CURING & SMOKING

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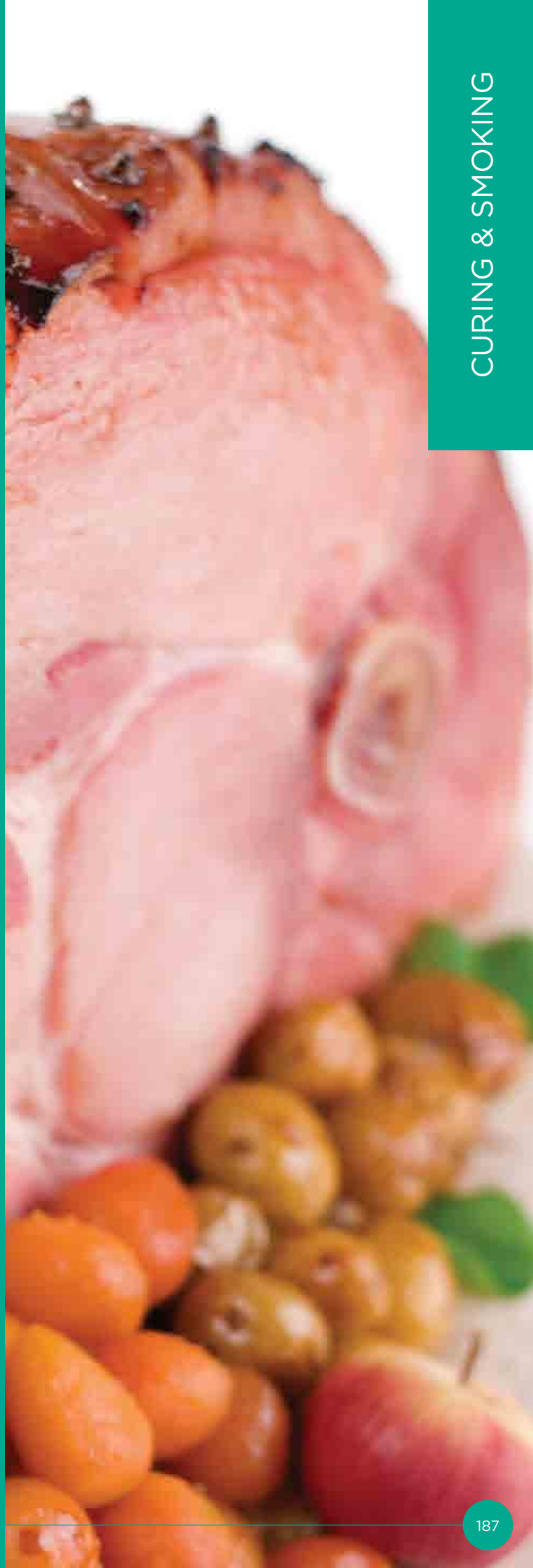


A QUICK GUIDE TO CURING & SMOKING

Curing is one of the oldest and most effective ways of preserving meat. It imparts an unmistakable flavour to meat and is also a prelude to smoking meat.

Meat handling before and during the curing process must be carried out hygienically - the better the quality of the meat, the better the end product.

At Dunninghams, we specialise in providing the finest quality curing and smoking ingredients and equipment, to assist you in producing the best products for your customers.

Following is a quick guide to the techniques behind successful curing and smoking. To find out more, or to select which Dunninghams products best suit your individual needs, please call our Customer Service Team on 0800 363 1921.

THE BATCH PACK SYSTEM

ADVANTAGES

Batch Packs offer you the following advantages:

- **Convenient Time Saving:**
  The need for weighing separate ingredient quantities is avoided.
- **Consistency of Flavour:**
  Each batch of product you prepare will contain the same, accurately weighed ingredients, giving you better quality control. Preservatives and cures, where applicable, are packed separately within the Batch Pack.
- **Reduced Stock Holding:**
  A variety of ingredients need not be held in stock. All the ingredients you require are blended in their correct proportions in each Batch Pack.
- **Eliminated Wastage:**
  No spillage or spoilage of separate ingredients, as Batch Pack contents are pre-weighed and the total contents of each pack is used.
- **Freshness:**
  Batch Packs are only opened prior to use. Non-Batch Pack ingredients, once opened, can lose their freshness if only partly used.
- **Quality Control:**
  The quality of raw materials used in each blend is carefully monitored and controlled by Dunninghams through its Microsafe® process.
- **Batch Control:**
  Each Batch Pack contains a production batch number which allows Dunninghams to track the raw materials used, in the unlikely event of a quality issue.

