Effect of thermal heat stress on dietary energy utilization in growing calves

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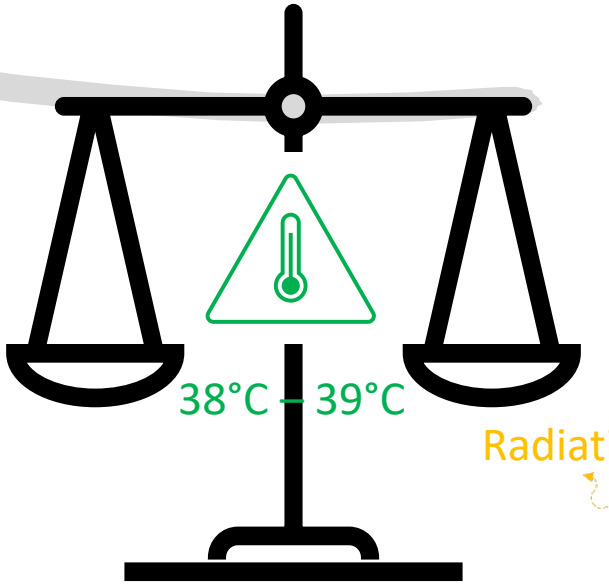
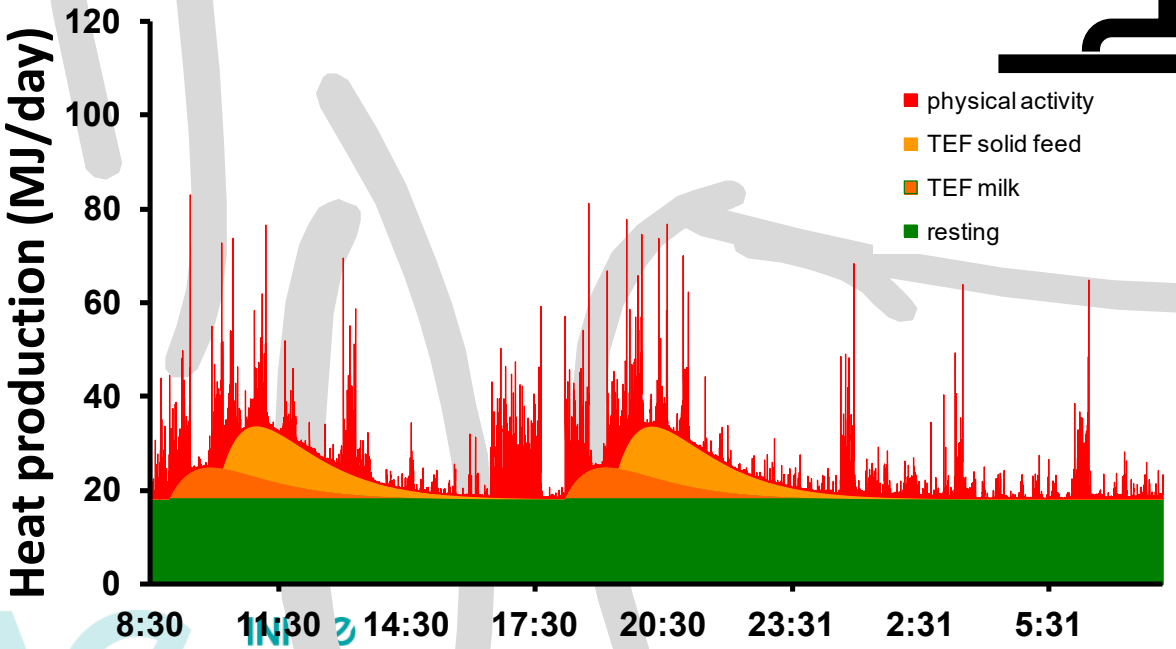
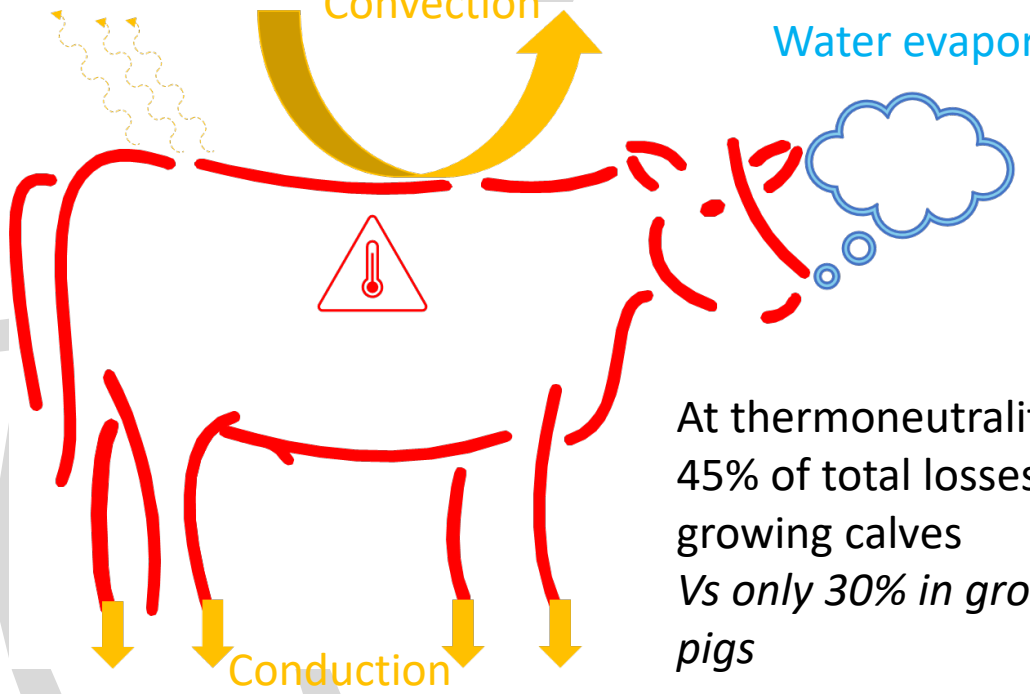
Regulation of body temperature in animals

