Melaninmisfarging i muskulatur hos laks

Erling Olaf Koppang

Norges veterinærhøgskole

Oslo

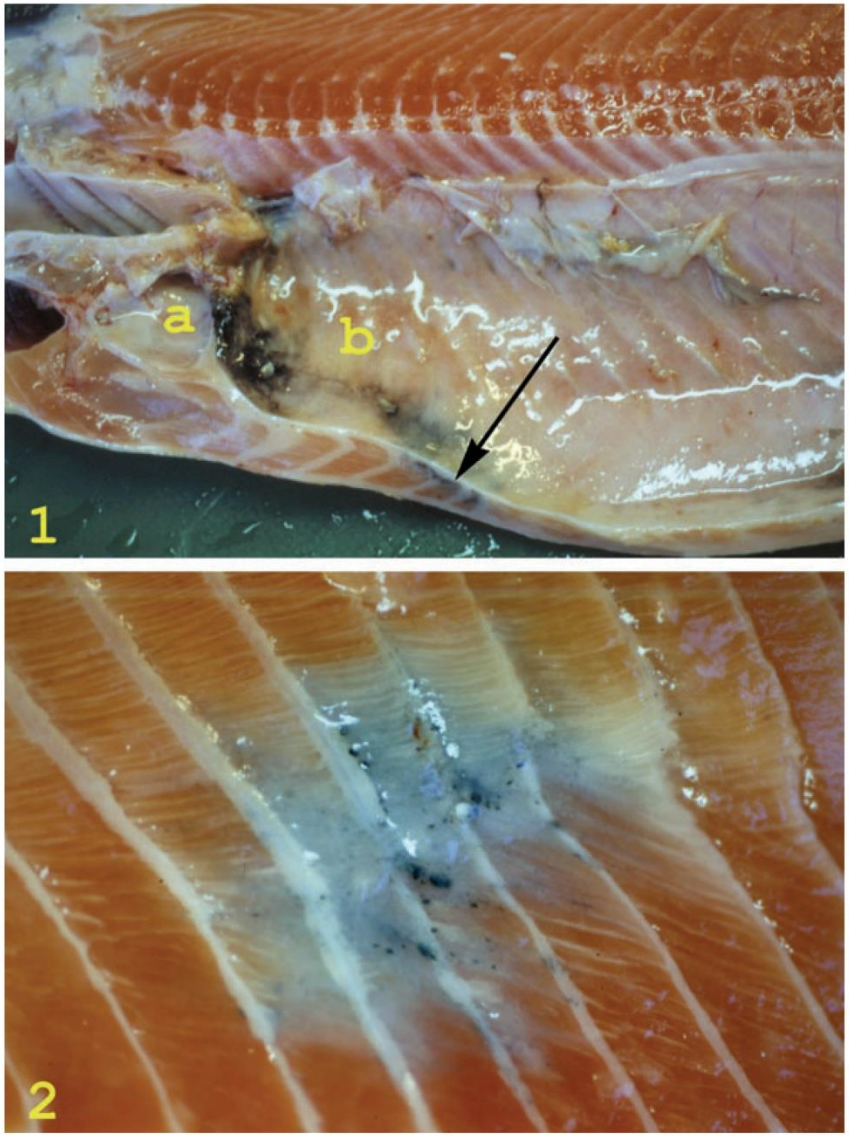

Figure 1 Gross pathological changes in the carcass of an Atlantic salmon. The pericardial cavity (a) is normal, but severe melanization is apparent in the abdominal cavity (b). Melanized musculature subjacent to the peritoneum is seen on the cut surface (arrow).
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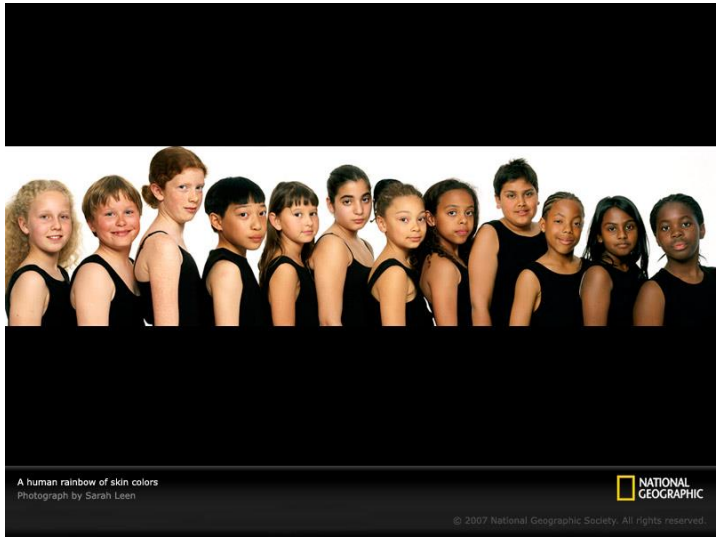
