

# Research Bulletin

ARM & HAMMER Animal Nutrition

## Cows fed MEGALAC®-R see improved cyclicity timing and frequency, reduced metritis and uterine abnormalities

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### KEY POINTS

- Cows supplemented with MEGALAC®-R resumed cyclicity earlier postpartum, had more estrous cycles at the conclusion of the voluntary waiting period (VWP), and had fewer instances of metritis and other uterine abnormalities than cows fed MEGALAC®.
- Positive reproductive outcomes attributed to higher EFA concentrations led to improved fertility in cows fed MEGALAC-R.
- Cows fed MEGALAC-R displayed measurable improved reproductive performance that justifies the extra feed costs.

### INTRODUCTION

Reproductive performance depends on a multitude of critical components working synergistically to create a pregnancy. While nutrition is believed to have a significant impact on reproductive performance, the precise mechanisms are not yet fully understood. However, research has proven essential fatty acids (EFAs) have a positive impact on reproductive performance when adequately and properly supplied to the cow.

EFAs perform several significant biological functions in the cow, all of which impact reproductive performance. First, they influence normal cellular functions, such as the synthesis of phospholipid membranes. Second, their high energy density helps alleviate postpartum negative energy balance. Third, linoleic and linolenic acids (contained in MEGALAC Rumen Bypass Fat and MEGALAC-R Omega-3 and Omega-6 Essential Fatty Acids) are precursors to eicosanoids and steroid hormones, and also aid in the stimulation and/or inhibition of other reproductive hormones.

Essential fatty acids must be supplied nutritionally. Linoleic acid is the major fatty acid in most seed lipids, such as soybean and corn meal, while linolenic acid is the primary

polyunsaturated fatty acid (PUFA) in forage lipids. Between 60 – 90 percent of PUFAs in crushed rapeseed were biohydrogenated (saturation of double bonds) in the

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rumen before reaching the small intestine for absorption, rendering them into nonessential fatty acids.<sup>1</sup> Therefore, to overcome microbial biohydrogenation in the rumen, EFAs must bypass the rumen and target the small intestine for delivery to the tissues for metabolism. This can

be accomplished by feeding ruminally inert fats, such as MEGALAC and MEGALAC-R.

A review<sup>1</sup> of over 100 research studies illustrates the effects of EFAs on reproductive events. Six studies with fat-supplemented cows found more follicles within a respective size class when compared to control cows fed basal rations, indicating a significant dietary effect

( $P < 0.06$ ). Eleven studies reported an improvement ( $P < 0.10$  or  $> 15$  percentage unit difference between means) either in first service A.I. conception rate or in the overall conception or pregnancy rates as a result of feeding supplemental EFAs. Five of those studies fed Ca-LCFA (calcium salts of long-chain fatty acids) as MEGALAC. The data from these studies show cows fed Ca-LCFA had a 5.8 percent increase in observed standing estrus, 5.9 percent increase in the activity of the ovaries and 12 percent more cows responded to a lowered dose of PGF<sub>2α</sub> (20-mg as opposed to a normal dose of 25-mg).

Better postpartum uterine health also can have an impact on improved reproductive performance. Most uterine infections occur after parturition, when the reproductive tract is compromised by the opening of the birth canal and the stress of calving. Delayed involution of the uterus postpartum may result in endometritis<sup>2</sup> and is also a limiting factor in fertility.<sup>3</sup>

Prostaglandin is a common treatment for endometritis in cattle.<sup>3</sup> Prostaglandin acts by regressing the corpus

luteum, thus initiating a new wave of follicle growth and subsequent uterine contractions.<sup>2</sup> These uterine contractions serve to flush the uterus of fluid and/or infectious agents and cause involution to improve the tone of the uterus and lessen the chances of infection. Because EFAs are precursors to eicosanoids and steroid hormones, and stimulate or regress production of progesterone, EFAs can influence prostaglandin production postpartum. This effect can improve uterine contraction and involution and lead to the prevention of endometritis.

MEGALAC, a high energy feed supplement containing ruminally inert Ca-LCFAs, has a net energy of lactation of 6.5 Mcal/kg. MEGALAC-R maintains the same energetic and rumen inert properties of regular MEGALAC, but is formulated to transport higher concentrations of linoleic and linolenic acids to the small intestine for absorption and use in tissue metabolism. MEGALAC-R contains approximately 4.5 times as much linoleic acid and more than 23 times as much linolenic acid as regular MEGALAC.

## STUDY OVERVIEW

Two study groups of commercial Holstein cows, control (MEGALAC) and treatment (MEGALAC-R), were used for this trial and were balanced by parity and milk production in their previous lactation. Cows were divided into groups by lactation number (1, 2, 3 and 4 or greater) and then by production, based upon the Arizona state average for the previous year (305d ME  $< 9,545$  kg or 305d ME  $> 9,545$  kg). First lactation heifers were balanced for production using sire PTA for milk. Cows from each of these eight groups were then randomly sorted into one of the treatment groups.

