The effect of XTRACT® on dairy cows experiencing either heat stress or temperate weather.

Compiled by: Frans Hagg (Technical manager, Allied Nutrition)

August 2017

Introduction

One of the great challenges that the dairy industry faces, especially during the summer month, is heat stress. Increase in temperature, together with an increase in humidity, results in a decrease in milk production, feed intake, feed efficiency and even reduced growth rate in heifers (West, 1999). Reproduction and health are also negatively affected by heat stress (St Pierre et al., 2003). Different management systems are used to reduce the effect of heat stress on dairy cows, for example, fans with water sprayers or dairy cow housing (shading). However, not all dairies are able to implement these kind of management systems, and even with these, cows still experience a certain amount of heat stress, depending on the environment.

What is heat stress?

The thermal comfort range of lactating dairy cows was estimated to be from -0.5 to 25°C (Berman et al. 1985). Temperature, however, is not the only factor that plays a role in heat stress. Increase in relative humidity also increase heat stress in animals. Both temperature and humidity are therefore used to calculate Thermal Heat Index (THI). In the past, it was determined that cows start to experience heat stress from a THI of 72 and more. However, with today's high producing dairy cows, Burgos Zimbelman and Collier (2011) proposed a revised THI scale to assess the impact of heat stress in dairy cattle (Fig 1). According to their re-evaluation, it appears that a THI of 68 is low enough to have a negative effect on production. Studies indicated that there is a significant negative correlation between THI and DMI (Holter et al., 1997), and the effect of THI is probably mediated through the effects of increasing body temperature. According to Ravagnolo et al. (2000), milk yield can decline by 0.2 kg, fat by 0.012 kg and protein by 0.009 kg/ per unit increase in THI when THI exceeded 72.

The effect of heat stress on production will not necessarily be directly after cows experience heat stress. According to West et al. (2003), there may be a lag time between increase in THI and the full effects on production. They reported that during hot weather the mean THI two days earlier had the greatest effect on milk yield, while DMI was most sensitive to the mean air temperature two days earlier.

Lactating dairy cows produce a large quantity of metabolic heat and accumulate additional heat from the environment. Heat production and accumulation, coupled with compromised cooling capabilities causes heat load increase in the cow to the point that body temperature rises, intake decline and ultimately a decline in production (West, 2003). Ruminants decrease feed intake in an attempt to create less metabolic heat, as the heat increment of feeding is a large portion of whole body heat production (Kadzere et al., 2002). In addition to reduced nutrient intake, heat stressed cows have an increase in maintenance cost (> 30%; Fox and Tylutki, 1998) as maintaining body temperature has a large energy cost. Because of decreased energy availability and increased energy utilization, heat stress cows enter into a calculated negative energy balance (NEB) (Moore et al., 2005). Methods to counter act the NEB include increased energy density of the diet or improve digestibility of feed components. Inclusion of feed additives, like ionophores, yeast or plant extracts can be beneficial for improved nutrient digestibility (Schelling, 1984; Beauchemin et al., 2003).

Fig 1. University of Arizona revised heat stress scale (Burgos Zimbelman & Collier, 2011). Legend: Yellow = Stress Threshold; Orange = Mild-Moderate stress; Red = Moderate – Severe Stress; Purple = Severe stress.

Temp	**% Relative Humidity**																		
(°C)	**0**	**5**	**10**	**15**	**20**	**25**	**30**	**35**	**40**	**45**	**50**	**55**	**60**	**65**	**70**	**75**	**80**	**85**	**90**
22	64	65	65	65	66	66	67	67	67	68	68	69	69	69	70	70	70	71	71
23	65	65	66	66	66	67	67	68	68	68	69	69	70	70	71	71	71	72	72
23.5	65	66	66	67	67	67	68	68	69	69	70	70	70	71	71	72	72	73	73
24	66	66	67	67	68	68	68	69	69	70	70	71	71	72	72	73	73	74	74
24.5	66	67	67	68	68	69	69	70	70	71	71	72	72	73	73	74	74	75	75
25	67	67	68	68	69	69	70	70	71	71	72	72	73	73	74	74	75	75	76
25.5	67	68	68	69	69	70	70	71	71	72	73	73	74	74	75	75	76	76	77
26	67	68	69	69	70	70	71	71	72	73	73	74	74	75	76	76	77	77	78
26.5	68	69	69	70	70	71	72	72	73	73	74	75	75	76	76	77	78	78	79
27	68	69	70	70	71	72	72	73	73	74	75	75	76	77	77	78	78	79	80
28	69	69	70	71	71	72	73	73	74	75	75	76	77	77	78	79	79	80	81
28.5	69	70	71	71	72	73	73	74	75	75	76	77	78	78	79	80	80	81	82
29	70	70	71	72	73	73	74	75	75	76	77	78	78	79	80	80	81	82	83
29.5	70	71	72	72	73	74	75	75	76	77	78	78	79	80	81	81	82	83	84
30	71	71	72	73	74	74	75	76	77	78	78	79	80	81	81	82	83	84	84
30.5	71	72	73	73	74	75	76	77	77	78	79	80	81	81	82	83	84	85	85
31	72	72	73	74	75	76	76	77	78	79	80	81	81	82	83	84	85	86	86
31.5	72	73	74	75	75	76	77	78	79	80	80	81	82	83	84	85	86	86	87
32	72	73	74	75	76	77	78	79	79	80	81	82	83	84	85	86	86	87	88
33	73	74	75	76	76	77	78	79	80	81	82	83	84	85	86	86	87	88	89
33.5	73	74	75	76	77	78	79	80	81	82	83	84	85	85	86	87	88	89	90
34	74	75	76	77	78	79	80	80	81	82	83	85	85	86	87	88	89	90	91
34.5	74	75	76	77	78	79	80	81	82	83	84	86	86	87	88	89	90	91	92
35	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93
35.5	75	76	77	78	79	80	81	82	83	85	86	87	88	89	90	91	92	93	94
36	76	77	78	79	80	81	72	83	84	85	86	87	88	89	91	92	93	94	95
36.5	76	77	78	80	80	82	83	83	85	86	87	88	89	90	91	92	93	94	95
37	76	78	79	80	81	82	83	84	85	87	88	89	90	91	92	93	94	95	96
38	77	78	79	81	82	83	84	85	86	87	88	90	91	92	93	94	95	96	98
38.5	77	79	80	81	82	83	84	86	87	88	89	90	92	93	94	95	96	98	99
39	78	79	80	82	83	84	85	86	87	89	90	91	92	94	95	96	97	98	100
39.5	78	79	81	82	83	84	86	87	88	89	91	92	93	94	96	97	98	99	101
40	79	80	81	83	84	85	86	88	89	90	91	93	94	95	96	98	99	100	101
40.5	80	80	82	83	84	86	87	88	89	91	92	93	95	96	97	99	100	101	102
41	80	81	82	84	85	87	88	89	90	91	93	94	95	97	98	99	101	102	103
41.5	80	81	83	84	85	87	88	89	91	92	94	95	96	98	99	100	102	103	104

Breede and Collier (1986) identified three management strategies to minimize the effect of heat stress: 1) physical modification of environment, 2) genetic development of heat tolerant breeds, and 3) improved nutritional management practices. The rest of the article will focus on the third strategy.

