Concepts of Turning

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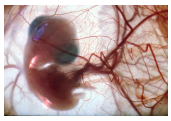

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Part of the series:

Understanding the WHY of what you see in the hatchery.

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Turning

- Common belief or at least when I was taught a long time ago about turning, if there was a turning malfunction, the embryo would adhere to the shell membranes and would have difficulty hatching.

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Two functions of turning

- Turning impacts physical development of certain extra embryonic components
- Turning impacts the temperature that the embryo develops at because of its influence on air flow across the egg mass.

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Impact on extra embryonic components

- Turning encourages:
  - –Growth of the area vasculosa (yolk sac membrane)
  - –Development of sub - embryonic fluid
  - –Growth of CAM

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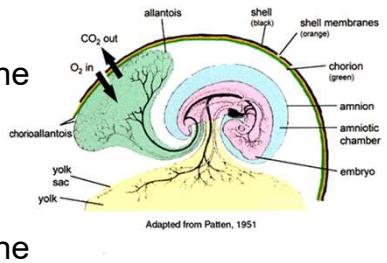
Extra-Embryonic Structures that are affected by turning

- Yolk sac membrane
- SEF
- Chorio-Allantoic membrane



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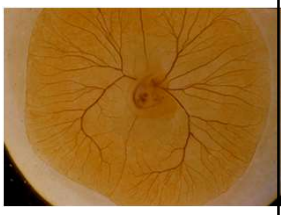
Why Turn the Embryo?

- Turning encourages the growth of the :
  - the Area Vasculosa (yolk sac membrane)
  - the yolk membrane (vitelline membranes) will be replaced by the yolk sac membrane



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Specialized cells of yolk sac

- Absorb nutrients for utilization by embryo
- There are cells that help transport water and certain ions into yolk from the albumen to form SEF

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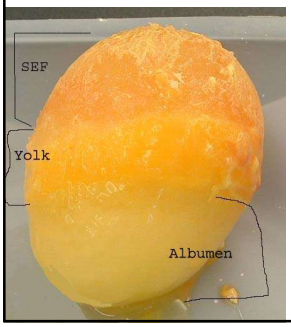
Formation of sub-embryonic fluid?



Turning also encourages development of sub embryonic fluid which is a source of water and nutrients to the developing embryo.

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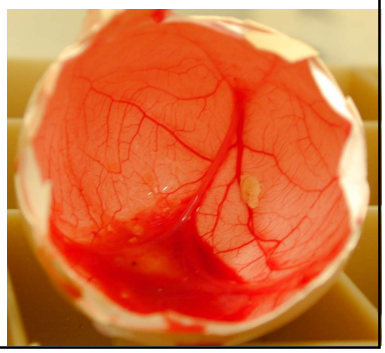
Turning influences development of:

Chorio-Allantoic Membrane (CAM) Completely formed by day 12

Failure to turn after day 12 has little or no affect upon formation of CAM



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Function of Chorio-Allantoic Membrane

- Primary respiratory organ
  - O_2 carried to embryo
  - CO_2 carried from embryo
- Provides some minerals that the embryo needs for proper development
  - Specialized cells in CAM that dissolve minerals from interior surface of shell and carry these minerals to the embryo

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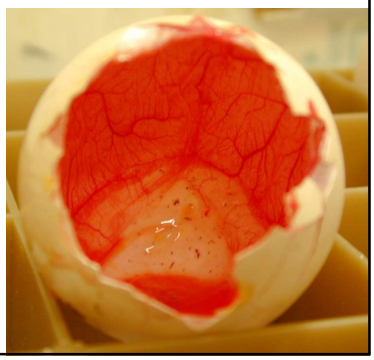
Failure to turn properly

CAM not fully formed….reduced respiration surface



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Turning failure

- Reduced hatch
- Chicks hatch later
- Poor quality chicks

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When do we turn eggs during incubation??

