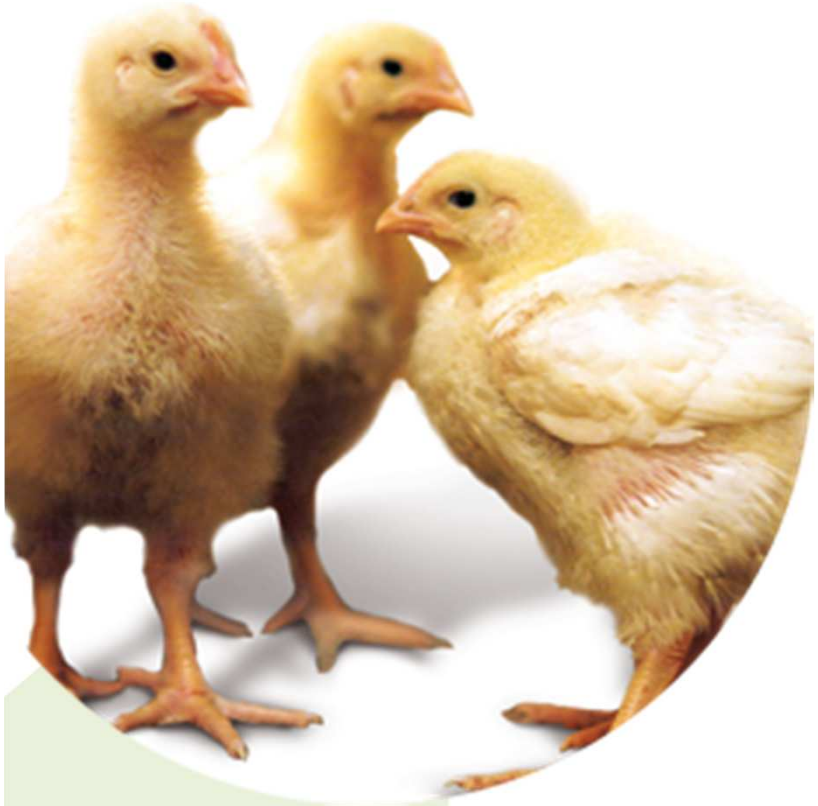
DARLING INGREDIENTS INTERNATIONAL

Plasma in broiler diets
Boost the intestinal resilience

ir Carine van Vuure
Nutritionist

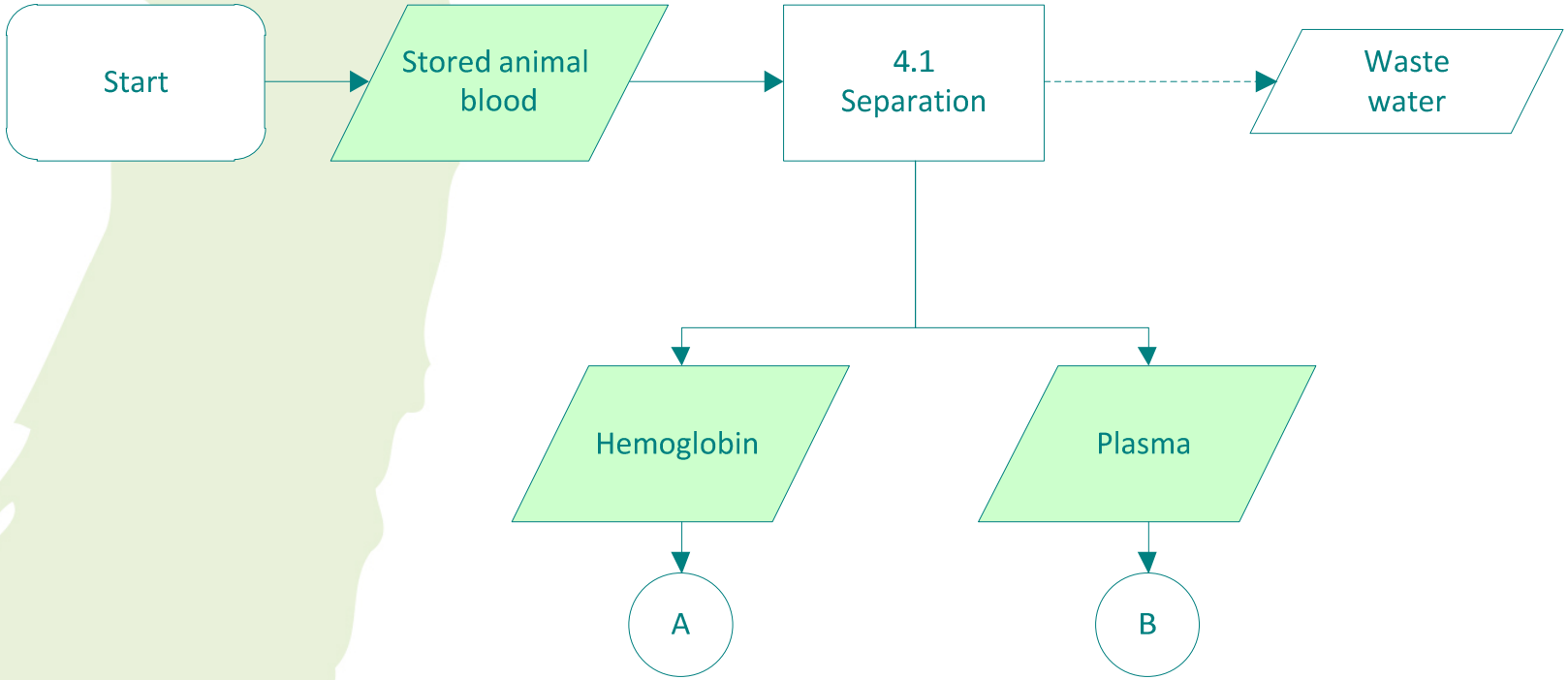
Improvement by nature

Table of content

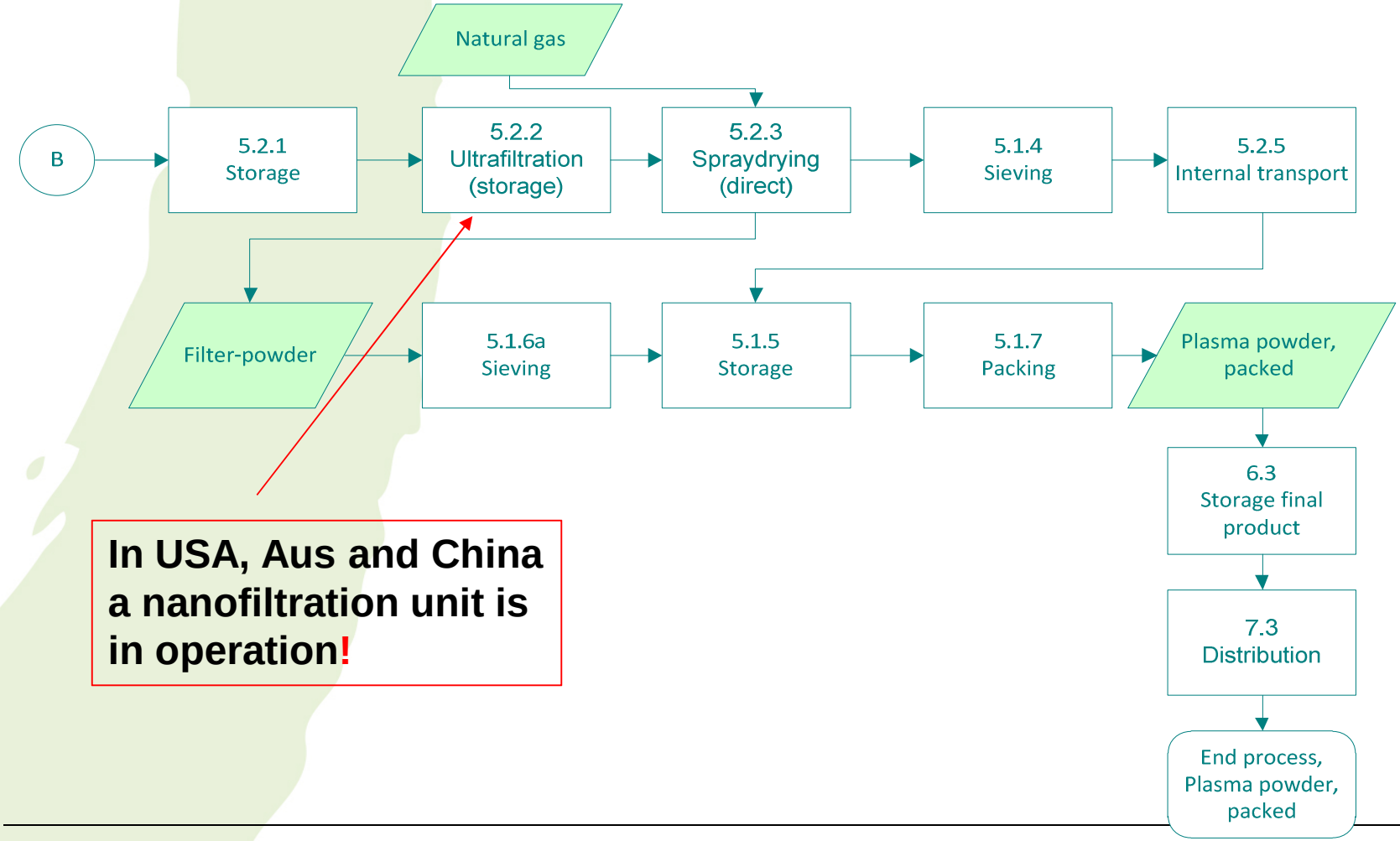


- What is plasma
- Overview of research done
- Discussion

Production process flow scheme



Production process flow scheme



In USA, Aus and China a nanofiltration unit is in operation!

Plasma application in Piglet and poultry Feed Market Segments

Mainly in the first stages of life / around weaning:

Application of plasma in the following piglet feed market segments:

- Piglet feeds before weaning (Creep feeds)
- Weaning diets (0 - 14 days after weaning)
  - Especially for early weaning (14 and 21 days)

Application of plasma in poultry diets:

- Starter diets for 5, 7 or 10 days
- If 5 days (or less) then also higher inclusion rate necessary
