

## Formulation of Calf Starters and Growers

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When pre-weaned calves are fed even very small amounts of roughage, starter intake, average daily gain (ADG), and feed efficiency are reduced (Figure 1). The pre-weaned calf's rumen is very small and it is not as functional with microbial populations and absorptive area as the rumen of an older calf. Thus, it has limited capacity to consume bulky roughage and has a limited ability to digest a fibrous feed.

Research from the 1950's (Hibbs; Warner) showed that pre-weaned calves should be fed starters based on grain to develop the rumen. Today, starter feeds are often based on by-products like soyhulls or wheat midds that are cheap and high in fiber relative to corn or other grains. When calves are fed starter based on high fiber, low starch by-products, their ADG, starter intake, and feed efficiency are reduced (Figure 2). Therefore, do not feed young calves' roughage or starter with high levels of byproducts.

These same concepts are true for the calves that have just been weaned. The rumen of the just weaned calf does not develop overnight to be a fully functional. When the weaned calf is fed increasing amounts of by-products (like soyhulls or wheat midds), ADG and starter intake are reduced (Figure 3). Similarly, when the calf is fed small amounts of hay, ADG and starter intake are reduced (Figure 4). A practical recommendation from controlled research trials is to not feed starters containing high levels of byproducts until the calf is at least 4 months old. Additionally, feed the calf only a limited amount of hay (approximately 5% of intake or 0.3 lb daily) until it is 4 months old. This calculates to less than 19% NDF on an as-fed basis.

Calves do not need extensively processed corn and they do very well when fed whole corn (Lesmeister, 2004). This was confirmed in Akey research in calves up to 3.5 months old. Calves dislike fine particles. Feeding starters with fines will reduce starter intake and ADG.

One aspect of starter nutrition that has received a lot of discussion but limited research of late is protein concentrations and sources. The research from the 1990's (Luchini, 1991; Akayezu, 1994) showed that 18% CP as-fed basis was correct for starters. The use of the 2001 Dairy NRC calf submodel also suggests that 18% CP. Energy, not CP, is the limiting nutrient for starters and growers (NRC, 2001). Akey research published in 2007 showed that 18% CP is correct for starters. Lower concentrations of CP limited both ADG and structural growth of the calf. Concentrations of CP greater than 18% did not improve ADG, efficiency, intake, or structural growth. Formulation of the starter for CP fractions such as rumen undegraded protein or metabolizable protein, lysine, and methionine did not change calf performance prior to 2 months of age. Newer research from the Akey unit has shown that 15 to 16% CP is correct for a starter fed to calves between 2 week post-weaning and 4 months old when limited forage is fed (5% hay). Our limited experimentation with rumen undegraded protein and metabolizable protein in the calf between 2 and 4 months old has revealed no benefit to starter formulated with this emphasis. To date, a starter based on corn and soybean meal has not been beat.

A new concept in calf nutrition is the use of specific essential fatty acids. The essential fatty acid linolenic acid (C18:3) appears deficient in the typical calf starter that is fed. Most requirement estimates in the literature suggests that the ratio of C18:2 to C18:3 be from 4:1 to 10:1. These estimates have been made in piglet and rat research used as models for human nutrition, but never in calves until Akey started in this area of research a few years ago and published it in 2007. Adding C18:3 from a rumen protected source which is very low in a typical starter feed to reduce the ratio of C18:2 to C18:3 have successfully improved calf ADG and efficiency (Figure 4). Calf ADG has consistently been improved by 0.1 lb/calf daily from 0 to 2 months of age and by 0.2 lb/calf daily from 2 to 4 months of age when specific essential fatty acids are added. Akey provides this technology through the use of their calf feeds that include A-Boost.

Summary points:

Do not feed roughage to calves less than 2 months old.

Limit roughage to about 5% of the diet (less than 19% NDF as-fed basis) in calves 2 to 4 months old.

Minimize alternative ingredients such as soyhulls and wheat midds that are high in fiber (maximize corn).

18% CP as-fed basis in starters for calves under 2 months old.

15 to 16% CP as-fed basis in starters for calves between 2 and 4 months old.

Soybean meal is the preferred source of protein.

