

**Studies on castration and growth period for
improving meat quality of Holstein bulls**

II.

**II. Determination of reasonable TDN level in
finishing concentrate for Holstein steers**

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1997. 12.. 20.

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SUMMARY

To produce high quality meat and to determine market weights of Holstein, animal were castrated at 200-250kg of body weight. Growth performance of steers were compared with bulls reared under the same feed and feeding condition. Steers were sacrificed at 500-550kg, 600-650kg and 700-750kg of body weight. Steers sacrificed at 600-650kg showed best result, but meat yield grade was decreased by castration. To improve meat yield grade, steers (4 animals/treatment) were fed on a diet containing three levels of TDN (CP 12%, TDN 70%, 72%, and 74%). Three bulls were fed on a diet containing CP 12% and TDN 70%. Results obtained from this study were as follows;

1. Total experimental period of bulls was 17.8-18.9 months, and experimental period of steers were shorter (0.7 - 1.1 months) than steers.
2. There were no differences in daily weight gain (0.96-1.09kg) and daily feed intake (8.4-9.1kg) between treatments.
3. There was difference in dressing percentage (57.1-59.6%) between treatments.
4. There were no differences in the percentage of tenderloin, loin, striploin, brisket-flank, rib-bone in between treatments. But, bulls showed better ($P < 0.05$) percentage of round, sirloin-knuckle, chuck-clod, neck, shank than steers. Bulls that are low in trimmed fat showed higher ($P < 0.05$) retail cut and steers that are high in

trimmed fat showed low retail cut. But, there was no difference by TDN levels.

5. The bone percentage (15.5- 16.1%) showed no difference between treatments.

6. Meat yields of bulls showed 100% in grade B, but steers showed 50%, 50%, and 25% grade B in TDN 70%, 72%, and 74%, respectively. Steers showed 50%, 50%, and 75% grade C in TDN 70%, 72%, and 74%, respectively.

7. All bulls showed carcass quality grade 3, but steers showed 50%, 50%, and 25% of carcass quality grade 1 in TDN 70%, 72%, and 74%, respectively. Steers showed 50%, 0%, and 50% of carcass quality grade 2 in TDN 70%, 72% and 74%, respectively, and steers showed 0%, 50%, and 25% of carcass quality grade 3 in TDN 70%, 72%, and 74%. Overall, steers fed on TDN 70% diet showed the best carcass quality.

8. Marbling degree was poor (1.3) in bulls because of low deposit fat in rib-eye muscle. Steers fed on TDN 70% diet showed the best (3.9, $P < 0.05$) marbling degree.

9. Bull showed higher moisture and protein content in loin than steers, but bulls showed lower fat content ($P < 0.05$) than steers. Steers showed no differences in moisture and protein content between levels of TDN.

10. There were no differences in shear force (3.7- 40kg/cm²) and water holding capacity (48.7- 51.0%) between treatments.

11. There was no difference in L(lightness) and b(yellow) values of meat color between treatments.

12. Steers fed on a 70% TDN diet showed an economic benefit by 123,977 won/animal, when feed intake and carcass sale were considered.

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1		
2		
3	12
1		
2		
3	가	
4		
5		
6		
4	26
5	28

1

1

1.

	(1997)		1996		
	22.7%			1	가
8,155	/kg	1	11,412	/kg	71.5%
	1996			168	87
(51.8%)		315	(0.2%)		

가 Jacobs (1977), (1996)

가 .

가

	1			
	3	100%		600- 650kg
	1	66.6%		.
(1997)		1		625kg
13.75%	,	(1997)	'96	
		0.1%	(74 /86,824)	,
10.2%	(32 /315)			
	.	가	1	2
	10.7%, 15.0%			
	가	.		

(1997) C
 6.8%, 15.9%
 B 100%
 600- 650kg C 62.5% 가 .

2.

