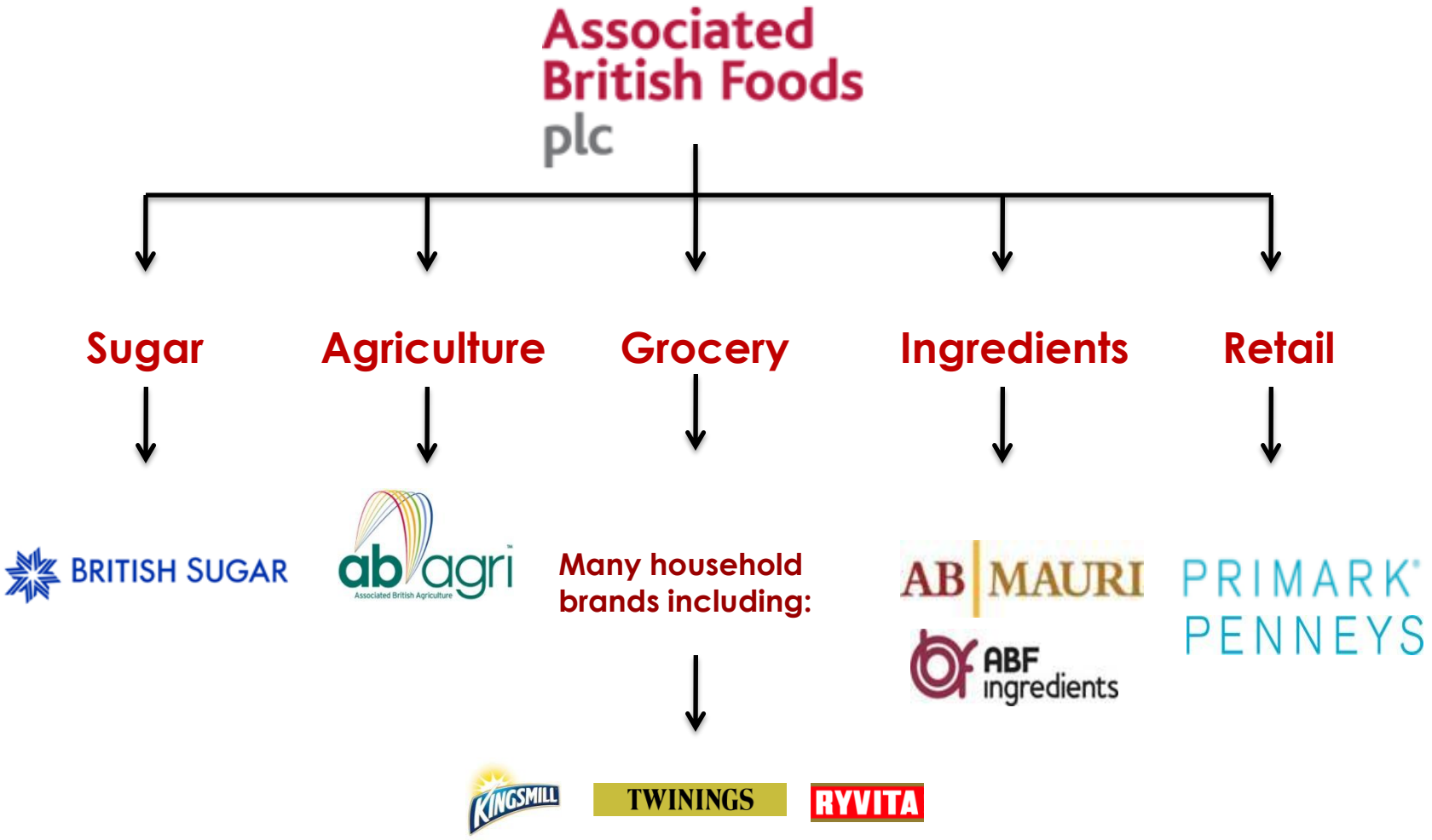
Responsible livestock farming from a feed industry perspective:

Turning trade-offs into win-wins

Dr Ian Wellock, AB Agri, UK

AB Agri: The agricultural group of ABF

Associated British Foods plc



Associated British Foods is a diversified international food, ingredients and retail group with sales of £12.3 billion and 106,000 employees in 47 countries

AB Agri is one of the UK's largest agri-food businesses

Revenue of £1.265bn

AB Agri

Frontier

- Agronomy expertise, crop inputs and grain marketing services to arable farmers and to food, drink and bioethanol producers

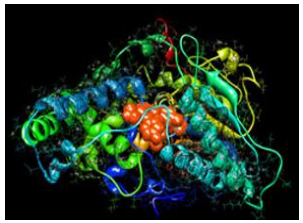
Premier Nutrition

- Nutrition solutions provider that produces starter feeds for the pig sector and premixes for the pig, poultry, dairy, beef, aqua and pet sectors

AB Connect

- Marketeer of food, drink and biofuel co-products
- Leading British manufacturer of pig and poultry compound feed

AB Vista

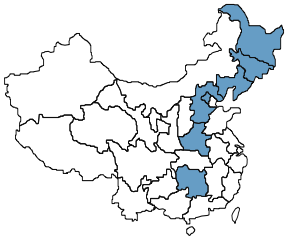


- International supplier of micro-ingredients to animal feed manufacturers
- Provider of NIR calibrations via AuNIR

AB Sustain

- Designs, develops and delivers sustainable agricultural supply chain solutions
- Specialists in supply chain, GHG modelling, biodiversity and animal welfare

China



- Compound feed, concentrates, pre-mixes and co-products from the Chinese food and drink industry

www.abagri.com

AB Agri is one of the UK's largest agri-food businesses

Primary Diets: assured nutrition for piglets

AB Agri

Premier Nutrition

- Nutrition solutions provider that produces **starter feeds for the pig sector** and premixes for the pig, poultry, dairy, beef, aqua and pet sectors

Responsible livestock farming: a feed perspective

A global and highly complex challenge

"Some problems are so complex that you have to be highly intelligent and well informed just to be undecided about them."

Dr Laurence J. Peter (1919-1990)

Feed becomes food…..

Healthy animals to good quality safe food

Feed

Food
(meat, fish, milk, eggs)

EU Feed sector

Livestock in EU-27 consume ≈ 467 million tones of feed/year
≈150 million tonnes produced by feed manufacturers

Quantity Quality Safety

Economic cost Perception

Environmental footprint

Traceability Food security

Effect on human health health

Feed becomes food…..

Healthy animals to good quality safe food

Food
(meat, fish, milk, eggs)

Feed

Raw Materials

Nutrient content (variability)

Production method

Livestock

genetics

Farm management

health

Quantity Quality Safety

Economic cost Perception

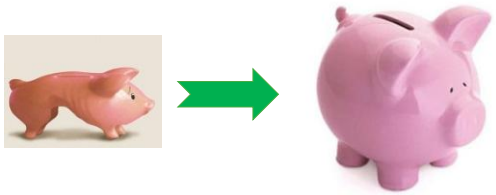
Environmental footprint

Traceability Food security

Effect on human health health

Defining the responsibility of the livestock industry
Consumer demands drive food (and feed) production

- **Consumer demands drive production**
  - Environmental concerns; e.g., pollution, Global Warming Potential
  - Animal production (welfare) systems: e.g., organic vs 'intensive'
  - Raw Material selection: e.g., palm oil, soya, by-products, GM
  - Price..
- **Healthy, nutritious, 'socially acceptable' food vs feeding the hungry**
  - How to achieve the correct balance?
- **Make our customers more sustainable / profitable**
- **"Sustainable intensification"**
  - More from less and a better use of resources



Addressing societal and environmental concerns
Good science must inform public opinion

- **Can we change perception to remove some trade-offs?**

An anti-GM foods advertisement in Paris

ENVIRONMENT

SAVE THE PLANET | STOP EATING MEAT

The UN says so, and so do a growing list of school boards. Meet the new eco enemy.

