Impact of biofuel production from cereals on the European pig and poultry sectors

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Biofuels Global Production

- Bioethanol – 75bn litres in 2008 (US 45%, BR 35%)
- Biodiesel – 12 bn litres in 2008 (EU 65%)
- Use of feeds for biofuel increases feed prices
- Negative impact on livestock producers and the consumer
- Net energy gain of biofuels is low
- Expansion of biofuels is driven by subsidies and mandatory blending

Overview of EU biofuel market

- C. 8.0*mt biodiesel and 3.0mt ethanol
- Bioethanol – Germany 30%, Spain 25%, France 20%
- Biodiesel – Germany 35%, France 25%
- Expansion of biofuels may cause change in cropping – less cereals, more rapeseed

EBB - 2008

Banse et al. 2008

Biofuel and EU feed prices

- Without mandatory blending (MB) of biofuels real world prices for agricultural products will continue to decline
- MB could increase oilseed prices by almost 20% and cereals by 5% in 2020

Banse et al. 2008

Projections for EU cereal market

	2007	2008	2010	2014
Production, mt	256	294	294	306
Bioenergy use, mt	2	5	6	18
Bioenergy, %	1	2	2	6

(Marouby & Gaudre, 2009)

Cereal to ethanol process

- DDGS = cereal minus most starch
- Cereal feedstock:
  - Ethanol
  - Carbon dioxide
  - DDGS
  - Approx equal amounts of each

Main sources of DDGS

- Maize - US
- Wheat – EU, Canada
  - Barley
  - Sorghum
  - Blend of cereals

Overview of US DDGS

- C. 30mt. produced per year
- Most fed to ruminants
- Increasing use by pigs
- Delays in GM authorisation are limiting EU imports

UMN website 2007

EU imports of maize byproducts

Will DDGS supply continue ?

- Political decisions may affect industry
- High oil prices will encourage biofuel production
- How much can US livestock use ?

Effect of policy changes

- Biodiesel is more efficient than bioethanol as a source of energy (energy yield v. energy input)
- Will this mean promotion of biodisel in Europe ?
- More rapeseed meal and less EU DDGS ?
- Bioethanol from non-feed materials ?

Composition of Maize and Wheat DDGS

	Maize DDGS	Wheat DDGS
Crude protein, g/kg	251	360
Oil, g/kg	87	29
NDF, g/kg	240	250
DE, MJ/kg	14.5	14.4
NE, MJ/kg	7.5	7.2

(Leterme & Beaulieu, 2009)

Composition of DDGS

- Influenced by:
  - Feedstock (variety, blend of cereals)
  - Manufacturing plant
  - Ratio of wet cake to solubles
  - Drying method

