

## *Whole Grain Connection*

*A California non-profit corporation, 501 (c) 3*

*P O Box 696*

*Los Altos*

*California 94023 - 0696*

*Telephone: 650 938 2865*

*e-mail: barmbaker@aol.com*

*Aiming to enhance the desirability and availability of 100% whole grain breads, and other 100% whole grain products, from organically and sustainably grown grains, and thereby connecting farmers and bakers.*

## *Whole Wheat Barm Bread 2008*

Recent improvements include the way the mash is prepared, incorporating salt in both mash and barm, and the preparation of a sponge. The results are better dough handling and better bread texture.

© Monica Alton Spiller 2008.

These recipes can be used freely at home or in bakeries. However they may not be reproduced in print for sale without obtaining permission in writing from us at the address:

*Whole Grain Connection, P O Box 696, Los Altos, CA 94023-0696*

If you use and enjoy these recipes please consider making a donation to the *Whole Grain Connection* so that we can continue to develop and publish whole grain recipes.

Suggested donations are \$5 for retirees and students, \$25 for families, \$100 for small bakeries and \$1,000 for large bakeries. Donations are tax deductible. At all levels of donation we shall be glad to give telephone and e-mail consultations.

We welcome your comments – they help us to improve our recipes.

## **Contents**

3	<i>Whole Wheat Barm Bread 2008</i>
3	<i>Mash</i>
4	<i>Barm refreshment</i>
4	<i>Sponge</i>
5	<i>Bread making</i>
6	<i>Whole Wheat Barm Bread 2008 - in cups and spoons, and temperature °F</i>
6	<i>Mash</i>
7	<i>Barm refreshment</i>
7	<i>Sponge</i>
8	<i>Bread making</i>
9	<i>Wheat Sprouts 2008</i>
9	<i>Using fresh sprouts</i>
9	<i>Making enzyme active sprouted wheat flour</i>
11	<i>Making your own barm 2008</i>
11	<i>Introduction</i>
11	<i>Initiating the barm</i>
12	<i>Refreshment of new barm</i>
13	<i>Notes for Whole Wheat Barm Bread 2008</i>
13	<i>Barm</i>
13	<i>Microorganisms in barm</i>
13	<i>Barm temperature</i>
13	<i>Barm refreshment</i>
14	<i>Barm refreshment intervals</i>
14	<i>Converting a sourdough to a barm</i>
14	<i>Acidity and pH measurement</i>
14	<i>Units for measuring ingredients and temperature</i>
14	<i>Flour to use for barm breads</i>
15	<i>Protein levels in flour, best for barm breads</i>
15	<i>Enzymes in whole wheat and malt</i>
15	<i>Water quality and minerals in water for barm bread</i>
16	<i>Salt</i>
16	<i>Mash conditions</i>
17	<i>Mash storage</i>
17	<i>Sponge</i>
17	<i>Separate preparation of mash, barm and sponge</i>
17	<i>General effect of varying temperature in bread making</i>
17	<i>Mash, sponge and barm formula in bakers' percent</i>
18	<i>Dough formula in bakers' percent</i>
18	<i>Basic formula for Whole Wheat Barm Bread 2008 - bakers' percent</i>

# Whole Wheat Barm Bread 2008

Amounts are for one loaf, total whole wheat flour 500 grams.

## Summary of method

First a mash is made, which is fermented with barm to become a sponge. This sponge then becomes a major ingredient in the final barm bread dough. Dough make-up follows familiar methods.

## Mash

Special equipment:

- Extra bowl for flour.
- Wooden mixing tool (spurtle) and flexible dough scraper
- Mash bowl with loosely fitting lid, made from stainless steel, heat-proof glass or acid-resistant ceramic. Size should be such that ingredients half fill it. In cold weather, warm the mash bowl and lid to lukewarm. Have a clean blanket available to wrap the mash bowl and so keep it warm.

Whole wheat flour	250 grams
Enzyme active malted wheat flour	0.5 grams
Salt	3.75 grams
Water	312.5 grams
Total	567 grams

## Method:

Weigh whole wheat flour and malted wheat flour into a bowl and mix well.

Remove approximately half of flour mixture to mash bowl.

Completely dissolve salt in water in a saucepan.

Heat salty water to 65-70°C, add it to flour in mash bowl and stir until evenly mixed. Temperature of mixture should be 55-59°C.

