

2006 Delmarva Conference

A Summary of Presentations from 'Managing the Embryo for Performance'

PSA 2006 University of Alberta

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Embryo Symposium

- M Hulet Managing Incubation: Where are we and why?
- G Fasenko Egg Storage and the Embryo
- S Lorens Incubation Parameters and Chick Quality
- B Tzschentke Attainment of Thermoregulation
- E Decuyperre The Endocrine Interface of Environmental and Egg Factors affecting Chick Quality
- E Moran Nutrition of the Developing Embryo and Hatchling
- S Velleman Muscle Development in the Embryo and Hatchling
- C Williams Where do we go from here?



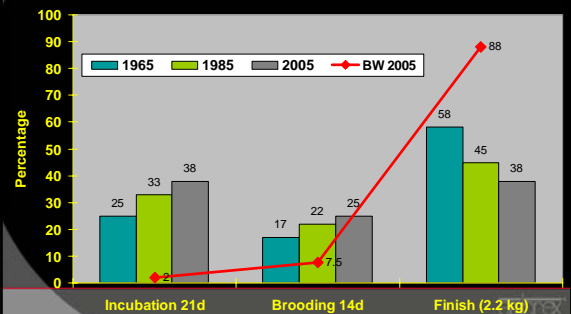
Summary

Mike Hulet, Pennsylvania State University
Pennsylvania

'Managing Incubation: Where are we and why?'



Growth of Broilers



Historical Background

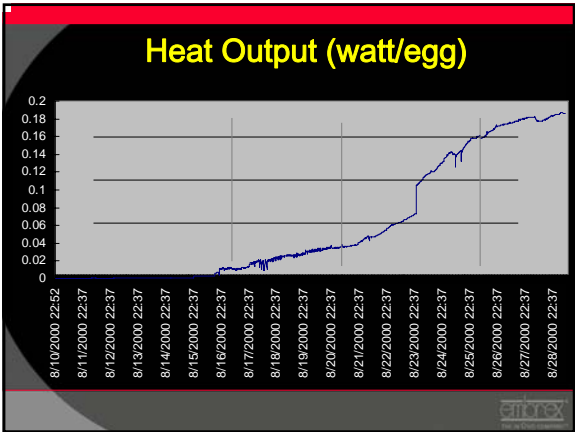
- Increased emphasis on chick quality – key to improved bird performance.
- Decreases in hatchability with increases in spread (difference between fertility and hatchability).
- Adjustment of hatch time because chicks/poults were hatching earlier.



Historical Background

- Observations in the field – multistage incubators of embryo and shell temperatures that varied by 4 degrees F (2.2 C) within a setter or hatcher (variation within machine).
- Field observations of egg shells temperatures that were >105 F.
- Hatch residue showing increased late dead embryos.





Post Hatch Effect on Body Weights (kg) of Incubation Embryo Temperature (last 5 days)

Age	99.5 F	101.5 F	103.5 F
0 d	.041 c	.042 b	.043 a
21 d	.714 a	.714 a	.669 b
35 d	1.722 b	1.756 a	1.664 c
44 d	2.214 b	2.263 a	2.165 c

Hatchery parameters (%) by high meat yielding broiler breeder strains and incubation temperature

	A Control	A 103.5 F	B Control	B 103.5 F
Transfer Fertility	93.18	92.17	90.19	88.13
Hatch of Fertile	93.77	91.27	90.58	87.20
Hatch of Total Eggs	87.37	84.09	82.32	76.77

Organ weight (g) and yield (%) of day old chicks by temperature of incubation

	Control 100.5 F	Test 103.5 F
Chick (g)	38.48 A	35.83 B
Heart (g)	.34 A	.29 B
Heart/chick (%)	.88 A	.80 B
Yolk sac (g)	2.99 A	3.17 A
Yolk sac/chick (%)	7.70 B	8.76 A

Hatchability (%) by high meat yielding broiler breeder strains and incubation temperature

	Strain A	Strain B	Strain C	Strain D
100 F	87.27	84.12	84.30	72.05
104 F	73.94	65.09	67.77	62.73
Difference	13.33	19.03	16.53	9.32

- ### Summary (Hulet)
- Embryos from modern high yielding broilers produce 44% more heat than reported in traditional broiler strains.
 - Embryo temperature for high yielding strains critical for hatchability and post-hatch performance.
 - Incubation research has moved from setter/hatcher temperatures to embryo/hatchling research

Summary

Gaylene Fasenko, University of Alberta

Canada

'Egg storage and the embryo'



Summary (Fasenko)

- Different metabolic profile during incubation from eggs stored long or short term
- Biological age lags behind chronological age
- In eggs that are stored for >7 days, embryo does not start development as soon as environmental temperature is right and embryo also develops slower



Summary (Fasenko)

- Longer storage period – cells die, yolk membrane weaker
- Reduced heart glycogen levels
- Lower metabolism, therefore slower growth rate
- Strain and flock age differences



Summary (Fasenko)

For eggs from older breeder hens stored longer than 10 days....

