## OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.

## DISCLAIMER



## FAIR USE POLICY



## CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

CA

05602

Distr.
LIMITED

ID/WG.172/16
7 June 1974

United Nations Industrial Development Organization

ORIGINAL: ENGLISH

AFRIFOODS - Regional Consultation on
Promotional and Technical Aspects of
Processing and Packaging Foods for Export
Casablanca, Morocco, 23 - 28 Jure 1974

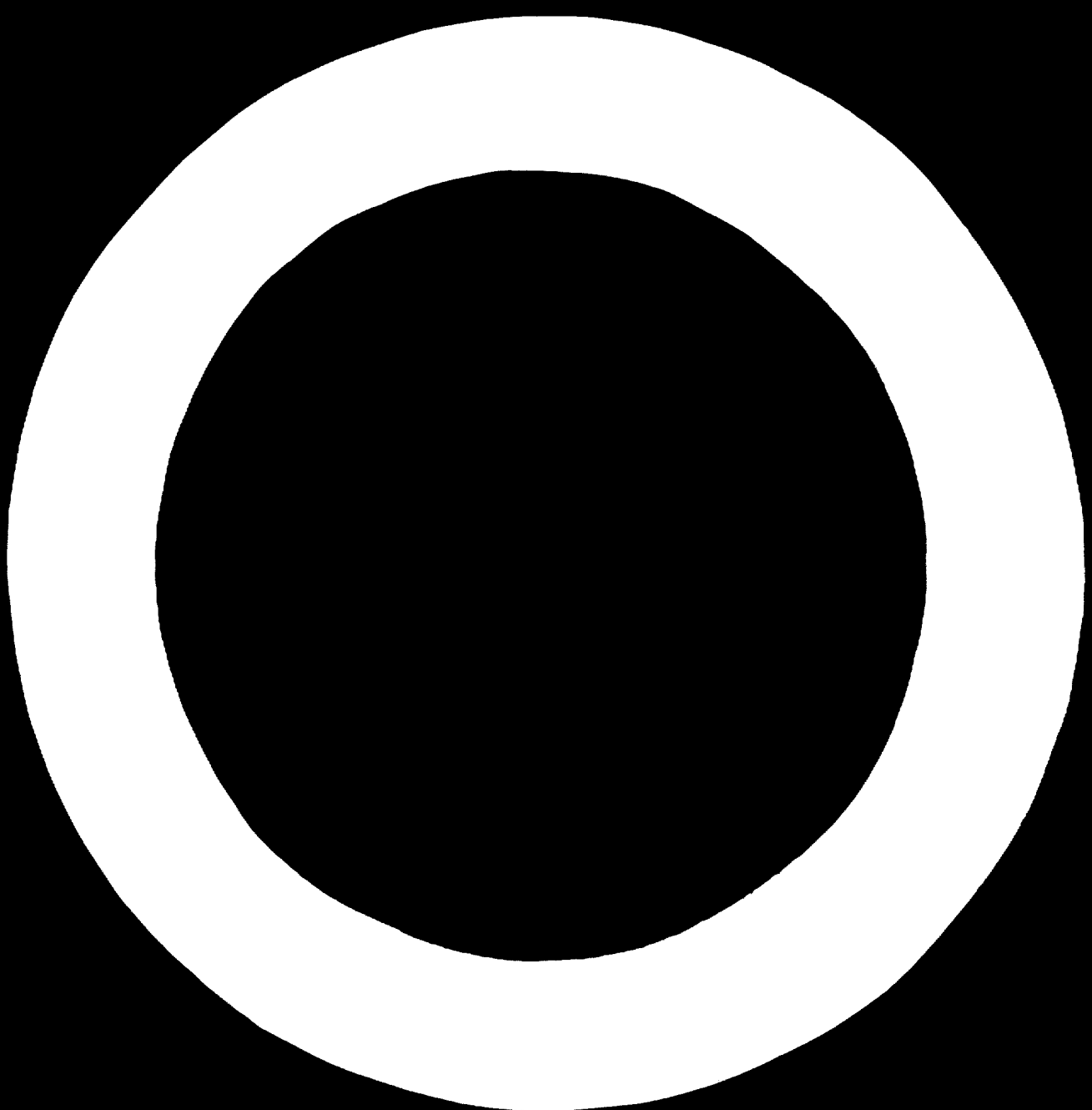
# FISH CURING AND DRYING[1/]

