The Impact of Whelk Handling/Storage Methods on Product Quality

Seafish Report No. SR 529

November 1999

The Sea Fish Industry Authority

Seafish Technology

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Summary

The development of Far Eastern markets in Korea and Japan since the early 90's has resulted in the growth of the whelk fishery in the UK and Ireland. An associated processing industry has developed in tandem to supply these markets. Industry sources suggest that in 1996 the UK exported up to 2500 tonnes of whelk meat which would equate with 10000 to 16000 tonnes of raw material.

There have been a number of problems associated with the processing of these whelks, not least being the receipt of poor quality raw material at processing plants. Whilst prompt cooking and freezing will stop further deterioration, processing cannot regain quality that has already been lost. The consequences of supplying poor quality product have in some cases been quite severe with large consignments of processed whelks being rejected in Korea at considerable cost to the exporters

Seafish was asked to identify what impact different catch handling practices have on the subsequent whelk quality. A literature search revealed that there was no published work which identified the correct handling practices required to maintain whelks in good quality post-capture. Seafish therefore undertook a small study to investigate the impact of whelk handling/storage methods on product quality.

For all of the quality indicators assessed, the results showed that storing whelks at ambient temperatures prior to processing resulted in a poor quality product, particularly in the summer months. This was the case even if the ambient storage was for only 1 day and the whelks were then subsequently chilled. Given this evidence and the fact that the current industry practice is to store whelks in sacks on deck with little or no control over the temperature, it is not surprising that processors have from time to time had problems caused by poor quality raw material.

Another factor exacerbating the problem is that in commercial practice there is only a very short time, approximately 15 seconds per pot, to empty the pot and put the whelks into the sacks. Given this, unless care is taken by the crew, dead whelks or rotting bait will sometimes be entering the sacks. In warm temperatures this will continue to rot and will make the whelks deteriorate much faster than otherwise would be the case. A slower hauling speed or a greater distance between the pots on the strings would help in this matter.

To improve whelk quality, changes will need to be made to current industry handling practices. The steps which can be taken to improve quality will, to some extent, depend upon the type and size of vessel.

Another factor which became apparent when conducting this study is that on some fishing grounds the red whelk, *Neptunia antiqua,* is caught alongside the common whelk, *Buccinum undatum.* It is important that the red whelks are identified and not landed along with the common whelks. This is because the red whelks contain a naturally occurring toxin which should not be consumed. Red whelks are usually slightly larger in size and have a smooth shell surface, whereas the common whelk has a rough surface to the shell. A longer time between each pot being hauled would provide more time to distinguish between the common and red whelks, if red whelks are present on the fishing grounds, to ensure that they are not stored with the common whelks that are going to be landed.

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1. Introduction

There has been an increase in the Far Eastern market in Korea and Japan for canned whelk meat called BAI-TOP which forms an integral part of the Korean Golbange-style of socialising. Resultant overfishing of their native whelks has resulted in the growth of the whelk fishery in the UK and Ireland. An associated processing industry has developed in tandem to supply these markets.

These Far-Eastern markets are not new. However, reductions in their traditional supply sources led fish buyers from Korea and Japan to look around the world for alternative sources of supply. The UK has partly met this demand with our native, *Buccinum undatum*, whelk. Other European countries are now also involved in this whelk export business. As indeed are Iceland, North America and Canada. To ensure a long-term viable fishery in the UK, considering the international competition for whelks, product quality levels must be as high as possible for the quality conscious Far-Eastern markets.

Industry sources suggest that in 1996 the UK exported up to 2500 tonnes of whelk meat, which equates to between 10,000 and 16,000 tonnes of raw material.

There have been a number of problems associated with the processing of whelks, including the receipt of poor quality raw material at processing plants. Whilst prompt cooking and freezing will stop further deterioration, processing cannot regain quality that has already been lost. The consequences of supplying poor quality product have in some cases been quite severe with large consignments of processed whelks being rejected in Korea at considerable cost to the exporters.

Seafish was asked to identify what impact different catch handling practices have on the subsequent whelk quality. A literature search revealed that there was no published work which identified the correct handling practices required to maintain whelks in good quality post-capture. Seafish therefore undertook a small study to investigate the impact of whelk handling/storage methods on product quality.

2. Objective

To compare whelk storage in ambient, chilled, iced and immersed conditions for a period of 1 - 2 days prior to processing and assess the impact the different storage methods have if any, on the subsequent whelk quality pre and post processing.

3. Methodology

Two one-day sea trips were carried out, during the summer months, on commercial fishing vessels working out of Bridlington, East Yorkshire.

The first sea trip was carried out to observe the normal catch handling procedures and to collect initial whelk samples in order to assist in developing the methods for assessing whelk quality.

