

# CALF COLLEGE™ COURSE NOTES

## — FOCUS ON ENERGY SOURCES FOR OPTIMAL CALF GROWTH AND PERFORMANCE —

### TAKE HOME MESSAGES

- The amount of milk or milk replacer fed has the greatest impact on delivery of total energy to calves.<sup>1</sup>
- The value of energy supplied by a milk replacer depends on more than just its face-value fat percentage.
- Traditional milk replacer formulas contained a singular source of fat; modern formulations feature a blend of fats that deliver a fatty acid profile that is more efficiently used by the calf.

Nearly all of young calves' nutrition is supplied via milk or milk replacer during the first 2-3 weeks of life, making it the only source of energy for young calves. Starter grain fed during this time does not supply significant additional energy as it is primarily fed for rumen development.

**To maximize the value of a calf raising program producers should manage their calf nutrition program to ensure 1.75 to 2.25 lbs of average daily gain (ADG) per calf through the preweaning phase. The goal is to double a calf's birth weight by the time she reaches 56 days of age.**

#### Temperature makes a difference

Like all animals, calves have a "thermoneutral zone" in which their environment does not affect their nutritional needs. A number of environmental conditions contribute, including age of the calf, bedding, wind, precipitation, humidity and shelter. But outdoor temperature is the main factor, and the thermoneutral range for calves is fairly narrow – approximately 60 to 75° F.<sup>2</sup> **Under thermoneutral conditions a 100 lb calf needs approximately 4.13 mega-calories (mcal) of metabolizable energy (ME) per day to achieve a rate of gain of 1.76 lbs per day (Table 1).**

<sup>1</sup> National Research Council. 2001. Nutrient Requirements of Dairy Cattle. Seventh Rev. Ed., Natl. Acad. Sci., Washington, D.C.



Table 1. NUTRIENT REQUIREMENTS OF A 100 LB CALF UNDER THERMONEUTRAL CONDITIONS

| RATE OF GAIN, LB/D | ME, MCAL/D | DMI, LB/D | ADP, G/D | CP, G/D | CP, % DM |
|--------------------|------------|-----------|----------|---------|----------|
| 0.44               | 2.35       | 1.12      | 87       | 94      | 18       |
| 0.88               | 2.89       | 1.40      | 140      | 150     | 23.4     |
| 1.32               | 3.48       | 1.67      | 93       | 207     | 26.6     |
| 1.76               | 4.13       | 1.98      | 235      | 253     | 27.5     |
| 2.20               | 4.80       | 2.39      | 286      | 307     | 28.7     |

Van Amburgh, M., and J. Drackley. 2005. Current perspectives on the energy and protein requirements of the pre-weaned calf. Chapter 5 in Calf and Heifer Rearing. P.C. Garnsworthy, ed. Nottingham University Press, Nottingham, UK.

When temperatures fall above or below that range, calves require additional energy to maintain core body temperature. **If those requirements are not supplied via nutrition, they will be taken from the calf's energy stores, resulting in weight loss, impaired immune function and possible illness or death.** The volume of liquid nutrition needed to meet calves' maintenance requirements and gain 1.5 lbs per day despite environmental conditions are shown in Table 2.

Don't let energy be a limiting factor to calf performance during times of stress; implement a feeding program that supports these increased energy demands.

### A full potential diet provides optimal nutrition

The traditional method of feeding approximately 2 quarts of 20:20 milk or milk replacer twice a day falls far short of the energy and protein requirements to support both maintenance and growth of young calves, Table 3. Feeding 4 quarts twice a day or 3 quarts 3 times a day of a full potential liquid diet with the correct balance between fat and protein can deliver the necessary nutrient levels. More frequent daily feedings, feeding higher volumes of milk replacer and automatic feeders are excellent ways to deliver full potential feeding.

### Achieving maximum total energy

Recognizing the importance of energy to calves, it is necessary to understand the most beneficial way to deliver it.

**Fat is not the only source of energy in milk or milk replacers.** Energy is predominately derived from two sources – fat and carbohydrates. The predominant source of carbohydrate in milk or milk replacer is lactose. Milk replacer generally is comprised of about 35 to 45% lactose.

