HealthBread

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HealthBread Nutritional Guideline

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HealthBread Nutrition Guideline

Contents

1. Executive Summary

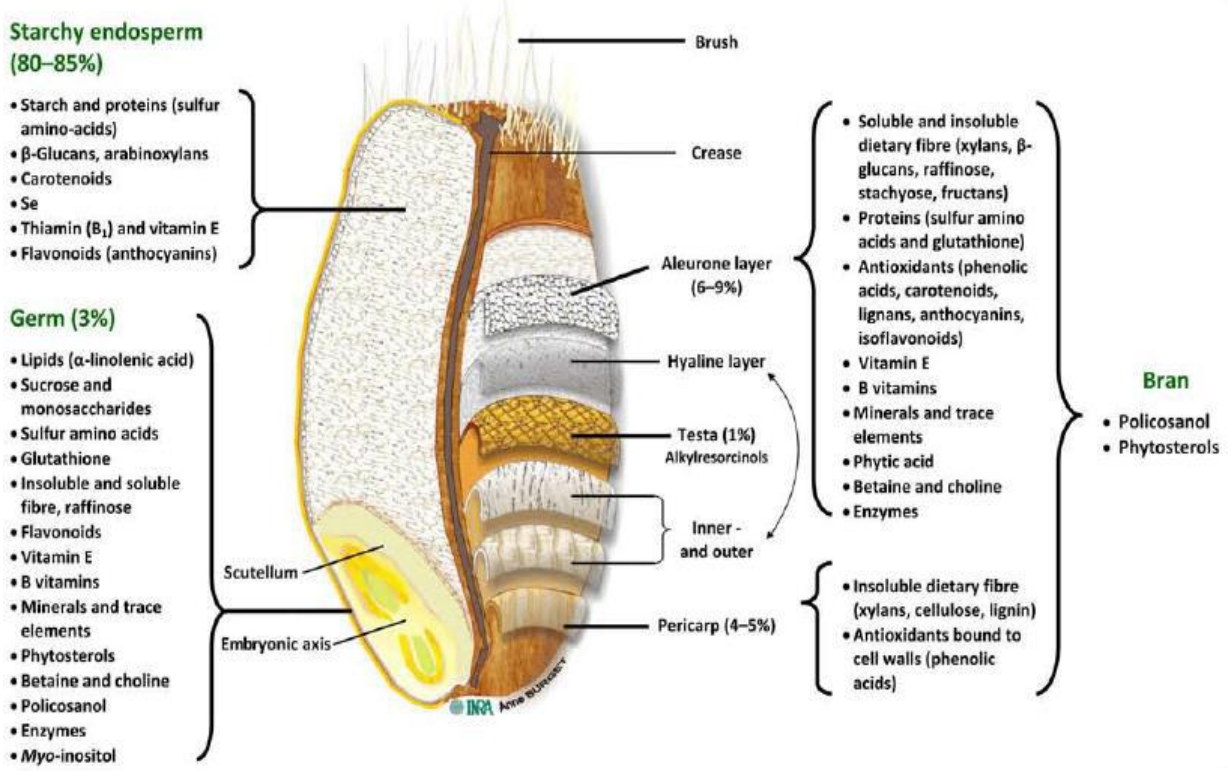
The HealthBread Nutrition Guideline is aiming at providing guidance for communication of nutritional and health benefits of HealthBread products fitting in the framework of the EU Regulation (EC) 1924/2006 for nutrition and health claims made on foods and related European and national regulations and guidelines. During the project a wealth of relevant scientific and regulatory information was collected and studied – worthwhile as such for further communication but too detailed for those SME bakeries who are primarily interested in clear concise guidelines on the(im-) possibilities for communication of nutrition and health benefits of HealthBread-type breads. Therefore, basic information on communication of nutrition and health benefits has now been included in the HealthBread Bakers Manual. This Manual – available in English, German, Italian and Dutch – will be widely distributed. The HealthBread Nutrition Guideline is providing both basic and background information, and is available on www.healthbread.org

2. The story of HealthBread

a. Why HealthBread?

Research carried out over the last decade makes it quite clear that the grain kernel contains many nutrients and other bioactive compounds that can contribute to health (figure 2). Most of the added nutritional value is concentrated in the outer layers of the kernel (figure 1). Also it is believed that the total 'package' has more value than the sum of all individual compounds: there is a synergistic effect. It is thus believed to be best for health to incorporate these layers of the grain kernel if you want to make (extra) healthy bread.

Figure 1. The three wheat fraction (bran, germ and endosperm) with their main bioactive compounds: whole grain wheat has a heterogeneous structure with bioactive compounds unevenly distributed within its different parts.



