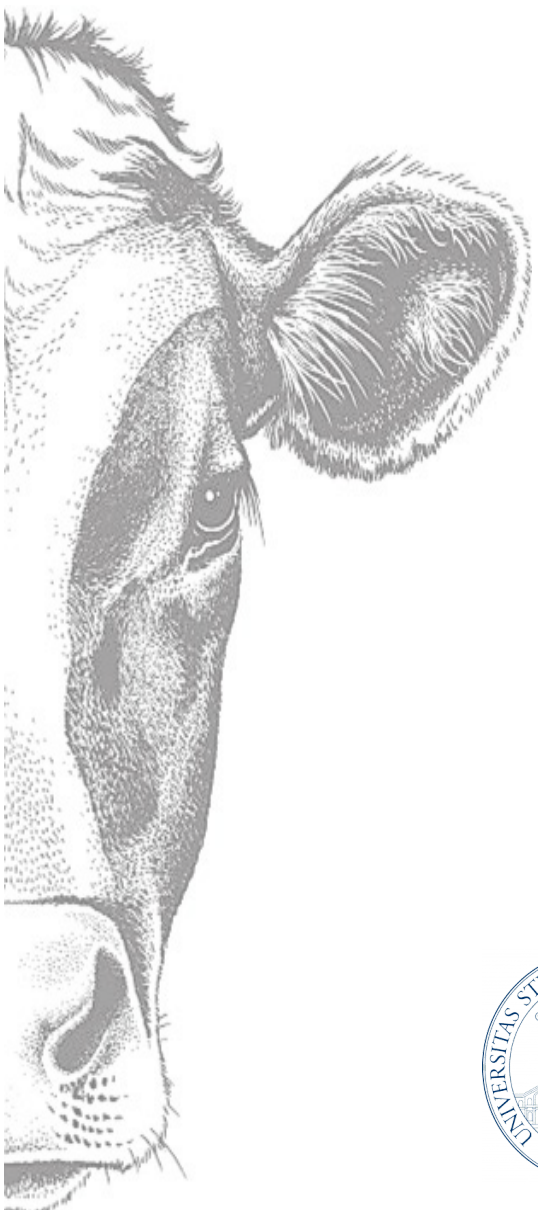




Effect of a blend of natural isoquinoline alkaloids on production efficiency, health, and cortisol levels in dairy cows during summer

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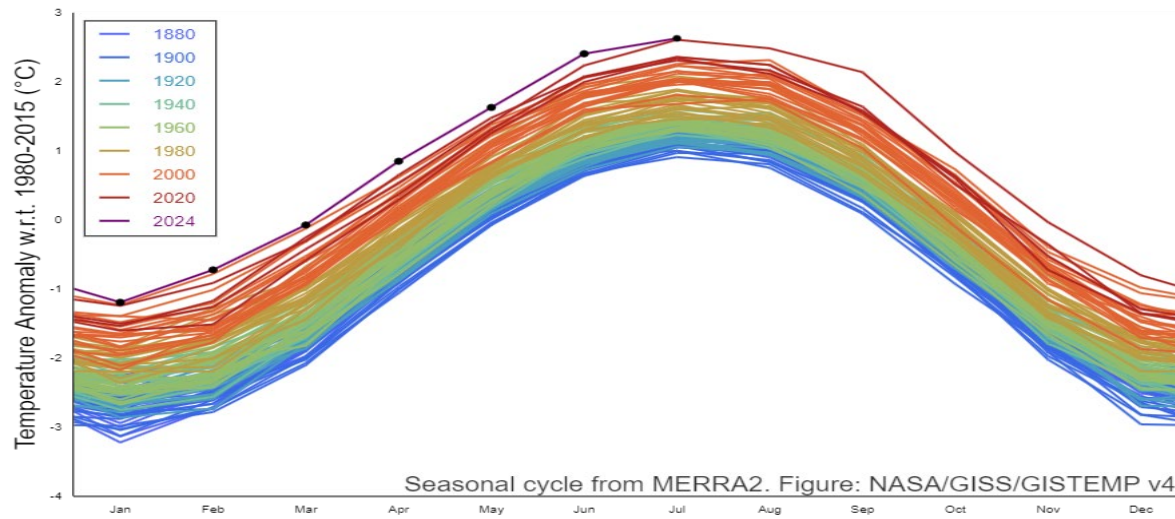
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DIPARTIMENTO DI MEDICINA
VETERINARIA E SCIENZE ANIMALI



