SEA FISH INDUSTRY AUTHORITY
Industrial Development Unit

STORAGE TRIALS OF VACUUM PACKED WHITE FISH

Internal Report No. 1277

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SUMMARY

The effects of vacuum packing on the chilled storage of white fish have been investigated together with a simple packing method using valved pouches.

Starting with very fresh fish the useful storage life of the packs held at iced temperatures was found to be similar to that expected for well iced unpackaged fish. The packaging method was found to be convenient and effective.

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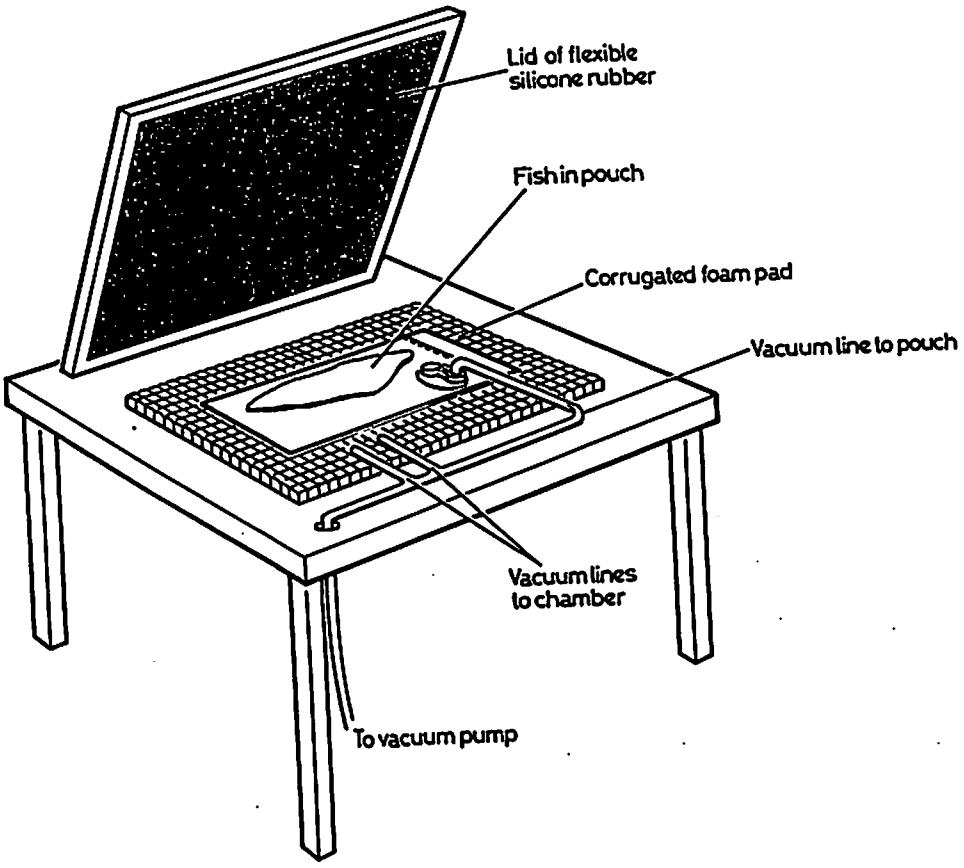
1. INTRODUCTION

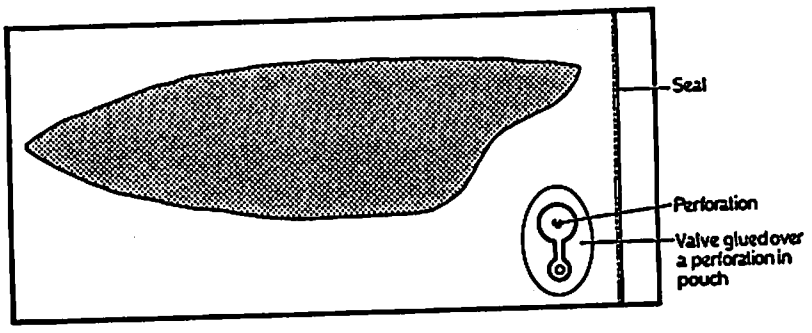
Vacuum packing of chilled fish offers the advantages of presenting fish with no smell or drip. The packs themselves are less bulky than CAP packs, but costs are slightly higher than for overwrap packs. Claims have been made that the technique can extend shelf-life and it is used extensively for smoked oily fish where the exclusion of air inhibits the development of oxidative rancidity. The evidence for extending the shelf-life of white fish is less clear and few companies have sold white fish in vacuum packs.