Heat production



Heat losses





At thermoneutrality, 45% of total losses in growing calves
Vs only 30% in growing pigs

Renaudeau et al., 2013; Labussiere et al., 2023

Objectives and experimental design

- Objectives:
  - to measure the effects of ambient temperature and relative humidity on behavior, feed intake, growth, nutrient balance and heat production and heat loss in growing calves
- Experimental design:
  - 4 levels of ambient temperature: 15, 20, 25 and 30°C
  - 3 levels of relative humidity: 60, 70 and 80%
  - 24 growing calves weighing ~100 kg
  - Fed milk replacer and solid feed
  - Adapted during 3 weeks to one level of ambient temperature (6 calves per condition)
  - Housed during 10 days in open-circuit respiration chamber
    - After one day, relative humidity varied every 3 days

Experimental design

CIRVEAU
CENTRE D'INNOVATION ET DE RECHERCHE SUR LE VEAU

LES BÂTIMENTS DU CIRVEAU





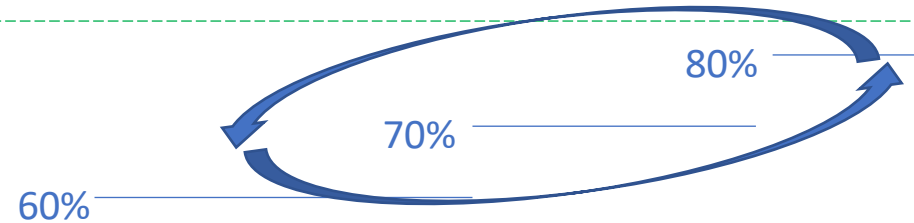






Adaptation 1	Adaptation 2	Adaptation 3	Mesurements	Mes.	Mes.

