SEA FISH INDUSTRY AUTHORITY

Seafish Technology

TNO/FAR INTERNATIONAL CONFERENCE

'UPGRADING AND UTILISATION OF FISHERY PRODUCTS'

12th-14th May 1992
Noordwijkerhout
Netherlands

Internal Report No. 1423

R.Watson
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SUMMARY

The TNO/FAR International Conference concerned with the upgrading and utilisation of fishery products was attended. The purpose of the visit was to present a short lecture on the Guidelines for the Handling of Chilled Finfish by Primary Processors and display a guidelines poster.

The conference was used to assess European attitudes and trends influencing the EC fish trade. The opportunity was taken to target European Institutes which could be partners for Seafish in future R&TD projects.

Most papers presented were of a scientific/research nature mainly concerned with surimi production, product microbiology or the quality of raw fish.

Comments on the Seafish guidelines were all positive. A list of participants, contacts and addresses was compiled along with a detailed abstract of each lecture. A link between Seafish and Lyngby Technical Laboratory has been established, with the possibility of future collaborative work.

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1. INTRODUCTION

Seafish recognises the importance of forging links with European Research Institutes and keeping up-to-date with current ideas shaping the EC fisheries. This area of work should not be reglected to prevent Seafish becoming isolated from Europe.

The International Conference on Upgrading and Utilisation of Fishery Products was attended to achieve the following:-

(a) Assess what attitudes are being taken by other Member States to EC Directives. In particular any help given to the industry in the form of guidelines.

(b) Production of a list of European Institutes which could be partners for Seafish in future R&TD projects.

(c) Display a Seafish Guideline poster and give a seminar on the Guidelines for the Handling of Chilled Finfish by Primary Processors.

(d) Develop awareness of trends influencing the development of the EC fish trade.

2. CONFERENCE CONTENT

The conference organised by Dr. Luten of TNO was held over two days and attracted over 90 participants. Posters were admitted which briefly outlined specific areas of work which related to upgrading and utilisation of fishery products. Posters were exhibited in a small room adjoining the lecture theatre. Unfortunately no fixed time was allocated to view posters thus making targetting interested parties and possible R&D partners difficult.

The programme consisted of a series of lectures initiated by short poster presentations. The main areas or research lectures were as follows:-

(A full abstract of each lecture is given in Appendix 1).

i) **Surumi**

The use of underutilised species as a basis for surumi and kamaboko production. Modification of texture and properties of surumi/fish gels. Development of new surumi products and the utilisation of sardine mince.

ii) **Microbiology**

a) Assessment of microbiological quality and the effect on shelf life

b) Controlled atmosphere packaging and the growth of food borne pathogens

c) The shelf life and survival of *C. perfringens* in sous vide products

d) Presentation of fish using lactic acid organisms

iii) **Quality**

a) The affect of different slaughter methods on the skeletal muscle of farmed fish

b) Development for a rapid quality indexing system for cod, based on storage and shelf life experiments

c) Quality assessment of fish by chemical and physical measurements

d) Handling and processing of *A. simplex* infected herring

e) HPLC determination of biogenic amines especially in pelagic fish.

f) Identification of species in canned fish especially tuna and tuna like species.

g) Integrated quality assurance, grading and processing of chilled fish at sea

A full scientific paper is available for each lecture.

3. DISCUSSION

Most papers presented at the conference were of a scientific/research nature. Few were aimed specifically at the catching sector focusing mainly on the processing and post harvest areas.

Comments on the Seafish Guidelines were all positive. Most people recognised the importance of a technical manual for industry and commented on the encompassing nature of the contents. It appeared that Seafish Guidelines were the only specialist publications available aimed at improving quality of the industry. The lack of a fixed session to view posters reduced the potential for discussing guidelines and areas for future collaboration.

It was surprising to find posters in the area of improving fish handling at sea, submitted by RIVO, Netherlands and the Technology Laboratory, Lyngby, Denmark. Considering the technical similarities with our work in this area it would have been an ideal area for a collaborative venture. Although RIVO is now moving into the area of Safety at Sea, F. Vennstra, Head of Engineering was particularly interested in the care of the catch video.

On sounding out possible areas of collaboration there was a general feeling that establishments had links with prefered partners. Most collaboration work was of the more research/scientific nature. A list of participants, contacts and addresses of possible partners was compiled. (Appendix 2).

An interesting scheme of which Seafish may be involved in the future is a network for fish processing research. Dr. T. Borresen of the Ministry of Fisheries, Lingby, Denmark is attempting to link research organisations in the following areas:-

1) Sensory Analyses

2) Hygiene in Fish Processing Plants

There may be a possibility of work in other areas. Seafish has been put forward for further information.

In summary the conference was an excellent opportunity to make European contacts, determine prominant areas of research and promote the work of Seafish.

Since returning to the UK the letter overleaf has been received from Dr. T. Borresen.

APPENDIX I

Lecture and Poster Abstracts

LIST OF CONTENTS

SESSION 1: CHAIRMAN A.W.BARENDSZ

Oral presentation

UPGRADING OF UNDERUTILISED LEAN WHITE FISH AS A BASIS FOR THE PRODUCTION OF SURIMI, KAMABOKO AND OTHER RETEXTURED REFORMED FOOD PRODUCTS

J. Bon, B.Bloemsma, K.K.Brünner
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Surimi is an intermediate food product made from fish by extracting its muscle tissues with water. When mixed with salt and heated, surimi has the potential to form gels. Its gelling capacity is related to the freshness of the raw fish. Therefore surimi is mostly made from fresh fish.
A technological study is reported on the manufacturing of surimi from lean fish. The main aims of the study were to determine the effects of the frozen condition and the freshness state of the raw materials on the quality of their respective surimis.
Raw materials included underutilised fish such as blue whiting and silversmelt, furthermore the flat fishes plaice and flounder.
It was found that deepfrozen blue whiting could serve as a raw material for good quality surimi until up to approximately nine weeks of frozen storage at -25°C. Thereafter the suitability of frozen blue whiting gradually declined. The surimi made from blue whiting, which had been stored during 40 weeks, had largely lost its functional properties.
Deepfrozen silversmelt was found to be a suitable raw material for surimi manufacturing, even after prolonged frozen storage.
Raw plaice and flounder appeared to be suitable as well, their freshness being a critical factor only for the former species.

Poster

FACTORS AFFECTING THE TEXTURE PROPERTIES AND COLOUR OF WHITE FISH GELS

R.J.Hastings and K.J.Whittle
Ministry of Agriculture, Fisheries and Food, Torry Research Station, 135 Abbey Road, Aberdeen AB9 8DG, United Kingdom

The effects of species, parts used for recovery, washing, frozen storage of raw materials and cryoprotectants on the texture and colour of white fish gels were examined. Surimi gels were compared from cod, whiting, haddock, saithe and dogfish, and from fillet, trimmings and frames of whiting and haddock. Gels were examined from unwashed minces of fillet, trimmings and frames of cod and whiting, both from fresh material and after frozen storage of the minces with and without the addition of a cryoprotectant mixture (4% sucrose, 4% sorbitol, 0.15% tetrasodium pyrophosphate and 0.15% sodium tripolyphosphate). Good quality surimi gels could be prepared from frozen cod but not from frozen blue whiting. The texture and colour of gels from whiting was poorer after frozen storage of the gutted fish. Reduction in the number of washing steps did not improve yield during surimi processing, but dewatering with a cloth with a smaller mesh size did improve yield.

Poster

TEXTURISATION OF LEAN FISH MINCE

H.Meyer
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Fish mince has a lower market value than fish fillet. The aim of the present work has been to investigate strategies for upgrading fish mince to added value products.

The inherent fibres in fish mince can be described as being partly disintegrated and non-parallel as opposed to the fibres in fish fillet. Various methods to create a more uniform structure in cod mince have been tried out.

It was found that carding technique broke cod fibres even if the fibres had been pre-treated with enzymes in order to make them more mobile.

