

# Effect of high Se and Co alfalfa forage on animal production

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## Introduction

Total and available selenium (Se) and cobalt (Co) concentrations are low in Chinese soils, especially those found in mainly in temperate humid sub-humid conditions in the northeast to the southwest band across China (Tan *et al.* 2002). The levels of Se and Co are marginally deficit in the brown soil of the Yellow River region which causes lower production level and quality in forage and crop plants. Application of Se and Co fertilizers to arable lands is essential to produce high Se and Co forages. Henan is a Province where produce high-quality grass forages are used to support dairy farming. The province is mainly spread along the Yellow River where soils are sandy and deficient in Se and Co (Lu *et al.* 2003). Se deficiency in forages not only limits livestock production, but also affects the quality and safety of food products (Rotruck *et al.* 2003). Since rabbits and dairy cows are especially sensitive to low Se levels in feed, we chose these as our test animals. The objective of this study was to analyze effect of high Se and Co alfalfa forage on animal production and feed conversion efficiency in order to establish a set of effective technical ways to solve trace element gaps of animal diets, i.e. by basal fertilization of Se and Co fertilizers in soil. This study was conducted as a series of field trials and animal experiments from 2007 to 2008.

## Materials and methods

Based on the nutrient requirements of domestic animals, we compared the effects of four kinds of alfalfa forage with high organic Se rich type (S<sub>2</sub>C<sub>0</sub>), Se-Co rich type (S<sub>2</sub>C<sub>1</sub>), and Co rich type (S<sub>0</sub>C<sub>1</sub>) and common type (S<sub>0</sub>C<sub>0</sub>) grown on Henan Yellow River beach soil on the growth and production of Holstein cows and New Zealand rabbits.

Thirty two Holstein cows were fed supplemental alfalfa forage. Of these, 8 Control cows were fed basal diets with common alfalfa forage (S<sub>0</sub>C<sub>0</sub>) and the remaining cows were divided into groups of 8 and fed basal diets with 5% of the high Se and Co forage treatments. Milk samples were collected to analyze the content of fat, protein, lactose and SNF in fresh milk at 6 day interval. Feed intake and milk yields were also measured every day.

Seventy New Zealand rabbits were used to investigate the role of Se in rabbit production when high Se and Co alfalfa forage (S<sub>2</sub>C<sub>1</sub>) were used as an additive

comprising 10–15% of the basal diet. Adopting separate feeding, the effects of diets with different types of alfalfa hay on growing performances, feed conversion rate and quality of animal products in New Zealand rabbits were studied at facilities provided by the Henan Sino-Dutch Dairy Technology and Development Co., Ltd, the Xinmi New-star Rabbit Raising Base and the Zhongmou Dorper Sheep Extension Base.

The experiments using rabbits were commenced on Sept 30, 2007 and last for 60 days, and the experiments using Holstein cows were started on August of 2007 and ended in August of 2008 and last for 2 years.

## Results

### Holstein cow

Comparing to common type alfalfa forage (S<sub>0</sub>C<sub>0</sub>), alfalfa forage of Se rich type (S<sub>2</sub>C<sub>0</sub>) increased not only body length, heart girth, body weight, but also daily milk yield up to 8.6%. Moreover, it decreased feed to milk ratio by 12.2% and improved forage conversion and utilization. The results in Table 1 also suggested that alfalfa forage of Se-Co rich type (S<sub>2</sub>C<sub>1</sub>) increased fat content and protein content compared with common alfalfa forage (S<sub>0</sub>C<sub>0</sub>). All Se rich forages increased daily milk yield by 8.6% and decreased feed to milk ratio by 6.2%, reflecting an obvious improved forage conversion efficiency.

### Rabbit

It is an accepted practice in Henan to provide alfalfa meals supplements to the diet of rabbits in first two weeks just after weaning. When the alfalfa meals in the diet was increased from 5% and 10%, respectively, daily gain and relative daily gain of rabbits increased by

**Table 1. The comparison of milk composition under different treatments (%).**

Treatments	The comparison of milk composition under different treatments			
	Fat	Protein	Lactose	SNF
S2C0	3.9 c	3.1 b	4.5 a	8.5 a
S0C1	4.6 b	3.3 a	4.3 a	8.5 a
S2C1	5.8 a	3.5 ab	4.1 b	8.1 b
S0C0	4.8 b	3.3 a	4.4 a	8.5 a

Note : Values with different superscript in the same column are significantly different ( $P < 0.05$ )

46.1% and 24.3%, respectively. In the whole experiments alfalfa, meals decreased the feed to gain ratio, i.e. feed conversion efficiency was increased significantly. When alfalfa meal added to the basal diet was increased further from 10% and 15%, feed to gain ratio decreased by 0.6% and 3.1% of the control diet. In addition, when the rabbits were supplemented with special S2C1 alfalfa meals – 1.9%, 0.4% and 0.8% of Se was found in the liver, heart, kidney and lung and 9.8% of Se was found in meat. More than 85% of Se was returned to soil as urine. Approximately 3.4% of Co accumulated in the internal organs and 11.4% in the meat and skin. Like Se, most of the Co fed in the diet (81%) was returned to soil as urine. At the same time, meat quality was also improved greatly.

In rabbit production, Se rich forage decreased forage to meat ratio and improved feed conversion rate in the 50-days feeding experiment. When high Se forage accounted for 10% and 15% of ration, forage to meat ratio was increased by 5.0% compared to the control. In addition, Se accumulated in the liver, kidney and meat of rabbit whereas less accumulated in skin. The yield of meat and meat products increased significantly.

## Discussion

Approximately 80% of arable land in China suffers from serious Se deficiency. The lack of Se in the soil has affected the development of forage and animal production, especially the quality of animal products (Zhang et al. 2000). Traditional approach to solve this issue was supplying inorganic Se as an additive to livestock feed (Zhao et al. 1997; Zhang 2000). However, this proved laborious and expensive, and rather dangerous due to significant release of Se into the environment through livestock wastes. To overcome these disadvantages, the use of organic Se compounds are recommended as a safer and more stable alternative to inorganic Se. Previous research has shown that inorganic Se applied as a mineral fertilizer to the soil in alfalfa pastures changed over to organic Se compounds, which in turn led to accumulation of high Se concentration in forage. These pastures with high organic Se compounds were safer and more effective for domestic animals than

inorganic Se chemicals. Alfalfa hay with high Se content improved milk quality and regulate nutrition of Holstein cows. It also increased daily gain and relative daily gain of rabbit when it was used to as a 10 to 15% dietary supplement. Further, Se was accumulated in the liver, heart, kidney, lung, and meat in significant amounts suggesting that this is an effective way to increase quality of milk and meat.

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