



BTSF Better Training for Safer Food *Initiative*

Animal welfare in poultry production (chickens kept for meat production) – IV Session

Rome 22-24 November, 2023

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Risk factors affecting the welfare of broiler chickens on farm

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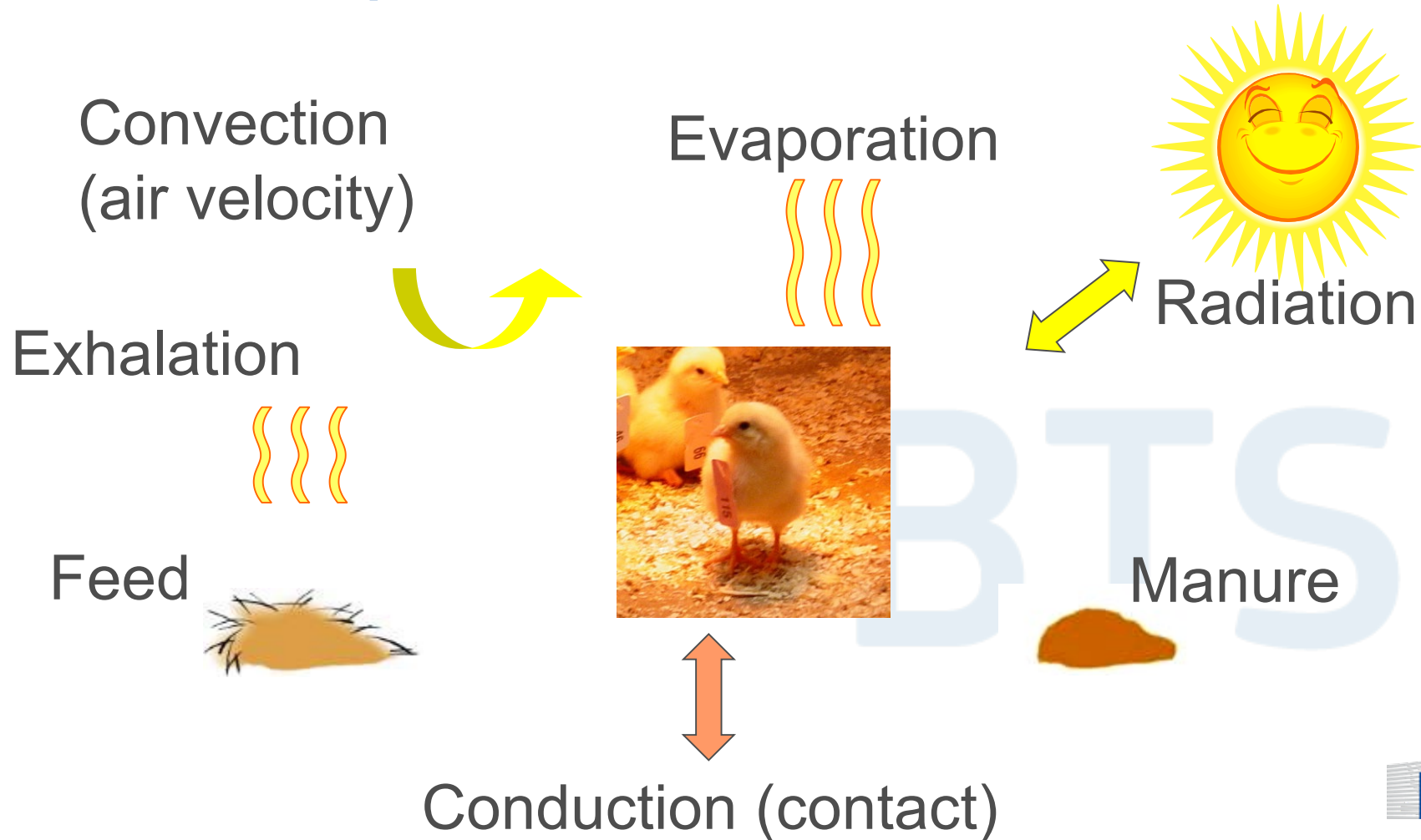
BTSF Contents

