Developing case ready retail and bulk catering pack for seafood using modified atmosphere packaging (MAP) technology

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SEAFOOD SERVICES AUSTRALIA

KAILIS BROS

Developing case ready retail and bulk catering pack for seafood using modified atmosphere packaging (MAP) technology

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Canning Vale, Western Australia

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2001/402: Developing case ready retail and bulk catering pack for seafood using modified atmosphere packaging (MAP) technology

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MAP SEAFOOD PRELIMINARY REPORT

MAP TRIAL 2 (RAW DATA)

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OBJECTIVES:

1. Assess raw material product quality to ensure viability from harvest onward

2. Establish procedures for hygienic handling, processing methods and distribution necessary for commercial success. Process controls and process specifications will be determined for the whole chain from boat to consumer.

3. Determine the relationship between gas/volume/mixtures/different seafood species with respect to shelf life, sensory quality, and commercial viability

4. Evaluate packaging equipment, packaging trays and films

5. Determine the market opportunities both domestic and export centred around the economics of producing MAP case ready and bulk catering packs bearing in mind the cost structures for raw material, processing and handling.

NON – TECHNICAL SUMMARY

OUTCOMES ACHIEVED

The fundamental outcome of this project was the production of potentially affordable case ready fresh and value added seafood for domestic retail outlets using modified atmosphere packaging. This was briefly demonstrated indicated by a steady level of sales of MAP products at local retail outlets.

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Background:

This project was to develop case ready retail and bulk - catering packs for seafood using modified atmosphere packaging (MAP). The purpose of using MAP technology was to extend product shelf life and reduce the amount of additives used in seafood.

The project focussed on determining initial fish quality for MAP process and initial chemical treatments to lower microbiological loads on raw materials used, the evaluation of various species in at least one gas mixture against controls and also to determine programs for further evaluation

Need:

As one of the leading seafood processor in Western Australia we have a need to position our company to be proactive during this major change in packaging fresh seafood.

Seafood is one of the last fresh protein items to be packaged in a MAP format for retail supermarket sale. Retailers have seen significant changes and growth in the presentation of red meat and poultry in the MAP format and are keen to see seafood processors develop the MAP technology.

There has been very little research done on the effect of MAP on Australian seafood species, in particular West Australian species, and more work is required to effect commercialisation of this project. There is also a need to develop bulk packs for domestic and potential export markets.

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Methods:

The aim of this project was to achieve a 40% increase in shelf life from 2 to 3 days to 5 days and be commercially viable, with the focus on improved quality throughout the entire extent of shelf life.

There were a series of trials conducted on a number of Western Australian fin fish species. The species used for the first set of trials were Big Eye *(Thunnus obesus)* Fillets, Blue Spot Emperor (*Lethrinus punctulatus*) fillets, Catfish (*Ariusi*) fillets, Silver Whiting (*Sillago schomburgkii*) fillets.

The second set of trials was conducted to evaluate the influence of chemical washing treatments on initial counts. The species used for the second set of trials were, Scarlet Perch, Red Snapper and Blue Spot Emperor. The fillets were then placed into clean plastic lugs to drip dry, before they were sent out for laboratory analysis. A series of trials were also conducted to determine the appropriate gas combinations and volumes to optimise MAP conditions. These samples were subjected to in-house sensory evaluation (appearance, odour and texture).

HACCP principles were followed throughout the process from receiving whole fish through to processing, storage, packing and distributing. Well-established HACCP plans were incorporated into the trials.

The Pratica, manufactured by Tecnovac – Confezionatrici Packaging Machine (Distributed by Emrich Industries) was used for this project.

Results and discussion:

The total plate counts for the species in the trials on Day 5 increased as expected. However, the bacteria counts for Scarlet Perch and Red Snapper was within 10^4 CFU / g (19000 and 98000 respectively). Although the Blue Spot Emperor fillets indicated considerably high total plate counts, it was within 10^5 CFU / g, which was a level achievable for the maximum limit at the end of shelf life. There was no significant reduction in the pH of the fillets. Readings were as low as 5.69 and up to 6.46.

Sensory assessment highlighted a clear distinction between the MAP product and controls. All MAP packs were in good condition by day 7, but by contrast 2/5 control samples were ‘off’. There was only one species that was not visually appealing at day 7.

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Conclusion:

Out of all the species in the series of trials, Blue Spot Emperor (*Lethrinus punctulatus*) was the best species of fish to use for MAP. The fillets retained its moisture, microbiological activity and general appearance, which made it the most suitable fish species for MAP technology.

Keywords: Modified atmosphere packaging, seafood production, gas mixtures, product safety, shelf life

ACKNOWLEDMENTS

Sincere thanks and appreciation is due to all Kailis Bros staff members (current and former) who have been engaged on the project, and contributed towards the completion of this project.

Sam Naomis (former project manager) initiated the project with the active cooperation of Wendy Ng. The project continued to progress with the dedication of Katja Lozic; Geordie Buscombe and Nick Beeley. Supporting staff members Christian White, Debbie Coutts; Lin Cui Yun; Judy Nightingale, Awhina Evans and Robert William Cody are also acknowledged for their efforts towards the project.

Jane Graham and the project coordinators from FRDC; have been most cooperative with Kailis Bros during the process of the project through their valuable guidance in the preparation and execution of this project.

Thanks to Allen Bremner; our project report reviewer from Allen Bremner and Associates. Allen contributed through his thorough review of the project report.

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BACKGROUND

This project was to develop case ready retail and bulk - catering packs for seafood using modified atmosphere packaging (MAP). The purpose of using MAP technology was to extend product shelf life and reduce the amount of additives used in seafood.

Consumers are becoming more selective with their choice of products. Therefore the demand for fresh, portion - controlled value added seafood products are increasing.

Modified atmosphere packaging offers the potential to satisfy the increasing demand of consumers and is rapidly spreading throughout Europe and overseas. It also offers flexible packaging, the convenience of purchasing smaller portions, protection of the product, less dehydration and avoidance of rancidity.

The project focussed on determining initial fish quality for MAP process and initial chemical treatments to lower microbiological loads on raw materials used the evaluation of various species in at least one gas mixture against controls and also to determine programs for further evaluation.

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NEED

As one of the leading seafood processor in Western Australia Kailis Bros have a need to position our company to be proactive during this major change in packaging fresh seafood.

Seafood is one of the last fresh protein items to be packaged in a MAP format for retail supermarket sale. Retailers have seen significant changes and growth in the presentation of red meat and poultry in the MAP format and are keen to see seafood processors develop the MAP technology.

In the UK for instance, 80% of case-ready seafood for retail supermarkets is presented in the MAP format, which has been available since the mid 80's. MAP of seafood in Australia is still in its infancy and to our knowledge there are only 2 seafood companies on the eastern seaboard producing MAP seafood for retailers.

There has been very little research done on the effect of MAP on Australian seafood species, in particular West Australian species, and more work is required to effect commercialisation of this project. There is also a need to develop bulk packs for domestic and potential export markets.

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OBJECTIVES

1. Assess raw material product quality to ensure viability from harvest onward

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5. Determine the market opportunities both domestic and export centred around the economics of producing MAP case ready and bulk catering packs bearing in mind the cost structures for raw material, processing and handling.

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METHODS

The aim of this project was to achieve a 40% increase in shelf life from 2 to 3 days to 5 days and be commercially attractive, with the focus on improved quality throughout the entire extent of shelf life.

The species used for the first set of trials were Big Eye *(Thunnus obesus)* Fillets, Blue Spot Emperor (*Lethrinus punctulatus*) fillets, Catfish (*Ariusi*) fillets, Silver Whiting (*Sillago schomburgkii*) fillets. These fillets were used as controls. Two samples of each type of fillets were taken from the filleting line, without any further processing or sanitisation steps. These samples (controls) were sent to the laboratory for microbiological analysis (Total plate counts and pseudomonas).

Much of the fish is caught at sea and held on ice for a few days before landing. To determine the range of quality (measured as bacteria counts) likely to be delivered, the fishermen were asked to tag fish with the day of catch. The samples tested were tagged day 1 (last day of catch), and day 5 (1st day of the catch). These tagged fish were filleted and the fillets sent for microbiological testing.

The second set of trials was conducted to evaluate the influence of chemical washing treatments on initial counts. The species used for the second set of trials were, Scarlet Perch, Red Snapper and Blue Spot Emperor. The fillets were washed in a vortexx - hydrogen peroxide solution (30 ppm) and cirtrofresh - citric acid solution before sending for testing. The fish fillets were washed for 30 seconds. The fillets were then placed into clean plastic lugs to drip dry, before they were sent out for laboratory analysis.

A venturi - dosing system (Dema 294CT venturi injection block) was used to dispense the vortexx solution. The dosing is controlled via a 'venturi', which creates a vacuum as the water supply moves along it, allowing chemical to be drawn up into the flow stream. The amount of chemical dose is controlled by using different sized nibs, the

larger the hole, the more the chemical dosed. For Vortexx the smallest nib possible (a tan coloured nib, 30 ppm) was used. The dispensed solution was transformed into ice slurry (100 L water + 250 g Butcher's Salt and 10Kg of Ice). This slurry was used as a "dipping" stage for the fillets. It also kept the temperature of the product low during the dipping process.

A series of trials were conducted to determine the appropriate gas combinations and volumes to optimise MAP conditions. Four out of the five target species, Trevally silver *(Pseudocaranx dentex)* fillets, Red Emperor (*Lutjanus sebae*) fillets, Blue Spot Emperor (*Lethrinus punctulatus*) fillets, and Scarlet Perch *(Lutjanus malabaricus)* fillets were prepared as mentioned above. Fresh fillets were washed in vortex. Fillets were wrapped in plastic and stored in the fridge (controls). These fillets were packed with the Tecnovac machine (Modified atmosphere packaging machine). The gas mixture used was 30% Oxygen (O_2), 40% Carbon dioxide (CO_2), and 30% Nitrogen (N_2). All samples were stored between 0 – 4^0 Celsius prior to microbiological analysis. These samples were subjected to in-house sensory evaluation (appearance, odour and texture). Microbiological analysis was conducted on Day 2, Day 5 and Day 8 (Total Plate counts).

Some MAP products were analysed by BOC gases for CO_2 content to compare with the target of 40% applied to the mixture.

A Novatech 1637 oxygen and carbon dioxide analyser was hired from Tech-rentals. Experiments were carried out to establish the operating characteristics of the machine and test a number of combinations of settings on the Tecnovac without product in the trays. This was done to establish a base data (control). Two further experiments were carried out with product.

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Experiment 2A was conducted with gas mixture 75% CO_2, 25% N_2. The vacuum & gas settings were 40% and 50%, 210 g of fish fillets were packed per tray (approx 1:3 product - gas ratio by volume).

Experiment 2B was conducted with gas mixture 40% CO_2, 30% O_2, 30% N_2. The vacuum & gas setting was 70% and 210 g of fish fillets were packed per tray.

These trials combined the use of the gas monitor with product evaluation over 11 days for both experimental product and controls (Experiment 3). A novel gas mix of 60% CO_2, 20% N_2, 20% O_2 was obtained from BOC. For this experiment both the trial product and controls were packed in trays. The controls were sealed without applying a vacuum. Species used for the above trials were Blue Spot Emperor (*Lethrinus punctulatus*) fillets, Scarlet Perch *(Lutjanus malabaricus)* fillets, Red Snapper (*Lutjanus erythropterus*) fillets, Travelly silver *(Pseudocaranx dentex)* fillets, and Silver Cobbler (*Arius midgleyi*) fillets.

Microbiological analyses (TPC), and sensory evaluation (in – house) were also conducted on the above samples. There were another two sets of gas trials carried out (Experiment 4, and 5) with a reduced vacuum of 50%.

Shelf life trials were conducted on the following samples, Blue Spot Emperor, Red Emperor, Shark, Scarlet Perch, Barramundi Fillets and Cobbler Fillets. Microbiological analysis (TPC) was conducted on day 1, 2, 4 and 5.

Further trials such as shelf life analysis, sensory evaluation on the following value added products Chilli fish balls, Chilli fish cakes, Oriental Marinated Fish fillets, Salmon Patties, Garlic King Prawns, Greek style garlic prawns, Thai Style Marinated Salmon, Teriyaki Squid Rings, cooked prawns and Chilli Stuffed Squid tubes.

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These products were developed during this project. Work procedures, handling, hygiene practices and optimum storage requirements were established for the above - mentioned products. Both microbiological and sensory evaluations have been conducted on the range of value added products prior to commercial trials.

HACCP principles were followed through out the process from receiving whole fish through to processing, storage, packing and distributing. Well-established HACCP plans were incorporated into the trials.

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MATERIALS

Equipment and packaging used

Four different types of MAP sealing machines were considered. The equipment considered were as follows:

1. **PRATICA**
   Manufacturer: Tecnovac Confezionatrici Packaging Machines
   Dimensions of moulds 260 x 350 x 100 mm, Dimensions 730 x 730 x 600 mm.

2. **QUICK 40m ^{3} /h**
   Manufacturer: Tecnovac Confezionatrici Packaging Machines
   Dimensions of moulds max: 350 x 290 x 100 mm.
   Dimensions 520 x 770 x 1145 mm.

3. **POCKET ST 60 m^3 /h**
   Manufacturer: Tecnovac Confezionatrici Packaging Machines
   Dimensions of moulds max: 268x379x110 mm.
   Dimensions: 1300 x 1000 x 1530 mm.

4. **LINVAC 100 m^3 /h**
   Manufacturer: Tecnovac Confezionatrici Packaging Machines
   Dimensions: 3000x850/1050X1800 mm. Dimension 520x770x1145mm.

The Pratica, manufactured by Tecnovac – Confezionatrici Packaging Machine (Distributed by Emrich Industries) has been used for MAP. A limitation with the Pratica was that it only allowed a 1:1 ratio of vacuum to gas mixture. This limits the machine to only a certain proportion of gas mixture. The second limitation of the machine was the long time taken to draw vacuum.

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Laminated Barrier Trays (Black) manufactured and distributed by Drypac Pty Ltd were used as packaging materials. Fish fillets were placed into black laminated trays (7" x 5" x 50mm and 7" x 5" x 40mm) 700 Micron "High Impact Polystyrene – Styron Grade", with moisture absorbent pads on the base of trays and clear flim was used to cover and seal trays.

