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Effect of Dietary Cysteine Supplementation on Growing Performance, Pelt Quality and Some Serum Biochemical Parameters of Young Rex Rabbit

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Abstract. The present study was conducted to evaluate the effects of dietary cysteine, a sulphur containing amino acid supplementation on growth performance, pelt quality and a number of serum biochemical parameters of young Rex Rabbit. One hundred and twenty Rex Rabbits aged 45 days were divided into five dietary treatment groups including one control group and 4 experimental groups. Each group was composed of 24 animals and was fed with different diets for 56 days corresponding to the fattening period. Diet was incorporated with 0% of cysteine (control group) and 0,10%, 0,20%, 0,30% and 0,40% respectively for the experimental groups. At the end of the experiment, results showed that cysteine supplementation to the diet affected average daily gain, live weight,skin length, skin area and pelt weight at the late phase of 42 to 56 days ($P<0.05$). Feed intake, feed efficiency, skin width and serum biochemical parameters were not affected in our study ($P>0.05$).

Keywords: Rex rabbit; cysteine; growing performance; pelt quality; serum biochemical parameter.

Introduction. Cysteine is one of the sulphur-containing amino acids with a chemical formula $HO_2CCH(NH_2)CH_2SH$ [IUPAC-IUB Recommendation, 1983]. Its plays a crucial role in cell metabolism. The thiol of cysteine is susceptible to oxidization to give the disulfide derivative cystine, which serves as an important structural component in many proteins. Cysteine can be used as a food additive and has the E number of E920. Because of its high reactivity, the thiol group of cysteine has numerous biological functions. It's a precursor of an antioxydant glutathione, iron-sulphur clusters and metal ion binding [Baker et al., 1987 ; Lippard et *al*., 1994 ; Lill et al.,2006]. Cysteine also plays an important role in protein structure. In the translation of messenger RNA molecules to produce polypeptides, cysteine is coded by the UGU and UGC codons [Heitmann, 1968].

Cysteine participates in many biological pathways, notably those involved in gluthathion (GSH), taurine and methionine metabolism. Cysteine metabolites play a crucial role in antioxidant defenses, which help ameliorate chronic inflammation [Drögue, 2005].

Many researches done in humans have proved the involvement of cysteine in many diseases including liver, cancers, cardiovascular diseases and others [Robert and al., 2011].

In general, amino acids were claimed to be the building blocks of proteins and muscle tissues, recovery muscles, strengh gains and fat loss and all types of physiological processes relating to sport-energy, mood and brain function are also intimately and critically linked to amino acids. Athlets also use cysteine supplement to burn fat and enhance muscle mass and strength. Hence cysteine has been one of the major supplement in athlets diet, especially among bodybuilders [Jeff Behar, 2013]. Cysteine is also the main structural component of keratin, which is abundant in feather, skin, horn, nail, hair and wool. Based on the level of sulphur contet the protein structure of wool fiber is grouped into three types; the low sulphur protein which constitute 60-70 % of total protein, the high sulphur protein which accounts for 20-40 % of total protein and contains very high level of cysteine (10% in wool) and the high tyrosine protein that comprise up to 1-2% of the total protein [J.P. Felix D'Mello, 2003].

The importance of cysteine as an essential amino acid for wool production has been reported in sheep, Angora, Cashmere and Merino goats only [Galbraith H., 2000, Powell B.C., 1994,Downes, A. M., 1961, Reis P.J., 1967], there are few reports about the role of cysteine in other farm animals.

Rex rabbit, (*oryctolagus cuniculis*) is a typical fur-meat dual purpose rabbit. Their fur is short, thick, plain, smooth, and beautiful and is widely used in China and around the world in the fur industry.

Therefore, the present experiment aims to test the effects of dietary cysteine supplementation on Rex rabbit growth performance, feed conversion ratio, and pelt quality and a number of serum biochemical parameters for different levels of cysteine incorporated to the diet.

Material and methods. MATERIAL

Animal

One hundred and twenty, 45 days old Rex Rabbits were randomly selected and divided into 5 groups. Each group contained 24 Rex Rabbit and was given one level of dietary cysteine.

