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BULLETIN

# Fat in Meat - Benefits and Challenges

**Fat in meat contributes to its odour/flavour. However, certain problems are associated with fat, some of which are related to pasture finishing. As well, fat in the diet has a very negative image for many consumers. This Bulletin addresses these issues and others related to fat in red meats.**

Many Western consumers are concerned about dietary fat; particularly its effect on body weight and health. But there are other issues related to fat in meat, including its effect on meat tenderness, odour/flavour and appearance.

All meat contains some fat, and even the very leanest of meat cuts will contain about 1.5% fat.

Some fat is usually visible as a layer on the surface of carcasses (subcutaneous fat), and thus on the surface of some cuts. There may also be thinner layers of fat between the muscles of a cut (intermuscular fat); and visible fat may also be present within the muscles (intramuscular fat – also known as marbling).

The layer of fat on muscle surfaces can be removed by trimming, but not the fat within the muscles themselves.

In New Zealand, subcutaneous fat is important, by way of schedule payment, to farmers. As well, visible, untrimmed fat presents potential problems or challenges to the meat processor/marketer.

Fat-related problems may include consumer concerns that fat is "bad for you", difficulties with fat colour itself and fat colour deterioration during storage, fat solidification on the plate due to a high melting point, and fat-associated flavours that derive from species and diet.

If all fat could be removed from meat, that might solve these fat-related problems. The fat could be rendered into tallow, which has many edible and inedible uses. Would our meat customers cheer a move to fatless meat?

## FATLESS MEAT?

Knowingly or not, consumers expect the meat they eat to contain some fat. This is because fat gives the meat a certain mouthfeel that people usually find desirable. As well, fat carries flavour. If all fat were to be eliminated from meat – and this has been done experimentally – the meat would taste much less meaty, and lose any characteristic species flavour.

**Lamb cuts showing various degrees of fat deposition on the cut surface and between the muscles, but little marbling.**

## FAT DEPOSITION, MARBLING AND TENDERNESS

If livestock are fed energy-rich diets, they tend to deposit visible fat, first under the skin and around the muscles and then as marbling within the lean.

New Zealand's pasture-based animal production system results in an animal diet that contains less energy than grain-based production systems. Hence, marbling is difficult to achieve.

In segments of some markets, notably the U.S.A. and Japan, marbling carries a price premium, probably because of three factors: mouthfeel, flavour and the view that marbled meat is more tender. If marbled meat seems more tender, that is probably because the presence of fat within the lean means there is less lean to impart toughness.

Lean meat that has been properly processed is tender and contains enough fat to generate flavour.

## FAT COLOUR

The ryegrass/clover pastures on which New Zealand meat animals are typically grazed contain high concentrations of carotene, a yellow pigment. (It is this pigment that

makes New Zealand butter very yellow, by world standards.)

Grazing animals, particularly cattle, absorb this carotene from their digestive system into the blood and deposit it in their fat. This causes the fat to become yellow.

Unfortunately, high-value beef markets currently favour the white fat that develops from grain-based diets.

While there is little prospect of eliminating yellow fat by modifying pasture species, there is some scope to reduce this fat colour problem by paying attention to animal breeding. For example, certain cattle breeds, notably Channel Island breeds, are well known carotene accumulators. Genetic variation for carotene accumulation probably exists in other breeds, and selective breeding could reduce the incidence of this trait.

If yellow fat cannot be eliminated, it may be better to either trim away as much visible fat as possible or persuade high-value markets that yellowness is a desirable attribute, rather than a defect. For example, yellow fat tells the consumer that the animals were raised "naturally", on pasture.

So long as cattle are raised on fresh pasture, some yellowness is likely to be here to stay. Thus, a sensible objective would be to ensure that all such fat is about the same colour, and not highly variable as at present.

**Trimmed lean meat is not a high-fat food.**

Although there might be some scope for classifying meat cuts on the basis of fat colour, it would be more sensible to minimize colour variability before the animal goes to the meat plant; that is, on-farm.

To do this, farmers would need accurate information on the fat colour of each animal, collected inexpensively, on-line, during processing. Farmers could then use the information to make decisions regarding which breeds or crosses to raise, to minimize problems with yellow fat.

## FAT MELTING POINT

The melting point of a fat is determined by its composition. Typically, the higher the fat's unsaturated fatty acid content, the lower the melting point.

The composition of fats deposited in the body reflects the composition of fats in the diet. This is particularly true for species with a single stomach, like poultry and pigs (and humans).

With ruminants (cattle, sheep, deer, goats), bacteria in the rumen (one of the chambers of the stomach) often change the composition of dietary fats before they are absorbed into the body.

For example, rumen bacteria convert unsaturated fats to saturated. As a result, fats in red meat cuts are usually more saturated, and therefore have a higher melting point (they are "harder"), than those in poultry and pork, whatever the animal diet.