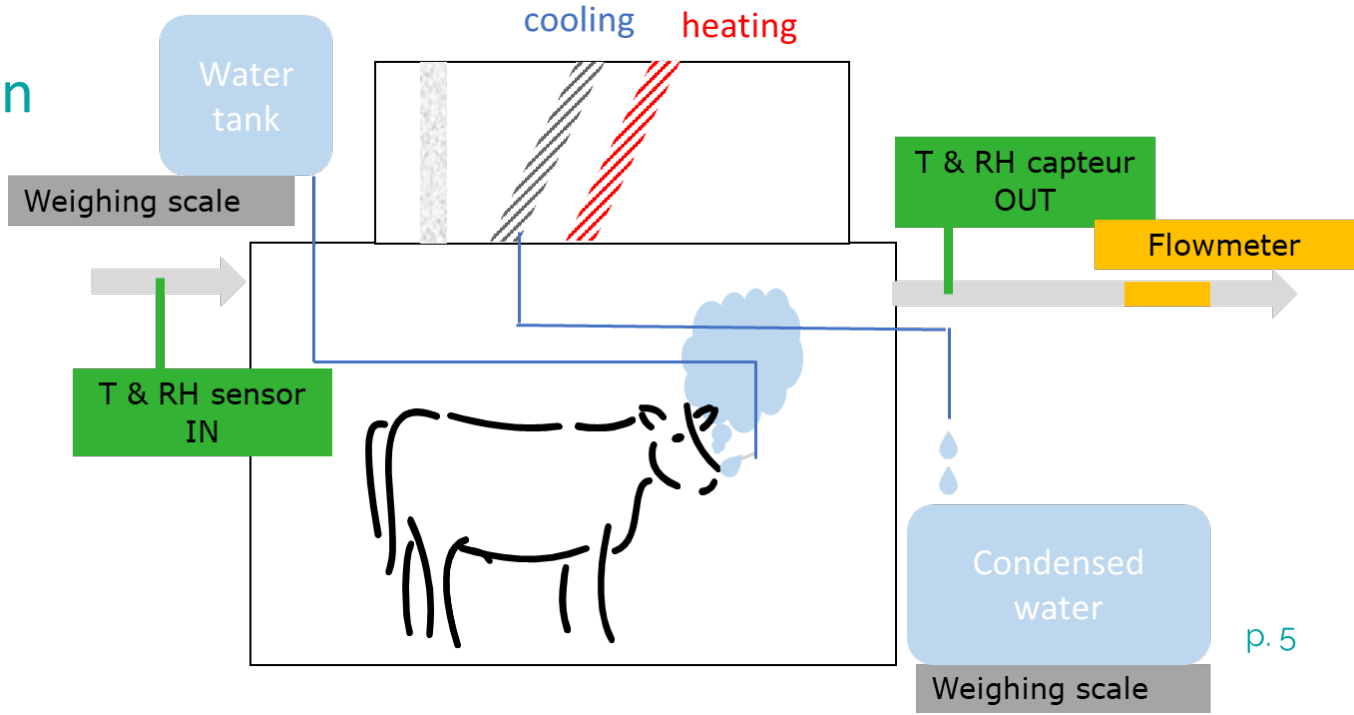
25°C



Mesurements



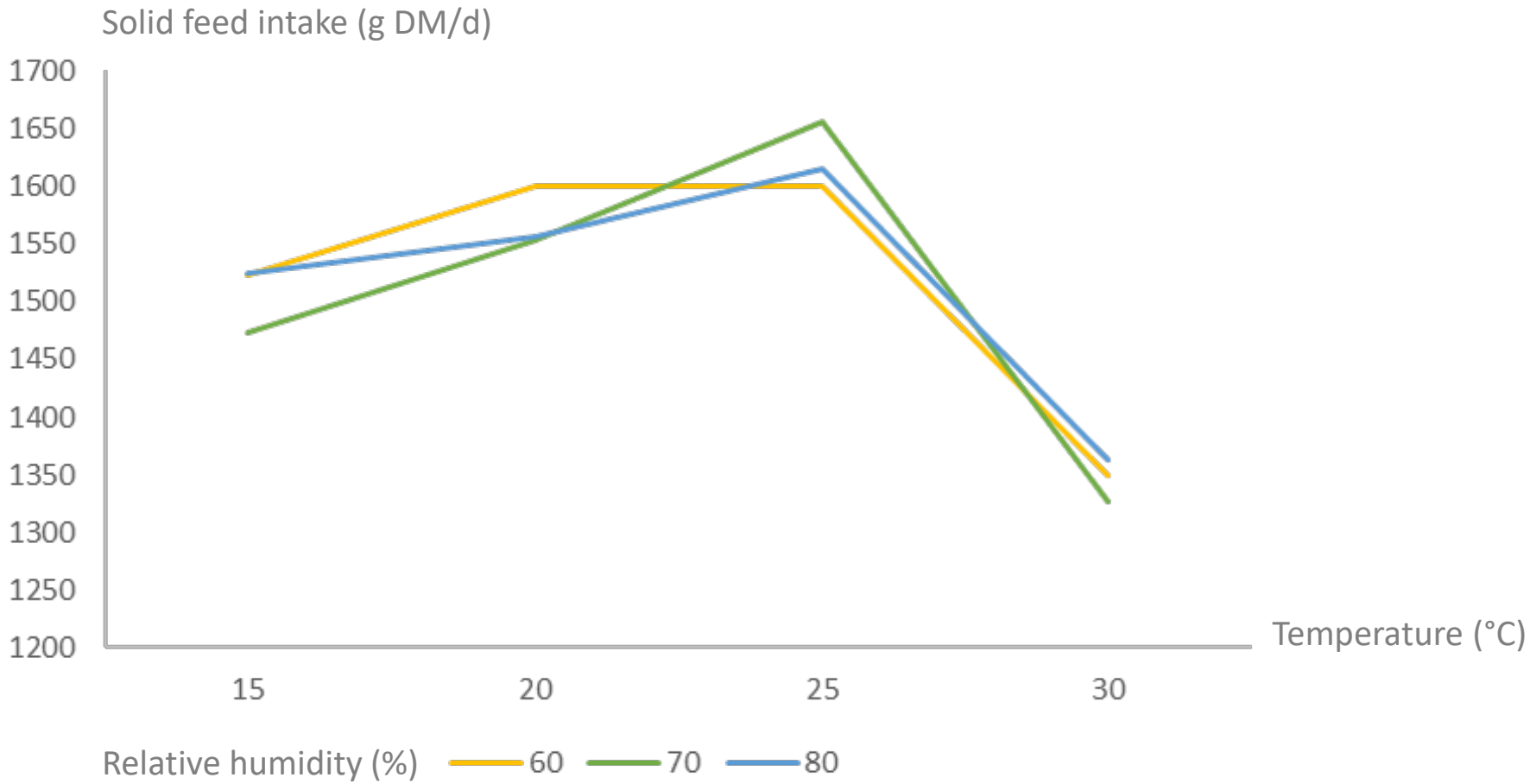
- Feed intake
- Total collection of feces and urine
- Gas exchange (O_2, CO_2 and CH_4) to calculate heat production
- Calculation of nitrogen and energy balance to determine protein and lipid deposition
- Measurement of water evaporation