600- 650kg 가
 550kg 650kg
 TDN 70, 72, 74%
 , 가 ,

2

1 .
 95- 110kg 15 , 200~250kg
 12 TDN 3 4
 3 가
 1.
 (300kg), (450kg), (550kg)
 , (650kg)

가 2. CP12%
 TDN 70, 72, 74% 3 , 550kg

Table 1. Chemical composition of purchased cocentrates and roughage

	composition %							
	moisture	crude protein	crude fat	crude fiber	NFE	ash	Ca	P
Growing 1)	11.1	13.72	1.85	14.83	48.97	9.54	0.52	0.33
Fattening 2)	10.3	14.33	2.89	9.82	52.52	9.90	0.75	0.54
Finishing 3)	14.6	13.08	3.07	4.46	59.27	5.54	1.28	0.37
Rice straw	12.2	5.01	1.76	30.11	39.55	12.32	0.33	0.10

1) : 100 - 300kg, 2) : 300 - 450kg, 3) : 450- 550kg

Table 2. Chemical composition of finishing concentrates fed from 550kg to final live weight

	bull		steer	
	TDN 70%	TDN 70%	TDN 72%	TDN 74%
CP	12.00	12.00	11.97	12.00
Crud fat	1.50	1.50	2.00	3.78
Crud fiber	15.00	15.00	9.88	19.80
Ash	10.00	10.00	9.88	7.93
Ca	0.6	0.6	0.7	0.7
P	0.3	0.3	0.4	0.3
TDN	70.00	70.00	72.12	74.02

2

16

4

가

가 ,

가 (1993)

10

,

가 13

AOAC , 가

3cm 가 70 10 가

가 % (Shear force) 가

0.5inch

, Warner Bratzler Shear- meter(G- R Elec. Mfg.

Co., USA) kg/cm2 .

Saffe Galbreath(1964)

5g 3%NaCl 30ml 가

(14,00rpm/2min.) 1,500 x G /10min.

3 100ml Cronall (1949)

biuret

mg/g .

가

Chroma- meter(CR- 10, Minorta Co., Japan) 3

CIE(: Commission Internationale de

l'Eclairage) L, a, b, .

(1996) Holstein (1996)
 (1.00- 1.14kg) , (1996)
 550- 650kg (0.71- 0.65kg)
 (1997) CP 11.5%, TDN 72.5%
 (0.8kg), (10.8kg)

Table 3. Daily gain and feed consumption of Holstein bulls and steers during whole period.

	Bulls		Steers	
	TDN 70%	TDN 70%	TDN 72%	TDN 74%
Initial body wt. kg	97.7 ± 8.0	92.8 ± 24.4	92.0 ± 17.3	89.0 ± 10.9
Final body wt. kg	644.0 ± 98.8	632.7 ± 8.3	647.7 ± 22.1	629.5 ± 13.0
Feeding period, months	17.8	18.5	18.5	18.9
Daily gain kg/day	1.02 ± 0.04	0.96 ± 0.08	0.98 ± 0.06	1.00 ± 0.07
Feed intake kg/kg gain	8.4 ± 0.4	9.1 ± 0.7	8.5 ± 0.5	8.7 ± 0.5

Within each columns with different letter are significantly differ at 5% by Duncan's range test

2 .

가 TDN 70% 59.6%

가 , , TDN 57.1- 59.6%

가 (p>0.05), (,)

(1996) 600- 650kg .

가 550kg 650kg 가

가 .

10 (Tenderlion),

(Loin), (Striploin), (Brisket- flank), (Rib- bone in)

1.9- 2.0%, 9.4- 10.9%, 1.9- 2.1%, 10.1- 10.5%, 13.1- 14.1%

, , TDN 가 . (Round), (

Sirloin- knuckle), (Chuk- clod), (Neck), (Shank)

가 (P<0.05). (1996) ,

, 가 가

.

가

3.5- 5.1% 가 가

(P<0.05), TDN 68.0- 69.3%

가 . (,)

) 600- 650kg . (1989)

5.6%

6.2% 가 1% .

