

Flour power: meet the bread heads baking a better loaf

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The best thing since sliced bread turns out not to be sliced bread. Our supermarket loaf, which accounts for 80% of all the bread bought in the UK, is sweetish, soft and pappy. The ingredients listed on the plastic sleeve include added E-numbers, enzyme “improvers”, extra gluten, protein powders, fats, emulsifiers and preservatives. It is baked according to the Chorleywood process (named after the location of the lab where it was invented) developed in the 1960s for speed, from grain that has been milled between steel rollers, removing the germ where the oils and nutrients reside, and the bran husk where the fibre is, leaving only the endosperm, a pure starch so nutritionally void that by UK law vitamins must be added back into white flour.



Mechanised food factories demand ingredients that are standard, stable and easy to transport, and make products that are standard, stable and easy to transport. New wheats have been bred for high yields and high protein content that require inputs of chemical fertilisers and pesticides. To increase efficiency, hedgerows and copses have been eliminated and farmland agglomerated into increasingly larger tracts of monoculture.

From soil to plastic-packaged loaf, industrialised breads are the end product of 100 years of innovation in agriculture, manufacturing and transport, all of which prioritises efficiency and cost over nutrition and taste. Bread is the most-bought food item in the UK, but the supermarket loaf is just part of a basket of highly processed foods that we are now beginning to understand is making us fat, sick and allergic.

While the big bakeries may market brown loaves under homely monikers such as farmhouse, wholegrain and multiseed, these are often distinctions without much meaning. The basic ingredient of highly processed flour is the same, even if bran or other sources of fibre are added back into the mix. More research is needed, but there is increasing evidence to suggest that gluten intolerance (not to be confused with coeliac disease, which means people cannot process gluten at all) could be caused by the extra gluten that is often added

to mass-produced wholewheat products, and that the old-fashioned longer proving time – the resting time that allows yeasts to ferment the dough and make it rise – is a key factor in rendering wholegrains more digestible.

Good bread needs no more than four ingredients: flour, yeast, water and salt. Wheats were once regional and adapted to the land; grain was milled locally and often baked as wholegrain flour into dense loaves. In Britain and the US, most of us have not eaten this kind of bread in so many generations there is no longer even a folk memory of what it tasted like. The desire for lighter and whiter bread is steeped in history: finer, paler, sifted flour was more expensive and the province of the rich, and as such has been an enduring trend, even as flour became a bland and cheap commodity, often bleached to make it even whiter.

But in the past couple of decades, new movements have begun to challenge the prevailing food culture. In the early 2000s, activist and journalist Michael Pollan wrote about how what we eat had lost its link with the land and the farmer. Leading the revolt against processed food, in 2010, Pollan came up with the line that became a catchphrase: “Don’t eat anything your great-grandmother wouldn’t recognise as food.” Dan Barber, a chef on a mission to bring back the links between sustainable farming and taste and nutrition, delivered a Ted Talk in 2008 in which he described modern industrial agriculture as “an insult to the basic laws of nature”. He and others have popularised the farm-to-table movement that is changing people’s eating habits, encouraging farmers to grow varieties for deliciousness over yield, efficiency of transport and shelf life.

In 2011, the geneticist Stephen Jones founded the Bread Lab in Washington, bringing farmers, millers, brewers and bakers together to develop new grains that emphasised taste. In 2014, Jones suggested the supermarket loaf should be called “American” or “processed bread”, to distinguish its mass-produced identity and nutritional characteristics. He told me he does not like to be in the same room as white flour. Meanwhile, a sourdough movement bubbled up in San Francisco, championing the resurgence of the traditional method of leavening bread using natural starters that harness a complex web of ambient bacteria and fungi, rather than strong modern yeasts bred to inject air into almost anything.

The great food writer Julia Child once said British white bread tasted “like Kleenex”. Maybe that is why we load our white sliced toast with so much jam and chocolate spread and peanut butter. Wholegrain, sourdough bread is a very different beast; crunchy, crusty, chewy, with a complex taste that is rich, nutty and tangy. Quite often, I find a couple of thick slices, spread with a generous swathe of butter, a satisfying lunch.

