



Economic Impact of Subclinical Coccidiosis

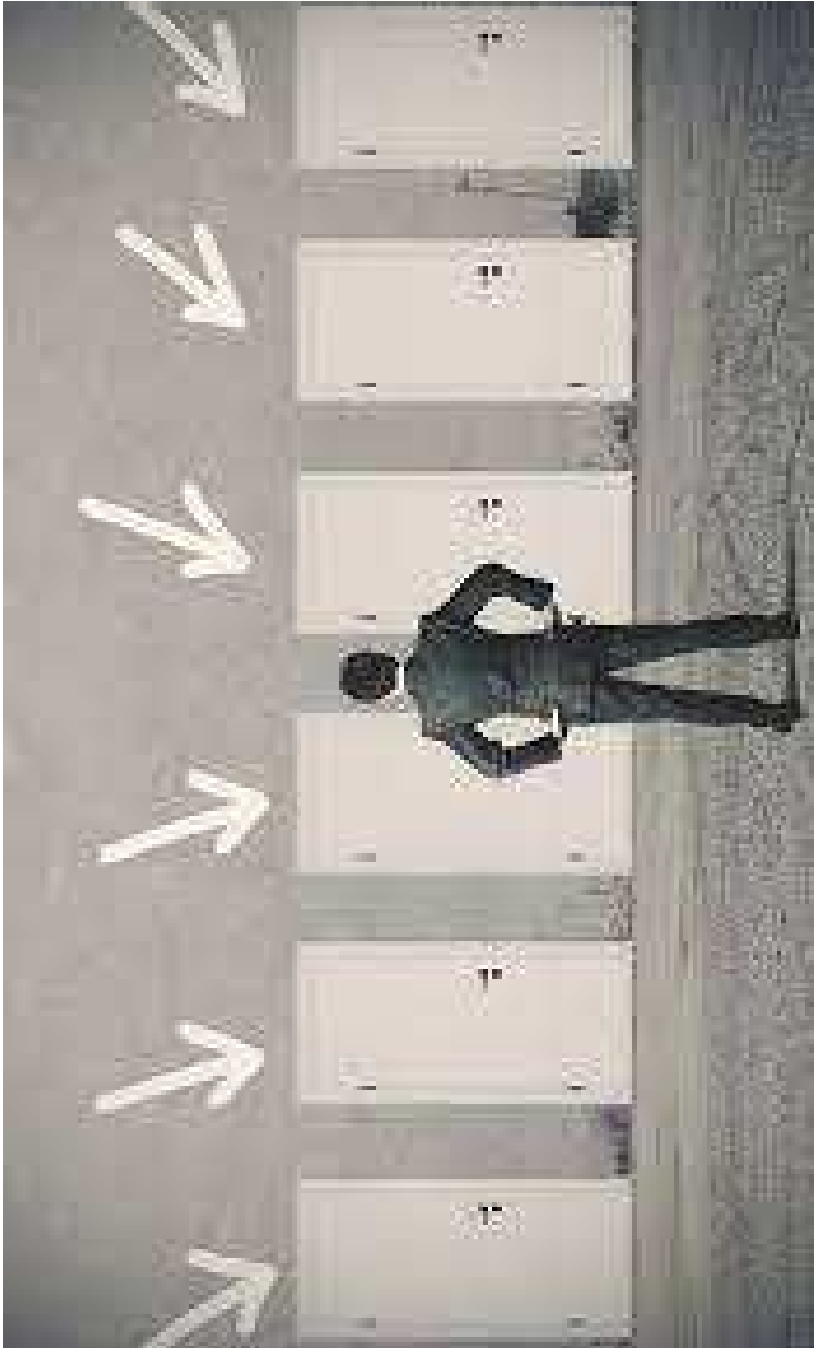
Corrado Longoni

Global Poultry Technical Director

June 8th 2023

Proprietary





Subclinical coccidiosis and *loss of sensitivity*



- Subclinical coccidiosis will not have the clinical/classical morbidity and mortality, but will **impact the bird performance**
- Early subclinical lesions allow time for recovery and there will be minimal performance effect.
- Lesions that occur in the final 2 weeks before slaughter, can have a very **significant** effect on weight, feed efficiency and bird **uniformity**

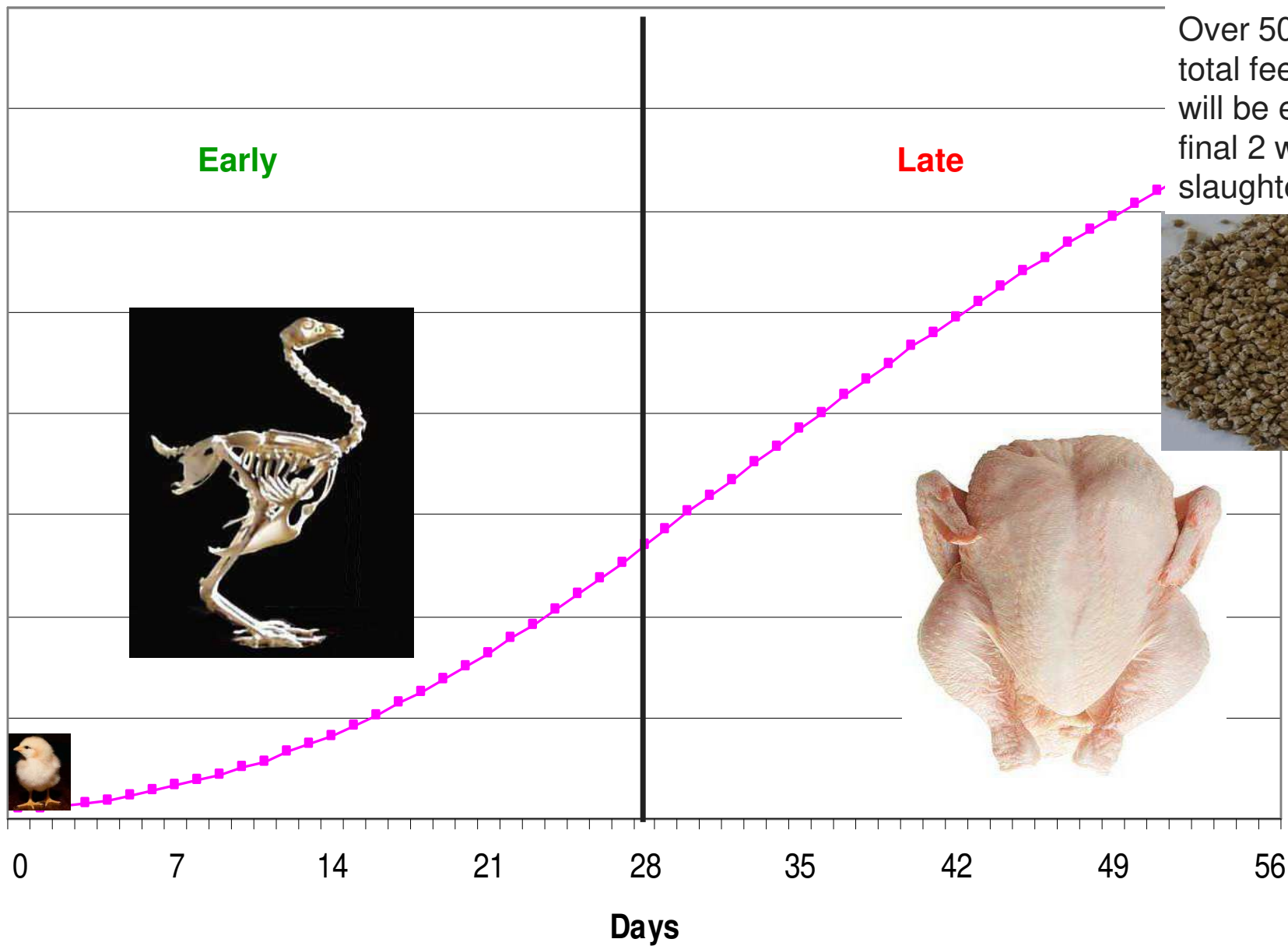


Significance of “loss of sensitivity”

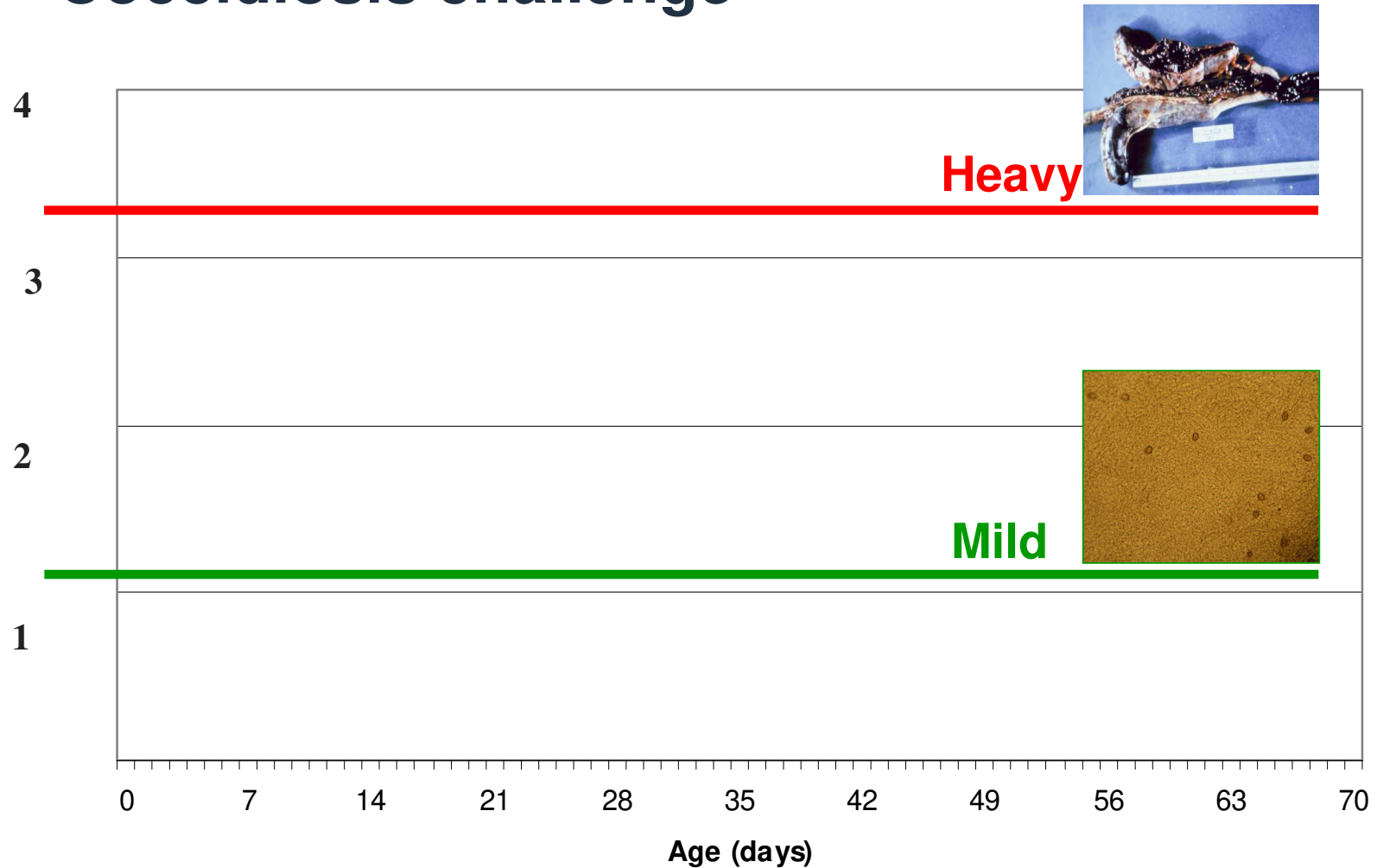


- Loss of sensitivity means that we see lesion scores that are **subclinical**. There is no mortality associated with these flocks.
- However, subclinical lesion scores are associated with *performance loss*. This can be observed in **weight gain or FCR deficit** compared to potential.
- It is important to know **when** the subclinical lesions might occur on the farm where this isolate was collected.

