BREADS

Food and Agriculture Organization of the United Nations

BREADS

1.- General information

Baking:general information

The term baking is usually applied to flour-based foods, for example wheat, oats, maize and sorghum. These grains and flours have a relatively long shelf life.

The main purpose of baking is to change the eating quality of the staple and to add variety to the diet. It is also a means of preservation, extending the shelf life by removing moisture and inhibiting enzymes and bacteria. After baking, goods such as breads and pastries have a shelf life of 2 to 5 days and other goods such as biscuits and some cakes have a shelf life of several months so long as they are correctly packaged. During baking food is heated by the hot air in the oven. Moisture at the surface is evaporated by the heat and a dry crust forms. Biscuit production involves slower heating so that moisture is also lost from the inside of the product.

Baked goods are produced from either doughs or batters which are a mixture of flour and water made by mixing, beating, kneading or folding. The processing method depend on the ingredients being used and the product being made.

Bread is either leavened or unleavened. Leavened bread is made from a mixture of flour, yeast, salt and water. Unleavened bread does not contain yeast and therefore does not rise. It is a flat bread that is quicker to make than yeast-bread.

To be successful, a bakery needs to operate systematically. Control systems should be implemented to ensure good hygiene and manufacturing practice.

Baking is affected by several external factors, all of which need to be monitored and regulated to produce consistent batches of bread.

Temperature and humidity are two of the most important variables that need to be controlled. These two factors vary throughout the day and change with seasons. Two bakeries sited close to each other may have different ambient temperature and humidity, which affects the breadmaking process.

The baker must remember that temperature and humidity of the ingredients in store are important factors that can influence the quality of the bread.

2.- Processing details breads

2.1.-The sponge and dough process

The sponge and dough process is suitable for small bakeries where there is no mechanical dough mixer available. The whole process is completed by hand.

The advantages of this process are better flavoured bread, better keeping quality and, often, better appearance.

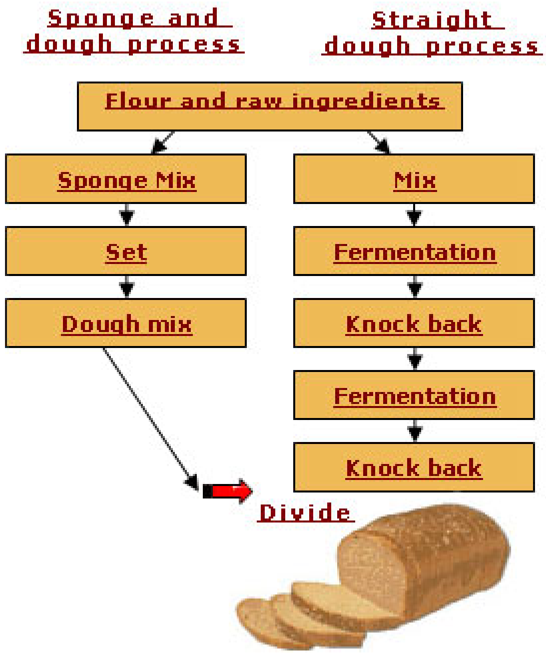
The sponge and dough process can be broken down into two parts:

First, a 'sponge' is formed. This is a fairly stiff batter that is made from part of the flour, the yeast, some sugar and part of the water. These ingredients are thoroughly mixed together, covered and left to ferment at a set temperature for a certain time. The length of time is determined by the quantity of yeast used and can be as long as 14-16 hours.

Second is the 'dough' stage. The remainder of the flour, sugar and water, the fat or margarine, salt and, sometimes, a small amount of yeast, are added to the sponge and thoroughly mixed together to make a smooth, fairly stiff dough.

The final dough mixing by hand is strenuous, but properly made bread using this process has an excellent flavour and an enhanced keeping quality.

The lengthier fermentation times for the sponge are more suitable to the single-handed baker who can set the sponge in the afternoon (eg between 4.00 and 6.00pm) and then continue with the dough at 6.00am the following morning. This allows the baker adequate time for rest. It also makes a substantial saving in yeast.



2.2.-Flour and row ingredients

SPONGE MIX

MIX

Sponge and dough

Weigh out the ingredients for the sponge. Calculate the temperature of the sponge-water that is needed to reach the desired sponge temperature. Calculate the amount of yeast required. This is based on the length of time the sponge will be left to set. The longer the setting time, the less yeast is required.

