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Autor: Meyer, W. / Schlesinger, C. / Neurand, K.

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Institut für Zoologie and Anatomisches Institut,
Tierärztliche Hochschule Hannover (F.R. Germany)

Membrane-coating granules (MCGs) in porcine epidermis¹

by *W. Meyer*², *C. Schlesinger* and *K. Neurand*

Introduction

Membrane-coating granules (MCGs) – also known as lamellar bodies, Odland bodies, cementosomes, keratinosomes, transitory dense bodies etc. – have been demonstrated in the cells of several keratinizing epithelia of different vertebrates including man [4, 7, 9, 13]. MCGs are obviously closely connected with the barrier functions of the epidermis [1, 7, 13, 18]. Although these granules are relatively well known, evidence is still insufficient in the hairy skin (*integumentum commune*) of the domestic pig. Here, however, their presence has been indicated by results obtained with histochemical methods [10].

Materials and methods

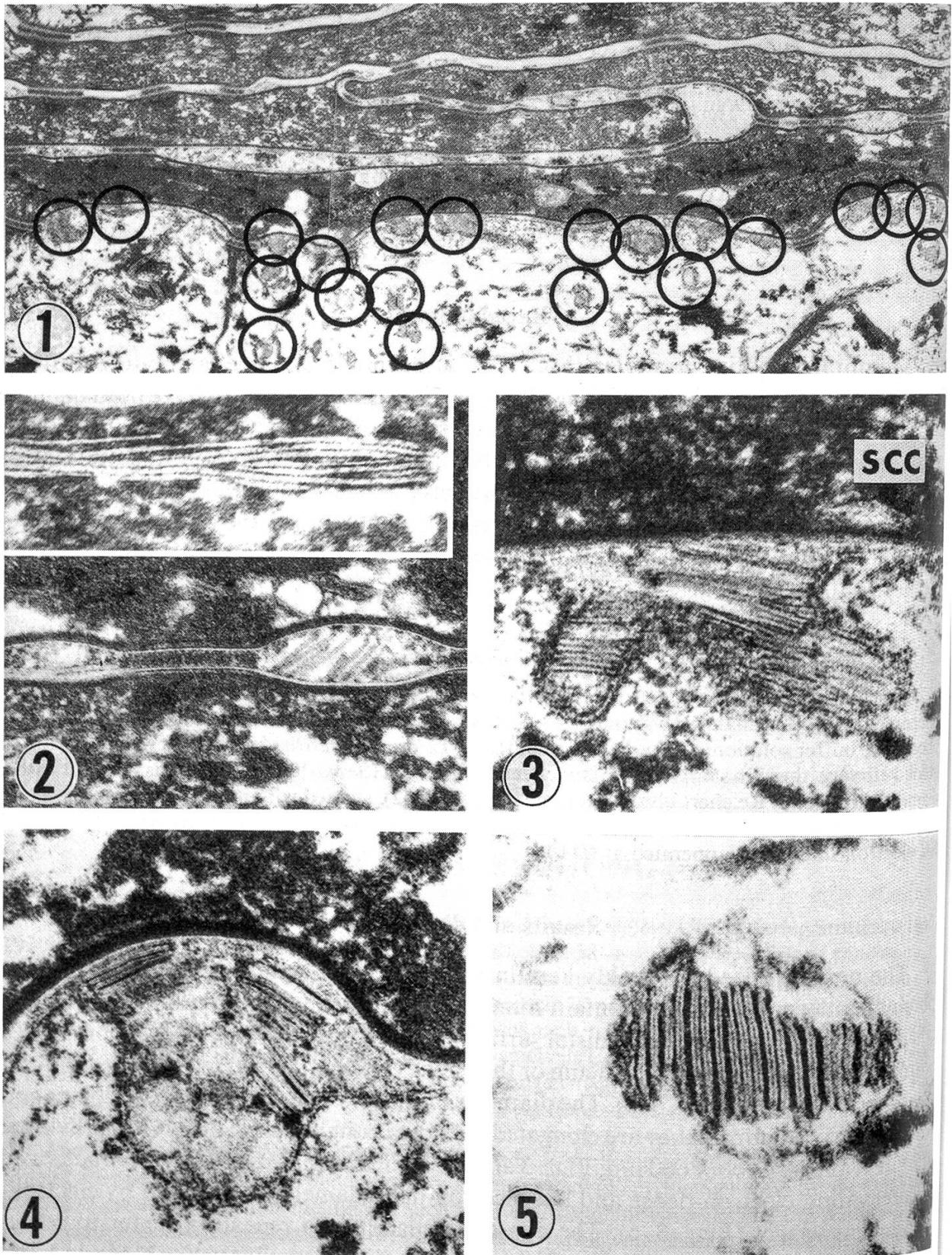
Skin samples were taken from the back, flank and abdomen of 3 female domestic pigs (60–80 kg) (German breed). The material was fixed in Karnovsky's fixative [5], washed several times in a sucrose-phosphate buffer solution, and postfixed in buffered 1% osmium tetroxide [11]. After dehydration in graded ethanol, the skin samples were embedded in Epon 812 (Serva) [8]. Thin sections were cut with a diamond knife on a Reichert ultramicrotome (type OM U2), stained with methanolic uranyl acetate [16], and lead citrate [14], partly also additionally with tannic acid [17], and examined in a Zeiss EM 9 S-2 electron microscope operated at 60 kV.

