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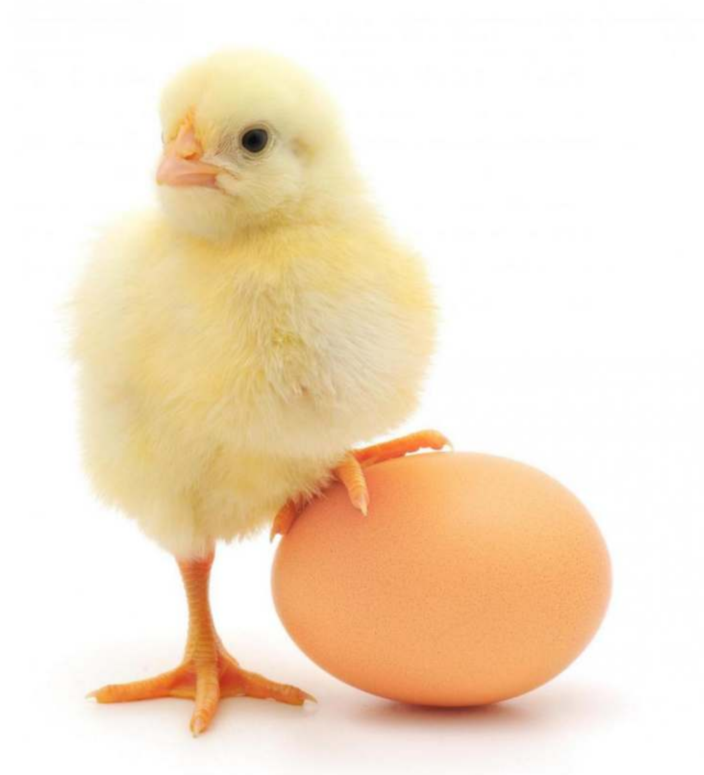

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Total Replacement of Sodium Selenite by Selenium Yeast Reduces non Prime Cuts Yields in Male Broilers

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Abstract: The objective of this study was to evaluate carcass traits, yield and meat quality of broilers supplemented with organic selenium (selenium yeast) in total replacement to sodium selenite in the diets. A total of 704 male Cobb chicks, one day old, were randomly allotted in 32 boxes, which one with 22 animals, in a total of 16 replicates per treatment. The diets were formulated based on corn and soybean meal and different sources of selenium. The treatments consisted of selenium in the inorganic form (sodium selenite, SS) and in an organic form (selenium yeast, SY) supplementation. At 42 days old, 64 birds per treatment were slaughtered and carcass traits, yields and meat quality were evaluated. SY group showed lower back yield in comparison with SS group. Breast yield was slighted higher in SY group, however, no statistic differences were found. Meat quality and traits were not influenced by dietary treatments. Total replacement of sodium selenite by selenium yeast in broilers diets reduces back yields, a non prime cut in chicken carcass. Sodium selenite can be totally replaced by selenium yeast without affecting broiler meat quality and traits.

Key words: Prime cuts, organic selenium, carcass yield

INTRODUCTION

Modern broiler chicken has been genetically selected mainly for performance parameters and carcass traits. However, intensive selection also has negative aspects; one of these is an increase in fat deposition on the carcass, which is prone to deterioration and some consumers may also find this fat unacceptable. Also losses in meat quality are more evident in carcasses with high fatty acids content, like pork, beef and chicken, been more prone to the lipoperoxidation process. Pork and chicken meat oxidize faster than beef, since their fat content is higher and more unsaturated fatty acids are present (Olivo and Shimokomaki, 2002). Oxidative reactions result in meat deterioration and the nutritional value of the meat is diminished (Bou *et al*., 2005) so, it's necessary to put quality in poultry raising since the first day that birds are allocated in poultry houses, choosing better ingredients to use in the diets in order to obtain high quality meat in the end of the process.

Trace elements in diet composition tend to start physiologic changes in muscle tissue, modifying meat in a beneficial way. To improve meat stability, selenium, as a component of glutathione peroxidase, has been added to animal diets, protecting the membrane of muscle fibers, helping to keep meat's natural characteristics (Downs *et al*., 2000). In addition, selenium deficiencies are common in animal diets; this deficiency causes nutritional muscle dystrophy which may cause losses by carcass condemnation.

Usually, animal diets are supplemented with levels of selenium in concentrations higher than recommended. The aim is to reach at least the ideal selenium concentrations in the body; but this may result in environmental contamination. In Europe, soil and water contamination by selenium comes mainly from the manure of animal production units which use sodium selenite in their diets (Sager, 2006). This selenium state does not have good absorption; because it interacts with other minerals in chickens gut became unavailable.

According to Payne *et al*. (2005), organic selenium (as selenium yeast or selenomethionine) is actively absorbed by the organism and can be directly incorporated into proteins. It also can be stored with higher efficiency in chicken breast compared to the inorganic form (Choct *et al*., 2004; Kuricova *et al*., 2003). The opposite occurs with sodium selenite, which's absorbed by passive transporting, competing for the same binding sites with other minerals (Surai, 2002). In the future, sodium selenite used in animal nutrition will pass through several legislative changes in UE. Under the new rules for feed promoters (Regulation-EC 1831/2003), all of them will be reviewed, including trace minerals.

