



'Think outside the Gut'

Effects of probiotics on animal performance and environment.

AJAY AWATI

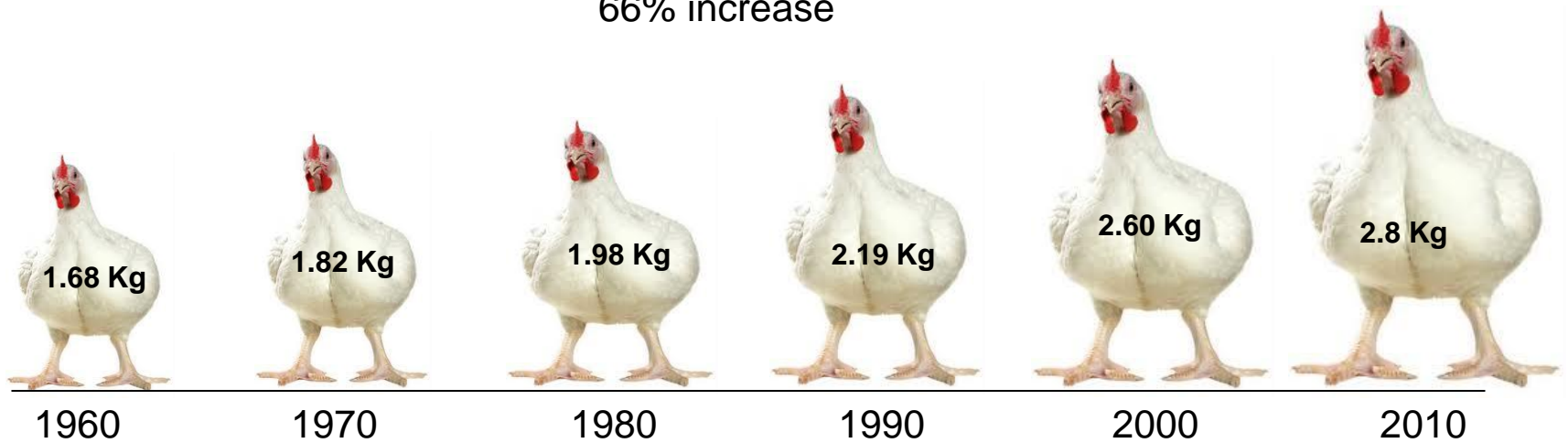
June 2014

IPC 2014, Budapest

Last 5 decades of growth improvement

Broiler body weight at 42 days

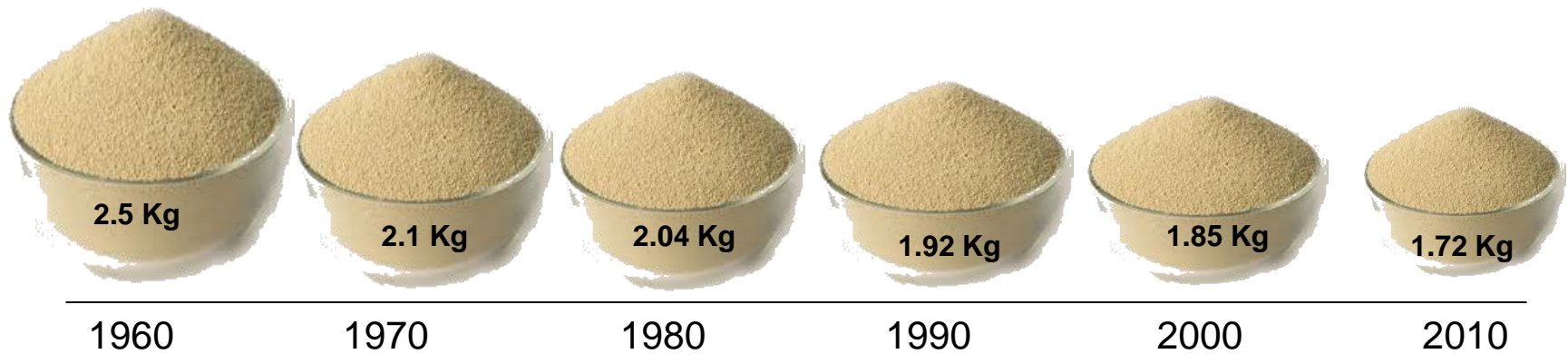
66% increase



Last 5 decades of efficiency improvement

Broiler Feed Conversion Ratio

32% improvement



Animal production: at the turn of millenium

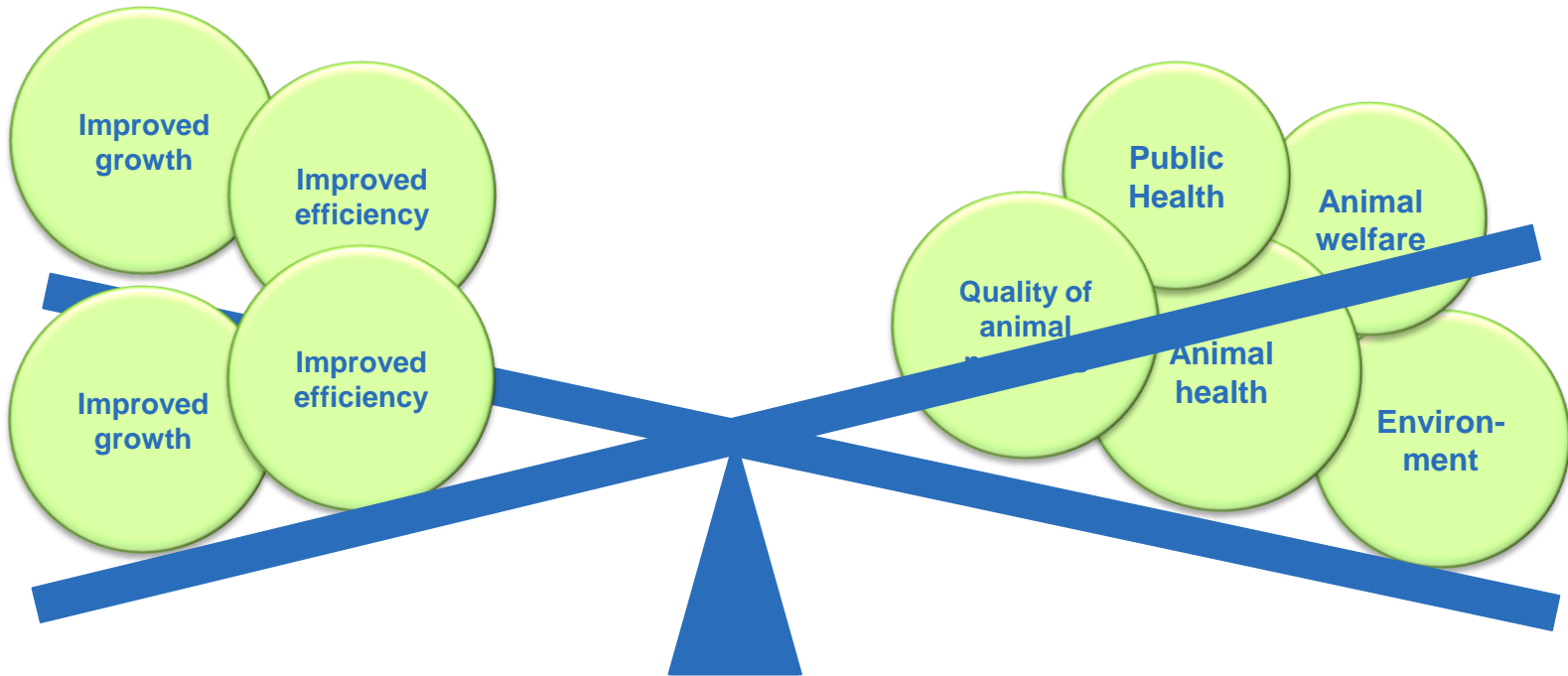
Table 1: Changes in global human population, pig and poultry inventories, and production and international trade of pig and poultry meat between 1996 and 2005.

	1996	2005	Annual growth (%)
Human population	5,762	6,451	1.1
Inventory			
Pigs (million)	859	963	1.1
Poultry (million)	14,949	18,428	2.1
Production			
Pig meat (thousand tons)	79,375	103,226	2.6
Poultry meat (thousand tons)	56,408	81,856	3.7
International trade			
Pig meat (thousand tons)	6,398	9,557	4.0
Poultry meat (thousand tons)	5,359	9,234	5.3

Source: FAOSTAT

Otte *et al.*, 2007

Success brings responsibilities: Just performance is not enough!



Bad news is most of these if not all are microbiota related

Microbiota and animal growth performance

- ✓VFA (butyrate) provide 70% energy needed by gut epithelium
- ✓Production of nutrients, such as vit k & vit B.
- ✓Improved water re-absorption in the large intestine