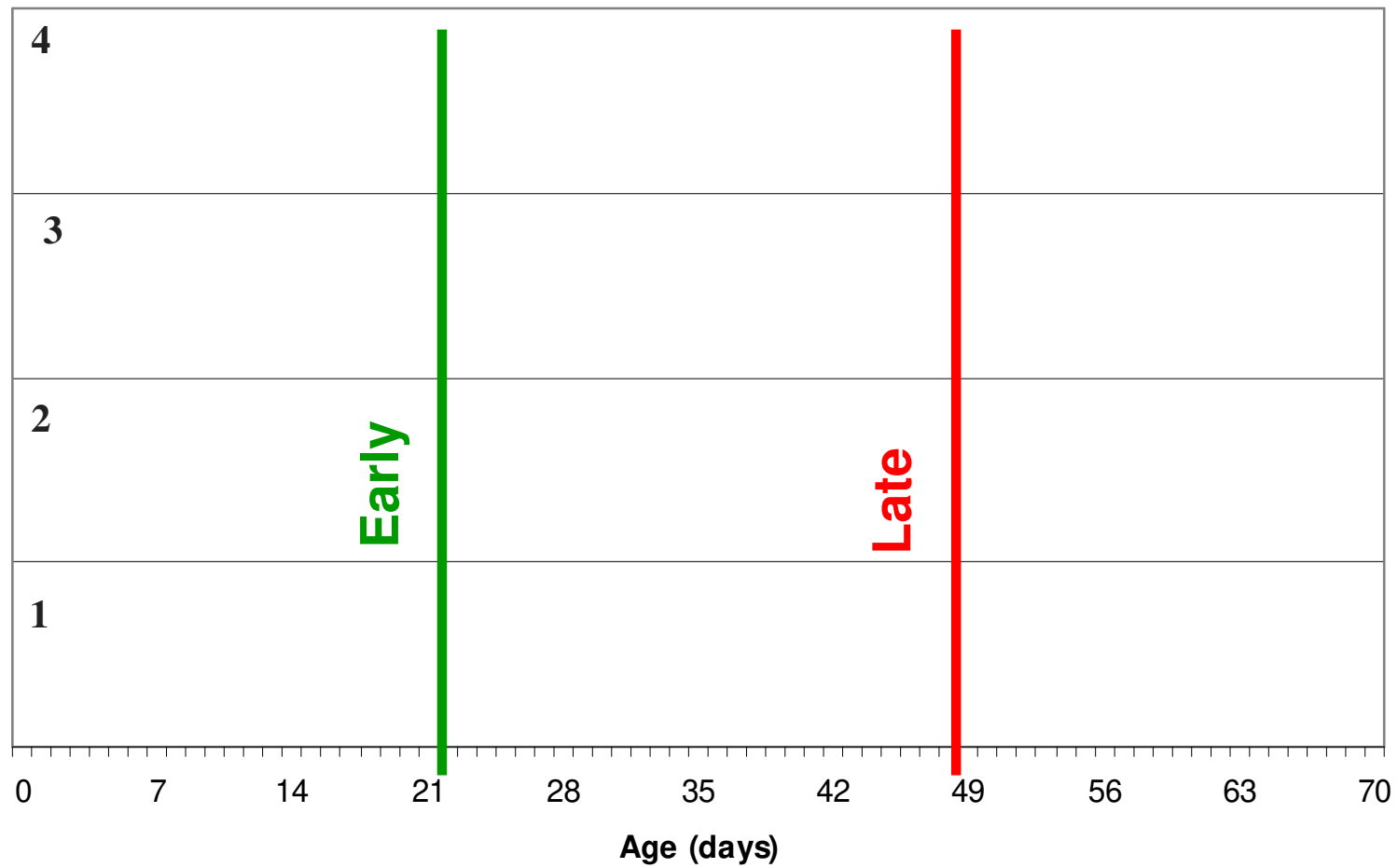




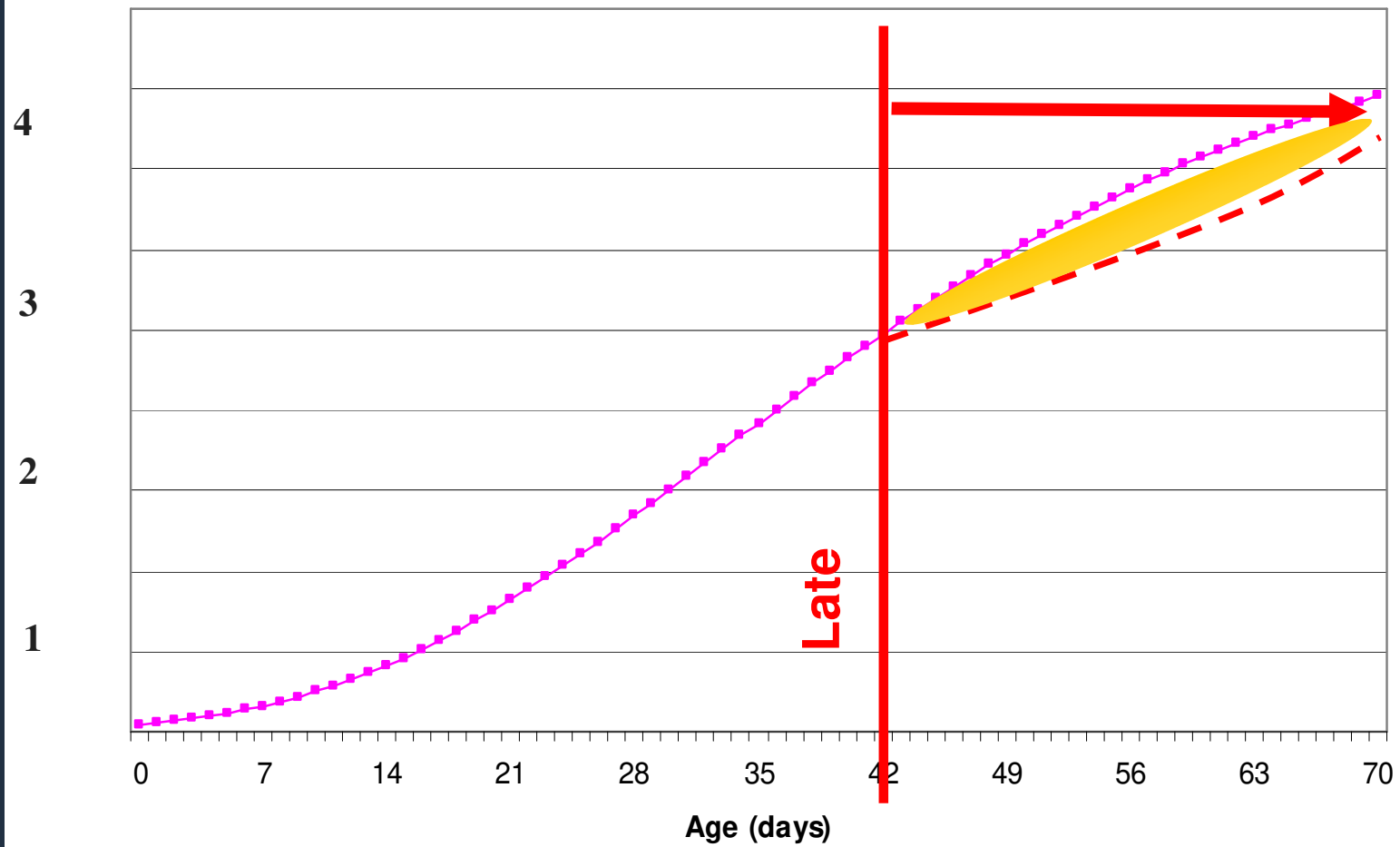
Coccidiosis challenge



Coccidiosis challenge

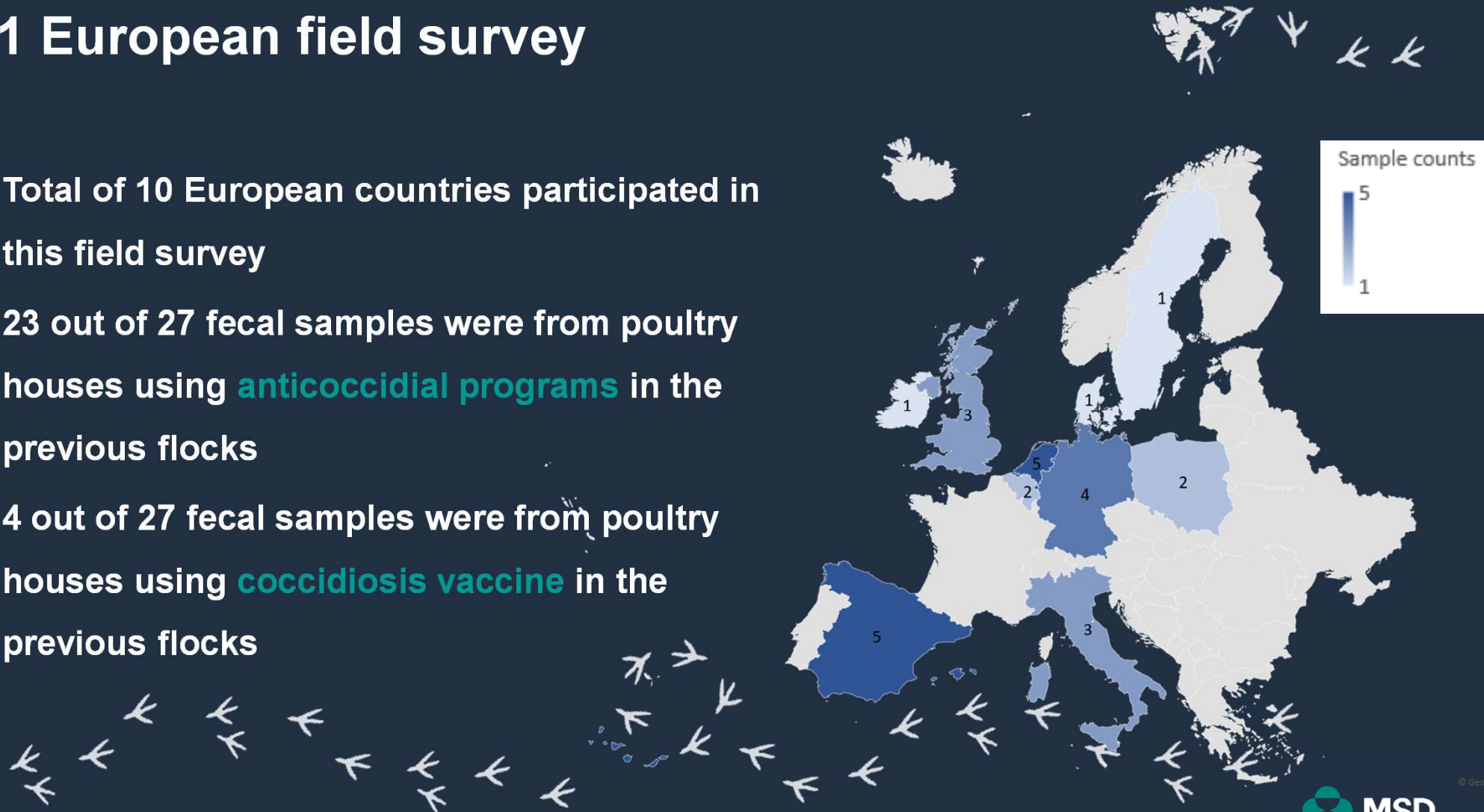


Impact of coccidiosis challenge



2021 European field survey

- Total of 10 European countries participated in this field survey
- 23 out of 27 fecal samples were from poultry houses using **anticoagulant programs** in the previous flocks
- 4 out of 27 fecal samples were from poultry houses using **coccidiosis vaccine** in the previous flocks



First indication of anticoccidial weakness = oocysts shed in the field

Avian Pathology (June 2008) 37(3), 333–341



A survey of the economic impact of subclinical *Eimeria* infections in broiler chickens in Norway

Anita Haug^{1,2*}, Anne-Gerd Gjevre¹, Eystein Skjerve³ and Magne Kaldhusdal¹

- The European Production Index was 9% lower in flocks with infection levels greater than 50,000 OPG



OPG per sample



Country of origin	Composition (oocysts/g)				History anticoccidial program
	<i>E. acervulina</i>	<i>E. tenella</i>	<i>E. maxima</i>	<i>E. mitis</i>	
The Netherlands	13400	200	800	6800	Coccidiosis vaccine
Germany	208000	26000	10000	4000	Nicarbazin, Monensin
Belgium	192000	1000	0	7	Narasin+Nicarbazin
Poland	147000	0	0	3000	Monensin+Nicarbazin
Sweden	104000	0	0	0	Narasin
Denmark	6000	126000	0	0	Narasin+Nicarbazin/ Salinomycin
Spain	292000	10000	12000	2000	Narasin+Nicarbazin/ Narasin
Ireland	800	0	5800	200	Narasin+Nicarbazin/ Salinomycin
Italy	90800	0	0	2000	Nicarbazin/ Narasin/ Salinomycin
UK	1200	0	1000	0	Narasin+Nicarbazin

Anticoccidial sensitivity test (AST)



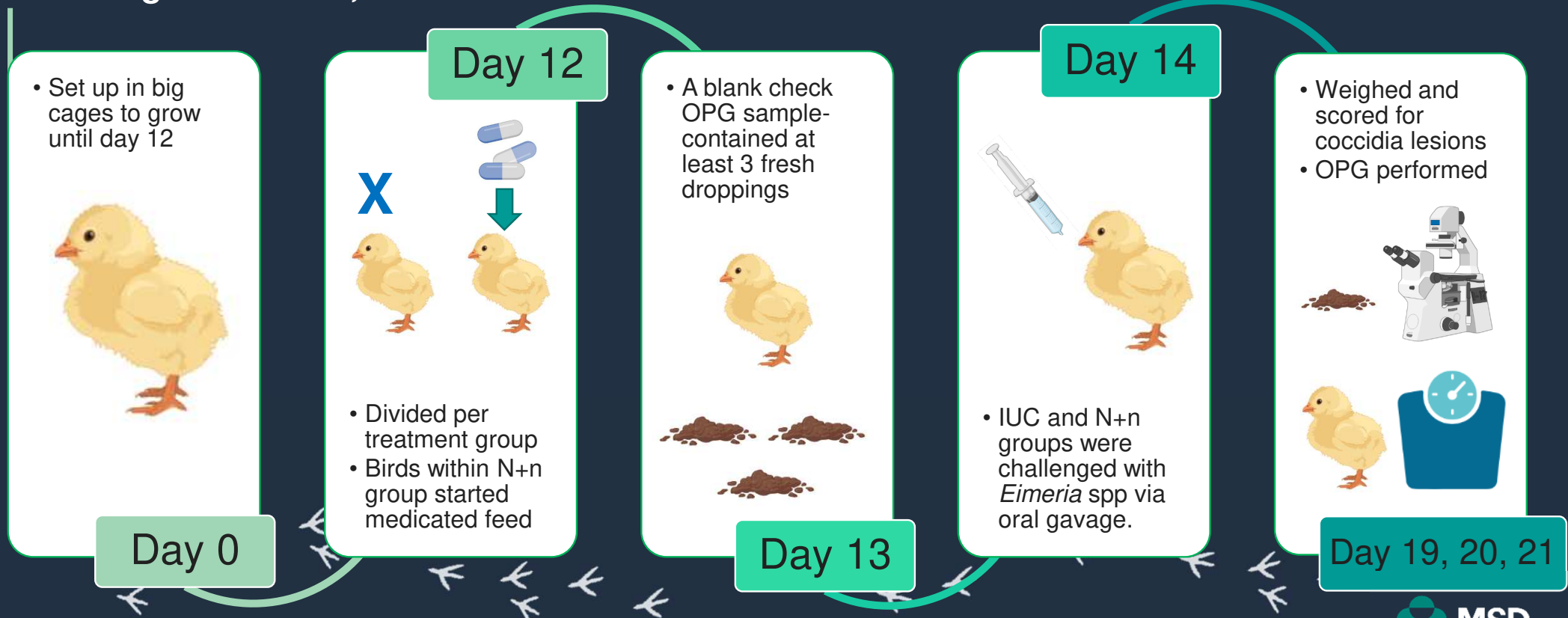
- Only assay to determine the efficacy of anticoccidial in the field
- Objective: to investigate the efficacy of Narasin+Nicarbazin against several Eimeria strains in chickens.
- Coccidiosis was induced by experimental infection of susceptible birds with different Eimeria field strains.

