

33°

Congreso
Argentino
de Producción
Animal

La ganadería, pilar del desarrollo nacional



Nuevos parámetros para definir la calidad de la leche y un nuevo método para clasificar y medir esta calidad

Roberto Rubino e coll.

CRA- Zoe Bella, Italia

- En el mundo se estudia mucho la calidad de la leche.
- Ma el ganadero vende la leche por litro

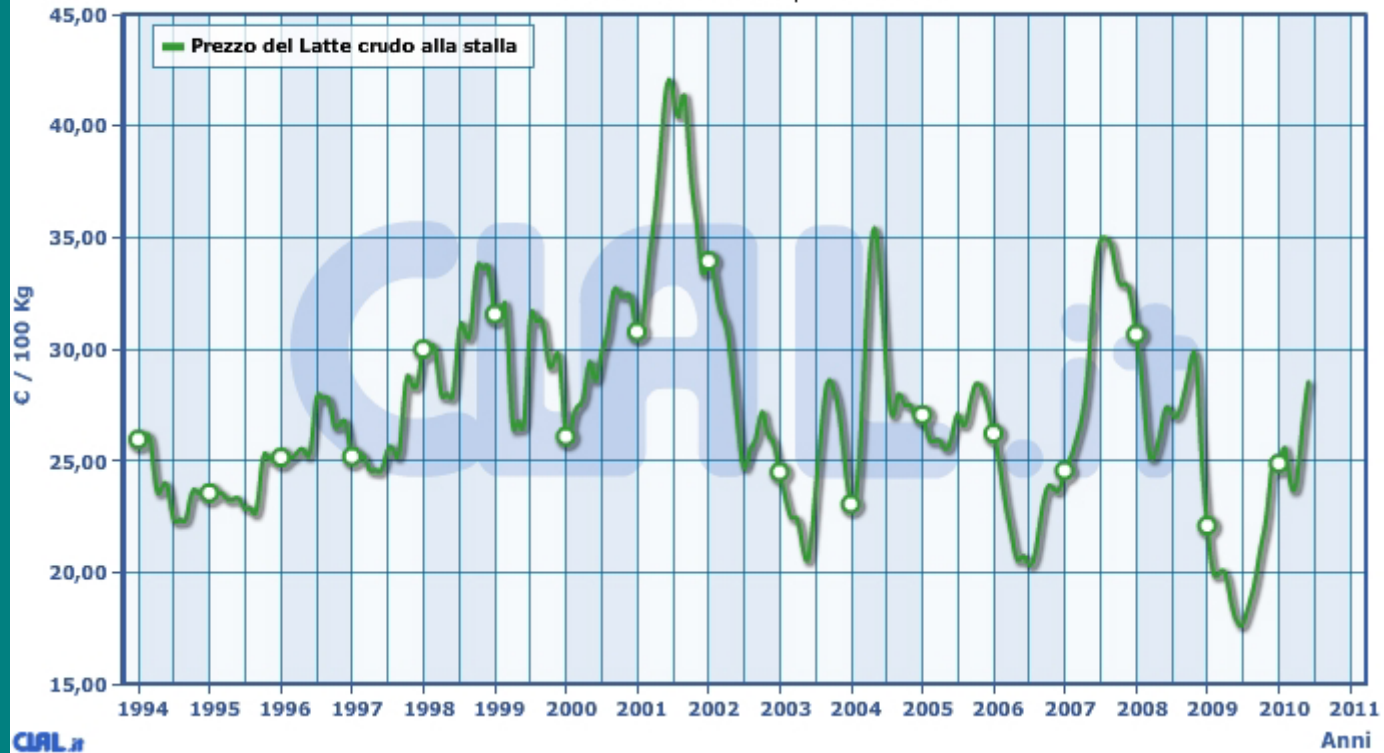
La leche es
toda igual?



USA (23 Stati) - Quadro storico dei prezzi del Latte crudo alla stalla (€)

Fluid Grade Milk

Fonte: AMS USDA Dairy Markets News



Objetivos

- Clases de calidad
- Una medida rapida

Metodologia

- 90 muestras de leche de vaca
- Sistema de alimentacion desde pastoreo hasta silo-mais
- Analisis:
- VOC, FAME, Vitaminas
- IR, Nariz electronico

- El sistema actual de pago de la leche no premia la calidad

Analisi univariate delle 5 variabili di base del latte secondo i 4 gruppi.

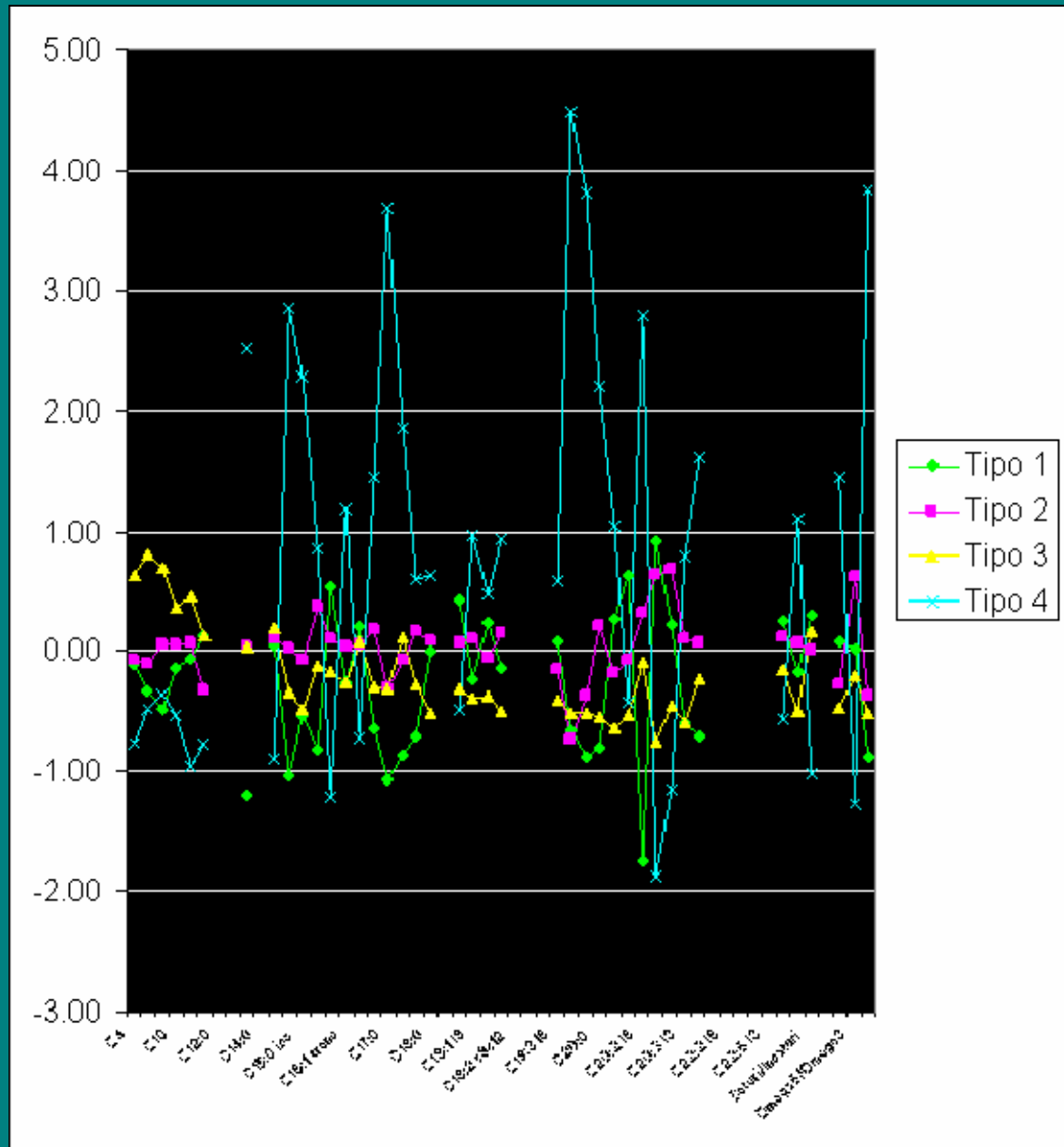
| | R ² | CV | SEM | Media | Prob | Medie | | | |
|--------------------|----------------|------|------|-------|--------|----------|----------|--------------|--------------|
| | | | | | | gruppo 1 | gruppo 2 | gruppo 3 | gruppo 4 |
| PH | 0.45 | 1.1 | 0.07 | 6.68 | <.0001 | 6.63bc | 6.69b | 6.76a | 6.58c |
| Grasso, % | 0.04 | 14.7 | 0.54 | 3.71 | 0.36 | 3.85 | 3.58 | 3.71 | 3.7 |
| Proteine, % | 0.14 | 6.1 | 0.19 | 3.26 | 0.01 | 3.31ab | 3.15b | 3.29a | 3.35a |
| Lattosio, % | 0.32 | 2.8 | 0.13 | 4.72 | <.0001 | 4.72b | 4.63c | 4.73b | 4.92a |
| Linear Score | 0.12 | 25.6 | 1.12 | 4.40 | 0.02 | 4.50ab | 4.72a | 4.34ab | 3.43c |
| SCCx106 | 0.05 | 80.3 | 285 | 355 | 0.21 | 334 | 436 | 327 | 236 |
| Produzione, q/anno | 0.83 | 14.7 | 9.35 | 63.71 | <.0001 | 82.9a | 73.9b | 47.8c | 25.0d |

| | Commerciali | | | | | Nutraceutiche | | | | VOC |
|---------------------|--------------|-------------|---------------|---------------|--------------|---------------|------------------------|--------------|-------------------------------|--------------|
| | PH + | grasso + | proteine + | Lattosio + | LINEAR - | Saturi - | Omega6/ Omega3 - | CLA + | Trombo genic Index - | |
| pH | 1 | 0.04 | -0.11 | -0.33 | 0.17 | 0.48 | 0.21 | -0.32 | 0.28 | -0.16 |
| grasso | 0.04 | 1 | 0.44 | 0.09 | 0.09 | 0.21 | -0.20 | -0.16 | 0.08 | 0.01 |
| proteine | -0.11 | 0.44 | 1 | 0.38 | -0.12 | 0.25 | -0.41 | -0.01 | -0.08 | -0.05 |
| Lattosio | -0.33 | 0.09 | 0.38 | 1 | -0.37 | -0.17 | -0.38 | 0.35 | -0.25 | 0.20 |
| Linear score SC | 0.17 | 0.09 | -0.12 | -0.37 | 1 | 0.10 | 0.24 | -0.26 | 0.15 | -0.27 |
| Saturi | 0.48 | 0.21 | 0.25 | -0.17 | 0.10 | 1 | 0.12 | -0.72 | 0.54 | -0.18 |
| Omega6/Omega3 | 0.21 | -0.20 | -0.41 | -0.38 | 0.24 | 0.12 | 1 | -0.41 | 0.61 | -0.11 |
| CLA | -0.32 | -0.16 | -0.01 | 0.35 | -0.26 | -0.72 | -0.41 | 1 | -0.56 | 0.23 |
| Trombogenic Index | 0.28 | 0.08 | -0.08 | -0.25 | 0.15 | 0.54 | 0.61 | -0.56 | 1 | -0.13 |
| VOC_Generale | -0.16 | 0.01 | -0.05 | 0.20 | -0.27 | -0.18 | -0.11 | 0.23 | -0.13 | 1 |
| Qualità | + | + | + | + | - | - | - | + | - | + |