BY KATIE ENGELHART AND NICHOLAS KÖHLER • One drizzly Thursday last May, the townsfolk of Ghent, a Flemish burg of some 250,000 souls famous for its *stoverij*—a stew of beef braised in beer—gathered outside a centuries-old slaughterhouse in the town's historic core to sample soy fritters, pick up a map of local vegetarian eateries, and to watch as a boy in a banana costume did valiant battle against another dressed as a beefsteak. This was Ghent's inaugural *Donderdag Veggiedag*—Thursday Veggieday, literally—a weekly holiday from the evils of beef, fish, pork and poultry introduced last year by city council, which declared that the moratorium on animal protein would be "good for the climate, your health and your taste buds." Said a representative of the Ethical Vegetarian Alternative, Belgium's largest vegetarian organization and a partner in the city initiative: "If everyone in Flanders does not eat meat one day a week, we will save as much CO_2 in a year as taking half a million cars off the road."

Though meatlessness in Ghent each Thursday is encouraged rather than required, the policy has made vegetarianism pervasive: 95 per cent of the city's children at 35 local schools, as well as the city's elected councillors and civil servants, now submit to the *Veggiedag* menu each week. One poster promoting the policy depicts a polar bear adrift on a shrunken hunk of ice declaring with relief: "*Oef*! It's Thursday."

Donderdag Veggiedag was a global first, putting medieval Ghent on the cutting edge of efforts to combat climate change by changing the way people eat. But elsewhere, too, the moderate meat movement is gaining ground. A Meatless Mondays organization founded in the U.S. has now opened branches in Holland, Finland, Canada, Taiwan and Australia. Following Ghent's lead, cities like São Paulo and Tel Aviv have created city-wide schemes. Last year, Baltimore became the first city in North America to mandate Meatless Mondays in its school cafeterias, for environmental as well as health reasons. A similar proposal has just been made for New York City schools.

Meanwhile, meatless manifestos are topping bestseller lists, from food phenom Michael Pollan's *In Defense of Food*, with its subtle suggestion, "Eat food. Not too much. Mostly plants," to American novelist Jonathan Safran Foer's painfully graphic anti-meat treatise, *Eating Animals*. Dwelling on all the nasty details of the livestock industry, Safran Foer reminds us that even meat from humanely raised cattle "came from an animal who, at best—and it's precious few who get away with this—was burned, mutilated and killed for the sake of a few minutes of human pleasure."

Star power, too, is focusing more attention on the cause. In December, former Beatle and long-time animal rights crusader Sir Paul McCartney appeared before the European Parliament in Brussels to back his Meat Free Monday campaign, which seeks to cut CO_2 emissions by encouraging people to go meatless once a week. An impressive score of

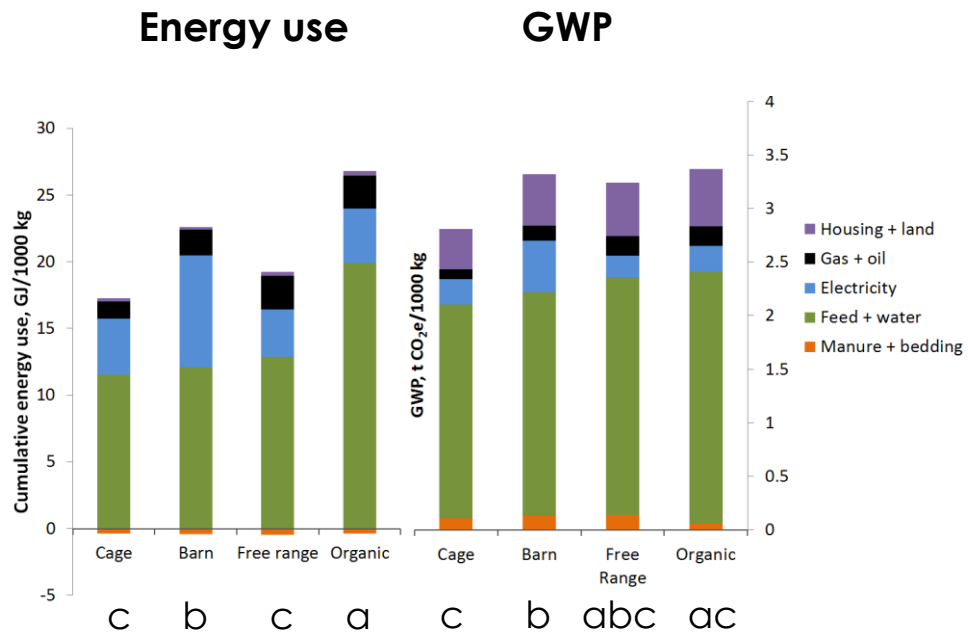
MACLEAN'S MAR 29 '10

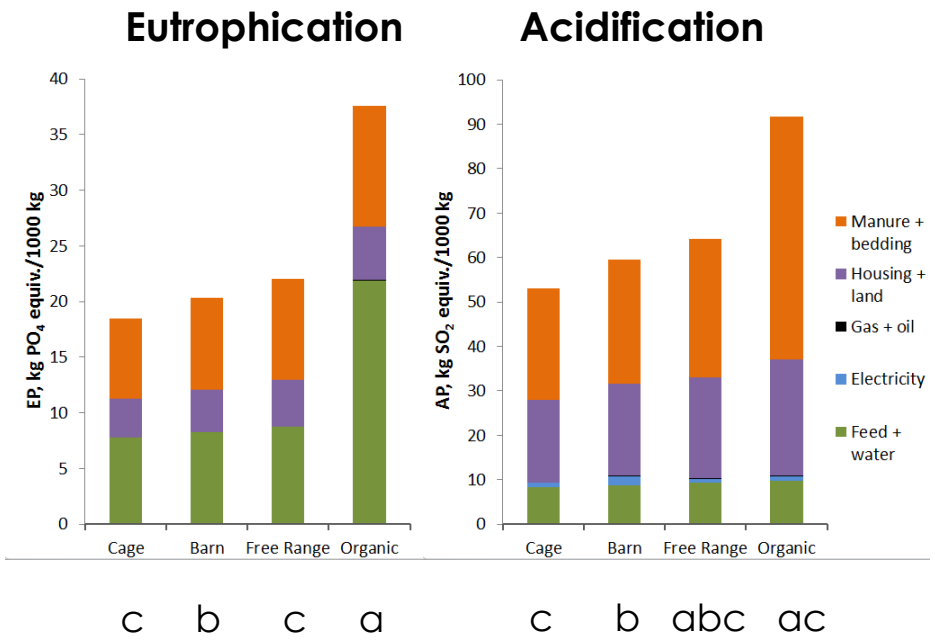
56

Canadian National news paper, 2010

Addressing societal and environmental concerns
Good science must inform public opinion

- **Environmental footprint of egg production by farming system**
  (Williams et al., 2013; Cranfield University)





Addressing societal and environmental concerns
Good science must inform public opinion

- **Antimicrobial resistance transfer from animals to humans**
  - Growing view that threat to human health incredibly small
  - Worst case scenario if everything was resistant was ***0.0031%*** of human cases or approximately 3.1 people/ 100,000 population (Burch, 2012)
  - "***No great importance to public health and there is only a minor link.***"
- **Responsible use of Antimicrobials**
  - win:win - health: welfare: performance: resource use

"Discovering that the animal and human populations of salmonella were as distinguishable as they were was a great surprise to us."

