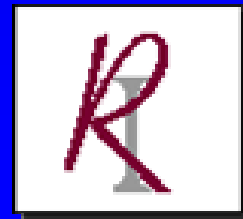


# What causes Foot Pad Dermatitis in Growing Turkeys?

**Ros Mayne, Rod Else and Paul Hocking**  
**Rosin Institute and R(D)SVS, University of Edinburgh**



# Outline

- **Field data**
  - How important is FPD?
- **Survey**
  - When does it start?
- **Experimental “model”**
  - Moisture vs excreta?
  - Allergy or inflammation?
- **Is supplementary biotin a cure?**
- **What next**

# Field Data

- **110,000 stags average 146 d**
  - 90 % affected
  - 60 % mild, 40 % score 2+
- **55,500 hens average 118 d**
  - 80 % affected
  - 60 % mild, 40 % score 2+
- **Season not very important**



# Field study

- **Affected/unaffected (N=40)**
- **Age 1,2,3,4,5,6,7,8, 10 and 21 weeks**
- **Lesions from week 1**
- **Fully developed lesion at 3 weeks**
- **All lesions full scale at 6 weeks**
- **Increase in size after 6 weeks**

# External Scoring System

- Score 0 = No signs of FPD, skin soft
- Score 1 = Slight swelling &/or redness
- Score 2 = Skin harder &/or swollen with redness, with compressed reticulate scales
- Score 3 = Skin swollen, red, hard, reticulate scales enlarged & separated. Small black necrotic areas
- Score 4 = Reticulate scales black, <1/8 total foot pad area
- Score 5 = Necrosis extends to a 1/4 of foot pad
- Score 6 = Up to 1/2 pad necrotic
- Score 7 = Over 1/2 of foot pad covered in necrotic scales

# External Scores at 6 Weeks

External score 0



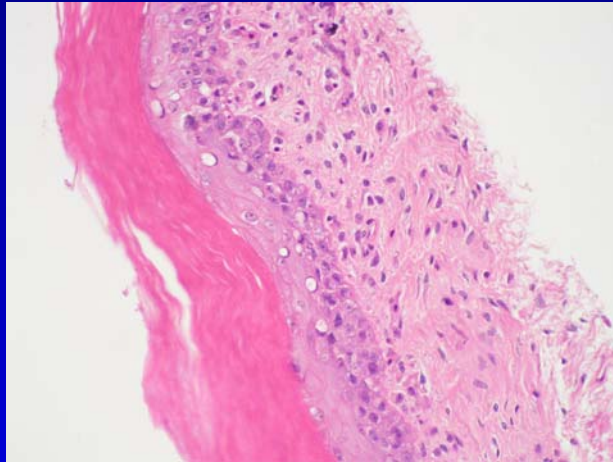
External score 6



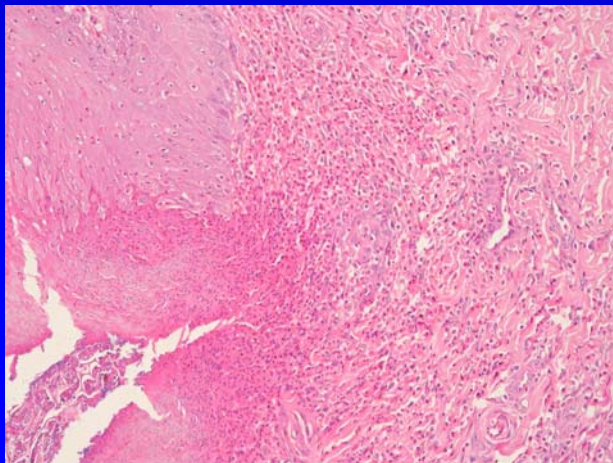
# Histopathological scoring system

- Score 0 = No change, sample normal
- Score 1 = Hyperkeratosis; abnormal keratin (compressed, loose, pegs; epithelial hyperplasia
- Score 2 = Acanthosis in epidermis; increased BV density in dermis
- Score 3 = Vacuoles in dermis and epidermis; necrotic debris in keratin/epidermis
- Score 4 = Inflammatory cells; heterophils, macrophages & lymphocytes in dermis
- Score 5 = Increased density of inflammatory cells; congested/necrotic BV, necrotic cell debris
- Score 6 = Split epidermis - one lesion
- Score 7 = Split epidermis - >1 lesion or covering > 1/3 total sample