A human rainbow of skin colors
Photograph by Sarah Leen
NATIONAL GEOGRAPHIC
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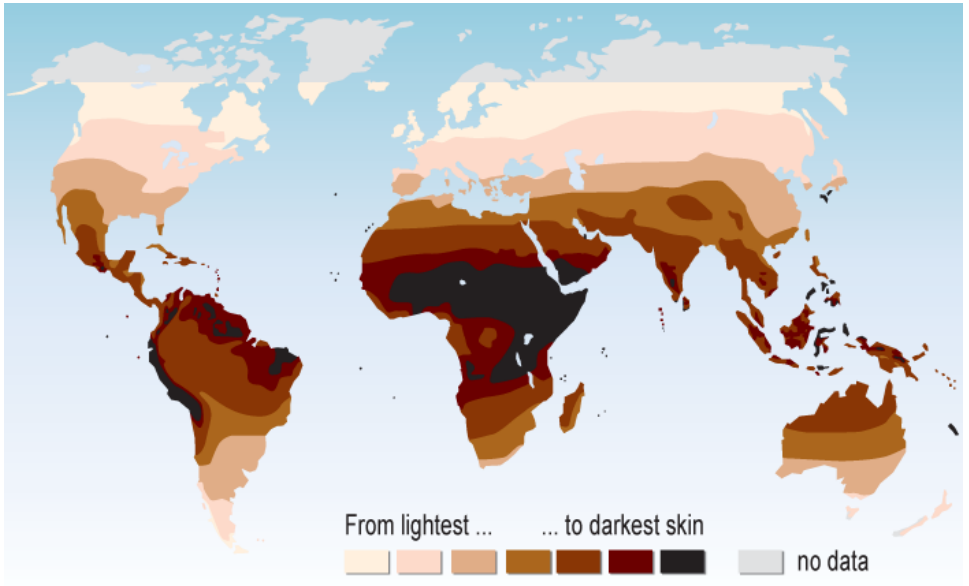
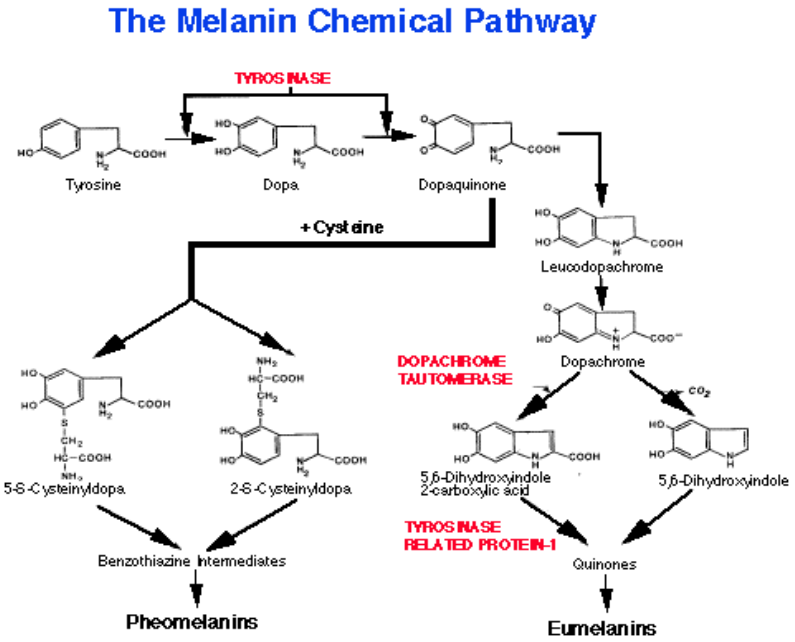
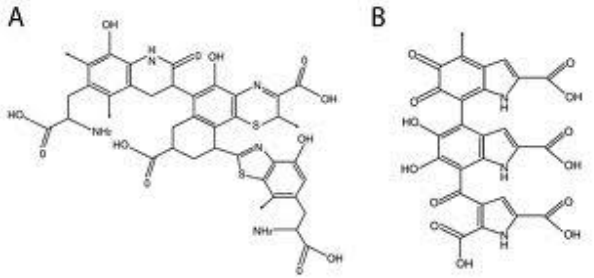
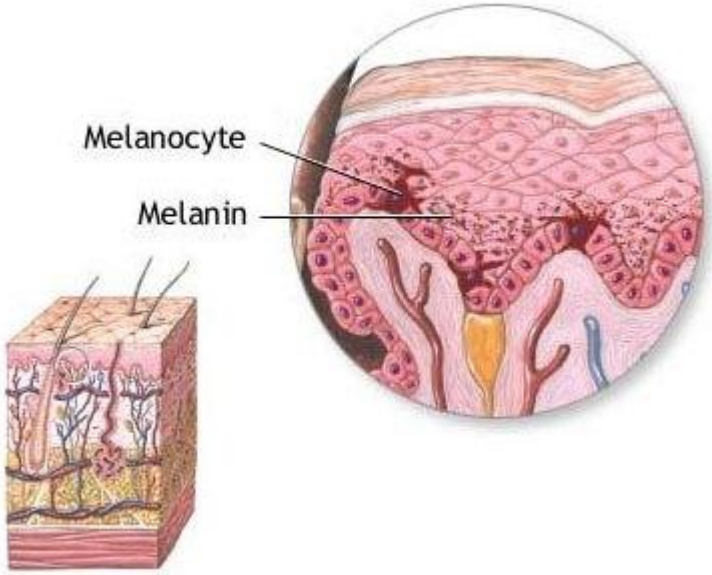

From lightest ...
... to darkest skin
no data

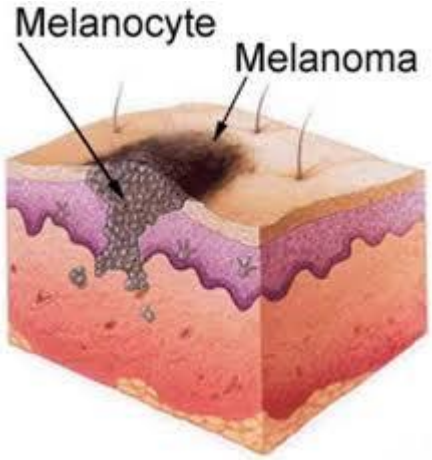
1. Hva er melanin?

