

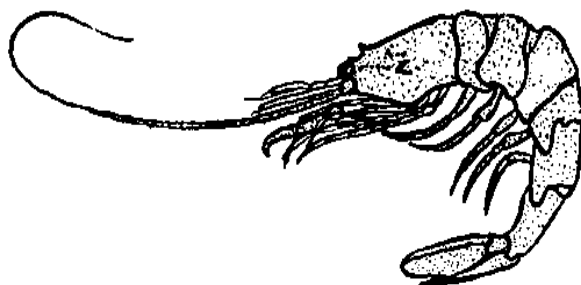
PRAWN ,SHIRMP,LOBSTER PROCESSING

Types of Shrimp:

BROWN SHRIMP

The brown shrimp, *Crangon crangon*, is found mainly in shallow water, from 0-12 m, around the British coast, and grows to a length of about 60 mm. Its greyish brown colour, and the absence of a pointed snout or rostrum, readily distinguish it from shrimps of the *Pandalus* family. It occurs mainly on soft sandy or muddy bottoms and is often abundant in or near estuaries; it can withstand fairly wide fluctuations in the temperature and saltiness of the water, and lives for 3-4 years.

Fig. 1. Brown shrimp *Crangon crangon*.

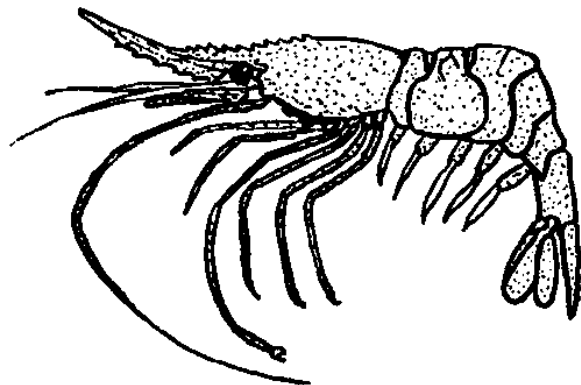


PINK SHRIMP

Although all species of *Pandalus* are pink, it is recommended that the name pink shrimp be applied in Britain to *Pandalus montagui*, one of the smaller species. Local names include prawn, sprawn and, for small specimens, smig.

The pink shrimp is caught mainly on hard bottoms in waters 5-30 m deep, and is often found near colonies of ross, a marine worm on which it sometimes feeds. It is fished extensively in spring and summer, but in late autumn it moves into deeper waters, 30-60 m, where the female carries eggs from about November to April, when the eggs hatch and the shrimp move inshore again. The pink shrimp reaches commercial size, about 50 mm, when 2-3 years old, and reaches a maximum of about 75 mm at the end of its life span of 3-4 years. *Pandalus montagui* changes sex; both males and females are hatched, but the males change sex after a period and then behave as females. The pink shrimp is most abundant in spring and summer. *Pandalus montagui* can be distinguished from *Pandalus bonnierii* and *Pandalus borealis* most easily by its smaller size and by the red and white stripes on the antennae which give a barber's pole effect.

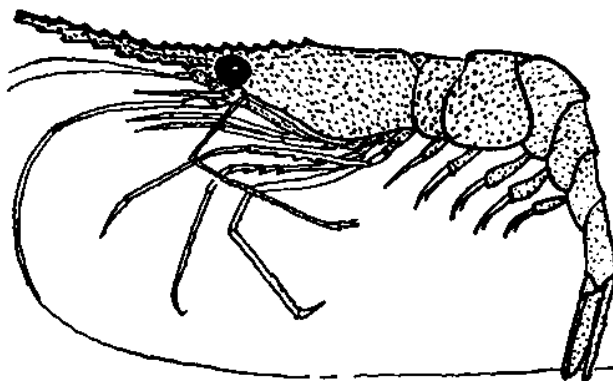
Fig. 2. Pink shrimp *Pandalus montagui*.



