ORGANIC AND INORGANIC SELENIUM IN POULTRY DIETS: EFFECT ON LIPID AND PROTEIN OXIDATION, DRIP LOSS AND GPx ACTIVITY IN FRESH AND AGED MEAT

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Abstract – The aim of this work was to evaluate the effect of the selenium supplementation in a finishing diet for broilers on the lipid and protein oxidation, GPx activity and drip loss in *Pectoralis* and *Gastrocnemius* muscles. A corn-soya base diet was supplemented with selenium from an organic source (seleniomethionine) and an inorganic source (sodium selenite) at 0.30 ppm from thirty-five until fifty-six days. In *Pectoralis* and in *Gastrocnemius* fresh or aged during 5 days, Se supplemented in diet did not affect lipid or protein oxidation. However, GPx activity was enhanced in both muscles and the drip loss was reduced significantly at 24 hours *post mortem*. No effect of source was observed. Muscle type has a effect on the response of TBARS and process, as aging in vacuum package reduced the GPx activity. Selenium supplementation could be a strategy to reduce the drip loss in poultry meat and the effect could be mediated by the GPx activity in muscle.

I. INTRODUCTION

The poultry meat has increasing acceptance in recent years in the region and the world due to the high nutritional value, functional attributes and lower cost than red meat (1; 2). However, the production of poultry meat is facing new challenges that make the concept of nutritional, sensory and technological quality. The major problems of poultry meat that occur in the *post mortem* may be originated in the *ante mortem* period, and diet is one of the factors that may influence them. In the *post mortem,* avian muscle suffers important metabolic changes that result in oxidative processes that negatively affect sensorial acceptance, processing and preservation. Oxidative processes such as lipid peroxidation and carbonyls formation (3) are the most prevalent factors in conservation and would strongly affect the water holding capacity of the muscle fiber and nutritional attributes, loss of fatty acids, heme iron loss and formation of secondary compounds (3). Consumers prefer fresh meat with a minimum loss of water during handling and cooking. Therefore, the water-holding capacity of the meat is considered among the most important meat quality characteristics (4). Dietary selenium has been shown to act on the drip loss in poultry meat (5). It has been shown that dietary selenium is a catalyst and has a key role in reducing the lipid peroxides hydrogenated (6) through the participation in the system of antioxidant defenses that comprise the GPx (glutathione peroxidase), SOD (superoxide dismutase) and CT (catalase). The muscle GPx enzyme has a high dependence on dietary Se and its activity increases with the level of dietary Se (7; 8). One approach to enhancing the oxidative stability of meat is to add antioxidants into the animal's diet and that incorporation of Se in the diet of pre slaughter meat birds would act on the oxidation of lipids and proteins, improving the technological characteristics of the meat, particularly the drip loss. However, the assimilative capacity of the dietary Se is largely dependent on the source used, either organic as selenomethionine or inorganic like sodium selenite (9; 10; 11).

Based on this argues, the aim of this work was to evaluate the effect of the incorporation of dietary selenium, in a organic and inorganic form, on oxidative deterioration of lipids and proteins, the activity of GPx and the drip loss in two highly commercial value avian muscles, *Pectoralis* and *Gastrocnemius* associated with technological processes.

II. MATERIALS AND METHODS

One-day old Ross birds were raised until thirty -five days on litter floor, in climate room with a photoperiod of 23 hours. They were fed with a commercial corn-soya diet (21.20 % CP; 3191 kcal/kg ME) and fresh water was given *ad libitum*. At thirty-five days, twenty-seven birds were divided into three groups of nine birds each and fed, *ad libitum*, with one of the experimental diets until sacrifice. At fifty-six days old, all the birds were sacrificed according to the CHEA rules. A corn-soya base diet was

formulated and considered as a basal diet. The other two diets were supplemented with 0.3 ppm of Se coming from an organic source (seleniometionina, SeMet) or an inorganic (sodium selenite, SeNa). All diets were iso-protein and iso- energetic (20% CP and 3100 Kcal /kg ME). Muscles *Pectoralis* and *Gastrocnemius* were obtained at 24 hours *post mortem* and divided in two portions, one was stored at -30 ºC (fresh) and another one was vacuum packaged and stored during 5 days (aged). In fresh and aged samples, lipid and protein oxidation and GPx activity were determined as follows. Lipid oxidation was determined by TBARS method (12) with some modifications (13). Protein oxidation was estimated by the reactions between carbonyls and DNPH (2,4-dinitrophenylhydrazine) (14;13). GPx activity was measured recording the oxidation of NADPH (15; 13). Drip loss was determined by the weight difference in 2,5 g of *Pectoralis* or *Gastrocnemius* samples at 24 hours *post mortem* (16). Data was analyzed for the main effects with ANOVA GLM (NCSS, 2007) with *post hoc* Tukey Test ($p<0.05$).