Prof Stuart Reid, RVC
(Mather et al., Science 2013)

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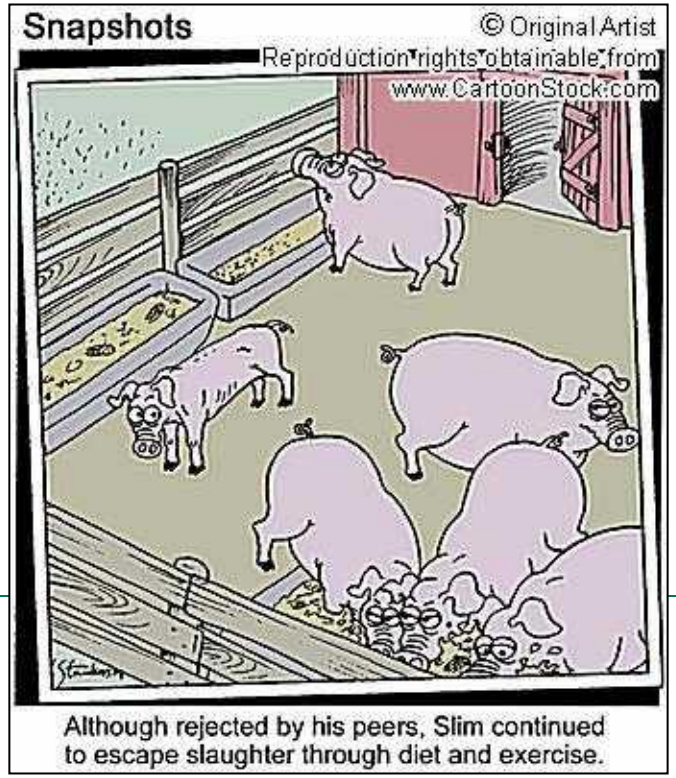
Associated British Agriculture

Sustainable intensification (more from less)

It's all about efficiency and optimisation!!

- **Precision feeding: Nutrient requirement vs supply**
- **Recycling of waste (co-products)**
- **Exploiting early nutrition**
- **Improving animal health and welfare**
- **An win:win example from our business**

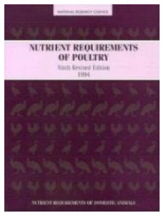


Precision feeding

Matching nutrients to requirements

NIR spectra

Ingredients matrix



Latest Requirements

Precision feeding

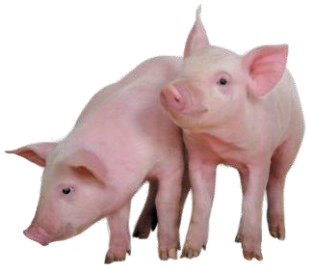
Matching nutrients to requirements

- **All farms are not the same**

Precision feeding

Matching nutrients to requirements

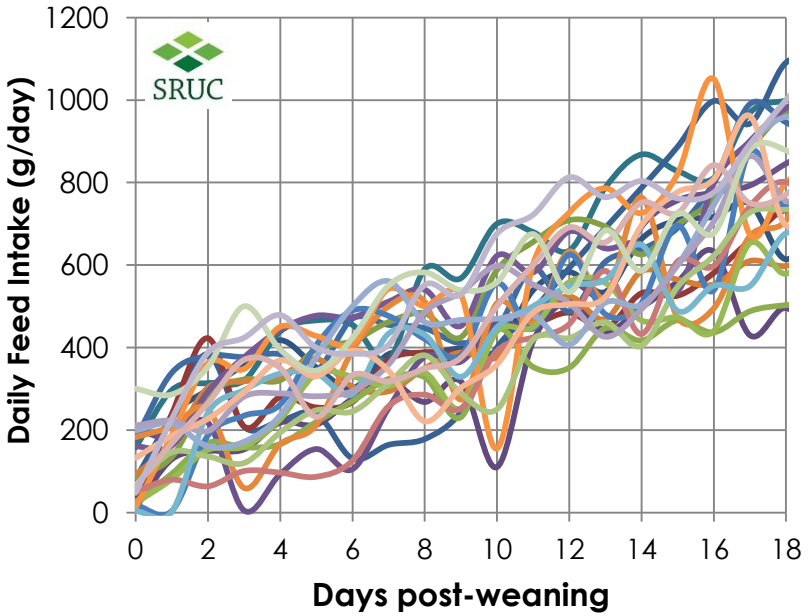
- All farms are not the same
- **All animals on the farm are not the same**

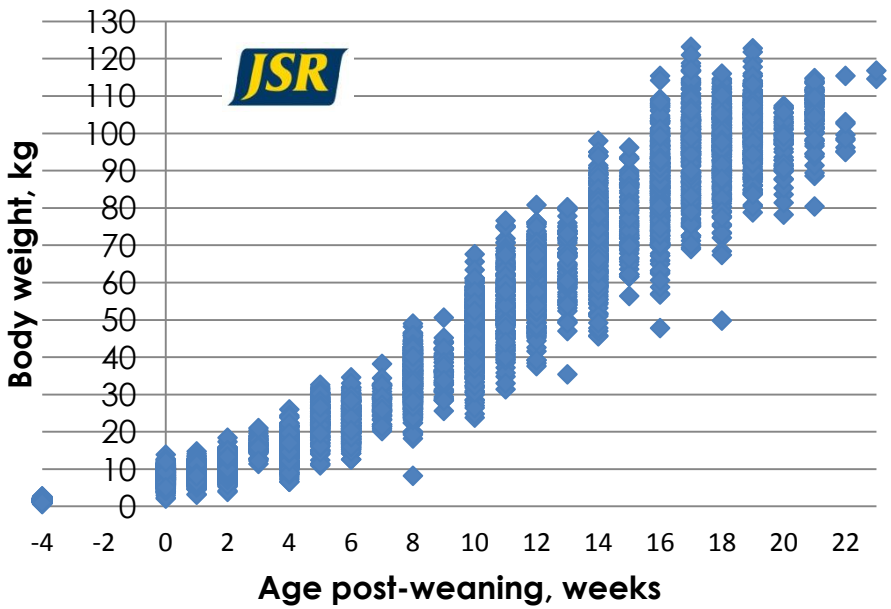


Precision feeding

Matching nutrients to requirements

- All farms are not the same
- All animals on the farm are not the same
- **All animals in the pen are not the same**





Wellock (unpublished data , SRUC)

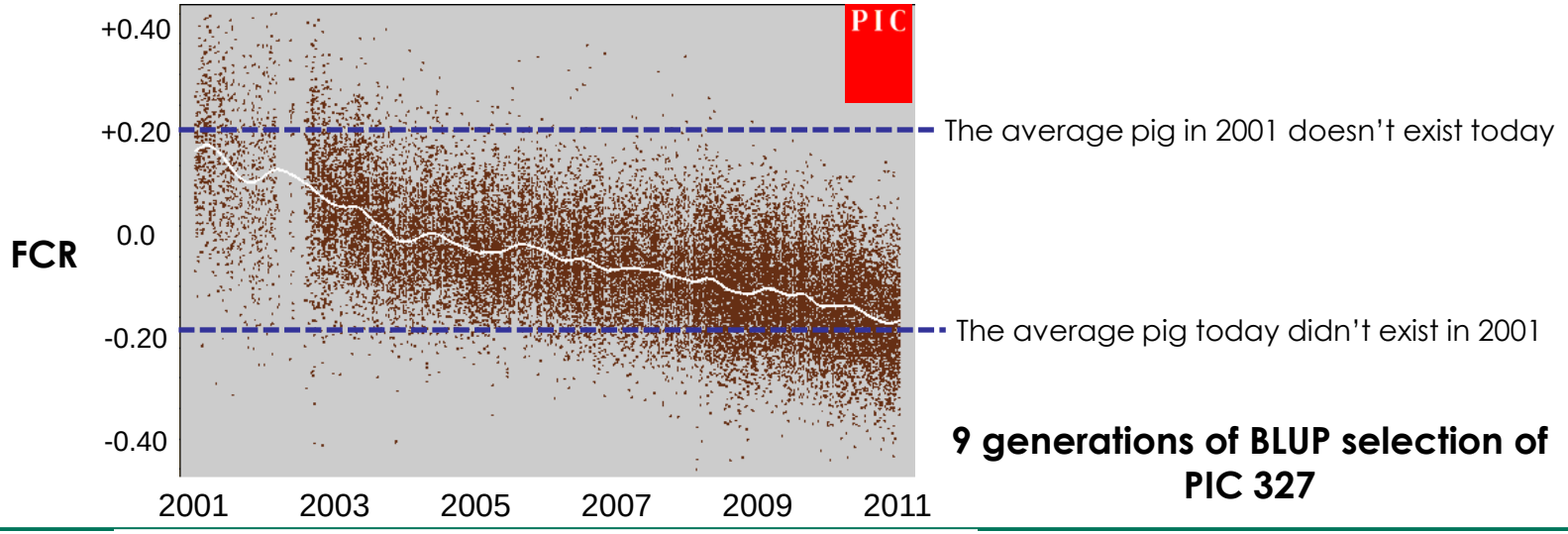
Precision feeding

Matching nutrients to requirements

- All farms are not the same
- All animals on the farm are not the same
- All animals in the pen are not the same
- **All genes are not the same**

