Spoilage of shark

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Since the introduction of mesh nets in the south-eastern Australian shark fishery in 1964 the overall quality of landed fish has declined. Numerous complaints have been made by buyers at the Melbourne Fish Market and some Tasmanian processors refuse to buy mesh-netted shark.

POOR quality of shark is generally reported to be due to two factors — the development of ammonia in the flesh and bad discolouration.

Both these problems were encountered during the development of the line fishery for shark during World War II, but were overcome by improving the handling practices. There is every reason to believe that the quality of mesh-netted shark can be substantially improved by modification of the handling method.

Study of the time/temperature relationships given in this article should enable the fisherman to control spoilage and to estimate the potential storage life of his catch when it leaves the boat.

Development of ammonia

Sharks belong to the group of fish known as Elasmobranchs, all members of which possess a cartilagenous skeleton. The other main group, Teleosts, have a bony skeleton and this order contains most of the food fishes.

The occurrence of a high level of urea in the muscle and blood is a characteristic of the Elasmobranchs. Urea content in sharks varies from 1 to 2.5 per cent by weight[1]. This urea is the precursor of the ammonia formed in shark after death. Many investigators have looked unsuccessfully for the enzyme urease in shark muscle and not found it. Many bacteria produce urease which breaks down urea to ammonia. The production of ammonia can therefore be linked to bacterial contamination after death, as muscle of live shark and other sea-fish has always been found to be sterile. The skin, gills, and guts, however, contain large and varied bacterial populations which can invade the flesh after death[2]. Production of ammonia can continue until the flesh contains 1000 mg of ammonia nitrogen (N) per 100 gram[3]. The limit of edibility has been assessed by Japanese work to be 30 mg of volatile base nitrogen per 100 gram flesh[4]. This is confirmed from a table of organoleptic data on the spoilage of dogfish landed in Scotland[5]. Almost all of the total volatile base in these fish was ammonia.

Spoilage of fish is a highly complex process dependent on the composition of the catch, fishing grounds, sexual cycle, and handling methods. However, workers at the Torry Research Station in the United Kingdom[6] have demonstrated that spoilage can be predicted in fairly simple mathematical terms. These workers suggested that the storage life of a particular fish can be defined as the period of holding time at a given temperature in which the spoilage reaches specified levels.

These specified levels are characterised as bacterial counts, taste panel scores, or chemical tests such as the ammonia production mentioned above. In the case of sharks such factors are intimately related, as the bacteria produce the urease which converts the urea to ammonia, causing tasters to reject the sample.

A mathematical relationship between specific rate of reaction and temperature was described as early as 1889 by Arrhenius. If the logarithm of the specific rate of any reaction is plotted against the reciprocal of the absolute temperature a straight line is obtained, provided the range of temperature is not too great. A quantity known as the apparent activation energy can be obtained from the slope of the line. Torry Research Station workers found that between +1°C and 15°C (34°F to 59°F), the average activation energy for various spoilage tests on wet white fish was between 15,000 and 18,000 calories per mole. Instead of a true spoilage rate in the relationship mentioned previously, the reciprocal of the time taken to reach a specified spoilage level may be substituted, e.g. for shark, 30 mg of ammonia N per 100 gram. flesh (spoiled) or 100 mg per 100 gram. flesh (putrefied)[5].

Work on the production of ammonia in shark flesh has been undertaken in many parts of the world. We have taken the data on uniced shark from three Japanese papers[3,7,8], Canadian work[9], and unpublished Australian research[10] and have estimated from the graphs of these workers the time required to reach the two spoilage levels mentioned above. We have plotted the logarithm of the reciprocal of the spoilage time against the reciprocal of the absolute temperature (1/T). These

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