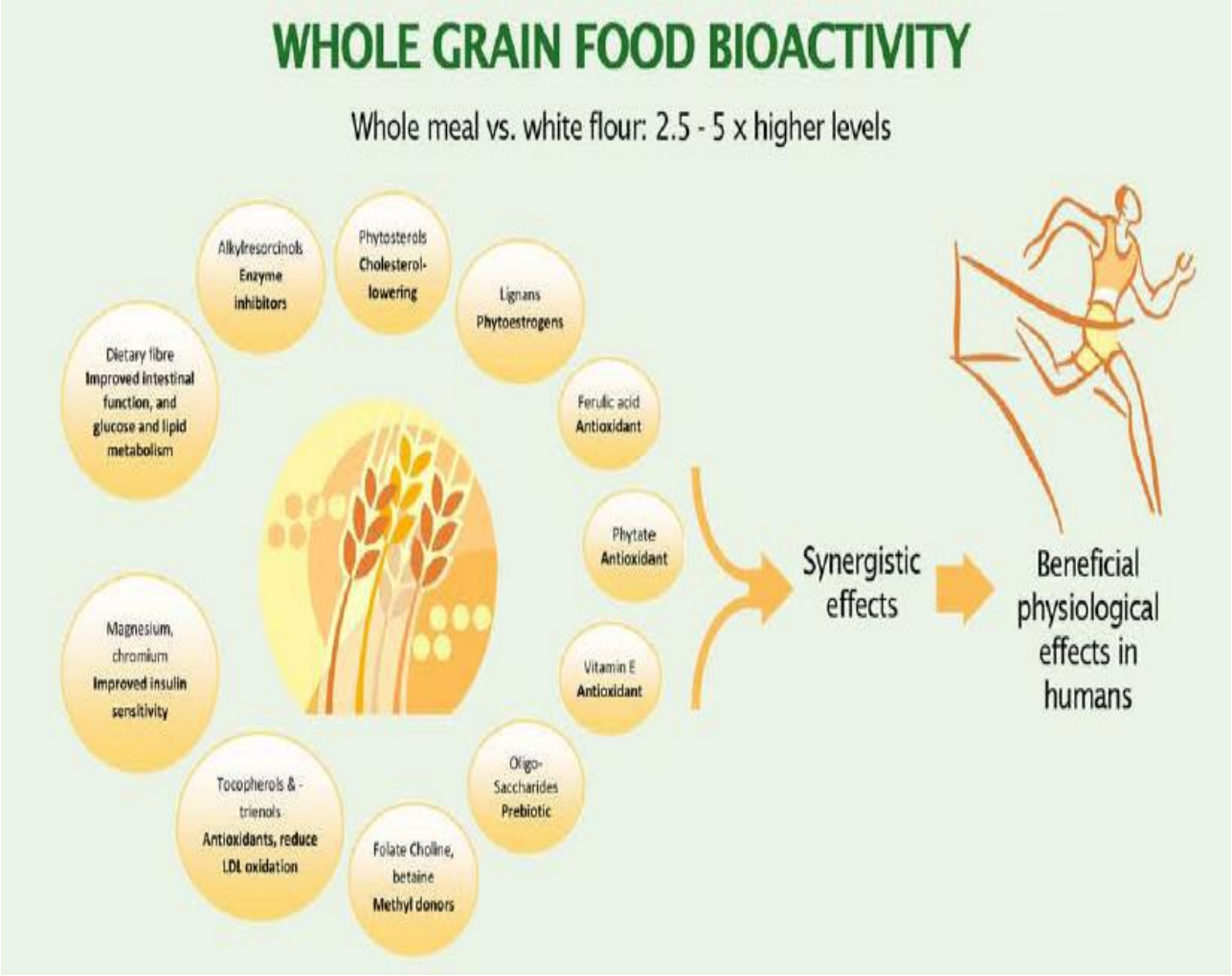
From: Healthgrain, 2011

Most European countries have clear guidelines on what a healthy diet should consist of and what it should deliver in terms of nutrients. Because they can contribute to the intake of dietary fibre and several other important nutrients, the advice to eat more whole grains is often incorporated in these guidelines. However, looking at the actual intake of consumers there is a discrepancy between the two. Information of national surveys comparing the guidelines with the actual intake by consumers. indicates that there are several nutrients of concern (Appendix 1 for details on country level). These are nutrients for which a significant part of the population does not meet the recommended intake levels. Many of them can be catered for by eating more whole grains instead of refined grains, namely: Dietary fibre, Folate (=vitamin B9/B11), Iron, Magnesium, Zinc, Vitamins B1 and B6.

The traditional way of producing wholemeal products is by using wholemeal flour instead of (a proportion of) white flour and to further use more or less the same recipe and processing. Although this indeed creates bread products with a higher proportion of dietary fibre and nutrients, this approach has two main drawbacks:

1) Product characteristics of wholemeal bread produced in this way are (much) different from consumer preference in many European countries. The likeliness to eat a lot of it just to promote one's health is small. So, there is a need for more palatable products incorporating the goodness of wholegrain.
2) Although wholegrain flour has a higher proportion of minerals than white flour, the availability of these minerals for uptake in the body, when using the same processing as for white flour bread, is partly inhibited by its binding to other nutrients in the outer layers of the kernel such as phytic acid.

Figure 2: Whole Grain Food Bioactivity



From: Healthgrain,2011

Currently there are products on the market aiming at tackling drawback 1. However, they do so by adding isolated dietary fibre, often (partly) from a non-grain kernel source. Besides this they only add one or a few important isolated (synthetic) nutrients (iron, vitamin B6, folate and/or zinc), thereby missing out on a lot of nutrients and other beneficial compounds and the synergy of the "wholegrain – package". It is also important to be aware of the fact that advisory bodies such as WHO explicitly advice to get your dietary fibre intake form natural sources of fibre, such as fruits, vegetables and whole grain products. They do not accept products enriched with isolated fibre, because it is unknown if the effects will be the same as with naturally fibre rich products, with all their beneficial 'co-passengers'.

In addition, it is worthwhile to note that recent dietary guidelines have emphasised the consumption of cereal fibre and fibre rich whole grain, in line with studies indicating stronger beneficial effects for cereal fibre compared to fibres from fruits and vegetables.

Studies in HEALTHGRAIN and elsewhere have paid attention to the composition of the aleurone layer, the single cell layer at the inner side of the bran. It contains most of the minerals, vitamins, phenolic antioxidants, and lignans of the wheat grain and less of the pigments and bitter tasting

components than the more outer bran layers. Therefore, wheat fractions high in aleurone have been prepared and used in HealthBread.

Products produced within the HealthBread project help to overcome the problem of palatability and bioavailability without using a "single nutrient approach". This is achieved by using fractions of the grain kernel that still have their natural composition concerning the contents of dietary fibre, vitamins, minerals and other bio-active compounds, while using processing technologies that optimize product quality and the bio-availability of some nutrients.

2.2 HealthBread ingredients & processes: the nutritional possibilities

For this project grain (wheat) components which are naturally rich in the "nutrients of concern" discussed in chapter 1 were used. However, nutritional content as well as particle size are variable between the fractions. This in combination with using different base flours (white or wholegrain) maximizes the possibilities for individual product development.

Table 1: Main nutritional characteristics of the ingredients used in the HealthBread project.

Fraction	Particle size	Main nutritional properties	Remarks
Standard wheat bran (SWB)	Coarse, micronized	Fibre level: ≈39% Relatively to white flour (=endosperm) high in minerals, folate, B1, and B6	
Soft wheat aleurone (SWA)	Coarse , medium sized, micronized	Fibre level: ≈52% Relatively to SWB and all other fractions: high in iron, magnesium, and folate	
Durum Wheat aleurone (DWA), heat treated	Medium sized	Fibre level: ≈45% Relatively to all other fractions slightly higher in vitamin B1. Relatively to SWB and WGC high in iron, magnesium and folate, (but folate levels are lower than SWA).	By heat treatment vitamin B levels may decrease
Whole grain concentrate, heat treated (WCG)	Coarse, medium sized, micronized, Special wheat variety with a light colour.	Fibre level : ≈35-40% Vitamin and mineral levels are more or less comparable to SWB.	By heat treatment vitamin B levels may decrease
Whole grain concentrate, heat treated, fermented (WCG)	Coarse, medium sized, micronized, Special wheat variety with a light colour.	Fibre level : ≈35-40% Vitamin and mineral levels are more or less comparable to SWB.	By heat treatment vitamin B levels may decrease

Note 1: Future availability of fractions will depend on developments in demand by bakeries.
Micronized fractions were considered to be less attractive, due to high production costs and no clear benefits regarding increased bioavailability of micronutrients

Processing

In the HealthBread project different processing methods were used to improve product characteristics as well as the availability of minerals and anti-oxidants for uptake by the human body (bio-availability). However, processing methods and aids used to improve product quality, may also impact the nutritional quality of the end product. It is good to be aware of these effects, because this may cause a difference in calculated versus analysed nutritional value.