Precision feeding
Matching nutrients to requirements

- All farms are not the same
- All animals on the farm are not the same
- All animals in the pen are not the same
- All genes are not the same
- **All continually changing and evolving……and faster….**



Precision feeding
Matching nutrients to requirements

- All farms are not the same
- All animals on the farm are not the same
- All animals in the pen are not the same
- All genes are not the same
- All continually changing and evolving……
- **But yet we still feed most farms/animals the same (few) diets!**

Same genotype, same feed, same time, different farm

	Farm A	Farm B
Intake (kg/d)	2.21	2.40
Gain (g/d)	780	951
FCR	2.84	2.52
P2 (mm)	13.0	12.4
Protein gain (g/d)	130	165

AB Agri internal data

Precision feeding
Where does all the potential go?

- **Productivity gap**
  - Top producers typically achieve ≈80% of genetic potential
  - Average producer ≈75% of top producers (≈60% GP)

- We deal with ***compromised genetic potential*** (reality)
  - Health
  - Housing and management
  - Genetics
  - Nutrition…… ***and probably in that order***

Improving average UK FCR (wean to slaughter) from average (2.17) to top 10% (1.93)
= 49,669 t less feed per year..

Precision feeding
Some win:win examples...

- **'Precision Nutrition' encompasses majority of nutrition R&D**
  - Improve productive efficiency through nutrition

- **Less feed use per kg meat/eggs/milk**
  - Lower morbidity and mortality
  - Less waste / lower environmental footprint
  - Lower FCR

Same genotype, same farm, same time, different feed

	1996 formula	2011 formula	Difference	
Start weight (kg)	8.09	8.09	-	-
ADFI (g/d)	313[a]	327[b]	+14	(+5%)
ADG (g/d)	244[a]	290[b]	+46	(+16%)
FCR	**1.29[a]**	**1.13[b]**	**-0.16**	**(+13%)**
Cost of gain (£/kg)	0.88[a]	0.77[b]	-0.11	(-12%)

University of Leeds; Primary Diets Weaner trial (UK)[Dec 2011]

Precision feeding
Some win:win examples...

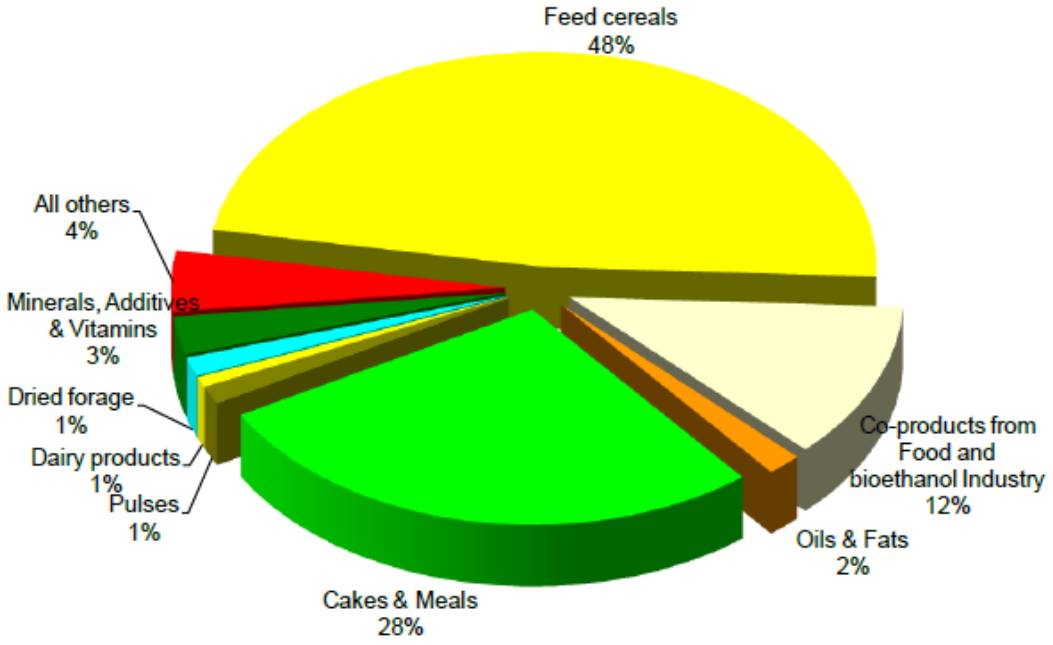
- **Targeting specific issues**
  - ***Improve RM quality (treatment and processing)***
    - Pre-treatment of forages to improve digestibility
  - ***Feed manufacture and processing***
    - Mixer Liquid Application to decrease power consumption
  - ***Reproduction***
    - Valine in sows to improve embryo implantation
  - ***Methane mitigation in ruminants***
    - Fibre: starch ratio, precision protein, additives
  - **Improved product quality / less wastage**
    - Vit D / mineral supply to improve egg shell quality

Recycling of waste (co-products)

Britians first bioethanol plant at Wissington sugar factory.

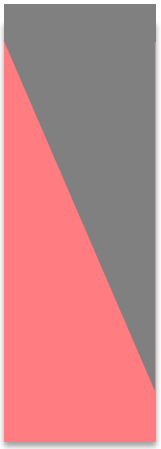
Recycling of waste (co-products)
Feed industry already excellent recyclers

- Feed industry already excellent recyclers of waste products
  - ≈ 40% of feed material used in EU-27 is co-products (≈ 187 million t)



Use of feed materials by the EU-27 feed industry in 2011 (FEFAC)

Sugar Beet
Citrus pulp
Bioethanol production
Biodiesel production
Distillery
Potato processing
Bakery
Cereal processing
Brewing
Confectionary
Dairy processing
Fish processing



Recycling of waste (co-products)
Can the feed industry do more?