DEEPWATER SHRIMP

The deepwater shrimp, *Pandalus borealis*, is a large species of shrimp, and as the name implies it occurs off the British coast mainly in deeper waters, particularly on the Fladen and Fame Deep grounds in the northern North Sea, and off Norway. There are unexploited stocks of *Pandalus bonnier*, another large species of shrimp, off the west of Scotland, particularly in the Minch, the Clyde estuary, and in the Irish Sea.

Fig. 3. Deepwater shrimp *Pandalus borealis*.



Pandalus borealis and *Pandalus bonnier* both grow to a length of 100-120 mm, and live for 3-4 years. They are so similar in appearance that for trade purposes they can be considered identical. They are found on soft grey muddy bottoms in depths from 40-120 m, with the main concentrations in deep holes. They feed on small worms, crustaceans and debris.

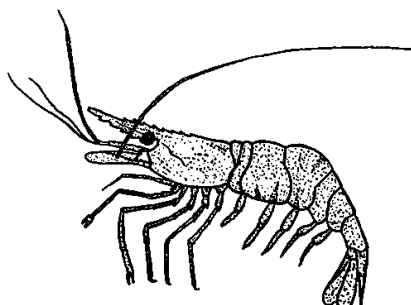
Mature females produce eggs in November and carry them until April when hatching takes place. *Pandalus borealis* changes sex in the same way as the pink shrimp, *Pandalus montagui*, but the two sexes of *Pandalus bonnier* remain completely separate throughout life.

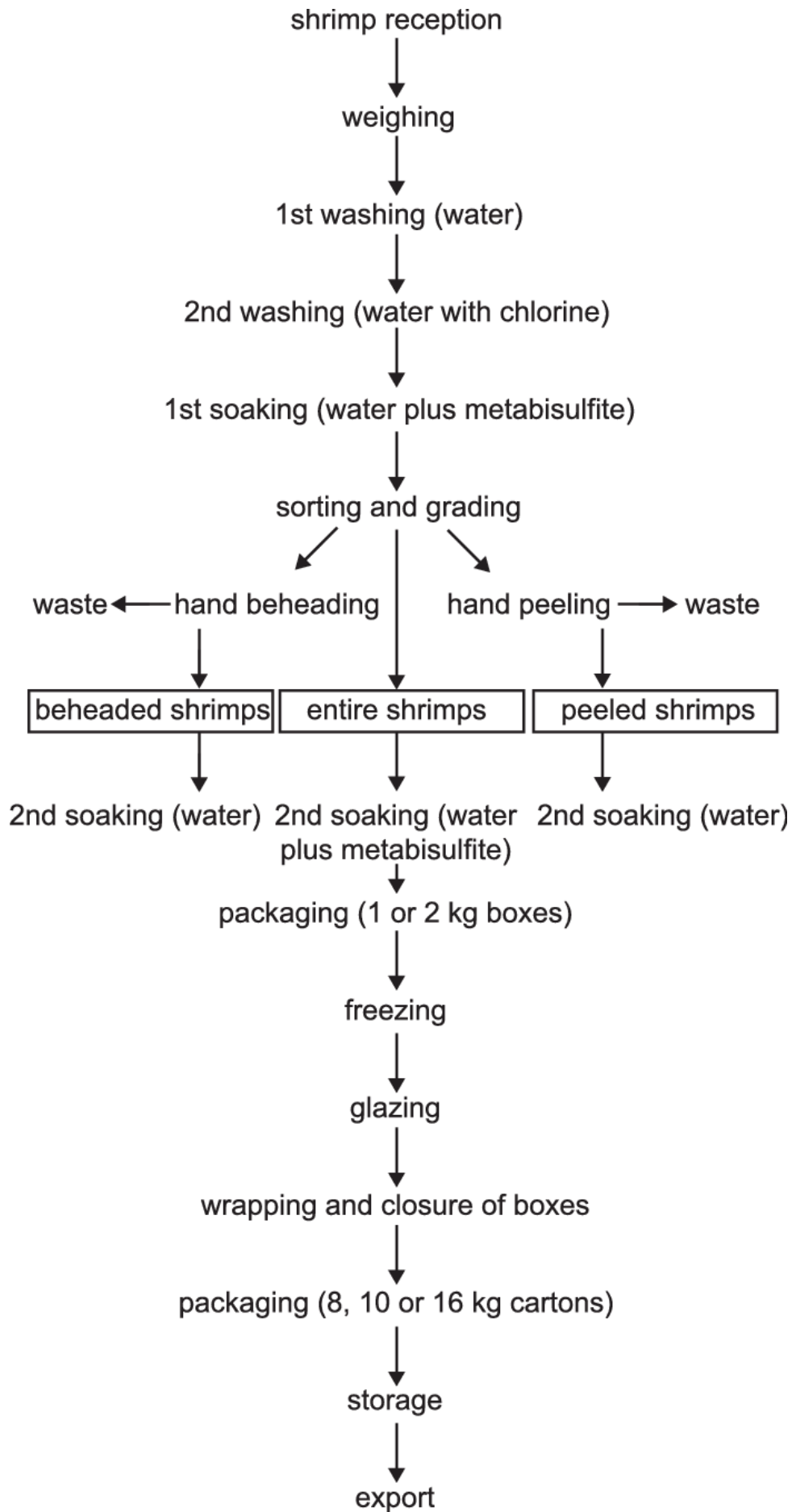
Pandalus borealis appears to be available in quantity throughout the year but *Pandalus bonnier* is most abundant in winter and spring.