Diet and feeding management

Each experimental group was assigned a fixed level of dietary cysteine: 0% (control group); 0.10(group 1); 0.20 (group 2); 0.30(group 3) and 0.40 (group 4). The whole experiment lasted 56 days and the feeding conditions were the same in all the five groups. The animals were being fed 2 times per day at 7:00 am. and 6:00 pm. Water was available *ad libitum* through the duck-beak model watering. All feeders, drinkers and hutches were cleaned and sterilized before the experiment was started. The basal experiment diet composition is shown in table1

Table 1: Experiment basal diet composition

Ingredients %	Ratio (%)	Nutrient levels	Nutrient Values
Corn	14	Digestible energy (KJ/Kg)	9.7
Wheat bran	10	Crude protein (%)	17.3
Soybean meal	12	Crude fiber (%)	14.6
Alfalfa meal	40	Calcium %	1
Corn gluten	12	Total phosphorus %	0.58
Yellow soybean	5	Phosphorus %	0.27
Sea buckthorn sub	5	Lysine %	0.82
Calcium hydrogen phosphate	0.5	Methionine %	0.24

Additive	1	Cystine %	0.25
Salt	0.5		
Cysteine	0		

The following medicines were added to the diet: Antifungal 100g/100kg; Allicin 50g/100Kg; Rhubarb soda tablets 8 package / 100Kg; Lactasin piece 1 bottle / 300kg.

METHODS

Measurement of growth parameters

During the experimental period, 4 growth parameters; comprising Body weights(BW), average daily weight gain (ADG), average daily feed intake (ADI) and feed conversion ratio (FCR) were measured to determine growth performances. Body weights were taken by electronic balance every two weeks. In order to get an accurate data, each day before the weighing day, animals were not given food for 12 hours prior to weighing.

Measurement of Fur Characteristic

At the end of the experiment, 20 Rex Rabbit (4 in each group) were slaughtered and their fur was removed. Fur gross weight and net weight were measured. The fur area (FR) was computed using the following formula:

$$FR = L\frac{(W1+W2+W3)}{3}$$

Where L is the length measured from the neck to the root of the tail by a ruler following the line of the spinal column. W1, W2 and W3 are the measurements of the width at shoulder, chest and abdomen levels respectively.

Blood Collection and Serum Preparation

At the end of the experiment, after the weighing procedure, blood samples were collected from the heart of 20 Rex Rabbit (4 in each group). Approximately 10 ml of blood was collected from each rabbit. Then, they were spun at 3000r/min for 10min. The serum was then extracted, placed in a separate20ml sterilized collection tubes, and store at -20^{0}C. The collected serums were later used to determine a number of serum biochemical parameters.

Serum Biochemical Analyze

The serum total protein and albumin were analyzed by the biuret and bromocresol green methods respectively using a commercial kit (The self-Biotechnology Research Institute of Beijing Biosino). Serum globulin was determined as the difference between serum total protein and albumin.

The urea nitrogen was estimated by Urease-Berthelot calorimetric methods, using a commercial kit (The self-Biotechnology Research Institute of Beijing Biosino). The total blood glucose and cholesterol levels also were determined using commercial kit. (The Self-Biotechnology Research Institute of Beijing Biosino).

Data processing

The obtained data regarding growth performance, pelt characteristics and serum biochemical were subjected to analysis of variance using GLM procedure of SPSS (Windows version of SPSS, release 17.0) The significant means were ranked using Ducan's Multiple Range Test.

Results and discussion. RESULTS

Effect of Dietary Cysteine Supplementation on Growth Performance of Rex Rabbit

In this study, we have evaluated four growing performances of Rex rabbits, fed different levels of cysteine supplement diets and results are shown in table 2.The result showed that dietary cysteine levels 0.20% at 42 days and 0.40% at 42 days and 56 days had significant effects on live BW ($P<0.05$). Besides, dietary cysteine level 0.40% has significant effect on ADG at 56 days. The

highest body weight gain and the highest average daily gain of 2.156 g/rabbit and 1.25g/rabbit respectively, were scored in the 0.40 % cysteine level supplemented group. None significant difference was observed between the control group and the four experimental groups concerning the FCR. Similar result was also observed regarding the DFI where only dietary cysteine level 0.10 showed a significant difference at 14 days ($P<0.05$).