- For broilers and turkeys

Well documented effects of plasma protein in piglets:

- Improvement of Feed Intake
- Improvement in ADG
- Improvement in Feed Efficiency

Excellent digestibility for young animals

in Poultry not so much research has been done,

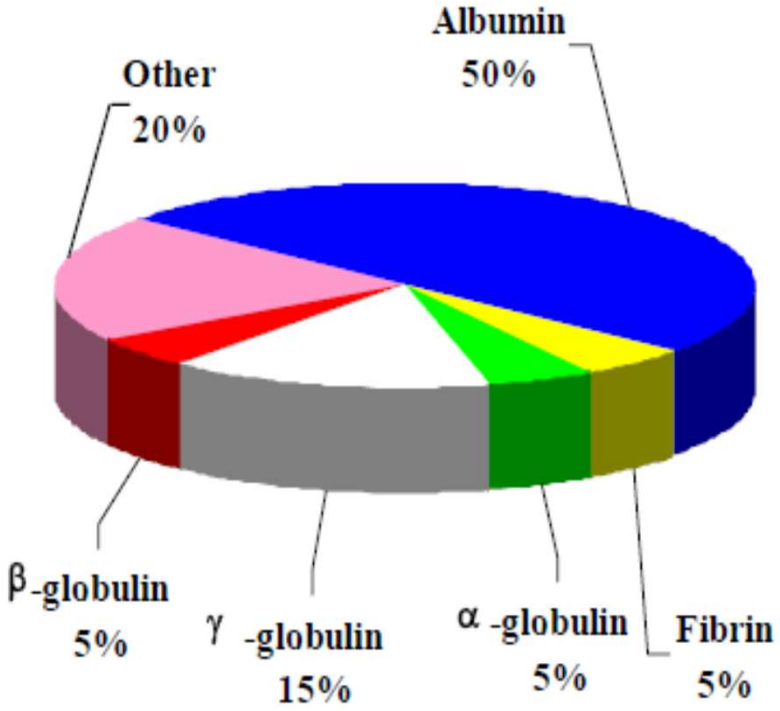
But there is some

Proteins in plasma

- Proteins are normally digested to amino acids prior to absorption

- Research indicates that some proteins retain biological activity in the intestinal tract

- Globulin proteins
  - alpha-globulin
  - beta-globulin
  - gamma-globulin (Ig)
- Albumin
- Bio-active peptides
- Enzymes
- Growth factors (like IGF)
- Endocrine factors



Mode of action of plasma protein as known from (foremost) piglet research

- Response to plasma protein is most likely mainly – but not only- linked to the IgG : many other bio-active components are present as well (abt 1400 proteins)
- Protects the intestinal mucosal layer