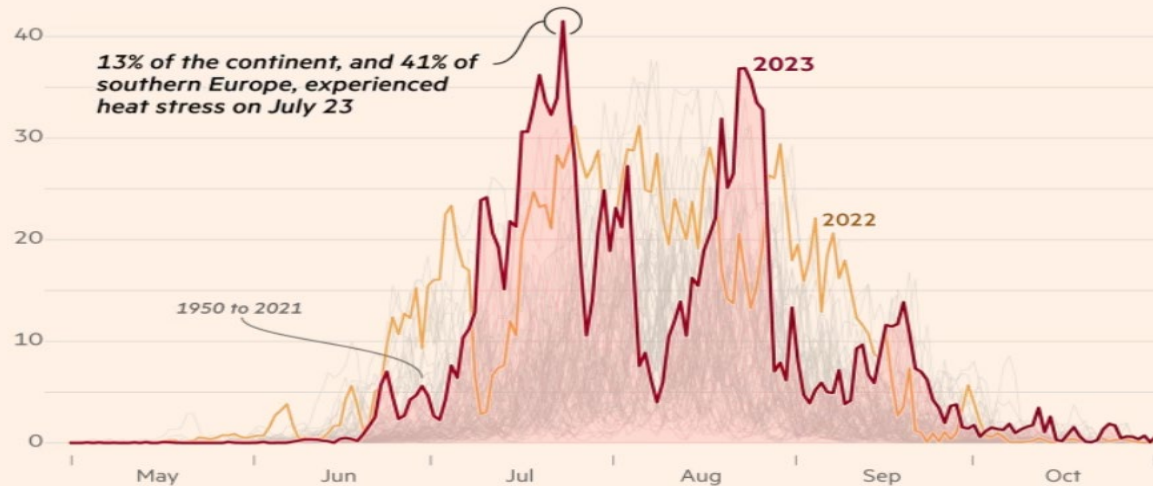
Global warming: its role on livestock production

GISTEMP Seasonal Cycle since 1880



Europe reported a record number of days with 'extreme heat stress' in 2023

Area of southern Europe affected by 'strong', 'very strong' or 'extreme heat stress' (% of total)



Sources: C3S; ECMWF
© FT

Threat for livestock production

Indirect effects

- ✓ Water scarcity
- ✓ Changes in feed availability and nutritional values
- ✓ New pests
- ✓ Emergence of new diseases
- ✓ Increased competition with other sectors for scarce resources

Direct effects



Negative effects of heat stress in dairy cows

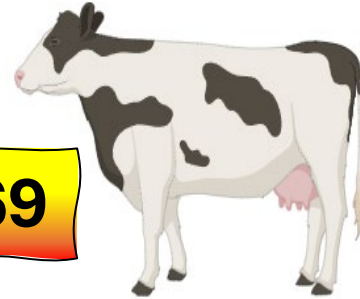
Behaviour changes

- Reduced feed intake
- Reduced rumination
- Reduced lying time

Reduced energy availability



THI > 69



Hormonal changes

- Increased anorexic hormones production
- Increased production of stress related hormones

Negative effects on immunity and reproduction

Damages to the ruminal and intestinal epithelia

- Increased proinflammatory status
- Increased absorption of endotoxins and other toxins
- Disproportionate immune response