Results and discussion

The unkeratinized or weakly keratinized cells of the stratum granulosum of the porcine epidermis normally contain numerous membrane-coating granules (MCGs), which often form a layer on the distal surface of the cell, particularly at the contact area with the cells of the stratum corneum or the already heavily-keratinized, dense granular cells, respectively (Figs. 1, 3, 4). The diameter of the MCGs varies between 230 nm and 420 nm, and sometimes they are elongated or form a conglomerate of several individual granules (max. \varnothing about 660 nm; Figs. 3 and 4). Their internal structure is characterized by alternating electron-dense and less electron-dense lamellae, separated by electron-translucent spaces (Figs. 3–5). The dense lamellae have a repeating center-to-center distance of about 7–8 nm, while the thickness of the single lamellae varies between 1 and

¹ Dedicated to Prof. Dr. W. Mosimann on behalf of his 65th birthday

² Address: PD Dr. W. Meyer, Institut für Zoologie, Tierärztliche Hochschule Hannover, Bischofsholer Damm 15, D-3000 Hannover, F.R. Germany



Figs. 1-5: Membrane-coating granules (MCGs) in porcine epidermis. (1) MCGs (encircled) at distal surface of a granular cell and between horny cells, $\times 21\ 000$; (2) MCG lamellae between horny cells, $\times 61\ 000$; inset - lamellar inclusion in horny cell, $\times 94\ 700$; (3) MCG discharged in intercellular space between granular and horny cell (SCC), $\times 94\ 300$; (4) Release of MCG conglomerate, $\times 99\ 000$; (5) MCG with typical lamellar structure, $\times 181\ 000$.