Demasiados moleculas
Para medir la qualidad necesita
agrupar en **clases** de qualidad

| | R ² | CV | SEM | Media | Prob | Tipo 1 | Tipo 2 | Tipo 3 | Tipo 4 |
|-----------------|----------------|--------|------|-------|--------|--------|---------|---------|--------|
| C4 | 0.16 | 41.41 | 0.55 | 1.33 | 0.00 | 1.27a | 1.28a | 1.67ab | 0.90b |
| C6 | 0.19 | 42.46 | 0.46 | 1.08 | 0.00 | 0.93b | 1.03b | 1.45a | 0.86b |
| C8 | 0.17 | 28.84 | 0.25 | 0.86 | 0.00 | 0.74b | 0.87ab | 1.03a | 0.77b |
| C10 | 0.07 | 24.37 | 0.55 | 2.26 | 0.10 | 2.18ab | 2.29ab | 2.46a | 1.97b |
| C10:1 | 0.16 | 33.32 | 0.08 | 0.23 | 0.00 | 0.23a | 0.24a | 0.27a | 0.16b |
| C11 | 0.07 | 59.81 | 0.02 | 0.04 | 0.11 | 0.042a | 0.036ab | 0.040a | 0.023b |
| C12:0 | 0.05 | 22.38 | 0.64 | 2.87 | 0.22 | 2.95 | 2.91 | 2.93 | 2.49 |
| C13:0 | 0.04 | 27.87 | 0.03 | 0.10 | 0.32 | 0.098 | 0.102 | 0.09 | 0.088 |
| C14:0 iso | 0.59 | 25.56 | 0.04 | 0.16 | <.0001 | 0.11c | 0.16b | 0.16b | 0.26a |
| C14:0 | 0.05 | 15.85 | 1.67 | 10.54 | 0.23 | 10.89 | 10.73 | 10.29 | 9.74 |
| C14:1 trans | 0.11 | 22.60 | 0.20 | 0.89 | 0.03 | 0.906a | 0.915a | 0.933a | 0.718b |
| C14:1 cis | 0.59 | 18.94 | 0.11 | 0.60 | <.0001 | 0.48c | 0.60b | 0.56b | 0.92a |
| C15:0 iso | 0.45 | 14.98 | 0.17 | 1.16 | <.0001 | 1.07b | 1.15b | 1.08b | 1.56a |
| C16:0 iso | 0.27 | 29.93 | 0.10 | 0.34 | <.0001 | 0.26c | 0.38ab | 0.33b | 0.43a |
| C16:0 | 0.22 | 13.85 | 4.09 | 29.50 | 0.00 | 31.76a | 29.91ab | 28.89b | 24.68c |
| C16:1 trans | 0.19 | 19.48 | 0.03 | 0.18 | 0.00 | 0.17b | 0.18b | 0.17b | 0.22a |
| C16:1 cis | 0.07 | 19.20 | 0.26 | 1.37 | 0.10 | 1.42a | 1.38a | 1.39a | 1.18b |
| C17:0 ante iso | 0.31 | 16.66 | 0.09 | 0.52 | <.0001 | 0.46c | 0.53b | 0.49bc | 0.64a |
| C17:0 | 0.68 | 15.42 | 0.11 | 0.68 | <.0001 | 0.57c | 0.65b | 0.65b | 1.07a |
| C17:1 | 0.39 | 20.25 | 0.05 | 0.25 | <.0001 | 0.21c | 0.25b | 0.26b | 0.35a |
| C18:0 iso | 0.14 | 26.65 | 0.02 | 0.09 | 0.01 | 0.07b | 0.09a | 0.08ab | 0.10a |
| C18:0 | 0.11 | 21.52 | 2.54 | 11.80 | 0.02 | 11.89b | 12.02ab | 10.54b | 13.43a |
| C18:1 t9 | 0.02 | 928.02 | 0.00 | 0.00 | 0.59 | 0.000 | 0.001 | 0.000 | 0.000 |
| C18:1 t11 | 0.10 | 42.99 | 0.05 | 0.13 | 0.03 | 0.15a | 0.13ab | 0.11b | 0.10b |
| C18:1 ω9 | 0.16 | 15.56 | 3.81 | 24.52 | 0.00 | 23.62b | 24.94b | 23.03b | 28.22a |
| C18:1 ω7 | 0.08 | 22.53 | 0.13 | 0.58 | 0.07 | 0.61a | 0.57ab | 0.53b | 0.64a |
| C18:2 t9t12 | 0.16 | 29.61 | 0.14 | 0.47 | 0.00 | 0.45bc | 0.49b | 0.40c | 0.60a |
| C18:2 t9c12 | 0.05 | 33.49 | 0.02 | 0.07 | 0.23 | 0.08 | 0.08 | 0.07 | 0.06 |
| C18:2 c9t12 | 0.04 | 303.00 | 0.44 | 0.15 | 0.29 | 0.279 | 0.085 | 0.053 | 0.186 |
| C18:2 ω6 | 0.08 | 25.90 | 0.66 | 2.57 | 0.07 | 2.64ab | 2.77a | 2.29b | 2.41ab |
| C18:3 ω6 | 0.07 | 32.26 | 0.04 | 0.13 | 0.10 | 0.13ab | 0.12ab | 0.11b | 0.15a |
| C18:3 ω3 | 0.76 | 29.69 | 0.14 | 0.49 | <.0001 | 0.39b | 0.38b | 0.41b | 1.13a |
| C18:2 c9t11 CLA | 0.70 | 35.56 | 0.28 | 0.78 | <.0001 | 0.54b | 0.68b | 0.64b | 1.84a |
| C20:0 | 0.45 | 18.80 | 0.04 | 0.21 | <.0001 | 0.18b | 0.22ab | 0.19b | 0.30a |
| C20:1 | 0.21 | 43.24 | 0.07 | 0.15 | 0.00 | 0.17ab | 0.14bc | 0.11c | 0.22a |
| C21:0 | 0.17 | 99.82 | 0.09 | 0.09 | 0.00 | 0.14a | 0.08b | 0.04b | 0.05b |
| C20:2 ω6 | 0.60 | 57.27 | 0.02 | 0.04 | <.0001 | 0.009c | 0.05b | 0.04b | 0.11a |
| C20:3 ω6 | 0.47 | 24.37 | 0.04 | 0.15 | <.0001 | 0.18a | 0.17a | 0.12b | 0.08c |
| C20:4 ω6 | 0.29 | 20.88 | 0.04 | 0.21 | <.0001 | 0.22a | 0.24a | 0.19bc | 0.16c |
| C20:3 ω3 | 0.16 | 165.97 | 0.01 | 0.01 | 0.00 | 0.004b | 0.010b | 0.005b | 0.023a |
| C20:5 ω3 EPA | 0.33 | 61.56 | 0.07 | 0.11 | <.0001 | 0.06c | 0.11b | 0.09bc | 0.21a |
| C22:0 | 0.05 | 75.20 | 0.04 | 0.05 | 0.24 | 0.050 | 0.058 | 0.057 | 0.030 |
| C22:2 ω6 | 0.04 | 87.86 | 0.19 | 0.21 | 0.31 | 0.272 | 0.204 | 0.189 | 0.160 |
| C22:4 ω6 | 0.03 | 53.34 | 0.22 | 0.41 | 0.56 | 0.435 | 0.391 | 0.380 | 0.481 |
| C22:5 ω3 DPA | 0.22 | 56.32 | 0.16 | 0.29 | 0.00 | 0.41a | 0.27b | 0.24b | 0.16c |
| C22:6 ω3 DHA | 0.07 | 84.25 | 0.17 | 0.20 | 0.13 | 0.250 | 0.218 | 0.152 | 0.133 |
| Saturi | 0.07 | 12.29 | 7.82 | 63.67 | 0.14 | 65.68a | 64.50ab | 62.48ab | 59.38b |
| Insaturi | 0.19 | 14.05 | 4.94 | 35.18 | 0.00 | 34.33b | 35.59b | 32.76b | 40.62a |
| Saturi/Insaturi | 0.15 | 18.41 | 0.33 | 1.82 | 0.00 | 1.92a | 1.82a | 1.87a | 1.48b |
| Omega6 | 0.10 | 21.13 | 0.79 | 3.72 | 0.03 | 3.88a | 3.93a | 3.32b | 3.55ab |
| Omega3 | 0.27 | 35.58 | 0.39 | 1.09 | <.0001 | 1.12b | 0.98b | 0.91b | 1.65a |
| Omega6/Omega3 | 0.27 | 33.61 | 1.28 | 3.81 | <.0001 | 3.83b | 4.59a | 3.54b | 2.18c |
| TRANS Tot | 0.02 | 15.73 | 0.26 | 1.67 | 0.68 | 1.68 | 1.7 | 1.62 | 1.64 |

Desviaciones estandarizadas



VOC

| | R2 | CV | SEM | Media | Prob | Tipo 1 | Tipo 2 | Tipo 3 | Tipo 4 |
|-----------------|------|-----|-------|-------|--------|---------|--------|---------|--------|
| T_Acohol | 0.09 | 400 | 3.11 | 0.78 | 0.0538 | 2.29a | 0.25b | 0.19b | 0 c |
| T_Aldeidi | 0.01 | 37 | 7.27 | 19.64 | 0.7535 | 20.56 | 18.69 | 19.31 | 20.78 |
| T_Esteri | 0.05 | 251 | 0.35 | 0.14 | 0.2462 | 0.09 | 0.16 | 0.24 | 0.00 |
| T_IdroCarburi | 0.56 | 80 | 3.00 | 3.75 | <0001 | 0.85c | 2.90b | 4.09b | 11.70a |
| T_Terpeni | 0.09 | 39 | 2.23 | 5.72 | 0.0566 | 5.40ab | 5.06b | 6.72a | 6.24a |
| Totale Generale | 0.07 | 36 | 13.45 | 37.88 | 0.1233 | 36.69ab | 34.95b | 38.90ab | 46.25a |

Indice **Commercial** (ICOM)

- Con segno + : pH, grasso, proteina, lattosio. Con segno – : Linear Score delle CS.