The second sea trip was carried out to gather sea-fresh whelks and to store whelk samples in different conditions to compare impacts on meat quality. These conditions were:

1. ambient temperature
2. chilled
3. directly iced
4. immersed in seawater

3.1 Assessment Methods

The assessment of whelk quality was carried out using the following parameters:

vivacity ("aliveness"),
organoleptical assessment (cooked odour and flavour),
microbiological and chemical analyses.

Previous work carried out by Seafish, for Highland Council, investigating the extended live storage of whelks had detailed a vivacity or "aliveness" index (Seafish Report No CR124). A modified version of this aliveness index was used in these trials which did not distinguish between the very alive and the alive categories. See Table 1 below.

Table 1 - Description of vivacity/aliveness of whelks based on their behavioural characteristics

Score	Vivacity or Aliveness	Behavioural Characteristics
3	Very Alive or Alive	Production of bubbles and/or froth. Foot retained inside shell. Extended foot retracts fully into shell when touched. Animals moving around on extended foot.
2	Moribund	Extended foot moves slightly when touched. Siphon retracts into body when touched.
1	Dead	Extended foot is limp and fails to move when touched. Siphon fails to move when touched.

Using whelk samples obtained from the first sea trip, a simple organoleptical-scoring scheme for cooked odour and flavour was developed. See Table 2 overleaf.

Table 2 - Organoleptical scoring scheme for cooked whelks

Score	Odour	Flavour
4	Shellfishy, Sweet, Milky, Seaspray	Sweet, Characteristic Shellfish
3	Neutral	Neutral, Bland, Chicken
2	Sour Milk, Off Shellfish	Sour
1	Faecal	Bitter, Off Flavours

Microbiological quality was assessed by carrying out an analysis of Total Viable Count (TVC). This was done by Hull PHLS.

Bio-chemical spoilage assessments were carried out by measuring the Total Volatile Nitrogen (TVN) levels. Humberside Scientific Services carried this out.

3.2 Trials Conditions

A total of 14 different combinations of storage conditions were assessed. These were based around the four basic storage conditions of:-

ambient temperature	18°C
chilled	4°C
directly iced	1°C
immersed in seawater	9°C

Each sample comprised of 24 whelks. 6 for microbiological assessment, 6 for chemical assessment and 12 for sensory assessment.

Table 3 - Combinations of storage conditions

Sample No.	Treatment - Day 1	Treatment - Day 2
1	Ambient	None*
2	Ambient	Ambient
3	Ambient	Chilled
4	Ambient	Iced
5	Ambient	Immersed
6	Chilled	None*
7	Chilled	Chilled
8	Iced	None*
9	Iced	Iced
10	Immersed	None*
11	Immersed	Ambient
12	Immersed	Chilled
13	Immersed	Iced
14	Immersed	Immersed

* Samples indicating None on day 2 were processed after 1 day.

The ambient stored samples were kept in tightly woven, white (bean) sacks as is industry practice and stored at a temperature of 18°C. In the absence of refrigeration facilities at sea, the chilled samples were placed into large plastic bags, put into insulated containers and covered with a layer of ice. The directly iced samples were placed into insulated

containers and mixed with ice. The immersed samples were placed into an insulated container filled with seawater (see Figures 1 – 4). The samples were kept in these containers throughout the trial.

Figure 1 – Iced whelk samples

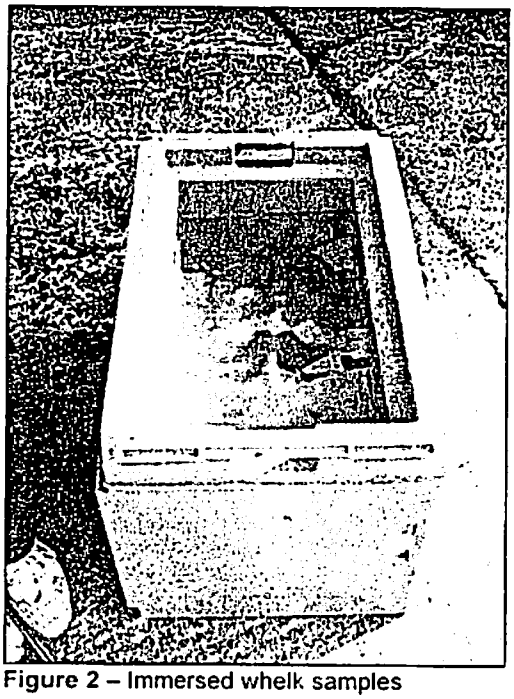

Figure 2 – Immersed whelk samples

Figure 3 – Chilled whelk samples

Figure 4 – Ambient whelk samples

Cooking of samples for organoleptical assessment was carried out in the Seafish Laboratory at Hull. The whelks were immersed in a large pan of boiling water for 13 minutes. The cooking time was arrived at after discussions with commercial processors and following an initial trial in the Seafish Laboratory, for reasons of food safety, to ensure that a cooking time/temperature regime of at least 90 seconds at 90°C core temperature was achieved. See Figure 5 overleaf for temperature profiles during cooking.