In addition, it is known that natural (sour dough) fermentation can also affect nutritional properties. Within the HealthBread project bioprocessing, which is fermentation (for ~ 12 - 18h) of the grain fractions with specific enzymes, was used with the aim to affect a few selected nutritional properties, namely:

1) Increase level of free ferulic acid
   Why?: Ferulic acid is an anti-oxidant which is normally bound to dietary fibre and therefore is not free for uptake in the human body. It has been suggested that free ferulic acid (FFA) might have several beneficial effects once absorbed by the human body. Mentioned effects among others are: anti-inflammatory, anti-bacterial and cholesterol lowering effects (Ou & Kwok 2006, Bjork et al 2011). However, bound ferulic acid (FA) also seems to have beneficial effects. Because it is available for colonic fermentation, it can work positively via the human digestive system. There is some evidence that bound FA influences inflammatory status via stimulating the production of beneficial gut microbiota (Bjork et al 2011, Neacsu et al 2013, Vitaglione et al, 2008). However, for all of these effects there is not enough evidence to substantiate an EU approved health claim. For more details see Appendix 2.

2) Lower the level of phytic acid
   Why?: It has been show in other studies that phytic acid inhibits the uptake of minerals such as iron and zinc in the human body. Decreasing this compound is expected to increase the bio-accessibility of these minerals (Troesch et al 2013). For more details see Appendix 3.

3) Increase the level of soluble arbinoxylans
   Why?: Arabinoxylan (AX) is a specific dietary fibre that, in its soluble form, has a scientifically proven effect on the blood glucose rise after a meal (slower = believed to be better for health). There is already an approved health claim for this effect on soluble arabinoxylan from wheat endosperm (EFSA, 2011). Within the project, the effect of specific fermentation processes on the increase of soluble AX at the expense of insoluble AX, in which the tested fractions are high, was investigated. Although there was an effect, this effect did not result in enough total soluble AX to use the existing health claim. A significant degradation of total dietary fibre was not observed.
4) Guarantee a high level of total dietary fibre
   Why?: A high dietary fibre level from a natural grain source was the main nutritional objective of this project. In all European countries, dietary fibre intake of most consumers is well below recommended levels.

Table 2 shows the expected effects based on the literature and analysis carried out on bioprocessed fractions within the HealthBread project.

Process	Expected effect of the process on nutritional composition
Proofing time **Dough fermentation**	Longer dough fermentation time can result in increased bioavailability of minerals and antioxidants.
Baking of bread	Bread baking may result in partial breakdown on B–vitamins (up to 30 %). Analysis of the end product is an option to show if the corresponding baking process has caused a loss of vitamins (and to which extent) or not.
Bioprocessing of ingredient fractions overnight with • ***Commercial xylanase (with small amounts of ferulic acid esterase, proteinase and hemicellulase; OR*** • ***?***	Bioprocessing of the fractions before use will result in: • More (up to 2-fold) free ferulic acid • 37-80% less phytic acid (studies done in SWB*) = more available iron & zinc (see appendix 2 for more details) • More (up to 3-fold) soluble arabinoxylan (but not enough for bearing a health claim) • Slightly less total dietary fibre (reduction max. -6%) *N.B. 1: The minimum fermentation time to reach a 50% reduction (2,5% to 1.25%) in phytic acid (in the ferment) is 20 hours, also there has to be a high level of yeast present (1.27%). The optimum pH for wheat phytase activity lays around 5.15 (Sandberg et al 1995) *N.B. 2: The degradation of phytic acid will not take place during bioprocessing of the fraction when the fraction is heat treated! This is due to inactivation of the naturally present enzyme phytase. Exogenous food-grade phytase could be added to compensate for this loss. N.B. 3: Native phytase is present in wheat fractions and also in white and wholemeal flour. In addition to long fermentation time of wheat fractions, also long dough fermentation times of dough will contribute to the lowering of phytate levels.
Use of specific enzymes (amylase, lipase, xylanase, GOX and/ ferulic acid esterase) as part of the recipe (without bioprocessing of fractions overnight).	No significant effects were found on fibre level in the final product when comparing products produced with or without enzymes as part of the main recipe. Effects on other nutrients were not measured, but are not expected to be significant.

Table 2: Expected effects of processing on nutritional composition of the end product

3.0 How to communicate "health" to your customers

3.1 Nutrition and Health claims: an introduction

It is not allowed to just tell anything to your customers about the nutritional value and health effects of your product. It is important that you understand and adhere to certain rules set out by the European Union. European law has registered rules that are meant to make sure that consumers get correct and honest information about food (Regulation (EC) No 1924/2006). These rules do not only count for statements on pack, but for any communication about your products, - so for websites, face-to-face contact in store, advertisements, radio interviews, etc. In this chapter these/the general/most relevant/most important rules are shortly discussed. In the next chapter a step by step approach will be used to guide you through the process to decide what claims you can use on your own specific HealthBread product.

3.2 Nutrient claims

Statements drawing attention to the level of (a) specific nutrient(s) in food products are called 'nutrition claims'. The Regulation says that you can only talk about the nutritional value of your product if you can prove with quantitative data that the nutrient you want to communicate about is above a certain level in the product you sell. There are different legal levels for different wordings of such claims. For example: if you want to say your product is a "source of" fibre, the minimum level of dietary fibre per 100 grams of product is 3 grams. But, if you want to say the product is "high in" fibre, this legal minimum level is 6 grams.

3.3 Generic health claims (article 13(1) and (5) claims)

Statements about the effects of your product or the nutrients in it, on the health and wellbeing of your customers are called 'health claims'. If you want to make such statements there should be sound scientific evidence for this effect and the health claim has to be authorised by the European Food Safety Authority (EFSA) and the European Commission (EC). To date thousands of such claims have been submitted to EFSA and only 224 have been authorised .

The authorised article 13 (1) claims can be used for products containing at least the required amount and fulfilling the conditions of use (see below, paragraph 2.2).

For wheat bran fibre two health claims have been authorised:

- "Wheat bran fibre contributes to an acceleration of intestinal transit" and
- "Wheat bran fibre contributes to an increase in faecal bulk
-

Companies who have the resources to build their own scientific database can apply for an article 13.5 health claim based on proprietary data. These data will be not released for a period of 5 year and the claim, when authorised, cannot be used by others.

