

Meat patty characteristics vary, depending on the types of raw ingredients, processing methods and storage used. This Bulletin discusses how processing variables and storage affect patty quality.

GENERAL PATTY PROCESSING STEPS

Patty processing methods can vary, but the steps common to most processes are as follows:

- Meat preparation
- Formulation for desired fat content
- Meat comminution
- Blending in of non-meat ingredients (may occur either before or after regrinding)
- Regrinding of mix through a finer plate (about 2.5-6 mm)
- Patty forming
- Patty packaging
- Patty storage

MEAT PREPARATION

The desired combination of fresh and/or frozen meat with the required fat content is selected.

If frozen meat is used, it must be tempered to a workable temperature (about minus 2°C) that is still low enough for efficient blending, grinding and forming late in the process.

Microwave tempering has shown advantages over conventional tempering: the meat increases in temperature quickly and uniformly, yields improve, there is no bacterial growth and space and labour requirements are reduced.

Microwave tunnels are less suitable for complete thawing because heating becomes uneven over the thawing temperature range and "hot spots" can develop. These can cause colour problems and the meat can spoil if held too long.

MEAT COMMINUTION

Grinding/Flaking

Grinding is the most common and traditional comminution method. Meat is usually ground through a coarse plate (holes of about 8-12 mm) followed by a fine plate (2.5-6 mm). Several brands of commercial grinding equipment are available and some grinding equipment has a bone elimination system.

Sometimes flaking is used instead of grinding. With flaking, the patties are claimed to have reduced gristle and connective tissue, better binding, less drip, and less cook loss.

However, products from flaked meat tend to be coarser, less tender, drier and more rubbery than from ground meat because the flake-cut product has stronger binding. Consumers are still more accustomed to patties made from ground meat.

Ground meat can be stored in the chiller until it is used. Storing the ground meat before use can improve patty tenderness, but can also result in flavour deterioration, appearance changes and increased microbial numbers.

BLENDING

Commercial blending equipment typically uses either a single or double screw system to blend meat and any added ingredients.

Blend temperature is critical and should be about minus 3°C to 0°C.

MEAT PATTY TECHNOLOGY 2:

Processing variables, storage, and final product quality

High temperatures or overblending, particularly in the presence of salt, will cause 'bruising' or 'smearing' whereby the mixture becomes tacky and patties will not form properly. Badly bruised patties may seal too quickly during cooking, so that pockets of hot juice form.



FORMING

Patties can be formed by one of the following methods:

- A block and die technique is used. This is by far the most common commercial method and a wide range of commercial equipment is available.

The ground beef mixture may be flattened between two plates, or it may be forced through a gap and flattened before being punched out as a patty. There is usually a conveyor attachment to transfer patties to the next processing step.

One problem associated with some commercial forming mechanisms is uneven shrinkage of patties during cooking. Some newer equipment has overcome this problem.

The Tender-form® forming method from Formax Inc. is used in some commercial operations. In this process, the blended meat mixture is gently forced up through a fill plate, and cavities in the mould plate collect the strands of meat, which are held in a vertical position. Spaces between the vertical columns of meat are believed to give patties a tender texture and good heat transfer properties during cooking.

- The mixture can be formed into a log in a high-pressure press, from which part-frozen patties are cut.
- The mixture is filled into a plastic casing to be wet chilled or partially frozen, and then sliced into individual units.

PATTY STORAGE

Patties may be stored chilled or frozen, and may be raw or pre-cooked. If patties are to be stored frozen, they are usually frozen individually before packing for storage. Vacuum or controlled atmosphere packaging may be used to extend the storage life.