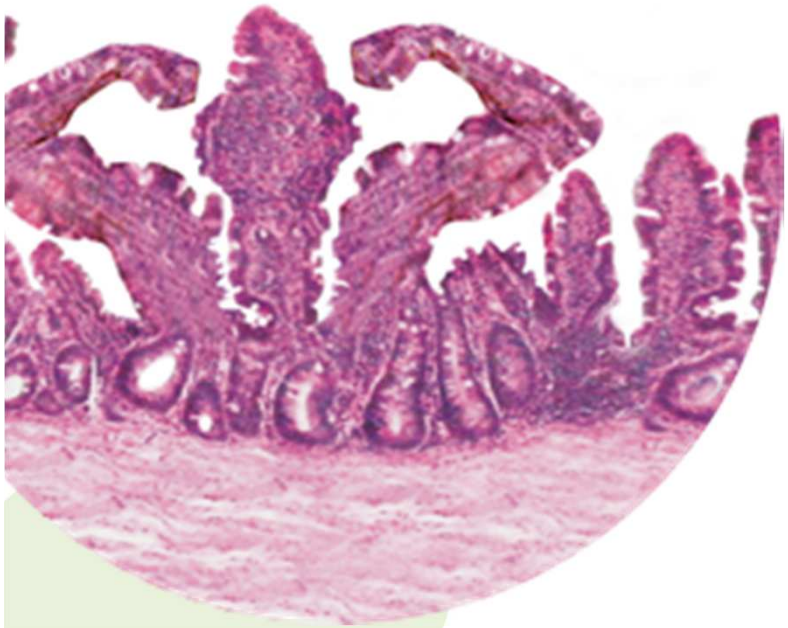
  → reduced tissue damage → better absorption
  → increased villus surface area → increased enzyme activity (e.g. maltase and lactase)
- Attenuates the (local) immune response to pathogens or external stimuli
  - Keeps the feed intake at a normal (higher) level
- Can bind to pathogens, like E. coli

Immunoglobulin's and Insulin Growth factor

(J. Houdijk, SRUC 2014)

	IgG	IGF-1	IGF-1	IGF-1
	g/kg	free mg/kg	total mg/kg	% active
Plasma	275	19	740	3
Enriched plasma	457	104	1001	10
Skim milk powder	0	11	1079	1

Table of content



- What is plasma
- Overview of research done
- Discussion

DARLING INGREDIENTS INTERNATIONAL

ecoson Rendac sonac Rousselot cth besthides

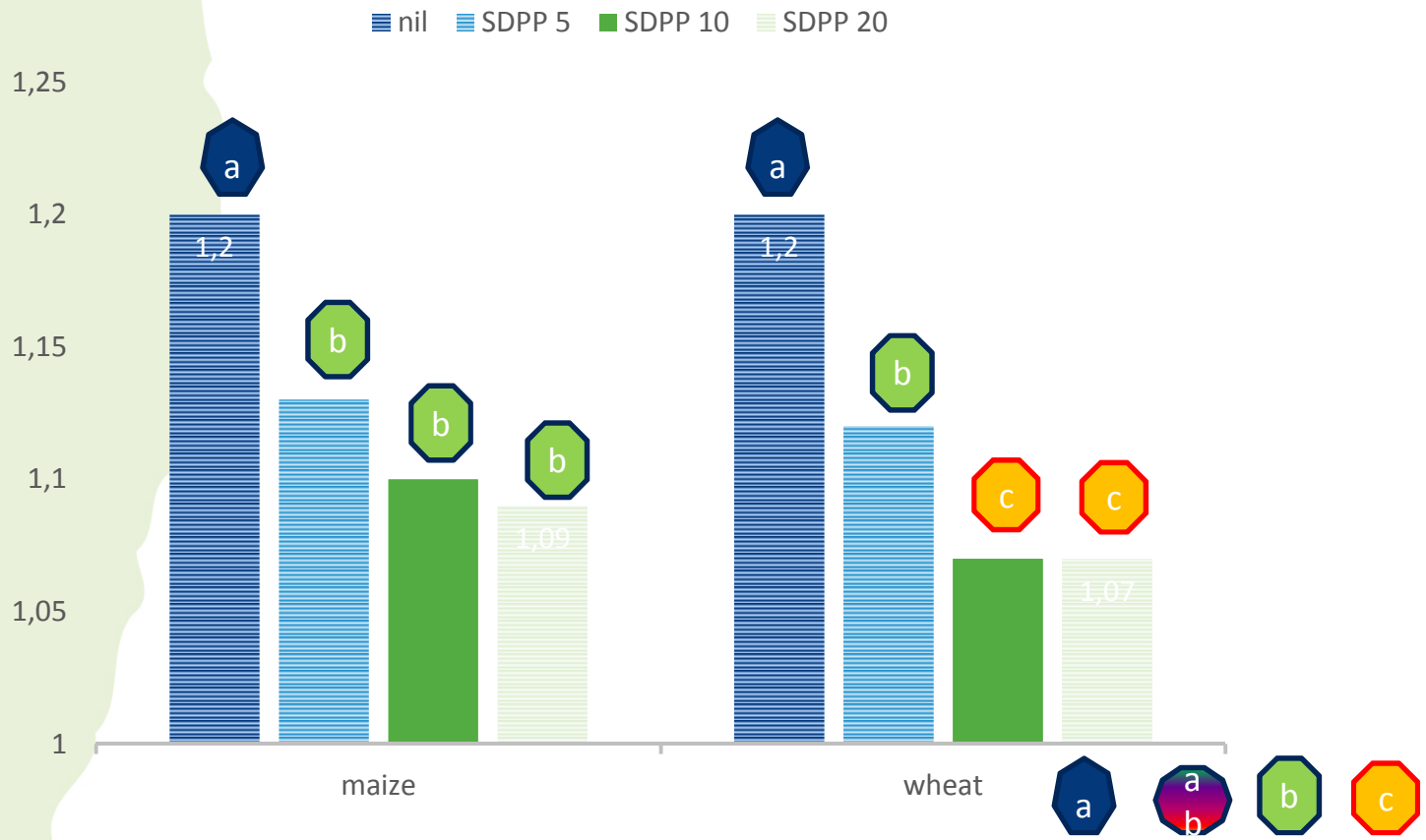
Overview broiler research

trial	Country / year	Organisation	Breed	Number of animals	Repli-cations	No. of animals/cage, pen	Challenge	cereal	com-paired to	Plasma type	Days fed	Dosage %	FCR 0-10 days	points ⇓	sign	FCR 0-35 days*	points ⇓	sign	FCR 0-49 days*	points ⇓	sign
1	Australia 2014	University of New England, Armidale (Bhuiyan, et al)	male Ross 308	240	6	8	No	Wheat	BLM, SBM, MM	Porcine	10	0,5	1,12	5	s	1,50	8	ns			
												1,0	1,14	3	s	1,48	10	ns			
										Bovine	10	0,5	1,15	2	ns	1,44	14	s			
												1,0	1,16	1	ns	1,47	11	s			
2	Australia 2014	University of New England, Armidale (Beski, et al)	male Ross 308	480	10	8	No	Maize	BLM, SBM, MM	Porcine	10	0,5	1,13	7	s	1,58	3	ns			
												1,0	1,10	10	s	1,52	9	s			
												2,0	1,09	11	s	1,53	8	s			
							No	Wheat	BLM, SBM, MM	Porcine	10	0,5	1,12	8	s	1,60	4	ns			
												1,0	1,07	13	ss	1,56	8	ns			
												2,0	1,07	13	ss	1,46	18	s			
3	Australia 2014	University of New England, Armidale (Bhuiyan, et al)	male Ross 308	480	10	8	No	Wheat	BLM, SBM, MM	Porcine	5	1,0	1,09	5	ns	1,5	2	ns			
												2,0	1,06	8	s	1,49	3	ns			
											10	1,0	1,04	10	s	1,47	5	s			
												2,0	1,01	13	ss	1,45	7	ss			
4	USA 2015	University of Missouri-Columbia (Firman, et al)	hubbard/ Ross cross	1.440	16	30	no	Corn	soya48	Porcine	10	0,5	1,27	-8	s	1,60	-2	ns	1,82	3	ns
												1,0	1,31	-12	s	1,57	1	ns	1,77	7	s
5	NL 2015	Research Institute Schothorst (Van de Belt, et al)	Ross 308	12.300	5	820	no	Wheat	potato protein	Porcine	10	1,0	1,24	3	ns	1,50	1	ns			
												2,0	1,20	6	s	1,50	0	ns			

