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Protein Deposition Prediction Equation

R. L. Hintz and F. N. Owens

Story in Brief

The protein deposition prediction equation which is a component of a model being developed by the S-156 Regional Project to simulate forage-beef production is as follows: protein gain (lb/day) from conception to maximum rate of gain = .37485 $[e^{(\ln(.006174/.37485)(DC\text{-}566)^2/566^2)}]$; protein gain (lb/day) from maximum rate of gain to maturity = .37485 $[e^{(\ln(.00002867/.37485)(DM^2/1177^2))}]$ where e is 2.71828, ln is the natural logarithm, DC is days after conception and DM is days after maximum rate of gain. Comparison with other protein deposition and gain predictions indicates that the equation predictions agree with predictions of other equations, particularly at lighter cattle weights.

Introduction

A computer model to simulate forage-beef production in the Southern region is being developed by the S-156 Regional Project. The purpose of this paper is to present a component of this forage-beef model which describes the protein deposition from conception to maturity.

Materials and Methods

Data reported by Moulton et al. (1922) were used to determine parameters of a sigmoid curve to describe protein deposition of steers from conception to maturity. The following parameters of a sigmoid curve were estimated:
Rate of protein gain at conception (lb/day) = .006174;
Maximum rate of protein gain (lb/day) = .37485;
Rate of Protein gain at maturity (lb/day) = .00002867;
Days from conception to maximum rate of protein gain = 566;
Days from maximum rate of protein gain to maturity = 1177.

Results and Discussion

The equation derived from data reported by Moulton et al. (1922) is: net protein gain (lb/day) from conception to maximum rate of protein gain = .37485 $[e^{(\ln(.006174/.37485)(DC-566)^2/566^2)}]$ where DC = days after conception and protein gain (lb/day) from maximum rate of protein gain to maturity = .37485 $[e^{(\ln(.00002867/.37485)(DM^2/1177^2))}[$ where DM = days after maximum rate gain. (Figure 1).

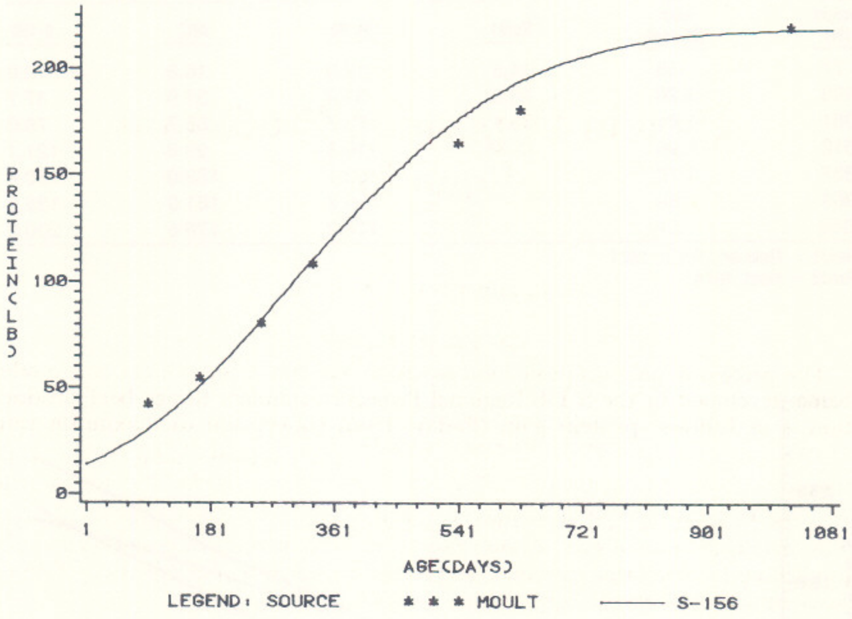

Figure 1. Plot of S-156 Equation and data reported by Moulton et al. (1922)

Similar equations as components of this forage-beef model have been developed to simulate retention of fat, water and ash. The summation of fat, water, ash and protein gain is an estimate of empty body weight gain. This approach can simulate animals of similar weights with different body composition. Also, simulation of animals with similar protein deposition and different empty body weights can be achieved.