XTRACT 7065 and XTRACT Caps XL

XTRACT 7065 and XTRACT Caps XL

What is XTRACT?

XTRACT is the result of a long-term research program studying the effects of at least 50 different plant extracts and their active substances on rumen function and animal behavioural patterns. Three plant extracts, namely Eugenol (clove), Cinnamaldehyde (cinnamon) and Capsicum (chilli pepper), stood out from the rest in terms of its effect on improvement in ruminant performance. XTRACT® 7065 is a blend of three different natural identical / synthetic essential oils namely: Capsicum (3.5%), Cinnamaldehyde (5.5%) and Eugenol (9.5%). XTRACT® Caps XL, code X60-7035 is a single plant extract which consists of standardized Capsicum oleoresin (20%).

Both XTRACT® 7065 and XTRACT® Caps XL are manufactured in accordance with ISO Fusion Technology™ ensuring homogeneous distribution and flow-ability, stability, uniformity & analytical traceable and are thermally protected by a retention agent. XTRACT® 7065 and XTRACT® Caps XL are compliant with EU regulations, free of GMO and animal products and carries FAMI-QS certificate of analysis. Both products are registered in South Africa in accordance with Act 36 of 1947: **XTRACT® X60 - 7065 - V 21630; XTRACT X60 - 7035 – V 23802.**

XTRACT® 7065 and XTRACT® Caps XL are especially developed for the ruminant market. *In vitro*, *in vivo* as well as production studies have been conducted by several scientists to determine the effect of XTRACT® 7065 and XTRACT® Caps XL on different ruminant parameters. These effects, in relation to heat stress in dairy cows, will be discussed in more detail in the rest of the document.

Feed and water intake

Feed intake plays a significant role in milk production. Not only the total amount of feed being consumed per day, but also the feed intake pattern during the day. Uneven feed intake during the day can have a negative effect on the rumen environment by increasing the fluctuation of rumen pH. During heat stress cows will most probably experience a decrease in feed intake (West, 2003) and possible variation in feed intake during the day and night. Cows tend to increase feed intake during the night when the air temperature decrease.

Cardozo et al. (2006) observed a 9.2% increase in DMI when Capsicum was added to the diet. Fandiño et al. (2008) also reported a 13% increase in DMI and Rodriguez-Prado et al. (2012) reported a 14% increase in total daily DMI as well as a reduction in the size of the first meal. This lead to a reduction in variation in feed intake during the day when Capsicum was added to the diet. As dairy cows can experience increase variation in feed intake during heat stress, a decrease in feed intake variation can be beneficial. Rodrigues-Prado et al. (2006; unpublished) observed an increase in rumen pH at 3 and 6 hours post feeding when capsicum was added to the diet. This is supported by French and Kennelly (1990) who reported that an increase in feeding frequency results in higher and less variable rumen pH.

By improving DMI, decrease DMI variation and thereby increase rumen pH, one can have a positive effect on dairy cows during heat stress, where a decrease in DMI it normally observed (West, 2003).

Water is arguably the most important nutrient for dairy cows. Increases in water intake, especially during heat stress, can have a positive effect on the decrease in body temperature as well as an increase in milk production (West, 2003). Cardozo et al. (2006) observed a 25% increase in water intake when capsicum was added to the diet. This increase in water intake could play a positive role in reducing the effect of heat stress on dairy cows.

Saliva production

Dairy cows produce on average between 166 and 253 g saliva per minute (Beauchemin et al., 2003). Saliva production during eating is higher compare to resting salivation rate (Cassida and Stokes, 1986). As reported by Rodriguez-Prado et al. (2012) and others, capsicum increase DMI, and therefore increase time spend eating. Increase in time spent eating could therefore lead to an increase in salivation. This was observed by Rodriguez-Prado et al. (2006; unpublished) when capsicum was added to the diet. Saliva production was especially increased during the first half of the feed intake period. Saliva secretion plays the biggest role in rumen pH buffering and plays a significant role in reduce the incidence of rumen acidosis (Beauchemin et al., 2008). Cows are panting during heat stress and a significant amount of saliva is lost through open mouth panting (West 2003). By increasing the saliva production, a smaller percentage of produced saliva is therefore lost through panting and more to be utilized for buffering the rumen.

Oxidative stress

Oxidative stress resulting from increased production of free radicals and reactive oxygen species, and/or a decrease in antioxidant defence, leads to damage of molecules and disruption of normal metabolism and physiology (Trevisan et al., 2001). When reactive forms of oxygen are produced faster than they can be safely neutralized by antioxidant mechanisms, oxidative stress results (Sies, 1991). Harmon et al. (1997) reported a reduction of antioxidant activity of plasma and therefore an increase in oxidative stress in mid-lactating heat-stressed dairy cows. Bernabucci et al., 2002, also observed an increase in oxidative stress in transition cows experience heat stress during the summer months.

The Heterophil : Lymphocyte ratio has been proved to be a reliable indicator of oxidative stress and heat stress in animals (Davis et al., 2008). The Heterophil : Lymphocyte ratio are increased when animals experience heat stress. Capsicum proved to have a positive effect on oxidative stress by decreasing the Heterophil : Lymphocyte ratio (Prieto and Campo, 2010). In this way, the oxidative injury induced by high ambient temperatures (Lin et al., 2006) could be reduced by the actions of antioxidants, like Capsicum.

