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BLOOD METABOLITES AND LIVER HORMONES IN RABBITS.**

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## EFFECT OF FEED RESTRICTION ON GROWTH PERFORMANCE, BLOOD METABOLITES AND LIVER HORMONES IN RABBITS

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### ABSTRACT

This trial was conducted to evaluate the effects of feed restriction on growth performance, blood metabolites and liver hormones in rabbits. A total of 144 post-weaning hybrid Hyla rabbits were divided into 4 groups. Control group (Group AL) which fed *ad libitum* all the time. Experimental groups which fed at 30%, 50% and 70% of *ad libitum* normal daily feed for one week and then fed *ad libitum* till the end of the experiment. The results showed that feed intake, feed conversion ratio of the feed restriction groups were lower than AL group ( $P < 0.05$ ). Feed restriction increased total protein ( $P = 0.007$ ) in serum during restriction period. Feed restriction could decrease hepatic growth hormone (GH), insulin-like growth factors-1 (IGF-1) ( $P < 0.05$ ) concentrations and GH, IGF-1 concentrations were then restored to normal after restriction was cancelled. In conclusion, feed intakes, weight gains and feed conversion ratio in restricted groups were all lower than AL group. Liver GH and IGF-1 levels restored to the normal after experiencing a decline during restriction interval.

**Key words:** feed restriction, growth performance, blood metabolite, liver hormones, growing rabbits

### INTRODUCTION

A variety of feeding strategies have been investigated to reduce the weaning stress of rabbits. Literatures on feed restriction have been mainly focused on the improvements of growth performance (Dalle Zotte et al. 2005), nutrient digestibility and nutrient conversion (Tumova et al. 2002; Gidenne et al. 2012). Moreover, nutritional status also affects hormone secretion and blood metabolism (Renaville et al. 2000; Guyton and Hall 2006). In this study, different levels of feed restriction in rabbits were applied to investigate the relationship between nutrient restriction and compensatory growth.

### MATERIAL AND METHODS

#### Experimental Design

In this experiment, a total of 144 post-weaning hybrid Hyla rabbits of 40-day age were at random divided into 4 groups. The experimental groups fed at 30% (L30 group), 50% (L50 group) and 70% (L70 group) of *ad libitum* feeding for one week and then fed *ad libitum* till the end of the experiment. Control group (AL group) which fed *ad libitum* all the time. The experiment was carried out in accordance with the Animal Care and Use Guidelines of College of Animal Science and Technology, Southwest University, Chongqing, China.

#### Feeding Management

The cages were made of galvanised wire net. The nutrition levels of feed were digestible energy 10.46 MJ/kg, crude protein 15%, crude fiber 13%. Natural lighting and automatic ventilation were used in the rabbit house. Water was available all time.

### Experimental Measurements

Body weight and feed were recorded on the first day of the experiment, and then every week. At the end of feeding restriction and the experiment, 8 rabbits from each treatment were chosen. Blood serum was analyzed the concentration of alkaline phosphatase (ALP), Triglyceride (TG), total cholesterol (TC), total protein (TP), blood urea nitrogen (BUN) by using commercial kits, according to the manufacturer instructions (Nanjing Jiancheng Bioengineering Institute, Nanjing, China). Growth hormone (GH) and insulin-like growth factor-1 (IGF-1) levels in liver were assayed by ELISA kits following the manufacturer's instructions made by Shanghai Resun Biological Technology Co., Ltd., China.

### Data Processing

All values are expressed as means and Standard error of the means (SEM). With one-way analysis of variance in SPSS Statistics 19.0, multiple comparisons were made by using Duncan's multiple range test. The significant level for differences was considered as  $P < 0.05$ .

## RESULTS AND ANALYSIS

### Growth performance

For the cumulative 0-5 week period, the feed intakes ( $P=0.020$ ) and feed conversion ( $P=0.016$ ) of the feed restriction groups were significantly lower than that of AL group, but there was no significant differences among three feed restriction groups ( $P > 0.05$ ). The results were consistent with the previous observations by Gidenne and Feugier (2009). The compensatory growth was observed, which improves feed efficiency and increases body weight gain (Park et al. 1988; Choi et al. 1997). This shows that feed strategy can be adapted to achieve an economically viable outcome (Fiems et al. 2013).