Huhtamaki – Packaging World wide was another packaging manufacturer was considered at the time for MAP packaging. These trays were also barrier laminated polystyrene case ready trays suitable for heat sealing and vacuum machines.

All of the above materials comply with food grade contact Australian Standards AS2070. Gas mixtures used (premix of 40% CO_2, 30% O_2 and 30% N_2) were from BOC gas.

A Novatech 1637 oxygen and carbon dioxide analyser was hired from Tech-rentals to monitor the oxygen and carbon dioxide levels.

RESULTS AND DISCUSSION

First set of trials: Trial 1

Fillets of different fish were removed from the processing line and two samples taken for total plate count and pseudomonas. The total plate counts (TPC) of colony forming units (CFU) per gram for the Big Eye *(Thunnus obesus)* fillets were less than 22 000 CFU/g. Blue Spot Emperor *(Lethrinus punctulatus)*, Catfish *(Ariusi)* and one of the Silver Whiting (*Sillago schomburgkii*) fillets TPC were considerably low. All of the samples tested for Pseudomonas were within the limits of FSANZ (all <100).

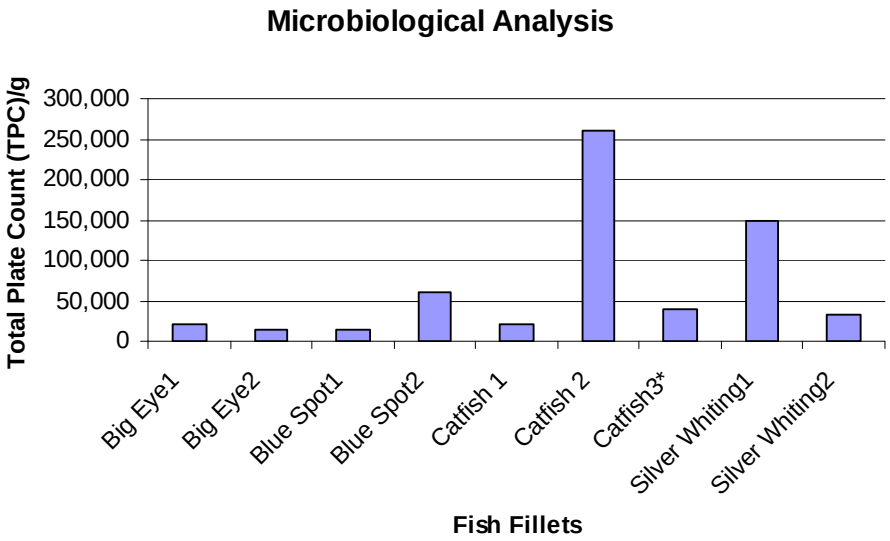

Figure 1: Microbiological analysis of Big Eye *(Thunnus obesus),* Blue Spot Emperor *(Lethrinus punctulatus)* fillets, Catfish *(Ariusi)* fillets and Silver Whiting (*Sillago schomburgkii*) fillets.

*Samples were packed as a trial MAP product. Sample 3 result obtained on Day 3 MAP, Day 7 was 390,000 cfu/gm.

The results were very promising given that these were standard products from random fish without special precautions. All products were rated 'good' on sensory evaluation after 7 days MAP storage (refer to Appendix 3).

Second Set of Trials: Trial 2

The total plate counts in Figure 2 indicate that chemical treatment on the fish fillets had a positive result. The TPC's of day 1 were generally very low for all fillets except the Blue Spot Emperor. Vortexx solution had a significant influence on all three fish fillets compared to Cirtrofresh. The results in Figure 3 illustrate that chemical treatment on the fish fillets which can significantly reduce the microbiological activity (low TPC).

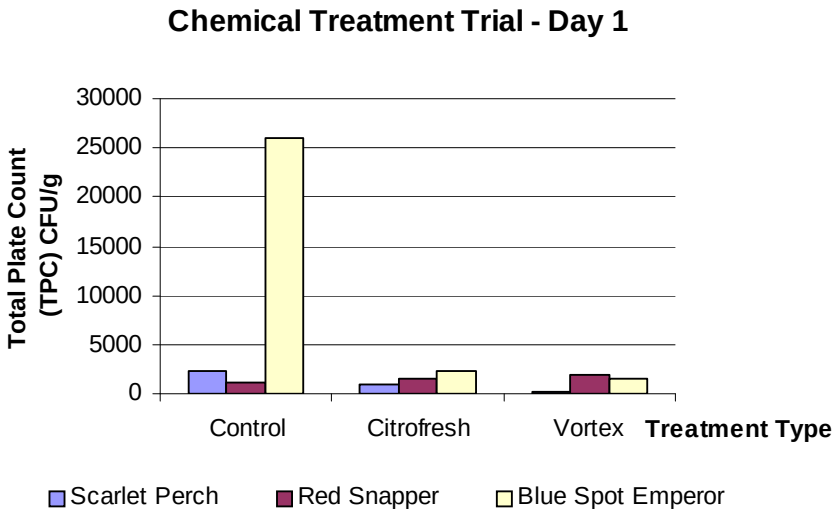

Figure 2: Chemical treatment trials (Day 1) conducted on Scarlet Perch *(Lutjanus malabaricus)* fillets, Red Snapper (*Lutjanus erythropterus*) fillets and Blue Spot Emperor *(Lethrinus punctulatus)* fillets.

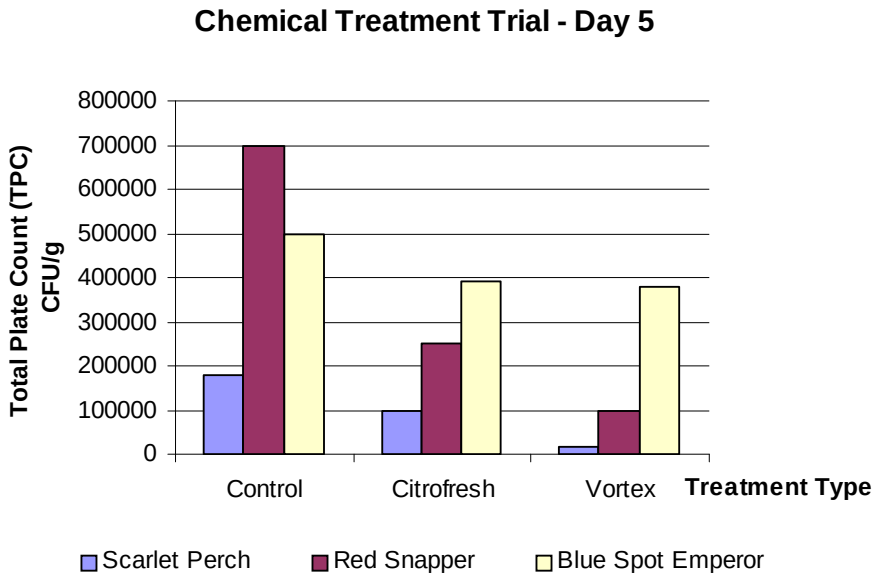

Figure 3: Chemical treatment trials (Day 5) conducted on Scarlet Perch *(Lutjanus malabaricus)* fillets, Red Snapper (*Lutjanus erythropterus*) fillets and Blue Spot Emperor *(Lethrinus punctulatus)* fillets.

All three samples of fish fillets used (Scarlet Perch, Red Snapper and Blue Spot Emperor) indicated a low total plate count, which was within 10^3 CFU / g (Scarlet Perch resulted with only 200 CFU / g on day 1) at the beginning of the trial. This was a realistic measure for the total plate count after treating the fillets with Citrofresh and Vortexx. The total plate counts for Day 5 increased as expected. However, the bacteria counts for Scarlet Perch and Red Snapper was within 10^4 CFU / g (19000 and 98000 respectively). Although the Blue Spot Emperor fillets indicated considerably high total plate counts, it was within 10^5 CFU / g, which was a level achievable for the maximum limit at the end of shelf life.

There were some trials conducted on Blue Spot Emperor and Red Snapper fillets where the samples of fish fillets were tested for pH, general appearance, drip loss and the general appearance after cooking in Microwave oven on high for 1 minute.

There was no significant reduction in the pH of the fillets. Readings were as low as 5.69 and up to 6.46. Figure 4 below illustrates the pH readings for Blue Spot Emperor fillets and Red Snapper fillets over a period of eight days. Drip loss was also recorded for the same species of fish. Red Snapper had 9.1 % moisture loss compared to the Blue Spot Emperor fillets, which had 4.1% drip loss (Appendix 3).

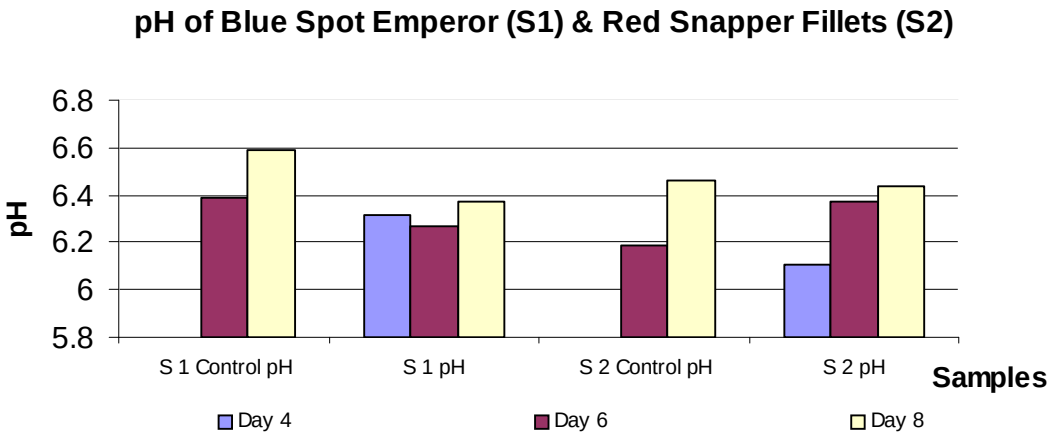

Figure 4: pH of Blue Spot Emperor *(Lethrinus punctulatus)* and Red Snapper (*Lutjanus erythropterus*) fillets from Day 4 to Day 8.

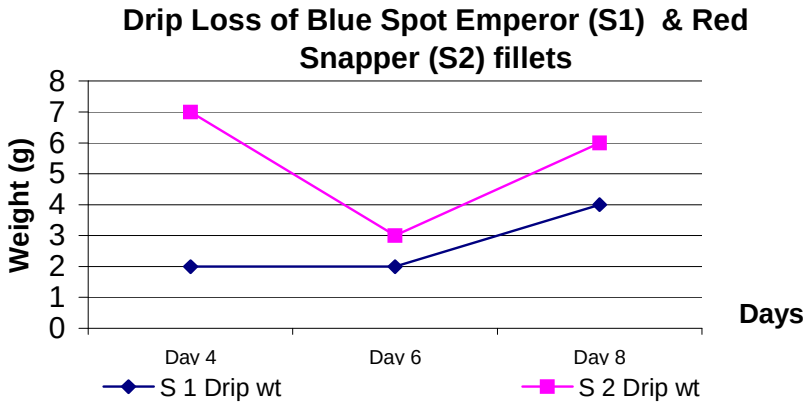

Figure 5: Drip loss of Blue Spot Emperor *(Lethrinus punctulatus)* and Red Snapper (*Lutjanus erythropterus*) fillets from Day 4 to Day 8.

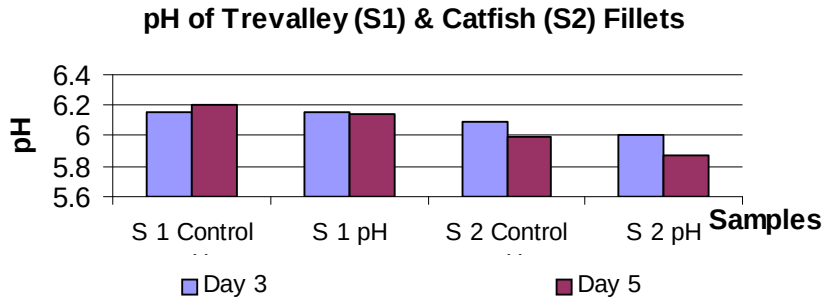

Figure 6: pH of Trevally Silver *(Pseudocaranx dentex)* and Catfish *(Ariusi)* fillets from Day 3 to Day 5.

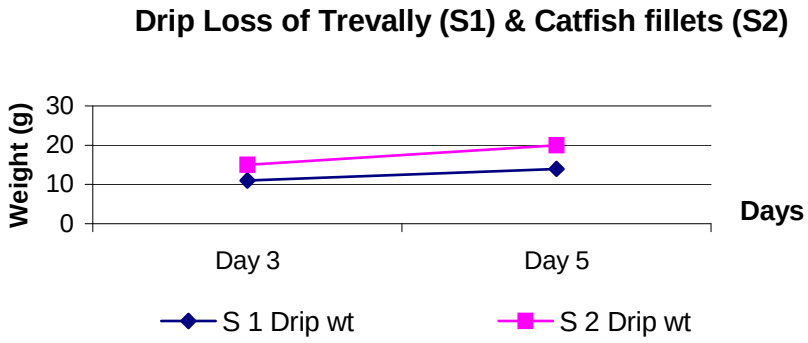

Figure 7: Drip loss Trevally Silver *(Pseudocaranx dentex)* and Catfish *(Ariusi)* fillets from Day 3 to Day 5.

The above results (pH and drip loss) indicated that Blue Spot Emperor fillets were better than the other fillets used in the series of trials.

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Determination of Gas Combination

Experiment 1 - 23rd July 2001

In this experiment four of the five target species were packed using the Tecnovac Pratica (MAP machine). The gas mixture settings were 30% O_2, 40% CO_2, and 30% N_2. The microbiological analyses of the MAP products are illustrated in Figures 8 and 9. These products were also subject to in-house sensory evaluation. Trevally Silver *(Pseudocaranx dentex)* fillets, Red Emperor (*Lutjanus sebae*) fillets, Blue Spot Emperor (*Lethrinus punctulatus*) fillets, and Scarlet Perch *(Lutjanus malabaricus*) were the species used for this trial.