M. G. Hunter*

*Managing Director, Afos Limited, Manor Estate, Anlaby, Hull, United Kingdom

1/ The views and opinions expressed in this paper are those of the author and do not necessarily reflect the views of the Secretariat of UNIDO. This document has been reproduced without formal editing.

id.74-4130



The majority of developing countries suffer from an insufficient supply of food, particularly those foods which add protein to the diet. Various schemes to improve the position are now in operation, many under the auspices of the United Nations, utilizing crops of different types. One such crop, rich in protein and readily available to many developing nations, is fish, and much work has been done to maximize this particular crop as evidenced by reports covering many areas of investigation.

One of the major problems of fish as a protein source in developing countries, which usually have a hot climate, is the relatively short storage life. Fresh fish in hot climates spoils quickly. For instance, species such as sole are completely spoiled 10 - 12 hours after catching. Other examples are sardine which spoils in 6 - 8 hours and catfish in 5 - 7 hours. These rates, of course, apply to small fishing vessels where the catch is brought ashore without ice and protection from sun, wind, etc.

These problems have been emphasised in reports and solutions, and recommendations put forward to improve the storage life to enable this valuable source of protein to be distributed further away from the fishing ports themselves. One such report (1) on the smoke curing of fish described how countries did in fact carry out certain methods of preservation, such as air drying and unsophisticated smoke curing, but that these were generally carried out with little or no thought for maintaining the intrinsic value of the raw material, and standards of sanitation and hygiene were very low. Final products in most cases were unappetizing and not suitable for food by themselves and were often only used as flavouring materials for other dishes, such as soups and rice.

The report continues to suggest that the position could be radically improved by adopting methods and techniques developed in the United Kingdom and European countries, where improved fish smoking has been practised commercially for many years. In recent years, modern transport and distribution facilities in industrially developed countries have reduced the need for really long-term storage of smoke cured fish, as most products are available to the consumer within a few days of processing. There is, however, a vast pool of information and experience in techniques which would apply to the problems of the lesser developed regions with hotter climates. Also, just as important, mechanical kilns have been developed and are commercially available which allow controlled processing under hygienic conditions.

One such kiln is based on a design by the Torry Research Station (2), which is part of the British Ministry of Agriculture & Fisheries. The kiln, therefore, is generally referred to as the "Torry Kiln". The kiln is in effect a wind tunnel operated by an electric fan into which smoke can be drawn from an external smoke producer. Fresh air can also be sucked into the kiln and a portion of the circulating wet smoky air mixture can be blown up the chimney. Heaters, thermostatically controlled, are used to maintain the temperature of the smoke circulating in the kiln. Kilns are

made in a number of different sizes, arbitrarily referred to in terms of the weight of medium-sized cod fillets that the trolleys will take when properly loaded. Clearly, these weights can only be approximate since a greater weight of small cod fillets than of large ones can be put into the space. The most usual size for the large scale production of wet fish is the 120 stone kiln, although a fair number of 50/60 stone kilns are also in commercial operation. (1 stone = 6.35 kg)

Smoke is produced in a special type of automatic producer which now replaces the original hand-operated one of Torry design. This smoke producer is robustly made to give many years' trouble-free operation, and produces smoke from any type of hardwood or softwood sawdust within a few minutes of lighting. The producer is connected to the kiln by a duct as indicated in the general sketch, Figure 1.

When the kiln is in use, the outer doors to each of the chambers are kept firmly closed. In a properly constructed kiln, arrangements are provided throughout for easy access to ducts and chambers so the whole equipment can be regularly cleaned. Access to the duct leading from the smoke producer is also gained through ports fitted at suitable points. During the curing process, it is sometimes necessary to open the kiln. Therefore, provision has been made for the by-passing of smoke from the smoke producer direct up the chimney. This arrangement consists of a direct connection to the chimney which is closed by a flap. This flap in its alternate position closes the duct from the smoke producer.