However, an organic source of selenium was approved for animal diets utilization (FDA, 2000). This form of selenium is obtained by growing yeast (*Saccharomyces cerevisiae*) in a selenium rich environment and reduced sulfur content, promoting the incorporation of selenium

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Table 1: Experimental diets composition

	Phase (days)			
Ingredients	Pre-start (0-7)	Start (8-21)	Growing (22-36)	Finishing (37-42)
Corn, grain	56.25	59.53	60.98	64.22
Soybean meal	37.80	33.90	32.10	29.00
Limestone	0.52	0.47	0.34	0.00
Salt	0.68	0.43	0.38	0.39
Soybean oil	1.75	2.67	3.20	3.39
Premix[1,2]	3.00	3.00	3.00	3.00
Total	100.00	100.00	100.00	100.00
Calculated chemical composition of dietary treatments				
ME (kcal/kg)	2950.00	3050.00	3100.00	3150.00
CP (%)	22.00	20.50	19.73	18.51
Ca (%)	1.00	0.97	0.96	0.91
P avail (%)	0.46	0.45	0.41	0.38
Methionine (%)	0.52	0.50	0.44	0.36
Lysine (%)	1.27	1.17	1.10	1.01
Cystine (%)	0.36	0.34	0.33	0.31
Crude fat (%)	4.38	5.35	5.90	6.16
CF (%)	3.59	3.42	3.30	3.20
Total Na (%)	0.30	0.20	0.18	0.18

[1]Supplied kg of product: Ca 210 g; P 85.7 g; Mn 2,500 mg; Zn 1,500 mg; Fe 1,250 mg; Cu 250 mg; I 15 mg; Se 8.2 mg; Vit.A 250,000 IU; Vit.D3 50,000; Vit.E 275 mg; Vit.K3 42.5 mg; Vit.B1 45 mg; Vit.B2 150 mg; Vit.B6 62.5 mg; Vit.B12 300 mcg; Niacin 1,000 mg; Folic acid 27 mg; Pantothenic acid 400 mg; Choline 12.5 g; Biotin 2 mg; Methionine 45 g.

[2]T1 Premix with Se yeast and T2 with sodium selenite

instead of sulfur into the methionine molecule (AAFCO, 2003). Selenomethionine cannot be synthesized by mammals or avian species (Schrauzer, 2000), when this amino acid is taken up, it can be incorporated in a non specific way into different proteins, for example muscle proteins (Surai, 2002). On the other hand, the utilization of these substances in animal nutrition is new and some inconsistencies are evident. This indicates that further research is required in this field. Keeping this in mind, the aim of this study was to evaluate the total replacement of sodium selenite by selenium yeast in broiler diets in carcass traits, yields and meat quality.

MATERIALS AND METHODS

This study was conducted at the Poultry Facilities at the Federal University of Pelotas, in Rio Grande do Sul, South of Brazil. A total of 704 Cobb male chicks, one day-old, were used. The birds were vaccinated for Marek and IBD in the hatchery. They were randomly distributed in groups of 22 birds per pen, in a total of 16 replicates per treatment. The diet was a corn/soybean meal based diet with nutritional requirement levels determined by the breeder manual (Table 1). Birds were fed *ad libitum* and treatments consisted in different source of selenium supplementation; as inorganic form (sodium selenite, SS) and organic form (selenium yeast, SY). In both treatments, selenium supplementation amounted was 0.3 ppm.

At the end of 42 days, two chickens per replicate were randomly separated in a total of 32 birds per treatment. These animals were identified and submitted to an eight hours fasting. The slaughtering was carried out according to the rules determinate by the RIISPOA. All animals were weight before slaughter, after the procedure, and before chilling. Data from breast, legs (thigh and drumstick), wings, wings drumsticks and back, remaining skin and bones were registered. Legs, wings and wings drumsticks were handling as groups. Carcass yields were calculated relating to live weight before slaughter and parts yields, were related to carcass weight. After the cuts were weighted, deep and superficial breast muscles were separated from the bone and the skin was removed for meat color evaluation, water retention and drip loss in this cuts. The color evaluation was carried out using the Minolta Chroma Meter CR-300 colorimeter, where three measurements were obtained at three different points in *Pectoralis major muscle*. Water retention was determinate according to the procedures described by Hamm (1960). A five grams sample was removed from the middle of *Pectoralis major muscle* for water retention evaluation. The rest of *Pectoralis major muscle* was used to measured drip loss as described by Northcutt *et al.* (1994). Drip loss was calculated as (weight of drip loss/initial weight of fillet) x 100.

The results were submitted for variance analyses and the averages were compared by Tukey test with 5% probability using a Statistic Program (SAS, 1999).

