



The University of  
**Nottingham**

**EPSO workshop**  
**"The European Feed Value Chain"**  
**Copenhagen: 26 June - 27 June 2007**

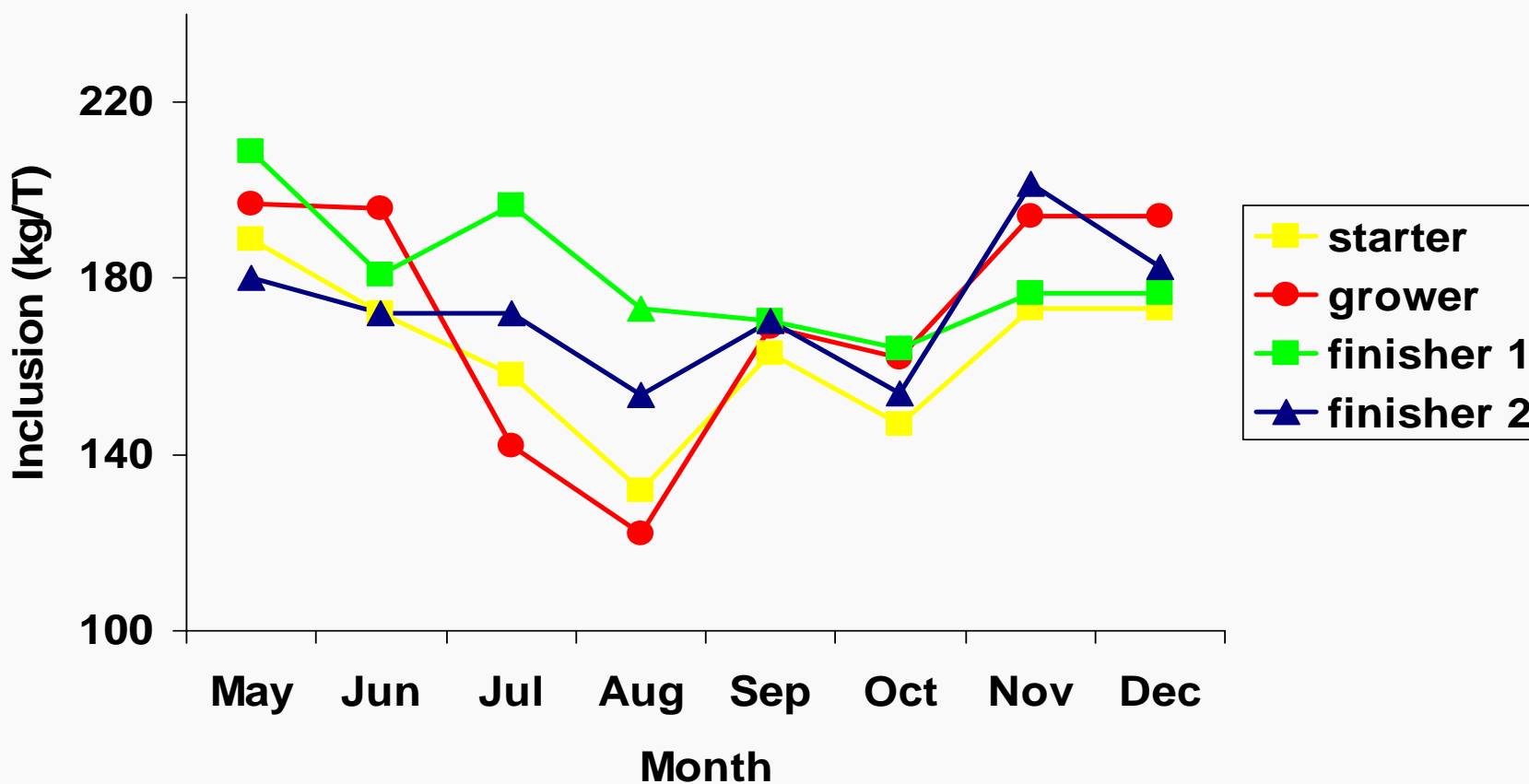
***Nutritional quality of plant diets for non-ruminant farm livestock***

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**University of Nottingham, UK**

# SBM.....

- **Soya bean meal**
  - **The bench mark against which ALL plant protein materials MUST be judged.**
    - **Highest protein content**
    - **Best amino acid profile**
    - **Relatively consistent quality**
      - **An ESSENTIAL aspect of feed production.**
    - **Available year-round**
      - **North / South America**
    - **End-user driven**
  - **Problems**
    - **European nitrogen balance**
    - **Carbon footprint - transport**

