National Certificate of Educational Achievement
TAUMATA MĀTAURANGA Ā-MOTU KUA TAEA

Exemplar for Internal Achievement Standard

Technology Level 2

This exemplar supports assessment against:

Achievement Standard 91353

Demonstrate understanding of advanced concepts used in preservation and packaging for product storage

An annotated exemplar is an extract of student evidence, with a commentary, to explain key aspects of the standard. It assists teachers to make assessment judgements at the grade boundaries.

New Zealand Qualifications Authority

To support internal assessment

	Grade Boundary: Low Excellence
1.	For Excellence, the student needs to demonstrate comprehensive understanding of advanced concepts used in preservation and packaging for product storage. This involves: • comparing and contrasting preservation and packaging techniques for a product in a national environment • discussing why labelling is legally required and how labelling for marketing is used in a national environment. This student demonstrated comprehensive understanding of preservation techniques for milk sold in New Zealand. This included comparison and contrast of fresh (raw) milk (1), pasteurised milk (2), and ultra-high temperature (UHT) pasteurised milk (5). Packaging techniques were also compared and contrasted. This included showing comprehensive understanding of tetra packs (3) (6) and light proof bottles (4). The student discussed why labelling is legally required (7). This includes the possible need to recall the product, to warn consumers of allergens, to provide a nutritional analysis, to indicate the freshness of the product, and to allow for price comparisons. The student discussed how labelling for marketing is used in New Zealand (8). This includes an analysis of the colours used to identify different types of milk. For a more secure Excellence, a greater range of milk preservation techniques for a national market could be compared and contrasted. This could include powdered, evaporated, and/or condensed milk. Because it is currently only able to be sold at the farm gate, the raw milk product that was discussed sits more within a local market.

In New Zealand milk can be purchased in a number of different ways...

[1] ...It can be purchased fresh (raw). This is milk that is unmodified ie not treated in any way. It is seen to have lots of health benefits, as it is not treated to kill bacteria and other beneficial enzymes. However, the Ministry of Primary Industries (MPI) documentation sates that it could possibly contain Salmonella, E. coli O157, Campylobacter and Listeria monocytogenes, which can cause severe illness. There have been disease outbreaks in NZ.
Because it is fresh, it needs extra care eg with cleaning the udder, careful testing of milk etc.
It can be stored for 7 to 14 days, as long as it does not get warm - it should be refrigerated at less than 4 degrees.
Currently in New Zealand, it is only available for sale at the farm gate...

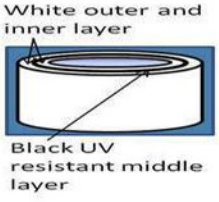
[2] ...Milk is generally pasteurised. This is done to reduce pathogens. It kills harmful bacteria. The advocates of raw milk state that it also destroys beneficial bacteria and enzymes. MPI states that "pasteurisation has minimal effect on milk fat and protein composition. It does not affect mineral stability, milk mineral content, or mineral bioavailability. Vitamins present in milk in high levels (riboflavin, B6 and B12) are reasonably heat stable. Folate utilisation is not reduced in pasteurised milk. There is 10% loss of vitamin C due to pasteurisation, but milk is not a significant dietary source of the vitamin. While it is true that the heating process can inactivate some enzymes important for human health in milk, the pasteurisation process adopted in New Zealand (72oC for 15 sec) has minimal effect on enzymatic activity."

One of the reasons for pasteurisation is to make it last longer. It gets handled a lot in the national market, and making it last longer helps to ensure profitability and safety. It also enables the milk to maintain that 'same taste', that consumers demand

Milk is stored into a cold storage room and packed into a refrigerated truck...

[3] Milk can be bought in tetra packs. These are cardboard boxes with polyethylene layers on the inside and outside. They are easy to distribute as they pack tight. They are wood based- so renewable and recyclable. But they do let in up to 25% of light—that effects the taste. Light damage interferes with frothing (because of increased levels of free fatty acids).

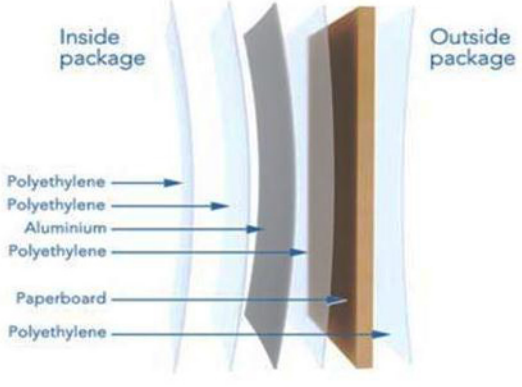
[4] The latest form of packaging for milk is light proof bottles. These are made from high grade, recyclable HDPD plastic (the same as other milk bottles - a recyclable product). They have screw-on induction foiled sealed caps - which keeps light out of the bottleneck. There are 3 light protective layers - a black layer between 2 whites. This guarantees that no light will get into the milk (compared to the tetra packs and other plastic bottles, where up to 25% of the light can get through). Light damages vitamins eg A, B2, D...