The revival of ancient varieties of wheat is inspiring a new movement of agronomists, farmers, millers and bakers in the UK. They are coming together to develop and grow new kinds of wheat that do not need dousing with chemicals, to mill the grain in such a way as to keep taste and nutrition intact, and to bake loaves that are delicious and healthy. In the

process, these artisans want to challenge the dominance of chemical agriculture and the supermarket loaf, to establish a new kind of supply chain that links our diet to nature and creates healthy communities.

Bread is a basic foodstuff. It is our land and our kitchen table, family tradition and religious celebration. Our daily bread is our daily life; it is economics – breadwinner, breadbaskets, breadlines; it is politics – upper crust, bread and circuses, grist for the mill. As this group of growers, millers and bakers are demonstrating, bread can be revolution, too.

In the 1960s, while we were falling for the abundance of postwar produce and the convenience of the supermarket, one British plant pathologist was battling with mould. As a young researcher in East Anglia, Martin Wolfe specialised in barley mildew. At the time, the prevailing view was that science could improve on nature's design; agronomy focused on breeding grains that would produce the highest yields, and developing fertilisers and pesticides to encourage and protect them.

Wolfe began to see that as soon as a new variety of barley was introduced, pathogens adapted to find a way to attack it; as soon as a new fungicide was formulated, the pathogen reacted by developing resistance to it. He realised that nature was always going to win the race.

He was single-minded, driven, almost obsessive; his family complained that he was difficult to call away from his desk for dinner. He understood earlier than most that adding more chemicals was not a sustainable answer, and looked for different ways to grow healthy crops. He experimented with breeding varieties carrying different resistance genes. When he planted out his new varieties and mixtures, he found that infection levels fell.

In the 70s, Wolfe worked with East German scientists who wanted to reduce their use of expensive foreign pesticides. By the end of the 80s, almost all their spring barley (an important crop, because the East exported malted barley to the West German brewing industry for hard currency) was being grown according to Wolfe's techniques. But when the Berlin Wall came down, they were encouraged, like other farmers in western Europe, via subsidies and promises of high yields, to use chemical fertilisers.

"I've always felt like a bit of an outsider," Wolfe admitted in an interview. He was a scientist, and at first sceptical of the organic movement that emerged in the 80s, which he felt was turning back the clock. His priority was breeding new crops to tackle the environmental challenges of the future. Over the decades, Wolfe became convinced that diversity – the very thing that modern agriculture was eliminating with its herbicides and monoculture – was the key to resistance. When a pathogen attacked a genetically homogenous crop, it could wipe out a whole field.

As he approached retirement, Wolfe wanted to put some of the new ideas about mixed

farming practices into use. Agroforestry had begun to gain ground in the 70s when Phil Rutter, an American plant breeder, asked a big question: if nature's dominant agriculture was trees – perennials – why had man spent 10,000 years developing annual crops? Rutter was convinced that trees such as hazel and chestnut could provide as much nutrition as cereals without having to be resown every year. His motto was: "The future of the world is nuts."

In 1994, Wolfe bought two meadows and a low-ceilinged long house in Suffolk called Wakelyns, which had been a pig farm, then a dog-breeding site. Wolfe drew up elaborate plans for avenues of hazel, willow and a mixture of fruit, nut and timber trees. In the lanes in between the trees, he would grow annual crops: vegetables, cereals, legumes. Wakelyns was always imagined as an experimental agroforestry farm, "a rather expensive personal hobby", as his son, David, put it, not a going concern. It soon became a centre for real research.

At first, the saplings, planted in mud with protective plastic rabbit-proof sleeves, looked thin, vulnerable and unimpressive. Visiting farmers shook their heads, wondering why land was being wasted by planting trees on it. "No experiment ever fails," Wolfe liked to say. As the trees grew and projects proceeded, visitors were drawn to Wakelyns to see for themselves one of the best examples of agroforestry in Europe. Wolfe walked them through his lanes of crops, his white hair glowing like a nimbus, backlit by the sun, explaining the how the trees, with their long roots, were able to draw nutrients from deep in the soil, which the annual crops also benefited from, via fungal networks in the soil. "There is an idea that crops suffer from competition with trees," he told one interviewer, "but it is not true – they are sheltered and protected by trees."