RESULTS AND DISCUSSION

According to Table 2, there was no difference between treatments for pre slaughtering weight and cut ups weight. Results from this study are in agreement with those obtained by Downs *et al.* (2000), Payne and

Table 2: Pre slaughtering live, carcass and cuts weights of broilers supplemented with different sources of selenium in diets (g)

Source of Se	PSW	CW	Foot	Legs	Back	Breast	Wings	WD
SS	2865	2363	104	639	535	744	108	105
SeY	2860	2351	105	647	522	752	111	105
p-value	0.90	0.73	0.64	0.55	0.21	0.65	0.16	0.90
CV%	6.27	7.22	7.72	8.33	8.23	9.13	8.85	7.40

SS = Sodium Selenite; SeY = Selenium Yeast; PSW = Pre Slaughtering Weight; CW = Carcass Weight; WD = Wings Drumsticks

Table 3: Carcass and cuts yields of broilers supplemented with different sources of selenium (%)

Source of Se	Carcass	Foot	Legs	Back	Breast	Wings	WD
SS	82.08	4.47	27.30	22.91[a]	31.29	4.62	4.49
SeY	82.37	4.49	27.71	22.21[b]	31.98	4.75	4.46
p-value	0.72	0.72	0.15	0.02	0.61	0.21	0.56
CV%	3.91	6.96	3.95	5.03	4.56	8.72	4.30

SS = Sodium Selenite; SeY = Selenium Yeast; WD = Wings Drumsticks.

[a,b]Means in a column within each main variable with no common superscript differed significantly ($p \leq 0.05$)

Southern (2005) and Sevcikova *et al.* (2006), who worked with different sources and levels of selenium in broiler's diets. However, there was a slight tendency of higher cut ups (drumstick, thigh and breast) in group supplemented with selenium yeast. Considering that the breast is the most valuable cut of the chicken in the North American market (Scheuermann *et al.*, 2003) and that very little differences in the size of this cut are able to interfere directly in poultry market, the results could have a commercial value, because an addition of eight grams per breast in one hundred broilers represents an increase of 800 kg of meat. The same can be extrapolated to thigh and drumstick. Nowadays chicken cuts are more acceptable to consumers than the whole carcass. However, it's necessary other studies to confirm with those benefits are attributed to selenium yeast supplementation.

Results in Table 3 indicate that a higher yield in chicken back cuts was obtained when broilers were supplemented with sodium selenite. Considering that this part of the carcass does not have a commercial value, the result indicates a negative aspect in relation to sodium selenite supplementation in chicken diets.

Upton *et al.* (2008), observed a higher carcass yield, edible entrails, foot and neck in chicken supplemented with selenium yeast comparing with a group receiving sodium selenite in the diets. In both cases, selenium yeast might be providing higher amount of available amino acids, a nutrient presenting in the commercial product.

Results of meat quality are presented in Table 4. There is no difference between treatments for the variables examined. Mahan *et al.* (1999) reported that the supplementation of 0.3 ppm of selenium yeast in diets with 0.06 ppm of based selenium, reduced drip loss in chicken breast meat. Downs *et al.* (2000); Naylor *et al.* (2000); Deniz *et al.* (2005) and Upton *et al.* (2008) concluded that broilers supplemented with different sources of selenium, showed a decrease in drip loss and better meat quality when they were fed selenium yeast.

Table 4: Meat instrumental evaluation of broilers supplemented with different sources of selenium in diets

Source of Se	WRC %	DL%	L*	a*	b*
SS	74.92	4.29	55.73	4.46	6.63
SeY	75.39	4.17	56.14	3.84	6.51
p-value	0.72	0.73	0.80	0.18	0.84
CV%	4.28	20.79	7.82	29.98	25.62

SS = Sodium Selenite; SeY = Selenium Yeast; WRC = Water Retention Capacity; DL = Drip Loss

Results of drip loss obtained by Mateo *et al.* (2007) in a study using swine receiving different sources of selenium, showed better carcass results in those animals supplemented with selenium yeast in diets. Although the same cannot be observed in this work, drip loss and water retention were slightly better in SY group, even there is no statistic significance.

There are no differences between treatments for meat color, indicating that both forms of selenium in diets are able to provide pigments stability. However, chicken meat is extremely prone to peroxidation because it has a high content of polyunsaturated fat acids, and this have affect on meat color (Ryu *et al.*, 2005). We expected that a higher bioavailability of selenium, as selenium yeast, would act avoiding peroxides formation in muscle fiber, which are responsible for oxidative damages affecting the sensorial quality of the meat. Considering color as the major factor of choice by consumers, it's desirable to improve this characteristic in order to obtain colorful carcass, mainly because the establishment that pale carcass are related to "unhealthy animals", a untruth comparison made by consumers.

Total replacement of sodium selenite by selenium yeast in broilers diets has god effect in carcass yields, reducing the amount of non prime cuts. Meanwhile, the organic source did not interfere in parameters related to carcass traits and meat quality, suggesting that it can be a substitute of sodium selenite in poultry diets.

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