Further negative effects on immunity, health and reproduction

-0.7 L/head

for each point of THI increase

-30% in fertility performances

Compared to winter performances

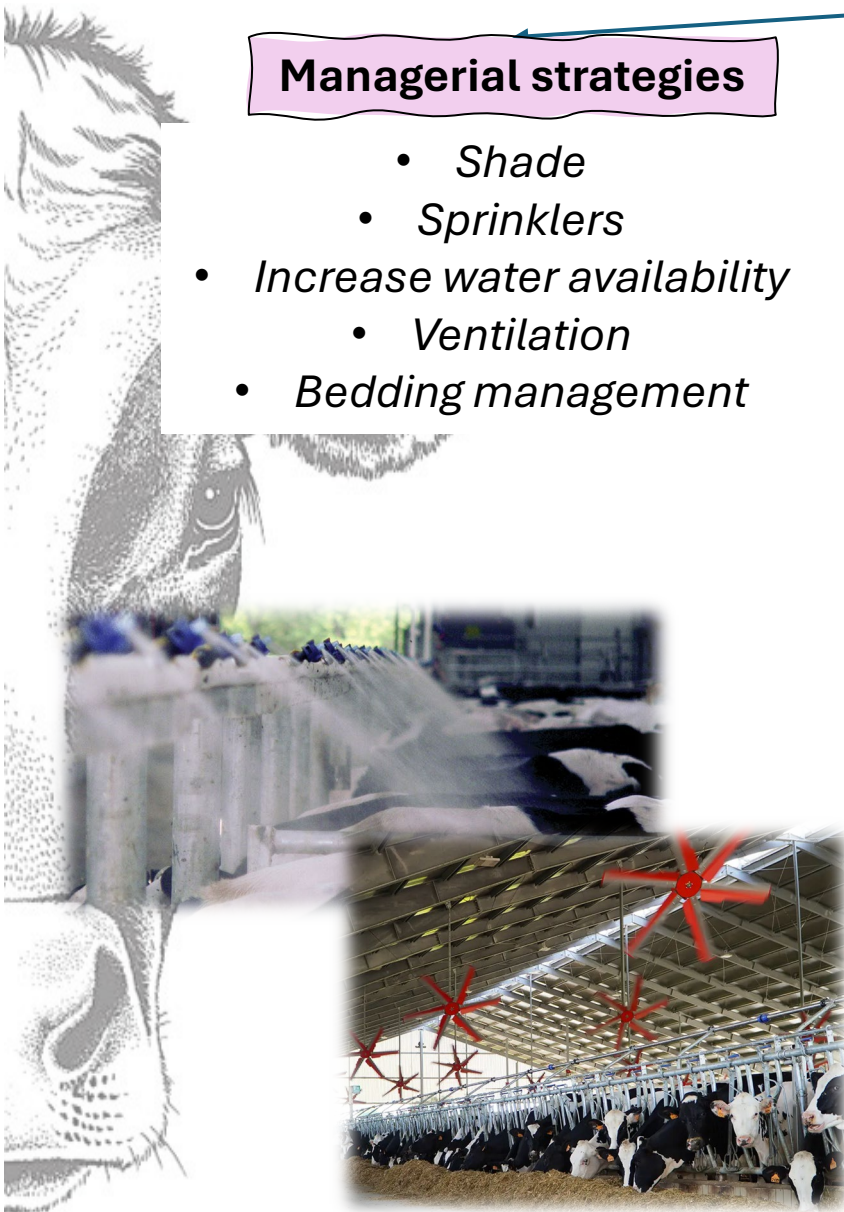
Economic losses

Sustainability issue

Strategies to counteract heat stress in dairy cows

Managerial strategies

- *Shade*
- *Sprinklers*
- *Increase water availability*
 - *Ventilation*
- *Bedding management*

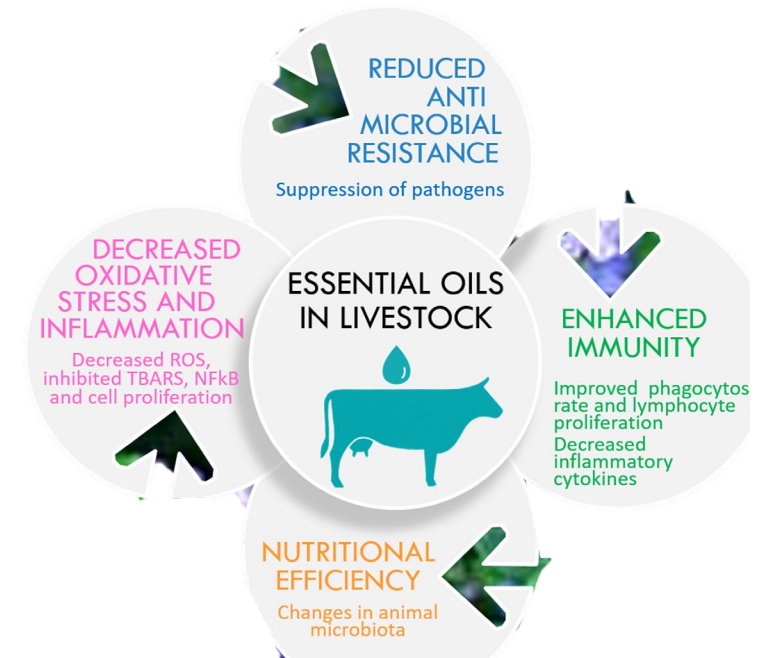


Nutritional strategies

- *Feed management*
- *Energy dense diets*
- *Prevent feed heating*
- ***Specific feed additives***



NATURAL PRODUCTS



The properties of *Macleaya cordata* and its isoquinoline alkaloids

- Family : Papaveraceae
- Origins : Cina, Japan
- Central and southeastern China



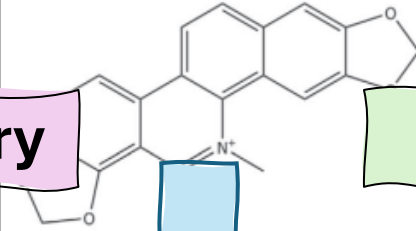
Isoquinoline alkaloids

Antinflammatory

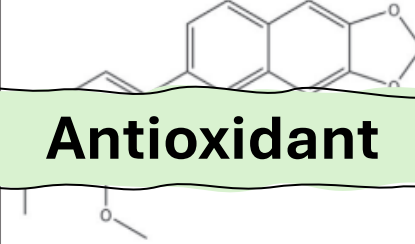
Antioxidant

Antimicrobial

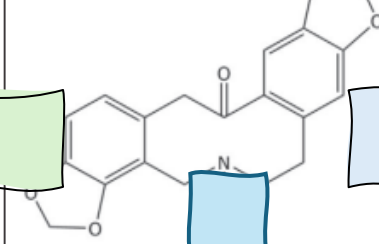
Sanguinarine (CAS No 2447-54-3)



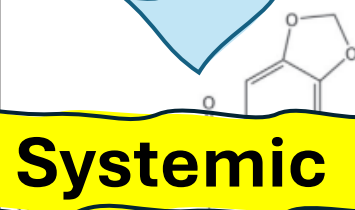
Chelerythrine (CAS No 34316-15-9)



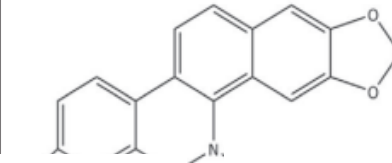
Protopine (CAS No 130-86-9)



Allocriptopine (CAS No 485-91-6)



Dihydrosanguinarine (CAS No 3606-45-9)



Dihydrochelerythrine (CAS No 688-00-0)



