

# Effects of dietary protein level on growth performance and nitrogen excretion of dairy heifers

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## Objective:

## Methods:

(11.9%), (13.5%) (70% 30%)  
(2.47 / ).

## Results:

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( <0.05)

## Conclusions:

11.9% ( 2.47 / )  
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## Keywords:

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## INTRODUCTION

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**MATERIAL AND METHODS**

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**Table 1.** Composition of diets with low, medium, and high protein

Ingredient, % of DM	Dietary treatment <sup>1)</sup>		
	Low	Medium	High
Chinese wild rye	40.7	40.7	40.8
Corn silage	27.1	27.2	27.2
Corn	16.0	12.8	10.6
Barley	3.2	2.6	0.0
Rapeseed meal	3.3	3.3	3.3
Soybean meal	3.2	6.4	9.6
DDGS (corn)	4.1	4.7	6.3
Mineral-vitamin premix <sup>2)</sup>	2.3	2.3	2.4
Chemical composition (DM basis)			
CP (%)	10.2	11.9	13.5
RUP <sup>3)</sup> (% of CP)	32.3	32.3	32.7
MP <sup>4)</sup> (%)	8.64	9.10	9.58
NDF (%)	59.4	58.6	61.8
ADF (%)	29.0	29.1	28.4
Ca (%)	0.79	0.80	0.81
P (%)	0.22	0.22	0.24
Ash (%)	6.45	6.59	6.95
ME <sup>5)</sup> (Mcal/kg)	2.47	2.47	2.48

DM, dry matter; DDGS, distillers dried grains with solubles; CP, crude protein; RUP, rumen undegraded protein; MP, metabolizable protein; NDF, neutral detergent fiber; ADF, acid detergent fiber; ME, metabolizable energy.  
<sup>1)</sup> Low, low level of dietary CP; Medium, medium level of dietary CP; High, high level of dietary CP.  
<sup>2)</sup> Mineral-vitamin premix per kg containing: Ca 166 g; Fe 1,800 mg; Cu 630 mg; Mn 630 mg; Zn 2,940 mg; Se 21 mg; I 38 mg; Co 8 mg; Vitamin A 240,000 IU; Vitamin D 60,000 IU; Vitamin E 1,200 IU.  
<sup>3)</sup> RUP value was estimated to be 30.5%, 35.35%, 37.0%, 19.6%, 26.6%, 30.8%, 47.5% of CP for Chinese wild rye, corn silage, corn, barley, rapeseed meal, soybean meal, DDGS (NRC,2001 [4]; NY/T-34, 2004[9]).  
<sup>4)</sup> MP (%) = 0.64 × microbial protein + 0.8 × RUP of CP(%) × CP(%), where microbial protein = 3.8 × Mcal of ME/kg DM.  
<sup>5)</sup> The ME value was estimated to be 2.33, 2.21, 3.12, 3.10, 2.75, 3.31, 3.03 Mcal/kg for Chinese wild rye, corn silage, corn, barley, rapeseed meal, soybean meal, DDGS (NRC,2001 [4]; NY/T-34, 2004[9]).

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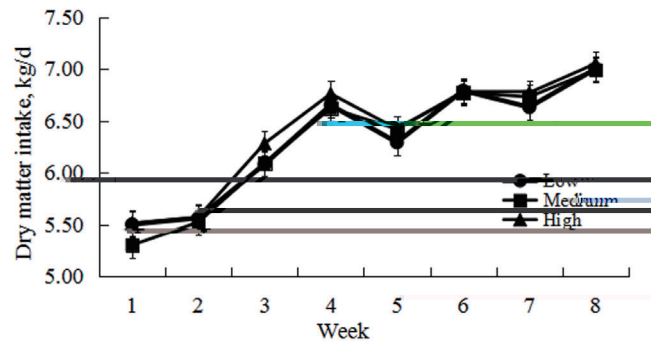


Figure 1. Change in dry matter intake of heifers fed diets containing different dietary protein level. The average dry matter intake were 6.31, 6.31, 6.39 kg/d for low, medium, and high group, respectively.