Smoke is drawn from the smoke producer into the top duct of the kiln by the main fan, see Figure 2. The temperature of the incoming smoke and air mixture is raised by heaters controlled by a thermostat, the sensitive element of which is placed in the main stream of the smoke down-wind of the fan as near to the first trolley of fish as conveniently possible. The rotating blades of the fan put a twirl into the smoke which has to be straightened out again. This is achieved by a series of baffles and plates fixed at appropriate positions in the smoke path. Provided that these are adequately adjusted, the smoke from across the smoke curing chamber should be uniform.

The smoke from the top duct is delivered into the smoke curing chamber and is then blown across the trolleys of fish, see Figure 2. As the smoke passes over the fish, it is cooled by the process of evaporation of water from the fish. After passing over all the trolleys of fish, the smoke is then either returned to the top duct or a proportion of it is diverted up the chimney. The precise amount which is recirculated is determined by the adjustment of the air inlet and the smoke outlet dampers. The kilns are prefabricated out of sheet steel on a framework of angle iron. The whole kiln is normally double-skinned and insulated between the skins with slag wool, glass wool or some similar material.

The power consumption of the kiln depends not only upon its size, but also upon what it is being used for. Clearly, if it is to be used for the preparation of hot smoke products, such as mackerel or hot smoked trout (at approximately 30°C air temperature), power consumption will be higher

than if it is to be used for cold smoking for such products as kippers and haddock (at 26°C). Also, to some extent, the amount of heat required and the amount of insulation depends on the situation of the kiln and the lowest temperatures likely to be encountered in the factory in which it is to be installed. Because of this, two basic versions of the kiln are made, one for hot smoking and one for cold smoking. This basic design was adopted many years ago and has since been further developed for use in numerous countries throughout the world.

In its programme of assistance to developing countries, the United Nations has supplied some of the smaller sizes of the kilns to various parts of the world to support their field operatives carrying out field surveys and the training of indigenous population. Examples of countries receiving kilns in this way are Egypt, Malawi, Malaysia, Peru and Senegal. Of particular interest to the delegates is the one that has been supplied to the UNDP/FAO Project MOR 31 in Casablanca and will be in operation shortly.

If you refer to Appendix 1, you will see examples of the types of product that are produced in these kilns currently in Europe. Appendix 2 gives the storage life of these products both under normal air temperatures, in chilled room temperatures and in cold storage. These products, as mentioned before, have relatively short storage lives at normal temperatures but considerably better than that of less than 12 hours mentioned previously when no processing is carried out. Owing to rapid communications in Europe, these times have been found to be long enough. It can be seen from the list of products that the kiln is extremely versatile and able to produce controlled conditions for products requiring vast differences in the amounts of smoke, process time, weight loss, etc. The kiln is therefore adaptable to any process required.

In developing countries, a longer shelf-life would probably be required which will in turn call for longer process time resulting in higher smoke concentration and greater weight loss. The best process for each particular market is obviously a question of research and development in the particular country and will obviously depend upon the type of fish available and what sort of product the market will accept. The smaller kilns in our range are therefore ideally suited for this purpose and, as previously mentioned, Government Fisheries Departments all over the world have purchased these for evaluation.

Earlier in the paper, we referred to the necessity of prolonging the storage life of fish to permit shipment to more remote areas. We then referred to the two basic methods that were found to be already in use, although at an unsophisticated level, namely smoke curing and air drying. We have given a resumé of the process and equipment available for smoke curing and would now like to turn our attention to the drying of fish.

The conventional method of air drying of fish in the sun has been used as a means of preservation for hundreds of years but its effectiveness is very low in hotter climates, owing to infestation by insects in the period that it is exposed. This leads to an unhygienic and most unappetising product.

In more northerly climates, the product produced does not suffer so much from this basic problem owing to lower ambient temperatures and in many cases, countries with hot climates have had to resort to importing this type of product, such as stock fish, to supplement their diets. There is obviously a limit to the supply of this type of product from northerly climates, however, and all the developing countries cannot take advantage of this source. Also, the cost of importing is relatively high and it would be far more economic to utilize the ready supply of fresh fish close to hand, if the problems of hygiene and insect infestation could be overcome

What is obviously required is equipment similar to the kiln described above for smoke curing to enable these countries to set up their own factories incorporating modern hygienic methods which will produce a high quality product. Much work has been done on the basic problem in various parts of the world and the search for the most economic method, both in power consumption and speed, has been extensive. The Torry Research Station in Britain has been investigating the problem for some 10 years and are now completing their research and development with a project in conjunction with a commercial company which is to finalize a control system which will optimize the drying rate throughout the process time. One further advantage of this special process is that the temperatures the fish are subjected to at the latter stages are high enough to kill off any low residual infestation caused during the short handling period before it is put into the dryer. These temperatures are used without losing any of the nutritional value of the fish and the process produces an extremely good finished product.

