FASCINATING IRIDESCENCE

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Everyone agrees meat colour is important for consumers, and there are countless research papers on the topic; but routine measurements with commercial colourimeters cannot explain underlying principles. A similar situation prevails for those attempting to predict meat quality from optical measurements. This is why iridescence is so fascinating – at least to anyone with a scientific curiosity. If we can incorporate iridescence into our understanding of how microstructure determines the bulk optical properties of meat (Swatland, 2012) then we may advance our understanding of meat colour and how to predict meat quality from optical measurements.

If iridescence is caused by pigments, what are they and how do they produce their effect? If iridescence is caused by myofibrils producing a surface diffraction grating, how can iridescence survive when a myosystem is tightly pressed into a packaging film or viewed underwater (Fig. 1)? If iridescence is caused by a surface film like an oil slick, how can it survive unchanged after cooking? An alternative view is outlined here.

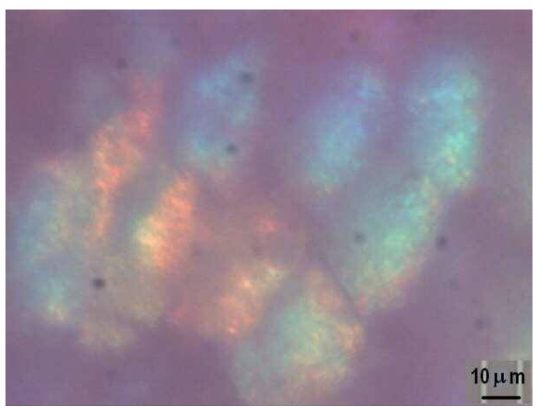

Fig. 1. Iridescence of cooked beef muscle fibres maintained under water.

We all survive our basic training in meat science by chanting the catechism for the longitudinal structure of striated skeletal muscle – fasciculi, fibres, fibrils and filaments. But long before his became the orthodox dogma, pioneer histologists like Bowman (1840) saw evidence of an alternative orientation – striated skeletal muscle fibres as a series of discs (Fig. 2), probably a result of post-mortem degradation of CapZ and actinin securing thin filaments into the Z line (Papa *et al*., 1999).

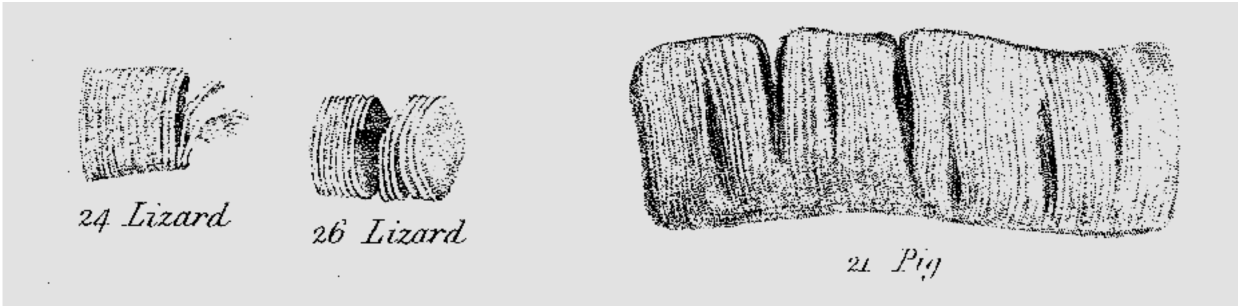

Fig. 2. From Bowman (1840), showing striated skeletal muscle fibres separating into discs.

The A and I bands of Bowman's sarcomere discs differ in refractive index (A > I) so that they can reflect light (Fig. 3). With reflections coming from different depths, this allows multilayer interference effects, like those of iridescent minerals (Rayleigh, 1923).

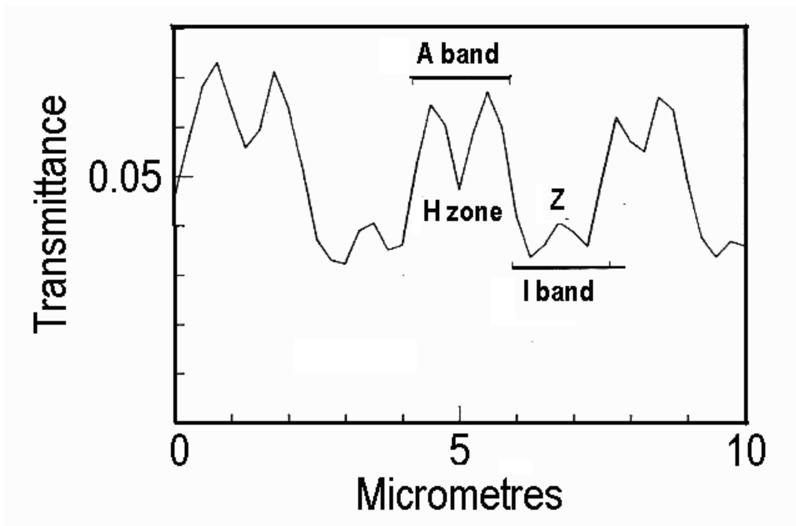

Fig. 3. Scanning along a myofibril with a polarizing microscope, with transmittance showing the strong birefringence of the A band and the weak birefringence of the I band.

Who knows if this idea is correct? I would be the first to change my mind if experimental data from those who believe in surface diffraction grating as a cause of meat iridescence can prove it experimentally (Martinez-Hurtado, Akram, & Yetisen, 2013). But if multilayer Fresnel reflectance from A bands is correct, then this has profound implications for light scattering in bulk muscle. Our dilemma right now is that short sarcomeres (tough meat) and low *p*H (soft or tender meat) both increase light scattering (Swatland, 2003). Younger and brighter minds than mine might solve this problem.

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