Volatile fatty acids and ammonia production

As mentioned earlier in the document, cows can experience a negative energy balance during heat stress. This is mainly due to the decrease in feed intake coupled with an increase in energy maintenance requirements (Fox and Tylutki, 1998). In addition, heat stress decreased total rumen VFA content (Schneider et al., 1988) and specifically propionate levels (Kelley at al, 1966). This finding is supported by Rhoads et al, 2009, who reported a decline in glucose concentrations during heat stress.

Cows generally experience a negative energy balance during early lactation and to counter act it, they mobilize body fat reserves, producing non-esterified fatty acids (NEFA) as energy source. However, Shwartz et al, 2009, reported that cows experience heat stress does not display the typical NEFA production. It appears that heat stress affects cellular physiology and systemic metabolism. Febbraio, 2001, reported that animals experience heat stress, rather prefer glucose, with propionate as precursor (Van Soest, 1982), as energy source instead of NEFA. This could be due to the fact that the ß-oxidation of NEFA may produce more metabolic heat that of carbohydrates (Baumgard and Rhoads, 2007).

Cardozo et al., 2006, added eugenol and cinnamaldehyde to a high concentrate diet and reported in increase in propionate and a decrease in acetate production in an *in vivo* trial. This could be positive for heat stress cows, as propionate can be used to produce more glucose (preferred energy source during heat stress), and less acetate (lower energy utilization efficiency for use of acetate compare to propionic acid; Moe, 1981). Busquet et al, 2006, also observed an increase in propionate and decrease in acetate proportions when eugenol was added to the diet. Cardozo et al., 2005, also observed an increase in total VFA, decrease in acetate, increase in propionate when capsicum or cinnamaldehyde were added to the diet. Calsamiglia, 2009, added XTRACT® 7065 to diets fed to goats carrying twins during the transition period (used as a cow model) and observed a reduction in NEFA and beta-hydroxybutyrate in the blood. This helped with a reduction in body condition loss. Therefore, by increasing propionic acid production in the rumen, using eugenol, cinnamaldehyde and capsicum, could play a role in improving the energy balance of dairy cows during heat stress by providing more glucose precursors, i.e. propionate

Cows experience heat stress could display an increase in plasma urea nitrogen (PUN) (Wheelock et al., 2010). This could be due to inefficient rumen ammonia incorporation into microbial protein, or hepatic deamination of amino acids from skeletal muscle. Cardozo et al, 2005, observed a decrease in ammonia N concentration in the rumen with the addition of capsicum to the diet. Cardozo et al, 2006, also observed a decrease in ammonia N concentrations in the rumen when eugenol and cinnamaldehyde was added to the diet. Therefore, by decreasing the ammonia N concentrations, there could a possibility to decrease PUN in cows experience heat stress, and therefore, improve protein metabolism.

Commercial dairy trials, evaluating XTRACT® 7065 under heat stress conditions.

In the light of the results obtained by various researchers regarding the effect of capsicum, eugenol and cinnamaldehyde on animal production, two commercial research trials were conducted at the same dairy farm in Israel to determine if XTRACT® 7065 could have a positive effect on the production of dairy cows during heat stress.

In the first trial (Pancosma TB 711) 92 high producing multiparous Holstein cows were randomly allocated to either Control (CON) or XTRACT® 7065 treatment (XT). XT cow group were supplemented with 1 gram XTRACT® 7065 per head per day. The trial was conducted during the summer in Israel for a period of 5 month (June to October). Cows were fed a concentrate diet (38.5% NDF, 60.3% DM and 15.1% CP). Days in milk for the both groups of cows were on average 190 days. Normal production parameters were measured during the trial.

The effect of XTRACT® 7065 compared to Control are reported in Table 1.

Table 1. The effect of XTRACT® 7065 compared to Control on the production parameters of Holstein dairy cows experience heat stress (June to October).

Parameter	Control	XTRACT® 7065
Milk (kg)	40.77[a]	43.60[b]
Body condition score	2.77[a]	2.92[b]
Milk Fat (%)	3.45	3.41
Milk Protein (%)	3.09	3.09
Fat Yield (g/kg)	1.34[a]	1.46[b]
Protein Yield (g/kg)	1.20[a]	1.33[b]
DM Intake (kg/d)	25.4[a]	26.2[b]
Feed efficiency (g/g)	1.60[a]	1.67[b]

Rows with different super script differ by $P < 0.05$

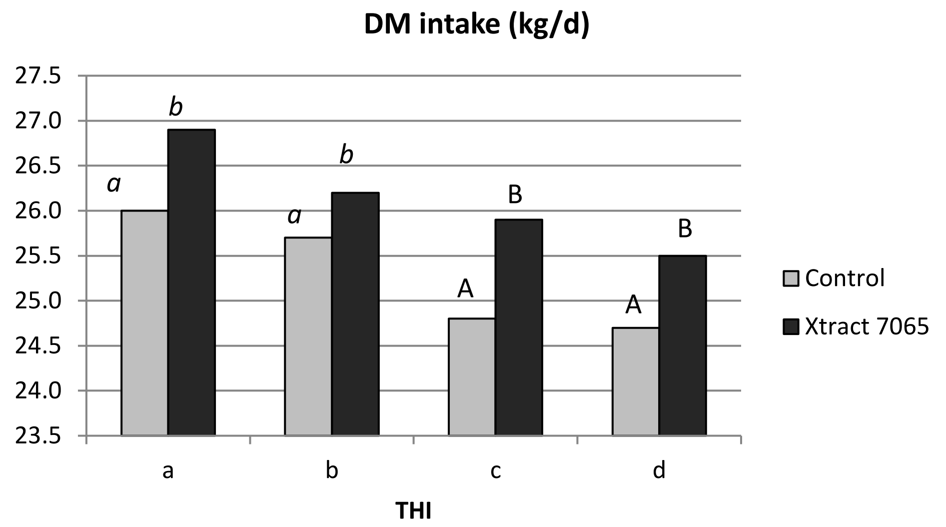
From the results reported in Table 1, is it clear that XTRACT® 7065 has a positive effect on animal performance. Milk production was increased by 6.9%, DMI improved by 3.1% and Feed efficiency by 4.4 %. Body condition score was significantly increase by XTRACT® 7065. This results also indicates that cows during heat stress minimizes body fat reserves mobilization as energy source, as indicated by the increase in body condition score in the XTRACT® 7065 group. There was no effect on milk fat or milk protein percentage.