The drying period is many times faster than that for air drying and is carried out on equipment similar to the kilns described previously. To give some idea of the comparison of times, this particular process would dry to a 20% final moisture content in 24 hours split fish of a length up to 45 centimetres. Drying by natural means depending on time of year, weather conditions etc., can take from 20 - 80 days. When the fish is dried to this low moisture level, its keeping time is many months and deterioration is minimal as long as it is packed sufficiently well to stop re-infestation by insects etc.

As mentioned, the Torry Research Station project is almost complete and equipment should be commercially available by the autumn of this year.

(1) F.A.O. Fisheries Report 88, 1970.

(2) Ministry of Agriculture, Fisheries & Food,
Torry Research Station,
P.O.Box 31,
135 Abbey Road,
Aberdeen AB9 9DG
Scotland
United Kingdom.

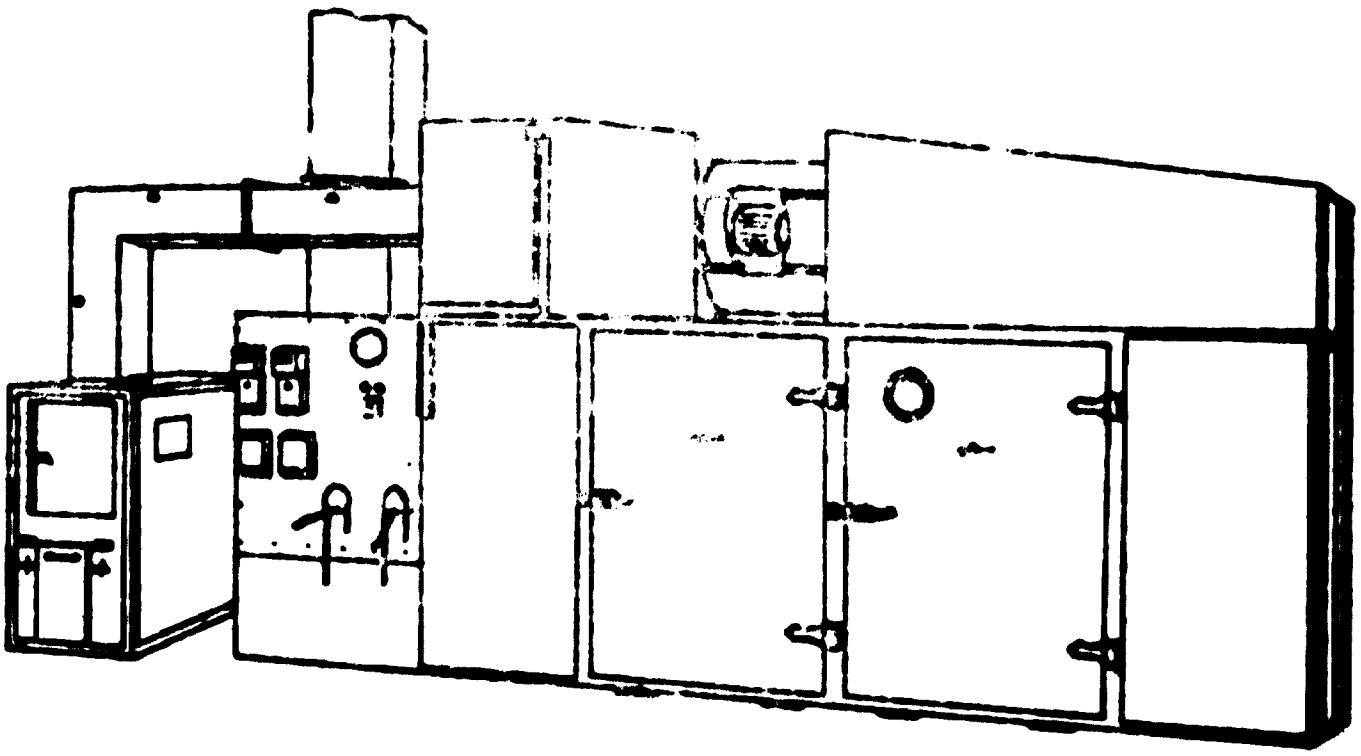


FIG.1 Illustration of Terry 60 stone kiln

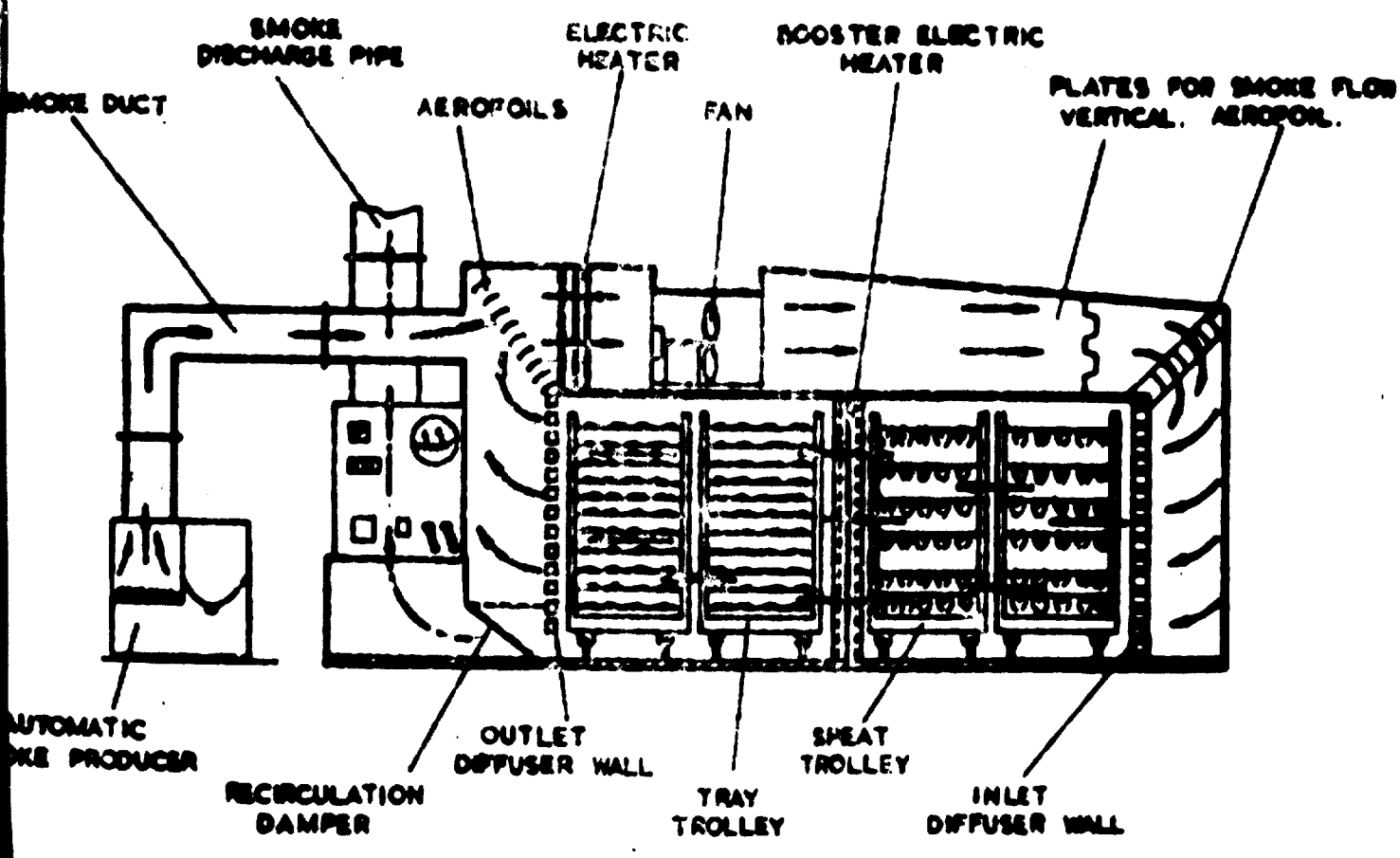



FIG.2 Sectional view of Terry 120 stone Kiln & Smoke producer

