

## 한우 거세 및 비거세우의 성장곡선 특성

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# Growth Curve Characteristics of Bull and Steer of Hanwoo (Korean Cattle)

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### 요 약

농협 한우 개량부에서 시험 사육한 거세우 및 비거세우 각각 60두의 자료를 근거로 고펜트츠 방정식에 의한 성장곡선을 추정한 결과 비거세우의 성장곡선 방정식은  $W_t = 906.1 \cdot \exp\{-3.956 \cdot \exp(-0.0034t)\}$ 이었으며, 거세우의 성장곡선 방정식은  $W_t = 823.1 \cdot \exp\{-3.301 \cdot \exp(-0.0027t)\}$ 이었다. 이 추정식에 의한 성숙체중은 과거에 추정된 식보다 높게 추정되었는데 이는 사양조건의 차이에 의한 것으로 사료된다. 비거세우에 대한 거세우의 체중비는 19.5개월까지는 급격히 감소하여 79.2% 정도에 이르렀으나, 이후 격차는 서서히 줄어들어 성숙시에는 90.8%에 이르렀다. 추정식은 생시 체중이 거세우의 경우 과다하게 그리고 비거세우의 경우 과소하게 추정되었으며, 실제 체중의 변이는 비거세우가 거세우에 비해 큰 경향을 보였다.

(Key words : Growth curve, Gompertz equation, Hanwoo, Korean cattle)

## I. INTRODUCTION

Growth models summarize information needed to understand the biological phenomenon of growth (Menchaca et al., 1996) or to construct computer simulation model of beef cattle (Kim and Ju, 1996). Some important traits, such as relative and absolute growth rates, maturing rate, and mature size can be described by using

growth functions in the simulation model (Kim et al., 1996; Kaps et al., 2000). Several nonlinear models have been evaluated with regard to their goodness of fit and biological interpretation of the parameters (Kim et al., 1996).

Farmers in Korea tend to castrate for young bulls in order to increase the marbling score, which is very important trait for high quality

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production. Therefore, the knowledge on growth patterns of steer is important in beef production system. However, It is very difficult to find out the growth curve equation of steer.

The objective of this study was to estimate the growth curves and to compare those characteristics of bull and steer of Hanwoo.

## II. MATERIAL AND METHOD

60 bulls and 60 steers about 6 months of age were raised from 1996 to 2001 up to 30 months of age at Korean Native Cattle Improvement Center, Seosan. The steers were castrated at 3 months of age. Weights of animals were recorded at birth and at 6~30 months of age by 28 days interval.

The Gompertz model (Gompertz, 1825) used to estimate growth curve was  $W_t = A \cdot \exp(-b \cdot \exp(-kt))$  where,  $W_t$  is body weight of animal at age  $t$ (day),  $A$  is a mature weight or upper asymptote,  $k$  is a function of the ratio of maximum growth rate to mature size and  $b$  is a function of the ratio of birth weight to mature size. DUD (doesn't use derivatives) method of NLIN procedure (SAS, 1988) was used to estimate parameters of growth functions, and the convergence criterion was  $(SSE_{i-1} - SSE_i)/SSE_i + 10^{-6} < 10^{-8}$ , where  $SSE_i$  is sum of squares of error for the  $i$ th iteration.

## III. RESULT AND DISCUSSION

The Growth curve equations of bull and steer of Hanwoo by Gompertz model (Gompertz, 1825) were estimated as follows;

$$\text{Bull : } W_t = 906.1 \cdot \exp\{-3.956 \cdot \exp(-0.0034t)\}$$

$$\text{Steer : } W_t = 823.1 \cdot \exp\{-3.301 \cdot \exp(-0.0027t)\}, \text{ where } t \text{ is days of age.}$$

The estimated mature weight, inflection weight and inflection days of bull were 906.1kg, 333.3kg and 407days and those of steer were 823.1kg, 302.8kg and 444days, respectively (Table 1). Mature weight estimated with Gompertz equation of bull was 906.1kg that is higher than earlier studies: 688.4kg(Kim et al., 1996), 545.4kg(Chung and Choi, 1998), 807.6kg(Cho, 2000). Environmental factor affects the parameters of growth curve, which estimated using uncorrected weight observations (Brown et al., 1976). In this case, major factor raising differences is feeding level.

Body weight was under-estimated for bull at birth, but over-estimated for steer at the same stage, but after yearling weight, the estimated and observed weights showed similar values (Table 2). However, the variations of bull were larger than the steer (Table 2, Fig. 1, 2). It indicated that the castration of bull calves suppressed the growth and reduced the variation.