(1996), (1996) 가
, Jacobs (1977)

Table 3. Percentage of portion yield in Holstein bulls and steers fed different TDN level from 550kg to final weight

Portion cut	Bulls		Steers					
	TDN 70%		TDN 70%		TDN 72%		TDN 74%	
	%	SD	%	SD	%	SD	%	SD
Carcass	58.0	±1.9	59.6	±0.6	57.1	±0.5	57.7	±1.1
Tenderlion	2.0	±0.1	1.9	±0.2	2.0	±0.1	2.0	±0.1
Loin	10.9	±1.1	9.5	±0.7	10.0	±0.7	9.4	±1.1
Striplion	2.0	±0.1	1.9	±0.2	2.0	±0.1	2.1	±0.1
Round	6.9	±1.1a	5.7	±0.4b	5.9	±0.1b	6.1	±0.3ab
Sirlion.knuckle	11.4	±0.3a	10.5	±0.3b	10.6	±0.3b	10.3	±0.5b
Chuck-clod	7.2	±0.3a	6.6	±0.2b	6.8	±0.3ab	6.6	±0.3b
Neck	4.3	±1.7a	2.7	±0.3b	2.8	±0.3b	2.9	±0.4b
Brisket-flank	10.5	±0.5	10.5	±0.2	10.2	±0.7	10.1	±0.6
Shank	4.4	±0.2b	4.7	±0.2ab	5.0a	±0.4	4.8	±0.2ab
Rib (bone in)	13.2	±0.2	14.1	±0.6	13.7	±0.6	13.5	±0.6
Retail cut 1)	72.9	±1.6a	68.3	±0.9b	69.3	±1.3b	68.0	±1.6b
Bone	16.0	±0.9	15.5	±1.3	15.9	±1.0	16.1	±0.7
Trimmed Fat	9.6	±1.4b	14.5	±1.3a	13.1	±0.8a	14.7	±1.7a

1) sum of meat included bone in rib

Within each columns with same letter are not significantly differ at 5% by Duncan's range test

15.5- 16.0% 가
 (p<0.05). 600- 650kg
 14.3% 1% 가 , (1996)
 가 , (1996)
 , (1997)
 가 . (1997)
 10.11- 12.70% 4- 5%
 .
3 . 가
 4 16 가 가
 5. . B 3 B- 3
 100% , 가
 B C 50%, 50% ,
 .
 600- 650kg 33.4%
 TDN 16.6%
 .
 가 3 100%
 , TDN 70, 72, 74%
 1 50%, 50%, 25% 2
 50%, 0%, 50%, 3 0%, 50%, 25% . TDN 70%

가 1 B 50% 가

(1996) 1996 315

A, B, C 0.3%, 83.2%, 15.9% , 1, 2,

3, 10.2%, 26.3% 62.9%

(1996)

A, B 0.6%, 76.6% , 1 (5, 4) 2

(3) 1.4%, 29.6%

Table 4. Frequency of carcass grade determined by Korean standard in Holstein bulls and steers fed from 550kg to final weight at different TDN level

Grade		Bulls		Steers		Total n = 12
		TDN 70 n = 3	TDN 70 n = 4	TDN 72 n = 4	TDN 74 n = 4	
Yield	A	0	0	0	0	0
	B	3 (100)	2 (50)	2 (50)	2 (50)	6 (50.0)
	C	0	2 (50)	2 (50)	2 (50)	6 (50.0)
Quality	1	0	2 (50)	2 (50)	1 (25)	5 (41.7)
	2	0	2 (50)	0	2 (50)	4 (33.3)
	3	3 (100)	0	2 (50)	1 (25)	3 (25.0)
Yield & Quality	B-1	0	1 (25)	1 (25)	1 (25)	3 (25.0)
	B-2	0	1 (25)	0	1 (25)	2 (16.7)
	B-3	3 (100)	0	1 (25)	0	1 (8.3)
	C-1	0	1 (25)	1 (25)	0	2 (16.6)
	C-2	0	1 (25)	0	1 (25)	2 (16.7)
	C-3	0	0	1 (25)	1 (25)	2 (16.6)

yield grade : A= abundant of lean meat (yield index : >77.0),

C= poor of lean meat (yield index : <74.5)

quality grade : 1st class=1, 2nd class=2, 3rd class=3

Table 6. Carcass yield traits, index and grade measured by Korean standard in Holstein bulls and steers fed from 550kg to final weight at different TDN level

