REVIEW ON THE TRADITIONAL MEAT PRESERVATION METHODS IN GHANA:

PROBLEMS AND SUGGESTIONS FOR IMPROVEMENT

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SUMMARY

This paper deals with the preservation of meat by the traditional processes of drying, salting and smoking.

The paper outlines the methods involved, problems associated with the methods and shelf life of end-products and suggests, improvements and modifications based in part on established techniques and in part to adapted techniques to local conditions.

Review on a current research proposed to develop alternative methods of preserving meat is also given.

1. BACKGROUND TO PRESERVATIVE PROCESSES

1.1 Role of Moisture Content and Water Activity(AW)

Water is the principal constituent of all raw foods, and is also an important structurising constituent of processed foods. Its presence is a major controlling factor in the stability of food in storage.

Fresh meat, like other natural foods perishes quickly in the absence of preservation. This is due to the high moisture content and Aw in the meat tissues which support the growth and multiplication of micro-organisms and of enzyme reactions. At such high moisture contents and Aw, the effect of biological deterioration overrides the effect of chemical reactivities and vice versa at lower moisture content and Aw.

Aw is defined as the measure of unbound 'free' water available to support biological and chemical reactions. Aw and moisture content thus influence the multiplication and metabolic activity of micro-organisms, and their survival and resistance.

The control of Aw and the moisture content therefore becomes important quality parameters in food preservation methods such as dehydration and in curing processes.

1.2 Role of Curing Salts

Chemical methods of meat preservation involves the addition of solutes such as sugar, salt, or acids or exposure of meat to chemicals such as smoke or fumigants to produce shelf stable products.

The efficiency of these processes stem up primarily from the discouragement of microbial growth caused by the enhanced osmotic pressures achieved in the product.

The curing salts (ie. salt and sugar), have relatively low molecular weights and the resultant high osmotic pressure effects (ie. reduced Aw) render water in the product unavailable to support bacterial growth. Wood smoke components such as phenolic compounds and formaldehyde also have anti-

microbial effects, they enhance the shelf life of cured smoked meat products.

The use of nitrite salts in curing mixes is to fix the attractive pink colour of cured meats, to account partly for the typical cured meat flavour, and also to provide protection against growth and toxin production of the pathogenic organism *Clostridium botulinum.*

Present cured meats are however, valued more for their organoleptic difference which develops during the curing process, rather than to their long-term storage stability. Hence, refrigeration, heat treatment and effective packaging are practised to prolong shelf life of these products.

Currently, other humectants have been sought in the chemical preservation of meat. These include Polyhydric-alcohols, (eg. glycerol), Brockmann, 1970); insoluble polymers, eg. starch, cellulose, (Karel, 1976); Combination of sodium chloride with alkaline metal salts of edible organic hydroxy carboxylic acids, eg. sodium and potassium citrite (Szczesniak and Mao, 1978), and enzyme or acid protein hydrolysates (Ledward, 1985); and antimycotics eg. sorbates and propionates. It is interesting to note that these techniques involve considerable reduction in the normal salt levels present in cured meats and the obviation of nitrite salts in nitrite cured meats. This could be advantageous because of the physiological implications of high salt level intake in the diet (Anon. 1986), and the potential production of carcinogens that may occur in nitrite cured meats (Anon. 1980).

These so-called novel meat products involves the area of intermediate moisture technology (Davies et-al, 1976).

2. PROBLEMS IN LOCAL MEAT PRESERVATION

In our (Ghanaian) tradition, the preservation of meat by either refrigeration or canning is impractical in most situations, as it is expensive, requires numerous imported imputs and expertise, and furthermore because of lack of electrical power sources in most areas. Thus, the need to rely on traditional methods become inevitable despite the problems also encountered here.

Various traditional methods have been evolved by our fore-fathers to preserve meat that can be stored for later consumption. Some of the more important methods include drying (ie. open air, sun's energy, and heat of fires which accompanies wood smoking), and salting (dry and brine curing). Due to poor standard measures for time, temperature control, handling and storage during processing and movement of end-products, alongside deterioration due to spoilage micro-organisms or insect damage, the product suffers considerable losses during storage, nutritional inadequacy, poor sensory characteristics and shelf instability, and may also be of health concern especially when the product is consumed after prolonged storage.

The following chapter discusses methods of traditional meat preservation and suggestions for their improvement.

2.1 Drying

Meat is dried in Ghana as whole portions (bone-in) or larger pieces, or as thin strips. The drying process may involve different activities depending on the area of the country and the season at stake. Generally, two seasons are encountered in the country, namely 'Dry' and 'Wet' seasons.

Open-air/sun drying is practised, with the most effective results, during the dry season and in the Northern half of the country. Here the environment is hot and dry. The best time is between November and May.

Elsewhere in the country, the high relative humidities and frequent rainfall makes this drying method inefficient, thus hot smoking becomes the preferred method of drying.