Table.2: Effect of dietary cysteine supplement on growth performance of Rex rabbit

	Dietary cysteine %				
Days	0	0.10	0.20	0.30	0.40
W(g/rabbit)					
1-14	1.345	1.345	1.411	1.330	1.351
1-28	1.665	1.662	1.749	1.672	1.689
1-42	1.832^{a}	1.837^{a}	1.936^{b}	1.846^{a}	1.931^{b}
1-56	1.999^{a}	2.009^{a}	2.070^{ab}	1.9997^{a}	2.156^{b}
DFI(g/rabbit)					
1-14	17.64^{a}	15.24^{b}	18.63^{ab}	14.82^{ab}	16.07^{ab}
1-28	20.26	18.93	21.42	19.62	20.13
1-42	17.48	16.81	18.71	17.21	19.16
1-56	16.08^{ab}	15.68^{a}	16.44^{a}	15.65^{ab}	18.41^{b}
ADG(g/rabbit)					
1-14	0.98	0.92	0.92	0.93	0.94
1-28	1.12	1.107	1.09	1.1	1.13
1-42	1.19	1.15	1.16	1.18	1.22
1-56	1.18^{a}	1.14^{a}	1.16^{ab}	1.19^{a}	1.25^{b}
FCR					
1-14	5.59	6.31	4.96	6.37	6.17
1-28	5.69	5.69	5.12	5.70	5.66
1-42	6.86	6.89	6.23	6.93	6.37
1-56	7.43	7.29	7.1	7.62	6.80

Effect of Dietary Cysteine Supplementation on Pelt Quality of Rex Rabbit

The effect of dietary cysteine supplementation on pelt quality is shown in table 3. Diet with 0.40% cysteine supplemented had significant effect on skin length and skin area ($P<0.05$). Besides, this group showed the highest value for the two traits cited above. Both diet with 0.10% and 0.30% cysteine supplemented had significant effects on skin length. And diet with 0.20% cysteine supplemented had significant effect on pelt weight ($P<0.05$). Based on those results we can conclude that cysteine has a positive effect on fur characteristics, with 0.40% the most beneficial level in our study.

Table 3: Effect of dietary cysteine on pelt performance

Cysteine level					
Parameters	0	0.10	0.20	0.30	0.40
Skin length (cm)	32.38^{a}	37^{b}	35.87^{ab}	37.25^{b}	38^{b}
Skin width (cm)	12.67	13.08	13.71	13.29	13.79
Skin area(cm^2)	411.65^{a}	484.08^{ab}	493.52^{ab}	495.38^{ab}	521.87^{b}
Pelt weight (g)	127.50^{a}	137.50^{ab}	150.00^{b}	137.50^{ab}	145.00^{ab}

Effects of Dietary Cysteine Supplement on Serum Biochemical

The serum biochemical parameters of rabbit fed with cysteine supplement diet is shown in table 4.

Table:4 Effect of dietary cysteine on serum biochemical

Cysteine level					
Parameters	0	0.1	0.2	0.3	0.4
Total protein g/l	69.93	72.77	69.85	71.17	74.05
Albumin g/l	38^{ab}	37.5^{ab}	34.67^{a}	35.07^{a}	39.92^{b}
Globulin g/l	31.93	35.27	35.17	36.30	34.12
Albumin/Globulin g/l	1.21	1.09	1.00	0.975	1.17
Urea nitrogen mmol/l	12.25^{ab}	10.51^{a}	10.43^{a}	13.46^{b}	12.41^{ab}
Glucose mmol/l	1.47	2.77	1.43	1.94	3.67
Total cholesterol mmolg/l	1.22	1.07	1.25	1.07	1.29

As shown in table 4, the total protein, albumin and total cholesterol were all within the normal range (54-83g/l; 24-46g/l; 0.3-2.1mmol/l respectively) for healthy domestic rabbits according to the standard values reported by Boyd (Boyd, 1984).Globulin values were higher than the reference value in all the groups (15-28g/l).They tended to increase with increased dietary cysteine level. Although there was a decrease between 0.30% and 0.40% groups, the difference was not significant. We have gotten a similar result concerning Urea nitrogen, were its value was higher than the normal range (4.6-10.4mol/l) in all the five groups. The Glucose level was lower than the normal range (4.1-8.5mmol/l), however its value at 0.40% dietary cysteine level was closer to the reference value.

Discussion. Impact of Varied Levels of Cysteine on Growth Performance of Young Rex Rabbit.