# Microscopic view of lesion



- Early FPD
- 1 week old
- Histopath score 3



- Advanced FPD
- 6 week old
- Histopath score 7

# Dry Clean Wood Shavings



# Litter wetness trial results (8 d)

Litter	Mean Scores at 8 Days	
	External	Histopath
Dry clean	0.7	1.7
Wet clean	2.3	5.7
Wet dirty	3.0	3.3
No litter	1.3	4.0
SED	0.92	1.76

Maximum scores 6 days after wetting

# Litter Wetness: Large Pens (n=5)

Litter	Water %	Mean Scores 6 d	
		External	Histopath
Dry clean	13	0.7	2.5
Wet clean	74	6.3	6.5
SED	2.2***	0.53***	0.41***

# Wet or Dry Litter for 48 h



**Wet Litter**



**Dry Litter**

# Large pens: 6 pens, n=6

Day	Treatment	
	Dry	Wet
0*	0.9	6.7
3	0.5	6.7
6	0.3	6.5
9	0.3	4.9
12	0.4	2.9
15	0.0	0.9
SED	0.38	

Histopathology scores  
at 15 days:  
Dry - 1.2  
Wet - 3.7

\* After 48 hours on dry or wet litter

# Litter Type and Wetness (6 d)

Litter	External		Histopath	
	Dry	Wet	Dry	Wet
Cardboard	5.0	5.5	5.8	6.3
Paper	1.8	5.8	3.3	6.8
Straw	4.8	5.3	4.8	6.3
Shavings	1.0	4.8	3.0	6.3
SED	0.95		1.10	

# Immune Responses (with IAH)

- **Aim**
  - Identify cells and cytokines in FPD
  - Immune response or allergy (irritant)?
- **Immune response in tissue**
  - **Cells**
    - CD4+ T, CD8+ T, macrophages, B cells stained
  - **Cytokines**
    - mRNA levels of IFN- $\gamma$ , IL-1 $\beta$ , IL-6, IL-8, IL-10, IL-13

# Immune Experiment

- 6 pens dry, 6 pens wet for 48 h.
- 6 turkeys/pen, 3 for immune tests
- At 48 h massive response
  - Unwilling to place foot on litter
  - Suggests painful

# Immunology: Cytokine responses

Cytokine	Dry	Wet	SED	Significance
IFN- $\gamma$	1.4	6.5	0.56	***
IL1 $\beta$	3.6	13.0	0.85	***
IL6	7.5	10.5	1.06	*
IL8	10.1	21.0	1.01	***
IL10	4.0	2.5	0.78	ns
IL13	7.4	8.5	0.26	**

# Immunology: Immune responses

- **Wet pens had more**
  - Macrophages, CD4+ and CD8+ cells
- **Higher inflammatory cytokines**
- **Non-specific inflammatory response**
  - Time too short for allergic response
  - Cytokines consistent with inflammation