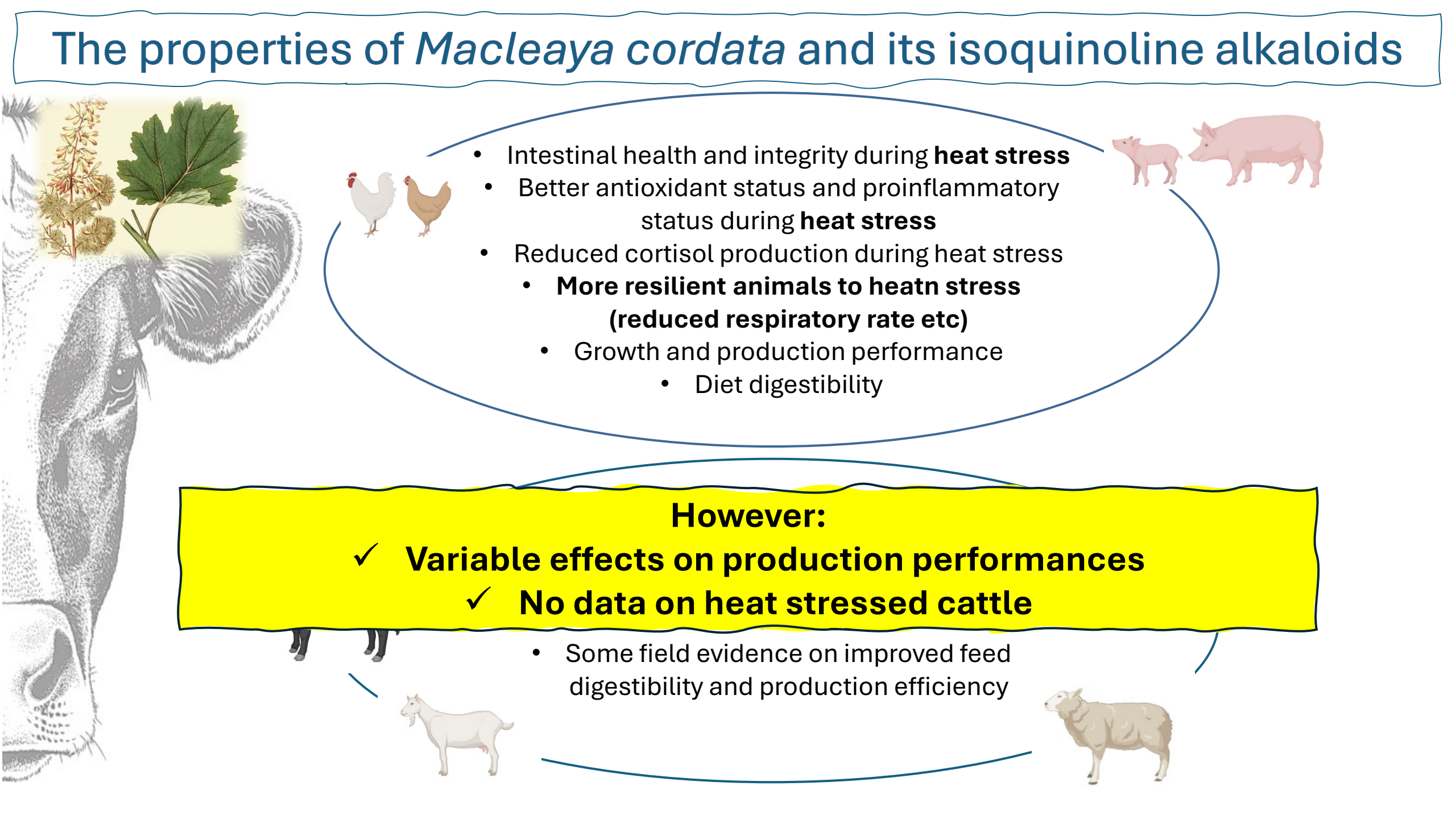
Systemic

Local

- Reduced inflammation
- Improved antioxidant defences
- Reduced metabolic heat production
- Reduced corticosteroids production

- Integrity of gut epithelium
- Increased strenght of tight junction
- Reduced colonisation of the epithelium with immune cells

The properties of *Macleaya cordata* and its isoquinoline alkaloids

- 
- Intestinal health and integrity during **heat stress**
 - Better antioxidant status and proinflammatory status during **heat stress**
 - Reduced cortisol production during heat stress
 - **More resilient animals to heat stress (reduced respiratory rate etc)**
 - Growth and production performance
 - Diet digestibility

However:

- ✓ **Variable effects on production performances**
- ✓ **No data on heat stressed cattle**

- Some field evidence on improved feed digestibility and production efficiency



Aim of the trial



To investigate the **effects** the administration of a product (Sangrovit Feed X5) containing **isoquinoline alkaloids (IQs)** deriving from *Macleaya cordata* in dairy cows **to counteract heat stress** with a focus on:

Production performances

- Milk production
- Feed conversion rate
 - Fertility

Animal health and wellbeing

- Disease incidence
- Levels of stress-related hormones

The Trial: groups and timeline



- 120 lactating Holstein Friesian cows
- Two study groups:
 1. Control, standard basal diet +60g/head/d of placebo of wheat bran
 2. Treatment, standard basal diet + 60g/head/d of the tested product (Sangrovit Feed X5) .