APPLICATIONS

- **Meat Products**
  Fresh sausages such as boerewors, beef, pork, mutton, and chicken sausage. Cured and dried sausage such as pepperoni, salami and cabanossi. Cured meat cuts such as ham, biltong and bacon. Smoked and cooked sausage such as Russians, Viennas and Frankfurters.
- **Poultry Products**
  Injection brine for pumping of whole birds and portions.
- **Sauces and Condiments**
  Dry and wet cook-in sauces, marinades, sauces and bastings.
- **Baked Goods**
  Pizza dough, breads, cakes and buns.

  ...and any other applications where combinations of functional ingredients are used in a batch system.

TYPICAL BATCH PACK CONTENTS COULD INCLUDE...

Protein	Anticaking Agents	Starch
Colours	Antioxidants	Flavours
Buffers	Preservatives	Stabilisers
Freeflowing Agents	Herbs & Spices	

BATCH PACK

INGREDIENTS USED IN **Dunninghams** CURING AGENTS

Dunninghams curing agents are carefully formulated to ensure the best possible quality characteristics of taste, colour, succulence and shelf life are achieved without compromising on yield.

With over 80 years' experience and a world wide network of suppliers, Dunninghams has developed a range of products specially formulated for the New Zealand meat industry.

Dunninghams formulations are continually being reviewed to ensure they encompass the most advanced food science, comply with New Zealand's food laws and optimise our customers' profitability.

The ingredients used, and their functions in meat products, are reviewed in the sections that follow.

SALT

Sodium Chloride - or common salt - has been used for the preservation of food from times of antiquity. In the modern food industry salt is not often used as a food preservative. In the production of manufactured and cured meats it is added to enhance the functional properties of the product. Salt is also used as a flavour enhancer.

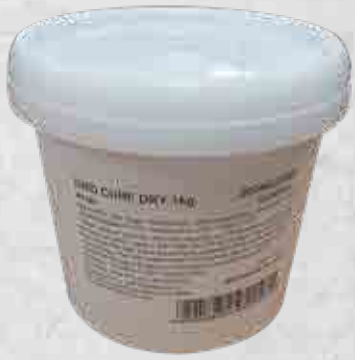
The most important function of salt is to combine with phosphates to hydrate and solubilise meat proteins. These functions are essential in the production of high quality meat products, where it is necessary to use active ingredients to optimise the natural properties of the muscle tissue.

Salt, in the presence of phosphates, begins to have an effect on muscle proteins at a level of 1.2%, or approximately 12g per Kg. This effect is enhanced as the salt concentration is raised, and at 2% salt, the meat proteins begin to be fully hydrated or activated.

Although salt is used at lower levels in the modern food industry, salt can still contribute to the shelf life of meat products, particularly in products where salt is used in conjunction with other properties such as reduced pH, modified atmosphere packaging and low storage temperatures.

A final and important use of salt is as a carrier of components which could be dangerous if misused. Nitrite is a necessary ingredient in many cured and smoked meat products. Its use is highly regulated, and it is important that regulatory limits are not exceeded.

For this reason, many countries do not allow nitrite to be added directly to meat products, but require approved suppliers to provide nitrite in a salt base. In New Zealand this is not a regulatory requirement, however many companies choose to use proprietary blends to ensure that high levels of nitrite are not added accidently. Dunninghams is an approved and certified handler of salt/nitrite blends.



NEW *DMD Dry Cure 1kg*

PHOSPHATES

Phosphates are salts, and could have been included in the preceding section. However, phosphates play such an important role in the meat industry, that they are often regarded as a specialised ingredient, and treated separately.

After slaughter, meat undergoes a number of irreversible changes. In the first instance these are observed as the 'stiffening' of the carcass during rigor. This is followed by a gradual relaxation of the muscle tissues during the aging process. The consequence of these changes is that meat has limited binding properties, and also tends to shrink on cooking. There are a number of reasons for these changes, all of which are related to the biochemical changes that take place after the slaughtering process.

The most important of these, from a meat processing viewpoint, is the loss of adenosine tri phosphate (ATP). This results in the muscle fibres becoming 'locked', so they remain in a contracted state after rigor mortis. Although there is some relaxation during the aging process, the original flexibility of the muscle is never restored.