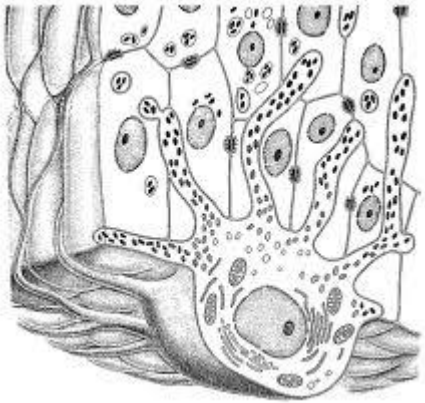




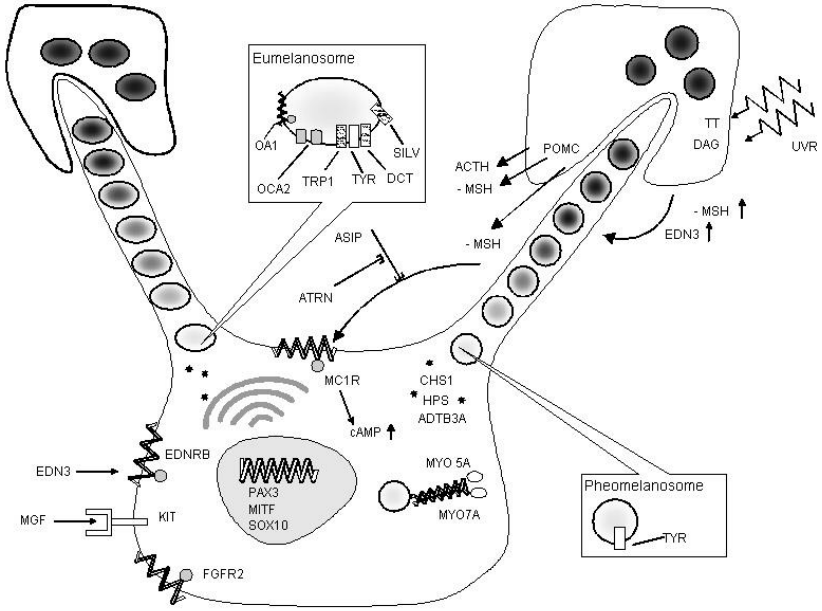
Hvor dannes melanin?

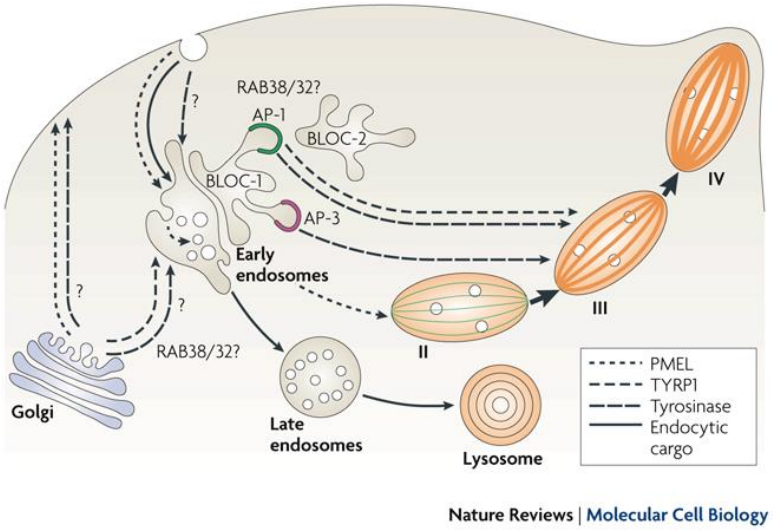






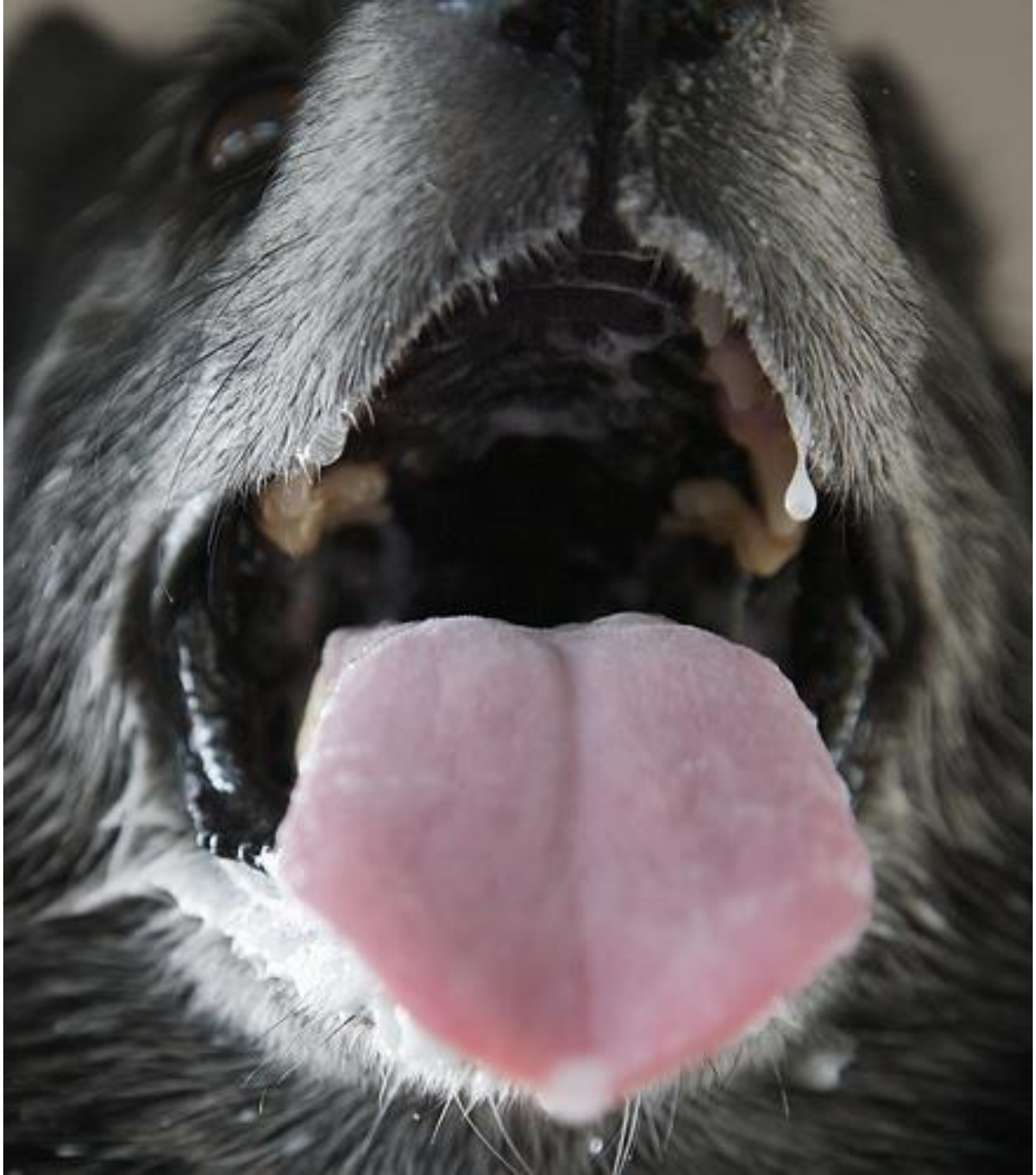
Melanosom: den intracelluære melaninfabrikken