A calendering technique showed promising results. After treatment, cod mince took the form of plates being 2-10 mm thick. After cooking and cooling, tensile strength measurements were made. The ratio between longitudinal and transverse strength was found to be between 2 and 3, indicating that orientation of fibres had taken place.

Layers of calendered material was powdered with dry gelatin, stacked and frozen. Fish fingers were cut and breaded. The samples were fried and served to an expert sensory analysis panel.

The calendered fish fingers were perceived as being more juicy and having better mouth-feel compared to samples produced from untreated mince. No change of taste and colour was observed.

It was concluded that cod mince can be texturised in order to obtain better mouth feel.

Poster

INCORPORATION OF SURIMI IN COMPOSITE FISH AND MEAT PRODUCTS

Ph.Bécel and V.Mulak
Centre d'Experimentation et de Valorisation des Produits de la Mer (CEVPM), 15-17 Rue de Magenta, 62200 Boulogne sur Mer, France

The possibilities of incorporating surimi in delicatessen and "traiteur" fish products and also in meat products were studied. Work was carried out on the following fish products: terrines, sausages, steaks and roasts.

Various qualities of frozen fish were used to make terrines and sausages: minces of cod, saithe, Alaska pollack and blue ling, fillets of peruvian hake, argentinian hake and Alaska pollack.

It was found that fish have very different functional properties. The incorporation of surimi is not necessary to obtain a firm texture with a fish that has good functional properties. With fish of poor functional properties, the addition of surimi up to 20% is necessary. The addition of surimi can improve and standardize the texture of products from various raw materials.

Functional properties of surimi were compared with other texture agents: xanthan, kappa carragenans, caroub, a mix of caroube/carragenans.
It was found that only kappa carragenans improved firmness provided that the quality of fish was not too bad.

The possibilities of incorporating surimi have been studied in fish steaks and roasts. They must have firm texture and they must be less pasty than terrines or sausages. Many tests were carried out with and without surimi incorporated in different manners.
It was shown that incorporation of surimi was to make products firmer. It must be used in the form of gel made up with water, salt and thickener.

Lastly, in meat delicatessen (we have worked on liver "paté"), part of the fat could be substitute with surimi. Incorporation of 10% of surimi does not modify texture but the products have a more neutral flavour.
On the other hand, more significant contents (20%) soften the texture and products have a sweet flavour.

Oral presentation

UPGRADING OF SARDINE: INVESTIGATION ON MINCE PREPARATION AND NEW TEXTURIZATION WAYS USING MINCE, SURIMI AND MIXED MATERIALS

L.Han-Ching[1], J.Borderias[2], J.C.Cheftel[3], M.L.Nunes[4] and P.Pirazzoli[5]
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[2]Instituto del Frio (SCIC), Ciudad Universitaria, 28040 Madrid, Spain
[3]Instituto Nacional de Investigacao das Pescas, Avenida Brasilia, 1400 Lisboa, Portugal
[4]Université Montpellier II, Science et Techniques du Languedoc, Place Eugène Bataillon, 34095 Montpellier Cedex 5, France
5Stazione Sperimentale per l'Industria delle Conserve Alimentari, Viale Faustino Tanara 311A, 3100 Parma, Italy

The aim of the work is to study sardine as source of proteins interesting for preparation of edible texturized products.
A process for preparation of washed sardine mince has been set up, and stability of the mince recovered during lean and fat season has been studied during frozen storage.
Different materials can be added to improve the properties of mince such as hydrocolloids or proteins to improve the final gels, and surimi to improve emulsion stability; after binding with surimi, this mince can be extruded to form a film and mechanically rolled after cooking. Preparation of canned fish-balls has been also studied.
Sardine surimi as a good stability during frozen storage and leads to high-quality gels if setting and cooking are precisely performed.
Various functional properties of sardine surimi have been evaluated: foaming, binding, emulsifying and gelling capacities.
Depending on the proportion of added surimi, it is possible to prepare emulsions with different characteristics of texture.

Poster

IMPROVEMENT OF MINCED SARDINE GELATION WITH HYDROCOLLOIDS AND PROTEINS

P.Montero, M.V.Pardo, C.Gómez, and A.J.Borderias
Instituto del Frio (SCIC), Ciudad Universitaria, 28040 Madrid, Spain

Using industrial processes, sardine surimi is obtained with very acceptable properties. However, with the present processing methods, yield is very low and hence the products is relatively expensive. In order to avoid this problem, it is intended to obtain gels from fish mince. The difficulty with this material is that it forms very week gels, and in order to achieve a good gel texture, other substances have to be incorporated.

The purpose of this work is to improve gels made with lightly-washed sardine muscle, by incorporating certain additives such as hydrocolloids (carrageenan, alginates, starch, agar) and proteins (egg-white and soja).

It has been observed that in minced sardine muscle with poor gelling properties because of the raw material or the processing, hydrocolloids such as carrageenan and alginates improve gelling capacity sufficiently to produce true gels, although these are very soft and elastic. However, the hydrocolloids which provide the best gel strength are far and away the iota-carrageenans: gel strength of up to 9 Nxcm can be obtained by adding 3.5% iota carrageenan.

On the other hand, it has been observed that when a fish mince has relatively good gelling capacity, the addition of hydrocolloids brings no significant improvement.

The proteins tried, especially egg-white when 2% to 6% is used, give gel strengths of around 100 Nxcm, a great improvement with respect to the gel strength presented by most sardine minces even where they have good gelling properties. These observations are borne out by the results obtained with other rheological methods such as relaxation test and texture profile analysis.

These texture values are sufficient for application to a wide range of products; in fact the limiting factors on the manufacture of such products are colour and flavour.

Poster

BEHAVIOUR OF SARDINE SURIMI DURING HEATING

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[2]Facultad de Biológicas (U.Complutense), Ciudad Universitaria, Madrid, Spain

The final texture of kamaboko-type gels depends on the characteristics of the surimi and on its processing conditions. A study was made of the influence of different parameters on the final gel strength of gels (78% final moisture) made with sardine surimi, by examining the effects of different setting (0, 30, 60 and 90 min and 25, 35 and 40°C) and cooking (15, 30, 40 and 60 min at 90°C) times and temperatures, and of percentages of salt (2.5%, 3% and 3.5%) added to solubilize the protein. The results indicate that depending on setting conditions and percentage of salt, gel strength in such gels is two to five times

greater than in gels prepared without setting. Optimum setting conditions for improved texture differ according to the percentage of salt added; higher gel strength values were obtained with high salt concentrations, but such gels turned out too salty. Generally speaking, gel strength was improved by long setting times at low temperatures, whereas improvement was not so clear with high setting temperatures. In all cases, long cooking times caused reduction in gel strength. When setting time or temperature is increased electronic microscopic scanning shows a loss of the reticular and fibrous structure in the gel matrix and enlarged areas of globular aggregates.

Poster

CANNED FISH-BALLS FROM SARDINE MINCE

P. Pirazolli and I.Incerti
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The aim of this study was the preparation of a new and simple canned product from sardine mince.
Several sardine-ball formulations, their process technology and the processing parameters for the preparation of canned products in sauce and in brine were established.
Then, one sardine-ball formulation was chosen on the basis of sensory assessments and the relative acceptability of the canned sardine-balls in sauce and in brine was compared; the former product met the approval of the assessors' taste more than the latter.

Poster

FROZEN STORAGE STABILITY OF SARDINE MINCES AND SURIMI

M.L.Nunes, N.M.Bandarra, H.M.Lourenço, R.M.Campos, R.Mendes, I.Batista
Instituto Nacional de Investigacao das Pescas, Avenida Brasilia, 1400 Lisboa, Portugal

The influence of some additives, season and frozen storage temperature on the quality of sardine (*Sardina pilchardus*) minces and surimi was followed by sensorial and biochemical methods. The denaturation of sardine proteins in minces seemed to be not so pronounced as it has been observed in lean fish products even after 12 months of frozen storage at -10°C and the lipids were also found to be quite stable, although more unstable in washed minces. On the other hand, season looked to have a deep influence on the frozen storage keepability of these products and on the contrary additives have not any significant influence. Sardine surimi appeared to be a relatively stable product in what concerns proteins and lipids although frozen storage at -10°C may have an adverse effect mainly on the myofabrillar fraction. Sensory assessment revealed more accentuated changes during frozen storage than those indicated by biochemical methods.