Indice **Nutraceutico** (INUT)

- Con segno + : CLA. Con segno – Saturi, Omega6/Omega3, TrombogenicIndex. Manca ancora DAP, il più importante, da sopravvalutare esempio dandogli un peso 2 o 3 .

Indice **Aromatico** (IAR).

- Totale dei VOC misurati con segno +.

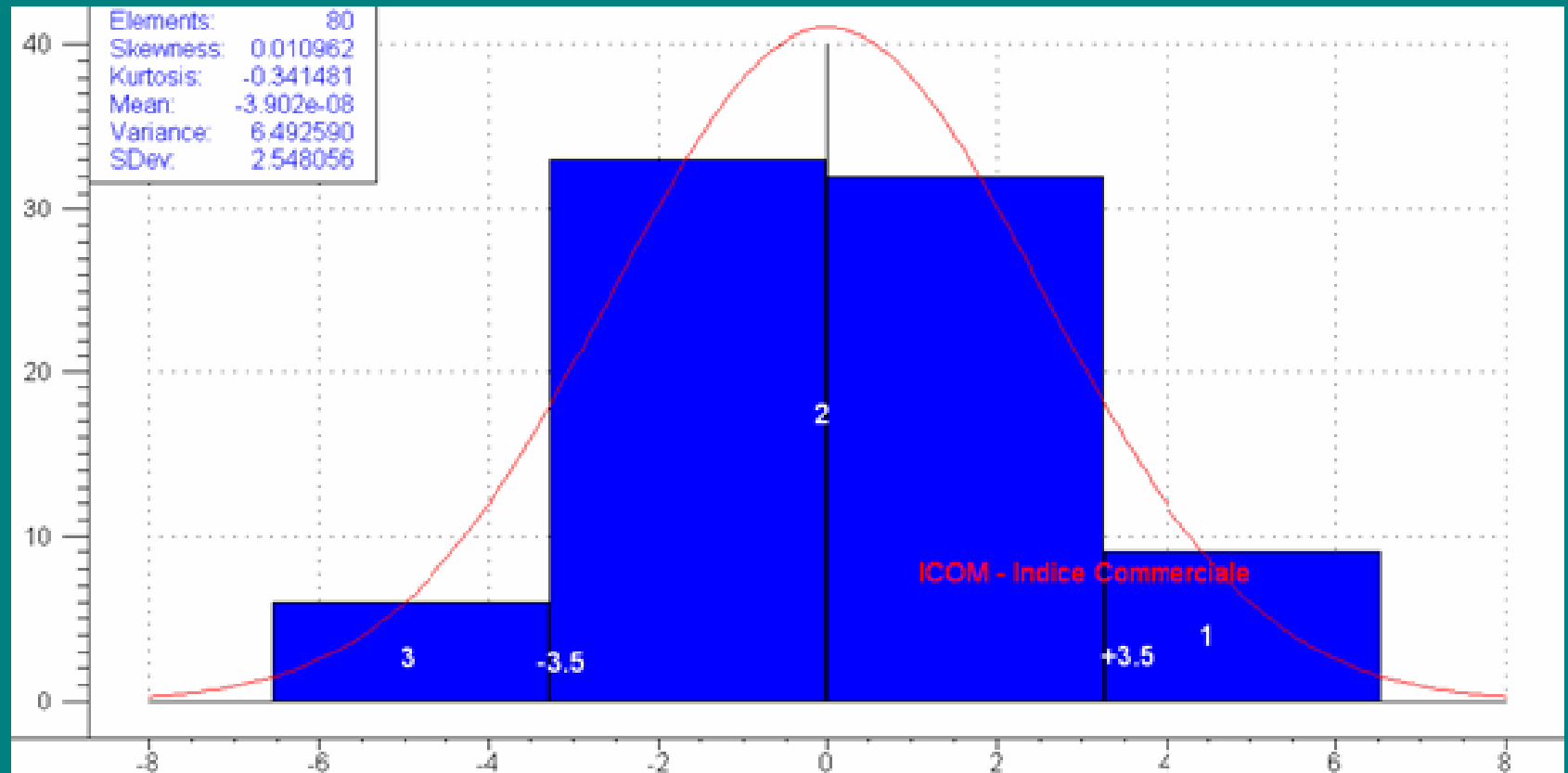
Indice **Total Qualità** (IQ).

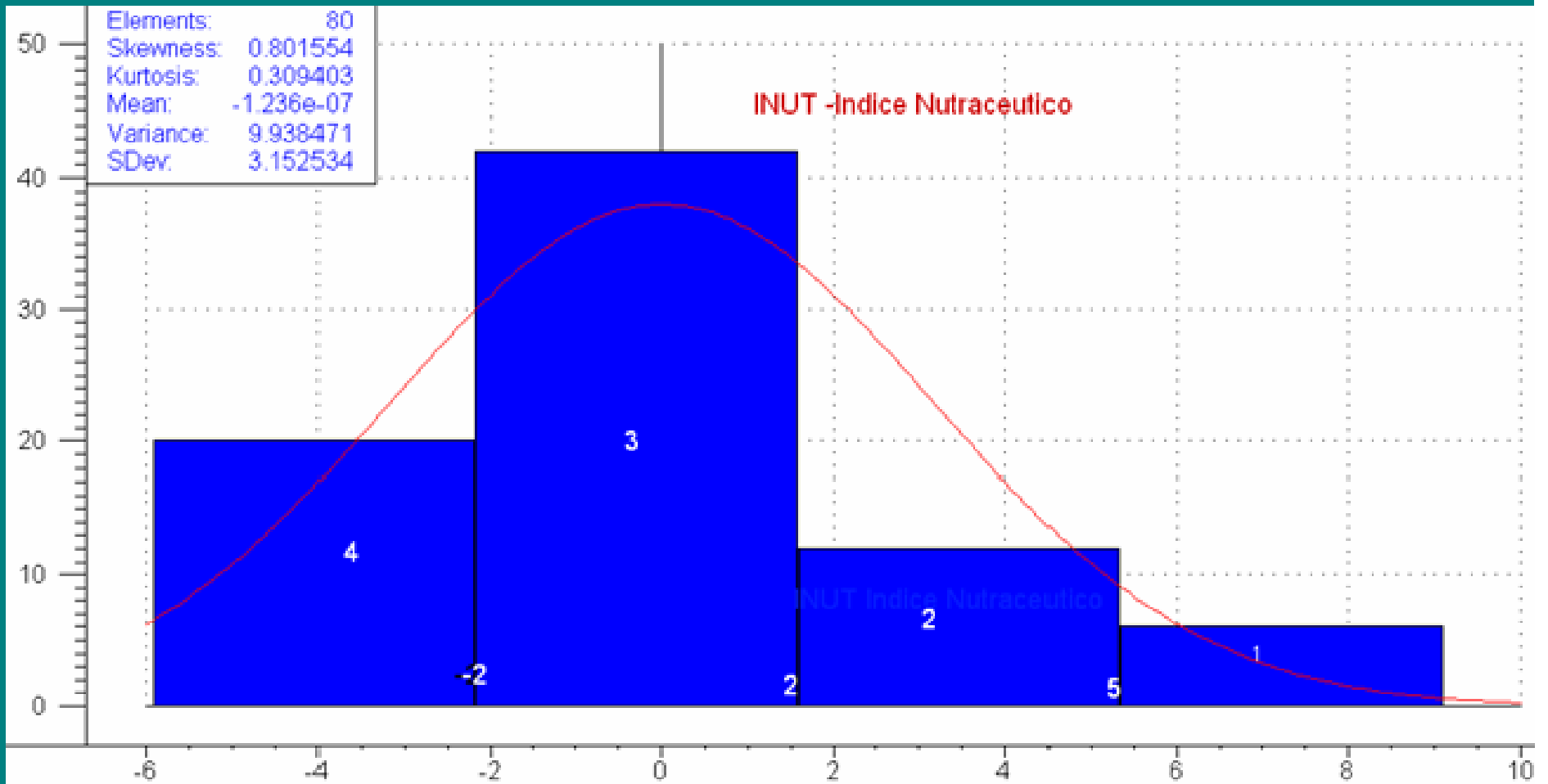
- Pari alla somma dei tre indici.