Group name	Inclusion product	Inclusion active molecule (ppm)	Replicates	N°/birds/group
Uninfected untreated control (UUC)	-	-	6	30
Infected untreated control (IUC)	-	-	6	30
Narasin+Nircabazin	500g/ton feed	40ppm narasin/40ppm nicarbazin	6	30



Experimental design

- Birds were weighed individually on D14. All remaining birds were again weighed on D19, D20 and D21.



Results – parameter evaluation

- **Total OPG – day 19, 20 and 21**
- **DWG – from day 14 until the end**
- **FCR – from day 14 until the end**
- **TMLS – day 19, 20 and 21**

Anticoccidial sensitivity index



Increased Level of Eimeria Sensitivity to Diclazuril after Using a Live Coccidial Vaccine

Author(s): G. F. Mathis and C. Broussard

Source: *Avian Diseases*, Sep., 2006, Vol. 50, No. 3 (Sep., 2006), pp. 321-324

Published by: American Association of Avian Pathologists

Stable URL: <https://www.jstor.org/stable/4099066>

3. Sensitivity index score: A sensitivity index score was calculated from an average of percent weight gain + percent lesion score reduction \div 2:

$$\frac{\text{percent weight gain}}{\text{TWG/NMU weight gain}} \times 100 \text{ and}$$

$$\frac{\text{percent lesion score reduction}}{\text{treatment average lesion score/NMI average lesion score}} \times 100.$$

Using this score, isolates were categorized into good (80–100), moderate (70–79), or poor (below 70) sensitivity to diclazuril. An example of this classification calculation is (80% weight gain + 70% lesion score reduction)/2 = 75 (moderate).



AST INDEX	
Good	80-100
Moderate	70-79
Poor	below 70

Anticoccidial sensitivity index

Isolate origin (country)	Cocci control program	% weight gain	% lesion score reduction	AST index Mathis (2006) Method	Good, moderate or poor sensitivity
BE	Anticoccidial	84.0136	14.71	49.36	Poor
BE	Anticoccidial	66.6667	2.05	34.36	Poor
PO	Anticoccidial	87.5	13.95	50.72	Poor
PO	Anticoccidial	79.7753	11.08	45.43	Poor
SE	Anticoccidial	92.4157	52.63	72.52	Moderate
DK	Anticoccidial	97.6912	32.00	64.85	Poor
ES	Anticoccidial	97.9798	-25.00	36.49	Poor
ES	Anticoccidial	82.3954	-2.78	39.81	Poor
ES	Anticoccidial	85.2814	8.57	46.93	Poor
ES	Anticoccidial	93.6508	29.41	61.53	Poor
ES	Anticoccidial	91.6306	10.71	51.17	Poor
IE	Anticoccidial	92.9293	28.95	60.94	Poor
DE	Anticoccidial	78.9322	7.14	43.04	Poor
DE	Anticoccidial	81.5296	21.57	51.55	Poor
DE	Anticoccidial	83.3333	1.22	42.28	Poor
DE	Anticoccidial	90.3061	6.74	48.52	Poor
IT	Anticoccidial	79.3651	5.88	42.62	Poor
IT	Anticoccidial	85.1371	5.00	45.07	Poor
IT	Anticoccidial	90.0433	16.67	53.35	Poor
NL	Anticoccidial	77.4892	-18.92	29.29	Poor
UK	Anticoccidial	77.4892	-3.12	37.18	Poor
UK	Anticoccidial	86.2915	-13.33	36.48	Poor
UK	Anticoccidial	75.9019	-13.79	31.05	Poor

In 1989,

Coccidia and intestinal coccidiomorphs, Vth International Coccidiosis Conference, Tours (France), 17-20 October 1989. Ed. INRA Publ., 1989 (Les Colloques de l'INRA, n°49)

Field isolates of *E. tenella* : sensitivity to diclazuril, maduramicin, narasin, salinomycin and a mixture of nicarbazin / narasin

H.D. CHAPMAN

Institute for Animal Health, Houghton Laboratory, Houghton, Huntingdon, Cambs, PE17 2DA, UK

Isolate Code	Anticoccidial indices					
	None	Diclazuril	Nicarb/Nar	Maduramicin	Narasin	Salinomycin
PL	-9	195 S	188 S	99 R	52 R	75 R
BR	38	197 S	177 S	159 PR	100 R	108 R
BU	71	195 S	179 S	160 S	92 R	66 R
OK	6	209 S	130 PR	90 R	43 R	28 R
FI	9	200 S	144 PR	85 R	45 R	21 R
RO	12	207 S	152 PR	127 PR	4 R	4 R
LE	30	207 S	147 PR	75 R	35 R	-14 R
GA	15	192 S	122 PR	75 R	13 R	7 R
OB	10	196 S	140 PR	122 PR	13 R	22 R
MW	55	190 S	175 S	154 PR	73 R	131 R
BD	58	195 S	164 S	96 R	4 R	-14 R
DO	7	200 S	107 R	86 R	19 R	21 R
PA	7	190 S	77 R	63 R	-6 R	-4 R
US	17	196 S	108 R	163 S	66 R	-21 R
RL	4	196 S	153 PR	122 PR	0 R	41 R
X	22 a	198 d	144 c	112 b	37 a	31 a

Values not followed by a common letter (a,b,c,d) are significantly different (P<0.05)SEM=8.1. S=Sensitive, PR=Partially resistant, R=Resistant

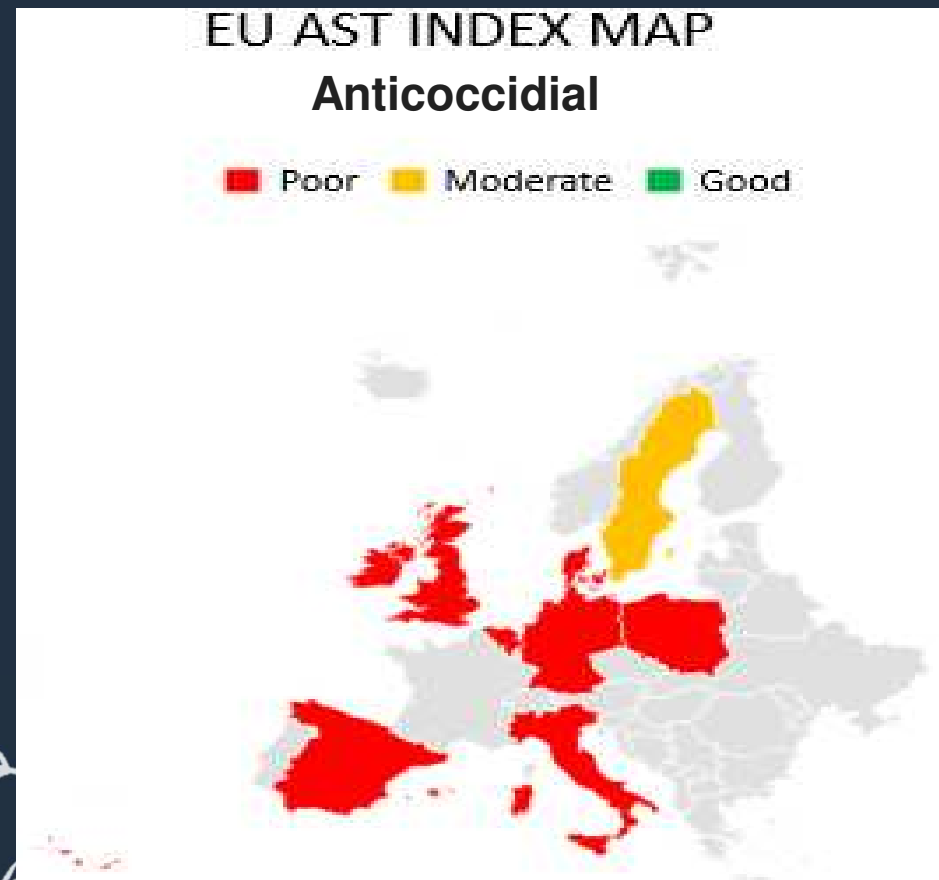


- **Samples from anticoccidial used farms**



Isolates from 23 farms used anticoccidial previously

- 95.7% of isolates (22 out of 23) samples had **poor** sensitivity index score
- 4.3% of isolates (1 out of 23) samples had **moderate** sensitivity index score
- 0% of isolates (0 out of 23) samples had **good** sensitivity index score



Results-anticoccidial

Belgium

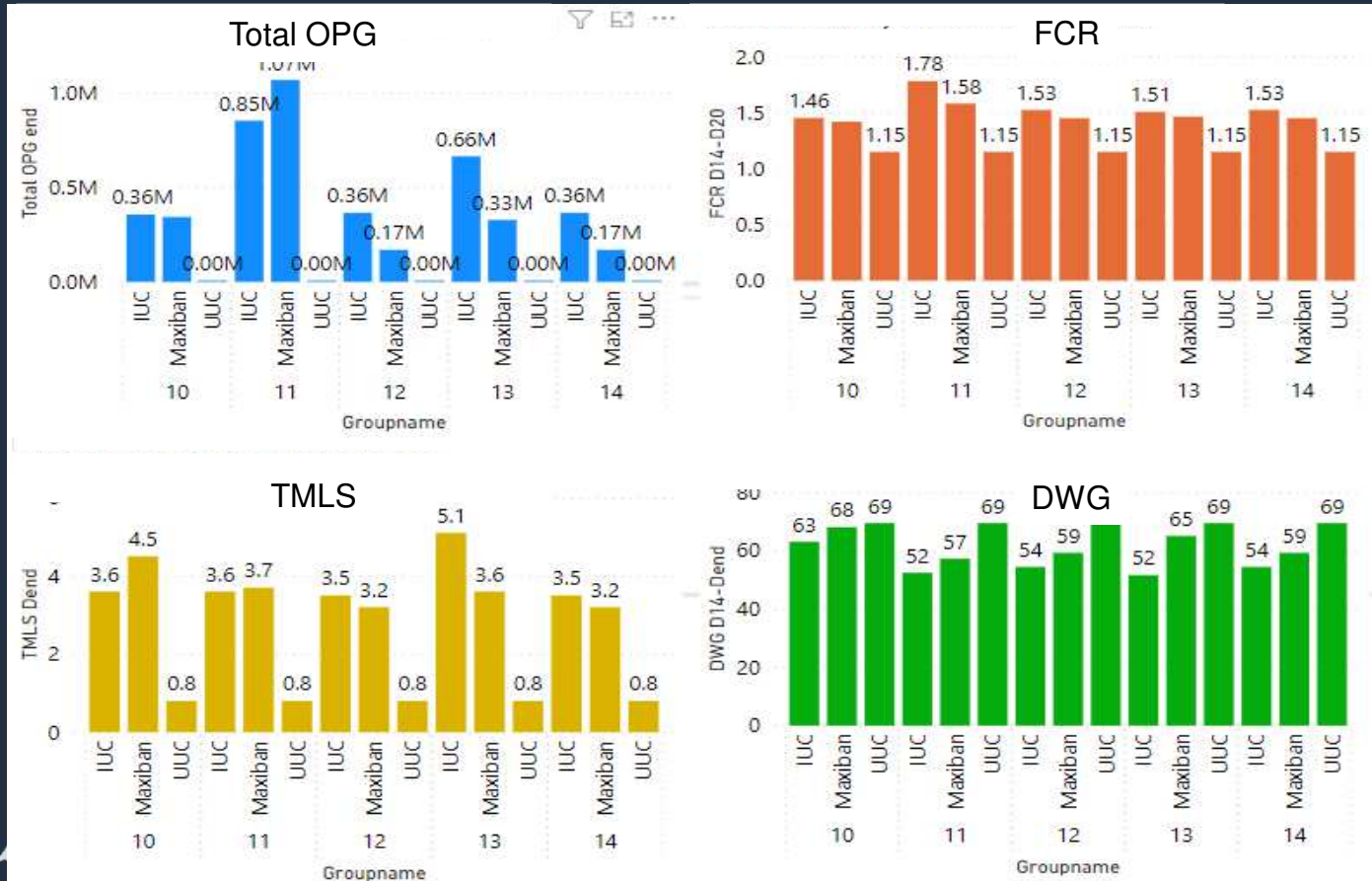


Group name	
UUC	Uninfected untreated control
IUC	Infected untreated control
N+n	Infected treated with Narasin+Nicarbazin



