MEAT PROCESSING: FORMULATIONS AND PROCESS METHODOLOGY

VOLUME 2

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INTRODUCTION

As a follow up to the preparation of the document on "**Meat processing laboratory: Guidelines for establishment**" (Tettey E.C-T., 1990), I found it quite incomplete if a document prepared to guide the prospective meat processor on meat product formulations and processing methodology was not available.

This script was therefore prepared to complement the previous document prepared above to serve as a complete guidance for the prospective meat processor in Ghana.

Currently, the intake of curing salts in the form of nitrite and nitrate in cured meat products is of great concern to the public due to their implication as possible carcinogens.

The formulations presented here have been carefully worked out through considerable period of trials and they represent quite low concentrations of the residual curing salts in the finished product, (about 50ppm) by far lower than the maximum allowable limits required by food regulations as indicated in the script.

MEAT PROCESSING: V0lume 2.

Formulations and process methodology.

Meat curing.

Two fundamental procedures can occur, namely:

i. Dry curing

ii. Pickle curing

There are however, up to six or more modifications of the above, but these will not be discussed here.

Dry curing.

In this process, the formulated ingredients are applied to the meat without additional water. The curing ingredients draw up enough fluids from the maet to form a brine which serves to transport the ingredients into the meat tissue by osmotic diffusion.
Meat must be packed tightly in curing containers. It is customary to overhaul packed meat at least once during the curing (holding) period to allow for uniform penetration of the brine.
Polyphosphates are sometimes used to aid fluid retention and increase yield of cured meats. The maximum allowable limit in the product is 0.5% .

Raw materials.

1. Meat:

Fatty cuts, fat backs, heavy bellies, etc.

2. Spices:

A host of local spices are available for use. Here are few examples:
a. Monodora myristica (calabash nutmeg)--- Local name(Mlaie)
b. Ocimum canum (American Basil)--- Local name(Kowe)
c. Xylopia aethiopica (Ethiopia pepper)--- Local name(So')
d. Eugenia caryophyllata (Cloves)--- Local name(peple')

NB: The local names are given in the Ga language.
Combinations of the above spices used may vary and depends on the type of meat used and the spice flavour required.

3. Salt: Local, solar evaporated (fine to coarse grain).

4. Sugar: Granulated.

5. Sodium nitrite (E250).

(POISON): Its function in meat curing is to develop the attractive pink colour of cured meats, to enhance flavour development and to inhibit growth of Clostridium botulinum bacteria. The exact level required to achieve these functions is not known, but regulations allow a maximum level of 150ppm.(150mg. per kilogram of meat) in the finished product for safety reasons.

6. Sodium nitrate (E251).

(POISON) : Acts as a buffer in the curing brine to release (through bacterial action) nitrite, which is involved in the meat curing process. The maximum allowable level in the finished product is 250ppm. (250mg. nitrate per kilogram of the cured meat).

Equipment and tools.

1. Plastic drums with air-tight covering.
2. Boning knives.
3. Stainless steel or plastic trays.
4. Measuring cylinder.
5. Weighing scales.
6. Scoop to collect ingredients.

STRONG SALT LEVEL CURING:

Salted beef and salted pork products.

Dry curing formulation.(Apply 1g of the mix to 3g of meat).

FORMULATION: 1.

Salt = 95.0g
Sugar = 5.0g
Sodium nitrite = 0.05g
NB: Coarsely ground local spice mixture may be added to the meat at the ratio of (1:1) of any spice combination and at the rate of 0.05% of the meat weight.

STRONG BRINE CURING FORMULATION.

FORMULATION: 2.

Salt	=	89.0g
Sugar	=	6.8g
Sodium nitrate	=	0.022g (22mg)
Sodium nitrite	=	0.011g (11mg)
Spices	=	0.05%
Food colour	=	15ml. of 10% colour solution per 100ml. brine.

NB: Use approximately 22.5 litres of brine per 50kg meat for curing.

FORMULATION: 3.

Salt	=	67.0g
Sugar	=	5.2g
Sodium nitrate	=	0.022g (22mg)
Sodium nitrite	=	0.011g (11mg)
Spices	=	0.05%

NB: Application of this formulation is the same as for formulation 2.

REPLACEMENT PICKLE: For salted beef and pork.

FORMULATION: 4.

Salt	=	95.0g
Sugar	=	5.0g
Glacial acetic acid	=	0.5ml.