# Biotin Trial (with DSM)

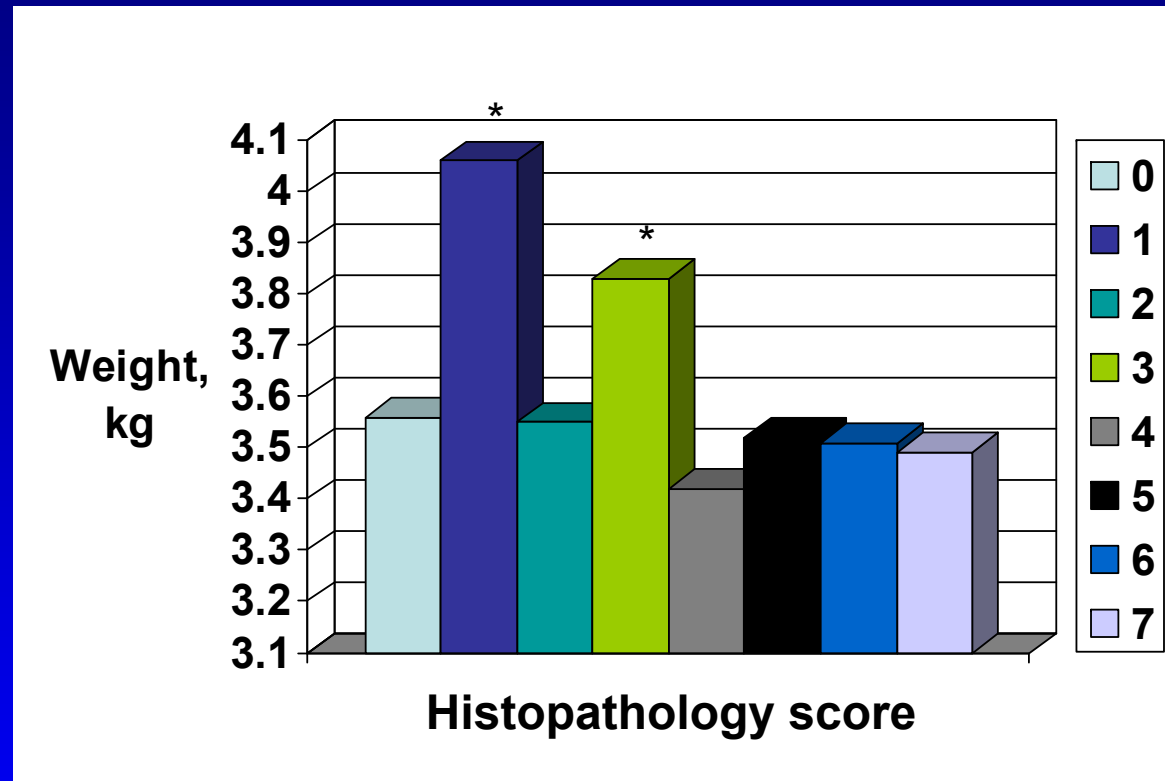
- **Dietary biotin**
  - 0, 200, 800, 1600  $\mu\text{g}/\text{kg}$
  - Day old to 14 weeks
- **Every 2 weeks**
  - Body weights
  - Foot score
  - Histology (2/pen)
  - Plasma biotin (2/pen)
- **4 replicates of 38 birds**
- **At 4, 8 and 14 weeks**
  - Liver sample
  - Litter moisture

# Biotin trial results

Biotin, $\mu\text{g}/\text{kg}$	External	Histopath	Fat, %	Biotin, $\text{ng}/\text{l}$
0	4.4	4.8	6.7	1553
400	4.6	4.9	5.1	1124
800	4.6	4.9	5.6	1972
1600	4.4	4.5	5.3	2910*
SED	0.13	0.35	0.20	549