Results-anticoccidial

Spain

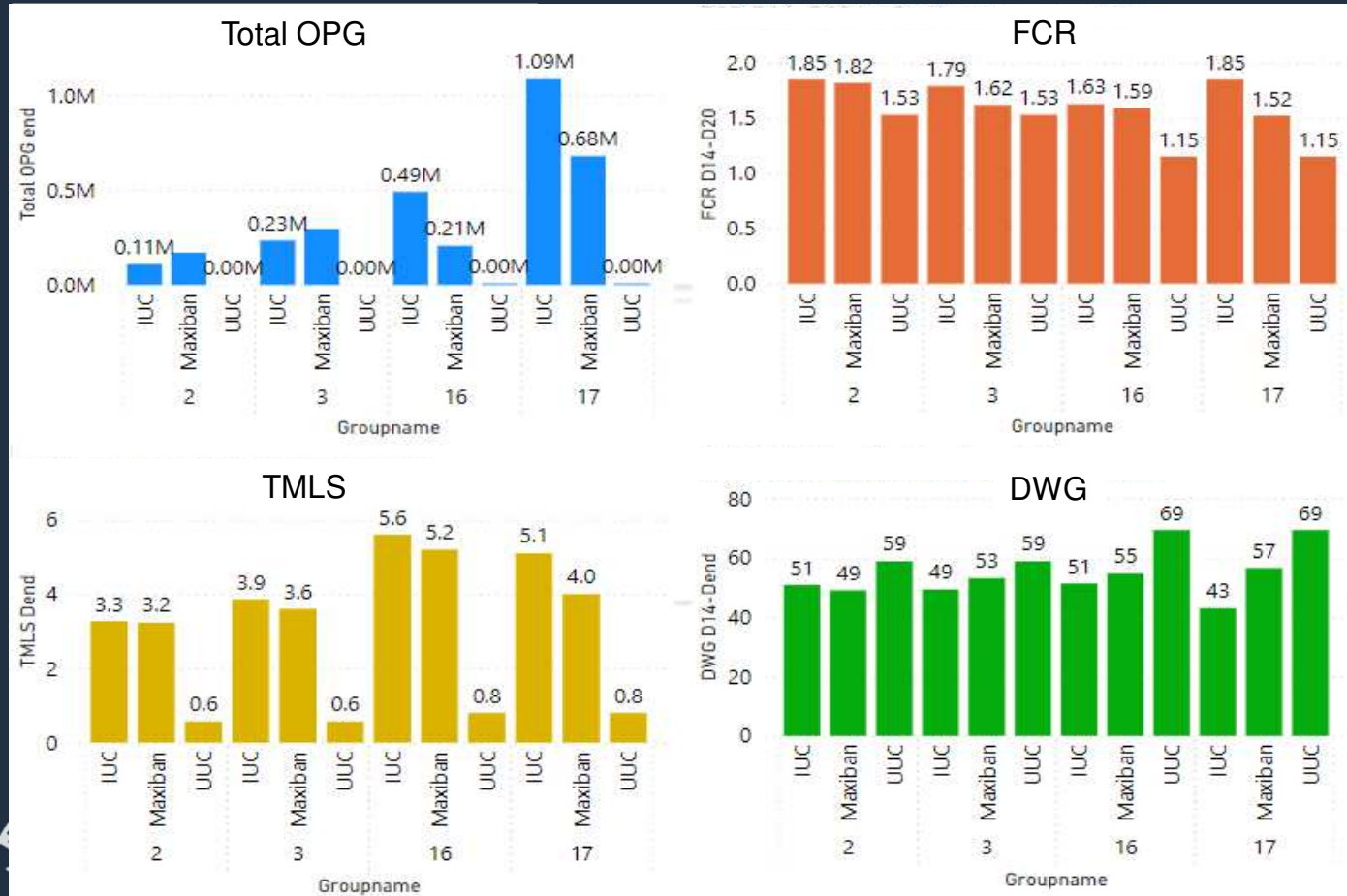


Group name	
UUC	Uninfected untreated control
IUC	Infected untreated control
N+n	Infected treated with Narasin+Nicarbazin



Results-anticoccidial

Germany



Group name	
UUC	Uninfected untreated control
IUC	Infected untreated control
N+n	Infected treated with Narasin+Nicarbazin





- **How about farms with coccidiosis vaccination history?**



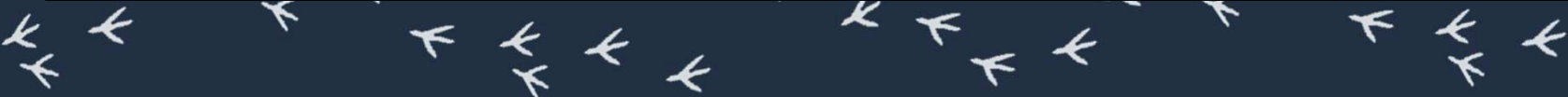
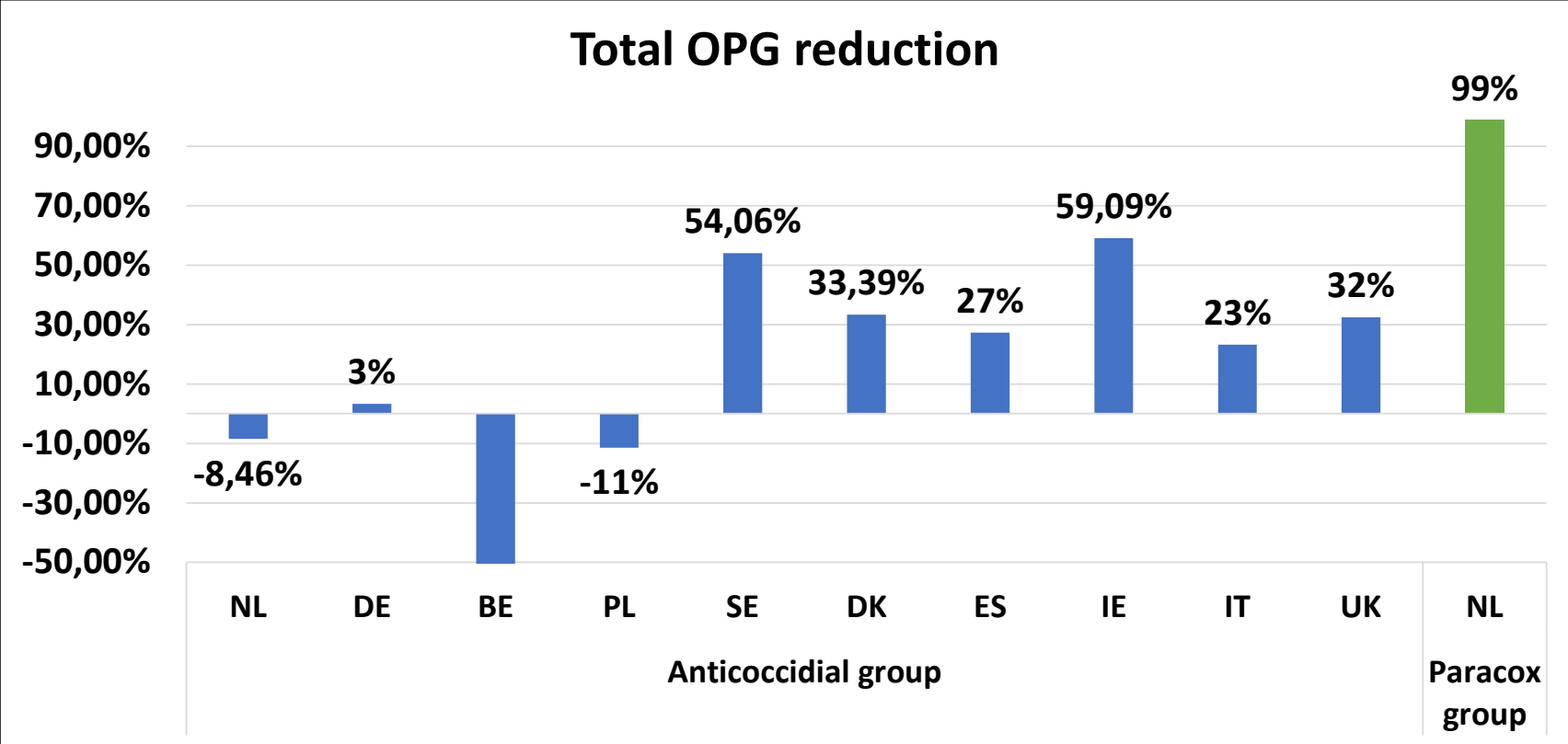
Results - Vaccine



