



**4th Latin America Cereals Conference
March 11-14, 2018**

INTEGRATED APPROACH TO UNDERSTAND THE FUNCTIONNING OF WHEAT QUALITY COMPONENTS AND THEIR INTERACTION WITH ENVIRONMENTS

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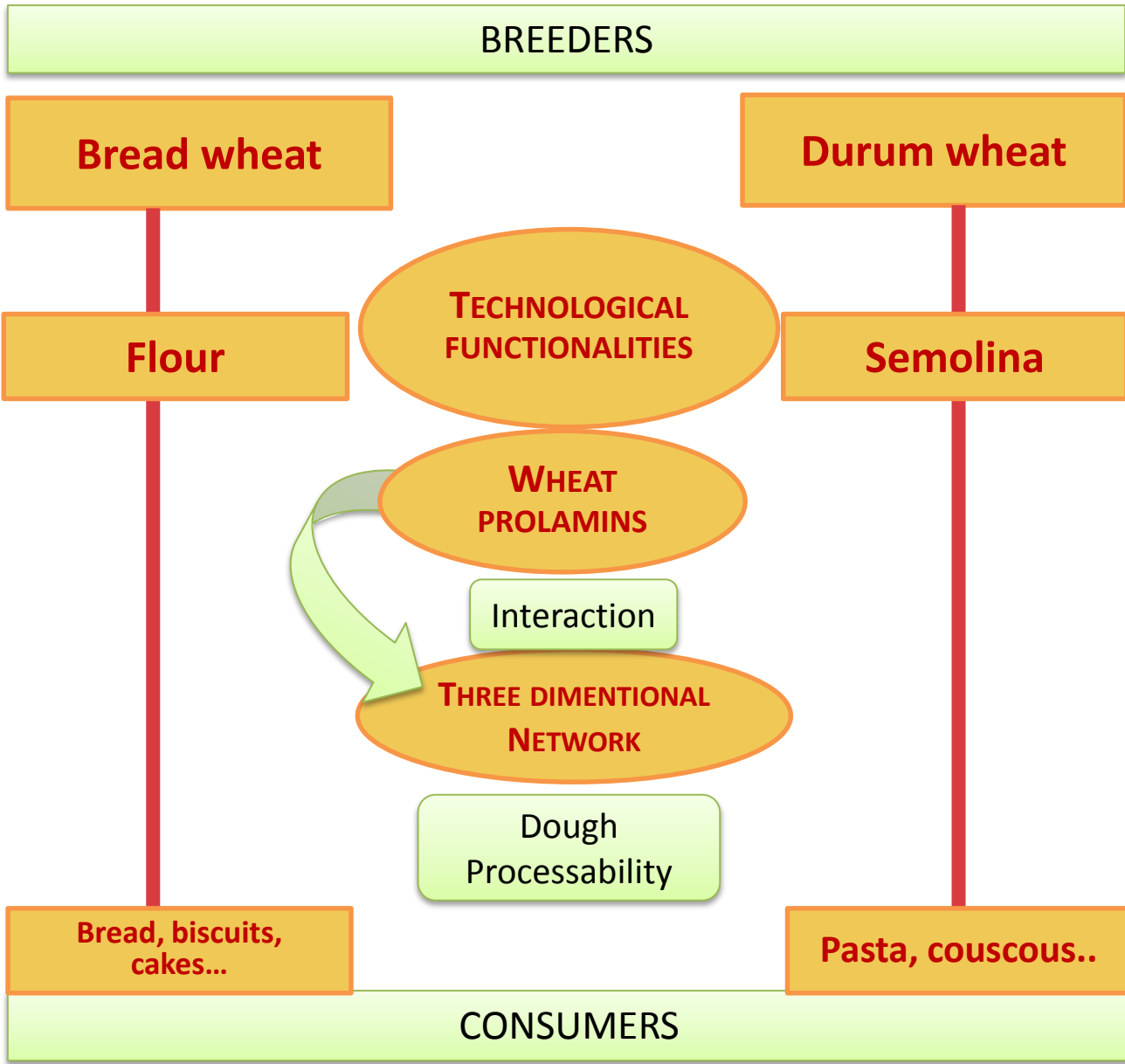
**¹ INAT: Institut National Agronomique de Tunisie – UR17AGR01
UR-Valorization of Tunisian Natural Ressources and Food Heritage through Innovation**