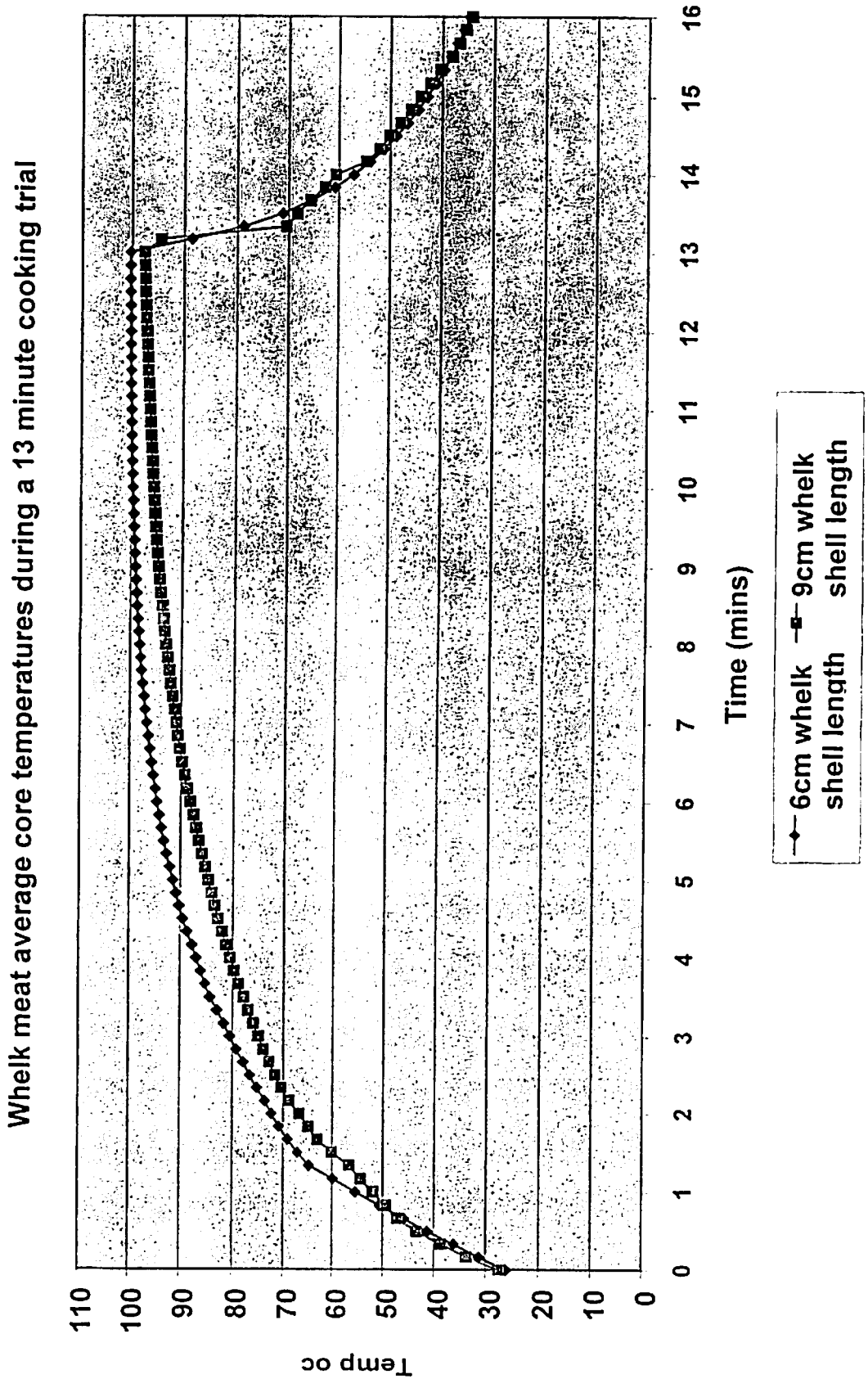

Figure 5 - Whelk meat core temperatures during a 13 minute cooking trial

4. Industry Practice

The whelk fishery is a static gear fishery based on the use of whelk pots. These are made from plastic containers. They have holes drilled in their sides and have a weighted base so that they sit upright on the sea bed. They have a mesh drawstring topside leaving a small opening for the whelks to enter the pot. The pots are baited with trash fish and crabs. Vessels work many strings of pots and may fish as many as 1000 pots per day. Catch levels can be as high as 4 tonnes per day. After hauling, the pots are emptied onto a steel table, from where the whelks are tipped into woven plastic sacks. On the vessel studied, the time interval for this between pots being hauled over the rail was about 13 – 15 seconds. The whelks sealed in the tightly-woven sacks are typically stored on the deck of the vessel through the day until landing. The boats usually fish on a daily basis, with vessels usually landing in the early evening. Under ideal conditions, the catch is landed directly into refrigerated transport, destined for a processing factory. See Figures 6 – 10 below and overleaf.