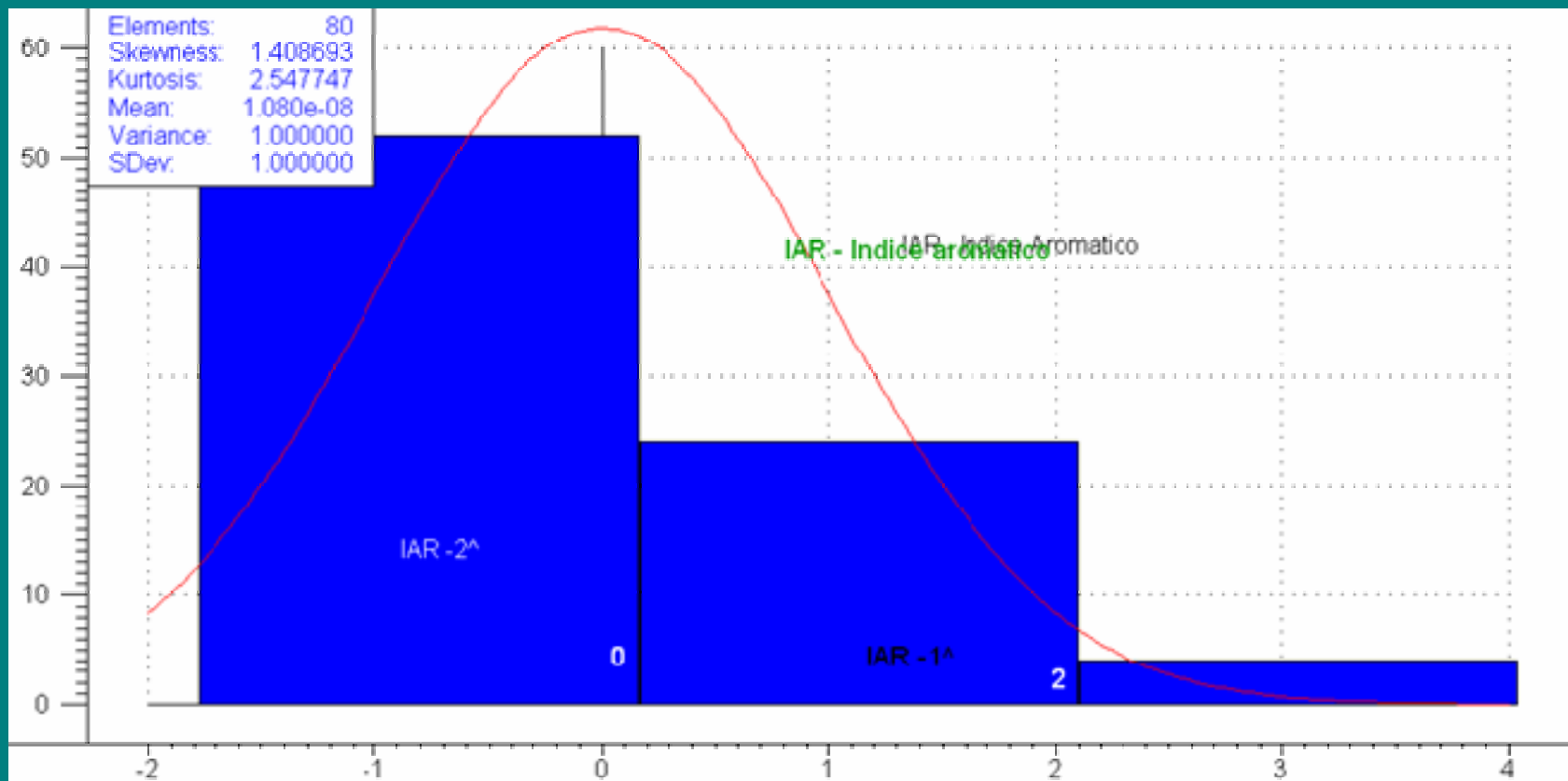
Correlaciones entre los índices

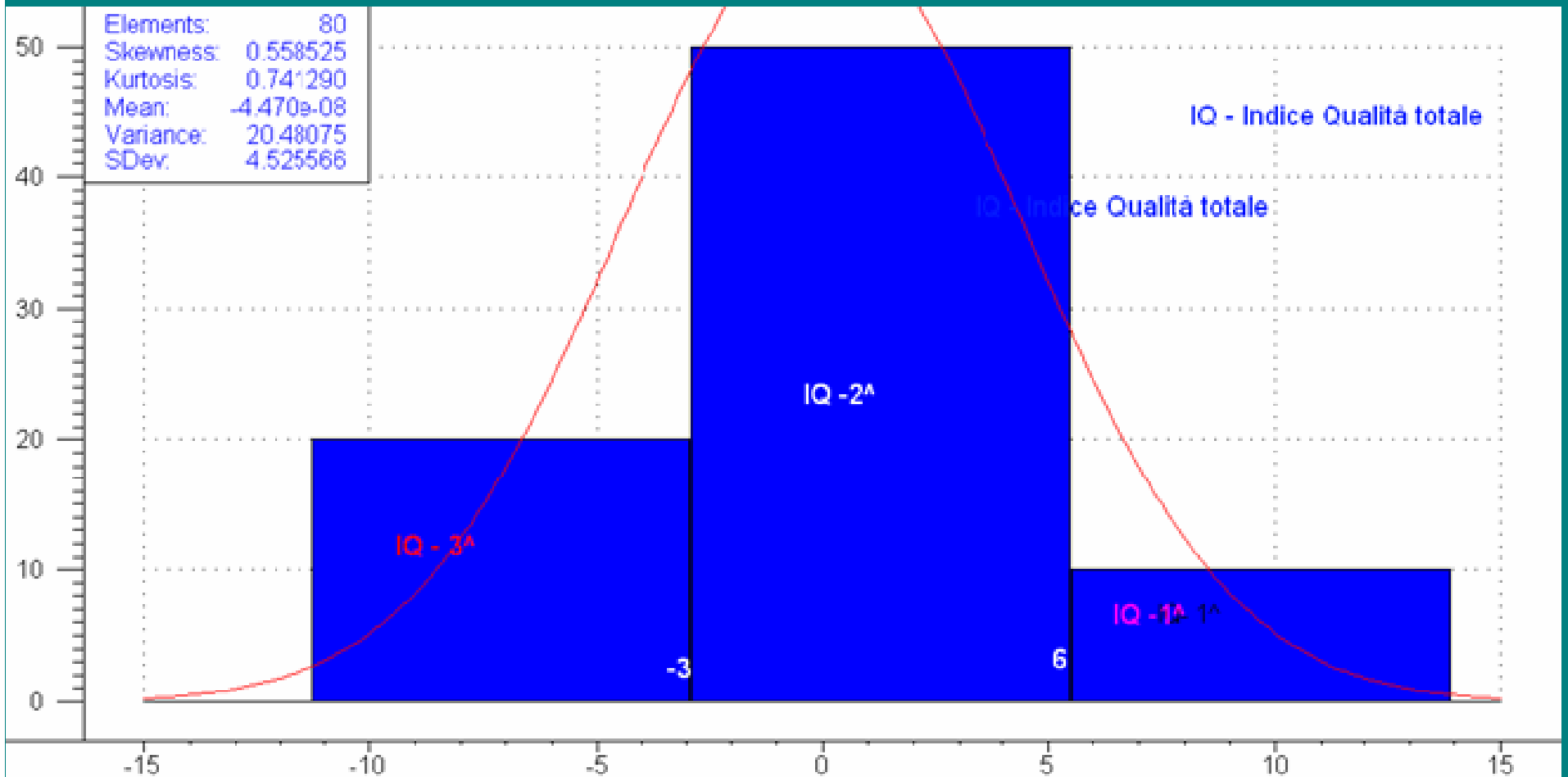
| | ICOM | INUT | IAR | IQ |
|------|-------------|-------------|-------------|-------------|
| ICOM | 1 | 0.07 | 0.10 | 0.64 |
| INUT | 0.07 | 1 | 0.21 | 0.78 |
| IAR | 0.10 | 0.21 | 1 | 0.42 |
| IQ | 0.64 | 0.78 | 0.42 | 1 |