²UniLaSalle: Institut Polytechnique UniLaSalle – UP T&A 2018.C103

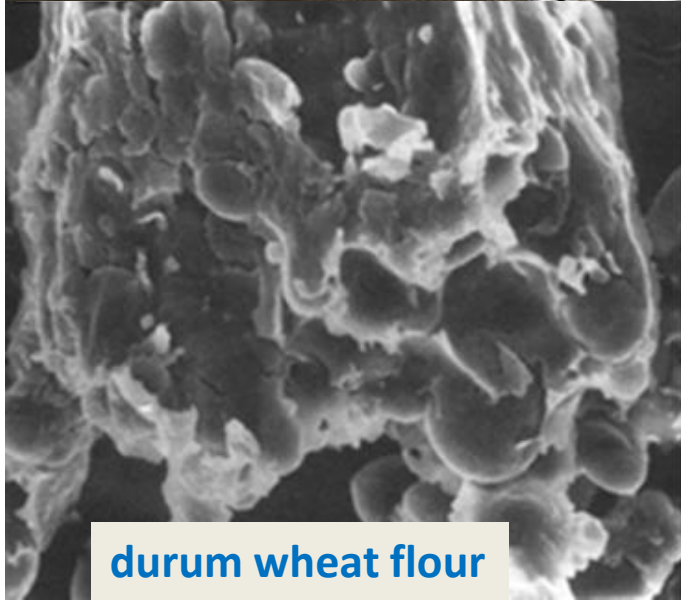
INTRODUCTION



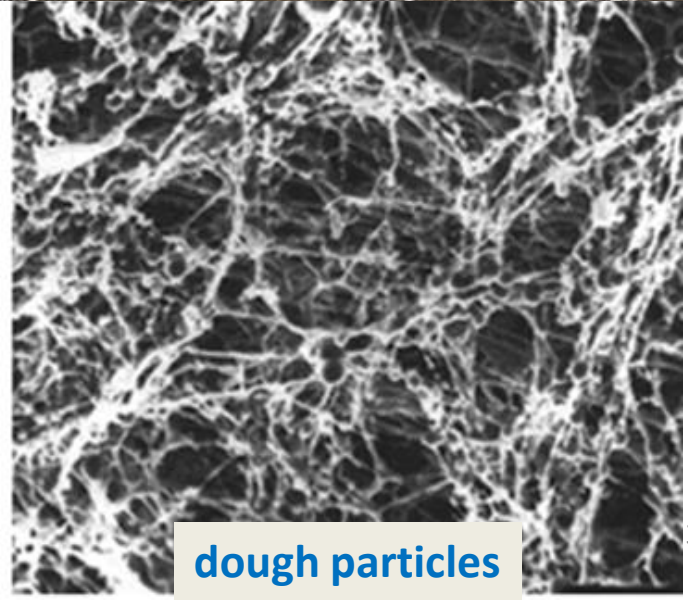
**CEREAL
FOOD
CHAIN**



INTRODUCTION



durum wheat flour



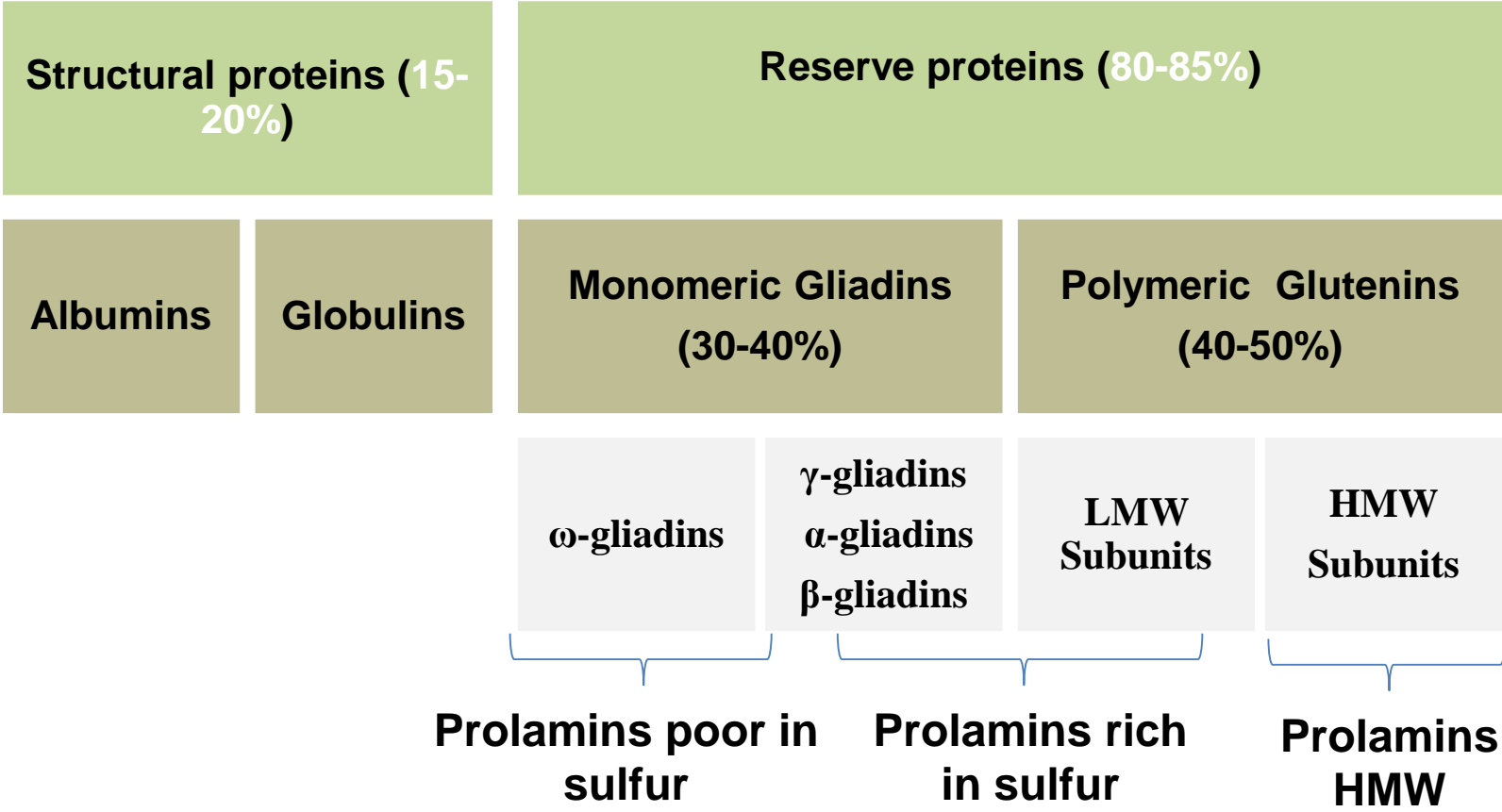
dough particles

Scanning electron micrographs

(Hoseney and Rogers
1990)