Phosphates are able to loosen the bonds that have been set up in the muscle fibres. This contributes to the solubility of the muscle fibres, particularly in the presence of salt. This is one of the main reasons why phosphates are used universally in the meat industry. Another change in meat after slaughter is a drop in the pH brought about by the conversion of glycogen to lactic acid. The final pH in meat will vary, but can be as low as 5.5. At this level the ability of muscle to hold water is minimal.

Phosphates are usually alkaline, and their addition to muscle tissue will raise the pH, restoring some of the capacity of the meat to hold water.

Some phosphates have a specific effect on muscle proteins, such that some of the chemical bounds in the muscle fibre are actually split. This effect is most important in the production of comminuted products such as sausage emulsions, where the muscle proteins are required to form stable gels and emulsions.

The selection of phosphates for different applications is highly specialised, where the different properties of the phosphates are either created under highly controlled conditions, or by blending different phosphates with specific properties to fulfil the requirements of a given application.

SODIUM NITRITE

Sodium nitrite is added to cured meat products to provide a stable pink colour, and also to enhance the flavour traditionally associated with cured meat. In addition nitrite is added as a food safety measure, as nitrite has some bacteriostatic effects, and acts as a preservative against certain bacteria.

Sodium nitrite is itself colourless. Colour is added to salt that has had nitrite mixed in. This is a safety attribute used to ensure that salt containing sodium nitrite is not used incorrectly.

When added to meat, sodium nitrite is converted to nitric oxide (NO). Nitric oxide forms a pink colour through a series of chemical reactions that ultimately enable the by-product of the nitrite to react with a form of myoglobin to produce a red compound called nitrosometmyoglobin. Nitrosometmyoglobin is in turn reduced to yet another unstable compound, nitrosomyoglobin. Nitrosomyoglobin is denatured to form globin and nitrosomyochromogen, the compound ultimately responsible for the stable pink colour in cured meat.

The series of reactions that lead to the formation of the pink colour are dependent on certain conditions. In the first instance it is necessary to provide mildly acid conditions, with the intermediary reactions taking place at a pH of 5.2 to 6.4, with the reaction occurring more rapidly at the lower end of the pH scale.

Normally the pH of meat products falls to 5.5 at the end of rigor. During aging the pH gradually rises due to ongoing enzymatic activity in the muscle. As the intention is to use meat when it is still relatively fresh, most meat products are pumped after 4-6 days' aging, with a pH of around 5.6 to 5.8. These conditions are normally quite suitable for the development of a stable colour.

Other conditions necessary for good colour development are a reasonable level of myoglobin in the meat, and sufficient nitrite in the cure.

Myoglobin levels can be quite low in products such as chicken. Highly extended products such as sandwich hams can also have a relatively low level of myoglobin in the final formulation. As a result, it can be more difficult to ensure a stable colour in these products.

There are a number of ingredients that can be added to cures to enhance the development of a stable colour, notably ascorbic acid and its salts. These are discussed in the section that follows. Essentially these compounds are reducing agents. That is, they remove traces of oxidising agents from the product which interfere with the formation of stable colours. If excessive levels of oxygen or other oxidizing agents are present, the ascorbates will be oxidized before achieving their purpose. This can lead to poor colour development, particularly in product where other negative factors, such as low level of myoglobin, prevail.

Like many other chemical reactions, the rate of colour development is affected by temperature, with the reactions being slower at the low temperatures used in the meat industry. For most curing applications there is a need to hold overnight. This usually conforms to the needs of operations such as tumbling.

Nitrite can react with various constituents in meat to form substances which are carcinogenic. In order to minimise the risk of this occurring, nitrites are highly regulated, and in New Zealand the maximum level for nitrite in cured and dried meat products is 125 parts per million.

Nitrite complexes, and this includes nitrosomyochromogen are sensitive to light. For this reason products exposed to light will experience fading. These changes will be more noticeable in products where colour development has been marginal.

CARRAGEENAN

Carrageenan is derived from seaweed. The type of carrageenan used in the meat industry is termed K-carrageenan. The reagent needs to be heated to 70^{0}C before it begins to form a gel. As a gel, carrageenan has the capacity to bind large quantities of water, with stable gels being produced with 1 part carrageenan and 100 parts water. Carrageenan gels are heat-reversible. That is, they will set at lower temperatures, but melt in heated products. For this reason they are more suited to products that are consumed cold.