Oral presentation

APPLICATIONS AND OUTLETS FOR SURIMIS

J.L.Millecamps
ADISUR, Chambre de Commerce et d'Industrie de Nantes, Boite Postale 18, 44027 Nantes Cédex 04, France

Our fields of investigation have provided us many important information. All results, positive or negative, contributed to a better estimation of surimi technological potentialities in various applications.

At a technological point of view, studies realised by the research centers, except those related to bakery products, demonstrated we may have new utilizations for surimis by:
- increasing final cohesion and reducing water loss while thermic process
- allowing formulation of new products for ready to eat dishes (expanded mousse ...) leading to new test and formulation.

The industrial use of this product is no more linked with sea food analogs, nevertheless, for EC surimi, those new applications are highly dependant on the following items:
- heterogeneity of surimis fabrication batches, leading to variable quality of this raw material preventing process standardisation
- final products totally rejected by the taste panel because of a fishy taste and fragance appearing when surimi was incorporated instead of other additives.

In fact, those remarks have to be minimised, results obtained via Adria and ID.Mer research centers clearly demonstrated we may get totally new products. Ready to eat dishes seem to be a good sector for surimi valorisation; in fact, it reduces fat contain and improves the total protein quality, two aspects the consumers are mainly looking for.

Oral presentation

THE DEVELOPMENT OF COMMERCIAL PRODUCTS FROM GREAT SILVER SMELT (*ARGENTINUS SILUS*)

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[2]Teagasc/National Food Centre, Dunsinea, Castleknock, Dublin 15, Ireland

Tighter TAC/Quota regimes for traditional species have increased interest in non-quota species, such as Great Silver Smelt (*Argentinus silus*). The considerable potential of the species as an acceptable raw material is reviewed, should a sustainable fishery be proved.

The suitability of Great Silver Smelt for processing is discussed, including handling, initial fish quality, filleting and mince block production. The suitability of the mince for enrobed fish portions and some analogue products is reviewed, with particular attention to water binding capacity and quality changes during cold storage.
The economics of processing, and the marktet potential of the species is considered, along with a brief review of its potential for surimi production.

SESSION 2: CHAIRMAN T.BORRESEN

Oral presentation

MICROBIOLOGICAL QUALITY AND SHELFLIFE OF FISH PRODUCT

H.H.Huss and P.Dalgaard
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Fish and fish products when not frozen, spoil primarily due to microbiological activity. For each type of fresh fish product, a characteristic microbial "spoilage flora" is likely to develop, depending on extrinsic factors (temperature, atmosphere, composition, water activity, etc.) and possibly also on intrinsic factors (fish specie or substrate composition). The objective of this research is to study the microbiological changes and spoilage of vacuum-packed and modified atmosphere-packed chilled fish products. The expected result is that a thorough understanding of the microbiological spoilage process will enable us to construct a methematical model based on the microbiological changes and thereby predict the spoilage of each product. This would benefit industry by providing a tool for establishing sage and realistic shelflife for their products.

In the initial phase, vacuum-packed fish and fish packed in modified atmosphere have been studied.

The provisional results confirm that Shewanella putrefaciens is the dominating spoilage bacteria for cod stored at 0°C irrespective of the surrounding atmosphere. However, at high CO_2 concentrations (60-100% of the atmosphere) the H_2S-producing Shewanella is found in low numbers only, but the activity of the reamining Shewanella is greatly increased by CO_2. This new finding makes modelling of shelflife based on bacterial numbers alone impossible. Studies are in progress how to clarify this essential finding.

Poster

OBSERVATIONS ON THE MICROBIAL FLORA ISOLATED FROM SALMON STEAKS

D.Donald, I.G.Millar, I.D.Ogden and D.M.Gibson
Ministry of Agriculture, Fisheries and Food, Torry Research Station, 135, Abbey road, Aberdeen AB9 8DG, United Kingdom

The spoilage characteristics and flora of chilled salmon has received little study, despite the enormous increase in its production and sale. Numerous spoilage experiments have been carried out with fish stored at 0, 5, 10 and 15°C. Changes in numbers with time and temperature of storage do not obey Ratkowsky kinetics. It is apparent that in contrast to the results with marine fish aeromonads are prominent and can predominate in the flora along with Shewanella putrefaciens. The spoilage potential of the isolates has been assayed in pure culture in salmon extracts sterilised by filtration and by irradiation. The latter was not succesful as spoilage odours were masked. Aeromonads are also implicated in human gastro-enteritis and it has been necessary to devise means of separating the pathogenic from the spoilage types. The biochemical and physiological characteristics of these isolates and their antibiotic sensitivity profiles have been determined and are indistinguishable from the isolates from pathogenic strains.

Methods have been developed to give plasmid profile and restriction endonuclease patterns. These appear to be very promising. Other molecular biological approaches may be applied. The growth rates of the spoilage bacteria under different environmental conditions of temperature, salt and pH being determined in a form suitable for mathematical modelling so that their time-temperature characteristics can be found.

Oral presentation

MODIFIED ATMOSPHERES: A "NEW" APPROACH FOR THE SAFETY AND QUALITY OF FRESH FISH AND FISH PRODUCTS

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[2]Institute of Technology of Agrotikon Proionton, S. Venizelou 1, Lycovrisi 14123, Athens, Greece

This project aims to determine the effects of modified-atmosphere packaging (MAP) on the growth of food-spoilage and particularly food-poisoning organisms on both UK and Mediterranean fresh fish and their products. Physicochemical changes will also be analysed during storage in an attempt to develop sensors for monitoring safety and freshness.

Initial studies in the UK have examined the growth/survival of Listeria monocytogenes and Salmonella typhimurium on farmed rainbow trout (Salom gairdneri). In both the modified atmospheres examined (60% CO_2/40% N_2 and 80% CO_2/20% N_2), either the survival of the foodborne pathogens was similar to that of aerobically stored fish, or pathogen growth was reduced in comparison with that of the aerobically stored fish. Several physicochemical analyses (e.g. hypoxanthine levels, headspace volatile analysis) were carried out on selected samples and the results of these will be presented.

In Greece, the preliminary studies have compared the microbial spoilage flora and the physicochemical results of MAP (100% CO_2) and vacuum-packed Mediterranean fish. Two species of fish - Sparus auratus (tsipoura in Greek) and Boops boops (gopa in Greek) - have been examined on two occasions. For both fish species, on both occasions, MAP was very effective in inhibiting the total aerobic flora, the pseudomonads, the lactic acid bacteria and the Enterobacteriaceae in comparison with those of vacuum-packed fish.

Poster

EFFECT OF MODIFIED ATMOSPHERES ON THE GROWTH AND SURVIVAL OF FOODBORNE PATHOGENS ON FRESH FISH

A.R.Davies, A.Slade and P.A.Gibbs
Department of Food Microbiology, Leatherhead Food Research Association, Randalls Road, Leatherhead, Surrey KT22 7RY United Kingdom

Whilst there have been many studies on the effects of modified atmosphere packaging (MAP) on the spoilage flora and shelf-life of fresh fish, with the exception of Clostridium botulinum, few studies have addressed the efffects on the foodborne pathogens.