Cover with lid and wait 10 minutes before adding the rest of the flour mixture to the mash bowl. When fully mixed the temperature should be 45-49 °C.

Cover mash bowl and immediately wrap it in a blanket, so that cooling to room temperature is very gradual.

The mash can be used after 1-3 hours, for barm refreshment or for making sponge. Mash should be cooled to 30°C before using.

Unused mash can be stored in refrigerator at 4°C, for up to 3 days, and used to make a sponge or refresh more barm.

## Barm refreshment

<i>Mature barm</i>	<i>90 grams</i>
<i>Mash</i>	<i>90 grams</i>
<i>Total</i>	<i>180 grams</i>

Mix mature barm and mash. Cover bowl and leave at 20°C for 24 hours, stir down once or twice during this time. pH should be 4 -4.5 initially and fall to 3.5 after 12-24 hours. Once mature, at 24 hours, the barm should be refrigerated at 4°C if not used.

## Sponge

*Effectively all the mash from above (567 grams) is used to make the sponge, because a portion (90 grams) was removed for barm refreshment and replaced by an equal amount (90 grams) in the form of mature barm i.e. mash that has already been fermented.*

<i>Mash</i>	<i>477 grams</i>
<i>Mature barm</i>	<i>90 grams</i>
<i>Total</i>	<i>567 grams</i>

Mix mash and barm completely. Cover bowl and leave at 20°C for 8-12 hours, stir down once or twice. Sponge will acidify and become well gassed at least twice as fast at 30°C.

Wait until pH drops to between 3.5 and 4 before using in dough.

## Bread making equipment

- *Multipurpose kitchen mixer can be used to mix and develop dough. Consult the instruction manual for your machine, or*

*Bread machine can be used for making barm bread, after preparing the sponge, or*

*Dough, in this amount, can be mixed and developed by hand in a large mixing bowl. Use water moistened hands to knead the dough, after first mixing the ingredients with a spurtle or wooden spoon.*

- *Loaf basket and cloth liner.*
- *Wooden oven peel.*
- *Line shelf of domestic oven with low-temperature-fired ceramic tile or other chosen baking surface.*

## Bread making

<i>Sponge</i>	<i>567 grams</i>
<i>Whole wheat flour</i>	<i>250 grams</i>
<i>Enzyme active malted wheat flour</i>	<i>0.5 grams</i>
<i>Salt</i>	<i>3.75 grams</i>
<i>Water</i>	<i>88 -138 grams</i>
<i>Total</i>	<i>909 – 959 grams</i>

### *Method*

Add sponge to mixing bowl.

Mix whole wheat flour and malted wheat flour before adding them to mixing bowl.

Completely dissolve salt in 88 grams water, and add to mixing bowl.

Mix until ingredients are evenly distributed. Add up to 50 grams more water if dough seems very stiff or too dry.

Mix further to develop gluten structure in dough, approximately 20 minutes in most slow kitchen mixers. Dough is properly developed when it becomes smooth and can be gently pulled into a paper-thin sheet.

Form dough into ball and transfer dough to a container with lid. Gently punch it down in the container, and leave it covered until it rises to approximately double in volume, approximately 4 hours at 20°C.

Using water-moistened hands, gently punch down and again form dough into a ball. Leave to rest seam side down, and covered with a clean dry cloth, on wooden board, 20-30 minutes.

Line a basket with linen cloth. Re-form dough ball, lightly coat surface by dipping into whole wheat flour. Place dough ball seam side up in prepared basket, and cover with ends of cloth liner. Allow to rise until at least doubled in volume and very puffy, 1-3 hours according to the dough temperature.

Preheat oven to 475°F (246°C).

Lightly sprinkle whole wheat flour on upturned base of loaf in basket. Invert onto oven peel, lightly cut the crust in a cross.

Slide loaf onto oven shelf. Immediately re-set oven to 350°F (177°C) and bake at 350°F (177°C) for 45 minutes. Turn oven off and leave loaf in oven for a further 15 minutes.

Allow the loaf to cool on wooden rack, for an hour before slicing.

