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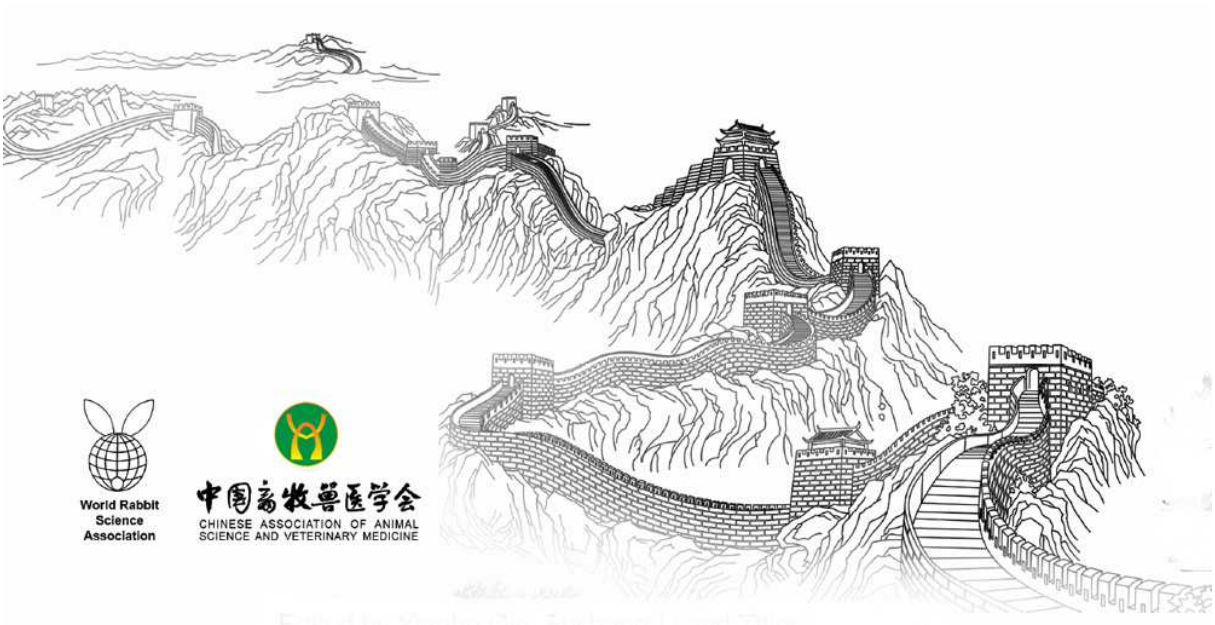

EFFECT OF DIETARY SELENIUM LEVELS ON BLOOD GLUTATHIONE PEROXIDASE ACTIVITY AND SOME MEAT QUALITY TRAITS OF RABBITS

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ABSTRACT

The current study aimed at investigating the effect of dietary supplemental selenium (Se) levels (none, 0.05, 0.10, 0.2, 0.4 or 0.8 mg/kg diet) on blood erythrocytes glutathione peroxidase (GPx) enzyme activity and some meat quality traits of APRI rabbits. Thirty six samples of blood erythrocyte and of hind-leg muscles (oxidative muscle fibers) kept frozen up to 3 months at -20ºC were assigned to carrying out the laboratory analyses.
Results indicate that GPx enzyme activity was significantly (*P*=0.049) differed between the experimental groups. It increased with leveling up the dietary Se level up to 0.2 mg Se/kg diet, while decreased beyond that level but still higher than the control. Carcass traits of hot carcass and dressing weight percentages were not significantly affected by dietary treatments. Monthly meat quality traits of lipid rancidity (TBARS), pH and water holding capacity of the frozen meat muscles were significantly affected by feeding treatments, except pH data for the third month of storage with no clear trend for dietary Se level on these quality traits. More interesting, the highest inclusion rates of Se (0.4 or 0.8 mg/kg diet), significantly showed the highest TBARS value after 1 month of storage, then inversely, 0.8 mg Se/kg diet had significantly the lowest value after 3 months of storage.
In conclusion: dietary Se level; none up to 0.8mg/kg diet had significant effect on GPx activity and meat quality traits of lipid rancidity, pH and water holding capacity.