A large catering supply company was interested in the application of vacuum packing for the distribution of its chilled fish and sought advice on the evaluation of the technique. The company arranged the fish and facilities required and supervised the distribution of the packs. IDU staff carried out assessments of the packs and tasted the fish.

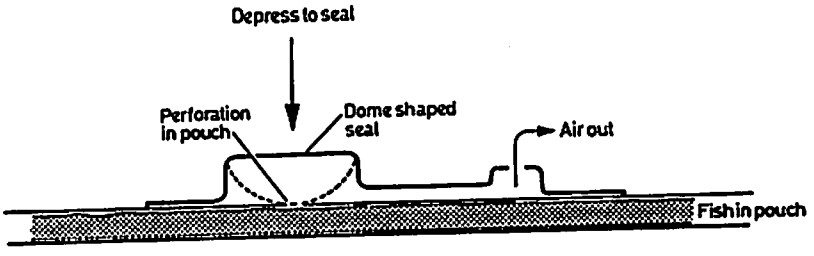
In addition to the storage trials, a prototype vacuum packing technique was evaluated. The principle was very simple requiring only basic equipment and a valved pouch. Advantages of the technique include reduced capital investment in machinery and also that size of pack need not be limited, a restriction applying to currently available vacuum packing machines. The prototype machine and the valved pouches were supplied by FGL Projects Ltd., a development organisation.



Fish in pouch before lowering lid to form vacuum chamber Diagram 1.



Cod Fillet in Valved Pouch Diagram 2



Side View of Valve to Show Perforation of Seal Diagram 3

2. OBJECTIVES

1. To evaluate the effectiveness of vacuum packing for chill-stored white fish.

2. To investigate a simple vacuum packing technique.

3. PROCEDURE

3.1 Raw Material

Fresh cod and plaice, still in rigor, were purchased from Grimsby overland market. The cod were filleted but the plaice were kept whole.

3.2 Packing

The fish were carefully placed inside a valved pouch which was then evacuated and sealed according to the following procedure.

1. The opening of the bag was heat-sealed with an ordinary bar-sealer.

2. The pouch was laid on the corrugated foam rubber of the vacuum machine (see diagram 1).

3. A vacuum line was attached to the outlet of the valve (see Diagram 2).

4. The flexible lid was lowered creating a vacuum chamber.

5. A vacuum was applied to both the pouch and the vacuum chamber, thus air was expelled from the pouch by direct suction, plus by pressure from the flexible silicone rubber membrane.

6. The domed top of the larger chamber of the valve was depressed to form a seal (see diagram 3).

3.3 **Treatments**

Different combinations of the following treatments were tried by the catering company:

1. Blotted - surface moisture was removed with an absorbent pad.

2. Pad - a backing pad of silver foil on cardboard was included in the pouch (as used for smoked salmon).

3. CO_2 - the packs were flushed with carbon dioxide at packing.

4. Heated - the packs were immersed in water at 80°C for exactly 15 seconds prior to chilling. The intention was to pasteurise the surface of the fish to reduce bacterial load.

The codes were as follows:

A. Blotted, packed, chilled then stored at IDU.

B. Blotted, packed, chilled then distributed.

C. Packed, chilled then stored at IDU.

D. Packed, chilled then distributed.

E. Blotted, flushed with CO_2, packed, chilled then distributed.

F. Packed with backing pad, given heat treatment, chilled then distributed.

G. Blotted, packed, given heat treatment, chilled, then distributed.

After treatment all packs were chilled by immersing in a brine solution at between -3°C and -5°C. The chilled packs were then iced top and bottom in plastic boxes and either distributed or kept in a temperature controlled cabinet at IDU. The distributed packs were sent by

commercial transport to a central depot for storage in ice from where the de-iced packs were sent to hotels and also to IDU for assessment. Unfortunately no temperature record was obtained for these packs as the data logger used by the catering company did not work. The control packs were kept at $-1.5^{o}C$ at the IDU.

