The History of Spelt

All living beings are the result of evolution. This is the development of different plants and animals over a very long period of time. Over many thousands of years, the variety of today's grains has developed through spontaneous changes in nature, that is, without being cultivated by people or by the controlled cultivation of grasses. Spelt, also known as Dinkel or German wheat, developed through the spontaneous crossing of the wild grass "*Aegilops squarrosa*" and Emmer (an ancient Egyptian grain) between 6000 and 5000 years before the Christian Era.

Aegilops speltoides
Genome BB n=7

Aegilops squarrosa
Genome DD n=7

	Diploidea Einkorn group Genome AA n=7	Tetraploidea Emmer group Genome AABB n=14	Hexaploidea Spelt group Genome AABBDD n=21
Wild forms	*Tr. boeoticum (aegiloqoides)* Wild einkorn	*Tr. dicoccoides* Wild emmer	----------
Cultivated forms hulled	*Tr. monococcum* Cultivated einkorn	*Tr. dicoccum* Cultivated emmer	*Tr. spelta* Spelt, dinkel, German wheat
Cultivated forms naked	----------	*Tr. durum* Durum wheat *Tr. turgidum* English wheat, also cone wheat, poulard wheat, rivet wheat *Tr. polonicum* Polish wheat	*Tr. aestivum* Common wheat, bread wheat, winter wheat *Tr. aestivum subsp compactum* Dwarf wheat, club wheat

The Einkorn genome AA linked with the BB genome of the *Aegilops speltoides* to produce Emmer wheat. The crossing of the *Aegilops squarrosa* DD genome as a spontaneous evolutionary event resulted in the hexaploid group of *Triticum*, and for the most part, this *Triticum* is hulled. Genetically, the hull is only determined by one gene. During the course of evolution, the naked form of spelt, namely wheat, developed from the spelt group.

Random hybridisation like this rarely produces seeds. But in this case, nature created something that is not only fruitful but also something very special—a new plant that keeps seeds on the field covered with firm hulls until either animals bite through the hull or people hull the seeds to use them for food.
In the Bronze Age (4000-1000 B.C.), spelt spread from the Near East, where it had spontaneously developed, across the Balkans and much later to Europe. The earliest mention of wheat is in the Bible in Exodus 9, verse 30; Isaiah 28, verse 25; and Ezekiel 4, verse 9.

Very early on in Europe, especially in Germany, spelt was grown at the same time as wheat. However, wheat became more popular because of its higher yields. In the 3rd–5th centuries, spelt became native in southern Germany, in northern Switzerland and in the Vorarlberg area of Austria.

This is also how the name "Alemannenkorn" (Grain of the Alemannians) came about. Names for villages such as Dinkelsbühl, Dinkelhausen and Dinkelscherben, as well as the family names Dinkelacker and finally the colloquial synonym Schwabenkorn (Grain of Swabia) for spelt show how important this grain used to be in the Swabian language region.

In 1900, the Mendel's laws (G. Mendel, 1865) were discovered again with the result that people started putting a lot of effort directly into crossing plants with certain desired characteristics (hybridisation).

In 1914, Theodor Römer-Bromberg published an interesting paper:
"Mendelism and hybridisation of agriculturally cultivated plants"
Since the time Mendel's laws were published, many spelt-wheat hybridisations have been made. Backcrossing with spelt after hybridisation brings back the **typical spelt characteristics**. In addition, the selections during successive Mendelian generations are more or less oriented to the typical spelt characteristics. The base material for previous cross breeding was often existing landraces. These species had not been hybridised very much but still showed certain desired adaptation features for their respective region that were good for cross breeding.
Nowadays, spelt is often considered to be, and is described as if it were, an ancient product resulting from evolution that has never been modified or hybridised. Actually, the opposite is true and the writings of Th. Römer-Bromberg prove it.
Terms such as "ancient spelt" are not correct and cannot be clearly defined either from a botanical standpoint or based on processing characteristics.