2. Hvilke funksjoner har melanin?

Burkhart & Burkhart. Int. J. Dermatol. 2005:44;340



Giovanni Sichel – Universitetet i Catania


Lung
Liver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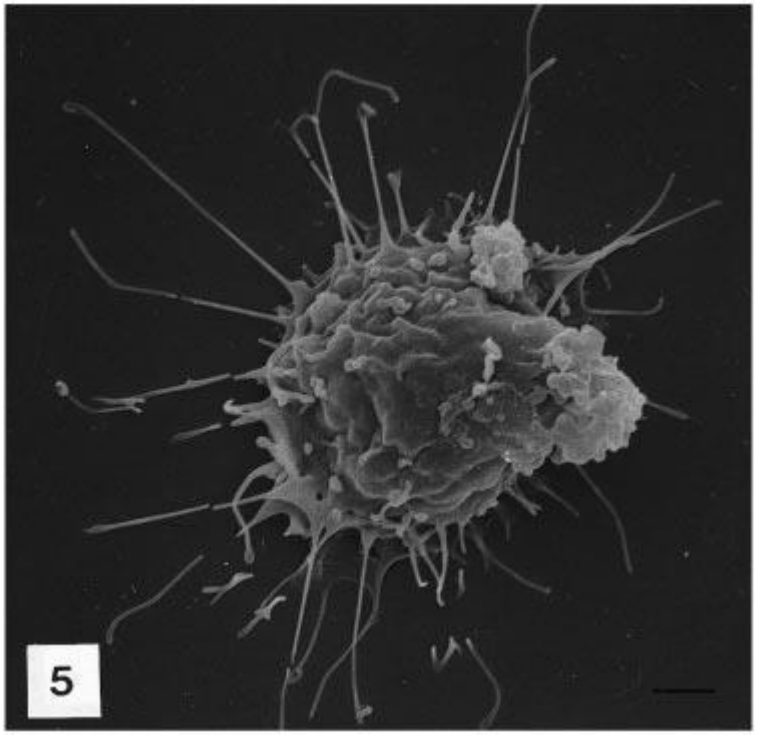
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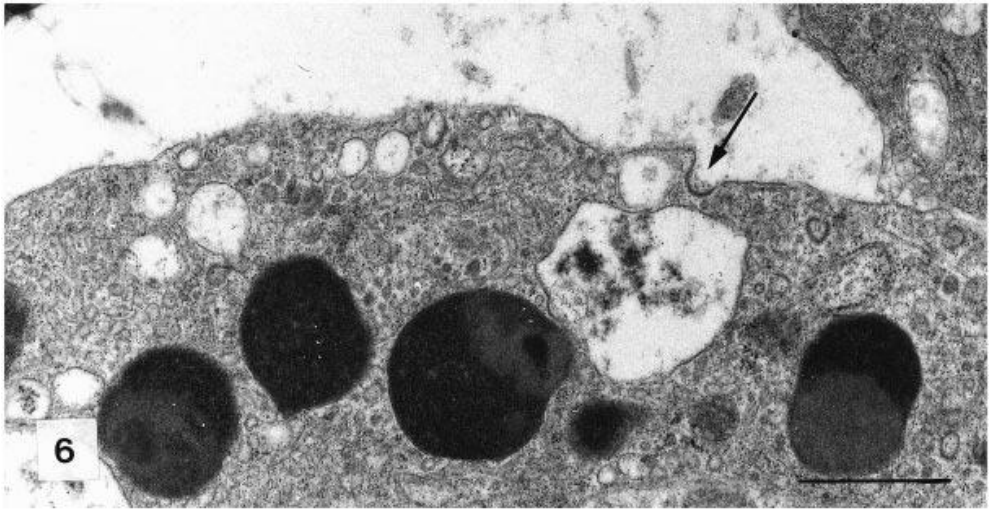
6

Giovanni Sichel og medarbeidere:

- Melaninproduksjon hos virveldyr er ikke utelukkende relatert til celler av ectodermal opprinnelse
- Kupfferske celler i leveren hos amfibier kan lage melanin
- Kupfferske celler er av mesenchymal opprinnelse
- Altså: Populasjoner av forsvarsceller kan lage melanin – ulikt det man ser hos pattedyr

Vaccine-associated granulomatous inflammation and melanin accumulation in Atlantic salmon, *Salmo salar* L., white muscle

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2 Department of Fisheries and Marine Biology, HiB, University of Bergen, Norway

Abstract

The purpose of this study was to investigate the nature of variably sized pigmented foci encountered in fillets of farmed Atlantic salmon, *Salmo salar* L. The material was sampled on the fillet production line and on salmon farms from fish with an average size of 3 kg from various producers. The fish had been routinely vaccinated by injection. Gross pathology, histology, immunohistochemistry using antisera against major histocompatibility complex (MHC) class II β chain and transmission electron microscopy (TEM) were used to characterize the changes. Macroscopically, melanized foci were seen penetrating from the peritoneum deep into the abdominal wall, sometimes right through to the skin, and also embedded in the caudal musculature. Histological investigation revealed muscle degeneration and necrosis, fibrosis and granulomatous inflammation containing varying numbers of melano-macrophages. Vacuoles, either empty or containing heterogeneous material, were frequently seen. The presence of abundant MHC class II^+ cells indicated an active inflammatory condition. TEM showed large extracellular vacuoles and leucocytes containing homogeneous material of lipid-like appearance. The results showed that the melanized foci in Atlantic salmon fillet resulted from an inflammatory condition probably induced by vaccination. The described condition is not known in wild salmon and in farmed salmon where injection vaccination is not applied.