According to the result of this study, cysteine could have an effect on young Rex rabbit live weight and daily weight gain, where 0.40% of cysteine seems to be the best supplementation level. On the other hand, it may not play an important role in feed intake improvement or in feed conversion since none significant difference was found between the control group and the treatment groups concerning the two traits mentioned above. Athletes use cysteine supplement to burn fat and enhances muscle mass and strength but very little results have been reported on the effect of cysteine on rabbit growing performances. Cao and her co-workers have demonstrated that 0.35% cysteine dietary level had significant effect on 2-4 months old Rex rabbit daily weight gain [Cao et *al.*, 2012]. However, several data exist on the use of cysteamine, a degradation product of cysteine in animal nutrition. Sha and his co-workers claimed that dietary supplementation of cysteamine significantly accelerated body weight gain ($P<0.05$) and improved the tenderness of semi tendinosus muscle of fattening goats [Sha et *al.*, 2007]. The supplementation of cysteamine in the diet increased plasma growth hormone concentrations and body moisture but a reduced body fat was observed in 16 weeks old turkey ($P<0.05$). Protein level remain unchanged [Maruyama et al., 2002] .

Effect of Dietary Cysteine Supplementation on Pelt Quality of Rex rabbit

According to the result of this study, cysteine had a significant effect on skin length, skin area and pelt weight where skin length and skin area highest values were obtained at 0.40% cysteine supplementation level. Many studies have demonstrated large effects of feed intake on wool growth in various breeds of sheep [Allden, 1979]. Cysteine has been reported to improve the wool growth of cashmere goats [Galbraith H., 2000]. Cysteine is also the major amino acid found in structural protein keratin, which is abundant in feather, skin, horn, nail, hair and wool. Many researchers have been focusing on the effect of cysteine in hair growth and strength. Cao and her co-workers found out that, cysteine had a significant effect on hair density, but not on hair length, leather area and leather thickness [Cao et *al.*, 2012].

Effect of Dietary Cysteine Supplementation Serum biochemical of Rex rabbit

The low values of glucose obtained in this study could be due to the stress, (transportation or fasting). Stress can become an experimental variable by changing blood parameters (stress leukogram, increased blood glucose), hormonal responses, wound healing rates [Phil L. and al 2003; Royo F et al 2004; Selye H. 1976]. All globulin values were above normal range both in the

control and treatment groups. The increase of globulin rate and the absence of loss of growth and the fact that the blood was taken from animals presenting no morbidity sign could be considered as a real benefit for immunity. The highest value of globulin was obtained at 0.3% cysteine supplementation. However the higher values of urea nitrogen obtained in all the groups suggested might be due to a kidney dysfunction.

CONCLUSION

From the results obtained in this study, we could say that cysteine supplementation in the diet could increase Rex rabbit live weight and improve pelt quality. 0.40 % level was the best supplementation level in our research work. However we suggest (recommend) that further investigation should be done with a bigger number of rabbits, a larger range of supplementation levels and at different seasons of the year.

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УДК 63

Влияние пищевых добавок на Цистеин Растущая производительность, качество Пелт и некоторые биохимические показатели сыворотки Rex Rabbit

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Аннотация. Настоящее исследование было проведено с целью оценки влияния диетических цистеин, серосодержащих аминокислот добавки кислоты на рост производительности, качества шкуры и ряд биохимических показателей сыворотки молодого кролика рекс. Сто двадцать Rex кроликов в возрасте 45 дней были разделены на пять групп диетического лечения, включая одну группу управления и 4 экспериментальные группы. Каждая группа состояла из 24 животных и подавали с различными диетами в течение 56 дней соответствующего периода откорма. Диета была объединена с 0% цистеина (контрольная группа) и 0,10%, 0,20%, 0,30% и 0,40% соответственно для экспериментальной группы. В конце эксперимента, результаты показали, что цистеин добавок в рацион пострадавших среднесуточный привес, живой вес, кожа длина участка кожи и шкуры веса на поздней стадии от 42 до 56 дней (P <0,05). Потребление корма, корма, кожи шириной и биохимические показатели сыворотки не были затронуты в нашем исследовании (P> 0,05).

Ключевые слова: Рекс кролика; цистеин; растущая производительность; качество шкуры; сыворотки биохимических параметров.