PRAWN

The prawn, *Palaemon serratus*, is caught in small quantities on the south and south-west coasts of England, and on the Welsh coast. It grows to a length of about 100 mm, and lives for 3-5 years. Females carry eggs for 2-3 months sometime between December and August, depending probably on the warmth of the water. Prawns occur mostly in rocky areas, and are sometimes captured in pots or hoop nets. Other species of *Palaemon* that grow only to about 50 mm are also found in small quantities. The commercial catch of prawns is insufficient to justify separate listing in landing statistics.

Fig. 4. Prawn *Palaemon serratus*.





Handling shrimp at sea

Care of the catch begins before the cod end comes on board a shrimp trawler. The trawl has to be towed long enough to get a reasonable catch, but unnecessarily long hauls can damage the shrimp in the net. Some fishermen claim that a weighted cod end makes subsequent sorting easier; when the cod end comes up vertically shrimps and flatfish tend to remain in the bottom of the cod end, while round fish move up towards the lengthening piece. It is also said to be possible to give the shrimp a preliminary wash by towing the trawl near the surface just before hauling. The efficacy of these techniques has not been examined at first hand.

Once the shrimp are on board, they must be handled quickly and carefully. Exposure to sun and wind on deck should be avoided, otherwise spoilage will be increased and chilling made more difficult. An awning should be rigged over the deck in warm weather.

The catch is first sorted or culled; other fish, dead or damaged shrimp and rubbish are removed by hand or by sieve. The shrimp are then washed thoroughly in sea water to remove any remaining mud or sand, and to reduce bacterial contamination. The shrimp are drained as much as possible and are then ready for further processing, usually freezing, cooking or chilling.

FREEZING ON BOARD

Shrimp are not frozen at sea on any British trawler at the present time, although the practice is now commonplace in some overseas fisheries, for example in the Gulf of Mexico. The economics of freezing the deep-water shrimp catch at sea, on the Fladen ground for example, may be worth examining in terms of improved quality and increased proportion of fishing time to steaming time.

Shrimp can be frozen at sea by immersion in a cold brine or a solution of sugar and salt, by air blast freezing or by plate freezing. Immersion and air blast freezers are used successfully on shrimp vessels in North and Central America. Freezing in sugar and salt solution is claimed to give an improved glaze on the shrimp, and to make separation of the shrimps easier when thawing.

Deepwater shrimps can be frozen in 10-15 minutes by immersing them in brine at -20°C . Very long immersion times result in an unacceptable product because of excessive uptake of salt. Shrimp can also be frozen satisfactorily in blocks 50 mm thick in a vertical plate freezer; the shrimp are poured into a polyethylene bag between the freezer plates, and the spaces between the shrimp are filled with water. Freezing time for a 50 mm block in a plate freezer operating at -35°C is 90 minutes. The added water gives protection against physical damage to the shrimp, provides better contact during freezing, and reduces dehydration of the shrimp during subsequent storage. The frozen blocks may need a further wrapping, for example in fibreboard cartons, to make them easier and safer to handle on a moving ship.