Varieties of spelt today

Plant cultivators indicate the pedigree of the variety and use this information to let others know the genetic ancestry and the crossing parents.
The cultivation of spelt currently has two goals: Firstly, attempts are being made to cultivate "pure, typical" varieties of spelt, if at all possible, which are essentially free of wheat components. The parents used are largely pure varieties of spelt. New varieties are often produced by repeatedly backcrossing with pure spelt, and then selecting for typical spelt characteristics.

Secondly, attempts are also being made to improve the agricultural characteristics as quickly as possible (in particular, higher yields). This is relatively easy to achieve by crossing with wheat. If something new is announced in the area of spelt and, for example, the harvest yields have increased by 10-15%, one can reasonably assume that the spelt has been crossed with wheat. The pedigree of the variety makes it clear.

Old varieties (they are often referred to as ancient spelt) have probably been crossed with wheat at some time, but this depends on a number of factors:
- What was crossed
- In which direction the selection was made
- How people react to the different varieties (especially, people allergic to wheat)
- How many back-crossings and with which varieties of spelt

Using controlled crossing and selection, the amount of wheat in the spelt can be minimized to a certain degree. However, the genetic material of spelt will never be 100% free of wheat genes!
In addition to high genetic purity, good varieties of spelt should be healthy in order to be able to produce fungus-free goods.

Both these characteristics, **high genetic purity** and **plant health**, are characteristics of "typical spelts" or "ancient spelts". The consumer should look for these characteristics when buying spelt or baking with spelt because only those varieties will display the beneficial characteristics of spelt which were already recognised as favourable by the German nun, Saint Hildegard von Bingen in the Middle Ages, and also today by many doctors and allergists.
However, typical spelts do not necessarily have to be one of the old varieties. There are also some varieties that have been approved in the last few years that also show favourable characteristics.

This includes the following varieties:

- **Ostro** cultivated by the Swiss Federal Research Station for Agroecology and Agriculture Zurich-Reckenholz
- **Oberkulmer Rotkorn** selection of an old Swiss landrace
- **Franckenkorn** a back-crossing from old varieties, currently the purest spelt
- **Schwabenkorn** a back-crossing to "roter Tiroler" cultivated by the University of Hohenheim
- **Bauländer Spelz** is used primarily for producing unripe spelt called "Grünkern"

Based on annual approval year statistics and the descriptions given by Prof. Roemer-Bromberg in 1914, it is clear that the age of a variety says nothing about its purity.

For economic reasons, there are currently quite a few varieties of spelt that produce high yields, some even comparable to wheat yields. In these cases, wheat has been crossed into spelt up to 50% (Hubel, Hercules; Rouquin, Lueg, etc.). This raises the question whether the specific characteristics of typical spelt are still present in these varieties.

Cultivating spelt for the agricultural market

Germany cultivates about 3 million hectares of wheat and probably about 20,000 hectares of spelt. Spelt statistics in Germany are collected, but not in all federal states. Therefore, clear statements cannot be made.

In 1920, the growing area in southern Germany (south of the Main river border) was divided into 55% wheat and 45% spelt. A closer look into spelt cultivation on a more regional basis shows indications from the Württemberg area that up to the 19th century spelt was the main grain used for bread.

The ratio of spelt to wheat has changed in the last hundred years in favour of wheat. There are a number of reasons for this:

- Artificial fertilizer was invented and therefore more wheat could be planted on lower yield soils.
- The successful cultivation of wheat resulting in higher yields.
- The higher work load required to process spelt because of the need to remove the hulls with de-hulling machines. Therefore, spelt is more expensive than wheat.
- The food supply problem during both World Wars also helped make wheat more popular due to its higher yields.

Typical varieties of spelt (Oberkulmer Rotkorn, Franckenkorn) do not yield as much as varieties with a high percentage of wheat. Spelt yields about 20% less than wheat. Since farmers must also think about the economic aspects of grain cultivation, the motivation to plant spelt is not very great. In order to guarantee a satisfactory and pure crop, SchapfenMühle enters into precisely specified cultivation contracts with farmers. For an extra payment of about 20%-25% for spelt, farmers are willing to plant spelt of the desired variety and quantity. The farmer also has additional financial advantages because the expenditures for fertilizer and pesticides are lower than for wheat or rye.

