**The Whole Grain Connection Newsletter #23**

**September 2018**

**Re-thinking whole wheat bread recipes**

There is a pervasive impression that bran and germ are villains in baked goods, whereas I’d say that the flavorful and vitamin rich wheat bran and germ need defending against the false accusation that they can ruin bread! Freshly stone ground, whole wheat flour from sound wheat is the best in both flavor and healthfulness for our daily bread. Nevertheless, we need to re-imagine our description of whole wheat flour for bread-making in light of the fact that 15% of whole grain flour consists of bran and germ and that only the endosperm flour, which is 85% of the whole at the most, is capable of creating bread structure. Thus, the loaf volume from 100 grams of whole wheat flour will only be 85% of the loaf size from 100 grams of refined endosperm flour. The amount of water needed will only be 85% of the amount used for a corresponding white loaf. For the same size loaf, 100 x 100/85 = 118 grams whole wheat flour would be needed, using the same or very little more water than would be used for 100 grams of refined flour. The whole wheat dough will be very stiff initially and a little stiffer to work with after the first rise, and the dough volume slightly larger, but that’s all; I’ve tried it. Here’s some logic for this:

*Bran behavior with water in dough*

In the presence of water, wheat bran seems to behave rather like a good linen cloth; it will hold as little or as much water as you would like. When the linen cloth is line dried it becomes amazingly stiff, when soaked in water it is completely flexible and can be used to mop up water. When wrung out it remains very soft and flexible *while holding just a small amount of water,*enough to say that it is still moist. Wheat bran can be compared with linen in the sense that both bran and linen contain cellulose fiber. Bran also contains other kinds of plant fiber some of which will be fermented away, but non-fermentable cellulose will definitely remain in the bread even after fermentation. The bran will stiffen the final dough just a little. We should expect that a whole wheat dough will be stiffer at each stage than a corresponding refined flour dough, especially at the first mixing.

*Bran behavior with oil or fat in dough*

Another property of bran is that it can absorb oil such as extra virgin olive oil. Bran can mop up oil, but in dough it will tightly hold just a small amount; it seems to do this in preference to tightly holding water, if oil is available. Oily bran suspends in the gluten structure more readily than if it had absorbed water.

*Wheat germ behavior in dough*

Wheat germ naturally contains a high percentage of oil, including phospholipids. These phospholipids are surfactant or emulsifying agents and enhance the texture of the dough, by accommodating oil in water emulsions. However, because of the oily nature of wheat germ it is expected to tightly hold only small amounts of water.

*Endosperm flour behavior with water in dough*

White flour, that is the endosperm wheat flour, will take up water and hold it in such a way that it cannot be wrung or centrifuged out. It will hold a relatively large amount of water in this way. My impression then is that in a dough the endosperm flour will actually draw water out of the bran. We do not need to add any additional water to dough specially to appease the bran! Instead, we know that the bran can *tightly hold*only very little water and still remain flexible. Bear in mind that only 85% of the whole wheat flour is endosperm flour, and we have the realization that whole wheat flour, as a whole, requires LESS water to make a dough than a corresponding amount of refined flour!

**Really, how much water can flour hold?**

*Farinograph water absorption*

The amount of water that endosperm flour can hold is approximately measured using a farinograph, but the values obtained can be deceptive. In their definitive book on (refined) wheat flour milling, Posner and Hibbs say that: *Because flours vary in slacking out during fermentation, this (farinograph water absorption) might not be the true absorption in the bakery*. Nevertheless, farinograph water absorption values at a given point in time, provide the baker with a starting point when working with a new batch of flour. Caveats are as follows: Farinograph endosperm flour absorption values tend to increase during a year of grain storage.  This at least partly explains why new crop wheat is so different in baking character to the crop from the previous year, which by then is 6-12 months old. This reality of changing absorption is managed by sophisticated millers and bakers, by waiting 3 months or more before using the new crop, or gradually mixing it in with the old crop. Now for even more intrigue: the average refined flour farinograph water absorption values for new crop wheat also depend on the wheat type. Approximately characteristic values are, for soft wheat 55%, hard wheat 65% and durum just 30 %, as discovered in 2007 by the *California Wheat Commission*, but 60% on the new 2018 crop.