NB: Dissolve the above mixture in 100ml. water.
ie. 10kg meat will require about 5 litres of brine for curing.

MILD CURING OF MEAT FORMULATIONS:For hams and bacon products.

FORMULATION: 5. DRY MIX FORMULATION.

Salt = 88.0
Sugar = 10.0
Sodium nitrite = 5mg
Spices = 2g

NB: Apply 1.0g mix to 20g meat.

FORMULATION: 6. PICKLE FORMULATION.

Salt = 8.0g
Sugar = 2.0g
Sodium nitrite = 5mg

NB: Dissolve above mixture in 100ml. of water.

a. Meat preparation and curing process: Dry mix curing.

i. Debone meat and cut into sizable strips or portions (between 5 to 10cm. thick). The length can be variable but reasonable to for easy packing to expose meat surfaces to the salt action.

ii. Rub prepared meat surfaces with small amounts of the required ingredient mix at a time until all meat surfaces are well coated with the mix.

iii. Sprinkle small amounts of the mix at the base of the plastic drum(previously thoroughly cleaned), and pack meat neatly by stacking one upon the other in the drum. Attempt to depress stacked meat to eliminate air pockets and to achieve tight packing. Any remaining mix must be sprinkled on the surface of the stacked meat and the drum lid must also be tightly closed after covering meat surface with polythene sheet.

iv. Place drum in a cool area and overhaul stacked meat ie. move the bottom meats upwards and vise versa, after at least 24 hours of curing.

v. Always handle cured meats with clean hands, (preferrably wear clean gloves). Brine will soon form in the curing drum over the meat. Ensure that all meats are well submerged in this brine by pressing down cured meat. Please, do not add extra water. Cure in a cool room.

Replacement pickle (brine) formulation.

Sometimes it becomes necessary to transfer cured meat into a new formulated brine, called replacement pickle or brine, (refer to formulation 4 above).
This is done when the original brine of the cured meat is deemed to be contaminated or diluted by meat fluids during the curing period.
The use of good, clean water in the preparation of the brine is very important. Preferrably boiled,and cooled water may be used.
If it was desired to use local spices to improve the flavour of cured meats,then we need to sterilize the spices. This is due to the usually heavy microbial loads on the dry spices as we purchase them from the market.
Sterilize spices by heating in an oven (at about 100C for twenty minutes), or in an ordinary saucepan on fire for about thirty minutes.

Dry curing for bacon and ham production.

Dry curing, as mentioned earlier, is most suitable with fatty cuts.
Bacon is a cured, smoked or unsmoked,cooked or uncooked meat product from usually fatty cuts of pork. Usually, bacon is produced from streaky cuts, loin, back, shoulder meats etc.
Ham, on the otherhand, is produced from the leg joint meat. The product is usually less fatty and more expensive on weight to weight basis compared with bacon.

Meat preparation.

1. Meat is prepared as usual by deboning. Meat may be cut up according to conventional pork cutting pattern before deboning. Bellies may be rolled and tied after rubbing meat surfaces with the curing mix. The skin is usually removed before curing but can be left on if desired.

NB: The pattern of meat cutting and deboning is an art which must be learned through practical means.

2. The prepared meat cuts are rubbed into with the required amount of curing mix weighed(see formulation 5). The procedure for packing and curing is the same as for strong brine curing.

3. Since the cured meat will be smoked, curing is done between 3 to 7 days (sometimes even longer), depending upon meat thickness. It is most ideal to cure meats at low temperatures as much as possible. The suggested temperature range for curing is between 3 to 5C.

4. After the curing process, the cured meat is removed from the brine, rinsed with clean water and then drained in open trays for about one hour before smoking.

Smoking procedure.

Two smoking oven designs have been provided (refer to the back pages).
The smoking oven is initially kept warm to about 82C by burning firewood. Cured meats can then be hung by way of hooks in the oven. Initial cooking and heating of meat should take place ie. between 1 to 2 hours, before smoke is applied through hardwood shavings or bagasse(sugarcane chaff).
The internal temperature of the meat should reach at least 60C in order to destroy trichinae organisms.
Smoke is applied intermittently and the dampers provided on the oven can be used to control the amount of smoke entering the oven. High smoke density entering the oven for a prolonged period will impart a "smoky" flavour to the meat.
The overall smoking time is variable ie. between 10 to 18 hours, depending upon the the finish required. Usually a chestnut brown finish will be deemed desirable. Avoid over heating of oven as much as possible. The smoked meat must be cooled after the smoking process before slicing and or packing.

