Quality Breeding at Bread Wheat

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Purpose of breeding

- **FARMER** - Yield, Disease tolerant

- **İNDUSTRY** - good breed, Pasta, biscuit quality and cheap.

- **USER CUSTOMER** - good test and quality.
Quality factors which have impact on wheat quality

Botanically:
Species (14), 3 species economically important

Tr. aestivum (Ekmeklik) - 42 Chromosome
Tr. compactum (Topbaş) - 42
Tr. durum (Makarnalık) - 28
Use of different species

**Tr. aestivum:**
Breed
Hardiness and protein content is different within species.

**Tr. compactum:**
Resistant to drought, White soft grain, Low protein, biscuit, Low gluten

**Tr. durum:**
Mostly spring, Mediterranean and Türkiye winter type.
Region, Climate, Aber colour, Gluten
Factors Affecting Wheat Quality

Milling Quality   Bread quality

- Protein
- Starch
  - Amount
  - Broken
- Environment
- Grain
  - Hardiness
  - Testa
  - Biggest
- KÜL

- Protein
  - Amount
  - Quality
    - Gliadine
    - Glutanine
- Carbohydrate
  - Starch
  - Sugar
  - Lipid
    - Polar
    - Non polar
- Environment
- Enzymes
- Variety
- Agronomic practices
Importance of wheat grain composition for breeding

- Different localization of grain quality chemical components within the grain
- Different concentration of chemical components within the grain
- Morphological shape
- Genotype x Environment for quality traits
- Nutrition
COMPONENT OF GOOD QUALITY
ENDOSPERM OF SOFT WHEAT
DURUM WHEAT ENDOSPERM
SDS-PAGE ELECTROPHORESIS

FRİABİLİN
GRAIN HARDINESS AND FRIABILİN

FRIABILİN -
Texture of grain
Not only friabilin causes softness
Other factors Starch
  Polar, Non polar, Glico phospholipids
FRIABILİN Interact with
polar lipids - Can use as a marker for softness
these knowledge can be used in breeding for
material with different hardiness
Environment effect on FARİNOGRAM (BEZOSTAYA)
EFFECT OF ENVIRONMENT ON FARİNOGRAM (GEREK 79 VARIETY)
INTERACTION BETWEEN BREAD VOLUME AND PROTEIN CONTENT
QUALITY

- Genetic - protein quality

- Environment – protein amount

Heredity of quality is important
QUALITY FOR DIFFERENT END-USES

- MILLER, BREAD MAKER, PASTA, PRODUCER etc..

- Breeder, Quality lab/ and Food health Breeder
  - Inheritance of quality traits
  - Commercial quality
TARGET OF RESEARCH

INHERITANCE OF QUALITY TRAITS

biochemical methods
Protein electrophoresis
Genetic control of proteins/

Genetic correction
INHERITANCE OF QUALITY IS

- Genetic,
- No effect of environment,
- Use of material

COMMERCIAL QUALITY

- Phenotype
- Environmental factors X Heredity
  - Grover
QUALİTY METHODS AND CORRELATION BETWEEN TRAITS

1. QUALITY, NEGATİVE CORRELATİON WİTH SOLUBLE PROTEİNS İN ACETİC ACİD.
   POSİTİVE CORRELATİON WİTH RESIDUAL PROTEİN (NON SOLUBLE İN ACETİC ACİD GLUTENİN) (sds->35)

2. GEL PROTEİN (JP)
   - JP: 4-18 mm

   - RELATİON : ZELENY, ALVEO, JP WİTH BREAD QUALİTY
   - NO RELATİON WİTH TOTAL QUALİTY AND GEL PROTEİN.
RELATION BETWEEN GLUTEN PROTEINS AND DOUGH QUALITY AND BREAD VOLUME,
EFECT OF GLUTEN, GLİADİN AND GLUTENİN PROTEINS ON BREAD QUALITY

(Total protein is % 12.0 all bread); 1 (normal flour), 2 (normal flour + gliadin), 3 (normal flour + glutenin), 4 (normal flour + gluten)
RELATION ZELENY SEDIMENTATION AND AMOUNT OF GLUTENİN
RELATION GLUTENIN AND BREAD QUALITY

GENETIC CONTROL OF HMW GLUTENİN PROTEİNS

GLU- A1, GLU-B1 ve GLU-D1 SUB-UNİTS ON LOCİ (LOCALİZED LONG ARM CROMOZOM 1A 1B 1D )
QUALITY BREEDING

BREEDER, USED TO DISCARD MATERIAL AT EARLY GENERATIONS.