3.4 Disease risk reduction claims (article 14(1)(a) claims)

These claims are statements that relate a certain food or one of its constituents to reducing a risk factor in the development of a disease. For example: "Oat (respectively barley) beta-glucan has been shown to lower/reduce blood cholesterol. High cholesterol is a risk factor in the development of coronary heart disease." In article 13 claims wordings referring to risk reduction of diseases can't be used.

3.5 Health claims stating an effect on children's development and health (article 14(1)(b) claims)

These claims are specifically directed at stating the beneficial effect of a product or ingredient on the health of children. An example: "Calcium is needed for a normal growth and development of the bones of children.

3.6 Medical claims

Medical claims, which relate a certain food product to the prevention or cure of disease, are not allowed. For example you cannot say: "This product is rich in vitamin X and vitamin X cures a sore throat" or "This product is high in fibre and fibre prevents bowel cancer". Such statements are strictly prohibited and high penalties will be given for their use.

Other claims that are **prohibited** are:

- Claims about the amount or timeframe of weight loss
- Claims that refer to the advice of medical professionals or medical institutions in which it is suggested that eating a specific food item will benefit your health or that not eating it could harm health.
- Claims that suggest not eating a specific food item could harm health.

As will be further outlined in section 2.3 a number of article 13.1 health claims may be used for HealthBread products.

3.7 Nutrition and health claims: conditions of use

On the website of the European Union there is a complete list of all the health claims that have been authorised and rejected. . See: http://ec.europa.eu/nuhclaims/

For using generic health claims (art 13.1) you do not need a specific permit, but they do always have **specific conditions of use** concerning:

- The minimum level of the nutrient related to the claim (for the claim "Wheat bran fibre contributes to an increase in faecal bulk", the product should be "high in" that fibre);
- Information to the consumer about the minimum daily intake needed to reach the claimed effect (in some cases; for the claim "Wheat bran fibre contributes to an increase in faecal bulk" information shall be given to the consumer that the claimed effect is obtained with a daily intake of at least 10 g of wheat bran fibre).

3.8 General conditions of use

Besides the specific conditions of use for specific nutrition and health claims there are general conditions of use you have to adhere to when you want to communicate a nutrition or health claim related to your product(s).

- The claim should be on the European Commission's list of approved claims.
- You should stick to the wording as approved by the EC. Most countries have guidelines for this wording available within the national translation of the European directive.
- You cannot suggest that a balanced dietary pattern does not provide enough nutrients. Also, you cannot stimulate overeating of the product.
- The claim has to apply to the ready to eat food product.

- The body has to be able to absorb/ make use of the claimed nutrient[1].
- Not all products are allowed to bare claims. For example, alcoholic beverages are excluded. In the future there will also be a ban on most claims on products that have too much sugar, salt and of saturated fat in them. These products will only be able to bear claims related to a reduction in these nutrients.
- If you make a nutrition or health claim, your product should have a nutritional declaration (on pack). This, however, does not count for unpacked foods.
- You should always state the importance of a balanced, healthy diet.

3.9 Required additional information

When using a health claim you are obliged to provide consumers with additional information. When the product is labelled, the information should be on this label. Otherwise, the information should be available to the consumer at the point of sales.

You have to give the following information:

- A statement about the importance of a balanced, healthy diet and lifestyle.
- The recommended daily amount that should be eaten of the product to get the claimed beneficial effect.
- If relevant, a warning about what sort of people should avoid eating the product because of possible harmful effects (for example pregnant women).
- If there is a potential risk of harm, there should be a warning against overconsumption.
- The nutritional value of the product stating the amount of calories, carbohydrates, sugars, dietary fibre, proteins, and salt. This list should be complemented with the amount of the claimed nutrient if the nutrient is not already part of this list.

3.10 Possible claims for HealthBread products in general

High in Fibre

The average daily intake of dietary fibre in Europe is substantially below the recommended levels and, as mentioned earlier, recent studies and recommendations (Germany, Hauner et al. 2012) highlight the importance of intake of **cereal fibre.** The 'source of' level for dietary fibre is already realised in many white breads. Fibre levels in standard wholemeal bread are well above the 6% level required for being high in fibre. Thus, bakers are advised to always go for the "high in fibre" claim (at least 6g fibre/100g) as this makes the health story stronger. The two health claims related to wheat bran fibre were already mentioned and can be viewed in detail via http://ec.europa.eu/nuhclaims/). During the project it was found out that this level is not so easy to reach for all fractions at the original recipes. Often higher levels of fractions are needed to reach this lvel. The downside of this is that higher levels of fractions often also result in bread characteristics that are more like wholegrain than like white, which is not desirable for WhiteBread Plus HealthBread-type concept products.

[1] The EU does not state what sort of evidence you should give to prove that the claimed nutrients are available for uptake in the human body. However, when setting the daily reference intake levels bio availability is always accounted for. So for nutrients of which we know they are less available for uptake in the human body the DRI is adjusted accordingly. Therefore one could argue that if a nutrient rich product is part of an average normal diet, and the nutrient of concern is part of the product naturally, there would be no reason to believe that the uptake in the body would pose a problem as long as the amount per 100g is at least 15% of the DRI.

At least 30% more fibre than a regular white or wholegrain product

This target, resulting in a comparison claim on dietary fibre i.e. this product contains 30% more fibre than product X, can be reached in most cases. Depending on the fraction used and the level of dietary fibre in the countries "regular" white bread product a +≈85% to even + ≈122% of the dietary fibre level is easily reached by replacing 11-18% of the base flour by one of the HealthBread fractions. A +≈30% can already be reached by replacing a minimum of 5-10% of the base flour by one of the HealthBread fractions. Compared to regular wholegrain bread (WB++ concept), the same amount as the standard reference bread can also be reached quite easily.

For a +30% claim compared to wholemeal, the higher fibre fractions are more suitable. For example, the claim can be reached by replacing around 23% of base flour with the fractions that are highest in fibre (soft wheat aleurone & durum wheat aleurone). However, for German bread this may be more difficult as the standard German wholemeal bread is reported to have higher fibre levels than in Italy and the Netherlands.

Source of iron, zinc, magnesium, folate and possibly other vitamins

Depending on the wheat fraction and level used, content claims for vitamins and minerals could be made. The claim should always be stating a specific vitamin or mineral, so you cannot state that your product is a source of minerals and/or vitamins in general. For mentioning that a product is a source of a mineral or vitamin, the minimum level is 15% of the daily reference intake (DRI). For stating that the product is high in a mineral or vitamin, at least 30% is required. Table 3 summarises the DRI levels for compounds relevant in bread as established in Commission Directive 2008/100/EC. For many of the HealthBread products the source of level was reached for iron and/or zinc, magnesium and folate.