- ✓Improved mineral absorption and bone mineralization
- ✓.....many more

Microbiota and animal growth performance

- X Decreased nutrient digestibility in chickens with microbial overgrowth in small intestine (Smits 1996)

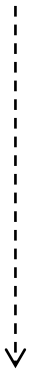
- X Non specific stimulation of immune response
 - IgA secreted across the GIT accounts for >70% of total antibody production (Macpherson and Uhr, 2004)

- X Increased absorptive cell turnover and mucus production
 - In chickens, gut metabolism accounts for 20-36% of the whole body energy expenditure, which is mainly due to cell turnover (Cant et al 1996)

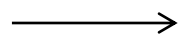
Microbiota and Animal Health and Public Health

Gastro-intestinal Pathogens

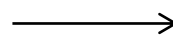
e.g. E.coli,
Clostridia,
Salmonella



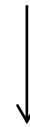
Threat to public health



In feed antibiotics



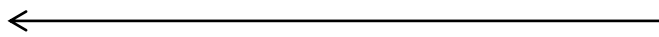
Increased antibiotic
resistance



Ban in EU and
some other countries



Further increase in
therapeutic antibiotics use



Microbiota and Quality of animal products and public health

Campylobacter infection

Commensal in poultry



Does not cause any infection,
But serious threat to human health

Salmonella infection

E.coli infection



Microbiota and Animal Welfare

Gastrointestinal microbes

e.g. *Staphylococcus spp.*
Clostridium spp.