The same trial data were re-evaluated by allocating the results to differ THI classes (Fig 2 – 4). THI classes: Class a = medium heat stress, Class d = severe heat stress. The THI class significantly affected milk production, DM intake and feed efficiency. The increase of the level of heat stress (via an increase in THI class) reduced milk production, dry matter intake and feed efficiency. However, the effect of XTRACT® 7065 on milk production, DM intake and feed efficiency was increasing when level of heat stress increased. XTRACT® 7065 increased milk production by 2.68% in class A of THI ($P = 0.027$ – graph 1), by 6.56% in class B ($P < 0.001$), by 10.11% in class C ($P < 0.001$) and by 8.96% in class D ($P < 0.001$). Un-supplemented cows exhibited a reduced feed efficiency when heat stress was increasing. However, cows fed XTRACT® 7065 maintained their feed efficiency whatever the level of heat stress.

Fig 2. The effect of XTRACT® 7065 on milk production during different THI classes.

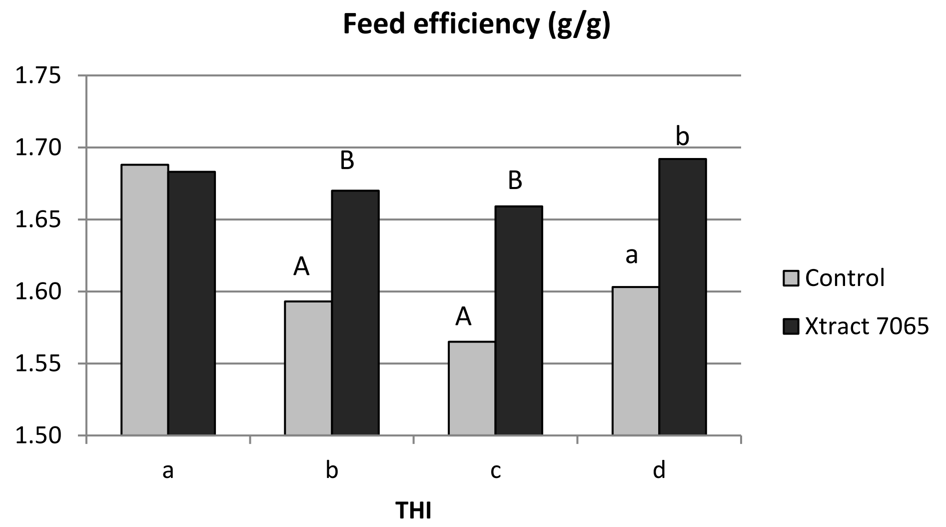
a, b = $P < 0.05$; A, B = $P < 0.01$

Fig 3. The effect of XTRACT® 7065 on DM intake during different THI classes.



a, b = P < 0.1 ; A, B = P < 0.01

Fig 4. The effect of XTRACT® 7065 on Feed efficiency during different THI classes.



a, b = P < 0.05 ; A, B = P < 0.01

In the second trial conducted on the same farm, but two years later (Pancosma TB 725), 140 Holstein dairy cows (± 120 DIM, ± 3.3 lactations) were randomly allocated to either Control (CON) or XTRACT® 7065 treatment (XT). XT cow group was supplemented with 1 gram XTRACT® 7065 per head per day. The trial was conducted during the summer in Israel, from June to September. The average THI during this trial was 80.1 (THI of above 72 can be considered as heat stress for dairy cows). Different performance parameters were measured during the trial period (Table 2)

Table 2. The effect of XTRACT® 7065 compared to Control on the production parameters of Holstein dairy cows experience heat stress (June to September).

Parameter	Control	XTRACT® 7065	P-Value
Milk (kg)	36.9	38.6	0.001
DMI (kg)	19.9	18.8	0.11
Fat (%)	3.5	3.4	0.20
Protein (%)	3.2	3.1	< 0.001
Lactose (%)	4.8	4.7	0.07
ECM (kg/d)	36.8	38.1	0.01
SCC (x 1000 cells/ml)	342.5	222.5	0.001
BCS	3.0	2.9	0.20
FCR	1.85	2.05	*

From the results reported in Table 2, is it clear that XTRACT® 7065 has a positive effect on animal performance. Milk production was increased by 4.6%, but DMI was not significantly affected by XTRACT® 7065. Milk protein percentage was significantly decreased by XTRACT® 7065. ECM (energy corrected milk) and SCC (somatic cell count) were significantly improved by XTRACT® 7065 treatment. Although not statistically analysed, FCR was improved by 10.8%.

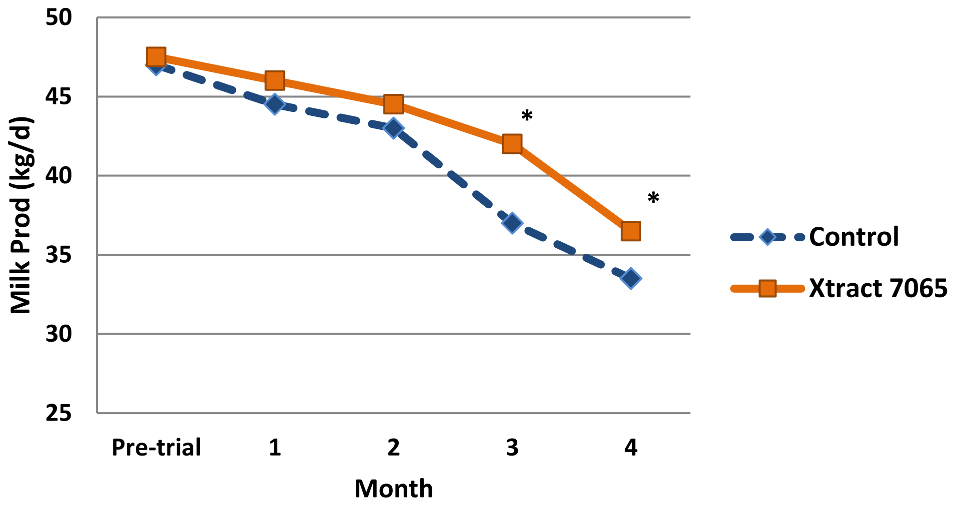
Data of both trials (Blanck et al, 2014) were also analysed together (Table 3; Fig 5).

Table 3. The effect of XTRACT® 7065 compared to Control on the production parameters of Holstein dairy cows experience heat stress (Trial 1 and 2 combined, June to September).