3.4 Assessment of Packs

Cod packs were assessed after 2,5,7,9 and 10 days and the plaice after 3,6,8,10 and 13 days.

Each species was assessed separately but the samples were presented at random so the panel did not know the treatment of any pack.

3.4.1 Pack Appearance

Each pack was examined to check that the seal was unbroken and that the pack had not blown. The quantity of drip visible in the pack was assessed as follows:

Drip Quantity	Score
None	1
Negligible	2
Detectable	3
Some	4

Comments were made on any unusual features, e.g. bruising, excessive squashing, exuding of flesh etc.

3.4.2 Pack Odour

The odour detectable on opening the pack was described by a panel of 3 assessors. A numerical scheme was developed to categorise odours depending on type:

Odour Type	Score
Fresh, characteristic	7
Sweet, creamy, shellfish	5
Stale, rancid, oily, faecal	3
Sulphides, sour, fruity, faecal	1

Interpolation of scores was necessary when mixtures of odours occurred, for example a pack with stale and shellfish odours would have scored 4.

An odour of plastic/cardboard occurred with some packs containing a backing pad and this was noted.

3.4.3 Cooked Fish

Samples from each pack were steamed and tasted by 2 trained plus 1 untrained assessors using the Torry System. Any unusual flavours or textures were noted.

4. RESULTS

4.1 Pack Appearance

Defective seals did not occur until after 8 to 10 days storage, out of 41 cod packs there were 3 defective seals and out of 48 plaice packs there was 1 defective seal.

Drip was not a problem in any of the treatments although there was slightly more drip with the plaice than the cod.

No other significant features were noticed in pack appearance.

4.2 Pack Odour

Changes in pack odour scores are given in Figures 1. Storage times to scores 5, 4 and 3 are given in Table 1.

TABLE 1

STORAGE TIMES TO REACH DEFINED PACK ODOUR SCORES

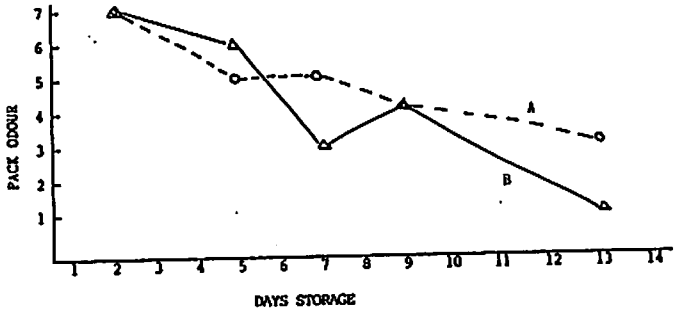
Treatment	Cod			Plaice		
	Days to reach Pack Odour Score			Days to reach Pack Odour Score		
	5	4	3	5	4	3
A	6	9	12	8	9	10
B	5	7	9	8	9	11
C	8	10	12	6	7	8
D	6	8	10	5	7	8
E	7	9	11	5	8	10
F	6	8	10	5	7	9
G	6	8	10	7	9	10

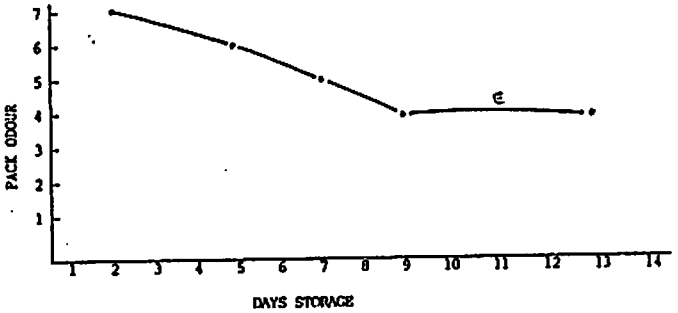
There were no consistent differences in pack odours, or trends related to treatment.