One advantage ruminant meats have is that their fat is more resistant to flavour changes associated with the development of rancidity than fats in pork and poultry. This is because saturated fats are inherently more stable than unsaturated.

Generally, sheep fat is the most saturated and therefore the "hardest" of all. So long as the consumer expects this, there should be no marketing problem (although a layer of solidified sheep fat on a cold plate is not aesthetically very pleasing).

Provided carcasses are lean to begin with or cuts are trimmed of excess fat before sale, the melting point of the fat should not be a problem.

## ODOURS/FLAVOURS

In meat, the flavour is primarily carried in the fat.

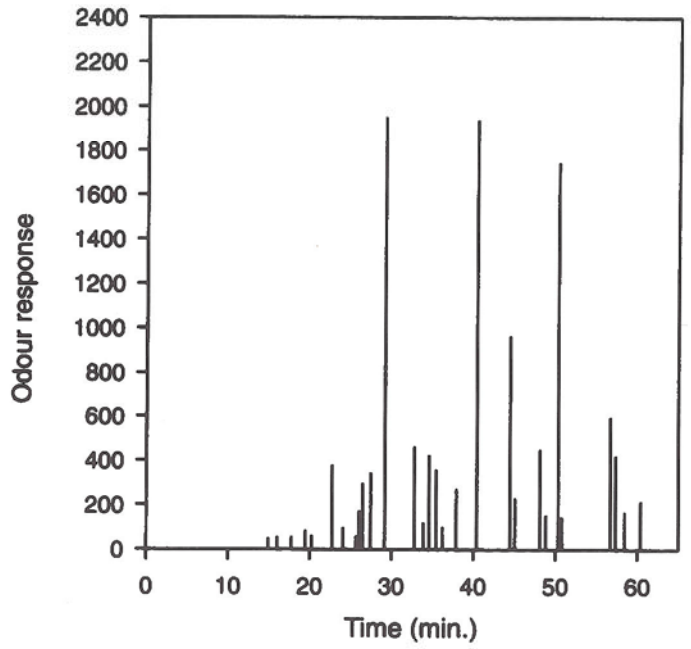
### Pastoral Odour/Flavour

Pastoral diets, as are dominant in New Zealand, are responsible for generating a "grassy" or "pastoral" flavour. This flavour is particularly noticeable in dairy products, where there is no background "meaty" flavour to help mask it. But even in meat, the flavour is noticeable to discerning palates, especially those accustomed to the blander flavour of meat from a grain-based diet.

It is this pastoral flavour, as well as the minimal marbling and yellow fat present in pasture-finished beef, that results in this meat not attracting the premium attached to its grain-finished equivalent.

The cause of pastoral flavour is currently under study in a joint MIRINZ-AgResearch Grasslands programme. Since the greater part of flavour is actually odour rather than taste, the cause of the flavour is being determined by studying volatile compounds released from fat when it is heated.

The volatile compounds short-listed to date as causes of pastoral flavour include the breakdown products of linolenic acid, which is the dominant fatty acid in grass, and skatole, which is a dietary breakdown product of protein and which has a faecal odour. It is possible that skatole accumulates in fat when livestock are fed high




**The human response to the odour of a heated meat fat sample as volatiles are separated one from another in the laboratory. Tall lines represent the volatiles with the strongest smell.**

protein pastoral diets like lucerne,

When the true causes of pastoral flavour are identified, pasture-based production systems can be adjusted to produce premium products for flavour-conscious markets.

## Species Odour/Flavour

Cooked sheepmeat has a characteristic flavour (really an odour), the cause of which has been identified from work in New Zealand and overseas. Certain unusual volatile fatty acids – which are incorporated in meat fats like any other fatty acid – are responsible.

Although the fatty acids responsible for the ovine odour/flavour are difficult to measure, some useful information on their occurrence has been collected in the past 20 years. For example, they are more abundant in the outer layers of subcutaneous fat.

This may explain why roasted lamb has a particularly distinctive aroma: during roasting, the outer layers of fat are subjected to very high temperatures, which would enhance the release of these volatile fatty acids.

Species odour/flavour can also be affected by the sex of the animal. The fat of older (adult) ram animals has higher concentrations of the "unusual" fatty acids, giving the meat from these animals an enhanced sheepmeat odour/flavour.

In recent years the production of ram lambs has been encouraged, because ram lambs tend to be leaner than ewe or wether lambs. Fortunately, the enhanced odour/flavour of ram meat – whether desired or not – probably develops only with puberty, so the odour/flavour of ram lambs, which are normally processed before they enter puberty, should not be affected.

Breed may affect sheepmeat odour/flavour intensity as well. In a recent comparison of sheep breeds, one breed was found to have double the "unusual" fatty acid concentration of another at the same age; however, this difference may have been due to differences in the rate of animal maturation. Experiments to resolve these matters are in progress.

## FAT COLOUR STABILITY DURING STORAGE

In common with lean meat, the colour of fat changes during storage. An early colour change in fat is a slight loss in yellowness caused by partial bleaching of carotene, perhaps not a bad thing.