# APPENDIX A

## Fish smoking in a "Torry" type mechanical kiln

| Type of cure | Time in kiln (h) | Temperature °C | Temperature °F | No. of fires | Designed weight loss (%) |
|---|---|---|---|---|---|
| Kippers | 4 | 29.4 | 85 | all | 14 - 18 |
| Kippers for canning | 2½ | 29.4 | 85 | all | 12 - 14 |
| Kipper fillets | 2½ - 3 | 29.4 | 85 | all | 10 - 12 |
| Cod and haddock fillets | 3 - 5 | 26.7 | 80 | ½ to all | 10 - 12 |
| Finnan haddock | 4 - 6 | 26.7 | 80 | ½ | 12 - 14 |
| Pale cured haddock | 2 - 3 | 26.7 | 80 | ½ to ½ | 8 - 12 |
| "Golden cutlet" haddock | 2 - 3 | 26.7 | 80 | ½ | 10 - 12 |
| Bloaters | 3 | 32 | 90 | ½ | 14 - 16 |
| Red herring | 36 intermittent | 29.4 | 85 | all | 20 - 25 |
| Silver cure herring | 8 | 29.4 | 85 | ½ | 8 |
| Salmon | 8 - 12 | 29.4 | 85 | ½ | 10 |
| Cod roe | 8 | 37.8 | 100 | ½ | 20 - 25 |
| Buckling | 2 - 3 | 26.7 - 71 | 80 - 160 | all | 10 - 12 |
| Sprats for canning | ½ - ¾ | 26.7 - 71 | 80 - 160 | ½ | 10 - 12 |
| Kielerspretten | 1 - 1½ | 26.7 - 71 | 80 - 160 | all | 15 - 20 |
| Smokies | 2 | 26.7 - 71 | 80 - 160 | all | 30 |
| Trout | 3 | 26.7 - 71 | 80 - 160 | all | 10 - 12 |