Foot pad lesions
in broilers

Microbial activity

Higher protein fermentation
-leading to higher ammonia
in excreta

Microbiota and Environment

- Globally livestock production contributes to 50% of ammonia emission
- Ammonia lost from manure decreases fertilizer value and cause serious air pollution
- Deposition of ammonia enhances N levels in soil and water, which affects aquatic and terrestrial eco-system



Microbiota and Environment

Farm odor and public defiance to animal farming



Ammonia along with phenols, indoles and skatoles contribute to strong offensive odor on animal farms

This can affect health of the people working & living in the farm neighborhood.

These odorous compounds are mainly produced due to protein fermentation

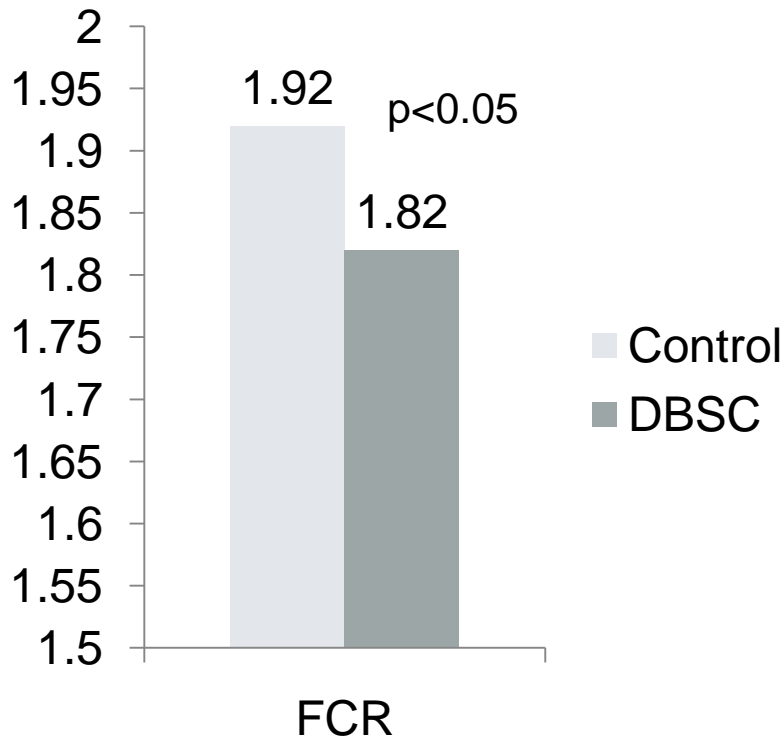
Protein fermentation also increases pH of the manure, which helps release of this compounds in the air

Can probiotics play role in it?

'Organisms and substances which contribute to intestinal microbial balance'.- Parker 1974

*'A live microbial feed supplement which **beneficially affects the host animal** by improving its **intestinal microbial balance**'.- Fuller 1989*