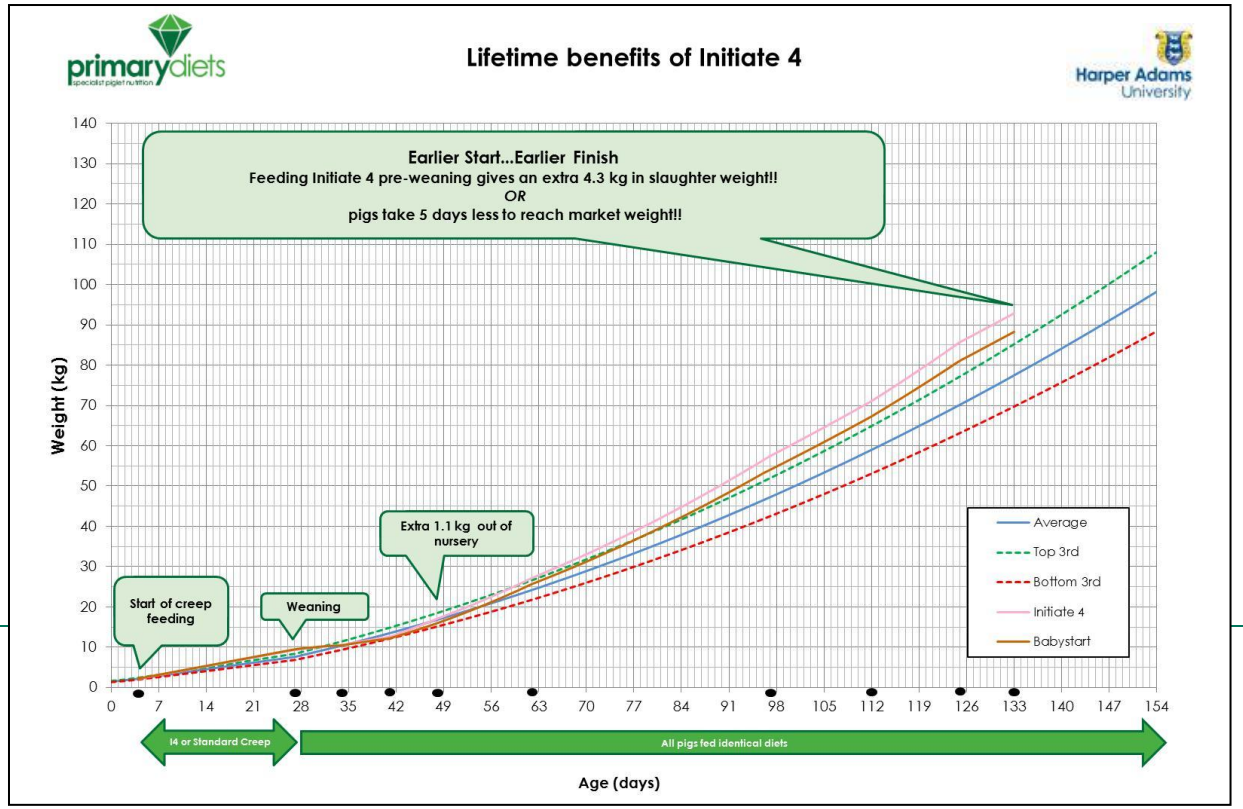
- **Yes….**
  - Certain waste foods, meeting EU feed safety requirements no longer destined for food use

- **But… be aware the potential dangers of swill feeding**
  - Regulation: Few feed mills vs many farms
  - Identification and segregation of what we can use (non-meat)
  - 2001 UK FMD epidemic (9 month and £8 billion to UK)

Exploiting early nutrition

Exploiting early nutrition
Improving lifetime efficiency

- Decrease morbidity and mortality (health/welfare)
- Improve lifetime growth/efficiency/profitability
- Feed early with 'precision'
  - feeding the gut microbiology (100x more bacterial genes than host genes)



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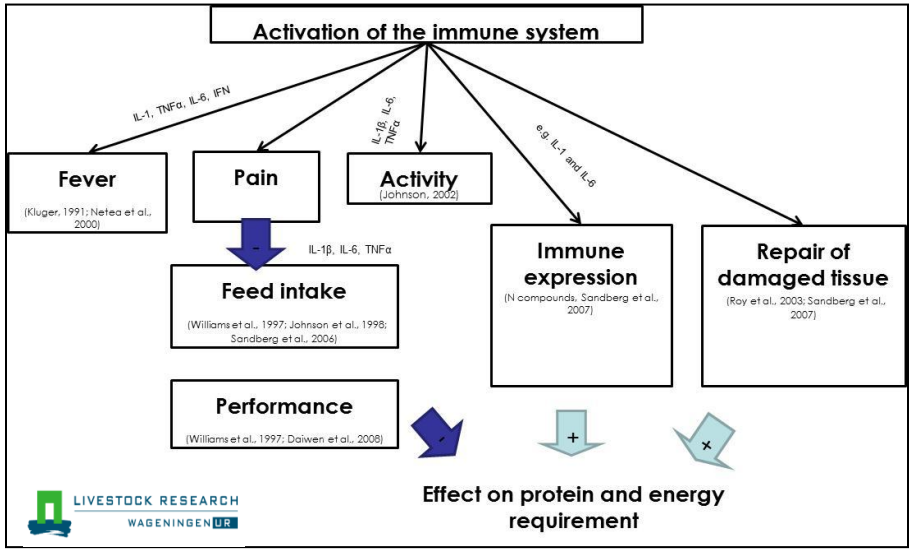
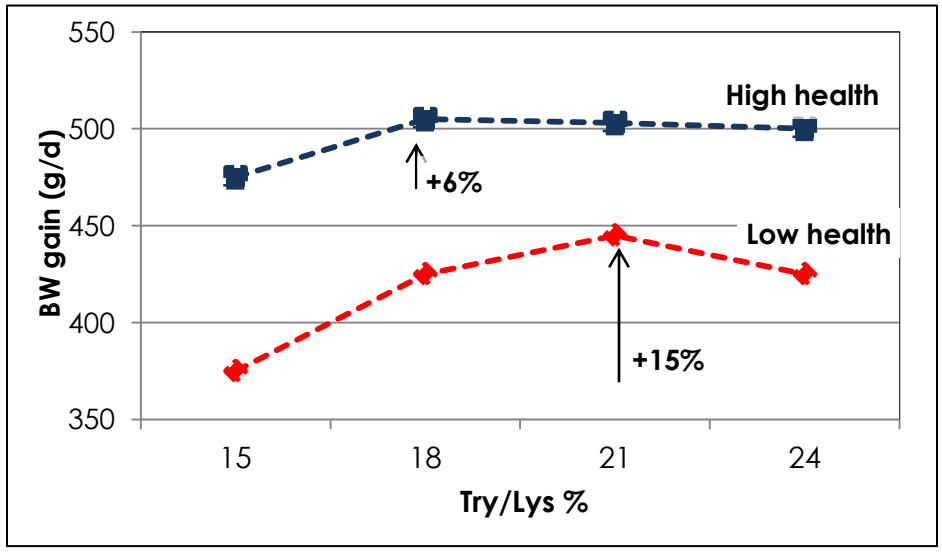
Improving animal health and welfare

Improving animal health and welfare
Feeding for health

- ***Most nutritional improvements in health and welfare lead to improvements in productivity***
  - Less mortality/morbidity/reproductive failure/premature culling
  - Understand and manipulate immune responses (costly to 'feed')
  - Feeding the gut and its microflora





Le Floch et al. (2010)