# Whole Wheat Barm Bread 2008

## - in cups and spoons, and temperature °F

*Amount is for one loaf containing 4 cups whole wheat flour.*

### Summary of method

*First a mash is made, which is fermented with barm to become a sponge. This sponge becomes a major ingredient in the final dough. Dough make-up follows familiar methods.*

### Mash

*Special equipment:*

- *Extra bowl for flour.*
- *Wooden mixing tool (spurtle) and flexible dough scraper*
- *Mash bowl with loosely fitting lid, made from stainless steel, heat-proof glass or acid-resistant ceramic. Size should be such that ingredients half fill it. In cold weather, warm the bowl and lid to lukewarm.*
- *Blanket to wrap the mash bowl and so keep it warm.*

<i>Whole wheat flour</i>	<i>2 cups</i>
<i>Enzyme active malted wheat flour</i>	<i>½ teaspoon</i>
<i>Salt</i>	<i>¾ teaspoon</i>
<i>Water</i>	<i>1¼ cups</i>
<i>Total</i>	<i>2 cups</i>

### *Method:*

Measure whole wheat flour and malted wheat flour into a bowl and mix well.

Remove approximately half of flour mixture to mash bowl.

Completely dissolve salt in water in a saucepan.

Heat salty water to 150 – 158 °F, add it to flour in mash bowl and stir until evenly mixed. Temperature of mixture should be 130 – 138 °F.

Cover with lid and wait 10 minutes before adding the rest of the flour mixture to the mash bowl. When fully mixed the temperature should be 113-120 °F.

Cover mash bowl and immediately wrap it in a blanket, so that cooling to room temperature is very gradual. The mash can be used after 1-3 hours, for barm refreshment or for making sponge. Mash should be cooled to 86 °F before using. Unused mash can be stored in refrigerator at 40 °F, for up to 3 days, and used to make a sponge or refresh more barm.

## Barm refreshment

*Mature barm ½ cup  
Mash ½ cup  
Total 1 cup*

Mix mature barm and mash. Cover bowl and leave at 68 °F for 24 hours, stir down once or twice during this time. pH should be 4 - 4.5 initially and fall close to 3.5 after 12-24 hours. Once mature, at 24 hours, the barm should be refrigerated at 40 °F, if not used.

## Sponge

*Effectively all the mash from above (2 cups) is used to make the sponge, because a portion (½ cup) was removed for barm refreshment and replaced by an equal amount (½ cup) in the form of mature barm i.e. mash that has already been fermented.*

*Mash 1½ cups  
Mature barm ½ cup  
Total 2 cups*

Mix mash and barm completely. Cover bowl and leave at 68 °F for 8-12 hours, stir down once or twice. Sponge will acidify and become well gassed at least twice as fast at 86 °F.

Wait until pH drops to between 3.5 and 4 before using sponge in dough.

## Bread making equipment

- *Multipurpose kitchen mixer can be used to mix and develop dough. Consult the instruction manual for your machine, or*
- *Bread machine can be used for making barm bread, after preparing the sponge, or*
- *Dough, in this amount, can be mixed and developed by hand in a large mixing bowl. Use water moistened hands to knead the dough, after first mixing the ingredients with a spurtle or wooden spoon. Additional flour should not be used.*
- *Loaf basket and cloth liner.*
- *Wooden oven peel.*
- *Line shelf of domestic oven with low-temperature-fired ceramic tile or other chosen baking surface.*

## Bread making

<i>Sponge</i>	<i>2 cups</i>
<i>Whole wheat flour</i>	<i>2 cups</i>
<i>Enzyme active malted wheat flour</i>	<i>½ teaspoon</i>
<i>Salt</i>	<i>¾ teaspoon</i>
<i>Water</i>	<i>¼ to ½ cup</i>
<i>Total</i>	<i>4 cups</i>

### *Method*

Add sponge to mixing bowl.

Mix whole wheat flour and malted wheat flour before adding them to mixing bowl.

Completely dissolve salt in ¼ cup water, and add to mixing bowl.

Mix until ingredients are evenly distributed.

Add up to ¼ cup more water if dough seems very stiff or too dry.

Mix further to develop gluten structure in dough, approximately 20 minutes in most slow kitchen mixers. Dough is properly developed when it becomes smooth and can be gently pulled into a paper-thin sheet.

Form dough into ball and transfer dough to a container with lid. Gently punch it down in the container, and leave it covered until it rises to approximately double in volume, approximately 4 hours at 68 °F, or 2 hours at 86°F.