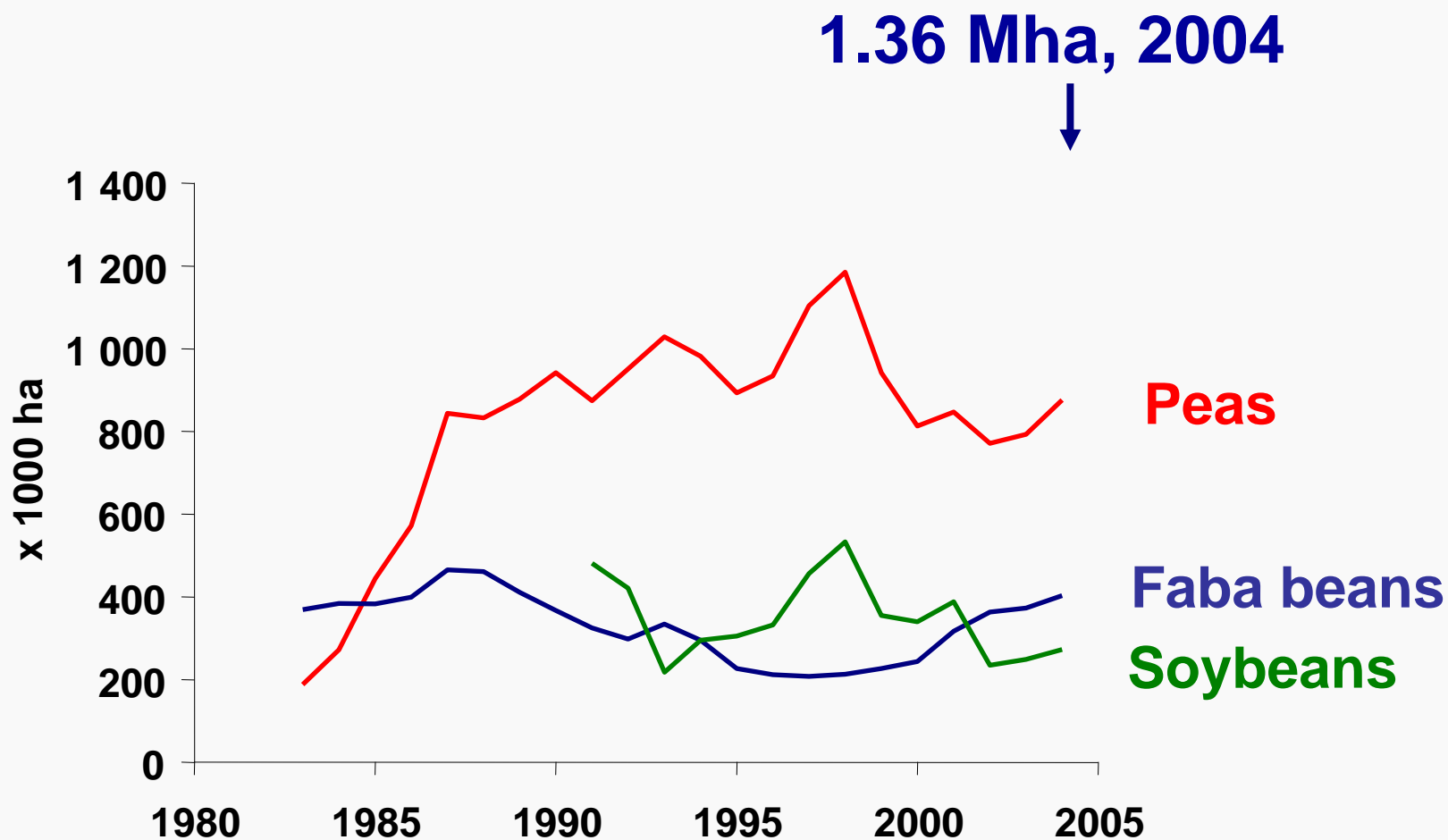
# SBM for broilers: UK feed mill



High levels of inclusion:

- emphasis on quality is CRUCIAL

# Major Grain Legumes; EU-15



Source : UNIP; Crepon 2007

# How much is used in the UK?

	Peas	Beans
Layers	100-150	50
Broilers	40 S, 60 G, 75 F	40 S, 60 G, 75 F
Turkeys	20 S, 50 G, 75 F	25 G 50 F

'Extrupro' is 500 Rape + 500 peas or beans; widely used.

-Thus hard to break down into peas and beans individually.