Item	Bull		Steer	
	TDN 70% x(n=3) SD	TDN 70% x(n=4) SD	TDN 72% x(n=4) SD	TDN 74% x(n=4) SD
Live weight kg.	644.0 ±98.8	632.7 ±8.4	647.7 ±22.1	629.5 ±13.1
Carcass kg.	375.0 ±68.4	377.0 ±7.7	369.7 ±15.6	363.2 ±10.2
Back fat cm	0.27 ±0.11	0.46 ±0.05	0.43 ±0.22	0.48 ±0.17
Eye-muscle area cm ²	80.7 ±14.4	68.5 ±9.8	72.3 ±11.2	71.0 ±3.7
Yield index	75.1 ±0.2a	73.7 ±0.8b	74.2 ±0.8ab	74.0 ±0.6ab
Yield Grade	2.0 ±0.0	2.5 ±0.6	2.5 ±0.6	2.0 ±0.6
Marbling score 1)	1.3 ±0.2b	3.9 ±1.4a	2.8 ±1.5ab	2.6 ±1.1ab
Meat color score 2)	4.7 ±0.5	4.0 ±0.8	4.3 ±0.5	4.5 ±0.6
Fat color score 3)	2.3 ±0.6	2.3 ±0.5	2.3 ±0.5	2.3 ±0.5
Firmness score 4)	2.1 ±0.3	1.7 ±0.3	1.9 ±0.3	2.0 ±0.0
Maturity score 5)	1.25 ±0.0	1.25 ±0.0	1.25 ±0.0	1.25 ±0.0
Quality Grade	3.0 ±0.0b	1.5 ±0.6a	2.0 ±1.2ab	2.0 ±0.8ab

Within each columns with same letter are not significantly differ at 5% by Duncan's range test.

$$\begin{aligned} \text{Yield index} = & 74.80 - [2.001 \times \text{backfat thickness (cm)}] \\ & + [0.07 \times \text{longissimus dorsi area (cm}^2\text{)}] \\ & - [0.014 \times \text{carcass weight (kg)}] \end{aligned}$$

Yield grade : A class=1, abundant of lean meat (yield index : >77.0),
C class=3, poor of lean meat (yield index : <74.5)

1) abundant=5 to devoid=1

2) light cherry red=1 to dark red=7

3) light =1 to yellowish=7

4) muscle texture : firm and fine=1 to soft and coarse=3

5) skeletal maturity : no-ossification=1 to complete ossified=3

quality grade : 1st class=1, 2nd class=2, 3rd class=3,

determined with each of item from 1) to 5)

(1996) , Holstein B 33.3%,
 12.5% , 3 (100%), 2 (87.5%) 3
 (12.5%)

가 6. 가 75.1
 73.7- 74.2 (p>0.05),

TDN 가 .
 600- 650kg 가 .

(1996), (1996) Holstein 가 ,
 (1997) (75.62- 75.77) .

0.27cm 0.43- 0.48cm
 (1996) 700- 750kg

가 , (1996)
 Holstein 1.19- 1.36cm (1997)

가 1- 3 1.28- 1.08cm .
 (rib eye muscle) 80.7cm²

68.5- 72.3cm² ,
 TDN . 600- 650kg

(70.5cm²) 가 , (1996),
 (1996) , (1997) 3

82.14cm² .

가 1.3

TDN 70% 가 3.9
(p>0.05), Worrell (1987), Field (1966), (1996), Jacobs
(1977) 가 . Miller
(1987), (1996)

, 가 , Jacobs (1977)

TDN

가 , (1996)
가 .

4 .

가 13 eye muscle()
7.
73.6%, 20.8% 69.6- 70.3%,
19.4- 19.7% 4.6%
9.3- 11.2% 가 (p<0.05).

(500- 550kg) (500- 750kg) 20.74% 19.4 .
20.97% 가
, (1997) 1
70.2%, 7.1%
가 .