The production staff and Managers tested appearance (colour), odour and texture of the fish fillets. All sensory evaluations of the fish fillets were rated "good" on day 2. Sensory evaluations for day 5 for the controlled samples (no gas) were also acceptable. However, the Trevally and Scarlet Perch *(Lutjanus malabaricus*) fillets were poor quality (see Figure 9). The TPC of all species of controlled samples were more than 2 million except the Red Emperor (*Lutjanus sebae*) fillets, which were 600,000 on day 5. Sensory evaluation (controlled samples) on day 8 found all of the species had an offensive odour, and discolouration to the flesh. On day 8, Red Emperor and Scarlet Perch fillets among the trial samples were of poor quality.

Some MAP products were analysed by BOC gases for CO_2 content and found to contain on average only 15% CO_2 compared with target 40%.

Although there was some variation in initial fish quality (note samples were only taken on day 2) the resulting micro counts increased quite rapidly after packing (day 5).

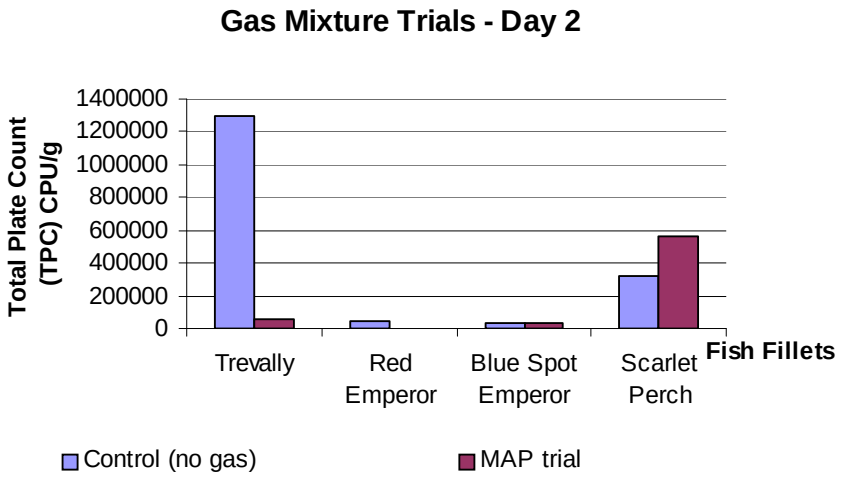


Figure 8: Gas mixture trials – day 2 on Trevally Silver *(Pseudocaranx dentex)* fillets, Red Emperor (*Lutjanus sebae*) fillets, Blue Spot Emperor (*Lethrinus punctulatus*) fillets, and Scarlet Perch *(Lutjanus malabaricus*) fillets.

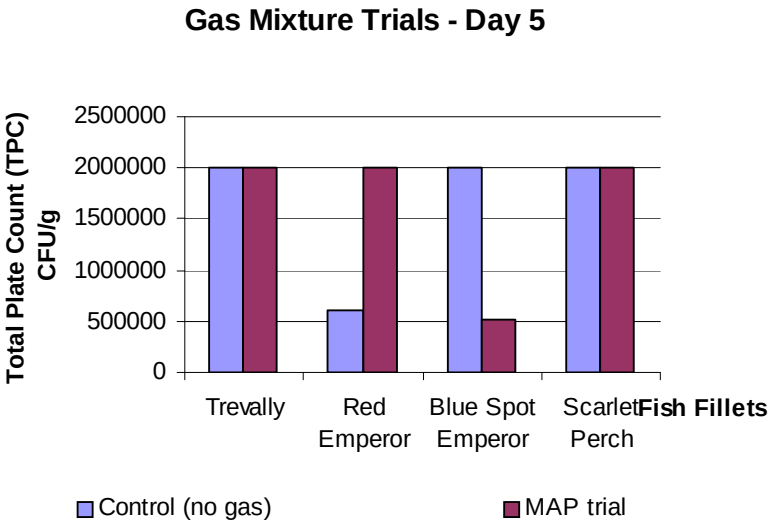


Figure 9. Gas Mixture trials – day 5 on Trevally Silver *(Pseudocaranx dentex)* fillets, Red Emperor (*Lutjanus sebae*) fillets, Blue Spot Emperor (*Lethrinus punctulatus*) fillets, and Scarlet Perch *(Lutjanus malabaricus*) fillets.

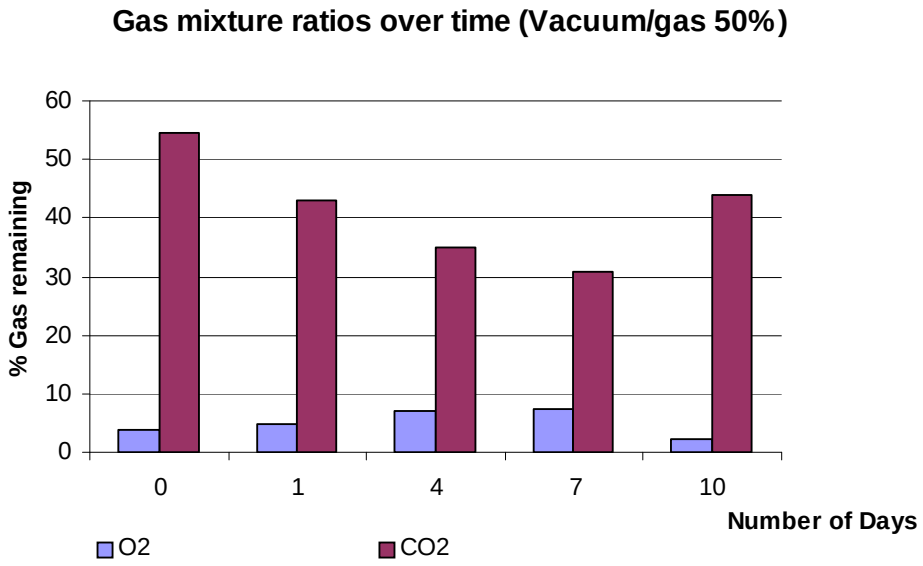


Figure 10. Gas Mixture ratios over time (Vacuum / gas 50%). 0 was production day and 10 the last day tested.

The percentage of O_2 remained steady and began to rise on day 4 & 7 (7.2 & 7.4%), then decreasing down to 2.4% on day 10 (Figure 10). The general trend of CO_2 was decreasing over time, with day 7 resulting 30.8% of CO_2. Then followed by an increase to 43.9%.

The trend for O_2 was decreasing (Figure 11). The result on day 10 was 3.7% while CO_2 remained steady between 34 and 40%. The percentage of CO_2 increased to 42.4% on day 10.

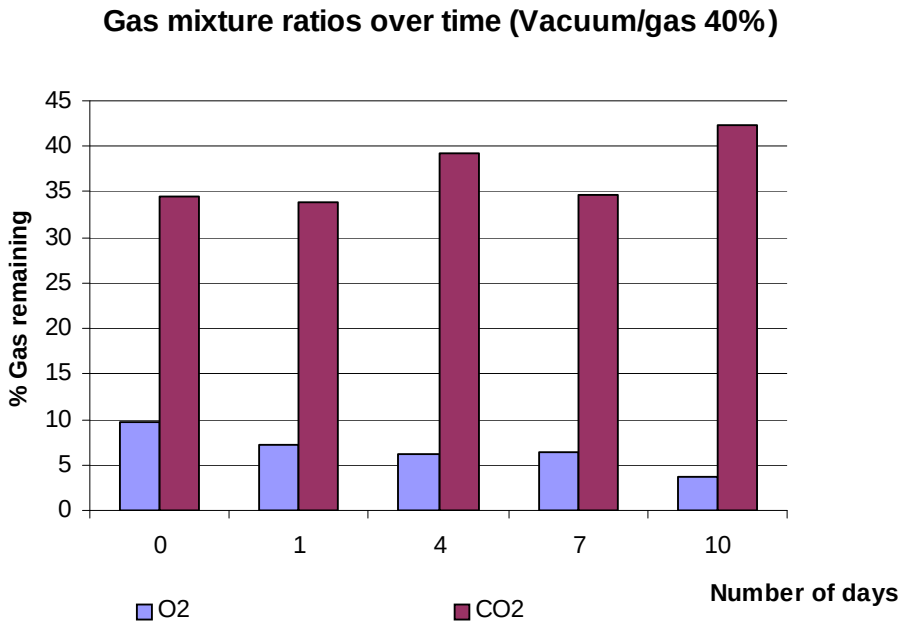


Figure 11. Gas Mixture ratios over time (Vacuum / gas 40%). 0 was the production day and 10 the last day tested.

Experiment 2A showed some variability in actual gas mixture, but with the vacuum/gas set for 40% actual vacuum was near 50%. With the vacuum and gas set at 50% the actual vacuum was near 70%.

In experiment 2B it was found, after packing the product, that the silicon seal had been damaged, therefore it was unlikely that a 70% vacuum/gas replacement had been achieved. This was confirmed later in the trials that only a 50% gas flush was indicated.

Further experiments (see Appendix 3) with the Novatech and Tecnovac demonstrated that with settings of vac/gas 50-70%, actual gas content varied from 50-80%. Attempting to remove all the gas (99%) resulted in a very long (impractical) cycle time on the machine. A realistic setting of 75% vac/gas (70-80% actual) was chosen for the next series of product evaluations.

Overall the sensory assessment highlighted a clear distinction between the MAP product and controls. All MAP packs were in good condition by day 7, but by contrast 2/5 control samples were 'off'. The red snapper was not visually appealing at day 7. If this persists in other trials it will be replaced by another species.

The microbiological total plate counts were very high in the control samples by day 5 and very high in 3/5 MAP samples by day 7. It was later found that the venturi system used to dose Vortexx solution into the main tank had an air leak, which resulted a lower dosage than targeted.

The biggest problem encountered was the degree of pack collapse, noticeable on day 1 and severe by day 11 as the carbon dioxide is absorbed. This was despite the CO_2 only being 40-47% on day 1.

2001/402 Developing case ready retail and bulk catering pack for seafood using modified atmosphere packaging (MAP) technology

Further Trials – Value Added Seafood

A gas mixture of 50% gas and 50% vacuum was applied with a gas pre mixture of 40% CO_2, 30% O_2 and 30% N_2.

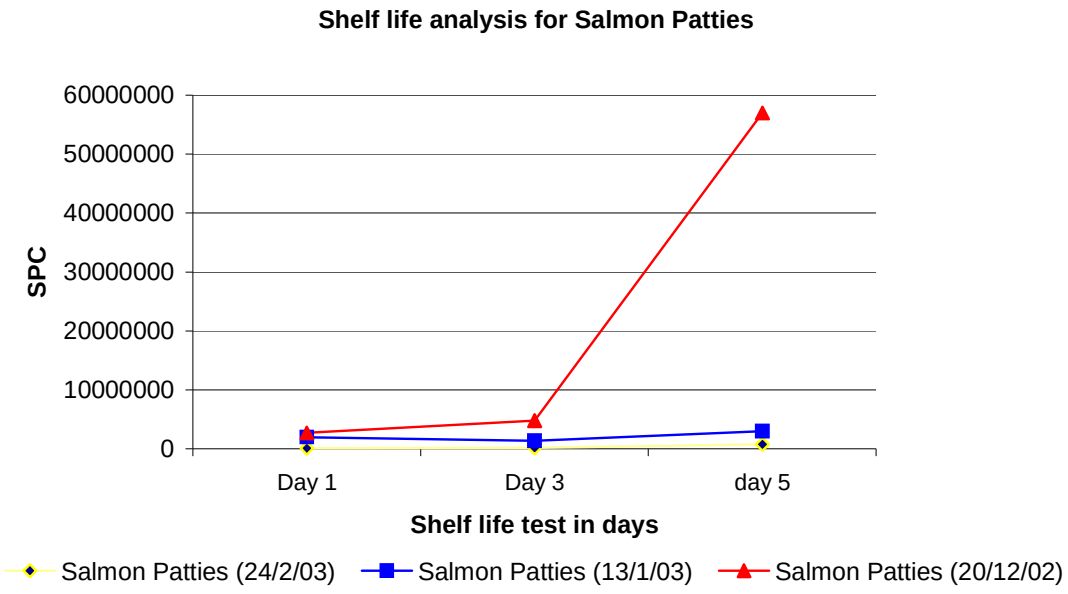


Figure 12. Shelf life analysis for Salmon Patties on days 1, 3 and 5.

The bacterial load was high for the salmon patties on tests dated 20/12/02 and 3/1/03. This does not necessarily reflect poor quality of product, as some of the ingredients used in the mixture may have contributed a significant number of micro-organisms.

The ingredients were tested separately (Figure 13), which gave an indication of the initial microbiological load of the value added products. Fish fillets were also tested in isolation (Figure 14) to give an indication of the initial SPC's.

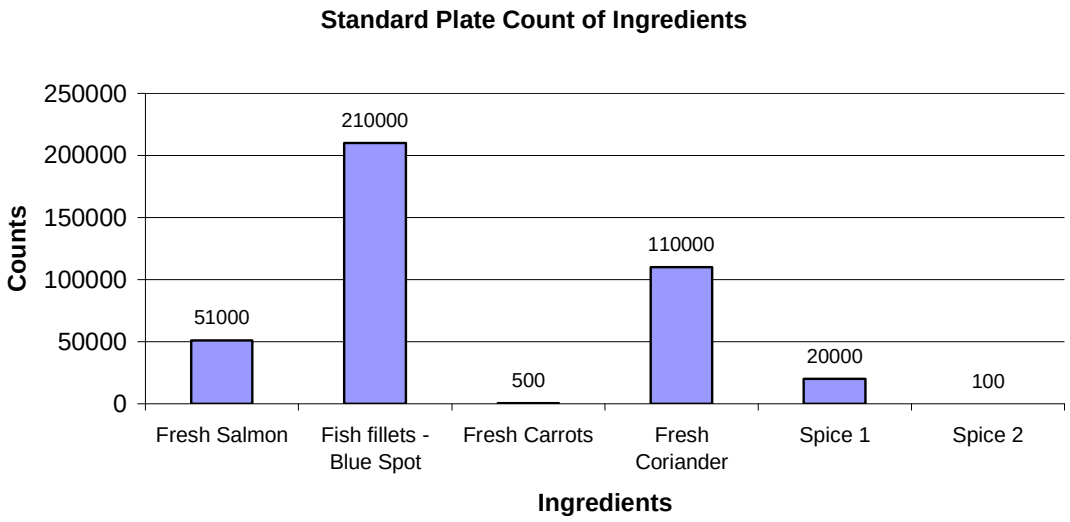


Figure 13. Standard plate counts of Ingredients used in the mixture of Salmon Patties.

