



Technical Bulletin 19

Rumen Development of Replacement Heifers

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Proper development of replacement heifers is essential to their long-term productivity as dairy cows. Improperly managed heifers will develop problems which will lead to early culling from the herd. Proper management of replacement heifers will include considerations for development of the skeleton, mammary system and digestive system. If the digestive system is not developed to handle a large volume of forage-based rations, the cow will experience problems during transition from gestation to lactation. In heifers and mature cows, energy requirements increase somewhat through gestation, and increase dramatically after parturition, while dry matter intake decreases by 30% up to parturition. If energy balance is not maintained, the cow may develop ketosis and fatty liver. Negative energy balance can also reduce peak milk yield which will decrease the milk yield potential for the entire lactation. This means that the energy concentration of the ration must be drastically increased in order to achieve desired energy intake. However, increasing the energy density of the ration to alleviate negative energy balance usually requires increasing the proportion of concentrates in the diet. This can lead to other challenges such as acidosis and displaced abomasum, which can reduce the lactation performance and lifetime productivity of the animal.

One way to reduce the need for excess concentrates in the diet of transition cows is to maintain adequate dry matter intake during late gestation and early lactation. There are many factors that help stimulate intake, including cow comfort, ration palatability and forage quality. However, ruminal capacity also plays a role in long-term intake potential. If the rumen has not been properly developed, rumen volume may limit the ability of heifers and mature cows to consume sufficient quantities of a forage-based diet, requiring inclusion of higher levels of concentrates.

Development of rumen capacity is as important as development of frame and skeletal size in contributing to long-term potential productivity of the dairy animal. The practice of limit-feeding high-energy diets to developing heifers has become more common during periods when the cost of grain is low relative to the cost of forages, especially when considered on the basis of cost per unit of energy. Although feeding a high-concentrate diet can increase rate of gain and feed efficiency, research has shown that feeding a diet higher in forage increases the size and capacity of the rumen relative to the size of the animal (table 1). Hence, even when feeding a forage-based diet does not give the lowest cost of gain, the returns to developing heifers with a forage-based diet will be provided in the long-term productivity of the animal.

Table 1. Rumen size as affected by forage consumption

Diet	Empty body weight ³	Reticulo-Rumen			
		Tissue Weight/EBW (lb/100lb)	Difference vs. Concentrate	Volume/EBW (ml/lb)	Difference vs. Concentrate
Trial 1 ¹					
Concentrate	231	.339	–	130	–
Hay	118	.365	+7.7%	314	+142%
Concentrate + Hay	207	.267	-21.2%	136	+4.9%
Trial 2 ²					
High Concentrate	144	3.24	–	156	–
High Forage	100	3.70	+14.1%	273	+75.8%

¹Adapted from Warner, Flatt, and Lossli (1956). Development of reticulo-rumen of calves at 13 weeks of age. ²Adapted from Stobo, Roy and Gaston (1966). Brit. J. Nutr. Development of reticulo-rumen of calves at 12 weeks of age. ³Empty body weight (EBW) = Live weight adjusted for gut fill.

Development of rumen size and capacity is crucial to long-term intake potential, as is maintenance of rumen epithelial health. Feeding coarse forages enhances the development of rumen papillae which are responsible for much of the nutrient absorption from the rumen. When calves are fed pelleted or high-concentrate diets, rumen papillae are reduced in size and total absorptive surface area, and become clumped and keratinized (3). These factors reduce absorption of volatile fatty acids (4) which are the primary source of energy for a ruminant. Keratinization is caused by excessive buildup of volatile fatty acids, primarily butyrate. Clumping of papillae is caused by a deficiency of coarse forage in the diet which is needed to stimulate the papillae.

Feed additives are important and economically beneficial tools in the replacement heifer development program. However, if the feed additive chosen has a negative impact on dry matter intake, development of rumen capacity may be reduced. GAINPRO® has no adverse impact on dry matter intake of cattle fed a forage-based diet. Moreover, cattle fed GAINPRO® have demonstrated greater dry matter intake than cattle fed Rumensin® (tables 2 and 3) or Bovatec® (table 4).

Table 2. Effects of feeding GAINPRO® vs. Rumensin® in hay-based diets with either corn-urea supplement or molasses-corn gluten meal supplement

	Corn-Urea		Molasses-CGM		Overall Advantage for GAINPRO®
	GAINPRO®	Rumensin®	GAINPRO®	Rumensin®	
Average Daily Gain (lbs./day)	1.45	1.35	1.26	1.10	+10.6%
Hay intake, % BW	1.56 ^a	1.27 ^b	1.51 ^a	1.29 ^b	+20.3%

Balbuena et al. 1966

^aMeans within a row containing different superscripts differ (P<.05)

Table 3. Effects of feeding GAINPRO® vs. Rumensin® in forage-based grower diets. (2 trial summary¹)

	GAINPRO®	Rumensin®	Advantage for GAINPRO®
Average Daily Gain (lbs./day)	2.63	2.56	+2.7%
DMI (lbs./day)	16.13	15.48	+4.2%

¹GAINPRO® Tech Bulletins #6 and #9.

Table 4. Effects of feeding GAINPRO® vs. Bovatec® in growing cattle diets. (3 trial summary¹)

	GAINPRO®	Bovatec®	Advantage for GAINPRO®
Average Daily Gain (lbs./day)	2.69	2.54	+5.9%
DMI (lbs./day)	15.88	15.55	+2.1%
F/G	5.92	6.15	+3.7%

¹GAINPRO® Tech Bulletins #6, #7 and #9.

Developing heifers require a great deal of management to minimize potential problems during the transition period. Feeding a high-forage growing diet can build rumen capacity and maximize rumen health to help ensure optimum dry matter intake for the life of the animal. GAINPRO® can help reduce feed costs without sacrificing the opportunity to grow rumen volume or capacity which will pay dividends in long-term productivity of the properly developed replacement heifer.

1. Warner, R.D., W.P. Flatt and J.K. Loosli. 1956. J. Agr. Food Chem. 4:788.
2. Stobo, I.J.F., J.H. Roy and H.J. Gaston. 1966. Brit. J. Nutr. 20:171.
3. McGavin, M.D. and J.L. Morrill. 1976. Amer. J. Vet. Res. 37:497.
4. Nocek, J.E., C.W. Heald and C.E. Polan. 1984. J. Dairy Sci. 67:334.
5. Balbuena, O., W.E. Kunkle, D.B. Bates, J.E. Moore, L.E. Sollenberger and A.C. Hammond. 1996. J. Anim. Sci. 74(suppl. 1):198.

The Safety Record Of GAINPRO® Is Unsurpassed.

- Unlike Rumensin® and Bovatec®, GAINPRO® will not back cattle off feed or cause injury or death to cattle if accidentally overfed.
- GAINPRO® has no precautions or warnings to humans on its label pertaining to mixing and handling.
- GAINPRO® is nontoxic and shows no adverse side effects if accidentally consumed by horses.
- Cattle fed GAINPRO® at 400 mg/hd/day (20 times the recommended level) for 66 days showed no residues in kidney, liver, muscle, skin and fat.
- GAINPRO® was fed at 75 times the recommended dosage for 21 days to cattle with no adverse effects observed. Blood samples from these animals tested negative for residues.
- The use of GAINPRO® in cattle feed does not increase the quantity, prevalence or duration of salmonella shedding. There is no increase in the frequency of resistance in the indigenous coliforms or salmonella.

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