- Temperature
- Indoor climate
- Dust and noxious gases

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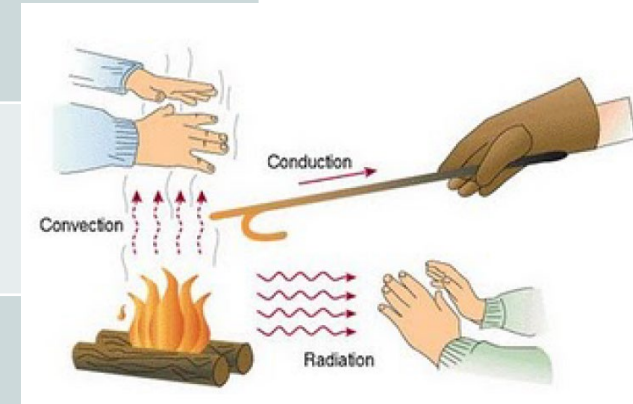
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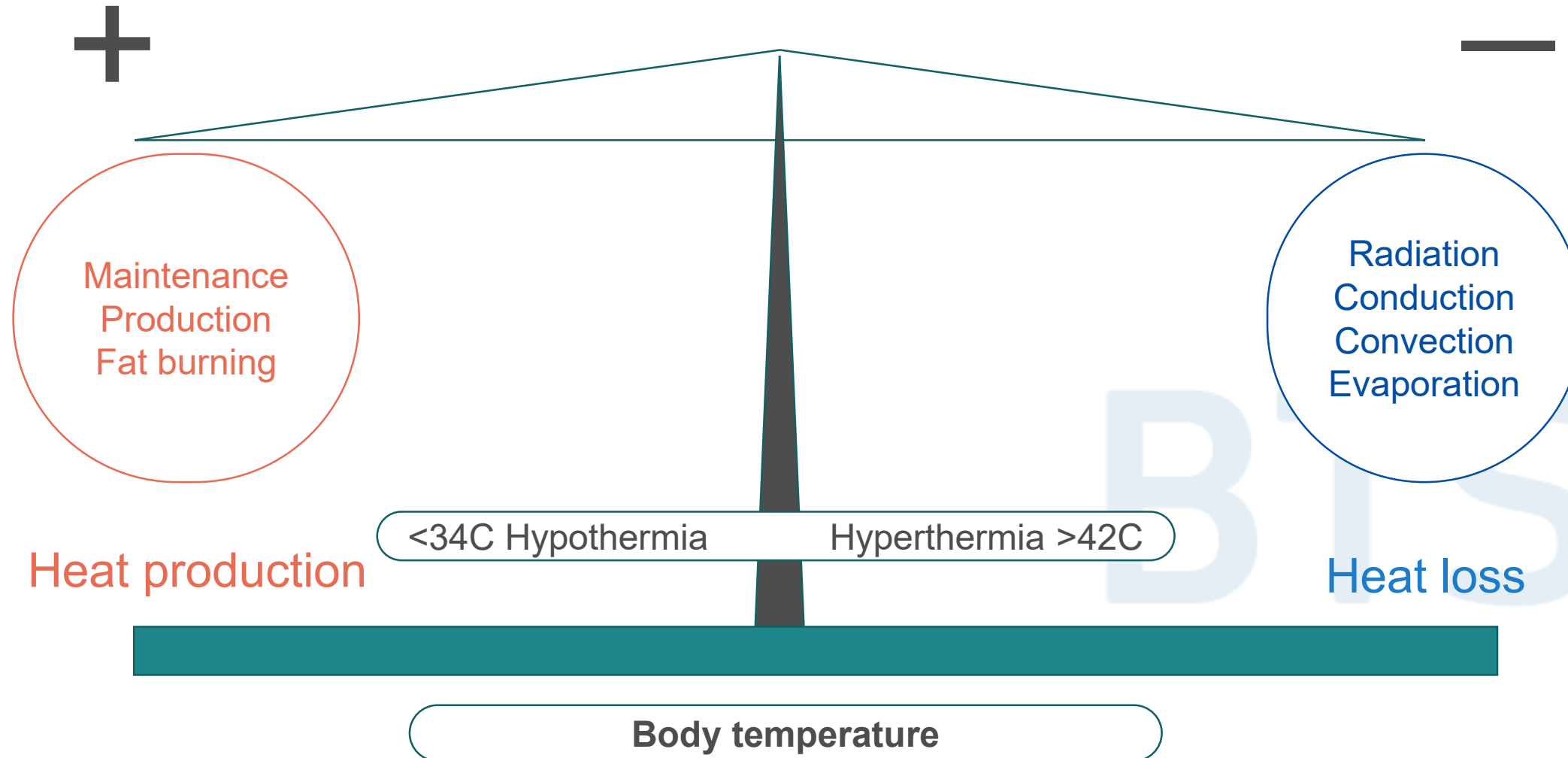
Temperature