New developments in DDGS

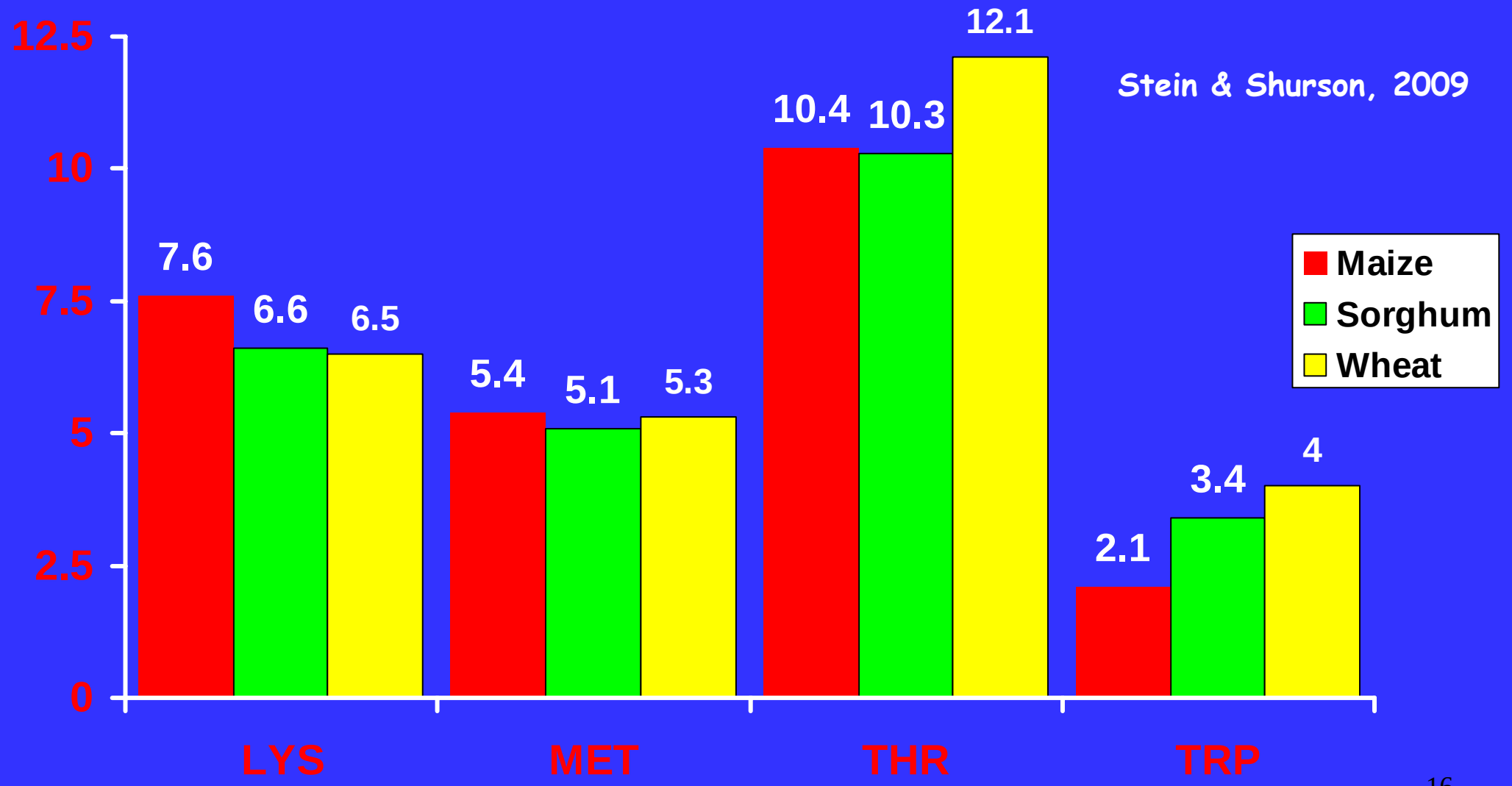
- Fibre removal
  - Increases CP by 6 to 8% units
- Oil removal
  - Reduces energy value

Energy content in maize and DDGS

	Maize	DDGS Average	DDGS Low	DDGS High
Energy Digy., %	90	77	74	83
DE, MJ/kg	14.7	14.9	14.2	16.5
Starch, g/kg	620	73	38	114