Regression equations have been estimated to predict protein deposition and/or gain as a function of weight, average daily gain and/or mature weight (Reid and Robb, 1971; Reid, 1974; Byers and Rompala, 1979; Garrett, 1981; Lofgreen, 1981; ARC, 1980). An animal has been simulated with the S-156 forage-beef model to make comparisons with other predictions. In studying the results, recall that the S-156 forage-beef model can simulate animals with similar protein deposition and different empty body weights since fat, water, ash and protein deposition are predicted with different equations. Comparison of other protein deposition predictions with the S-156 prediction indicates that they agree well at lighter cattle weights, but the S-156 equation predicts a greater rate of protein for heavier cattle (Table 1). The S-156 equation predictions and predictions from two equations developed by Reid agree very closely from birth to 725 lb (Figure 2). The difference in protein deposition of the heavier weights of cattle can be reduced by simulating an animal with a faster rate of fat deposition without changing the protein deposition. Similar conclusions are

Table 1. Protein deposition predictions (lb)

Empty body weight (lb)	Empty body gain (lb/day)	Source[1]			
		Reid1	Reid2	ARC	S-156
77	.68	14.5	12.3	16.8	13.9
193	1.28	36.9	37.8	37.0	37.7
381	1.81	73.1	75.7	65.7	76.6
612	1.96	117.4	116.3	99.0	121.1
837	1.70		150.1	133.0	160.4
983	.88		168.7	161.0	188.9
1066	.51		178.2	176.6	206.0

[1]Reid1 = Reid and Robb, 1971.
Reid2 = Reid, 1974.

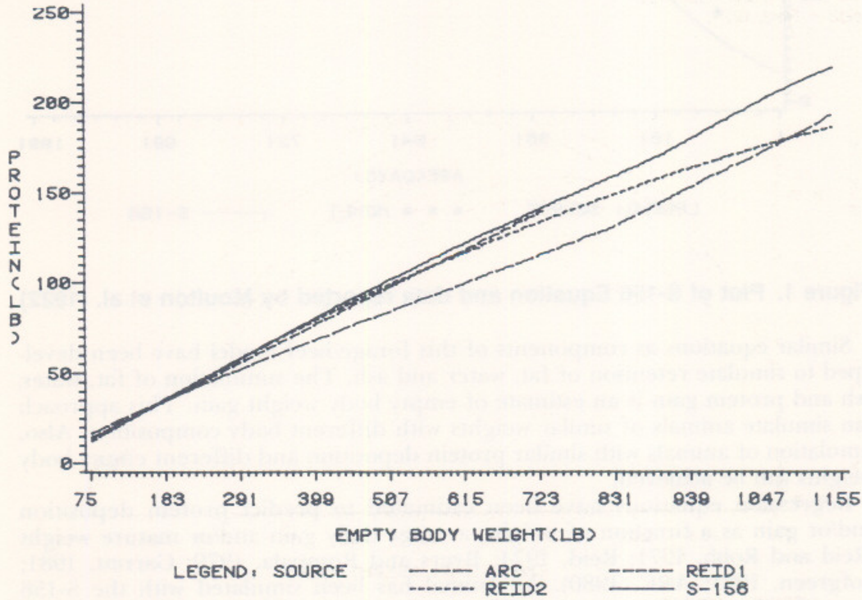

Figure 2. Protein deposition predictions

drawn when comparing other protein gain predictions with the S-156 prediction (Table 2). The protein gain increases as the animal grows until it reaches a certain weight; then the protein gain decreases as the animal grows (Figure 3). With the simulated animal, protein deposition and gain predictions agree at lighter weights of cattle but differ at heavier weights of cattle. The decrease in gain is a function of (1) decreased rate of gain and (2) decreased protein content of deposited tissue.