Cows were milked 4 X/d for two months and 2 X/d until dryoff. Cows were fed a TMR, and the rations were balanced for caloric intake between treatments by the herd nutritionist. Based upon the recommendations of the herd nutritionist, all cows were fed 0.114 kg/d MEGALAC prepartum and 0.159 kg/d of

either MEGALAC or MEGALAC-R from parturition to 150 DIM. No cows were administered bovine somatotropin.

Cows 50 – 56 DIM (60-day VWP) were initiated into the Ovsynch™ regimen in Table 1.

Ultrasound was conducted and all ovarian structures were recorded individually. Specific abnormalities were noted including metritis, fever, foot rot, and/or compromised uterine position. Ultrasound was conducted every other week in May, June, December and January.

Progesterone was assayed twice weekly from a subset of cows in each treatment. Progesterone concentrations were measured by Enzyme ImmunoAssays (EIA) of whole milk samples.

TABLE 1		Ovsynch™ regimen schedule <sup>4</sup>
DIM	Ovsynch Day	Action
50 – 56	0	GnRH (Cystorelin®)
57 – 63	7	Prostaglandin (Lutalyse®)
59 – 65	9	GnRH
60 – 66	10	Timed AI

## Other Data

Uterine health data were collected through the event analysis function of DHI-Plus® for prostaglandin treatment(s). The herd veterinarian treated cows based upon rectal examination of the reproductive tract. Abnormalities (uterine tone, endometritis, retained placenta) were recorded and treated.

Ultrasound, synchronization and uterine health data were analyzed using Chi-square analysis. Cyclic data obtained through progesterone profiles were analyzed using the PROC-mixed procedure of SAS, with parity and milk production as covariates. The predetermined significance level was  $P < 0.05$ .

## RESULTS

Tables 2 and 3 show ultrasound results. Presence of a corpus luteum or corpus hemorrhagicum indicated an ovulation. A significant difference was detected ( $P < 0.005$ ) for number of ovulations between treatments by 30 DIM. No significant difference was found between treatments for numbers or sizes of follicles at either 14 or 30 DIM, as analyzed by Chi-square.

However, a trend of MEGALAC-R supplemented cows having more follicles was noticed for number of class 1 follicles 15 – 30 DIM ( $P < 0.07$ ) and number of class 2 follicles 15 – 30 DIM ( $P < 0.09$ ). Number of cows differs due to a set of cows that were ultrasounded twice—once before 14 DIM and again between 15 and 30 DIM.

**TABLE 2**

Effects of MEGALAC-R supplementation on percent ovulations by 30 DIM as determined by transrectal ovarian ultrasonography.

Parameter	Control n=63	MEGALAC-R n=57
Ovulations by 30 DIM	17	28
% ovulations	27 <sup>a</sup>	49 <sup>b</sup>
Mean DIM at ultrasound	24.9	24.0

<sup>a,b</sup> Superscripts differing within row indicate significant difference ( $P < 0.005$ ).

**TABLE 3**

Effects of MEGALAC-R supplementation on follicle populations by 14 DIM as determined by transrectal ovarian ultrasonography.

Follicle class	Cows:	1 – 14 DIM		15 – 30 DIM	
		Control (9)	MEGALAC-R (20)	Control (60)	MEGALAC-R (47)
1 (1 – 5 mm)		25	58	102	112
2 (6 – 10 mm)		11	22	57	60
3 (11 – 15 mm)		5	12	30	22
4 (> 16 mm)		3	4	29	19
<b>Mean number of follicles per cow</b>		4.89	4.80	3.63	4.53
<b>Mean size (mm)</b>		8.56	6.37	8.53	7.62

Table 4 shows the differences between treatments for number of estrous cycles and mean progesterone concentrations prior to 60 DIM for multiparous cattle. A cycle was recorded if progesterone concentrations declined below 4 ng/mL, followed by a rise above 4 ng/mL, the predetermined value identifying when a corpus luteum was fully functioning. A significant difference between treatments was detected between numbers of cycles by 60 DIM ( $P < 0.03$ ). However, no significant difference was detected between mean concentrations of progesterone, average lactation number or average milk production in the covariate analyses. This is not surprising because the treatments had been balanced for parity and milk in previous lactations prior to randomization between treatments.

Table 5 shows the differences between treatments for numbers of cows treated with prostaglandin by the herd veterinarian as a therapy for uterine abnormalities. Significant differences were detected between treatments for total number treated, as well as first and second case treatments. Additionally, a difference in the number of cysts was detected, although the overall frequency of cystic ovaries was less than 3 percent in both treatment groups.