In 2000, Wolfe created a very special crop. With the help of plant breeders and the scientists from the Organic Research Centre, Wolfe took 20 varieties of wheat that had been doing well under low-input conditions in the UK, half chosen for their quality – their high protein and gluten contents – half for their high yield, and cross-bred them every which way, resulting in 190 new crosses. Normally, a breeder would look at these plants and select for the traits they wanted. But this time seeds from all 190 were thrown together in a field, grown, harvested and reseeded together for several years. Wolfe called it YQ, for "yield" and "quality".

Whereas selection ordinarily narrowed the genetic pool, as with inbreeding dogs, this method maintained it. The genetic diversity in this crop meant the wheat was not only resistant to pathogens, but also tolerant of varying growing conditions. The yield of YQ was never going to match that of high-yield wheat in a good year, but over time, Wolfe showed, its yields through wet or dry or pestilential years, when whole fields of homogenous wheat could be wiped out, were compellingly consistent.

Wolfe milled his YQ grain into flour in a small electric stone mill in his barn. His wife, Ann, made cakes and pastry with it, and everyone loved its rich, nutty taste. But Wolfe had not yet found a baker who would turn it into bread.

Last February, I drove north to meet one of the foremost of a new generation of British artisanal bakers – Kim Bell, who started The Small Food Bakery in Nottingham five years ago and, in 2018, won a prestigious BBC Food and Farming award. I found Bell cleaning up at the end of the day. Hale, with floury hands, and her hair tied up in a cloth bandana, she gave me a bottle of house-made rhubarb kefir as she finished vacuuming the ovens. She is a proper baker – a mix of passion and exhaustion. When she finally sat down, I said: “One day you’ll have someone else to do the washing up!” Bell shook her head. “We don’t have anyone who comes in to do menial work. We all do it ourselves.” This, she explained, was deliberate, part of a policy to encourage autonomy and responsibility. She wanted each baker to be mindful of resources: energy, time and hot water.

I ate one of her cinnamon buns: sticky, soft and crunchy all at once; sweet from the chestnut honey and sour from the tang of the naturally fermented dough. Every mouthful was differently delicious.

Bell had gone to art school but didn’t want to be an artist. For many years, she worked with her father in a contracting business, specialising in installing coffee shops and minimarkets in petrol stations. They were successful, but she found the world of mass-market retail depressing and wasteful. Bell is the kind of person who always has a dozen projects on the go and a large cast of collaborators. She was often cooking on the side, filling in at a friend’s pub, catering a wedding or baking for the Women’s Institute market. At one point, she got involved with helping a friend open a cafe.

She also started reading Michael Pollan and Dan Barber, and discovered the US food movement linking sustainable agriculture and deliciousness. She went to listen to a talk by Andrew Whitley, the godfather of the British sourdough movement, who had opened the first organic bakery in the UK – the Village Bakery in Melmerby in Cumbria – in 1976. “Andrew was selling the idea of a bread revolution where we use wild yeasts and we know where our grain comes from.”

Bell is a very good baker; she is also a political baker. Learning about soil depletion and disease and social justice, she was appalled, and then galvanised. “It just all came together for me: there is a problem in our food system and we need to fix it.”

Thoughts converged, and events conspired: a small kitchen-cafe came up for hire in an artists’ co-op in Nottingham, and in 2014, Bell found herself with a space and an oven. Opening a bakery seemed an obvious way to challenge all that she felt was wrong with the

industrial food system, a sourdough gauntlet to throw down in opposition to the supermarket loaf in its plastic sleeve.