The flexibility of the S-156 forage-beef model allows one to simulate animals with different body composition. Simulation of the components, fat, water, ash and protein, will improve our ability to simulate animal performance (e.g. average daily gain and carcass composition). Continual refinement of these equations for the S-156 forage-beef model will improve their flexibility and usability.

Table 2. Protein gain predictions (lb/day)

Empty body weight (lb)	Empty body gain (lb/day)	Source[1]						
		Reid1	Reid2	Byers	Garrett	Lofgreen	ARC	S-156
77	.68	.131	.154				.118	.135
193	1.28	.247	.272				.204	.267
381	1.81	.348	.344		.320	.296	.259	.366
612	1.96	.377	.319	.348	.290	.275	.260	.360
837	1.70		.233	.237	.212	.200	.220	.288
983	.88		.104	.129	.101	.090	.117	.189
1066	.51		.057	.059	.057	.048	.070	.101

[1]Reid1 = Reid and Robb, 1971.
Reid2 = Reid, 1974.

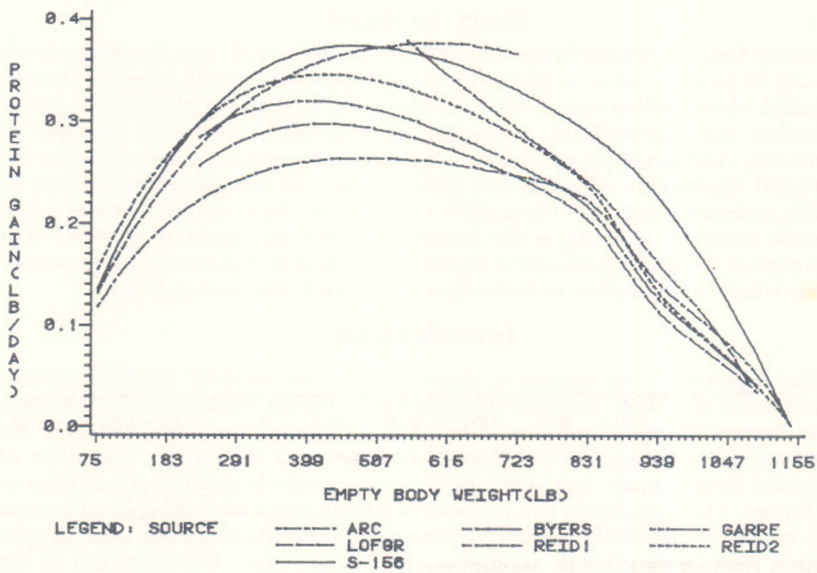

Figure 3. Protein gain predictions

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Effect of Intake and Roughage Level on Digestion

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Story in Brief

Twenty-four Hereford-Angus steers (800 lb) were fed two roughage levels (10 and 50 percent) at two intake levels (1 and 2 percent of body weight). The diet included whole shelled corn (WSC), forage and 8 percent supplement. As intake increased, the digestibilities of organic matter, starch, fiber and nitrogen all decreased. Additional forage in the diet decreased organic matter digestion but increased digestibility of starch and fiber. Intake and roughage level effects on rumen retention time and ruminal pH may explain these results. Forages which increase retention of grain in the rumen may increase digestion of WSC. The influence of forage level on starch digestion may be less important with processed grains where fermentation is more rapid and starch digestion is higher.

Introduction

The digestibility of rations is depressed as the level of intake increases (Andersen et al., 1959). Reduced digestibilities at higher intakes may be the result of an increased rate of passage through the digestive tract and less time for digestion. Since forages may influence passage rates differently, the effect of increased forage intake may differ with physical and chemical characteristics of the forage. The objective of this research was to examine the influence of level of feed intake on digestibility of mixed diets containing whole shelled corn supplemented with various forage sources at two forage levels. Corn was fed in the whole form to enhance effects of intake and roughage level on digestibility.