**Table 1.** Effect of feed restriction on growth performance in rabbits

	L30*	L50	L70	AL	SEM	P value
feed intake(g/rabbit)	4013 <sup>a</sup>	3880 <sup>a</sup>	4055 <sup>a</sup>	4605 <sup>b</sup>	145	0.020
Body weight gain(g/rabbit)	1317	1341	1363	1386	42	0.701
Feed conversion	3.03 <sup>a</sup>	2.89 <sup>a</sup>	2.98 <sup>a</sup>	3.33 <sup>b</sup>	0.09	0.016

Notes: \* L30, L50, L70 group were fed at 30%, 50% and 70% of normal daily feed for one week and then fed *ad libitum* till the end of the experiment; AL group were fed *ad libitum* during the experiment.

### Blood metabolites

As shown in Table 2, during the feeding restriction period, different levels of feed restriction did not cause significant influence ( $P > 0.05$ ) on the levels of alkaline phosphatase (ALP) and Triglyceride (TG) in blood serum. There was a significant difference on total protein (TP) between the feed restriction groups and the AL group ( $P < 0.05$ ), which was opposite to the finding of Ebeid et al. (2012). BUN is considered as an indicator of liver and kidney function, which was highest in L50 group ( $P < 0.05$ ) and lowest in L30 group in the restriction period.

**Table 2.** Effect of feed intake limitation on serum biochemistry index in rabbits

	L30*	L50	L70	AL	SEM	P value
<b>At the end of feed restriction</b>						
ALP (U/L) <sup>§</sup>	208	198	213	205	13	0.856
TP (g/L)	46 <sup>b‡</sup>	48 <sup>b</sup>	52 <sup>b</sup>	40 <sup>a</sup>	2	0.007
BUN (mmol/L)	4.25 <sup>a</sup>	5.98 <sup>b</sup>	4.72 <sup>a</sup>	4.47 <sup>a</sup>	0.39	0.051
TG (mmol/L)	1.13	0.93	1.11	1.54	0.23	0.306
<b>At the end of experiment</b>						
ALP (U/L)	182 <sup>ab</sup>	192 <sup>ab</sup>	173 <sup>a</sup>	218 <sup>b</sup>	13	0.099
TP (g/L)	50	52	50	49	2	0.695
BUN (mmol/L)	7.14	7.73	7.81	7.49	0.72	0.879
TG (mmol/L)	1.25	1.82	1.26	1.53	0.20	0.141

Notes: \* L30, L50, L70 group were fed at 30%, 50% and 70% of normal daily feed for one week and then fed *ad libitum* till the end of the experiment; AL group were fed *ad libitum* during the experiment. ALP- Alkaline phosphatase; TP-Total protein; BUN—blood urea nitrogen; TC-Total cholesterol; TG-Triglyceride.

### Liver hormones

At the end of the feed restriction, GH and IGF-1 levels in the three restriction groups were all lower than those of AL group ( $P < 0.001$ , Table 3). However, no significant differences were found in the liver GH and IGF-1 concentration in all the experimental groups at the end of the experiment ( $P > 0.05$ ). This finding is consistent with the fluctuation of blood IGF-1 in the study of Renaville et al. (2000). Synthesized by the anterior pituitary gland, GH is then distributed throughout the body and quickly eliminated by the kidneys and liver (Guyton and Hall 2006). Blood IGF-1 is mainly derived from the liver, so it positively correlates to the mRNA expression of liver IGF-1 (Fenwick et al. 2008).

**Table 3.** Effect of feed intake limitation on liver hormones in rabbits

	L30*	L50	L70	AL	SEM	P value
<b>At the end of feed restriction</b>						
GH <sup>†</sup> (pg/mg protein)	5.16 <sup>a‡</sup>	5.26 <sup>a</sup>	5.41 <sup>b</sup>	5.63 <sup>c</sup>	0.04	<0.001
IGF-1 (ng/mg protein)	0.61 <sup>a</sup>	1.04 <sup>b</sup>	1.32 <sup>c</sup>	1.45 <sup>d</sup>	0.05	<0.001
<b>At the end of experiment</b>						
GH (pg/mg protein)	5.67	5.61	5.50	5.54	0.08	0.421
IGF-1 (ng/mg protein)	1.38	1.31	1.28	1.26	0.06	0.507

Notes: \* L30, L50, L70 group were fed at 30%, 50% and 70% of normal daily feed for one week and then fed *ad libitum* till the end of the experiment; AL group were fed *ad libitum* during the experiment; † GH-growth hormone; IGF-1 - insulin-like growth factors-1.

### CONCLUSION

Feed intakes, weight gains and feed conversion ratio in feed restriction groups were all lower than AL group. Liver GH and IGF-1 levels restored to the normal after experiencing a decline during restriction interval.

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