Results : body weight and milk replacer intake

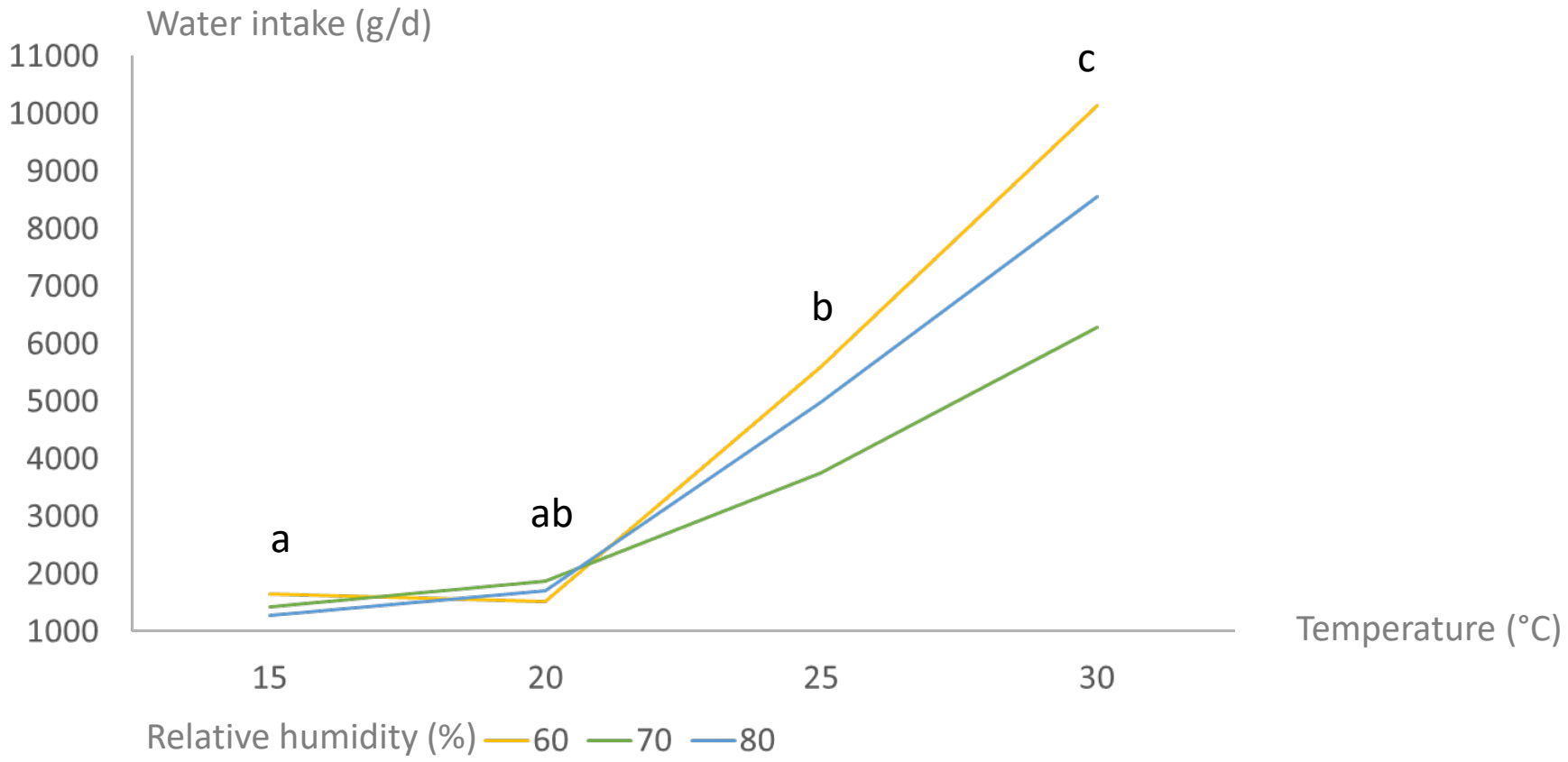
		15	20	25	30	ETR	T	RH	T × RH
Body weight (kg)						3.8	0.96	0.31	0.99
	At 60% RH:	133.8	135.4	135.6	135.4				
	At 70% RH:	134.3	136.1	136.3	135.1				
	At 80% RH:	136.9	137.1	137.6	135.7				
Milk replacer intake (g DM/d)						85	0.98	0.42	0.90
	At 60% RH:	1282	1326	1284	1264				
	At 70% RH:	1322	1315	1331	1312				
	At 80% RH:	1330	1291	1342	1318				