In a nutshell, turning is very important the first 7 days

	Hatch of Fertile
Turned for 18d	92.88[a]
Turned for 1-3d	90.84[ab]
Not 1-3d	84.85[b]
Turned for 1-7d	93.33[a]
Not during 1-7d	80.38[b]
Not turned	70.43[c]

Cutchin and Wineland, 2009

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	% Hatch of Fertile	Sub Embryonic Fluid (ml)
Turned 18d	92.88[a]	28.47[a]
Turned 1-3d	90.84[ab]	
Not 1-3d	84.85[b]	
Turned 1-7d	93.33[a]	
Not 1-7d	80.38[b]	
Not turned	70.43[c]	26.11[b]

Time of Not Turning

- Increase residual albumen
- Increase early & late mortality

Cutchin et al, 2009

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Albumen Transport to Amnion

- Absence of turning decreases amount of amniotic fluid (less albumen entering the amnion via the sero-amniotic connection)
  - **LESS NUTRIENTS AVAILABLE TO EMBRYO**
  - **If chicks hatch → sticky chicks**

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TURNING ANGLE

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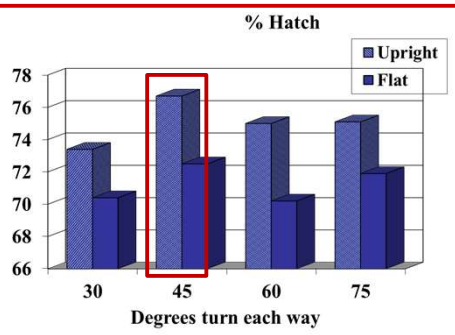
Effects of Egg Turning Angle

(Funk and Forward, Poul.Sci. 1960)



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Trials: Effects of turning angle

–First: turning angles of 15, 30 and 45 degrees from vertical 1 time per hour

Cutchin and Wineland 2009

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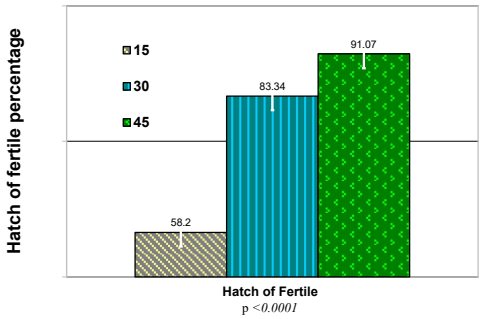
Effects of turning angle- Hatch of Fertile

Trial 1



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Effects of turning angle - Trial 1

- Turning eggs at 15° caused:
  - Increased incidence of malpositions– head over left wing and head in small end of egg
  - Increased embryonic mortality between d 4-10 and d17-21
  - Increased incidence of pipped chicks
  - Increased incidence of residual albumen & hemorrhage

(Cutchin and Wineland, 2009)

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Effects of turning angle - Trial 1

- Turning only 15°:
  - Decreased sub embryonic fluid
  - Decreased hatch of fertile
  - Smaller chicks with larger residual yolk sacs as a percentage of initial egg weight
- Turning 30° was not as harmful as 15°, but not as beneficial as 45°.

(Cutchin and Wineland, 2009)

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Trials: Effects of turning angle

–Second: turning angles of 15 and 45 degrees, turned 1 time per hour, and another treatment of 15 degrees turned 3 times per hour.