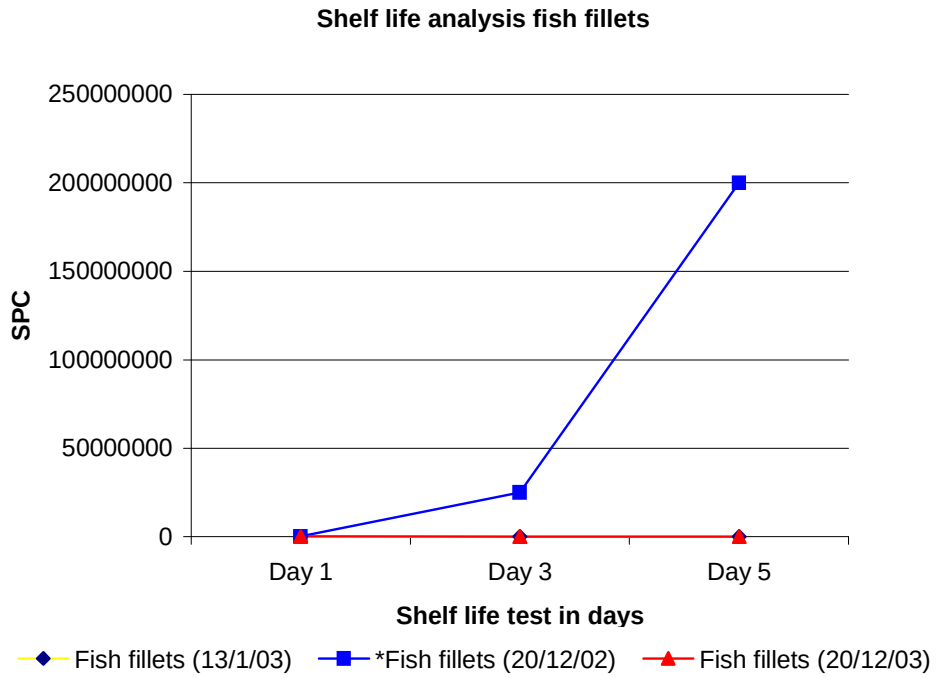


Figure 14. Shelf life analysis of fish fillets

2001/402 Developing case ready retail and bulk catering pack for seafood using modified atmosphere packaging (MAP) technology

The hygiene and handling practices during and immediately after production of the patties were closely monitored and a few changes were made. The changes in production were cleaning and disinfecting food contact surfaces thoroughly prior to production, and between the preparations of ingredients.

Maintenance of the cold chain has played a major role during production. The temperature of the Ingredients and the mixture of Salmon Patties were closely monitored. Ice was used to keep the temperature of the mixture and prepared patties within 0 – 4 ^{0}C. The temperature of the fridges and chillers were also closely monitored to maintain the cool chain through out production and storage prior to delivery to the customer.

The tests conducted on 13th January 2003 for Fish Fillets have indicated a significant improvement on the SPC's compared to the tests conducted on 20th December 2002 Figure 14 illustrates the low micro counts of 11 000 for Day 1 and 51 000 for Day 5.

The tests conducted on 24th February 2003 for Salmon Patties indicated that the hygiene and handling practices during production and storage along with temperature control had a significant influence on the reduction of the initial microbiological load (77 000 SPC's on Day 1). The SPC's were well within limits on day 5 with an increase of log 1 (760 000).

2001/402 Developing case ready retail and bulk catering pack for seafood using modified atmosphere packaging (MAP) technology

FURTHER DEVELOPMENT

Areas that need further development are primary handling and storage of whole fish prior to further processing. This was one of the objectives outlined for this project, which was not fully explored. The method of catch, onboard handling and storage of whole fish, storage time prior to transportation to a seafood manufacturer are all factors which may have a significant influence on the quality of the finished product.

Detailed consumer survey on the MAP products and their response to the quality, packaging, convenience and affordability of the finished product are areas for further development.

CONCLUSION

Consumers are becoming more selective with their choice of food products. Consumers are becoming more health conscious, and are changing their buying habits from frozen foods to fresh food. Customer feedback on problems associated with frozen seafood such as freezer burn, dehydration and un – appealing packaging have influenced manufacturers to present the same product in more attractive packaging such as vacuum packs or trays with modified atmosphere (Thrower, IFIQ).

The demand for fresh, portion controlled, value added seafood has increased over the recent years. Therefore, food manufactures constantly have to invest into product innovation to suit the growing needs and demands of our consumers.

Carbon Dioxide (CO_2) is known for its use in modified atmosphere packaging (MAP) to inhibit bacteria and the growth of mould. Initially the general trend of CO_2 was decreasing. However, further experiments conducted to test the gas levels have clearly indicated that the level of CO_2 remained steady. A minimum of 20 % of CO_2 is required to achieve extended shelf life of seafood (Thrower, IFIQ). The steady percentage of CO_2 enhanced the shelf life of the various fish fillets.

Blue Spot Emperor (*Lethrinus punctulatus*) resulted as the best species of fish to be used for MAP. The fillets retained its moisture, microbiological activity and general appearance, which made it the most suitable fish species for MAP technology.

It was also important to obtain fresh fish from reputable fishermen. Although the above trials didn't expand on the handling methods of freshly caught fish, it was imperative to receive fish from line caught methods rather than the trap method. The general product quality is greatly influenced by the initial handling methods, prior to further processing in the production area.

2001/402 Developing case ready retail and bulk catering pack for seafood using modified atmosphere packaging (MAP) technology

The microbiological analyses of the fillets indicated that a low total plate count, as low as 200 CFU / g on day 1, was achieved with Blue Spot Emperor fillets with a sanitising step prior to MAP. The total plate counts for Day 5 increased as expected. Although the Blue Spot Emperor fillets indicated considerably high total plate counts, it was within 10^5 CFU / g, which was a level achievable for the maximum limit at the end of shelf life.

REFERENCES

Bateh, F. F (1990). Improved seafood packaging: recipe for success in the 1990s. Infofish International. 5 (91).

Fey, M. S. & Regenstein (1982) Extending Shelf – Life of Fresh Wet Red Hake and Salmon Using CO_2 – O_2 Modified Atmosphere and Potassium Sorbate Ice at 1 ^{0}C. Journal of Food Science. **47** (1982).

Guise, Bill. (1983). Controlled atmosphere packaging. Food Processing, April 1983 pp 29 – 33.

Maurer, I. M (2001) Sterilization and Disinfection.

Ogrydziak, D. M & Brown, Duane (1982). Temperature Effects in Modified – Atmosphere Storage of Seafoods. Food Technology May 1982.

Statham; J. A. (1984). Modified atmosphere storage of fisheries products: the state of the art. Food Technology in Australia. **36** (5)

Szabo, L. (2000). MAP Technology for Seafood. CRC for International Food Manufacture and Packaging Science.

Veranth, M. F. (1979). CO_2 – enriched atmosphere keeps fish fresh more than twice as long. Food Processing, April 1979 pp76- 79.

APPENDIX 1: INTELLECTUAL PROPERTY

The value of FRDC's intellectual property will be 40.0%, based on the financial contribution of FRDC towards the project.

APPENDIX 2: STAFF ACKNOWLEDMENTS

Sincere thanks and appreciation is due to all the staff members (current and former) who have been engaged on the project, and contributed towards the completion of this project. The following individuals had a significant contribution toward this project.

- Sam Naomis (former employee)
- Wendy Ng (former employee)
- Katja Lozic (former employee)
- Nick Beeley (former employee)
- Geordie Buscombe
- Christian White (former employee)
- Debbie Coutts
- Lin Cui Yun (former employee)
- Judy Nightingale
- Awhina Evans (former employee)
- Robert William Cody (former employee)

APPENDIX 3: EQUIPMENT AND PACKAGING MATERIALS

- Packaging equipment: CA. VE. Co. Tema VG 100
  - CA. VE. Co. Tema VG 100 technical data
  - Tema VG 100

- HUHTAMAKI packaging worldwide
  - Huhtamaki enters the Case-Ready market with MAP (From Pack to Plate)

- OAKHAM .. setting the standard in modified atmosphere packaging
  - OAKHAM fresh packaging system

- Technovac vacuum technique and modified atmosphere
  - Quick. Linvac, Pocket ST
  - Application
  - Technical data

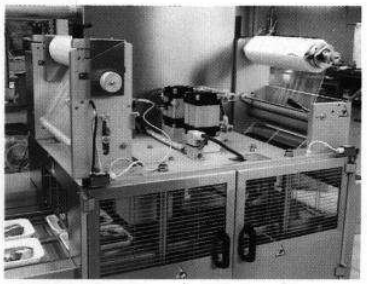
- Map Seafood Preliminary Report

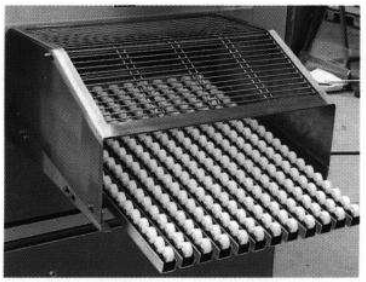
- Map Trial # 2 (Raw Data)

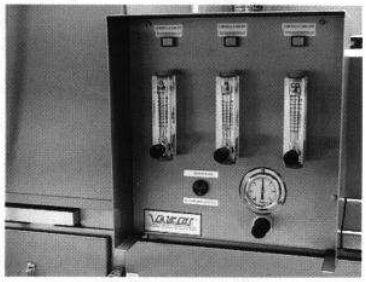
C.A.VE.CO. S.R.L.®

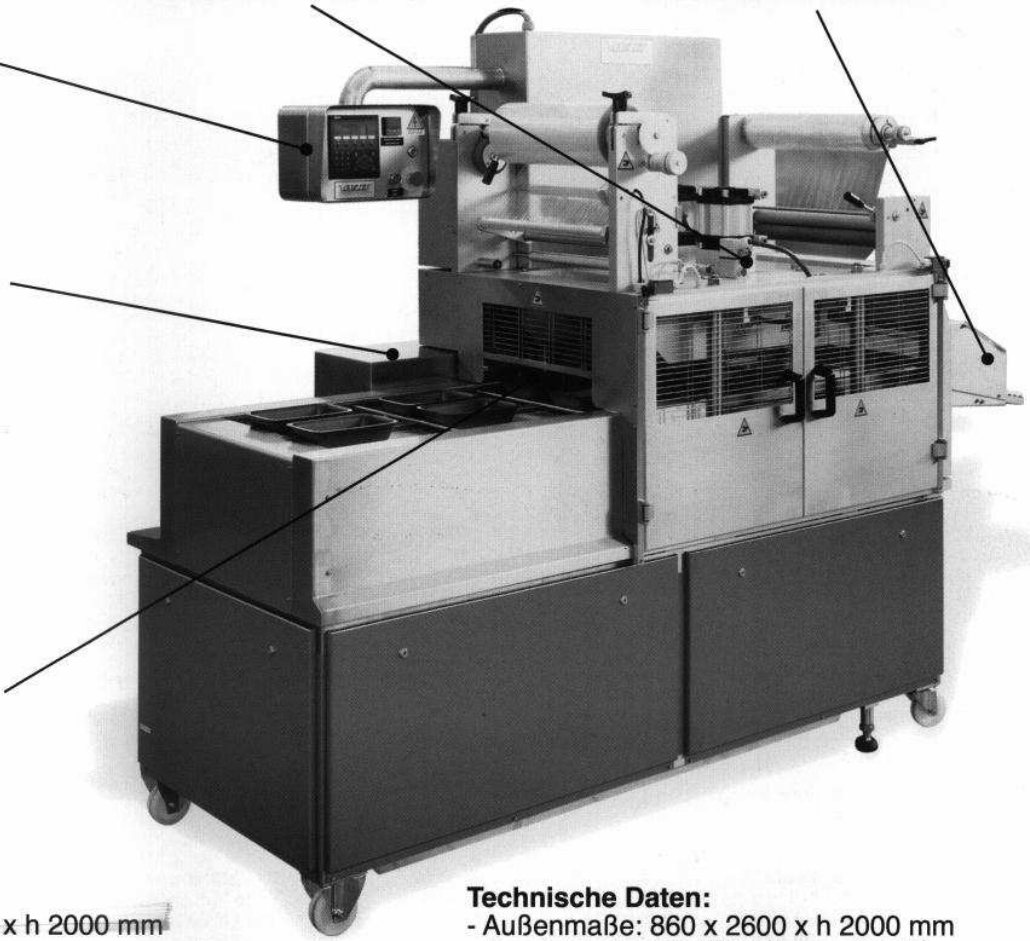
IL CONFEZIONAMENTO - IL DOSAGGIO AUTOMATICO

TEMA VG 100





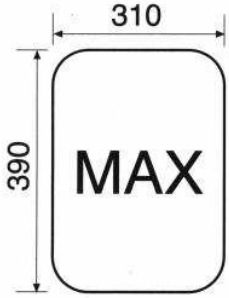




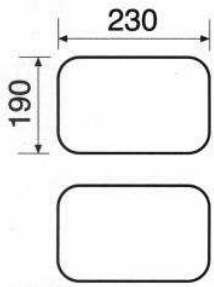
Technical data:
- Overall dimensions: 860 x 2600 x h 2000 mm
- Weight included pump: 130 Kg
- Work top height: 980 mm
- Max tray size: 390 x 310 mm
- Max tray height: 100 mm
- Max film width: 350 mm
- Max film diameter: 250-300 mm
- Max film mandrel diameter:75-80 mm

Technische Daten:
- Außenmaße: 860 x 2600 x h 2000 mm
- Gewicht einschließlich Pump: 130 Kg
- Arbeitshöhe: 980 mm
- Max Schalenmaße: 390 x 310 mm
- Max Schalenhöhe: 100 mm
- Max Folienbreite: 350 mm
- Max Foliendurchmesser: 250-300 mm
- Innendurchmesser Folienspindel: 75-80 mm

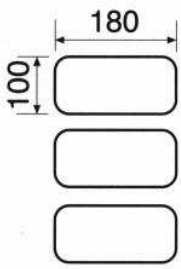
No 1 PIECE PER CYCLE
Nr 1 STÜCK JE TAKT



No 2 PIECES PER CYCLE
Nr 2 STÜCKE JE TAKT



No 3 PIECES PER CYCLE
Nr 3 STÜCKE JE TAKT



C.A.VE.CO. S.R.L.®
IL CONFEZIONAMENTO - IL DOSAGGIO AUTOMATICO

TEMA in models "T" and "VG+T"
Automatic tray sealing machine suitable for packaging trays with plastic films from reel

The tray-sealer TEMA is designed to hygienically pack food products in the food industry.
In order to pack in modified atmosphere MAP and to reach therefore a longer product shelf-life, the sealing machine is equipped with a vacuum pump and a connecting unit for protecting gases.

