SHELF STABLE CARP BASED SMALLGOODS
PROJECT No. 97/414

Aim.
The purpose of the project is to apply modern meat processing technology to the preparation of shelf stable Carp (Cyprinus carpio) from Australian waters. Further the project is designed to evaluate the products produced in terms of whether there is consumer appeal for them, how to present the products and define the production processes necessary to produce safe products.

Background.
Carp (Cyprinus carpio), is ubiquitous in some Australian fresh water systems. It is not indigenous to Australia. Apart from the fact that after illegal importation it has multiplied and spread successfully to the point of being classified as a pest.

Despite the fact that Europeans cherish Carp as a delicacy and present it in many culinary ways it is not generally acceptable into current Australian culture as a food. In addition observation from general fish processing technology such as smoking, there is little adaptation of red meat processing technology. Yet both food sources are protein based and can be often treated in the same manner.
Value adding to Carp has the possibility of increasing consumption by consumers and increase viability of Carp fishing. Currently much of the Carp caught from the southern river ends up as fertilizer, with little value-adding.

Currently it is possible to purchase Carp for about $1.80 per Kg live weight. It must be pointed out however that the price quoted here is an experimental price only and it is assumed that with increased demand for the fish by commercial processors should reduce this price significantly. At this point it is not possible to determine the cost to the processor. At present Carp can be bought as whole fish requiring gutting and filleting. It can also be bought as filleted provided the quantities are economically viable. Fillets and roe constitute 28% and 7% respectively. Leaving 65% of the live weight to be utilized in some other way. Consequently the demand for the fish as a culinary product with appeal will depend on the quality and the ability of the marketers to convince the consumer of the value as a healthy food. This report will describe a procedure whereby not only can the fillets be converted to very acceptable small goods, but the remainder of the fish frame can be converted into fish stock as a cooking aid in the food service area and also for general consumer requirements.

A number of product recipes were tried and evaluated. This report lists those that were the best. One product in particular won the Innovative Seafood Product Competition at the '99 Innovations for Seafood Conference, Surface Paradise.

Production statistics.

The following is based on 500 Kg of freshly caught Carp delivered from southern NSW in ice filled crates. Cost $1.80 per Kg. This is considered to be an unreal cost. However it will serve to illustrate the production costs necessary for commercial processing. Filleting takes about 4 hours for 2 people, and the yield is as follows 28-30% fillets suitable for freezer storage, 7 % roe and the remainder 65% is frame and internal organs.

Table 1. Processing costs to produce filleted Carp

500 Kg fresh whole Carp @ $1.80	$900.00
4 hours labour at $13.61 per hour for 2	$108.88
Factory overhead at 65% of direct cost	$544.40
Total cost for producing 140Kg of fillets for freezer storage. (28% of fish weight)	$1553.28
Filleted Carp cost per Kg	$11.10

Table 1 indicates the need for the fish to be obtained at a more reasonable cost for the filleted Carp to compete with red meat in the market place. Experimentally the cost of fish represents 67.4% of the cost of goods (COG)

which is commercially not viable. Increased demand for the fish will reduce the cost to between $0.7 to $.90 per Kg. The COG per fillet will be reduced to $7.88 per Kg. To convert the fillets to small goods however the price of the finished product as prepared in this project would increase to between $2.00 to $4.00 per Kg COG. This price is competitive with other fish products and processed meat products currently available in the market place. These costs are based on the running costs of a small goods factory with significant infra structure.

It was however possible to obtain filleted Carp at $3.50 per Kg from a supplier. Clearly this supplier had a different operation with a different cost structure.

Carp Small Goods Prepared.

There were many product types that could be produced using frozen or fresh filleted Carp. Those chosen and tested in the market place were frankfurts, sausages, Carp ham, Carp bacon and Carp salami. These products, the processes and characteristics described below, were chosen, as they required application of common modern meat processing technology. All products were prepared in a commercial food operation practicing HACCP principles.

The roe although acceptable to a few was found to have a strong fish flavour, not easily camouflaged and abhorrent to many people. The potential to pickle or pate the roe is real but was not evaluated in this program.

