

Quality Characteristics of Wheat Cultivars for Flour and Bread
Production in Southwestern Europe.

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**Quality Characteristics of Wheat
Cultivars for Flour and Bread Production
in Southwestern Europe**


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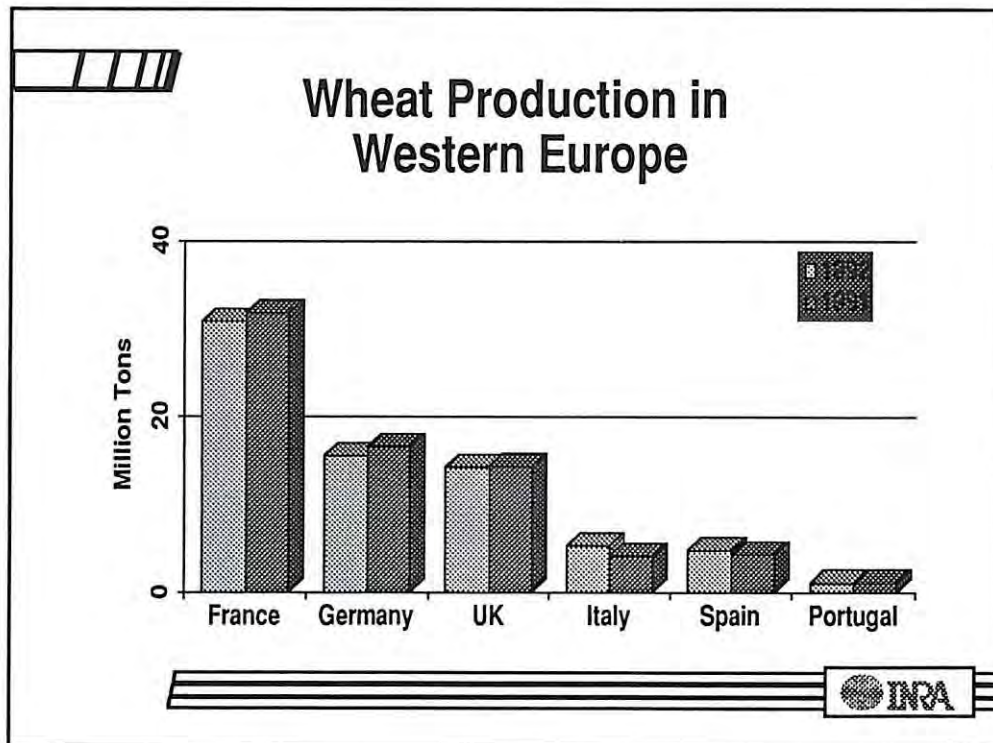
Thank you, Mr. Chairman, thank you for invitation to participate to this ICC Symposium and talk about wheats and breads in Southwestern Europe.

 Wheat and Flour : Production and Export (88-89-90-91 Mean, Million Tons)		
	<u>Production</u>	<u>Export</u>
China	92.6	-
ex-USSR	85.3	-
EEC	83.8	20.9
USA	58.3	33.4
India	51.2	-
France	32.4	18.7
Canada	26.5	18.7
Australia	13.5	10.4
[World]	[540.0]	[98.8]

Colleagues and friends,

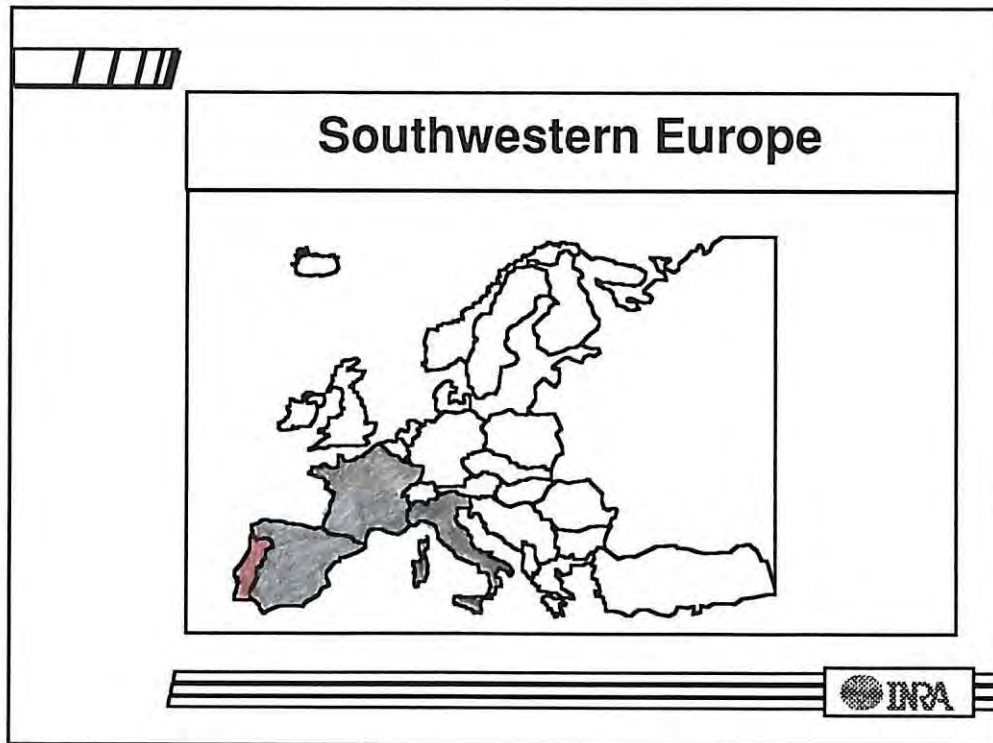
This first slide shows a 4-year mean of the production and exportation of wheat and flour in the world.