[5] ...Ultra high temperature (UHT) pasteurization completely sterilizes the product. In UHT pasteurization, the temperature of the milk is raised to about 135 - 150 degrees C for a few seconds. It has a shelf life of 3 -9 months. Some nutritional loss can occur but others will argue that the quality is higher than plain old pasteurised - because the raw milk has to adhere to higher quality standards and because higher temperatures eliminate all micro-organisms....

UHT milk is used in places where, for example, there is poor or a lack of refrigeration (e.g. camping), or where the business does not want to be constantly changing the milk (eg hotels), or in places where there is a high cost of refrigerated transport, or for emergency food supplies (eg in case of earthquake). Some like it for cooking as it is already at room temperature. UHT milk is dearer to buy, but is compensated with convenience, that it is safe to consume and that it allows for individual portions (ie the potttles). The milk is protected from the light and oxygen and microbiological contamination until opened. However the packaging is not recyclable. Most consumers do not like the taste, there is some debate about loss of vitamins and generally consumers are not prepared to pay this price for every day milk. Some consumers also nervous about it not being kept under refrigeration...

[6] UHT milk requires triple layer pre-sterilised tetra packaging (to avoid recontamination) - aluminium foil as a middle layer and polyethylene coated cardboard on either side. Generally you push open the gables to make an easy pour spout (that's why it is called gable top). This packaging is not easily recyclable. However, the packaging helps protect the milk from light, oxygen and germs. To compensate, there is a reduced carbon footprint because of the lack of it needing to be refrigerated and because there can be less wastage (in comparison to pasteurised or fresh milk, which can go off before being consumed)...



[7] A food label must be in English. In general, the label must show:

- the name of the food
- the lot identification. This includes the premises where the food was packaged and/or prepared and the batch it came from. This is in case it needs to be recalled (this may also be the date mark)
- Contact details for the supplier and business in New Zealand who can be contacted if more information is needed
- mandatory warning statements, advisory statements and declarations to identify certain ingredients/ substances that may trigger allergies or be of concern
- ingredient list in descending order of in-going weight including any food additives, such as preservatives, flavours and colours, which are identified by their function and name or code number. This is a check for consumers who may have allergies or don't consume certain ingredients for religious reasons etc.

- date marking is needed for most packaged food with a shelf life of less than two years, most commonly these are 'Use By' (after that date, the food may have spoilt and be a health or safety risk) and 'Best Before' dates (still safe, but lost some quality)
- directions for use and storage (where needed) to ensure the food will keep for the period indicated by the date mark, and/or how you should store the food to stop it spoiling or reduce the growth of pathogens that may cause illness
- Nutrition Information Panel to allow you to compare the quantities of seven key nutrients per serving and per 100g or 100ml of liquid
- percentage labelling of characterising ingredient
- net weight or volume. This helps consumers compare the value of different products.

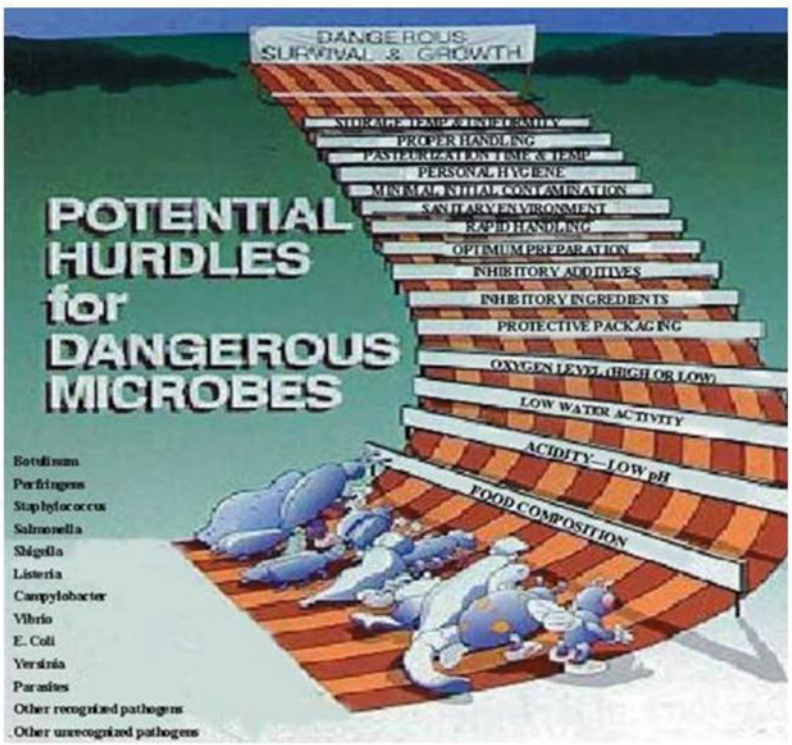
[8] Milk packaging is colour code to show the different types of milk:
- purple - full fat. Appeals to cream lovers or those who like the thought of milk straight from the cow
- dark blue - standard fat. This is good for children under 2 years old.
- light blue - light fat. This can be introduced to children as they get older.
- dark green - trim (semi skimmed)
- light green - trim (fully skimmed). This is good for those who are watching their weight.
- yellow - trim (fully skimmed with added calcium). This is a good milk for those who are diet conscious but need extra calcium eg women who might be susceptible to osteoporosis. Also good for toddlers with high calcium requirements.
- red - cream

This makes it easier for the consumer to identify what milk they want to buy.
Milk labelling is also intended to humanise the product. For example, often the colour blue is used to depict the quality of freshness (Blue often associated with sterility). The word blue is often more prominent than the word milk—as it is the colour that people are looking for.