‘Superdosing’ a Win:Win example

Discovering and refining superdosing

Paul Toplis

primarydiets

Dr Pete Wilcock

primarydiets ABVista

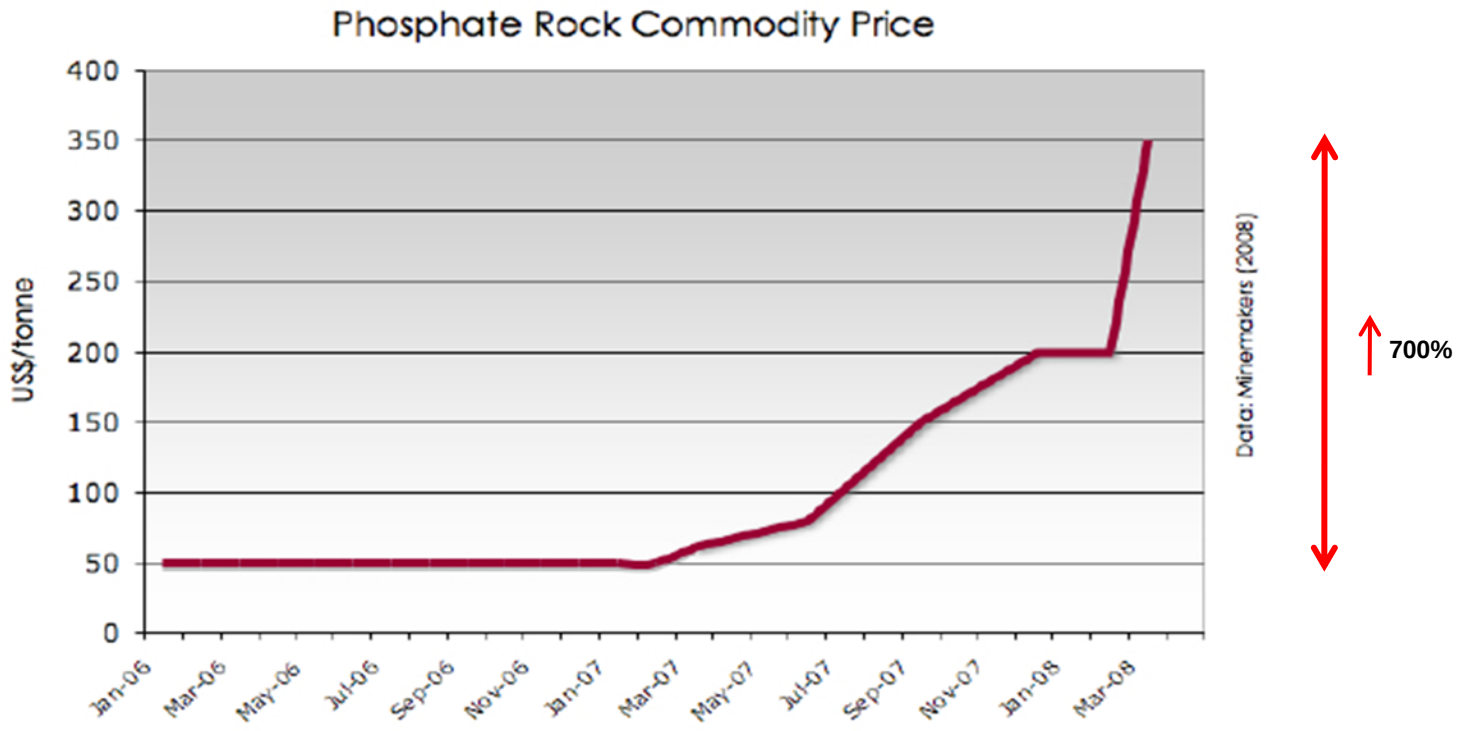
Dr Carrie Walk

ABVista

‘Superdosing’ a Win:Win example

Discovering and refining superdosing

- Rapid increase in price of rock phosphate (short supply)



‘Superdosing’ a Win:Win example

Discovering and refining superdosing

- Phytase widely used in pig and poultry diets to replace di-calcium P

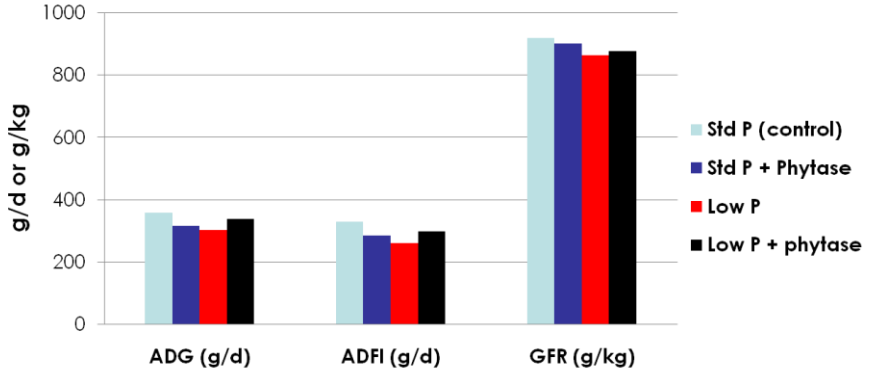
	Broiler starter (phytase)	Broiler starter (no phytase)
Wheat	59.05%	57.53%
Soybean meal	33.08%	33.45%
Soy oil	3.86%	4.28%
Salt	0.38%	0.38%
DL Methionine	0.39%	0.39%
Lysine HCl	0.36%	0.35%
Threonine	0.10%	0.10%
Limestone	1.17%	0.98%
di-calcium P	**1.12%**	**2.06%**
Phytase	**0.01%**	**0.00%**
Vitamin premix	0.50%	0.50%
Crude protein %	23.0	23.0
ME kcal/kg	3,038	3,038
Calcium %	1.00	1.00
Phos %	0.71	0.73
Avail Phos %	0.50	0.50
Cost £ per MT	**248.31**	**254.27**

‘Superdosing’ a Win:Win example
Discovering and refining superdosing

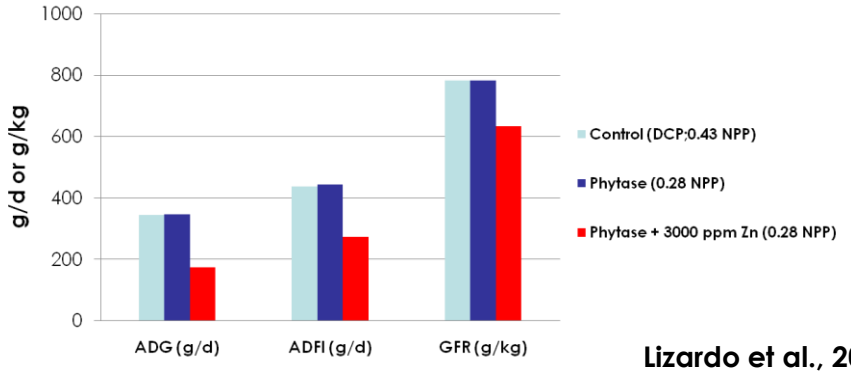
- Phytase reported not to work in weaner pigs due to interaction with high levels of ZnO

Phytase (low-P)

Phytase (low-P) + 3000 ppm ZnO



Miller and Toplis, 2002



Lizardo et al., 2004

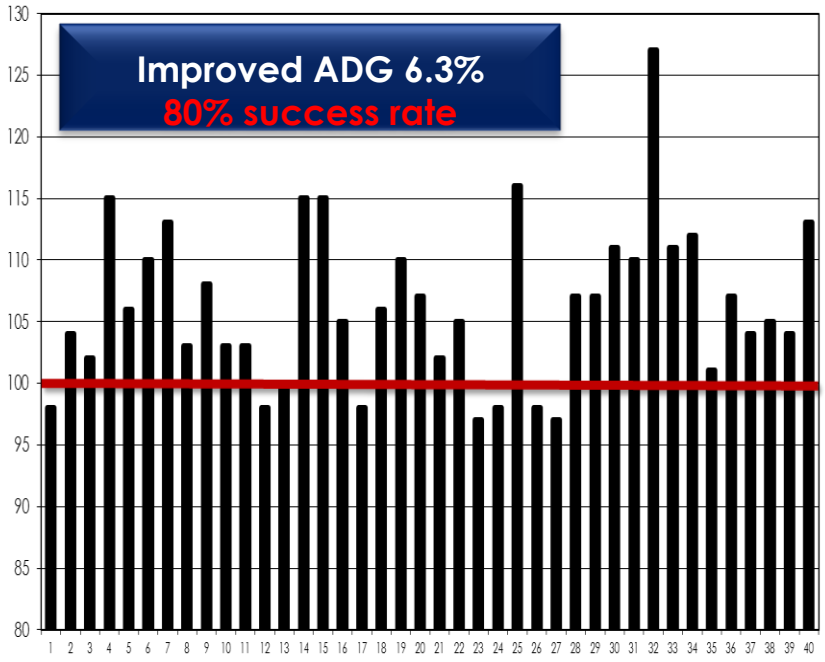
‘Superdosing’ a Win:Win example
Discovering and refining superdosing

- >10 trials conducted at University of Leeds (2007-2010)
  - Superdose (>1250 FTU) levels of phytase improves performance
- Launched commercially in UK (2010)
- Launched in Europe, Asia, and US (2011-)
- Further R&D insight (2011-)
  - Extra phosphoric effects of phytase (more than just P-release)
    - lowers acid/mucin production (lowers AA and energy cost)
    - Generation of myo-inositol
    - Restoration of P/Ca proportionate release
- Migrated into other species (turkey and broiler)
- Other feed companies adopting (2012-)