I. Carp Frankfurt

Table 2. Proximate Analysis of Carp Frankfurt

Component	Carp Frankfurt % w/w
Carp fillet	50
Soy protein isolate	3.8
Fat	21.63
Salt	2.0
Sodium nitrite	0.14
Phosphate as poly phosphate	0.4
* [1]Seasonings	0.4
Added water	21.63%

Method of preparation

1. Prepare Soy fat emulsion by adding to a high-speed meat cutter one part soy isolate (90% protein) and 6 parts ice water. Cut this mixture to a uniform consistency then add 6 parts by weight fat slowly while continuing cutting/emulsifying. The fat can be either pork back fat or vegetable oil. Continue to emulsify the mixture until a firm mass is obtained. Remove the soy fat emulsion from the cutter and store refrigerated or frozen until required for production later.
2. To a high-speed cutter/emulsifier add the required amount of frozen filleted Carp meat.
3. Start the cutter on low speed and add the poly phosphate, salt, and nitrite.
4. Increase the speed of the cutter/emulsifier to produce a fine smooth emulsion.
5. Add the frozen soy emulsion and the seasoning and continue to cut/emulsify the mixture to a smooth emulsion.
6. Transfer the mixture to sausage filler and fill into 22mm collagen casing.
7. Transfer to a smoke house and cook to an internal of 75 °C with a smoke house temperature of 85 °C for 4 hours.
8. Remove from the smokehouse and allow cooling before chiller storage followed by vacuum packaging.

*[1] Typical seasoning can be, per Kg batter white pepper 4.4 g, ground mace 1.2 g, ground mustard seed 2.0 g, onion powder 0.6 g, garlic powder 0.2 g, sodium erythorbate 0.05 g.

II. Carp sausage (Chippolata style)

Table 3. Proximate Analysis of Carp Sausages (Chippolata style)

Component	Carp Sausages % w/w
Carp fillet	50
Soy protein isolate	3.8
Fat	21.7
Salt 2.15	
Poly phosphate	0.3
Sodium meta bisulphite	0.06
Milk protein emulsifier	0.2
*[2] Seasoning	q.s

Method of preparation.

1. Prepare a soy protein fat emulsion as described for the Carp Frankfurt.
2. To a high-speed meat cutter/emulsifier add the Carp fillets, salt, milk protein emulsifier and seasonings.
3. Start the cutter on slow speed and add the soy fat emulsion.
4. Cut the emulsion to a smooth uniform consistency. Do not let the cutter temperature to rise above 12 °C.
5. Remove the batter form the cutter and transfer to sausage filler.
6. Fill into natural hog casing approximately 22-mm dia.
7. Store in chiller or freezer depending on the mode of distribution.

*[2] Typical seasoning can be, per Kg batter, ground black pepper 2.0 g, onion powder 1.0 g, Nutmeg powder 1.0 g, ginger powder 1.0 g, garlic powder 0.5 g.

III Carp Ham.

Method of preparation.

1. Soak carefully chosen intact frozen or chilled fillets in a fresh *[3] pickle brine for 8 hours at approximately 8 °C.
2. Transfer the cured fillets to a smokehouse and cook and hot smoke to an internal temperature of 68 °C, following the following temperature regime; dry for 40 min. at 40 oC with no added humidity, smoke 10 min. at 40 °C, dry 7 min at 40 °C, smoke 8 min at 40 °C, set smokehouse at 72 °C; RH at 80% and cook to the internal temperature of 68 °C.
3. Remove from the smokehouse.
4. Chill.
5. Slice and or vacuum pack.

*[3] Pickle formulation used is as follows: Salt 50 g/Lt, Sucrose 14 g/Lt, Sodium nitrite 1 g/Lt, Sodium tri poly phosphate 30 g/Lt, Smoke powder 0.7 g/Lt, MSG 1.0 g/Lt.

IV Carp Bacon.

Method of preparation.

1. Soak carefully chosen intact frozen or chilled fillets in a fresh *[3] pickle brine for 8 hours at approximately 8 °C.
2. Transfer the cured fillets to a smoke house and cook and cold smoke to an internal temperature of 48 °C.
3. Remove from the smokehouse.
4. Chill.
5. Slice and or vacuum pack.

V Carp Salami.