It shows that Western Europe and especially EC ranks third in wheat production and has emerged as a major exporter. Especially important is the French wheat production (32.4 Mi tons) owing to ideal growing conditions in France.




The second slide shows the wheat production in the main European countries

In this talk we'll report quality characteristics of wheat cultivars for flour and bread production in Southwestern Europe, i.e. France, Italy, Spain and Portugal.

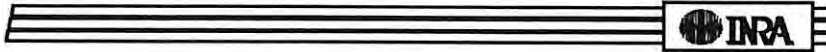


Here is a map of Europe indicating the location of these four countries: France, Italy, Spain and Portugal.



Trends of South-Western Europe Wheat Production

- **Increasing production in less area**
- **Intensive or very intensive cultivation (Paris Basin)**
- **Large variations in quality between regions**
- **Importance of variety in the domestic grain trade (electrophoresis inspections)**

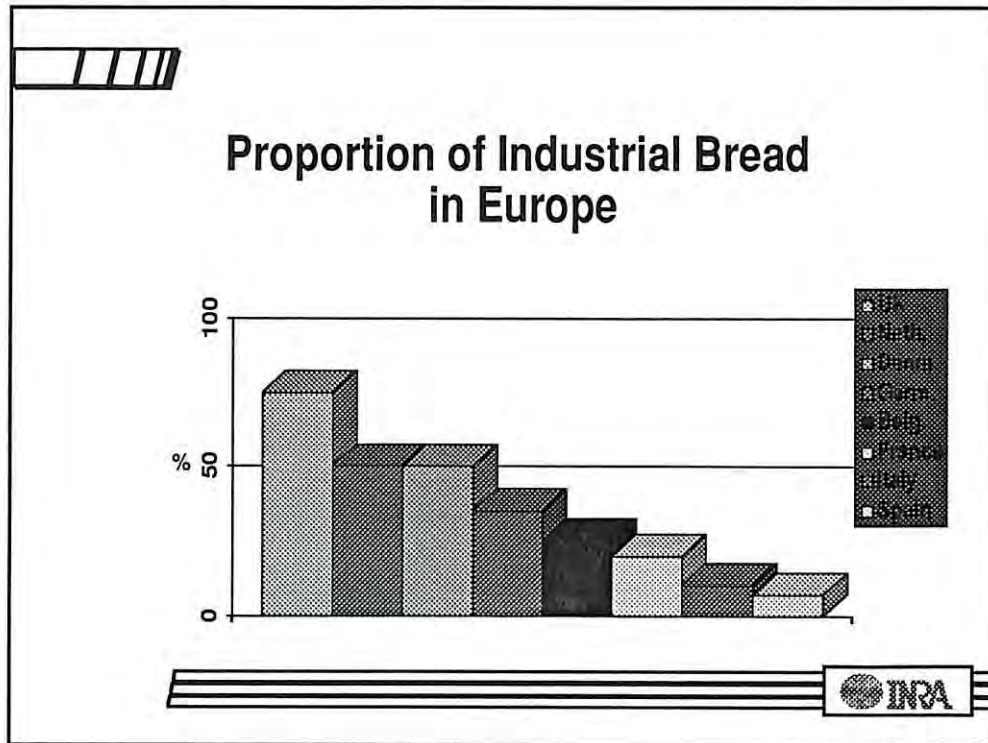


And here is a slide indicating that the main trends of South-Western Europe production are characterized as follows:

- *Increasing production in less area.* French wheat production has doubled in the last 50 years, and crop yields have increased 3.5 times. There is a similar trend in the other countries, with some differences (50 % of the wheat produced in Italy and 25 % of that if Spain are durum), although the picture is changing following the reformation of the European Agricultural Policy.
- *Very intensive cultivation* with an average yield of 92 bushels/acr), which is still on a continuous increase, and considering that the Paris Basin and the northern areas even produce much higher yields (higher than 150 bushels per acre in many places).
- *Large variations in quality between regions* (due to the small size of our productive areas, compared to North America or Australia), and a strong seasonal effect resulting in variable quality. The consistency of the quality of the greater part of existing wheat is insufficient because of too great a sensitivity to agronomic and climatic factors. In contrast with the coastal regions of North Europe, where the crop can be cultivated intensively (but where sprouting puts a severe strain on both yield and quality), in Southern parts of Italy and in Spain and Portugal, the climate is often the factor limiting both yield and quality.
- *Importance of variety in the domestic grain trade.* Millers and other members of the wheat sector have based their trade policy on the declaration of variety and perform electrophoresis inspections from as many as several thousand of deliveries per year.
- *Shorter and shorter life of varieties:* generally 3-5 years now, which stands against the situation 10 years ago (France kept typical quality standards such as Hardi or Capitole during more than 15 years).