Meat to be dried is prepared after slaughter (ie. dehairing and evisceration). The meat is then cut into convenient portions. Meats may be lightly salted or not or spiced as desired prior to drying. All kinds of wildlife (game animals) including the African giant snail are dried as well as meats from other domestic animals (ie. sheep, goats and cattle).

Drying is carried out on racks made of wood or by hanging on strings on a line. Drying is continued for several days, turning meat pieces periodically, until meat is well dried and hard to the touch. Large meat pieces are sometimes tempered on fire from time to time, or hung in fire places. In this way, the meat is exposed to smoke and heat action from daily cooking activities and this further prolongs the shelf life of the product for several months.

During the drying process, the outer surfaces of meats may case harden. Hence inner meat tissues of very thick meat pieces are left moisture laden and this predisposes the product to spoilage. Meats dried in this way also have poor textural qualities, hence require reconstitution or prolonged cooking to make them tender. Such dried meats however, are generally consumed in traditional soups where meats cook in the soup for long periods thus becoming tender at the time of consumption.

For improvement in texture and overall quality of dried product, the meat must be trimmed of fat and cut into thin strips; no more than 2cm thick, then preferably lightly salted along with spices and then dried on racks or by hanging on strings. Where environmental conditions are unfavourable ie. high relative humidities and intermittent rainfall, then a type of solar dryer (developed at the Food Research Institute, Accra,), can be used. This dryer can simulate the hot and dry environment found in the Northern part of the country, so that drying can be done continuously elsewhere with hot and humid conditions.

The solar dryer is a rectangular wooden structure fitted with legs about 60cm above ground and provided with a triangular-shaped roof about 90cm high. The roof is covered with a transparent plastic sheeting which receives the sun's rays and directs them into the chamber.

The drying receptacle which is the base of the triangular structure is coated with black oil paint to collect and radiate the heat of the sun to dry the product. Meat to be dried should be treated similarly as discussed above.

Drying can be continued for a few days with periodic turning of meat slices until it is crisp-dry, then removed, powdered or bagged in moisture resistant pouches before storage.

2.2 Smoking

Smoking is the leading method of preserving meat, in Ghana and indeed in the West African sub-region. This process might have originated from the fact that smoking is applied to condition meat or mask off undesirable flavours as a result of spoilage and also the fact that smoke keeps away flies which settle on meat soon after slaughter. The species commonly smoked is wildlife (game animals), although carcass of domestic stock ie. cattle, goat, sheep are at times given similar treatment. With game animals, the carcass is eviscerated after dehairing and skewed along the vertical axis of the body and across the arms and legs with sharpened sticks. This method helps to flatten the carcass during the smoking process. The meats are normally smoked without any prior curing but some local spices can be applied to impart flavour to the meat.

Hot smoking rather than cold smoking is the common practice in Ghana. It has a more profound preservative effect because of its associated heat action which accelerates moisture removal from the meat. Stronger flavours are also imparted from hot smoking while additionally the product comes out cooked thus making it ready to eat. Meats are smoked with firewood on grills in a locally constructed kiln with earth or petrol drum.

This method of smoking produces very dark and hard product. The uncontrolled temperatures during the smoking process may lead to over-cooking and thus loss of nutrients. The product also requires reconstitution prior to use. Such products may also be hung in the fire place where daily cooking of food is done. Hence the products are further exposed to moderate heating and smoke action daily, and this also prolongs the shelf life of the product up to several months. A modified smoking method is as follows:

Process meats hot initially, using the traditional kiln and fueled by firewood. Set grill close to the heat source, about 40cm high from the base. Two or more grills may then be mounted at intervals above this to accommodate more meat. The top of the kiln should be covered with aluminium sheet or similar material allowing only a small closeable vent for periodic exit of spent smoke.

Meats to be smoked should be cut into sizeable portions as thick meat pieces will not preserve well in their inner tissues and this can lead to spoilage. Hard wood shavings or bagasse (chaff from sugarcane stems) can be used. The latter imparts a golden yellow finish to the smoked product as well as giving it a desirable smoke flavour.

Turn meats from time to time as well as overhaul the grills by placing upper layers downwards and vice versa. This is done to allow all the meat surfaces to receive uniform smoke action.

Continue smoking afterwards at lower heat intermittently for a few days until product is well dried.

Other smoke houses exist where alternative layers of shelves are provided to support meats hung on hooks or strings in the smoke house. They are more efficient than the petrol drum types because there is less heat and smoke wastage, thus reducing the overall smoking time and giving a better smoked product.

2.3 Salting

As a rule, salting is not the normal method for preserving meat in this country. This is due to unsatisfactory results often obtained in the process, such as harsh taste and tough texture. However, salting works out successfully with fish. This is being applied in conjunction with drying and fermentation for the production of the local dry salted fish or stinkfish.

In spite of this lack of tradition in meat salting, imported brined meats, such as salted pig's feet (trotters) and salted fatty beef are very popular in this country. Furthermore, their quality problems are minimal as colour, texture and shrinkage effects are tolerable. Salted meat also keeps under brine without any deterioration for long periods unless contaminated.