	Grade Boundary: High Merit
2.	For Merit, the student needs to demonstrate in-depth understanding of advanced concepts used in preservation and packaging for product storage. This involves: • explaining the links between preservation and packaging techniques and the types of decay • explaining why a particular combination of preservation and packaging techniques was chosen for storage in a national environment. This student demonstrated in-depth understanding when they explained the links between preservation and packaging techniques and types of decay in fruit juice. The explanation starts by recognising fresh juice as the quality benchmark, but also its susceptibility to spoilage (1). The explanation for alternative preservation techniques included the effect of temperature (2) (4) (5), pasteurisation (3), low oxygen environments (5), and the hurdle technique (6). Suitable packaging for these preservation techniques was explained. This includes pasteurising then bottling (7), and tetra briks and pouch packs for ambient storage (8). The explanation also touched on labelling requirements (9). The student explained why a particular combination of preservation and packaging techniques were chosen for storage of kiwifruit juice in a national (New Zealand) environment. This included explaining the benefits of storing the juice in concentrate form (10), blast freezing (11), pulping and storing in poly-lined cartons or zip lock bags (12), and pasteurising and aseptically packaging in PET bottles (13). To reach Excellence, comprehensive understanding needs to be demonstrated. This would require comparing and contrasting the chosen preservation and packaging techniques. Labelling requirements and use in marketing would also need to be discussed.

[1] The aim is to maintain the quality and nutritional attributes while stopping spoilage as much as possible. The standard of excellence is freshly prepared, unprocessed juice. However this has got a very limited shelf life—days or hours under the best conditions. It is more susceptible to spoilage than the fruit itself—as it is not protected by skin or cell walls. The fluid is mixed with air and microorganisms from the environment. Because it is unheated, it is subject to rapid microbial, enzymatic, chemical and physical deterioration. Aflatoxin producing mould contamination on the surface of the fruit can end up n the juice, and these can be potent liver carcinogens. Unpasteurised fruit juice has been known to cause outbreaks of salmonella and emerging pathogens such as E. Coli.
Even though pathogenic microbes may be kept out, the natural microflora in fruit will be active.

[2] The most significant processes that will extend shelf life are sanitisation and low temperatures. Keeping the juice to as close to freezing point as possible (-1 to - 3 deg C) can enable juice to last up to a month. Minimum temperatures need to be maintained during distribution and also in the consumers fridge at home.



[3] Pasteurisation (which destructs spoilage organisms) and hermetic (airtight) packaging will increase storage life. Thermal processing does away with the need to refrigerate and inactivates enzymes. However some fruits (mainly tropical) can't tolerate even gentle heat processing. The flavour becomes scorched and the colour deteriorates.

[4] If juice can be stored above fridge temperature (5degC) it will be subject to maillard browning (as a result of sugar reacting with amino acids).

[5] Freezing and storing in a low oxygen environment can maintain the fresh character. The decline in nutrients, ascorbic acid, enzymatic activity, colour, flavour and viscosity will be much slower (months).

[6] In fruit juice production, the hurdle principle is significant. That is, a number of barriers together can enhance product stability (see the diagram).

Juices can change in their physical quality - clear juice can turn cloudy or release a displeasing precipitate, chemically or freeze-thaw induced colloidal reactions can effect viscosity (thicken or thin) and influence the taste.

[7] Some juice is bottled using a plate heat exchanger that pasteurises the juice prior to filling. The hot juice sterilises the bottle and cap. This requires no preservatives and can have a shelf life of 18 months.

[8] Packaging also includes tetra briks. These are square or rectangular cartons that include cardboard and foil and possibly a cap. The aseptic boxes allow juice to be stored at ambient temperatures.

Pouch (retort) packs are also now being used (more for single serve size). These are a laminate of flexible plastic and metal foils. It is a sterile packaging that allows juice to be kept at ambient temperature.

[9] In NZ there is a voluntary code of practice to ensure more honest labelling. For example, some juice companies were claiming their product had up to 7mg per 100ml of Vitamin C, but in fact had none at all.

Any product labelled juice must contain 100% juice ie it can not be diluted with water and it can not have more than 4% added sugar. Concentrate (that needs to have the water added back in) can be labelled as juice, but it must instruct that the same amount of water than was removed is added back in.
Orange juice can be labelled as this as long as it does not have more than 10% of mandarin or tangelo juice.

[10] Kiwifruit juice is supplied in concentrate form to the hospitality, catering and further food processing industries as well as household consumers in NZ. This is done in order to reduce storage, packaging and handling costs. An integrated membrane process is thought to be a good method, advantages being that this process helps to maintain colour and flavour. It can be operated at room temperature, which preserves the freshness, aroma and nutritional value. The process does not cause damage or denature the flesh or cells. One company processes using enzymes and fining agents to produce a clear juice. It is then evaporated under vacuum to a syrupy concentrate. It has a brix level of about 65 and a turbidity of less than 5 NTU.