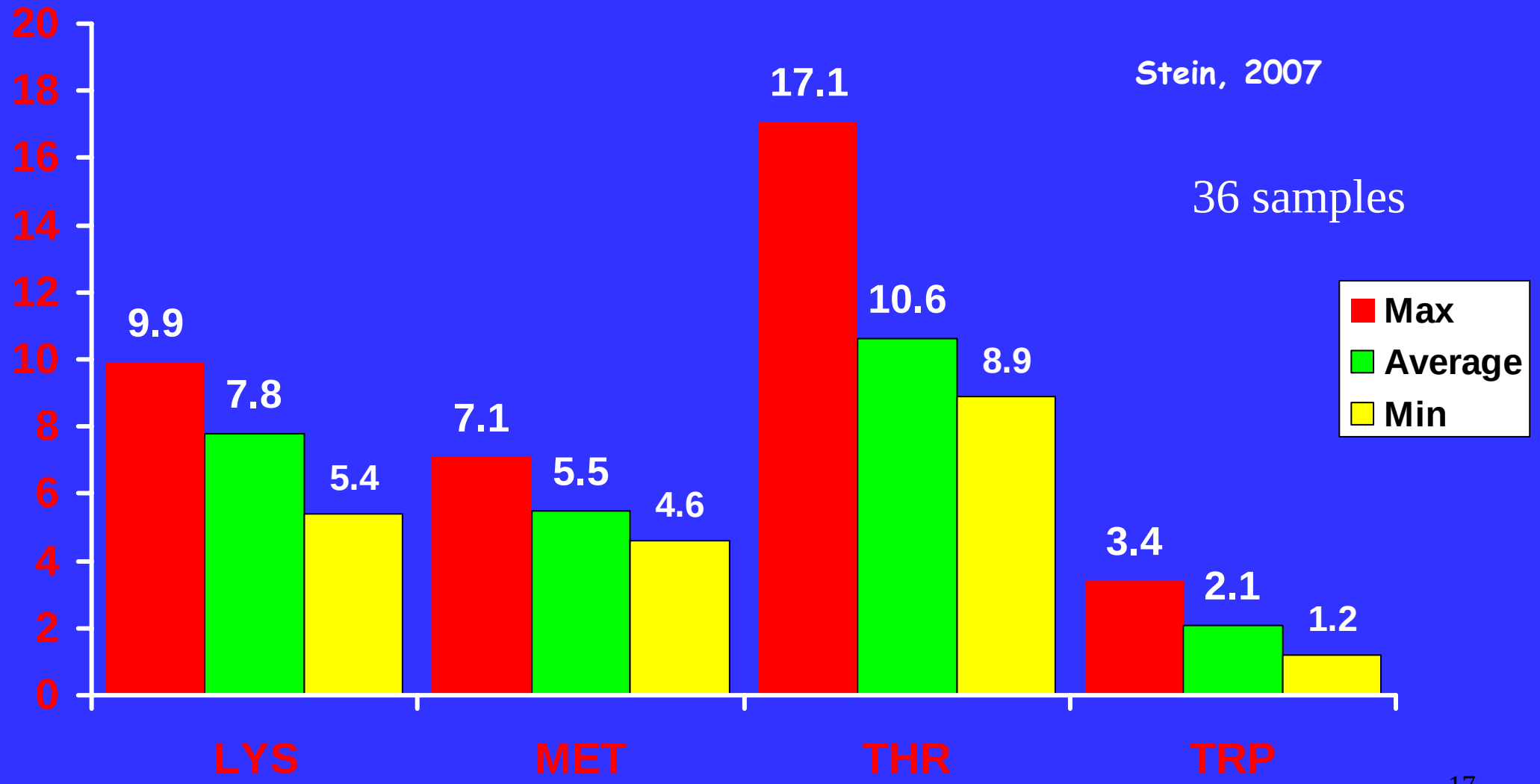
(Stein, 2007)

