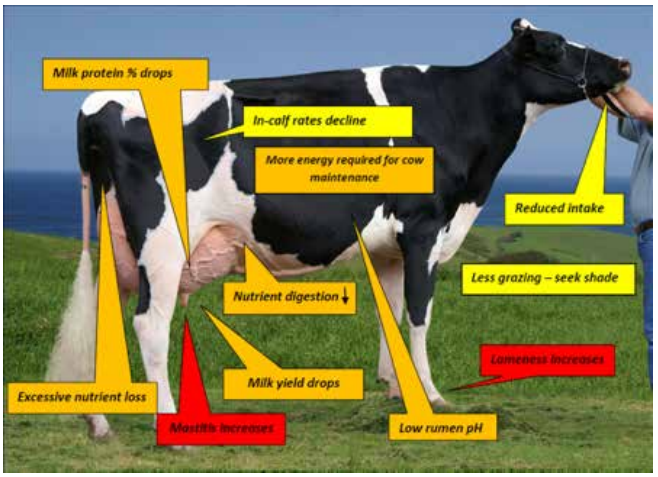
Feeding additives during summer

What is the evidence, benefits to milk production and cost?



In mid-2017, the new Sunshine Coast Regional Group of Subtropical Dairy undertook a project to develop a concise summary of the effectiveness of various additives to increase milk production during conditions inductive to heat stress. The table below summarises the findings from published research on active ingredients fed to milking dairy cows under hot conditions. This information was compiled by Dr Brad Granzin from Subtropical Dairy, with support from Jason Weare of Parmalat, and Dr Dave Barber from Department of Agriculture and Fisheries Queensland.

There are some important considerations regarding this project:

- The table on the next page was compiled from scientific literature, both domestically and internationally. For many additives, there are a limited number of publications.
- For much of the research, experimental conditions differ from typical farming practices in Queensland and northern NSW. This means that milk production responses on-farm will vary from what is reported here and alter the Benefit/ Cost of supplementation. If feasible, on-farm trialling is recommended.
- The comments in the table are confined to the effectiveness of these active ingredients to improve milk production during periods of heat stress. Some of these additives may provide other benefits during heat stress conditions which have not been reported here e.g. milk composition and reproduction. Some also have proven production benefits as general additives under non-heat stress conditions.
- While additives will assist in some cases to alleviate the effects of heat stress, they are not a substitute for modifying the cow's environment (for example providing shade) and suboptimal diet formulation. Please see www.coolcows.com.au and www.dairyinfo.biz for further technical information.
- Pricing of both milk and additives is indicative.
- Some additives have a similar mode of action. For example, those that help with rumen pH. Feeding two additives with the same mode of action won't necessarily give an added benefit.
- You will find commercial products containing these additives and active ingredient on the internet or by talking to your local feed supplier.
- If unsure, seek further nutritional advice.

Table 1. Background regarding the effectiveness and benefit/cost of various feed additives (active ingredients) to counteract heat stress in lactating dairy cows.

Name	Classification	How does it work?	Science-based evidence	Average milk production responses (observed under experimental conditions)	Range in milk response observed under experimental conditions	Typical level of feeding	Avg cost per cow per day (plus range)	Benefit cost analysis (at 58 cents per litre and supplement cost per day)	Comments
Additives to increase energy intake or metabolism									
Monensin sodium	Ionophore	Has been shown to benefit ruminants during high temperatures. Leads to greater supply of glucose to the mammary gland per unit of feed intake.	There is a lack of specific production experiments demonstrating the benefits of monensin to lactating cows under heat stress conditions. Overall reviews under normal conditions show an average response of 0.7 to 1.0 litre per cow per day.	0.7 litres per cow per day.	Responses have ranged from slightly negative results to more than 2.5 litres per cow per day.	300 mg per cow per day.	3 cents.	13:1	Monensin may decrease feed intake on certain diets and counteract milk yield responses. Milk fat concentrations may also decrease.
Betaine	Amino acid derivative. Also classed as an osmolyte.	Reduces the maintenance energy requirement of a cow.	Has been shown to improve fat mobilisation, milk yield and fat content when fed during dry period and into lactation. Supporting evidence for other species. Lack of production data for dairy cows under heat stress.	Limited data. Average from three experiments was approximately 1.4 litres per cow per day.	0 to 3 litres per cow per day.	2 grams per cow per day (natural betaine). Commercial products vary in feeding rate from 15 to 50 grams. Please check with the manufacturer.	17 cents. (8 to 26 cents)	5:1	Good reports received from on-farm. Preliminary research would indicate that feeding from drying off through lactation leads to higher production.
Fibrolytic enzymes	Enzyme	Increases fibre digestibility (contain cellulase and xylanase enzymes) and increasing intake. There is a lack of knowledge regarding optimum supplementation rates. Applied to feed as a solution.	Has been shown to increase milk yields of cow grazing tropical pastures in summer and under TMR conditions in tropical regions.	Limited data. Average from three experiments was 1.9 litres (7%).	0.8 litres per cow per day (4%) under grazing. A study during heat stress conditions in Egypt showed a 3-litre response (11%). A 2 litre per cow per day response was observed in Florida (6%).	750 ml per tonne dry matter.	33 cents assuming 18 kg dry matter intake per cow per day.	3:1	Higher responses under higher starch diets. May suggest that low rumen pH may compromise fibre digestion. Increased response when fed with diet as opposed to pre-spraying.
Rumen inert (Bypass) fat	Energy	Metabolic studies have shown that bypass fat has little direct effect on alleviating heat stress symptoms, although theoretically this should occur. The benefit is from an increase in diet energy density.	There are few published papers specifically relating to feeding rumen inert fat to cows during hot conditions. Further research is warranted.	4% yield increase. 0.9 litres per cow per day for control of 22 litres.	Responses range from 0 up to 3.6 litres (average 1.3 litres) in high producing cows under TMR conditions.	350 grams per cow per day. Feeding rates vary from 200 to 500 grams per cow per day depending on fat source.	54 cents.	1:1	Rumen inert fat has been shown to assist with reproductive performance.
Additives to help with low rumen pH caused by heat stress									
Yeasts	Probiotic	Assists maintain rumen pH, stimulates fibre digesting bacteria, feed intake. Of benefit when intakes of forages decline under heat stress.	Adopted internationally. Active ingredients include Saccharomyces cerevisiae.	1.2 litres per cow per day.	0.5 to 1.8 litres per cow per day.	7 – 56 grams subject to concentration.	6 cents.	12:1	Will work best when high grain diets are fed or there is rapid grain intake leading to low rumen pH.
Sodium bicarbonate	Buffer	Assists with maintaining rumen pH. Response often associated with improved intake.	Performance as buffer well documented. As breathing rates increase during heat stress, cows use bicarbonate metabolically to balance increasing blood acidity.	Estimated at 1.5 litres per cow per day under heat stress.	Responses up to 2.2 litres per cow per day or 10%. Latest literature indicates diet DCAD is a critical factor and needs to be taken into account.	0.45 to 0.6 % dry matter sodium (Na).	33 cents assuming 18 kg dry matter intake per cow per day.	3:1	Higher responses under higher starch diets. May suggest that low rumen pH may compromise fibre digestion. Increased response when fed with diet as opposed to pre-spraying.

