



RIGOR MORTIS

WHAT is rigor mortis?

In order to swim, fish muscle uses energy to continually contract and relax. The degree of physical activity of a fish immediately prior to harvest directly effects the rate at which rigor mortis occurs. When a fish is slaughtered, its muscle relaxes and will remain in that state as long as there is energy available in the muscle. When the energy runs out the muscle contracts, becomes hard and is said to be in rigor mortis (rigor). As rigor recedes, the muscle becomes soft and relaxed again.

Below: SBT being cleaned on a factory processing line



Rigor (or relative muscle stiffness) is a recognised indicator of freshness in fish. To satisfy the consumer, fish may be required either pre, post or in rigor. However, from a processors viewpoint fish in rigor are difficult to handle and their muscle can easily be damaged during processing. By understanding rigor and what influences its rate of development (onset), it may be possible to manipulate the rate of post-mortem change and rigor onset by altering harvest and post-harvest practices.

FISH response to harvest stress

Harvest generally leads to frantic activity in fish. Immediately prior to death, this alarm reaction will cause a depletion of muscle energy and a build up of lactate acid in the blood tissue which will have an effect on post mortem events, including the rate of rigor onset.

There are two important muscle energy compounds that are relevant when measuring the rate of rigor onset and flavor enhancement of the flesh. These are respectively, adenosine triphosphate (ATP) and inosine monophosphate (IMP). When ATP is depleted from the muscle rigor mortis is complete and the fish will be stiff and firm to touch.

Can we influence the rate of post-mortem change?

- harvest method does influence muscle energy levels in farmed tuna; and
- there appears to be scope for manipulating post-mortem biochemical change and the rate of rigor onset in tuna through alterations to harvest husbandry practices.



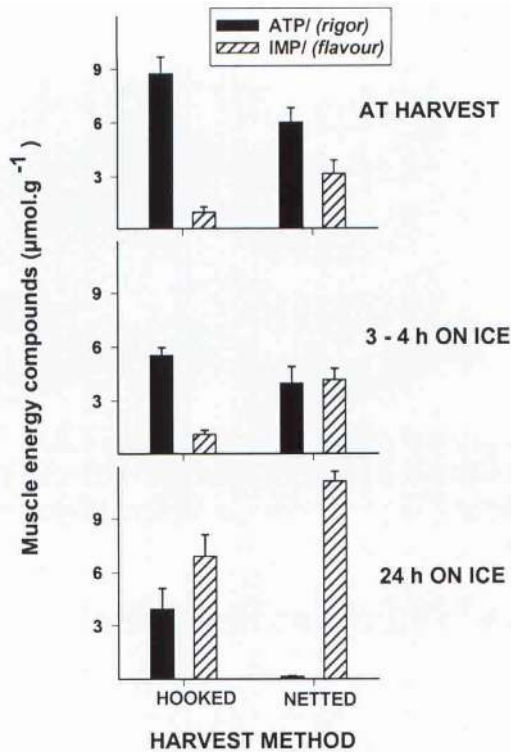
Left: Frozen SBT ready for shipment to Japan

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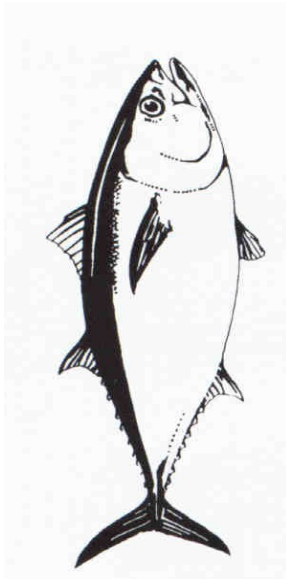
- > Rigor mortis is the stiffening of muscles which occurs after death due to the presence of residual energy.
- > Harvesting techniques can influence the rate at which rigor occurs in fish.
- > Net-diver methods are preferable when harvesting SBT, as rigor is completed in a shorter period of time and flavor enhancement is higher.



Above: Caged and frozen SBT trunks being transported.

Figure 1. Energy levels (represented by adenosine triphosphate (black bars) and inosine monophosphate (lined bars)) in tuna muscle of fish, subject to different harvest methods.

ATP & IMP concentration in muscle over time



Flavour of the fish will peak when IMP concentration in the muscle is high and the concentration of compounds that result from its degradation are low. Early in 1999 we measured the change in these compounds, in two groups of fish, at death and during 24hr storage on ice (Fig. 1). One of the groups had been hook harvested, and the other netted and then harvested by divers. The results show that in hook harvested fish muscle energy (ATP) is higher at slaughter and up to 24hr in ice storage compared to net-diver harvested fish that were killed and stored the same way (Fig. 1). As muscle ATP depletion results in rigor onset, it can be seen that rigor mortis was complete within 24h in the net-diver harvested fish but not in the hook harvested group. The results also show, that following 24h storage, the flavour enhancing potential of IMP is higher in the net-diver harvested fish than the hook harvested fish. Overall these results indicate that energy depletion in tuna muscle is less at death and delayed during storage in hook harvested fish compared to those harvested by the net and diver method.