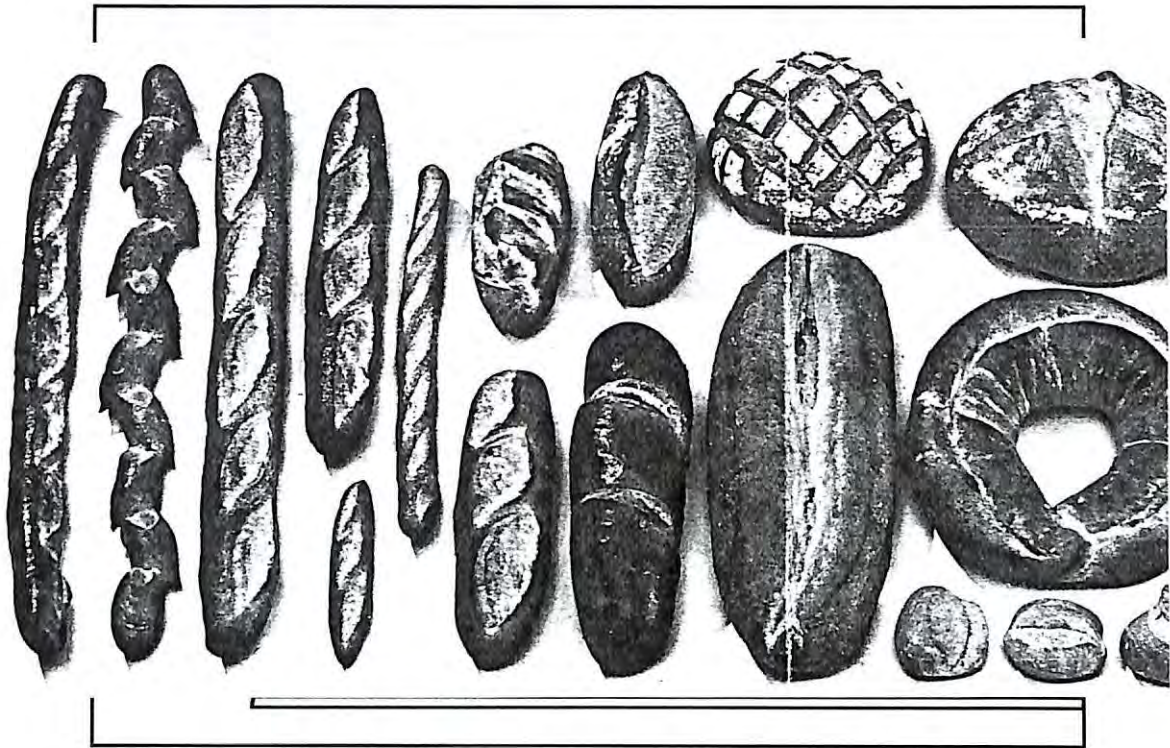


As in all other Western nations, per capita daily bread consumption has declined in the recent decades. For instance, in France, it declined from 350 to 165 g and no longer occupies as preeminent a place in the diet as it once did. Nevertheless, it is well known that in all Southern Europe countries, bread still continues to play an important socioeconomic role and that most consumers would not like to do without it. Most consumers make daily purchases of fresh bread from small bakeries.

