Effect of Antioxidants on Cholesterol Oxidation in ω-3 Enriched Chicken Meat

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Summary

The influence of vitamin E (**VE**) and seleniomethionine (**SM**) on cholesterol oxidation in raw and cooked ω-3 enriched dark chicken meat was evaluated. Two levels of VE and SM were supplemented in broiler diets. Extruded linseed was used as a source of ω-3 fatty acids (α-linolenic acid; **LNA**). Cholesterol oxidation products (**COPs**) were analyzed in raw and cooked chicken thigh meat (boiled, pan-fried and roasted) with GC-MS. High level of antioxidants in the diet did not show any significant reduction in COPs formation in raw meat compared to low levels. However, during boiling COPs formation was inhibited by high level of VE and SM. Contradictory results were found during roasting; high VE levels prevented cholesterol oxidation while high SM did not show any protective effects. Unexpectedly, pan frying did not increase the level of COPs in any of the dietary treatments. These results proved that VE seems to protect cholesterol against oxidation more efficiently than SM.

Problem

It is known that ω-3 polyunsaturated fatty acids (**PUFA**) have potential in the prevention and treatment of cardiovascular diseases. Based on these considerations, health authorities in many Western countries are advising people to consume more ω-3 fatty acids. One means of increasing ω-3 PUFA consumption is to increase ω-3 PUFA in edible tissue like muscles.

Figure 1. Linseed

Linseed oil contains 50-60% of LNA, which is the precursor of long chain ω-3 PUFA. For these reasons, it is used widely in ω-3 PUFA muscle enrichment. However, high level of linseed in broilers diet increases the degree of unsaturation of lipids leading to a reduced oxidative stability of muscle foods.

In meats, in addition to PUFA oxidation, cholesterol oxidises forming COPs, especially when it is exposed to light, radiation, long-term storage and elevated temperatures during cooking.

It has been reported that cholesterol oxidation might be accelerated in the presence of ω-3 PUFA in poultry meat.

Our Approach

128 Birds

Ross 308

Table 1. Dietary Treatments.

	Linseed	VE	SM[1]
Low antioxidants	20%	50 IU/kg feed	0.1 mg/kg feed
VE	20%	200 IU/kg feed	0.1 mg/kg feed
SM	20%	50 IU/kg feed	0.3 mg/kg feed
VE plus SM	20%	250 IU/kg feed	0.4 mg/kg feed

[1]SM:Selenomethionine (Organic Selenium)

- Raw
- Boiled
- Pan -Fried
- Roasted

Extruded linseed and antioxidants were supplemented during the 22-61 d Finisher phase

COPs were quantified by Gas-Chromatography (GC) and GC-Mass Spectrometry (GC-MS)

Figure 2. GC

Our Observations

Identification of COPs by GC-MS

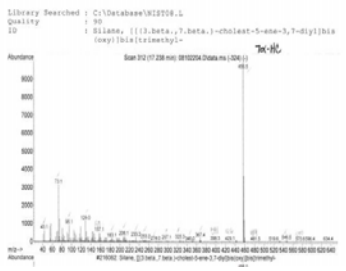

Figure 3. GC-MS 7-α-hydroxycholesterol

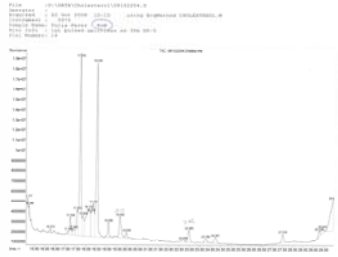

Figure 4. GC-MS Roasted Meat

25-hydroxycholesterol, which is considered most cytotoxic, was not detected.

The average level of total COPs in raw ω-3 enriched dark chicken meat was 19.05 μg/g of fat which is almost 7 times higher than total COPs in not enriched breast chicken meat (2.88 μg/g of fat)

The low levels of COPs in pan-fried meat may indicate that some compounds are showing an antioxidant effect during pan-frying, probably released peptides from either proteins or collagen.

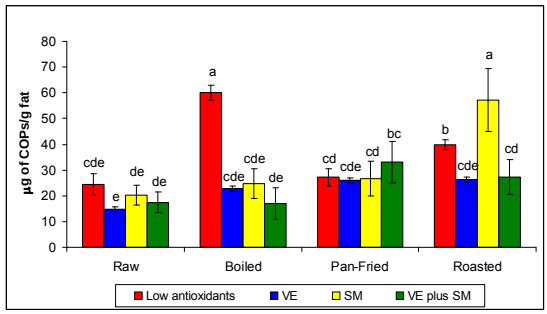

Figure 5. COPs in Raw and Cooked Chicken Meat. Total COPs were calcualted as the sum of 7-α-hydroxycholesterol, 7-β-hydroxycholesterol, β-cholestanetriol, α-cholestanetriol and 7-keto cholesterol.

What does this mean?

- SM had limited potential for increasing the oxidative stability of meat compared to VE in some of the samples. Selenium works as an antioxidant by using the glutathione peroxidase enzyme which is part of an *in vivo* mechanism and it is also inactivated at temperature above 80˚C.
- The generation of COPs on the cooking conditions. In fact, pan-frying generated less oxidation products compared to roasting and boiling.
- Further research is needed to quantify toxicological effects of COPs on value-added food products especially after cooking and their evolution after storage.

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