BTSF Factors affecting heat loss

Heat loss	Animal factors	Factors in the surroundings
Radiation (Heat) (Solar)	<ul style="list-style-type: none"> • Body temperature • Heat resistance • Body area (effective) • Radiation properties 	<ul style="list-style-type: none"> • Surface temperature • Radiation properties
Convection	<ul style="list-style-type: none"> • Body temperature • Heat resistance • Body area (effective) 	<ul style="list-style-type: none"> • Air temperature • Air velocity
Conduction	<ul style="list-style-type: none"> • Body temperature • Heat resistance • Body area in contact with material 	<ul style="list-style-type: none"> • Air and material temperatures • Thermal conductivity • Heat capacity
Evaporation	<ul style="list-style-type: none"> • Surface temperature • Surface moisture • Body area (effective) 	<ul style="list-style-type: none"> • Air temperature • Relative humidity • Air velocity





BTSF The animals can regulate sensible heat loss by:

- Hyperventilate, poultry 250 – 300 times per minute (*Not down into the alveoli*)
- Regulate the thermal resistance in body (tissue)
 - vasoconstriction = tighten blood vessels
 - vasodilation = dilate blood vessels
- Regulate the thermal resistance in coat
 - piloerection - ruffling feathers
- Change the behaviour
 - huddle together
 - choose a warmer place

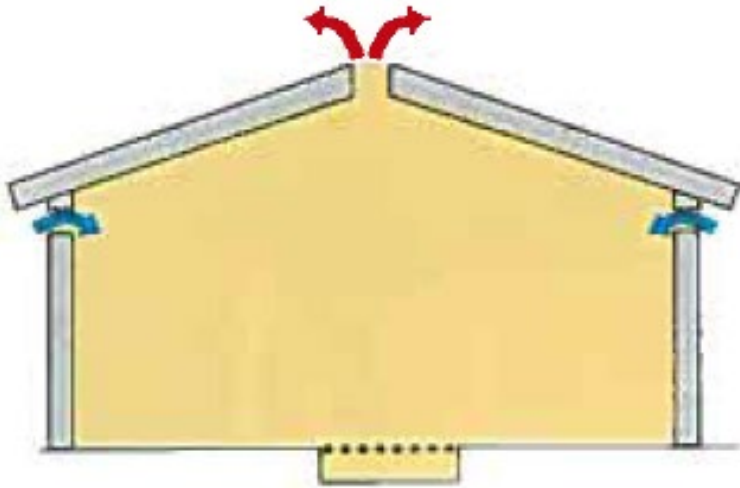
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BTSF Temperature Broiler chickens

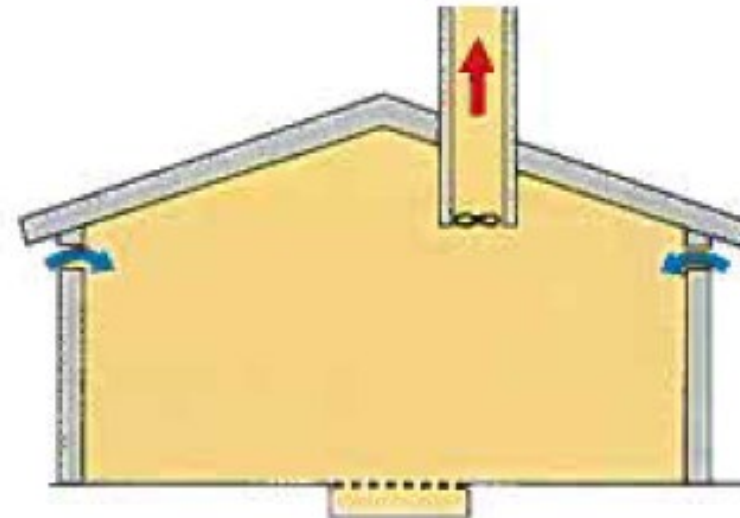
- Start temperature for one day old chickens - 32-35C
- Second week: 30-32C
- Decrease in temperature 2-3C per week
- Final temperature 20-23C
- Air velocity < 0,2 m/s
- Relative humidity 50-70%