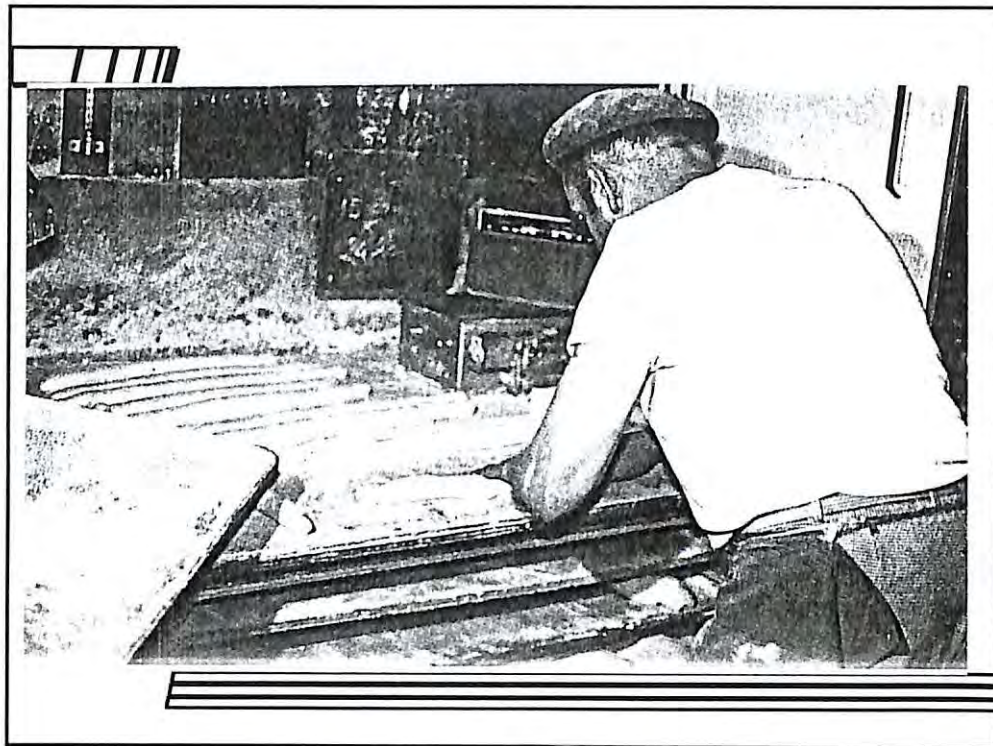


This slide shows a picture of industrial bread production: % of industrial bread/all bread in the various European countries.

In contrast with North Europe (the UK, the Netherlands, Denmark, Germany, Belgium) there is a much lower percentage of industrial bread in South-Western European countries: In France, only 20 % of all bread is produced in large wholesale bakeries; less than 10 % in Italy and Spain.



At first sight, a considerable diversity exists among French, Italian or Spanish breads: e.g. baguette (France), gressini (Italy), sour dough breads (Spain), etc.



In fact, many of the South European breads are produced from lean formulas by craftsmen on the oven hearth of small shops.




South European Breads Differ from American or British Loaf


- Essentially four ingredients - flour, water, yeast, salt
- Small amounts of ascorbic acid and no shortening, sugar, dry milk, etc.
- Normally baked on the oven hearth rather than in a pan
- The dough is cut with a blade before baking



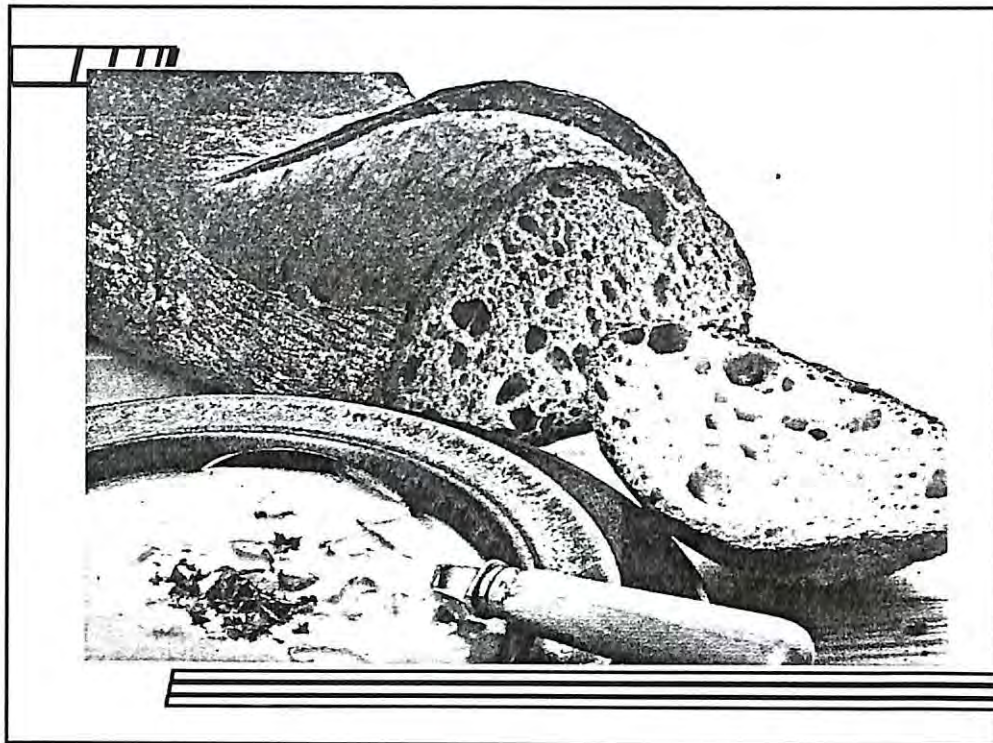
Therefore, it is clear that typical South European breads differ from the conventional American or British loaf in three main respects:

- They are made of essentially four ingredients - flour, water, yeast, and salt - with small amounts of ascorbic acid, but little or no shortening, sugar, or dry milk, and no potassium bromate.
- They are normally baked on the oven hearth rather than in a pan
- The dough is cut with a blade, immediately before cooking.

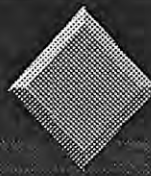
 Typical French Bread Formula 'baguette'	
● Ingredients	%
- Flour	60
- Water	100
- Yeast	2,5
- Salt	2,0
- Ascorbic acid	0,005
● Possibly	
- Malt	0,3
- Lecithin	0,3



A formula representative of a typical French bread (baguette, pain parisien, gros pain).