Cooked whole shrimp can be frozen satisfactorily in a plate freezer in the same manner as raw shrimp, but immersion freezing of cooked shrimp is unsatisfactory because the thawed shrimp are difficult to peel, and the texture of the meat is poorer.

COLD STORAGE OF WHOLE SHRIMP

Frozen shrimp should be stored at sea at -30°C . The frozen shrimp can be transferred to shore cold storage at -30°C on arrival at the port, or thawed immediately for further processing.

COOKING ON BOARD

Cooking immediately after capture helps to retain the best flavour and colour, but food poisoning bacteria can grow rapidly on the product if it becomes contaminated after cooking. In order to reduce the risk of food poisoning, the cooked shrimp must either be frozen on board immediately, or landed and processed ashore the same day. Chilled storage of cooked shrimp at sea for several days cannot be recommended.

Cooking time must be as short as possible; slow boiling results in poor flavour and texture, and the shrimp lose more weight. After sorting and washing, the shrimp are tipped into briskly boiling sea water; batches must be

small enough to allow the shrimp to move freely in the water. Densely packed shrimp will not cook uniformly. The ratio should be about 1 kg shrimp to 5 litres water, and the heat input should be sufficient to cook the shrimp in 6-7 minutes. A typical shipboard boiler may hold about 90 litres of water, and when 18 kg shrimp at 10°C are tipped into this amount of sea water boiling at 101°C, the water temperature will fall to about 86°C.

The water in a shrimp boiler should be changed as often as possible; dissolved protein and dirt in the water may accelerate the production of off odours and flavours in the shrimp.

After removal from the boiler, the shrimp are cooled. On small inshore shrimp vessels this is often done by immersing the shrimp in sea water or by spreading them out on clean canvas or wire mesh trays in the open air. Cooling in sea water can contaminate the cooked product, and canvas or trays are extremely difficult to keep clean. Cooling by evaporation also results in some weight loss. Where possible the cooked shrimp should be packed in polyethylene bags and surrounded by ice; the shrimp can be kept chilled in this way until they are landed later the same day or are frozen on board.

CHILLING ON BOARD

After sorting and washing, the raw whole shrimp are drained and packed in ice in shallow boxes; the time between catching and chilling must be short. A delay of an hour or so on a warm day can cause considerable spoilage.

The box should be not more than about 200 mm deep to avoid crushing the bottom shrimp. A layer of flake ice or finely crushed block ice should be placed in the bottom of the box. A layer of shrimp not more than 50 mm deep should be laid on the ice and covered with more ice. Successive layers of shrimp and ice are then added until the box is full. Boxes must not be overfilled, or shrimp will be crushed when boxes are stacked. The shrimp should still be well covered with ice when they are landed; if they are not, then insufficient ice has been used. As much as 1 kg ice to 1 kg shrimp may be needed in an uninsulated fishroom in summer. The fishroom temperature should be kept at 1-3°C so that the ice melts slowly; meltwater should be free to drain from the bottom of a box.

Raw whole deepwater shrimp stowed in crushed ice will keep in good condition for up to 4 days, but for best results the iced shrimp should be processed on shore within 2 days of capture. The typical shrimp flavour disappears completely after 6 days in ice and the meats become soft, discoloured, and difficult to peel; after 8 days sour fishy odours and flavours develop. Shrimp processing plants on shore should not use iced raw material more than 4 days old for subsequent cooking, peeling and freezing.

Discoloration due to melanosis, or black spot as it is commonly called, is not a serious problem in shrimp from UK grounds, because it normally does not occur until after the shrimp have spoiled so much as to be already unacceptable.