- Incubated for 6 hours after egg collection and before storage
- Increased hatch by 10%
- Did not see advantage in eggs from younger breeder flocks
- Can NOT store → incubate → store



Summary

Sander Lourens, Hybro

The Netherlands

'Incubation parameters and chick quality'



Summary (Lourens)

Short technical update

- embryo development
- embryo temperature
- heat transfer
- their relations and interactions



How do we make a good quality chick??

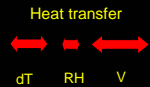
Incubations conditions should be created that support this increased metabolic rate

- CO₂ removed or used; not critical?
- Metabolic water removed (12-15%): adjust relative humidity
- Constant embryo temperature?



Embryo Temperature:

- balance between heat production and heat transfer between embryo and incubator
- Heat transfer:
- Temperature difference embryo and incubator (dT)
- Heat capacity of air (temperature + RH)
- Speed of air (V)



Practical problems:

- machines designed for air temperature
- based on low heat producing embryo's
- multi-stage setting

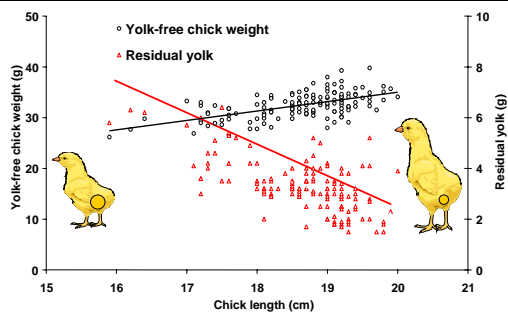
Consequences:

- loss of hatch of fertiles (late deads)
- first week mortality (navel/YS problems)
- ascites related problems (organs develop)
- loss of growth, feed conversion



Development and Performance

- Body weight
- Feed conversion
- YFB and RY
- Organs



Embryo Development

	ET (16-18 days)	% of egg weight		
		YFB	RY	% heart
setter high	104.0 F	55.9 ^b	20.1 ^a	0.632 ^a
setter low	102.4 F	58.9 ^a	17.6 ^b	0.757 ^b

Experiment (NCSU, M. Wineland)



Embryo Performance

Day 16-21 temp (embryo)	Bodyweight	Fcr (2 kg)
99.5	2.214	1.82
101.5	2.263	1.75
103.5	2.166	1.80

Annotations:
- 50 g (between 2.214 and 2.263)
- 100 g (between 2.263 and 2.166)
+ 7 points (between 1.82 and 1.75)
+ 5 points (between 1.75 and 1.80)

Experiment (Penn State, Gladys et al)



Biggest challenge for incubator manufacturers (...poultry industry)

- Develop machines that regulate the right temperature
- a uniform embryo temperature at every spot in the machine
- Develop and adjust incubation programs to specific requirements of different breeds + age PS
 - EST
- Oxygen availability + oxygen conductance



Summary

Barbara Tzschentke, University of Berlin
Germany

'Factors influencing attainment of thermoregulation'



Summary (Tzschentke)

- Incubation is the time that the environment 'imprints the 'physiological control system' of the peripheral and central nervous thermoregulatory mechanisms
- Initially an 'open loop' system – totally dependant upon the environment...non-adaptive
- As feedback mechanisms develop, the system becomes a 'closed loop'...adaptive



Summary (Tzschentke)

- Temperature 'adaptation' begins in the last week of incubation...maturity is during early post-natal development
- Critical phase of development that sets or changes from set the physiological control program – 'training' of adaptive and non-adaptive mechanisms



Summary (Tzschentke)

- Environmental temperatures during incubation modulates the development of the control systems for the entire life of the bird
 - Neural organization, circulating hormones
 - Expression of effector genes
- Incubate at + 1 C....warm adapt
- Incubate at - 3 C....cold adapt



Summary

Eddy Decuypere, Katholieke University
Belgium

'Hormonal development in the embryo and
its effect upon chick quality'



Summary (Decuypere)

- Review of quantitative and qualitative scoring mechanisms for day old chick quality measurements
- Maximal hatch is not always synonymous with maximal post hatch viability and growth potential



Summary (Decuypere)

- Pre-incubation factors
 - Egg storage duration
 - Age of breeders
- Incubation factors
 - Heat production, metabolism
 - Turning
 - Gases in environment (O_2 , CO_2)



Summary (Decuypere)

- High hatch, chick quality, growth to 7 days is associated with...
- High pCO_2 levels in air cell
 - Higher T3/T4 ratios at internal pip or hatch



Summary (Decuypere)

The spread of the hatching curve...sequence of hatch (early or late) interacts with pre-incubation and incubation factors....