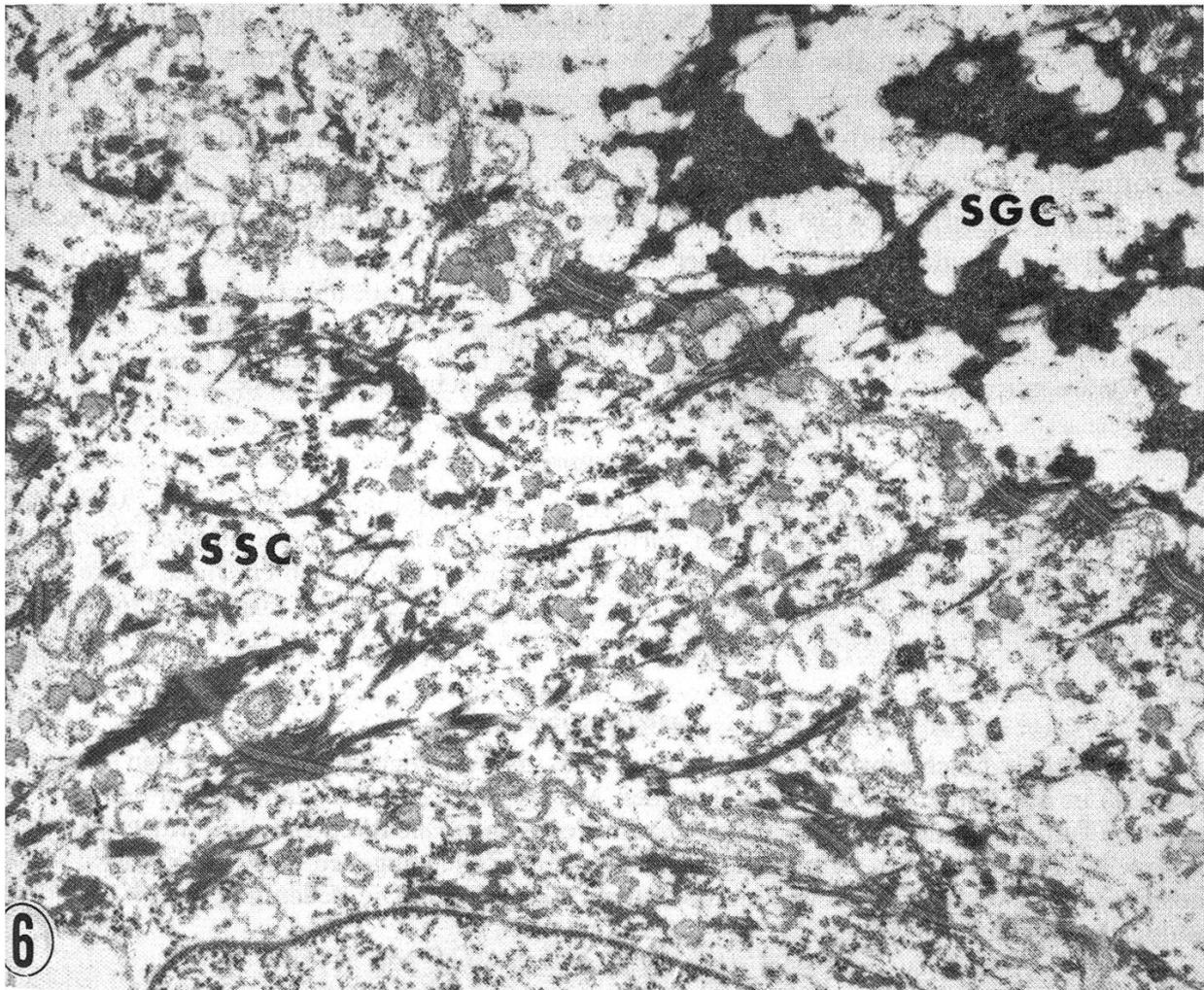


Fig. 6: Overall view of spinous cells (SSC) with numerous stages of MCGs (SGC = granular cell), 22 000.

nm, i.e. the MCG-lamellae of the porcine skin epidermis are similar to those observed in man [7]. The MCGs discharge their contents into the intercellular space between the granular and horny cells (Fig. 1, 3, 4). During this process of exocytosis the membrane surrounding the MCGs fuses with the cellular plasma membrane. Membrane-like, lamellar figures are also frequently found between the horny cells of the lower region of the stratum corneum (Fig. 2). Sometimes relatively long lamellar inclusions are also seen within the horny cells (Fig. 2, inset). The uppermost cells of the stratum spinosum consistently show several granules scattered throughout the whole cytoplasm, but lacking the characteristic lamellar structure (Fig. 6); they could be regarded as the precursor stages of MCGs [2, 3].

The results obtained with regard to the MCG structure are in general accordance with findings describing MCGs in the human epidermis or other keratinizing epithelia of laboratory mammals [4, 7, 13] as well as different other vertebrate groups [6, 9]. Our EM observations, and recent results reported from the porcine epidermis using lipid- and lectin histochemical methods [10], and biochemical findings [18], suggest that the

MCG lamellae consist of glycolipids. As has been claimed lately, glycolipids could be essentially involved in the water barrier function of the epidermis [1, 6, 13, 15, 18]. However, although this type of intercellular barrier against water loss seems to be most important in sparsely haired mammals like the domestic pig and man, the situation may be somewhat different in densely haired animals, where surface layer lipids could be of even greater significance [10, 12]. This is especially true of wild mammalian species, as opposed to their domesticated descendants [10].