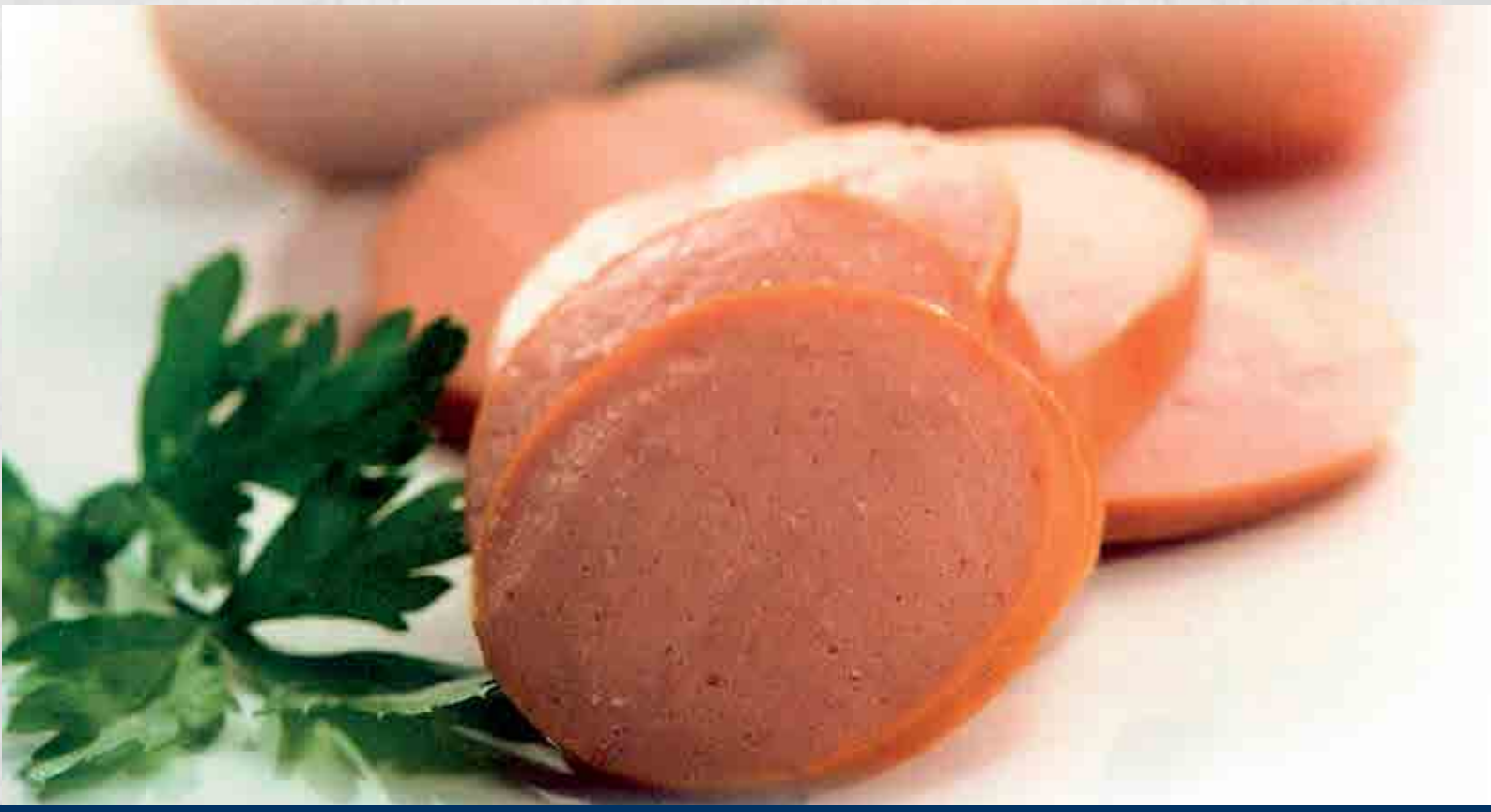
ADDED PROTEINS

A number of different proteins are used in the meat industry to enhance the water-holding capacity, and to assist in the formation of gels.

The most widely used has been soy protein, or soy isolates. Dairy proteins such as whey powder and casein have also been used, as has egg albumin.

All of these substances are allergens. Where possible, Dunninghams has replaced allergenic substances with non-allergenic alternatives such as other vegetable proteins or pork rind powder.

Proteins are added to meat products to improve the gelling and emulsifying characteristics. This in turn leads to improvements in the mouth feel of the product, whilst reducing purge in sliced and pre-packed products.