[11] The juice is susceptible to microorganism spoilage. One way it is supplied is in blast frozen form below - 18 deg C. This allows it to be stored for more than 12 months and up to 3 years. The juice can darken over time, so it is recommended that it is used within a shorter time frame. The exclusion of oxygen during processing helps to reduce browning during storage. Also, storing at the low temperature (some will go below -20 deg c to minimise browning and loss of ascorbic acid.
Once reconstituted so the kiwifruit particles are finely dispersed and suspended , it needs to be consumed within 3 days.

[12] The fruit is pulped so the cell structure is preserved and a preservative is not required. The juice is sometimes packaged in poly lined cartons that are taped closed. The poly lining helps to prevent the juice from seeking through. It is sometimes also packed in zip lock pouches that are heat sealed. The idea is that the pouch would be thawed, ripped open and used in one day, but it can be refrigerated for a few days once opened.

[13] Alternatively it can be packaged in recyclable PET bottles, which is what a NZ based company called NEKTA does.

For it to be suitable for consumers, NZ pasteurises and aseptically packages it to achieve a shelf life of 12 months. Pastuerisation destroys the bacteria and mould responsible for spoilage. It is packaged straight way before regrowth can occur. The nutrients are maintained during the preservation and packaging—so preservatives do not need to be added. It must be stored under refrigerated conditions that are below 4 deg C and it is recommended that it is consumed within 7 days once opened. This is because it is exposed to air. This is in line with any pasteurisation of juice that does not contain preservative.

Another NZ company (Elliots) pasteurises their kiwifruit slowly by a belt system. They bottle it cold and then slowly move it through a system that raises the temperature so microorganisms are killed. It is quickly cooled so that as many as the nutrients and vitamins as possible are preserved in the bottle.

	Grade Boundary: Low Merit
3.	For Merit, the student needs to demonstrate in-depth understanding of advanced concepts used in preservation and packaging for product storage. This involves: • explaining the links between preservation and packaging techniques and the types of decay • explaining why a particular combination of preservation and packaging techniques was chosen for storage in a national environment. This student explained the links between types of decay and preservation techniques for the crushing (1), fermentation (3) (4), and sediment removing (5) stages of wine making. The effect of adding sulphites was highlighted (2) (6). The student also explained the significance of packaging techniques for preservation of wine. This explanation includes the role of corks and caps (7), storage of bottles (8), why some bottles are coloured (9), how to preserve wine once opened (10), and the advantages of some less common forms of packaging (11). The explanation also included labelling requirements (12). For a more secure Merit, the student would need to more clearly explain why a particular combination of preservation and packaging techniques was chosen for storage in a national environment.

[1] When the grapes are crushed, it is important the skin doesn't tear too much. As well as causing unwanted excess tannins and making it difficult to separate off the juice, the juice may get over oxidised. Some wineries don't crush the grapes but use a process called carbonic maceration. Carbon dioxide helps the juice to ferment while still part of the fruit. Sulphur dioxide is added at this stage to prevent oxidisation and inhibit microbial activity.

[2] Sulphur dioxide (SO_2) is added as part of the wine making process in quantities up to 400mg/L (for some sweet wines, but generally up to 250mg/L). These amounts are set by Food Standards Australia and New Zealand. SO_2 stops the growth of unwanted yeast (which causes mould) and bacteria.

Sulphur dioxide also stops oxidisation (caused by excess oxygen, which spoils wine flavour—makes it taste like vinegar— and colour—white wines go darker, others go cloudy) and preserves the wines natural flavour and colour. White wines are more prone to oxidisation, because red's higher tannin levels act as a buffer. Even if not added, there will be some present as it is a by-product of alcoholic fermentation of natural yeasts. High levels of sulphur can cause headaches, skin flushes, sinus, nausea, asthma etc.

[3] The fermentation process preserves the grape juice and converts it into wine.
Primary fermentation is the process when microscopic yeast (which seems like a powder on the grape's skin) ferments anaerobically (without oxygen) converts the sugars and natural acids from the fruit into alcohol and carbon dioxide. White wines need a temperature between 15 & 18C and red wines need a higher temperature (22-25). Malolactic fermentation is when certain strains of bacteria are added to the process to convert harsher acids into tamer acids, making a different kind of wine.

[4] Secondary fermentation happens when the wine is stored in airtight containers (stainless steel vats or oak barrels) and any remaining sugars are converted into alcohol. The barrels are in cellars that have an even temperature and perfect humidity conditions. Wine can only store for a certain amount of time (depending on the variety and how that years harvest was) before the wine deteriorates.
Mould can grow in the barrel. This causes an earthy, mouldy, musty smell that masks the natural fruit aromas that are so valued in wine.
Brettanomyces is yeast spoilage. This thrives on wood (ie barrels) and will make the wine taste disgusting.

[5] Sediments that could harm the wine are removed after fermentation. This can be done by filtering, siphoning or adding substances (eg gelatin, milk, egg products) to make the solids stick together and fall to the bottom.

[6] More sulphites may be added before the wine is bottled. This is to ensure fermentation will be hindered.
Wine may also start re-fermenting if the dormant yeasts wake up because the bottling environment was not sterile.