Such breads are characterized by a crisp eggshell crust (1/8 inch thick), an open grain, an attractive flavour, and high crust:crumb ratio, especially in the long types such as the baguette.



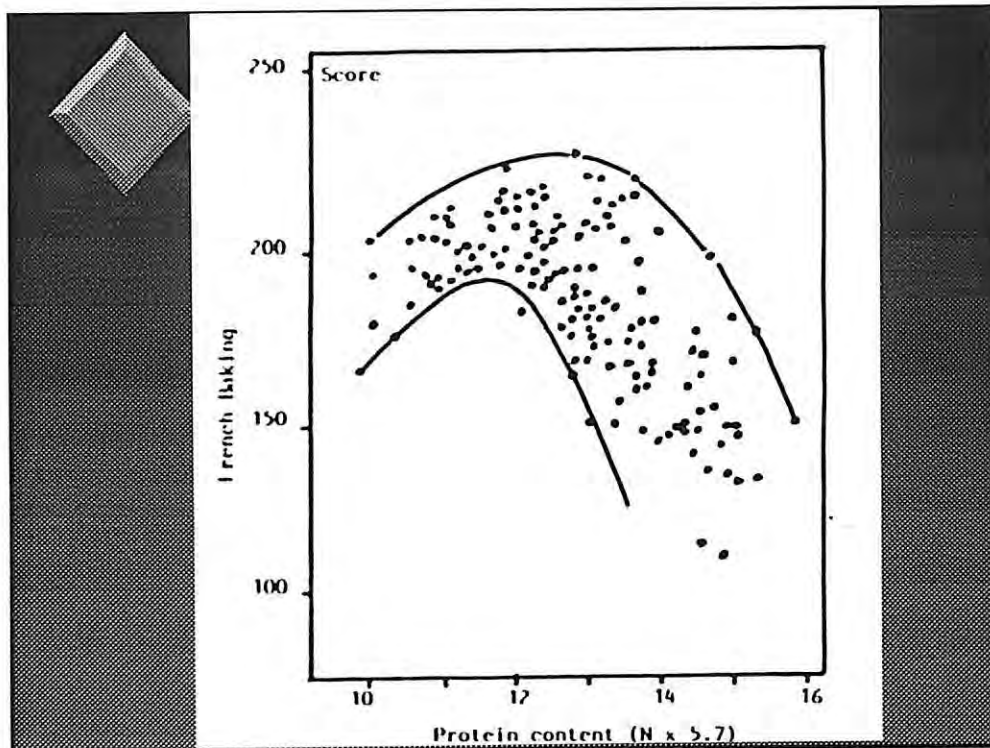
For many years the requirements of wheat quality in South Europe were:

- ❖ Traditional breadmaking required soft types of wheat with a protein of 10.5-12.0
- ❖ Higher protein generally detrimental to baking score
- ❖ Baking quality specifications extensively based on the *W, P, G, P/L* characteristics shown by the Chopin Alveograph

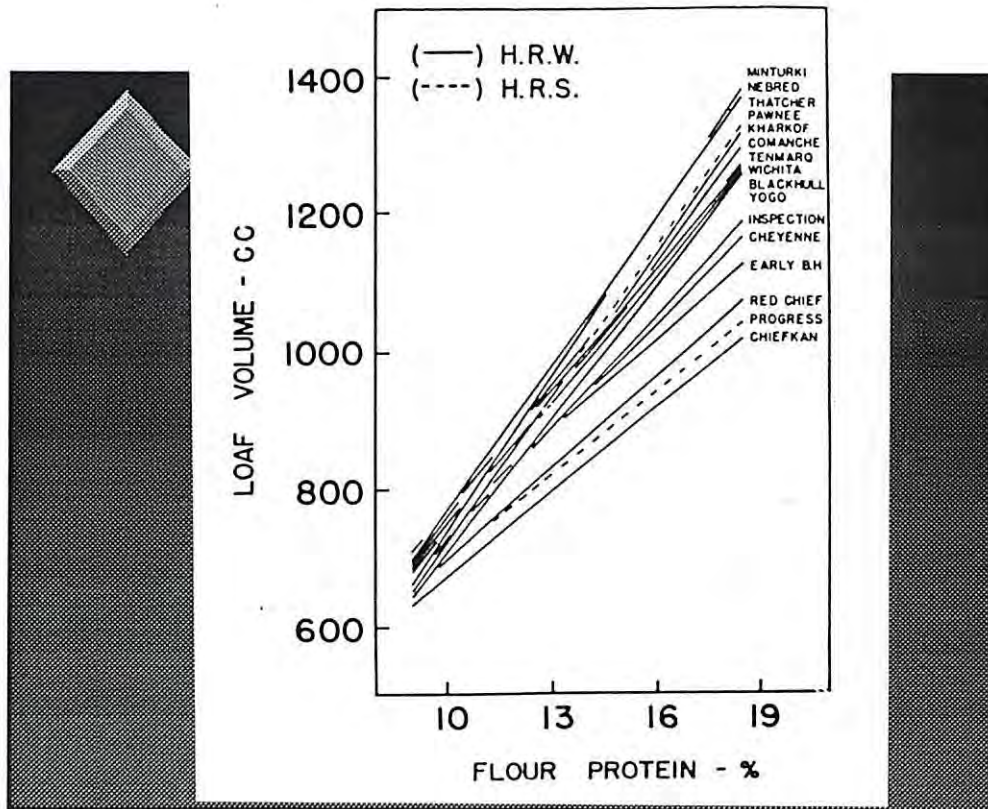


All these facts have governed for many years the major requirements of wheat quality in South-Western Europe:

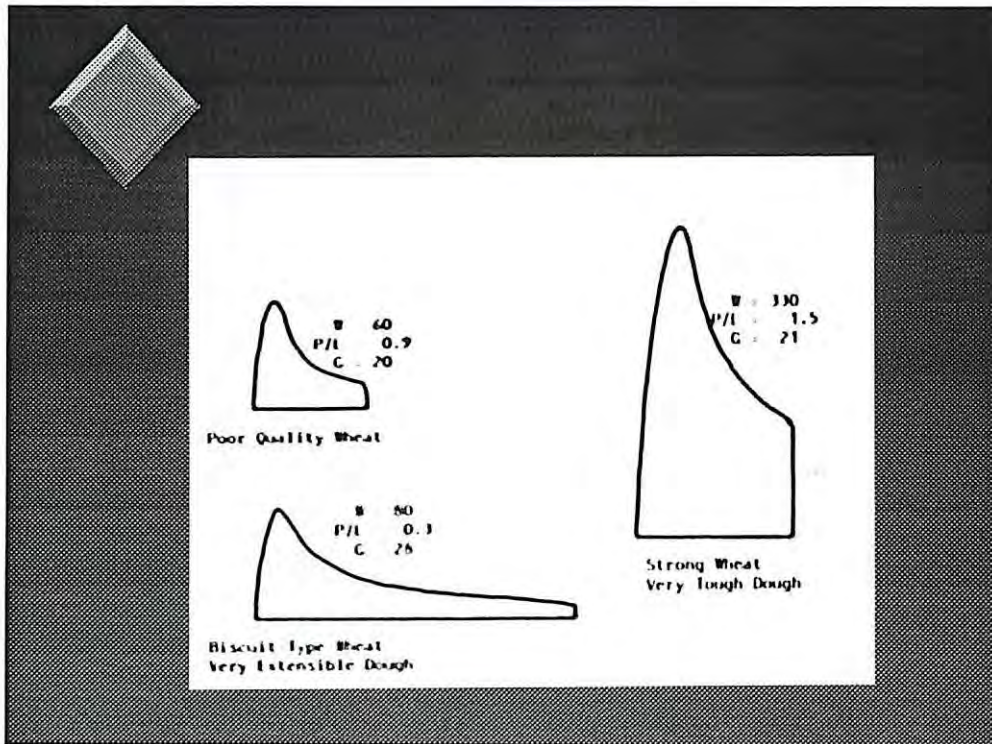
- Traditional breadmaking required relatively soft types of wheats with a protein of 10.5-12.0.
- Unlike in English or American breadmaking, very high protein contents were detrimental to baking score.
- Also, baking quality specifications have been extensively based on the *W, P, and G* characteristics shown by the Chopin Alveograph.



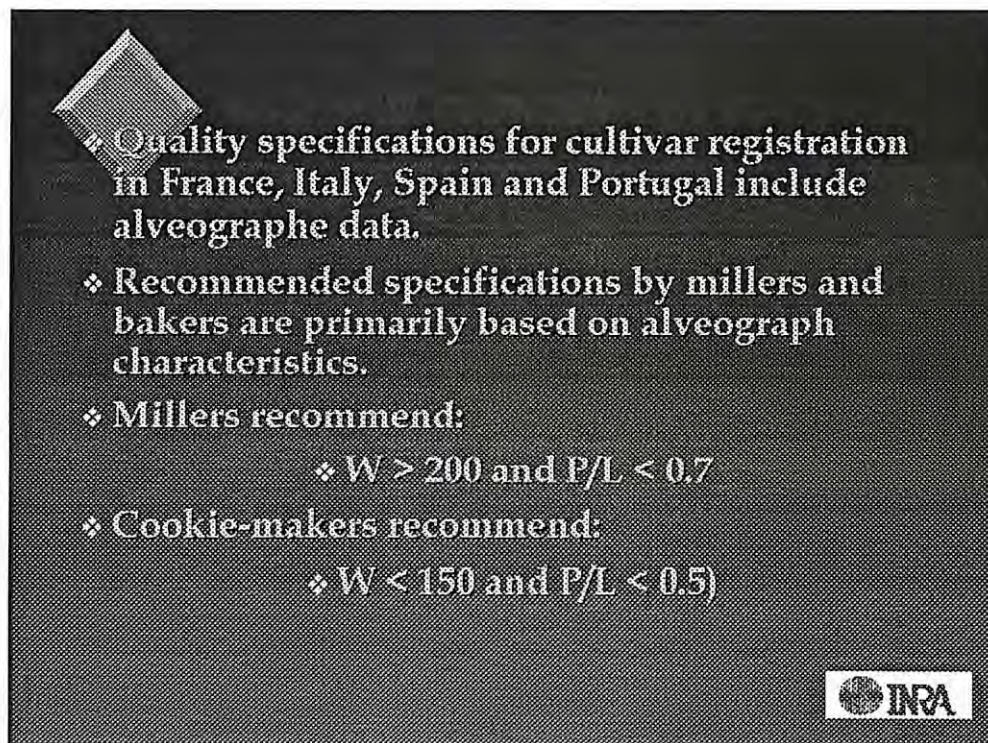
This slide shows the relationship between French baking score and flour protein content, demonstrating that high protein contents are detrimental to (French) baking score..