Using water-moistened hands, gently punch down and again form dough into a ball. Leave to rest seam side down, and covered with a clean dry cloth, on wooden board, 20-30 minutes.

Line a basket with linen cloth. Re-form dough ball, lightly coat surface by dipping into whole wheat flour. Place dough ball seam side up in prepared basket, gently punch dough into place, and cover with ends of cloth liner. Allow to rise until more than doubled in volume and very puffy, 1-3 hours according to the dough temperature.

Preheat oven to 475°F.

Lightly sprinkle whole wheat flour on upturned base of loaf in basket. Invert onto oven peel, lightly cut the crust in a cross.

Slide loaf onto oven shelf. Immediately re-set oven to 350 °F and bake for 45 minutes. Turn oven off, and leave loaf in oven for a further 15 minutes.

Allow the loaf to cool on wooden rack, for an hour before slicing.

# Wheat Sprouts 2008

## Introduction

*This easy small-scale method for sprouting grain requires a covered bowl, large enough to be initially approximately one third filled with wheat grain and water. A wooden spoon or rubber spatula, for gently mixing and aerating the sprouts as they grow, is also required. If moulds appear then discard the sprouts and start over with a fresh batch of organic wheat and a clean bowl. Sprouts are ready to use in 3-4 days.*

<i>Wheat grain (organic)</i>	<i>500 grams</i>
<i>Water</i>	<i>250 grams</i>
<i>Water</i>	<i>75 grams</i>
<i>Total</i>	<i>825 grams</i>

## Method

Add wheat grain and most of the water (250 grams) to large bowl. Gently and completely toss the wheat grain so that the water is almost completely used to wet the grain. Repeat this tossing of the grain 2-3 times in each 24 hours.

Eventually there should be no free water in the bottom of the bowl, but the grain should be quite adequately moist. Toss in the rest of the water (75 grams) only after there is no free water draining to the bottom of the bowl on standing.

Fresh sprouts are ready to use when the leaf shoot is almost the length of the grain. The root shoots will be 1-2 centimeters in length (half an inch) at that time.

## Using fresh wheat sprouts

Before adding fresh sprouts to a bread dough, or using them to make a starter, they can be chopped coarsely by hand or they can be chopped to a dough texture in a food processor, possibly with a little more water. Make note of the ratio of the amount of water to the amount of grain, so that the water in the final dough can be adjusted accordingly.

## Making enzyme active sprouted wheat flour

Fresh sprouts can be dried in a food dehydrator set at warm room temperature (25 - 35°C), so that the enzymes will not be heat-damaged.

First weigh one tray of sprouts, as a test, and continue drying until there is no further change in weight of test tray of sprouts. When there is no further

decrease in weight of test tray of sprouts, the sprouts will have been dried down to 5-9% moisture, in a dry climate. This method would need modification in a humid climate, such as the addition of a dehydrating material to the bottom tray of the food dehydrator.

Dried sprouts can be stored in a closed container at cool room temperature, for approximately 6 months. They can be ground to a flour as needed, in a mill suitable for making whole grain flour, although it may be necessary to partially grind them in a blender, or food processor to chop the roots and shoots which can otherwise interfere with flow through a stone mill.

Flour from sprouted wheat can be stored in a closed container, at cool room temperature, for approximately 6 months.

# Making your own barm 2008

## Introduction

*A simple fresh barm can be made using organic wheat grain. Approximately half of the grain is ground to whole grain flour and the rest is in the form of fresh sprouts (see earlier recipe) ground to a dough texture in a food processor. The barm is started by mixing the flour, and fresh sprouts, with enough water to make a batter texture. The microorganisms are inherent on the wheat or come from the air and they are fed as a result of the enzyme actions from the whole and sprouted wheat. The presence of a small amount of salt will enhance the natural selection of good tasting bread microorganisms.*

*The presence of salt makes the process comparable with the production of sauerkraut and naturally fermented cucumbers. However, it is usually possible to produce a good barm without using salt.*

*It takes approximately 2 weeks for the yeasts and lactic bacteria to multiply sufficiently in the new barm, to leaven and acidify bread.*

*Colored pH (acidity) testing paper, ranging from pH 3 to 5.5, or a pH meter, is useful when making and maintaining a barm. The dyes used in pH (acidity) testing are not edible, and may be poisonous, therefore when using pH paper it is always necessary to test a portion of dough that has been taken out of the main batch, on a spoon or other suitable implement, and which is afterwards discarded.*