-3.3 million tonnes broiler food

~100g/kg = 165,000 T peas and beans

-Soya is always used in poultry diets

-Level is price sensitive; applies to all raw materials

-Around 550,000 T / annum for UK poultry

# Chemical composition of legumes

## Positive

### - Crude Protein

Amino acids

Essential vs non-essential

### - Starch

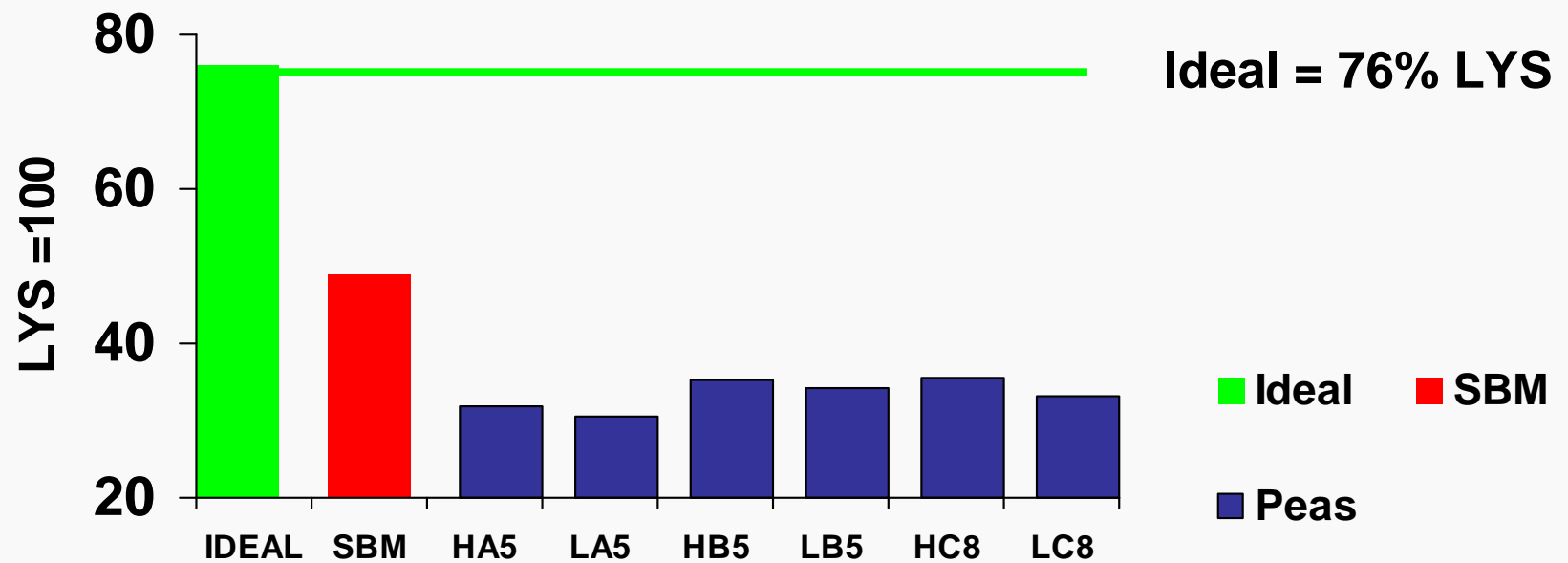
Energy-yielding

# Chemical composition of legumes

Positive	Negative
<ul style="list-style-type: none"><li>- Crude Protein<ul style="list-style-type: none"><li>Amino acids</li><li>Essential vs non-essential</li></ul></li><li>- Starch<ul style="list-style-type: none"><li>Energy-yielding</li></ul></li></ul>	<ul style="list-style-type: none"><li>Crude Fibre</li><li>Trypsin Inhibitors</li><li>Tannins</li><li>Vicine / convicine</li></ul>

# Amino acid composition of pea protein Methionine + Cystine

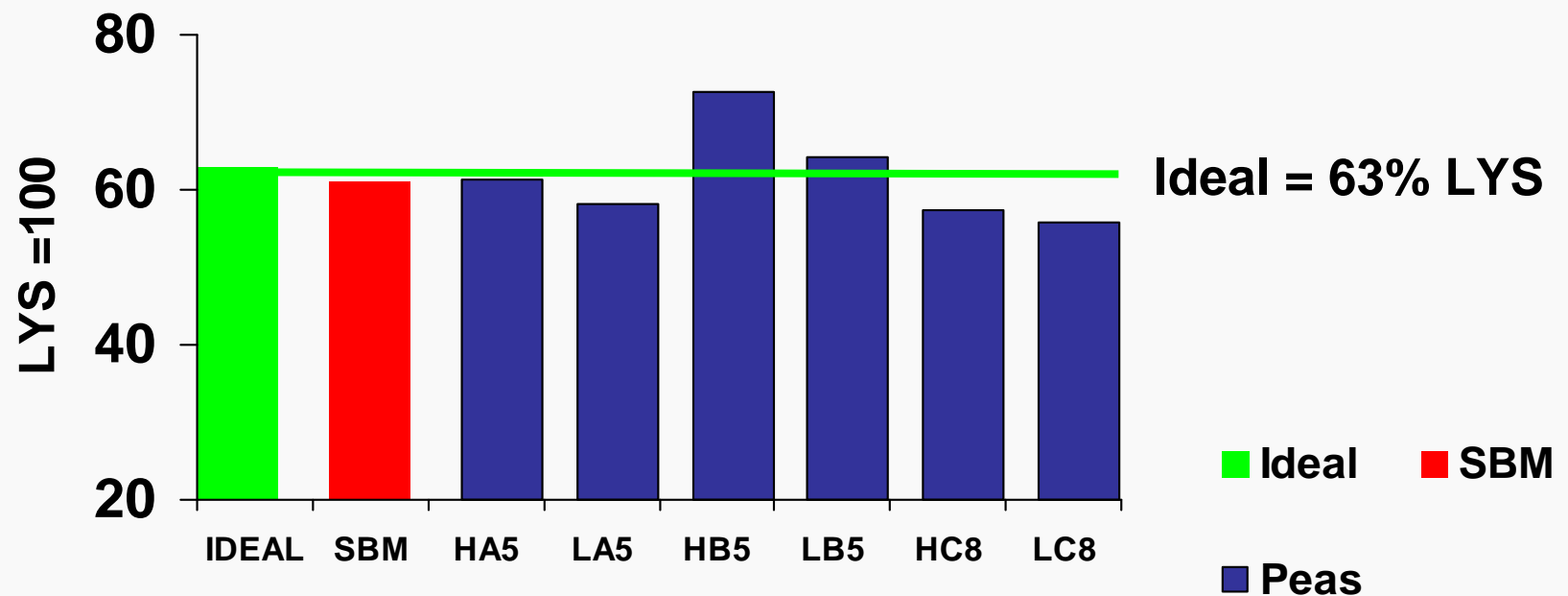
Concept of 'ideal protein'