Acknowledgement

We are grateful to Miss K. Jeitner for her excellent technical assistance.

Summary

This study describes the occurrence and structure of membrane-coating granules (MCGs) in the epidermis of the domestic pig. MCGs are particularly numerous in the unkeratinized granular cells, from where their lamellar contents are normally discharged into the intercellular space between granular and horny cells. The upper spinous cells contain these granules in their precursor stages. The function of MCGs is discussed with particular regard to comparative aspects.

Zusammenfassung

Die Arbeit beschreibt Vorkommen und Struktur von sogenannten lamellären Körperchen (MCGs) in der Epidermis des Hausschweines. MCGs sind besonders zahlreich in den nicht oder schwach verhornten Granulosum-Zellen anzutreffen, von wo sie ihren Inhalt normalerweise in den Interzellularspalt zwischen Granulosum- und Corneum-Zellen abgeben. Die oberen Lagen von Spinosum-Zellen enthalten offenbar Vorstufen dieser Körperchen. Die Bedeutung der MCGs wird aus vergleichender Sicht diskutiert.

Résumé

Ce travail décrit l'existence et la structure des ainsi-dits corpuscules lamellaires (MCGs) dans l'épiderme du porc. Ils sont particulièrement nombreux dans les cellules, non ou faiblement cornifiées, du Stratum granulosum, d'où elles déchargent normalement leur contenu dans l'espace intercellulaire des cellules du Str. granulosum et corneum. Les couches supérieures du Str. spinosum semblent contenir des précurseurs de ces corpuscules. La signification des MCGs est discutée du point de vue comparatif.

Riassunto

Questo lavoro descrive la presenza e la struttura dei cosiddetti corpuscoli lamellari (MCGs) nell'epidermide del maiale domestico. MCGs sono particolarmente numerosi nelle cellule non o debolmente cheratinizzate dello Strato granuloso, da dove riversano di regola il loro contenuto nello spazio intracellulare fra le cellule dello Strato granuloso e dello Strato corneo. Gli strati superficiali delle cellule spinose contengono verosimilmente gli stadi preliminari di questi corpuscoli. L'importanza degli MCGs è discussa sotto gli aspetti comparativi.

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Manuskripteingang: 21. November 1986

DIE ECKE DES REDAKTORS

Ein Kollege schrieb mir vor Monaten:

«ich habe im SAT bis jetzt zwar noch nie eine besondere Kolumne für amüsante Texte gefunden, doch ist mir der Gedanke dazu gekommen, als ich in der Berliner Tierärztlichen Wochenschrift des 25. Jg. vom 15.4.1909 den beigelegten Artikel fand. Werden wohl unsere Berufskollegen in 77 Jahren über unsere Probleme mit Katalysatorautos schmunzeln?»

Ich glaube, dass der Text in unserer Zeit des angeblich wachsenden Umweltbewusstseins, das allerdings in katastrophalster Weise mit unserem Verhalten kontrastiert, und der Diskussionen um Solarmobile durchaus lesenswert ist. Wahrscheinlich hat der Herr Polizeitierarzt Götze nicht geahnt, aus welchen Gründen 80 Jahre später seine Idee wieder Aktualität erhalten könnte.

Das Klein-Auto in der tierärztlichen Praxis!

Von Polizeitierarzt Götze – Berlin.

Lange schon fühle ich das Bedürfnis, in dem für unsere Zwecke eigens herausgegebenen Blatte einmal die Beförderungsmittel des Land- und Stadtarztes einer näheren Betrachtung zu unterziehen.

Vorausgesetzt sei, daß der Arzt nicht nur das Interesse einer Verkehrserleichterung für seine eigene Person hat, sondern dem Umstande Rechnung tragen muß, jederzeit zur schnellen Hilfeleistung bereit zu sein, und hierzu ist eine möglichst schnelle und zuverlässige Beförderung an den Ort des Patienten erforderlich.