Products that are a source of a certain vitamin or mineral can also state one or more of the generic health claims approved for the vitamin or mineral in question (see http://ec.europa.eu/nuhclaims/).

Table 3: Daily Reference Intake (DRI) levels of some minerals and vitamins (Regulation (EU) No 1169/2011)

	Fe	Mg	Zn	Vitamin B1 thiamine	Vitamin B2 riboflavin	Vitamin B3 niacin	Vitamin B6 pyridoxine	Vit B9 folate	Iodine
DRI (mg/100g)	14	375	10	1,1	1,4	16	1,4	0,2	0,15

3.11 Iron and/or zinc are better available for uptake in the body

If your HealthBread product is a source of iron and/ or zinc AND you have used at least 16h of bioprocessing, it could also be interesting to make a claim about the accessibility of these nutrients for uptake in the body. As for normal wholegrain products, this uptake is limited by the fact that iron and zinc are bound by phytic acid, which prevents the body from efficient uptake. When you bioprocess your fraction at least 16 hours (with sufficient amounts of the natural or added enzyme phytase present) before adding it to the dough, you can reduce the phytate content of the bread by 50 to 80% compared to the same product produced without bioprocessing, but also compared to standard wholegrain bread. Hereby you decrease the ratio phytate to minerals, which indicates that more minerals will be better available for uptake in the body. Appendix 3 gives more background information on the substantiation of this claim.

When (not) to use the improved bio-accessibility argument

Before getting too excited, it is important to remember that bio-accessibility is a very complex thing. Besides the inhibiting effect of phytate there are a lot of other different factors that can positively or negatively influence the accessibility and uptake of minerals. Therefore, the inhibiting effect of phytate should not be exaggerated. Although in single meal studies the inhibiting effect has been shown, these effects are much less pronounced when looking at total diets, especially if these diets are balanced and include meat and sources of vitamin C (Gibson et al 2010, Rosalind et al 2010, Troesch et al 2013). We would therefore advice bakers to use the improved bio-accessibility argument when their product is marketed for an audience that is known to be prone to iron and/or zinc deficiency, such as vegan or vegetarian women. For other parts of the population (i.e. meat eating men), the claim is irrelevant and might be perceived as misleading.

3.12 Stepwise approach for claims determination for your own HealthBread products

1. Determine your own recipe (you can use the Bakers Manual for inspiration)
   - Choose ingredients wisely to suit the story you want to tell (nutrition wise and image wise).
2. Determine the nutritional value of your product
   - Analysis at a certified laboratory. Calculation: HealthBread mentoring partners may help.
3. Determine possible nutrient and health claims for the product
4. Determine which possible claims you want to use
   - Think of the claims that fit your target population.
5. Determine the wording of your marketing message
   - Translate formal EU claims language to understandable language for your customers. Make use of experts in this field or consult the HealthBread mentoring partners to make sure your translation into laymen terms still fits within the legal framework.
   - Do not forget to incorporate the extra information mentioned in chapter 2.2 of this guideline

3.13 Natural & clean label

Besides nutrient and health claims concerning dietary fibre, specific B-vitamins and minerals like iron, magnesium and zinc, there are a few other statements that might be interesting for HealthBread products. Below we discuss the possibilities for using the statements “natural” and “free of additives/ clean label”.

3.14 Natural

A product that is a natural source of one or more nutrients can be promoted as such, as long as it fulfils the criteria of the claims legislation for these nutrients. I.e. a product being stated as “natural source of fibre” should contain at least 3 grams of natural present fibre per 100 grams of product. Most HealthBread products can thus be marketed as naturally rich in dietary fibre and as natural source of iron, zinc, and several B-vitamins (should be specified). Also, one can state that (inter)national advisory health bodies have advised people to preferably consume their dietary fibre from natural sources such as grains, pulses, fruits and vegetables.

3.15 Clean label

A “clean label” is the label of a food product which has, in addition to its main components, as little ingredients as possible, and the ingredients that are in it are recognisable by the customer. Some producers translate the term clean labelling just as “without” (recognisable) E-numbers.

Additives are given an E-number by the European Union to state that they are useful and safe to use in food. They are strictly researched and monitored for their safety before they are allowed for use in foods. However, a growing number of consumers are worried about E-numbers and they think all E-numbers are in fact unhealthy. These beliefs are not based on sound science but rather on “gut-feeling”. Nevertheless, they can be very strong.

Therefore producing and selling products without additives, or so called “E-numbers”, are commercially interesting because every day more consumers are convinced this is a “better for you” choice. At the same time, active marketing of these products can create a dilemma, because often these products are offered besides the normal products with additives. So, by promoting additive free do you now admit (unrightfully) to your consumers that the regular product you offer isn’t good or healthy? Of course you can also choose to make a product “clean label” without actively promoting this. So, then it is just a selling point when people specifically ask for it.

Every baker has to make his own choice whether or not he wants to make his HealthBread products “clean label”. Of course it will fit perfectly well into the broader HealthBread story. But it is good to be aware of the lacking science behind the health benefits of producing “clean label” and also about the positive and negative sides of actively promoting products as being additive free.

However, if you do decide to make this part of your marketing story, be sure you are true about it. So don’t refer to health benefits of additive free yourself, let the consumer fill this in for themselves. Also don’t trick the consumer by using additives but by stating only the substance name on the label without the E-number. This is legally allowed, but will be perceived as misleading to those consumers who scan product labels for E-numbers.

4. Case study: Women's White

HealthBread: Women's White

Many women believe their health is important, but have too little time in their busy lives to make healthy choices. Although a balanced diet will give you all the nutrients you need, in practice many people eat too little dietary fibre. For women especially other nutrients of concern are iron and folate (vitamin B9).

"Women's White" is one of several breads which were developed within the project. It is high in dietary fibre from wheat bran and a source of iron and folate*. This is good for you because wheat bran fibre helps to maintain a natural bowel function and iron and folate contribute to the reduction of tiredness and fatigue.

For this bread plain white wheat flour is used in combination with the part of the wheat kernel that is especially high in nutrients: the aleurone layer. Purely natural! Therefore, this bread has the same level of iron, folic acid and dietary fibre as wholemeal bread. On top of this, the iron in Women's White is better available for uptake in the body due to a special long fermentation process.

HealthBread participant/partner: "By using this approach, we aim to get the perfect combination of nutritional value, good structure and great taste! We are very curious to know whether you think we succeeded in this mission."

***Nutritional Value of Women's White per 100 gram bread:**

Nutrient	Women's White	% RDI adult women
Energy	243 kcal	12%
Carbohydrates	44 grams	
Of which sugars	1 gram	
Fat	3 grams	
Of which saturates	1 gram	
Protein	10 grams	
Salt	1,1 gram	
Dietary Fibre	6,4 grams	25%
Iron	3 milligrams	20%
Folate	53 micrograms	26%

One slice of Women's White weighs about 35 grams.