Advantages:
CA.VE.CO. tray sealing machines fulfil the necessary hygiene and cleaning requirements in the food industry. The construction is in stainless steel and materials suitable for food products. All the surfaces and parts, which can be in contact with the product, are easy to clean.
All the current regulations regarding a safe operation are respected. The various working phases are controlled through incorporated sensors and probes; possible failures are shown on the display of the electronic panel. The signals on the display can be stated in different languages to avoid comprehension problems for the foreign operators.

Easy to operate:
The trays are set on the conveyor belt; all the following operations are automatically carried out: the trays are sealed, if necessary in vacuum and/or modified atmosphere, and the film is automatically cut and trimmed according to the form of the tray. Closed trays are expulsed on the exit belt. Trays of same shape, but different heights can be simultaneously closed with the same sealing die. The changing of the die set and other sealing equipment is very easy. It can be done in few minutes by the operator without using any special instruments. All CA.VE.CO. sealing machines are suitable for any kind of tray in plastic, cardboard or aluminium with maximum dimensions up to 390 x 310 mm and 100 mm of height. The trays are closed with sealable films unwound from reel. The film waste remaining after the closure is wound on a roll easy to take out. It is possible to use printed films thank to a photocell, installed in the film unwinding system, able to read the print.

Safety and reliability:
The exchange of atmosphere inside the packages is carried out through the air evacuation by an incorporated vacuum pump. A safety device controls that the protecting gases come first of all in the vacuum chamber. In this way normal vacuum pumps can be used also for a high concentration of oxygen in the packages.
All the electrical installations are protected against water and humidity according to the IP 65 regulations.

Flexibility and versatility:
This sealing machine, as all CA.VE.CO. packaging machines, is suitable for a wide range of products such as ready meals, fresh or frozen, meat, fish, vegetables, especially salads, dairy products, pasta and so on. These kinds of machines are used in all food sectors, small and big companies, butchers, supermarkets and others.

Production and output:
The packaging machine TEMA mod. T, without vacuum and MAP, can reach 15 cycles per minute, while the TEMA mod. VG+T, with modified atmosphere MAP, produces from 6 up to 9 cycles per minute. This last machine can carry out the following types of closures:
- only thermosealing
- only vacuum + thermosealing
- only vacuum + gas + thermosealing.

According to the tray dimensions the machine closes one, two or three trays per cycle. For every kind of product, tray and film a proper program can be performed, stored and retrieved. During the execution of a program the different operations are shown and checked through the display.

Optional and special equipment:
A special gas mixing device can be installed on the rear side of the machine to mix three different protecting gases according to the type of product to seal, in order to obtain the optimal shelf-life of the product.
On request a longer conveyor belt can be mounted at the machine entry. Further sealing die sets are available for trays with specific shapes or different dimensions.

TEMA in Modellen "T" und "VG+T"
Automatische Schalenverschließmaschine zum Verschließen mit Folien aus Kunststoff von der Rolle.

Das Modell TEMA wurde besonders für hygienisch verpackte Lebensmittel in der Industrie oder in den größeren Handwerkbetrieben konstruiert. Um in ausgetauschter Atmosphäre MAP zu verpacken und eine möglichst lange Haltbarkeit der Produkten zu erreichen, ist die Schalenverschließmaschine mit einer Vakuumpumpe und einem Anschluß für Schutzgase ausgerüstet.

Vorteile:
Alle CA.VE.CO.-Verschließmaschinen erfüllen höchste Ansprüche bezüglich Hygiene und Sauberkeit in der Lebensmittelindustrie. Herstellung aus Edelstahl und Materialen, die für Geräte in der Lebensmittelindustrie zugelassen sind. Alle Normen und Anforderungen an die Betriebssicherheit sind eingehalten. Die Unfallverhütungsvorschriften werden erfüllt. Alle Abläufe des Verschließvorganges werden durch eingebaute Sensoren oder Sonden überwacht; eventuelle Störungen werden auf dem Display der elektronischen Steuerung angezeigt. Die Anzeige auf dem Display kann in meheren Sprachen erfolgen. Ausländische Mitarbeiter haben somit kaum Verständigungsprobleme.

Leicht zu bedienen:
Die Schalen werden auf die Einlaufstrecke gesetzt; alle folgende Funktionen werden automatisch durchgeführt: die Schalen werden in Vakuum und/oder in ausgetauschter Atmosphäre versiegelt; die Folie wird automatisch geschnitten und nach der Schalenform gestanzt; die Folienreste werden zur Entsorgung auf einer Rolle aufgewickelt. Die verschlossenen Schalen kommen auf einer Auslaufbahn aus der Maschine. Für bedruckte Folien ist eine Druckmarkensteuerung ausgerüstet. Ohne das Verschließwerkzeug zu ändern, lassen sich gleichzeitig unterschiedlich tiefe Schalen verschließen. Verschließwerkzeuge lassen sich in wenigen Minuten austauschen. Hiezu werden keine Handwerkzeuge benötigt.
Alle CA.VE.CO.-Verschließmaschinen sind für jeden Schalentyp aus Kuststoff, Karton oder Aluminium bis zu einem Höchstmaß von 390 x 310 mm und einer Höhe von 100 mm geeignet.

Sicherheit und Zuverlässigkeit:
Der Atmosphärenaustausch in den Packungen erfolgt nach dem Evakuieren der enthaltenen Luft durch die eingebaute Vakuumpumpe. Eine absolut sichere Steuerung gewährleistet, daß die Schutzgase erst in die Vakuumkammer gelangen, wenn dieser Vorgang abgeschlossen ist. Dadurch können auch bei einer hohen Konzentration von Sauerstoff in den Packungen normale Vakuumpumpe eingesetzt werden.
Alle elektrische Ausrüstungen entsprechen IP65. Die Anlage kann in Feuchräumen aufgestellt und mit Wasser gereinigt werden.

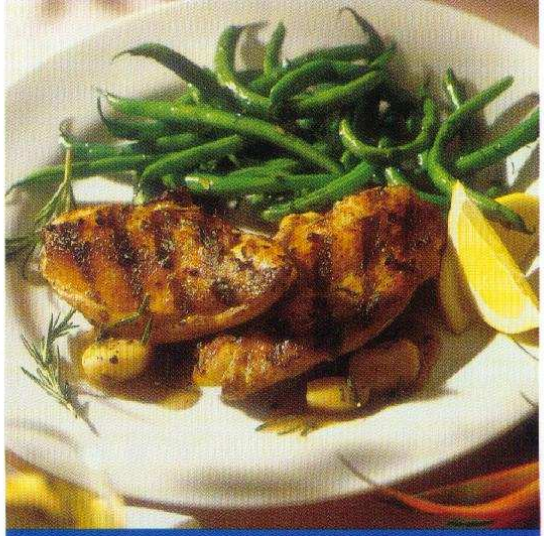
Flexibilität und Vielseitigkeit:
Diese Verschließmaschine, wie alle CA.VE.CO.-Verpackungsmaschinen, ist für eine größe Auswahl von Produkte geeignet, wie Fertiggerichte, Tiefkühlkost, Frischfleisch, Fisch, Gemüse, besonders Salate, Molkereiprodukte, Nudeln u.s.w. Diese Maschinen werden in zahlreichen Lebensmittelbetrieben verwendet.

Produktion und Leistung:
Die Verschließmaschine TEMA mod. T erreicht 15 Takte pro Minute ohne Vakuum und Schutzgase, während die TEMA mod. VG+T in Atmosphärenaustausch MAP 6 bis 9 Takte pro Minute leistet. Diese letzte Maschine leistet die folgende Verschließungsarte:
- nur Thermoversiegelung
- nur Vakuum + Thermoversiegelung
- nur Vakuum + Gas + Thermoversiegelung.

Abhängig von der Schalengröße können eine, zwei oder drei Schalen je Takt verschlossen werden. Für jedes Produkt, jede Schalen und Folienart kann ein passendes Programm erstellt, gespeichert und danach abgerufen werden. Auf dem Display werden die Programmschritte vorgegeben und danach während dem Programmablauf überwacht.

Optionen und Sonderausstattungen:
Die Maschine kann mit einem angebauten Gasmischgerät ausgerüstet werden, welches es ermöglicht, drei verschiedene Schutzgase speziell auf das zu verpackende Produkt abzustimmen, um optimale Haltbarkeiten zu erzielen. Auf Wunsch kann ein verlängertes Einlaufband geliefert werden. Zusätzliche Verschließwerkzeuge sind für Schalen mit besonderen Formen und verschiedenen Maßen verfügbar.

TEMA VG 100



FRESH FOODS

Keep-it-Fresh

Case-Ready Packaging
Customer-Ready Solutions
With MAP

HUHTAMAKI
PACKAGING WORLDWIDE

From Pack to Plate

Huhtamaki enters the Case-Ready market with MAP.

Convenience food is the fast moving trend in retailing today. And Case-Ready is the next major advancement in the packaging and presentation of fresh meat and seafood for supermarkets and convenience stores. In keeping with market trends Huhtamaki; a global leader in consumer packaging, has developed a wide range of products for processors keen to enter this growing market.
A complete Fresh Food packaging solution.

MAP is the new direction

MAP, or Modified Atmosphere Packaging is the new direction in packaging. MAP means that fresh meat and seafood may now be centrally packed and shipped to store. The modified atmosphere prevents spoilage and extends shelf life, thereby significantly expanding the seafood and value added meat markets.

Huhtamaki's MAP solution is the result of innovation and involvement from our worldwide resources; technology that delivers to the consumer packaging that is both superior in presentation and performance. Packaging that quite literally sells itself...right off the shelf.

The Tray

A barrier laminated polystyrene tray is the basis of the package. Features include:

- An EVOH layer to provide optimum barrier for extended shelf life
- Unobtrusive tray ribbing, to provide focus on the product
- Flat bottom to allow for labeling and scanning
- A tray design that facilitates use with standard pick and place de-nesters. No customizing is necessary

The Benefit: A safer extended shelf life product that provides greater customer appeal at retail, thereby enhancing sales through the trade.

The Pad

An effective absorbent pad enhances the product. Features include:

- Cost effective padding from local and international pad manufacturers.
- Pre placed in the tray, if required, for greater time and cost savings

The Benefit: An effective absorbent pad removes moisture for optimum presentation.

The Lidding

A 6-layer barrier film tops off a great package. Features include:

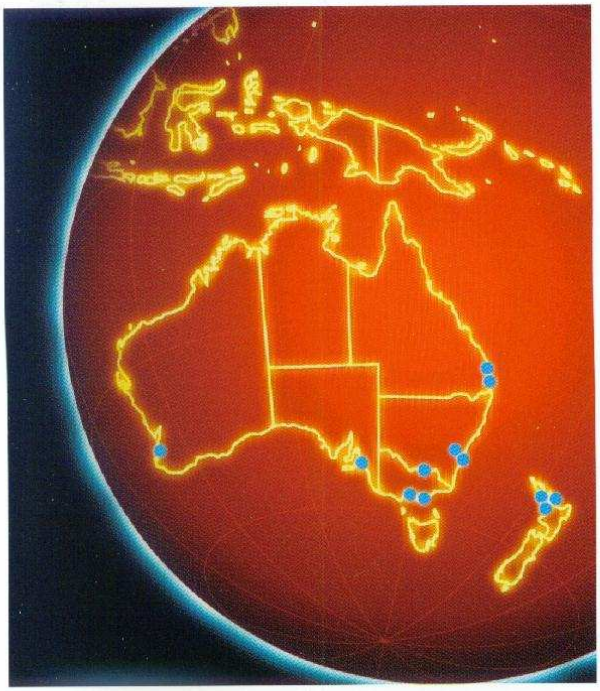
- An EVOH layer to provide optimum barrier for extended shelf life
- An Anti-fog additive to ensure excellent product presentation
- Enhanced tear resistance, cut and printability
- Lidding matched specifically with the tray for enhanced seal through contamination

The Benefit: A safer extended shelf life product that provides better processability and greater customer appeal at retail level, enhancing sales and profitability through the trade.

The Sealing Equipment

A cost effective heat sealing machine from Sealpac. Features include:

- Internal cut for improved presentation
- Excellent economies on both film and gas usage – lower cost to use
- Quick tool change and user friendly set-up process
- Leasing and rental options available



Huhtamaki. Fresh Foods.

Huhtamaki provides a broad range of packaging solutions in the fresh foods area for meat, seafood, chicken, fruit, vegetables, salads and ready meals in fresh, minimally processed and value added formats.

The product range covers industrial packaging and processing solutions and packaging for store fresh prepared meals in the retail area. Products include foam trays, rigid plastic trays, tubs and lids, hinged packs and sealing films... providing a complete Fresh Food packaging solution.

Huhtamaki. Packaging Worldwide.

Huhtamaki is a world leader in specialty consumer food packaging, operating in over 30 countries. Huhtamaki's product range includes thin walled plastics and paper containers, moulded fibre products and high performance flexibles, for the food service and food processing industries.