Table 7. Composition of Rib-loin in Holstein bulls and steers fed from 550kg to final weight at different TDN level

% of contents	Bull		Steer	
	TDN 70%	TDN 70%	TDN 72%	TDN 74%
	x(n=3) SD	x(n=4) SD	x(n=4) SD	x(n=4) SD
Moisrure	73.6 ±0.4a	69.6 ±0.5b	70.3 ±1.2b	70.0 ±0.8b
Protein	20.8 ±0.5a	19.4 ±0.5b	19.5 ±0.7b	19.7 ±0.7ab
Fat	4.6 ±0.4b	11.2 ±0.9a	9.3 ±1.5a	9.3 ±0.9a
Ash	0.95 ±0.02	0.92 ±0.04	0.90 ±0.04	0.91 ±0.05

Within each columns with same letter are not significantly differ at 5% by Duncan's range test

Table 8. Physicochemical properties of rib-loin in Holstein bulls and steers fed from 550kg to final weight at different TDN level

Properties	Bulls		Steers	
	TDN 70%	TDN 70%	TDN 72%	TDN 74%
	x(n=3) SD	x(n=4) SD	x(n=4) SD	x(n=4) SD
Shear porce kg/cm2	3.8 ±0.4	3.8 ±0.4	4.0 ±1.0	3.7 ±0.5
WHC %	48.7 ±4.3	51.0 ±3.6	48.9 ±5.4	50.3 ±4.5
Heating loss %	42.8 ±2.4	41.1 ±1.4	42.6 ±2.1	42.3 ±1.5
Meat color : L (CIE)	34.6 ±1.5	37.0 ±1.8	37.8 ±2.4	35.1 ±1.0
	+a	18.5 ±0.9	19.5 ±1.3	19.2 ±1.0
	+b	6.7 ±0.4	8.3 ±2.2	7.8 ±1.5

Within each columns with same letter are not significantly differ at 5% by Duncan's range test,

WHC : water holding capacity

L : brightness value. +a : red value. +b : yellow value

8. 3.7~ 4.0kg/cm²

48.7- 50.3% TDN

가 .

(1997) 5.12- 5.50kg/cm² , (1996b)

6.20- 9.57cm² , (1996)

650kg (5.13- 7.79kg/cm²)

가 , (1996b)

가 .

가 41.1- 42.8% 가 ,

가 , Miller (1987)

(1996) 가

가 .

Chroma- meter L(), +b()

TDN ,

가 +a() 가 .

(1996a) L. a. b.

a, b , Shackleford (1992) L

, (1996b)