[7] The bottles are corked or capped. In NZ, we will generally find that caps are used. The caps sometimes have an added capsule to make the seal more secure. Corks naturally create an air seal in the neck of the bottle because they can compress into the area then expand out.

[8] Wine needs to be bottle aged and stored properly. Those with corks should be stored lying down and at ~ 70% humidity to keep the corks from drying out. Storing at 10-12C is best as higher temperatures speed up the aging process. Heat exposure (called maderized) can happen through improper storage. UV light (called lightstrike) can cause unwanted flavours.

[9] Wine is generally stored for consumption in a glass bottle. Sometimes the colour of the glass is used as a way of helping to signal the type of wine or the region it comes from. The main reason for coloured glass is that natural light can break down desirable oxidants such as Vitamin C and tannins, which effects storability and can cause the wine to oxidise. Therefore it is mostly ready to drink wines that don't need to be stored for a long period of time which are bottled in clear colourless bottles.

[10] Once the bottle of wine is opened, there are some ways of preserving it. One is a vacuum pump (to pump out the oxygen). This might extract aromas from the wine, which wouldn't be wanted. Or you can add an inert gas that is heavier than air so floats on top of the wine.

[11] Some wine is sold in a wine box. This is a plastic bladder with an airtight tap that is protected by a cardboard box. One of the main advantages is seen to be the prevention of oxidisation during dispensing (wine in a bottle is oxidised by air in the bottle which has displaced the wine poured). Most has a best before date and is not intended for cellaring. It may show noticeable deterioration after 12 months.

Wine is also sold in plastic (PET) bottles. Because they are lighter, smaller (for the same volume of wine) and harder (than glass) to break, they make transporting more efficient, thus reducing the carbon footprint. However, more oxygen can get in (compared to glass) so the wine has a shorter shelf life.

Eco-friendly cardboard wine bottles are also appearing on the market. They are made from compressed recyclable cardboard with a plastic liner. These are claimed to have a carbon footprint of 67% less than a glass bottle. They are also claimed to keep the wine cooler for longer.

[12] Wine sold in NZ must be labelled to meet the following requirements: legibility and in English, Name of food (eg white wine, pinot gris etc), lot ID, name and address off supplier, alcoholic declaraction (eg 13% alc by volume), net contents, standard drinks, country of origin, date of labelling, allergens (all wine must declare sulphite if it is more than 10 mg/kg). Wine labels must not make health claims or say they are low in alcohol or non-intoxicating etc.

	Grade Boundary: High Achieved
4.	For Achieved, the student needs to demonstrate understanding of advanced concepts used in preservation and packaging for product storage. This involves students: • describing the links between preservation and packaging techniques and types of decay • describing legal and marketing requirements for labelling in a national environment • describing how a specific product could be effectively preserved, packaged and stored to maintain product integrity in a national environment. This student focused on a range of milk based products to describe the links between preservation and packaging techniques and types of decay. This includes raw (1), pasteurised (2), sweetened condensed (3), evaporated (4), and powdered milk (5). The legal and marketing requirements for labelling in a national environment (New Zealand) were described. A label on a bottle of milk was the focus (6). How cheese could be effectively preserved, packaged and stored to maintain its integrity in a sequence of locations within New Zealand was described. The description referred to processes that increase shelf life (7), the effects of pasteurisation (8), different stages of the cheese making process (9), refrigeration (10), the susceptibility of different cheese types (11), and the reasons for different packaging techniques (12). To reach Merit, the student would need to explain the links between preservation and packaging techniques and the types of decay. They would also need to focus on a particular combination of preservation and packaging techniques, and explain why it was chosen for storage.

[1] Milk that is untreated (generally called raw milk) and unpackaged will deteriorate in smell and taste more quickly than treated milk. It is considered to have less aesthetic properties. Microbiological degradation and textural changes also occur more quickly e.g. it goes lumpy and there is vitamin loss.

[2] Pasteurisation of milk is a short heat treatment that lowers the microbiological content so we don't get food poisoning. Packaging prevents the milk from getting further contaminated and stops light (which destroys beneficial vitamins etc) from entering. The chilling that happens in the milk factory, while being transported and while in the supermarket slows microbiological growth. However over time it will deteriorate but it has a longer shelf life than raw milk because of this preservation and packaging.

[3] Sweetened condensed milk is when the water is taken out. This involves heating, which destroys some microorganisms and inhibits oxidisation. It is also pasteurised. Sugar is added, which extends its shelf life as the sugar increases the osmotic pressure, which acts as a preservative and prevents microorganism (bacteria, mould) growth. It does not need any preservatives to be added.
It is generally canned, which will make it last for months. It should be stored below 50% humidity can the can doesn't corrode. Turning the cans upside down will stop the fat and other contents separating out and to prevent it forming a surface cream line if stored for a long time. The sugar can also cause yeasts to ferment and spoil the product if it is kept for a long time. Fermentation can cause the can to blow, and the product should not be used.
It is also packed in tubes. These can be stored unopened at room temperature. Once opened, the tube should be resealed with the cap and stored in the fridge for up to 30 days.

