

# Heat stress: minimising the consequences with nutrition management

Heat stress is a major concern in the management of dairy herds which adversely impacts welfare, performance and farm profitability. Moreover, considering global climate change – with an estimated average rise of temperature on earth, between 0.5-4.8°C by 2100 – heat stress episodes should become more common on farms.

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To measure heat stress, the best indicator remains the Temperature and Humidity Index (THI). Dairy cows struggle with heat stress when THI rises above 72 units. This level is reached, for example, from a temperature of 24°C and a humidity of 68% (see Fig. 1 on page 9). Above a 72-THI, each unit of supplementary THI will cause a fall of 0.2kg of milk per cow.

In Northern Europe, heat stress situations may even occur below this gradient. For example, a recent study in Scotland following the performance levels of a dairy herd over several years shows a decrease in milk production from a 60-THI.

## Multiple consequences

Heat stress has different consequences on dairy cows:

- Above 71°F (22°C), voluntary feed intake decreases, deteriorated by high humidity

**Table 1. Voluntary feed intake decreases with rising temperatures and humidity (Garcia and Diaz-Royon, South Dakota University, 2014).**

Feed intake	Relative humidity (%)			
	50	60	70	80
68.0	100	100	99	99
71.6	98	97	97	96
75.2	96	95	94	93
78.8	94	92	91	89
82.4	91	90	82	86
86.0	89	87	85	83

Location	No. of animals	Cattle breed	THI	Milk			P-value
				Control	Axion Thermoplus	Difference	
France	54	Holstein	72	31.20	32.40	+1.20	p<0.05
Vietnam	178	Holstein	82	24.20	25.00	+0.80	p<0.05
Vietnam	39	Holstein	82	24.00	25.05	+1.05	p<0.05
Mexico	44	Holstein	72	37.00	39.05	+2.05	
Turkey	20	Holstein	80	28.40	30.19	+1.76	
Hungary	632	Holstein	79	29.46	31.73	+2.27	
Brazil	175	Zebu Cross	75	30.60	31.60	+1.00	p<0.05
Brazil	36	Zebu Cross	79	18.00	19.30	+1.30	p<0.01

**Table 2. Improving milk yield during heat stress (CCPA Group, 2016).**

(Table 1). To compensate for this feed intake fall, there is an increase in body reserve mobilisation.

- There is also a redistribution of blood to the periphery to maximise radiant heat dissipation, while vasoconstriction occurs in the gastrointestinal tract. As a result, the exchanges at intestinal level are impaired in both ways: there is less nutrient assimilation in blood and there are potential risks of damage of the intestinal barrier.
- Besides, panting increases heart rate and the excretion of carbonic gas. To maintain blood pH the cow eliminates bicarbonates through the kidney, leading to metabolic acidosis. Moreover, the reduction of salivation increases the risk of acidosis.
- Another consequence is an important loss of electrolytes, through sweating.
- Several studies show an increase of the anoestrus period after calving, for dairy

cows suffering from heat stress, largely due to a lack of energy intake.

- Heat stress during the dry period of dairy cows decreases calf birth weight and compromises the passive IgG transfer from colostrum and cell-mediated immune function of the calves during the pre-weaning period.

All these impacts are amplified with high-potential animals, which are particularly sensitive to temperature and hygrometry variations.

## Nutrition to fight heat stress

Due to the wide variety of heat stress impacts, it is very difficult to solve it with a unique and single mode of action. Among the possible options, nutrition can play an important role.

The nutritional solution Axion Thermoplus incorporated into feed was developed to act at the different levels impaired by hot weather in order to maintain animal performance, in three ways:

- To prevent the feed intake drop, Axion Thermoplus, as a specific blend of feed ingredients (with selected plant extracts and aroma), supports dry matter intake. In fact, its active components stimulate the activity of the key enzymes which contribute to feed digestibility (amylase, lipase, trypsin, and chymotrypsin).
- The management of the mineral fraction via the use of Axion Thermoplus (DCAD,

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Location	No. of animals	Weight at start (kg)	ADG		FCR	
			Control	Axion Thermoplus	Control	Axion Thermoplus
Brazil	1600	470	1020	1236	9.86	8.17
Brazil	700	400	1775	1845	6.11	5.96

**Table 3. Increasing growth during heat stress (CCPA Group, 2012).**

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buffers) also contributes to boost the feed intake with a better balance of electrolyte needs. Plant extracts increase salivary production which gives supplementary help for buffering the diet.

● Plant extracts are also active in the general metabolism regulation, with a reduction of the heart rate and body temperature of the cows.

### Field trial results

#### ● Dairy farms:

CCPA Group undertook several trials testing several diets and nutritional solutions, in different countries.

In each country, an increase in milk production during the hot period was seen for the batches of animals supplemented with Axion Thermoplus: from 0.5-3.0 litres more, depending on different parameters.

Even on farms with existing cooling systems (for example in Vietnam), a gain was seen with Axion Thermoplus.

Table 2 summarises several field trials led with two batches of animals, in different countries worldwide.