Australian trials in Detail

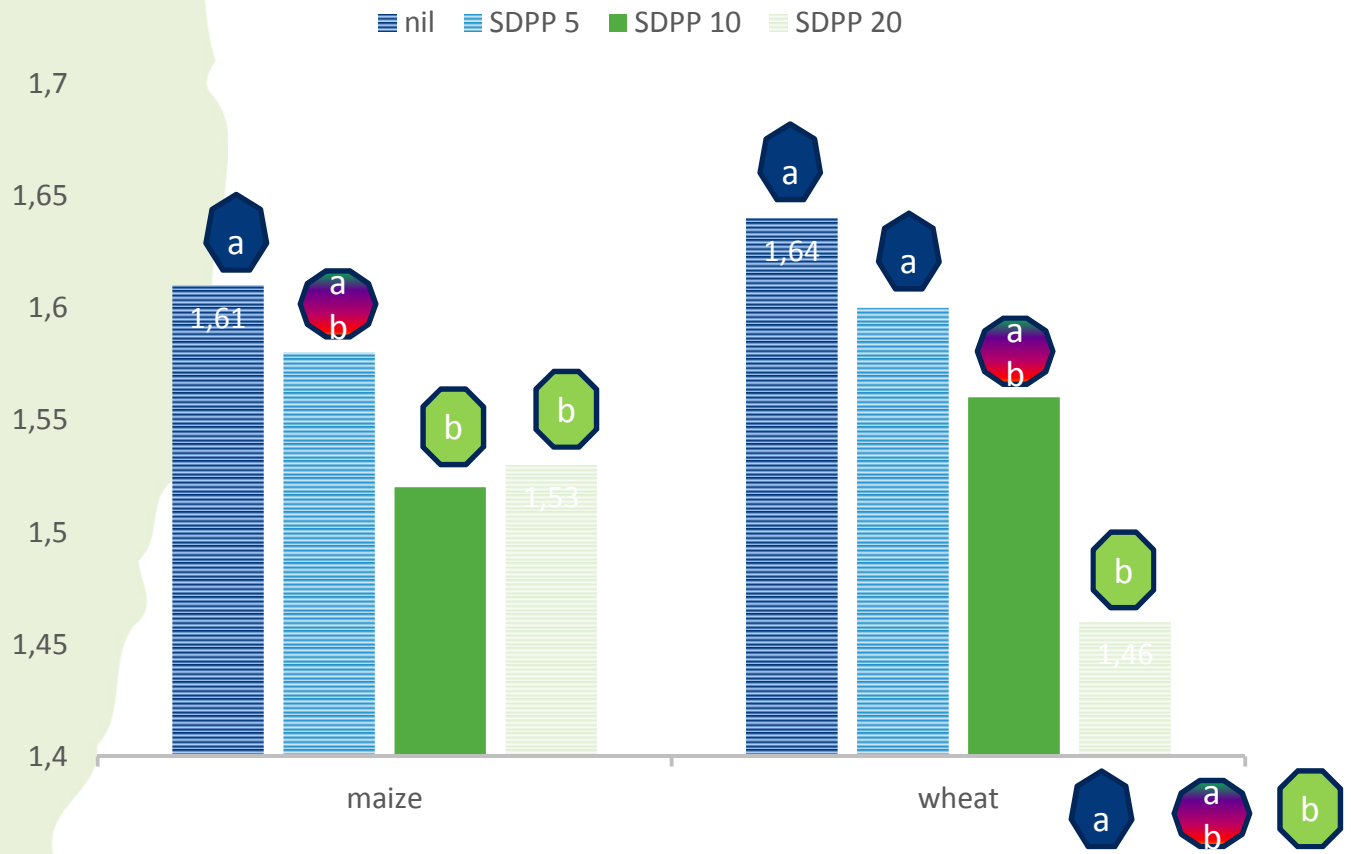
cereal	com-paired to	Plasma type	Days fed	Dosage %	FCR 0-10 days	points ⇓	sign	FCR 0-35 days*	points ⇓	sign
Wheat	BLM, SBM, MM	Porcine	10	0,5	1,12	5	s	1,50	8	ns
				1,0	1,14	3	s	1,48	10	ns
		Bovine	10	0,5	1,15	2	ns	1,44	14	s
				1,0	1,16	1	ns	1,47	11	s
Maize	BLM, SBM, MM	Porcine	10	0,5	1,13	7	s	1,58	3	ns
				1,0	1,10	10	s	1,52	9	s
				2,0	1,09	11	s	1,53	8	s
Wheat	BLM, SBM, MM	Porcine	10	0,5	1,12	8	s	1,60	4	ns
				1,0	1,07	13	ss	1,56	8	ns
				2,0	1,07	13	ss	1,46	18	s
Wheat	BLM, SBM, MM	Porcine	5	1,0	1,09	5	ns	1,5	2	ns
				2,0	1,06	8	s	1,49	3	ns
			10	1,0	1,04	10	s	1,47	5	s
				2,0	1,01	13	ss	1,45	7	ss

FCR in the first 10 days (starter period)



Significance ($p<0,05$)

FCR during 35 days (overall)



Significance ($p<0,05$)