Straight dough

Weigh and measure the ingredients. Calculate the dough-water temperature to ensure the correct dough temperature.

Calculate the length of the bulk fermentation time (BFT)and the amount of yeast required. The BFT includes the period from the end of mixing the dough until the start of cutting the dough into pieces.

2.3.-Set / fermentation

Sponge and dough

Sponge and dough. When the sponge is mixed, measure and record the temperature. Cover the bowl with a damp cloth and leave to ferment in a draught-free place.

Straight dough

Straight dough. Leave the dough to ferment in a warm, moist environment for up to 4 hours. During this time the dough will almost double in size. If the bread is allowed to ferment for too long, too much air will be formed, the bread will overstretch and then collapse. This will give a hard, flat bread.

2.4.-Knock back

MIX-KNEAD

Sponge and dough

Weigh the remaining ingredients for the bread and add them to the sponge. Measure and record the sponge temperature. Calculate the temperature of the dough water that needs to be added to the dough to reach the final temperature. Mix the dough ingredients into the sponge. If mixing by hand, the total water content of the dough (including the water used for the sponge) should be about 60% of the total flour. If using a mixer, the dough needs to be a little stiffer to prevent it sticking on the machines. The water content should be about 57-59% of the total flour. Mix the dough until all the ingredients are uniformly combined and the dough is stretchy and pliable. Air is incorporated into the dough during mixing.

This stage allows the formation of the protein structure that will later trap the air and cause the bread to rise.

Knock back

Straight dough

Knock the dough back after about three quarters of the bulk fermentation time have passed. If the BFT is 4 hours, knock back the dough after 3 hours. Place the dough in the mixer for a couple of minutes to knock all the air out of the dough. Alternatively, pummel and knead the dough by hand for a few minutes. This releases the air from the dough and levels the temperature throughout the dough ready for further rising.

2.5.-Second fermentation

Sponge and dough

Straight dough. Cover the dough, place in a warm environment and leave to rise for the remainder of the bulk fermentation time.

At the end of the BFT, knock the dough back again by hand to release all the gas from the dough.

2.6.-Knock back

MIX-KNEAD

Sponge and dough

Weigh the remaining ingredients for the bread and add them to the sponge. Measure and record the sponge temperature. Calculate the temperature of the dough water that needs to be added to the dough to reach the final temperature. Mix the dough ingredients into the sponge. If mixing by hand, the total water content of the dough (including the water used for the sponge) should be about 60% of the total flour. If using a mixer, the dough needs to be a little stiffer to prevent it sticking on the machines. The water content should be about 57-59% of the total flour. Mix the dough until all the ingredients are uniformly combined and the dough is stretchy and pliable. Air is incorporated into the dough during mixing.

This stage allows the formation of the protein structure that will later trap the air and cause the bread to rise.

Knock back

Straight dough

Knock the dough back after about three quarters of the bulk fermentation time have passed. If the BFT is 4 hours, knock back the dough after 3 hours. Place the dough in the mixer for a couple of minutes to knock all the air out of the dough. Alternatively, pummel and knead the dough by hand for a few minutes. This releases the air from the dough and levels the temperature throughout the dough ready for further rising.

2.7.-Divide

Straight dough. Cover the dough, place in a warm environment and leave to rise for the remainder of the bulk fermentation time. At the end of the BFT, knock the dough back again by hand to release all the gas from the dough.

2.8.-Ball mould

Mould the dough pieces into balls, either by rolling with the hand or using a ball moulder.

2.9.-Rest

Leave the shaped dough pieces to rest or prove. The length of time varies according to the size of the pieces (anything from 12 to 20 minutes). Proving is carried out either by placing the dough on trays and putting them in a proving cabinet or by passing the trays through a moving prover on a conveyer belt.

2.10.-Mould and tin

Mould the dough into the required size, either by hand or mechanically using a dough moulder. Place the moulded pieces onto greased trays or into tins with the seam side downwards. Place the tins onto racks on a wheeled trolley.

2.11.-Final Proof

Wheel the racked trolley into a steam proving chamber (optimum humidity 85% and temperature of 35-43°C). If there is no steam-proving chamber, cover the trolley with damp cloth sheets and place in a warm, draught free humid area. If a little steam can be introduced under the sheets it will be beneficial.

Take care not to over-prove the products before putting them in the oven. The structure of the bread will collapse and the products will not expand during baking.