It is also possible to reduce the impact of heat stress for small ruminant production. Indeed, another test with goats leads to the same kind of results.

#### ● Fattening units:

For fattening bulls, trials were also led in Brazil (Table 3).

These experiments have shown better performance levels and feed conversion rates with Axion Thermoplus.

Of course, beside nutrition, it is strongly recommended to control and adapt

housing conditions and cooling systems and to select the time of feed distribution.

In order to evaluate the risk level of heat

stress in farms, CCPA Group has also developed a heat stress application for smartphones (Iphone and Android) entitled ThermoTool, which can be downloaded free from the Apple store or Google Play.

Thanks to this application, breeders can anticipate heat stress over five days and quickly adapt, if necessary, the management of their farm and the animal nutrition. ■

References are available from the author on request

**Fig. 1. Heat stress diagram for dairy cows (Burgos Zimbelman and Collier, 2011). Low heat stress = THI 68-71, Mild heat stress = THI 72-79, Mild to severe heat stress = THI 80-89, Extreme heat stress = THI 90-99, Death = THI >99.**

Temperature		Relative humidity (%)																		
°F	°C	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90
72	22.0	64	65	65	65	66	66	67	67	67	68	68	69	69	70	70	70	71	71	71
73	23.0	65	65	66	66	66	67	67	68	68	68	69	69	70	70	71	71	71	72	72
74	23.5	65	66	66	67	67	67	68	68	69	69	70	70	70	71	71	72	72	73	73
75	24.0	66	66	67	67	68	68	68	69	69	70	70	71	71	72	72	73	73	74	74
76	24.5	66	67	67	68	68	69	69	70	70	71	71	72	72	73	73	74	74	75	75
77	25.0	67	67	68	68	69	69	70	70	71	71	72	72	73	73	74	74	75	75	76
78	25.5	67	68	68	69	69	70	70	71	71	72	73	73	74	74	75	75	76	76	77
79	26.0	67	68	69	69	70	70	71	71	72	73	73	74	74	75	76	76	77	77	78
80	26.5	68	69	69	70	70	71	72	72	73	73	74	75	75	76	76	77	78	78	79
81	27.0	68	69	70	70	71	72	72	73	73	74	75	75	76	77	77	78	78	79	80
82	28.0	69	69	70	71	71	72	73	73	74	75	75	76	77	77	78	79	79	80	81
83	28.5	69	70	71	71	72	73	73	74	75	75	76	77	78	78	79	80	80	81	82
84	29.0	70	70	71	72	73	73	74	75	75	76	77	78	78	79	80	80	81	82	83
85	29.5	70	71	72	72	73	74	75	75	76	77	78	78	79	80	81	81	82	83	84
86	30.0	71	71	72	73	74	74	75	76	77	78	78	79	80	81	81	82	83	84	84
87	30.5	71	72	73	73	74	75	76	77	77	78	79	80	81	81	82	83	84	85	85
88	31.0	72	72	73	74	75	76	76	77	78	79	80	81	81	82	83	84	85	86	86
89	31.5	72	73	74	75	75	76	77	78	79	80	80	81	82	83	84	85	86	86	87
90	32.0	72	73	74	75	76	77	78	79	79	80	81	82	83	84	85	86	86	87	88
91	33.0	73	74	75	76	76	77	78	79	80	81	82	83	84	85	86	86	87	88	89
92	33.5	73	74	75	76	77	78	79	80	81	82	83	84	85	85	86	87	88	89	90
93	34.0	74	75	76	77	78	79	80	80	81	82	83	85	85	86	87	88	89	90	91
94	34.5	74	75	76	77	78	79	80	81	92	83	84	86	86	87	88	89	90	91	92
95	35.0	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93
96	35.5	75	76	77	78	79	80	81	82	83	85	86	87	88	89	90	91	92	93	94
97	36.0	76	77	78	79	80	81	82	83	84	85	86	87	89	90	91	92	93	94	95
98	36.5	76	77	78	80	80	82	83	83	85	86	87	88	89	91	92	92	93	94	95
99	37.0	76	78	79	80	81	82	83	84	85	87	88	89	90	91	92	93	94	95	96
100	38.0	77	78	79	81	82	83	84	85	86	87	88	90	91	92	93	94	95	96	98
101	38.5	77	79	80	81	82	83	84	85	86	87	89	90	92	93	94	95	96	98	99
102	39.0	78	79	80	82	83	84	85	86	87	89	90	91	92	94	95	96	97	98	100
103	39.5	78	79	81	82	83	84	86	87	88	89	91	92	93	94	96	97	98	99	101
104	40.0	79	80	81	83	84	85	86	88	89	90	91	93	94	95	97	98	99	100	101
105	40.5	79	80	82	83	84	86	87	88	89	91	92	95	96	97	98	99	100	101	102
106	41.0	80	81	82	84	85	87	88	89	90	91	93	94	95	97	98	99	101	102	103
107	41.5	80	81	83	84	85	87	88	89	91	92	94	95	96	98	99	100	102	103	104