Cutchin and Wineland 2009

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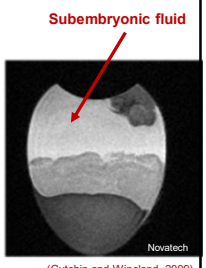
Turning frequency effect on day of Hatch

	15 1x/hr	15 3x/hr	45 1x/hr
Hatch of Fertile %	44.46c	64.09b	91.30a
Chick Wt (gm)	42.32b	44.77a	45.57a
Chick w/o yolk	36.67b	38.27a	38.58a
Heart Wt (mg)	0.322b	0.355a	0.383a
Sub embryonic fluid (ml)	15.73b	14.93b	17.08a



(Cutchin and Wineland, 2009)

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Embryonic Mortality
(Different angles)

Angles	Days 1-3	Days 4-10	Days 11-16	Days 17-21	Pipped
15 1x/hr	11.18[a]	5.56[a]	2.15	28.51[a]	7.59[a]
15 3x/hr	8.41[a]	3.07[a]	1.96	15.28[b]	6.12[a]
45 1x/hr	1.77[b]	2.01[b]	0.69	3.54[c]	0.51[b]
Mean ± SEM	7.12, 1.14	3.55, 0.99	1.60, 0.52	15.78, 2.06	4.74, 0.87
p value	<0.0001	0.0552	0.1263	<0.0001	<0.0001

Cutchin and Wineland 2009

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Malpositions Day of Hatch - Residue

% of fertile	15 1x/hr	15 3x/hr	45 1x/hr
Over left wing	0.36[a]	0.0[b]	0.0[b]
Under left wing	3.95[a]	1.61[b]	0.86[b]
Over right wing	3.06[a]	1.23[a]	0.00[b]
Small end embryo	5.07[a]	3.73[a]	1.44[b]
Head between legs	1.07	0.36	0.18

(Cutchin and Wineland, 2009)

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Observations in day of hatch residue

% of fertile	15 1x/hr	15 3x/hr	45 1x/hr
Residual albumen	24.04[a]	15.51[b]	1.76[c]
Exposed intestines	1.79[a]	0.70[b]	0.18[b]
Hemorrhage of CAM	1.97[a]	0.52[b]	0.34[b]
Excess Urates	1.61[a]	0.53[b]	0.34[b]

(Cutchin and Wineland, 2009)

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Effects of turning frequency
Trial 2

- Turning eggs at 15° 3x/hr compared to 15° 1x/hr is still not the angle of choice because it:
  - Did not improve sub embryonic fluid development
  - Did not decrease incidence of embryonic mortality between d1-3, 4-10, or pipped
  - Did not decrease incidence of certain malpositions

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What if?

- Some machines there may be a problem to set 40-45 degrees because of large eggs
- If you have the inability to turn 40-45 degrees from vertical… increasing turning frequency could help

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Turning Frequency per Day
(same angle)

	24 Times	48 Times	96 Times
Fertile hatchability	88.28 b	88.10 b	89.47 a
Early dead	5.31	5.85	5.28
Mid dead	0.78	0.60	0.51
Late dead	4.95 a	4.68 a	3.88 b

Elibol and Brake 2003

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Speed of Turning

	Hatchability	% Early Dead	% Late Dead
Continuous slow turning 1x/hr	87.24	5.53 a	5.30
Rapid turning 1x/hr	86.76	8.00 b	3.75

Ozlu et al. 2008

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Turning also impacts temperature that embryo develops at

AND Temperature governs rate of development

Influence size of embryo entering plateau stage of oxygen consumption

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Turning

- Manages air flow across the egg to provide heat to newer developing embryos (multi-stage) by removing metabolic heat from older embryos
- Air seeks path of least resistance

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- Turning inadequacies created by airflow that cause “elevated temperatures” will result in embryos and chicks demonstrating some of the effects and symptoms of elevated temperatures

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Airflow between incubator type

- Chick Master multi-stage
- Jamesway multi-stage
- Petersime multi-stage
- Chick Master single-stage
- Jamesway single-stage
- Because of the orientation of egg flats to air flow

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Egg Orientation During Incubation

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Hatch and Embryo Mortality of Eggs Set Upside Down

Treatment	Mort. Before Transfer	Mort. After Transfer	Hatch of Fertile
Exp. 1			
Large end up	3.9	6.8	89.3
Small end up	2.4	26.4	71.2

Wilson H.

