EFFECTS OF DIFFERENT IODINE CONTENTS IN DIETS ON GROWTH AND DEVELOPMENT OF GROWING REX RABBITS

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ABSTRACT

Iodine deficiency can reduce the synthesis of thyroid hormones, leading to neurological and intellectual development disorders in fetuses and children. Iodine excess can inhibit the synthesis and release of thyroid hormones and induce and aggravate thyroid autoimmune injury. Therefore, maintaining iodine nutrition microenvironment is very important for improving animal health and promoting growth and development. In order to determine the optimum iodine level in feed, the effects of different iodine levels on the growth and production performance of Rex rabbits were studied by single factor design method. 200 healthy Rex Rabbits of 3 months old and similar physique were randomly divided into 5 groups (40 replicates in each group and 1 in each replicate). The experimental diets were supplemented with 0, 0.2, 0.4, 0.8 and 1.6 mg/kg iodine (potassium iodide) respectively. The preliminary period is 7 days and the positive period is 53 days. During the experiment, routine feeding management and immunization procedures were adopted. Two feedings were given at 08:00 a.m. and 17:00 p.m. daily to ensure free feeding and drinking water, natural ventilation and daylighting. Test result: On the premise that the initial body weight (IBW) had no significant difference ($P > 0.05$), the final body weight (FBW) of 4 month old Rex rabbits was significantly affected by dietary iodine levels ($P < 0.05$), and the final body weight of Rex Rabbits reached the maximum value of 2.63 kg when the dietary iodine content was 0.8 mg/kg. Meanwhile, when 0.8 mg/kg iodine was added to the basic diet, the average daily intake (ADI) was significantly affected ($P=0.0001$). Dietary iodine supplementation significant effect on the hind leg muscle rate and muscle redness ($P < 0.05$), and had significant effect on the anterior leg muscle rate ($P < 0.01$). Dietary iodine supplementation with different amounts had significant effects on thyroid stimulating hormone (TSH), tetraiodothyronine (T4) and free tetraiodothyronine (FT4) in Growing Rex Rabbits ($P < 0.01$), and on triiodothyronine (T3) ($P < 0.05$). Dietary iodine levels had significant effects on Noggin mRNA expression in Growing Rex Rabbits ($P < 0.05$), but had no significant effects on versican（Ver）, Hepatocyte growth factor（HGF）, Alkaline phosphatase (ALP）, Bone morphogenetic proteins（BMP2） and （BMP4） mRNA expression ($P > 0.05$). Different iodine content in diet can affect the feed intake and growth level of Rex rabbits. In conclusion, 0.8mg/kg iodine is the most suitable supplementation in the diet of Growing Rex rabbits(The measured value of iodine in basic diet was 0.92 mg).

Key words: Iodine, Growing rex rabbits, Production performance, thyroxine, gene expression.

INTRODUCTION

Among non-metallic minerals, iodine is an important component of thyroid gland. Iodine can activate many enzymes in vivo, accelerate growth and development, and regulate energy conversion. Iodine deficiency can lead to stunting and excessive iodine can lead to hyperthyroidism(Bürgi, 2010; Zimmermann and Boelaert, 2015).

Among the existing standards for raising rabbits containing iodine(0.2 mg/kg, NRC, 1980; 1 mg/kg, AEC, 1993), the iodine requirement varies greatly. It is great significance to study the iodine requirement of Rex Rabbits in accordance with the characteristics of China.

MATERIALS AND METHODS

Animals and experimental design

200 healthy Rex Rabbits of 3 months old and similar physique were randomly divided into 5 groups (40 replicates in each group and 1 in each replicate).

The experimental diets (the digestible energy of feed is 10 MJ/kg, crude fat is 3.3% and crude protein is 16%) were supplemented with 0, 0.2, 0.4, 0.8 and 1.6 mg/kg iodine (potassium iodide) respectively. The preliminary period is 7 days and the positive period is 53 days. During the experiment, routine feeding management and immunization procedures were adopted. Two feedings were given at 08:00 a.m. and 17:00 p.m. daily to ensure free feeding and drinking water, natural ventilation and daylighting.

Chemical Analyses

Total RNA extraction and qRT-PCR were performed as described previously(Liu et al., 2014). The PCR data were analysed using the 2−ΔΔCT method (Livak and Schmittgen, 2001). The mRNA levels of the target genes were normalized to those of glyceraldehyde 3-phosphate dehydrogenase (GAPDH) and β-actin (ΔCT). Based on the cycle threshold (CT) values, GAPDH mRNA expression was stable across treatments in this study (P>0.1).

Statistical Analysis

All of the data collected were subjected to one-way ANOVA with the Statistical Analysis Systems (SAS) statistical software package (Version 8e, SAS Institute). Homogeneity of variance among groups was confirmed using Bartlett's test (in SAS software). When significant differences were observed in ANOVA, the differences between means were assessed with unpaired t-tests. A value of P<0.05 was considered to indicate statistical significance.