NB: Dry cured meat products may have a harsh taste due to the increased salt penetration and drastic loss of weight of the product during the curing and smoking processes.

Mild brine curing: For hams and bacon.

In this process, the formulated ingredients are dissolved in water and the ensuing solution (brine) is used to cure the meat.
The meat cuts are submerged in the brine and cured at low temperatures as discussed earlier until the meat is completely cured. Overhauling of packed meats also occur to ensure uniform penetration of the brine into the meat tissues.
Usually brine to about 10% by weight of the meat is pumped into the meat tissue (by using the stitch pump) before submerging pumped meats into the remaining brine.
Polyphosphates may also be used to aid water retention and increase yield of the cured meat. Maximum level of use is 0.5% polyphosphate in solution.

NB: The stitch pump is a large needle with several openings attached to a barrel. Manual and mechanical versions are available.

Processing procedure.

Prepare meats as before. Thick joints eg. gammon, shoulder cuts, etc. should be pumped in their deeper tissue to avoid meat spoilage.Ideally the pump is delivered severally at various points within the meat tissue.
After pumping, the meats are tumbled ie. massaged to enhance pickle distribution. This can be done manually or with a machine(tumbling machine).
After this process,the meat can then be submerged in the brine(cover pickle), and cured at low temperature as stated before.
The meat is drained after curing and rinsing, then prepare for smoking as described before.
Gammon cuts (from the leg portion of pork) produce HAM, while bellies, loin and shoulder cuts etc. produce BACON.
NB: Ham may be produced from boneless or bone-in cuts.

* In all cases, care must be taken to ensure uniform penetration and distribution of the brine to all parts of the meat tissue especially the deeper tissue parts.

* Wet cured products have a milder taste and higher yield than dry cured products.

* Expressions such as "sweet pickle", "sweet and sour pork", "hot cure", "salinometer reading"," arterial pumping",etc. etc. when come across, are all terms related to procecces and activities in meat curing.

Comminuted meat products.

Comminuted meat products are those that the surface area of the meat has been increased by grinding, mincing or chopping with the addition of meat extenders, emulsifiers, binders, fillers, seasonings etc., to produce a value-added product. Usually, cheap cuts ie. from the neck, shoulder, shin meat, bellies, head meat etc. are utilized to produce added value products either stuffed in casings, canned or formed.

We shall discuss here the following products:
i. Sausages ie. fresh pork sausage.
ii. Beefburger.

Pork sausage: procedure for preparation.

This product utilizes trimmed meat from the head, bellies, shoulder meat, shin meat etc. The meats are prepared as stated before, and diced or cut into small pieces suitable for mincing or chopping.
Two main methods can be used to produce sausages, namely:by using a bowl cutter or chopper, and by a mincer and a mixer.

Fresh sausage recipe: (with 65% meat content).

Ingredient	percentage level
Lean pork	37.50
Pork backfat	27.50
Rusk	11.25
Seasoning mix	2.50
Water(iced)	21.25
	100.00

NOTE: * Seasoning mix can be made up of a combination of local spices eg. "peple", "caraway seeds", "white pepper", and "salt" in the ratio of(2:1:1:3).
It must also be noted that other local spice combinations can be formulated to suit the final flavour of the product required.

* Rusk may be bread crumbs ground into powder, potato flour and other cereal or carbohydrate flours.
  It must be stated that each type of rusk, or cereal or other carbohydrate filler used and the level incorporated has a different effect on the flavour and other eating characteristics of the final product.

* Lean pork may have a visible fat level of about 20 to 30% .

* Meat content refers to the total proportion of meat and fat in the formulation. Usually the level of meat content allowed in any comminuted meat product is specified by food regulations or laws.

Method using a mincer.

i. Mince all meats after preparation through the medium plate.
ii. Pre-soak rusk with approximately half the water(iced).
iii. Place meat mix in the mixer,add seasoning and the remaining water and mix for one minute.
iv. Add pre-soaked rusk and mix well.

v. mince the mixed meat mix through the fine or medium plate according to desired texture.

vi. Fill into selected casings and hang in chill room(about 2 to 4C) for a minimum period of one hour before packing.