Calculo de los puntos (clases) de qualidad

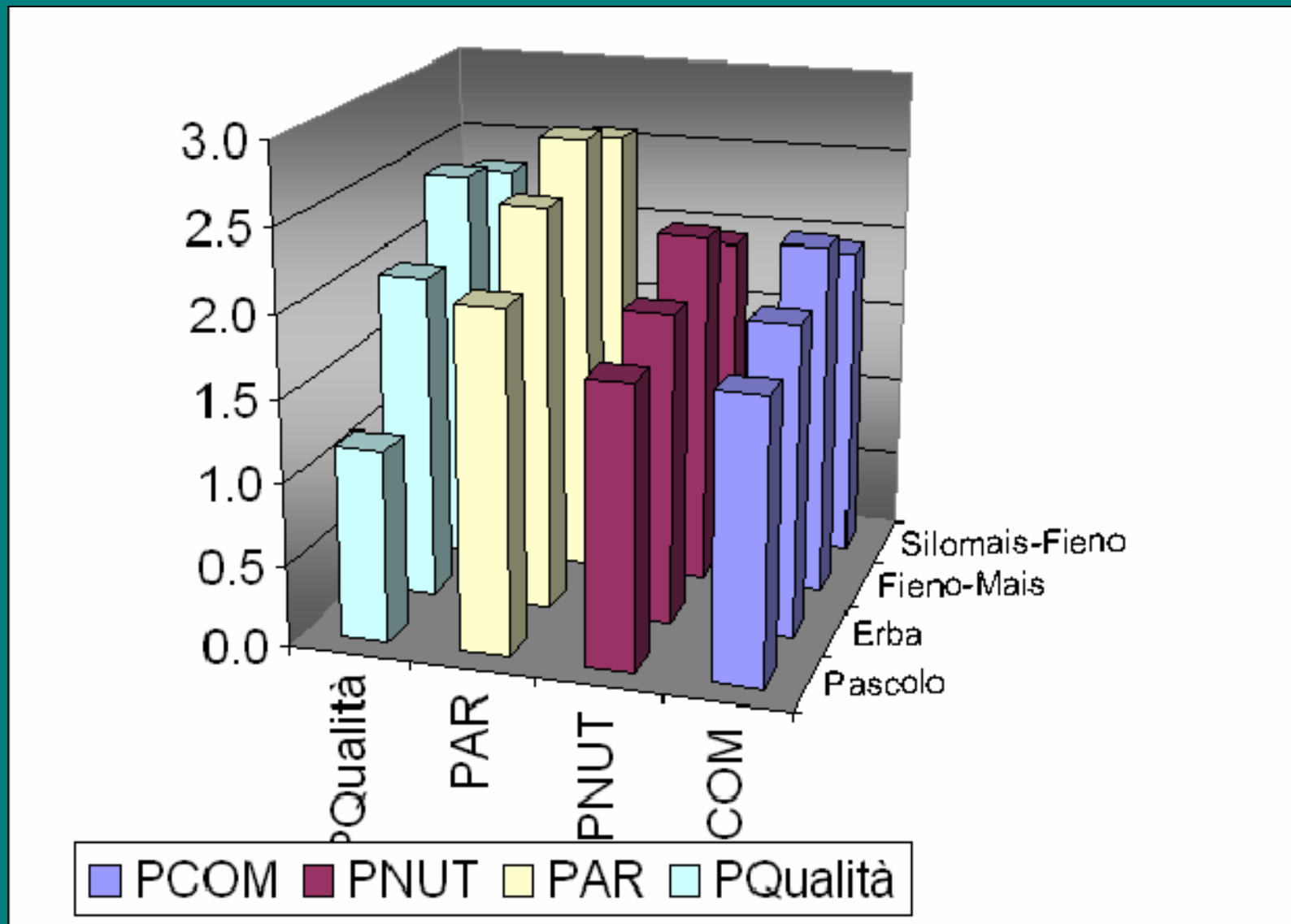








Puntos o clases de calidad



| Tipo | <i>PCOM</i> | PNUT | PAR | PQ |
|-------------------------|--------------------|-------------|-------------|-------------|
| 4-Pascolo | 1.73 | 1.00 | 2.09 | 1.18 |
| 3-Erba | 1.90 | 2.19 | 2.48 | 2.00 |
| 2-Fieno-Mais | 2.17 | 2.24 | 2.72 | 2.45 |
| 1-Silomais-Fieno | 1.95 | 2.32 | 2.58 | 2.32 |

Necesita tambien un metodo
de analisis muy rapido

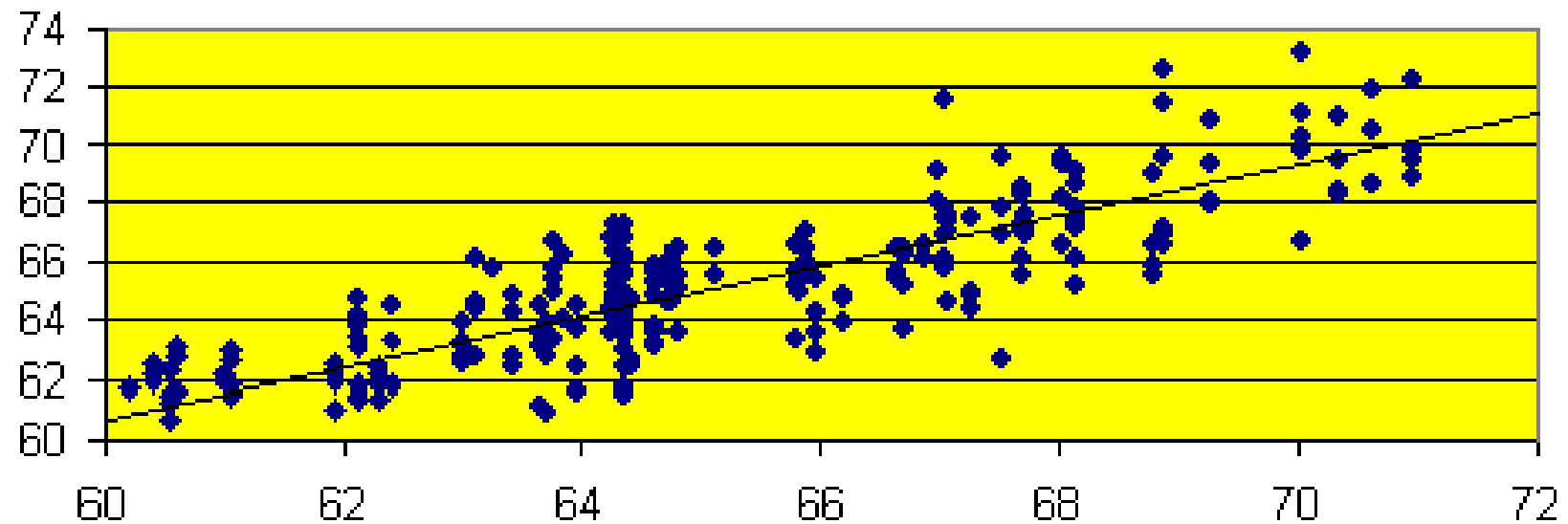
Analisis rapidos

| Constituente | | IR | Naso |
|--------------|------------------|----------------------------|----------------------------|
| | | R ² validazione | R ² validazione |
| Acidi grassi | Saturi | 0.81 | 0.56 |
| | Omega6/Omega3 | 0.78 | 0.27 |
| | CLA | 0.88 | 0.76 |
| | TrombogenicIndex | 0.78 | 0.59 |
| Indici | ICOM | 0.70 | 0.20 |
| | INUT | 0.78 | 0.78 |
| | IAR | 0.60 | 0.73 |
| | IQ | 0.78 | 0.77 |