Correspondence *Trygve T Poppe, Department of Basic Sciences and Aquatic Medicine, Norwegian School of Veterinary Science, Ullevålsveien 72, Box 8146 Dep., 0033 Oslo, Norway (e-mail: trygve.poppe@vetmh.no)*

Keywords: Atlantic salmon, inflammation, melano-macrophage, major histocompatibility complex class II, mineral oil, vaccine.

Introduction

Various pathological conditions may be associated with abnormal pigmentation in tissues and organs. Such pigments may either be of exogenous or endogenous origin. Endogenous pigments include derivates of lipids, haemoglobin, porphyrins and melanin. The term melanosis is used to describe the presence of melanin in abnormal locations (Thomson 1984). In vertebrates, melanin is synthesized by melanocytes and organized in melanosomes, which are lysosome-related intracellular organelles (Orlow 1995; Raposo, Fevrier, Stoorvogel & Marks 2002). Mammalian melanocytes originate from the embryonic neural tube (Sulaimon & Kitchell 2003) and it has been observed that such cells can migrate into inflamed tissue (Thomson 1984).

Inflammatory reactions and tissue regeneration in salmonids seem similar to those of mammals (Finn & Nielson 1971), but have in addition been associated with the involvement of so-called melano-macrophages (Roberts 1975; Agius & Roberts 2003). The origin of melanosomes in melanin-containing viscerally located cells in fish is not clear (Agius & Roberts 2003), but Sichel, Scalia, Mondio & Corsaro (1997) suggested that melanogenesis in poikilothermic vertebrates may occur in mesenchyme-derived cells of the haematopoietic lineage. Although teleost melano-macrophages have been ascribed macrophage-like properties, their functions and significance are

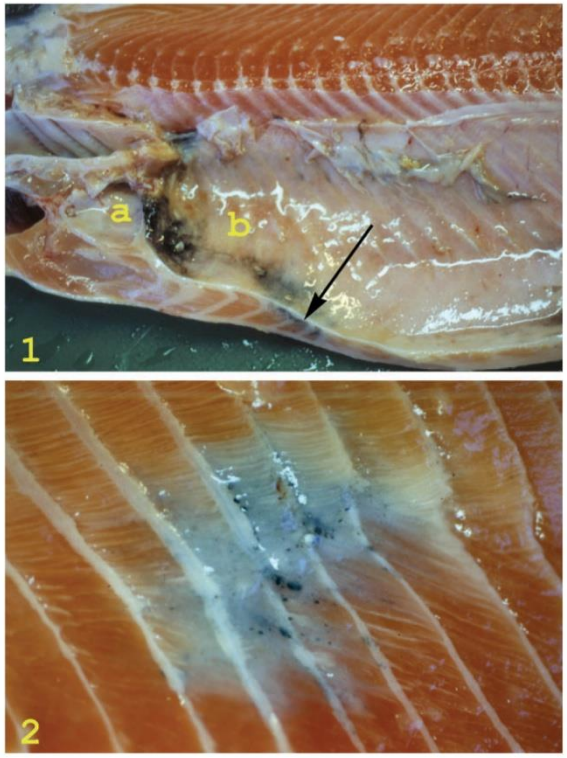

Figure 1 Gross pathological changes in the carcass of an Atlantic salmon. The pericardial cavity (a) is normal, but severe melanization is apparent in the abdominal cavity (b). Melanized musculature subjacent to the peritoneum is seen on the cut surface (arrow).
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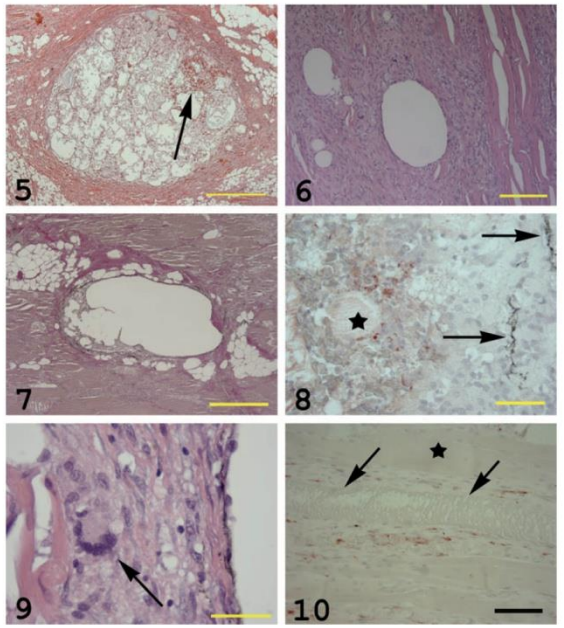
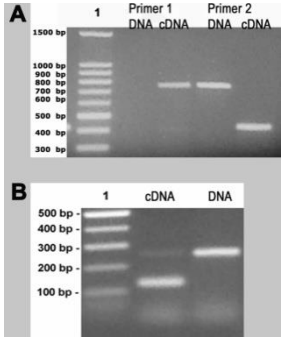