Table 1. Growth curve parameters, inflection points and residual mean squares (RMS) estimated with the Gompertz equation for bull and steer of Hanwoo

Sex	Parameters*			RMS	Age at Inflection (day)	Body wt. at Inflection (kg)
	A ± SE	b ± SE	k ± SE			
Bull	906.1 ± 13.26	3.956 ± 0.0846	0.0034 ± 0.00009	2,055.0	407	333.3
Steer	823.1 ± 15.15	3.301 ± 0.0489	0.0027 ± 0.00007	744.6	444	302.8

\*A is a mature weight, the asymptotic value as age approaches infinity.

b is a function of the ratio of birth weight to mature size.

k is a maturing index, a function of the ratio of maximum growth rate to mature size.

Table 2. Body weight means of different stages of growth and those of estimate with the Gompertz equation for bull and steer of Hanwoo (kg)

Age (month)	Bull		Steer	
	Mean ± SE	Estimate	Mean ± SE	Estimate
At birth	23.0 ± 0.27	17.3	22.3 ± 0.33	30.3
12	273.4 ± 5.05	286.1	233.9 ± 3.36	238.8
18	491.6 ± 7.55	486.8	390.0 ± 4.24	386.2
24	658.2 ± 9.62	647.5	515.6 ± 6.57	517.6
30	734.5 ± 12.28	756.0	623.4 ± 6.63	619.8

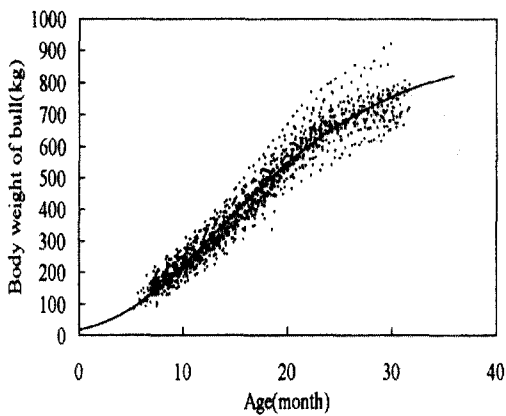


Fig. 1. Growth curve estimated with Gompertz equation and actual data of Hanwoo bull.

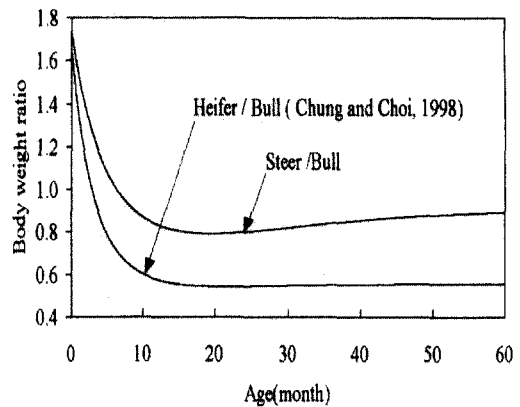


Fig. 3. The relative growth of steer to bull of Hanwoo.

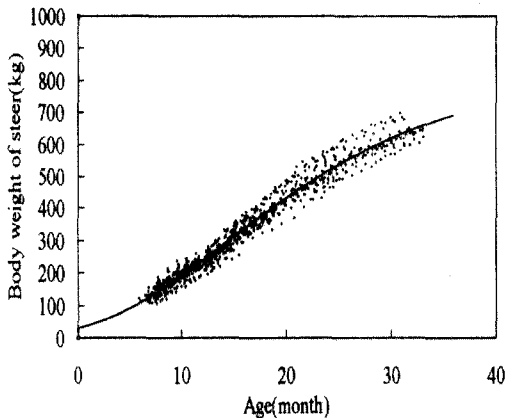


Fig. 2 Growth curve estimated width Gompertz equation and actual data of Hanwoo steer.

The weight loss by castration is about 20% at 24 months of age.

Relative body weights of steer to bull were rapidly decreased to 79.2% until 19.5 months of age, and then increased slowly (Fig. 3). The ratio was 90.8% at mature state. Chung and Choi (1998) reported that the minimum relative body weight of heifer to bull was 54.4% at 21.5 months of age, and the ratio at mature state of heifer was 55.7%. Those facts indicated that growth pattern of steer is more similar with bull than heifer.

#### IV. ABSTRACT

Body weight-age data from 60 bulls and 60

steer of Hanwoo in the Korean Native Cattle Improvement Center was used to determine the growth curve parameters with Gompertz equation. Estimated growth curve functions were as follows;

$$\text{Bul l : } W_t = 906.1 \cdot \exp\{-3.956 \cdot \exp(-0.0034t)\}$$

$$\text{Steer : } W_t = 823.1 \cdot \exp\{-3.301 \cdot \exp(-0.0027t)\}$$

Mature weight estimated with Gompertz equation of bull is higher than earlier studies. And the major factor raising differences from the other is feeding level. Relative body weights of steer to bull were rapidly decreased to 79.2% until 19.5 months of age, and then increased slowly. The ratio was 90.8% at mature state. Body weight was under-estimated for bull at birth, but over-estimated for steer, and the body weight variations of bull were larger than the steer.

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