Solid feed consumption



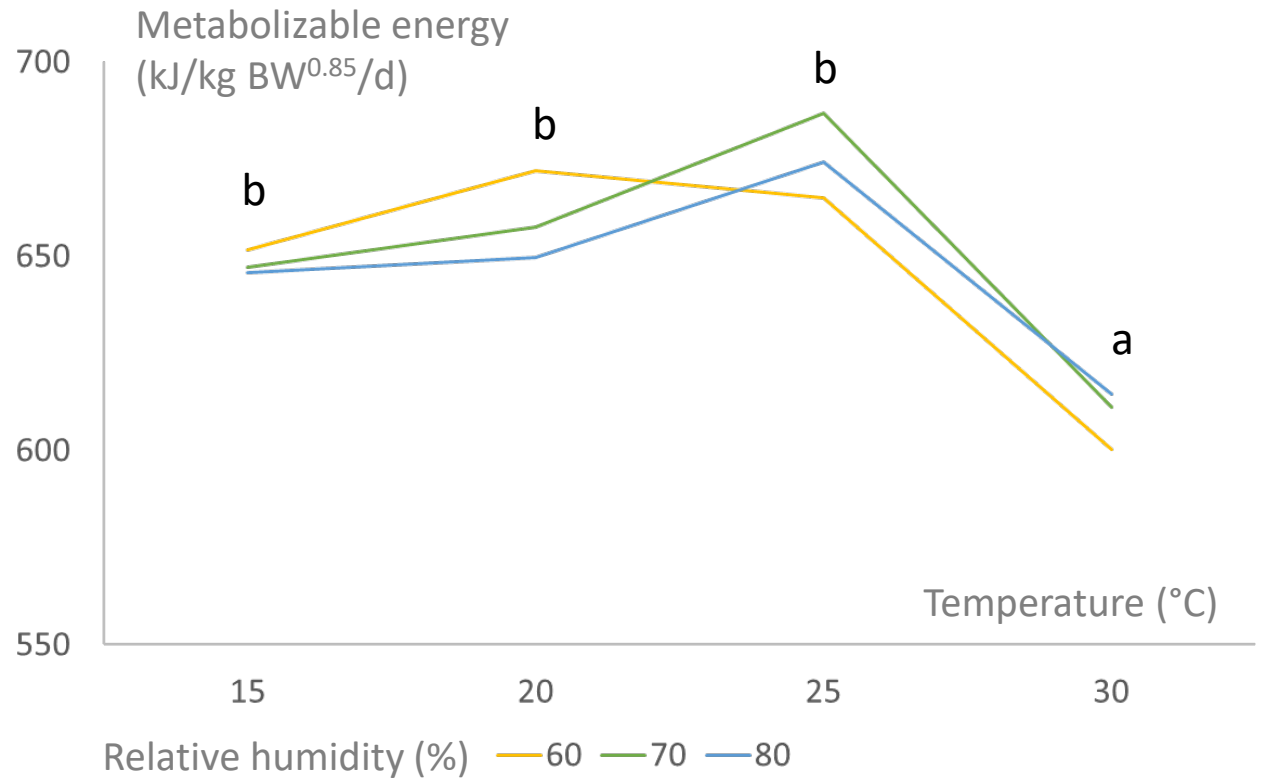
P_{temp} = 0.13
P_{RH} = 0.91
$P_{temp \times RH}$ = 0.93