Carbohydrates are rapidly digested and provide nearly “instant energy,” while fat is stored for longer-term use and is a reserve energy source that is mobilized as needed.

### Low fat does not equal low-energy

**Keep in mind that just because a milk-replacer product has a low fat percentage, that does not necessarily mean it is a low-energy product.**

For example, Cow's Match® WarmFront® calf milk replacer contains just 10% fat, yet it provides 90% of the metabolizable energy per pound of dry matter

**Table 2. AMOUNT OF MILK REPLACER OR MILK DRY MATTER REQUIRED TO MEET MAINTENANCE REQUIREMENTS AND GAIN 1.5 LBS PER DAY (12.5% SOLIDS UNLESS OTHERWISE NOTED)**

|                                   | TEMPERATURE |     |     |     |      |      |
|-----------------------------------|-------------|-----|-----|-----|------|------|
|                                   | 68          | 32  | 15  | 5   | -5   | -20  |
| <b>Dry Matter</b>                 | 1.75        | 2.1 | 2.2 | 2.4 | 2.5  | 2.6  |
| <b>Qts/day</b>                    | 6.6         | 7.6 | 8.0 | 8.8 | 9.2  | 9.5  |
| <b>Qts/feeding (2x)</b>           | 3.3         | 3.8 | 4.0 | 4.4 | 4.6  | 4.75 |
| <b>Qts/feeding (3x)</b>           | 2.2         | 2.5 | 2.7 | 2.9 | 3.1  | 3.2  |
| <b>Qts/fdg (2X) at 15% Solids</b> | 2.6         | 3.1 | 3.3 | 3.6 | 3.75 | 3.9  |

\*100 lb. Bodyweight

**Table 3. NUTRITIONAL REQUIREMENTS AND COMPARISON OF ABILITY TO MEET THEM WHEN FEEDING A TRADITIONAL AND FULL POTENTIAL MILK REPLACER PROGRAM TO AN 88 LB CALF AT 32° F.³**

| Requirements                      | Met. Energy (Mcal/d)  | Protein (g/d)     |
|-----------------------------------|-----------------------|-------------------|
| Maintenance                       | 2.45                  | 30                |
| Growth at 1.8 lb ADG              | 2.44                  | 206               |
| <b>Total</b>                      | <b>4.89</b>           | <b>236</b>        |
| Provided by 1.25 lbs of 20:20     | 2.69 (2.2 Mcal short) | 113 (123 g short) |
| Provided by 2.2 lbs of ColdFront® | 4.98 (+0.09)          | 259 (+23)         |

compared to Cow's Match® ColdFront®, which contains 20% fat. It does this via a unique combination of carbohydrates that provide ready energy needed for respiration and cooling in warm weather conditions, while keeping fat levels low, because fat reserves are not as necessary in warmer climate conditions and to encourage starter intake which will often be low in warmer weather.

### Its about the proper protein to energy balance

The balance between fat and protein levels also plays a key role in optimal calf nutrition. Excessively high fat levels (above 20%) can suppress starter intake and result in heifers that have poorer feed efficiency and may not meet growth and breeding benchmarks in an economical timeframe. A good rule of thumb is to try to achieve at least a 2.5 to 1 ratio of protein to fat in the milk replacer diet of large breed calves in warm weather and at least 1.4 to 1 in the winter.

### Fat is not a generic ingredient

The source of fat in milk replacer is an important and often-overlooked consideration. Milk fat, due to its high value in the human nutrition market, usually is not used in calf milk replacers. That leaves alternative sources to supply fat in milk replacers, which traditionally have been lard, choice white grease or tallow.

The fatty acids that make up fat are classified as short-chain, medium-chain and long-chain fatty acids. The length of the chain depends on the number of carbon [C] atoms that make up the structure of each fatty acid. Medium-chain fatty acids are highly digestible, as they are absorbed directly from the small intestine to the liver, where they are converted to available energy. Certain polyunsaturated fatty acids (omega-3's) modulate the inflammatory response by the calf's immune system, allowing the calf to recover more quickly from an immune challenge.