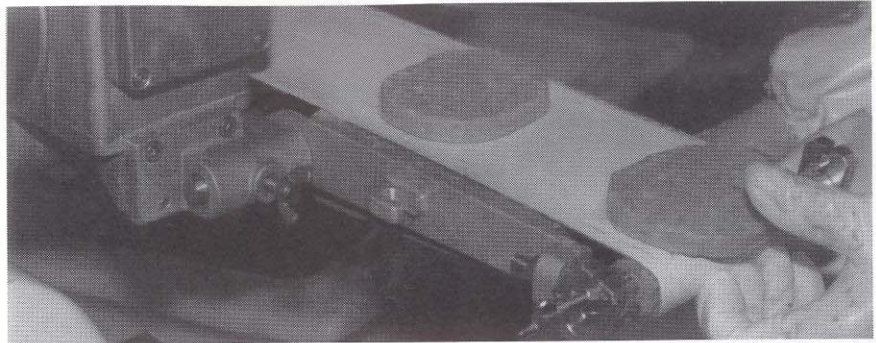
Freezing and frozen storage

Once formed, patties can be frozen by a variety of methods including cryogenic freezing, air blast freezing and freezing in a still-air freezer (conventional walk-in freezer).

Cryogenic freezing

This method uses a cryogen such as liquid nitrogen or liquid carbon dioxide and usually involves passing the patties through a freeze tunnel.

Patties are placed on the belt of the tunnel as a single layer and exit the tunnel frozen. Patty quality is not affected by the type of cryogen (liquid N₂ or CO₂), so the cryogen can be selected on the capital costs of the equipment and costs of the cryogen itself.



Cryogenic freezing can cause the surface of the frozen patties to be pale, but the patties usually re-bloom after thawing.

Effects of freezing and frozen storage

In general, quick freezing methods such as cryogenic freezing or blast freezing at low temperatures (e.g. minus 30°C) result in better tenderness, juiciness, beef flavour intensity and moisture retention, and lower cooking losses. Quick freezing also produces lighter-colour products. Fast freezing results in small ice cavities, which may explain the lower cook losses.

During prolonged frozen storage the patty surface can discolour (freezer burn), and odour, flavour and juiciness can deteriorate. Drip losses and cook losses often increase with increased storage time. These changes may be due to protein denaturation and subsequent loss in water holding capacity.

Frozen storage temperature

Storage temperature should be chosen to maintain quality while minimizing energy costs.

High storage temperatures (about minus 10°C or higher) lead to rapid quality deterioration, including freezer burn and patty dehydration, toughness, colour defects, off-odours, rancidity, and decreased beef flavour intensity. A temperature of minus 18°C should be sufficiently low for protecting patty quality.

PACKAGING

Patty storage life is greatly affected by the type of packaging film, the

gaseous environment within the package and the storage temperature used.

Product life can be lengthened by using a preservative packaging, like vacuum packaging or controlled atmosphere packaging (CAP).

Preservative packaging can be used to store chilled whole-tissue meat before processing, and ground meat before forming. (Holding ground meat can lead to problems, however, as grinding increases susceptibility of meat to oxidation.) Preservative packaging can also be used to store chilled or frozen patties and to display patties.

Preservative packaging methods include:

- Vacuum packs (storage for up to about 8-12 weeks)
- Low oxygen MAP (storage for up to about 10-12 weeks)
- Oxygen-free saturated CO₂ CAP (Storage for up to about 14-20 weeks)
- High oxygen MAP. (Retail display life of up to 5-10 days)

LIPID OXIDATION IN MEAT PATTIES

Meat patties provide the ideal environment for oxidation.

Oxidation can result in:

- Rancid flavour/odour
- Reduced red meat colour
- Reduced nutritional value

The following factors promote oxidation in patties:

- Presence of metal ions such as copper, iron or aluminium (e.g. through comminution with iron blades, or presence of ions in salt, spices or water).

- High surface to volume ratio in ground meat (thereby allowing high contact with oxygen).
- Long storage periods.
- Relatively high fat levels.
- Pro-oxidant ingredients.
- Exposure to light.
- Metmyoglobin formation.
- Pre-cooking.
- Grinding.