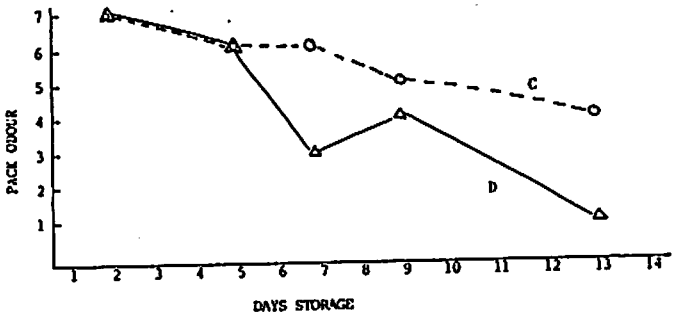
Pack odours generally became unpleasant after about 8 days storage.

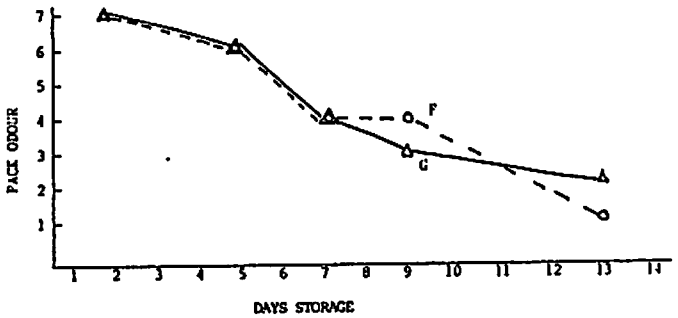
FIGURE 1

COD

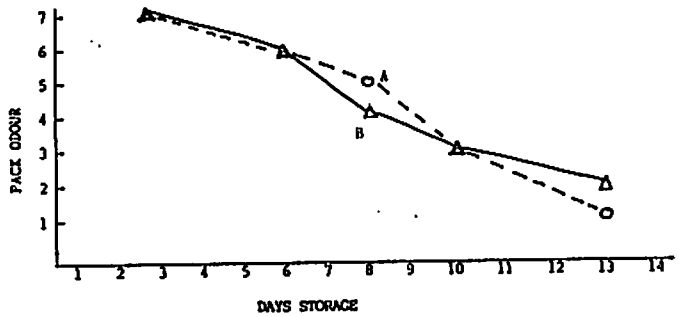


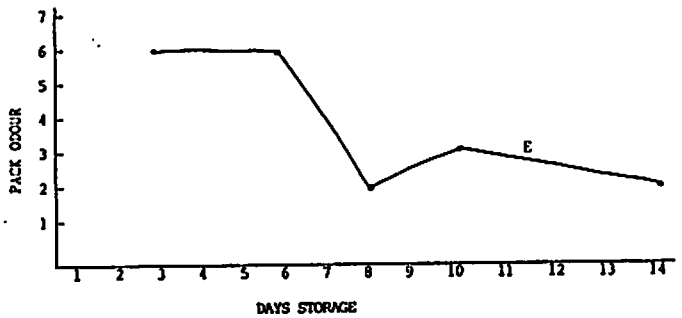


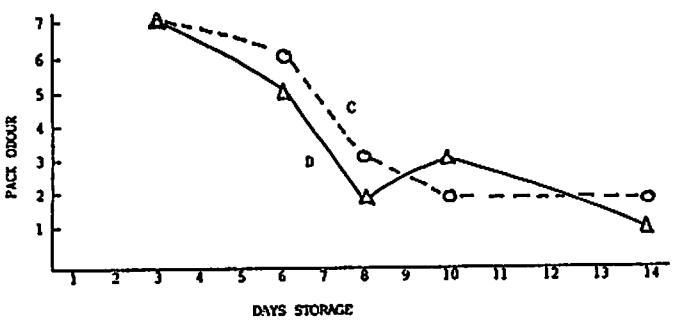




PLAICE







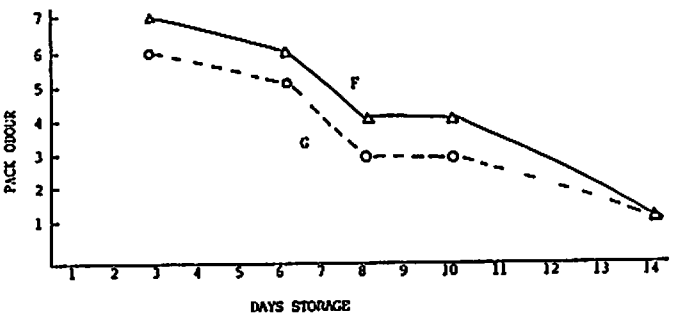