Classification and Polymorphism of Wheat Grain Proteins

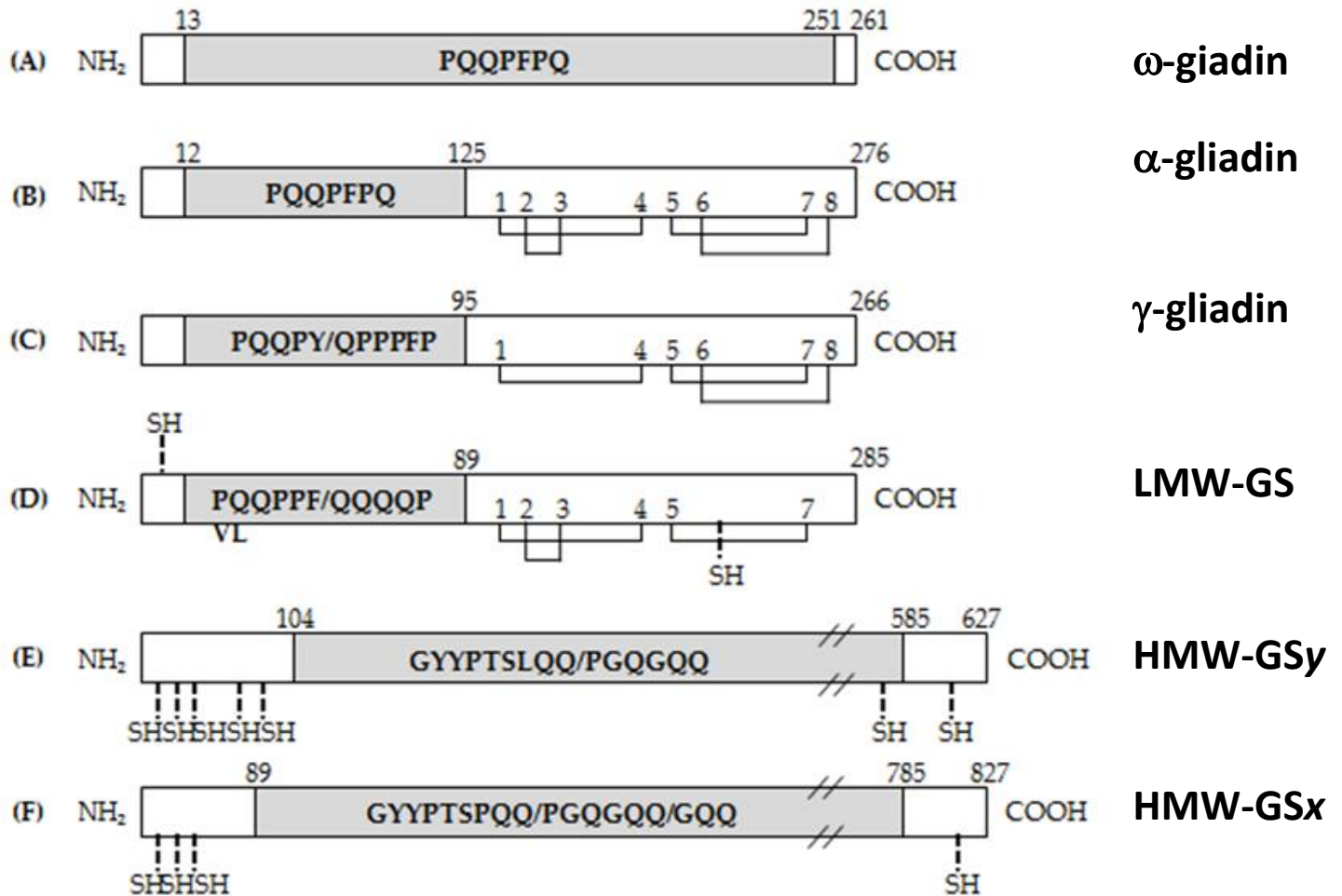


Wheat Proteins

Molecular Weight Distribution (MWD) of Wheat Storage Proteins



Classification and Polymorphism of Wheat Grain Proteins

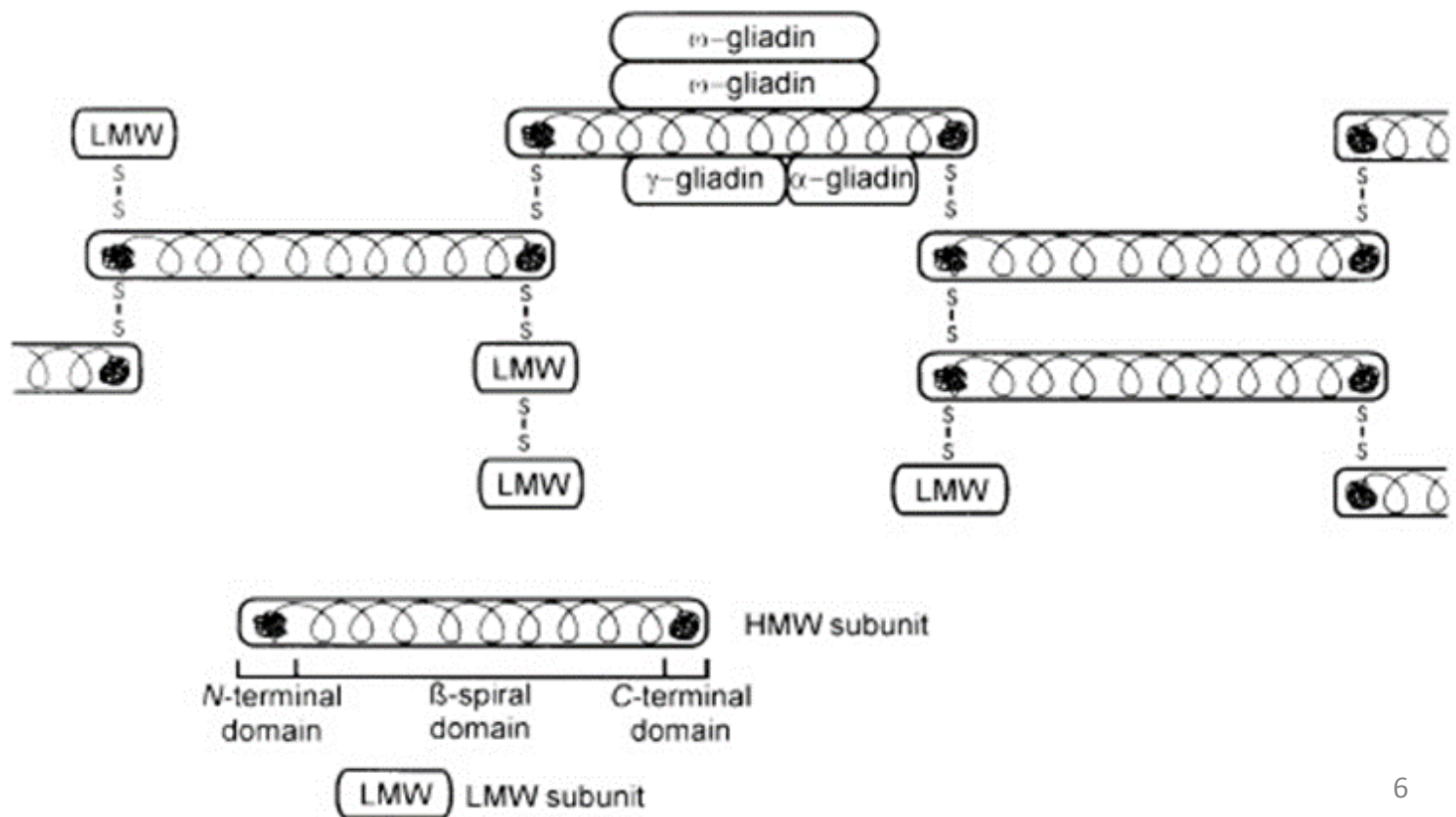


Schematic structures of typical primary structures of wheat proteins

Molecular Weight Distribution (MWD) of Wheat Storage Proteins



Gliadin to Glutenin Ratio



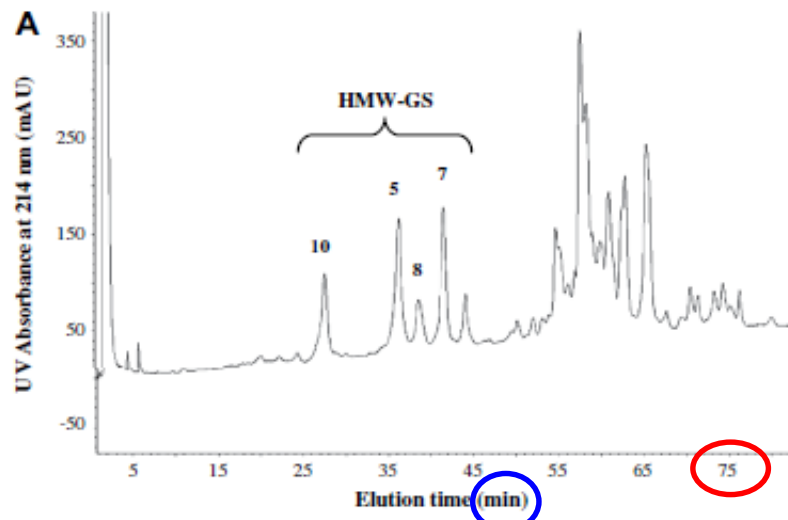
A structural model for wheat gluten

Molecular Weight Distribution (MWD) of Wheat Storage Proteins



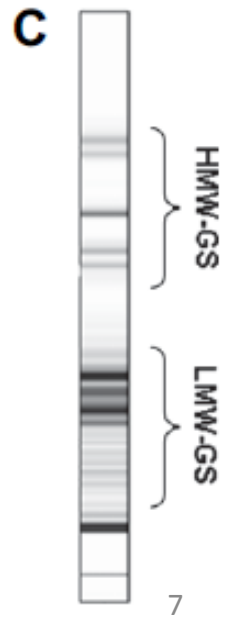
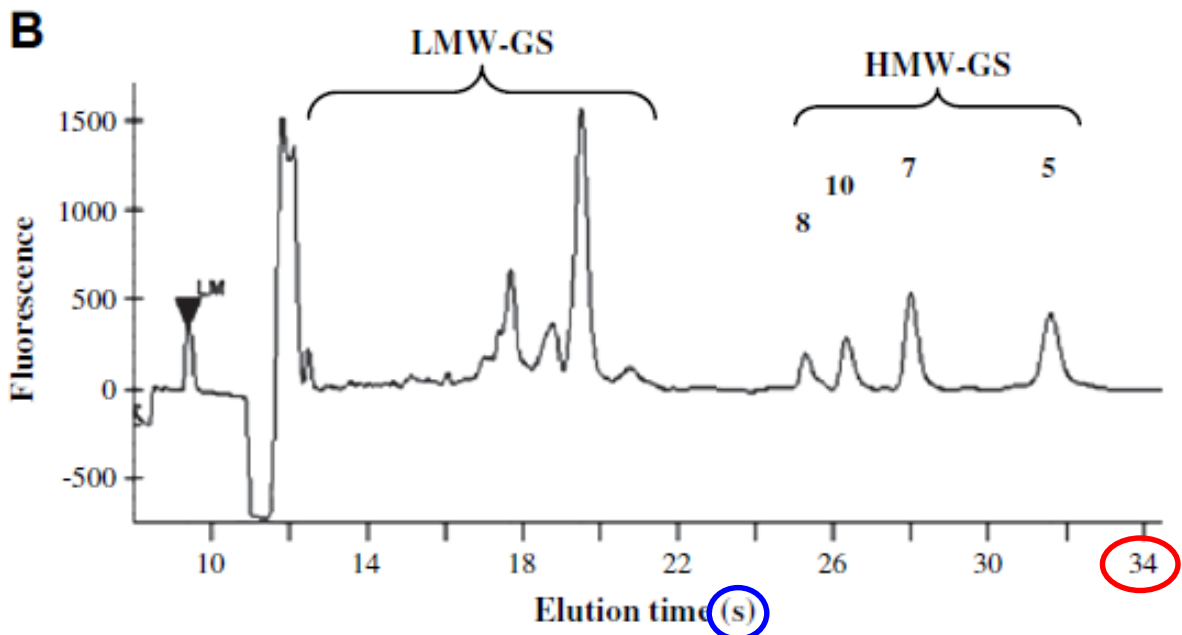
Distribution of Glutenin subunits