FLOUR PROTEIN, SDS SEDIMENT AND HMW-G SUB UNITS KNOWLEDGE
BREEDING FOR SPECIFIC QUALITY

- SPECIFIC PROTEIN CONTENT
- GLIADIN ELECTROPHOREGRAM
- PROTEIN SUB-UNIT COMPOSITION

MUST BE KNOWN BY BREEDER
1. KNEAD AND BREAD QUALITY, SOMALÌNA - PASTA MACORONI QUALITY - HAS RELATÎON SPECIFIC GLIADIN BANDS

2. FUNCTIONAL RELATION BETWEEN GENES
   Linkage
Gliadin amounts is low.. ( % 1-3 of total proteins) But big effect on dough quality.

SELECTION FOR HİGH QUALITY MATERIAL
1. F3 (or half of grain in F2 ) 2;7+8;5+10 band combinations or, GLU-1 quality point be 10 select.

2. F5 selection can be SDS .

3. PYT, YT, RYT AND CANDÎDATES SELECT REOLOJIC (alveograf, farn.,miks) AND COOKİNG BREAD
HMW - GLUTEN SUB UNITS HAS RELATION AT BREAD QUALITY

NO RELATION WITH PASTA MACORONY
HMW-G AND LMW-G PROTEINS BANDS
### Correlations Between Bread Making Quality and Glu-1 Proteins

<table>
<thead>
<tr>
<th></th>
<th>GLU-1</th>
<th>FLOUR Prot.</th>
<th>W Alv. Ener</th>
<th>S-SDS</th>
<th>STA. Far.</th>
<th>İMROVİ NG TİME</th>
<th>ABS. far</th>
<th>Yİ ELD</th>
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</thead>
<tbody>
<tr>
<td>GLU-1</td>
<td>1.00</td>
<td>0.38</td>
<td>0.51*</td>
<td>0.63**</td>
<td>-0.14</td>
<td>-0.07</td>
<td>-0.50*</td>
<td>0.60*</td>
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<tr>
<td>FLOUR Prot.</td>
<td></td>
<td>1.00</td>
<td>0.21</td>
<td>0.44</td>
<td>-0.13</td>
<td>0.08</td>
<td>0.35</td>
<td>0.42</td>
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<tr>
<td>&quot;W&quot;</td>
<td></td>
<td>1.00</td>
<td>0.77**</td>
<td></td>
<td>-0.06</td>
<td>-0.11</td>
<td>-0.31</td>
<td>0.45</td>
</tr>
<tr>
<td>S-SDS</td>
<td></td>
<td></td>
<td></td>
<td>1.00</td>
<td>-0.18</td>
<td>0.16</td>
<td>-0.29</td>
<td>0.64**</td>
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<tr>
<td>STA.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.00</td>
<td>-0.37</td>
<td>0.33</td>
<td>-0.06</td>
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<td>İMROVİ NG TİME</td>
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<td>1.00</td>
<td>-0.29</td>
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<td>ABS.</td>
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<td>1.00</td>
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</table>
GEL FILTRATION METHODS
- HIGH GLUTENIN - LONG KNEAD, HIGH QUALITY
- ELECTROPHORESIS BANDS - W(energy), L (LONGLES OR EXTENDNESS) HAS POSITIVE CORRELATION
Can be use for crossing
HMW G and LMW - G IN TURKEY 1986

GENERAL GLUTENIN SUB UNIT COMPOSITION IN TURKİSH MATERİAL:
- Genaraly - 2*,7+8,2+12; 2*,7+8,5+10 ve 2*,7+9,5+10
- BEZOSTAYA - 2*,7+9, 5+10, GEREK- 79; 2*,7+8 ve 2+12
Distribution of Subunit Composition of some Turkish Winter Wheat Varieties

Number of Varieties

Subunit Composition No
Frequencies of HMWG Subunits among the Varieties
QUALITY POINTS OF HMW MA-GLUTENIN