2 Ontario Ministry of Agriculture and Food, "Feeding pre-weaned veal calves during winter months: understanding calf metabolism and milk replacers," veal fact sheet on [www.omafra.gov.on.ca](http://www.omafra.gov.on.ca)

3 Earleywine, T.J. "Nutrition 101 - Newborn," presentation based on research by Land O'Lakes Animal Milk Products Co., 2013

The key to optimizing fatty acids is to formulate their balance in milk replacer to mimic their levels in cow's milk. While a good share of cow's milk fat is made up of long-chain fatty acids, it also contains between 8 and 12% medium-chain fatty acids.

Land O'Lakes Animal Milk Products Company milk replacer formulations – including Cow's Match® ColdFront®, Cow's Match® WarmFront®, Cow's Match® ColdFront® Protein Blend, Cow's Match® WarmFront® Protein Blend and Herd Maker® Protein Blend – all contain an enhanced fatty acid profile derived from a variety of fat sources. This carefully balanced blend allows fat to be utilized more efficiently by the calf than traditional fat sources utilized in milk replacer, while capturing additional beneficial properties that may promote digestive development and immunity.

In addition, Land O'Lakes Animal Milk Products' full potential milk replacers contain L-carnitine, a unique additive that increases the rate of fat oxidation, making the energy availability of fat more similar to that of carbohydrates.

Table 4 demonstrates the minor differences in energy content of milk replacers at different fat levels and the energy level equivalent in Land O'Lakes Animal Milk Products' formulations and the technologies included.

**Table 4. MEGA-CALORIES OF METABOLIZABLE ENERGY PER POUND OF DRY MATTER.**

|   | % FAT |      |      |
|---|-------|------|------|
|   | 10%   | 15%  | 20%  |
| <b>National Research Council Calf Model</b>   | 1.99  | 2.06 | 2.17 |
| <b>Equivalent Energy in Land O'Lakes Animal Milk Products Calf Milk Replacer with Technologies Based on Research*</b> | 2.16  | 2.17 | 2.26 |

\*Due to a better combination of carbohydrates and fat, fatty acid profile adjustments as well as others depending on product, such as L-carnitine, MOS, FOS, Digestarom®, etc.<sup>1, 4, 5, 6</sup>

Table 5 compares performance between calves fed a traditional 20:20 milk replacer diet with a single fat source, to that of calves fed LAND O LAKES® Herd Maker® Protein Blend Calf Milk Replacer, fed at the same rate. LAND O LAKES® Herd Maker® Protein Blend Calf Milk Replacer is a 22:15 milk replacer with a carefully balanced blend of fatty acids. Total gain, average daily gain and calf starter intake all were numerically higher for the calves raised on LAND O LAKES® Herd Maker® Protein Blend Calf Milk Replacer.<sup>6</sup>

**Energy is a critical nutrient in young-calf nutrition, but it must be fed at correct volume and in proper balance with fat and protein to provide optimal results.**

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- 4 Land O'Lakes Answer Farm Research Studies; CT 06-2010; 16-2010; 01-2011, 08-2011.
  - 5 Land O'Lakes Animal Milk Products Cow's Match® WarmFront® and Cow's Match® ColdFront® Protein Blend Research Trials, 2013 & 2014
  - 6 Land O'Lakes Animal Milk Products Herd Maker® trial summary, 2014

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**Table 5. COMPARISON OF CALF PERFORMANCE WHEN FED A TRADITIONAL 20:20 MILK REPLACER WITH A SINGLE FAT SOURCE, AND A 22:15 MILK REPLACER WITH BLENDED AND BALANCED FATTY ACIDS.<sup>6</sup>**

|  | <b>20:20<br/>TRADITIONAL<br/>CALF MILK<br/>REPLACER</b> | <b>LAND O LAKES®<br/>HERD MAKER®<br/>PROTEIN BLEND CALF<br/>MILK REPLACER</b> |
|--|---|---|
| <b>Number Of Calves</b>                      | 44  | 43  |
| <b>6-Week Average<br/>Total Gain</b>         | 49.6 lbs  | 53.0 lbs  |
| <b>Average Daily Gain</b>                    | 1.18 lbs  | 1.26 lbs  |
| <b>Average Total Calf<br/>Starter Intake</b> | 44.6 lbs  | 49.8 lbs  |