We have examined the effect of MAP on the growth/survival of Listeria monocytogenes and Salmonella typhimurium on farmed rainbow trout (Salmo gairdneri) stored at 0° and 5°C.
Eviscerated fish were inoculated using a dip innoculation technique with either L. monocytogenes (NCTC 1194) or a cocktail of four "marked" strains of S. typhimurium. Inoculated and control (uninoculated) fish were then packaged in air, 60% CO_2/40% N_2, or 80% CO_2/20% N_2 and the total aerobic flora at 25°C and pathogen numbers determined over a 14-day storage period. At 0°C, numbers of both S. typhimurium and L. monocytogenes remained static or declined slightly over the 14 days' storage in all atmospheres. At 5°C,
L. monocytogenes numbers increased by ca. 3 $\log_{10}$ on the aerobically stored trout, remained static in the 80% CO_2/20% N_2 atmosphere and increased very slightly (ca. 0.5 $\log_{10}$ in the 60% CO_2/40% N_2.
S. typhimurium numbers at 5°C declined slowly over the 14 days in all three atmospheres.

A comparison of inoculated and control counts at 0°C indicates that inoculation with both organisms, but particularly L. monocytogenes, exerts an inhibition on the natural microflora. The reason for this is currently being examined.

Oral presentation

PASTEURIZATION/COOKED-UNDER-VACUUM SEA PRODUCTS

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There have been numerous attemps to combine thermal preservation techniques with forms of packaging less severe than canning so that the sensory characteristics of the product are maintained. One of these is called "sous vide", being the process of cooking under vacuum. The foods are vacuum packaged and then thermally processed but not sterilised and have a long (weeks) shelflife. The main perceived microbiological hazard lies with sporeforming pathogens especially those of the genus Clostridium, and in particular *C. botulinum* and *C. perfringens*. With fish, there is always the risk that the former may be present. Experiments have been done in which cod fillets ave been vacuum packed and heated for various time-temperature regimes, cooled and stored chilled 4, 8, 12, 15 and 20°C. Packs were inoculated with cocktails of non-proteolytic *C. botulinum* before heating. Uninoculated packs treated similarly served as

controls for organoleptic assessment. In all the work done so far *C. botulinum* has survived and has outgrown at the higher storage temperatures to produced toxin before the products were regarded by expert taste panels as spoiled and inedible. These finds have very serious public health indications. Control of botulism in such products relies solely on proper temperature controlled storage. The data obtained are being submitted for testing in the predictive microbiology model for toxin formation by clostridia to determine firstly if the data fit the model and secondly to obtain predictions of the maximum storage times possible under different temperatures (constant and fluctuating) consistent with public safety.

Poster

COMMERCIAL METHODS OF PASTEURISATION, SURVIVAL OF *CLOSTRIDIUM PERFRINGENS* IN SOUS VIDE FISH PRODUCTS AND SHELFLIFE OF SOUS VIDE FISH PRODUCTS

V.Mulak,
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The main problem with pasteurised cooked foods is the survival and subsequent outgrowth of bacterial spores, particularly those of the anaerobic food poisoning bacteria *Clostridium perfringens* and *Clostridium botulinum.*

The stability and safety of these products depend on the conditions of the pasteurisation process and especially on the subsequent storage temperature of the products.

The aim of the first phase of the study was to determine the safety parameters of replicate samples treated with a mixture of spores of *Clostridium botulinum* and *Clostridium perfringens* and to determine the shelflife by sensory and bacteriological anlaysis of selected uniculated products.

CEVPM carried out the work on *Clostrium perfringens* whilst Torry Research Station performed the work on *Clostridium botulinum.*

Four cooking regimes were tested:
1. Cooking temperature 75°C, core temperature 70°C for 1 min.
2. Cooking temperature 75°C, core temperature 65°C for 1 min.
3. Cooking temperature 65°C, core temperature 65°C for 1 hour.
4. Cooking temperature 80°C, core temperature 80°C for 1 hour.

Bot inoculated and uninoculated samples were stored at 8, 12, 16 and 20°C and tested at regular intervals.

No development of *Clostridium perfringens* was observed in inoculated samples kept at 8 and 12°C. However, development of *Clostridium perfringens* was observed in inoculated samples stored at 16 and 20°C. After four days of storage at 16°C the number of *Clostridium perfringens* was greater than 3.10^6 org/g and the fish were regarded as unacceptable for the taste panel.
After three days of storage at 20°C, the number of *Clostridium perfringens* was greater than 3.10^5 org/g and the fish were regarded as acceptable by the taste panel.

SESSION 3: CHAIRMAN L.HAN-CHING

Oral presentation

THE EFFECTS OF STUNNING AND SLAUGHTER METHODS ON CHANGES IN SKELETAL MUSCLE AND QUALITY OF FARMED FISH

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Biochemical and biophysical observations were undertaken on rainbow trout (*Salmo gairdneri Richardson*) and brown trout (*Salmo trutta*) which had been maintained under conditions which minimised stress. The fish were stunned and killed by electrical stunning and by a sharp blow to the head. Some fish were killed following anaesthesia and asphyxiation without stunning. The initial concentration of ATP was higher in the myotomal muscle of the anaesthetised fish (1.5 ± 0.2 μmol/g for rainbow trout; 2.7 ± 0.2 μmol/g for brown trout) than in that form asphyxiated fish (0.3 ± 0.1 μml/g for rainbow trout; 0.6 ± 0.1 μmol/g for brown trout) and electrically stunned fish (0.6 ± 0.1 μmol/g for rainbow trout and 1.3 ± 0.2 μmol/g for brown trout). Anaesthesia was also associated with higher initial pH values (7.07 ± 0.03 for rainbow trout; 7.09 ± 0.04 for brown trout) than was asphyxiation (6.76 ± 0.02 for rainbow trout; 6.53 ± 0.04 for brown trout) and electrical stunning (6.90 ± 0.02 for rainbow trout; 6.74 ± 0.03 for brown trout).
The rate of onset of rigor mortis was greatest in the asphyxiated fish. Keeping quality indicated by visual assessment was similar in all the groups of fish although the rate of fall in Torrymeter readings was greater in the asphyxiated rainbow trout and the electrically stunned brown trout. The effects of stunning and slaughter methods on the nucleotide degredation profiles and on the production of biogenic amines are being examined.

Poster

COMPARATIVE ASPECTS OF POST MORTEM CHANGES IN SKELETAL MUSCLE OF SOME FISH AND MAMMALIAN SPECIES

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The onset of rigor mortis in skeletal muscle of mammals and fish is accompanied by chemical changes the rate and extent of which are dependent on physiological status at time of death, the death reaction and the temperature of rigor onset. Inadvertent stimulation at time of death, experimental stimulation of muscle in situ, anaesthesia or neuromuscular block influence the rate at which such changes occur post mortem. There appear to be qualitative similarities over a range of species, which include the pig, ox, greyhound, rat, wild salmon, rainbow trout and brown trout, in the pattern of chemical rigor in muscle maintained at 37°C under nitrogen.

Poster

PRACTICAL ASPECTS RELATING TO RETENTION OF QUALITY OF FARMED SALMON AND TROUT IN IRELAND

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1. Pre-harvest:

a) Site selection
b) Withdrawal time in degree days
c) Feed input and lipid content of finished product
d) Starvation of fish prior to harvest.

2. Harvest:

a) Provision of correct facilities
b) Provision of equipment to minimise damage to fish
c) Selection of killing method
d) Bleeding of fish
e) Temperature control of fish
f) Staff expertise
g) Quality control system.

3. Post-harvest:

a) Facility design
b) Staff expertise
c) Temperature control
d) Packaging
e) Quality control system.

4. Carriage:

a) A.T.P. registrated transport
b) Temperature control monitoring
c) Good hygiene practices.

Oral presentation

DEVELOPMENT OF METHODS FOR QUALITY INDEX OF FRESH FISH

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Development of a storage system especially designed for the food fish industry is one of the basic ideas of the FAR-programme UP-2-452 in which the Technological Laboratory, Ministry of Fisheries, Denmark is participating. The other participants are Department of Fish Technology TNO, in the Netherlands, Leatherhead Food Research Association in United Kingdom and Institute of Food Technology in Greece.