Water intake

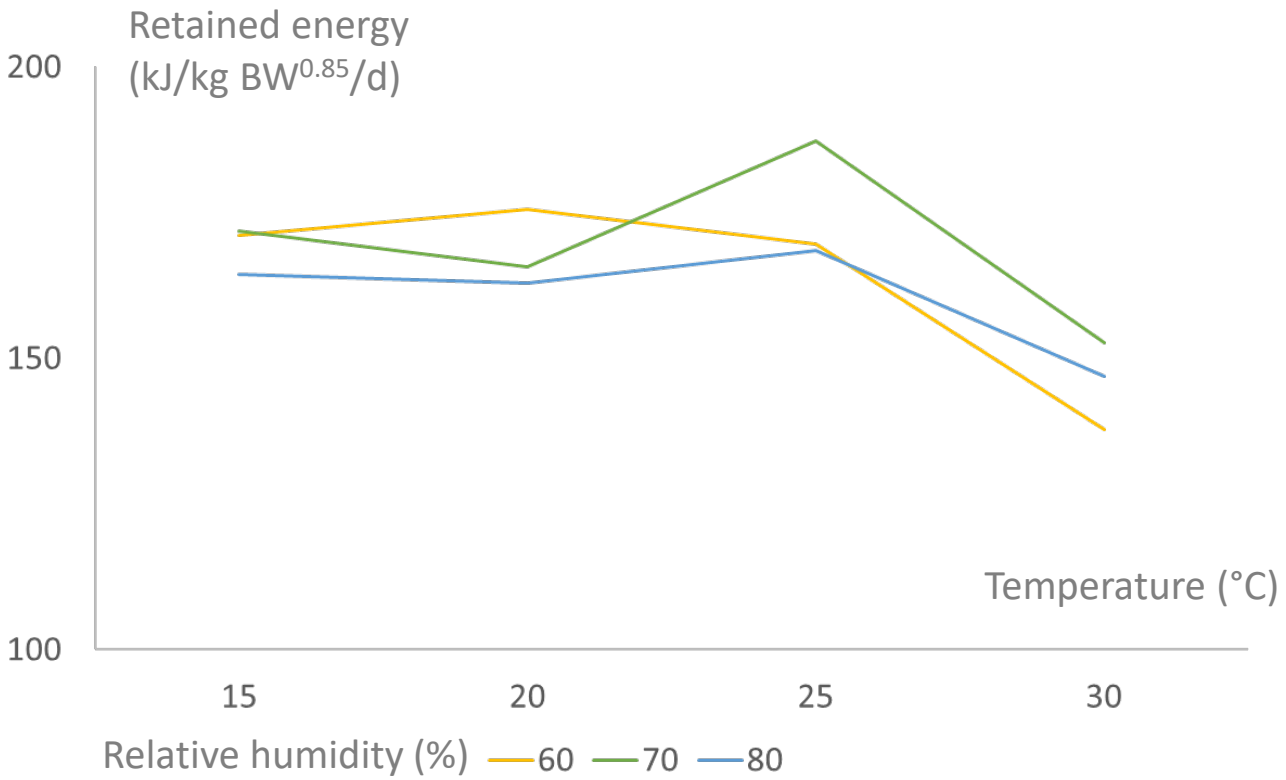


$P_{temp} < 0.01$
$P_{RH} = 0.13$
$P_{temp \times RH} = 0.45$

Energy utilisation