Probiotics and Growth performance

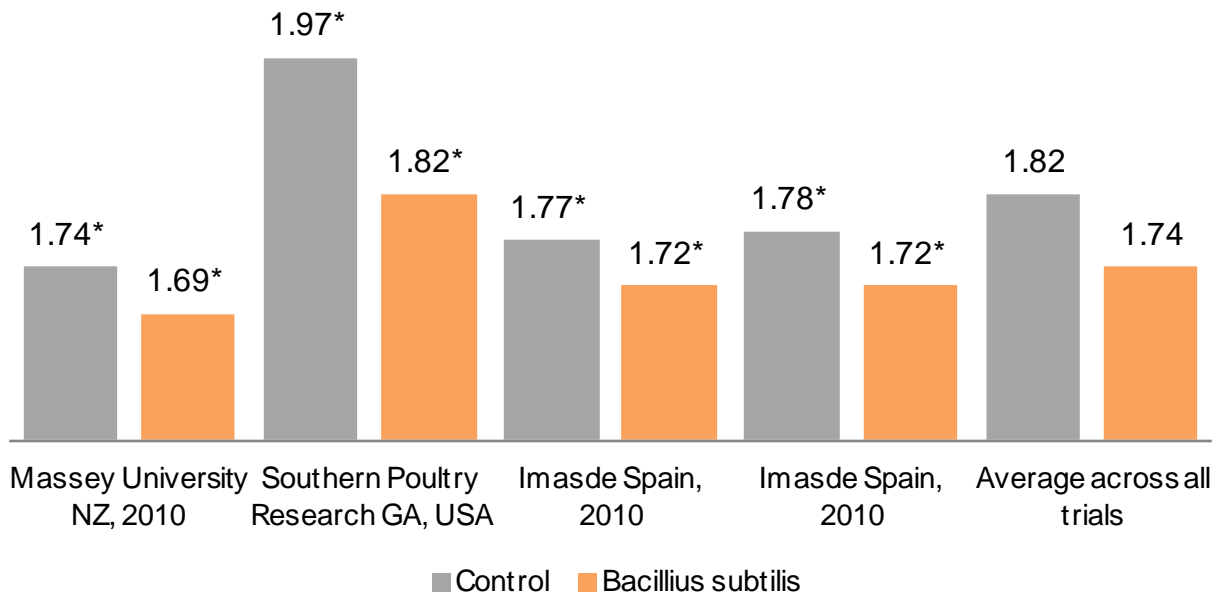


Production Performance

Animal: Broilers
 Probiotic: *Dried bacillus subtilis culture*

Probiotics and performance

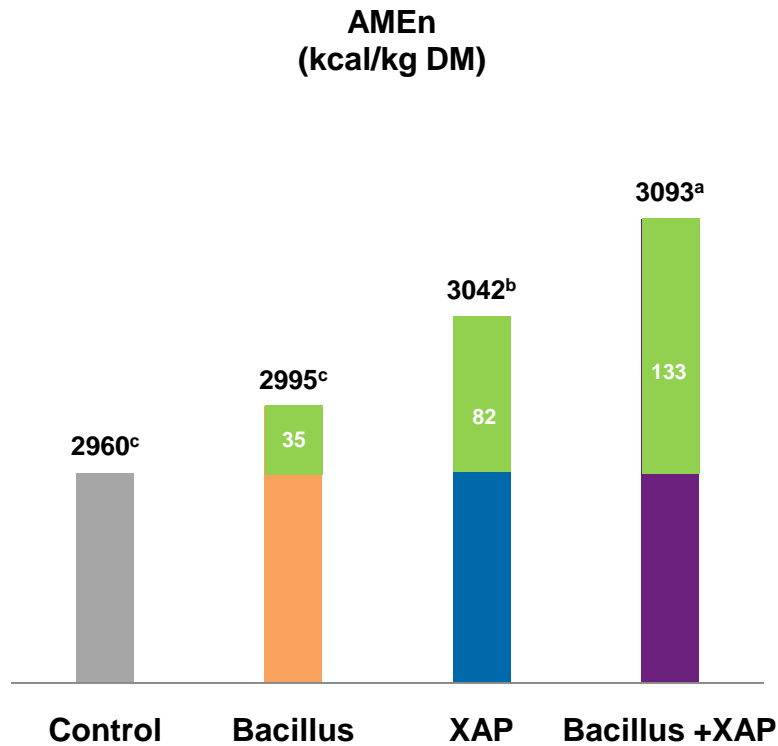
Improvement in FCRc after addition of *Bacillus subtilis* to broiler diets