RP-HPLC



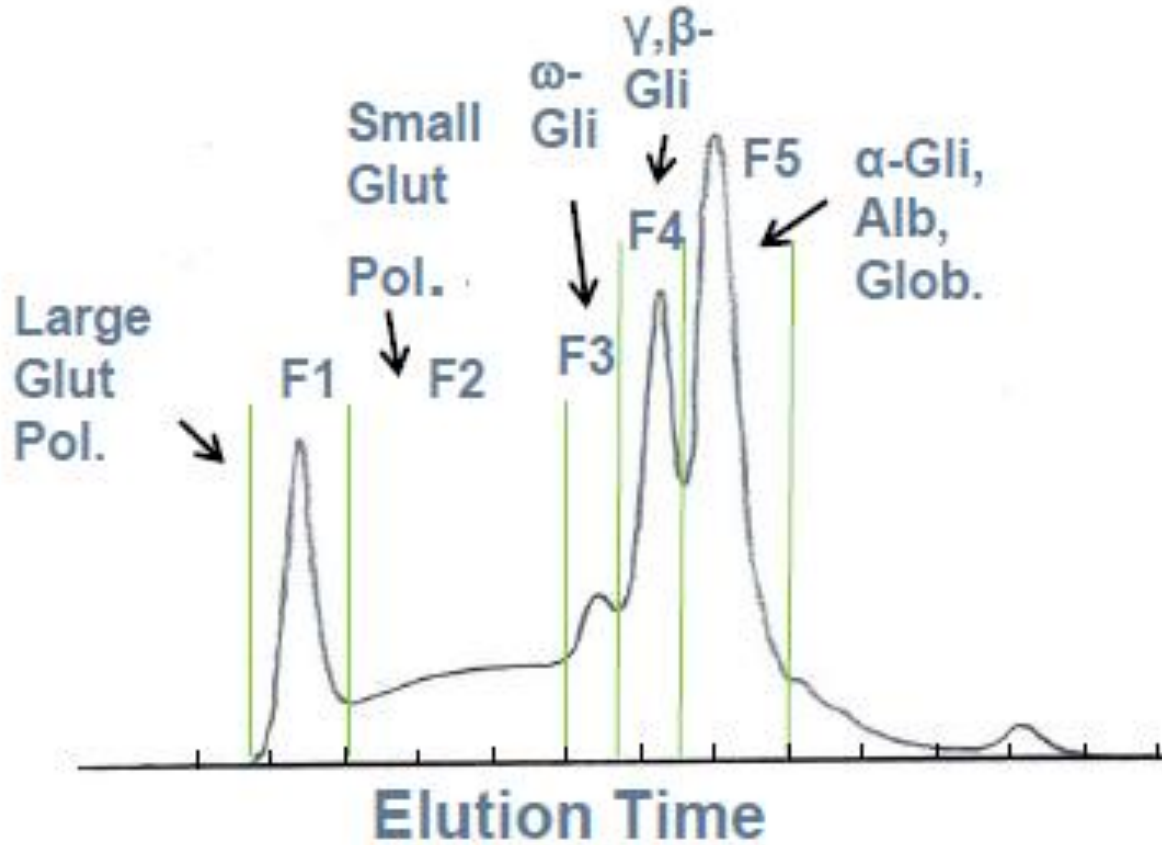
Lab-On-Chip

HMW-GS
identification
and
quantification





Size Distribution of Polymeric Proteins

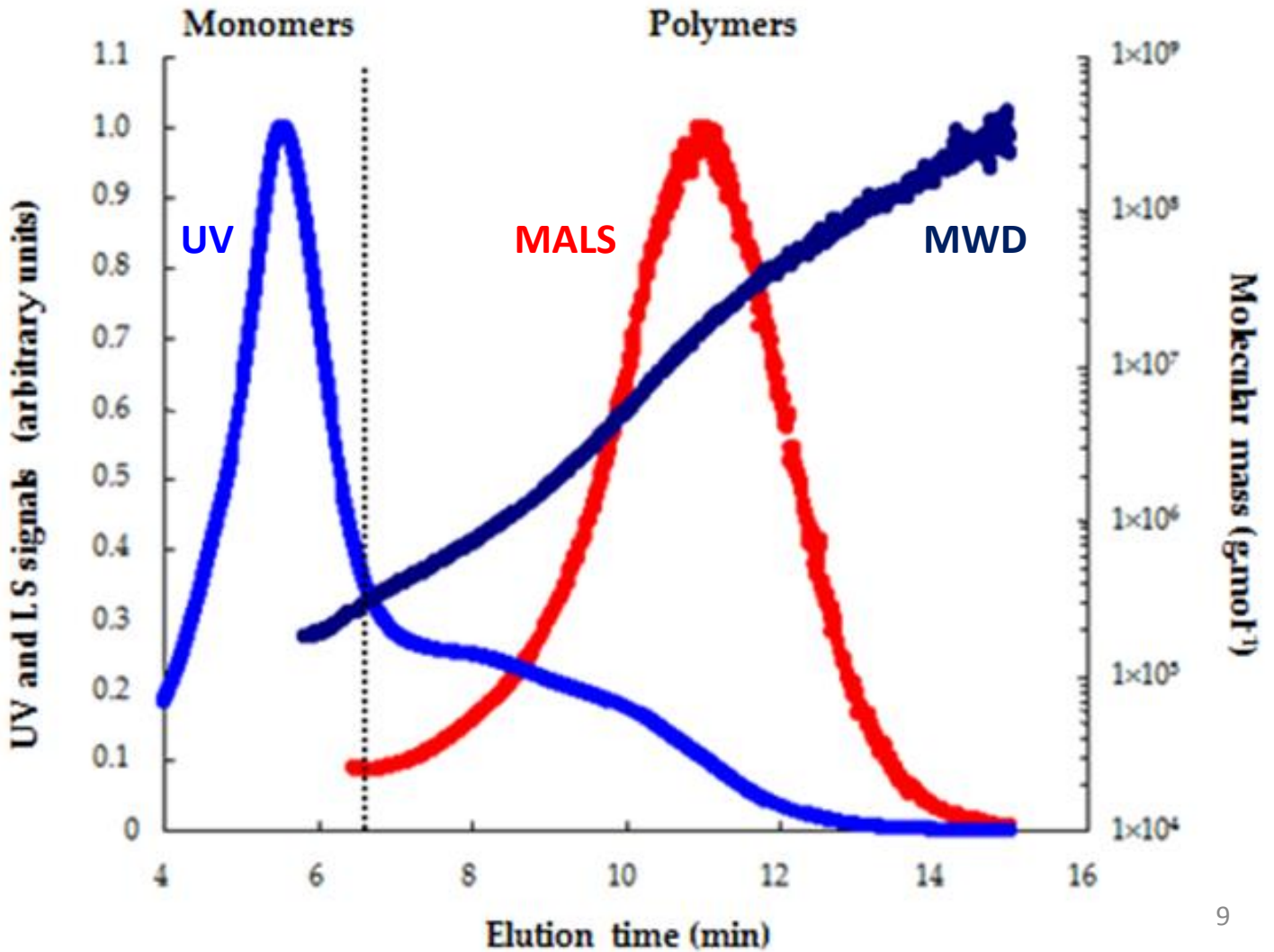


SEC-HPLC

Molecular Weight Distribution (MWD) of Wheat Storage Proteins



Size Distribution of Polymeric Proteins



Asymmetrical
flow field-
flow
fractionation
(A4F)