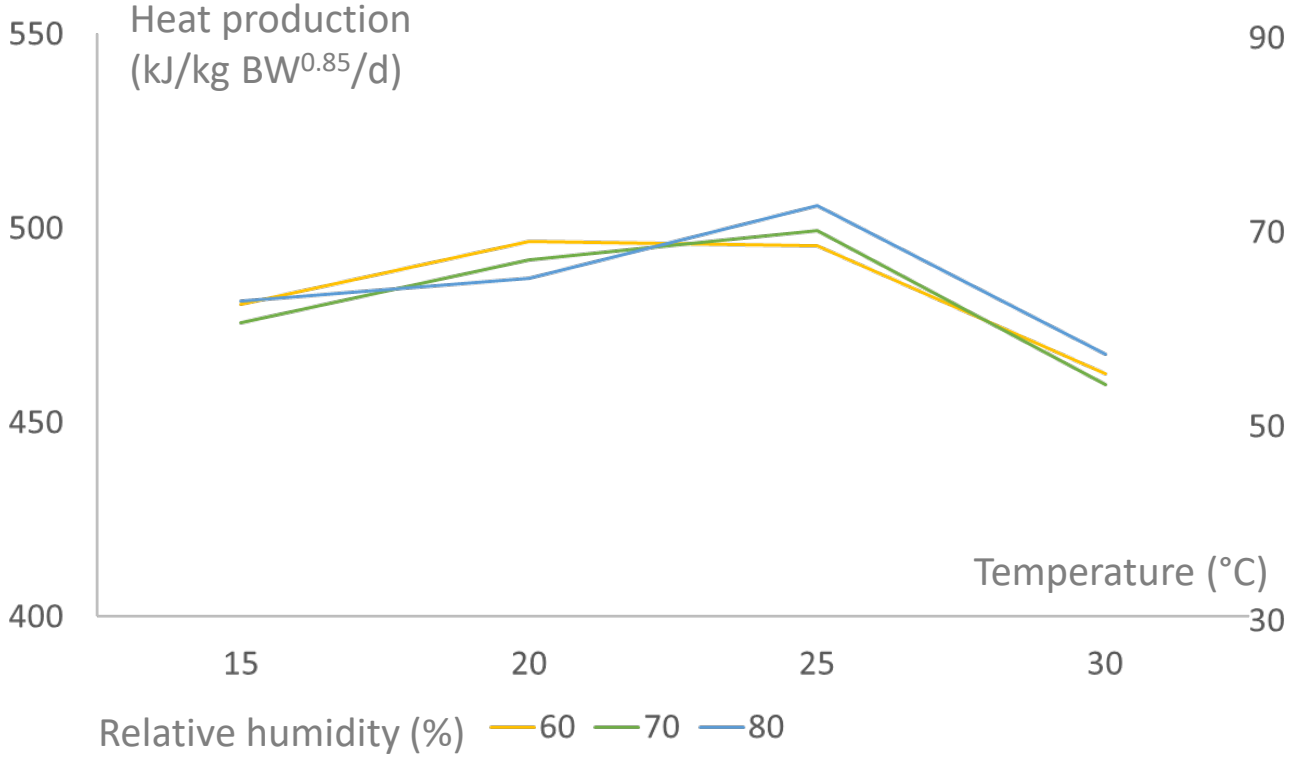


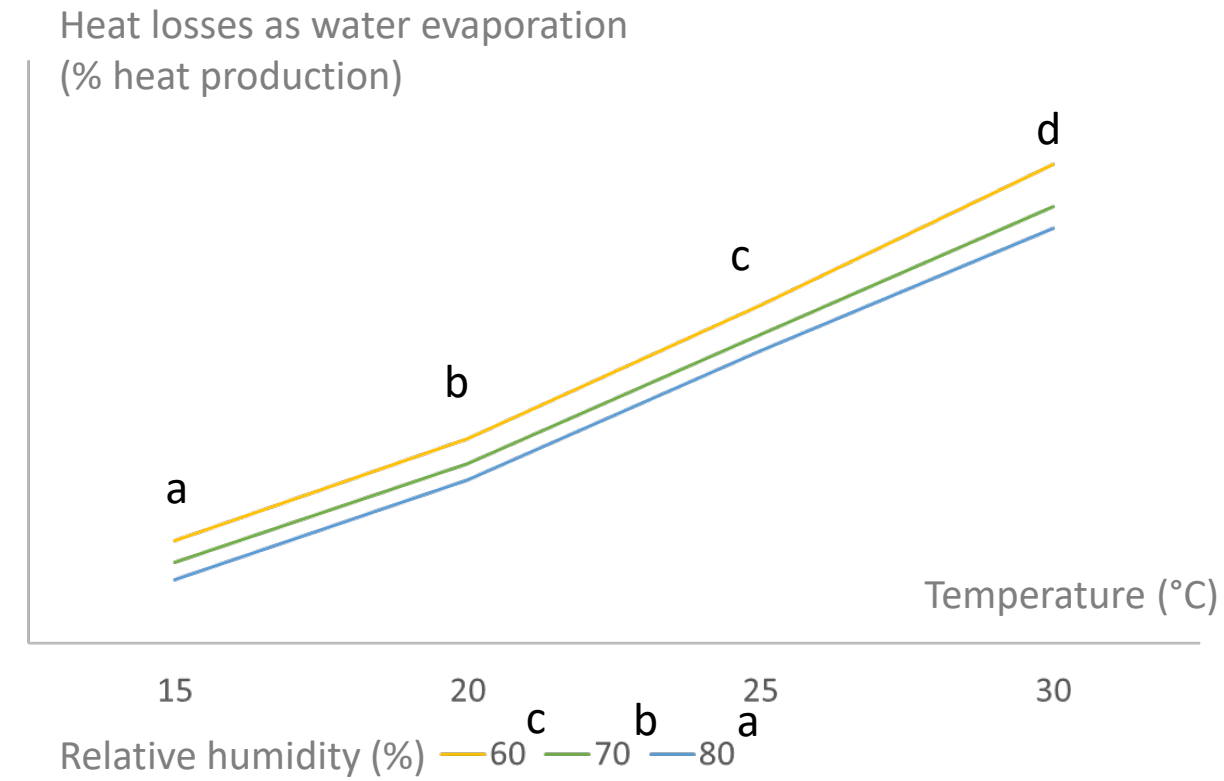
P_{temp} = 0.05
P_{RH} = 0.89
$P_{temp \times RH}$ = 0.79