5. Appendixes

Appendix 1: Nutrients of concern, per country

Country	Nutrients of concern	Target population	Reference
Italy	Dietary Fibre	All age groups	Sette a.o. ,2011‡
	Folate?	Not analysed	Elmadfa, 2009
	Magnesium	Adults Male & female (18-65+y),	
	Iron	Adults male (18-65y) & female (18 – 65+y),	
	Zinc	Adults male (18-65y) & female (18 – 65+y),	
	B1 & B2	Elderly women	
Germany	Dietary Fibre	All age groups	Mensink a.o. 2012*
	Iodine	Children, Youth, Adults and Senior, 4- 60+y	Mensink a.o. 2012*
		Youth, 11-17y, female	Max Rubner-Institut, 2008 **
	Iron	Adults, male (14%) & female (58%)	Max Rubner-Institut, 2008 **
	Zinc	Adults male (32%) & female (21%)	Mensink a.o. 2012;
	Potassium	Youth & Adults, 11-60y, female; Adults male *4%) & female (8%)	Max Rubner-Institut, 2008 ** Max Rubner-Institut, 2008 **
	Magnesium	Adults male (26%) & female (29%)	Max Rubner-Institut, 2008 **
	Vitamin B1	Adult, male (21%) and female (32%)	Mensink a.o. 2012*; Max Rubner-Institut, 2008 **
	Vitamin B2	Youth, 11-17y, female; adults male (20%) & female (26%)	Mensink a.o. 2012
	Vitamin D	All age groups	Max Rubner-Institut, 2008 **
	Folate (B9)	Adult men (79%) and women (86%)	Max Rubner-Institut, 2008 **
Austria	Dietary Fibre	All age groups	Austrian Nutrition Report 2008
	Folate	Critical, whole population	
	Iodine	Critical for school children (6-15y) and pregnant women	
	Vitamin D	Critical, whole population	
	Iron	Critical for Schoolchildren (13-15 y), women of childbearing age,	
	Vitamin B1	Critical for Schoolchildren (13-15y) and women aged 75-84, marginal for pregnant women	
	Vitamin B2	Critical for Schoolchildren (13-15y), marginal for pregnant women	
	Vitamin B6	Critical for Schoolchildren (13-15y) & pregnant women, marginal for men aged 55-84 y	
	Potassium	Critical for Schoolchildren (13-15y), girls	
	Magnesium	Critical for men aged 55-84y, marginal for women aged 75-84	
	Zinc	Marginal for schoolchildren (10-15y), boys & pregnant women	
Netherlands	Dietary Fibre	All age groups (7-69y)	Van Rossum a.o. 2011 *** Mensink a.o. 2012*;
	Folate	Youth 11-17y , female; Adult male(7-15%), & female (14-28%)	Van Rossum a.o. 2011**
	Iron	Youth & adults, 11-60y, female	Mensink a.o. 2012*; Van Rossum a.o. 2011
	Zinc	Children 4-10 years, mainly girls	Mensink a.o. 2012*; Van Rossum a.o. 2011
	Potassium	Low general intake	Van Rossum a.o. 2011
	Selenium	Youth, Adults & Senior (11 –60+)	Mensink a.o. 2012*
	Magnesium	Youth, 11-17y, female	Mensink a.o. 2012*
	Vitamin D	All age groups (1-60+y)	Mensink a.o. 2012*
	Vitamin B2	Youth & adults, 11-60y, female	Mensink a.o. 2012*

* More than 5% have intakes below LRNI, ** x% of population below recommended levels

*** Mean and 95th percentile intake below recommendations

‡ Note: in this study no conclusions were drawn on % of people not meeting the requirements, also no specific nutrient of concern were mentioned. Therefore, we compared results ourselves with EU RDI.

Appendix 2: Background on free ferulic acid and anti-oxidants

In the HealthBread project enzymes (e.g. ferulic acid esterase) were used in order to increase the amount of free ferulic acid (FFA). The enzymes were added during different phases of the baking process: during pre-fermentation of the fraction ("bioprocessing") and/or at the dough mixture phase when no bioprocessing was done. Within the project, the enzymes were tested in the bioprocessing phase of two different wheat fractions: coarse bran of soft wheat and medium sized wholegrain wheat concentrate. Ferulic acid was measured before and after different fermentation times. Fermentation times of 13h or more resulted in an increase of free ferulic acid levels of more than 200%.

So, what can we tell consumers about this?

Nutrition claims – i.e. claims about levels of compounds – can only be made for nutrients listed in the Annex of Regulation (EC) No 1924/2006. Ferulic acid is not listed in this Annex.

Ferulic acid is also not mentioned in any health claim. Therefore, communication on ferulic acid, its levels or health benefits cannot be made in a direct relation to a HealthBread product. Such communications may be made in scientific publications about HealthBread results.

More generally, approval of health claims was not given for anti-oxidants. The claim "contributes to the protection of cells from oxidative stress" was approved for a range of minerals and vitamins – e.g. copper, manganese, selenium, vitamin B2, C, E, and zinc. In conclusion, the presence of anti-oxidants in HealthBread can be mentioned, (since they are co-passengers of the fibre of the wheat fractions), but mentioning health benefits is not allowed.

Final remarks

Even when a claim on FFA could be made, the question remains: will the consumer understand? Ferulic acid is not a compound that is generally known for its positive health benefits. You will have to explain the consumer what FFA is, and why it is good for you. One might think of telling the consumer that ferulic acid is an anti-oxidant. But this won't do, as all claims on anti-oxidants have been rejected by EFSA because of lack of characterisation and/or lack scientific evidence of a beneficial effect (http://ec.europa.eu/nuhclaims). Besides this, about the supposed positive effect of anti-oxidants in general the scientific consensus is not there (Bast & Haenen, 2013).

Appendix 3: Background on phytate breakdown & mineral bioaccessibility

The schedule below explains the concept of bioavailability, differentiating between bio-activity and bio-accessibility. Within the HealthBread project, the approach was to improve bioavailability by improving bioaccessibility. It is therefore better to talk about the increase of bioaccessibility (instead of bioavailability) because this is just a part of eventual bioavailability. However, in languages other than English no easy-to-communicate wording for bioaccessibility is available.