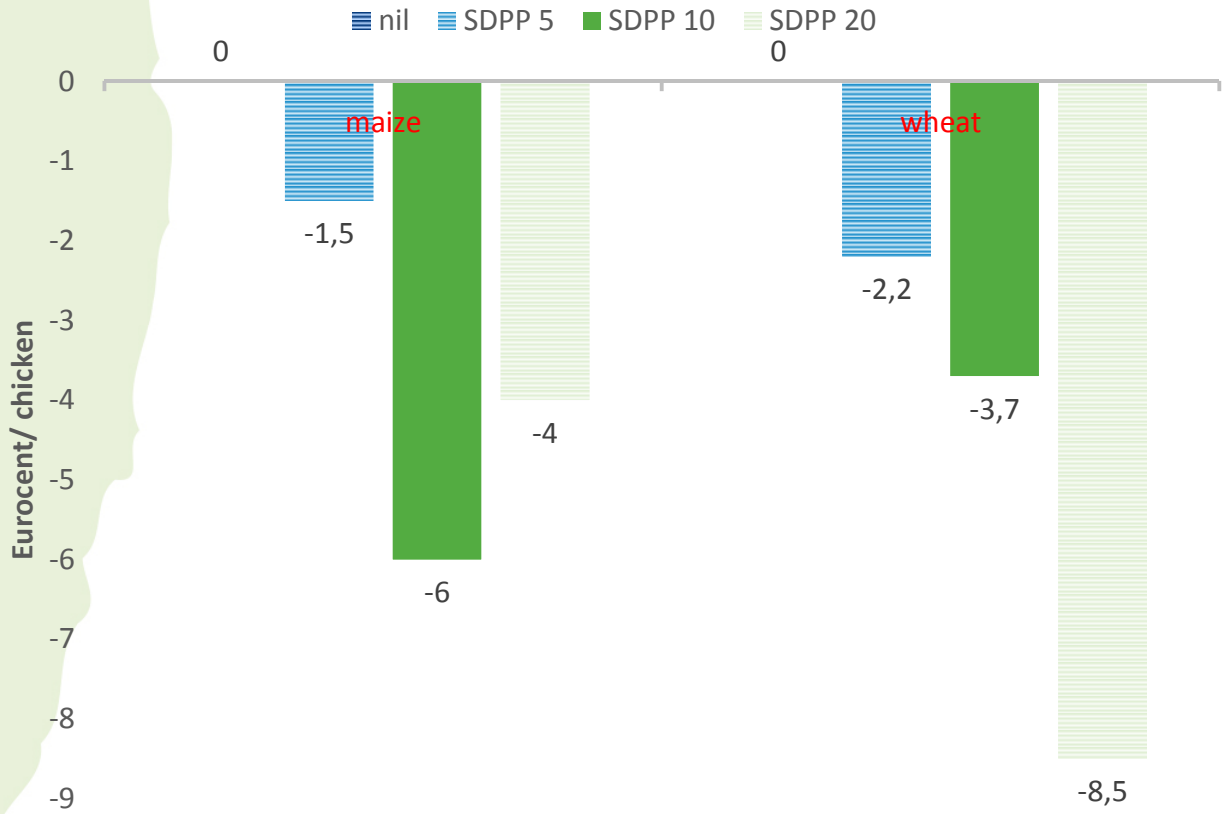
Economics

For the economical evaluation following assumptions have been made:

- Diet costs were recalculated using Dutch feed formulas for starter, grower and finisher diets
- Price level: September 2014
- Plasma price set at 4 €/kg
- 1 % plasma addition increases cost price by app. 30 €/ton

- Cost price starter 26,34 €/100 kg (no premix)
- Cost price grower 28,54 €/100 kg (no premix)
- Cost price finisher 27,40 €/100 kg (no premix)

Economics: feed cost benefit per chicken (2500 g gain) against the control diet



1st Wrap-up

- Australian trials:
  - Clear effect in first 10 days
  - Already effects possible at 0,5%
  - Shorter period ↔ higher inclusion necessary
  - Wheat is more challenging than corn
  - Both bovine and porcine plasma show effects
- US trial (Missouri):
  - Probably an incorrect nutrient value of plasma
  - Significant results after 49 days
- Dutch trial (Schothorst)
  - No challenge, too optimal circumstances

DARLING INGREDIENTS INTERNATIONAL

ecoson Rendac sonac Rousselot cth besthides

Overview broiler research

trial	Country / year	Organisation	Breed	Number of animals	Repli-cations	No. of animals / cage,pen	Challenge	cereal	compaired to	Plasma type	Days fed	Dosage %	FCR 0-14 days	points ⇓	sign	FCR 0-21 days	points ⇓	sign	FCR 0-42 days	points ⇓	sign
6	USA 2005	IOWA (Campbell, et al)	male Ross 308	240	8	6	used litter	Corn	SBM		42 3 fases	1,0/0,5/0,25 0,75/0,375/0,18 0,5/0,25/0,125 0,25/0,125/0,062							quadratic response with increasing levels		s
7	USA 2006	IOWA (Campbell, et al)	male Ross 308	240	8	6	used litter	Corn	SBM		0-35 0-14	1,0/0,5/0,25 1,0/0/0	1,31	15-19	S*	1,71	20-27	S*			
8,1	Brazil 2013	Federal University of Rio Grande do Sul (Henn, et al)	male Ross 308	1.400	8	35	used litter + contaminated coccidian	Corn	SBM	Bovine	1-7 1-21 1-21	1,5/0/0 1,5/0,5/0 3,0/0/0 3,0/0,5/0				1,35 1,35	3 3	s s	1,69	2	s
8,2	Brazil 2013	Rio Grande do Sul (Henn, et al)	male Ross 308	880	10	22	used litter	Corn	SBM	Bovine	1-8 1-21 1-42	1,5/0/0 1,5/0,5/0 1,5/0,5/0,25							1,81 1,74 1,74	-2 4 4	ns ns ns

*contrast: control vs SDP

Details of trial No.7 (USA)

	Treatment									
	Control	Powder, continuous	Powder, discontinuous	Granular, continuous	Granular, discontinuous		Contrasts[2] (*P*-values)			
Item	1	2	3	4	5	SEM	1	2	3	4
d 0 to 14										
ADG, g/d	19.21	25.97	24.61	25.97	26.96	0.54	0.0001	0.0372	NS	—
ADFI, g/d	28.58	34.72	32.83	33.55	34.66	0.60	0.0001	NS	NS	—
Gain:feed	0.675	0.751	0.753	0.777	0.778	0.009	0.0001	0.0087	NS	—

[2]Contrasts were as follows: 1) control (treatment 1) vs. SDP (treatments 2, 3, 4, and 5); 2) Powder (treatments 2 and 3) vs. Granular (treatments 4 and 5); 3) SDP continuous feeding (treatments 2 and 4) vs. SDP discontinued feeding (treatments 3 and 5); 4) interaction of feeding duration and form of SDP (treatments 3 and 4 vs. 2 and 5).