Key words: Rabbit, dietary selenium, summer, glutathione peroxidase, meat quality.

INTRODUCTION

The need for selenium in rabbit feeds is doubtful. Commercial vitamin-mineral premixes without supplemental Se have been marketed for years without evidence of impaired productivity in does and in growing-fattening rabbits (Lebas, 1990; Mateos and Piquer, 1994). According to Lee et al., (1979) rabbits do not develop symptoms of Se deficiency when fed diets deficient in Se. Lebas (1990) and Maertens (1992) reported no dietary requirements for Se for the rabbit, and to avoid potential problems in long-term rabbit production, Mateos et al., (2010) suggested a supplemental Se rate of 0.05 ppm in the feeds given to rabbits.

Selenium is supposed to play a predominant role in the enzyme activity and regulation of glutathione peroxidases, a class of enzymes which protect the cells against oxidation in animal tissues (Mùller et al., 2002). This assumption is not clear in case of the rabbit (Abdel-Khalek, 2013). According to Lee et al., (1979), rabbit liver and kidneys contain a sufficient level of none Se-dependent GPx activity, whereas lungs, heart, spleen, erythrocytes and plasma have only the Se-dependent GPx activity. Also, Dokoupilová *et al.,* (2007) found that Se supplementation did not change GPx activity in liver, loin and hind-leg of the rabbit. While, Erdélyi et al., (2000) reported that GPx activity showed a slight increase in the erythrocyte haemolysate with feeding the rabbits with extra Se dose.

Results on the effect of supplemental Se on rabbit carcass and meat quality are scarce. Marounek et al., (2009) reported that increasing dietary Se level did not significantly influence dressing out percentage

and formation of TBARS in the hind-leg of rabbit meat stored for up to 6 days at 4°C, while, lipid rancidity was higher with increasing dietary Se level (1.97 *vs.* 1.37 mg MDA/kg meat). More interesting that excessive Se feeding may show pro-oxidant characteristic, one explanation for this phenomenon is the toxicity of Se (Erdélyi et al., 2000).

The aim of the present was to evaluate the effect of graded levels of dietary supplemental Se up to ten-times of Se-recommended level suggested by NRC'1977 (none up to 0.8 mg/kg diet) on blood erythrocytes glutathione peroxidase enzyme activity and some meat quality traits of APRI rabbits.

MATERIALS & METHODS

Treatments, feeding, management and slaughtering protocol:

During growth period, APRI rabbits were equally divided into six groups and fed diets with different supplemental Se levels (none, 0.05, 0.10, 0.2, 0.4 and 0.8 mg/kg diet) as sodium selenite for 10 experimental weeks according to NRC' (1977) recommendations. Vitamin-mineral premixes were adjusted for the studied Se levels. Ingredient and chemical composition of the basal diet are presented in Table 1. Rabbits were kept under the same managerial routine during July-September months.

Table 1: Ingredients and calculated chemical composition of the basal diet.

Ingredients:	Barley 32.0%,clover hay 31.0%, soybean meal (44%) 20.9%, wheat bran 9.2%, molasses 3.0%, di calcium phosphate 2.2 %, limestone 0.7%, NaCl 0.30%, vitamins & minerals premix* 0.30%, dl- methionine 0.2%, anti-coccidial 0.10% and anti-fungal 0.10 %; **Total:** 100.0%.
Chemical composition:	DM, 89%; CP, 18.35%; DE (kcal/kg) 2498; CF, 13.4%; Ca, 1.29%; P, 0.81%; Lysine, 0.97%; methionine + cystene 0.75%.

*Supplied per 1 kg diet: 6000 IU vit. A; 900 IU vit. D3; 40 mg vit. E; 2.0 mg vit. K3; 2.0 mg vit. B1; 4.0 mg vit. B2; 2.0 mg vit. B6; 0.010 mg vit. B12; 5.0 mg vit. PP; 10.0 mg vit. B5; 0.05 mg B8; 3.0 mg B9; 250 mg choline; 50.0 mg Fe; 50.0 mg Zn; 8.5 mg Mn; 5.0 mg Cu; 0.20 mg I, and 0.01 mg Se