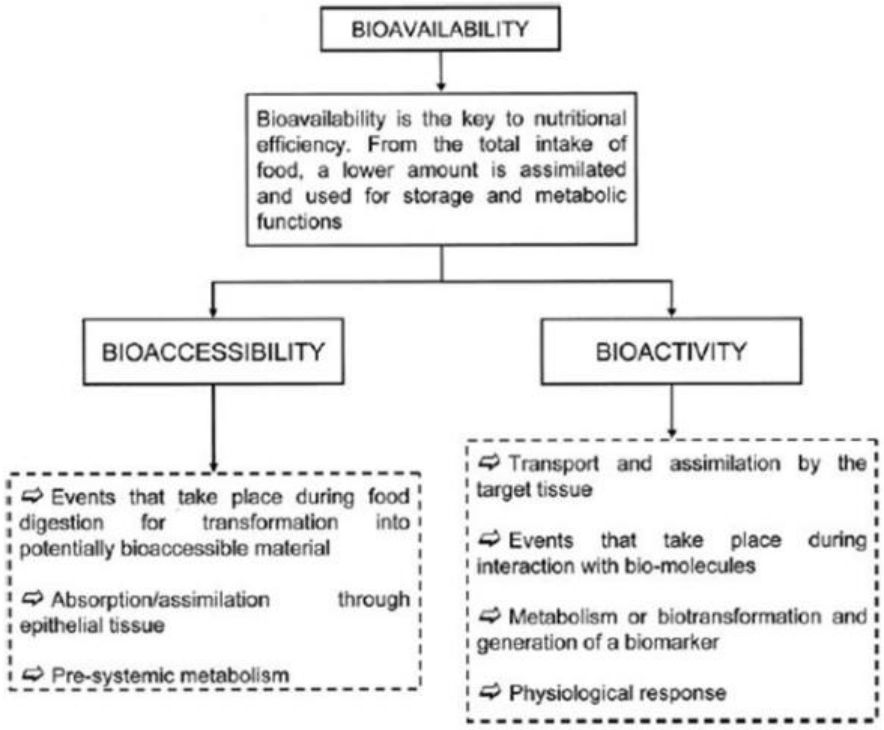
It is known from the literature that phytate in foods inhibits the uptake of iron and zinc in the human body. The negative effect of phytate on iron absorption is dose dependant and starts at 2-10 mg of phytate/ meal (Hurrel & Egli 2010).

Within the HealhtBread project, the aim is to free iron and zinc from their bond with the inhibitory substance phytate. This is done by activating the wheat intrinsic enzyme phytase and/ or adding exogenous phytase during overnight fermentation (bioprocessing) of the used wheat fractions, before they are added to the dough.

From reduced phytate to better uptake of iron and zinc

In the HealthBread studies, only the effect of phytase on the total amount of phytate in the fermented fraction and/or in the final product produced with this fermented fraction was investigated/analysed. It was not looked at the actual effect on the solubility of iron and zinc or on the uptake of these minerals from the end product by the human body (or a technical, so called in vitro, model for this). However, it is reported in the literature that soaking and fermentation decreases phytate level and in turn will increase the solubility and absorption of minerals like iron and zinc from grain sources (Sandberg 1991; Sandberg a.o. 1996; Etcheveryy and others 2012; Hurrell & Egli 2010; Rosalind and others 2010, Troesch a.o. 2013). Troesch a.o. (2013) published a systematic review of all studies that had been done to date on the effect of phytase (endogenous and exogenous) on phytate breakdown and bioavailability of zinc and iron (most studies used stable isotopes to assess mineral absorption rate). They state that the majority of the studies looking at iron, and all the studies with zinc, found statistically significant improvement in mineral absorption following a phytase treatment (either during production or during consumption of phytate rich foods). This increase ranged from 1.0 to 11.6 fold for iron, and from 1.4 to 2.0 fold for zinc.

Figure 1: Definition of bioavailability as a sum of bio-accessibility and bio-activity. Physicochemical events involved on each stage. From: Fernández-García, Carvajal-Lérida, Pérez-Gálvez, 2009



Phytate breakdown in HealthBread

Fermentation of the HealthBread wheat fractions was carried out by adding water and enzymes to the fractions and leaving them for 6 to 20 hours. The enzymes used were xylanase and ferulic acid esterase. The working mechanism for the phytate reduction is mainly the activation of endogenous (=naturally present) phytase by soaking and leaving it to ferment. In our project the best results were reached with a fermentation time of 20 hours. Also, the breakdown of phytate was better if yeast was present. The targeted 50% phytate reduction in ferment was reached only with a high yeast level of 1.27% and a fermentation time of 20h. However, significant decrease of 40% was reached with 13h of fermentation and 0.63% of yeast content.

Adding lactic acid to reach a slightly lower fermentation pH (5,5 instead of 6,2 at T0) can increase this natural phytate breakdown by over 40% compared to fermentation at the higher pH.

Stabilisation by heat treatment of wheat fractions is applied by flour millers when a long storage period is foreseen. Results of HealthBread showed that wheat phytase is inactivated by this way of stabilisation. Addition of exogenous phytase resulted in a phytate reduction of 79%. Addition of lactic acid to create a lower pH for fermentation did not have a substantial additional effect on total breakdown here. This was to be expected as the literature states that especially wheat endogenous phytase is more active at pH around 5, but that this optimum is different for exogenous phytase (Sandberg a.o. 1996).

Since 1/3 of the endogeneous phytase in wheat is present in the endosperm (Zimmermann et al, 2002), also fermentation of a complete dough for bread will contribute to breakdown of phytate. Most bakery partners in HealthBread applied - primarily for taste reasons – long dough fermentation processes, with doughs based on (white) wheat flour and a wheat fraction. Others choose for the pre-fermented and dried (by the supplier, KFI) wholegrain concentrate fraction; here Here KFI is fermenting the fraction before heating, allowing native wheat phytase to act.

Phytase breakdown and mineral bioavailability in HealthBread - conclusion and recommendation

Applying of a range of fermentation processes of long duration, both of wheat fractions and of dough has become a preferred option for HealthBread-type products – thereby allowing wheat phytate to realise significant breakdown of phytate. We recommend to ascertain with analysis that the phytate level has dropped by significantly, i.e. by at least 30% compared to similar products without any fermentation, before 'improved bioaccessibility' is in cluded in communications to consumers

Table 2 – overview of concept products developed in HealthBread

Bakery	Product name	Wheat fraction	Fermentation (F.) And/or other remarks
Ripken	Vollwert Riese	WGC-F	48h dough **F**. With apple +malted rye flakes
Kasses	Vollwert Laib	WGC-F	Multistage fermentation.
Lasser	Europa Krusterl	SWA	90% wheat, 10% rye
Fusè	Salutello	WGC	21h Biga dough fermentation
Regazzoni	Fibra Piu	DWA	Wheat pre-ferment, long fermentation
Boni	Fiore	WGC	2 step long dough fermentation (20h)
Saccani	Rosa	DWA	Sourdough fermentation
Kamstra	Goed Begin	SWA	With wheat sourdough (+starter culture)
Uljee	Origo Wit	WGC	24h dough fermentation

Legend: SWA –Soft wheat aleurone. DWA Durum wheat aleurone
WGC Wholegrain concentrate WGC-F Wholegrain concentrate, fermented and dried

Phytase and bio-accessibility – some additional remarks

Below some additional information is presented about the binding of minerals to phytate.