*Serendipitous farinograph absorption*

For the record, even more serendipitous lab. results for farinograph water absorption on my one-year old wheat stock were as follows: soft white Sonora (55%) and Durum-Iraq (75%). Lately I’ve been making bread from both of these with approximately 50% hydration and loving the soft, spongy and finely textured bread, using my [Thin Crust Pizza](http://r20.rs6.net/tn.jsp?f=001oC-16Vvv8-ZvO6Ljtw_lqkZutXQs1Lae7_Ar4oDv5z8-yXkoPMn8KxdgenL1IQqu6-I2_REVHXYwZFt5EgK_-6Ndd80120Ckqi82ko2C2Puk5XfXaqterJvTjV03y1NIDNXcoUBkUe3VM4MJAFHlLCsno9kSV90C3IrRx24svKYEn5lo7eJKNzYD1juBEORL2-0r6sesFgHQe-O1EA31kkJxe8v9HtNXRViZScuRfL0=&c=82mjpC6Tj2E9d8d7YXeITGwNL1hTIRRSvJBUwa3ls_GIIz2gj-NvZA==&ch=Eu1KG8-60YUdNxmYSbT_QAGWrfroox5eenmIVcJR27SqbaTkm176ew==)recipe, which works as a pan or basket bread formula. *I’ve actually been using 4% extra virgin olive oil for this bread instead of 6% in the recipe, with respect to the total whole wheat flour*. The dough is initially inordinately stiff but ferments out to a very nicely workable dough. I am ready to use even less hydration where warranted, and to recognize that the initial dough will be alarmingly stiff but will almost certainly slacken and become a beautiful dough as a result of the first rise.

*Appropriateness of low hydration dough?*

This low hydration style works well for soft white wheat and tetraploid types (e.g. durum, emmer, khorasan, cone); I have not given hard-red wheat or spelt varieties a fair trial as yet, using this particularly low hydration. However, I expect they too will make soft textured breads when dough water is reduced way down. In any case, the popular high hydration bread style managed by skilled bakers generally with hard red wheat flour, can be regarded as an altogether different style from low hydration breads. It may also be true that the high hydration style fits high protein / strong gluten wheat bread, and the low hydration style fits lower protein / mellow gluten wheat bread, since gluten protein is proportionately a major draw on dough water. Starch, and pentosans especially, hold a substantial amount of water; damaged starch holds an extra-large amount. Damaged starch produced by the milling process, or by gelatinizing a portion of the starch with hot water, initially holds lots of water and makes the dough stiff, but this effect disappears if enzyme active malt is present. The alpha-amylase in the malt preferentially attacks and removes the damaged or gelatinized starch. The soluble fiber pentosans are fermented away during a sourdough fermentation. All this contributes to a very much slacker dough than the one first mixed.

*Perfection is forever elusive?*

As you can see, the exact amount of water that is needed to make a dough, depends partly on the wheat type but mostly is a matter of choice depending on the final texture and style of bread being made. However, just as a recipe seems to have been perfected the flour changes its character, and the nicely set hydration, will need to be checked again! The main reason seems to be due to the changes that occur within the living grain during storage. The exact nature of these changes is not known, therefore precise prediction of water absorption by the flour cannot be made. However, a good artisan baker knows to check out the flour absorption regularly with a small experimental loaf. There is never a dull moment in a whole grain artisan bakery! And no matter what those naysayers may tell you, fresh bran and germ are fabulous in bread!