# Amino acid composition of pea protein

## Threonine

Concept of 'ideal protein'

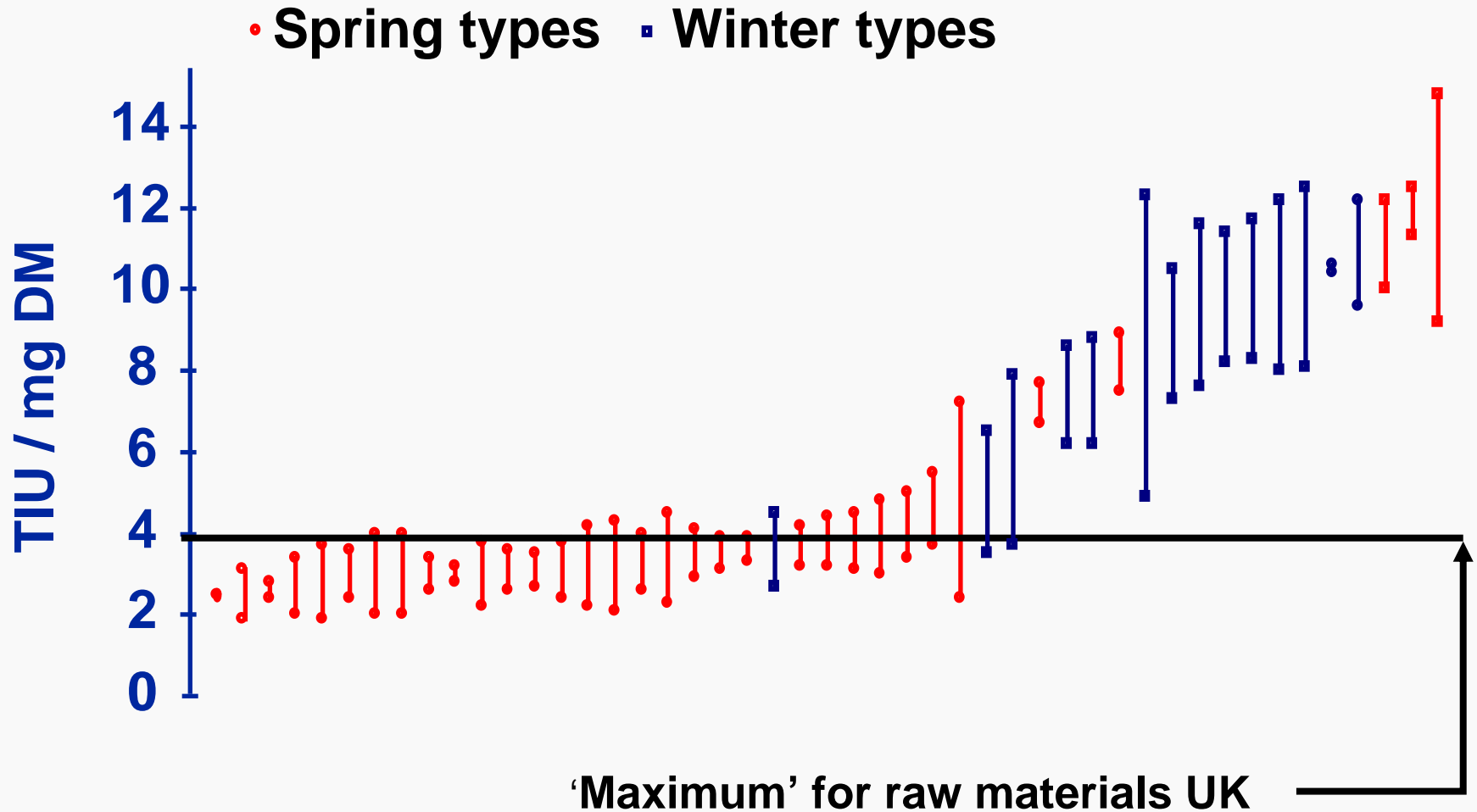


Wiseman et al., 2003,2005

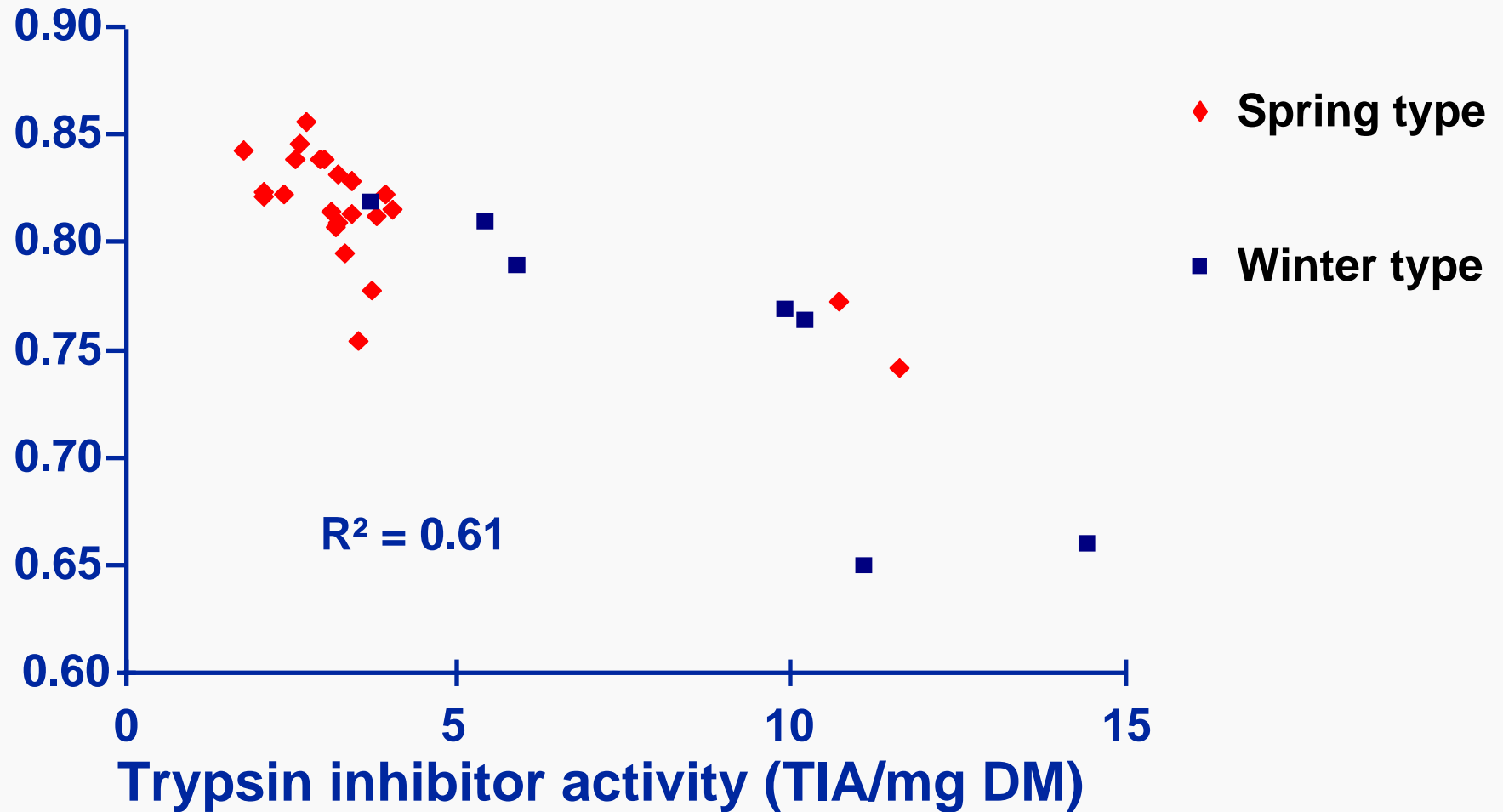
# Trypsin Inhibitors

- Naturally-occurring
- Several compounds present with anti-trypsin activity
  - True trypsin inhibitors
    - Dependent on assays utilised
    - Bowman-Birk type predominate in peas
      - Two active binding sites
  - Tannins
- Interfere with protease activity
  - Reduction in protein / amino acid digestibility
- Hyper-secretion of trypsin
  - Pancreatic hypertrophy
  - Increased demand for sulphur amino acids
- Selection for low TI?
  - TIs are themselves high in sulphur amino acids