Rancidity develops much more slowly in raw than in cooked meats. Both grinding and cooking cause cell rupture and the breakdown of bound iron, which can accelerate lipid oxidation. Rancidity usually becomes apparent in cooked meats within 48 hours when held at 4°C. Rancid flavour and odour are especially noticeable in reheated meat and are collectively referred to as warmed-over flavour (WOF).

Lipid oxidation can be inhibited by using antioxidant ingredients or controlling environmental conditions. The most obvious method is to keep oxygen from the product, e.g. by using an oxygen-free pack atmosphere and oxygen-impermeable packaging.

A variety of ingredients with antioxidant properties can be used in patties. Some of these are familiar ingredients often used in meat dishes; for example, some herbs and spices (e.g. rosemary, sage, black pepper, ginger), onion juice, and garlic juice. Other ingredients with antioxidant properties are phosphates, soy protein, tocopherols, ascorbic acid, citric acid, and synthetic

antioxidants. Some antioxidants have a synergistic effect when used together.

Antioxidant additives may give the patty an undesirable flavour, and this should be kept in mind when choosing them.

EFFECT OF COOKING METHOD ON PATTY QUALITY

A variety of cooking methods can be used, including broiling/grilling, charbroiling, conventional oven roasting, convection oven roasting, frying, microwaving, and infrared processing.

Cooking conditions should be chosen to ensure that patties are completely cooked and microbiologically safe, yet maintain desirable sensory properties.

Cooking method can affect the palatability of patties. Microwave-cooked patties generally have poor sensory attributes (flavour, odour, appearance, texture). They often lack tenderness and juiciness, defects linked to interior drying. Microwave ovens have shown potential for reheating frozen pre-cooked patties, however.

Pre-cooking patties

Patties can be pre-cooked before frozen storage. However, precooked patties often tend to have a less desirable flavour (through the development of off-flavours, e.g. metallic, sweet, rancid, putrid), less juiciness and a lower overall acceptability. These defects can be reduced by adding soy protein. The cereal flavours of

the soy protein may mask stale flavours, although if cereal flavours are too intense they may themselves become undesirable.

Advantages of pre-cooking are convenience, reduced volume and weight for packaging and transport, and shorter preparation time before serving; disadvantages include increased energy use (precooked product is heated twice and must be cooled before freezing) as well as problems with sensory acceptability.

MICROBIOLOGICAL QUALITY

Hamburger patties are not a health risk, provided they have been hygienically prepared and are cooked sufficiently before consumption. However, deviation from Good Manufacturing Practice can result in serious diseases outbreaks, causing illness or death. Therefore, it is essential that patties be cooked to an internal temperature sufficient to kill pathogenic bacteria that may be present in the centre of the patties, and to inactivate heat-labile pre-formed toxins (see table).

Bacteria, sometimes including pathogenic species, can be present in patties due to contamination of the meat during carcass dressing and further meat handling. Meat surfaces become contaminated when touched by workers, machinery, and environmental surfaces. During grinding, sterile inner tissues become mixed with outer tissues containing bacteria, so bacteria become dispersed throughout the patty. Some spices and additives can also be a source of contamination.

Higher than optimal temperatures during storage and transport, and long holding times allow any organisms present to grow, often to high numbers.

PATTY ACCEPTABILITY Flavour and Odour

Some ingredients may be added to enhance flavour. Added ingredients, however, may dilute the meat flavour, or they may cause undesirable non-meat flavours. Thus, the benefits of using flavour ingredients must be weighed against any undesirable effects.

Permitted heat processing temperature/time combinations for fully cooked patties. (Code of Federal Regulations, 1994)	
Minimum internal temperature at the patty centre (°C)	Minimum holding time (sec.) after maximum temperature is reached
66.1	41
66.7	32
67.2	26
67.8	20
68.3	16
68.9	13
69.4 or higher	10

Acceptability is often based on what the consumer is familiar with. For example, United States consumers prefer grain-fed beef over grass-fed. Also, consumers in many countries dislike sheepmeat flavours.