[4] Evaporated milk is milk that is concentrated to a half or less its original volume under higher pressure and temperature. It is sterilised and generally canned (sometimes sterilised after canning) or packaged for long shelf life (up to a year) without refrigeration. It can be used as a milk substitute by adding the water back into it. It is homogenised to prevent it separating when stored. IT can be stored for about a year under ambient temperatures before it is opened. It should be consumed within 2-3 days after opening.

[5] Milk is powdered by further evaporating the milk. The process includes pasteurisation. It is also heated which destroys bacteria and inhibits enzyme growth. This product is good because it does not require refrigeration. Whole powdered milk has less of a shelf life (6-9 months) than non fat milk powder as the fats start to go rancid. It can be stored for up to 2 years. Ensuring it is stored to keep out light, heat (below 25 degrees) , moisture (below 65 % humidity) and oxygen will extend the shelf life.

Milk powder is sometimes stored in quad bags. This is formed from rolled aluminium and plastic film. It is a good moisture, oxygen and light barrier. It has good low temperature resistance and strong sealing strength

[6] **Legal and marketing requirements for labelling in a national environment:**
All food for retail sale must have a list of ingredients. It must describe the true nature of the ingredient and the percentage. This milk contains 100% fresh pasteurised homogenised milk. It must be prominent and legible.
It should also contain the name of the product ie milk. Milk tends to be identified more by the colour of the label. This label is light blue because it is low fat. The word lite is in relatively big font size, to appeal to a sector of the market.

The label should also show contact details for the supplier. This milk comes from Gizzy Milk Ltd, 161 Riverside Rd, Gisborne, New Zealand.
The bar code on the milk should enable the lot to be identified. This should state the batch and the date it was processed.
Because it has a shelf life of less than two years, it must have a date marking. This milk has a best before date (in black, stamped on to the bottle). Up to this date, it should still be safe to consume, but it may have lost some quality.
It should have directions for use and storage. This milk should be stored below 4 degrees. The nutrition information panel should enable you to compare the qualities of 7 key nutrients per 100ml or per serving. This label shows 100ml servings and lists the amount of energy, protein, fat, carbohydrates, sugars, sodium and calcium. It also states that 100mls of this milk contains 14% of the recommended daily intake (RDI).
It should also show the net weight or volume. This milk is 1 Litre.

[7] Cheese is a concentrated form of milk. The cheese making process removes water from the milk and lactose is converted to lactic acid and salt is added. These processes increase the shelf life.

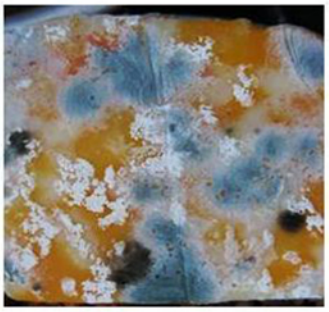
[8] A legal requirement for cheese making in NZ is that the milk is pasteurised. This kills pathogenic (harmful, capable of causing diseases such as tuberculosis or leptospirosis) bacteria. The milk is heated to 72 °C and then rapidly cooled. Some manufacturers will use data capturing technology to digitally monitor and record temperature of the milk at any given time.

[9] The curd that makes the cheese is formed by adding a good bacteria culture. This acidifies the milk, and this helps prevent foreign bacterial contamination.

After moulding, the cheese is immersed in a brine solution. The salt helps to prevent contamination from foreign bacteria.

Some cheeses have ambient moulds from the air added to give a distinct flavour. It is sprayed onto brie and injected into blue cheese.

[10] Cheese is refrigerated until the desired age is reached. This may be several months or several years.



[11] In general, hard cheeses that do not have a high water content are susceptible to attack by moulds, while moister cheeses can be affected by bacteria. Also the fats of some cheeses are prone to oxidation by oxygen in the air, which can make the cheese become rancid.

[12] When cheese is to be sold in supermarkets, it is usually cut into appropriate size blocks and either shrink wrapped in an atmosphere of carbon dioxide, which dissolves into the body of the cheese, or vacuum sealed in a special “top-and-bottom" "webbed" package. Of these two packaging techniques, vacuum seal will give the longest shelf life because it removes all the air. The subsequent anaerobic environment prevents mould growth on the cheese surface. Many cheeses, such as Brie and Camembert, are ready for sale at maturation and are packaged in special aerating wrapping and in porous boxes.

Some cheeses are wrapped in paper. This allows the cheese to keep ripening.
Others are packaged using a a state of te art flow wrapper. This is a loose modified atmosphere packaging. During packing, the cheese is flushed with carbon dioxide and sometimes nitrogen. This removes the oxygen and protects the cheese from spoiling, but slow ripening can still occur. Mascarpone and Cream Cheese have been processed and packaged using special heat treatments, therefore extending their shelf life.

Gouda cheese is coated with a food grade substance (this is called waxing) . This protects the cheese from contamination, while still allowing moisture to evaporate. It is also vacuum packed and stored at 4 °C . This slows down the ripening process, which means it maintains its flavour and it also prevents contamination.

Cheese is also sold as grated in resealable zipped plastic pillow bags. This pillow effect gives a space around the chese to breathe and develop more flavour and also makes the cheese easier to separate and makes the appearance better once it is opened.