Because of its physical characteristics, spelt is especially suited for doing business with an ecological focus. Compared to wheat, spelt has a longer stalk, which hinders the spread of harmful fungus including *Fusarium*. The great distance from the spikes to the ground basically keeps fungus from spreading in the splashing rain. This firm hull structure also gives the kernel special protection against spike diseases. This avoids quality problems with seed formation if the spike has to be treated.

The ash content of the hull (without the spelt kernel) contains about 90% silicic acid. The amount of silicic acid measured in the leaves and the hull is very important. It strengthens resistance against sucking and biting insects as well as against fungus infections (Sticher and Bach, 1995; Handreck and Jones, 1968). The high level of silicic acid in the hull is mainly responsible for the positive effect of spelt pillows.

Wheat spike

Spelt spike

Spelt hull with spikelet

When it comes to preparing planting seed, the closed hull structure of spelt has certain advantages. One advantage is that it protects the seed so well that the seed hardly ever needs to be treated.
In addition, after sowing, the hulls protect the grain very well from pests from the ground (fungus and other microorganisms).
The hull also protects the spelt grain from environmental influences.
For example: After the Chernobyl reactor catastrophe in 1986, grain could be sold in Germany with a radioactive level of up to 600 Bq. Measurements of radioactivity made by the University of Constance on various agricultural products, also spelt, showed that spelt kernels had only 4–6 Bq. This was clearly lower than the average level for wheat kernels.

Spelt is known as a robust type of grain well able to withstand the winter. This also makes it is suitable for growing in the border regions of the wheat growing area. Spelt is not as demanding as other grains. It also grows in unfavourably high climate regions. Spelt does not make special demands on soil quality (nutrient level, moisture level).

Spelt has an extensive root system and easily extracts the nitrogen it needs. These characteristics make it possible for spelt to achieve relatively high yields with high protein levels but a low level of nitrogen fertilization. All this makes spelt an important grain for use in water conservation areas.

Growing spelt requires less plant treatment agents than other types of grain do. Ecological cultivation means cultivation that is easy on the soil. The University of Hohenheim was able to determine that large amounts of fertilizer used on spelt did not increase yields. Too high levels of fertilizer even had a negative effect. The extra fertilizer resulted in longer stalks, which tended to bend and end up lying on the ground. A normal spelt plant is unaffected by too much dampness and even by extreme dryness and drought. This can be attributed to its deep roots.

The combine harvester harvests the hulls with the spelt kernels "packed inside". This is called "raw spelt".
Since the spelt hulls are firmly attached to the kernel and are difficult to remove, the spelt grains must go through an additional special preparation step, the hulling process. To do this, the miller uses a hulling mill.

These pictures show the great amount of effort needed to produce hulled spelt and milled spelt products. It can be seen which amount of raw spelt is necessary to get a relatively small amount of spelt grains or whole grain spelt flour.

Spelt cannot be simply threshed. The hulls are firmly attached to the grain and are difficult to remove. In order to get the kernel, a special additional preparation step is necessary. This is called the hulling process for which a hulling mill is used.

The following pictures show the hulling equipment in the hulling mill:

Spelt and well being

In her book "Physika", Saint Hildegard von Bingen describes quite impressively the special health advantages spelt has in comparison to all other edible grains.

Hildegard von Bingen (1098–1179) was a gifted observer. As an abbess, she was responsible for the welfare of all those in her charge. Not only the health and healing of disease, but also the well being of the nuns and the parish were very important to her. She wrote what she saw and documented the healing effect of spelt and herbs. Hildegard's descriptions of the positive effects of spelt are still proving themselves today.