"I flung my doors open one day with absolutely no fanfare," Bell remembered. "I didn't announce it. There was no sign. I had one customer the whole day. And she was gluten intolerant." Bell had no formal baking training; she did what most new artisan bakers do: she tried to copy the Tartine Bakery in San Francisco, with its much-lauded and Instagram-famous crumb (bread's interior texture) full of big holes, and its sharply crunchy crusts.

"You think flour is a stable ingredient," Bell explained to me as she opened a few bags of different flours for me to feel and taste. "But if it's done right, it's living and alive." I held some flour in my palm and saw how it clumped a little when I compressed it – the measure of its moisture. The flour I had unthinkingly always used is really only an inert powder of indefinable shelf life, whereas this kind of whole grain, containing the oils of the germ, lasts a few months before it can go rancid.

Bell is one of the vanguard of bakers in the UK trying to make better flour and tastier, more satisfying loaves. Part of the taste comes from using different grains – the ancient progenitors of modern wheats, like spelt, einkorn and emmer, or cereals such as rye, buckwheat, barley and oats – and part from the lactic tang of the "starter", the natural leavening ferment made from a flour-and-water paste and ambient yeasts.

When Bell first started the bakery she used organic flour from Shipton Mill, a British miller that provides high-quality blends of flour. But she wanted to understand more about the products she was using, where they came from, how they were grown; she wanted, as part of the mission and identity of the bakery, to source ingredients locally. She soon found someone who was milling organic flour in a windmill only 40 miles away.

After working for years in the corporate world, Paul Wyman and his wife, Fari, bought the refurbished windmill at Tuxford 14 years ago, pretty much on a whim. The learning curve was steep. Wyman had to figure out the hard way the difference between "milling wheat" and "feed wheat" fit for animals (it has a different protein content; a lot of bakers are used to working with higher protein contents because it creates a more open, structured crumb), and there were plenty of mechanical problems and sudden wind gusts, but, he admitted, "slowly, I became a pretty good miller".

His wife presides in the tea room, selling cakes and scones made with flour he has milled, to showcase how different the taste can be. (I bought two bags of his Tuxford Gold and made everything from pasta to pastry with them; the difference in quality was clear – it was richer, more complicated, more interesting.)

There is something quite extraordinary about the sheer physicality of a working windmill. The big canvas sails turned as gracefully and powerful as a tall masted ship. Inside the shafts

and chains and pulleys and wooden toothed gears clanked and thumped as the iron spindle revolved, running through the centre of the two heavy grinding stones. People have been grinding grain into flour in this way for thousands of years.

The grain is poured into a hole in the centre of the circular mill stones. The top stone is smooth, and the bottom one carved into grooved sections. The grooves funnel the wheat to the outside of the stones, slicing each grain 20-30,000 times before it falls over the edge as fine fluffy flour. Milling in this way is a technical art. Milling at a cooler temperature allows the miller to grind a wholegrain – 100% of the grain, germ and bran included – and then sift the flour, shaking through sieves of different sizes, to varying degrees. When there is still a fair bit of bran in the flour, it is called middlings (“hence the origin of the term ‘fair to middling,’” explained Wyman). A full extraction to white flour might discard a third or more of the whole grain.

Milling wholegrain preserves the grain’s essential nutrients, as Stephen Jones at the Bread Lab in Washington state explained to me. “A kernel of grain has 8% fibre, white flour has zero. A kernel of grain has 35-100mg of iron per kilo, white flour has close to zero.” The bran is usually sold off cheap, as animal feed or potting material.

Jones convenes an annual symposium, the Grain Gathering, which brings together bakers, breeders and millers from all over the world. Jones is a global leader developing new wheats and other cereals tailored to the varied needs of bakers, brewers, farmers and consumers. Recently, the Bread Lab launched a new sliced loaf developed to appeal to consumers brought up on soft and sweet American bread.

Kim Bell met Jones several times at the Grain Gathering. For the past two years, she has organised a UK version, the Grain Lab, a two-day event bringing together 150 farmers, millers and bakers from 14 countries to discuss issues of marketing, transport and cost.