AA in DDGS from cereals, g/kg

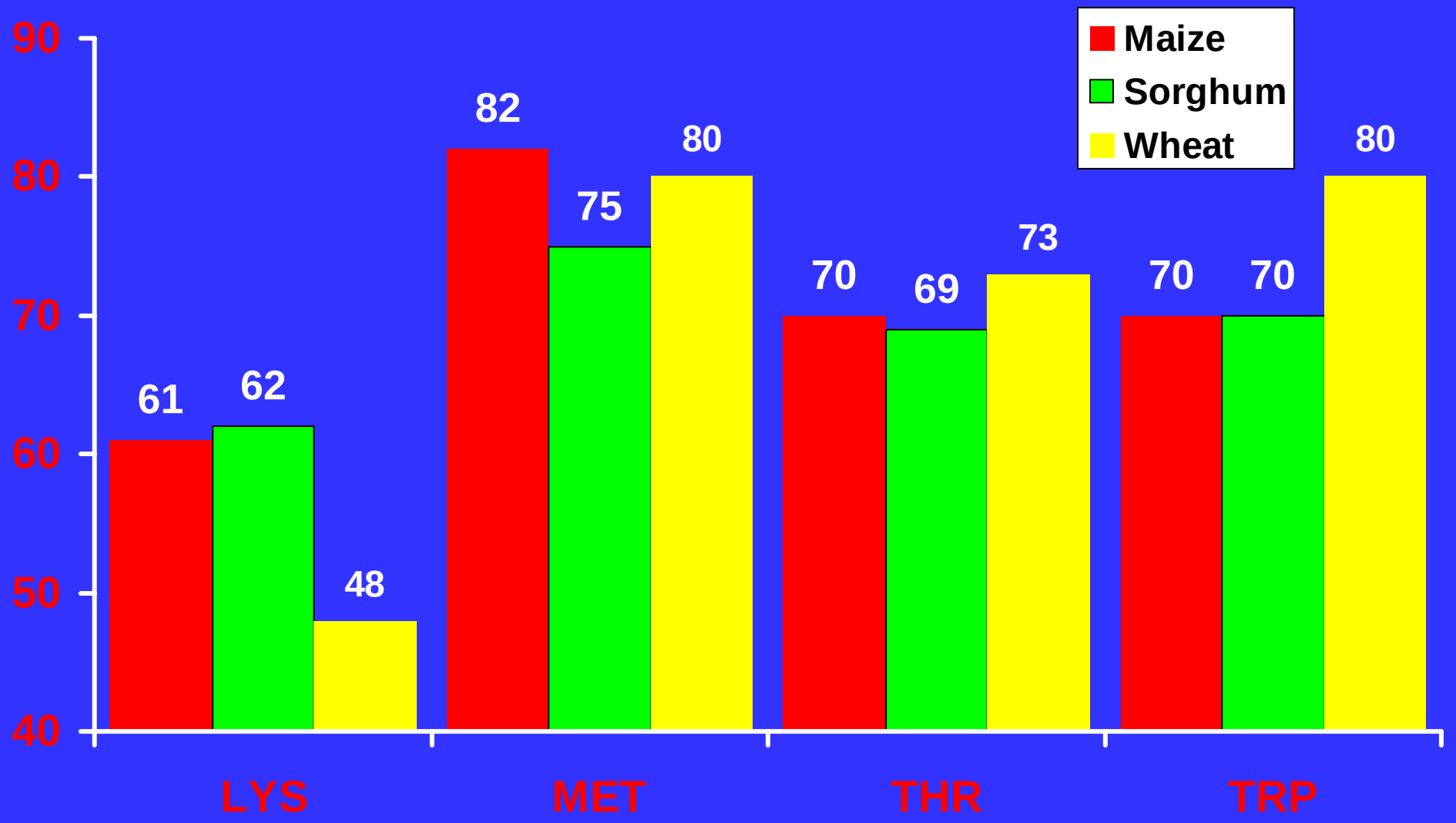


Yeast in DDGS

Variation in AA in maize DDGS, g/kg

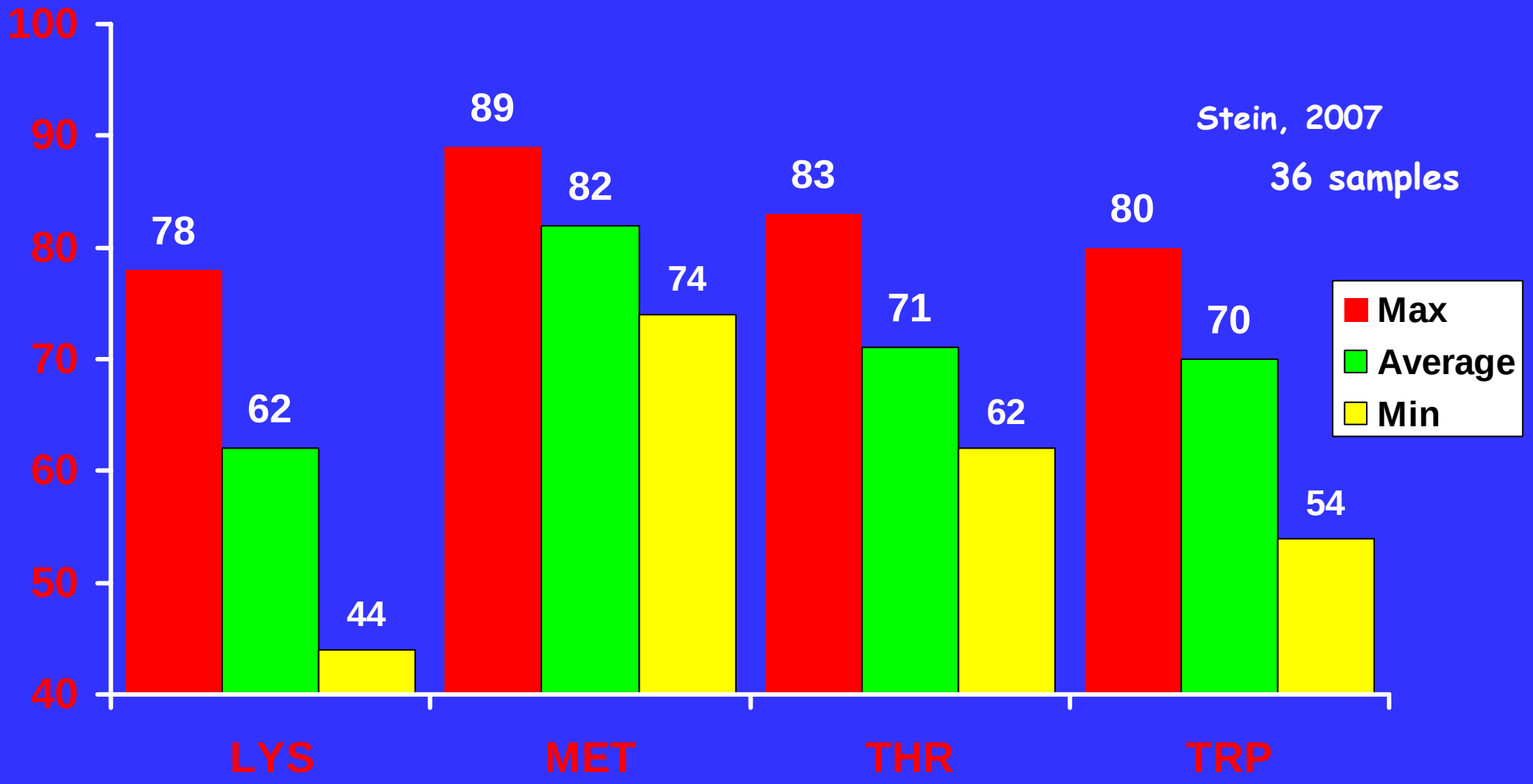


Digy. of AA in DDGS from cereals, g/kg

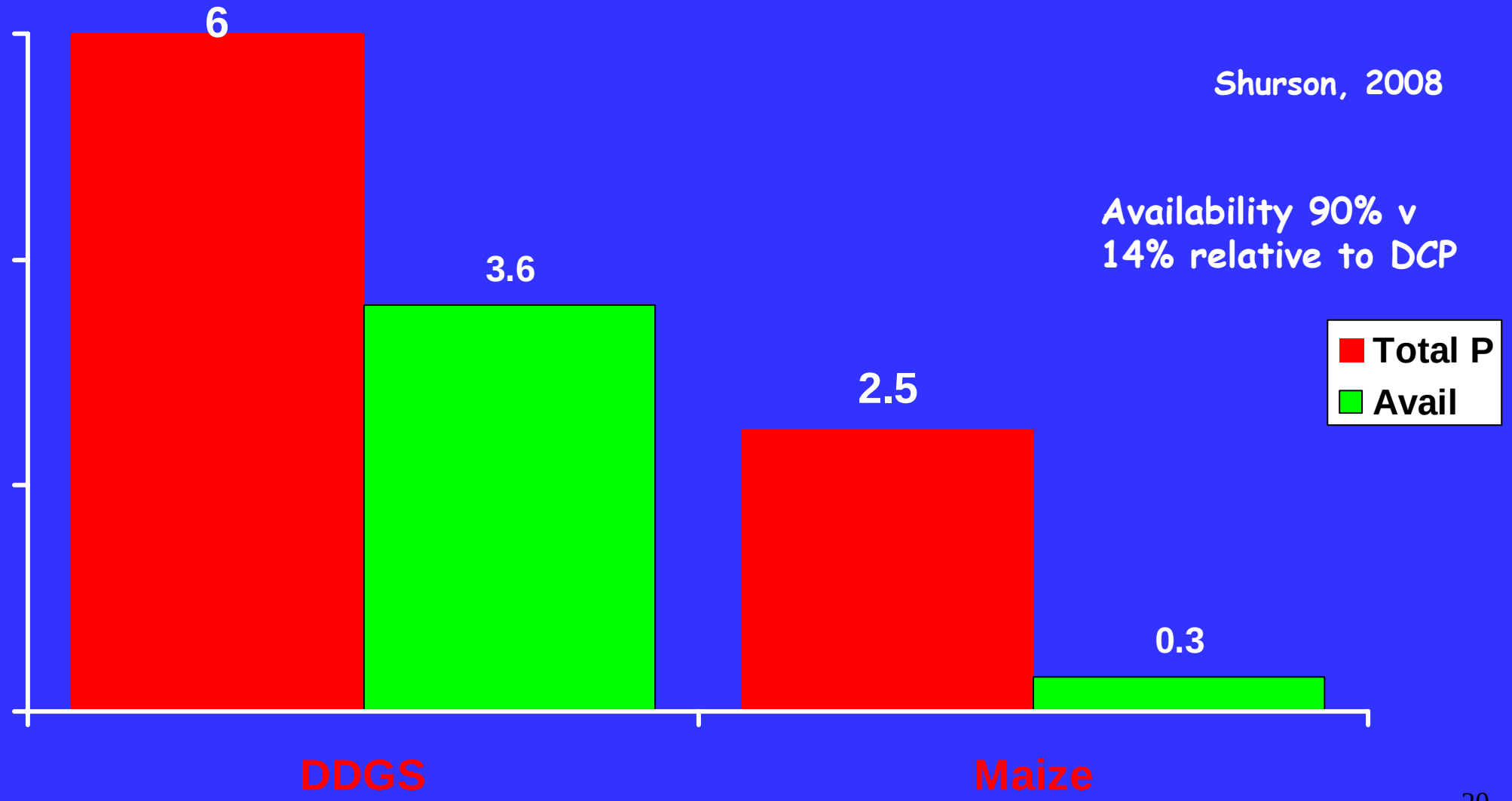


Stein & Shurson, 2009

Variation in digy. of AA in maize DDGS, %



P level and availability in maize and maize DDGS for pigs, g/kg



Maize DDGS for weaner pigs (no. trials)

	Improved	No effect	Poorer
ADG	0	10	0
Feed/day	0	8	2
FCE	5	5	0

Stein & Shurson, 2009

Summary of 10 trials with 0 to 30% DDGS in maize-SBM diets

Maize DDGS for G-F pigs (no. trials)

	Improved	No effect	Poorer
ADG	1	18	6*
Feed/day	2	15	6
FCE	4	16	5
Iodine value	0	1	7