Figure 6 - Whelk pots stored on deck

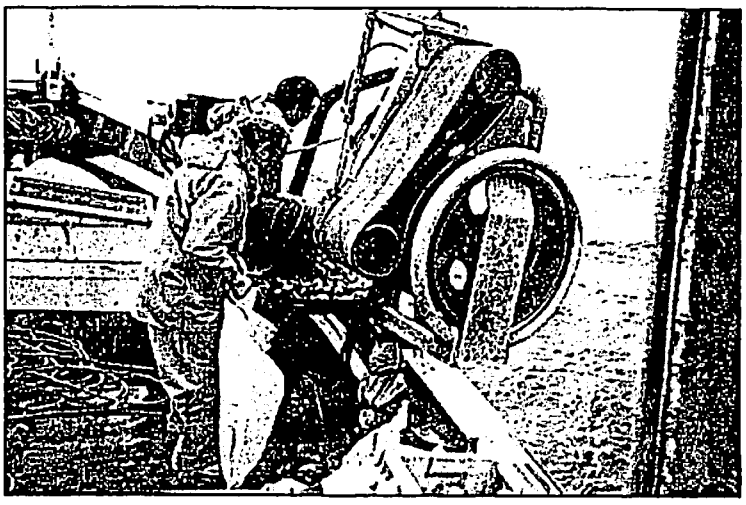

Figure 7 - Whelk pots being hauled and whelks being put into sacks

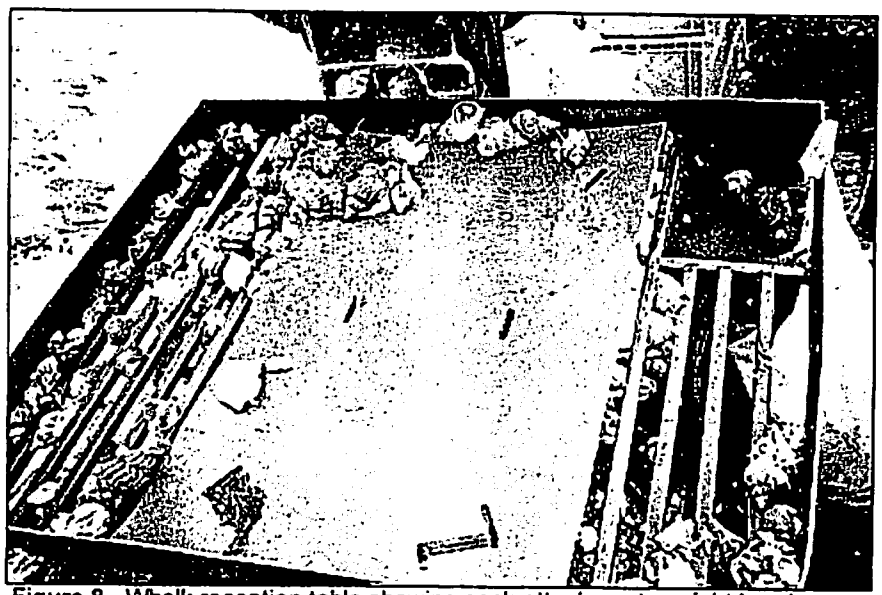

Figure 8 - Whelk reception table showing sack attachment on right hand side corner

Figure 9 - Sacks with whelks inside, stored on aft deck

Figure 10 - Whelks in chill store at factory awaiting processing

5. Trials Results

A summary of the results is shown in Figures 11 – 14 overleaf. These figures summarise the results for 6 out of the 14 treatments. Further detail for all treatments is given in Appendix I.

Figure 11 shows that the whelks kept at ambient conditions in sacks started to die much faster than the whelks which were chilled, directly iced or kept immersed in seawater. Figure 12 shows that the cooked flavour was poor for the ambient stored whelks and was best for the immersed ones, with the chilled or directly iced whelks nearly as good. Figure 13 shows higher bacteriological counts in the ambient stored samples. Figure 14 shows a higher level of bio–chemical deterioration in the sample stored at ambient temperature for two days.

Another issue, which became apparent when conducting this study, is that on some fishing grounds the red whelk, *Neptunia antiqua,* is caught alongside the common whelk, *Buccinum undatum*. It is important that the red whelks are identified and not landed along with the common whelks. This is because the red whelks contain a naturally occurring toxic chemical called tetramine in their salivary glands. Red whelks should not be consumed. Red whelks are usually slightly larger in size and have a smooth shell surface, whereas the common whelk has a rough surface to the shell. See Figures 15 and 16 overleaf.