Over the years, market women selling imported salted meats have learned to use the left-over brines to preserve available meat for sale.

Commercial production of salted meats locally is on a low threshold, probably due to poor quality of the product, lack of appropriate technical information on the required levels of nitrite and other curing salts, and perhaps most important of all, lack of available raw material (ie. meat).

With the increase in demand for pork and pork products these days, it would not be surprising to see more salted pork products (ie. salted bellies, shoulder, trotters etc), on the market. One major concern however, is monitoring of the use and levels of nitrite salts in curing mixes and in the cured meat products offered for sale. This is an area of research and it will afford the consumer a more wholesome and safer cured meat products on his table.

The technology of brining involves the preparation of a saturated solution of common salt (ca.18-20% Nacl) to which is added sugar, sodium nitrite and an acid preservative such as acetic acid or citric acid. Often a red food colouring solution or powder of vegetable origin is added to enhance the appearance of the meat.

The presence of sugar in the brine improves flavour and texture as the salt alone tends to give the meat a harsh taste and a hard brittle texture. It is also known that some bacteria in meat are capable of breaking down sugars to organic acids which in turn suppresses the growth of spoilage bacteria.

2.3.1 Use of Strong Brines

Meats most suitable for this are fatty boneless beef preferably from the brisket (shoulder), pig's feet, shanks, tails and spare ribs, also mutton or goat breasts and shoulder.

Shave feet, shanks and tail, wash off hair, and remove toes. Other meat should be cut into strips or slabs not more than 2cm thick.

Formulate brine solution in glassware, plastic or stainless steel containers as follows:-

Preparation of dry cure (Mix thoroughly)
Per 100g Weight of mixture (apply 1g. curing mix to 16g meat).

Salt	92.8g
Sugar	7.0g
Sodium nitrite	0.2g

Wet cure (100cm^3 Water): NB (10 litres of brine will cover about 5kg meat)

Salt	22.2g
Sugar	16.7g
Colour	0.09cm^3(of 3% colour solution)
Acetic acid	0.17cm^3(Of 98% glacial acetic acid)

Apply the dry cure first by rubbing meat pieces individually on all sides, then place in a container pre-sprinkled with some of the cure. Pack the meat pieces tightly against one another sprinkling some of the mixture on successive layers. Cure at room temperature for at least two days, then transfer meat into brine (wet cure) and stir. Discard the squeezed out juice from the dry cure. Meat can store in the brine for about 2 months. For prolonged storage, the solution should be changed after this period.

2.3.2 Use of Weak Brines

For pigs feet, pork rinds, cow hides, sheep and goat skin with accompanying meat if desired. Prepare meat as before.

Dry cure – as discussed above.

Wet Cure: Blend 8% salt (sodium chloride) solution with 5% solution of 98% glacial acetic acid at the ratio of, 1:2 (acid to salt solution). Keep meat in this acidified brine solution for 30 days in tightly sealed containers. The solution may be changed if further storage is required. The use of weak acidified brines in curing is not a very common procedure but considering the local problems of storage, the technique is worth examining for commercial application.

3. PROPOSED RESEARCH: *(Intermediate moisture meats)*

Hollis et al., (1968) defines Intermediate Moisture Foods (IMF) as "foods that are partially dehydrated and have a suitable concentration of dissolved solids to bind the remaining water sufficiently to inhibit the growth of bacteria, moulds and yeasts".

Important considerations in the processing and development of intermediate moisture foods include reduced spoilage, improved safety and increased shelf life at tropical ambient temperatures, and retention of the soft moist texture. These advantages have been gained by lowering the Aw of the food through addition of low molecular weight soluble solutes (such as polyhydric alcohols, salt, sucrose), addition of mycostatic and bacteriostatic agents and other chemicals to improve stability and organoleptic quality.

Currently, the development of intermediate moisture foods for human consumption has been slow, primarily because of poor organoleptic acceptability. The success of some specialized food systems such as food for space feeding and clinical nutrition, and the rapid penetration of the pet food market of intermediate moisture foods, demonstrate that the drawbacks in IMF for human consumption may be overcome by intensive application of technology.

IMF technology looks even more promising for the developing countries where poor infrastructure for freezing and canning prevail. Furthermore, due to the physiological implications of high salt level intake and nitrite salts in cured meats, alternative humectants or their combinations must be sought that are organoleptically acceptable, non-toxic when consumed in large quantities, and which will produce cured meats with minimal salt levels, and also obviate the use of nitrite salts.

Glycerol has been suggested an ideal humectant (Heidelbaugh and Karel, 1975), in depressing the Aw in desorbed intermediate moisture meats and also safe when consumed in large quantities as it is metabolized *in vivo* into energy, carbon dioxide and water just like carbohydrates (Brockmann,

1969). The only disadvantage is the sugary taste imparted to the meat product.

It is hoped that active research in this area will yield fruitful results that can be implemented in the developing countries to serve as a low-cost preservation method for meat.

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