Estimacion IR

Saturi

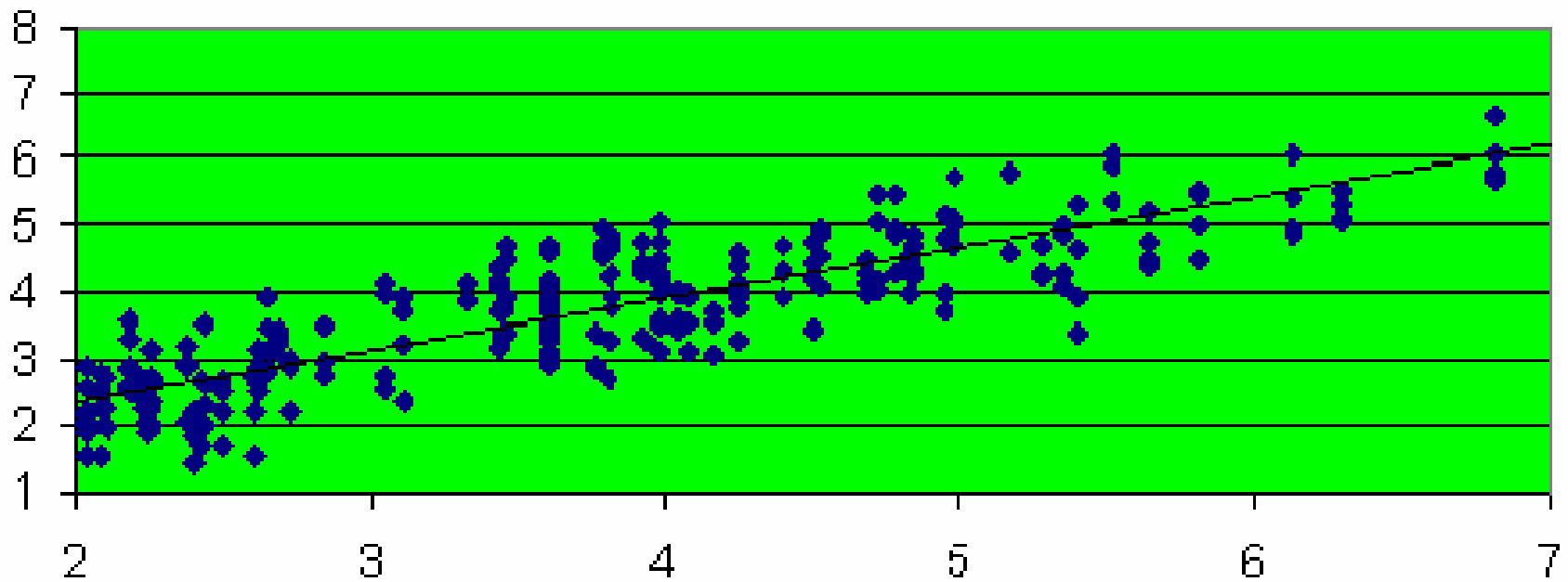
$R^2 = 0.8462$



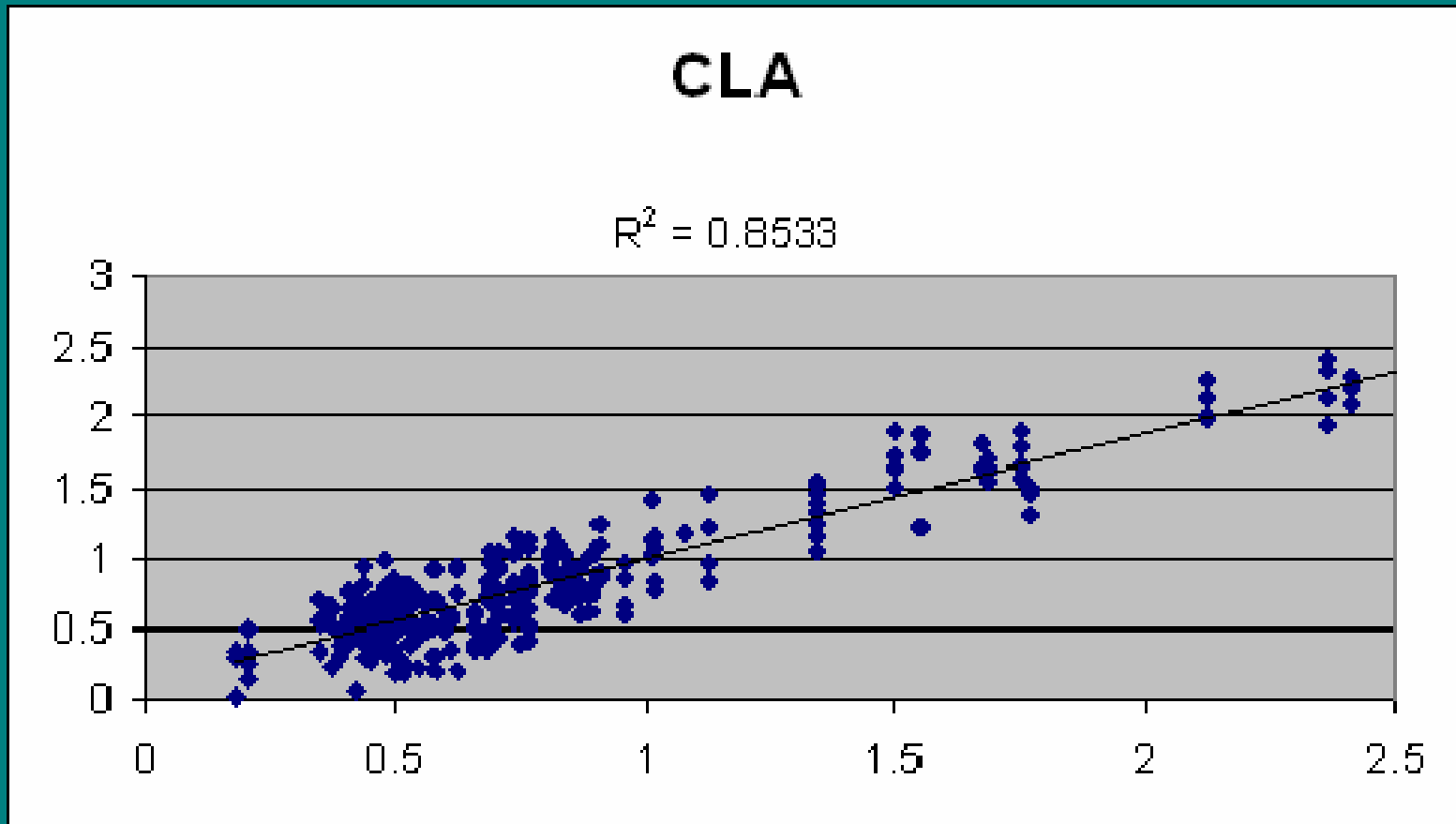
IR

Omeg6/Omega3

$$R^2 = 0.8005$$



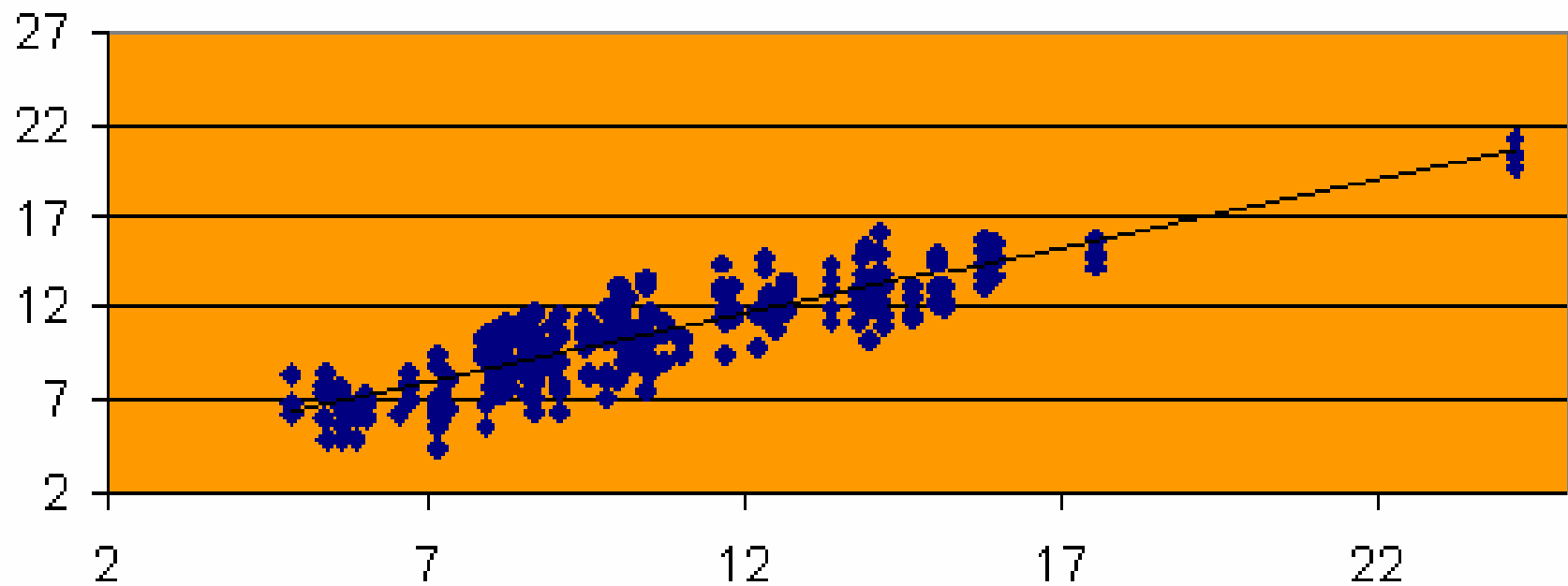
IR



IR

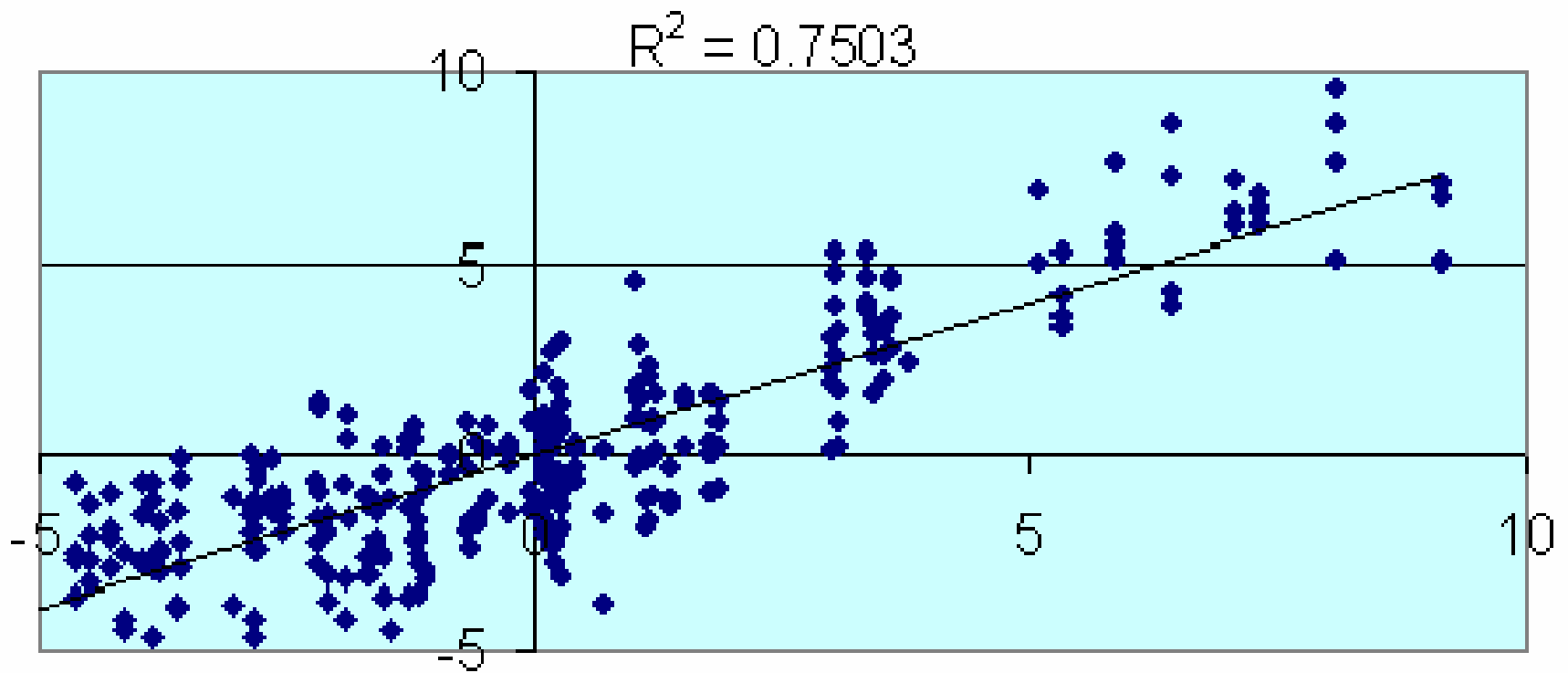
Indice Trombogenico

$$R^2 = 0.7705$$



IR

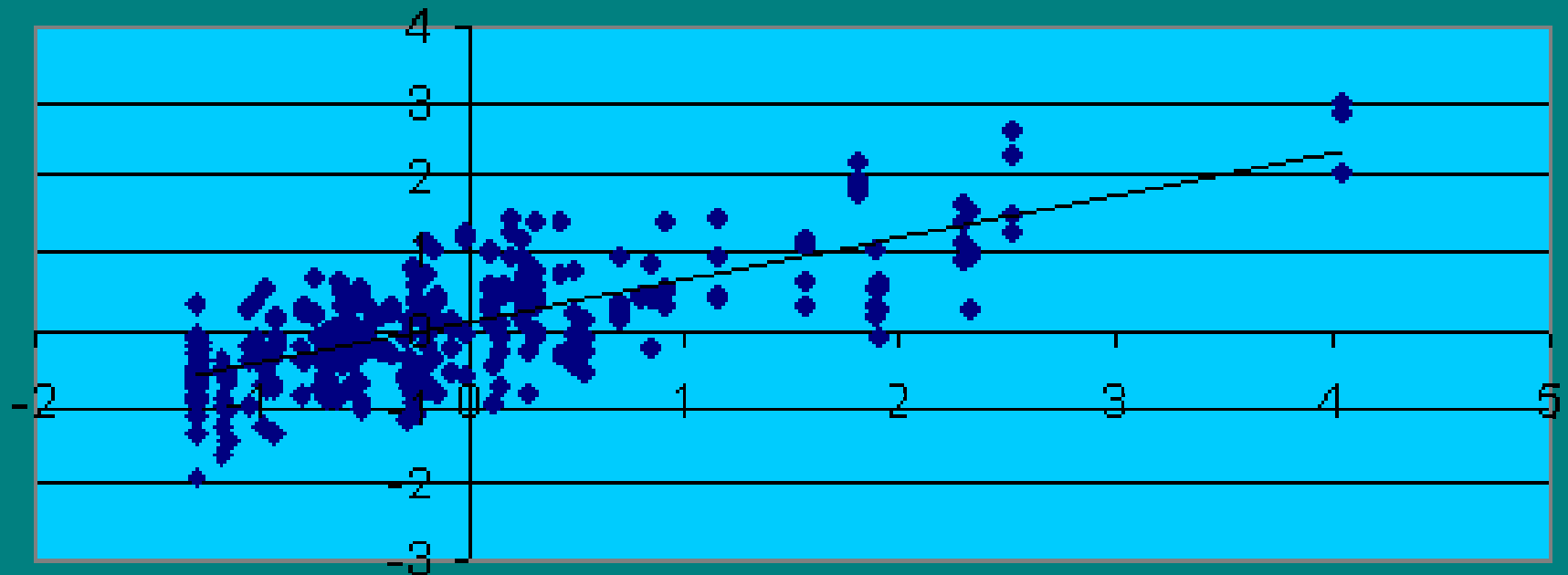
INUT