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BTSF Natural or mechanical ventilation

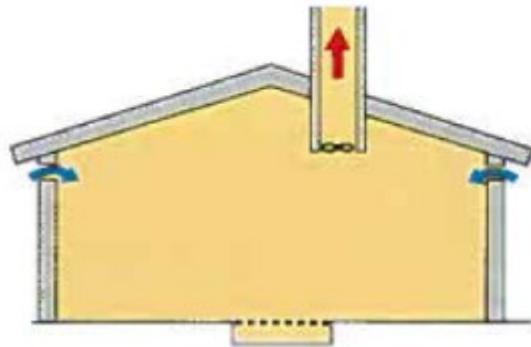


Natural = draught

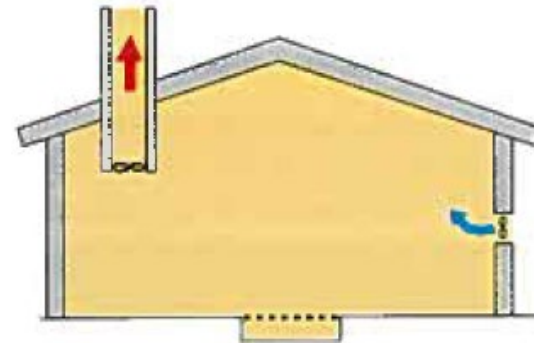
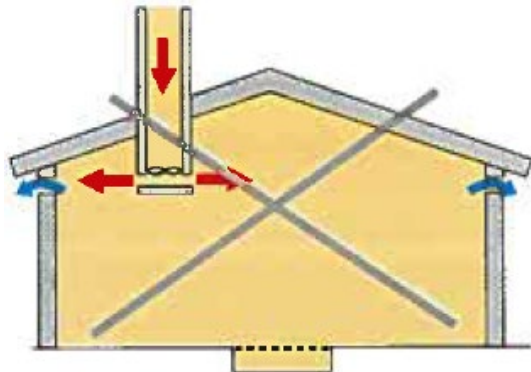


Mechanical = electric fans
Requires solid walls

BTSF Negative pressure or neutral pressure



Under pressure
preferred



Neutral,
preferred for houses with pop holes

Positive pressure,
hatcheries etc.

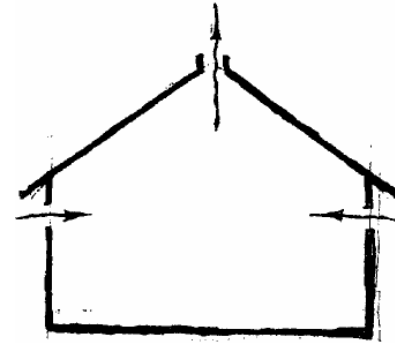
BTSF Natural ventilation

- Ventilation by

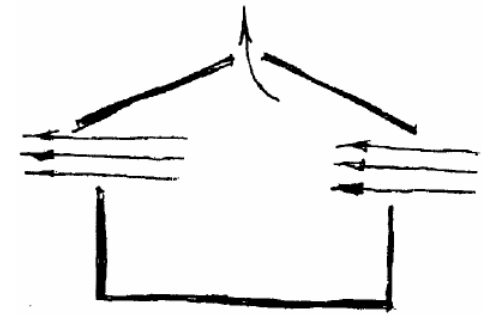
- the chimney effect (warmer air is ascending)