The storage system developed is based on evaluation of the effect of time-temperature conditions on raw fish using an objective sensory assessment and on the measurements of physical dimensions of the raw fish.

The present paper describes development of the sensory system to be used as a quality index for raw fish. The technique can be used at any stage, from catching to market place or beyond.

The quality index method is based on the significant sensory parameters for raw fish using as many as 12-16 parameters and a score system from 0 to 3 demerit points, where 0 is best quality. By assessing many parameters no single parameter can unduly imbalance the score. There is a linear correlation between the sensory quality expressed as the sum of demerit scores and storage life on ice, which makes prediction of shelflife possible. The scoring system can be incorporated into a hand-held data terminal to be used as an electronic note book.

The quality index method is non-destructive and species specific. Weighted parameters and standardized question/answers are used and the assessors need minimum of training.

Poster

RAPID QUALITY INDEXING OF COD BASED ON STORAGE AND SHELFLIFE EXPERIMENTS

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Fresh cod (*Gadus morhua*) were obtained two days after catch and placed in chilled storge on ice. At intervals during storage, whole fish were assessed, using a panel of experienced buyers, for sensory attributes (e.g., appearance of eyes, firmness of flesh, odour of gills, etc.). In parallel, cod fillets, derived from the same fish, were cooked and their eating quality assessed by the panellists. Results from the whole fish assessment were expressed as "demerit points" and analysed in combination, using computer software developed by the Danish Ministry of Fisheries, to give a prediction of residual storage life on ice. Results of this sensory appraisal were correlated with the outcome of the eating quality assessment.

Eating quality of the cod was regarded as unacceptable after about 16 days, while the combined demerit score reached a maximum after 17 days. At intermediate storage times, good agreement was obtained between the residual storage life, predicted using the computer software, and the actual subsequent shelf-life observed before the fish became unacceptable. Use of this software in a hand-held computer would allow the rapid assessment of the age and remaining storage life of whole cod.

Poster

QUALITY ASSESSMENT OF PLAICE BY SENSORIAL, CHEMICAL AND PHYSICAL MEASUREMENTS

J.W.van de Vis, J.B.Luten and W.Bouquet
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Plaice is an important fish specie for the Dutch fish industry. For the economics of handling of caught plaice, of stock control and production planning within the industries, it is important to accurately estimate the influence of time, temperature and catch handling on quality of plaice. Therefore an already proven sensorial method for assessment of plaice has to be completed. Also chemical and physical assessment of plaice quality is of interest as this may have advantages over sensorial measurements.

In experimental studies plaice was stored on ice. The sensorial quality changes during storage were determined according to different (EC)-schemes for plaice. Changes in chemical and physical properties of gutted plaice in the course of storage were investigated by measuring ATP-related breakdown products and by measuring changes in the capacitive component of the A.C. resistance of fish tissue by use of a Fish Tester, respectively.

Transformation of data obtained by sensorial analysis to a calibration curve indicated that this curve could be used to express quality of an unknown catch of plaice in days of storage on ice. The results also indicated that an evaluation questionnaire could be obtained suitable for development of a software programme for a handhold instrument. Data obtained from te non-sensorial methods used showed that K-values and Fish Tester values changed in the initial phase and changed linear during storage, respectively.

SESSION 4: CHAIRMAN M.L.NUNES

Oral presentation

HANDLING AND PROCESSING OF HERRING INFECTED WITH ANISAKIS SIMPLEX

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The possible presence and the public health significance of nematode larvae (*Anisakis simplex*) in herring and herring products has been known for a long time. The present work was carried out to investigate, if new and modern fish handling practices on board the fishing vessels caused increased migration of larvae from the fish viscera to the edible part of the fish (the fillet) and if presently applied processing techniques are safe.

It has been found that no migration of nematode larvae takes place in the fish post mortem irrespective of handling and chilling methods applied to the fish. Thus there is no need to introduce new handling procedures on board such as rapid gutting immediately after capture.

Large quantities of herring are processed into marinated herring products. After a period of time, depending on the salt and acid concentration, the nematodes present in the fillets will be killed. The results of this work has shown that present regulations regarding production of marinated herring are insiffucient and longer holding time for products before sale are necessary. In herring products, marinated according to traditional German and Danish procedures, Anisakis larvae may survive up to 5 and 6 weeks, respectively.

Poster

EFFECT OF TEMPERATURE ON SURVIVAL OF ANISAKIS LARVAE IN HERRING AND SAITHE

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In model experiments Anisakis marina L3 larvae from herring were submitted to high temperatures.
The nematodes are killed within one minute at 55°C, within two minutes at 52.5°C and in about seven minutes at 50°C, when heated rapidly.
When heated under practical conditions (in whole herring in a smoking kiln) no surviving nematodes are found when maximum temperatures are reached of 48, 50 and 57°C in 99, 65 and 8 minutes respectively.

In a series of experiments with belly flaps of saithe temperature profiles and survival of (added) Anisakis larvae were estimated.
If core tempertatures of 44-49°C were reached 47% of the nematodes survived.
For core temperatures of 51-54 and 55-58°C the survival was 2.5 and 0% respectively.

In another set of experiments portions of 130-200 g of saithe fillet were heated according to household and commercial recipes as prescribed in cooking books.

After cooking the samples were tested by a trained panel for the terms "raw", "just acceptable" and "cooked". A number of samples ended up in the 51-54°C core temperature range. Although some panel members judged these samples as "raw" in most cases this in fact unsafe fish was evaluated as "just acceptable".

The experiments with herring were performed in the Netherlands, those with saithe in Germany.

Oral presentation

A EUROPEAN INTERCOMPARISON EXERCISE ON THE DETERMINATION OF BIOGENIC AMINES IN HERRING AND TUNA BY 35 LABORATORIES

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Biogenic amines have been defined chemically as aliphatic, alicyclic and heterocyclic organic bases of low molecular weight. They arise as a consequence of metabolic processes in animals, plants and microorganisms. Biogenic amines present in fish do usually not represent any hazard to individuals unless large amounts are ingested.
Incidents of histamine poisoning after eating fish are mainly due to poor quality of the raw material or poor processing. Important biogenic amines are histamine, putrescine, cadaverine, tyramine, spermine and spermidine.
Quality criteria with respect to the presence of histamine in fishery products are now formulated within the EC. Criteria for the other biogenic amines in fishery products can not be ruled out.
Therefore harmonized and validated analytical methods for the determination of biogenic amines in fishery products are essential. The results of a European intercomparison exercise on the determination of biogenic amines in herring and tuna will be presented. Canned samples of fresh herring and tuna spiked appropriate amounts of biogenic amines were analysed by 35 laboratories with different methods (HPLC (pre/post column derivatisation), Continuous Flow Analysis, Ion Exchange Chromatography). Repeatability within each laboratory was good. Reproducibility among laboratories should be improved. Approximately 30% of the participants were able to determine histamine at a level of 25-110 mg/kg accurate and reproducible.
The accuracy and reproducibility of the methods for determination of histamine of 25% of the participating laboratories should be improved strongly.

Poster

HPLC DETERMINATION OF BIOGENIC AMINES IN FISHERY PRODUCTS WITH PRE-COLUMN DERIVATIZATION

J.P.Gouygou, M.Etienne, A.Landrein and P.Durand
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Biogenic amines formed by decarboxylation of amino acids can be considered as a good index for determining the freshness of seafood. Biogenic amines are determined by reversed-phase high pressure liquid chromatography (HPLC) with fluorimetric detection. The method is based on the derivatization of amines with o-phtalaldehyde in the presence of mercaptocthanol which form a strongly fluorescent adduct. The OPA complexes obtained from fish TCA extracts are separated by reversed-phase HPLC under gradient elution conditions. This HPLC method allows the simultaneous analysis of biogenic amines and their quantitative determination in 40 min with detection limit of 2 mg/kg.