P_{temp} = 0.18
P_{RH} = 0.58
$P_{temp \times RH}$ = 0.88

Heat production and heat losses as water evaporation

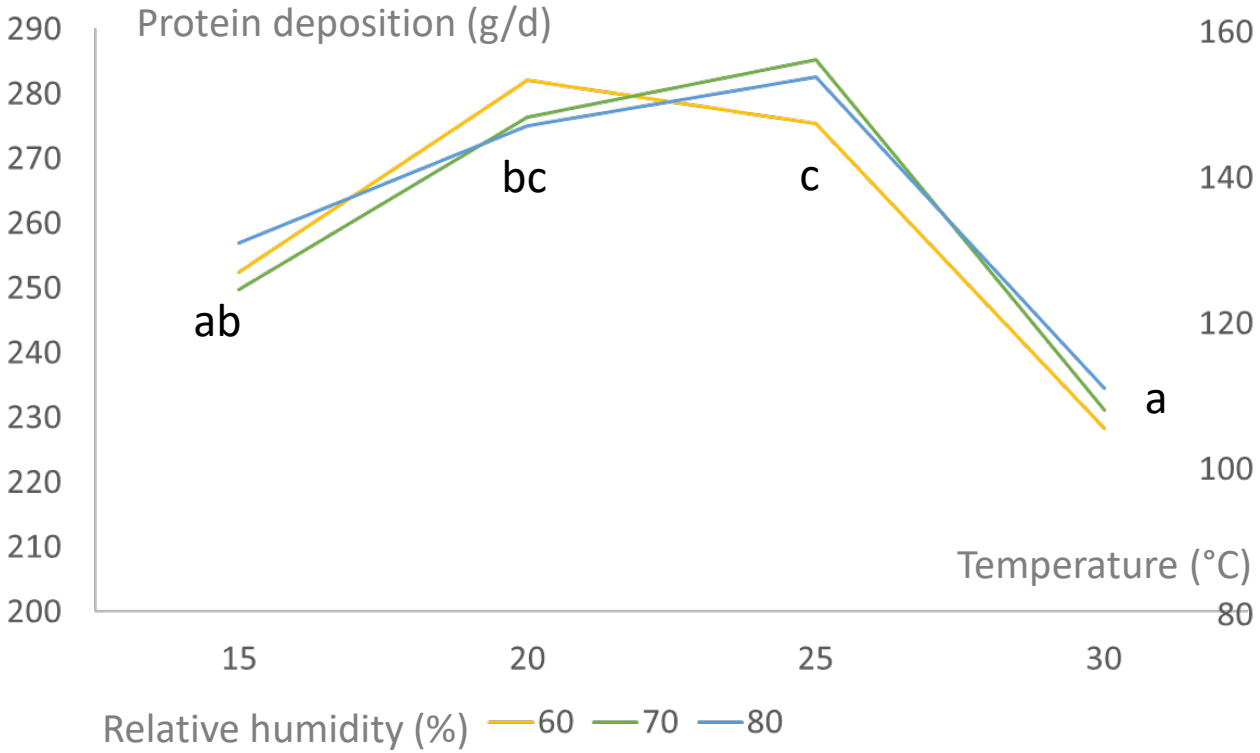


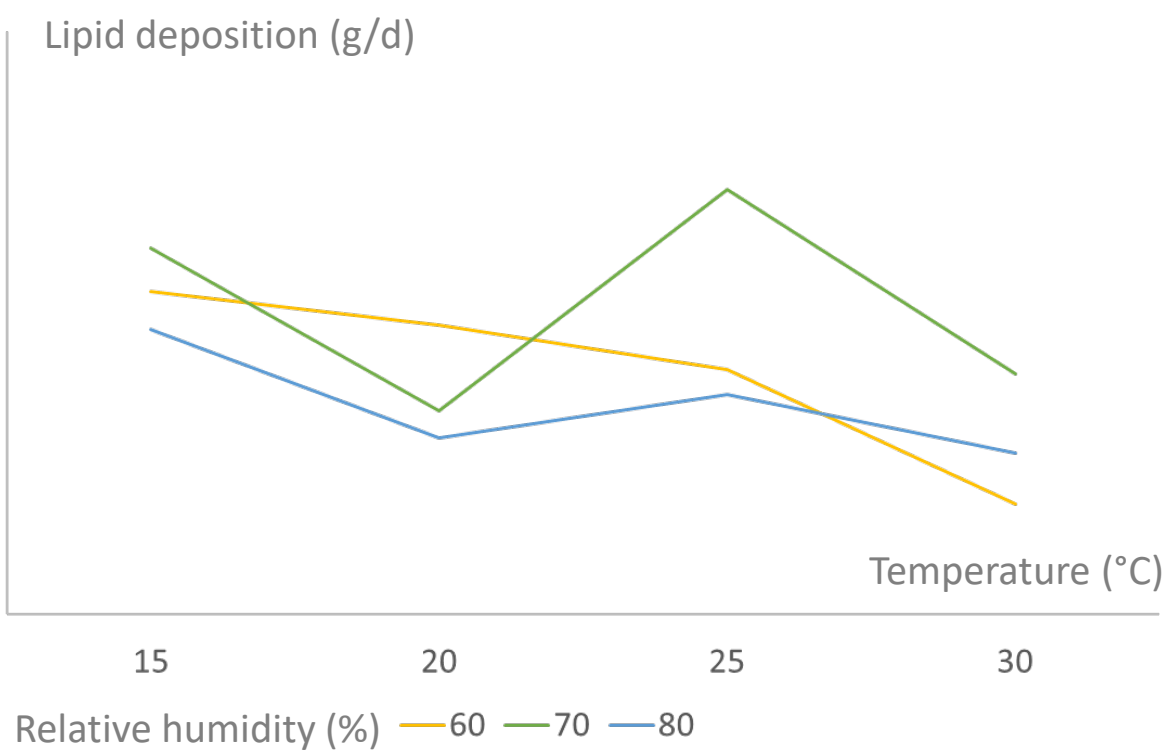


P_{temp} = 0.10
P_{RH} = 0.53
$P_{temp \times RH}$ = 0.44

P_{temp} < 0.01
P_{RH} < 0.01
$P_{temp \times RH}$ = 0.94

Nutrient deposition

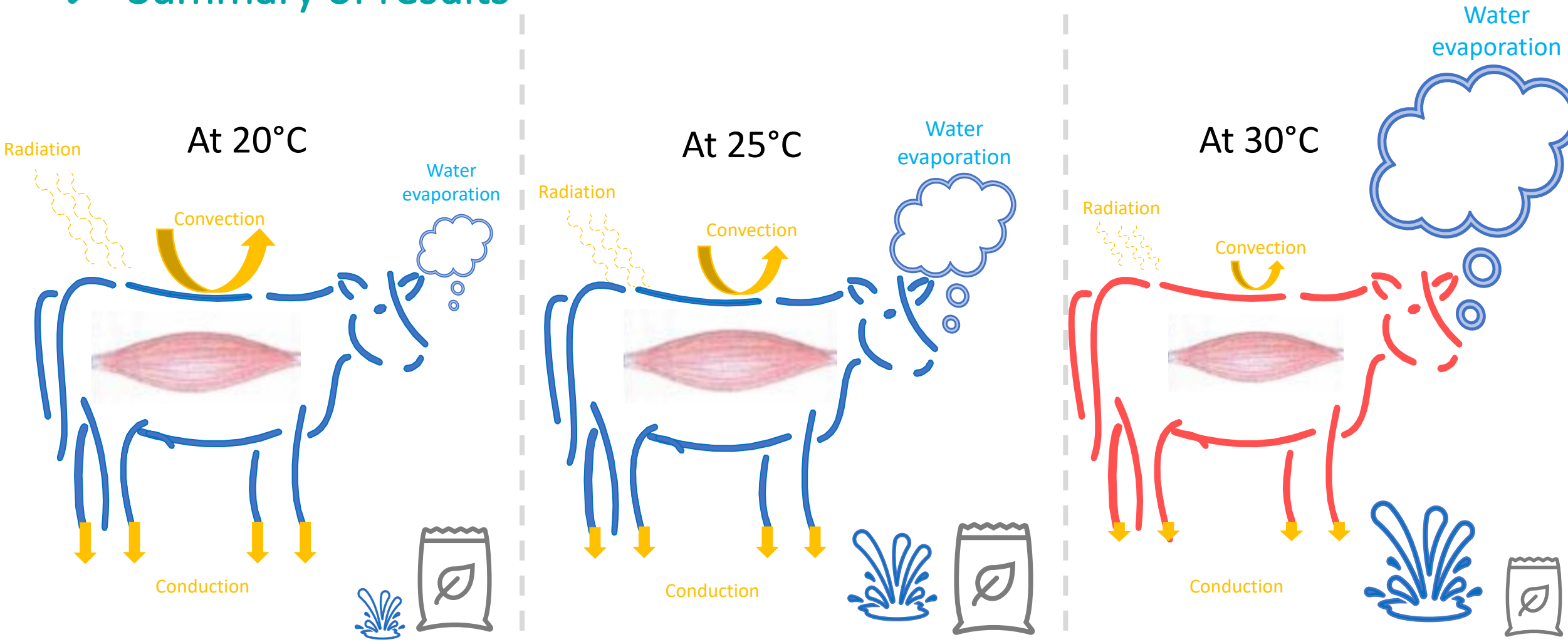




$P_{temp} < 0.01$
$P_{RH} = 0.84$
$P_{temp \times RH} = 0.84$

$P_{temp} = 0.64$
$P_{RH} = 0.51$
$P_{temp \times RH} = 0.93$

Summary of results



Thank you!





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