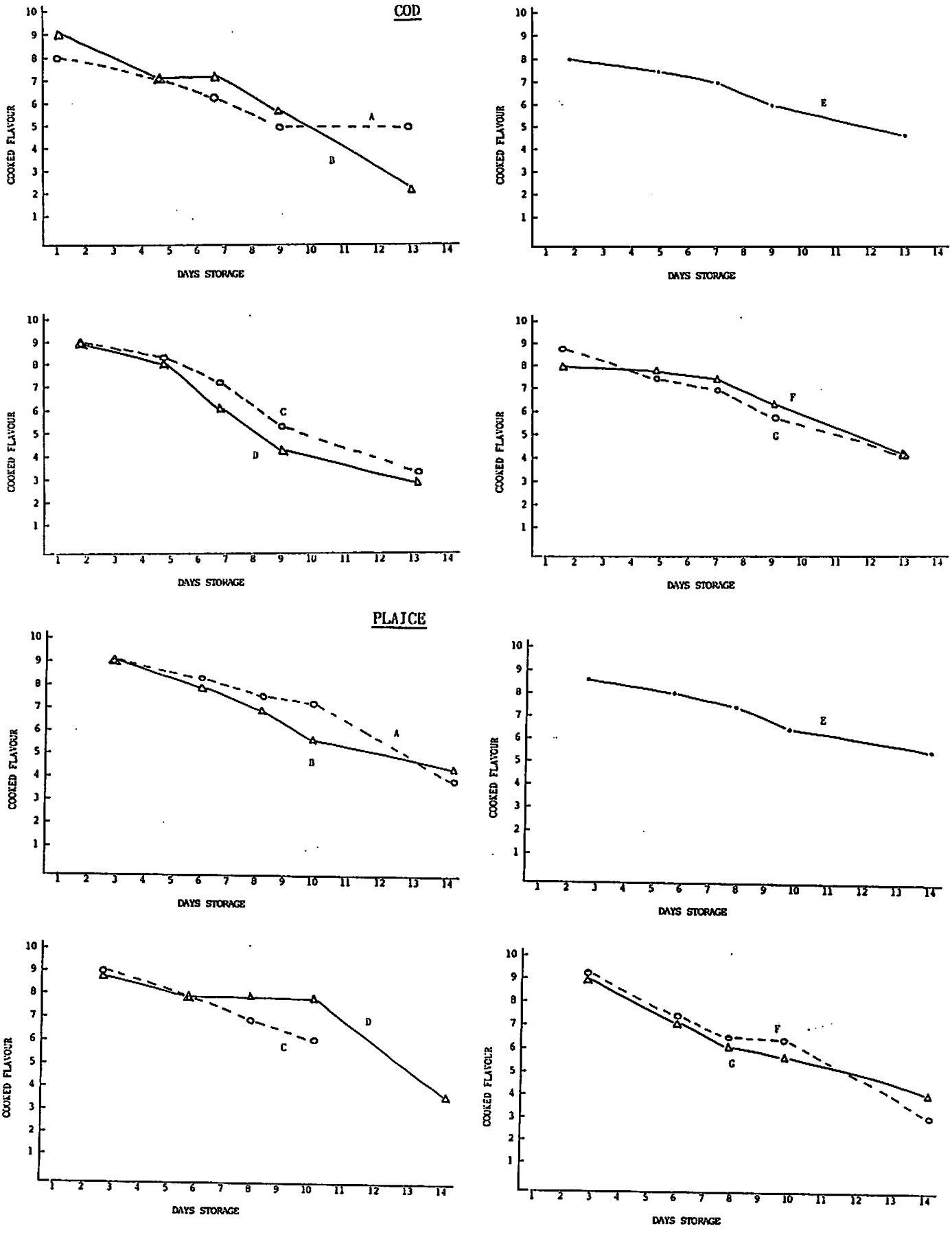


FIGURE 2



4.3 Cooked Flavour

Changes in cooked flavour scores are given in Figure 2. Storage times to reach cooked flavour scores 7, 6 and 5 are given in Table 2. Results obtained for fish in overwraps on previous trials (Technical Report 191) are included for comparison.