Do not leave the products uncovered for any length of time as this causes a hard crust to form on the surface. Arrange the production flow to ensure that the oven is kept as full as possible.

Try and avoid bottlenecks of fermented products waiting to be baked.

2.12.-Bake

When the dough pieces are doubled in size, bake in a pre-heated oven at 230-260°C. The bread can be brushed with milk to give a shiny glaze on top. The baking time depends on the size and type of bread, the number of loaves in the oven and the type of oven.

When loaves are properly baked, they make a hollow sound when tapped on the base with the fingers.

2.13.-Cool

Bread should be removed from the tin (depanned) to cool as soon as possible. If it is left in the tin, condensation will form and soften the crust.

Hot bread is quite fragile so must be handled carefully to avoid breakages.

After a few minutes cooling in the tins, turn out onto wire cooling racks. Place the loaves close to each other, but not touching, to allow the air to circulate. Do not stack the loaves on top of each other.

Use clean gloves to remove the loaves from the tins. Ensure the table they are removed onto is clean.

Depanning tables that have rubber edges to prevent damage to the tins are available. They can be made locally. Clean the bread tins properly and grease them ready for the next batch.

2.14.-Slicing and wrapping

Slicing is an expensive process with a low profit margin. It should only be carried out if the cost is included in the selling price. It may be difficult to keep the slicer blades clean which can give problems with the shelf-life of the bread. Slicing should only be done by large-scale bakers with automatic equipment.

Transport and distribution

Bread should always be allowed to cool down before it is loaded into delivery vehicles. The delivery vehicles must be clean and should have shelves for holding the bread.

3.- Suitability for small-scale processors

The traditional process used to make hand-made breads is suitable for small-scale production.

The basic technologies are simple and small-scale production can be profitable, particularly when local cereals are used.

Baked goods are an ideal convenience food because they are not expensive, they store relatively well and do not require further processing before eating. Baked goods provide plenty of scope for producers to use locally available ingredients to create a variety of value-added products.

In general, it is more profitable to make buns, biscuits and cakes than bread. However, prices for wheat flour vary from country to country and are heavily affected by price and import subsidies.

Packaging requirements are minimal as many of the products are for immediate consumption.

This reduces some of the problems for small-scale processors.

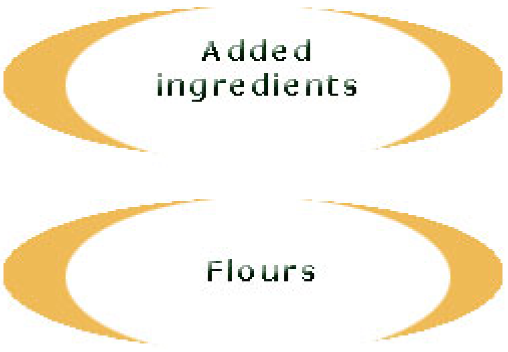
4.- The principles of bread making

The basic ingredients of leavened bread are flour (usually wheat flour), salt, yeast and water. Other ingredients can be added to alter the flavour, appearance and keeping qualities of the bread.

Fat or oil can be added to improve the flavour and help to keep the bread fresh for longer. Milk can be used instead of or in combination with water to make a bread with a softer texture. Savoury ingredients such as onion, tomato, cheese or herbs and sweet ingredients such as sugar, cinnamon and dried fruits can all be added to the basic dough to make a range of products.

A combination of different flours, such as rye, cassava, sorghum, millet or maize can be mixed with the wheat flour in different proportions to produce a range of different breads.

At least 70% wheat flour must be used in leavened breads to allow the bread to rise. Unleavened breads are made from many different types of flour, depending upon what is locally available. Salt and water are added to the flour, but no yeast is used. The flour and water are mixed and kneaded to give a smooth dough that is baked into a crisp flat bread. Examples of unleavened bread include chapattis, rotis, matzos and tortillas.



5.- Added ingredients

- Yeast -

Bakers yeast is a living micro-organism that is used to make the dough rise. When yeast has optimal conditions to grow (warmth, moist and food) it becomes active and starts to ferment. Yeast fermentation is the conversion of sugars to carbon dioxide, water and alcohol.

Bakers yeast can be obtained as compressed fresh yeast, but is mainly available as dried yeast. Dried yeast is easy to transport and store and has a longer shelf life than compressed yeast. It needs to be reconstituted in five times its own weight of warm water before it is used in a bakery. The amount of yeast added depends on the time and temperature of fermentation but is usually between 0.3 and 1.0% of the flour weight.