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Mortality after transfer

- Not all embryos malposition in eggs set upside down:
  - –Weak embryo
    - Less oxygen availability – no access to air cell – hypoxic state longer
    - Hatching slightly sooner – Navel healing

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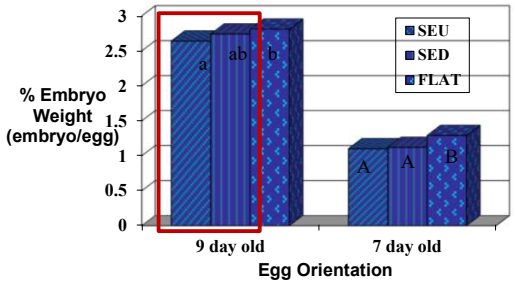
Egg Orientation - embryo weight

(Takeshita and McDaniel, 1982)



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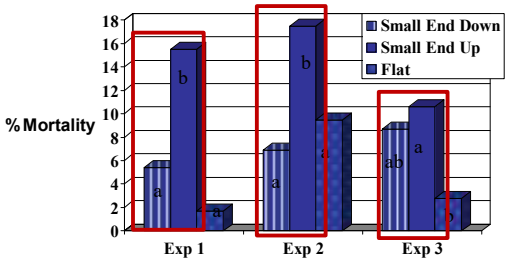
Egg Orientation – % embryonic mortality

(Takeshita and McDaniel, 1982)



SEU – Small end up had the greatest amount of embryonic mortality

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Egg Orientation

(Takeshita and McDaniel, 1982)

	Pip to Hatch (hours)	Hatch %	Chick Weight (g)
Small End Up	20.7 a	82.9 a	45.4 a
Flat	16.4 b	89.6 b	46.0 ab
Small End Down	10.8 c	93.4 b	46.4 b

Small end down (SED) - had the shortest pip time and best hatch

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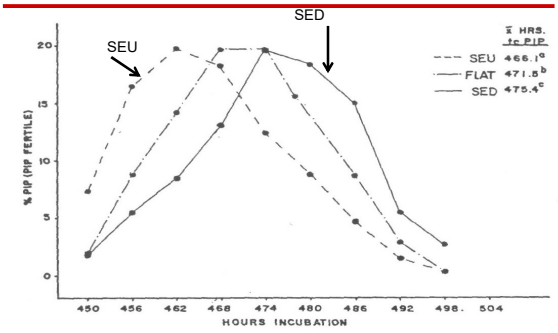
Egg Orientation – External Pip Time

(Takeshita and McDaniel, 1982)



Small end up embryos pipped earlier because their lack of access to aircell

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Egg Orientation – Hatch Time

(Takeshita and McDaniel, 1982)

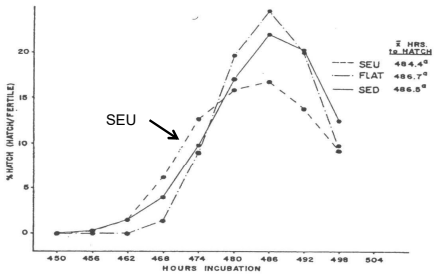

FIG. 5. Effect of incubation position on hatch time, Experiment 4. Means with different superscripts differ significantly.

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Need to verify turning angles

- Uniformity within a setter
- Uniformity between setters
- Produce more uniform development of embryos

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Summary

- If we don't have uniformity of angle within and between machines?
  - –Produce embryos at different stages of development at transfer…could impact efficacy of in-ovo vaccination
  - –Hatch window will be larger because of embryos at different stages of development

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Summary

- Many factors influence incubation, turning is one of them
- The angle of turning, frequency, the orientation of the egg and which days of incubation the eggs are turned, all influence the embryo and hatchling.

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Remember

- You must have control of the incubation processes to produce hatchlings that will perform near their genetic potential

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QUESTIONS ????

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