Poster

DETERMINATION OF BIOGENIC AMINES IN FISHERY PRODUCTS BY HPLC WITH POST COLUMN DERIVATISATION

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Ministry of Agriculture, Fisheries and Food, Torry Research Station, 135 Abbey Road, Aberdeen AB9 8DG, United Kingdom

Spoilage bacteria present in fish and fish products produce decarboxylases which convert free amino acids present in the tissue into toxic biogenic amines. Histamine has been implicated in episodes of scrombotoxicity and its concentration in fish flesh frequently used as an index of spoilage, particularly pelagic fish, which have relatively high contents of free histidine. However, other amines e.g. tyramine, putrescine and cadaverine are also produced in significant amounts in the later stages of spoilages of fish. The HPLC method described using post-column derivatisation with orthophtaldehyde (OPA) allows these amines to be separated and quantified.

Aqueous trichloroacetic acid extracts of fish after filtration are injected onto a RP-C18 column without further treatment and the amines eluted with a solvent containing an ion pair agent. The fluorogenic reagent OPA is mixed with the column eluant and the isoindole product formed with the amines is detected and measured fluorimetrically. With this method using standard solutions of these amines, linear responses are obtained in the range 0-500 ng per injection

Data on the production of amines in spoiling mackerel (*Scomber scombrus*) and herring (*Clupea harengus*) stored at three different temperatures (+1, +6 and +20°C) are presented. Cold smoked salmon, stored at +1°C either as whole fillets or thinly sliced, has been shown to develop these amines but over a longer period of time.

Poster

DETERMINATION OF BIOGENIC AMINES IN FISHERY PRODUCTS USING ION-EXCHANGE HIGH PERFORMANCE LIQUID CHROMATOGRAPHY

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A quite-old methodology devoted to determination of biogenic amines in cancerology has been adapted to the determination of histamine, putrescine, cadaverine, spermidine and spermine in fishery products, using a Kontron "Chromakon 500" Amino-Acid Analyzer.

Principle:
Cation-exchange chromatography with post-column ninhydrin detection.
Column: 200 x 4 mm filled with 7 µm Kontron "AS70" resin.
Step gradient: two Na^+ containing buffers + NaOH 0.2 N (regeneration).
Extraction: 2 g of homogenized material in 20 ml of a 10% TCA solution. Washing (di-ethylether), evaporation and redissolution in injection buffer.
Sensitivity: from 1 mg/kg (putrescine) to 3.5 mg/kg (histamine).
Advantage: very reliable chromatographic procedure.

Drawbacks: time consuming (100 minutes per run) - extract in TCA has to be evaporated and redissolved. No casy internal standard. Tyramine not eluted.

Poster

MONOCLONAL ANTI HISTAMINE ANTIBODIES

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Seven histamine-protein conjugates were prepared using as coupling agents: 1,4 Benzoquinone, Traut's reagent, SPDP, SMCC, or DSS respectively.
These conjugates were used to immunize mice for raising of monoclonal antibodies (Mab) to histamine. Five Mabs were obtained which appeared forming two groups when they were tested in an inhibition solid-phase EIA. In this assay histamine previously modified by treatment with coupling agents, was allowed to react with a limited amount of the Mab. The remaining free Mab was then detected in an EIA performed with a histamine-protein conjugate (histamine-traut-SPDP-thyroglobuline, histamine-benzoquinone-casein) coated onto the wells of a microtitration plate.
Two Mabs (4C9 and 7E10) were selected in each group. They were able to detect 5-10 ng amount of derivatized histamine and did not react with cadaverine, putrescine and tyramine, after chemical modification by the coupling agents. Then they could be used as powerful tools in an inhibition EIA to detect and quantify histamine in food products.

Oral presentation

AN INVESTIGATION INTO METHODS OF IDENTIFYING SPECIES OF CANNED FISH

I.M.Mackie[1], P.Reece[1] and R.I.Pérez-Martín[2]
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Although the species of tuna and bonito are differentiated commercially and are so named on labels of products to comply with labelling regulations, there are at present no certain methods of differentiating one from another when canned. This is because these species, as a group, are closely related genetically and when the usual electrophoretic methods of differentiating species of fish after heat-processing are applied, the separation profiles obtained are so similar that differentiation and identification of the species are uncertain. Alternative or improved analytical procedures are required to enable to unequivocal identification of the species of canned tuna and bonito. These methods will be of economic assistance within the EC in enabling the enforcement of labelling regulations and the effective application of import tariffs. For this study the whole flesh of seven authenticated species of tuna and bonito albacore (*Thunnus alalunga*), little tunny (*Euthynnus alleteratus*), skipjack tuna (*Katsuwonus pelamis*), bigeye tuna (*Thunnus obesus*), yellowfin tuna (*Thunnus albacares*), bluefin tuna (*Thunnus thynnus*) and bonito (*Sarda sarda*) has been canned under mild, normal and severe conditions of autoclaving. An assessment is being made of the potential of different protein splitting agents in solubilising heat denaturated flesh to give species-specific profiles when separated by electrophoretic or chromatographic techniques. A subsidiary study on the potential value of the fatty acid composition of the lipids for species identification is also being made.

Poster

IDENTIFICATION OF SPECIES IN TUNA CANS

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Although the various species of tuna, bonito and tuna-like fish are differentiated commercially and are named on labels to comply with labelling regulations, there is at present no certain method of differentiating one from another when the flesh is canned.

The aim of this research project is to check several techniques cited at the literature and to develop a methodology for separating, analysing and quantifying species-specific components of the canned flesh for one to use the procedure for the unequivocal identification of the species.

At this poster we describe briefly the preparation of samples of canned flesh from several commercially important species of tuna and bonito and some of the approaches that we are now testing, mainly working with the protein and lipid fractions:

- water soluble fraction of protein
- solubilization of heat-denaturated fish flesh
- use of protein splitting agents
- analysis of proteins of residues by electrophoresis, isoelectric focusing, HPLC, capillary electrophoresis, etc.
- fatty acid composition of phospholipids.

Oral presentation

LACTIC ACID ORGANISMS IN MARINE PRODUCTS

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Lactic acid producing microorganisms are responsible for the preservation of a wide range of foods spread all over the world. Sour milk/yoghurt and cheeses; salami and chorizo; sourdough breads; pickled vegetables and fish-based sauces and pastes are examples.

The current project is assessing the characteristics of the lactic acid bacteria isolated from marine sources for the processing of fresh fish and fish products (mince and surimi). The particular features of marine lactic acid organisms of use include growth at low temperatures, low acid production but production of bacteriocins. Acid preserved fish may be stable without freezing and be preferable to salted or smoked products.

The work has three elements: isolation and selection of organisms, application of selected organisms to fish products and assessment of the effect of the organisms on the functional and sensory properties of the products. This talk will describe the background to the project and progress so far after four months.

Poster

DEFECT DETECTION IN FISH FILLETS BY IMAGE ANALYSIS

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Techniques that use computer-aided image processing for detection, observations and material handling are gaining considerable interest in a wide variety of industries. There are several potential applications of this technique in the fish processing industry that deserve examination.
The advantages of computer-aided imaging include automation, increased process efficiency and improved quality control, resulting in a decrease of production costs and an increase of added value.
One of the important fish processing unit operations is filleting. After filleting the fish is trimmed manually for defects like bones, blood spots, remnants of skin and black membranes and textural faults. The trimming operation is laborious and it is impossible to guarantee fillets free from defects.
It is obvious that automation of grading, selecting and sorting of fish fillets with defects offers the possibility for the fish processing industry to enhance the added value of their products.
IMAGE ANALYSIS for detection of fish fillets defects is expected to be an extremely good tool for automation of grading, selecting and sorting.

The preliminary results of this FAR-UP feasibility study, started recently (January 1992) on the defect detection in fish fillets by image analysis, will be presented.
In the first phase of the project fillets of plaice, dab and flounder from approximately thirty fish processing companies were investigated for defects according to the Codex Alimentaris criteria. It is shown that the presence of blood spots in fish fillets is a serious problem.