Figure 5 A large vesicle embedded in an intermyotomal septum containing macrophage-like cells, debris and a fresh haemorrhage (arrow) (H&E, bar = 500 μm).
Figure 6 Empty vesicles surrounded by granulomatous tissue embedded in the white musculature. Note adjacent, seemingly unaffected muscle cells (H&E, bar = 200 μm).
Figure 7 Vesicles embedded in the white musculature surrounded by fibrogranulomatous tissue (red staining) (EVG, bar = 500 μm).
Figure 8 Reaction against oil (red staining) in a vesicle as shown in Fig. 5. Homogeneous masses (asterisk) and macrophage-like cells show positive reactions. Note the melano-macrophages in the vesicle wall (arrows) (oil red O, bar = 50 μm).
Figure 9 High magnification of the wall of a vesicle as seen in Fig. 6. The wall contains a multinucleated giant cell (MGC)(arrow), epithelioid-like cells, small vacuoles and is lined towards the lumen of the greater vesicle with melanosome-containing cells, probably swollen melano-macrophages (H&E, bar = 40 μm).
Figure 10 Muscle cells infiltrated with MHC class II^+ cells. One muscle cell is unaffected (asterisk). One fibre shows severe degeneration (arrowhead), whereas one is invaded by MHC class II^+ cells (red reaction) (MHC class II immunostain, haematoxylin counterstain, bar = 100 μm).

- Primer pairs recognising a fish CD83 homolog



doi: 10.1111/j.1600-0749.2006.00297.x

Melanogenesis and evidence for melanosome transport to the plasma membrane in a CD83^{+} teleost leukocyte cell line

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Key words: CD83/dendritic cell/endosomal pathway/macrophage/melanogenesis/melanomacrophage/teleost

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Summary

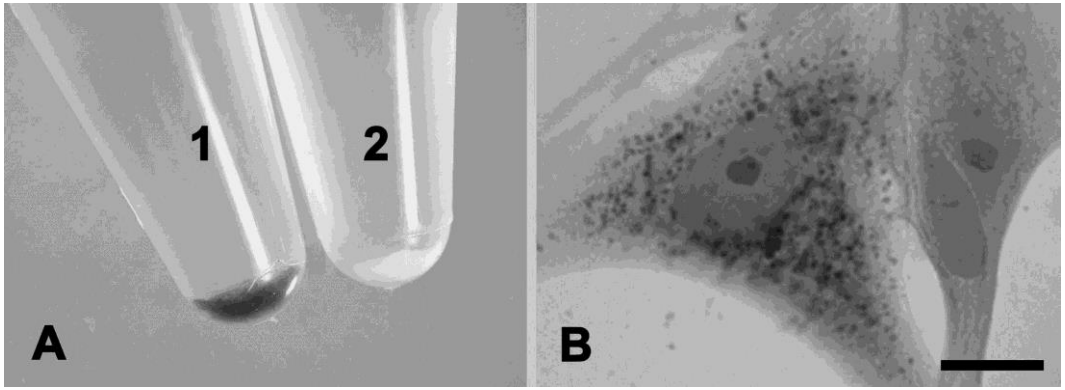
Introduction

Melanins are complex polymeric pigments, which are formed by a wide variety of living organisms ranging from fungi and bacteria to higher vertebrates (Margalith, 1992; Orlow, 1995; Raposo et al., 2002). Common for

- Primer pair detecting Dct/TRP-2

- A; 0,1 mM PTU inhibit tyrosinase dopachrome production from L-DOPA

- B; a few long cultured cells showed melanin reduction potential



doi: 10.1111/j.1600-0749.2006.00319.x

Isolation of the Atlantic salmon tyrosinase gene family reveals heterogenous transcripts in a leukocyte cell line

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*Address correspondence to Jim Thorsen, e-mail: jim@jim.no