Refrigerated sea water, rsw, can be used as an alternative to ice for the stowage of raw whole shrimp at sea. The shrimp will keep in good condition for up to 4 days in rsw at 0°C, but for best results they should be processed on shore within 2 days of capture. A suitable stowage rate is 2 kg shrimp to 1 litre of water; the sea water can be refrigerated mechanically or by the addition of ice.

Deepwater shrimp stored in rsw have a generally more attractive appearance than iced shrimp of the same age; the raw whole shrimp look cleaner and have a better pink colour, and the cooked meats are again pinker than their iced counterparts. There is some uptake of salt; raw rsw shrimp contain about 2 per cent by weight of salt after 2-3 days storage, which is normally an acceptable concentration.

Handling shrimp on shore

Whole raw shrimp should be processed at factories close to the ports of landing. Unless freezing facilities are available on board the catcher, all processing, including cooking, is better done ashore. Inshore species of shrimp as well as deepwater shrimp can be cooked and further processed on shore under more hygienic conditions with little loss of quality if they are iced at sea immediately after capture.

FREEZING OF WHOLE SHRIMP

The methods described earlier for freezing shrimp at sea are equally applicable on shore, provided the chilled raw material is frozen within 2-3 days of capture; the thawed product can then be used for further processing in the same way as fresh shrimp.

COLD STORAGE OF WHOLE SHRIMP

Whole shrimp, raw or cooked, frozen individually in air blast or in blocks with water in a plate freezer, will keep in good condition in cold store at -30°C for at least 6 months. Individually frozen whole shrimp will keep for 3-4 months in good condition at -20°C, and for only 1 month at -10°C; whole shrimp stored at -10°C are more difficult to peel when thawed. Blocks of shrimp with added water will keep a little longer at these temperatures, up to 6 months at -20°C and 2-3 months at -10°C. It is recommended that wherever possible whole shrimp being stored for an indefinite period should be kept at -30°C.

Raw and cooked frozen whole shrimp develop cold store odours and flavours during storage, and the higher the storage temperature, the more quickly they develop. Shrimp cooked after freezing and cold storage are usually paler in colour than shrimp that are cooked before freezing. Both raw and cooked whole shrimp must be adequately protected against dehydration during cold storage, either by glazing or by suitable packaging; the shell of the shrimp provides no protection. Glazing should be inspected periodically and renewed as required.

THAWING OF FROZEN WHOLE SHRIMP

Blocks of whole shrimp frozen at sea or on shore can be thawed in air or water. Thawing times for a typical commercial block measuring 1050 mm × 530 mm × 50 mm thick and containing about 18 kg shrimp and 6 kg water are as follows; 20 hours in still air at 18°C, 2 hours in saturated moving air at 18°C, 1½ hours immersed in water at 18°C and 1 hour in a water spray at 18°C. The water spray method is the fastest because the fine jets help to break up the block as individual shrimp thaw on the surface, thus exposing a greater surface area. With each of the methods, the blocks are soft enough to break up by hand before the shrimp are fully thawed, but it is difficult to do this without damaging some of the shrimp.

The thawed shrimp can be further processed in the same way as whole chilled shrimp.

Individually frozen shrimp can be thawed in a few minutes, or they can be cooked directly from the frozen state.

SIZE GRADING

Whole raw shrimp on receipt at the factory are first graded for size, since large shrimp are generally more valuable than small ones, and mechanical peelers require a supply of shrimp within a fixed size range. Small shrimp that are uneconomic to peel are either discarded or are used in chopped form as raw material for various products.

COOKING

Shrimp are cooked to provide a product that is ready to eat, and to loosen the meat in the shell prior to peeling.

The cooking process can be more easily controlled on shore than at sea; more space is available, better heating systems can be used, and instrumentation is more practicable. A short brisk cook is better than a long slow one. The ratio of shrimp to water should be as low as possible, so that the water returns to the boil as quickly as possible after the shrimp have been put in. With a ratio of 1 kg shrimp to 20 litres of water, the temperature of the water will fall initially to about 95°C, and there should be sufficient heat available to bring it back to the boil in 1-2 minutes. The water in the boiler should contain 3-5 per cent salt; the use of stronger brines can cause discoloration of the meats during subsequent chilled storage.