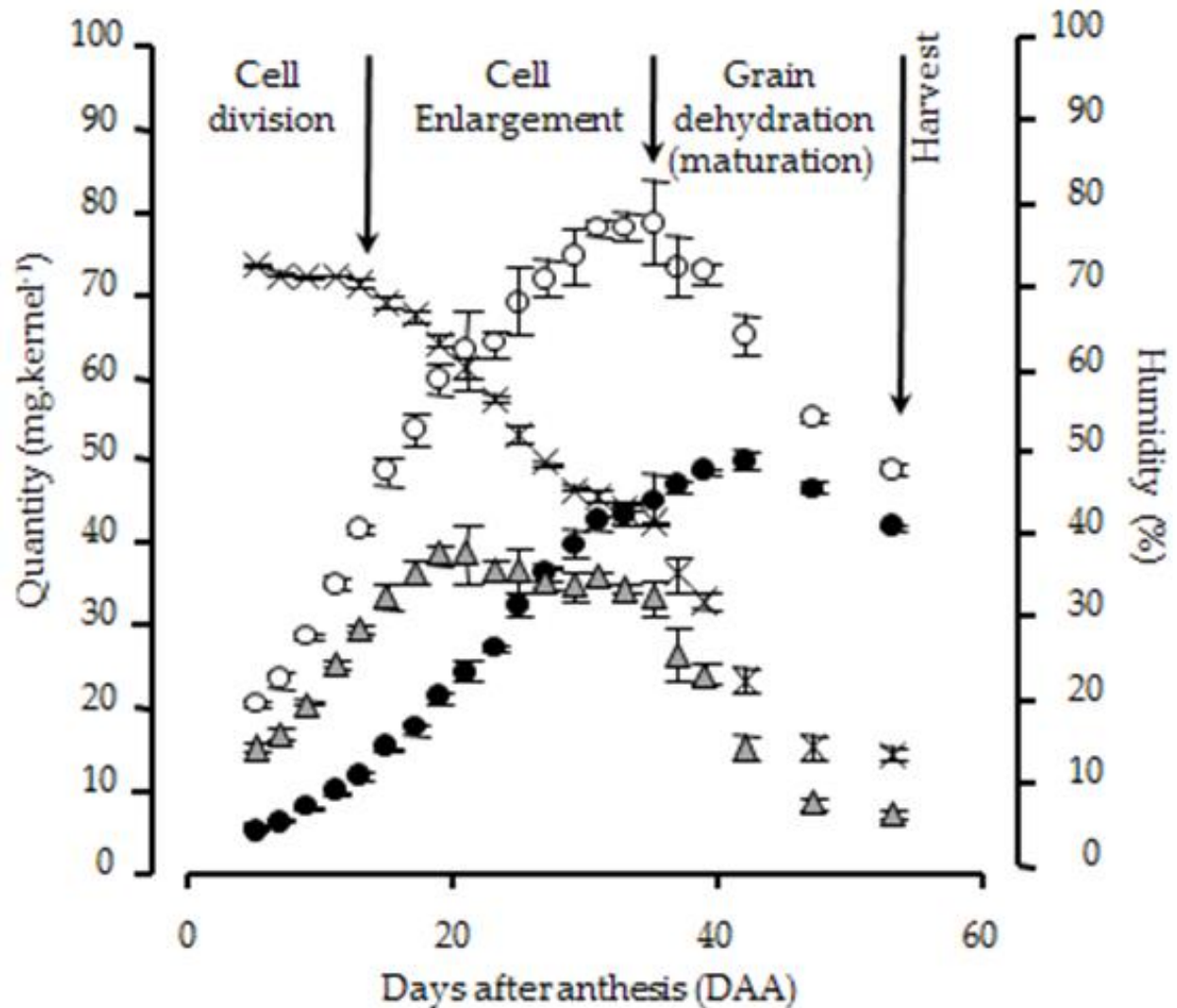
Accumulation of Prolamins in Developing Wheat Grains



Endosperm development

- Per kernel
- (●) dry matter
- (O) fresh matter
- (▲) water quantity
- (X) grain humidity

Grain filling period for a common wheat cultivar (Soissons).

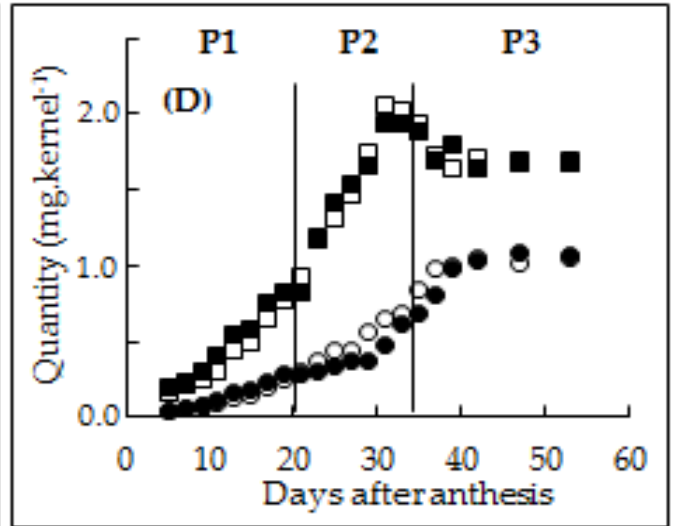
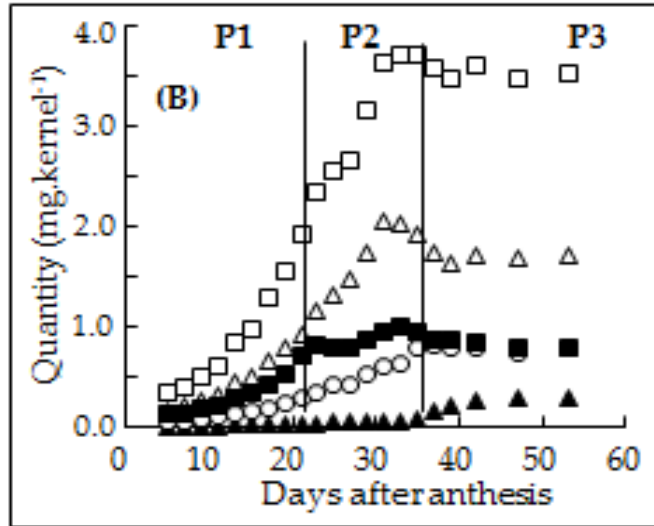
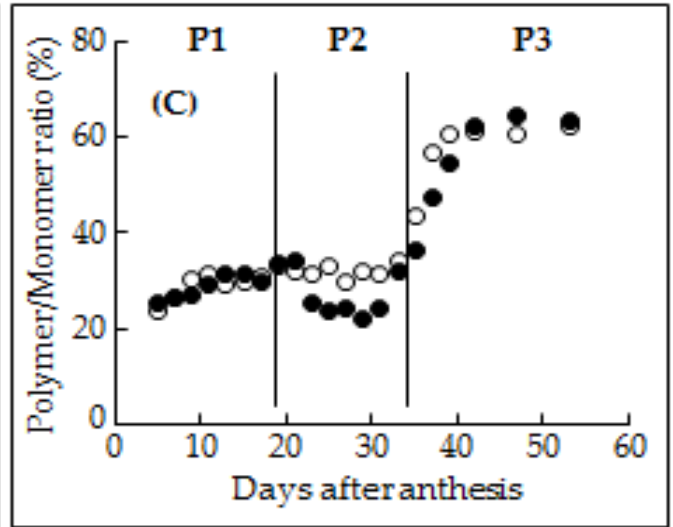
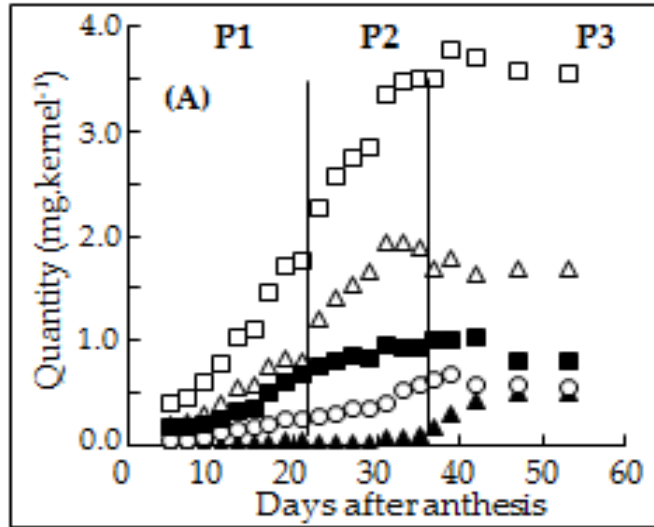


Accumulation of Prolamins in Developing Wheat Grains



Fig A & B

(▲) SDS-insoluble polymers
(○) SDS-soluble polymers;
(■) albumins and globulins;
(Δ) monomers and;
(●) total proteins