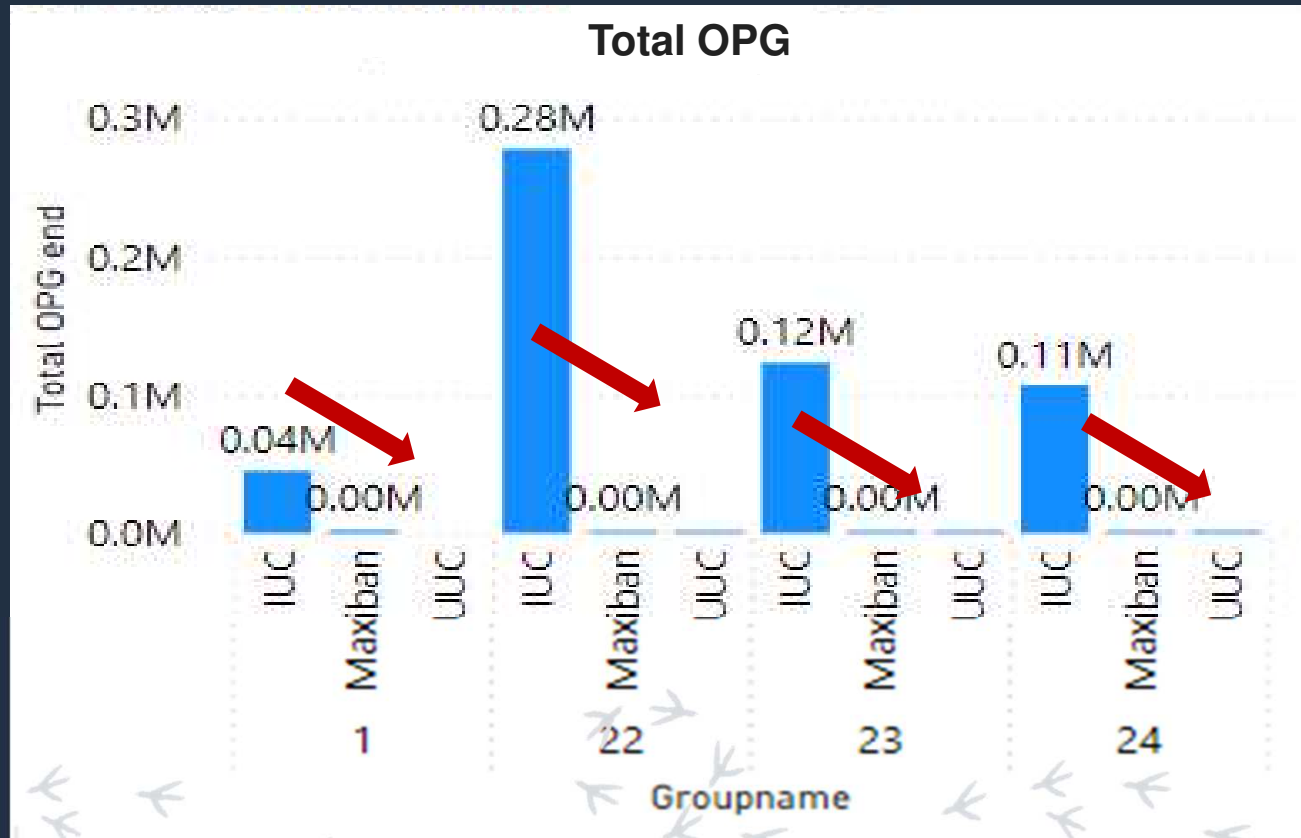
Isolate 22



Total OPG reduction

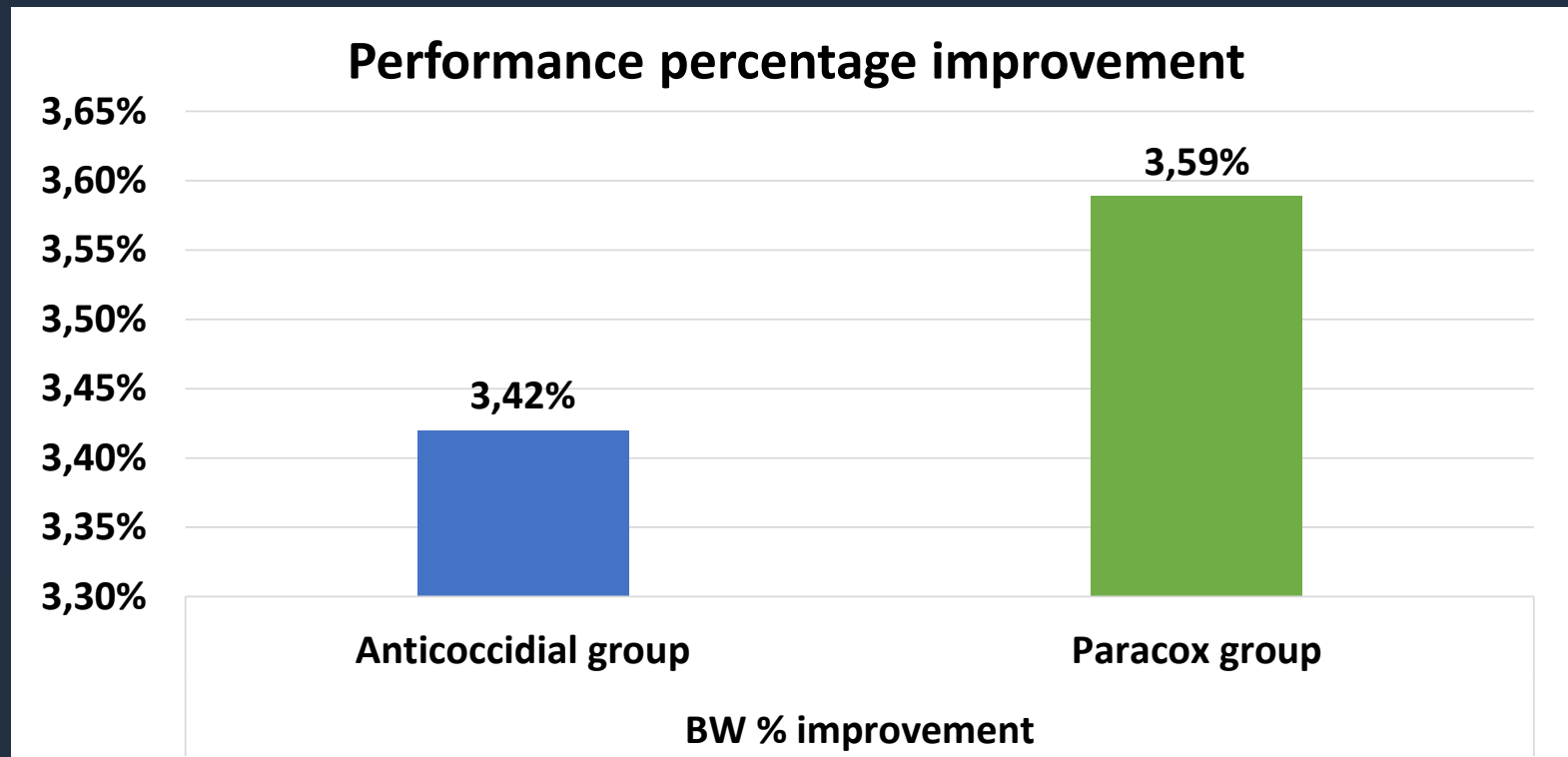


Results - Vaccine



Performance improvement

Narazin+Nicarbazin vs IUC



Isolates from farms used coccidiosis vaccine previously

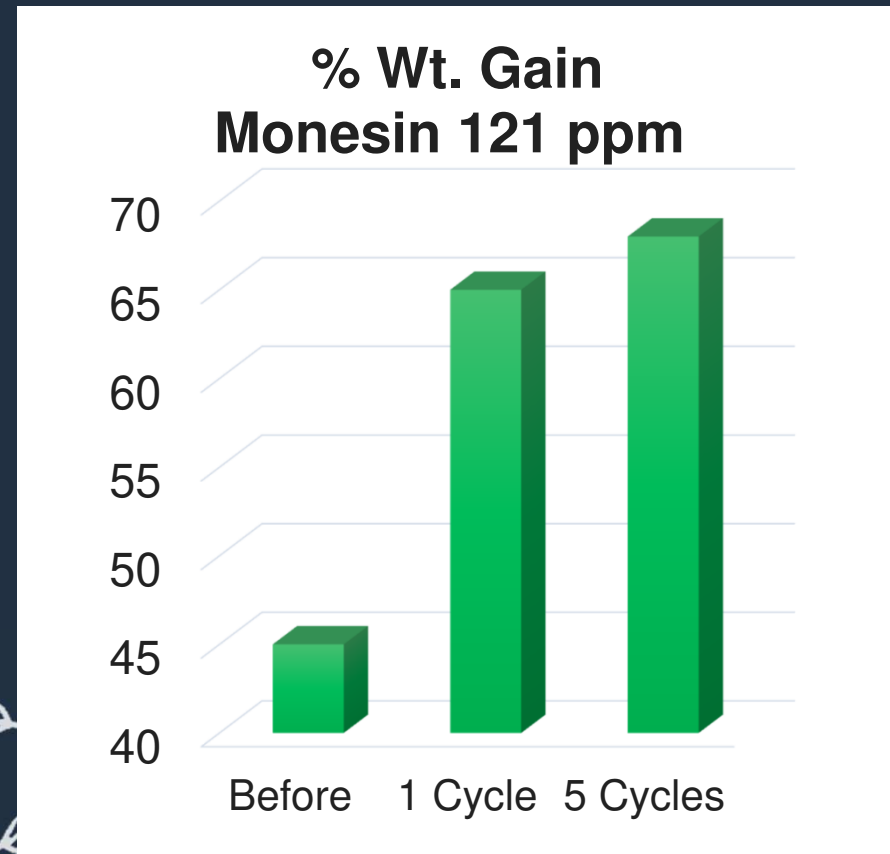
- 100% of isolates (4 out of 4) samples had **good** sensitivity index score
- 0% of isolates (0 out of 4) samples had **moderate** sensitivity index score
- 0% of isolates (4 out of 4) samples had **poor** sensitivity index score due to limited lesion score reduction



Restoration of anticoccidial sensitivity



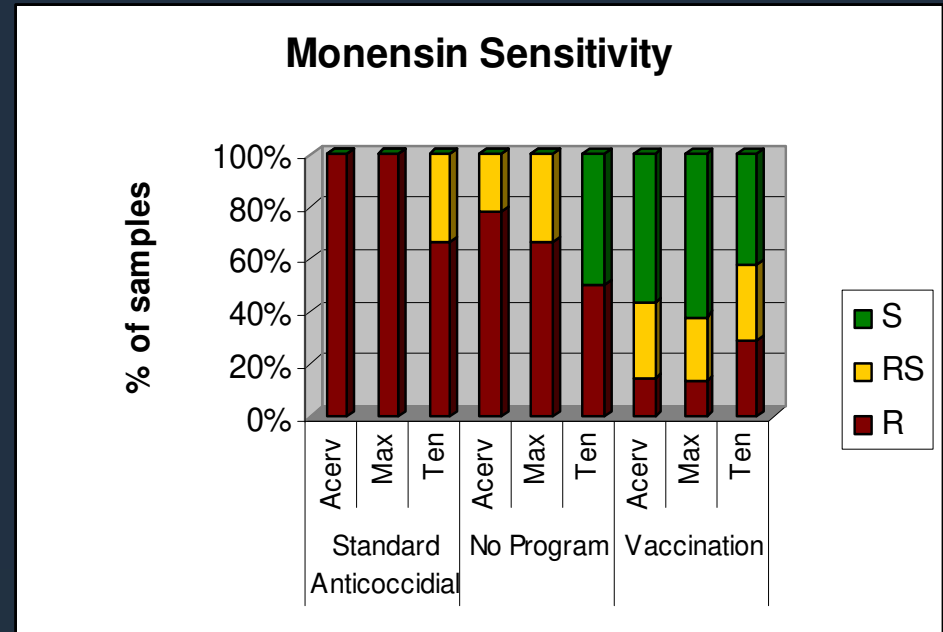
- Chapman (1994) showed that a field population was more sensitive to Monensin after vaccine usage



Restoration of anticoccidial sensitivity



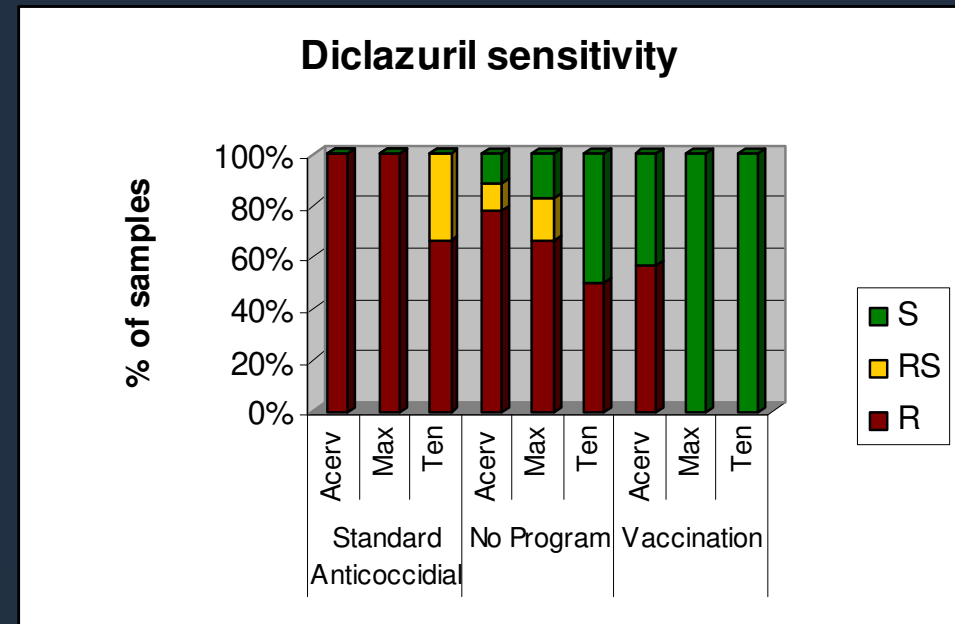
- Peek and Landman (2006) demonstrate the impact of the use of a vaccine on the sensitivity of European isolates to Monensin and Diclazuril



Restoration of anticoccidial sensitivity



- Peek and Landman (2006) demonstrate the impact of the use of a vaccine on the sensitivity of European isolates to Monensin and Diclazuril



**What cost
of gro**

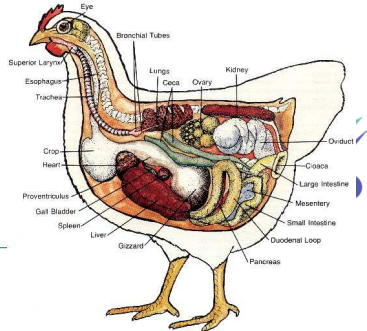


**the cost
meat?**



Thermoregulation

Maintenance



Growth

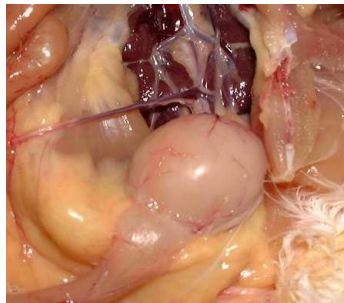


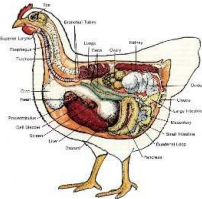
Excreta



Activity

Immunity





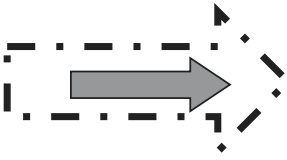
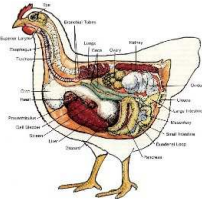
“Ideal”



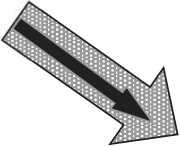
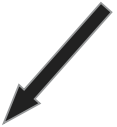
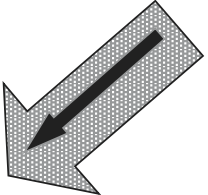
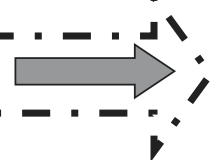
Growth



“Coccidiosis”



Growth



Subclinical Coccidiosis Effects

➤ **Appetite suppression**

- Birds feel sick...they do not eat as much.
- Feed conversion increases because maintenance cost becomes a higher percent of the total energy consumed.

➤ **Increased nutrients lost to feces**

- “Excreta Energy”
- Clinical signs: watery feces, diarrhea, feed passage, “rapid transit”

➤ **Increased maintenance requirements**

- Fever (cytokines increase metabolic rate)
- Increased oxidation rate and CO₂ production
- Immunity

Subclinical Coccidiosis Effects

All species affect all three components, but some have a greater influence on one particular area:

- **Appetite suppression**
 - *E. tenella*

- **Increased nutrients lost to feces**
 - *E. maxima*
 - *E. acervulina* (especially protein)

- **Increased maintenance requirements**
 - *E. tenella*
 - *E. maxima*

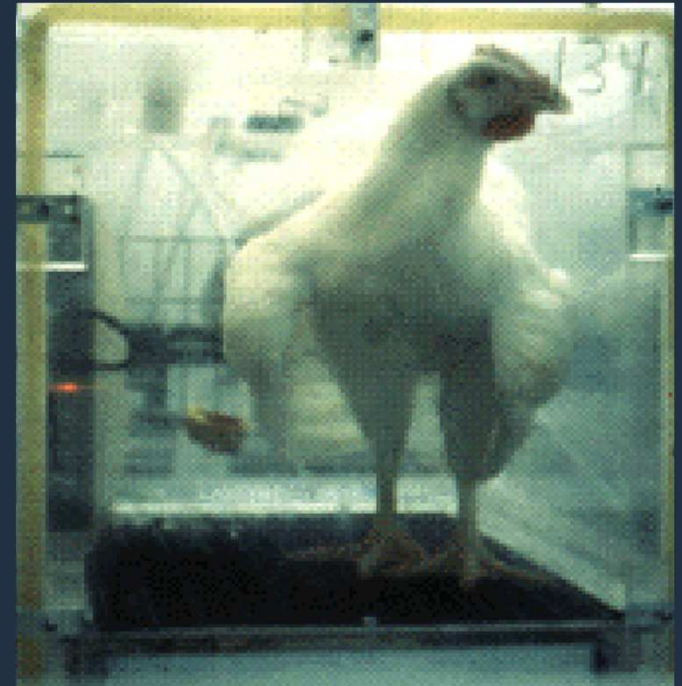
Oklahoma State University

Dr. Robert Teeter - 2007

Largest collection of calorimetry chambers in the world.