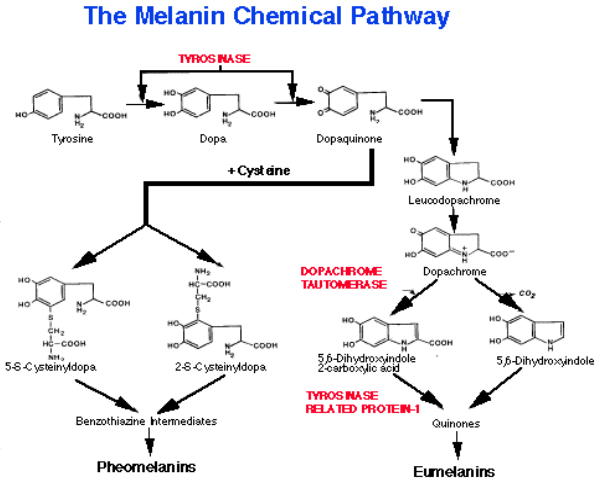
Summary

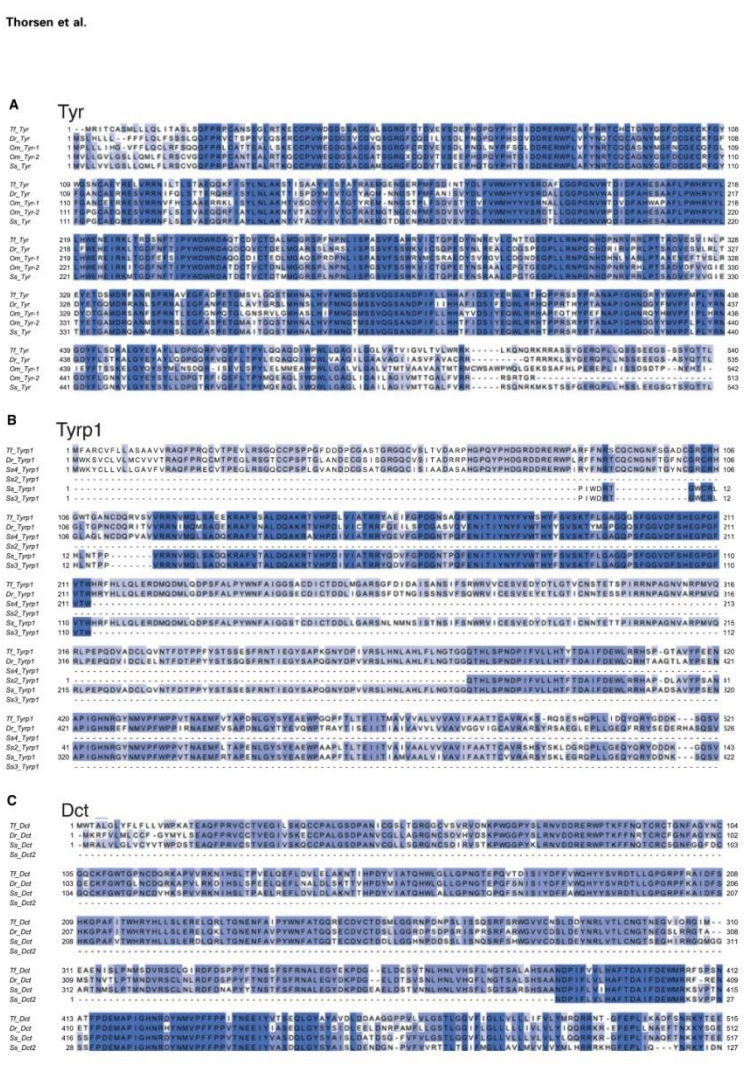
In ectothermic vertebrates, visceral organs harbor melanin-containing cells. Their ability as pigment producers is nevertheless disputed. To address expression of the key genes for melanogenesis in Atlantic salmon (*Salmo salar*), a tyrosinase-positive leukocyte cell line (SHK-1) and skin were used to obtain full-length tyrosinase (Tyr), tyrosinase-like protein-1 (Tyrp1), and dopachrome tautomerase (Dct) mRNA transcripts. In the SHK-1 cells, two different Tyrp1 transcripts were identified, one lacking exon 1. However, only the full-length version of Tyrp1 was identified in the skin. Sequen-

Introduction

The pigmentary system of vertebrates has predominantly been addressed in cells derived from the embryonic neural tube ectoderm (Boissy and Nordlund, 1997). Pigmented cells or melanocytes in the normal adult mammal occur in the skin, uvea, retina, meninges, the inner ear, and the Harderian gland (Boissy, 1998). Such cells are characterized by their ability to synthesize melanin, a process confined within discrete organelles termed melanosomes. Melanosomes share several properties with lysosomes (Orlow, 1995; Raposo et al., 2002), and any melanocyte precursor is defined as a melanoblast (Fitzpatrick et al., 1966). The functions of melanin are not only restricted to absorb, scatter and reflect light, but also include binding of metal ions and organic cations, and acting as antioxidants and scavengers of free reactive radicals (Margalith, 1992; Sarna and Swartz, 1998). Interestingly, increasing information link the functions of the pigmentary and immune systems (Mackintosh, 2001; Raposo et al., 2002).

The principal genes encoding the enzymes involved in





Biochem Cell Biol. 2012 Dec;90(6):769-78. doi: 10.1139/o2012-033. Epub 2012 Nov 20.

Melanogenesis in visceral tissues of Salmo salar. A link between immunity and pigment production?

Arciuli M, Fiocco D, Cicero R, Maida I, Zanna PT, Guida G, Horsberg TE, Koppang EO, Gallone A.

Source

Sezione di Biologia Medica, Dipartimento di Scienze Mediche di Base, Neuroscienze ed Organi di Senso, Università degli Studi di Bari, Policlinico-Piazza Giulio Cesare, 70124 Bari, Italy.

Fish & Shellfish Immunology 33 (2012) 277–285

Contents lists available at SciVerse ScienceDirect

Fish & Shellfish Immunology

journal homepage: www.elsevier.com/locate/fsi

Pigment-producing granulomatous myopathy in Atlantic salmon: A novel inflammatory response

Hilde A.S. Larsen [a], Lars Austbø [b], Turid Mørkøre [c], Jim Thorsen [d], Ivar Hordvik [e], Uwe Fischer [f], Emilio Jirillo [g], Espen Rimstad [h], Erling O. Koppang [a,*]

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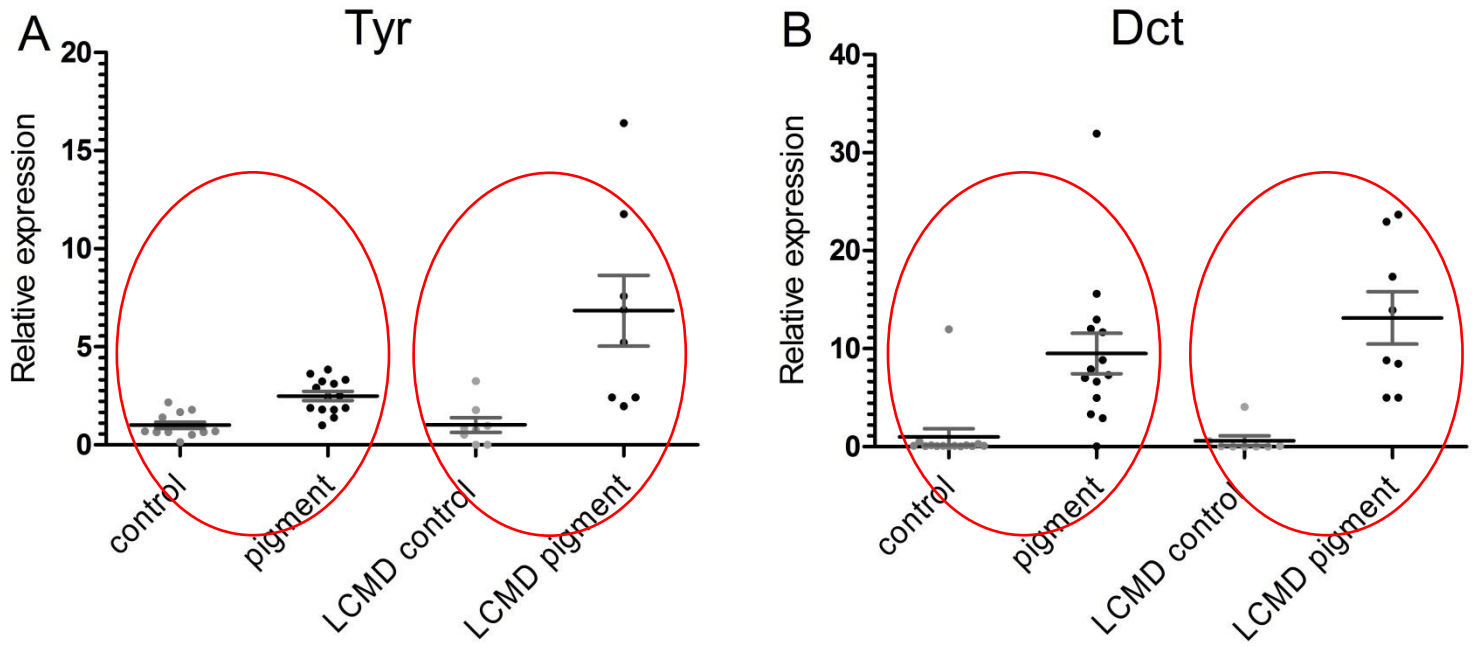
Up-regulation of the tyrosinase gene family in the black spots