# TIA of pea cultivars (mean $\pm$ sd)

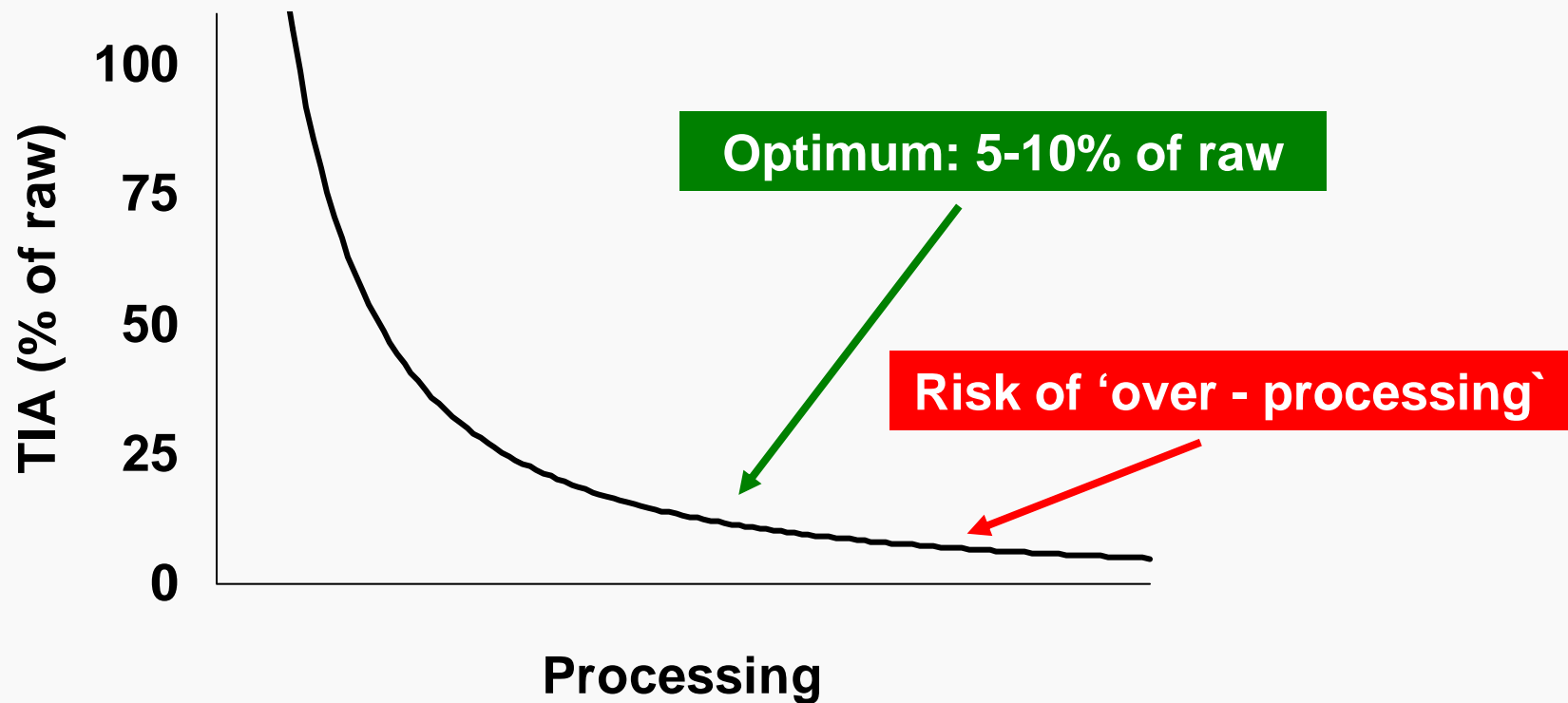


# Standardized ileal digestibility of pea protein based on TIA



# Optimum vs overheating

- Precision of processing assuming greater importance

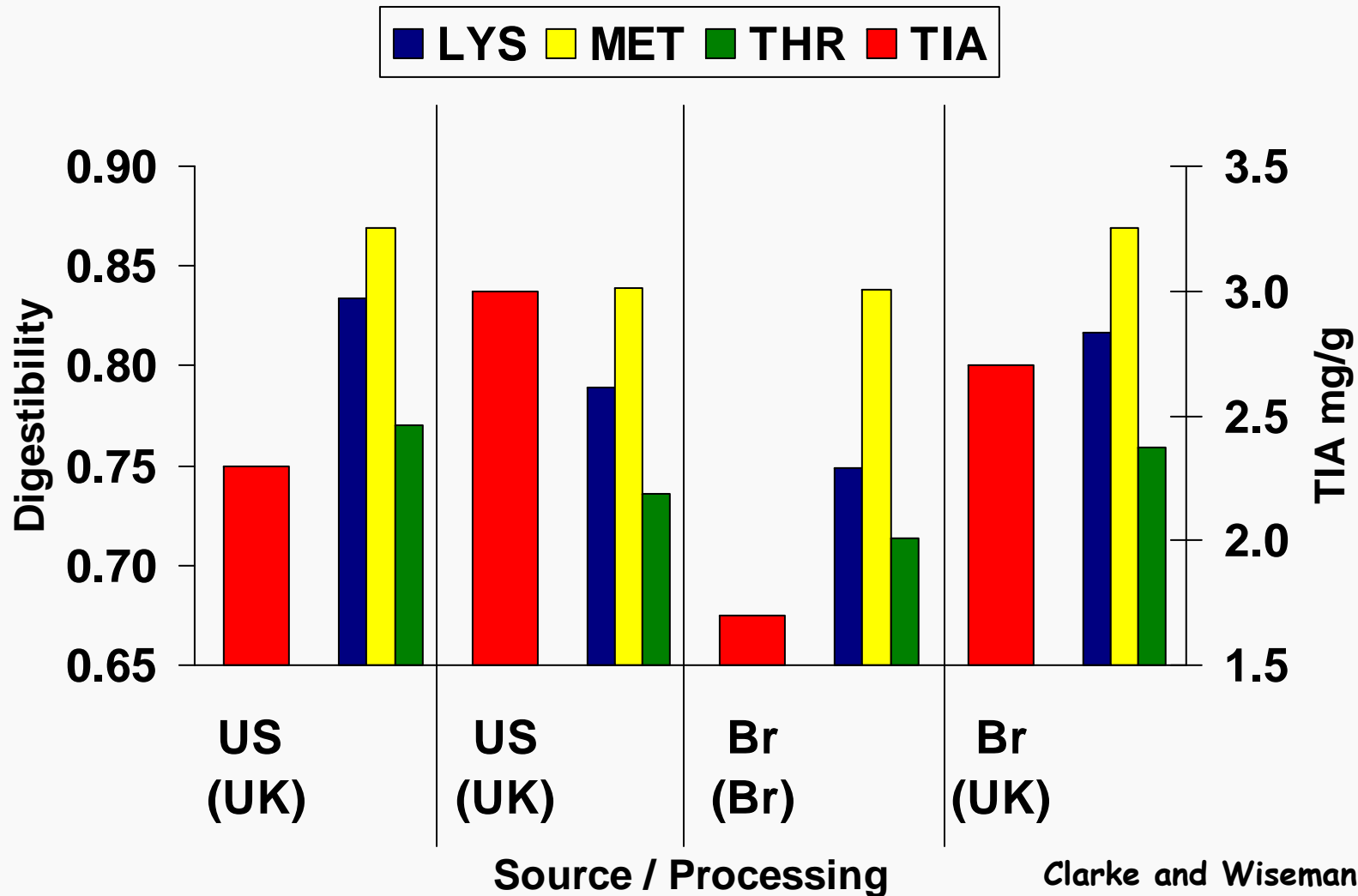


# Near isogenic lines of peas Allow assessment of true TIs

- A, B and C Lines near-isogenic, except for the *Tri* and closely linked genetic loci.
- *Tri* locus contains the *T11* and *T19* classes of genes encoding
  - major seed trypsin / chymotrypsin inhibitor proteins
  - relatively minor seed trypsin / trypsin inhibitor proteins
- Genetic locus also controls quantitative variation in trypsin inhibitor activity (TIA).