Parameter	Control	XTRACT® 7065	P-Value
Milk (kg)	39.4	42.2	0.01
DMI (kg)	22.6	22.5	0.70
Fat (%)	3.45	3.46	0.90
Protein (%)	3.17	3.14	0.30
ECM (kg/d)	40.1	42.2	0.01
SCC (x 1000 cells/ml)	306.1	242.3	0.03
FCR	1.74	1.89	< 0.001
BCS	2.8	2.9	0.20

The results in Table 3 give a clear indication of the effect of XTRACT® 7065 on animal performance. Milk production (7.1%), ECM (5.2%), SCC (20.8%) and FCR (8.6%) were significantly improved. In Fig 5 one sees the effect of heat stress in correlation with the addition of XTRACT® 7065 to milk production. Milk production drop in both the Control and XTRACT® 7065 treatment, but as time progress, drop in milk production was less severe when cows were fed XTRACT® 7065.

Fig 5. The effect of XTRACT® 7065 compared to Control on milk production over time of Holstein dairy cows experience heat stress (Trial 1 and 2 combined).



* P < 0.05

Xtract 7065 for pasture based cows experience mild heat stress

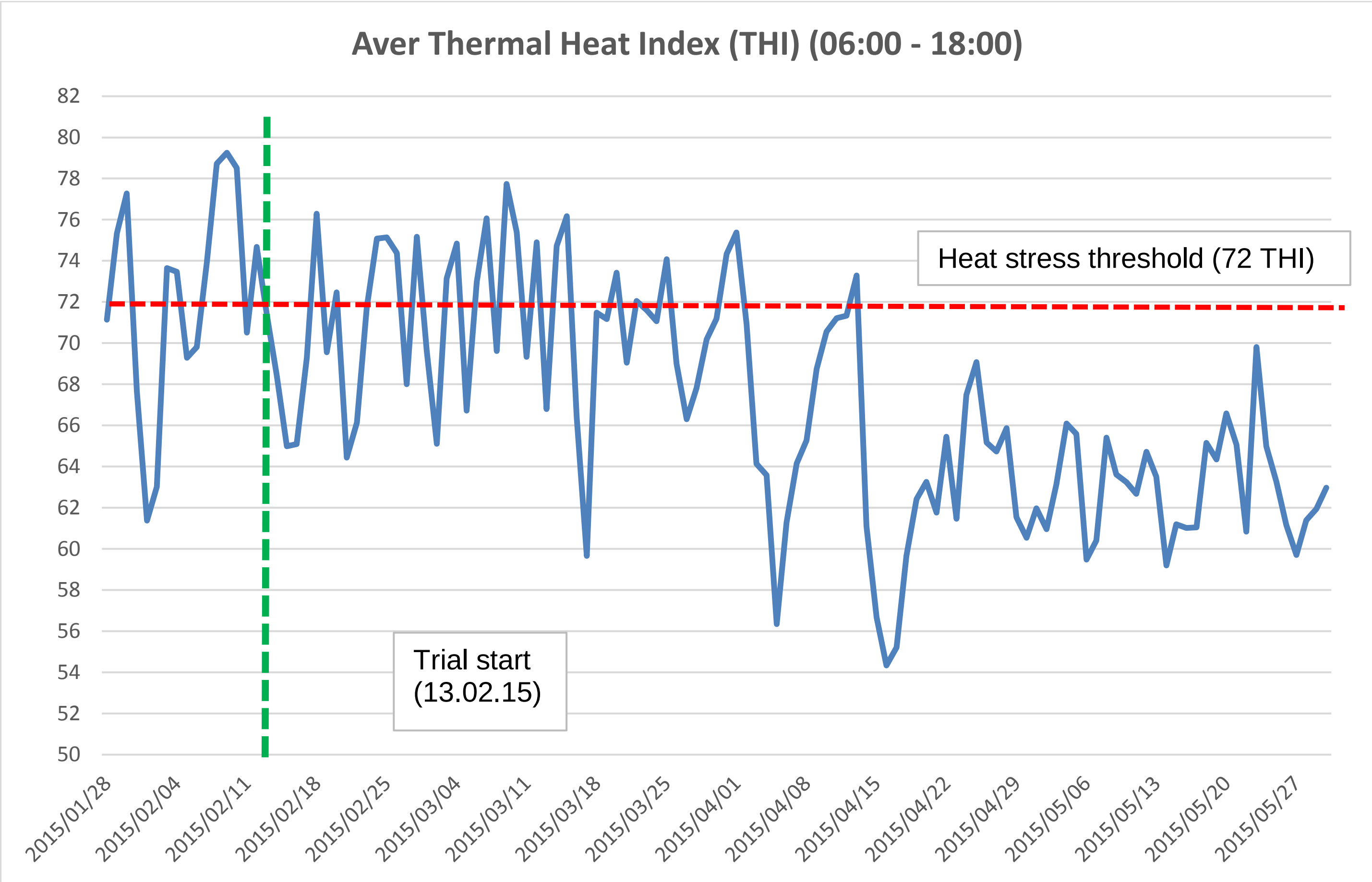
A local study was conducted in the Eastern Cape to evaluate the effect of Xtract 7065 on pasture based dairy cows during summer. The trial was conducted on a commercial dairy farm, with a herd consists of approximately 1200 cows in milk. Cows were on pastures during the day and were fed concentrate 2 times a day during milking based on the Afikim feed program. There were two groups of cows on the farm. The cows grazed on two different pasture camps, but milked in the same parlour. The compositions of the two groups were as follows:

- Group 1: All multiparious cows with a body weight of 530 kg or more (mostly Holstein cows)
- Group 2: All primiparous cows as well as multiparous cows with a body weight of less than 530 kg.

Cows in each group were allocated to the different treatments before the start of the trial. Cows that calved during the trial period were randomly allocated to either Control or Xtract 7065.

The average thermal heat stress index (THI) for the trial period are presented in Fig 6. From the graph, it is clear that the cows experienced little heat stress (about 22.5% of the days of the trial). An accepted definition for heat stress is if the THI is above 72 units. THI is calculated using both temperature and humidity measurements. Cows mainly experienced some heat stress during the first month of the trial. There were also no prolonged periods of heat stress, which is known to have a more severe negative effect on milk production.

Fig 6. The average thermal heat index for the trial period.