Here is a well-known quote from Saint Hildegard von Bingen:

> *Spelt is the best grain... It is rich and nourishing and more delicate than all other grains. It gives the one who eats it a strong body and healthy blood. It makes one happy and cheerful. Whenever people eat it, either as bread or in another form, it is delicious and easily digested. If someone is so sick that he is too weak to eat, take whole spelt grains and boil them in water, add a bit of butterfat or egg yolk to make it taste better and then give it to the sick person to eat. This will heal him from the inside out like a good and wholesome ointment.*

She described spelt as a natural remedy because, as opposed to other types of grain, it is said to be nutritiously balanced. Because of its inherent bioavailability, it has proven effective as a part of a basic diet for treating degenerative diseases, ailments of the skin and mucous membranes, as well as metabolism and digestive disorders. It is also said to improve blood production and nerve function. It is easily digested and has a "mood-uplifting effect" on those suffering from depression. The positive effects of spelt are especially well known when treating neurodermatitis. Neurodermatitis is a wide-spread skin disorder, especially among small children. Food allergies are considered as possible trigger for the symptoms. Spelt has proved itself as a part of basic diet against neurodermatitis. Changing ones diet to include **typical** spelt normally results in a reduction of symptoms.

Spelt under analysis

The difference between spelt and wheat can be analytically determined to a limited extent only. The nutritional and physiological advantages can be clearly documented, but the reasons for them have not yet been proved scientifically. That is the problem with dealing with the topic of "spelt". It all comes down to the fact that genetically, spelt and wheat are equally structured and share the same evolutionary relationship. Nevertheless, these two plants - wheat and spelt - are very different.

When it comes to analysis, science still has many open questions about spelt regarding the qualitative difference to wheat. Spelt consists of a brilliant mix of vitamins, minerals, carbohydrates, and fats as well as a high level of protein and fibre.

The comparison of the nutrients in the two grains is important for the final consumer. Food producers can also use this as a reason to convince people to buy spelt rather than wheat.

Components	**Spelt**	**Wheat**
Fat content	**+**	**-**
Percentage of unsaturated fatty acids	**+**	**-**
Vitamin content	**+**	**-**
Mineral content	**+**	**-**
Heavy metal intake	**-**	**+**

The literature has been describing the better digestion of spelt for a long time, but this is only empirical information and not enough analyses have been made. The reasons for this effect lie not only in the protein, but also in the structure of the starch.
Because of the excellent water solubility of spelt, the vital components are easier and more quickly absorbed by the body. This means that the digestive system does not have to work as hard. The components are quickly absorbed and made available to the entire body. This can explain why weaker people such as small children or older ailing people tolerate spelt better.

Here is some well-known analytic information:

Spelt has a higher fat content than wheat:

Spelt: 2.8 %
Wheat: 1.8 % Source: Coors, U., Speer, K. and Luekas, B., Univ. Hohenheim

Spelt has a different amino acid content than wheat

The amino acid content of the whole grain (100 g fresh weight)

	Spelt	Wheat
Cystine	0.35	0.26
Isoleucine	0.48	0.33
Leucine	0.94	0.66
Lysine	0.36	0.32
Methionine	0.20	0.14
Phenylalanine	0.67	0.47
Threonine	0.41	0.31
Tryptophan	0.18	0.14
Valine	0.60	0.45

Source: Gollwitzer, W. and Hertzka, G.

Spelt has a higher vitamin content

	Spelt	Wheat
Thiamine = B1	516 µg	448 µg 100 g
Riboflavin = B2	129 µg	97 µg 100 l
B6	303 µg	225 µg 100 l
E	2.4 mg	1.5 mg 100 g

Source: Bognar, A. German Federal Research Centre for Nutrition and Food Organization

Spelt has a higher mineral and phytase content and higher phytase activity than wheat

	Spelt	Wheat
CA	0.26	0.31
Mg	1.25	1.10
K	4.23	3.96
Total P	4.23	3.64
Phytase P	3.42	2.91
Phytase activity	515 E	470 E

Source: Lantzsch, H.-J., Univ. Hohenheim

One typical feature when detecting **typical spelt** in the field is, according to H.-M Müller, Univ. Hohenheim 1991, and Dr. Franck, that there should be **no detectible level of Fusarium (**as opposed to crossed varieties of spelt, for example, half spelt/half wheat).

Marketing

The decisive point for consumers to spend more money on spelt products is the purity of the original grain. Purity must be defined in two ways, first in the sense of "pure spelt" (genetic purity) and then whether it has been mixed with wheat (technical purity). "Old" varieties of spelt normally come from hybridisations between wheat and spelt with varying amounts of back-crossings. This makes it quite clear that "old" does not mean "pure". To demonstrate the difference, we refer to pure spelt as **typical spelt**.