Table 4. Proximate Analysis of Carp Salami

Component	Composition % w/w
Soy fat emulsion (frozen)	45.8
Carp Fillet (frozen)	50.0
Sodium nitrite	0.07
Salt	2.8
White pepper	0.2
Sucrose	0.08
Sodium erythorbate	0.05
Malto dextrin	0.6
Dextrose	0.2
MSG	0.15
*[4] Lactic starter culture	Min 1000 per gram.
Lemon zest	0.05

Method of preparation.

1. Add the Carp and the frozen soy emulsion to a cutter and cut at slow speed.
2. While cutting ad the other ingredients listed above in Table 4. Leaving the starter culture to last.
3. Alter the speed of the cutter until the texture of the block batter is reduced to the desired particle size.
4. Transfer to a sausage filler
5. Fill into 75 x 50 mm modified cellulose casings.
6. Commence incubation at 20 °C, 98% RH for 12 hours.
7. Continue at 20°C, 90% RH, for a further 12 hours.
8. Change the RH to 88% and continue fermentation at 20 °C for 12 hours.
9. Alter the RH to 86% and the temperature to 18 °C for 12 hours
10. Finish off the fermentation at 16 °C, 86% RH for another 12 hours.
11. Allow the salami to mature at room temperature until the a_w reaches 0.92.

*[4] Lactic starter cultures used were a mixture of Lactobacillus plantarum, Lactobacillus saki, Staphyloccus carnosus, and Staphyloccus xylosus.

VI Consumer acceptance testing.

All products described above were tested for acceptability using teams of people ranging in number from 8 to 10. The product was presented as a cooked product in the case of Carp Frankfurt and Carp sausage. The Carp Frankfurt were immersed in just boiled water and left for 10 minutes before serving and the sausages were fried in a a non stick frying pan. The consumer panelists were asked to simply indicate their opinion of the product and whether they would consider them suitable for their consumption. They were also asked whether or not the products had a distinctive flavour or could be prepared better in some way. The panelists were not told the products were fish based.

In all cases the Carp Frankfurt and the Carp Sausages were considered acceptable by all panelists. One in 8 indicated that the frankfurts could have had a stronger smoke flavour and 2 in 10 panelists indicated that more pepper could be incorporated in the Carp Sausage.

At the completion of the tasting the panelists were told that the products were fish based at which time a strong negative reaction was initially observed.

The Carp Ham on the other hand was presented as thinly sliced slivers for nibbling. The panelists clearly knew that the product was fish based and were asked to comment. The major response was that it was a pleasant smoked fish suitable for salads. The panelists equated the product with that of smoked salmon although the pink colour of salmon was not developed to the salmon intensity.

The Carp bacon on the other hand was diced into small 5-mm cubes fried as bacon would be and presented to the panelists for identification. Nine of the ten panelists had no problems in identifying the product to be bacon like and all were extremely surprised to learn the product was a derivative of the fish Carp.

The Carp salami was presented to people for comment only. In general it was found to be rather bland in flavour. Although the technology to produce fish salami has been shown to work. The flavour profiles need more innovation.

All products prepared from Carp were presented to a number of chefs from the Sydney CBD hotels. Their conclusion is that the Carp ham and the Carp bacon would certainly have a place in their menu development. Similarly the Carp sausage and frankfurt. However the overall reaction to using the term fish or Carp as a prefix to a common smallgood is not a market option at present. Clearly for the products to be accepted by the normal consumer more innovation is required in terminology and the significance of the lack of red meat in the products emphasized.

VI Preparing Carp fillets with "muddy" taint.

It was found the simplest method for de-tainting Carp fillets was to simply soak them in a mixture of fresh lemon juice diluted 90% with cold water and leave them for a period of about 12 hours. Fillets treated this way were easily stored at freezer temperatures waiting for further processing. It must be pointed out however that the majority of Carp used for the project did not appear to have a taint problem.

VII HACCP considerations.

Table 5. The process for the preparation of Carp can be tabulated as follows in a simple HACCP table.