Cooking time is important; about 3 minutes is usually sufficient for UK shrimp, but the precise time for a certain size or quality of shrimp should be determined by experiment. The boiling time should be long enough to develop fully the flavour and texture of the shrimp meat, and to loosen the meat from the shell; overcooking can destroy the flavour and can cause loss of weight.

A lidded wire mesh basket can be used for immersing the batches of shrimp, and the basket of shrimp should be agitated gently in the water to ensure uniform cooking. Scum should be removed from the surface of the water as often as possible, and the water in the boiler changed frequently, preferably several times a day.

COOLING

The shrimp should be cooled immediately after cooking. Cooling in air is claimed to give the whole cooked shrimp a better colour but, unless the shrimp are to be marketed in this form, it is recommended they be cooled in water. The yield of meat from water cooled shrimp can be up to 4 per cent higher than from air cooled shrimp. They can either be immersed direct into chilled water for about 3 minutes until they are at a temperature of about 0°C, or they can be cooled in two stages, first in water at tap delivery temperature and then in chilled water. The latter method will be more economic in terms of ice or mechanical refrigeration. The shrimp should never be left to soak any longer than is necessary to chill them. As soon as they are down to chill temperature, they should be lifted out, drained, packed in clean boxes and transferred either direct to the peeling area or into a chillroom. Water and ice used for cooling must be clean; hygiene is important, and a chlorination system may be necessary.

PEELING

Brown shrimp and pink shrimp from inshore waters are still normally peeled by hand, but machines are now available that will handle the larger deepwater shrimp.

In hand peeling, the body of the shrimp is held in one hand, and the head twisted off with the other. The first two or three segments of shell are then broken open with the thumb, and the tail is squeezed to release the meat. A skilled worker can peel 2½-3 kg whole shrimp an hour.

American and Danish peeling machines are now available commercially that can handle deepwater shrimp. Successive pairs of rollers ahead of the shrimp, split the shell along the back and pull the shell from the meats. Output depends on the size of shrimp, but a single machine can peel as much shrimp as 16 hand workers.

Shrimp are often consumed without any further cooking; therefore particular attention must be paid to hygiene and sanitation. Regular bacteriological control of processing is important for this type of product. The main source of bacterial contamination of cooked shrimp is the peeling process, particularly hand peeling. Workers must wash their hands frequently, and all working surfaces must be kept scrupulously clean. Recommended procedures for factory cleaning are given in Advisory Note 45 'Cleaning in the fish industry'. The use of chlorinated water on the processing line can be of considerable help in keeping down contamination, but shrimp waste must not be allowed to accumulate since the chlorine is rapidly inactivated by protein. The shrimp must be kept cool throughout the process.

Machine peeling results in far less recontamination of cooked shrimp than hand peeling. Provided the peeling machines are cleaned at frequent intervals, the risk of increasing spoilage or introducing food poisoning bacteria is much less with machine peeling than with hand peeling.

Where raw meats are required for further processing, thawed frozen whole shrimp are much easier to peel than very fresh unfrozen shrimp. Peeling of unfrozen shrimp becomes easier after 1-2 days chilled storage.

YIELD AND PACKING DENSITY

Yield of meat from whole shrimp is variously quoted as ranging from 20 to 45 per cent, but it is not always specified whether the yield is from raw or cooked whole shrimp. The head constitutes about 40 per cent of the weight of whole raw shrimp, and the tail shell and legs a further 15 per cent; yield of raw meat is thus about 45 per cent. The yield of cooked, peeled meats from samples of raw whole deepwater shrimp, weighed first after freezing and thawing and again after cooking and hand peeling, is about 28 per cent. The weight loss during a 3-minute cook is about 26 per cent, and a further 46 per cent is lost during hand peeling. If the initial weight is taken to be that of the whole cooked shrimp, the yield on hand peeling is about 38 per cent. There is little difference between yields from large deepwater shrimp, counting 190/kg, and medium sized ones counting 320/kg.