HELPFUL HINTS **Problem Solving - Bacon & Ham**

1: SPOILAGE PROBLEMS

(A) PIN HOLES

Pin holes can be due to mechanical or microbiological causes. Commonly associated with ham, this effect appears as small holes in the cut surface of the finished product and can be due to air being drawn into the injector, either because the inlet hose is not properly submerged, or there is a leak on the inlet side of the pump.

Gas-producing bacteria can also cause the pin hole effect, although this is unusual in products with reasonable levels of curing salts. Nevertheless, it is important to maintain certain hygiene standards, with the following being important:

- Use only fresh meat. Tainted or old meat cannot be 'refreshed' by curing.
- Brines which are re-used, kept too long or used for a variety of products may become contaminated. It is recommended that brines (especially injection brines) are made fresh for a particular operation and are not stored for prolonged periods of time.
- Plant and equipment should be cleaned and sanitised daily. Proper cleaning may involve stripping some pieces of equipment. Refer to user manuals, and follow the recommended procedures.

(B) BONE TAINT

Bone taint can be a problem specific to Cooked on the Bone Hams (COBs). Products such as ham that are cured 'bone-in' may suffer bone taint if the meat around the bone is not properly cured. This can be resolved by using a hand injector to inject curing brine up along the hock. It is also necessary to ensure the meat is not tainted before curing.

(C) POOR SHELF LIFE

Although the shelf life of ham and bacon products is a broad subject, many problems can be overcome by adhering to four basic principles:

- Use the correct cures and marinades. The combination of curing salts, cooking, correct packaging and cold-holding temperatures are the basis of a product's shelf life. Salt levels in the finished product should be about 2%. This is necessary to inhibit some of the spoilage organisms that can grow at low temperatures.
- Cook ham products correctly. A core temperature of 68^{0}C is recommended for large products such as leg hams, which may take a number of hours to reach core temperature. Smaller products, such as chubs, cook more quickly, and should be cooked to a core temperature of 72^{0}C.
- Products to be sliced, or stripped of cooking bags or netting, must be handled through equipment and on benches that have been thoroughly cleaned and sanitised.
- Storage temperatures are inversely related to shelf life. A reduction in holding temperatures from 4^{0}C to 1^{0}C will result in a significant increase in shelf life. Operators able to reduce temperatures to -1^{0}C will see additional improvements.

2: COLOUR PROBLEMS

(A) PRODUCT FADES ON OUTER SURFACE, BUT REMAINS PINK ON INSIDE

The cured pigment is affected by strong light and in particular by neon lights. It is possible to improve the retention of colour by the addition of reducing agents. Ask your Dunninghams representative about colour-fast additives.

(B) PRODUCT HAS GREY PATCHES, OR HAS POOR COLOUR THROUGHOUT

The product is likely to be insufficiently cured. There are a number of possible reasons for this:

- Insufficient myoglobin (meat pigment) in the meat. This is not normally a problem. The exceptions are products such as sandwich hams that are highly extended. Chicken products can also have minimal levels of myoglobin.
- Insufficient nitrite level in the cure. Pumping brines correctly prepared will have the correct level of nitrite. However, it is important that cover brines are also maintained with the correct nitrite level.
- Insufficient time given for complete curing before the product was cooked. The reaction of curing salts with the meat pigments is quite complex and takes a certain period of time. Holding the product overnight (16 hours) is normally sufficient for good colour development.
- Temperatures are too cold. It is important that temperatures of pumped meats do not exceed 4^{0}C. On the other hand, temperatures must not be too cold, as colder temperatures will reduce the rate of development of curing colours. For this reason it is important to ensure frozen meats are completely thawed, and meat temperatures are between 2 and 4^{0}C before curing is attempted.

(C) PRODUCT HAS GREEN DISCOLOURATION

Green discolouration can be brought about by the use of incorrect levels of curing agents, or by microbial spoilage:

- Excess levels of nitrite (about 5 times the legal limit) can lead to a condition known as nitrite burn. It is recommended to use nitrite in the form of nitrite salt blends, or complete curing blends such as Dunninghams Ultracure or Honey Dew to ensure excessive levels of nitrite are not used inadvertently. Cover brines should also be tested periodically to ensure nitrite levels are controlled.
- Bacterial spoilage can bring about green discolouration under certain conditions, such as the loss of vacuum in sealed packs. High storage temperatures can also be implicated.