Process Critical Point	Critical Issue (Hazard)	Risk	Control of Risk
Received fresh Carp from regional NSW in plastic tubs filled with crushed ice	Crushed ice found to be often dirty. Algae slime on fish.	Risk of bacterial contamination.	Wash the Carp in running water before scaling and filleting. Ensure catch date is known. Obtain guarantee of constant storage at <4°C
Filleting the Carp	Scales are large and difficult to collect. Internal organs often break. Roe membrane often breaks.	Contamination from internal organs always a possibility.	Separate all parts of the fish into clearly marked containers and wash the fillets in fresh running water. Soaking the fillets in water acidified with natural acids and lactates will reduce bacterial growth. Freezer storage of fillets is strongly recommended.
Processing of the Carp fillets into small goods	The risks here are no more than those experienced by meat smallgoods operators.	Poor factory hygiene.	All raw materials must have minimum bio burden. All machinery must be thoroughly cleaned and sanitized prior to use. Regular TPC to be carried out and trend records kept. All temperatures and times

			for processing must be adhered to and recorded. Storage temperatures even those of vacuum packs must be controlled.

VIII Process for use of 70% of Carp.

As stated earlier the COG resulting wholly from the use of Carp fillets for smallgoods preparation is not satisfactory. However it is possible to utilize the Carp frame (composed of head, spine tail and fins) for the production of fish stock. This process is not necessarily capital intensive if the final product is hot filled and then stored at freezer temperatures. Ideally the final product should be UHT treated prior to packaging. Stock made using this process is currently available in the market place. However a pasteurizing process could also be implemented into a small factory operation without great capital cost.

Fish stock has a ready market especially in the area of Asian cooking. The procedure reported here was an experimental process and the authors believe that scale is within common food engineering processes. Some refining to the finished product need to be carried out to control the gelatin content of the finished stock, batch to batch. The most probable method for this would be by blending prior to stock packaging.

The process is as follows.

1. Washed Carp frames, the residue from filleting are transferred to a steam kettle to which water is added at 50% of the frame weight.
2. Steam kettle cooking is carried out for 4 hours.
3. The hot stock is filtered through a suitable fine filter such as a GAF filter or similar into a suitable storage tank.
4. Density and solids content is measured.
5. Stock with the suitable solids content and density is then either pasteurized into sterile containers or UHT filled into shelf stable packs. Canning into large A10 cans also an option for the food service industry.

IX Conclusion

The use of Carp fillets for the production of small goods as shelf stable as red meat smallgoods has been demonstrated as viable and acceptable to the market place. This is more than demonstrated by the fact that the Carp bacon won the Innovative Seafood Product Competition at the '99 Innovations for Seafood Conference, Surface Paradise.

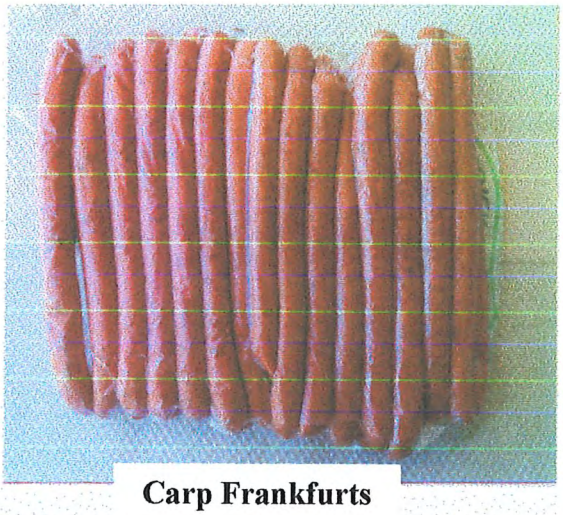
The consumer is not totally accepting of the prefix fish, being applied to products commonly associated with beef, lamb, pork or poultry. Clearly some innovative terminology needs to be devised along with a consumer training program to accepts the nutritional benefits of fish based smallgoods.

This project has also demonstrated the ability to produce a solid fermented fish product, the salami. Products are not known here and there is some doubt that similar products such as a fish salami is made anywhere else in the world. From this point of view the project has been novel.