Salt

Salt is obtained from two sources - rock salt and seawater. Powdered rock salt is recommended for baking as it is purer than seawater salt. The salt should be clean, free from large lumps and easy to dissolve. Salt is used during fermentation for the following reasons:

It emphasises flavour

It improves colouring

It reduces staling

It helps to strengthen the gluten of the dough

It helps to control the rate of fermentation.

Salt is hygroscopic therefore helps to retain moisture in the baked loaf.

Salt should be added at around 2.5-3% of the total weight of water. Care must be taken not to add too much salt as this can prevent the yeast from working properly. Salt should be stored in a dry place away from stored liquids, high humidity or damp.

Salt and yeast should not be allowed to come into direct contact with each other in the raw state as the salt will damage the yeast cell walls and reduce or prevent fermentation.

Baking powder

Baking powder is a combination of two main ingredients - one alkaline (bicarbonate of soda) and one acidic (cream of tartar). When the two ingredients are mixed together thoroughly, then moistened and heated, they give off carbon dioxide gas. For the formula to be successful, the ratio needs to be two parts of cream tartar to one part bicarbonate of soda.

Sugar

Flour normally contains sufficient natural sugar (about 2.5-3%) for the fermentation, but sometimes a little extra sugar is added to the yeast to help activate it.

In some countries sweetened bread is popular, but in general non-sweet breads are preferred. Between 1 and 1.5% sugar is added to the flour.

Panela is unrefined dark sugar made from sugar cane juice. It can be used instead of refined sugar.

Sugar for cake making should be fine and granulated. It gives cakes their sweetness and a good golden colour. Sugar also improves the eating and keeping quality of cakes.

Fats

Fats used in baking include butter, margarine, bakers fats, vegetable oil.

When making bread, it is not necessary to add fat, although the inclusion of a small amount of fat (up to 1% of the flour weight) can improve the keeping quality and softness of the loaf.

Some bakers like to add up to 3% fat as it improves the nutritional value of the bread. Excessive use of fat is not recommended as it can inhibit the fermentation process.

Eggs

Chickens eggs are suitable for cake making. The eggs should be fresh. Eggs vary greatly in size, so it is advisable to weigh them after shelling to ensure the correct amount is used for each recipe. Eggs form the strength and structure of the cake. They improve the flavour and the quality. If the amount of egg being used in a recipe is increased, the amount of fat should also be increased - the quantity of eggs should be equal to or greater than the fat. If the amount of eggs is increased in a recipe containing milk, the quantity of milk should be reduced to prevent the mixture being too moist.

Milk

Milk is used in several types of cake. Fresh skimmed milk or reconstituted dried skimmed milk are both suitable to use. Sour milk and buttermilk are also used in some products, particularly for lactic fermented scones and buns.

Water

In breadmaking, water is mixed with the flour to make a strong, stretchy dough. The amount of water added depends on the type of flour but is usually half the weight of flour used. The water should be slightly warm (body temperature (36°C) is ideal) to encourage fermentation by the yeast. It should not be hot as this reduces the yeast activity.

The water should be clean and potable.

The pH of water varies from acid to alkaline. The length of time needed to mix the dough depends partly on the pH of the dough. Alkaline doughs take longer to mix than acidic doughs.

Fermenting dough has a pH between 5 and 6.

6.- Calculation of sponge and dough temperatures

To achieve a good fermentation, the temperature of the sponge or dough should be maintained at 32 to 35°C. This is the optimum temperature for yeast to multiply. At temperatures lower than this, the rate of fermentation is reduced. At higher temperatures (especially over 42°C), the yeast is killed. The temperature of the water that is added to the flour should be adjusted to be in this range. A thermometer is required to measure the water temperature.

Straight dough process - doubling method

Each recipe for fermented dough recommends a temperature for the mixed dough (the dough temperature).

The formula for the doubling method is as follows:

(dough temperature x 2) - flour temperature = temperature of the water

Straight dough process - major factor method

This is a trial and error method that requires accurate temperature measurements to be made throughout the production period for a number of days. The ambient temperature and all conditions of production need to be measured and recorded. The quality of the bread from each batch is also monitored.

When the perfect bread is made, the temperature readings of the dough and of the flour, water and air that were used are studied. From these readings the 'major factor' figure is calculated. For future doughs, the temperature of the water to be used is calculated from the major factor figure minus the flour and bakery temperatures.

