 ± 3	60 ± 22	14 ± 3	16 ± 4
Granulosum	—	7 ± 0	—	57 ± 14	4 ± 1	8 ± 2
Spinosum	527 ± 6	44 ± 11	91 ± 8	222 ± 47	14 ± 5	30 ± 9
Basale	54 ± 7	7 ± 2	11 ± 3	47 ± 10	6 ± 2	10 ± 0

¹ All data are expressed as mm^3/cm^3 of the whole tissue.

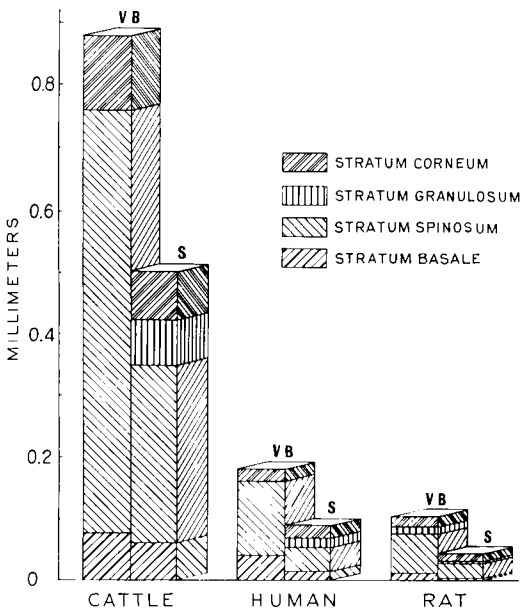


Fig.2. Average strata composition of vermillion border (VB) epidermis and skin lip (S) epidermis of cattle, rats and humans.

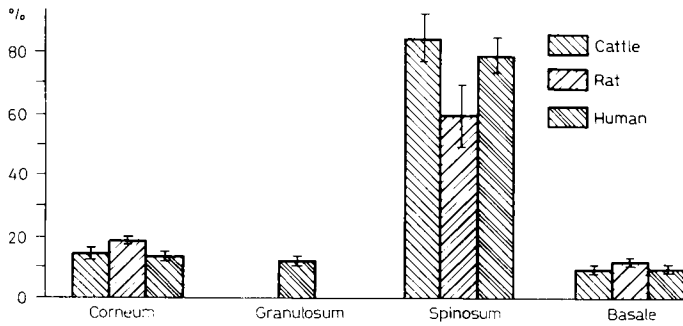


Fig.3. Diagram of epithelial thickness characterizing the vermillion border epidermis. Values calculated as percentages of epithelial tissue.

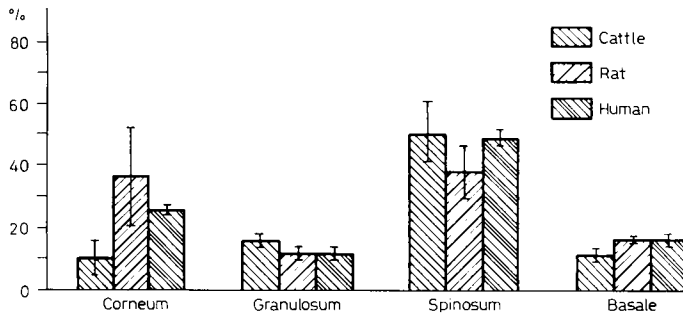


Fig.4. Diagram of epithelial thickness characterizing the skin epidermis. Values calculated as percentage of the entire epidermis.

has a thickness of 880 μm , that of man 180 μm and that of the rat 105 μm . Moreover, the corresponding skin has a thickness of 500, 70, and 30 μm respectively.

The volumetric stratum composition of the three epithelia is expressed as percentage of the entire epithelium in figures 3 and 4. The basal layer of the vermilion border epithelium occupies 8–11% of the whole epithelium, the spinous layer 59–78% and the horny layer 13–19%. A one-way analysis of variance contrasting the media of the percentage of volume occupied by each layer of the corresponding tissues under study showed no significant difference among these media ($p \geq 0.99$).

Discussion

The main objective of our study was to evaluate morphometric data of the different epithelial layers. Using stereologic methods we could characterize the epithelia as regards their absolute volumes and thicknesses as well as the volume density of each of their layers.

The evaluated results show that the values of volume and thickness of the vermilion border are two times higher than those of the skin. This fact would indicate a specialized function characterizing the epithelium lying between the mucosa and the skin of the lip.

The data gathered in our study indicate that although the ratio between the epithelial thickness was 8:1 for cattle versus rats and 5:1 for cattle versus humans, each epithelium was proportionally composed by almost the same amount of basal, spinous, granulous and horny constituents.

Homeostatic mechanisms would act as regulators of the relative volume relationship between the epithelial layers [Elgjo *et al.* 1971; Bullough 1972].

References

- Amakiri, S.F.: A comparative study of the thickness of the stratum corneum in Nigerian breeds of cattle. *Br. vet. J.* 129: 227–280 (1973).
- Bullough, W.S.: The control of epidermal thickness. *Br. J. Derm.* 87: 187–199 (1972).
- Elgjo, K.; Gaerum, O.D., and Edgehill, W.: Growth regulation in mouse epidermis. *Virchows Arch. Abt. B Zellpath.* 8: 277–283 (1971).
- Hashimoto, K.: Fine structure of horny cells of the vermilion border of the lip compared with skin. *Archs oral Biol.* 16: 397–410 (1971).
- Landay, M.A. and Schroeder, H.E.: Quantitative electron microscopic analysis of the stratified epithelium of normal human buccal mucosa. *Cell Tissue Res.* 177: 383–405 (1973).
- Meyer, M. and Schroeder, H.E.: A quantitative electron microscopic analysis of keratinizing epithelium of normal human hard palate. *Cell Tissue Res.* 158: 177–203 (1975).
- Rey, B.M. de and Klein-Szanto, A.J.P.: A histometric study of acute radiation effects on rat tail epidermis. *Strahlentherapie* 143: 699–704 (1972).
- Sauter, L.S. and Loud Alden, V.: Morphometric evaluation of sebaceous gland volume in intact castrated and testosterone-treated rats. *J. invest. Derm.* 64: 9–13 (1975).
- Sauter, L.S. and Weibel, E.R.: Morphometric evaluation of skin structures by stereologic methods. *Dermatologica* 143: 174–183 (1971).
- Schroeder, H.E. and Munzel-Pedrazzoli, S.: Application of stereologic methods to stratified gingiva epithelia. *J. Microscopy* 92: 179–198 (1970).
- Weibel, E.R.; Kistler, G.S., and Scherle, W.F.: Practical stereological methods for morphometric cytology. *J. Cell Biol.* 30: 24–38 (1966).

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