- the air velocity effect

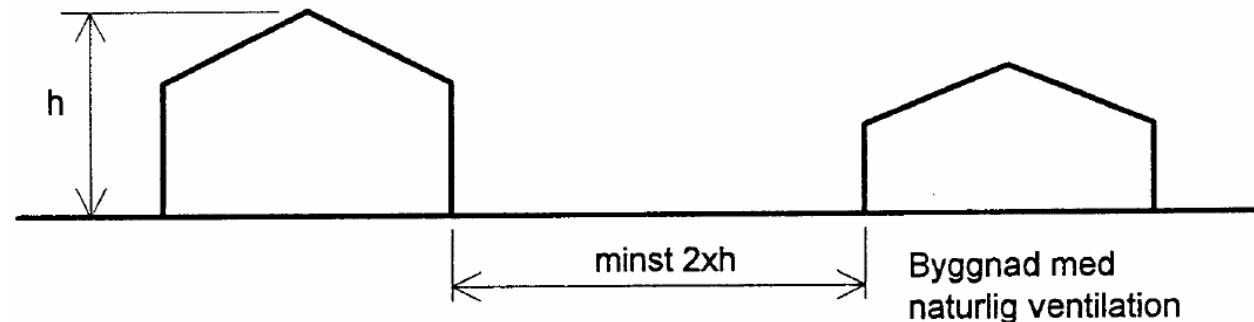
- Low effect - 3-10 % percent compared to mechanical



