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Selenium nanoparticles-loaded chitosan microspheres as a dietary selenium source in rabbits: impact on meat selenium concentration and oxidative stability

E. Fortatos[1], E. Giamouri[1], A.C. Pappas[1], S.N. Yannopoulos[2], G. Papadomichelakis[1]

[1] *Laboratory of Nutritional Physiology and Feeding, Agricultural University of Athens, Greece*

[2] *Institute of Chemical Engineering Sciences, Foundation for Research and Technology-Hellas, Patras, Greece*

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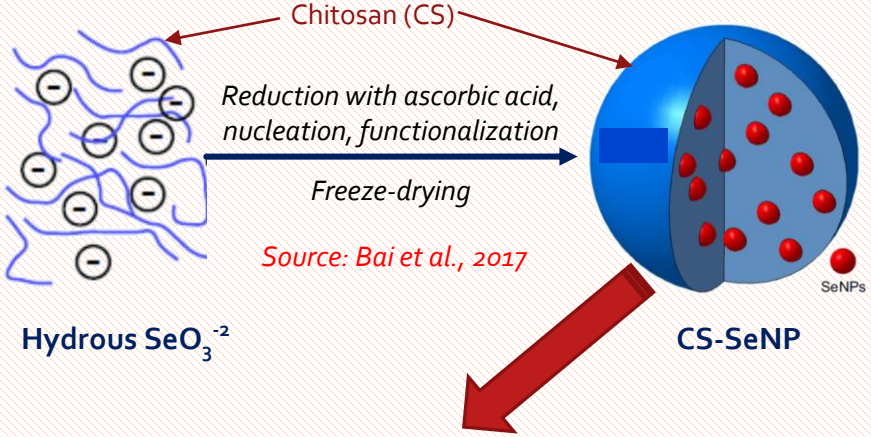
BACKGROUND

Dietary selenium (Se) is an important trace element to enhance the antioxidant defense. The commonly-used Se sources (**sodium selenite; SS and Se-yeast; SY**) have a narrow margin between beneficial and toxic effects. A new form of Se nanoparticles stabilized in chitosan microspheres (**CS-SeNPs**) is well established for low toxicity, but their bioavailability and antioxidant potential has not been extensively investigated in livestock feeding.

OBJECTIVES

- Synthesis of CS-SeNPs with chemical reduction
- Characterization of CS-SeNP physico-chemical properties
- Comparison of CS-SeNP with SS and SY *in vivo*
  - Growth performance
  - Meat Se concentration
  - Meat oxidation

METHODS



- **Dynamic light scattering (DLS):** size distribution
- **X-ray diffraction (XRD):** structure of Se
- **X-ray photoelectron spectroscopy (XRD):** composition of CS-SeNP
- **Hydride vapour generation (AA):** Se content

In vivo trial

96 New Zealand × Californian rabbits (age 35 d)

Control (C)	T1	T2	T3
Basal diet (BD) with no added Se	BD+0,4 mg Se/kg: 0,2 mg from SS + 0,2 mg from SY	BD+0,4 mg Se/kg: 0,2 mg from SY + 0,2 mg from CS-SeNP	BD+0,4 mg Se/kg: from CS-SeNP

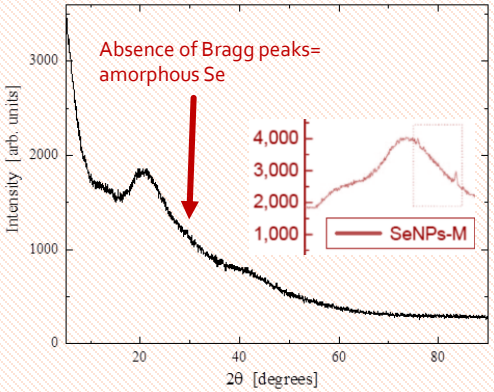
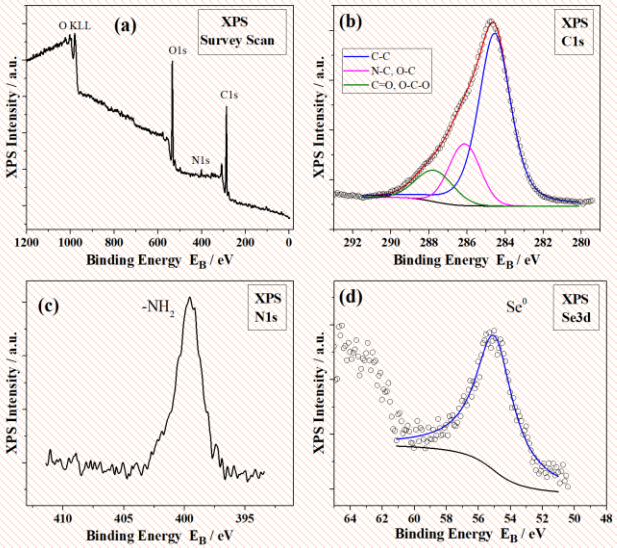


Figure 1: X-ray diffraction (XRD) patterns of CS-SeNP



Element	Binding energy (eV)	Concentration (%)	Assignment
O1s	532.53	28.67 ± 0.05	C-O
C1s	284.75	67.97 ± 0.06	C-C, C-N, O-C
N1s	399.55	3.12 ± 0.04	$-NH_2$, -NH
Se3d	55.28	0.25 ± 0.01	Se (0)

Figure 2: (a) Survey X-ray photoelectron spectroscopy (XPS) spectrum of the CS-SeNP. (b) Deconvolution of the C1s XPS spectrum (c) N1s XPS spectrum. (d) Se3d XPS spectrum.