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Additives to help with low rumen pH caused by heat stress									
Magnesium oxide	Buffer	Assists with maintaining rumen pH. A source of magnesium.	Few direct results available in literature.	Not available.	Not available.	0.35% dry matter magnesium (Mg).	2 cents.	Not available	There are various interactions between magnesium and other nutrients. Nutritional advice should be sought before feeding high levels.
Calcareous marine algae	Buffer	Slow release rumen buffer, supports maintenance of rumen pH. Supplies calcium and magnesium.	Limited research available in Australia. Encouraging results from overseas research, particularly South Africa. On farm results in Australia are encouraging.	Limited data under heat stress conditions. Has been shown to increase milk production better than sodium bicarbonate with high starch diets.	NA for heat stress. A 2.7 litre response was noted in a small metabolic experiment where a low pH inducing diet was fed.	90 – 100 g per cow per day.	9 cents (8-10).	Not available but estimated based on metabolic studies to be more effective than sodium bicarbonate	This product has the advantage in compared to other buffers as a source of calcium. Further on-farm research in Australia is warranted.
Additives that supply minerals									
Sodium chloride	Macro-mineral	Supplies sodium. Has a role in maintaining normal electrolyte balance in body tissues during heat stress.	There are a limited number of published papers showing the benefits of higher sodium chloride diets during heat stress conditions.	Not available due to the limited number of experiments. Assume 4% or 0.8 litre.	Research in northern NSW has shown increases up to 2.0 litres fat corrected milk per cow per day in grazing cows over summer.	0.45 to 0.6 % diet dry matter sodium (Na).	2 cents at a rate of 60 grams per cow per day.	Estimated at more than 10:1	The high chlorine content of sodium chloride may cause intake to be depressed if other high chloride feedstuffs are fed. DCAD should be balanced to between +30 to 40 meq/kg DM.
Potassium	Macro mineral	Has a role in maintaining cellular integrity and healthy nerve and muscle function.	With increased sweating, cows loose additional potassium. However, when cows pant excessively, potassium may not be as effective has a heat mitigation strategy.	Average response of 4%. Would equate to 0.8 litres for a cow producing 22 litres per day.	Limited recent data. Responses range from 0 up to 2 litres per cow per day.	1.3 to 1.6% diet dry matter potassium (K). Overall DCAD of diet should be between +30 and 40 meq kg dry matter.	8 cents per day assuming feeding rate of 50 gram of potassium chloride.	6:1	It is rare in high forage diets that potassium supplementation is warranted. High potassium diets can also increase magnesium and calcium requirements. Potassium carbonate can lower diet palatability.
Zinc	Micro-mineral	Has a role in general growth and metabolism. Required for normal bone and cartilage development. Involved in maintaining the integrity of skin and mucous membranes, hair and hooves and in wound healing.	There are limited reports of the effects of zinc under heat stress conditions. It has been recorded to reduce somatic cell counts which may lead to improved udder health. Hoof hardness has also been recorded to improve leading to reduce lameness.	Not available.	Not available.	1 gram per day (zinc sulphate). 300 – 500 mg zinc per day from organic sources.	1 cent. 20 cents.	Not available	The bioavailability of zinc sulphate as a supplement is quite low at 10%.
Additives that supply vitamins									
Niacin	Vitamin	Involved in general metabolism and red blood cell formation. Has a role in maintaining normal healthy skin and hair condition.	Inconsistent reports. Most responses are not statistically higher.	Assume 0.5 litres per cow per day under heat stress conditions.	Increase of 0.7 to 0.9 litres per cow per day under moderate and extreme heat stress.	12 grams per cow per day.	29 cents.	1:1	Response to niacin have been variable. It is most likely to be effective when rumen fermentation is compromised.