TABLE 2

STORAGE TIMES TO REACH DEFINED COOKED FLAVOUR SCORES

Treatment	Cod			Plaice		
	Days to reach Cooked Flavour Score			Days to reach Cooked Flavour Score		
	7	6	5	7	6	5
A	5	7	9	8	10	11
B	5	7	9	7	8	10
C	7	8	9	7	9	11
D	6	7	8	8	10	12
E	6	8	10	8	10	12
F	7	9	10	6	9	11
G	6	8	9	6	9	11
Overwraps	5	7	9	4	7	11

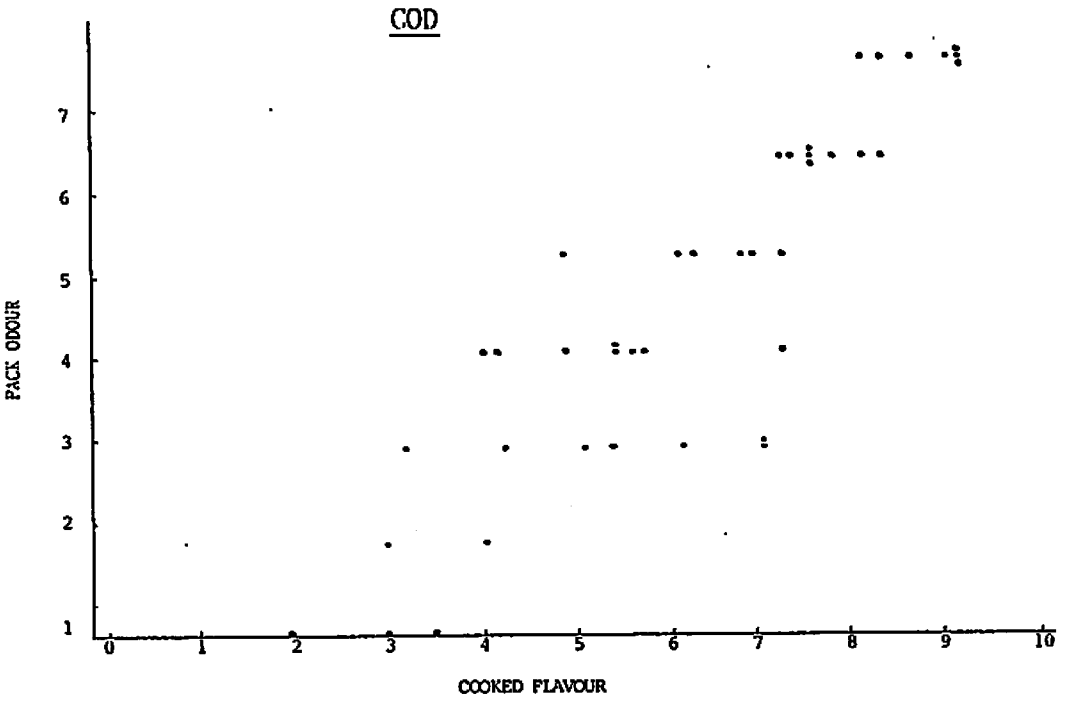
There was no major difference between treatments. It is interesting that the vacuum packed plaice spoiled less rapidly down to a cooked flavour score of 6 than did the plaice in overwraps, but there may have been differences in the intrinsic condition of the fish in the previous trials.