(A) Soissons and
(B) Thésée

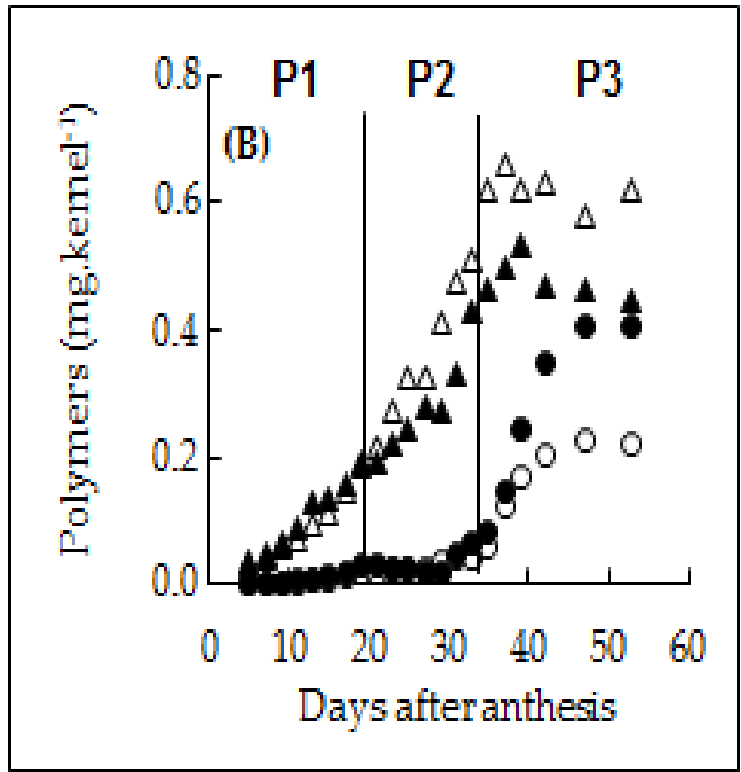
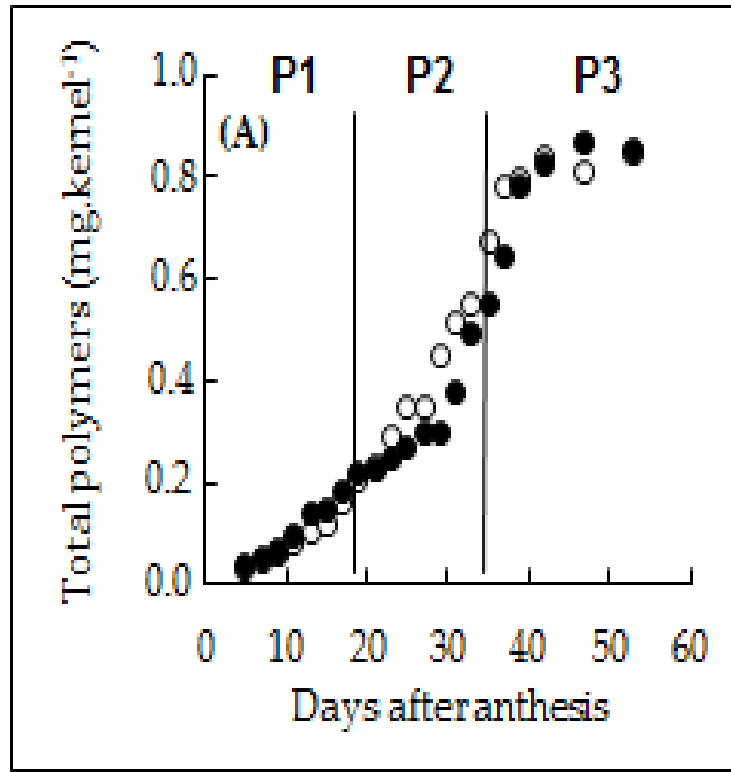
(C): (○, ●) total polymers of Thésée and Soissons respectively
(D): (■, □) Monomers of Thésée and Soissons respectively

Accumulation of Prolamins in Developing Wheat Grains



**Unextractable
Polymeric
Protein (UPP)
accumulation**

Accumulation of total polymers, SDS-soluble and SDS-insoluble polymers



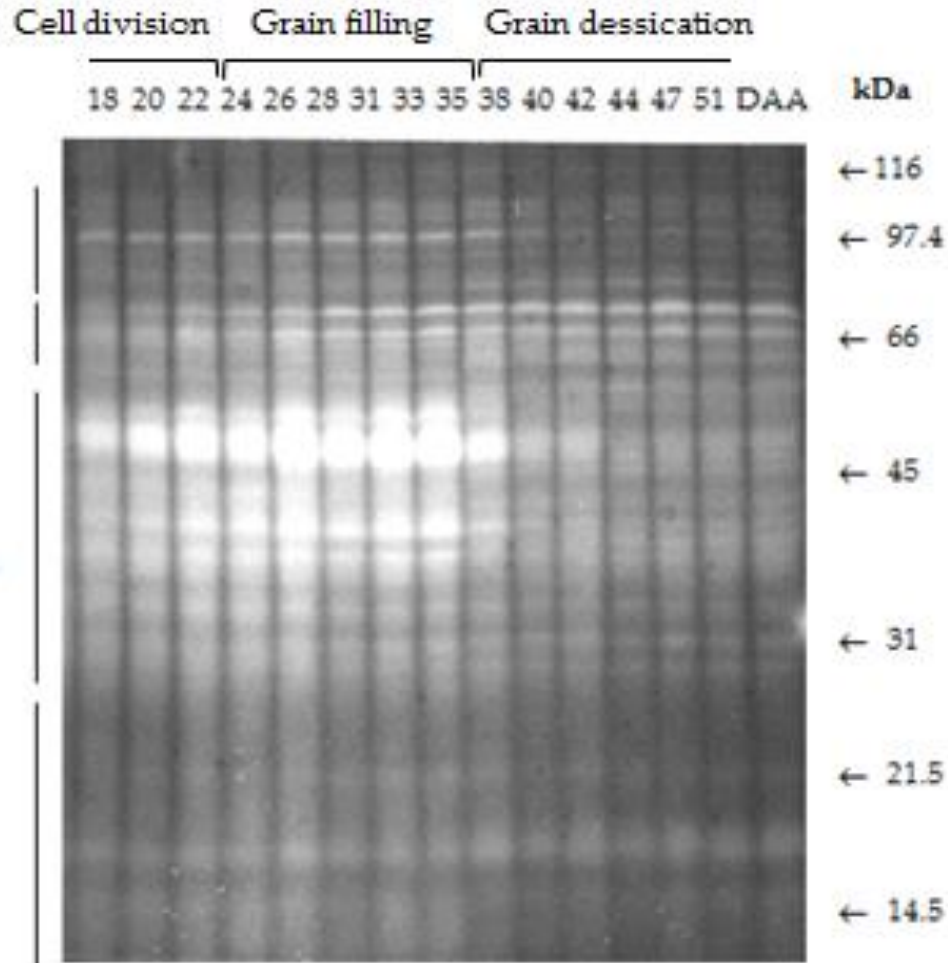
(●) Soissons and, (○) Thésée.

Open symbols = Thésée,
closed symbols = Soissons.
(▲, Δ) SDS-soluble polymers
(●, ○) SDS-insoluble polymers.

Accumulation of Prolamins in Developing Wheat Grains



**Unextractable
Polymeric
Protein (UPP)
accumulation**



Change in sulfhydryl status of wheat proteins during grain development and maturation. MBBBr-derivatized

Impacts of Environmental Factors on Glutenin subunits



Variation of the HMW-GS relative percentages,
the HMW-GS/LMW-GS
And
HMW-Gsy/ HMW-Gsx ratios

Source	DF	HMW-Gsy to HMW-Gsx	HMW-GS to LMW-GS
E	3	0.0159**	312.7616**
r(E)	8	0.0041	11.6443
G	7	0.7660**	483.3586**
F	3	0.0184**	44.0489**
ExG	21	0.0020**	67.5617**
GxF	21	0.0013**	44.9707**
ExF	9	0.0025**	79.5278**
ExGxF	63	0.0012**	35.6428**
r (ExGxF)	248	0.0006	3.9836
CV(%)		8.4	9.7

Changes in
HMW/LMW
HMWy/HMWx

8 durum wheat genotypes
grown in 4 different environments
during 2 cropping seasons



Coefficient of variation for:
 Total Proteins (TP %),
 Unextractable Polymeric Proteins (UPP)/ TP ratio,
 Extractable Proteins/TP ratio,
 UPP/EP and
 distribution of glutenin subunits

Variables	Genotype														Environment
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
TP	11	12	10	10	12	11	13	10	10	13	12	12	10	14	11
UPP/TP	34	25	33	37	22	36	40	91	50	51	37	36	35	31	40
EP/TP	3	3	4	4	3	4	4	7	5	6	4	4	3	4	4
UPP/EP	38	28	38	42	26	42	43	96	57	59	42	38	39	35	44
HMW	16	9	8	12	14	10	11	10	12	11	12	11	11	8	11
LMW	7	4	3	5	5	4	4	4	23	4	5	4	5	3	6
HMW/LMW	38	13	11	17	23	15	15	15	20	16	17	16	17	11	18