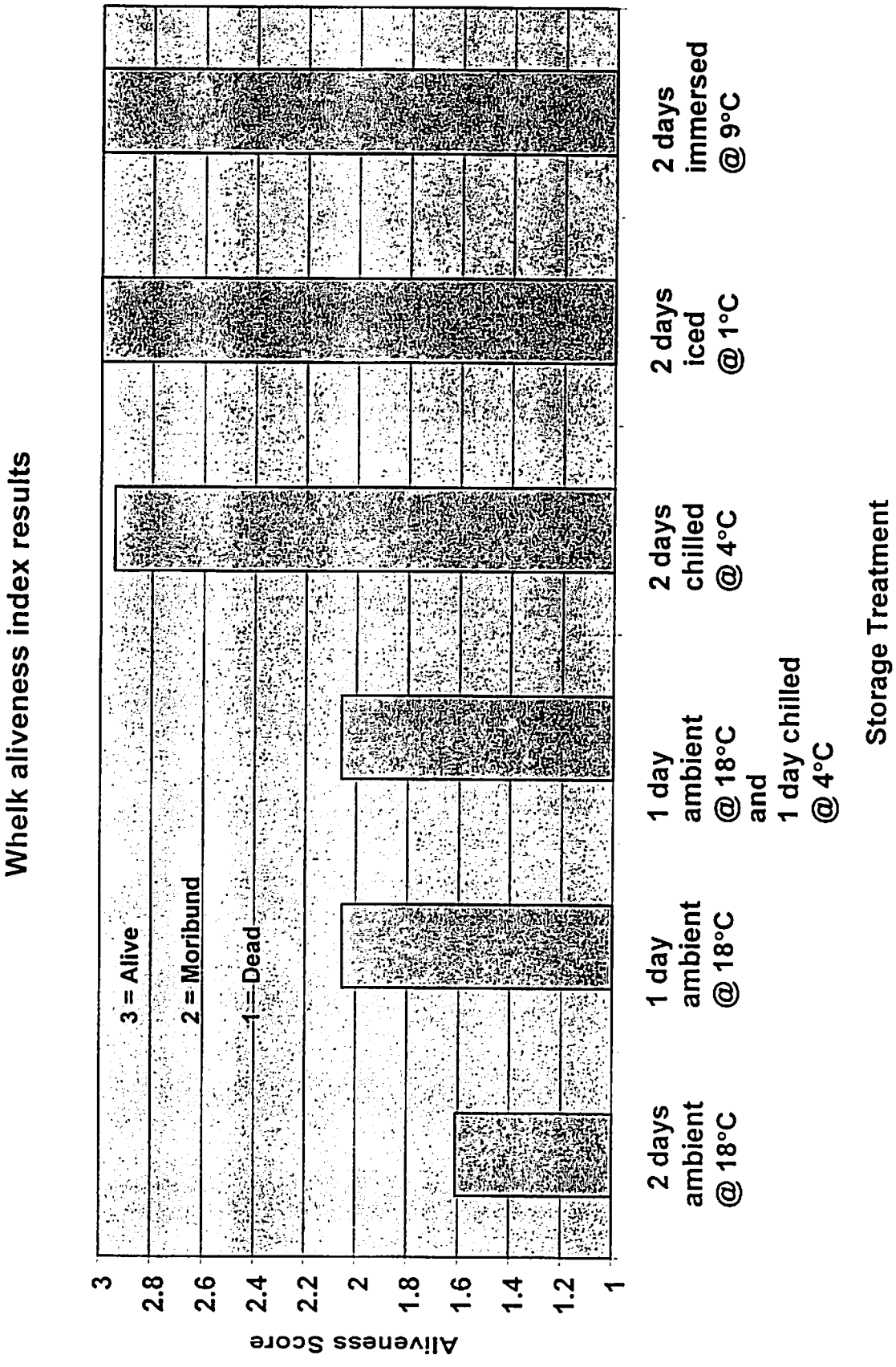

Figure 11 - Whelk aliveness index results

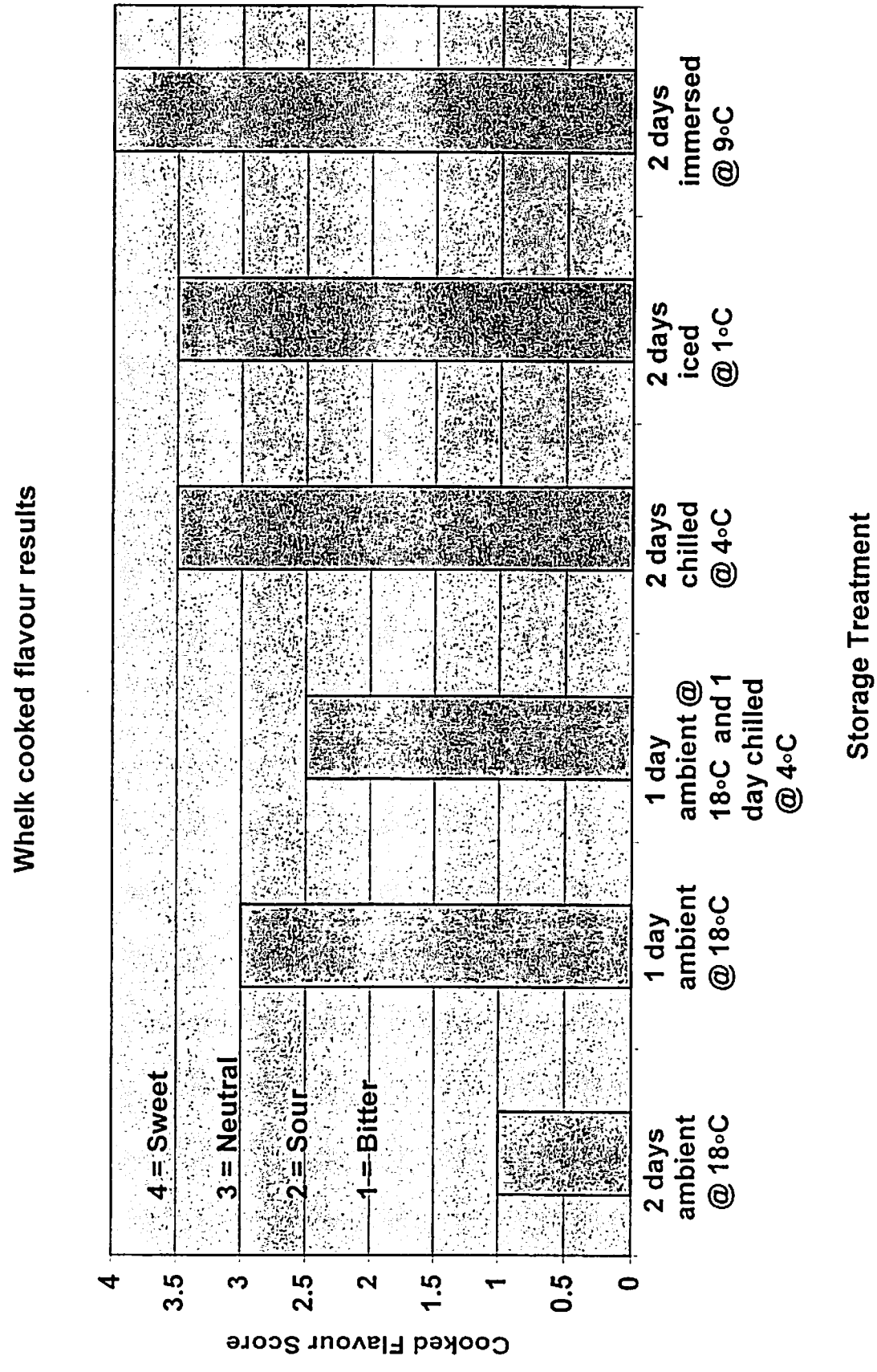