Packing densities, based on a few measurements of samples of deepwater shrimp, are provisionally as follows

Packing density of deepwater shrimp kg/m³

	Unfrozen	Frozen
Raw	whole 560	360
	meats 890	440
Cooked	whole 500	
	meats 620	400

DIPPING

A number of dipping treatments between peeling and freezing of deep-water shrimp have been tried in British trade practice, in order to improve flavour or colour. For example, salt, monosodium glutamate, citric acid or sodium citrate, polyphosphate and dye have all been, or are being, used at some stage in the process. The value of some of these treatments is questionable. Where dipping solutions are used, they should be kept chilled and renewed at frequent intervals to prevent bacterial contamination of the cooked meats.

The meats are sometimes dipped in a 3-7 per cent salt solution when the salt uptake during boiling is found to be insufficient. Monosodium glutamate is used to enhance flavour, and the use of polyphosphate is claimed to reduce weight loss on thawing. Citric acid or sodium citrate is used to reduce discoloration of meats, and dye is used to give a uniform pink colour; the dye is sometimes added at the cooking stage. Most if not all of these treatments should be unnecessary on good quality shrimp meats handled and processed expeditiously.

FREEZING OF MEATS

The peeled meats can be frozen individually or in blocks. Individually quick frozen, IQF, meats are particularly suitable for catering and retail outlets, since the required amount can be dispensed from the pack without thawing. Meats in blocks suffer less weight loss during freezing, and are better protected in cold storage, but have the disadvantage that a complete block has to be thawed and used at one time.

IQF meats can be frozen in either an air blast freezer or a liquid nitrogen freezer. The air blast freezer can be either a batch or continuous type, but delays between freezer and cold store are more likely with a batch freezer, and individual small meats can warm quickly during this time; continuous freezers are therefore recommended to ensure a steady flow of frozen meats from freezer to cold store. The fluidised bed type of freezer is used for freezing individual shrimp but, where the meats are moved through the freezer entirely by agitation in air, there is some weight lost in the form of pulped meat or mush, which may have to be recovered and utilized in some way. A modified form of fluidised bed freezer is available that overcomes this difficulty by agitating the meats just enough at the start of freezing to ensure that they are individually frozen, and then moving them by belt through the remainder of the freezing process.

IQF meats of deepwater shrimp require a freezing time of about 10 minutes at -30°C in air moving at 5 m/second. Liquid nitrogen freezers are compact and can freeze shrimp meats quickly; a freezing time of 3½-5 minutes is typical, but they are expensive to operate, and a high degree of utilization is essential in order to keep down cost. Sheets of plastics film or trays with nonstick surfaces may have to be used to prevent the meats adhering to the freezer belt. If the meats are not laid out individually, some inevitably stick together, and separation of these before packing adds to the labour cost.

Blocks of shrimp meats are normally prepared by packing the meats into trays or moulds and freezing them in a horizontal plate freezer. The trays are slightly overfilled so that there is compacting during freezing to give a homogeneous block. A typical block is 25-30 mm thick. The freezing time for a 25 mm block in a horizontal plate freezer operating at -35°C is about 40 minutes. The frozen blocks are usually packed in cartons with an inner wrapper, and then moved to cold store. Alternatively the shrimp may be cartoned before freezing; the freezing time for a 25 mm block in a carton is about 50 minutes.

PACKING AND GLAZING

Individually quick frozen meats for sale to caterers and retailers are normally weighed into flexible film bags which are sealed and packed in fibreboard outer cartons for storage and distribution. The film used for the individual packs should have a high resistance to the passage of water vapour and oxygen, so that dehydration and oxidation are kept to a minimum; for example a laminate of polyethylene and polyester, or a single polyamide film, is suitable.