Appearance

The overall appearance of a patty encompasses colour (type, intensity, uniformity); surface texture (uniformity, smoothness/roughness, presence of crumbs in cooked patties); patty shape, size, and thickness; and apparent degree of doneness in cooked patties.

The appearance of raw patties is especially important for retail display, but may also be important for sale to a commercial client. Consumers may prejudice other sensory qualities, based upon appearance.

Patties can be unattractive when myoglobin is oxidized to the brown pigment metmyoglobin. This oxidative deterioration is interrelated with lipid deterioration.

Texture

Since the hamburger patty is a coarsely comminuted meat product, texture characteristics are complex, and terminology and measurement techniques have not been standardized. Common terms related to patty texture are rubberiness, adhesion, ease of fragmentation, degree of comminution, tenderness of particles, moistness/juiciness and overall texture

YIELDS

Patties lose weight during chilled storage, thawing and cooking. This weight loss, which may involve the loss of both water and fat, is economically undesirable. As well, fat losses reduce the total energy content of the patty.

Manufacturers and retailers must supply patties that retain a certain net weight. Hence, weight loss during storage is important. The cooked patty weight is often important, particularly in the fast food business, and cooked weight

will be affected by losses during storage/thawing as well as during cooking.

For frozen patties, cook losses tend to be lower if patties are cooked directly from the frozen state, possibly because there is less damage to the muscle structure than if the patties are thawed first.

Yields are measured as a change in weight or size. Diameter changes are important for catering operations because the patties should cover a constant bun area. Visible exudation or shrinkage during thawing or cooking indicate to household consumers that product they have paid for is being lost.

ALTERNATIVE TECHNOLOGIES

Mechanical desinewing

Mechanical desinewing is used to reduce high levels of connective tissue. This technology has shown potential for improving the texture of meat patties made from low-quality meat from mature animals.

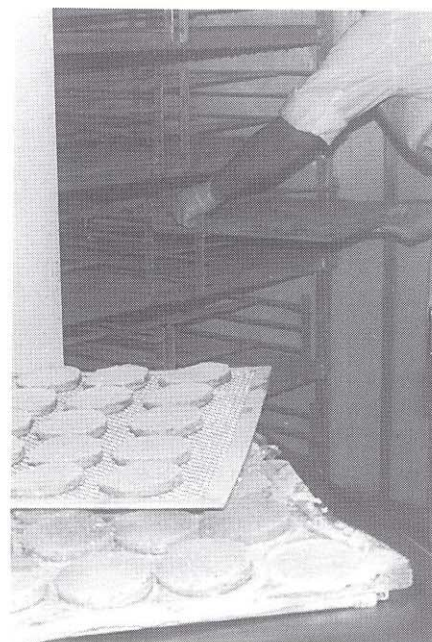
Pressure treatment

Applying high pressure (between about 50 and 150 MPa) to beef patties increases the binding strength. Research has shown that treatments are most effective for patties containing salt and with a pH of 5 to 6. Cook losses decrease with pressure treatment when at least 1% salt is present.

Dehydrated meat patties

Meat patties can be dehydrated so they are microbiologically stable, yet have similar properties to those of fresh meat patties when rehydrated. Precooked patties can be rehydrated with hot water for immediate consumption.

Dehydrated patties usually contain a binder to prevent them from falling apart on rehydration.



FURTHER READING

Hamburger Patty Technology: A Literature Review by V.L. Mikkelsen, MIRINZ Publ. NO. 932, Dec. 1993.

Meat Patty Technology 1: Raw materials and formulation. MIRINZ Bulletin No. 30, September 1995.

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For more information please contact:
AgResearch MIRINZ
Private Bag 3123
Hamilton 3240
New Zealand

Phone: +64 7 838 5576
MIRINZ@agresearch.co.nz