Figure 12 - Whelk cooked flavour results

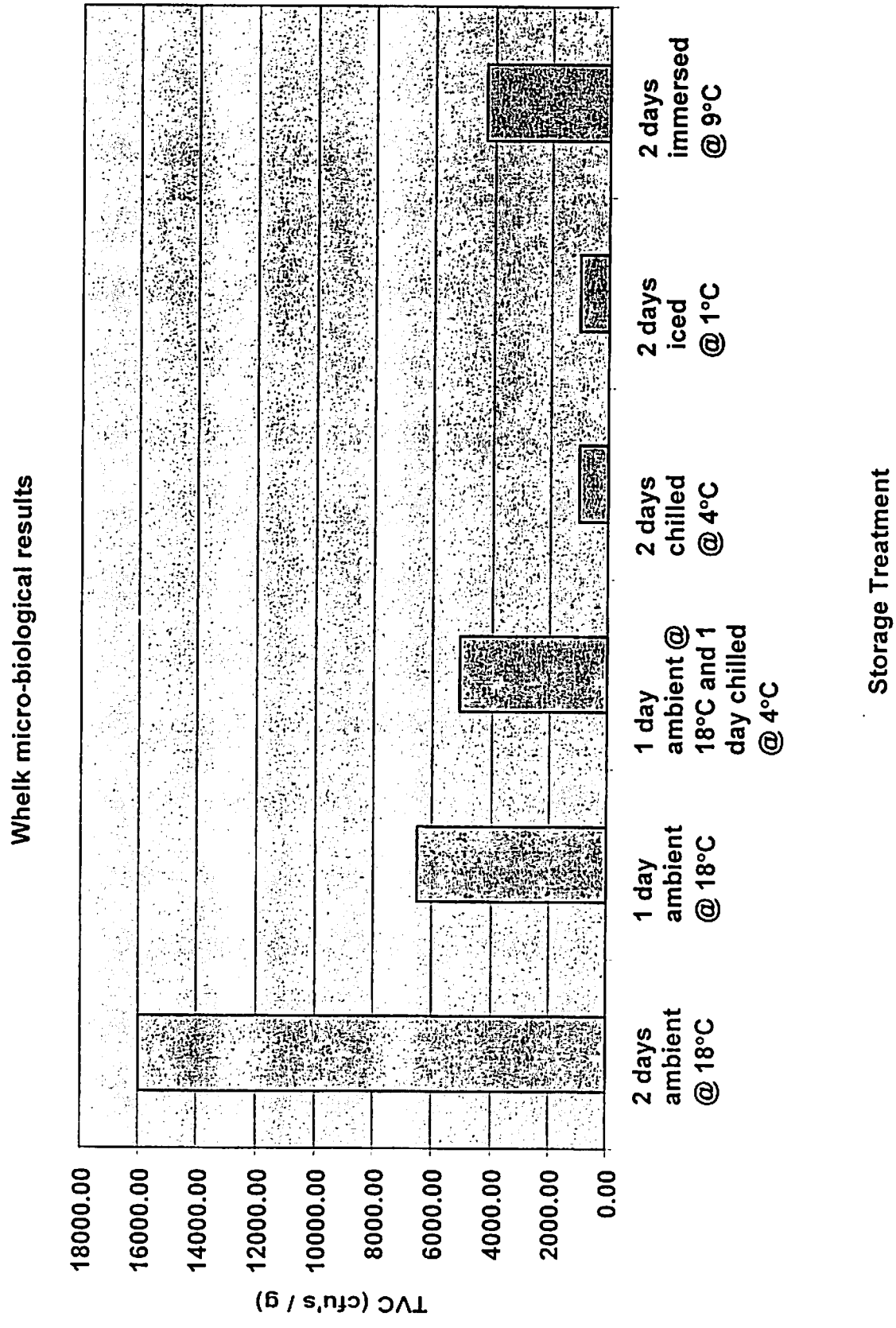

Figure 13 - Whelk micro-biological results