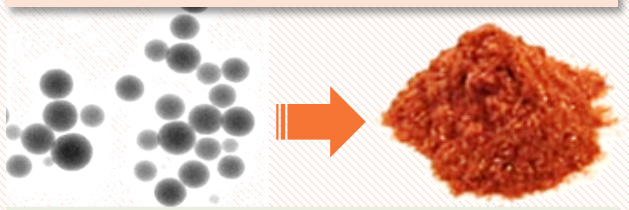
RESULTS

CS-SeNP characterization

Spherical monodispersed CS-SeNPs of 80.5±20 nm average diameter were obtained. The SeNPs were exclusively composed of **amorphous** (Fig.1) **elemental Se (Se0)** and were **totally encapsulated in CS**, as indicated by the XRD and XPS surveys, respectively (Fig. 2).

In vivo trial

Growth performance traits were not affected by dietary Se addition in any form (Table 1). Meat Se content (Fig. 3) and oxidative stability (Fig. 4) was similar in T1, T2 and T3 rabbits, but significantly higher (P< 0.05) when compared to C rabbits.



CONCLUSIONS

The **Se from CS-SeNPs enriches meat with Se** and **enhances meat oxidative stability** in a manner similar to the commonly-used inorganic and organic forms. Given their well-established low toxicity**, CS-SeNPs have a very good potential as dietary Se source** and should be further studied.

Table 1: Dietary Se content and growth performance of rabbits at 77 days of age

	C	T1	T2	T3	SEM	P-value
Dietary Se, mg/kg	0.093	0.508	0.516	0.478	-	-
Initial BW, g (35 d)	1005	1000	1013	1012	34.3	0.793
Final BW, g (77 d)	2952	3010	2943	2975	100.1	0.916
Feed intake, g/d	157.9	161.2	160.6	156.3	6.48	0.863
BW gain, g/d	47.8	49.6	47.8	48.0	1.83	0.740
FCR, g/g	3.31	3.27	3.35	3.26	0.071	0.537
Cold carcass, g	1763	1813	1774	1784	71.3	0.906
Dressing, %	62.7	63.9	63.8	63.6	0.65	0.265

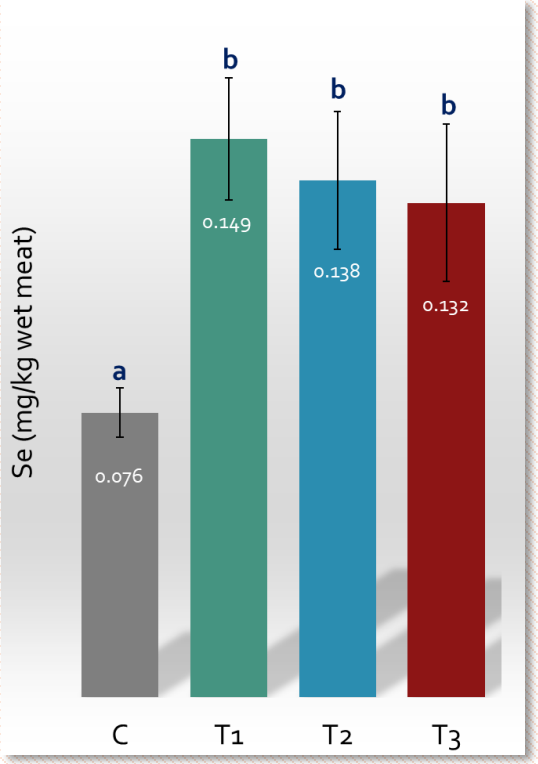


Figure 3: Meat Se content

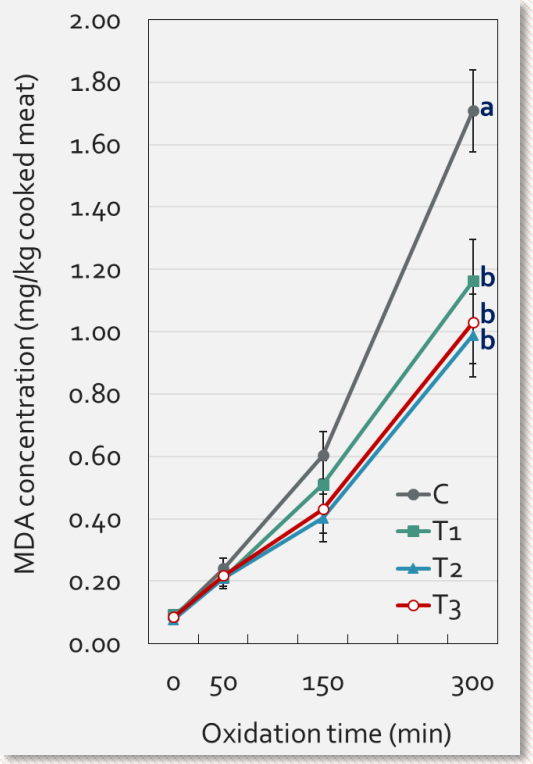


Figure 4: Meat malondialdeyde (MDA) values