**Converting bread recipes to 100% whole grain flour and sourdough**

Here are some suggestions:

*Replacing yeast plus sugar*

The yeast plus refined sugar leavening system for a white flour bread can be replaced with 10% whole wheat sourdough, with respect to the total flour. This is true only for a simple whole wheat sourdough made and matured as described at [www.wholegrainconnection.org](http://r20.rs6.net/tn.jsp?f=001oC-16Vvv8-ZvO6Ljtw_lqkZutXQs1Lae7_Ar4oDv5z8-yXkoPMn8K_3zsKWxhEGC-1yHHzT3YJnuOA06Esq33GQm-kmeaeGlrn92Kl4rppOVef42suMCPWeavzIa0yuBKro5TligG7lwyjskT72s7F8PBSVyCp9_Q6p3FjEX1_X-VEV7qoIwK-3yfW6RpYVSwyp-egTSOfcXk6Wnt0oQV28vXV1BYH51ILeTNPC_V3X2SSuvSy-rBkrrp1htyCOh&c=82mjpC6Tj2E9d8d7YXeITGwNL1hTIRRSvJBUwa3ls_GIIz2gj-NvZA==&ch=Eu1KG8-60YUdNxmYSbT_QAGWrfroox5eenmIVcJR27SqbaTkm176ew==). If you are using a different sourdough system, then you will need to make your own estimate for the conversion from yeast. Zero added sugar is needed for any wheat or rye sourdough fermentation.

*Replacing refined flour*

The total refined flour will need to be replaced with a greater weight of 100% whole grain flour in order to compensate for the bran and germ portion, which occupies approximately 15% of the whole grain flour weight. For example: 100 grams of refined flour would need to be replaced by 118 grams of whole wheat flour in order to produce a similar loaf volume.

*Liquid addition*

Provided the refined flour has been replaced as described above, the liquid needed to make the desired dough texture will be the same as in the original recipe. Bear in mind though that the amount of liquid needed for any dough is variable according to many factors. Note especially that the bran does not require any extra water or other liquid. Instead it will accommodate the liquid present and will simply make the dough somewhat stiffer to work with, particularly at the beginning.*Excessive water that is insufficiently held by the dough makes bread heavy. It is better to err on the side of too little water, so that more can be added after the first rise, if really warranted.*

*Natural bread improvers*

Natural bread improvers include enzyme active malt flour and vitamin C that may not have been mentioned in the original refined flour recipe. However, enzymes from active malt or other sources would have been automatically present in commercial refined flour, whereas it needs to be added to 100% whole grain flours stone milled directly from sound grain. A suggested rate of addition is 1% enzyme active malt flour, with respect to the total whole grain flour used.

Vitamin C addition is optional such that the final dough contains approximately 75 ppm vitamin C. This is best managed by the addition of [vitamin C with the enzyme active malt](http://r20.rs6.net/tn.jsp?f=001oC-16Vvv8-ZvO6Ljtw_lqkZutXQs1Lae7_Ar4oDv5z8-yXkoPMn8K6E4H94OwZWHRyBNn8z0BTkmg0H4i0oht_Fxmlh4uJA2nSkCknrL6tVTdqZlmY42UodIifj6q8CmCPXTXj4gc_miq3jeVYIn5CWP1pTeKZgd9p2AQ9xcNsJftPyGlFve-EE5PwruWzolyHQRXg3alNfOQxYOkqXEKfAFvIPr2pcyUTmiCMBIoSUaemTLR3E4pcuXXrIiRgKZ&c=82mjpC6Tj2E9d8d7YXeITGwNL1hTIRRSvJBUwa3ls_GIIz2gj-NvZA==&ch=Eu1KG8-60YUdNxmYSbT_QAGWrfroox5eenmIVcJR27SqbaTkm176ew==)

Other improvers such as extra virgin oils, natural fats, and egg can be added according to taste and suggestion of the original recipe. Fats and oils are best mixed into the dry flour at the beginning. For best flavor and to avoid unwanted spoilage, egg is best incorporated after the first rise of the dough, by which time the dough has been acidified to pH 4, as a result of the fermentation.

Added sugar for texture and flavor is not recommended for basic bread recipes, since they would spoil the healthfulness of the bread as an everyday food. Of course, for confections, then added sugars might be included.

**Cautionary Labels**

***Cautionary labels for pregnant women and children, on bread made with un-enriched refined flours, sifted flours and refined sugars.***

A warning label for pregnant women and children is suggested for bread containing refined and sifted flours without enrichment and refined sugars. These breads lack sufficient essential nutrients that would normally be found in 100% whole grain breads and should not be regarded as basic food for regular consumption. *What do you think of advocating for these labels?*

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