RESULTS AND DISCUSSION

As shown in table 1, with the increase of iodine addition, the average daily intake and final body weight increased first and then decreased. When the dosage was 0.8 mg/kg, it reached the maximum value, which was significantly different(P<0.5) from contral groups. Different iodine dosage had no significant effect on average daily gain(P>0.5). According to this experiment, adding 0.8 mg/kg iodine to the feed can increase the intake and gain a larger body weight.

Table 1: Effects of dietary I supplementation levels on growth performance of growing Rex （*n*=40）

Items	level					MSE	*P* value
	0	0.2	0.4	0.8	1.6		
initial body weight(g)	1741.77	1765.51	1732.84	1756.39	1754.00	206.9758	0.8901
final body weight(g)	2885.17^{b}	2896.61^{b}	2921.14^{b}	3033.21^{a}	2901.38^{b}	0.2143	0.0223
average daily gain weight(g)	18.75	19.27	19.71	20.84	19.46	3.3283	0.1671
average daily intake(g)	172.93^{Bb}	179.93^{Aa}	181.17^{Aa}	183.69^{Aa}	180.44^{Aa}	3.7254	0.0001

Means with different letters on the same row differ significantly

As shown in table 2, iodine supplementation significantly increased plasma concentrations of T4, FT4 and T3 in the experimental group compared with the control group(P<0.5), but had no significant effect on FT3(P>0.5). The amount of iodine added to Rex Rabbit diets can promote thyroid secretion of thyroid hormones to some extent, increase its concentration in plasma, and promote metabolism.

Table 2: Effects of dietary iodine levels on serum thyroid hormones of growing Rex rabbits (*n*=8）

Items	level					MSE	*P* value
	0	0.2	0.4	0.8	1.6		
T_4 （μg/L）	14.14^{d}	14.97^{b}	14.79^{b}	15.76^{a}	14.45^{c}	0.1857	<0.0001
FT_4 （ng/L）	3.90^{c}	4.02^{c}	4.14^{b}	5.65^{a}	4.12^{b}	0.1388	<0.0001
T_3 （μg/L）	0.66^{b}	0.71^{a}	0.67^{ab}	0.71^{a}	0.67^{ab}	0.0401	0.0298
FT_3 （ng/L）	1.80	1.83	1.85	1.84	1.80	0.0583	0.2018

Means with different letters on the same row differ significantly

As shown in Figure 1, iodine supplementation significantly increased the mRNA expression of Noggin. When the iodine content was 0.4mg/kg, it had a significant effect compared with the control group(P<0.5). Noggin could inhibit the expression of BMP2 and BNP4. It is consistent with the test results that adding a certain amount of Rex Rabbit diet can down-regulate the expression of BMP2 and BMP4(BMPs Inhibiting follicle morphogenesis), but the effect is not significant(Park and Morasso, 2002). Adding a certain amount of iodine to the diet could up-regulate the mRNA expression of Ver(plays an important role in hair follicle morphogenesis, regeneration and growth), HGF(promote epithelial and endothelial cell proliferation) and ALP(a specific marker for the detection of dermal papilla and an important indicator of the ability of dermal papilla to induce hair follicle formation), but the effect was not significant(P>0.5)(Soma et al., 2005). It can be inferred that iodine supplementation in diet can promote hair follicle development of Rex rabbits.

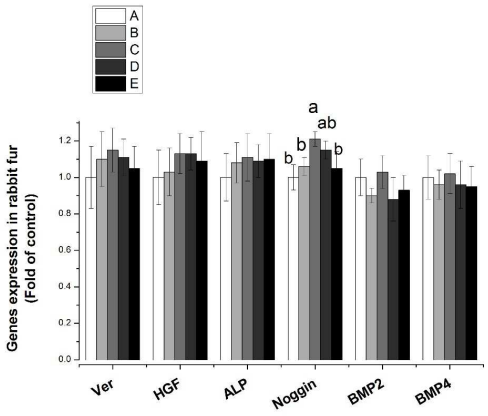

Figure 1 Effect of dietary iodine supplementation on expression of growth associated genes Rex (*n*=8)

A: control group(0 mg potassium iodide per 1kg feed); B: 0.2 mg potassium iodide per 1kg feed; C: 0.4 mg potassium iodide per 1kg feed; D: 0.8 mg potassium iodide per 1kg feed; E: 1.6 mg potassium iodide per 1kg feed;
a, b Means with different superscripts are significantly different (P<0.05).

CONCLUSIONS

Adding a certain amount of iodine in Rex Rabbit diets can increase average daily feed intake and final weight, promote body metabolism, facilitate growth and promote hair follicle development. According to the comprehensive test results, the suitable amount of iodine is 0.8 mg/kg.

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