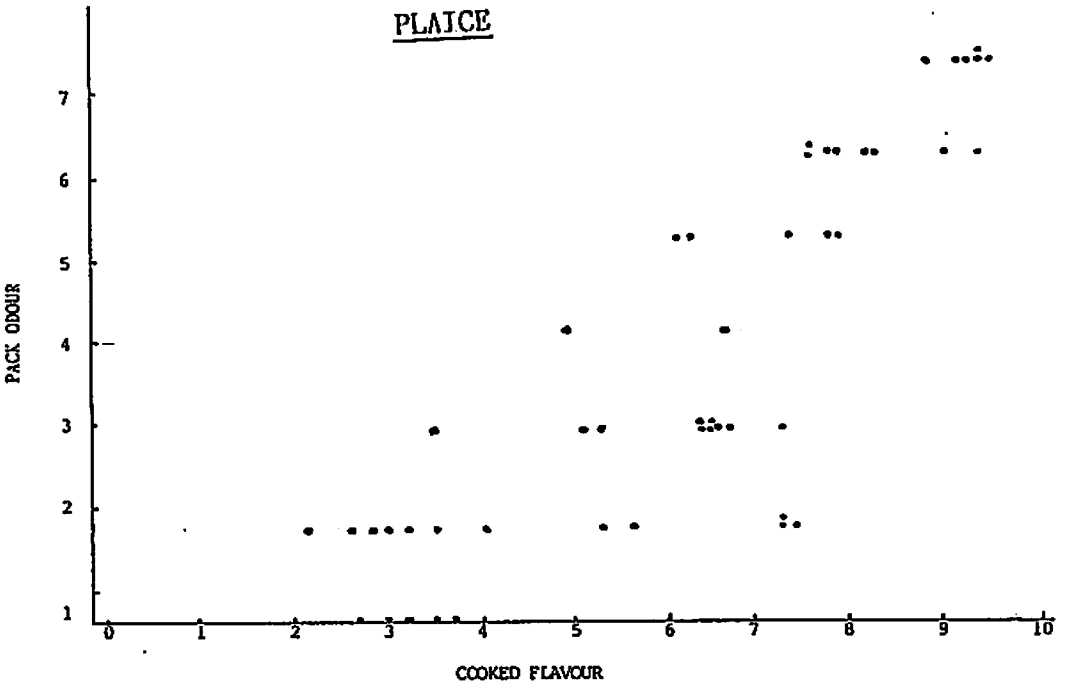
A slight difference in rate of spoilage was noticed between the species with the plaice spoiling slightly less rapidly than the cod.

4.4 Other Factors

Occasionally unusual features in odour flavours or texture were detected, but were not consistent within a treatment and so were accounted for by natural intrinsic variation.

FIGURE 3


COD
PACK ODOUR
1
2
3
4
5
6
7
0
1
2
3
4
5
6
7
8
9
10
COOKED FLAVOUR


PLAICE
PACK ODOUR
1
2
3
4
5
6
7
0
1
2
3
4
5
6
7
8
9
10
COOKED FLAVOUR

4.5 Comparison of Pack Odour and Cooked Flavour

Figure 3 correlates pack odour and cooked flavour scores for each pack. A pack odour score of 4 corresponded to a cooked flavour score of 6 for plaice and 5.5 for cod.

5. CONCLUSIONS

5.1 Very fresh vacuum packed cod can be stored in chill conditions for up to 8 days before sour flavours develop, whole plaice can be stored for up to 10 days. Similar storage lives could be expected for well iced unpackaged fish.

5.2 Vacuum packing did not cause any serious detrimental effects on the odour, flavour or texture of the fish. Any unusual features that did occur were attributable to natural variation in the fish.

5.3 A prototype vacuum packing technique using valved pouches and simple equipment worked well. Only 4 out of 89 packs leaked, and 3 of these were after 10 days storage.

5.4 Drip was not a major problem with the packs and pre-drying the fish had a negligible effect. The backing pad used gave a noticeable plastic/cardboard type odour and was unsuitable for the purpose.

5.5 A rapid heat treatment of the fish packs intended to pasteurise the surface of the fish did not have a noticeable effect on extending storage life.

5.6 Pack odour scores correlated well with cooked flavour scores and the simple numerical scheme derived for pack odour could be used as a predictor of eating quality of the fish.

6. ADDENDUM

Since these trials were carried out the catering company has been supplying a range of vacuum packed species and products to hotels.

A shelf-life of 4 days from the date of packing was given. Although the extra costs incurred as a result of this method of packaging did produce some adverse comments, the general reaction from the hotels to the technique was favourable because of the high fish quality and ease of handling.

A modified version of the valved pouch is now commercially available (November 1988).