Production Performance

*Shows significance at $P < 0.05$ in the individual trials
 FCRc: corrected 3 points for 100g of liveweight difference
 3 strain mixture of *B. Subtilis* was used.

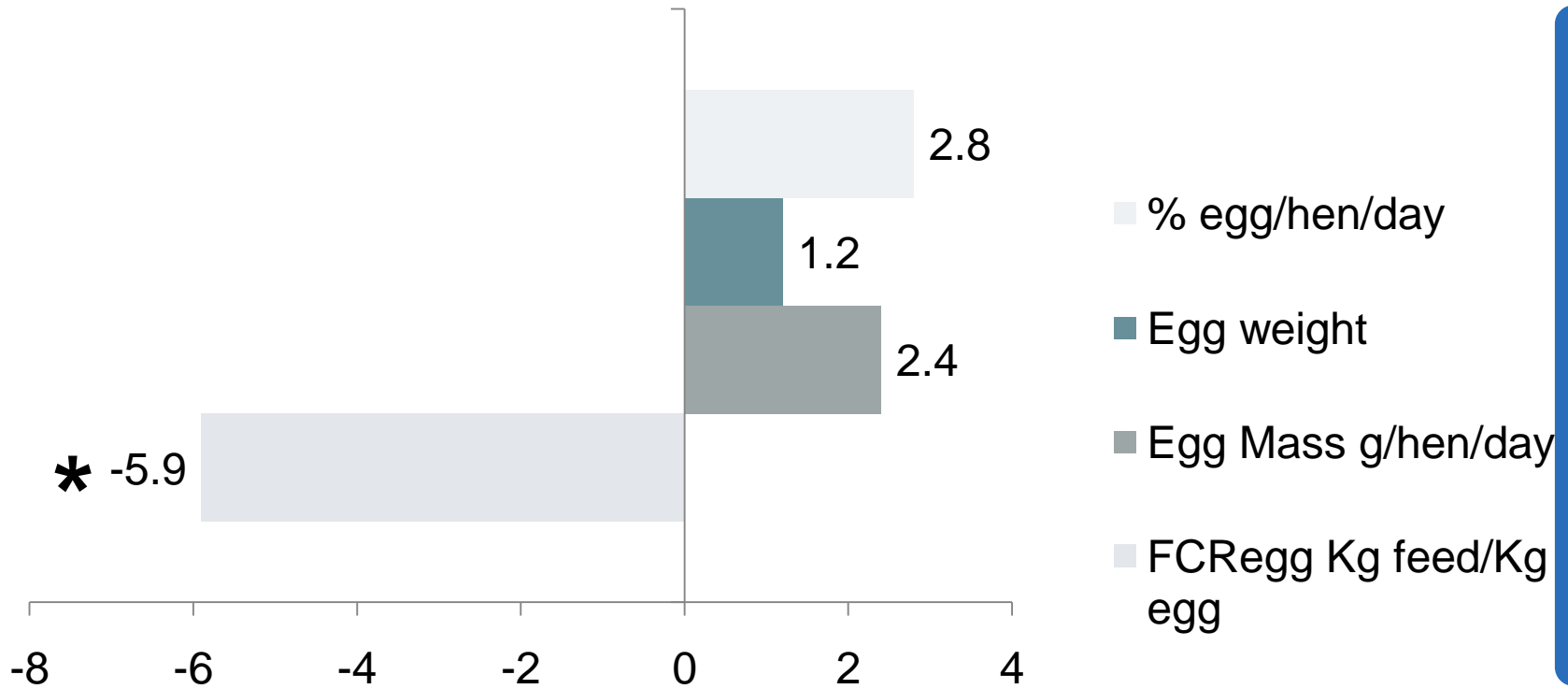
Probiotics and synergy with other feed additives