14 Bread wheat cultivars, 11 Locations (7 in France, 4 Europe)



A4F-MALS

Genetic (G) and Environmental (E) Influence on Molecular Weight Distribution of Storage Proteins

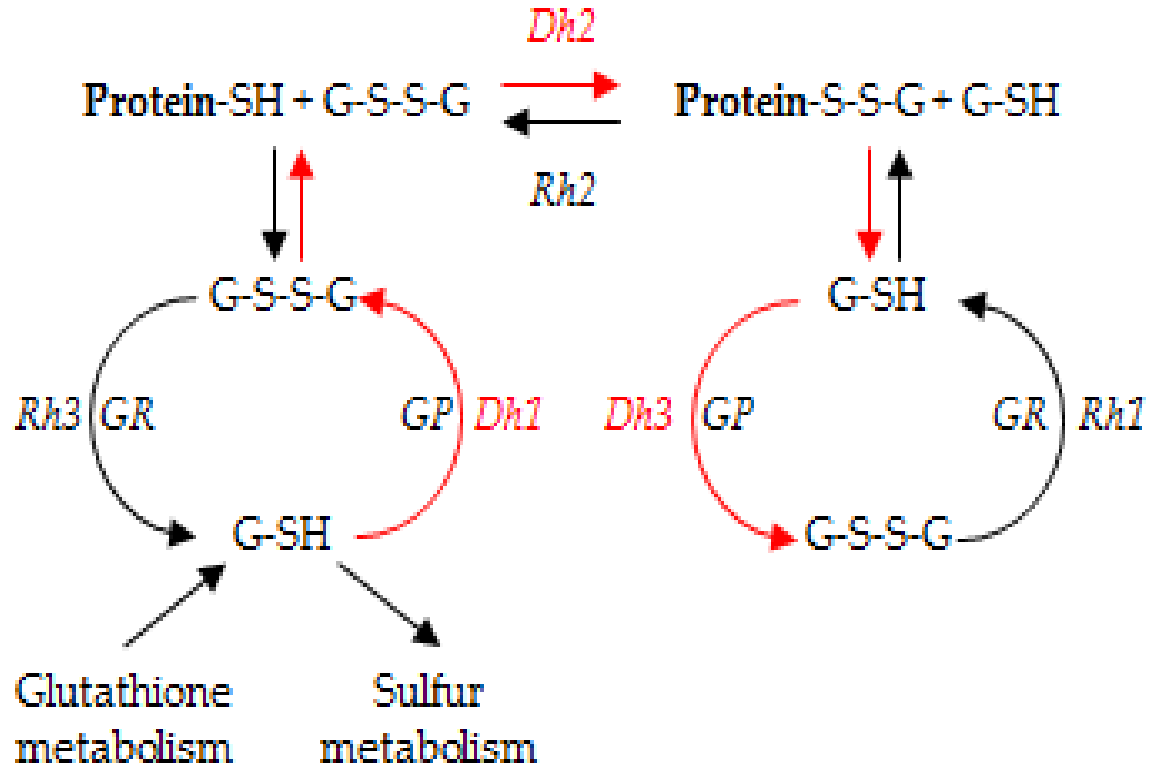
Parameters	Maximum value	Minimum value	Mean value	σ^2_G/σ^2_R	σ^2_E/σ^2_R
Total proteins	8.700	15.100	11.187	11.411***	271.577***
Total polymers	2.785	5.755	4.016	11.104***	187.462***
Polymer/monomer	0.321	0.700	0.561	14.845***	72.611***
Polymer M_n	0.730 x10 ⁶	9.609 x10 ⁶	0.972 x10 ⁶	1.068 ^{NS}	4.383***
Polymer M_w	1.142 x10 ⁶	22.970 x10 ⁶	7.640 x10 ⁶	3.370***	38.974***

130 Soft wheat genotypes
grown in 3 different environments
during 2 cropping seasons

Impacts of Environmental Factors on MWD of Prolamins



Glutathione disulfide-dependent protection of protein thiol groups during desiccation.



Changes in PP and PP-S-S-G content during the grain development.

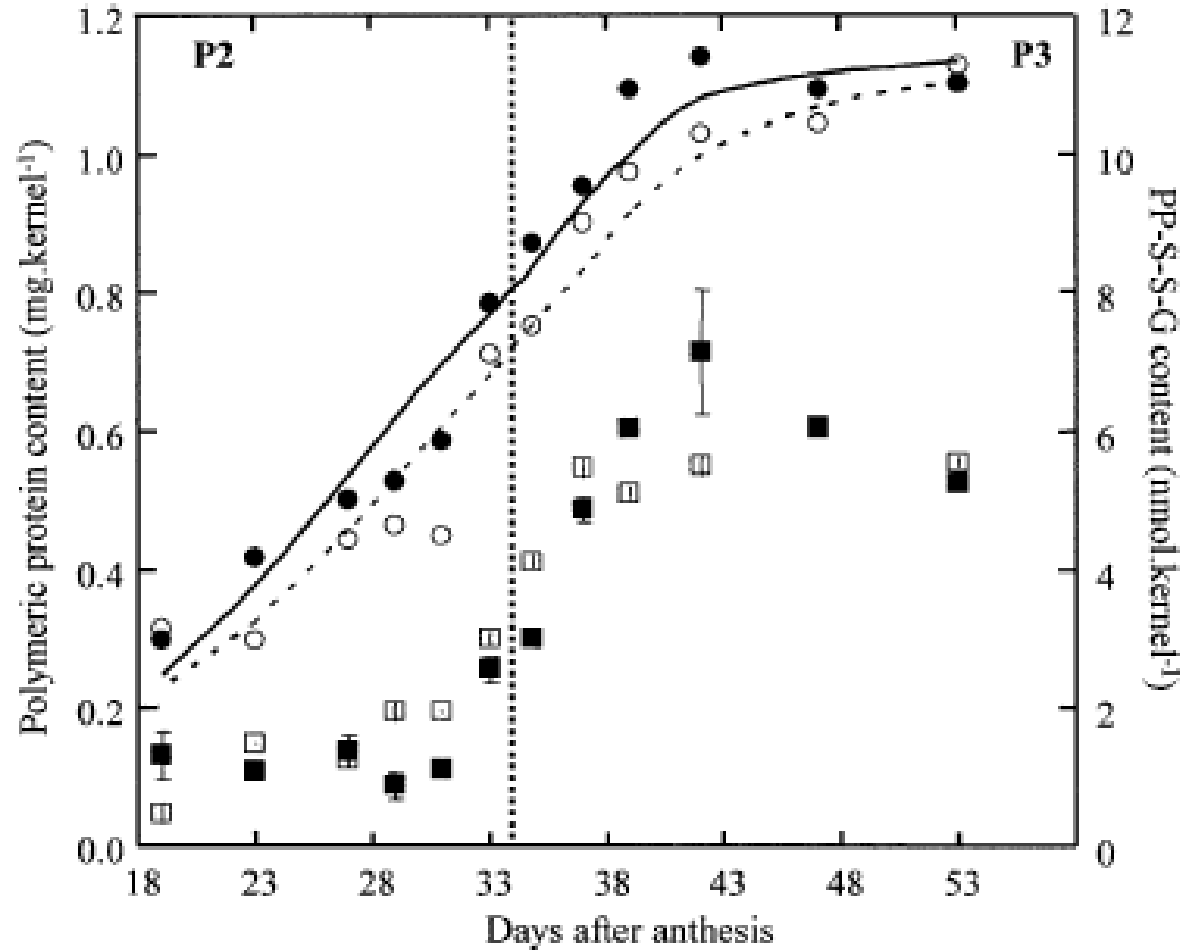
DH, Dehydration steps.
GSH, reduced glutathione;
GSSG, glutathione disulfide;
GR, glutathione reductase.

Impacts of Environmental Factors on MWD of Prolamins



Changes in PP and PP-S-S-G content during the grain development.