Journal of Fish Diseases 2013 doi:10.1111/jfd.12106

The effect of vaccination, ploidy and smolt production regime on pathological melanin depositions in muscle tissue of Atlantic salmon, *Salmo salar* L.

H A S Larsen[1], L Austbø[2], A Nødtvedt[3], T W K Fraser[3], E Rimstad[4], P G Fjelldal[5], T Hansen[5] and E O Koppang[1]

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4 Department of Food Safety and Infection Biology, Section of Microbiology, Immunology and Parasitology, Norwegian School of Veterinary Science, Oslo, Norway
5 Institute of Marine Research, Matre Research Station, Matredal, Norway

Paper II

Developmental and Comparative Immunology 41 (2013) 50–58

Contents lists available at SciVerse ScienceDirect

Developmental and Comparative Immunology

journal homepage: www.elsevier.com/locate/dci

Transcription of the tyrosinase gene family in an Atlantic salmon leukocyte cell line (SHK-1) is influenced by temperature, but not by virus infection or bacterin stimulation

Hilde A.S. Larsen [a], Lars Austbø [b], Melanie König [b], Henning Sørum [c], Espen Rimstad [c], Erling O. Koppang [a,*]

[a] Section of Anatomy and Pathology, Department of Basic Science and Aquatic Medicine, Norwegian School of Veterinary Science, Oslo, Norway
[b] Section of Genetics, Department of Basic Science and Aquatic Medicine, Norwegian School of Veterinary Science, Oslo, Norway
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Paper III

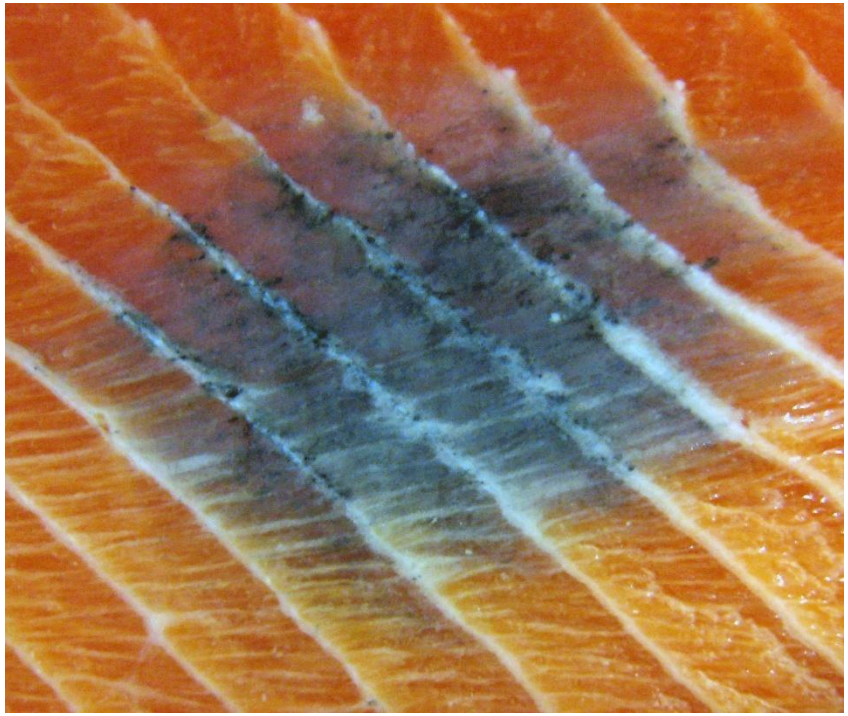
Pathological pigmentation in the hearts of Atlantic salmon (*Salmo salar* L.) with cardiomyopathy syndrome

Hilde A. S. Fagerland[1], Lars Austbø[2], Camilla Fritsvold[3], Marta Alarcon[3], Espen Rimstad[4], Knut Falk[3], Torunn Taksdal[3] and Erling O. Koppang[1,5]

[1]Section of Anatomy and Pathology, Department of Basic Science and Aquatic Medicine, Norwegian School of Veterinary Science, Oslo, Norway. [2]Section of Genetics, Department of Basic Science and Aquatic Medicine, Norwegian School of Veterinary Science, Oslo, Norway. [3] Norwegian Veterinary Institute, Oslo Norway. [4]Section of Microbiology, Immunology and Parasitology, Department Food Safety and Infection Biology, Norwegian School of Veterinary Science, Oslo, Norway.

Accepted for publication in Veterinary Research

Er melanin alltid melanin?




Australia
Melbourne
Devonport
Strahan
HOBART

8. Kan melanisering unngås?
Ja, tydeligvis!