MEAT RESEARCH NEWS LETTER

CSIRO

NUMBER: 69/3

MEAT RESEARCH LABORATORY

DATE: 11th. April, 1969

P.O. BOX 12. (CNR. CREEK AND WYNNUM ROADS). CANNON HILL. BRISBANE. QLD. 4170. TELEPHONE 954006 TELEGRAMS FOODPRES BRISBANE

TENDERISING MEAT BY AGEING

Improvement in quality of meat through holding at temperatures above freezing is a traditional process in the meat industry. The improved eating is the result of a marked increase in tenderness and a slight increase in flavour.

When a carcase has just passed into rigor it is in its toughest condition. As the meat is held in storage or "aged", changes take place which increase the tenderness. The exact nature of the chemical changes taking place is not fully understood, but they are not due to micro-organisms. It is thought that the tenderisation is the result of breakdown by tissue catalysts (enzymes) of long molecular chains of protein into simpler substances. These chemical reactions do not require oxygen and are speeded up by higher temperatures (the rate of tenderisation doubles for each 18° F rise in temperature).

The principal problems involved with ageing are to avoid weight loss and the growth of micro-organisms. The risk of multiplication of food poisoning organisms (e.g. Salmonellae) must be avoided by maintaining meat temperature below 45°F.

The ageing process involves considerable costs, since capital is tied up in cold storage space and in meat undergoing treatment.

The advantages of ageing are that it produces a more uniformly tender product which may command a premium on local and export markets and offers new market possibilities.

The principal factor in selecting the storage conditions is to control the microbial spoilage. The methods described here are designed to increase the storage life beyond the ageing period at the various temperatures.

Different Methods of Ageing

The main methods that can be used to age meat are:

1. As sides, quarters, carcases or individual cuts in the unwrapped condition.

The meat is hung in storage rooms under the following conditions:-

(a) Temperature and Time:

43°F for 8 days or

36°F for 14 days or

32°F for 16 days.

The periods at their corresponding recommended temperatures are close to maximum storage without deterioration and will produce near to maximum tenderisation for initially good quality meat.

(b) Relative humidity not greater than 90% and preferably not less than 85%.

(c) Meat not touching.

(d) Air flow adequate to maintain the above conditions around the meat (a flow of about 10 feet per minute near the meat surface is sufficient for adequately chilled meat).

After the period of ageing, any bone in meat is boned in the conventional manner. Distribution and cooking or freezing has to be done within 1 - 2 days of the end of the ageing period. The method relies on the evaporation of water from the surface to inhibit the growth of the spoilage organisms.

The disadvantage of this method is that there is weight loss, colour deterioration and the risk of spoilage by bacteria. Usually, the meat has to be trimmed after ageing and this incurs additional weight loss. Wrapping in a gas permeable film (polythene or cellophane) will reduce weight loss but will also increase the moisture on the surface and thus make spoilage more rapid. Large bone in meats have the added disadvantage of taking up considerable hanging space.

2. As small cuts packed in heat shrinkable gas impermeable film.

The meat is boned out after normal hygienic chilling operations. The cut is then placed in the bag (such as cryovac), the bag evacuated and then sealed and heat shrunk. Instructions of the bag manufacturer should be followed.

To eliminate possibility of drip discolouring the fat, the bagged meats are then placed fat surface upwards on racks in the storage room. Depending on customer requirements, the cuts may be packed in cartons first. The time elapse between boning and placing in the storage chiller should not exceed 30 mins.

Temperature and Time:

36°F for 14 days or

32°F for 16 days.

With export production it may be desirable to lengthen the time period by up to 50% more for initially tough meat, i.e. 36°F for 21 days may be necessary for cows and six-tooth and full mouth ox. Further experiments will give a better indication of time for different types.

This method is designed to restrict the growth of the normal spoilage organism (Pseudomonas). This organism needs oxygen for growth and its growth is retarded by the presence of carbon dioxide. The meat and bacteria in the bag release carbon dioxide which cannot escape through the bag and therefore accumulates. The oxygen level within the pack rarely falls below 1% but the carbon dioxide level can become as high as 20% of the gas volume. The normal spoilage organism is not restricted until the oxygen levels fall below 1%, so it appears that the carbon dioxide build up is the controlling factor. Other organisms resistant to carbon dioxide can grow but they grow only slowly. It is interesting to note that if the meat is held too long, these resistant organisms produce a "souring" of the product instead of the usual slime associated with fresh spoiled meat.

The advantages are:

(a) Storage life of the meat is extended. If the bag is unopened, the meat should keep at 36°F for a total of 4½-5 weeks.

(b) Control of humidity in the room is not essential.

(c) There is no weight or trimming loss.

(d) There is less storage space required compared to bone in meat.

The disadvantages are:-

(a) Relatively costly in terms of labour and packaging material and does not fit in well with current boning room product flow.

(b) Oxygen and CO_2 concentration within the packs are variable and thus predictions of the outcome in terms of colour and spoilage are difficult.