HUHTAMAKI

PACKAGING WORLDWIDE

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www.huhtamaki.com

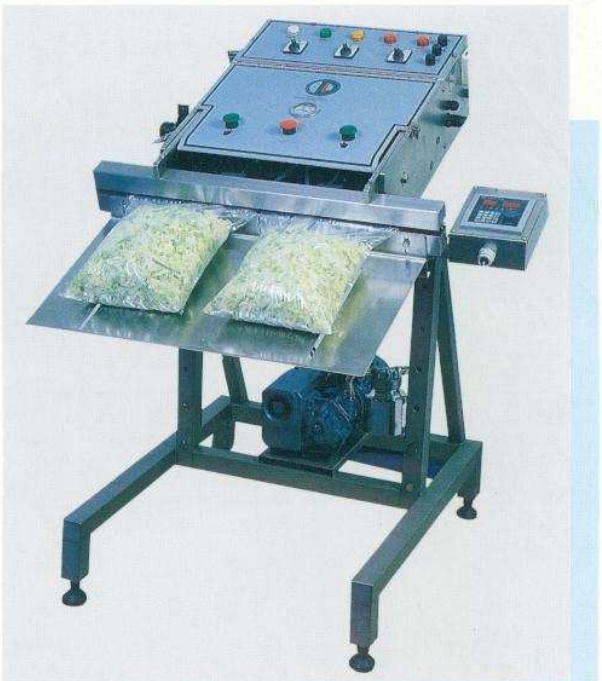
OAKHAM .. setting the standard in modified atmosphere packaging!

. . . extended shelf life for fresh product.

OAKHAM FRESH PACK PACKAGING SYSTEM

OAKHAM MODIFIED ATMOSPHERE PACKAGING

- Gives a significant extension to the fresh shelf life of a wide range of products.
- Inhibits bacterial spoilage and mould growth.
- Protects against shrinkage, discolouration and cross contamination.
- Minimises drip loss.
- Requires only standard refrigeration for distribution and storage.



VERSATILITY

- Handles a full range of pack sizes from full cartons to retail packs.
- Packages with ease those normally "difficult" products such as fresh sausage, hot filled cheese, wet coleslaw and soft salad.
- Enables use of the "Master Pack" concept of bulk packaged consumer ready packs.
- The use of special option snorkels enable even light, dry powders to be fully vacuumed and then backflushed if required.
- Can be used in a horizontal setting for smaller packs or mounted in an upright position over a conveyor when handling full carton packs.

EASE OF OPERATION

- Provision for 8 individual pack cycles to be pre-programmed into the control system and be selected via a single "pack selector" switch.
- Pre-programmed control system means minimal operator dependance and maximum package consistency.

- Security lock out of control system prevents unauthorized alterations to the packaging cycle.
- Twin push button start and auto cycling.

SEALING

- A unique self-regulating sealing system gives maximum seal security across a full range of packaging films from light gauge produce bags to heavy co-extrusions and laminates, including aluminium foil.

CLEANING

- All critical components are contained in a sealed compartment to allow full washdown.
- A "clean in place" system allows full flushing of all vacuum lines and snorkels.
- "Quick change" snorkels and removable vacuum lines for full immersion sanitising if required.

RELIABILITY AND EASE OF MAINTENANCE

- The control system is based on an internationally proven programmable controller which gives exceptional reliability.
- Straight forward pneumatics mean minimal maintenance.

TECHNICAL SPECIFICATIONS

- Standard seal bar lengths: 600mm, 750mm, 900mm.
- Power requirements: 240v, 1 phase, 9 amp duty
  or 115v, 1 phase, 15 amp duty.
- Air Consumption: 1 CFM at 80-100 psi
- Construction: Stainless steel and anodised aluminium
  or full stainless steel construction.

OAKHAM FRESH PACK RANGE

- A410 Compact model for smaller plants.
- A310 The versatile medium sized model.
- A210 Designed for high volume processors.

Range of products currently being packed by Oakham Equipment:

Beef	Nuts
Pork	Coffee
Lamb	Eggs
Fish	Bakery Products
Processed Meats	Animal Fodder

Fresh and Cooked Sausage
Fruit and Vegetables
Cheese — including shredded, hot filled and blocks
Poultry — both whole birds and portions

Distributed By:

FOR SALES OR SERVICE
PHONE: **9354 9477**

PERTH - PAK

T600

MISURE CAMERA
Chamber Dimensions
Dimensiones de la Chambre
735x530x280 mm

BARRA SALDANTE
Lenght of Seal
Longueur de Soudure
1x720 mm
1x450+1x680 mm

POMPA A VUOTO
Vacuum Pump
Pompe à Vide
100 m³/h

DIMENSIONI
Dimensions
Dimensiones
810x680x1050 mm

T900

MISURE CAMERA
Chamber Dimensions
Dimensiones de la Chambre
960x370x130/210 mm

BARRA SALDANTE
Lenght of Seal
Longueur de Soudure
1x930 mm
1x320+1x900 mm

POMPA A VUOTO
Vacuum Pump
Pompe à Vide
60 m³/h

DIMENSIONI
Dimensions
Dimensiones
1060x550x900 mm

PRATICA

DIMENSIONI STAMPI MAX.
Moduls dimension max.
Dimensiones max. de les outilages
260x350x100 mm

DIMENSIONI
Dimension
Dimensiones
730x730x600 mm

T700

MISURE CAMERA
Chamber Dimensions
Dimensiones de la Chambre
680x530x240 mm

BARRA SALDANTE
Lenght of Seal
Longueur de Soudure
2x500 mm

POMPA A VUOTO
Vacuum Pump
Pompe à Vide
60 m³/h

DIMENSIONI
Dimensions
Dimensiones
750x700x910 mm

ERMETICA M2

DIMENSIONI
Dimensions
Dimensiones
260x470x310 mm

DIMENSIONI VASCHETTE MAX.
Max. trays dimensions
Dimensiones de les barquettes max.
198x290x210 h

ERMETICA M3

DIMENSIONI STAMPI MAX.
Moulds dimensions max.
Dimensiones max. de les outilages
400x290x130 mm

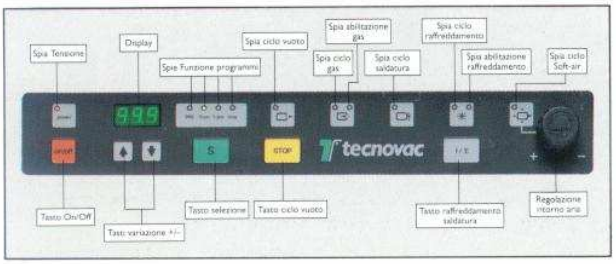
DIMENSIONI.
Dimensions
Dimensiones
630x650x500 mm

QUICK

POMPA A VUOTO
Vacuum Pump
Pompe à Vide
40 m³/h

DIMENSIONI
Dimensions
Dimensiones
520x770x1145 mm

DIMENSIONI STAMPI MAX.
Moulds dimensions max.
Dimensiones max de les outilages
350x290x100 H mm



Pannello elettronico delle funzioni per scheda a microprocessore.
Electronic panel of the funtions to drive the microprocessor card.
Tableau éléctronique des fonctions pour commande fiche à microprocesseur.

POMPA A VUOTO
Vacuum Pump
Pompe à Vide
100 m³/h

DIMENSIONI.
Dimensions
Dimensiones
3000x850/1050x1800 mm

LINVAC

DIMENSIONI STAMPI MAX.
Moduls dimensions max.
Dimensiones max de les outilages
268x379x110 H mm

POMPA A VUOTO
Vacuum Pump
Pompe à Vide
60 m³/h

DIMENSIONI.
Dimensions
Dimensiones
1300x1000x1530 mm

POCKET ST

SOTTOVUOTO E ATMOSFERA MODIFICATA

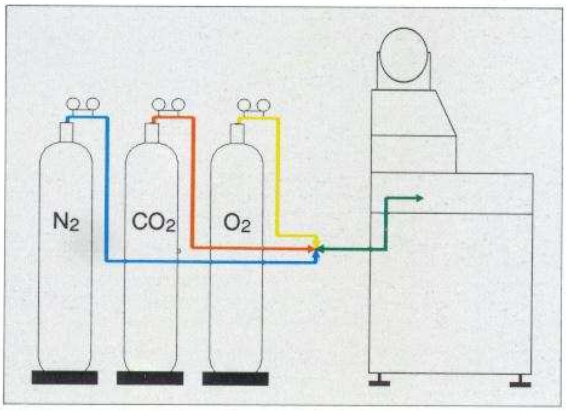
Al fine di prolungare la durata e la freschezza degli alimenti si procede alla messa in sottovuoto quasi totale del prodotto dopo ciò l'aria estratta viene rimpiazzata da un gas di protezione o da una miscela di gas diversi. In questo modo la forma del prodotto rimane integra senza danneggiamenti superficiali. I gas utilizzati sono prodotti naturali normalmente presenti nell'atmosfera. Essi sono perfettamente purificati e asettici.
Anidride Carbonica (CO_2): questo gas si dissolve facilmente nel liquido e nel grasso del prodotto. Se combinato con acqua può formare acido carbonico il quale provoca una diminuzione del pH. Questo gas ritarda la proliferazione microbica e l'apparizione di muffe, aumentando così la conservazione dell'alimento.
Azoto (N_2): si comporta in maniera perfettamente neutra nell'imballo. È generalmente utilizzato sia allo stato puro che in miscela con Anidride Carbonica o Ossigeno. Questo gas fa da cuscinetto alla lenta diffusione di Anidride Carbonica e nel contempo impedisce una deformazione dell'imballo e del prodotto. L'uso dell'Azoto riduce il restringimento del film sul prodotto al contrario della CO_2.
Ossigeno (O_2): è necessario per molti processi biologici. È necessario per esempio nel confezionamento di carni al fine di mantenere il bel colore rosso, al contrario il colore si brunisce con assenza di ossigeno. In tale caso una forte concentrazione di ossigeno può impedire la proliferazione di microbi, rinforzando la durata di conservazione.
È chiaro che la conservazione in atmosfera modificata diventa un'alternativa valida a qualsiasi altra procedura di conservazione, senza utilizzo di conservanti chimici.
Tutte le macchine sottovuoto a campana possono essere predisposte per il confezionamento in gas inerte, con l'utilizzo di sacchi in plastica.

VACUUM TECHNIQUE AND MODIFIED ATMOSPHERE

To the purpose to longer the duration and freshness of food it proceed to the quite total under vacuum procedure of the product; after that the extracted air is remplaced by a protection gas or by a mixture of different gases. In this way the product form remain intact without surfacing damagements. The gases employed are natural products usually present in the atmosphere. they are perfectly cleaned and aseptic.
Carbon Dioxide (CO_2): this gas can easier dissolved in the liquid or in the product fat. If jointed with water it can generate carbonic acid which produce a pH diminution. This gas inhibits the bacteria moltiplication and the appearing of moulds, increasing the food preservation.
Nitrogen N_2): involves itself in neutral way in the packing. Generally it is used pure or mixed with Carbon Dioxide or Oxygen. Such gas make as a bearing to the slow Carbon Dioxide diffusion and contemporary impede a packing and product deformation. The Nitrogen utilisation reduce the preshrinking of film on the product, on the contrary of CO_2.
Oxygen (O_2): it is needed for several biological processes. It's necessary for example for the meat packaging in order to maintain a fine red color, on the contrary the coulor burnished in oxygen absence. In this case a strong oxygen concentration can inhibits the bacteria moltiplication, reinforcing the preservation.
It's obvious that the modified atmosphere preservation become a valid alternative to each other procedure, without the utilisation of chemistry substances. All vacuum machines may be equipped for the inert gas packaging, using plastic bags.

SOUS-VIDE ET ATMOSPHÈRE MODIFIÉE

Au fin de prolonger la durée et la fraîcheur des aliments on se procéde à la mise sous vide presque totale du produit et après ça l'air extraite est remplacée par un gaz de protection ou par une mélange de gaz divers. De cette façon la forme du produit reste intacte sans endommagements superficiels. Les gaz utilisés sont produits naturels normalement présents dans l'atmosphère. Ils sont pairfaitement purifiés et aseptiques.
Anhydride Carbonique (CO_2): cet gaz se dissout facilement dans le liquide ou dans le gras du produit. Si joint avec eau il peut former acide carbonique qui provoque une diminution du pH. Il retad la prolifèration microbienne et l'apparition de moissure, en augmentant de cette façon la conservation des aliments.
L'Azote (N_2): ce comporte d'une façon pairfaitement neutre dans l'emballage. Il est employé à l'état pur, ou melangé à l'Anhydride Carbonique ou Oxygène. Cet gaz fait comme tampon à une lente diffusion de l'Anhydride Carbonique et en même temps empêche une déformation de la confection et du produit. L'usage de Azote réduit la retrécissement du film sur le produit, au contraire de CO_2.
Oxygène (O_2): il est necessaire pour beaucoup processus biologiques. Il faut par example dans le confectionnement des viandes mantenir le beau couleur rouge, au contraire le couleur se brunisse en absence d'oxygène. Dans cet cas une fort concentration d'oxygène peut empêcher la prolifération des microbes, en prolonguant la durée de conservation. Il est clair que la conservation en atmosphère modifiée devient un'alternative valable à n'emporte quelle autre procédure, sans l'usage de conservants chimiques. Toutes les machines sous vide à cloche peuvent être disposés pour le confectionnement en gaz inerte, avec l'utilisation de sachets en plastique.



Schema connessione gas inerti. - Inert gas connections sketch. - Plan des connections gaz inert

Il modello Quick è una macchina concepita per il confezionamento in vaschette preformate di diverse dimensioni. Attrezzata con unità per ciclo vuoto e unità per atmosfera modificata. Così equipaggiata consente di dare ai prodotti una maggior conservabilità unita ad una buona presentazione. Ideale per pasta fresca, formaggi, carne, prodotti gastronomici e precotti.

Gli utilizzi

La termosigillatrice con unità vuoto e atmosfera modificata modello Quick viene utilizzata per diverse applicazioni:

- Per incrementare la conservazione del prodotto alimentare preservando freschezza e qualità.
- Per proteggere da eventuali manomissioni le confezioni durante i trasporti.
- Per immagazzinare con più razionalità i prodotti confezionati.
- Per mantenere sterili prodotti medicali monouso.
- Per test di laboratorio nelle grandi industrie.

La macchina

L'equipaggiamento generale e la pompa del vuoto sono inclusi nel corpo della macchina. L'intera struttura della macchina è in acciaio inox verniciato o naturale secondo le norme vigenti. Le movimentazioni sono gestite da PLC con azioni meccaniche e pneumatiche. il sistema elettronico consente la programmazione di 10 cicli diversi per differenti prodotti. Il grado di vuoto e la quantità di gas neutro sono gestite da sensore elettronico che consente misurazioni estremamente precise. La sua semplicità nella struttura, nelle parti elettriche e meccaniche assicura minima assistenza e massima utilizzazione.