A very deleterious fat colour change that can happen during extended chilled storage is the development of a grey discoloration in fat.

Recent work at MIRINZ has shown that the most likely cause of this greying is discoloration of meat drip that has permeated the fat during storage. Options for preventing such fat greying include drip retention with absorbent pads, and, obviously, complete trimming of fat.

## HEALTH ISSUES

Currently, health issues and fat are inextricably linked in the minds of consumers, and all too often meat and fat are linked as well.

The major health issues in consumers' minds relating to dietary fat are obesity, high blood cholesterol levels, and the presence and ratio of essential omega 6 and omega 3 polyunsaturated fatty acids.

### Obesity

The body lays down fat when more energy is consumed in the diet than is expended through metabolism. If large amounts of body fat are laid down, the person's health risks increase.

In terms of the energy intake vs. expenditure balance, dietary fat is particularly troublesome, as a given weight of fat has almost twice the energy as the same weight of protein or carbohydrate.

Customers need to be reminded that trimmed lean meat is not a high-fat food.

### High Blood Cholesterol

High levels of blood cholesterol and heart disease have been related to the consumption of some saturated fatty acids (palmitic, myristic and lauric).

These fatty acids together constitute less than a third of the total fatty acids in lean beef, lamb, pork and chicken. Other major fatty acids found in beef and lamb fat, such as stearic acid (which is saturated) and oleic acid (which is monounsaturated), do not raise blood cholesterol. (Not all saturated fatty acids have the same effect on blood cholesterol.)

Some consumers are still concerned about the level of cholesterol in their diet. The health implications of dietary cholesterol are far from clear. Nevertheless, meat fat and meat lean contain about the same concentration of cholesterol.

Although cholesterol consumption is an issue for individuals whose blood cholesterol is naturally high (people who are genetically hypercholesterolemic), for the general population cholesterol consumption is less important in terms of health than fat consumption.

## Essential Fatty Acids

Small proportions of essential polyunsaturated fatty acids (omega 6 and omega 3 acids) are present in meat fats. These acids are required for the development of the brain and retina and play important roles in cell membranes and the formation of ecosanoids, which influence blood clotting.

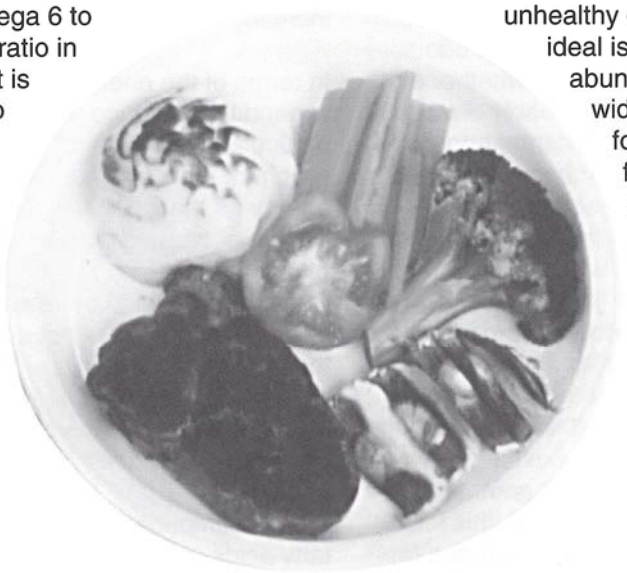
A low omega 6 to omega 3 ratio in dietary fat is thought to help prevent blood clotting (thrombosis) – a potentially beneficial effect. This ratio is lower in the fat of grass-fed animals than in the fat of grain-fed animals, and is much lower than the ratio in vegetable fats.

Likewise, vitamin E is also richer in meat from grass-fed animals than unsupplemented grain-fed animals. This vitamin has a protective effect against heart disease. (Note, however, that meat is not a significant source of dietary vitamin E.)

Some forms of cancer have been linked to high meat consumption or consumption of overcooked meat. However, research shows that it is high fat and high total energy consumption, rather than high meat consumption, that is better related to cancer development. As well, links between cancers and overcooked meat are not observed when the meat is eaten with vegetables.

In general, links between meat, dietary cholesterol, saturated fat, cancer and heart disease are tenuous at best. For example, the French diet is very rich in saturated fats, yet heart disease rates are comparatively low.

In resolving this paradox, it is important to distinguish between foods and diets. There are neither "healthy" foods nor "unhealthy" foods, only healthy and unhealthy diets. The ideal is a diet abundant in a wide variety of foods and no food eaten to excess. Animal fats, in moderation, have a justifiable place in a balanced diet on the basis of supplying energy and being a carrier of flavour.



**There are no such things as "good" and "bad" foods – only "good" and "bad" diets. The ideal is a diet abundant in a variety of foods, and no food eaten to excess.**

## FURTHER READING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