	Grade Boundary: Low Achieved
5.	For Achieved, the student needs to demonstrate understanding of advanced concepts used in preservation and packaging for product storage. This involves: • describing the links between preservation and packaging techniques and types of decay • describing legal and marketing requirements for labelling in a national environment • describing how a specific product could be effectively preserved, packaged and stored to maintain product integrity in a national environment. This student described the links between preservation and packaging techniques and types of decay of seafood by first highlighting the susceptibility of seafood (1). Links within primary processing (2) and secondary processing - salting (3), brining (4), and smoking (5) - are described. Legal and marketing requirements for labelling fish and fish products in New Zealand (6) were described. This includes identifying the scientific name when transporting the product, complying with The Australia New Zealand Food Standards Code, highlighting additional labelling requirements, and labelling with the Marine Stewardship Council eco label. The student described how mussels could be effectively preserved, packaged and stored to maintain product integrity in a national environment (New Zealand). The description includes the testing process to ensure that toxins are not present (7), and describes preservation, packaging and storage techniques for mussels in their half shells (8) and marinated mussels (9). For a more secure Achieved, this student could describe a greater range of packaging techniques and how they link to preservation techniques and types of decay.

[1] Of all flesh foods, fish is the most susceptible to tissue decomposition, rancidity, and microbial spoilage.

[2] One primary processing company in NZ packs their seafood into ice filled bins as soon as it is caught. It is then be transported to a factory and packed according to guidelines depending on the type of seafood. Some are layer packed in to poly bins with ice packs, some are individually bagged or packed. Some product will be blast frozen to - 20 C. Gutting and skinning fish removes an enzyme that starts to decompose the fish and also microorganisms that cause spoilage. It is further distributed by refrigerated truck.

Apparently fish stored above 4C will loose I days shelf life per hour. Carefully handled fish should stay fresh for 4-6 days. Ideally it should be stored between 1 and 4C. In the home fridge, ideally fish should be sitting on an ice pack and covered with plastic on the bottom shelf.

Frozen fish should be wrapped in plastic and put in an air tight container so ice crystals do not spoil the fish. It should be eaten within 3 months. Commercially frozen fish is blast frozen below—20C so can be kept frozen for longer.

[3] Secondary processing of food includes salting it. The salt takes the water out of the flesh, which is what bacteria and microbes (which feed on the flesh) need to survive. The salting process also increases the salt content of the flesh, which dehydrates and kills the bacteria. Salting fish will preserve it almost indefinitely. Iodised salt should be avoided as this will make the fish go dark and influence the flavour.

[4] Fish can also be brined. This is preserving it in a salty liquid or in the liquid that the salt will extract out from the fish. This will preserve the fish for several weeks.

[5] Smoking. This is drying it out (like salting) to make an environment where bacteria can't multiply. Smoking uses heat to drive off the moisture.

[6] **Legal and marketing requirements for labelling**

Fish and fish products must be labelled (on the outer packaging) with the scientific fish name when transporting the product.

Fish products must be labelled in accordance with the Australia New Zealand Food Standards Code.

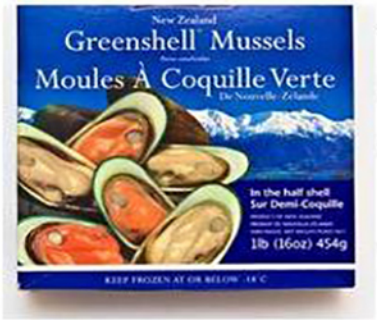
Additional labelling requirements include:

- Allergens—a warning statement is required eg presence of peanuts, cereals, unpasteurised egg products, added sulphites
- A nutrition claim (as part of the nutrition information panel) eg gluten free, low fat
- Irradiated food (ie treated with ionising radiation) eg irradiated herbs have been added
- Percentage of fish in the product eg in fish cakes
- Raw fish has been formed to look like a cut of fish, cooking instructions to indicate how the microbiological safety of the product can be achieved eg for fish fingers

Some seafood is labelled with the Marine Stewardship Council (MSC) eco label. This identifies seafood as coming from an independently certified sustainable fishery that is well managed, has healthy numbers and that carefully manages impacts on the marine environment.

[7] There is a rigorous testing process to make sure there are no toxins present before mussels are sent to market. These operating regimes are laid down by both New Zealand government regulations and international food processing standards . Regular audits are carried out by Ministry inspectors as well as buyer appointed auditors. Each factory runs its own quality control program including a Hazard Analysis Critical Control Point (HACCP) plan.

[8] Some mussels are processed in their half shell. They will be sold as chilled or frozen. The whole mussels are cleaned, and any broken ones discarded. They are heated treated (generally lightly steamed) to open the shell. They are debearded as the threads they use to cling on with are not edible.



They are then sent through a freezing plant where they are snap frozen quickly (called quick frozen, QF) to preserve the goodness and quality.

Frozen mussels should be thawed in the fridge for 5-8 hours before cooking. Excess liquid should be drained off. They should be used immediately.