Comparison Phytic Acid levels compared to level in standard WG Bread	g/100g		
Standard wholegrain Italy	0,6		
Standard wholegrain Germany (Sourdough?)	0,33	reduction % compared to standard	
		IT	GER
WB+ 2.4 with phytase & Lactic acid	0,10	-84	-71
WB+ 2.4 with Lactic acid	0,14	-76	-56
WB+ 4.3 with phytase & Lactic acid	0,09	-85	-72

Table 3: Comparison of phytic acid level of HealthBread test products compared to standard wholegrain bread in Italy and Germany.

Molar ratio of phytate to minerals

Sandberg (1991) stated that the phytate level of a meal should be below 0,5 µmol/ gram to get a strong improvement of iron bio-accessibility (if there are no enhancing factors present). Complete degradation of phytate, they state, will result in a 6 times better iron availability. According to other literature sources, the molar ratio of phytate to minerals affects their bio-accessibility. This ratio differs depending on the mineral and the total diet composition. Etchaverry et al. (2012) reported that the uptake of iron was 91% less when the molar ratio was 20:1 compared to a ratio of 0:1. According to Hurrel & Egli (2010) the molar ratio of phytate to iron should be < 1:1 or preferably < 0.4:1, to significantly improve iron absorption in plain cereal or legume based meals that do not contain any enhancers of iron. If iron enhancers, such as vitamin C or meat are present in the meal, the ratio could be <6:1. Gibson and colleagues (2010), like Hurrel & Engli, found that the ratio phytate to iron should be below 1. They also report molar ratio's for other minerals: phytate to zinc should be below 18 and phytate to calcium below 0.17. Troesch and others looked at studies of phytate and zinc absorption more closely and found that significant results were seen with residual phytate to zinc ratios between <0.17 to 10.5. The last one compared to a staring ratio of 23.5 to 1.

Product (Bread)	Phytic Acid g/100g	Phytic acid mol/100g	Iron g/100g	Iron mol/ 100g	Molar Ratio PA:Fe	Zinc g/100g	Zinc mol/ 100g	Molar Ratio PA:Zn
WB_standard 99 (process 0)	0,09	0,00014	0,00124	0,00002	6	0,0009	0,00001	10
WB + 4.2 process 1 NOT fermented (red = based on calculation from recipe, 12,5% fraction)	0,12	0,00018	0,00170	0,00003	6	0,0015	0,00002	8
WB + 4.2 WGC micro standard proces NOT fermented	0,17	0,00025	0,00196	0,00004	7	0,0019	0,00003	9
WB + 4.2 WGC micro Ezyme threatment overnight (proces 3)	0,18	0,00027	0,00199	0,00004	7	0,0020	0,00003	9
WB + 4.3 process 1 NOT fermented (red = based on calculation from recipe, 19% fraction)	0,47	0,00071	0,00225	0,00004	18	0,0029	0,00004	16
WB + 4.3 (19%) process 1, + fermented overnight (blue= calculation basesd on analysis form this product)	0,35	0,00053	0,00225	0,00004	13	0,0029	0,00004	12
WB + 4.3 (19%) process 1, + fermented overnight with phytase	0,10	0,00015	0,00225	0,00004	4	0,0029	0,00004	3
WB + 4.3 (19%) process 1 + fermente overnight with phytase & lactic acid	0,09	0,00014	0,00225	0,00004	3	0,0029	0,00004	3
WB + 2.4 process 1 NOT fermented (red = based on calculation from recipe, 19% fraction)	0,53	0,00080	0,00283	0,00005	16	0,0017	0,00003	30
WB + 2.4 (14%) process 1 + fermented overnight	0,24	0,00037	0,00283	0,00005	7	0,0017	0,00003	14
WB + 2.4 (14%) process 1 + fermented overnight with lactic acid	0,14	0,00022	0,00283	0,00005	4	0,0017	0,00003	8
WB + 2.4 (14%) process 1 + fermented overnight with phytase & lactic ac	0,10	0,00014	0,00283	0,00005	3	0,0017	0,00003	5
Reference Breads								
Standard White- NL	?	?	0,00100	0,000018	?	0,0007	0,00001	?
Standard White- GER	0,02	0,000030	0,00070	0,000013	2	0,00067	0,00001	3
Standard White- IT	0,05	0,000076	0,00080	0,000014	5	?	?	?
Standard Wholemeal- NL	?	?	0,02000	0,000358	?	0,00141	0,00002	?
Standard Wholemeal- GER	0,33	0,000500	0,00200	0,000036	14	0,0015	0,00002	40
Standard Wholemeal- IT	0,6	0,000909	0,00250	0,000045	20	?	?	?

Table3: Phytate, iron and zinc content of HealthBread products and their molar ratios

As can be seen from the results reported in table 3, in the HealthBread project we demonstrated that a 16h fermentation of used fractions, with active phytase present (either naturally present or added), can significantly decrease the phytate: mineral ratio in the final bread product compared to the non-fermented products as well as compared to the reference standard national wholemeal products.

The **phytate : iron ratio** doesn't reach the < 1 limit, which is stated in the literature to be the optimum for improved iron accessibility. However, the studies that underpin this optimum limit were carried out with maize, beans, oats, soy and white wheat samples, that all started out with a much lower phytate to iron ratio (between 0.6- 8.0) than the wholegrain derived products tested within HealthBread. We therefore suspect that, despite not reaching the optimum ratio mentioned in the literature, the ratio reduction we achieved will nevertheless result in a significant increase of iron availability for uptake in the body. Also, when eaten as part of a balanced diet that will have vitamin C source (vegetables or fruits) as part of every meal the literature stated a ratio of 6:1 will be sufficient for good iron uptake. As shown in table 3 this limit can be reached easily.

According to Troesch et al (2013) significant improvement in zinc absorption is reached when the **phytate : zinc ratio** drops with 55% (from 23,5:1 to 10,5: 1) As shown in table 3 the fermentation process used resulted in a minimum drop in phytate to zinc ratio from 12:1 to 3:1 (-75%) and a maximum drop of 30:1 to 5:1 (-83%). Based on this, one would expect a significant increase in zinc accessibility due to the fermentation process used in HealthBread products.

Appendix 4: List of references

Note: For information about HealthBread's publications see http://www.healthbread.eu/press-corner/

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