Group	Number of animals	Parity	Days in milk (DIM)
Control	60	2.02	51.9
Treatment	60	2.07	48.8

- ✓ 13 weeks, starting from the 28th of June 2023
- ✓ Temperature, humidity and THI: hourly recorded from the nearest ARPA station

The Trial: parameters recorded

Production Performance

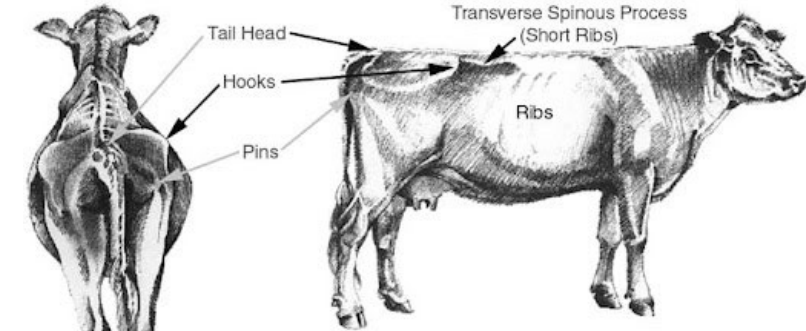
- ✓ Milk Yield: daily individual productions, individual weekly averages
- ✓ Milk Quality: monthly for fat, protein, urea, caseins and lactose beta-hydroxybutyrate and somatic cells count



- ✓ Feed Intake: weekly group feed intake
- ✓ Feed Conversion Rate



- ✓ Body Condition Score: individual evaluation once a month



- ✓ Reproductive Performances: % of pregnant cows at the end of the trial, conception rate (pregnant cows/total number of services), average services per head

The Trial: parameters recorded

Apparent total tract digestibility (aTTD)

- ✓ Characteristics of diets and Feces: monthly on 3 consecutive days
- ✓ Apparent Total Tract Digestibility calculation for each parameter (P):

$$\text{aTTD, \%} = \frac{\left(\left(\frac{P_{\text{feed}}}{(ADL_{\text{feed}} - AIA_{\text{feed}})} \right) - \left(\frac{P_{\text{feces}}}{(ADL_{\text{feces}} - AIA_{\text{feces}})} \right) \right)}{(P_{\text{feed}} / (ADL_{\text{feed}} - AIA_{\text{feed}}))}$$

Janckewicz et al. (2017)

P=parameter
ADL= lignin
AIA= acid insoluble ash



Health and blood parameters

- ✓ Incidence of diseases and health issues
- ✓ Blood samples for the evaluation of the cortisol levels (d0 and d60) on a subset of cows (10 per group)



Statistical analyses:

1. Mixed procedure of SAS for single and repeated measure
2. Chi square test for frequencies and incidence
3. Significance set at pvalue <0.05 and tendencies at pvalue <0.1

Results: production performance



Parameter	Control	Treatment	P value
Milk production, L/head/day	30.04	30.89	<0.0001
Feed intake, kg/head/d d.m.	22.0	21.7	0.170
Feed conversion rate	1.38	1.43	<0.0001