* Mainly at 40% inclusion

Stein & Shurson, 2009

Summary of 25 trials with 0 to 40% DDGS

Response to DDGS in maize – SBM diets (23 to 114kg) - growth

DDGS, %	0	10	20	30
ADG, kg	0.92	0.92	0.92	0.91
Feed/d, kg*	2.57	2.55	2.49	2.47
FCE*	2.79	2.76	2.71	2.7

* Significant linear effect

Shurson, 2008

Response to DDGS in maize – SBM diets (23 to 114kg) - carcass

DDGS, %	0	10	20	30
Dressing, % *	77.9	77.8	77.1	76.7
Belly firmness	40	35	32	27

* Significant linear effect

No effect on fat stability in storage to 28 days.
Iodine value and PUFA increased

Xu et al 2007 by Shurson, 2008

Effect of maize DDGS on manure

- Increased faeces (reduced DM digestibility)
- No effect on urine volume
- Increased N excretion
- Increased P excretion at >20% of diet
- No effect on NH_3 and H_2S

Shurson, 2008

Feeding liquid DDGS

- Possible near manufacturing plant
- Increased manure volume
- Damp conditions in house
- Loss of synthetic AA
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Response to wheat DDGS in wheat – SBM diets (25 to 52kg)

DDGS, %	0	10	20	25
ADG, kg*	0.81	0.77	0.75	0.72
Feed/d, kg*	1.50	1.47	1.41	1.37
FCE	1.86	1.89	1.88	1.91

* Significant effect

Iso-DE, total LYS

Thacker, 2005

Response to wheat DDGS in wheat – SBM diets (52 to 113kg)

DDGS, %	0	10	20	25
ADG, kg	1.05	1.02	1.06	1.09
Feed/d, kg	2.87	2.86	2.84	2.92
FCE	2.74	2.80	2.70	2.66