Sponge and dough system

Setting the sponge in hot climates can be difficult. Suitable temperatures can vary between 21 and 26°C depending on the bakery site, the humidity and the difference between day and night temperatures. The following formula can be used to estimate the water temperature:

$$\frac{(\text{desired sponge temperature} - \text{flour temperature}) \times \text{weight of flour (grams)}}{\text{weight of water (grams)} \times 2}$$

When mixing a sponge with flour, other ingredients and water to make a dough, the water temperature is calculated as follows:

(desired dough temperature x 3) - (flour temperature + sponge temperature)

7.- Calculation of bread yield

During the production of bread, there are several stages where weight is lost. During fermentation there is about 1% weight loss of air through the knock-back procedure.

Moisture loss through evaporation during baking, depanning and cooling can account for about 9-11% weight loss. The baker must allow for about 10% loss of weight.

To obtain a 500g baked loaf, a piece of dough of 560g must be used. For an 800g loaf, a dough piece of 880g should be used.

8.- Correcting mistakes

During breadmaking, there are several points where mistakes can be made. It can be difficult to find and rectify the problem as some of the factors are inter-related. The following chart helps to identify some of the common problems:

- Possible causes of external bread faults. G Bathie (2000) -

Possible cause	Nature of fault				
	Lack of volume	Excess volume	Lack of crust colour	Excess crust colour	Shell tops
Dough too tight, especially with tinned bread	*				*
Dough chilled during fermentation	*				
Dough temperature too high			*		
Dough skinned during proof			*		
Dough too slack		*			
Dough under-ripe	*			*	*
Dough over-ripe	*		*		
Too much yeast			*		
Insufficient yeast	*			*	
Insufficient proof	*				*
Slack moulding		*			
Oven temperature too high	*			*	*
Oven temperature too low		*	*		
Too much salt	*			*	
Insufficient salt		*	*		
Over use of chemical improver	*			*	
Excess water			*		
Flour with high maltose figure				*	
Flour with low maltose figure	*		*		*
Over-bleached flour	*				
Flour too strong	*				
Too much proof		*			
Crust formed before maximum expansion					*

- Possible causes of internal bread faults. G Bathie (2000) –

Possible causes	Nature of fault						
	Coarse texture	Poor crumb colour	Crumbly texture	Streaks, cores, seams, condensation marks	Holes in crumb	Dryness and rapid staling	Damp, clammy or close crumb
Dough too tight, especially with tinned bread		*	*		*	*	
Dough chilled during fermentation				*	*		
Dough temperature too high		*	*	*	*	*	
Dough too slack	*	*					
Dough not properly mixed	*	*	* (over)	* (under)	*		
Dough scraps from machinery		*		*	*		
Dough felling							*
Dough under-ripe			*		*	*	* (cold dough)
Dough over-ripe		*	*			*	
Flour not sifted or blended properly				*			
Flour with low maltose content							*
Flour with high maltose content		*		*			
Too strong flour with excessive yeast					*		
Flour too strong		*			*		
Too much dusting flour or dough skinned during fermentation				*	*		
Rope disease							* (damp)
Too much yeast		*	*		*		
Insufficient yeast					*		
Too much salt			*		*		*
Insufficient salt		*	*			*	
Overuse of mineral/ chemical improver			*	*		*	
Overuse of milk or fat			*				*

Grease from dividers				*			
Excessive grease in moulders				*	*		
Insufficient proof					*		
Too much proof	*	*			*		
Slack moulding	*				*		
Incorrect moulding		*		*	*		
Oven temperature too high	*				*		
Oven temperature too low	*	*	*		*	*	
Flash heat in oven					*		
Excessive top heat in oven					*		
Insufficiently baked							*
Incorrect cooling				*			

9.- Bread recipes

The following is a range of basic bread recipes.

Basic bread recipes

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9.1.-Brown wholemeal bread (no-time dough)

Reference. Bathie, 2000 (Ref 16)

16kg strong bakers flour

16kg wholemeal flour

485g dried yeast (if fresh yeast is used, double the amount) 576g fine salt

370g granulated sugar

795g fat or margarine

19.2kg water

Method

Sift the flour, mix in the wholemeal and rub in the fat.

Disperse the yeast and a little sugar into a portion of water at a temperature of 35°C (approximately 5-10 times the yeasts weight in water). Stir vigorously and leave for 12 minutes for the yeast to activate.