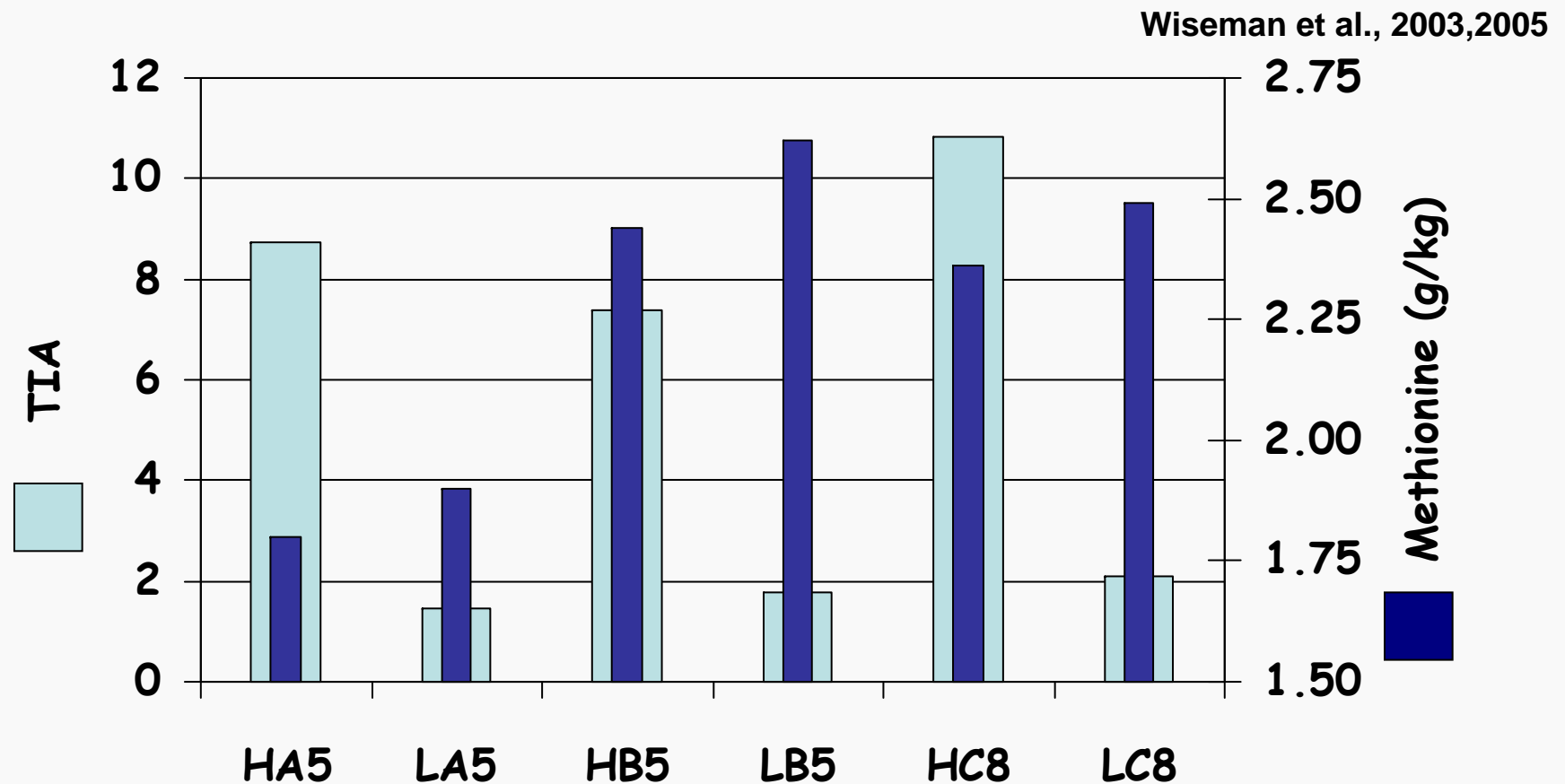
# Variability in UK quality? Broilers

All below accepted TIA maximum of 4.0 mg/g



Clarke and Wiseman, 2001

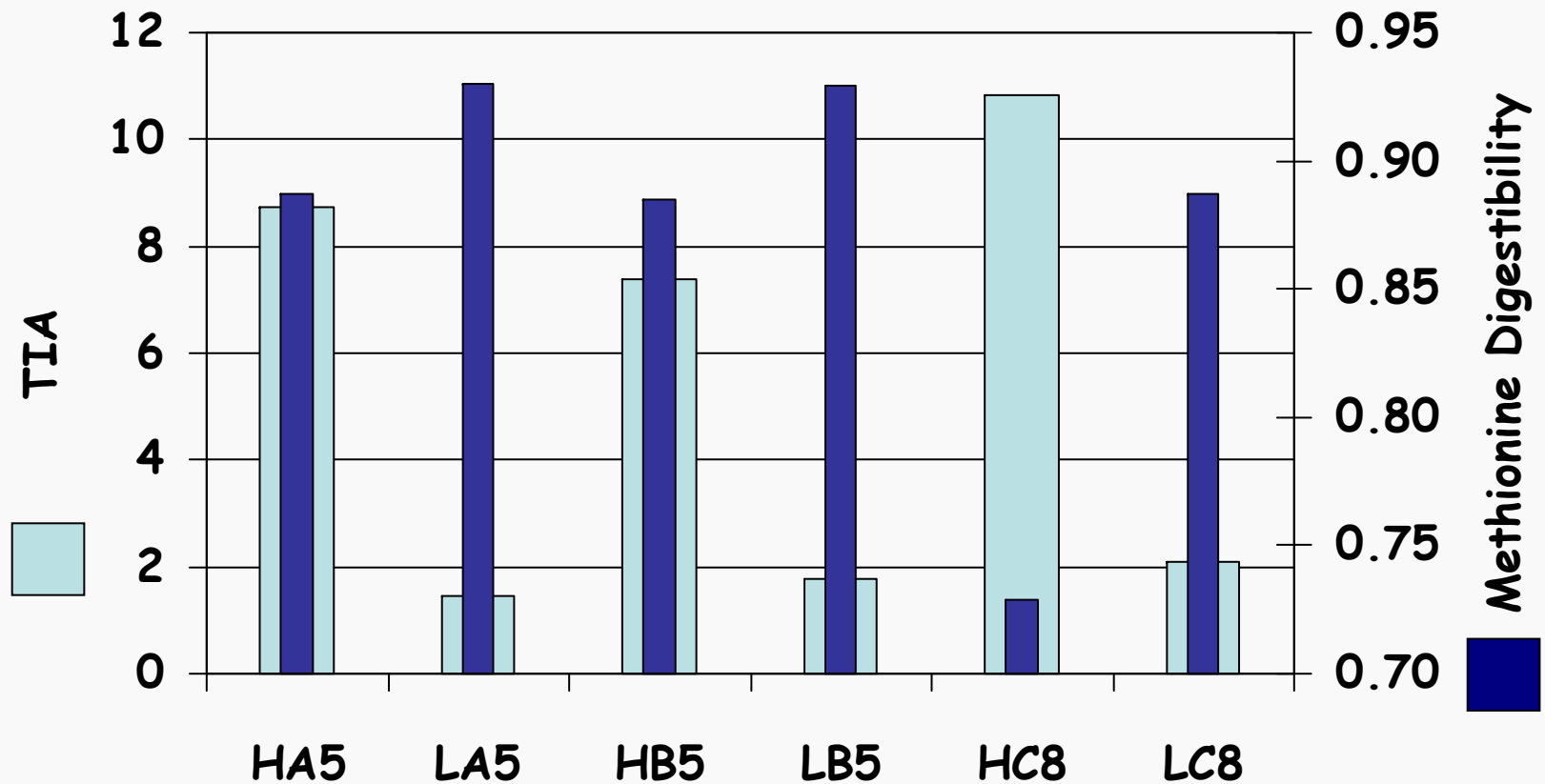
# Near isogenic lines of peas Allow assessment of true TIs



Lines LOW in TIA have HIGHER levels of Methionine

- Thus, as genes controlling TIA are known, selection for low TIA WITHOUT compromising Methionine content is possible.

# Near isogenic lines of peas



Lines LOW in TIA have HIGHER levels of Methionine Digestibility

# Conclusions

- **Legumes**
  - **Essential plant protein components of livestock diets**
  - **World market dominated by soya**
    - **Key quality issues**
  - **'EU' legumes**
    - **Quality, variability, seasonality**
    - **Problems CAN be addressed**
      - **Essential to move to end-user market-driven**
  - **Will the EU ever use more 'EU' legumes?**
    - **At the moment no !**
    - **C and N tax introduction may change picture?**
      - **Home grown legumes vs increased N pollution associated with poorer quality raw materials ?**
- **Don't forget wheat – at 600g/kg it will supply 0.25 of Lysine.....**



**Thank you for your attention**



**Questions.....?**

**It IS the Chinese golden year of the pig !**