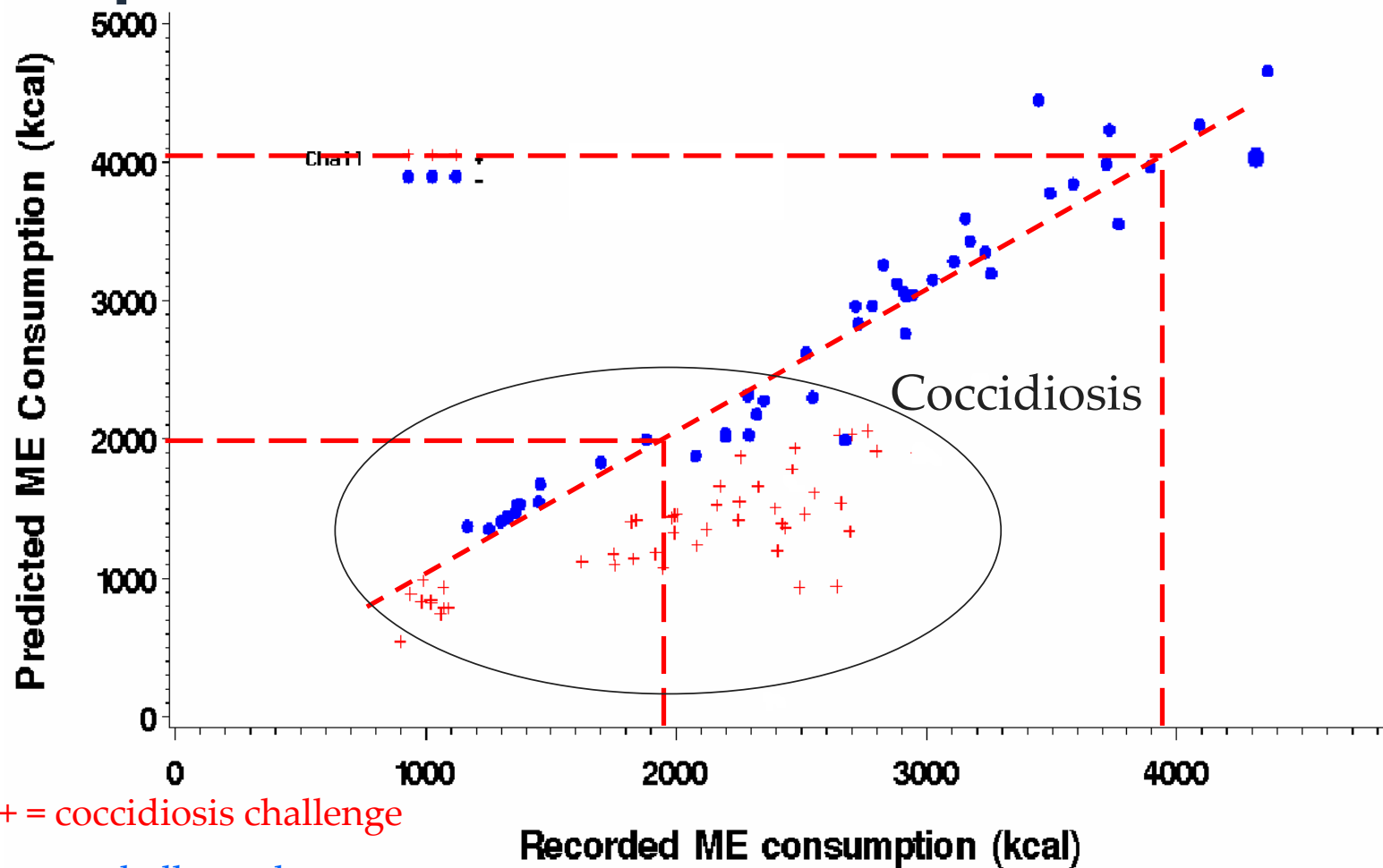
Research on nutrition, metabolism, energy utilization.

Calorimetry chambers measure calorie input vs. calorie disposition (feces, heat, CO₂, body composition, growth...)



Proprietary

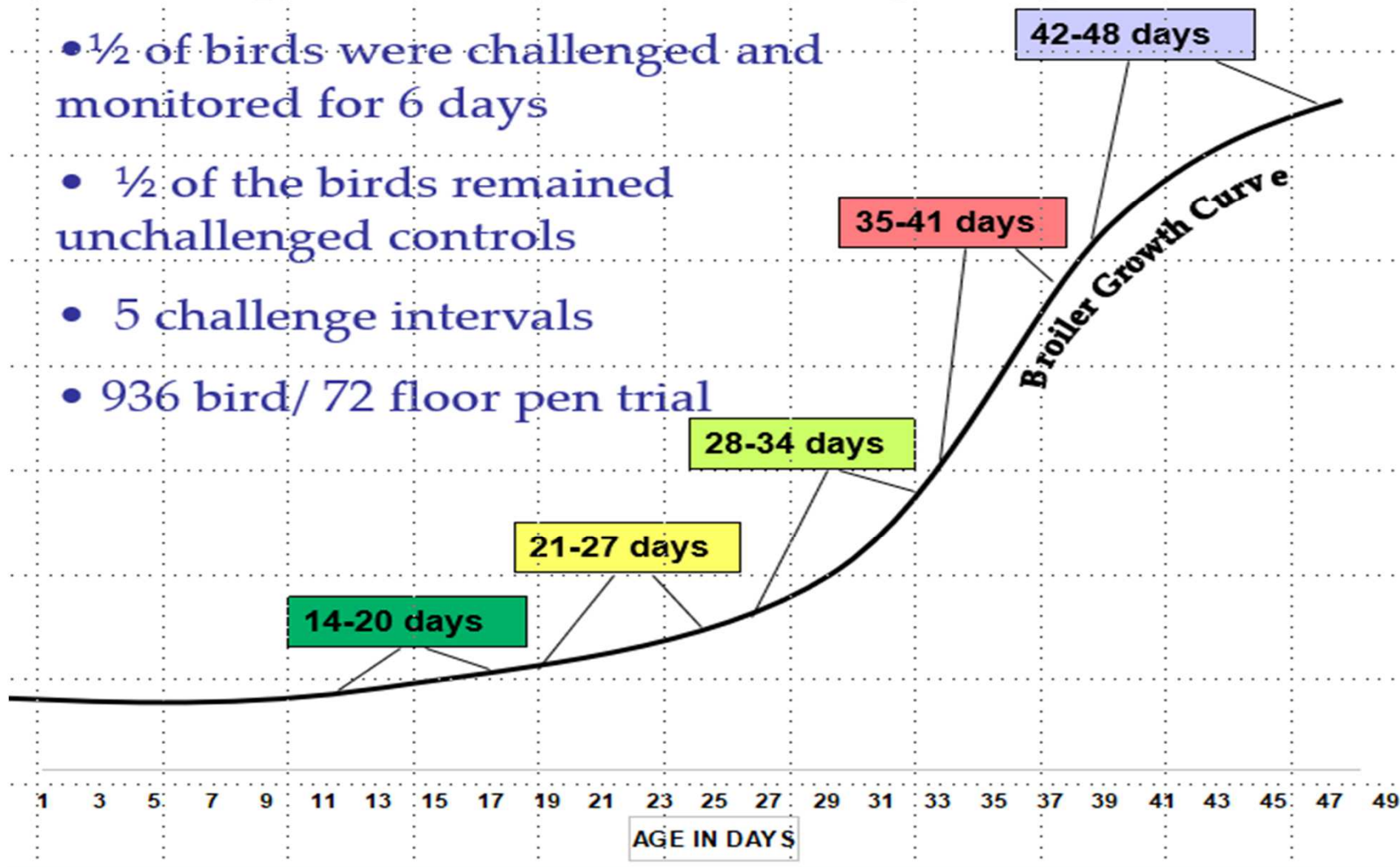
Predicted vs. Actual Metabolizable Energy (ME) consumption



Robert Teeter Cocciform Brazil September 2007

A new study model was developed to examine the impact of coccidiosis along the growth curve

- 1/2 of birds were challenged and monitored for 6 days
- 1/2 of the birds remained unchallenged controls
- 5 challenge intervals
- 936 bird/ 72 floor pen trial





Materials and Methods

- Challenge birds were predetermined at random using only wing band numbers
- Half of the birds removed were orally gavaged with coccidiosis spore solution (1 ml)
 - *Eimeria acervulina*
 - *Eimeria maxima*
 - *Eimeria tenella*
- Remaining birds received sterile water (1 ml)

Materials and Methods

After the 6 day challenge + metabolic chamber housing birds were removed from metabolic chambers:

Weighed

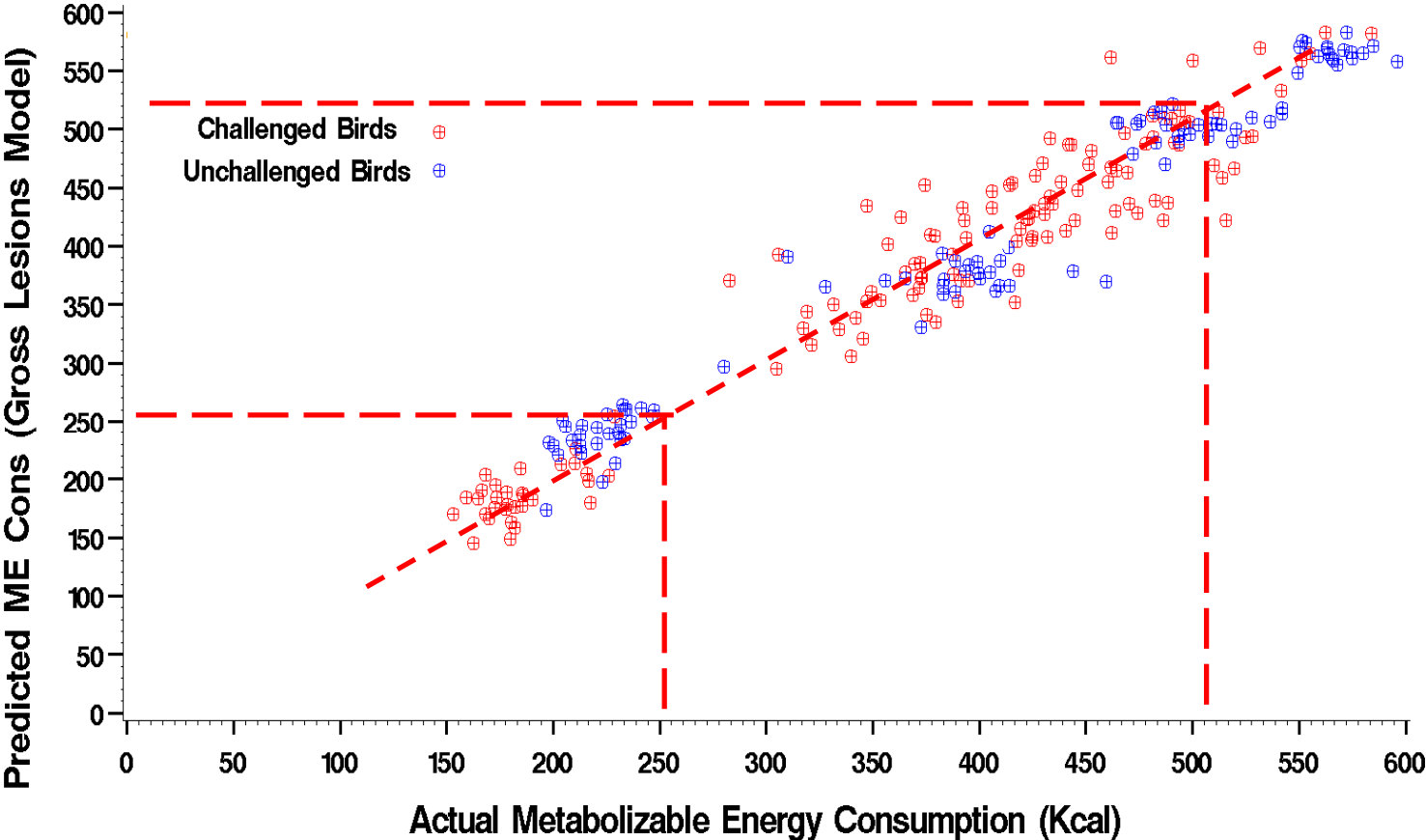
Humanely sacrificed

Necropsied for intestinal lesion score
(upper SI, middle SI, and ceca)