Chimney effect

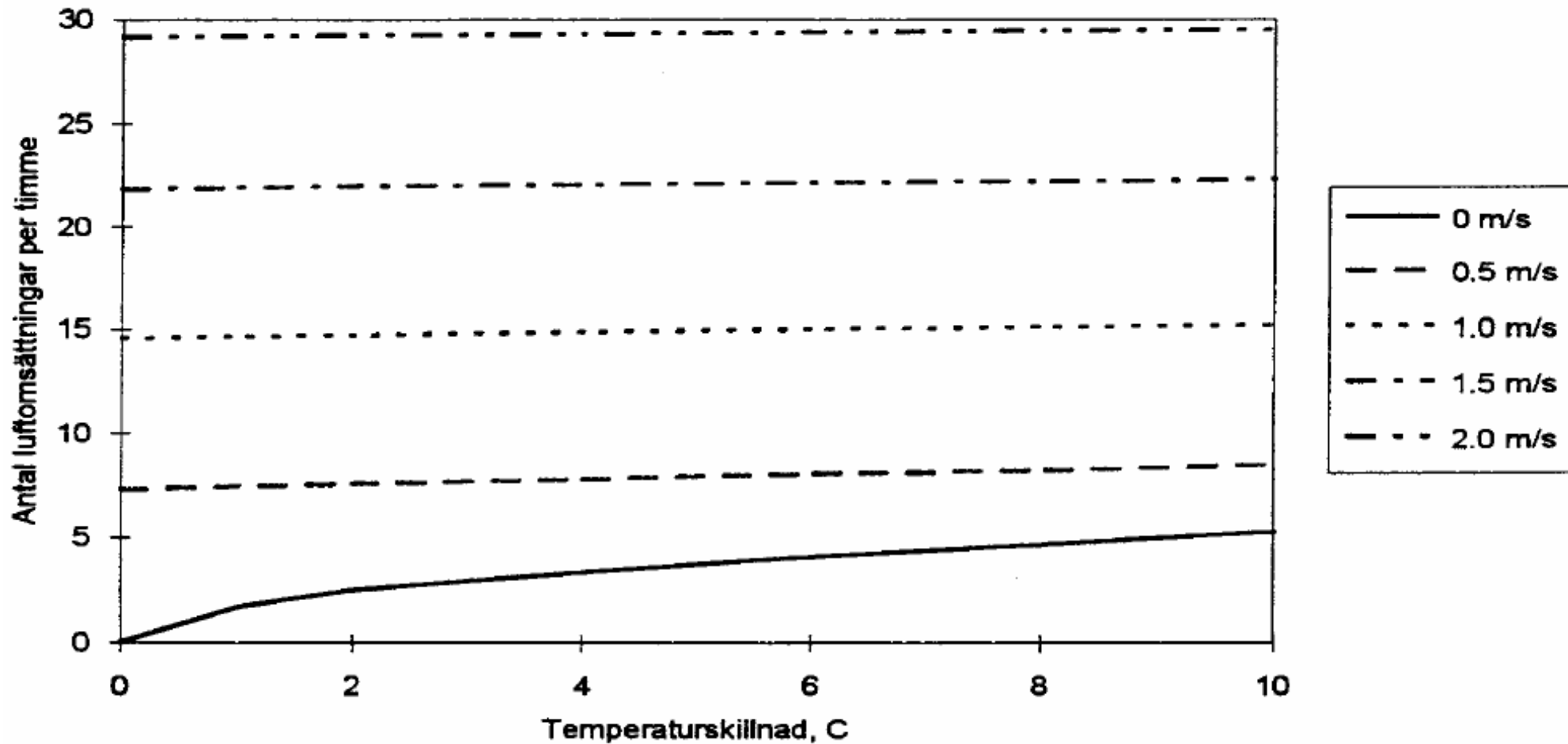


Air velocity effect



(Ehrlemark, 1995)

BTSF Importance of chimney effect and air velocity



(Ehrlemark, 1995)

BTSF Advantages and disadvantages of natural ventilation

- Silent
- Energy efficient
- Emergency ventilation included
- Little care and maintenance
- Limited thermal driving force (chimney effect) at small temperature difference inside-outside
- Wind sensitive
- Low air speeds in the barn in warm weather

BTSF Minimum or maximum ventilation

- In winter, moisture (and gases) primarily need to be ventilated away, without the temperature dropping too much → **minimum ventilation**
- In summer, the heat primarily needs to be ventilated away → **maximum ventilation**
- The ventilation requirement and capacity of building should be calculated when building plans are made. **Hard to adjust later.**

BTSF Seasonal variation



During cold days an air exchange eight times an hour



During warm days an air exchange >30 times an hour

- **Water vapor (H_2O)**

From exhalation and evaporation, watering system

- **Carbon dioxide (CO_2)**

Open air ~415 ppm in 2021, (355 ppm in 1991)

Exhalation breath ~4%

- **Ammonia (NH_3)**

From aerobic decomposition of urine and manure

- **Hydrogen sulphide (H_2S)**

From anaerobic decomposition of manure

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Urea hydrolysis in manure

Ureas
enzyme in
bacteria

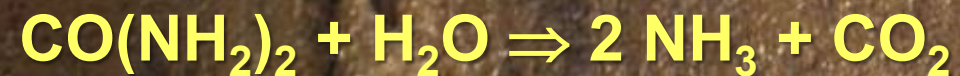


Photo: Dept of
Animal health and
Environment, SLU

BTSF Ammoniak (NH_3)

- Pungent odour >10 ppm
 - Poultry avoid high concentrations >10 ppm
- Irritation >30 ppm, Clinical impact >100 ppm, Death risk >500 ppm
- Causes mucous membrane irritation, eye irritation, excessive breathing, cilia effect, respiratory tract damage, keratolysis
- High levels indicate insufficient manure handling (wet litter) or incorrect function of the exhaust air device

Ensure that each house has ventilation and, if necessary, heating and cooling systems designed:

- a. **ammonia (NH_3) max 20 ppm**, and concentration of **carbon dioxide (CO_2) max 3 000 ppm** - measured at the level of the chickens' heads*
- b. inside temperature, when the outside temperature measured in the shade exceeds $30\text{ }^\circ\text{C}$, does not exceed this outside temperature by $>3\text{ }^\circ\text{C}$*
- c. average relative humidity measured inside the house during 48 h max **70 %** when the outside temperature is below $10\text{ }^\circ\text{C}$.*

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BTSF Ammonia emission in house

Bird density – amount of manure

Litter type

The pH of manure, water content and carbon/nitrogen ratio

The temperature

The size of the wet manure surface

The ventilation (control and air flow)