Milk production results are presented in Table 4. Evaluations were done with the whole trial period as well as non-heat stress days and heat stress days. About 22.5% of the days can be defined as days that the cows experience some kind of heat stress (THI above 72). As heat stress normally affects the next day or two's milk production, the THI of the previous day were correlated with the current day's milk production (for example the THI of 3 March were correlated with the milk production of 4 March).

Table 4. The effect of Xtract 7065 compare to a negative control on the milk production of dairy cows on pasture.

	Control	Xtract 7065	P-value
Whole period			
Group 1	23.12	23.4	0.28
Group 2	19.57	19.5	0.63
Group 1 + 2	21.53	21.47	0.70
Non-heat stress days			
Group 1	23.65	23.86	0.47
Group 2	19.82	19.8	0.90
Group 1 + 2	21.87	21.7	0.31
Heat stress days			
Group 1	21.29	21.82	0.03
Group 2	18.71	18.45	0.06
Group 1 + 2	20.36	20.69	0.02

Table 5. Average thermal heat index (THI) for the different days.

Aver THI (non-heat stress days) (06:00 - 18:00)	65
Aver THI (heat stress days) (06:00 - 18:00)	74
Aver THI (Total) (06:00 - 18:00)	67
% Days experience heat stress	22.5

From the results in Table 4 it is clear that Xtract 7065 has no significant effect on cows on pasture that experience no heat stress. It's also interesting to note that the milk production of cows from group 1 (multiparous and with a body weight of 530kg or more) increased significantly (P = 0.03) when fed Xtract 7065 during the heat stress periods whereas Xtract 7065 had no significant effect on the milk production of group 2 (first lactation and multiparous cows with a body weight of less than 530kg). A possible explanation for the lack of response on Xtract 7065 supplementation with group 2 is that the cows experienced lower physiological stress due to lower milk production and with a smaller body weight, it might have been easier for them to get rid of excess body heat. Heavier and higher producing cows that experience heat stress most probably experienced a higher physiological stress, seems to react in a positive way when Xtract 7065 was supplemented. However, when both group 1 and 2 were add together, Xtract 7065 supplementation significantly increased milk production compared to control during the heat stress days.

The different THI measurements are presented in Table 5. THI of the total trial period was 67 and below the heat stress threshold. This is due to the low number of days that the cows experience heat stress (22.5% of days the THI was above 72). Even during the heat stress days, the average THI was 74, thus cows experienced only mild heat stress during the trial.

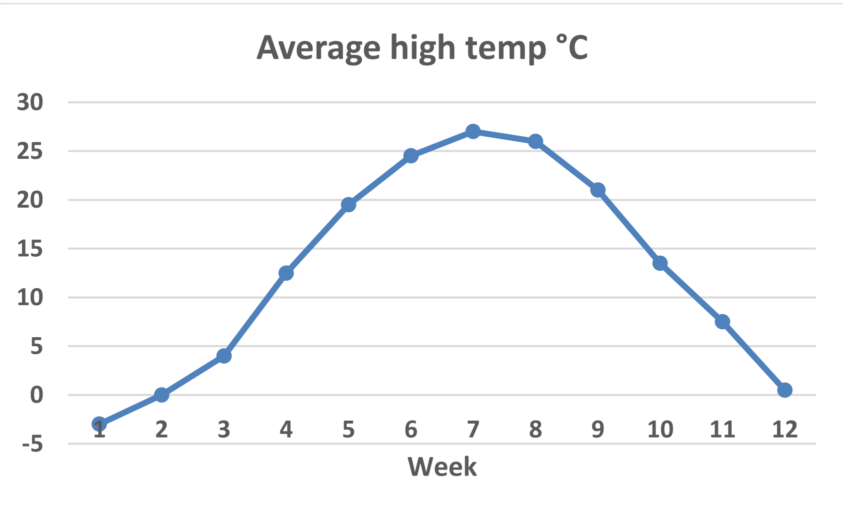
From the results, it is clear that although the aim of the trial was to evaluate Xtract 7065 for cows that experience heat stress, the weather did not play along that well. Cows only experienced mild heat stress for 22.5% of the time. However, the supplementation of Xtract 7065 at 1 gram/animal/day had a significant positive effect ($P < 0.05$) on the milk production of the heavier multiparious cows (live weight to 530 kg or more). The primiparious cows and lighter multiparious cows had a numeric drop in milk production during the heat stress days. However, when the milk production of both group 1 and 2 are added together, there is a significant increase in milk production ($P = 0.02$). From the results of this commercial dairy trial, one can conclude that Xtract 7065 has a significant positive effect on milk production on pasture based cows that experience heat stress (THI 72 or higher).

Xtract 7065 for dairy cows during cool / temperate weather

For the last few years, Xtract 7065 has mainly be used to reduce the effect of heat stress on dairy cows. However, new research assist in answering the following question: Does Xtract 7065 has any beneficial effect on dairy cows during cool / temperate weather?

Two commercial trial were conducted to try to answer the question above. The first trial was conducted in Spain from 1 February to 20 April 2008 (Pancosma TB 08XT-TS16). Fig 7 reports the average daily temperature per week for the trial period. It's clear that the cows did not experience any significant heat stress during that period.

Fig 7. The average temperature per week during the trial period.



364 dairy cows were allocated into two treatments. Negative control with 188 cows and Xtract 7065 (1 g/h/d) group with 176 dairy cows.

Dairy cows were fed a TMR diet with 45 % forage (corn silage, alfalfa hay) and 55 % concentrate. Milk production and milk components were determined during the trial period.

The production results are presented in Table 6.

Table 6. The effect of Xtract 7065 on the milk production of high producing dairy cows during cool weather.

Parameter	Control	Xtract 7065
Milk yield (kg/day)	45.70[a]	47.30[b]
Milk protein (%)	3.00	3.00
Protein yield (kg/day)	1.37[a]	1.42[b]
Milk fat (%)	2.65	2.60
Fat yield (kg/day)	1.21	1.23
Somatic cell count (10^3/ml)	161	145

a, b: P < 0.05

The dairy cows fed with XTRACT™ 7065 produced significantly more milk (47.3 vs. 45.7 kg/d, P < 0.05). While the protein content was not affected, the XTRACT™ supplemented diet produced a significantly higher protein yield by +3.5 % (1.42 vs. 1.37 kg/d, P < 0.05). Fat content was numerically decreased by 1.9 % while fat yield was numerically increased by 1.5 % due to the improved milk yield in animals fed XTRACT™ 7065. Somatic Cell Count was not significantly decreased in the XTRACT™ supplemented group. However, a numerical decrease by 9.4 % can be reported.