Natural Necrotic Enteritis Exposure (No.7)

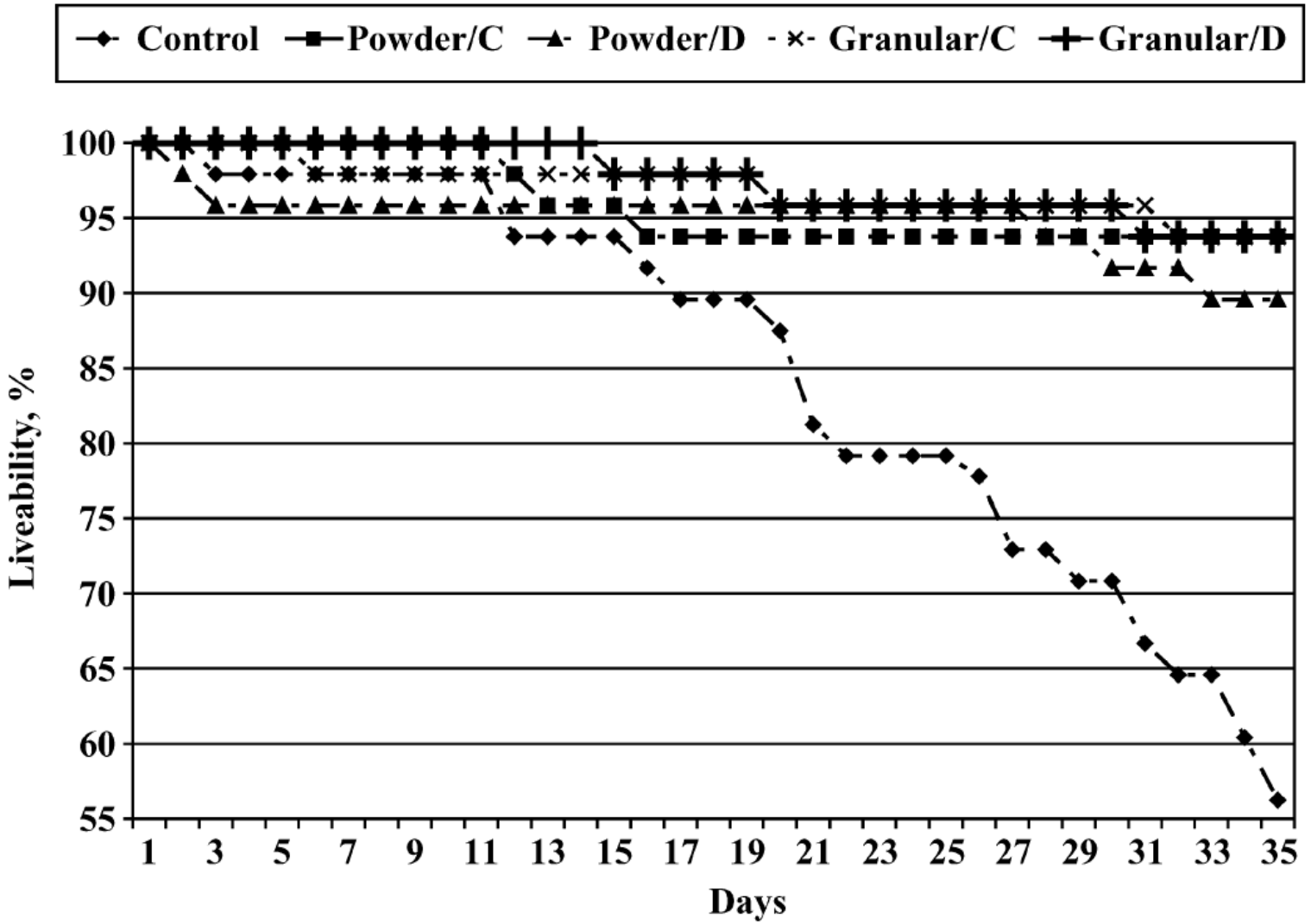


Figure 1. Effect of spray-dried plasma (powder or granular) fed continuously (C) or not (D) on liveability (%).

Effect of continuous vs discontinuous and granular and powder

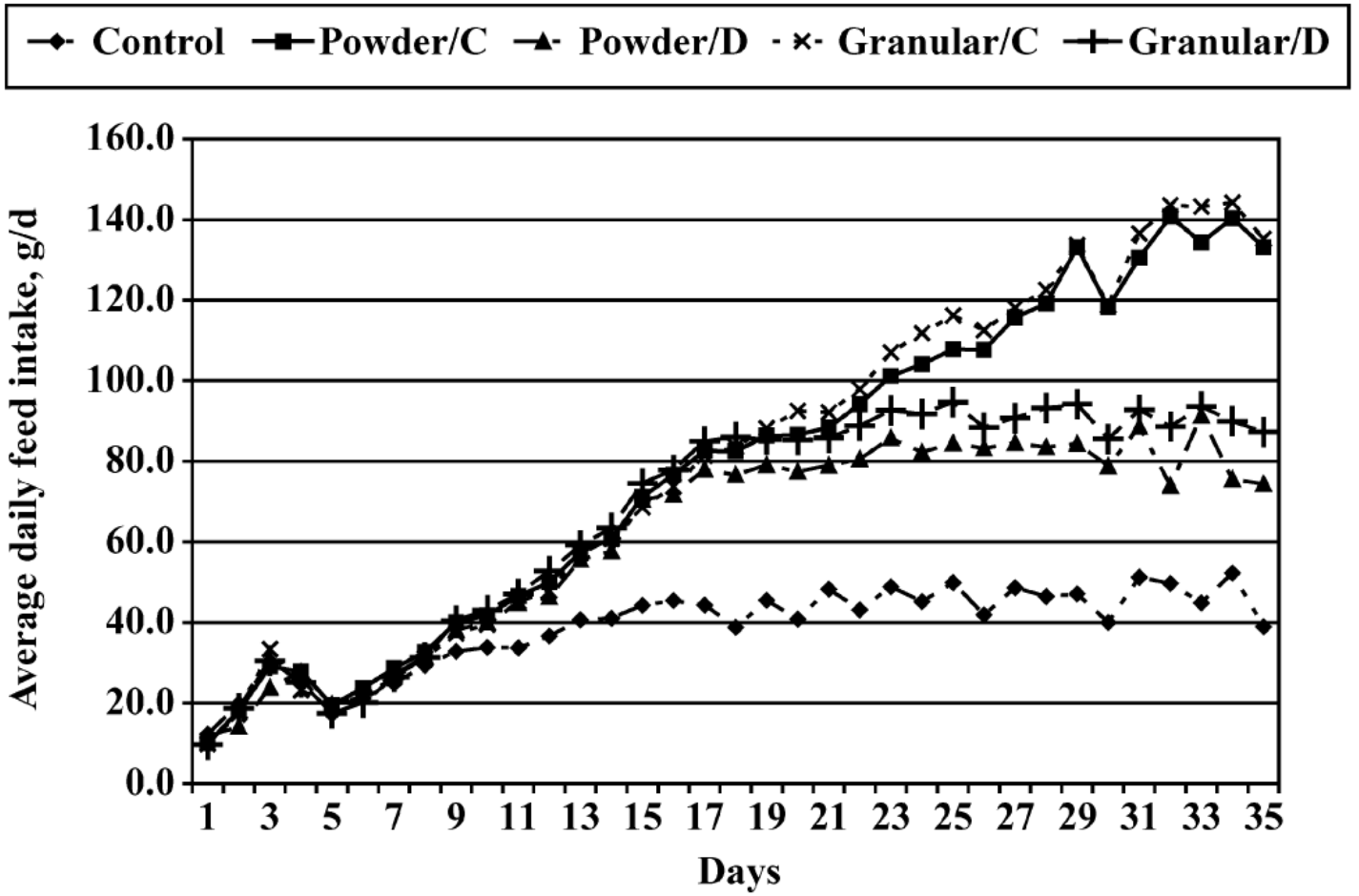


Figure 2. Effect of spray-dried plasma (powder or granular) fed continuously (C) or not (D) on average daily feed intake (g/d).