Il funzionamento

La macchina ha diversi sistemi di funzionamento in rapporto alle diverse necessità ed alle diverse qualità di prodotti da confezionare:

- Solo sigillatura
- Ciclo vuoto + sigillatura
- Ciclo vuoto + gas + sigillatura.

Sia il grado di vuoto desiderato che la quantità esatta di gas inerte da inserire sono espressi con valori percentuali dallo 0% al 99,9%. Il dispositivo per la misurazione del vuoto a sensore elettronico garantisce un preciso grado di vuoto finale richiesto, mentre il sensore per l'iniezione del gas inerte garantisce un approvvigionamento sempre costante. I due sistemi separati e ben installati nella camera del vuoto garantiscono un residuo di ossigeno nella confezione inferiore allo 0,5%.

Confezionamento con gas inerte

La macchina è predisposta per una programmazione della percentuale di gas inerte richiesto. Il processo consente di iniettare gas inerte nella vaschetta immediatamente dopo il processo di evacuazione e prima della sigillatura. Il vantaggio di confezionare in atmosfera modificata è di dare maggior conservazione al contenuto e di evitare allo stesso tempo l'inevitabile schiacciamento o deformazione della confezione. Generalmente vengono utilizzati tre tipi di gas naturali puri ed asettici: l'Azoto (N_2), l'Anidride Carbonica (CO_2) e l'Ossigeno (O_2).

Stampi

La dimensione dello stampo consente il confezionamento di diversi formati singoli o multipli, fino alle dimensioni massime (riportate in tabella) della camera di evacuazione. L'eventuale sostituzione con forme differenti risulta estremamente semplice, pratica e veloce. La parte superiore dello stampo riscaldata viene teflonata per garantire una maggior durata ed è sagomata con il profilo della vaschetta che viene definita.

Film sigillatura

Il film di sigillatura, in rotoli, viene posto sulla parte superiore della macchina.
Lo svolgimento del film è effettuato con l'introduzione dello stampo.

Machine Model Quick is conceived for the thermoseling of preformed trays with different shapes. The machine is provided with unit for vacuum and inert gas flushing system. Equipped with these units it permits to give to the packaging a good shelf-life with a better presentation. Ideal for fresh pasta, cheese, neat, catering service and laboratories.

Application

Thermosealing machine mod. Quick is provided with vacuum and inert gas flushing unit, it can be used for different applications:

- To increase the self-life of products while preserving quality and freshness.
- To protect food stuff against damage during transport and distribution.
- To stock rationally packed products saving space.
- To maintain the sterility of single-use medical products.
- To test products in industrial laboratory.

Machine structure

The general equipment (apparatus) and the vacuum pump are included in the body of the machine. The complete machine frame is in natural or painted stainless steel, according to the rules in force. Movements are drived by PLC through mechanic or pneumatic actions. The electronic system allows the programming of 10 different cycles for various products. The vacuum degree and the quantity of neutral gas are controlled by an electronic sensor, which permits measurements extremely precise. The simple structure of electrical and mechanical components, assures the minimal assistance and the maximum using.

Operating

The machine is provided with different operating systems according to the several products to pack:

- Thermosealing only
- Vacuum + thermosealing
- Vacuum + gas + thermosealing.

Either vacuum meter and inert gas quantity are fixed in percentage from 0% to 99,9%.
The meter device for vacuum, drived by electronic sensor, guarantee a very precise point of vacuum requested, while the gas flushing unit, equipped with a sensor, assures an always constant supply of neutral gas. The two systems, which are separated and well installed in the vacuum chamber, guarantee an oxigen residue into the packaging lower than 0,5%.

Packaging with inert gas flushing

The machine is equipped for a programming in percentage of inert gas required. Immediately after the evacuation cycle and before the sealing is camed out, this process permit to inject gas into the tray. The advantage of such packaging procedure is to give more preservation to the contents and to avoid the crushing or deformation of the packaging. Generally three types of inert gas pure and aseptic are used: Nitrogen (N_2), Carbon dioxide (CO_2) and Oxigen (O_2).

Moulds

Mould dimension permit to pack several size of trays, singles or multiples, up to reach the maximum sizes (see technical data) of the vacuum chamber. The probable substitution with different sizes is extremely simple, pratical and quick.
The heating part of the mould, located in the upper part, is covered by teflon, to guarantee a long life and it's moulded with the tray profile.

Sealing film

The sealing film, in spools, is placed on the top of the machine.
The film unwinding happens at the "come in" of the mould.

Le modèle Quick a été étudié pour le scellage des barquette préformées. La machine offre la possibilité de conditionner barquettes sous vide et sous atmosphère modifiée. Equipée comme ça elle donne aux produits plus temps de conservation et un beau aspect. Idéal pour plates fraîches, fromages, viande, produits de gastronomie et pre-cuites.

Utilisation

La machine de conditionnement pour le scellage Mod. Quick est utilisée pour différentes applications:

- Pour améliorer les délais de conservation des produits alimentaires tout en préservant leur qualité et leur fraîcheur.
- Pour emballer les articles alimentaires et les protéger pendant les usages de la distribution.
- Pour magasiner les produits confectionés avec plus rationnalité.
- Pour mantenir la stérilité des produits médicaux à usage unique.
- Pour test de laboratoire des industries.

La machine

L'équipement général et la pompe à vide sont compris dans le corp de la machine. La structure complete de la machine est en acier inoxidable, vernisée ou naturel, selon les normes en vigeur. Les movimentations sont commandées de PLC avec actions méchaniques et pneumatiques. Le système électronique permet la programmation de 10 différents cycles pour divers produits. Le valeur de vide et la quantité de gaz neutre sont commandés par un sensor électronique qui permet des mesurages extrêmement exacts. La simplicité de la structure électrique et méchanique assurent l'assistance minimal pour un usage optimal.

Le fonctionnement

La machine a plusieurs systèmes des fonctionnement en relation aux plusieures necessitées et aux différentes qualités des produits à confectioner.

- Sceller seulement
- Cycle vide + scellage
- Cycle vide + gaz + scellage.

Soi que le valeur du vide que la quantité exacte de gaz inert à injecter, sont exprimés avec des valeurs en pourcentage de 0% à 99,9%. Le dispositif pour la mesure du vide par le sensor électronique, permet d'obtenir un valeur de vide final demandé toujours précis. Le sensor pour injecter le gaz inert garantie an approvisionnement de gaz neutre toujours constant. Les deux systèmes, séparés et bien installés dans la chambre de vide, assurent un résidu d'oxygène dans la confection inférieur aux 0,5%.

Emballage avec injection de gas neutre

La machine est équipée pour une programmation de la pourcentage du gaz neutre demandé. Ce procès permet d'injecter gaz neutre, dosable de façon précis, dans la barquette, après l'evacuation et avant le schellage. L'avantage d'emballer sous atmosphère modifiée est de prolonger la durée de vie et la fraîcheur des aliments et en même temps d'obvier au inévitable aplatissement ou déformation de la confection. En général sont utilisés trois types de gaz naturels pures et aseptiques comme l'Azote (N_2), Dioxyde de carbon (CO_2) et Oxygène (O_2).

Moules

La dimension du moule permet de confectionner beaucoup de formats, singuls our multiples, jusqu'aux les dimensiones maximes de la chambre d'evacuation (voir la table). L'eventuel remplacement avec des différents moules est très simple, rapide et pratique. La partie supérieure du moule, réchauffée, est couverte de tephlon pour garantir une longue durée et elle est façonnée avec le profil de la barquette.

Film de scellage

Le film de scellage, en rouleaux, c'est placé sur la partie supérieur de la machine.
Le déroulement du film est effectué avec l'introduction du moule.

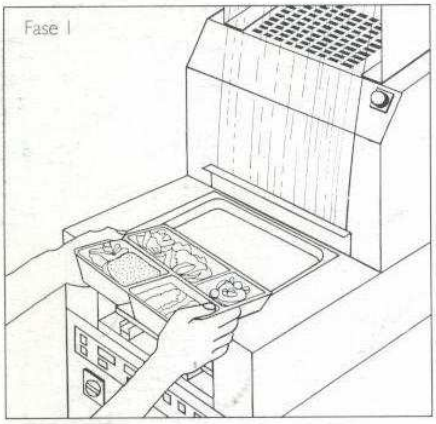
Dati tecnici
Technical data
Dates techniques

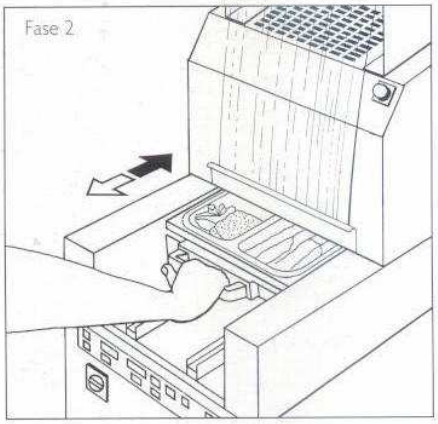
Quick

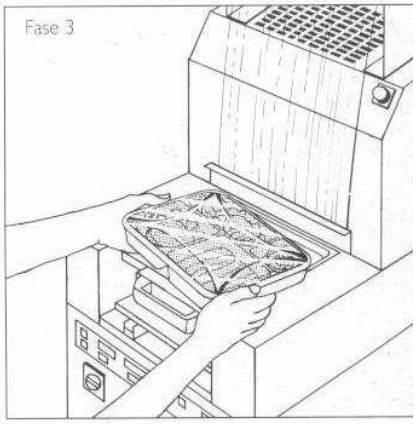
Modello	Model	Modèle	Quick 40
Larghezza macchina	Machine width	Largeur de la machine	520 mm
Altezza macchina	Machine height	Hauteur de la machine	1145 mm
Profondità macchina	Machine depth	Profondeur de la machine	770 mm
Peso ca.	Weight approx.	Poids approximatif	240 kg
Dimensione massima vaschetta	Maximum tray dimensions	Dimensions max. de la barquette	350 x 290 mm
Altezza massima vaschetta	Maximum tray depth	Profondeur max. de la barquette	100 mm
Pompa vuoto	Vacuum pump	Pompe à vide	40 m^3/h
Max. largh. bobina film sigillatura	Maximum upper web width	Laize max. du film d'operculage	340 mm
Cadenza cicli	Cycle capacity	Cycle cadence	2/4 min.
Stampo a fustella adattato al profilo della vaschetta	Cutting system adapted to the tray shape	Système de découpe adapté à des barquettes	*
Tastiera digitale	Digital pannel	Clavier digital	•
Scheda a microprocessore con 10 programmi memorizzabili	Microprocessor card control with 10 programs in memory	Microprocessor fiche avec 10 programmes de mémoire	•
Connessione per gas inerte	Inert gas connection	Connection de gaz inert	•
Stop emergenza	Emergency stop button	Bouton arrêt d'urgence	•
Termoregolatore digitale	Digital thermoregulator	Thermoregulator digital	•
Segnalazione guasti	Warning signal	Signal en panne	•
Aria compressa	Compressed air	Air comprimé	70 Nl/min. 6 bar
Alimentazione	Electrical supply	Raccordement électrique	230/400V - 50/60 Hz - 3 ph. + N + E
Potenza elettrica	Power consumption	Puissance électrique	2500/3500 W

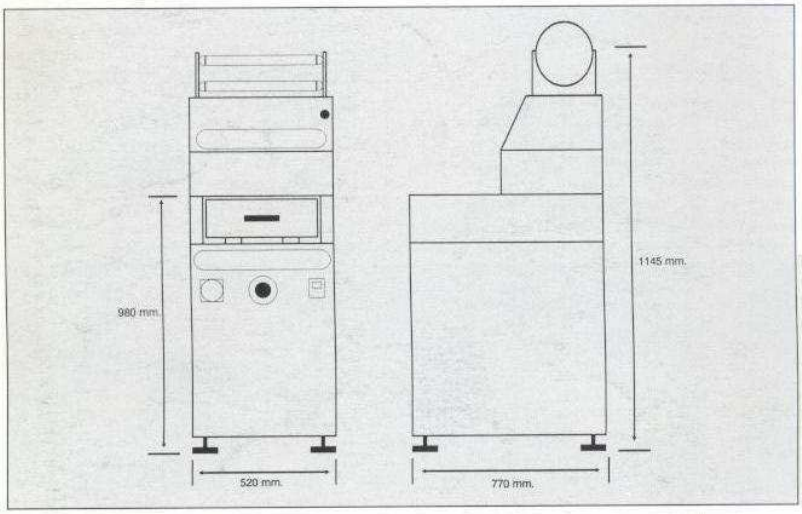
• Standard. - Standard feature. - Équipment standard.

* A richiesta. - Optional feature. - En option.









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MAP SEAFOOD – PRELIMINARY TRIALS

TRIAL ONE – TEST CALIBRATION on 1/12/00

Tray Size: 7” x 5” x 50 mm

Results

Trial No	Vac	Gas	Time	Temp	RH Gas	LH Gas
	(%)	(%)	(sec)	(C^o)	kPa	kPa
1	30	-	1	125	-	-
2	25	-	0.7	125	-	-
3	20	-	1.0	125	-	-
4	20	10	1.0	125	1000	400
5	20	15	1.0	125	1000	400
6	**20**	**20**	**1.0**	**125**	**1000**	**400**

Conclusion

Trial 6 presented the best parameters for MAP packaging producing a great seal and a slight pillow of gas.