[9] Mussels are also removed from their shells and marinated. While still in their shells, they are immersed in boiling water for 4-6 minutes to destroy the natural enzymes that would otherwise cause the meat to break up during marinating. They will soaked in water or brine after that to get rid of any remaining sand or grit. They are packaged in plastic pots with an acetic acid or vinegar mixture poured over them. The acid content and packing process needs to be carefully controlled to eliminate bacterial spoilage of the mussels and the liquid and also mould growth on the surface of the mussels.

	Grade Boundary: High Not Achieved
6.	For Achieved, the student needs to demonstrate understanding of advanced concepts used in preservation and packaging for product storage. This involves: • describing the links between preservation and packaging techniques and types of decay • describing legal and marketing requirements for labelling in a national environment • describing how a specific product could be effectively preserved, packaged and stored to maintain product integrity in a national environment. This student described the links between preservation and packaging techniques and types of decay. This includes the storage of raw meat and the illegality of using preservatives (1), and the effects of vacuum packing (2) and modified atmospheric packaging (3). The student described how meat is effectively preserved, packaged and stored in New Zealand to maintain product integrity. This includes packaging on polystyrene trays and covering in shrink wrap (4), and packaging in an atmosphere of oxygen and carbon dioxide (5). The legal and marketing requirements for labelling in New Zealand are described. This includes general requirements (6) and specific things that must be included (7). Labels designed to inform a particular market are described (8). To reach Achieved, the student would need to more clearly describe the links between preservation and packaging techniques and types of decay. This would apply for storing raw meat and for when vacuum packing meat.

[1] Raw meat must be chilled to reduce the growth rate of pathogenic bacteria. Raw meat should be placed in containers to prevent juice dripping onto other food.
Freezing keeps meat safe. There is also less risk of dripping juices contaminating other products of the storage space.

It is illegal to use preservative on fresh meat.

Packaging creates a physical barrier to cross contamination. Covering makes it last longer and maintain better quality.

[2] Vacuum packing helps make the storage time longer as it removes air. This meat can last 6-10 weeks, depending on the type of meat and storage temperature.

[3] Modified Atmospheric Packaging (MAP) or gas flushing helps to preserve foods by replacing some or all of the oxygen inside the packet with other gases such as carbon dioxide or nitrogen. This slows down the growth of bacteria. Different rations of gases may change the look of the meat (the red meat will turn purplish) and make it less attractive to buyers. Producers must work out the right balance. Carbon monoxide is sometimes used in small quantities as part of the MAP process—it helps to keep the bright red meat colour—but it stops it browning naturally with age so it makes it difficult to tell how fresh the meat is. This meat can last 10-14 weeks depending n the meat type and storage temperature.

MAP requires the correct type of plastic packaging that will seal and retain the gases.

All MAP food must be labelled with a 'best before' or 'use by' date. For meats it is recommended that it is the best before date that is applied. Storage instructions are essential as MAP products still require strict temperature control. Cooler temperatures help control the growth of micro-organisms and also improve the effect of the gases on the bacteria. Instructions should say what to do once the packet is opened.

[4] Meat that is sold in NZ is sometimes (most commonly) placed on a polystyrene tray and covered in polyethylene overwrap (shrink wrap) . The shrink wrapped meat has a maximum shelf life of 7-10 days, depending on the microbial numbers at the time of packaging. The shrink wrap does not offer protection from food borne disease causing bacteria on the meat. Pathogens such as salmonella, listeria and campylobacter can grow on the meat, so food poisoning at home can be a problem if sound food safety practices are not upheld when the meat is unwrapped and prepared for cooking.

[5] Or it is packaged in an atmosphere that contains 70—80 % oxygen and the balance carbon dioxide. This latter method is described as 'high oxygen atmosphere deep draw pack'. This meat can last 3-4 weeks, depending on the meat type and as long as it is not stored above 0C. It is the colour deterioration that limits the shelf life, rather than microbial spoilage. This packing method does control the growth of food poisoning bacteria. The high oxygen content slows down the growth of anaerobic bacteria such as clostrifium botulinum. The high carbon dioxide controls the growth of aerobic pathogens eg salmonella, E Coli.

Labelling requirements in New Zealand

[7] General requirements

Legibility—must be easy to read and in English

Labels must tell the truth - information must be clear and accurate

[8] Date marking—either use by or best by date

Name or description of the food

Some foods have prescribed names eg fermented comminuted meat products like pepperoni. Because New Zealanders generally would be unlikely to expect a food to contain horse meat, simply labelling the meat component generically as "meat" would be misleading under food and fair trading legislations. Horse meat would be a term that clearly describes the nature of the food.

Name and address of the business - in case they need to be contacted

Warning and advice - for particular ingredients including those that might cause allergens

Ingredients list

Percentage of the characteristic ingredients eg percentage of meat.

[9] There are also labels such as:

the 100% New Zealand Pork, PigCare Accredited logo. This is to guarantee you are purchasing only pork that has been raised in NZ.

The New Zealand Beef & Lamb Quality Mark , which not only confirms the beef or lamb is from New Zealand, it also has to reach the highest standards of tenderness and food safety.

the Heart Foundation Two Ticks. New Zealand beef and lamb displaying the Quality Mark and this label have less than 4% saturated fat and trimmed of visible fat to no more than 5mm.

Halal