<b>TABLE 4</b>		Effects of MEGALAC-R supplementation on number of estrous cycles by 60 DIM in <i>multiparous</i> cows as determined by progesterone profiling.		
<b>Parameter</b>	<b>Control n=18</b>	<b>MEGALAC-R n=17</b>	<b>SEM</b>	<b>P-value</b>
Overall [P] (ng/mL) 1st 60 DIM	7.4	6.2	2.84	NS
Number of cycles 1st 60 DIM	2.0	2.76	0.24	< 0.031
Range in number of cycles	0 – 3	1 – 5		
95 % C.I. for cycles mean	1.52 – 2.48	2.27 – 3.26		
Mean parity	2.44	2.47		NS
Mean 305d ME production (kg)	9,366	9,605		NS

<b>TABLE 5</b>		Effects of MEGALAC-R supplementation on number of cows treated with prostaglandin for uterine health issues by the herd veterinarian.	
<b>Parameter</b>	<b>Control treated/total</b>	<b>MEGALAC-R treated/total</b>	
Number treated (1st case) for uterine abnormalities by 60 DIM	421/1312	186/708	
% treated	32.1 <sup>a</sup>	26.3 <sup>b</sup>	
Number retreated (2nd case) by 60 DIM	90/421	19/186	
% retreated	21.4 <sup>c</sup>	10.2 <sup>d</sup>	
Total treated by 60 DIM	511/1312	205/708	
Total % treated by 60 DIM	38.9 <sup>c</sup>	29.0 <sup>d</sup>	

<sup>a,b</sup> Superscripts differing within row indicate significant difference ( $P < 0.01$ ).

<sup>c,d</sup> Superscripts differing within row indicate significant difference ( $P < 0.005$ ).

Table 6 shows the overall cumulative pregnancy results of both the control and treatment groups. A historical herd value is included for reference.

Milk production, percent fat and percent protein production were maintained as anticipated from previous trials, as shown in Table 7.

<b>TABLE 6</b> Cumulative pregnancies of MEGALAC-R supplementation at 21-day intervals during the first 126 DIM.			
<b>Cumulative Pregnancies</b>			
<b>Interval</b>	<b>Herd Historical</b>	<b>Control</b>	<b>MEGALAC-R</b>
63	15.4	10.8	9.9
84	28.4	30.8	35.1
105	39.4	50.8	59.5
126	48.7	63.8	71.2

<b>TABLE 7</b> Summary of effects of MEGALAC-R supplementation on milk traits and reproductive outcomes.			
<b>Parameter</b>	<b>Control</b>	<b>MEGALAC-R</b>	<b>P-value</b>
3.5% FCM (kg/d)	37.00	37.10	NS
% Fat	3.36	3.32	NS
% Protein	2.99	2.81	NS
SCC	314,000	315,000	NS

## DISCUSSION

The results of this trial clearly show that cows supplemented with MEGALAC-R resumed cyclicity earlier postpartum (49 percent vs. 27 percent by 30 DIM,  $P < 0.005$ ) had more ovulatory cycles by the VWP (2.76 vs. 2.00 by 60 DIM,  $P \leq 0.031$ ) and were treated less often for uterine abnormalities and infections (29.0 percent vs. 38.9 percent by 60 DIM,  $P < 0.005$ ) than control cows supplemented with MEGALAC.

No significant differences were found in terms of follicle population sizes and diameters between treatments on this trial. The linoleic and linolenic acid concentrations in MEGALAC, while in smaller concentrations than MEGALAC-R, are still substantially higher than base rations used in previous studies. This fact likely accounts for comparable follicle populations between treatments in this study.

Vasconcelos, et al.<sup>5</sup> reported “cows in which Ovsynch was initiated near midcycle had...greater pregnancy rates.” Control cows, on average, had completed two ovulatory cycles, and were in the beginning to mid phase through their third cycle when Ovsynch was initiated. In contrast, the MEGALAC-R cows completed two

ovulatory cycles and were in the late stages of their third cycle. This difference in cycle phase at the initiation of Ovsynch could explain why no significant difference was detected between groups for conception rates, although earlier resumption of cyclicity, more cycles by VWP and improved uterine health would be expected to lead to increased fertility in the MEGALAC-R treated cows if they had not been hormonally programmed. Those results may have been observed if cows had not been scheduled for timed AI with Ovsynch. That was the design of this trial due to confounding results previously published when fertility could not be directly compared because visual detection of estrus was the sole basis for detecting a cow should be inseminated.<sup>6,7</sup> Furthermore, the number of cycles a cow completes prior to breeding is positively correlated with conception rates.<sup>8,9</sup> Those findings were reported for cows not fed fat and not subjected to a hormonal management program. Based on the findings in this trial, it could be recommended that herd managers feed MEGALAC-R and use an Ovsynch synchronization regimen initiating at 75 DIM.

For additional information on enhancing reproduction through proper nutrition visit [www.dairyrepro.com](http://www.dairyrepro.com).

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