...whereas in the case of the American loaf, the relationship between baking score and flour protein content has been reported as essentially linear.



Some typical alveographe curves are shown on this slide. Especially important is a satisfactory balance between the two main parameters: P (resistance to dough deformation) and G (dough extensibility), the latter being perhaps more critical and sometimes a better indicator of our bread-making ability than the W index itself.



As a consequence, quality specifications for cultivar registration in France, Italy, Spain and Portugal include alveographic data (in complement with protein content, Zeleny test and sometimes baking score).

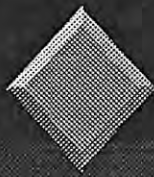
On the other hand, recommended specifications by millers and bakers are primarily based on alveograph characteristics. For instance, millers use to recommend:

- $W > 200$ and $P/L < 0.7$

...whereas cookie-makers recommend:

- $W < 150$ et $P/L < 0.5$).

But this is, in fact, a picture of the traditional end-uses.



Several recent changes

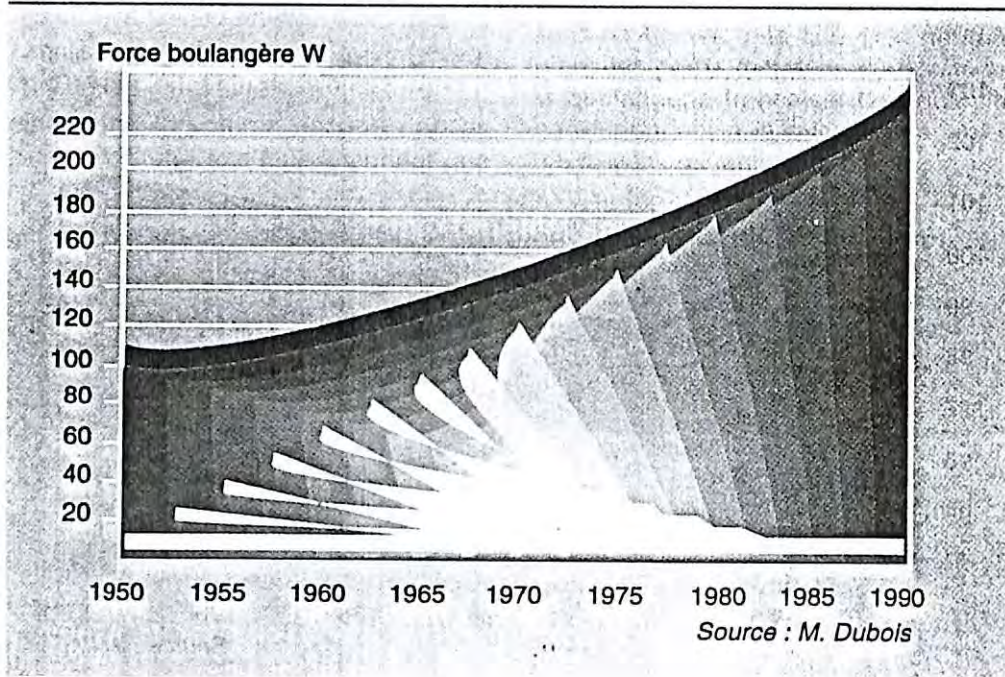
- **Decrease of manual handling of the dough**
- **Introduction of 'cold' methods in baking**
- **Rapid development of fast food breads and rolls which require higher baking strength**
- **New specifications of higher protein content for export trade**



Several important changes in wheat technology have occurred over the last years, that are worthy of mention:

- The decrease of manual handling of the dough and the mechanization of dough dividing
- The introduction of cold methods in a majority of bakeries, either dough refrigeration, to better control fermentation and to limit the night work of the bakers, or dough freezing, which is largely used by supermarket bakeries. For instance, as measured by the alveograph W index, the strength needed for baking has evolved from 100 in the 1950s, to at least 250 today, even for ordinary (baguette) breadmaking.
- Moreover, the rapid development of new products such as rolls, or fast food breads, or buns now requires W indexes as high as 300 or 350.
- On the other hand, new specifications for higher protein contents (up to 14 %) are resulting from increased export trade.

Figure 3 : Part de la production industrielle du pain dans les pays européens (en% du total)



All these changes have been more or less taken into account in the European breeding programmes.

Much stronger lines have been selected, as shown by the increase of the *W* index in the last 40 years...