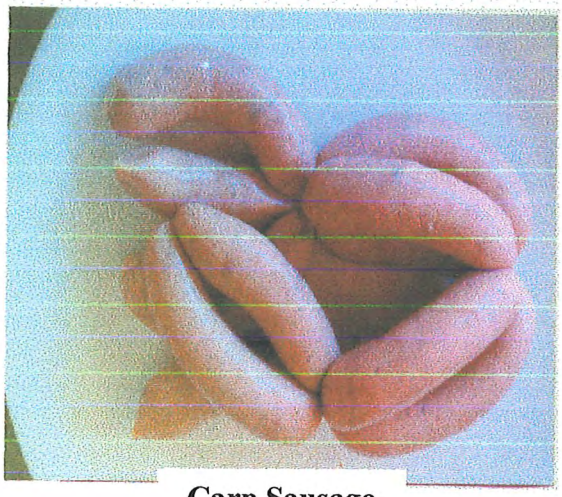
From the costing information presented it is clear that the price of fresh Carp must be reduced well below the $1.80 charged by the suppliers used for this project. In addition the Carp suppliers must become more reliable. During the project two suppliers had to search because of supply unavailability. The potential to utilize the frame for stock manufacture is however an added boosts to the economics of the project. The combination of both fillet utilization and frame utilization constitutes approximately 70% of the animal being suitable for converting into consumer acceptable products. The remainder can of course be rendered into stock feed or fertilizer that is taking the bulk of Carp catches at present.

Commercialization.

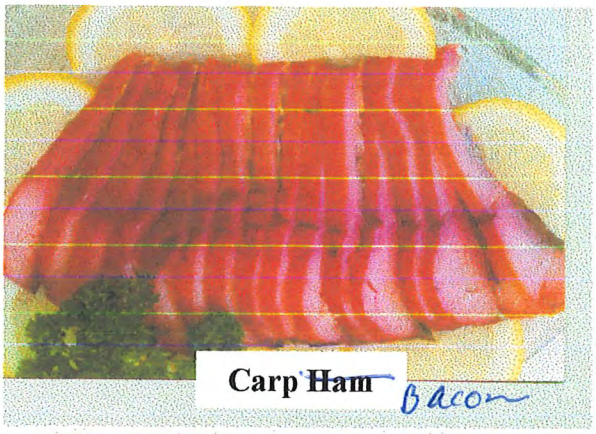
Because of the success with the production of Carp ham and bacon these products will be promoted to the hotel catering personnel. Thereby allowing for the initial penetration of carp protein into the consumer market.



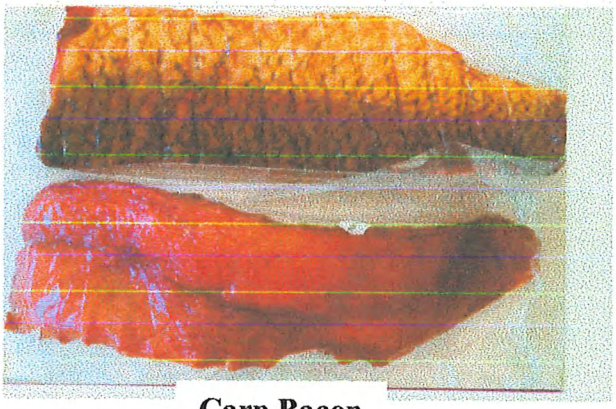
Carp Frankfurts



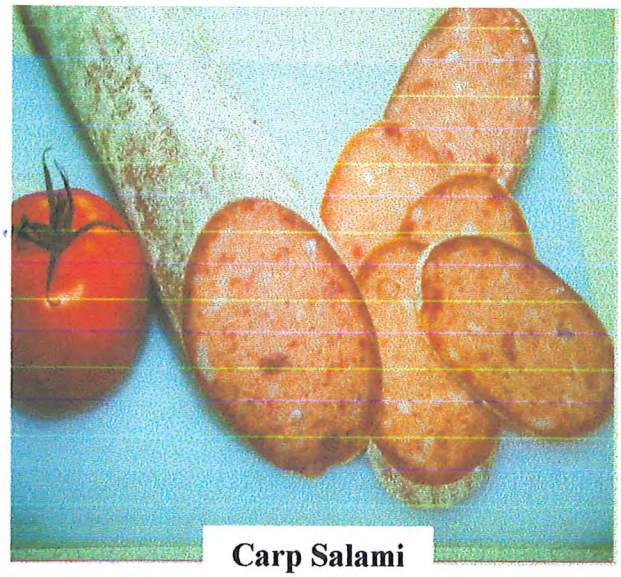
Carp Sausage



Carp ~~Ham~~ Bacon



Carp Bacon



Carp Salami