Another commercial study was conducted in Vermont, USA to determine of Xtract 7065 has any beneficial effect on dairy cow performance in a temperate climate (Pancosma TB 734). The average high and low temperatures for Vermont are reported in Fig 8. It’s clear that the cows were unlikely to experience any significant heat stress during the 8-week trial period.

201 Holstein cows (average 125 DIM) were allocated to either Control (300 mg Monensin / cow /day; 104 cows) or Xtract 7065 treatment (300 mg Monensin / cow /day + 1 gram Xtract 7065 / cow /day; 97 cows). Both primiparous and multiparous cows were use in the trial with a mean parity of 2.43. A free-stall pen equipped with an automated milking system (AMS) were used in the study. Cows entering the AMS were either fed the Control dairy concentrate or Xtract 7065 dairy. The rest of the feed were fed in a communal feed bunk.

The trial results are presented in Table 7.

Fig 8. The average high and low temperatures per month in Vermont, USA.

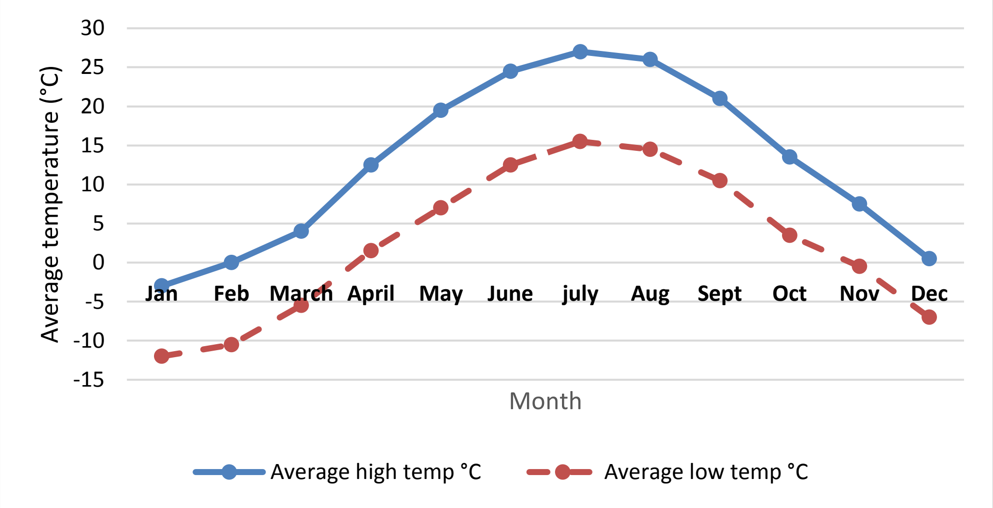


Table 7. The effect of Xtract 7065 on the milk production of dairy cows during temperate weather.

Parameter	Monensin	Monensin + Xtract 7065
Milk yield (kg/d)	35.5[a]	37.5[b]
Fat yield (kg/d)	1.41	1.41
Protein yield (kg/d)	1.12[c]	1.17[d]

a,b: P < 0.01 ; c,d: P < 0.05

Parity affected all parameters measured. Primiparous cows had lower milk, fat and protein yields, milkings and energy corrected milk than multiparous animals (P <0.01). In addition, the treatments did not affect BW (P = 0.76).

XTRACT 7065 increased milk production and protein yield, respectively by 5.6% and 4.9%, and did not alter fat yield. No FCR could be calculated as part of the feed intake of both the Monensin and Monensin + Xtract 7065 group consumed the feed from a communal feed bunk.

Although an increase in milk yield could be partially attributed to a possible increase in DMI, having in increase of 2 kg / cow/day during non-heat stress period can be seen as a positive effect of Xtract 7065 that was fed on top of Monensin.

Conclusion

It can be concluded that plant extracts, especially XTRACT® 7065 can have a positive effect on production in cows experience heat stress as well as cows that do not experience heat stress.

References

Baumgard, L.H. and Rhoads, R.P. 2007. The effects of hyperthermia on nutrient partitioning. Pages 93 – 104 in 69th Proc. Cornell Nutr. Conf. Cornell University, Ithaca, NY.

Beauchemin, K.A., Colombatto, D., Morgavi, D.P. and Yang, W.Z. 2003. Use of fibrolytic enzymes to improve feed utilization by ruminants. J. Anim. Sci. 81(E.Suppl. 2):E37 – E47.

Berman, A., Folman, Y., Kaim, M., Mamen, M., Herz, Z., Wolfenson, D., Arieli, A. and Graber, Y. 1985. Upper critical temperatures and forced ventilation effect for high-yielding dairy cows in a subtropical climate. J. Dairy. Sci. 68:1488 – 1495.

Bernabucci, U., Ronchi, B., Lacetera, N. and Nardone, A. 2002. Markers of oxidative status in plasma and erythrocytes of transition dairy cows during hot season. J. Dairy. Sci. 85:2173 – 2179.

Blanck, R., Vecht, K., Oguey, C. and Wall, E. 2014. The effect of supplementation with a blend of capsicum, cinnamaldehyde, and eugenol in milk production perforormance of dairy cows. Abstract 1603. JAM 2014.

Breede, D.K. and Collier, R.J. 1986. Potential nutritional strategies for intensively managed cattle during thermal heat stress. J. Anim. Sci 62:543 – 554.

Burgos Zimbelman R. and Collier R. J. 2011. Feeding strategies for high producing dairy cows during periods of elevated heat and humidity. Tri-State Dairy Nutrition Conference.

Busquet, M.S., Calsamiglia, S., Ferret, A. and Kamel, C. 2006. Plant extracts affect in vitro rumen microbial fermentation. J. Dairy Sci. 89:761 – 771.

Calsamiglia, S., Cavini, S., Bouattour, A., Ferret, A., Bravo, D. 2009. Essential oils may reduce the risk of ketosis in dairy goats carrying twins. J. Dairy Sci. 92 (E-Suppl. 1): 375-375.

Cardozo, P.W., Calsamiglia, S. Ferret, A. and Kamel, C. 2005. Screening for the effects of natural plant eXTRACTs at different pH on *in vitro* rumen microbial fermentation of a high-concentrate diet for beef cattle. J. Anim. Sci. 83:2572 – 2579.