Animal: Broilers
 Probiotic: 3 *Bacillus* strains

Production Performance

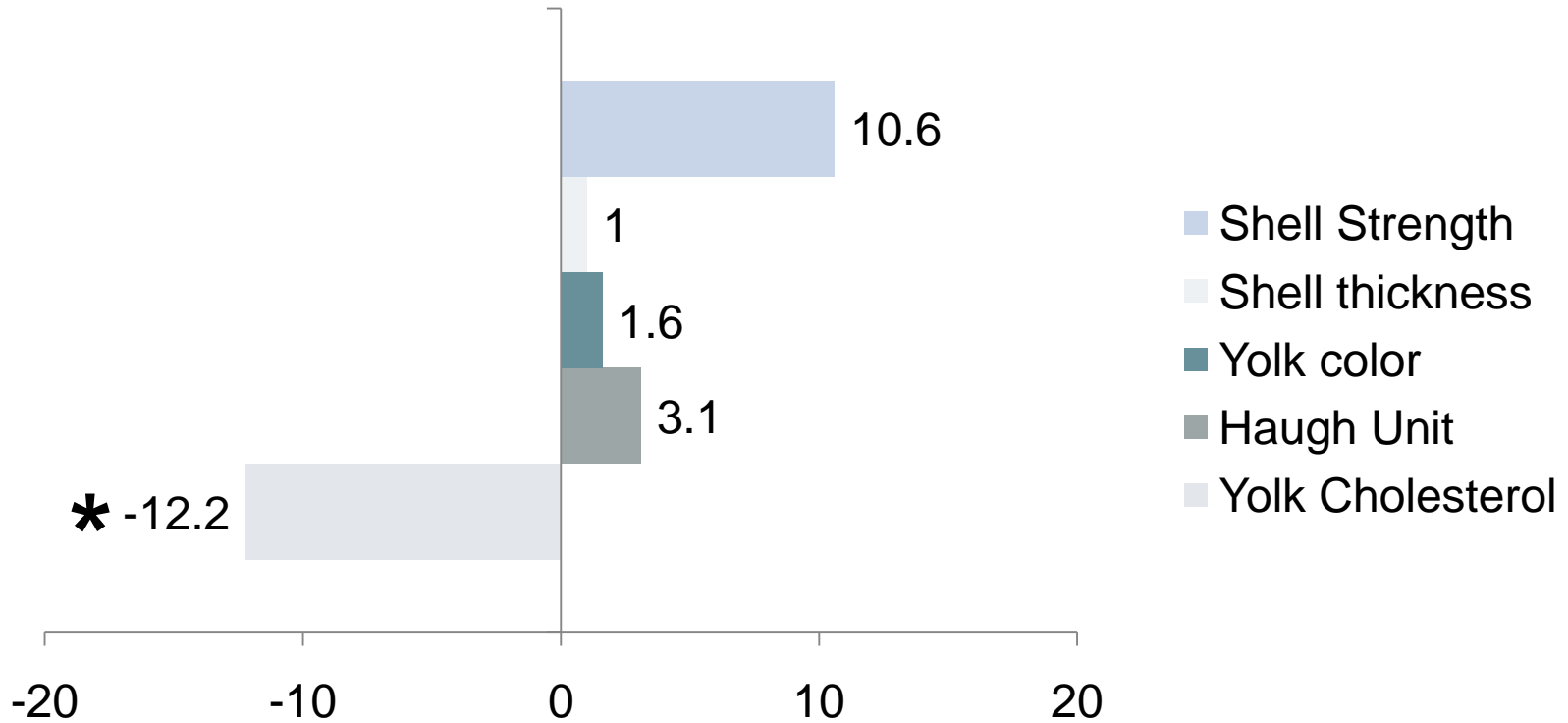
Probiotics and Egg production



Production Performance

Animal: Laying hens
 Probiotic: *Dried bacillus subtilis culture*

Probiotics and egg quality



Animal: Laying hens
 Probiotic: *Dried bacillus subtilis culture*

Quality of Animal Products

Probiotics and meat quality

Effect of probiotic on proximat composition of leg and breast meat of chickens

		Control	Probiotic	Pooled SEM
Moisture %	Leg	71.35 ^a	72.40 ^b	0.04
	Breast	72.87 ^c	73.77 ^d	0.05
Protein %	Leg	20.67 ^a	21.77 ^b	0.02
	Breast	21.99 ^c	22.97 ^d	0.04
Fat %	Leg	7.06 ^a	4.87 ^b	0.06
	Breast	3.95 ^c	1.99 ^d	0.07
Ash %	Leg	0.92 ^a	0.96 ^b	0.004
	Breast	1.19 ^c	1.25 ^d	0.002

Means in the same row with no common superscript differ significantly ($p < 0.05$).

Animal: Broilers

Probiotic: *Mixture of lactobacilli and bifidobacterium*

Probiotics and public health concerns

Effect of probiotic on microbial status of carcasses meat

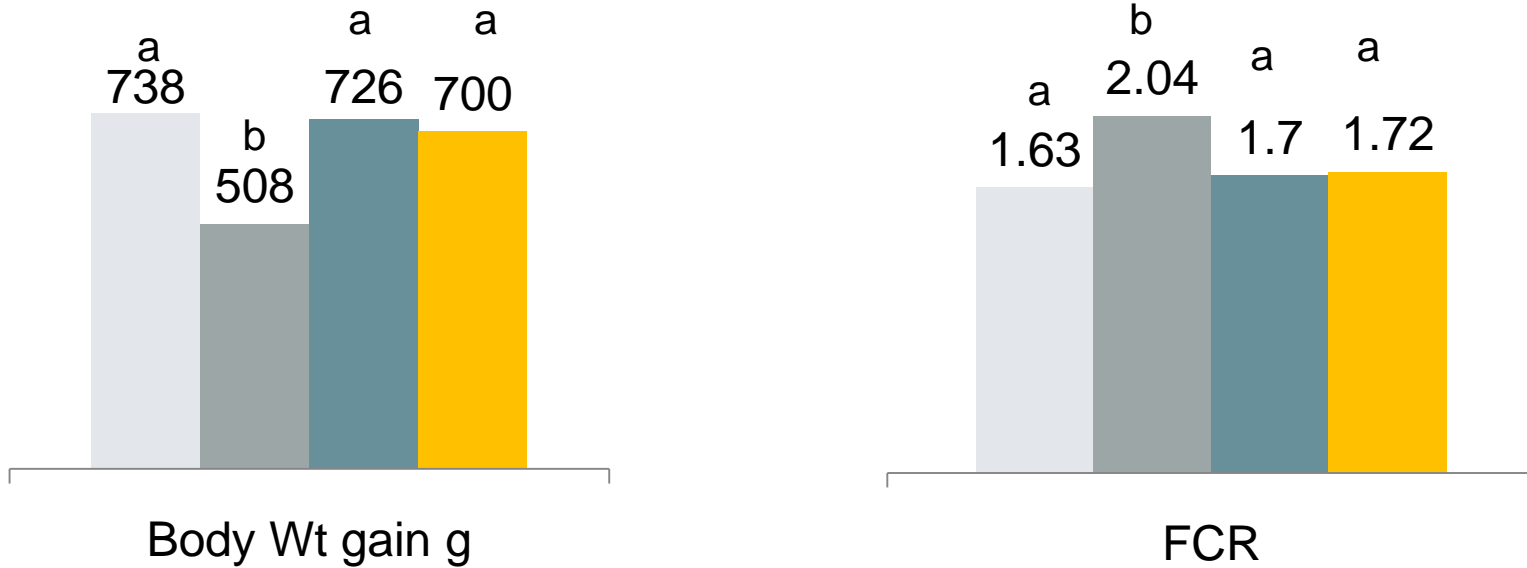
Measurement	Control	Probiotic	Pooled SEM
Salmonella (number positive/total)	40/40 ^a	16/40 ^b	
Log CFU/ml campylobacter	3.04 ^a	2.67 ^b	0.09
Log CFU/ml coliforms	2.52 ^a	1.55 ^b	0.11

Means in the same row with no common superscript differ significantly ($p < 0.05$).