| Eels | 2 | 26.7 - 71 | 80 - 160 | all | 10 - 15 |

Source: Burgess et al., 1965.

# APPENDIX 2

## Storage life of some species of smoked fish

| Species | Smoked product | Storage life | | | |
|---|---|---|---|---|---|
| | | 15°C (60°F) | | 0°C (32°F) | |
| | | in first class condition | remains edible | in first class condition | remains edible |
| | | days | days | days | days |
| Cod | Single fillets, cold smoked | 2 - 3 | 4 - 6 | 4 - 6 | 8 - 10 |
| Haddock | Single fillets, cold smoked | 2 - 3 | 4 - 6 | 4 - 6 | 8 - 10 |
| | Block fillets, cold smoked (golden outlets) | 1 - 2 | 2½ - 3 | 4 | 6 |
| | Finnans, cold smoked | 2 - 3 | 4 - 6 | 4 - 6 | 10 - 14 |
| | Palss, cold smoked | 1 - 2 | 2½ - 3 | 4 | 6 - 7 |
| | Smokies, hot smoked | 1 - 2 | 2½ - 3 | 3 - 4 | 5 - 6 |
| Herring | Kippers and kipper fillets, cold smoked - unwrapped | 2 - 3 | 5 - 6 | 4 - 6 | 10 - 14 |
| | cold smoked - wrapped | 1 - 2 | 3 | 3 | 3 - 44 |
| | Bloaters, cold smoked | 1 - 2 | 2 - 3 | 3 - 4 | 5 - 6 |
| | Buckling, hot smoked | 1 - 2 | 2 - 3 | 3 - 4 | 5 - 6 |
| Salmon | Fillets, cold smoked | 2 - 3 | 4 - 5 | 4 | 10 |
| Trout | Whole, gutted, hot smoked | 3 | 7 | 6 | 10 |