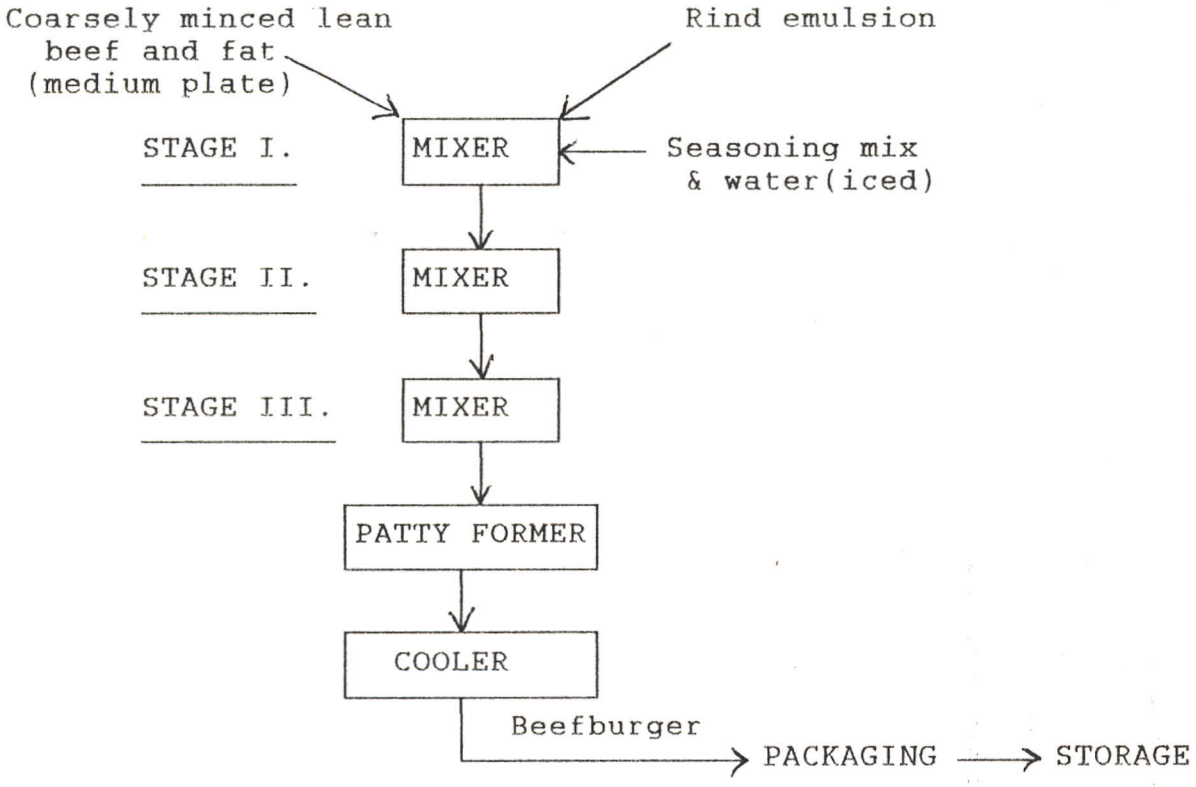
Method using a Bowl Cutter.

i. Transfer prepared lean meat to the bowl cutter.
ii. Add seasoning and iced water, and chop until free water has been absorbed.
iii. Add rusk and chop two more revolutions.
iv. Add backfat and chop on fast speed to desired texture.
v. Fill into selected casings and hang in the chill room for at least one hour before packing.