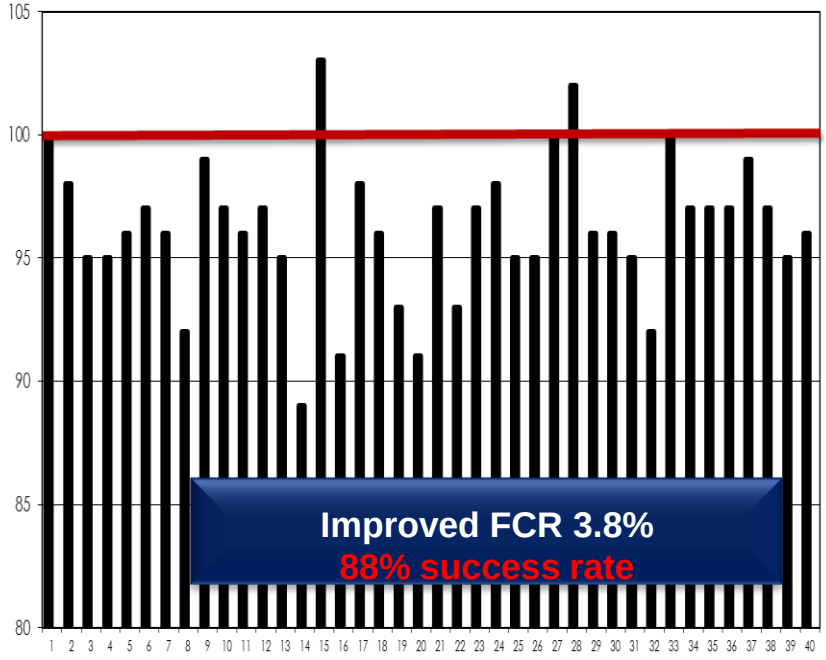
‘Superdosing’ a Win:Win example

Win 1: improved performance

Piglet ADG (d 21/35 post-weaning)



Piglet FCR (d 21/35 post-weaning)



[1] Positive control was formulated to be adequate in all nutrients

AB Vista/Primary Diets (internal data)

‘Superdosing’ a Win:Win example
Win 2: lower diet cost

- Partial replacement of animal protein with increased soya (piglets)

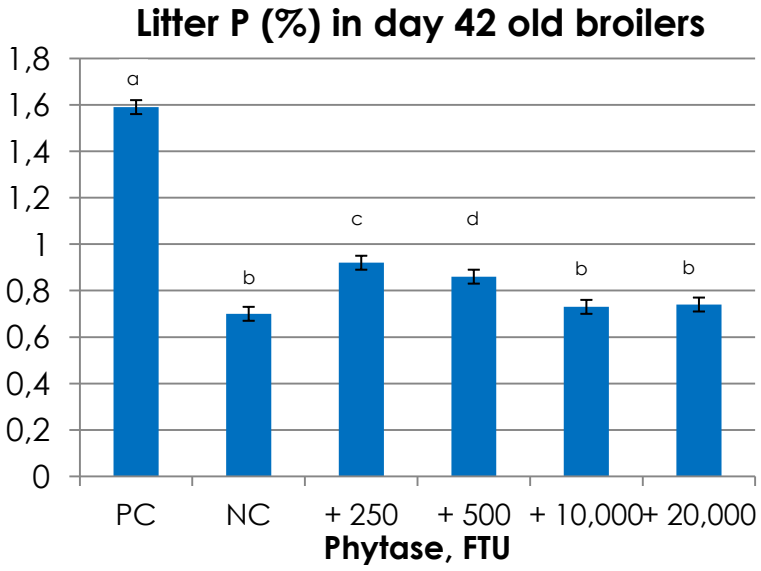
	Phase 1		Phase 2	
	Week 1 Post-Weaning		Week 2+3 Post-Weaning	
	Complex	**Simple + SD**	**Complex**	**Simple + SD**
Maize	31.40	25.80	39.78	35.22
Oat groats	12.50	12.50	5.00	5.00
Soya	**15.00**	**25.00**	**25.00**	**33.00**
Whey	**21.60**	**14.50**	**14.29**	**7.36**
Lactose	**0.00**	**5.00**	**0.00**	**5.00**
Plasma	**5.00**	**3.00**	**2.50**	**1.50**
Fish Meal	**7.5**	**6.25**	**5.00**	**3.00**
Fat	4.90	5.40	4.70	5.40
Cost ($US/t)	**782**	**682**	**563**	**518**
	-$100		**-$45**	

AB Vista/Primary Diets (internal data)

‘Superdosing’ a Win:Win example

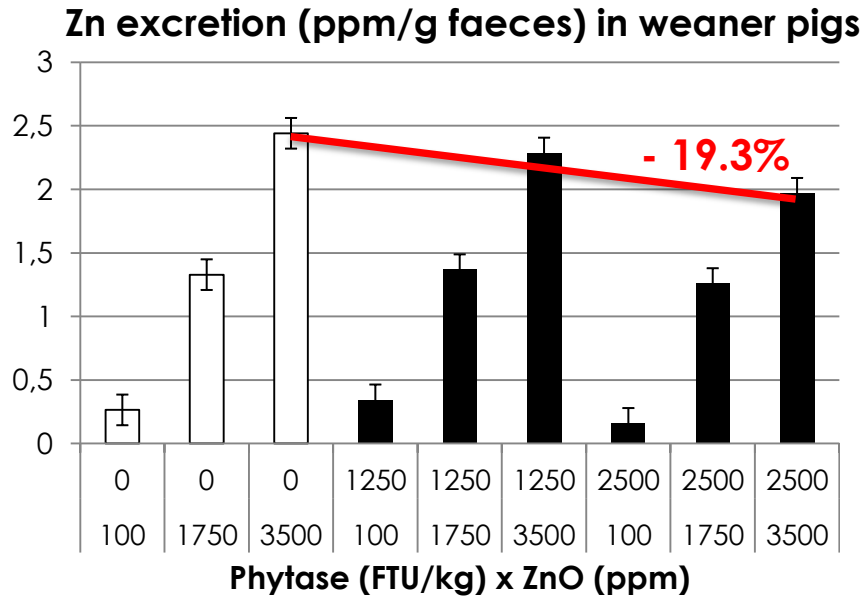
Win 3: lower environmental cost / impact

- Less rock phosphate mining *(lower energy usage)*
- Lower P excretion / pollution
- Lower Zn and other heavy metal pollution



NC (-0.15% Ca and -0.25% avP)

Ledoux and Walk, 2006



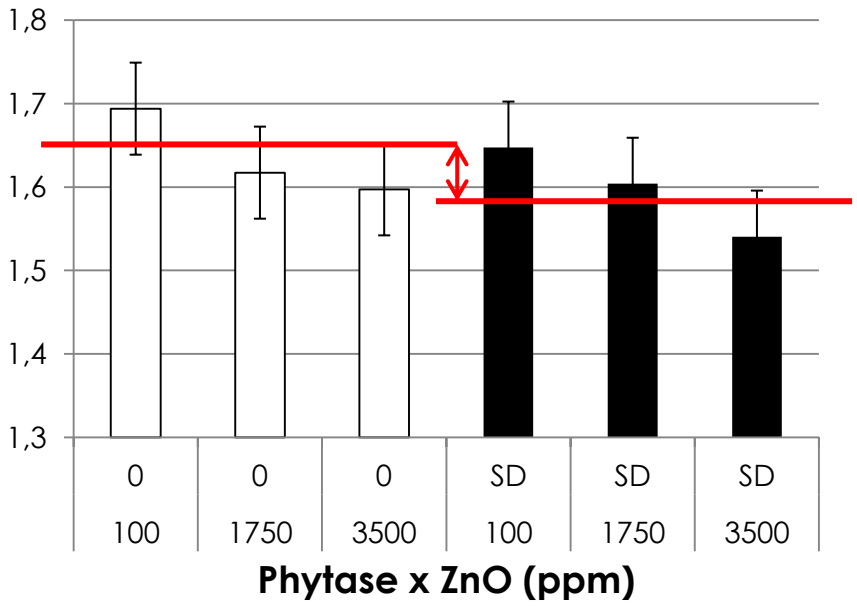
ZnO P < 0.0001 , Phytase dose P = 0.0574, ZnO x phytase P = 0.4843, Replicate P = 0.2834

