Melanin pigmentation in salmon fillets—causes and risk factors

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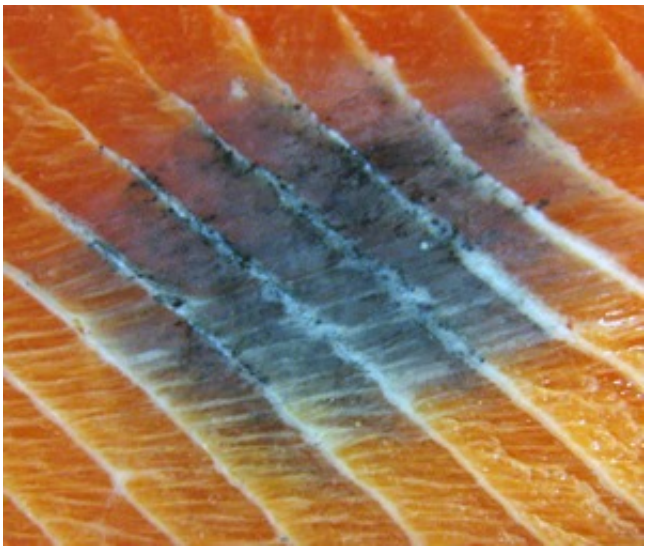
A PhD project carried out at the Norwegian School of Veterinary Science has examined the unwanted discoloration, or melanin "black spots", of muscle fillets from farmed salmon.

The cause of these spots was previously believed to be due to the use of vaccines with oil-based adjuvants, but this study shows that spots with

similar characteristics can also occur in unvaccinated salmon. The search for the cause of this phenomenon must therefore focus on other areas.

Farming of Atlantic salmon in Norway contributes to make the country the world's second largest producer and exporter of fish. Norwegian aquaculture generates a great deal of revenue. However, the downgrading of salmon fillets due to melanin spots leads to losses of several hundred million kroners per year. At the time of slaughter, up to 10-30% of the salmon can show signs of black spots in their muscle fillets. This phenomenon is caused by chronic inflammation sites in the muscles, where cells containing melanin accumulate and give rise to black discoloration. The cause of these spots was thought to be linked to the use of vaccines containing oil adjuvants, but other factors such as environmental conditions, genetics and disease also appear to play a role.

Hilde Fagerland's thesis is a study of pathological melanin pigmentation in farmed salmon. Her analyses showed that the melanin probably arises as a result of chronic inflammations and scar tissue formation. Fagerland used data obtained from vaccinated fish to analyse equivalent spots in unvaccinated fish – both diploid and triploid fish and spring and autumn smolt (juvenile salmon). The formation of the black spots in unvaccinated fish resembled those found in the vaccinated fish, irrespective of ploidy or production season (spring or autumn). Fagerland found just as many individuals with fillet pigmentation amongst unvaccinated fish as amongst vaccinated fish. However, triploid fish were found to be more likely to develop black spots than diploid fish.



One particularly interesting finding was the combination of vaccination and temperature/photoperiod smolt production (autumn smolt), which resulted in a larger number of affected fish compared to fish that are vaccinated and then undergo simulated natural smoltification (spring smolt). This may point to a possible cumulative effect of, or interaction between, raised temperatures and vaccination. This temperature-related effect was corroborated by the results of a cell experiment (SHK-1), where the synthesis of melanin appeared to be affected by the temperature.

Analyses of pathological pigmentation in the hearts of fish suffering from cardiomyopathy syndrome (CMS) also found a link between black discoloration and processes of repair and scar tissue formation in the fish .

In short, the findings of this project indicate that melanin is formed as a support to the defence and repair processes that occur following chronic inflammation.

Cand.med.vet. Hilde Anette Søiland Fagerland defended her doctoral research on 4th October 2013 at the Norwegian School of Veterinary Science with a thesis entitled: "Studies of extracutaneous pathological pigmentation - black spots - in Atlantic salmon."

Provided by Norwegian School of Veterinary Science