Figure 14 - Whelk bio-chemical spoilage results

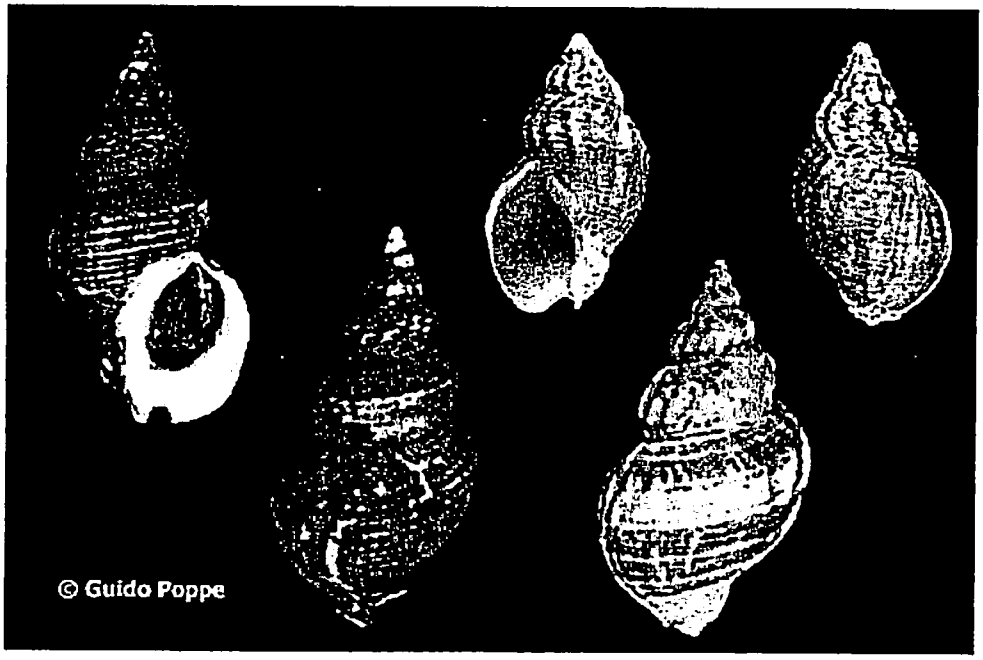

Figure 15 - *Buccinum undatum* (Common Whelk)