III. RESULTS AND DISCUSSION

The effect of the supplementation with Se and the process on the lipid and protein oxidation was measured and results are shown in Table 1 and 2. Lipid and protein oxidation was not affected by the selenium supplementation. The type of muscle had an influence on the TBARS but not the process. The *Gastrocnemius* lipid oxidation expressed as TBARS was higher than in *Pectoralis*. Carbonyls were not different among the muscles or process. Data of the GPx activity are shown in Table 3. Selenium supplementation increased the GPx activity in both muscles, but muscle type did not affect it significantly. The GPx activity was higher in fresh than aged muscles. These results are in accordance with previous works (17; 18; 7). In Table 4, it is shown that the Se supplementation decreased significantly ($p<0.01$) drip loss in both muscles, without an effect of source or muscle type on the response. It seems like that a stabilising effect of Se is also associated with maintaining muscle membrane integrity. In this sense, Edens (5) showed that drip loss was decreased when organic Se was fed to broilers. Using a model system based on red blood cell membrane stability, Edens (19) confirmed a membrane-stabilising effect of organic Se.

Table 1. Effect of organic (SeMet) and inorganic (SeNa) Se supplementation in a diet received two weeks prior sacrifice on the lipid oxidation, measured as TBARS (mg MDA/kg meat) in fresh and aged *Pectoralis* (PM) and *Gastrocnemius* (GM) muscle.

		Selenium source		
		Basal	SeMet	SeNa
Process	Muscle			
Fresh	PM	0.28 ±0.02	0.22 ±0.02	0.28 ±0.03
	GM	0.28 ±0.02	0.33 ±0.02	0.31 ±0.03
Aged	PM	0.27 ±0.02	0.29 ±0.02	0.28 ±0.01
	GM	0.28 ±0.02	0.33 ±0.03	0.32 ±0.03
Main effects				P
Diets	Basal	SeMet	SeNa	
	0.278	0.296	0.300	0.49
Muscle	*Pectoralis*		*Gastrocnemius*	
	0.271b		0.312a	0.01
Ageing	Fresh		Aged	
	0.285		0.298	0.41

Table 2. Effect of organic (SeMet) and inorganic (SeNa) Se source in a diet received two weeks prior sacrifice on the protein oxidation, measured as nmoles DNPH/mg protein, in fresh and aged *Pectoralis* (PM) and *Gastrocnemius* (GM) muscles.

		Basal	SeMet	SeNa
Process	Muscle			
Fresh	PM	0.20 ±0.03	0.16 ±0.06	0.17 ±0.01
	GM	0.19 ±0.01	0.16 ±0.02	0.15 ±0.01
Aged	PM	0.22 ±0.02	0.17 ±0.03	0.18 ±0.01
	GM	0.19 ±0.01	0.18 ±0.01	0.20 ±0.02
Main effects				P
Diets	Basal	SeMet	SeNa	
	0.20	0.17	0.17	0.16
Muscle	*Gastrocnemius*		*Pectoralis*	
	0.18		0.18	0.49
Process	Fresh		Aged	
	0.17		0.20	0.41

Table 3. Effect of organic (SeMet) and inorganic (SeNa) source of Se in a diet received two weeks prior sacrifice on the glutathione peroxidase activity (GPx), measured as nmoles/min/mg protein, in fresh and aged *Pectoralis* (PM) and *Gastrocnemius* (GM) muscle.

		Selenium Source		
		Basal	SeMet	SeNa
Process	Muscle			
Fresh	PM	6.71	7.38	8.11
		±0.84	±1.33	±0.63
	GM	6.55	7.35	5.24
		±0.32	±0.65	±0.75
Aged	PM	3.96	6.43	7.25
		±0.57	±2.00	±1.17
	GM	5.95	5.13	5.10
		±1.14	±1.03	±0.14
Main effects				P
Diets	Basal	SeMet	SeNa	
	5.80b	6.58a	6.437a	0.05
Muscle	*Gastrocnemius*		*Pectoralis*	
	5.90		6.65	0.07
Process	Fresh		Aged	
	6.90a		5.64b	0.01

Table 4. Effect of organic (SeMet) and inorganic (SeNa) Se supplementation in a diet received two weeks prior sacrifice on drip loss at 24 hours *post mortem* in the *Pectoralis* and *Gastrocnemius* muscles.

	Selenium Source			
Muscle	Basal	SeMet	SeNa	
GM	2.09	1.31	1.21	
	±0.25	±0.12	±0.22	
PM	1.73	1.31	1.22	
	±0.25	±0.18	±0.10	
Main effects				P
Diet	Basal	SeMet	SeNa	
	1.91a	1.38b	1.22b	0.01
Muscle	GM	PM		
	1.46	1.54		0.63

IV. CONCLUSION

Selenium supplementation as organic or inorganic forms decreased the drip loss in both muscles studied, *Gastrocnemius* and *Pectoralis* and increased GPx activity. However, no effect was observed for lipid and protein oxidation. The muscle type affected the response only in TBARS. Ageing process in vacuum package decreased the GPx activity. No effects of source were observed in anyone of the parameters measured.

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