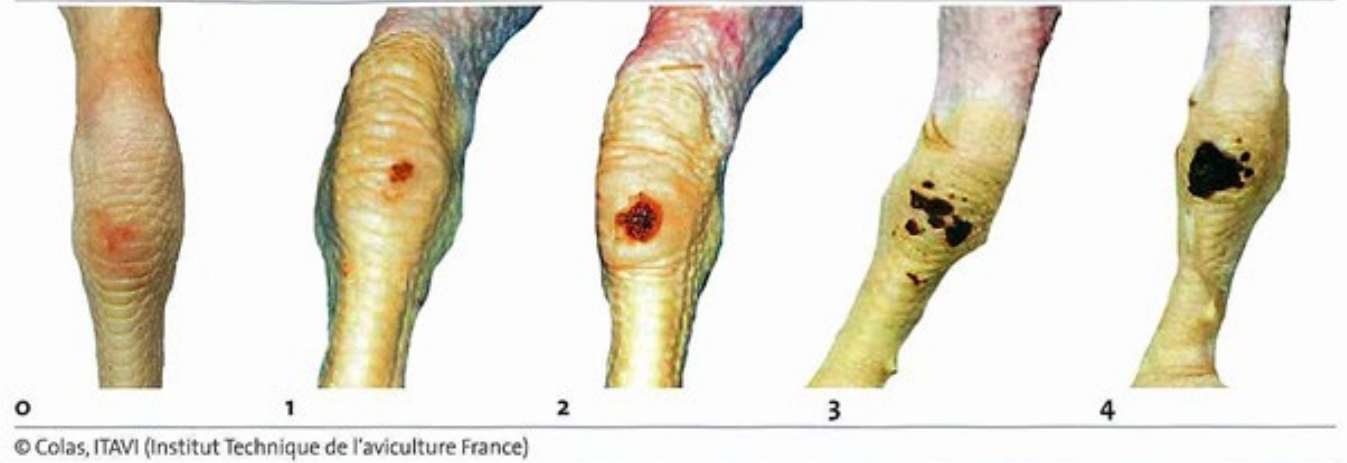
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Foot pad dermatitis
Breast blisters
Hock burns



Photo: Dept of Animal health and Environment, SLU



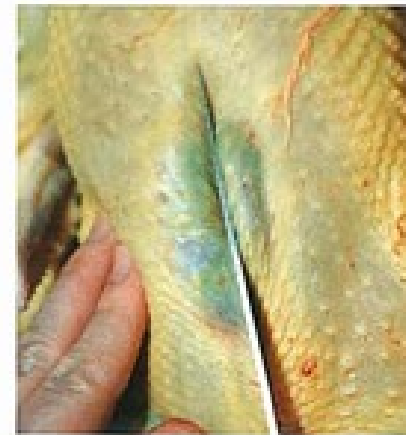
© Colas, ITAVI (Institut Technique de l'aviculture France)



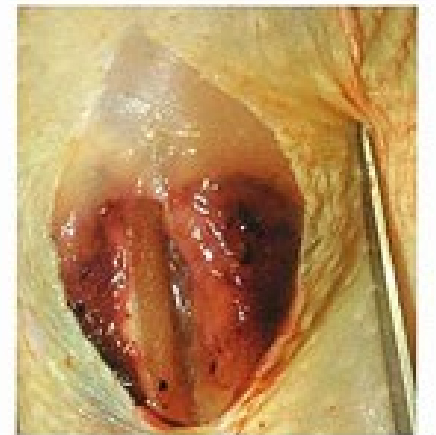
0 No breast blister



1 Breast blister



Breast blister
before incision



Breast blister
after incision

BTSF Dust

- Solid particles in air
- Derived from the birds (skin, hair, feathers, manure), feed or litter
- Particle size 1-2 μm most common in stable air
 - Respirable dust 0.5-3.0 μm (human)
 - Sedimentation time 100 min at 5 μm , 25 min at 10 μm
- In stables approx. 0.3-7 mg/m^3 , short-term 25 mg/m^3
- Causes local irritation, allergies, and vector for microorganisms and endotoxins
- High ammonia \rightarrow Ciliae in lungs impaired \rightarrow more dust into alveoli
- Some countries have included that in Animal welfare regulations : e.g. Sweden - organic dust <10 mg/m^3 except temporarily
- Working environment requirements