Poster

GUIDELINES FOR THE HANDLING OF CHILLED FINFISH BY PRIMARY PROCESSORS

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The guidelines form a complete reference manual concerned with helping primary processors achieve high quality standards that enhance the value and sales of fish.

The guidelines are aimed at primary processors who cut and pack chilled finfish for the wholesale trade.

Bound in a strong cover with easy to clean pages the guidelines specify standards demanded by law and gives practical advice on how to achieve them.

The guidelines inform the processor about the necessity of good practice, assessment, control of freshness and the law. A section on quality management and standards sets out the customers requirements, specification for products and raw materials and details the maintenance of quality through management and QA procedures.

The guidelines cover the design and layout of premises and equipment, construction materials, services, storage facilities and equipment.
The guidelines recommend handling practices from port to factory, fish storage, waste disposal, processing, packaging and delivery.

Finally the guidelines stress the importance of hygiene. Methods of cleaning, disinfection, detergents, personal hygiene and cleaning schedules are discussed.

The guidelines were prepared by an industry panel of experts together with Seafish staff, Environmental Health and Trading Standards Officers in collaboration with Torry Research Station. They are truly industry led standards and are realistic.

Account has been taken of likely proposals from the European Commission, however some detailed aspects of the guidelines may need updating when legislation is finalised.

Poster

ESTIMATION OF REDOX POTENTIAL AND ELECTRIC RESISTANCE IN POST-MORTEM FISH MUSCLE - USEFUL METHODS FOR EVALUATING FRESHNESS?

U. Erikson[1] and B. Johansen[2]
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Redox potentials (E_h) and electric resistances (R) were measured directly in rainbow trout and atlantic salmon muscle just after slaughtering and during subsequent two weeks of storage on ice. The pH in the muscle was recorded simultaneously.
A teflon probe having needle-shaped stainless steel electrodes and a saturated calomel reference electrode was inserted directly in the tissue for recording E_h and R. The resistance value was obtained from AC impedance measurements.

The E_h of well bled, gutted fish was relatively stable at values between + 100 to + 230 mV throughout the storage period. To verify that actually no oxydation of the stainless steel electrodes took place, platinum electrodes were tested simultaneously, showing the same trend but a higher E_h, i.e. + 200 to + 370 mV. The results indicate the fish still being organoleptically acceptable from a bacterial point of view after two weeks on ice.

The resistance values starting at 175 - 225 ohm just after slaughtering, gradually decreased to values 100 - 160 ohm after three to six days. However, the resistance values were not very reproducable when comparing different fishes. Work is still in progress in trying to correlate impedance measurements and the process of rigor mortis.

Poster

BIOGENIC AMINES PROFILE DURING CANNED TUNA AND ANCHOVIES PRODUCTIONS

M.T.Veciana-Nogues, T.Hernandez-Jover, M.C.Vidal-Carou and A.Marine-Font
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Ten biogenic amines (Put, Tyr, Cad, Ser, His, Agm, ß-Phen, Sperm, Tryp and Spermd) were determined during the elaboration process of 9 canned tuna (45 samples) and 4 semi-preserved anchovies (32 samples). All samples of these studies corresponded to real processes within two Spanish industries.

Samples of different phases of canned tuna elaboration showed, in general, a very low concentration (<2μg/g) of the biogenic amines related with fish spoilage (Tyr, Cad, Put, Agm, His). No formation or decrease of these chemical compounds was observed during the 9 elaboration processes studied (including sterilization). Sperm and spermd contents were the highest (4-5 and 10-20 μg/g respectively), but it was observed that they decreased after appertization. For this reason, we considered disputable the application of Mietz and Karmas (1977) formula to evaluate, in canned tuna, the hygienic quality of the raw material.

Biogenic amines of samples corresponding to different steps in the anchovies elaboration showed a great variability and we cannot conclude any formation or decrease of these compounds during the manufacturing process, because we also observed a similar variability in the biogenic amines level found in the raw material used.

Finally, data is presented with respect to comparative study on the biogenic amines level in fresh tuna (n=18), canned tuna (n=12) and semi-preserved anchovies (n=10), all adquired in Spanish market. Results showed that, in general, canned tuna had higher levels of all biogenic amines than fresh tuna (for both kinds of amines, related and non-related with fish spoilage). Likewise, biogenic amines contents in semi-preserved anchovies were higher than those in canned tuna.

Poster

HPLC OF BIOGENIC AMINES: COMPARISON OF PRE- AND POST-COLUMN DERIVATIZATION METHODS

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1-Thiosubstituted 2-alkylisoindoles are formed from primary amines after reaction with o-phtaldialdehyde (OPA) in the presence of 2-mercaptoethanol. Highly sensitive and selective detection of the primary amines following HPLC of the underivatized compounds is effected by post-column derivatization with OPA/3-mercaptorpopionic acid and fluorescence monitoring.

For pre-column derivatization, the stability of the isoindole derivatives of amines and diamines has to be increased substantially. This is achieved by employing nephtalene-2, 3-dicarboxaldehyde (NDA) and potassium cyanide instead of OPA/R-SH. The 2-substituted 1-cyanobenz(f)isoindoles (CBI-derivatives),

obtained upon reaction of NDA/CN with primary amines, are more stable than the respective OPA derivatives and therefore they are excellently suited for pre-column derivatization.
HPLC separation of the CBI-derivatives is achieved on a reversed phase column with gradient elution.
With pre-column derivatization using NDA/CN it becomes feasible to couple diode-array, fluorimetric and electrochemical detectors in series.
Thus, primary amines of interest may be determined unambiguosly.

poster

RELIABILITY OF HPLC METHODS TO DETERMINATION OF FISH-QUALITY CHEMICAL INDICATORS: BIOGENIC AMINES AND ATP-RELATED COMPOUNDS

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The reliability of HPLC method for ten biogenic amines determination in tuna was studied. This method consists of the separation of C_{18} column of ion pairs formed between biogenic amines and octane sulphonic acid, a post-column derivatization with o-phtalaldehyde and 2-mercaptoethanol and spectrofluorometric detection. Sample preparation only includes two extractions with 0.6N PCA. Put, Tyr, Cad, Ser, His, Agm, ß-Phen, Sperm, Tryp, and Spermd can be determined in less than 60 minutes. This method was linear for each amine between 0.25 and 9 mg/l. The average recovery was from 92% to 103%. The precision (CV) ranged between 0,70% and 9.75%. The detection limit was between 0.05 and 0.25 mg/l. The absence of interferences from volatile amines, aminoacids and dipeptides was verified.

A simple HPLC method for ATP and related compounds (ADP, AMP, IMP, inosine and hypoxanthine) in tuna includes the extraction of the sample with 0.6N PCA, followed by neutralization of the extract. The separation is performed on C_{18} column and the detection is by UV-absorption. This method was linear between 0 and 400 mg/l. The average recovery was from 90.5% to 103.8%. The precision (CV) ranged between 6.6% and 20.9%. The detection limit was between 0.017 and 0.18 µmol/g.

All biogenic amines contents in fresh tuna samples (n=19) were less than 2 mg/kg, except for spermine and spermidine (4-5 and 10-20 mg/kg, respectively). Differences between dark and white musculatures (n=34) were only found in spermine contents (higher in dark than in white muscle). In the same samples, ATP, ADP and AMP showed levels less than 0.20 µmol/g, IMP contents were higher than the other ATP related compunds (4-5 µmol/g). Contents of inosine and hypoxanthine were between 0.80 and 3 µmol/g. White musculature showed more IMP, whereas inosine was found in major concentraticn in dark musculature.