Animal: Broilers

Probiotic: *Mixture of lactobacilli and bifidobacterium*

Probiotics and Necrotic enteritis challenge (0-28d)



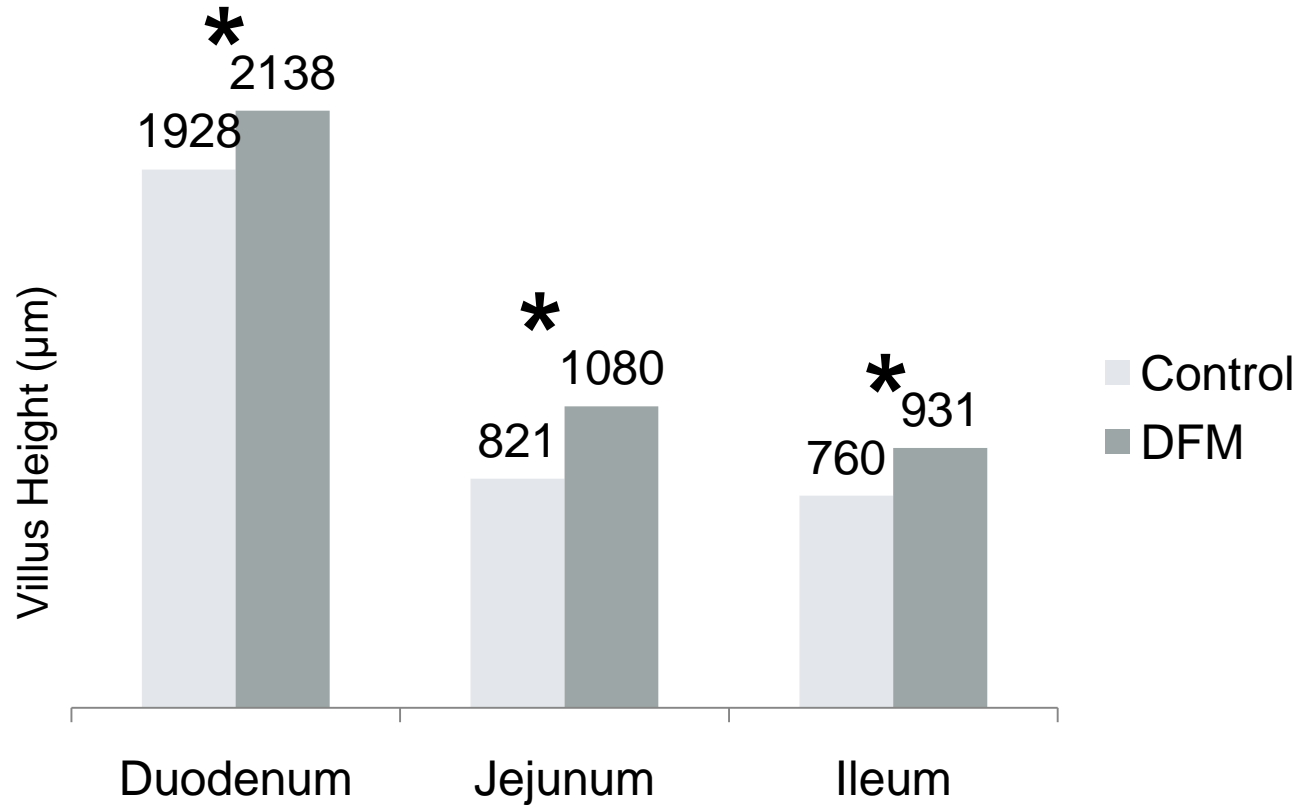
Unchallenged Control
 Challenged Control
 CC+BMD
 CC+DFM

Animal: Broilers challenged with necrotic enteritis
 Probiotic: 3 strains mixture of *bacillus strains*