2nd Wrap-up

- Increased levels show increased effects
- Continuous > discontinuous
- Course ground (granular) => gizzard motility ⇑

- Challenged trials show clear results: spray dried plasma improved ($P<0.05$) livability
    - independent of the form or duration

- Trials with bovine plasma also with interesting results

- Second (challenged) Brazilian trial showed effects on weight gain
  from d 8-21 and d 1-42

Overview broiler research

Turkeys

trial	Country / year	Organisation	Breed	Turkey poults	Replications	No of animals/ pen	Challenge	treatment	Plasma type	Days fed	Dosage %	FCR 0-7 days	points ⇓	sign	FCR 0-28 days	points ⇓	sign	FCR 35-49 days	points ⇓	sign
9.1	USA 2004	IOWA (Campbell, et al)	Hybrid Turkeys	280	10	7	clean litter	via drinking water	Bovine serum	0-28	0,45/0,90/1,35	1,16-1,19	6-9	s	1,36	4	ns			
9.2	2004		Hybrid Turkeys	224	8	7	used litter		Bovine serum		0,45/0,90/1,35	1,3	0	ns	1,4	5	s			
10	USA 2004	IOWA (Campbell, et al)	Nicholas Turkeys	80	3	6 or 7	no challenge day 35 pasteurella	via drinking water	bovine serum	0-49	1,3 (d 0-7)/ 0.65 (d 8-14)/ 0,325 (d15-21)/1,3 (d22-49)	1,20	15	s				1,79 1,72	6 4	s s

3rd Wrap-up

- Spray dried serum => increased performance in 1st week
- Strong effects of a challenge
- In experiment 9.2 linear increase in ADG
- With addition via drinking water one escapes the depressed feed intake due to immune stimulation

Challenge with Pasteurella multocida on day 35

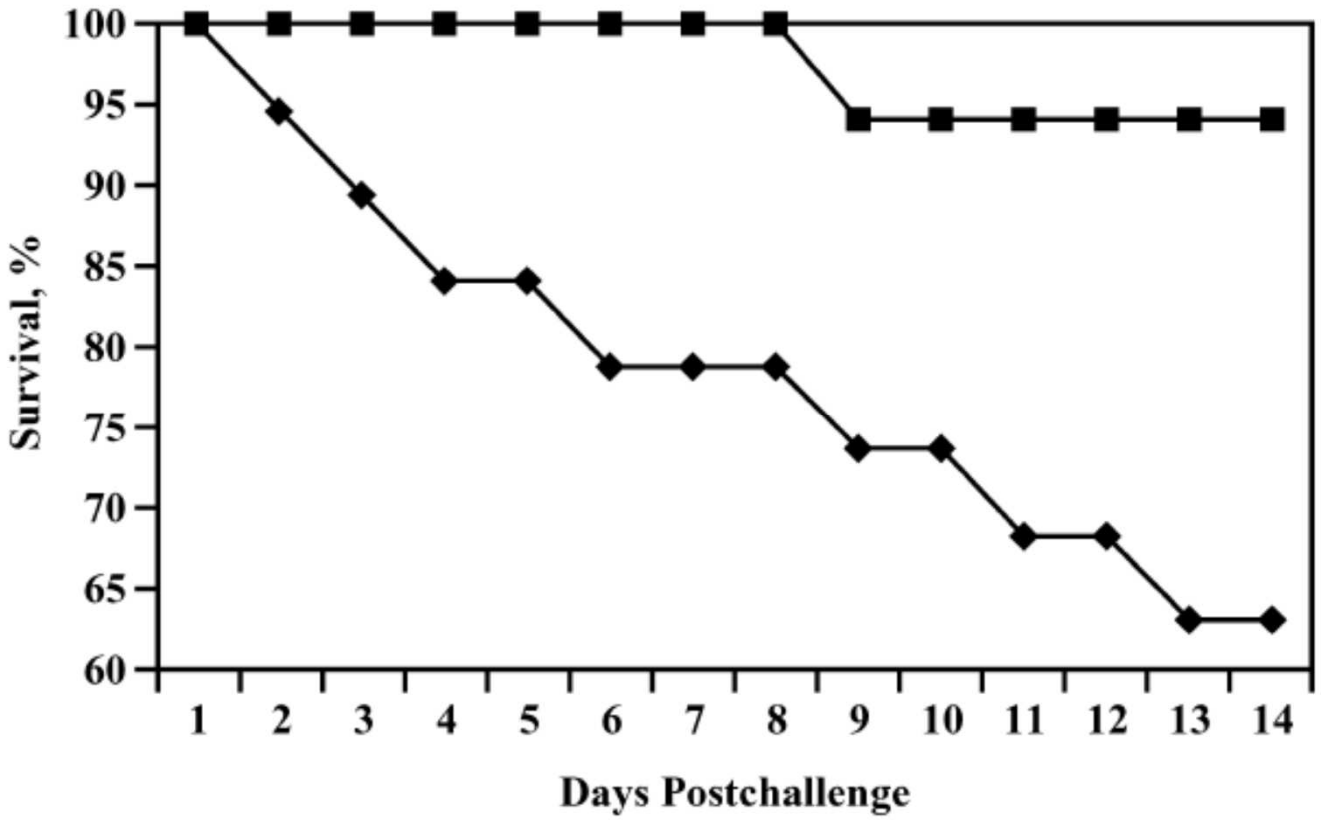
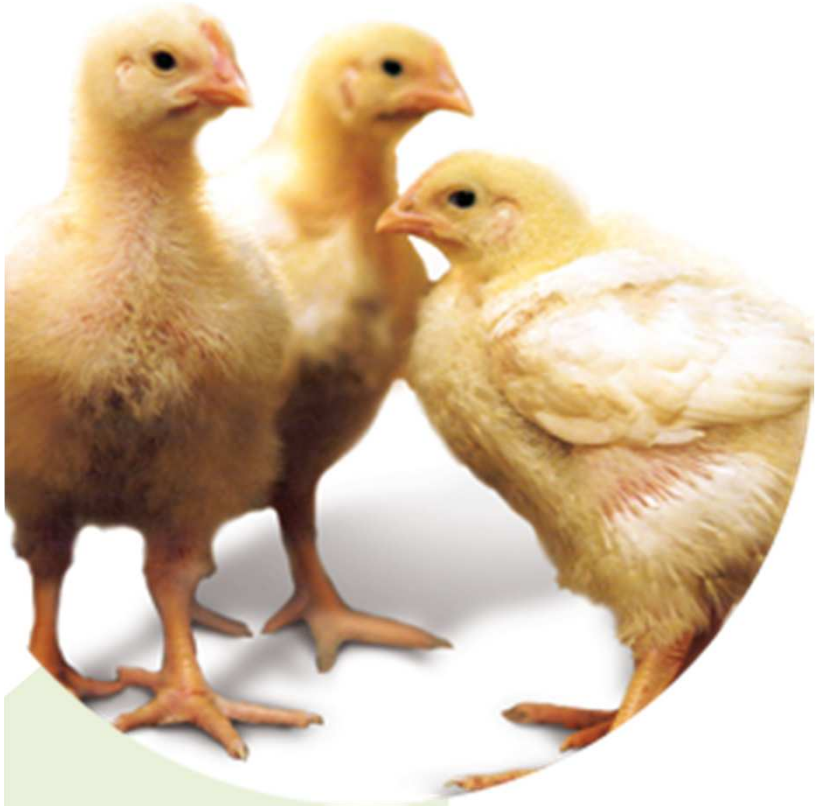