The individual meats are often glazed, that is dipped in cold water to coat them with ice, before packing them, to protect the product against drying in cold storage. However, packing in sealed film bags is sufficient to protect the unglazed product under good commercial conditions. Vacuum packing will give added protection against the possibility of occasional poor commercial cold storage. It is extremely difficult to control the amount of ice picked up by small meats during glazing, due to variation in size and temperature of the frozen product, the temperature of the glazing water, and the duration of the dipping or spraying process. The proportion of glaze to total glazed weight can vary from 10 to 40 per cent. The weight of glaze is usually included in the declared weight of contents of consumer packs, and the resulting loss of weight on thawing can cause customer dissatisfaction. Successful prosecutions have been brought against processors for excessive application of glaze to shellfish meats.

The addition of glaze also results in considerable warming of the product, and it may be necessary to refreeze in order to avoid imposing an excessive heat load on the cold store. Meats frozen in liquid nitrogen are often at a low enough temperature to cause the glaze to shatter and become ineffective as a protective barrier. For all these reasons it is strongly recommended that the practice of glazing individual meats for sale to caterers and retailers be discontinued and replaced by adequate packing.

Blocks of shrimp meats can be glazed as an alternative to protective packaging, or they can be wrapped in a suitable plastics film and packed in fibreboard outers. Bulk lots of individually frozen meats awaiting further processing can also be glazed before storage. It must be remembered that glazed products in cold store must be inspected periodically and the glaze renewed as required.

COLD STORAGE OF MEATS

Frozen cooked shrimp meats should be stored at -30°C ; they will keep in good condition at this temperature, provided they are properly wrapped or glazed, for at least 6 months. Long term storage at higher temperatures is not recommended; for example after 3-4 months at -20°C the development of undesirable odour and flavour and poor texture can make the product unacceptable.

CANNED SHRIMP

Shrimp meats are not canned commercially in the UK at the present time. Typical North American practice may serve as a guide to those considering the possibilities of canning. The peeled meats are blanched by immersing them for 2-3 minutes in boiling water containing 6-8 per cent salt, cooled and drained on a conveyor and packed by hand into cans lined with a sulphur resistant lacquer. For a typical wet pack, hot brine containing 2-3 per cent salt is added to the can, and sometimes a small amount of citric acid is added to reduce iron sulphide discoloration. The cans are closed without exhausting at about 65°C and then heat processed in a retort. A 150 g can requires about 10 minutes at 120°C or 20 minutes at 115°C . A 250 g can requires about 12 minutes at 120°C or 35 minutes at 115°C . The cans are cooled to about 38°C in the retort, then removed, dried and stacked for about 48 hours before labelling, cartoning and storage. Sometimes a dry pack is made by blanching the meats for 8-10 minutes and packing them in parchment lined cans without brine. The cans are evacuated, sealed and heat processed for about 60 minutes at 120°C , or 85 minutes at 115°C , for a 150 g can.

The wet pack process can be modified for packing shrimp meats in glass.

SMOKED SHRIMP

Cold smoked products can be made from shrimp. Whole headless shrimp, or peeled meats, are boiled in a 10 per cent salt solution for about 3 minutes, drained for about 2 hours, laid on oiled mesh trays and smoked in a mechanical kiln for 1-1½ hours at 30°C . The yield of headless smoked shrimp from whole raw shrimp is about 36 per cent. The brining and smoking treatments can be varied to suit particular tastes.

POTTED SHRIMP

In the UK cooked peeled meats are heated in melted butter, sometimes with added spices, and then ladled into containers, typically waxed cartons; the mixture is left until the butter has set, lids are put on and the cartons are wrapped in greaseproof paper and packed in outer cartons for dispatch. The product is highly perishable and should be sold within 1-2 days of manufacture.

OTHER SHRIMP PRODUCTS

Shrimp meats can be used in the preparation of a number of seafood products, including pastes, spreads, crisps, soups, bisques, sauces and other prepared dishes, most of which can be stored for long periods after freezing or canning. It is not possible within the space of this note to give individual methods of preparation.

Composition of shrimp

Raw shrimp meat contains 75-80 per cent water, 18-20 per cent protein and about 1 per cent fat; cooked meat contains 65-70 per cent water, 25-30 per cent protein and about 1 per cent fat. The calorific value of cooked shrimp meat is about 4.5 kJ/g. Vitamins A and D are present in small quantities.