## Initiating the barm

<i>Whole wheat flour (organic)</i>	<i>125 grams</i>
<i>Wheat sprouts (organic, ground to a dough)</i>	<i>205 grams</i>
<i>Salt (optional)</i>	<i>3.5 grams</i>
<i>Water</i>	<i>230 grams</i>
<i>Approximate total</i>	<i>560 grams</i>

If salt is used it should be completely dissolved in the given amount of water, before mixing the barm. In a small bowl, that will be no more than one third filled initially, mix whole wheat flour, wheat sprouts and water to a thick batter. Cover the bowl with a plate and leave at normal room temperature, preferably 20-25°C.

Make note of date and time, temperature, initial pH, aroma, and extent of gassing.

Stir the mixture at 8-12 hour intervals and note any changes in temperature, pH, aroma and extent of gassing.

Expected observations during the first 2-3 days might be the development of a strong grassy aroma, and plenty of gassing. However, until the pH falls to 3.5 - 4 the microorganisms present will not be suitable for breadmaking. Therefore the barm should not be given the first refreshment until the pH falls to 3.5 - 4. This low pH shows that the lactic bacteria are multiplying well.

### Refreshment of new barm

*Unless you would like to make a large quantity, only part of the new barm should be refreshed.*

<i>New barm at pH 3.5 - 4</i>	<i>280 grams</i>
<i>Whole wheat flour (organic)</i>	<i>125 grams</i>
<i>Salt (optional)</i>	<i>3.5 grams</i>
<i>Water</i>	<i>156 grams</i>
<i>Approximate total</i>	<i>560 grams</i>

Continue to keep the barm in a covered bowl at 20-30°C, stir at 8-12 hour intervals and continue with observations. Refresh again whenever the pH falls to 3.5 - 4, using the same proportions or amounts of flour and water given. The sprouts will gradually be diluted but there should still be enough enzyme activity supplied to the barm.

The time taken for the barm pH to fall to 3.5 - 4, after refreshment, should be 12 hours, under these conditions. In general a new barm achieves this after 1-2 weeks, and it can then be used to make bread and for continued refreshment. Other favorable observations seen in a healthy barm should be good gassing power and a mild and pleasant aroma, perhaps fruity or buttery.

# Notes for Whole Wheat Barm Bread 2008

- Barm

The word *barm* was used historically, for a mixture of naturally occurring and compatible yeasts and lactic bacteria in a whole grain mash. The mash preparation, which is related to making a mash for beer, makes use of the enzymes found in the aleurone and germ of whole and sprouted grains. The combined use of a naturally occurring mixture of microorganisms and grain enzymes, in a variety of ways, seems to have been characteristic of the *barm* used by ancient bakers.

- Microorganisms in barm

The majority microorganisms found in our original *barm* were *Saccharomyces dairensis* and *Lactobacillus brevis*, atypical. Care was taken to use organic whole wheat and water free from antibacterials and anti-fungals, so that the naturally occurring microflora on wheat could thrive. The advantage of the yeast *Saccharomyces dairensis* is that it uses only a limited range of nutrients from the wheat and so allows a full growth of acidifying lactic bacteria. An organic whole rye *barm* similarly prepared originally was found to contain the same majority microorganisms.

- Barm temperature

For consistency it is best to use the same temperature constantly for the barm fermentation, preferably 20°C and a storage temperature of 4°C, in this way the barm microorganisms are much more likely to remain constant. Higher temperatures, such as 30°C, can encourage the invasion of microorganisms that cause bitter flavors especially if salt is absent. Freezing barm causes the microorganisms, especially the yeast, to die. The barm can only be frozen after it has been dried.

- Barm refreshment

Barm refreshment consists of mixing equal weights of mature barm and mash. The mixture is left loosely covered at 20°C for 24 hours. During this time the mixture can be stirred down once or twice. The pH should fall to 3.5 after 12 hours. In any case further refreshment should only be done after pH has fallen to 3.5.