Unfortunately, common methods of analysis have not helped sufficiently to examine the phenomenon of "good spelt". There have been studies on the genetic distance between wheat and spelt, where even the hybridisations have been identified. However, the allergy problem can only be dealt with in clinical tests on real people. People who suffer from allergies are looking for direct sources of bread made with pure typical spelt.

Spelt is often associated with organic food products. It does not necessarily have to be this way, even if it is well suited for organic farming. According to current estimates, the spelt market is divided into around 70% conventionally grown spelt and about 30% organic spelt.
In Germany, the most popular varieties continue to be Franckenkorn at the top, followed by Oberkulmer Rotkorn.

Spelt in the bakery

Schwabenkorn whole grain bread and spelt yogurt rolls from bakery mixes produced by SchapfenMühle.

Both respective German Guidelines on bread and biscuits as well as on fine bakery wares define that the floor used to make baked goods labelled as spelt baked goods must contain a minimum of 90% spelt calculated to the total amount of grain. To deliver the entire benefits of spelt, this recommendation must be kept or even increased to 100 %. Mixing spelt with wheat makes the end product less expensive but it also reduces the special effects of spelt. Buying spelt is a matter of trust!

Baking characteristic and rheological properties

Spelt flour analysis data for the last four years

Harvest year	2001	2002	2003	2004
Wet gluten content	33.5 %	31.8 %	34 %	34 %
Gluten index	43	55	50	55
Sedimentation value	29 ml	32 ml	34 ml	30 ml

The wet gluten qualities were all well extensible.

The crumb colour of baked goods made with spelt super fine flour is a bit more yellow compared to wheat which varies from light grey to white. This reflects the knowledge of growers that original spelt varieties have a greater yellow pigment content. The yellowish colour comes from carotinoids. Spelt has a higher protein content than wheat but spelt gluten has a different structure and in not as strong as wheat gluten.

Unfortunately, bakeries still view baking spelt baked goods with a very critical eye due to the following reasons:

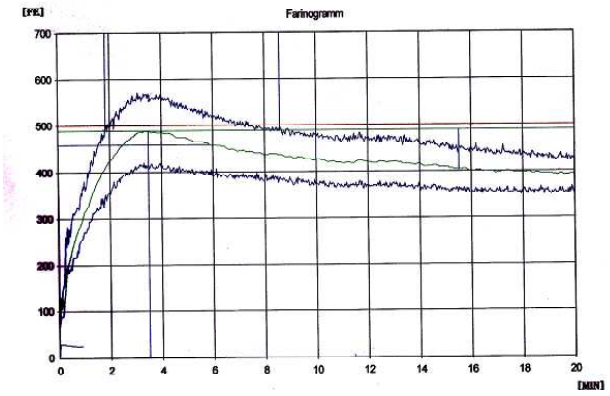
- The mixing tolerance of spelt is not as good according to popular opinion.
- The surface of the dough tends to become moist making it more difficult to process in machines.
- The baking tolerance is less stable.
- Pastries made from spelt become stale more quickly and clearly lose some of its hedonic value.

To avoid these negative characteristics, the following should be done:
- Always use sponge doughs to ensure proper swelling.
- Add sufficient water to the dough.
- Use gentle kneading techniques (more time for the mixing stage and less time for intensive kneading).

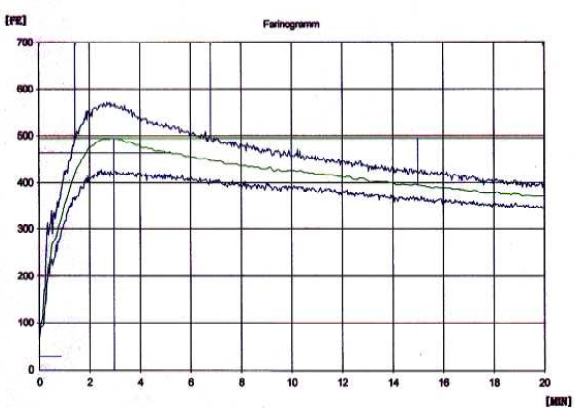
When these instructions are followed, spelt baked goods have a full taste and a pleasing texture.