A supermarket loaf might cost about £1, a loaf from an artisanal bakery three or four times that. Inevitably, the price of sourdough has given it an elite, middle-class foodie tag. Supermarket bread sells at wafer-thin margins, and big bakeries operate on giant economies of scale; small bakeries have to contend with high rents and labour costs, expensive organic ingredients and a time-intensive process. Bakers defend the value of their loaves, their high satiety (one thick slice fills you up quite happily) and lower waste: supermarket bread is so undervalued that almost half of it is thrown away. Increasingly, we are beginning to understand the real costs of an industrialised food supply, not borne by the agro-food industry, but by the taxpayer. [A study](#) for the Sustainable Food Trust in 2017 suggested that when you have factored in the health costs of obesity and diabetes, environmental clean-up and subsidies, the real cost of our food is double what we pay for it in a shop.

Bell and others are trying to put together local networks of supply, to create a new kind of grain economy; inevitably, their efforts come up against the problem of how we value benefits that we can feel, rather than count. Bell told me that the connections she makes are often personal and unexpectedly moving (for example, when farmers taste bread baked with grain they have grown for the first time). For Bell, the quality of her relationships is as important as the quality of the ingredients.

One day, more than three years ago, Josiah Meldrum, an organic farming activist, walked into Kim Bell's bakery with a bag of YQ flour. Meldrum, co-founder of Hodmedod's, a Norfolk company selling and championing British legumes, was a close friend of Martin Wolfe and keen to help him get bakers interested in YQ. He told Bell the story of YQ and asked her if she would try baking with it, explaining apologetically that YQ had a relatively low protein content. Most bakers would have been put off, but Bell smelled its toasty nuttiness and was intrigued.

Her first efforts produced tough, dense loaves, or the dough became a puddle of unshapeable slop. Bell tried varying the proportions of starter, upped hydration levels, reduced the temperature, mixed it vigorously instead of gently. "It was just trial and error really." She wanted to bring out the flavour of the wheat. Finally, she was satisfied and had a domed loaf with a dark umber crust and a russet interior of soft, pillowy crumb that she could take to show Wolfe at Wakelyns.

Bell was nervous: "He's a bit famous." But they ended up spending all day talking. "He was delighted, because he had been working on this project for 20 years and scientists were fascinated by it, but he couldn't seem to get a baker to bake with it." Bell and Wolfe recognised in each other the other half of an equation. For Bell, the YQ wheat represented "everything we had been thinking about in the bakery, diversification and decentralisation, resonated back down to the seed."

Since the early 20th century, seeds that are sold commercially have had to be legally registered according to variety. In this way, buyers are protected and breeders can receive royalties on plants they have spent time and money developing. Accordingly, seeds and plant varieties must conform to certain criteria for uniformity and stability. But YQ is genetically thousands of different varieties of wheat, known as a "population". As such, it could not be legally registered, or traded, in Europe.

When Bell fell in love with YQ and its story, Wolfe had been growing it for almost 15 years. In the US, they were continuing to develop populations, as were a few agronomists in France, Germany and Italy. But generally, these were a new, untested type of crop. Between 2007 and 2013, YQ went on a tour around Europe, to see how it would grow in different climates. The results showed that even in varying weather conditions and soils the overall yield of YQ was remarkably stable.

In the meantime, Wolfe went back and forth between Brussels and Westminster to lobby for an exception to the EU regulations that would allow YQ to be sold. Finally, in 2014, he was successful, and in July 2017 YQ seed, officially called the ORC Wakelyns Population, was the first population wheat to go on sale in Europe.

Bell wanted to use YQ flour at the Small Food Bakery, but she needed to find a farmer to grow it. She asked Paul Wyman at Tuxford Mill if he had any ideas. Wyman sourced a lot of his organic wheat from John and Guy Turner, who had a family farm in Lincolnshire, 40 minutes down the A1. He suggested giving them a call.

The Turner brothers at Grange Farm are fourth-generation farmers with 100 hectares (250 acres). Over the decades, they had watched other small farmers around them struggle and sell up. So, in 2001, they decided to go organic. "Basically, we've been holding on by our fingertips for the last 30 years," John Turner told me. They had begun to send their wheat to Paul Wyman when they were looking for a way to sell a few tonnes of extra grain. When Bell asked if they would be interested in planting YQ the brothers said: "OK. Why not?"