3: TEXTURE & CONSISTENCY PROBLEMS

(A) PRODUCT NOT RETAINING WATER

Different products have an inherent ability to retain a certain level of water, resulting in an industry-accepted yield. It is important to note that different styles of product don't all retain the same level of water. For example, a COB may be acceptable with a yield of 10% of green weight, whilst sandwich or pressed might be expected to yield 150 to 200% green weight.

Allowing for these differences, there can be reasons for products not retaining the expected level of water:

- Phosphates not used correctly. Phosphate blends are prepared to interact with the meat proteins in the presence of salt to enhance the water-holding capacity of meat products. Phosphate blends are scientifically formulated to achieve the desired result in different products. Ensure you follow the pumping charts for given applications, and avoid using phosphates at low or higher levels than is recommended
- Acid conditions can result in poor water uptake. Ensure brines containing acidulates such as GDL are used in the prescribed time. Avoid using PSE meat.
- Excessive pump pressures will cause the flesh to tear and result in lower water uptake. For higher yield and uniform products it is important to use a multi-needle injector. It is almost impossible to achieve a high yielding product using a hand injector. When using multi-needle injectors it may not be possible to achieve the desired uptake of brine in a single pass, which is likely to cause rupture in the flesh. Any brine retained in the torn flesh will be lost readily when the product is cooked. It is preferable to use two passes at a moderate pressure, ensuring a more even distribution of the brine.
- Excessive cooking temperatures will result in additional losses. It is recommended cooking temperatures be monitored using a probe. It is also important to adjust the final temperature to the size or diameter of the product, with larger hams requiring lower core temperatures than small or thin products. For food safety reasons, all hams should be cooked to achieve a minimum of 68^{0}C, with chubs and smaller products taken to 72^{0}C. Oven temperatures and humidity should also be well controlled. Yield can be improved by staging cooking temperatures so they are 25-30^{0}C higher than the core temperature.

(B) REFORMULATED PRODUCTS DON'T HOLD TOGETHER

Sometimes reformulated products break apart, especially on slicing. Reasons for this are varied, as the condition can be brought about by the way the meat is selected and prepared; by using meat that has undergone a degree of spoilage; the use of the incorrect ingredients; and by applying severe cooking methods.

- Meat with excessive levels of fat will not adhere properly. It is important to trim fat from meat to be injected and tumbled. Not only does fat interfere with the binding process, but fat has no capacity to hold water. Thus, fatty meat causes excessive amounts of water to pass into the lean parts of the meat, resulting in these structures becoming weakened.
- When meat is correctly injected and tumbled it should be sticky to touch. All the water in the tumbler should be taken up, and no free liquid should be evident. Signs of free water can be due to excessive amounts of water added to the tumbler. The condition can also be brought about if the time between injecting and tumbling is too long. Another reason for the meat not being sticky at the end of tumbling is that the wrong curing ingredients have been used. Consult your Dunninghams representative for advice on the use of specialty cures. Yet another reason is the tumbling time is insufficient. A general guide is that reformed meats should be tumbled 2500 revolutions. It may be necessary to use a higher number of revolutions for smaller tumblers.
- Meat that has undergone early stages of spoilage can be slightly acid. It is difficult to extract meat proteins under these conditions. Products prepared from such meat will be compromised in terms of gel strength and water retention.
- Loose bagging of reformulated meats will result in the meat not binding correctly on cooking. Ensure bags are pulled up tight to provide good contact between the meat pieces in the bag.

4. PROBLEMS WITH SMOKING

Smoking is considered an art, and even operators using modern, well-controlled smoke houses can have problems from time to time. Common problems are invariably related to the way the smoke cycle is set up and managed:

- Uneven smoke colour is usually the result of insufficient or uneven drying of the product before smoking. 'Striped' patterns are due to condensate running over the product during smoking. Spotty or uneven patches are a result of moisture interfering with the uptake of smoke and can usually be remedied by increasing the drying time/ temperature before smoking. Overloading the oven can also cause problems with airflows and lead to variable smoking and cooking outcomes. In certain instances faulty equipment has also been found to cause uneven smoking, with airflow patterns, leaks and the like allowing for cold spots in the oven.
- Products that are wrinkled or tough are invariably the consequence of over-drying before or during the smoking process.

Problem Solving - Emulsion Products

To discuss problems including spoilage problems, colour problems, problems with texture or consistency, problems during cooking or smoking, contact your Dunninghams sales representative.