Poster

INTEGRATED QUALITY ASSURANCE OF CHILLED FOOD FISH AT SEA, RESULTS AND ITS FUTURE UTILIZATION

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The aim of the project is to significantly improve the quality of fresh fish landed by community vessels and to increase the proportion of the fish caught which is used for food purposes.
This will be achieved by specifying and developing safe, efficient, mechanized, on-board handling systems which will enable the catch to be sorted, characterized for length and weight, prepared quickly and correctly for rapid chilling and stowage in appropriate, labelled containers at 0°C until sold. A monitoring, measuring, container labelling and data storage system will be developed to specify the quality potential yield of the fish to the buyer at the sale by reference to the actual time/temperature history of the fish prior to the sale and to the measurements of length and weight.

In the period a general flow diagram on an integrated quality assurance system which reasonably can be connected to an electronic information system has been set up for white fish handling on a 27 m L.p.p. sterntrawler, and for a flatfish beam trawler. On the beam trawler a general IQAS lay-out include a flatfish gutting machine, a RIVO (Fisheye) vision module or CIVO-LED system for size grading and an automatic icing station. A white fish gutting machine preserving roe and liver undamaged has been finally tested and evaluated. A prototype machine has been developed for transferring white fish from the rotating gutting machine, where fish are hanging on the gills, to hooks on an overhead chain conveyor. A tool for lifting the fish off the hooks has been developed. A bleeding/washing method for fish being transported on the chain conveyor has been investigated. On a rolling chain conveyor Line-Scan length estimation has an STD-% of 4-7% depending on rolling conditions. Weighing by wave-compensated weighing cells of individual fish on a rolling chain conveyor has an STD of 1-2% depending on rolling conditions and conveyor speed. Computer Vision for volume estimation on plaice has an error about 5% using contour analysis. Computer Vision for mass estimation of whiting based on estimates of length and area showed an error of ± 14% and 9% respectively. The same estimates for plaice is 17% and 14% respectively. Batch weighing of flat fish based on volume estimation looks promising and will result in an absolute error of 0.6%. A simple prototype system using LED's for length estimation of flatfish, which is much more accurate than manual grading, has been developed and gives an STD of 0.7 cm.

Storage of plaice in ice + melt water gives a better yield (1½-3%) when the basis for calculation is the weight of catch, but lower yield is obtained when the basis of calculation is the weight just before filleting.

Baseline fish temperature and rate of quality loss for boxed, iced codling has been investigated. The mean core temperature is -0.4°C for fresh-water ice rather than the assumed 0°C. Comparison of bulk containers, where plaice are stored in meltwater, to plaice stored in drained boxes showed that bulk containers are to be preferred to boxes whe stored for more than 6 days.

Preliminary suggestions have been made on process control and data acquisition of parameters necessary for documentation of the landed fish quality and how it can be implemented on a modern beam trawler and a white fish trawler.

Poster

AN IQAS PROCESSING LINE FOR PLAICE ON BOARD DUTCH BEAMTRAWLERS

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Within the framework of the EC Research Programme in the Fisheries Sector (FAR), RIVO and TNO try to significantly improve the quality of fresh fish landed by Dutch beamtrawlers, to increase the proportion of fish caught for food purposes as well as to improve the on board working conditions.

In the first phase of the project some additional operation units have been developed and tested ashore, while since July 1991 further development takes place to implement it on board (1992/1993), resulting in an integrated quality assurance line (IQAS) combined with registration and documentation of every batch of fish. The project is linked to the similar IQAS project for white fish (Denmark, Scotland).

For a succesful implementation cooperation has been sought with Dutch manufacturers and suppliers of fish processing equipment. Above deck it means that the existing line of hand grading conveyors must be extended with an operation unit for semi-automatic plaice sorting and grading, plaice gutting and washing and discharge below deck. In the fish hold the line must be mechanised regarding the stowage of plaice I, II, III, IV and the by-catch in containers, appropriate iced and labelled with catch data, including length and weight. The lay-out and parameters have already been analysed and given in the first phase of the project. The main objectives of the second phase of the project are cooperation and full scale trials on board a beamtrawler.

Poster

GRADING AND QUALITY OF FISH AT SEA

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Systems analyses were carried out as desk studies to identify the most important factors in handling fish from the catching pound to the quayside. Rapid chillng was found to be the key factor to minimise quality loss.

Trials were carried out on a research vessel to test the potential applicability of a "Marel" weight grader to continuously grade haddock. The test showed the weight grading onboard at a rate of 76 fish/min was within the EC regulations for all size grades tested.

A computer vision system was used to estimate the weight of fish by length and area. It showed that the estimation of weight by area had a 50% smaller error than estimating weight by length. The vision system was also used to determine fish species by shape and colour. Experiments showed that demersal pelagic species were sorted with 100% and 98% reliability.

Experiments were carried out to evaluate the effects on the quality of cod stored in traditional ice compared with salt water ice which depresses the melting point. The lower temperature of storage did not have an effect on the organoleptic spoilage until after day 9, when the salt water ice extended shelflife by about 40%.

SESSION 5: CHAIRMAN J.BON

Oral presentation

QUALITY IMPROVEMENT OF FATTY FISH TECHNIQUES FOR GRADING - HANDLING AND PROCESSING

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The aim of this project is to develop a quality assurance system for fatty fish, caught by trawl or purse seiner and then cooled in different ways. The advantages and the disadvantages of different cooling methods are explained. Possible problems are to be solved.

The project started spring 1991, and till now a comparison has been made of the quality of herring caught in trawls and stored in iced boxes, Refrigerated Sea Water (RSW) and Chilled Sea Water (CSW). Furthermore herring caught in trawls and stored in CSW (large containers) and iced boxes have been compared with regard to the quality. Finally, on one particular trip a comparison has been made of the quality of herring caught in a purse sein and stored in CSW and iced boxes.
So far the results obtained show that RSW chilling of the examined trawler appears to be quick and effective. This is also true in the case of the purse seiner. In connection with CSW chilling in a container, an inexpedient construction of the container has been established. Furthermore, the filling method may result in the formation of warm areas at the bottom of the container so that the chilling is not homogeneous. In other parts of the container the chilling is quick and effective.

A number of alterations to the construction of the container have been made to give it a more appropriate appearance. Furthermore, a dosing system has been developed to ensure correct dosing of ice and fish when the container is filled.

The comparison of advantages and disadvantages of the three different chilling systems reveals that chilling is quickest and most effective in RSW-tanks, followed by the CSW-container and at last the iced boxes. The storage temperature is lowest in RSW-chilling (-1.5°C), followed by CSW-chilling (+1°C to -0.5°C) and highest in the iced boxes (1.5°C to 3°C). The temperatures are the same all over the investigated RSW-tanks, whereas they vary in CSW and iced boxes.

RSW and CSW treated herring are better protected against oxidative rancidification than herring iced in boxes (the TBA-amount is three times as high in iced boxes than in RSW and CSW). The salt content in RSW herring is, approx. 35 hours after being caught, twice as high as in CSW and herring iced in boxes (actually there has been a solt absorption in the RSW treatment).

The colour saturation is a little lower in herring iced in boxes and CSW storage compared to RSW (meaning that fillets from herring iced in boxes and CSW are a little more grey). There are no differences in the texture between herring from RSW, CSW or iced in boxes, measured approx. 35 hours after being caught.

With a background in the work carried out up till now, future effects will be concentrated on the following areas: Continuation of the investigations carried out up till now, including specifications of deck arrangements for the different catch handling methods. Explanation of a possible coherence between influence by the weather and the quality of fish. Development of a method for registration and documentation of the quality of the fish, either by means of a "quality parameter" or by indication of the registration progress.

Poster

IMPROVEMENT OF SARDINE HANDLING AND PRESERVATION TECHNIQUES IN PORTUGAL

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About 58% of total landings in Portuguese ports are small pelagics and within these species sardine (*Sardina pilchardus*) is the most important.
This species is relatively fragile and on account of this its quality is influenced by handling and preservation on board and also by the conditions of manual landing in fishing ports. This paper deals with a short characterization of sardine fishery in Portugal and also with the way of handling, preservation and manual landing of this species.

APPENDIX II

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UPGRADING AND UTILIZATION OF FISHERY PRODUCTS
12-14 MAY 1992
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