Sampling and analyses

At slaughtering, 36 rabbits were assigned for the current study. Erythrocyte GPx determination was carried out using six blood samples of each treatment that collected in heparinized tubes and plasma was separated with centrifugation (2500 rpm, 20 min). 1:9 rate haemolysate was prepared from the erythrocytes with distilled water. GPx activity was assayed with a GSH reduction coupled to a NADPH oxidation by glutathione reductase (Agergaard and Jensen, 1982). Also, six hind-leg samples of each treatment were kept frozen at -20ºC for 3 months. Monthly meat quality traits of lipid rancidity (TBARS), pH and water holding capacity percentage were determined. Rate of lipid oxidation was measured according to Piette and Raymond (1999). pH was measured with a Crison pH-meter, equipped with a Xerolite electrode (Crison instruments, Spain). Water holding capacity was measured using the filter paper press method of Grau and Hamm (1956).

Statistical procedures

Data were subjected to a one-way analysis using SAS (1990). Variables having significant differences were compared at 5% significant difference level using Duncan's Multiple Range Test (Duncan, 1955)

RESULTS & DISCUSSION

Results of the current study are presented in Table 2. None of hot carcass and dressing weight percentages was significantly affected by dietary Se levels. GPx enzyme activity in erythrocytes was significantly (P=0.049) differed between the experimental groups. The highest value was for the rabbit group fed 0.2 mg Se/kg diet (557 u/ml), while the lowest was for the control group (210 u/ml).

There was no clear trend for dietary Se level on studied meat quality traits. Although, the highest inclusion rate of Se (0.4 and 0.8 mg/kg diets) showed significantly the highest TBARS value after 1 month of meat storage. While the group on 0.8 mg Se/kg diet had significantly the lowest TBARS value after 3 months and lowest pH value after 2 months of meat frozen storage. Also, no clear trend could be

withdrawn for the effect of dietary Se levels on WHC of the frozen meat; however, the response was significant for the studied intervals.

Table 2: Effect of dietary selenium levels on glutathione peroxidase activity and meat traits of rabbits.

Criteria		Dietary Se level (mg/kg diet)						Pooled SE	*P* value
		None	0.05	0.10`	0.20	0.40	0.80		
Plasma GPx activity (U/ml)*		210^{c}	460^{ab}	408^{abc}	557^{a}	291^{bc}	355^{bc}	35.0	0.049
Hot carcass percentage		50.58	52.31	51.46	52.10	53.59	52.54	0.26	0.340
Dressing percentage		60.20	62.67	60.95	61.86	63.36	62.47	0.25	0.260
TBARS (mg MDA/kg meat)**	1 month	2.33^{b}	2.38^{b}	2.18^{b}	2.29^{b}	3.34^{a}	3.19^{a}	0.12	0.001
	2 months	10.29^{bc}	9.66^{c}	10.63^{ab}	9.59^{c}	11.04^{a}	9.85^{c}	0.16	0.020
	3 months	23.10^{a}	22.93^{a}	24.61^{a}	18.41^{b}	18.22^{b}	14.95^{c}	0.85	0.001
pH	1 month	7.03^{b}	7.00^{b}	7.17^{a}	7.04^{ab}	6.96^{b}	6.90^{b}	0.03	0.043
	2 months	6.23^{b}	6.43^{a}	5.98^{c}	5.45^{d}	5.70^{cd}	5.63^{d}	0.09	0.001
	3 months	5.40	5.30	5.40	5.18	5.57	5.60	0.05	0.121
Water holding capacity (WHC) percentage	1 month	33.47^{a}	28.30^{b}	35.00^{a}	34.77^{a}	35.17^{a}	34.57^{a}	0.65	0.001
	2 months	39.27^{c}	38.53^{c}	41.63^{bc}	41.20^{c}	46.80^{a}	44.33^{b}	0.77	0.001
	3 months	45.60^{b}	46.13^{b}	46.87^{b}	50.97^{a}	50.60^{a}	49.90^{ab}	0.70	0.042

* Expressed as µmol NADPH oxidized/min/ml erythrocytes.
** Meat was frozen at -20°C
* $^{a, b,....}$ means in the same row with different superscripts differ significantly.