+0.85
L/head/d

✓ No effects on milk quality parameters

+2.8%

Production

+

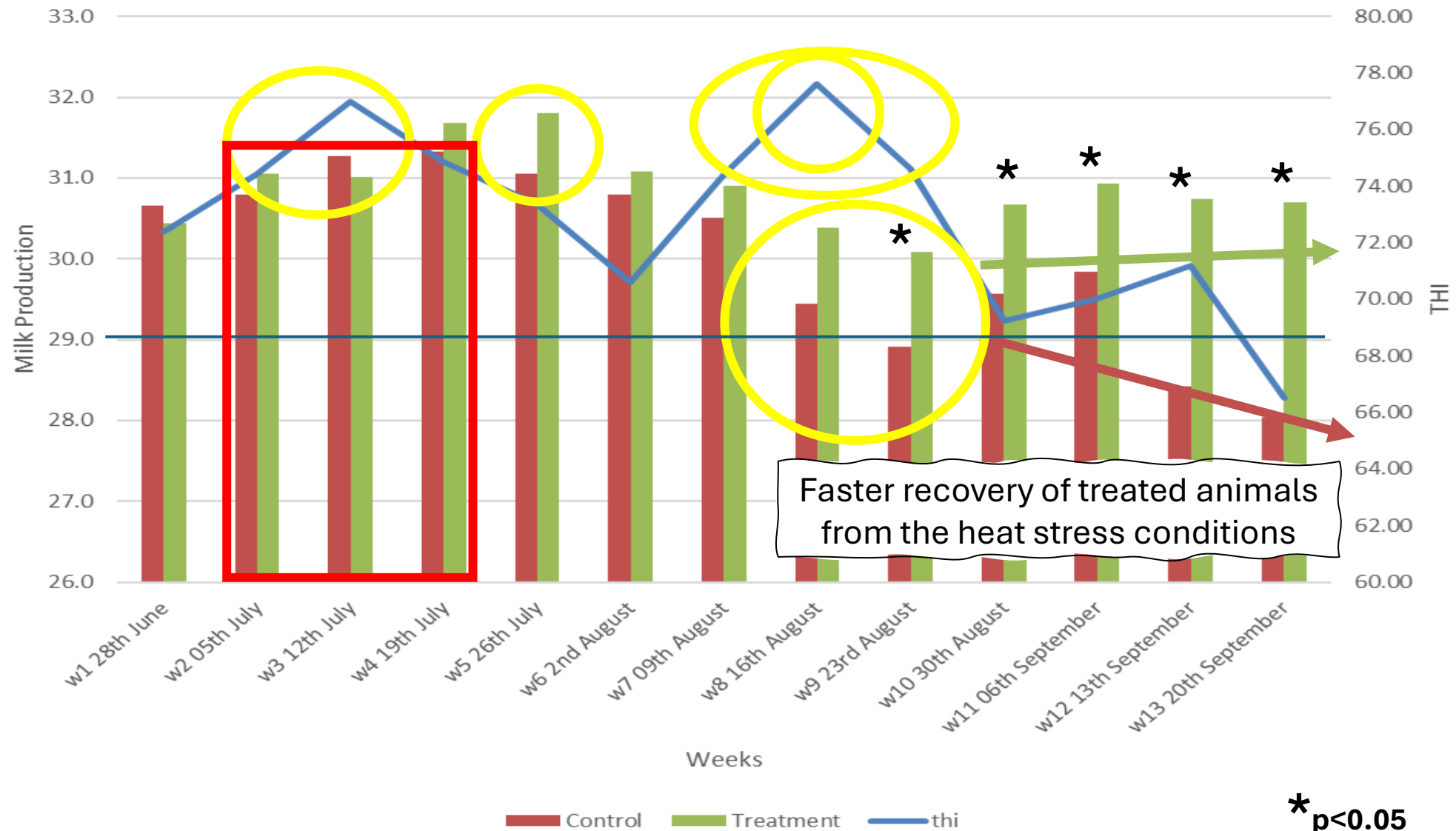
Similar feed intake

=

+3.6%

Improvement in the overall
production efficiency

Results: milk production



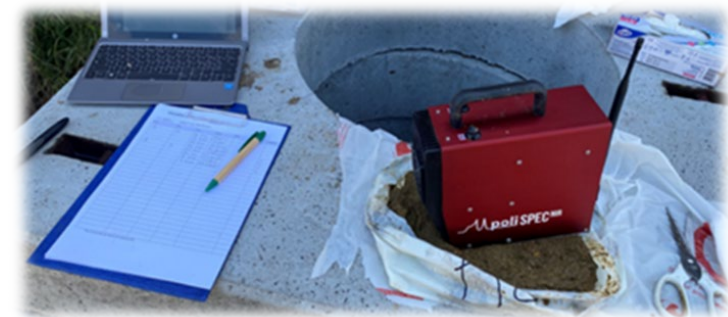
✓ Same trends for feed conversion rate

Results: diet digestibility



Months	Control	Treated	P-value
NDF, %			
<i>1st month (July)</i>	49.23	49.54	0.902
<i>2nd month (August)</i>	44.92	44.92	0.377
<i>3rd month (September)</i>	52.92	53.62	0.840
Starch, %			
<i>1st month (July)</i>	97.81	95.87	0.111
<i>2nd month (August)</i>	96.38	97.28	0.297
<i>3rd month (September)</i>	96.39	97.27	0.301

No effects on NDF and Starch
✓ Levels in feces and diets
✓ Digestibility



Results: BCS



Month	Control	Treated	P-value
	BCS		
<i>Start of the trial</i>	2.99	2.98	0.727
<i>1st month (July)</i>	2.90	2.88	0.644
<i>2nd month (August)</i>	2.89	2.92	0.587
<i>3rd month (September)</i>	2.95	2.95	0.951

- ✓ **Similar mobilisation of body reserves in the two groups**
- ✓ **No main effects of heat stress on body condition scores**

Results: health status



Issue, % (n)	Control	Treated	P-value
Lameness	24.14 (14)	10.34 (6)	0.029
Severe lameness*	6.90 (4)	0.00 (0)	0.059
Mastitis	10.34 (6)	3.45 (2)	0.105
Abortion	3.45 (2)	0.00 (0)	0.247
Bloat	6.90 (4)	0.00 (0)	0.059
Total	50 (30)	13.33 (8)	0.0010

*cases of lameness that needed to be treated with antibiotics

- ✓ Increased uptake due to epithelial damages cause by heat stress
- ✓ Increased systemic proinflammatory status

- ✓ Local damages at the hoof level
- ✓ Impairment of the reproductive function

Treatment

- ✓ Counteract the proinflammatory status
- ✓ Improve antioxidant defences
- ✓ Protect the intestinal/ruminal barrier
- ✓ General better resilience

Reducing thus the negative effects of mycotoxins as well as, directly, of heat stress

Results: cortisol levels



Days, d	Control	Treated	P-value
Cortisol, µg/dL			
<i>d0</i>	0.635	0.672	0.651
<i>d60</i>	0.586	0.339	0.0032

Lower levels of cortisol

- ✓ Reduced abnormal behaviour (feeding and lying time)
- ✓ Reduced negative effects on immune functionality
- ✓ Reduced negative effects on insuline production