Add the salt and remaining sugar into the dough water and add to the flour mixture.

Once the dough water is almost drawn in, add the activated yeast and continue mixing until an elasticated dough is formed.

Cover the dough with a damp cloth and rest for 20 minutes.

Divide the dough into equally weighed pieces and mould them into desired shapes.

Cover with damp cloths and put in a proving cabinet for final proofing.

Bake at 220°C for 30 minutes for a 500g loaf or 40-50 minutes for an 800g -1kg loaf.

Remove the bread from the oven, remove from tins and stand on cooling trays to cool.

Pack in paper or polythene bags depending on the length of storage time before sale or consumption.

9.2.-Standard white bread

Reference. Bathie, 2000 (Ref 16)

90kg strong bakers flour

910g dried yeast (if fresh yeast is used, double this amount)

1.59kg fine salt

850g granulated sugar

910g bakers fat or margarine

53kg water

Method

Sift the flour and mix in the fat.

Disperse the yeast and a little sugar into a portion of water at a temperature of 35°C (approximately 5-10 times the yeasts weight in water). Stir vigorously and leave for 12 minutes for the yeast to activate.

Add the salt and remaining sugar into the dough water and add to the flour mixture.

Once the dough water is almost drawn in, add the activated yeast and continue mixing until an elasticated dough is formed.

Cover with a damp cloth and rest the dough in 'bulk fermentation' for about 45 minutes.

Knock back the dough - lightly knead the dough - to expel the air. This can be done by mixing in a mixer for 1 minute.

Rest for 15 minutes (this makes the total bulk fermentation time 1 hour) then divide the dough into equally weighed pieces. Mould these into the desired shape.

Cover with a damp cloth and rest for 10 minutes before the final moulding.

Place in a steam space or proving cabinet for the final proof.

Bake at 220°C for 30 minutes for a 500g loaf or 40-50 minutes for an 800g -1kg loaf.

Cover with a damp cloth and rest the dough in 'bulk fermentation' for about 45 minutes.

Remove the bread from the oven, remove from tins and stand on cooling trays to cool.

Pack in paper or polythene bags depending on the length of storage time before sale or consumption.

9.3.-White bread - overnight dough (12-14 hours)

Reference. Bathie, 2000 (Ref 16)

Sponge

54kg strong flour

150g dried yeast

41kg water

Dough

81kg strong flour

50g dried yeast (booster)

2.44kg fine salt

1.99kg granulated sugar

1.35kg bakers fat/margarine

40kg water

Method

Sponge

Sift the flour.

Disperse the yeast and a little sugar into a portion of water at a temperature of 35°C (approximately 5-10 times the yeasts weight in water). Leave for 12 minutes for the yeast to activate.

Bring the sponge water to a temperature of 21°C and mix into the flour. Immediately add the activated yeast and water and mix together to make a soft batter.

Record the sponge temperature on the production record.

Cover the sponge with a damp cloth and set in a a draught-free place for 12-14 hours.

Dough

Sift the flour for the dough onto the sponge and rub in the fat.

Disperse the booster yeast into 5-10 times its weight of water at a temperature of 35°C. Add a little sugar. Whisk together and set aside to activate the yeast for about 12 minutes.

Disperse the salt and remainder of sugar into the dough water (at a temperature of 26.7°C) and add to the other ingredients.

Start the mixer and as the ingredients are becoming absorbed, add the booster-activated yeast water and continue mixing to obtain a stiffish dough that comes cleanly away form the side of the bowl.

Cover with a damp cloth and rest for about 30 minutes.

Knock the dough back to expel the air - knead for about 1 minute with the mixer.

Divide the dough into equally weighed pieces and mould into the desired shape.

Cover with a damp cloth and rest for 10 minutes before the final moulding.

Place in a steam space or proving cabinet for the final proof.

Bake at 220°C for 30 minutes for a 500g loaf or 40-50 minutes for an 800g -1kg loaf.

Remove the bread from the oven, remove from tins and stand on cooling trays to cool.

Pack in paper or polythene bags depending on the length of storage time before sale or consumption.

9.4.-Cheese Loaf

Reference. Bathie, 2000 (Ref 16)

2kg soft flour

62g baking powder

31g fine salt

31g dry mustard

480g bakers fat/margarine

1kg grated cheese

1.24kg milk

Sift and mix the flour, baking powder, salt and mustard together. Rub the fat into the dry ingredients.

Mix in the grated cheese. Add the milk and mix to form a soft dough.