Walk et al, 2013 (submitted)

‘Superdosing’ a Win:Win example
Win 4: improved health and welfare

- Less piglet scour post-weaning
- Improved bone strength (gilts rearing, broilers)

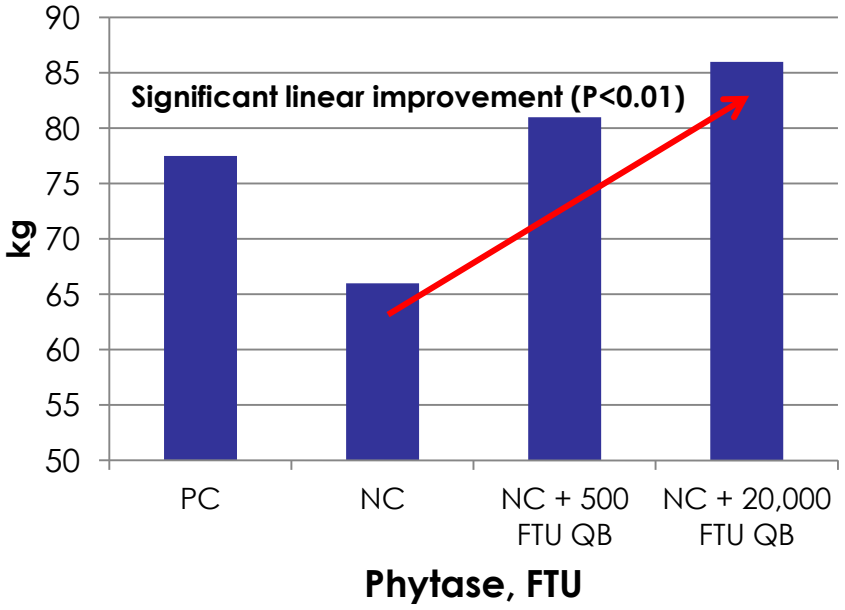
Faecal Scores (d 0 to 10 post-weaning)



ZnO P = 0.2182, Phytase dose P = 0.4015, ZnO x phytase P = 0.9178, Trial site P < 0.0001

Walk et al, 2013 (submitted)

Impact of phytase on bone breaking strength



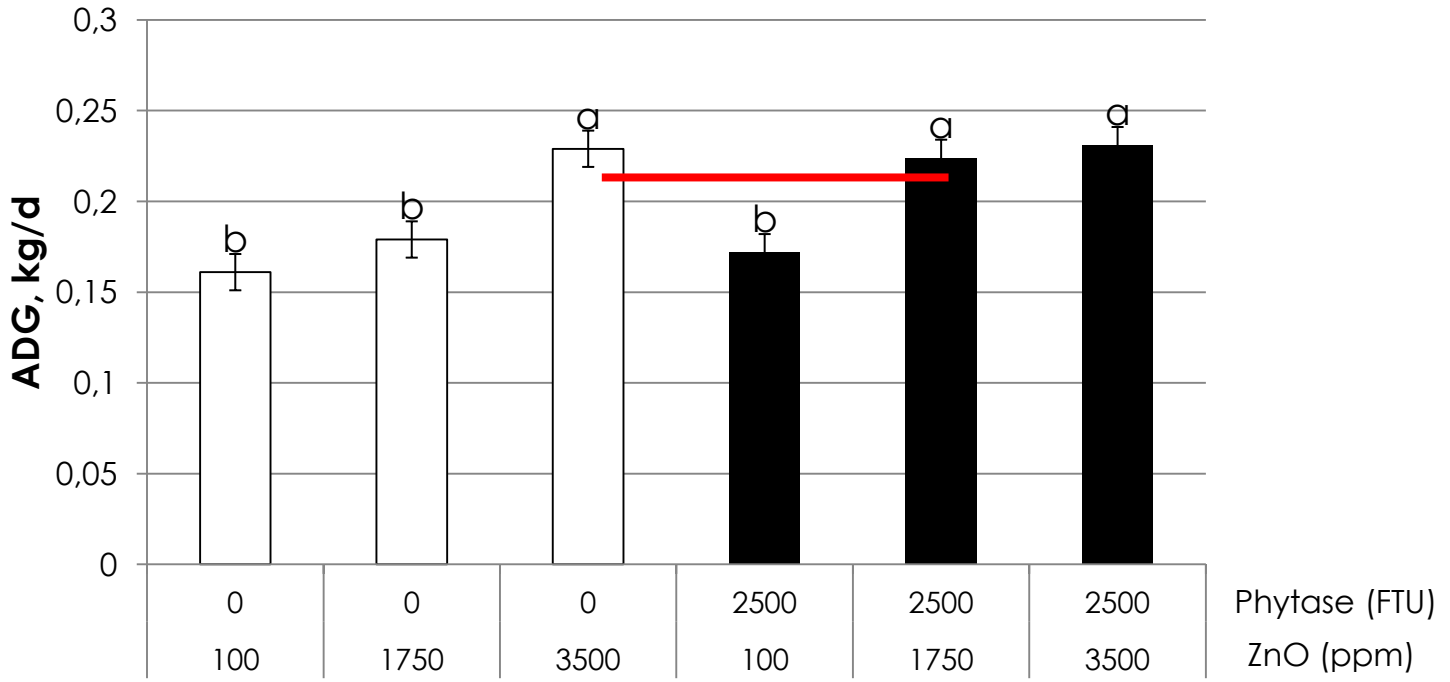
NC (-0.16% Ca and -0.15% avP)

Santos et al., 2013 (in press)

‘Superdosing’ a Win:Win example
Win 5: less reliance on zootechnicals

- Ability to lower ZnO by 50% and maintain performance (and health)

US piglet trial (5 to 9 kg)



ZnO P < 0.0001, Phytase dose P = 0.0042, ZnO x phytase P = 0.0185

Walk et al, 2013 (submitted)

‘Superdosing’ a Win:Win example
Win 6: lower cost of production

- Reduced cost of gain in the nursery (7 to 15 kg)

	Control	SUPERDOSE	P-Value	Difference (%)	
Start weight (kg)	7.19	7.18	-	-	-
ADFI (g/d)	343	362	0.304	**+19**	**(+6%)**
ADG (g/d)	306	338	*0.087*	**+32**	**(+10%)**
FCR	1.13	1.07	*0.093*	**-0.06**	**(-5%)**
Weight gain (kg)	6.14	6.76	*0.105*	**+0.61**	**(+10%)**
Cost of gain (£/kg)	**0.74**	**0.65**	**<0.001**	**-0.09**	**(-12%)**

University of Leeds; Primary Diets Weaner trial (UK) [Nov 2010]

Research needs of the future

If we knew what we were doing it wouldn't be research

- ***Nutrient and resource efficiency***
  - Dynamic models (include health, behaviour, emissions etc.)
- ***Alternative (more local) protein sources***
  - Processed rapeseed, insect protein
- ***Nutrigenomics***
  - Feeding the individual (genes)
- ***Feed : microbe : host relationship***
  - Unravel interactions between nutrients, microbiota and immune system
- ***Precision livestock farming***
  - On line live monitoring from plough to plate via the mill, farm and abattoir
- ***Holo-analysis***
  - Re-search the existing research

Problems cannot be solved at the same level of awareness that created them. *A. Einstein (1879 – 1955)*

The feed industry
Research into practice

- Feed industry is the best vehicle for delivery mechanism of nutrition R&D solutions to farmers (our customers)

- Farmer has a major role to play (capture farm efficiency)
  - Data capture often poor - "*you can't control what you don't measure*"

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Thank you

Addressing societal and environmental concerns
Good science must inform public opinion

- **Alternative protein source in egg and broiler production**
  (Williams et al., 2013; Cranfield University)