- ✓ Improved health
- ✓ Improved productivity
- ✓ Improved reproductive function

Results: fertility



Parameter	Control	Treated	P-value
Pregnant cows, % (number)*	37.93 (22)	72.41 (42)	0.0001
Average services per head	2.34	1.93	0.0028
Conception rate, %**	16.18	37.5	-

*2 animals per group were already pregnant at the start – removed from those evaluations

**pregnant cows/total inseminations performed per group

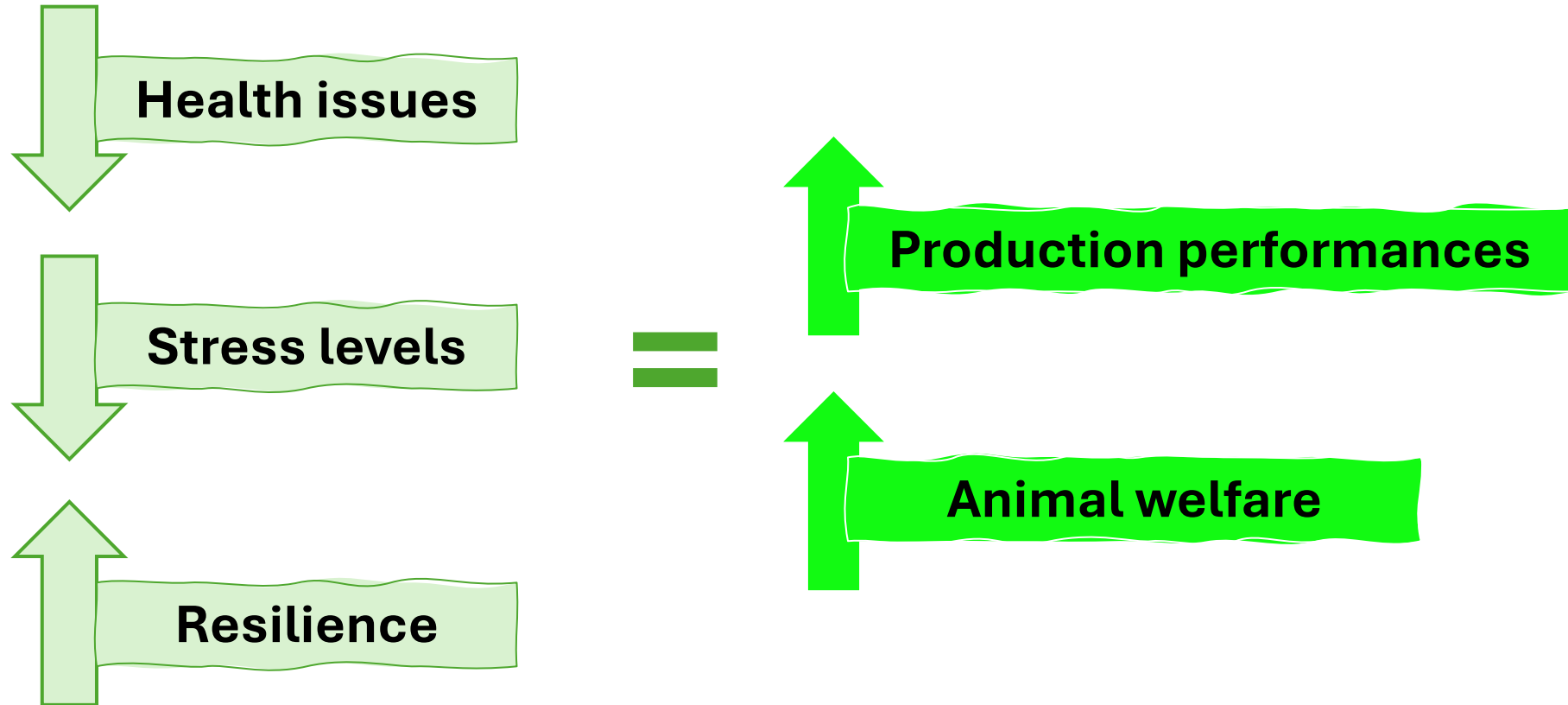
Treatment

- ✓ More stable hormonal production
- ✓ Better resilience to heat stress → negative effect on follicular development
- ✓ Reduced uptake and circulation of endotoxins and mycotoxins
 - ✓ Higher energy availability