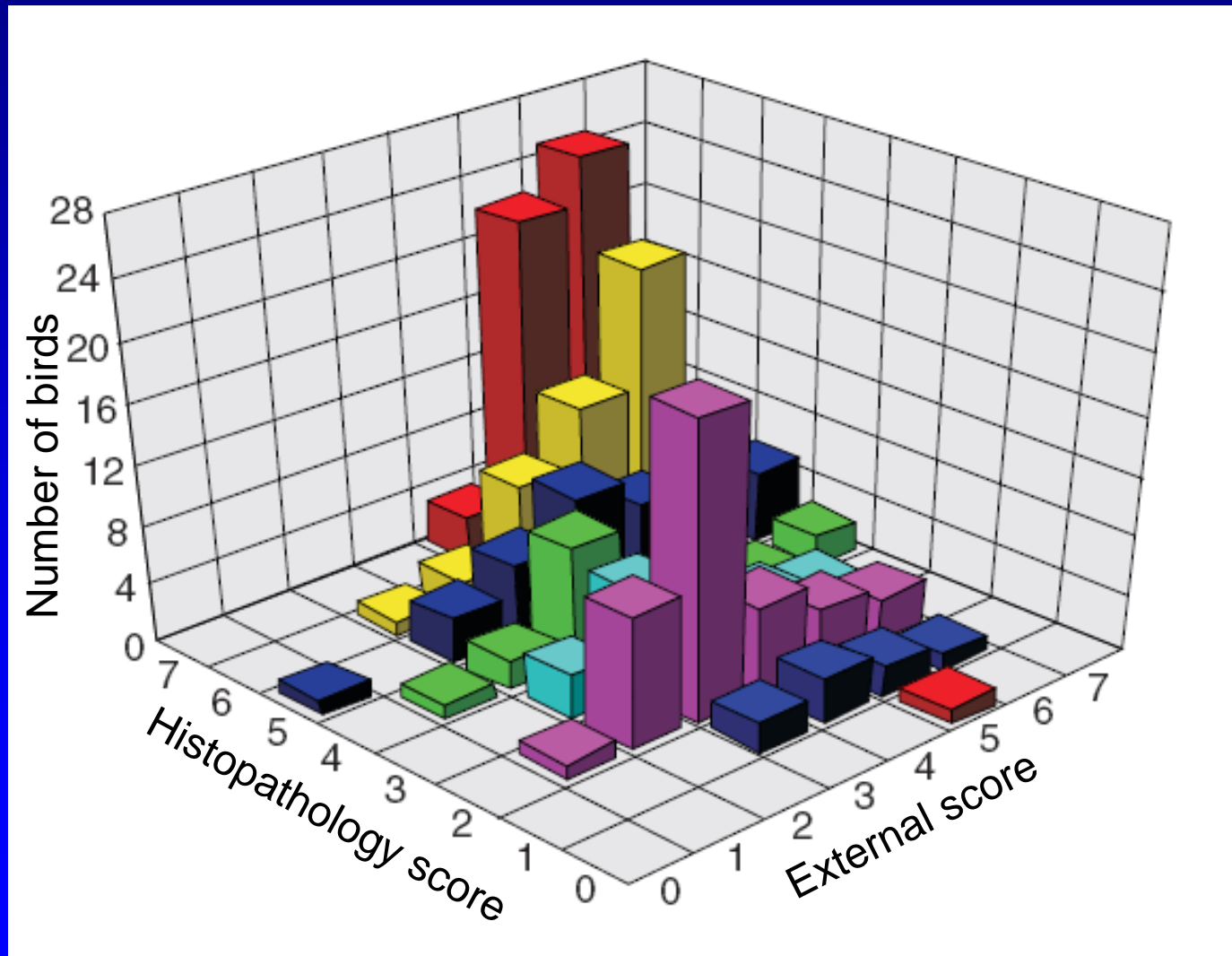
- No treatment differences
- Scores maximum from 6 week (cf field trial)
- Litter moisture (50 to 60%)

# Histopath Scores and Weight, $r=0.65$



External scores and weight,  $r=0.54$

# External and Histopathology Scores are Poorly Related ( $r=0.54$ )



# General Conclusions 1

- **Primary cause of FPD is wet litter**
  - Not nutrition or gut infection
- **Absorbency of litter may affect FPD**
  - Straw and cardboard are poor
- **FPD develops at a young age (1-3 weeks)**
- **FPD develops rapidly (2 d) on wet litter**
  - Maximum scores at 6 weeks
  - Increase in affected area thereafter

# General Conclusions 2

- **Lesions heal after 15 days on dry litter**
  - Confirmation of water as cause of FPD
- **No effect of high dietary biotin**
  - Usual concentrations adequate
- **Inflammatory response not allergy**
  - Physical injury?
  - Immature epidermis?
- **Management solutions**
  - Drinker design
  - Ventilation and humidity control

# General Conclusions 3

- **FPD is not caused by high stocking rates**
- **FPD is caused by high litter moisture**
- **External score is not a good indicator of histopathology**
- **FPD might be negatively associated with weight**
- **FPD may be painful**

# EU Project (research for SMEs)

## *Three experiments*

- Minimum litter moisture that causes PFD
- Involvement of acidity (formic acid)
- Genetic differences (2 small, 2 large)
  - Pathological differences
  - Behavioural changes

## *Subsequently*

- Immune response mechanism
- Physical differences (EM, collagen)
- Pain model?
- Is commercial FPD painful?

# EU Project (research for SMEs)

## *Participants*

- **European turkey group**
  - BUT and producers
    - UK, Germany, France, Italy, Poland, Sweden
- **Research**
  - University of Edinburgh (Hocking)
  - University of Oxford (Dawkins)
  - University of Hannover (Kamphues )
  - University of Warmia (Jankowski )
  - Schothorst Feed Research (Veldkamp)

# EU Project Research

- **University of Edinburgh (Hocking)**
  - Welfare assessment of FPD
  - Immune mechanisms
- **University of Oxford (Dawkins)**
  - Stocking rate and management
- **University of Hannover (Kamphues)**
  - Nutrition and the GIT
- **University of Warmia (Jankowski)**
  - Feed ingredients; amino acid digestibility
- **Schothorst Feed Research (Veldkamp)**
  - Interaction of nutrition-gut-microbes