Scoring was blinded to sample ID

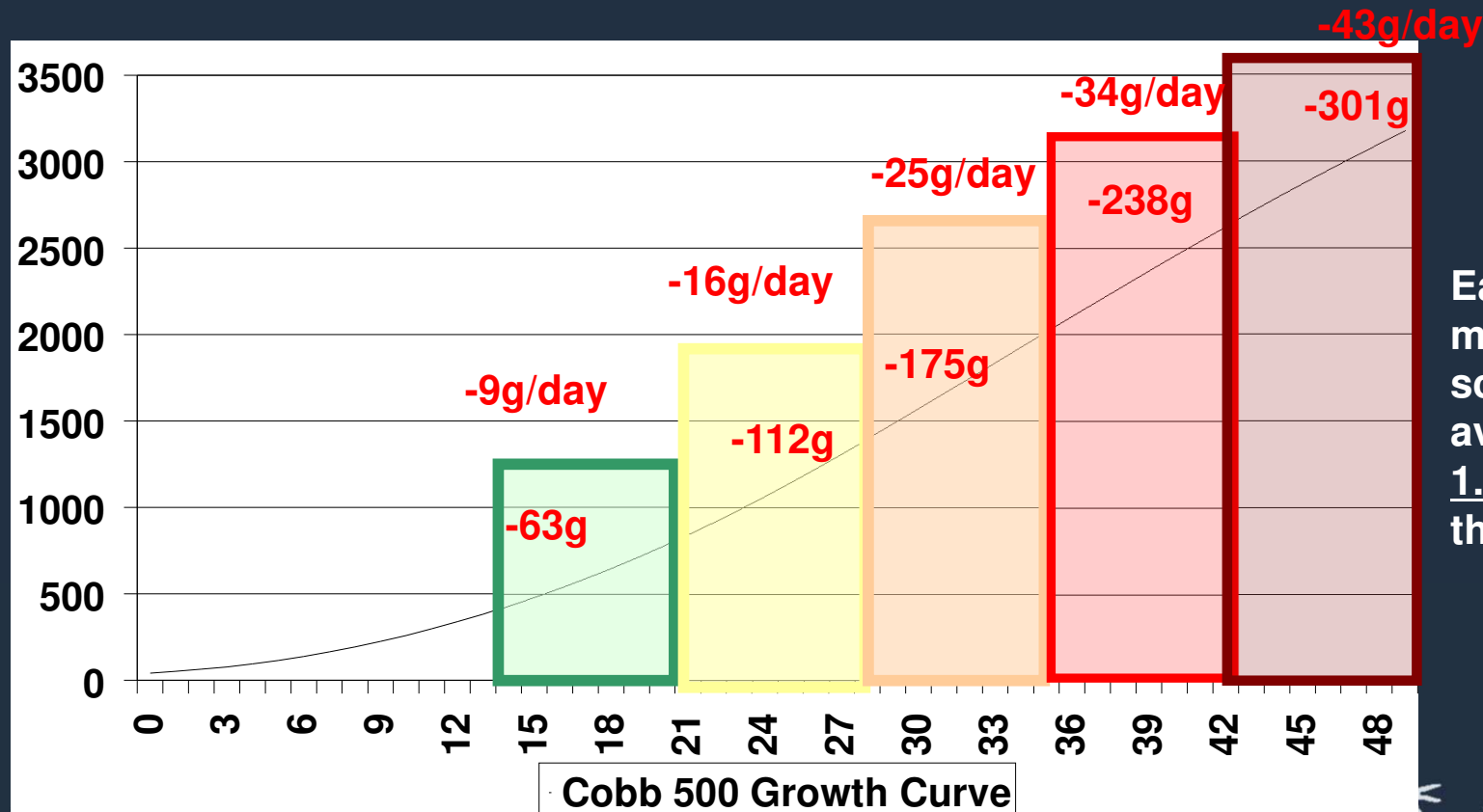
Lesion score variable added

Predicted Versus Actual ME Consumption Using Gross Lesions



Effect of a +1 microscopic coccidiosis score

As birds age, the effect of +1 cocci for 6 days has a greater impact



Each Increase In microscopic lesion score, decreases average daily gain by 1.5% of body weight throughout the period

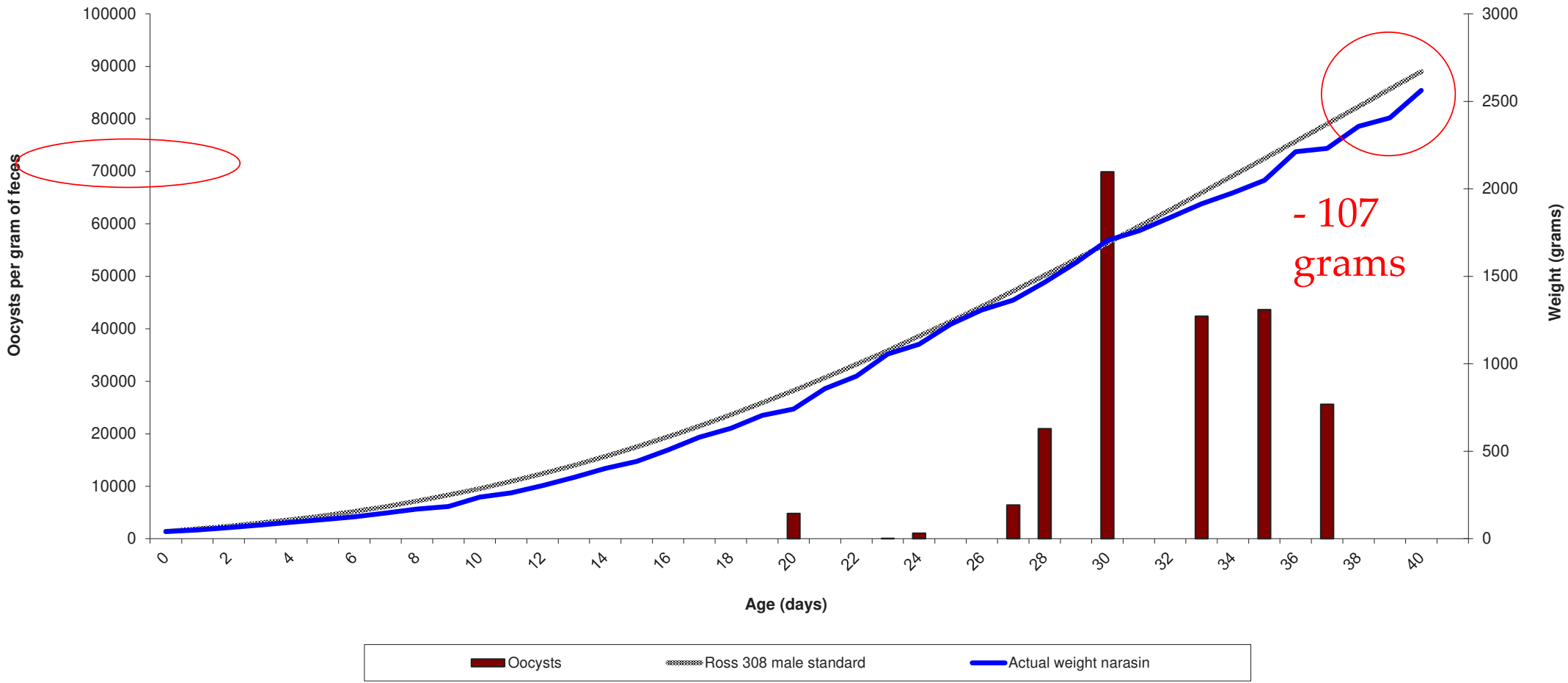
Effect of subclinical coccidiosis



- Remember that in a real-life flock, **not every bird will have a lesion score of +1**. Some will be 0, some will be +1 and maybe some will be +2.
- That is why **uniformity** is reduced.
- Average lesion scores of **less than +1** have been demonstrated to reduce weight or raise FCR based on large-scale integrator studies.

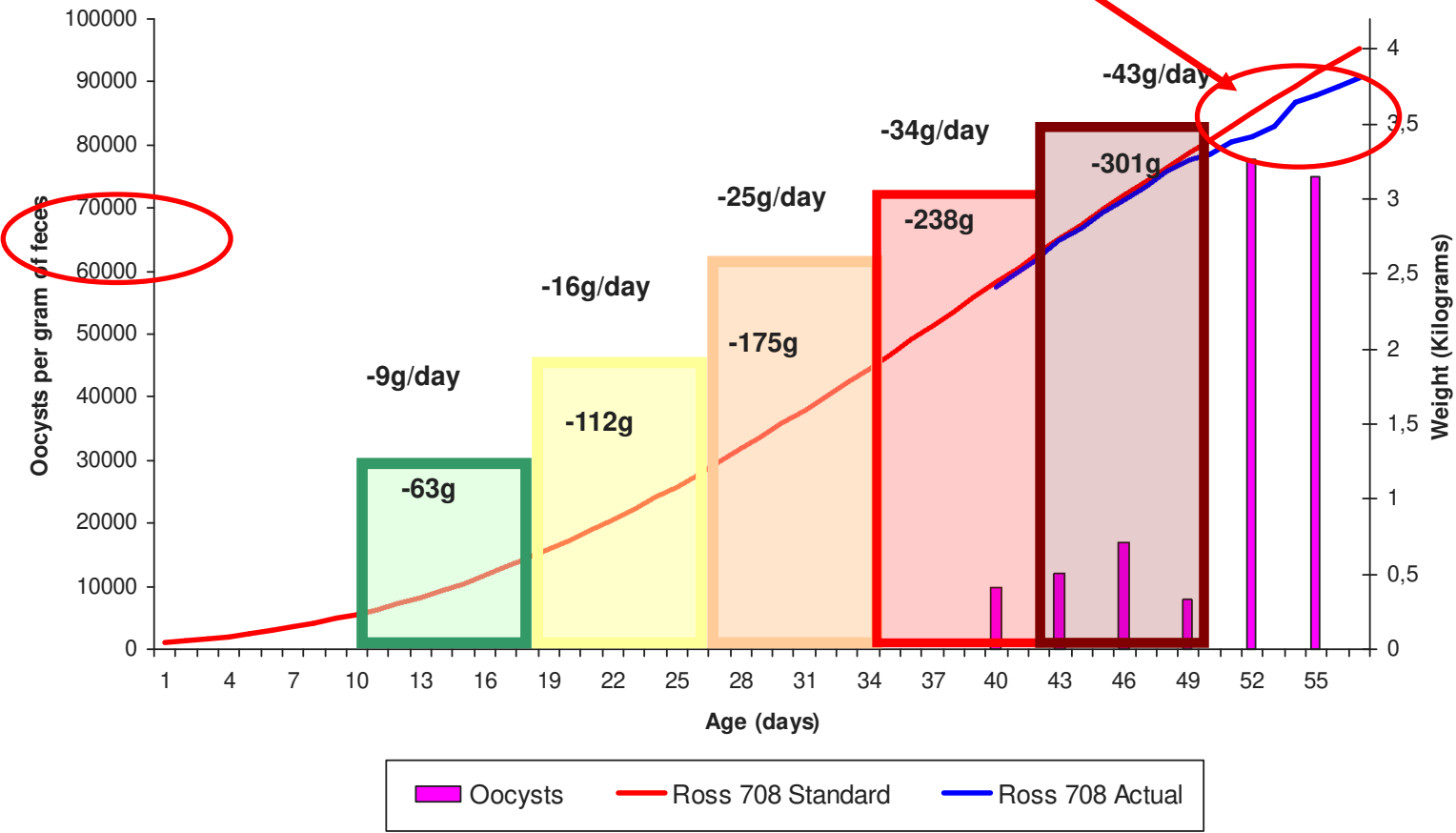


Ontario Producer 2007 Growth vs. Ross 308 and Cocci Challenge (Note: *no clinical signs*)



Reality: Italy 2009

52 days peak weights – 211 grams



Analysis of Real-World Data (RWD) – U.S broiler production

□ **RWD**: Data that is routinely collected from a variety of sources relating to the health and productivity of animals or livestock management¹

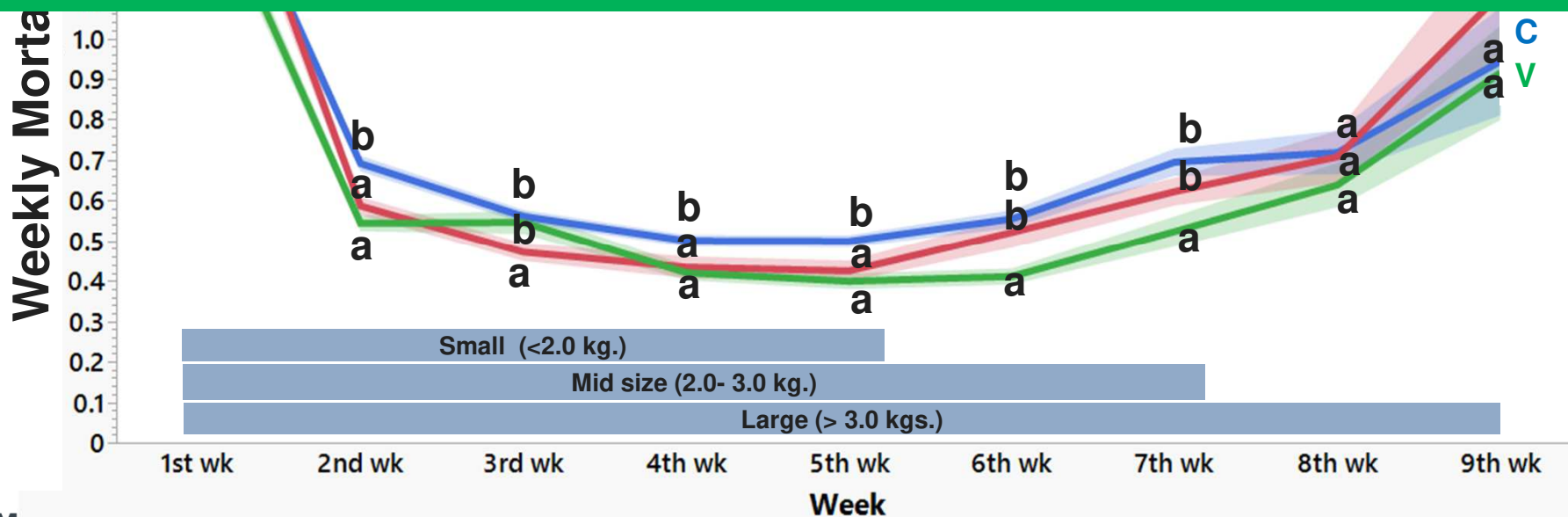
□ 2020 US broiler industry data (Jan – Dec 2020) – De-identified data