The Main Bread Wheat Cultivars Grown in Italy in 1992

<u>Cultivars</u>	<u>%</u>	<u>Baking Class</u>	<u>W</u>
• Centauro	29.5	Medium	200-250
• Pandas	14.2	High	250-300
• Mec	10.5	Medium	180-200
• Brasilia	7.5	Medium	200-250
• Gemini	5.8	Medium	150-200
• Spada	3.5	Medium	150-200
• Manital	3.0	High	300-320
• Golia	2.9	High	280-300



... and many new strong cultivars are now quite extensively grown.

For instance, this slide shows the main bread wheat cultivars grown in Italy 1992 indicating mean W and quality classes. All have a relatively high baking strength and 3 of these leading cultivars (Pandas, Manital, Golia) have W a index $\geq 250-300$.

The Main Bread Wheat Cultivars Grown in France in 1992

<u>Cultivars</u>	<u>%</u>	<u>Baking Class</u>	<u>W</u>
• Soissons***	23.1	Very High	260-300
• Thésée	8.3	Medium	140-160
• Sidéral***	7.0	High	190-220
• Apollo	4.8	Very poor	50-90
• Ritmo	4.6	Medium-low	190-210
• Récital***	4.5	Very high	220-240
• Forby**	3.8	Medium-high	180-200
• Scipion	2.9	Medium	



...and in France, 4 of the main cultivars (out of 8) fall into a high or very high baking class and are now recommended by the National Association of Millers (Soissons, Sidéral, Récital, Forby).


As a result from the use of oversea genotypes in crosses, new problems unknown before in Western Europe:

- ❖ **increased endosperm hardness (occurrence of medium hard types in the leading cultivars)**
- ❖ **more starch damage**
- ❖ **under-hydration of the protein network in doughs (excessively tough doughs, lacking extensibility, with P/L ratio > 1, and sometimes > 2 or 3) [especially in the case of high pentosan content]**
- ❖ **possible problem of dough hydration in quality evaluation by alveographie**



However, these new stronger wheats were derived from crosses with oversea (Mexican, very hard) genotypes and, as a consequence, we are now facing with new quality problems unknown before in South-Western Europe. For instance:

- an increased endosperm hardness (occurrence of medium hard types in the leading cultivars)
- consequently, more starch damage
- consequently, an under-hydration of the protein network in doughs (excessively tough doughs, lacking extensibility, with P/L ratio > 1, and sometimes > 2 or 3) [especially in the case of genotypes - or phenotypes - with high pentosan content].
- possible problem of dough hydration in quality evaluation by alveographie



There are consequences on the need to better understand the two main parameters that are becoming critical when aiming at improving further wheat quality:

New research lines:


- ❖ **Physico-chemical bases of wheat hardness, endosperm fracture and separation of endosperm particles**
- ❖ **Mechanisms of dough formation, especially physico-chemical bases of extensibility in order to tailor new cultivars giving strong and extensible doughs**



So, when aiming at improving further wheat quality, it is now necessary to better understand the two main parameters that are becoming critical, and that's why the new research lines now concern:


- a) the physico-chemical bases of milling quality, including wheat hardness, endosperm (fragmentation and separation of endosperm particles).
- b) the mechanisms of dough formation, especially physico-chemical bases of extensibility in order to tailor new cultivars giving strong and extensible doughs.

For this second point, in complement with Peter Payne's studies on HMW subunits of glutenins, the improvement of baking quality in South-Western Europe [because of a different baking technology, and also because of different climatic conditions - hot, dry condition causing premature ripening that often tends to lower dough extensibility], it may be recommended to develop further studies on allelic variation of other fractions such as LMW subunits of glutenin, as well as simple and rapid quantitation of specific subunits, or of the main fractions: HMW, LMW and gliadins.



Recent observations

- EC wheats are not really adapted to a wide range of applications, especially to their future developments
- New industrial processes have not been described in terms of wheat quality requirements
- Poor consistency of quality



In conclusion, I'd like to point out some other recent observations:

- EC wheats have been improved, but they are still not really adapted to a wide range of applications, especially to future developments: new technologies of bread-making, wholemeal bread, cookie-making, starch-gluten separation, flour blends, sour doughs, sweet products),
- also, because most of the biochemical and genetic studies have taken the white breadmaking as reference, new industrial processes have not been described in terms of wheat quality requirements,
- and we still have a poor consistency of quality.

ECLAIR Programme: To Explore and Improve the Industrial Use of EC Wheats

• Objectives:

- 1) To fill the gap between process development and its understanding in terms of processing requirements and wheat quality requirements.**
- 2) To stimulate breeding and development of wheats capable of satisfying the present and future demands of European industry and the export market.**



This is why a big 4-year programme, aimed at exploring and improving the industrial use of EC wheats (in the framework of the ECLAIR - European Collaborative Linkage of Agriculture and Industry through Research - programme), started in 1991, involving 23 laboratories in 7 European countries, and whose objectives are:

- 1) To fill the gap between process development and its understanding in terms of processing requirements and wheat quality requirements.
- 2) To stimulate breeding and development of wheats capable of satisfying the present and especially the future demands of European industry and the export market.

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