Supplement the essential fatty acid linolenic acid (C18:3) that are deficient in starter feeds.

Simple formulation guidelines for calf starters fed up to 4 months of age are shown in Table 2.

Figure 1 0, 2%, 4% chopped hay  
Fed with a textured starter

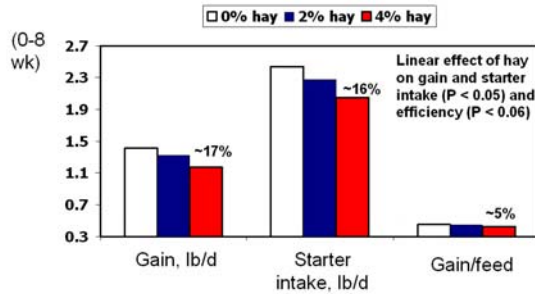


Figure 2 Corn or soyhulls  
Pelleted starter

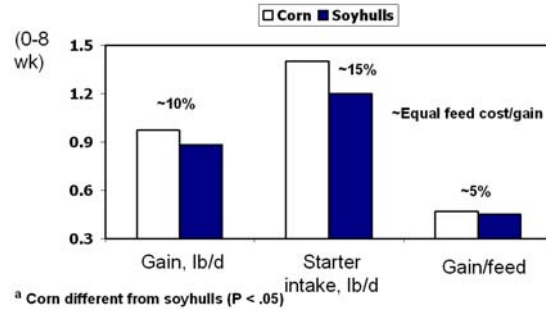


Figure 3 0, 14, 28, 42% soyhulls (SH)  
(replacing corn)

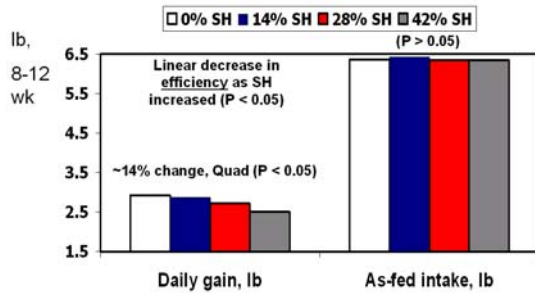


Table 1 Amount of hay for calf growers

	5% hay	15% hay	
Gain, lb/day	2.27	1.99	14% difference*
Concentrate intake, lb/day	4.91	3.88	
Hay intake, lb/day	0.24	0.63	
Total as-fed intake, lb/day	5.92	5.19	14% difference*
Gain:Feed (Conc.+hay)	0.39	0.39	
Hip width change, in.	3.5	3.2	
Condition change	0.2	0.1	
Hay consumed vs. offered	98%	88%	

\* Differed ( $P < 0.05$ )

Figure 4 C18:2 to C18:3 ratio  
(3 to 4 month old calves)

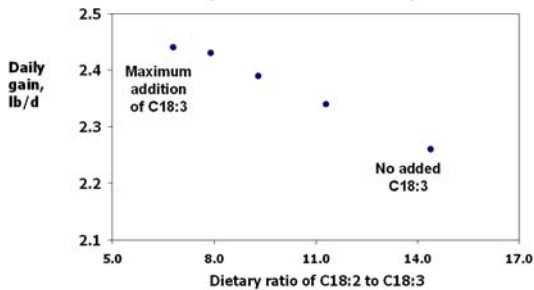


Table 2. Simplified formulation guidelines

Age of calf, months	0 to 2	2 to 4
CP minimum, %	18	15 - 16
Protein source	Soybean meal	
Alternatives to corn	Minimize, use only as pellet binders	
Hay maximum, %	0	5 - 10
NDF maximum, %	15	19
Calcium, %	0.7 - 0.8	
Phosphorus, %	0.5 - 0.6	
Magnesium, %	0.18 - 0.2	
Sulfur, %	0.16 - 0.2	
Salt, %	0.5 - 1.0	
C18:2 to C18:3	~8:1 corrected with Akey premix*	
Vitamins, trace minerals	from Akey premix*	

\*Calf premix w/A-Boost at 15 lb per ton of complete feed  
\*Heifer premix w/A-Boost at 7.5 lb per ton of complete feed

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