"Over the winter, we weren't too sure about it at all," Guy told me. "It was quite a spindly, thin crop. But then in the spring, when the weather warmed up, it just absolutely took off. You could almost sit at the edge of the field and watch it grow."

"You don't appreciate the diversity until you actually see it," said John. "Some plants were four foot high, some two foot, some had awns [bristles], some were without, some had spikey filaments hanging off, some had square heads, chunky and robust, some were more slender." The summer of 2018 was very dry and not a good year for cereals, and YQ outperformed a lot of the conventionally grown crops in the area.

Bell continued to champion YQ to other bakers and gave baking demonstrations with it at her Grain Lab. Ben Mackinnon at E5 Bakery in London Fields, which mills its own flour at its premises under a railway arch, grew up on a farm near Wakelyns, knew Wolfe (he once spent a month digging up potatoes for him) and said he would take four tonnes. Turner was delighted. The only problem was how to get the grain to London. Turner suggested he take a load on a trailer hooked up to his 4X4. He soon got lost in the narrow streets. "I felt like a real hick from the sticks," he said, laughing. I said he was doing something that probably hadn't been done in 150 years: a farmer transporting his own grain into central London to be milled.

When I visited E5 in April, they had almost run out of the Turner's YQ and had begun to source it from another farmer in Essex. Word had gone around, artisanal bakers were excited by the YQ story and its flavour; almost the whole 2018 crop had sold out.

Martin Wolfe died after a short illness in March. We had been in touch and he had invited me to come to see his farm. Two weeks after his death, his son David and Josiah Meldrum

kindly met me at Wakelyns. It was a brittle spring day, bright spots of sun in a cold wind.

They showed me Martin's office – a mess of papers, slides of mildewed barley leaves, a nest of wires on the floor, chainsaw parts. In the sheds and barns, there were tractors and combine harvesters and all sorts of Heath Robinson-esque machinery he had modified for his experiments. "There's not much you can't do with a Ribena bottle," David laughed, pointing to plastic bottle taped to a stick. "Everything tied up with baler twine," Meldrum added. "Martin would never let a good idea be stymied by not having the right equipment."

And here were the avenues of trees, and between them alleys of clover and blades of green YQ. The trees were splotted with green and white and pink blossom, 40 kinds of apple, multiples of pear, plum. There were the prints of muntjac deer and hares in the mud and thrushes warbling in the hazel.

We walked through a hedge and came out on to a lane as a blast of raw wind, unchecked by trees, blew into our faces. Before us was a 40-hectare expanse of wheat on the neighbouring farm, as evenly green as a billiard table. The contrast between the variegated beauty of Wakelyns agroforestry and this conventionally farmed field could not have been more stark.

We are only beginning to understand the importance of diversity and the complex systems that plants – and animals, and us – need to thrive. In an interview, Martin Wolfe once argued that value should be accounted not just according to the cash received for a crop, but to the effect of the plants on the soil and carbon sequestration, and wider effects "on mood, on beauty, on community". The story of YQ spins a narrative from soil health to grain resistance to nutritious flour to tasty bread, and it also describes a group of people working together to create a local food network that nourishes a community.

"Martin was always full of crazy ideas," said his son. We walked to the end of a grassy meadow. His wife Ann's grave was marked with a simple stone among stands of daffodils. In April, Martin was buried next to her.

As a result of his lobbying, YQ wheat will receive legal status to be traded from the EU in 2021. Before he died, Bell told me: "I'm buoyed by Martin. Last year he said to me: 'Kim, it's happening, I'm seeing it for the first time in my life. It's going to come. Things are changing.'"

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- This article was amended on 11 October 2019 because an earlier version said genetically modified wheat was grown in the US. However, there are no approved GM wheat varieties in the US. In addition, the Bread Lab and Grain Gathering are in Washington state, not Oregon. This has been corrected.