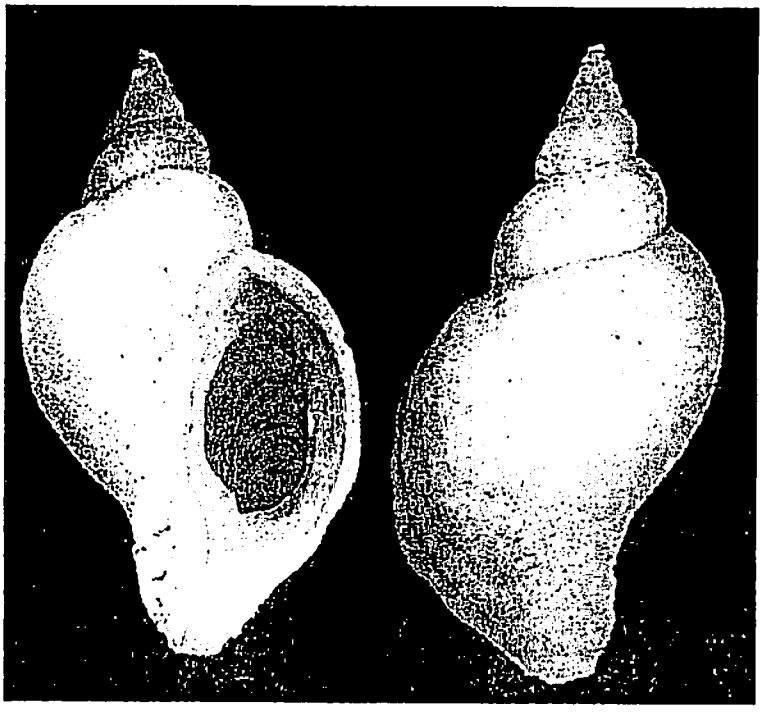

Figure 16 - *Neptunia antiqua* (Red Whelk)

6. Discussion

The overriding picture from all four of the quality indicators assessed is that storing whelks at ambient temperatures prior to processing results in a lower quality product, certainly in the summer months. This is the case even if the storage is for only 1 day and the whelks are then chilled for one day prior to testing. Given this evidence and the fact that the current industry practice is to store whelks in sacks on deck with little or no control over the temperature, it is strongly advised that current practices are amended to include chilling of the whelks and covering to reduce dessication.

One factor that will be exacerbating the problem is that given the short time for the crew to empty the pots and put the whelks into the sacks, it is inevitable that dead whelks and uneaten, rotting bait will sometimes be entering the sacks. In warm temperatures this will continue to rot and will make the whelks deteriorate faster than would otherwise have been the case. A slower hauling speed or a greater distance between the pots on the strings would help in this matter. This will also provide more time to distinguish between the common and red whelks, if red whelks are present on the fishing grounds, to ensure that they are not included with the common whelks that are landed. The biggest problem for whelk processors is some dead whelks being mixed with the good quality ones, as it is extremely difficult to identify these dead animals and separate them from the good quality products, either before or after processing. In extreme circumstances this can lead to batch rejection in the Far East, which in turn gives a bad reputation for UK sourced product.

To improve whelk quality, changes will need to be made to current industry handling practices. The steps to be taken will, to some extent, depend upon the type of vessel. Larger vessels with fish rooms could make improvements by storing the catch in the fish hold and either directly or indirectly icing the whelks. This could be done by putting the whelks into fish boxes with ice or by covering sacks of whelks with ice.

Some vessels fishing for whelks have vivier tanks. These trials and previous Seafish work has indicated that immersed storage of whelks is feasible. However, some experimentation would be required to ascertain the appropriate stocking densities and water exchange rates for vivier tank storage.

For the typical smaller inshore vessels without fish holds or vivier tanks, options include installing a sprinkler system from the deck wash and using loose-woven sacks in preference to the tightly woven white (bean) sacks. Some protection from the wind and the sun should also be provided.

The chilling of the whelks should be continued ashore prior to processing. The time delay prior to processing should be kept to a minimum. Processors must continue the chilling process prior to cooking.

The useful storage life of well handled whelks has not yet been determined by Seafish.

Recent legislative changes requiring a 45mm minimum size for whelks may necessitate the adoption of mechanical size grading onboard vessel. This, if designed well, could also facilitate the removal of any gash fish coming out of the pots hence improving quality matters. However, care will need to be taken to ensure that any mechanical grading is gentle as well as effective. Similar experiences in the mussel industry have shown poor grader designs can severely reduce product shelflife. Industry problems lead to Seafish developing an effective yet gentle mussel grader in the early 1990's.

7. Conclusions and Recommendations

1. Care should be taken to ensure that no dead whelks trapped in the bottom of pots and no uneaten bait enters the whelk storage containers.

2. Stopping temperature increase and wind-induced desiccation (drying-out) are the single biggest factors the fishermen can influence to improve the quality and longevity of their catch. Ambient storage for as little as 1 day in summertime conditions results in poor quality products.

3. Ideally whelks should be put into chilled, iced or immersed storage immediately after capture. For small inshore vessels without fish hold or vivier facilities, it is strongly recommended that loose-woven sacks are used in preference to the tightly-woven white (bean) sacks, that a sprinkler system running from the deck wash be installed over the sacks on deck and that some covering or shelter be used to protect the whelks from both the wind and sun.

4. Upon landing all catches should be kept chilled. Supplementary cooling by the use of ice, either directly or indirectly, can be beneficial.

5. All catches should be transported in refrigerated vehicles to the processing factory.

6. The time interval between capture and processing should be kept to a minimum.

7. Fishing grounds that contain red whelks should be avoided. If red whelks are caught, care should be taken to ensure that they are not landed.