- **Barm refreshment intervals**

For best results barm should have been refreshed daily 3-7 times before making bread. It is interesting to realize that after 7 refreshments only a trace of the original barm mixture will remain, and it will be very vigorous after 7 daily refreshments. A refreshment rate of 5 times per week gives consistently good bread. Such well-refreshed barm can be stored for 4-6 weeks and then be revived with a series of daily refreshments. Barm loses activity if it is only refreshed once weekly, and stores less well.

- **Converting a sourdough to a barm**

If you already have a sourdough starter that has been successfully maintained with whole wheat flour, you may be able to convert it to a barm by refreshing seven times with mash.

- **Acidity and pH measurement**

As described here, pH measurement is to the nearest 0.5 units and is measured with colored indicator paper strip (range pH 0.3 to 5.5). As used in the recipes here, the measured value for pH indicates newly formed acidity. On standing, more acid is made by the bacteria, but the pH will remain steady after reaching a low point of approximately 3.5 in a healthy barm.

- **Units for measuring ingredients and temperature**

Measurements make use of the metric system for weights and volumes, and the Centigrade system for temperature. In the case of oven temperatures values are given in both degrees Fahrenheit and degrees Centigrade. Digital scales can generally be set to measure in grams and Kilograms. Measuring jugs are generally marked with volume in Liters and milliliters. Digital thermometers can be set to read in degrees Centigrade.

Percentages are with respect to the flour added as such, and are therefore also known as “bakers percentage ” units.

A separate recipe (page 6) is included using measurements in cups, spoons and degrees Fahrenheit.

- **Flour to use for barm breads**

Flour is *organic* whole wheat throughout, except when vital wheat gluten is substituted to increase the gluten protein. In developing this recipe, whole wheat flour from medium hard wheat was stone ground, with no particular effort to produce a finely ground bran. In any case larger pieces of bran are nutritionally advantageous. It is more important for loaf volume that all of the endosperm should be finely ground, and usually this is possible with a single pass through a properly set stone mill.

- Protein levels in flour, best for barm breads

For best results whole wheat flour should naturally contain at least 13.5% protein on a 12% moisture basis, and ideally it should contain 15% protein. Some higher protein whole wheat flour can be substituted to compensate for lower protein flour. Low protein, whole wheat flours are too deficient in gluten protein to produce a cohesive dough, and generally should only be lightly mixed, i.e. mixed only to homogeneity, rather than aiming for the point in time when they could be sheeted. When protein content is 9 -12% in a whole wheat flour, that you would nevertheless like to use for bread, then vital wheat gluten (75% protein) can be used to supply gluten protein with only a small dilution of the whole wheat components as follows: In every 100g whole wheat flour, for each one percent increase in gluten protein desired, substitute 1.3 grams Vital Wheat Gluten for an equal amount of the flour, to a maximum of  $7 \times 1.3 = 9.1$  grams, which is the amount to increase gluten protein by 7 percentage points, from 8% to 15%. Thus the dilution of whole wheat, due to the use of Vital Wheat Gluten flour, is less than 10% in all cases. More usually only  $3 \times 1.3 = 3.9$  grams (4 grams) of Vital Wheat Gluten needs to be substituted in each 100 grams of original whole wheat flour.

- Enzymes in whole wheat and malt

The natural enzyme activity present in the aleurone and germ is retained in whole wheat flour. When wheat is sprouted, as it is in the production of malted wheat, the enzyme activity is greatly enhanced. To make sure that there is enough enzyme activity to produce a successful bread, at least 0.2% malted wheat or malted barley are added to the whole wheat flour. For this purpose, it is necessary to ask for *enzyme active* malted wheat or barley. Malted grains that have been roasted for use as flavors and colors should be avoided for this use, because the roasting process can reduce the enzyme activity to zero.

- Water quality and minerals in water for barm bread

Water quality for barm bread making is important; primarily it should be good drinking water quality. There should be no antimicrobial chemicals present. Generally these can be removed by passage through an active carbon filtration system. Ideally the water should be well mineralized with calcium, magnesium, chloride, bicarbonate and sulfate ions in amounts matching good water for beer making. For example, the famous water used in the beer making city of Burton-on-Trent, in England has: calcium 270 ppm; magnesium 60 ppm; chloride 40 ppm; bicarbonate 200 ppm and sulfate 640 ppm; and the total dissolved solids is approximately 1,200 ppm.