TRIAL TWO – MAP on 1/12/00

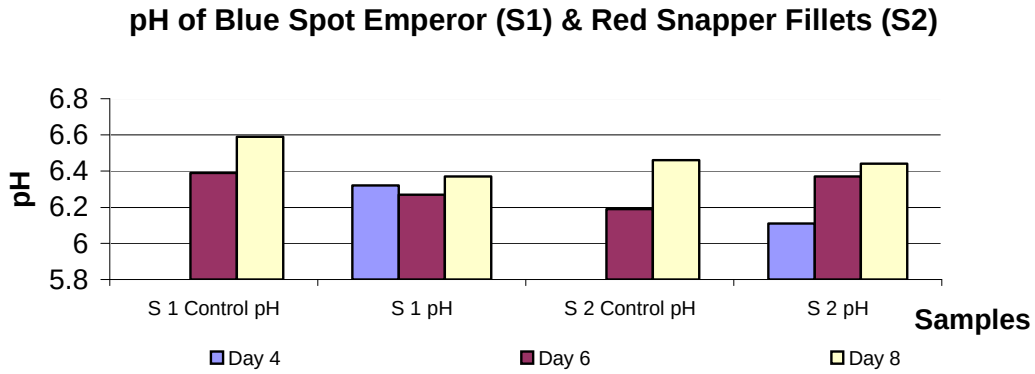
General

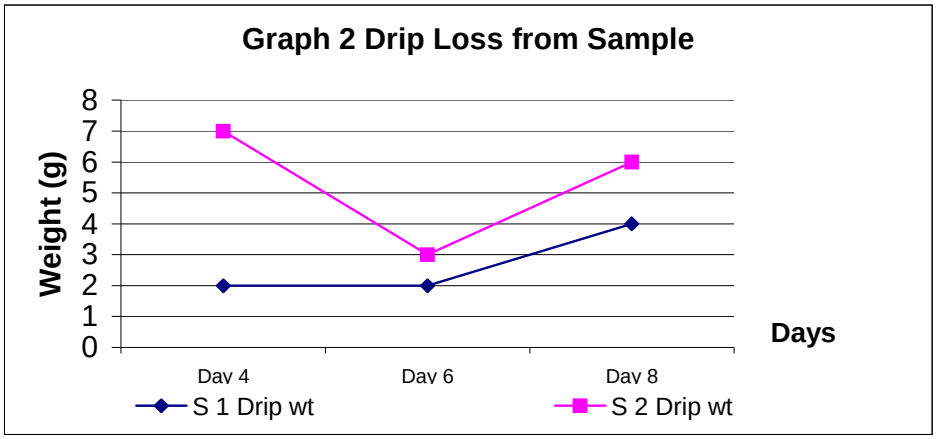
MAP parameter as trial 1.
Sample 1 Blue Spot Emperor Fillet
Sample 2 Red Snapper Fillet
Pack parameters 150g – 200g

Cooking – fish fillet wrap with glad wrap and cooked in microwave for approximately 1 min.

Result

Sample	Control		pH	Drip	Cooking	General
	pH	General appearance		Wt		Appearance
Sample 1						
Day 4	-		6.32	2	Ok	5
Day 6	6.39	**Good/ok**	6.27	2	Ok ,slight strong odour	5
Day 8	5.69	**Off odour**	6.36	4	Good	5
Sample 2						
Day 4	-	**Ok**	6.11	7	Good	5
Day 6	6.19	**Ok**	6.37	3	Good strong odour	5
Day 8	6.46	**Ok**	6.44	6	Good fish smell	5





Conclusion

Graph 1 indicates that there is an increase in pH for the fillets packed in MAP and the control as the day progress. Drip weight is a measure for moisture loss from the fillet in MAP packing. Sample 2 had double the moisture loss at 9.1% compared to sample 1 with 4.1%. Assessments on the general appearance of the fillets indicate Sample 2 had a greater deterioration compared to Sample 1.

Blue Spot emperor fillet is a better fillet for MAP packaging compared to Red Emperor fillet.

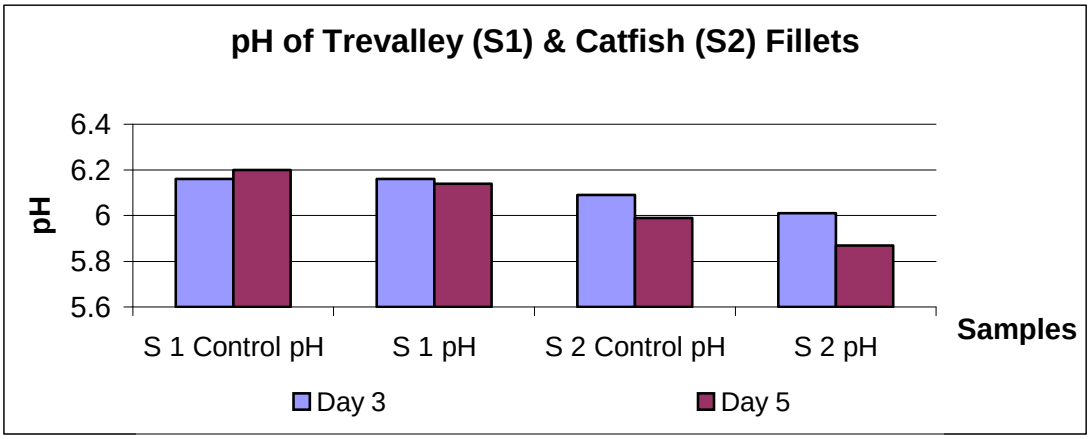
TRIAL THREE – MAP on 4/12/00

General

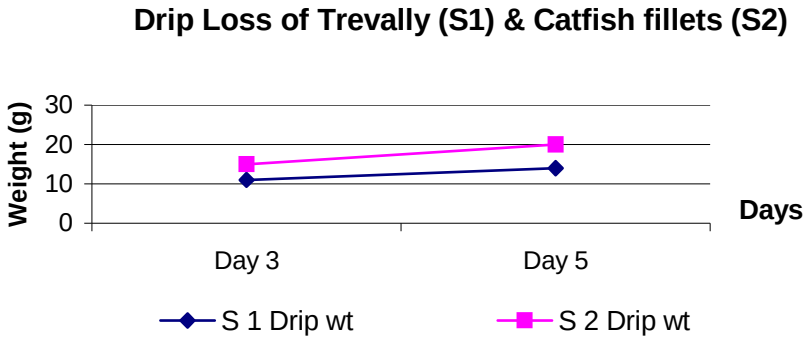
11 x 9 x 40 mm
800 – 900 g weigh per packet
Parameter – 17.5% for Vacuum and Gas, 1 sec, 125^{o}C
Sample 1 Trevalley fillet
Sample 2 Catfish fillet

Results

Sample	Control		pH	Drip	Cooking	General
	pH	General appearance		Wt		Appearance
Sample 1						
Day 3	6.16	**Good**	6.16	11	Good	5
Day 5	6.20	**Good/ok**	6.14	14	Good	5
Day 9						
Sample 2						
Day 3	6.09	**Good**	6.01	15	Good	5
Day 5	5.99	**Good**	5.87	20	Good	5
Day 9						5



Conclusion



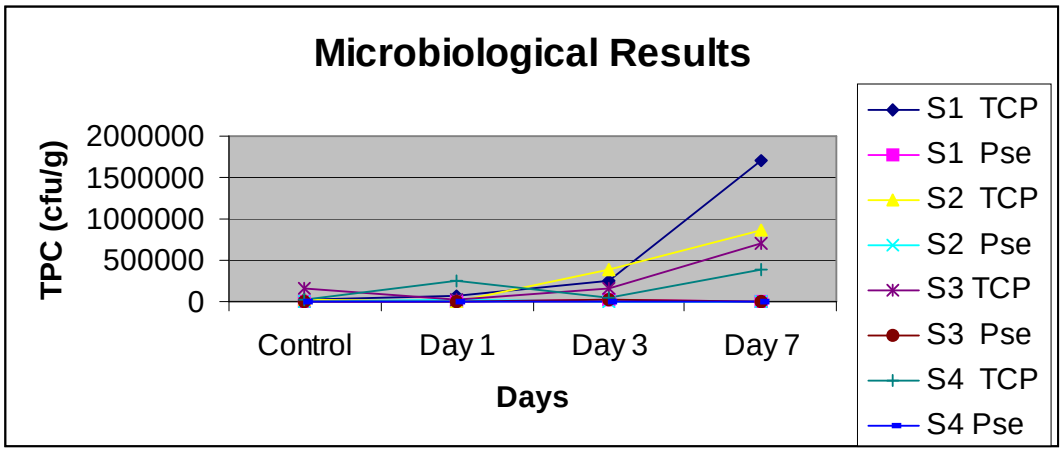
The bulk packaging had a 50% headspace and fillets packed in bulk MAP have a good overall appearance. No microbiological samples were performed on this trial.

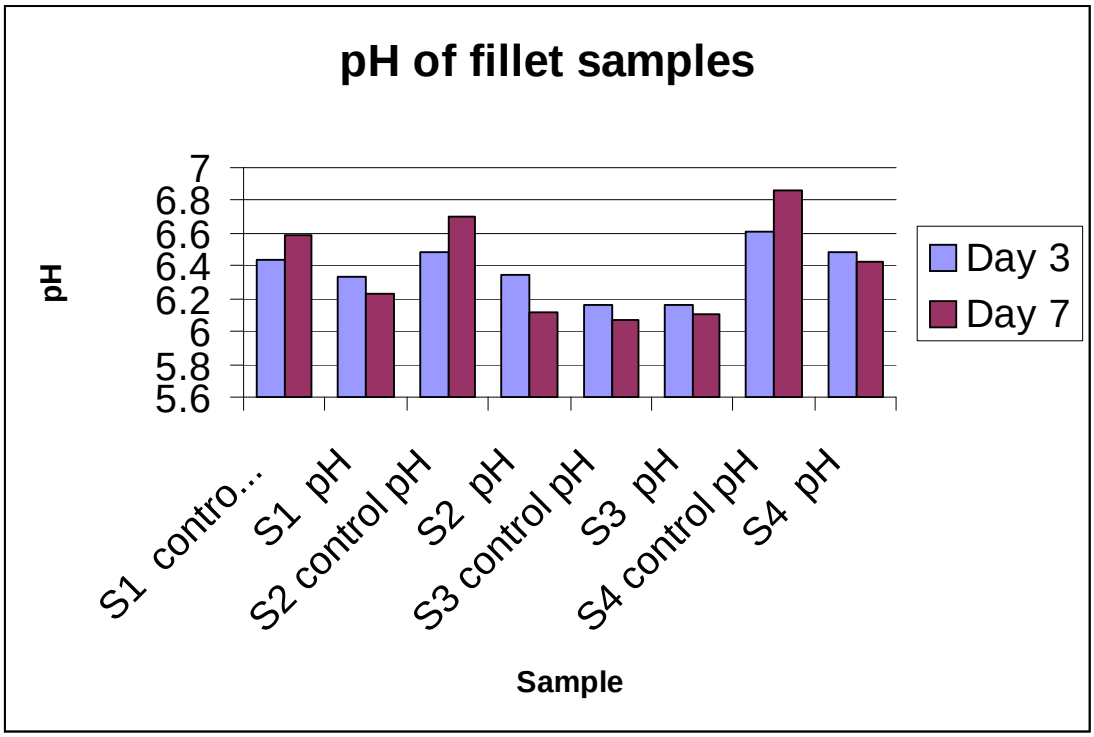
TRIAL FOUR – MAP on 12/12/00

General

7 x 5 x 40mm
MAP parameters – 17.5% gas and vacuum, 1 sec and 125^{o}C
Sample 1 Blue Spot Emperor Fillet
Sample 2 Big Eye Fillet
Sample 3 Cat fish Fillet
Sample 4 Silver Whiting Fillet

Results





Conclusion

The tray size 7x5x40mm appears to have a better overall appearance compared to the 7x5x50mm as used in trial 2. The micro results indicate that the hygiene handling of the fillets can be improved but generally the microbial counts were below the 10^6 industry standard.

Map Trial Tuesday 21st August

Gas Composition: 40%CO2 30% N@ 30% O2
%Vacuum 50% %gas 50% sealing temp 125 sealing time 2 secs

	DAY1						DAY4					
Species		In House						In House				
	Micro	Gas			**Drip loss**	**Sensory**	**Micro**	Gas			**Drip loss**	**Sensory**
		CO2	**O2**	**N2**				**CO2**	**O2**	**N2**		
Blue Spot Emperor	200,000	20.9	26.8	52.3	10gms	good	>2.1m	15.4	28.6	56	24gms	good
Scarlet Perch	26,000	21.8	26.8	51.4	2gms	good	>2.1m	17.1	26.4	56.5	6gms	good
Red Snapper	110,000	22	27.1	50.9	2gms	good	>2.1m	19.4	28	52.6	6gms	good
silver cobbler	77,000	20	27.8	52.2	9gms	good	>2.1m	9.8	28.7	61.5	11gns	good

	DAY7											
Species		In House										
	Micro	Gas			**Drip loss**	**Sensory**						
		CO2	**O2**	**N2**								
Blue Spot Emperor		13.4	26.9	59.7	25gms	good						
Scarlet Perch		23.8	18.9	57.3	6gms	off						
Red Snapper		17.5	25.3	57.2	5gms	off						
Silver Cobbler		12.8	28.6	58.6	11gms	good						

Note: slight collapse on all packs from day 4 : Red snapper not visually appealing on day 7

Weights listed below
Gas Composition: Nil
Control

	DAY1						DAY 4					
Species		In House						In House				
	Micro	Gas			**Drip loss**	**Sensory**	**Micro**	Gas			**Drip loss**	**Sensory**
		CO2	**O2**	**N2**				**CO2**	**O2**	**N2**		
Blue Spot Emperor	490,000		20.7	79.3	12gms	good	>2.1m	1.9	18.2	79.9	22gms	good
Scarlet Perch	300,000		20.7	79.3	1gm	good	>2.1m	4.2	14.3	81.5	5gms	slight odour
Red Snapper	57,000		20.5	79.5	4gms	good	>2.1m	1.7	19.6	78.7	5gms	good
Silver Cobbler	130,000		20.6	79.4	6gms	good	520,000		19.8	80.2	8gms	good

	DAY7											
Species		In House										
	Micro	Gas			**Drip loss**	**Sensory**						
		CO2	**O2**	**N2**								
Blue Spot Emperor		6.8	12	81.2	15gms	ok						
Scarlet Perch		10.6	1.83	87.57	3gms	off						
Red Snapper		2.9	15.6	81.5	5gms	ok						
Silver Cobbler		1.5	17.7	80.8	4gns	off						

TRAY WEIGHTS: Control - No Gas

Species	**Day1**	**Day4**	**Day7**
BS Emp	316g	250g	250g
S Perch	120g	272g	168g
Red Snapper	198g	202gm	226g
Cobbler	268g	204g	174g

Tray Weights: Gas 40%CO2 30% N2 30% O2

	Species			**Day1**	**Day4**	**Day7**						
	BS Emp			240gm	230gm	326gm						
	S Perch			220gm	224gm	208gm						
	Red Snapper			240gm	250gm	236gm						
	Cobbler			294gm	266gm	236gm						