BTSF Dust measurement

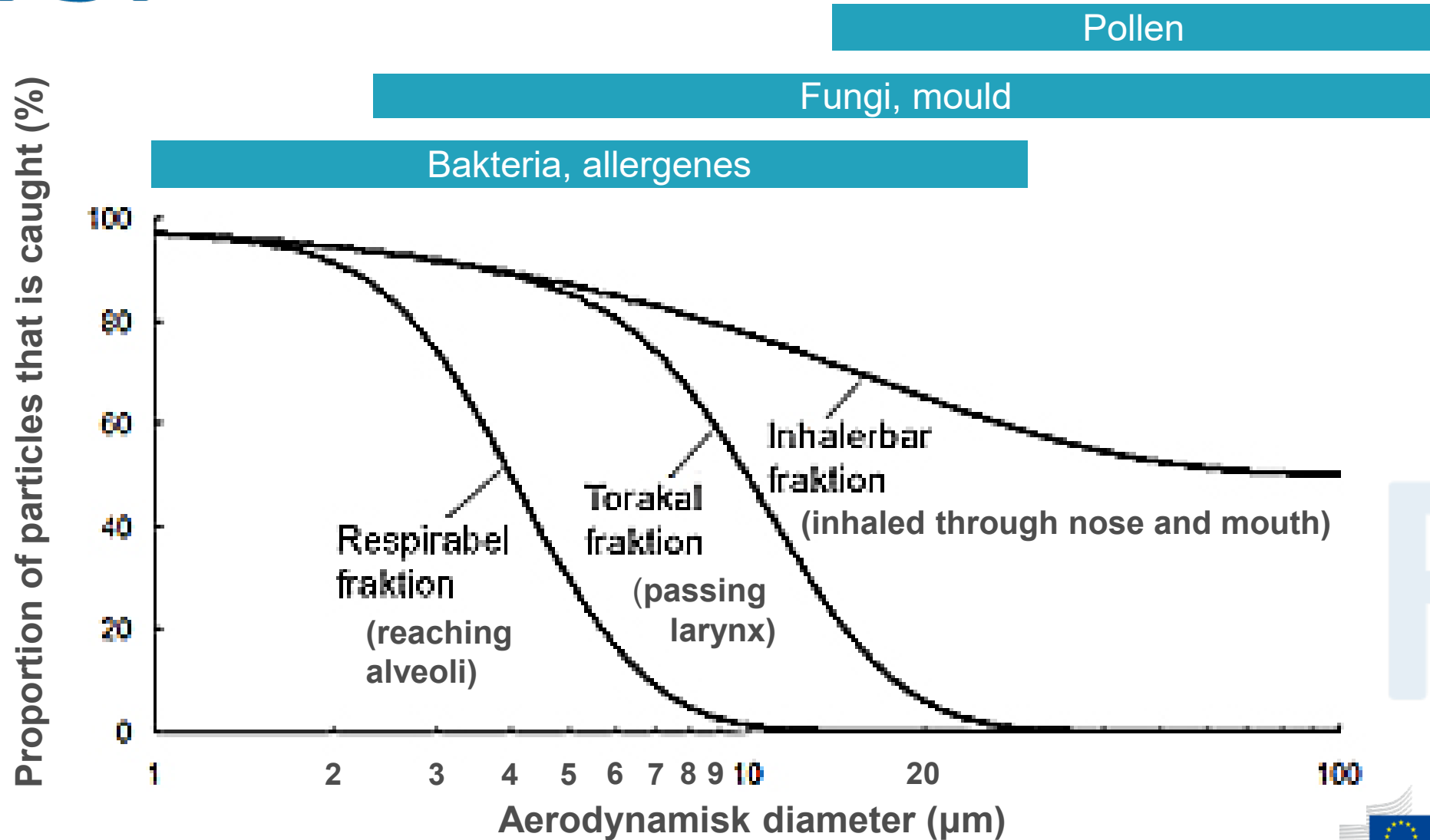


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(Picture SLU)

Fractions of dust



BTSF Dust reduction

- Adjust work routines and ventilation
- Relative air humidity ~70%
- Spraying with water droplets
- Spraying with oil droplets



BTSF Litter management

- Increase pecking and scratching
 - Litter type – wood shaving
 - Stocking density
 - Ventilation
 - Season
- Thin layer of litter
 - Nipple drinkers



Photo: Dept of Animal health and Environment, SLU

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Thank you

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