- **Salt**

Salt (sodium chloride) is used in this formulation at the rate of 1.5% with respect to the flour. The way in which the salt is incorporated at the mash stage of barm breadmaking is key to the success of this most recent recipe. Explanations are given to explain the effects of salt in this recipe, but experimental work is still needed to verify them:

One effect of dissolved salt in the mash is the natural selection of the barm microorganisms during refreshment, so that the bread flavor is mild, and the acidification by the lactic bacteria is strong enough to easily and quickly bring barm and sponge pH close to 3.5.

A second effect of the presence of dissolved salt is to strengthen the gluten structure in the mash, by enhancing the hydrophobic character of the gluten. By this I mean that the gluten is much less likely to be partially dissolved in the water at any stage, instead it is forming a cohesive mass within itself. It should be noted that part of the favorable effect of highly mineralized water is also to enhance the cohesiveness of the gluten and reduce the possibility of it partially dissolving in the water. Chemists routinely call this effect “a salting out effect”. If the mineral content of the water is naturally high then the amount of added salt can be reduced to zero for those who need a low sodium bread, while still maintaining reasonable bread structure.

Like gluten, enzymes are proteins by nature, so they can also be influenced in their behavior by the presence of dissolved salt and other minerals. The presence of salt in the mash appears to enhance favorable enzyme activity, as well as formation of cohesive dough.

- **Mash conditions**

This particular mash is prepared using water at 65 -70°C so that when it is added to the flour, the mixture temperature is 55-59°C. The goal is to cause the starch and other carbohydrates to swell so making them more readily attacked by enzymes, and at the same time avoiding heat damage to the wheat gluten, which is unaffected below 60°C. Enzyme activity is very fast in this temperature range. After 10 minutes, more flour is added to produce cooling down to 45-50°C and to add fresh flour enzymes that might be denatured at a higher temperature. At 45-50°C the speed of enzyme activity is still much greater than at ambient temperatures. When left for 1-3 hours to very gradually cool to ambient temperature, there is ample opportunity for an effective mashing, i.e. change brought about by enzymatic action.

- **Mash storage**

Mash can be stored in refrigerator at 4°C for approximately 3 days, and used on a daily basis to refresh barm.

- **Sponge**

Sponge is made by mixing mash (5.25 parts) and mature barm (1 part) by weight

- **Separate preparation of mash, barm and sponge**

Mash, barm and sponge can be regarded as separate ingredients and prepared separately ahead of baking day, in amounts appropriate for the amount of bread to be made. In a domestic setting it is possible to make bread daily and to prepare the sponge and barm as indicated in the method given. Under these circumstances, if losses occur in the barm quantity (due to fermentation and transfers) then adjustments can be made between the barm and sponge without undue change in bread quality.

- **General effect of varying temperature in barm breadmaking**

It is useful to know that all enzyme activities and fermentations speed up with rising temperature, so that for every 10°C rise in temperature the speed increases 2 to 3 fold. For example, if the time to rise to double volume is 3 - 4 hours at a dough temperature of 20°C, it will only require 1 - 2 hours at 30°C, to reach double volume. This is a useful observation to remember when comparing summer and winter conditions.

- **Mash, sponge and barm formula in bakers' percent:**

<i>Ingredient</i>	<i>Bakers' percent</i>
<i>Whole wheat flour</i>	<i>100</i>
<i>Salt</i>	<i>1.5</i>
<i>Water</i>	<i>125</i>
<i>Enzyme active malted wheat flour</i>	<i>0.2</i>

- Dough formula in bakers' percent:

<i>Ingredient</i>	<i>Bakers' percent</i>
<i>Whole wheat flour</i>	<i>100</i>
<i>Sponge</i>	<i>225</i>
<i>Salt</i>	<i>1.5</i>
<i>Water</i>	<i>35 - 55</i>
<i>Enzyme active malted wheat flour</i>	<i>0.2</i>

- Basic formula for *Whole Wheat Barm Bread 2008*, in units of bakers' percent:

<i>Ingredient</i>	<i>Bakers' percent</i>
<i>Whole wheat flour</i>	<i>100</i>
<i>Salt</i>	<i>1.5</i>
<i>Water</i>	<i>80-90</i>
<i>Enzyme active malted wheat flour</i>	<i>0.2</i>

Half of the total flour (50) is mashed and then fermented to a sponge, and a small amount of this total mashed flour is provided by the barm (8)