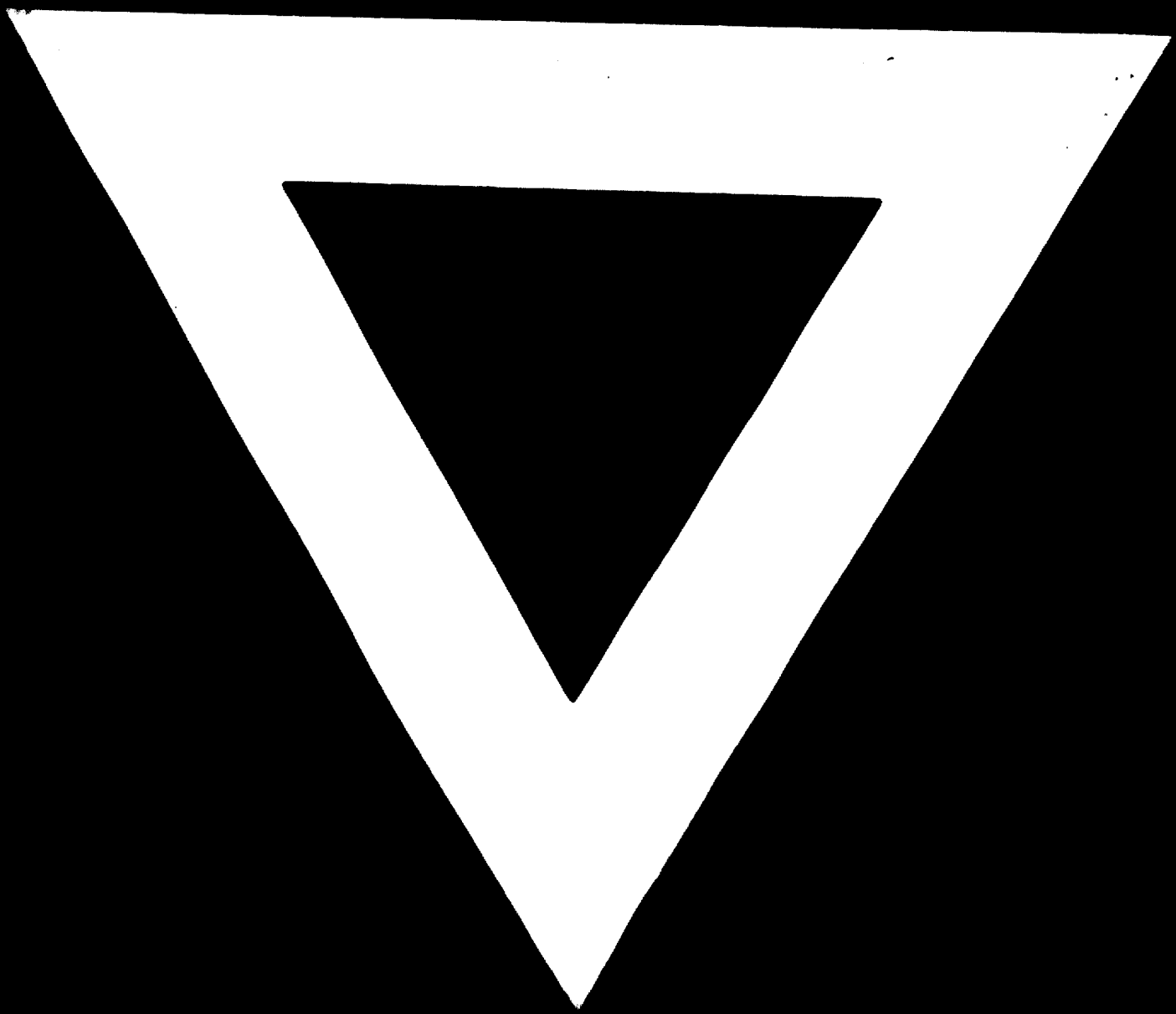
## Cold storage life of smoke cured products made from good quality raw material

| Type of fish | -9.5°C (15°F) | | -20°C (-5°F) | | -29°C (-20°F) | |
|---|---|---|---|---|---|---|
| Smoked white fish | 1 month | 3 months | 3½ months | 10 months | 7 months | more than 1 year |
| Smoked fatty fish | 3 weeks | 2 months | 2 months | 5 months | 4½ months | more than 9 months |

Source:

F.A.O. Fisheries Report No. 88 1970.

[redacted]



74.10.1