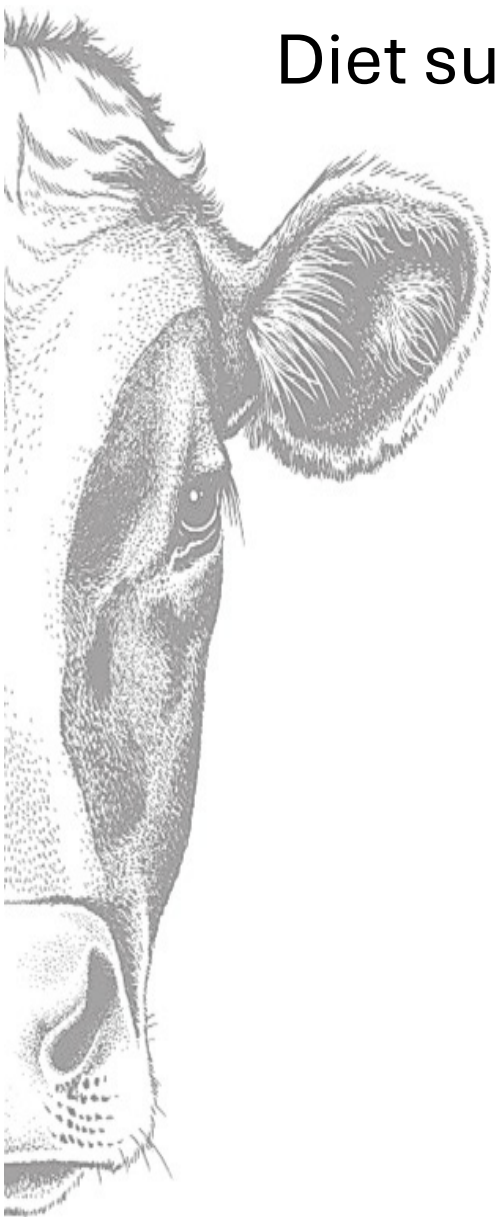
Trial conclusions



Diet supplementation with ***Macleaya cordata*** extract have led to:



HOWEVER....



Conclusions

**General response
to all possible
stressors**



Affected behaviour



Increased corticosteroids production



Increased oxydative stress



Worsened inflammatory status



Affect immune response

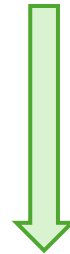


Affect hormonal production



Affect integrity and stability of the
gut ephitelia

IQs alkaloids



Corticosteroids production
Oxidative stress
Inflammatory conditios

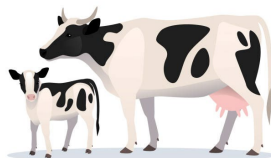


Tight junciton strengh
Gut epithelial barrier
Antioxidant defences
Improve inflammatory status

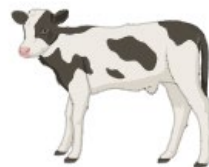
Can be a **preventive** and **functional** strategy:



During each stressfull phases and conditions



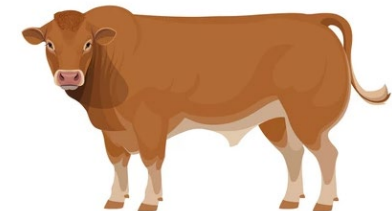
Transition period



Calf weaning



Arrival period



High-grain diets

Conclusions

Role of gut health in ruminants:

DIGESTION

4 - 5% of **starch** and
5 - 12% of **NDF**
are **digested** in the **gut**

PROTECTION

Barrier that **limit the transmigration** of
critical compounds (**toxins, antigens and
bacteria**)

HEALTH

Crucial for **immunity** and in the **pro
inflammatory cascade**
→ *leaky gut*



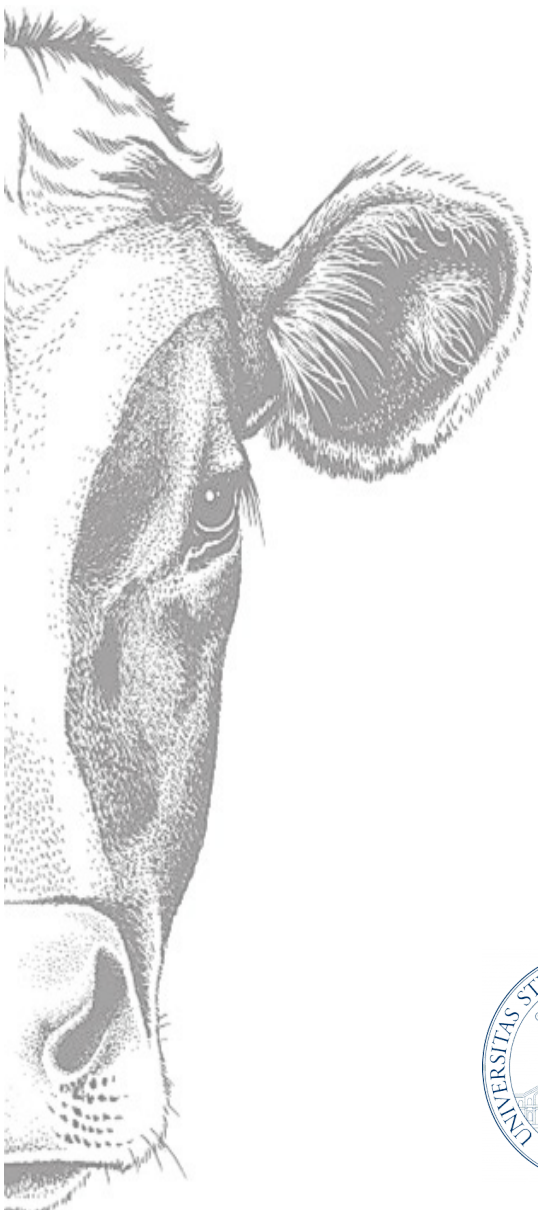
IQs alkaloids

Oxidative stress
Inflammatory conditios

Tight junciton strengh
Gut epithelial barrier
Antioxidant defences

Can be a **preventive** and **functional** strategy:

✓ To generally sustain animal health and production efficiency



THANKS FOR THE ATTENTION

....AND TIME FOR QUESTIONS!



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