Unpublished data

Animal Health

Probiotics and gut health

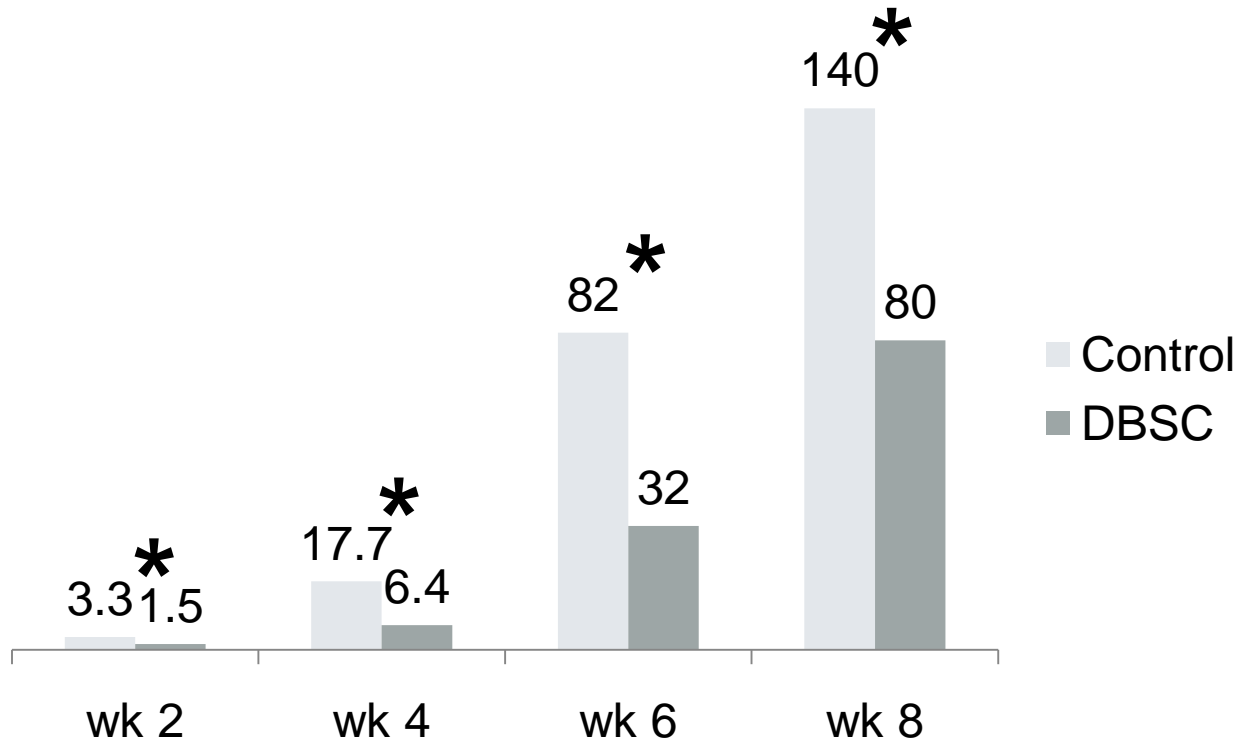


Animal: Broilers challenged with *Eimeria* vaccine
 Probiotic: *Mixtures of bacillus strains*

Animal Health

Probiotics and Environment

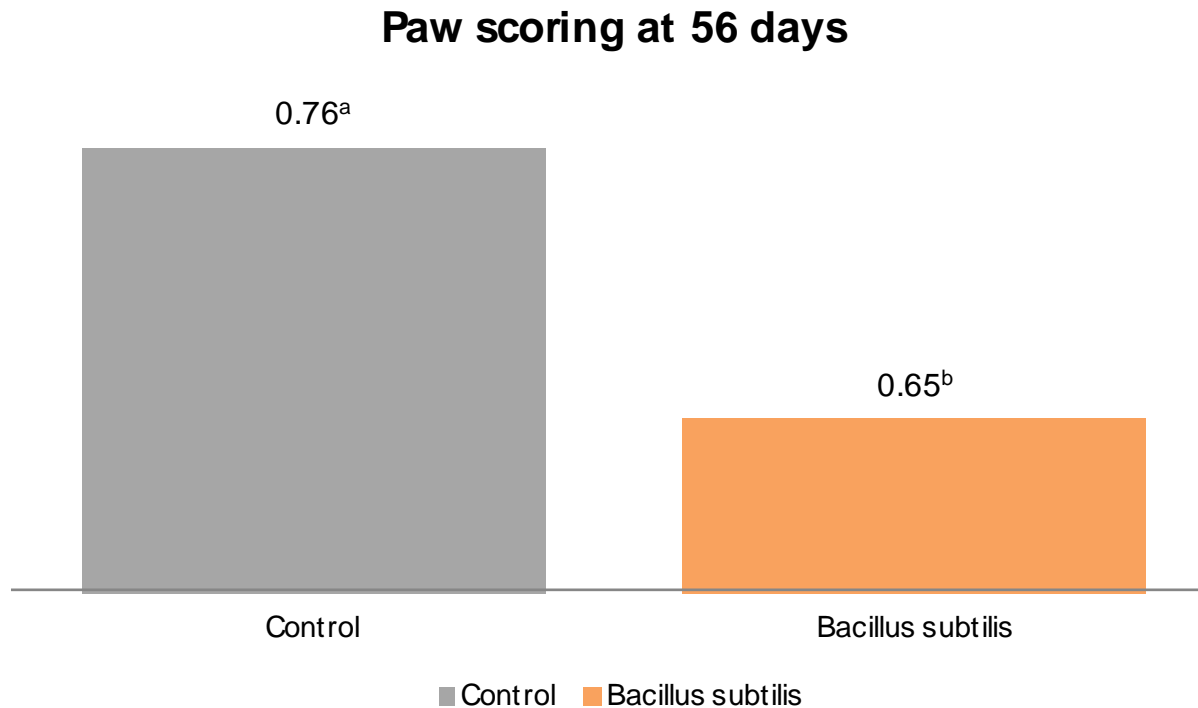
Ammonia concentration in manure, ppm



Environment

Animal: Laying hens
 Probiotic: *Dried bacillus subtilis culture*

Probiotics and Foot pad lesions



Animal welfare

Animal: Broilers
 Probiotic: *mixture of 3 strains of Bacillus subtilis*

Unpublished data

Probiotics: Thinking outside the ‘gut’

Probiotics in feed

Gut	Microbial balance	Gut Health	Synergy with other feed additives
Animal	Production performance	Welfare	Health
Environment	Manure Quality	Farm odour reduction	
Public Concerns	Meat Quality	Egg Quality	Lower antibiotic use

Summary

Animal nutrition in modern days
can not be all about

‘Gut filling’ of animal

or

‘Gut feeling’ of nutritionist

We must

‘think outside the Gut’



Thank you for your attention

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