FIGURE 1. The effect of water treatment on survival of poults 14 d postchallenge with *Pasteurella multocida*. ■ = Innavax (INX), ◆ = control; $P < 0.03$.

4th Wrap-up

- Pasteurella multocida => fowl cholera => a respiratory challenge
- Plasma serum dosed via drinking water =>
  improved survival of poults
  P< 0.03 =>63.2 vs 94.1 %
- Suggestions for the mode of action:
  - Bind toxins
  - Improve repair of damaged tissue
  - Direct antigen-antibody interaction
- Several literature references (pigs)=> suggest reduced local intestinal inflammatory response
- Result: less stimulation of immune system => more nutrients for growth and systemic immunity

Table of content



- What is plasma
- Overview of research done
- Discussion

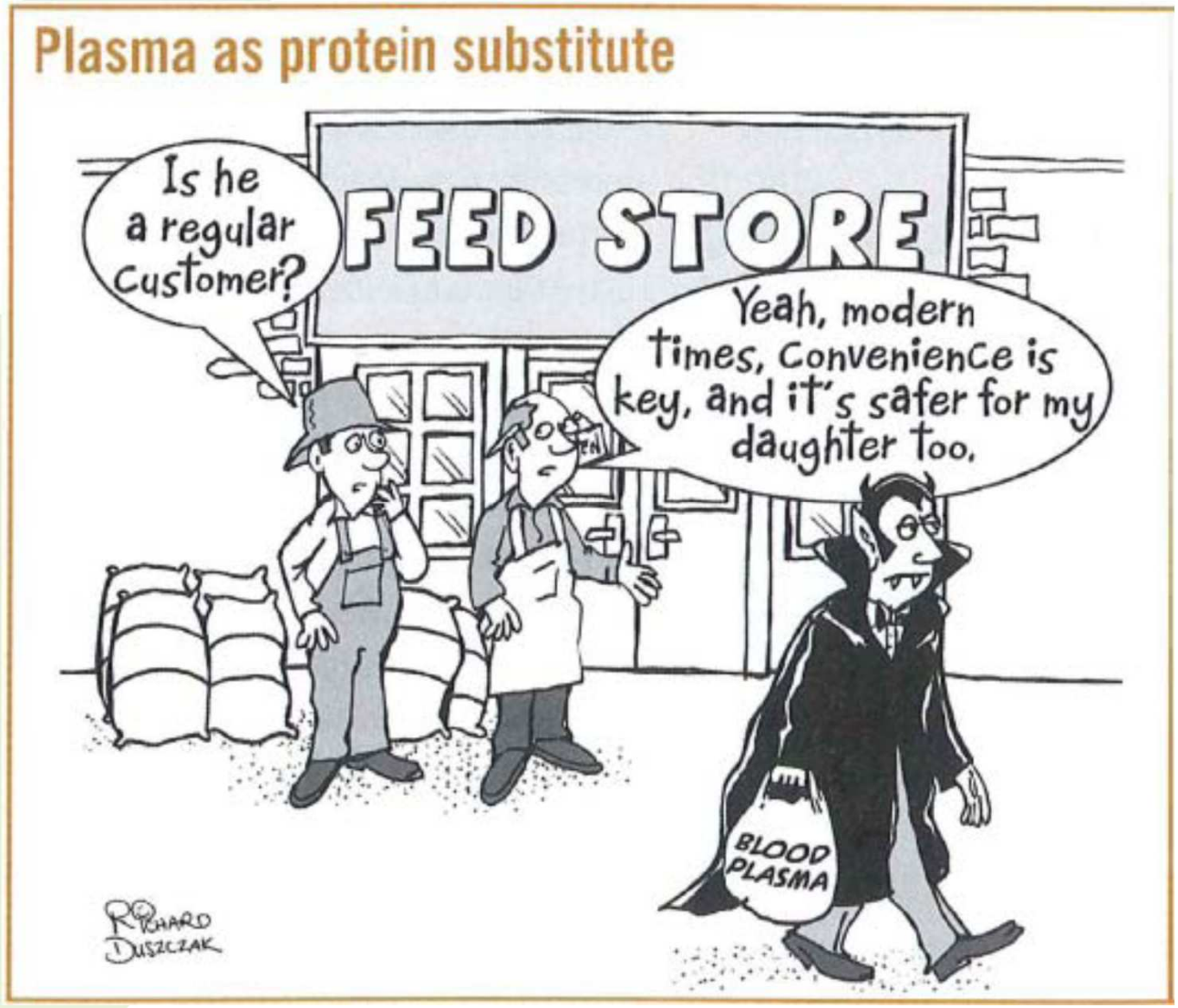
Discussion

- Relative response to plasma is greater => high antigen environment
- Stimulating immune system = altered metabolism =
  - Reduced feed intake, growth rate, protein accretion
- Hypothesis: plasma provides passive protection and prevents overstimulation of the immune system
- Early nutrition influences intestinal and immune system development
- Plasma has been shown to improve:
  - intestinal morphology (Bosi et al, 2001 & 2004) - pigs
  - Digestive enzyme activity (Cain et al, 1995) - pigs
  - Diet digestibility (Quigley et al, 2004) – dogs
- Plasma => reduced morbidity & mortality in challenged animals:
  - Turkeys, calves, pigs, trout, shrimp

Plasma and the antibiotic theme

- Dutch report (SDA-report) about the use of antibiotics in feed producing animals in the Netherlands in 2014 (published in May)
  - Within EU the largest reduction in NL
  - BUT: in broilers is has been increased compared to 2013 with 21.1% and in turkeys with 4.9 % !!!

- So alternatives to stimulate the resilience of poultry is a must!!


Plasma as protein substitute
FEED STORE
Is he a regular customer?
Yeah, modern times, convenience is key, and it's safer for my daughter too.
BLOOD PLASMA
RICHARD DUSZCZAK