No significant effect

Iso-DE, total LYS

Thacker, 2005

Diet formulation on SID LYS basis (1)

Maize DDGS, %	0	10	20	30
maize, %	80	71	61	52
Soyabean meal, %	18	18	17	16
Misc	2	1	2	2

Diet formulation on SID LYS basis (2)

DDGS, %	0	10	20	30
Cr. protein, g/kg	155	172	189	206
Fat, g/kg	37	45	46	50
ME, MJ/kg	14.1	13.9	13.7	13.4

Shurson 2008

Maize DDGS in sow diets

- Considered risky due to mycotoxin concerns
- Increased lactation intake
- Sows more content
- Less constipation
- In UMN trials up to 30% in lactation diet had no effect on sow and litter performance

Stein & Shurson 2008

Maize DDGS and gut health in pigs

- **"Dietary inclusion of 10% DDGS appears to provide some benefit to growing pigs subjected to a moderate *L. intracellularis* challenge, similar to those of a currently approved antimicrobial regimen"**

Whitney et al. 2006

Maximum inclusion levels of Maize DDGS in pig diets

- Nursery (>7kg) 30%
- Grow-finish 30%
- Gestation 50%
- Lactation 30%

* Golden high quality US DDGS

(Shurson 2008)

Barriers to maize DDGS use in pig diets

- **Variability in nutrient content and digestibility**
- **NSP content (more a problem in wheat DDGS)**
- **Small particle size and flowability**
- **Perceived risk of mycotoxins (sows)**
- **Poorer pellet quality**
- **Effect on carcass fat quality**
- **Reduced intake at high levels**
- **Lack of reliable net energy values**

Shurson, 2007

Quality control in DDGS purchase

- Source / production system
- Chemical composition (CP > 27%; fat >9%; P >0.55)
- Colour (light golden is best)
- Odour (normal versus burnt)
- Mould / mycotoxins
- Lysine availability
- LYS:Protein ratio (>2.8%; Low value related to low LYS digestibility)

Stein, 2007

Contaminants in maize DDGS

- Small number of samples from US plants had Fumonisin above FDA threshold
- Virginiamycin (or other antibiotic) isused in some processes but should be destroyed in drying

Wheat DDGS in growing pig feeds

- High fibre can limit intake
- AA balance
- Limit to 5 to 10% in G-F diets
- Above 10% if energy and AA balanced

Wheat DDGS in pig feeds - Europe

- Geatating sows - 40%
- Finishing pigs - 20%
- Nursery pigs 3-5 wks - 5%

Maize DDGS in poultry diets

- Benefits
  - Good energy and AA source when <15% of diet
  - May reduce P excretion
  - Improved egg yolk and skin colour
  - "Golden" gives best performance
  - Very palatable
- Limitations
  - Energy value 84% of maize
  - Protein quality
  - High Na may affect litter moisture

Shurson 2008

Maize DDGS in poultry diets - limits

- Broilers and layers
  - 10% inclusion without energy adjustment
  - >10% with adjustment for energy and AA
  - Some used 15 to 20% with little effect

Wheat DDGS in poultry feeds

- Nutritional profile similar to canola
- Little information on its use
- Up to 15% used for broilers without problems

Biodiesel co-products

- Rapeseed meal - Long history of use
  - Solvent extraction
  - Cold pressed – higher in fat
  - Should be from "00" varieties
  - Optimum inclusion rates 8 to 12% - Occasionally higher
- Glycerol

Feed grade glycerol

- About 80% glycerine, water, minerals, methanol (trace)
- Risk of residues e.g. dioxin from animal and waste fats
- Up to 5% in pig feeds; 10% in poultry
- Some excretion of glycerine via kidneys
- Integrity of source is critical

Doppenberg & van der Aar, 2007

Conclusions

- Growth in biofuel will increase ingredient prices
- In Europe biodiesel is more important
- Big tonnage of DDGS on world market is from maize
- Maize and wheat DDGS can be used in pig feeds
- Quality must be assured
- Need accurate values in formulation
- Long term supply uncertain – subsidies, GM issues

Useful websites

- www.ddgs.umn.edu
- www.ddgs.usask.ca