In match with the current findings, Marounek et al., (2009) reported that increasing dietary Se level did not significantly influence dressing out percentage of the rabbit meat. Also, results are in line with Erdélyi et al., (2000) who reported that GPx activity was increased in the erythrocyte haemolysate of rabbits with increasing dietary Se level (0.314 *vs.* 0.125 ppm). However, the increase in GPx activity is not linear with increasing dietary Se level. In this turn, the decrease in plasma GPx activity with the highest Se inclusion rate (0.4 and 0.8 mg/kg diets) compared with lower inclusion rate could be interpreted on base that excessive Se feeding may show pro-oxidant characteristic, which may be partly due to the formation of the selenite ion free radicals that in excess, together with abundant glutathione, can generate superoxide anions and produce other types of reactive oxygen species (Erdélyi et al., 2000).

In the current study, the increase in GPx activity in plasma with increasing dietary Se level compared to the control did not reveal a corresponding instant retard in lipid oxidation of the meat. In this context, Marounek et al., (2009) suggested that the high dietary concentration of α-tocopherol (50 mg/kg), which is a strong antioxidant, is enough to maintain TBARS values as close as possible, irrespective the increase in plasma GPx activity due to increased dietary Se inclusion rate. In this connection, Mùller et al., (2002) suggested that the anti-oxidative effect of selenium is especially important during periods of vitamin E deficiency.

CONCLUSION

This study indicates that fattening rabbit could tolerate up to 10 times of Se than recommended by NRC'1977 without a negative impact on meat quality traits and that the relationship between dietary Se level and blood GPx is not linear.

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REFERENCES

Abdel-Khalek A.M. 2013. Supplemental antioxidants in rabbit nutrition: A review. *Livestock Sci., 58:95-105.*

Agergaard N., Jensen P. 1982. Procedure for blood glutathione peroxidase determination in cattle and swine. *Acta Veterinaria Scandinavia, 23: 515-527.*

Dokoupilová A., Marounek M., Skřivanová V., Březina P. 2007. Selenium content in tissues and meat quality in rabbits fed selenium yeast. *Czech J. Anim. Sci., 52: 165-169.*

Duncan, D.B. 1955. Multiple range and multiple F test. *Biometrics, 11: 1-42.*

Erdélyi M., Virág Gy., Mézes M. 2000. Effect of supra-nutritional additive selenium supply on the tissue selenium concentration and the activity of glutathione peroxidase enzyme in rabbit*. World Rabbit Sci. 8: 183–189.*

Grau R., Hamm R.1956. Die bestimmung der wasserbindung des fleisches mittles der premethode. *Fleischwirtsch. 8: 733-734.*

Lebas F. 1990. Recherche et alimentation des lapines. *Cuniculture, 17: 12-15.*

Lee Y., Layman D., Bell R. 1979. Selenium dependent and non selenium dependent glutathione peroxidase activity in rabbit tissue. *Nutr. Reprod. Int. 20: 573-578.*

Maerten L.1992. Rabbit nutrition and feeding: a review of some recent developments. *J. Appl. Rabbit Res., 15:889-913.*

Marounek M., Dokoupilová A., Volek Z., Hoza I. 2009. Quality of meat and selenium content in tissues of rabbits fed diets supplemented with sodium selenite, selenized yeast and selenized algae. *World Rabbit Sci, 17: 207–212.*

Mateos G., Piquer J. 1994. Diseno de programas alimenticios para Conejos: aspectos teoricos formulacion practica. *Boletin de Cunicultura, 17:16-31.*

Mateos G., Rebollar P., de Blas C. 2010. Minerals and vitamins and additives. In*: de Blas, C., Wiseman, J.2nd. (Eds.), Nutrition of the Rabbit. CABI Publishing, New York, NY, USA, p. 128-129.*

Müller A., PaLlauf J., Most E. 2002. Parameters of dietary selenium and vitamin E deficiency in growing rabbits. *J. Trace Elem. Med. Biol., 16: 47-55.*

NRC 1977. Nutrient requirements of rabbits. *National Research Council, Washington DC., USA.*

Piette G., Raymond Y. 1999. Vergleichende bewertung verschiedener methoden. Bestimmung der *Ranzigkeit In Fleischprodukten. Fleischwirtschaft, 7: 69–73.*

SAS, 1990.SAS/STAT User's Guide: Statistics, Release 6.04, SAS Institute, Inc., Cary, NC., USA.

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