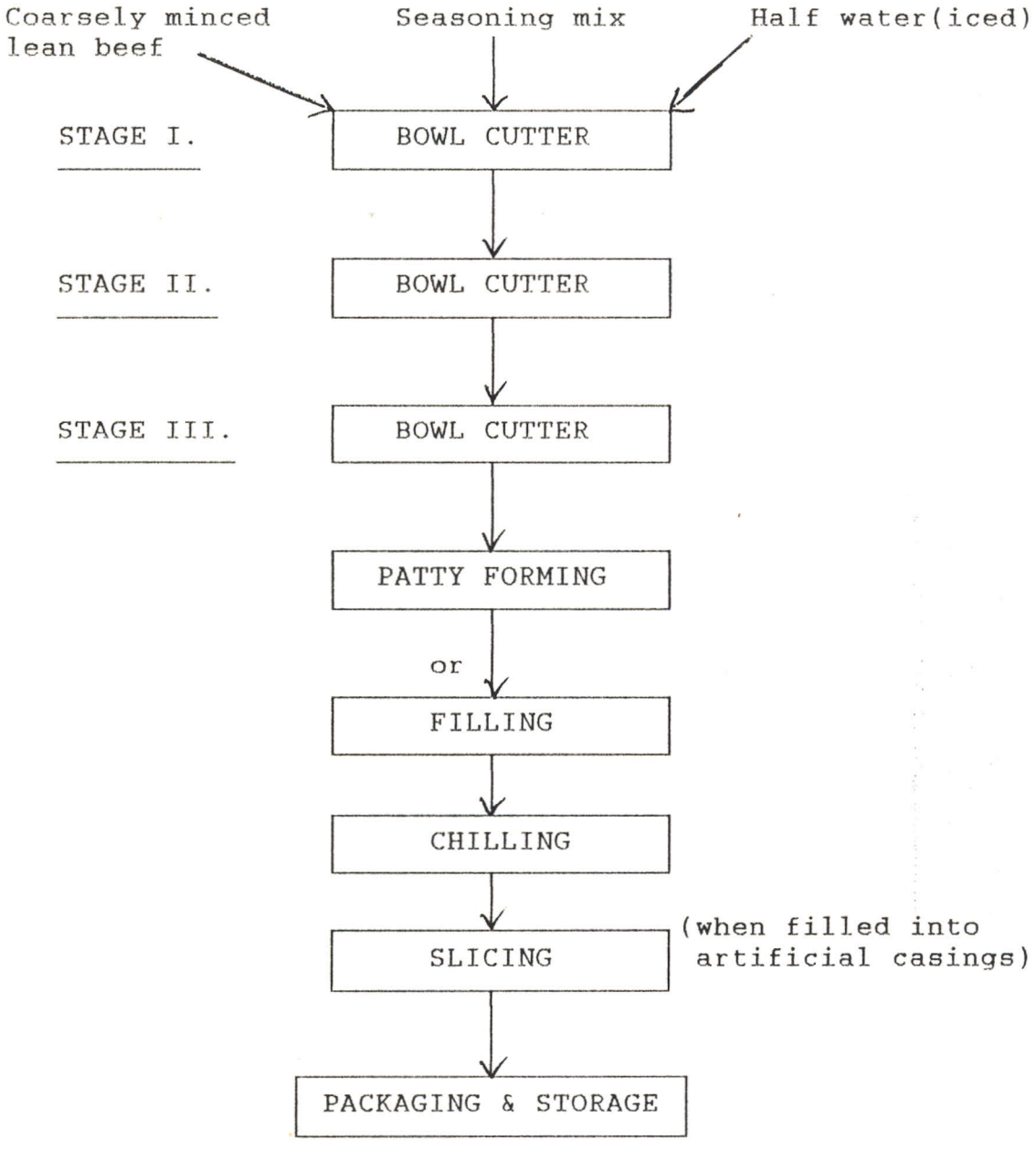
Beefburger (with 80% meat content).

Ingredient	% level (without rind)	% level (with rind)
1. Lean beef (about 20% visible fat)	60.0	60.0
2. Beef fat	20.0	10.0
3. Rind emulsion	---	10.0
4. Rusk	5.0	5.0
5. Water (iced)	12.5	12.5
6. Spice mix	2.5	2.5
	100.0	100.0

Method using a mincer and a mixer.



Method using a bowl cutter.



Preparation of rind emulsion.

Recipe.	% level.
Hot rind (pork or beef skin)	33.0
Boiling water	31.0
Hot fat	30.0
Soy isolate(or milk powder or sodium caseinate)	4.0
Salt	2.0
	100.0

Method.

Boil rind till tender, and transfer to bowl cutter and chop at high speed while adding pre-blanched fat, boiling water, soy isolate and salt. Chop to smooth consistency. Hold in tray under refrigeration when cool for only a short period. For prolonged storage and stability, store under freezing conditions.

Cost of production calculations.

	Cost(cedes)
i. Cost of materials per 50kg product ----------	X
ii. Add cost of production: $\frac{\text{labour} * 100}{\text{total output}}$ -------	Y
iii. Add overheads: $\frac{\text{labour} * 100}{\text{total output}}$ ----------	Z
TOTAL COST OF PRODUCTION:	{ X + Y + Z }

NB: Add your desired profit margin to this total.