Cardozo, P.W., Calsamiglia, S., Ferret, A., and Kamel, C. 2006. Effects of alfalfa extract, anise, capsicum, and a mixture of cinnamaldehyde and eugenol on ruminal fermentation and protein degradation in beef heifers fed a high concentrate diet. J. Anim. Sci. 84:2801 – 2808.

Cassida, K. A., and Stokes, M.R. 1986. Eating and resting salivation in early lactation dairy cows. J. Dairy Sci. 69:1282–1292.

Davis, A.K., Maney, D.L. and Maerz, J.C. 2008. The use of leukocyte profile to measure stress in vertebrates: A review for ecologists. Funct. Ecol. 22:760 – 772.

Fandiño, I.S., Calsamiglia, S., Ferret, A. and Blanch, M. 2008. Anise and capsicum as alternatives to monensin to modify rumen fermentation on beef heifers fed a high concentrate diet. Anim. Feed Sci. Technol. 145:409 – 417.

Febbraio, M.A. 2001. Alterations in energy metabolism during exercise and heat stress. Sports Med. 31:47 – 59.

Fox, D.G. and Tylutki, T.P. 1998. Accounting for the effects of environment on the nutrient requirements of dairy cattle. J. Dairy Sci. 81:3085 – 3089.

French, N. and Kennelly, J.J. 1990. Effects of feeding frequency on ruminal parameters, plasma insulin, milk yield and milk composition in Holstein cows. J. Dairy Sci. 73:1857 – 1863.

Harmon, R.J., Lu, M., Trammel, D.S. and Smith, B.A. 1997. Influence of heat stress and calving on antioxidant activity in bovine blood. J. Dairy Sci. 80(Suppl. 1):264.

Holter, J.B., West, J.W. and McGilliard, M.L. 1997. Predicting ad libitum dry matter intake and yield of Holstein cows. J. Dairy Sci. 80:2188 – 2199.

Kadzere, C.T., Murphy, M.R., Silanikove, N. and Maltz, E. 2002. Heat stress in lactating dairy cows: A review. Livest. Prod. Sci. 77:59 – 91.

Kelley, R.O., Martz, F.A. and Johnson, H.D. 1966. Effect of environmental temperature on ruminal volatile fatty acid levels with controlled feed intake. J. Dairy Sci. 50:531 – 533.

Lin, H., Decuypere, E. and Buyse, J. 2006. Acute heat stress induces oxidative e stress in broiler chickens. Comp.Biochem. Physiol. A Mol. Integr. Physiol. 144:11 – 17.

Moe, P.W. 1981. Energy metabolism of dairy cattle. J. Dairy Sci. 64:1120 – 1139.

Moore, C.E., Kay, J.K., Van Baale, M.J., Collier, R.J. and Baumgard, L.H. 2005. Effect of conjugated linoleic acid on heat stressed Brown Swiss and Holstein cattle. J. Dairy Sci. 88:1732 – 1740.

Pancosma TB 08XT-TS16. Effect of Xtract 7065 on performance of high-producing dairy cows. 2009.

Pancosma TB 711. Effect of XTRACT® 7065 on the performance of dairy cows in heat stress situation. 2011.

Pancosma TB 725. XRACT Ruminant increases milk production of dairy cows. 2014.

Pancosma TB 734. Xtract Ruminant improves performance of dairy cows farmed under commercial conditions. 2016.

Prieto, M.T. and Campo, J.L. 2010. Effect of heat and several additives related to stress levels on fluctuating asymmetry, heterophil : lymohocyte ratio, and tonic immobility duration in White Leghorn chicks. Poult. Sci. 89:2071 – 2077.

Rhoads, M.L., Rhoads, R.P., Van Baale, M.J., Collier, R.J., Sanders, S.R., Weber, W.J., Crooker, B.A. and Baumgard, L.H. 2009. Effects of heat stress and plane of nutrition on lactating Holstein cows: 1 Production, metabolism and aspects of circulating somatotropin. J. Dairy, Sci. 92:1986 – 1997.

Rodriguez-Prado, M., Ferret, A., Zwieten, J., Gonzalez, L., Bravo, D. and Calsamiglia, S. 2012. Effects of dietary addition of capsicum extract on intake, water consumption, and rumen fermentation of fattening heifers fed a high-concentrate diet. J. Anim. Sci. 90:1879 – 1884.

Schelling, G.T. 1984. Monensin mode of action in the rumen. J. Anim.Sci. 58:1518 – 1527.

Schneider, P.L., Beede, D.K. and Wilcox, C.J. 1988. Nycterohemeral patterns of acid-base status, mineral concentrations and digestive function of lactating cows in natural or chamber heat stress environments. J. Anim. Sci. 66:112 – 125.

Shwartz, G., Rhoads, M.L., VanBaale, M.J., Rhoads, R.P. and Baumgard, L.H. 2009. Effects of supplemental yeast culture on heat stressed lactating Holstein cows. J. Dairy Sci. 92:935 – 942.

Sies, H. 1991. Oxidative stress: Oxidants and Antioxidants. Academic Press, San Diego, CA.

St Pierre, N.R., B. Cobanov, and G. Schnitkey. 2003. Economic losses from heat stress by US livestock industries. J. Dairy Sci. 86 (E Suppl.):E52-E77.

Trevisan, M., Browne, R., Ram, M., Muti, P., Freudenheim, J., Carosella, A.N. and Armstrong, D. 2001. Correlates of markers of oxidative status in the general population. Am J. Epidemiol. 154:348 – 356.

Van Soest, P.J. 1982. Nutritional Ecology of the ruminant. Cornell University Press, Ithaca, NY.

West, J.W. 1999. Nutritional strategies for managing the heat-stressed dairy cow. J. Dairy Sci. 2:21 – 35.

West, J.W., Mullinix, B.G. and Bernard, J.K. 2003. Effects of hot, humid weather on milk temperature, dry matter intake and milk yield of lactating dairy cows. J. Dairy Sci. 86:232 – 242.

West, J.W. 2003. Effects of heat-stress on production on dairy cattle. J. Dairy Sci. 86:2131 – 2144.

Wheelock, J.B., Rhoads, R.P., VanBaale, M.J., Sanders, S.R. and Baumgard, L.H. 2010. Effects of heat stress on energetic metabolism in lactating Holstein cows. J. Dairy Sci. 93:644 – 655.