- 1404 complexes (68% of the total U.S's 9.2 billion broilers in 2020)
- Based on the current cocci program of each individual complex
 - Chemicals only program
 - Ionophores only program (salinomycin, narasin, narasin + nicarbazin)
 - Naked Vaccine program

Excluded: Bio-shuttle (Vaccine followed by in-feed program)

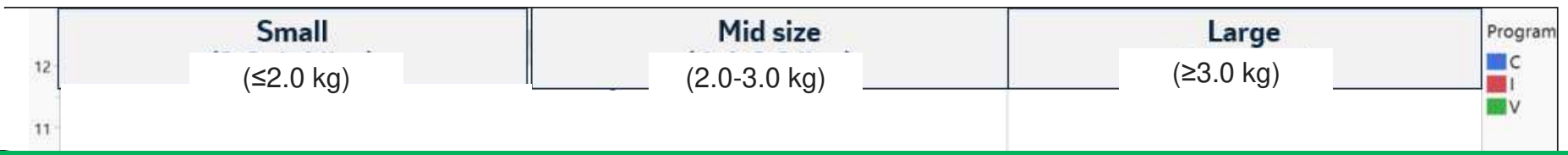
Weekly Average Mortality (%) – (all combined)

Overall higher weekly mortality with the chemical program
Chemicals > Ionophore ≥ Vaccines

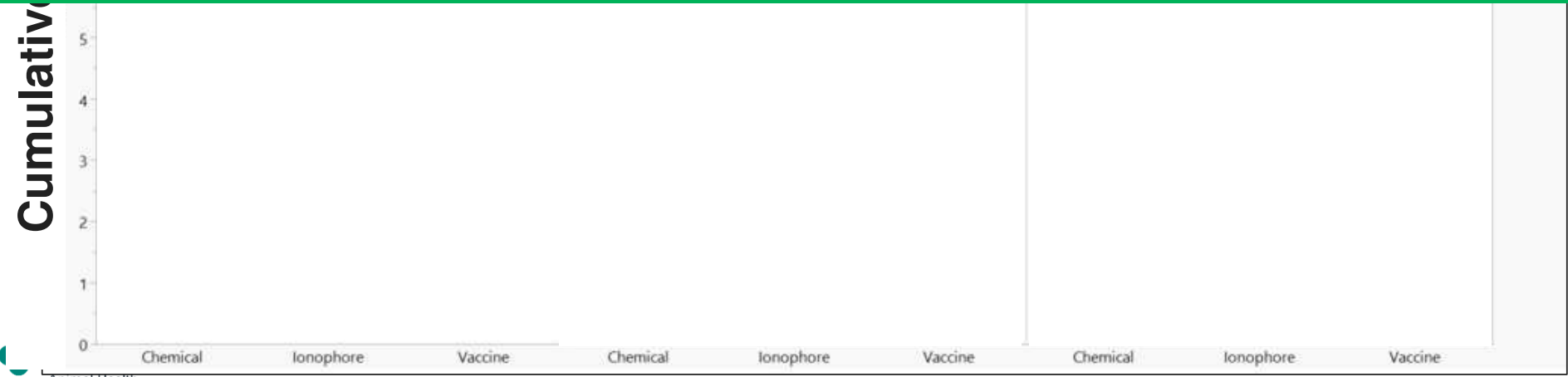


Proprietary

Cumulative Mortality (%) of life of flock (by bird size)



Overall higher cumulative mortality with the chemical program
Chemicals > Ionophores ≥ Vaccines



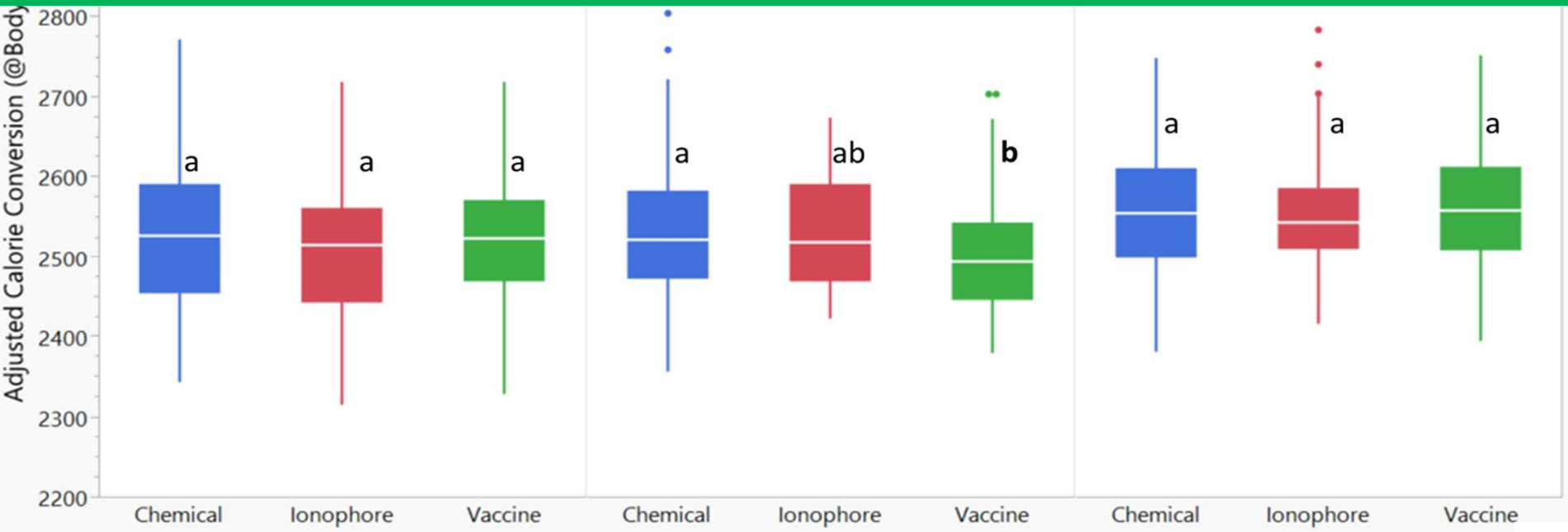
❖ Different letters indicate statistical differences at $p < 0.01$. (Kruskal-Wallis Test – Dunn all pairs for joint ranks)

Proprietary

Adjusted Calorie Conversion to 3,03 kg wt. (by size)

No statistical differences in adjusted calorie conversion (except mid-size).
Chemicals = Ionophores \geq Vaccines

Adjusted Calorie Conversion



❖ Different letters indicate statistical differences at $p < 0.01$. (Kruskal-Wallis Test – Dunn all pairs for joint ranks).

Results - Vaccine



Isolate 24



Summary - mudar

Anticoccidial vs vaccine



Anticoccidial

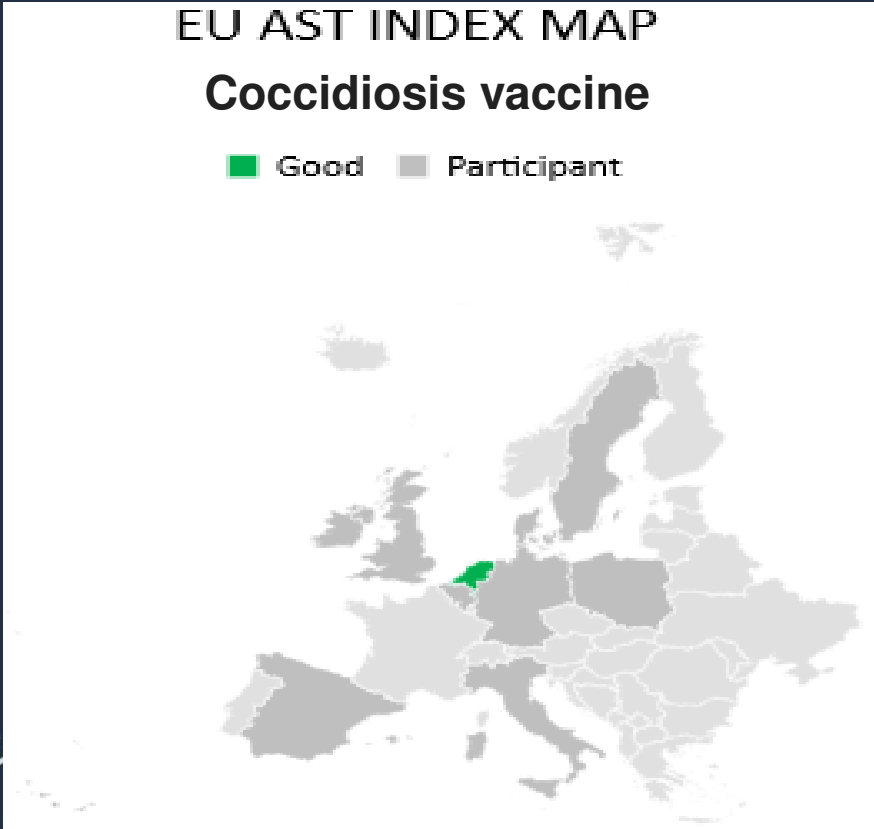
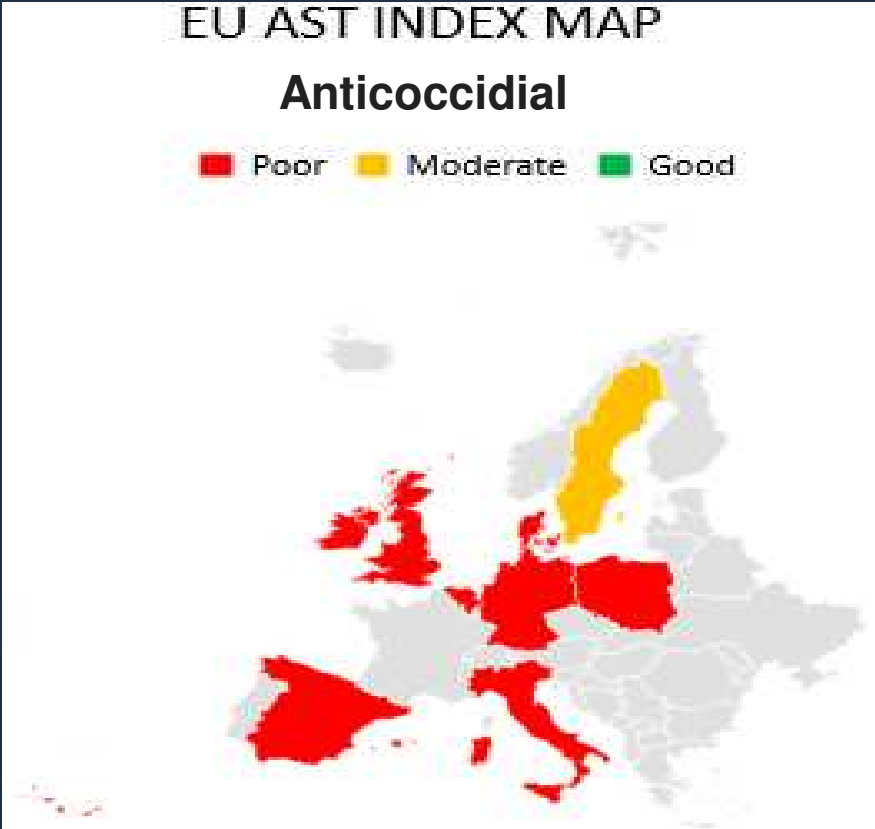


Vaccine



Summary

Anticoccidial vs vaccine



Conclusion

- Narasin+Nicarbazin against field coccidiosis is demonstrating some resistance in most countries in Europe
 - OPG counts demonstrated “loss of sensitivity” of field samples
- The isolates from vaccinated farms are significantly VERY sensitive to Narasin+Nicarbazin
- Rotational programs including a coccidiosis vaccine are advised and can help the anticoccidials to better control coccidiosis
- The U.S broiler production data for 1 year period (2020) was analyzed to compare the performances of birds under different coccidiosis control programs.

Conclusion



- The U.S broiler production data for 1 year period (2020) was analyzed to compare the performances of birds under different coccidiosis control programs.
- Birds treated with the chemical program had statistically higher total live production cost, mortality rates, and adjusted feed cost, compared to the ionophore or vaccine programs
- The current data analysis showed that the chemical program did not outperform the vaccine program
- Making use of all coccidiosis tools including vaccination will optimize the performance and sustain coccidiosis control into the future



THANK YOU

KÖSZÖNÖM