Divide the dough into 539g pieces and mould into balls using the minimum of dusting flour.

Cover with a damp cloth and rest for 10 minutes before final moulding.

Roll into sausage shapes of an even thickness, place on a greased tin and press down level. Cover with a damp cloth and rest for a further 10 minutes.

Bake at 204°C for about 20 minutes. After this time, lightly sprinkle some grated cheese on the top of each loaf.

9.5.-Fermented sweet bread

Reference. Bathie, 2000 (Ref 16)

45.5kg soft wheat flour

11 lires water

11.35kg sugar

8.45kg lard or vegetable oil

1.35kg dried yeast

1.35kg baking powder

454g salt

9kg eggs

Mix together the flour and water. Mix in the sugar, fat, yeast, baking powder, salt and eggs to form a dough.

Cover with a damp cloth or oiled polythene and rest for 20 minutes.

Divide the dough into equally sized pieces according to desired shape. Place each shape on a baking tray.

Cover the dough pieces with a damp cloth to prevent drying out. Leave for 3 hours at a temperature of 20-24°C.

Bake at 180°C for 25 minutes. For large loaves, lower the temperature and bake for longer. The surface should be dark brown when baking is finished.

Remove from the oven and cool before packaging.

Pack in paper or polythene bags depending on the the length of storage time before consumption.

9.6.-Chapati (pancakes)

Reference:Fellows 1997

Flour

Water

Eggs - optional

Oil - optional

Chapattis are round flat unleavened breads made from wheat flour. The flour can be white, brown or wholemeal flour. White flour is finely ground but it is more common to use brown flour at an 85% extraction rate. Chapattis have a shelf life of 3-5 day.

1. Mix the flour with water (2 parts flour to 1 part water at 37-40°C). If eggs are used, the amount of water should be decreased. Add salt to taste.

2. Knead for 8-10 minutes to make a smooth elastic dough.

3. Shape the dough into smooth balls, cover with a clean piece of damp cloth and rest for 10 minutes.

4. Roll each piece on a floured surface using a rolling pin. Grease the surface of the dough with a little oil before rolling to a diameter of 15cm and a thickness of 2-3mm.

5. Grease the pan with a little oil and fry until the surface is brown.

6. Cool to room temperature. Pack in plastic bags and store in cool dry place away from sunlight.

9.7.-Mais Tortilla

Reference:Fellows 1997

4.5kg maize grain

70g lime (calcium hydroxide)

The tortilla is a type of pancake that is the staple in some Latin American countries. It is consumed instead of bread and as the basis of many snackfoods. Fresh tortillas have a shelf life of 1 or 2 days. To store for longer than this they must be refrigerated. The method of processing involves cooking the maize grains in lime (Calcium hydroxide) to soften it before removing the hulls and wet-milling to a paste or dough. The dough is pressed by hand or machine to a disc of the desired thickness and diameter.

1. Boil the maize grain in water plus lime for one hour. Ensure the level of water covers the grain.

2. Wash the grains by shaking under running water to remove the hulls and excess lime. Drain to produce clean, hulled grains.

3. Wet-mill the grains using a stone mill to form a soft dough.

4. Divide the dough and shape the tortillas by hand or with a tortilla press.

5. Cook the tortilla by griddling on both sides on a clay hotplate until golden in colour.

6. Cool to room temperature and pack in polythene bags in quantities of 6 or 12. Store in a cool dry place or refrigerate to increase the shelf life.

9.8.-Pop Corn

Reference:Fellows 1997

Maize grains

Popcorn is a snackfood made from a variety of maize known as popcorn maize. It is made by exploding the grain of maize under high pressure, so that it has a light, crisp texture. The grains are heated in a closed container until the moisture content within the grain vaporises and causes the grain to expand (or pop). In some places the grains are heated in hot sand or in a little oil inside a closed container. In other places, a pressurised chamber is used. The grains used should be ripe, fully mature ad free from mould or growth. They should have a oistur content of 13-14%. The popped grains should be cooled rapidly after popping to prevent overcooking or excessive drying.

1. Clean the popcorn maize grains. The grains should be shelled and dried for storage.

2. Heat the dry grains in a closed container until a popping sound is heard. This happens when the grains reach about 177°C.

3. Mix in salt to taste.

4. Remove the product from the cooking vessel and allow to cool in a clean dry place.

5. Pack in moisture proof packaging and store in a cool dry place.