<table>
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<tr>
<th>QUALITY POINT</th>
<th>1A</th>
<th>1B</th>
<th>1D</th>
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<tbody>
<tr>
<td>4</td>
<td>-</td>
<td>-</td>
<td>5+10</td>
</tr>
<tr>
<td>3</td>
<td>1;2</td>
<td>17+18;7+8</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>-</td>
<td>7+9</td>
<td>2+12;3+12</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>7;6+8</td>
<td>4+12</td>
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<tr>
<td>VARIETY</td>
<td>Glu-A1</td>
<td>Glu-B1</td>
<td>Glu-D1</td>
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<tr>
<td>----------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
</tr>
<tr>
<td>Bezostaya</td>
<td>2* (3)</td>
<td>7+9 (2)</td>
<td>5+10 (4)</td>
</tr>
<tr>
<td>Flamura</td>
<td>2*</td>
<td>7+8 (3)</td>
<td>5+10</td>
</tr>
<tr>
<td>Pehlivan</td>
<td>2*</td>
<td>7+9</td>
<td>2+12 (2)</td>
</tr>
<tr>
<td>Ikizce 96</td>
<td>1</td>
<td>7+8</td>
<td>5+10</td>
</tr>
<tr>
<td>Sünter</td>
<td>2*</td>
<td>7+8</td>
<td>2+12</td>
</tr>
<tr>
<td>Dogu 88</td>
<td>N</td>
<td>7+9</td>
<td>5+10</td>
</tr>
<tr>
<td>Vratza</td>
<td>1</td>
<td>7+8</td>
<td>2+12</td>
</tr>
<tr>
<td>Karasu</td>
<td>N</td>
<td>7+8</td>
<td>5+10</td>
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<tr>
<td>Murat-1</td>
<td>1</td>
<td>7+9</td>
<td>2+12</td>
</tr>
<tr>
<td>P8-6</td>
<td>2*</td>
<td>17+18</td>
<td>2+12</td>
</tr>
<tr>
<td>Sultan</td>
<td>2*</td>
<td>7</td>
<td>2+12</td>
</tr>
<tr>
<td>Libellul</td>
<td>1</td>
<td>20</td>
<td>2+12</td>
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</table>
Dr. Javier Pena QUALITY POINTS

FINLAND 8.3
WINTER 7.8
SPRING 8.8

ENGLAND 5.2
GERMANY 5.8
FRANCE 5.8

TURKEY 8.0

EFFECTS OF PROTEIN BANTS

GLU-1 > GLİ-1 > GLİ-2
<table>
<thead>
<tr>
<th></th>
<th>GLU-A1</th>
<th></th>
<th>GLU-B1</th>
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<th>GLU-D1</th>
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<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>NULL</td>
<td>6+8</td>
<td>7+8</td>
<td>7+9</td>
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<tr>
<td>CANADA</td>
<td>78,3</td>
<td></td>
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<td>USA</td>
<td>76,1</td>
<td></td>
<td>64,2</td>
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<td>RUSSIA</td>
<td>53,5</td>
<td>40,1</td>
<td>83,0</td>
<td></td>
<td></td>
<td>93,5</td>
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<tr>
<td>ENGLAND</td>
<td>17,6</td>
<td>5,9</td>
<td>76,5</td>
<td>52,6</td>
<td>17,6</td>
<td>41,2</td>
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<td>GERMANY</td>
<td>69,6</td>
<td></td>
<td>56,1</td>
<td></td>
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<td>47,0</td>
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<td>CHEKOSLOVACIA</td>
<td>61,5</td>
<td></td>
<td>29,2</td>
<td></td>
<td></td>
<td>45,3</td>
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<td>SLOVACIA</td>
<td>54,5</td>
<td>40,9</td>
<td>77,5</td>
<td></td>
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<tr>
<td>HUNGARY</td>
<td>66,8</td>
<td></td>
<td>83,4</td>
<td></td>
<td></td>
<td>66,6</td>
</tr>
<tr>
<td>ROMANIA</td>
<td>50,0</td>
<td>41,9</td>
<td>41,9</td>
<td>58,1</td>
<td></td>
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<tr>
<td>TÜRKİYE</td>
<td>50</td>
<td>54,5</td>
<td>13</td>
<td>41,0</td>
<td></td>
<td>73,3</td>
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EFFECT OF HMW GLUTENIN SUB-UNITs ON MIKSOGRAM
DISTRIBUTIONS OF HMW-G SUB-UNITS SDS-PAGE ELECTROPHORESIS
1. 2, 7+9,5+10
2. 2, 7+9,5+10
3. 2, 7+9
4. 2, 7+9
5. 2,7+8,5+10
6. 2,7+9
7. 2,7+9,5+10
8. 1,2,7+8,5+10

1B/1R
RYE : SECALİN
43 K MOBILITY
RELATIONS BETWEEN BREAD VOLUME AND PROTEIN AMOUNTS

Loaf volume (mL/100 g flour)

% Protein (flour)

R = 0.605
PROTEIN AND EXTENSOGRAF AREA RELATION

![Graph showing protein and extensograf area relation with R = 0.92]
BREAD WHEAT QUALITY ANALYSIS

1- GRAIN QUALITY
- 1000 kernel weight
- Hektolitr weight
- Hardness
- Protein amount
- Protein quality (SDS Sedimentation)
- Flour yield