(c) The possibility of bacterial spoilage always exists because of leaks developing due to inadequate sealing or by the bags being punctured. This possibility means that it is best not to pack the cuts in cartons until after ageing and visual inspection.

(d) It is not ideal for retention of fresh meat colour because the formation of a brown pigment (metmyoglobin) is maximal at about 1% oxygen.

(e) The exudation of some fluid by the packaged meat can be unsightly.

3. As small cuts packed in gas permeable films in a room of controlled atmosphere.

Results of laboratory scale experiments in controlled atmospheres are promising and tests under commercial conditions will be commenced this month.

Although the process has not yet been tested on a large scale, it is envisaged that the meat would be boned out after normal hygienic chilling operations, and the cut would be then wrapped or bagged in a permeable film such as polythene or cellophane. The bagged meat cuts would then be placed fat surface upwards on racks in gas tight storage rooms. Depending upon the result of pilot scale experiments, the cuts may first be packed in cartons within the boning room and the cartons then stacked in the storage room in such a way as to allow free air flow.

The room would ideally be designed to hold one day's production. At the end of the boning day, the room would be closed and carbon dioxide injected in until a predetermined level is reached. Automatic metering would ensure that this level is maintained throughout the storage period. The temperature would be adjusted to the required level and the room left sealed until the end of the ageing period.

The most promising method for initially tough meat in laboratory experiments is storage at 36°F under 25% carbon dioxide in air for the same time as in method 2.

This method restricts the growth of Pseudomonas by increasing the carbon dioxide concentration to 25% without decreasing the oxygen concentration appreciably. The film used is water impermeable but gas permeable so that the gas mixtures can freely permeate into the meat pack.

The choice of 36°F as the storage temperature is for four reasons:

(i) The effect of carbon dioxide increases as the temperature is decreased.

(ii) The organisms which grow in carbon dioxide grow poorly at 36°F.

(iii) Although an increase in temperature from 36°F to 43°F approximately halves the ageing period, there is a four-fold increase in bacterial growth.

(iv) Browning (metmyoglobin formation) is less at 36°F than at 43°F.

The level of carbon dioxide is limited because concentrations above 30% may give a bleached appearance to the meat. The presence of carbon dioxide does not influence the tenderisation process.

With our present technology, this process of ageing appears to give the most consistent and satisfactory results.

The <u>advantages</u> are:

(a) Exact control of carbon dioxide concentration and hence good control of bacterial growth, storage life and uniformity of product.

(b) Good control of oxygen concentrations and hence the product is of good uniform fresh meat colour. As long as the oxygen concentration is kept above 5% no more browning occurs than during storage in air (at 25% carbon dioxide the oxygen concentration is about 15%).

(c) No humidity control necessary.

(d) Negligible weight loss.

(e) The method fits in well with current meatworks practice and the packaging films are relatively inexpensive. The direct costs of packing and handling (including carbon dioxide) are at least 1¢/lb cheaper than method 2.

(f) Breaks in the pack cause no great difficulties.

The disadvantages are:-

(a) The additional capital cost of a new storage room suitable for controlled atmosphere is up to 25% more than a conventional room. However, this additional cost is soon paid for by the savings outlined above.

(b) Exudation of fluid as in method 2.

(c) Under chilled conditions the meat, after ageing and removal from the controlled atmosphere storage room, will not keep for as long a period as meat packed in gas impermeable films. This is not a disadvantage if the meat is held chilled in carbon dioxide until sold or if the meat is frozen immediately after ageing.

GENERAL DISCUSSION:

The periods are based on the meat being handled correctly prior to ageing (mutton and lamb carcases should be chilled to 45°F within 12 hours of loading chillers and medium beef sides should be chilled to 50°F within 20 hours of loading chillers). The commencement of the ageing period is taken as 24 hours after slaughter. Temperatures are storage room temperatures and should be controlled within ± 2°F of those stated.

Both of the last two methods open up possibilities of ageing chilled meats aboard ship. Argentina is currently doing this. For long distance shipment, temperatures just above freezing would be used.

Experiments are continuing on investigations into the ageing process. The aim is to gain better understanding of what happens. This will better enable us to predict the period required for different cuts from specific carcase types. The eventual aim is to reduce the ageing period to something less than that presently recommended.

Enquiries on any aspect of this work are invited.

...oo000oo...

NEWS JOTTINGS:

Next issue will be Meat Colour.

Refractive Index Experiments: Subsequent to our News Letter No. 69/2, it has been found that a Whatman No. 1 Filter Paper will eliminate cloudiness in the filtrate and therefore this type should be used in preference to the one mentioned.

Artificial Meat: A Japanese firm has applied for patents for a process which converts the gluten portion of wheat into "wheat meat". The researchers claim that it is an advance on the several ways of producing meat from soya bean.

The Chairman of the Australian Meat Research Committee, Mr. J.L. Shute, and ten Members of the Committee visited the Meat Research Laboratory on Friday, March 21st. A short talk by the Officer-in-Charge and by Dr. R.P. Newbold on biochemical changes in muscle after slaughter took place, followed by inspection of new laboratories and cold rooms which are almost complete.