- Variable length in time between hatch and first feeding
 - Additional effects on yolk uptake, gastrointestinal maturity, metabolic 'status'



Summary (Decuypere)

- Post hatch feed intake strongly influences...
- Insulin levels
 - p70S6 kinase activity (key enzyme in protein synthesis)
- Hatch spread...early vs late...can be viewed from hormonal differences and resulting post hatch performance



Summary

Ed Moran, Auburn University
Alabama

'Nutrition of the developing embryo and hatchling'



Summary (Moran)

Nutritional Focus of the Embryo

<u>Days</u>	<u>Activity</u>	<u>Central Nutrient</u>
0-7	Establish Germ	CHO & O ₂
7-14	Body Completion	FA Oxidation
14-19	Emergence Prep	CHO-Fat-CaP



Summary (Moran)

Nutritional Focus of the Embryo

<u>Days</u>	<u>Activity</u>	<u>Central Nutrient</u>
19-21	Establish Lungs	O ₂ -CHO-CaP
21-24	Reserves → Feed	Fat(CHO)-H ₂ O



Summary

Sandra Velleman, Ohio State University
Ohio

'Muscle development in the embryo and hatchling'



Summary (Velleman)

- Review of muscle development at embryonic (cellular) level
- 'Frame-work' for muscle formation in today's broiler is set during embryonic development
 - Rapid growth and enlargement of breast muscle mass

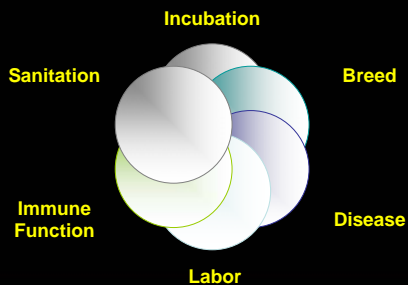


Managing the Embryo for Performance
Where do we go from here?

What are the changing variables for the next 5-15 years?

How do we continue to push the knowledge envelope when industry struggles to incorporate what we know today?

Managing Embryonic Performance



Incubation - Now

- Average age 20+ years (US, Canada >30)
- Majority are multistage
- Majority of hatcheries over 10 years old have 'new' additions and expanded capacity from original design
- Average per week set capacity exceeds 1.2 M

Incubation - Future

- Average age – will continue to RISE...slow growth due to market conditions (AI) and cost of new construction
- New Construction – trend towards SINGLE STAGE INCUBATION to better optimize incubation performance and potential
- Expansions ('new' additions) to older hatcheries will continue, mixed SS and MS
- WEEKLY SET CAPACITY will continue to INCREASE
- Challenges – maintenance, management, environmental control, 'minimizing damage'

Incubation

- Egg Storage
 - turning, pre-incubation, temp, CO₂ ?
- Early Development (day 1 - 7)
 - CO₂.....standards, applications to MS?
- Late Development (day 18 - 21)
 - Improving hatcher environmental control
 - Reducing metabolic load in hatcher?
 - Candling

Sanitation

- Egg Sanitation
 - Pre-set, during incubation, @ transfer, CO₂ ?
- Fumigation alternatives

Immune Response

- Inovo vaccination
 - Application uniformity – amnion
 - Timing egg injection for maximum immune response
 - Vectored vaccines
- Maximizing yolk sac absorption (Mab)

Disease

- BioSecurity of Production Chain
- ND transmitted from hen to chick
- Avian Influenza
- ALV

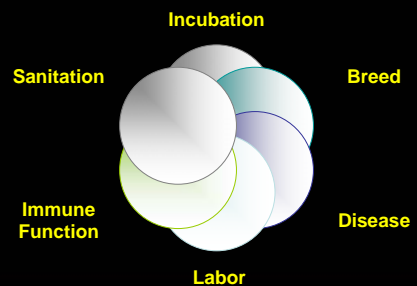
Breed

- Selection for breast meat yield will continue
- Changing every 2-4 years
- Egg size is increasing
- Continual need to recognize different incubation and management required

Labor

- Management required
- Education
- 'On the job' training
- Automation

Managing Embryonic Performance



Cost of Production

- Continual pressure to reduce (chicks/man hour)
- Continual increases
- Cyclic market
- Difficult to 'sell' new technology and improved production in cost center (hatchery)
- Cost to Value determinations

Where do we go from here?

Understand the changing variables for the next 5-15 years.

Continue to push the knowledge envelope in research, targeting the challenges of the key variables, establishing standards...

Apply the knowledge so that industry better understand the value.