RESULTS AND DISCUSSION

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Table 2. Initial age, body weight (BW), and average daily gain (ADG) of heifers fed different dietary protein level

Item	Dietary treatment <sup>1)</sup>			SEM	p-value <sup>2)</sup>		
	Low	Medium	High		T	L	Q
Initial age (d)	273.1	272.9	273.2	6.15	1.00	0.99	0.98
Initial calculated BW <sup>3)</sup> (kg)	240.7	227.5	239.4	11.6	0.46	0.91	0.22
Crude protein intake (g/d)	695.3 <sup>c</sup>	795.1 <sup>b</sup>	942.8 <sup>a</sup>	14.3	<0.01	<0.01	0.18
ADG (g/d)	799.9 <sup>b</sup>	955.2 <sup>a</sup>	970.3 <sup>a</sup>	51.1	0.04	0.02	0.29

SEM, standard error of the mean.

<sup>1)</sup> Low, low level of dietary CP; Medium, medium level of dietary CP; High, high level of dietary CP.

<sup>2)</sup> T, effect of treatment; L, linear effect; Q, quadratic effect. <sup>3)</sup> BW (kg) = heart girth<sup>2</sup> (m) × body length (m) × 87.5.

<sup>a,b</sup> Superscripts that differ are significant at p < 0.05.



**Table 5.** Effect of different dietary protein level on rumen fermentation of heifers

Item	Dietary treatment <sup>1)</sup>			SEM	p-value <sup>2)</sup>		
	Low	Medium	High		T	L	Q
pH	6.63	6.60	6.61	0.07	0.93	0.79	0.79
NH <sub>3</sub> -N (mg/100 mL)	1.16 <sup>b</sup>	2.28 <sup>ab</sup>	3.42 <sup>a</sup>	0.38	<0.01	0.001	0.98
Volatile fatty acid							
Acetate (mmol/L)	60.8	62.3	63.0	3.47	0.83	0.54	0.91
Propionate (mmol/L)	15.0	12.4	13.4	1.16	0.31	0.34	0.24
Butyrate (mmol/L)	9.34	8.64	8.72	0.40	0.43	0.29	0.45

SEM, standard error of the mean.

<sup>1)</sup> Low, low level of dietary CP; Medium, medium level of dietary CP; High, high level of dietary CP. <sup>2)</sup> T, effect of treatment; L, linear effect; Q, quadratic effect.

<sup>a,b</sup> Superscripts that differ are significant at p < 0.05.

**Table 6.** Effect of dietary protein level on manure N excretion and retention of heifers

Item	Dietary treatment <sup>1)</sup>			SEM	p-value <sup>2)</sup>		
	Low	Medium	High		T	L	Q
Feces							
kg of DM/d	2.05	2.09	2.05	0.14	0.97	0.99	0.81
kg of wet manure/d	13.4	13.3	13.0	0.83	0.95	0.77	0.90
Urine							
kg/d	4.29	5.21	4.91	0.53	0.49	0.40	0.39
Total manure							
kg of wet/d	17.6	18.3	17.9	1.02	0.89	0.72	0.68
N intake (g/d)	111.3 <sup>c</sup>	127.2 <sup>b</sup>	150.8 <sup>a</sup>	2.29	<0.01	<0.01	0.18
Fecal N (g/d)	40.7	40.5	40.6	2.06	0.99	0.97	0.97
Urine N (g/d)	30.8 <sup>b</sup>	45.1 <sup>a</sup>	50.0 <sup>a</sup>	4.89	0.02	<0.01	0.52
Urinary urea N (g/d)	11.0 <sup>b</sup>	15.1 <sup>ab</sup>	19.1 <sup>a</sup>	2.23	0.05	0.02	0.97
N retention							
g/d	38.3	41.9	56.1	9.10	0.07	0.02	0.77
% of N intake	35.3	32.7	37.5	6.63	0.80	0.72	0.58

SEM, standard error of the mean; DM, dry matter.

<sup>1)</sup> Low, low level of dietary CP; Medium, medium level of dietary CP; High, high level of dietary CP. <sup>2)</sup> T, effect of treatment; L, linear effect; Q, quadratic effect.

<sup>a,b,c</sup> Superscripts that differ are significant at p < 0.05.

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## ACKNOWLEDGMENTS

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## CONCLUSION

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## CONFLICT OF INTEREST

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