가 가 , Feldhusen

(1995) Oxymyoglobin +a 가

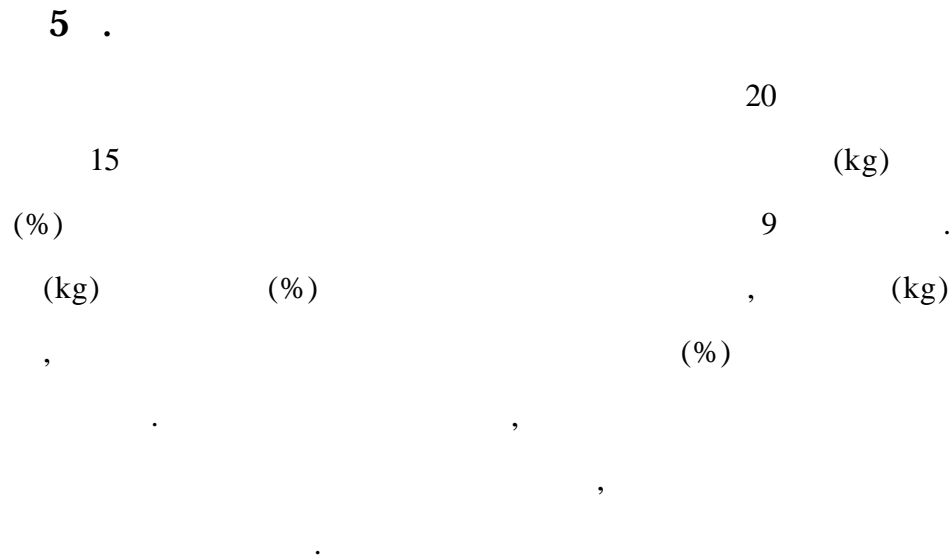


Table 9. Correlation between percentage of portion yield and yield's factor

n = 35	carcass kg	loin kg (%)	retail cut kg (%)	eye muscle area (cm ²)	back fat thickness	yield index
carcass kg	1					
loin kg (%)	.5813** (.1420)	1				
retail cut kg (%)	.9121** (-.5780**)	.7111** (.3549)	1			
eye muscle ¹⁾	.4482*	.5486** (.4182*)	.5831** (.0789)	1		
fat thickness	.4457*	.1678 (-.0287)	.2111 (-.5767**)	-.1321	1	
yield index	-.4967*	-.0540 (-.2089)	-.2422 (.6698**)	.4660*	-.8286**	1

* : correlation significant at 0.01

** : correlation significant at 0.001

(): correlation coefficients among the % of loin and retail cut with eye muscle area, back fat thickness and yield index

1) rib eye muscle area (cm²)

(%)

가

가

30 data

$$\text{Retail cut \% (Yield index)} = 78.63 - [3.46896 \times \text{backfat thickness (cm)}] \\ + [0.10406 \times \text{longissimus dorsi area (cm}^2)] \\ - [0.04250 \times \text{carcass weight (kg)}]$$

6 .

가

1996

가 (1996)

가

10.

TDN 70%

123,977

TDN 72%, 74%

가

가

TDN 70%

Table 10. Comparison of profit between prices of carcass and consumed feed stuffs

won/head	Bull	Steer		
	TDN 70%	TDN 70%	TDN 72%	TDN 74%
Market price of Carcass*	2,310,750	2,797,905	2,539,626	2,545,770
Calf price, purchased	1,200,000	1,200,000	1,200,000	1,200,000
Feeds : concentrates	1,228,585	1,266,928	1,209,680	1,210,349
: rice straw	204,700	207,000	207,000	196,950
Investment	2,633,285	2,673,928	2,616,680	2,607,299
Income	- 322,535	123,977	- 77,054	- 61,529

* Average prices according to carcass grade at the auction market in a year(1996)

4

600- 650kg가

500- 550kg

600- 650kg

74% 3 CP 12% TDN 70%, 72%,
 3 (CP 12%, TDN 70%)
 12 TDN 3 4
 가 , 10

1. 17.8- 18.9

0.7- 1.1

2. 0.96- 1.09kg

8.4- 9.1kg

가

3. 57.1~59.6% , TDN

가

4. , , , , TDN

가 , , , ,

(p<0.05).

가 (p<0.05),

TDN

5. 15.5- 16.1% 가 .
6. B 100%
 TDN 70%, 72%, 74% B 50%, 50%, 25% ,
 C 50.%, 50.%, 75% .
7. 3 100%
 TDN 70%, 72%, 74% 1 50%, 50%, 25% , 2
 50.%, 0.%, 50% . 3, 0%, 50%,
 25% TDN 70%
 가 .
8. 1.3
 TDN 70%가 3.9 가 (p<0.05).
9. 가 ,
 (p<0.05). TDN
10. 3.7~4.0kg/cm² 48.7- 51.0% ,
 TDN 가 .
11. Chroma- meter L(), +b()
) , TDN 가 .
12. 가 ('96) (+)
 TDN 70% 123,977
 TDN 72%, 74% .

5

1. , , , , (1995)
 . 19(1) 69- 80.
2. , , , , , . (1996).
Holstein ,
 . 38(2) 610- 618.
3. , , , 199 .
 () 30(3) 15- 19
4. , , , , , , 1996.
 . 38(3)
239- 248.
5. , , , , , , 1996.
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9. , , , 1997.
가 . 39(4) 375- 382
10. (1996). . 15- 47.
11. 가 (1993). 가 . 6.
621- 630
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1.

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2.

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3. 가

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