Changes in PP (●, ○) and PP-S-S-G (■, □)

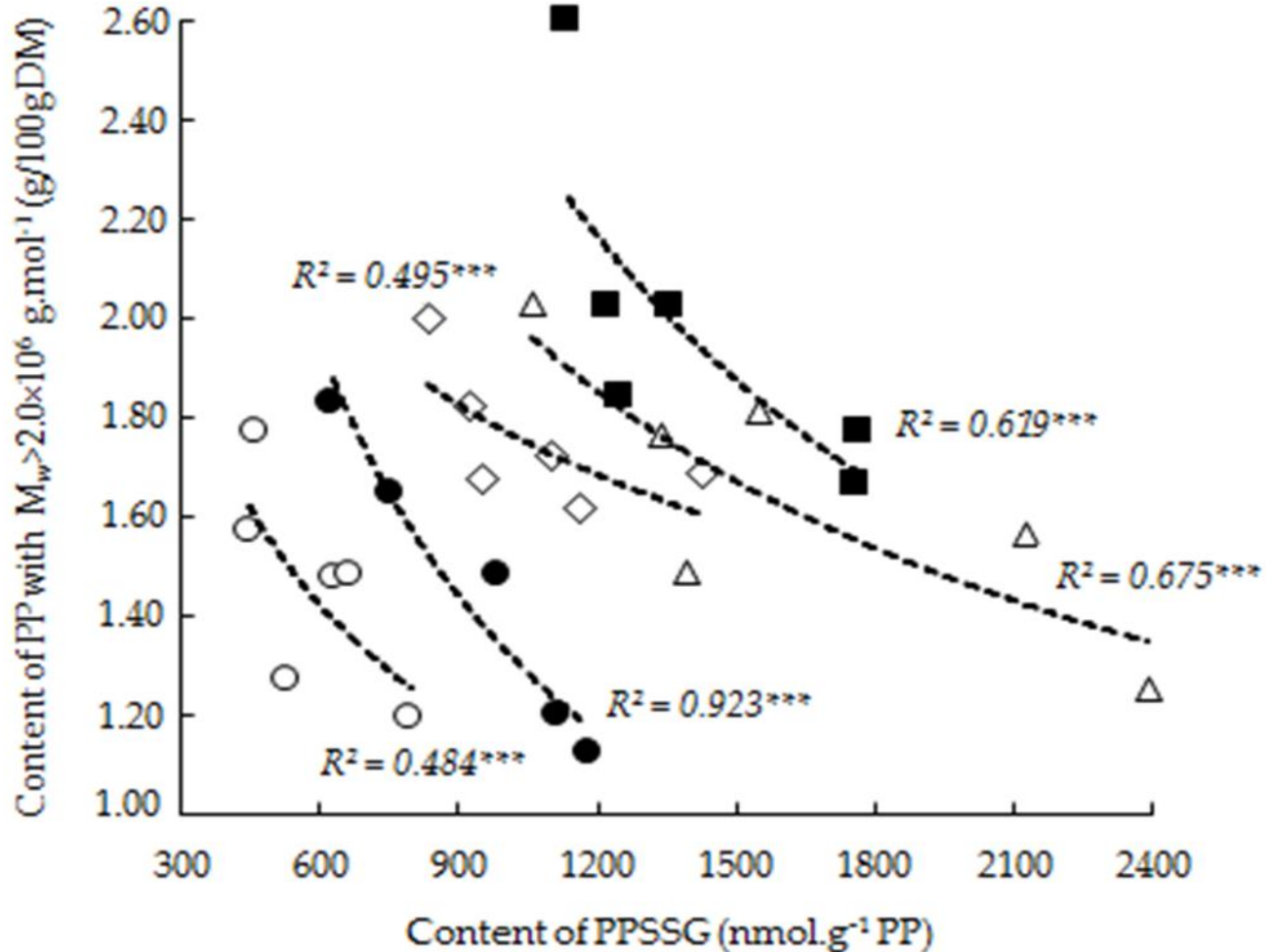


Open symbols = cv. Soissons
Closed symbols = cv. Thésée.

Impacts of Environmental Factors on MWD of Prolamins

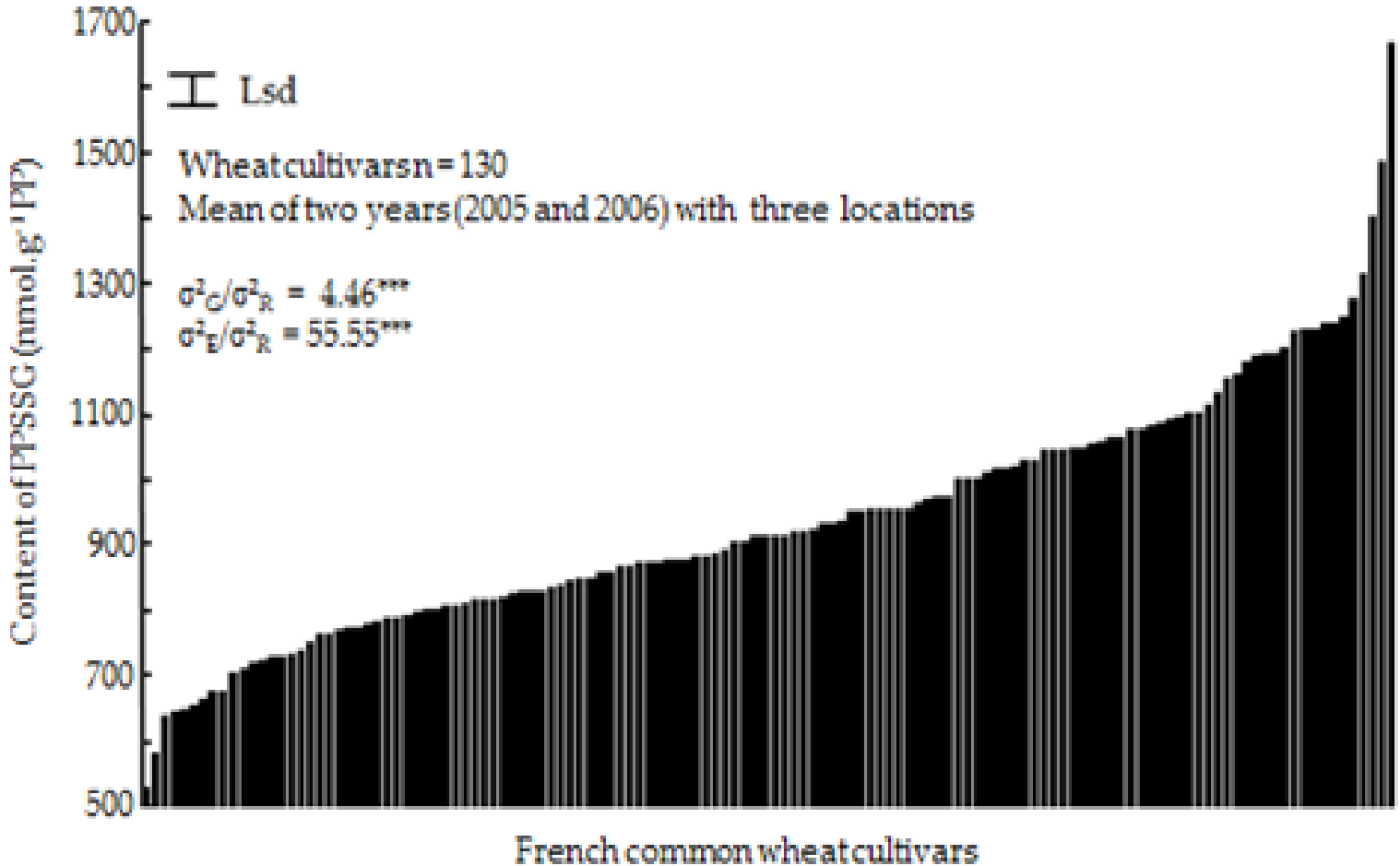


Accumulation
of PP and PP-
S-S-G:
correlations



The relationship between the content of high aggregated polymeric proteins (PP with $M_w > 2 \cdot 10^6$ g.mol⁻¹)
And
the content of polymeric proteins conjugated to glutathione (PPSSG) ¹⁹

Impacts of Environmental Factors on MWD of Prolamins



Accumulation
of PP-S-S-G:
Genetic
impact

Variation of the content of polymeric proteins conjugated to glutathione (PPSSG) for 130 cultivars

ACKNOWLEDGMENTS