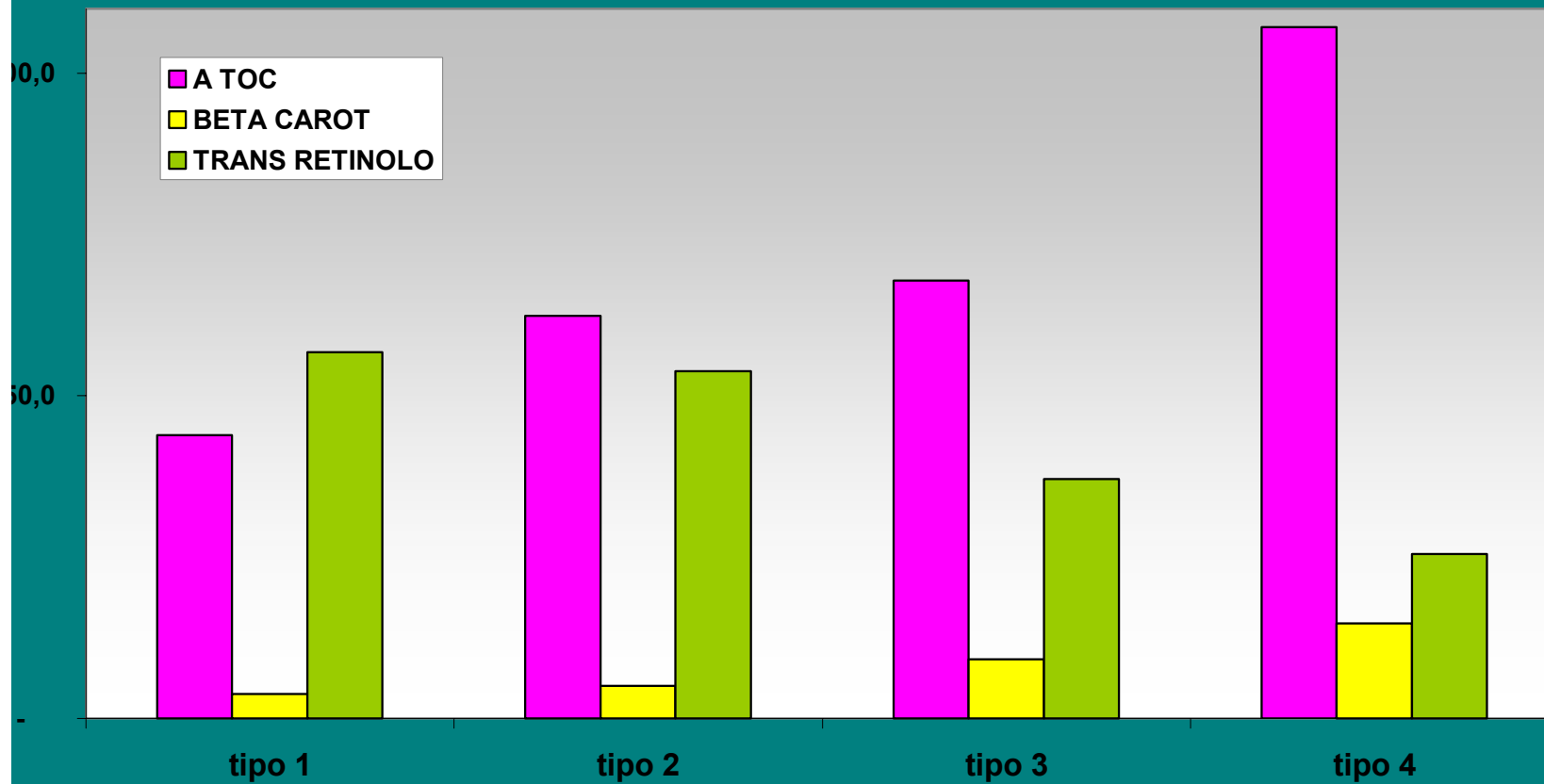


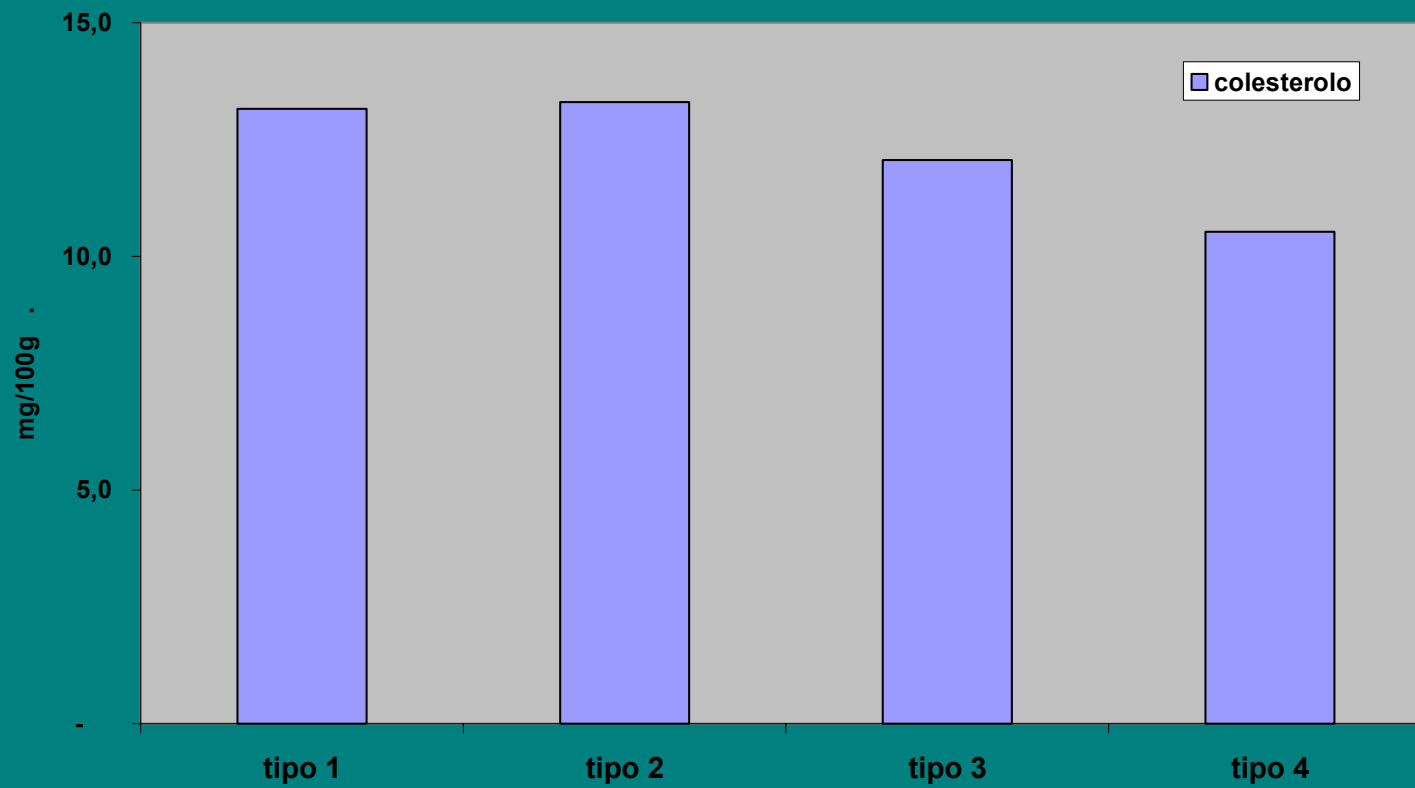
IR

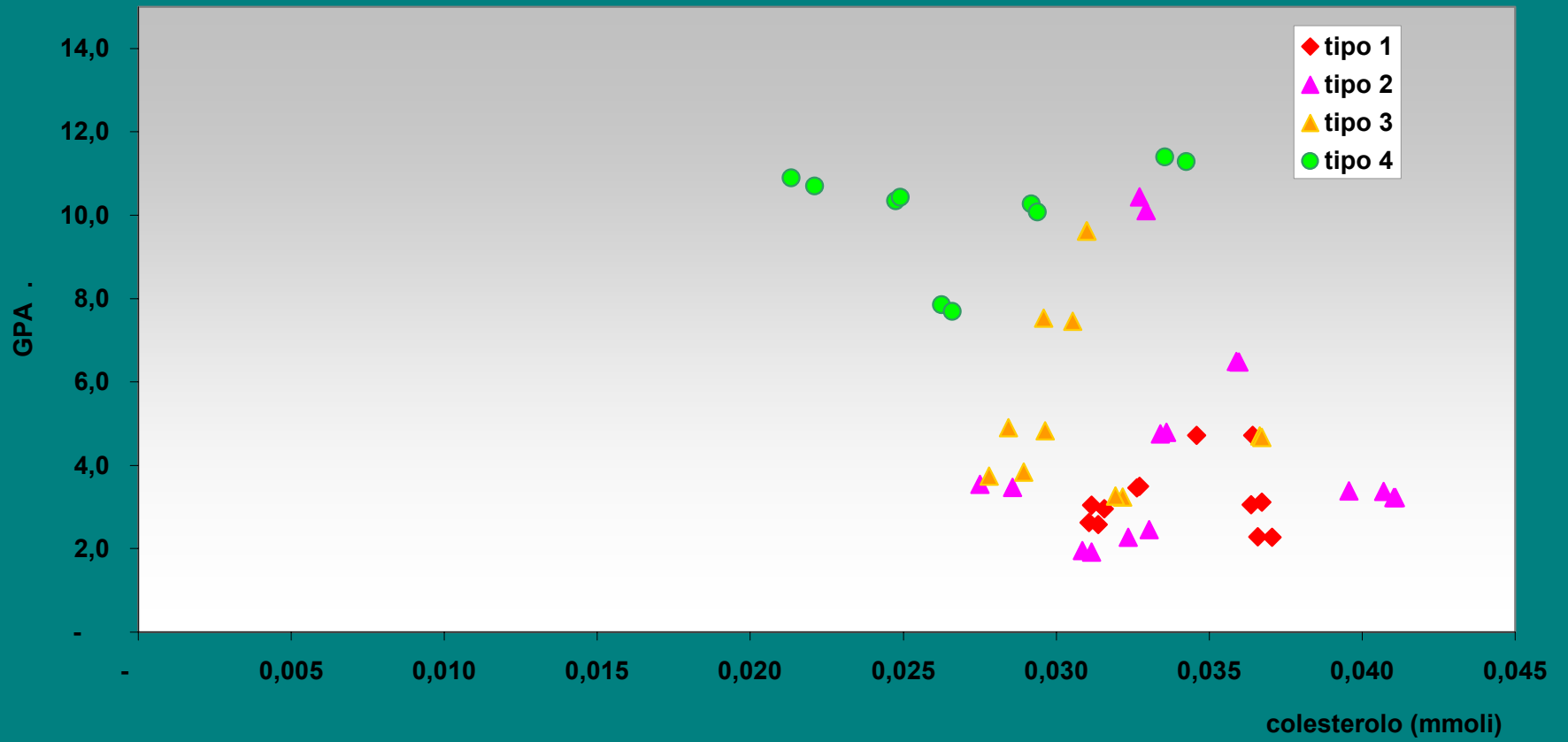
IAR

$R^2 = 0.5256$

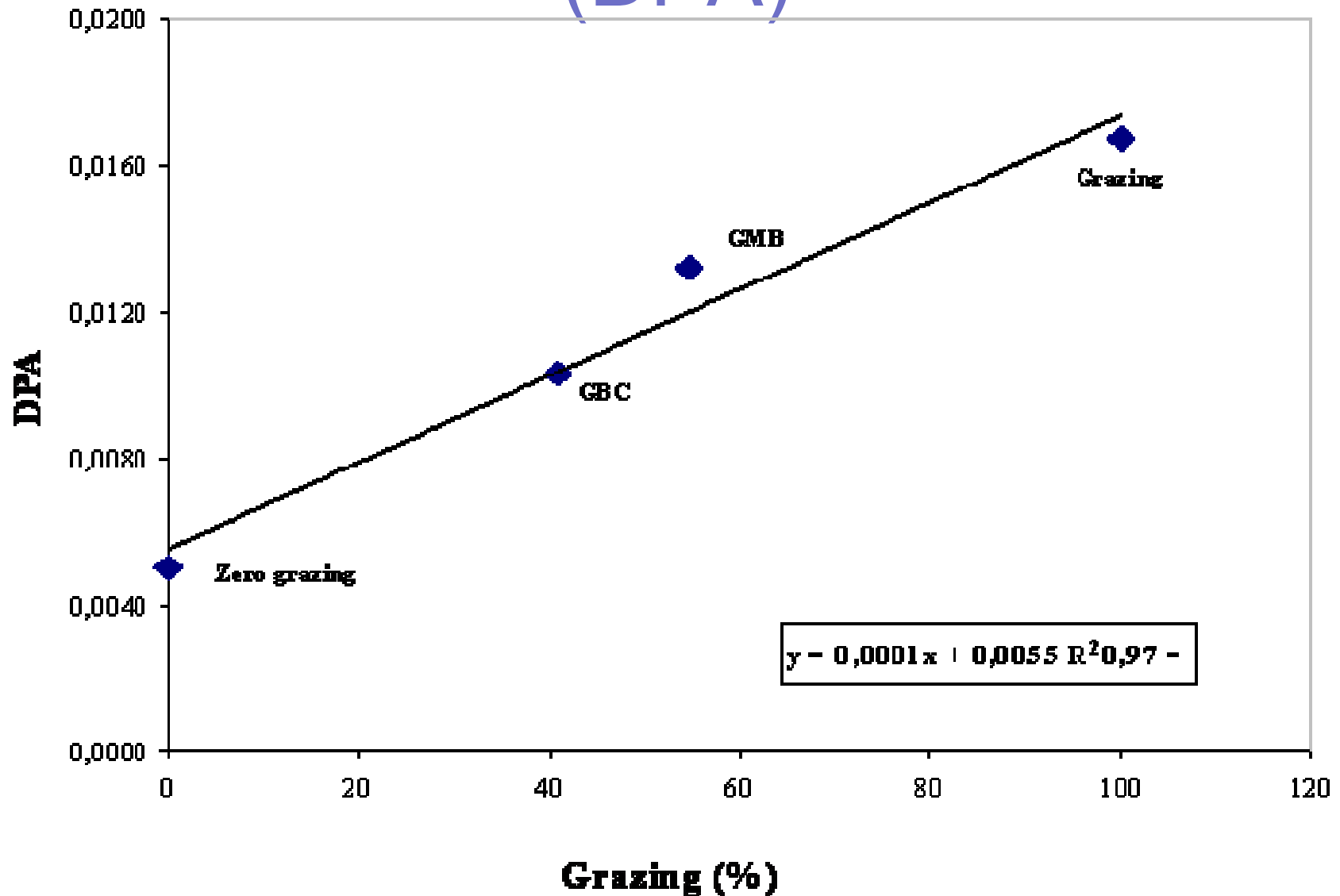








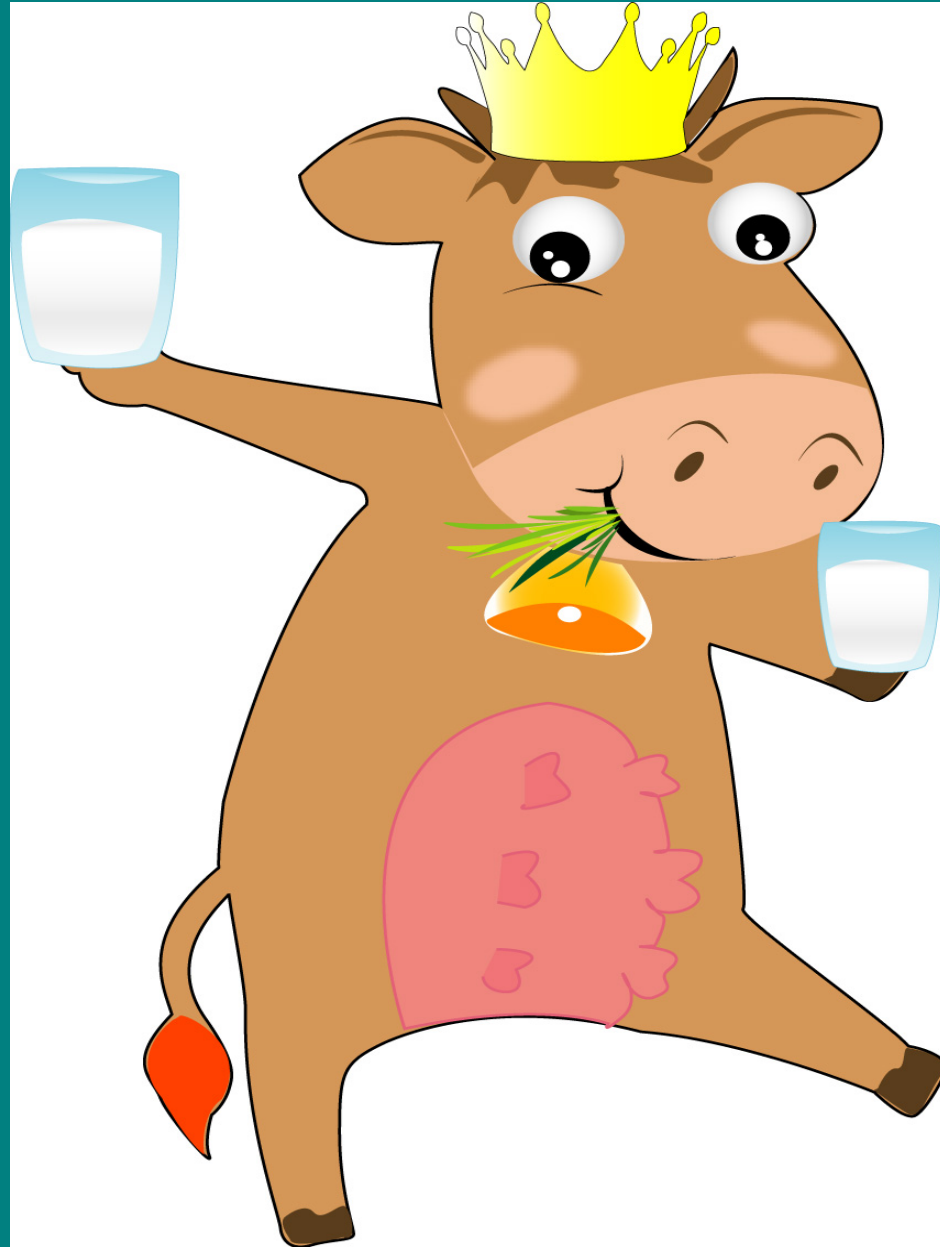
Grado de proteccion antioxidante (DPA)



Conclusiones

- El numero de las clases dependerà de la variabilidad del sistema
- En Italia 3 clases parecen bastante
- El IR estima mejor de la Nariz

GRACIAS



Latte Nobile



Disciplinare

- Quantità di erba nella razione: 70%
- Numero di erbe: >4
- Concimazione: 80 Kg fosforo/ha
- Livello produttivo vacca < 5000 litri

Promozione



Un gioco



Funzionerà?

- Se il consumatore saprà trasformare la sua voglia di qualità in una domanda di qualità