When testing flours, the farinogram and extensogram curves show that the dough characteristics of spelt are different compared to wheat due to the varying mineral content. The dough softening time is higher and the mixing tolerance is lower.

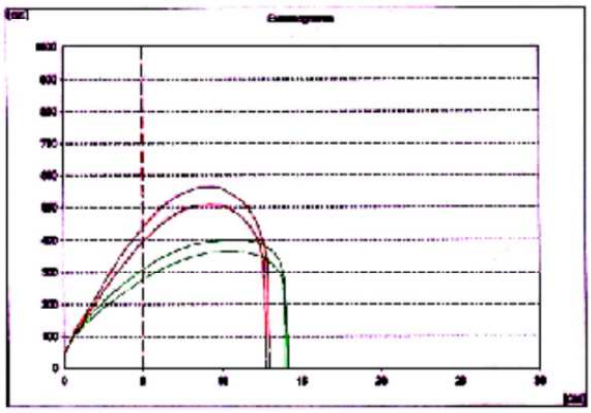
Farinogram commercial **Wheat** flour



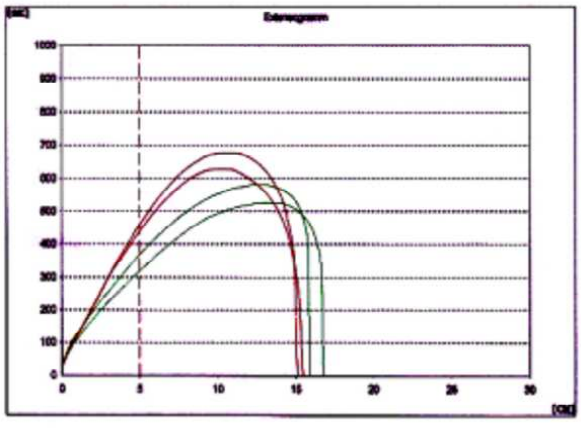
Farinogram commercial **Spelt** flour



Extensogram commercial **Wheat** flour



Extensogram commercial **Spelt** flour



Grünkern (unripe spelt grain)

One particular spelt speciality of excellent quality is called Grünkern (literally translated "green kernel"). The spelt variety Bauländer Spelz is preferred for this. To make Grünkern, the spelt is harvested while it is still green (about two weeks before final maturity). The hulls, which still contain the spelt kernels, are carefully dried in special Grünkern kilns on perforated sheets under hot smoking beech wood coals at 100-120℃. The drying p rocess lasts about 6 hours during which the grain must be constantly stirred. This old work-intensive method is increasingly becoming a thing of the past. Nowadays, most of the harvest is dried using hot air equipment. In order to get a smoked effect, additional hard wood burning is used. After drying, the Grünkern is hulled. The drying gives Grünkern its strong nutty flavour. It is also known for being easily digested. Because of the drying process, Grünkern flour cannot be used for baking. Grünkern can be used as a whole grain, pearled, as grits, as flour and flakes for making baked puddings, soups and vegetable burgers among other things. Grünkern was "invented" out of necessity as it often happens. In earlier days, this was how farmers saved their spelt harvest when bad weather kept the spelt from maturing properly.

Summary

Even if spelt has not yet been studied enough scientifically, it is clear that spelt is different from wheat and offers many advantages. Due to its lower demand for fertilizer and pesticides, spelt actively contributes to the protection of the environment. The nutritional and physiological advantages have been empirically confirmed many times.

Spelt will probably remain a niche product in the future. However, the acceptance of spelt by end consumers has greatly improved in the past few years due to intensive information campaigns. The consumer knows spelt as a "healthy grain“ and is willing to pay more for it.

All merchandisers are encouraged to bring typical spelt with no wheat content to the market so that both spelt and the distributor can maintain a good reputation.

Karl Schmitz heads the bakery business at Schapfenmühle. He has compiled this lecture and held it for the first time in November 2004 on the occasion of a technical meeting at the Federal Grain Research Institute in Detmold, Germany.

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