2- Reolojik Analysis
- Alveograf
- Farinograf
- Gluten
- Mixograf
- Zeleny Sedimentation
- Extensograf
QUALITY TEST FOR BREEDING MATERIAL

1. (F2-F6): 3-5 g GRAİN SELECTION, HARDINES, PROTEIN, SDS SEDİM
2. PYT 250 g; SDS SEDİM. PROTEIN ve MIXOGRAF.
3. YT 500 g: + ZELENÝ SEDİM FARINOGRÁF FLOUR YIELD
4. RYT: 3 kg + EXTANSOGRÁF ALVEOGRÁF (GRAIN, WHOLE WHEAT 1mm, FLOUR)

1. GRAIN- hardiness, color, big, 1000 kernel weight, Hectolitre weight.
2. WHOLE WHEAT 1mm - Protein Ash content Sediment,
   (Flour must weight 15 days for natural improvement)
3. FLOUR- flour yield, Protein, Zeleny Sedimentation, ash, REOLOJIk K ANALYSIS; FARINO, MİXO, ALVEO, EXTENS, BREAD MAKING
STABLE QUALITY CHARACTERS

HARDINESS (PI = PEALING NUMBER, NIR/ PSI-NI), 1000 k w., ZELENY SEDIMENTATION DEGREE (EARLY GENERATION)

PROTEIN PERCENTAGE IS NOT STABLE
STABLE VARIETY

drought, Rainy

Low protein content

Genetically show good performance at different conditions.
FAST QUALITY ANALYSIS

NIR/ NIT

Single kernel characterisation system (SKCS)

Digital spectre analysis (SEM)

Micro Quality analysis
(Protein, humidity, hardiness, sds, mini,

SDS-Sedimentation

SDS-PAGE ELECTROPHORESIS
HMW-G AND GLI ADI N PROTEIN SUB UNITS
USING BIOTECHNOLOGY IN BREEDING

3 STEP PROCESS:
1. GENERATE GENETIC VARIATION
2. SELECT GENOTYPE WHICH MAY BECOME A VARIETY
3. SELECT GENOTYPE WITH SPECIFIC TRAITS LIKE QUALITY, DISEASE RESISTANCE AND YIELD

GENETIC VARIATION:
IN THE PAST: MUTATION AND HYBRIDIZATION AS SOURCES

GENETIC ENGINEERING:
TRANSFER GOOD GENES FROM ONE ORGANISM TO ANOTHER
SYNTHETIC GENES
MOLECULAR MARKERS RELATED WITH IMPORTANT TRAITS

HIGH PROTEIN CONTENT

HIGH FLOUR YIELD

STARCH AND NOOD QUALITY

VISCOITY OF FLOUR

BREAD QUALITY

GRAIN HARDINESS
RELATIONSHIP BETWEEN DURUM WHEAT QUALITY AND GLIADIN AND GLUTENIN SUB-UNITS

HMW G-

6+8; 7+8  General
20  very few

Influence of HMW G in quality:

6+8; 7+8  Very good quality
6+8 LMW-2  Excellent quality
7+8-  High sedimentation
      High elasticity

Yellow PİGMENT- new quality criteria
- XANTOPHYLs (yellow PİGMENT)
Lipoxidase enzyme break yellow pigments (Genetic)
Durum Wheat Quality

Gama-Gliadin 45 band: high quality and high cooking quality
Genetic transformation can be used to improve quality

For pasta quality you need:
- Hard grain
- Big grain
- Golden colour grain

Durum wheat quality for:
- SPAGETTÎ
- NOODLE

Durum wheat Semolina must be:
- Hard
- Elastic
- Not sticky

For quality two aspects are important:
- Genotype
- Environment
CONCLUSIONS

• Each country has different quality criteria

• Each bread type needs different quality traits

• Milling, dough preparation, and cooking are very important steps of bread preparation

• Quality criteria are related to each other

• High flour yields reduce quality

• Breeder objective must match with miller and consumer objectives
MAKARNALIK BUĞDAY ISLAH MATERYALİNİN KALİTESİNİN BELİRLENMESİ

Hazırlayan: Tülin ÖZDEREN, Nurettin ÇİNKAYA, Aliye KARAHAN
SUNU: Dr. Emin Dönmez
Renk tayin aleti

Protein tayin aleti

Makarnalık buğday

SDS
MAKARNA YAPIMI

Yoğurma

Presleme

Kurutma

Duyusal test
İrmik Değirmeni

PURİFAYR (İrmik Sasörü)

2001 / 5 / 18
TEŞEKKÜRLER