Cholesterol oxides as putative indicators of disorders in lipid metabolism in salmon

Jana Pickova, Department of Food Science; SLU, Sweden

Paresh Dutta, Annette Pettersson, Livar Fröyland

Anders Kiessling

Fish eggs are rich in polyunsaturated fatty acids and cholesterol

Egg composition is dependent on broodstock nutrition

Importance of oxidative stress on gamet quality

Broodstock environmental stress factors

- Physical (water, temperature, handling, etc.)
- Physiological (nutritional factors, genetic factors, etc.)

Oxidative stress

Wild populations

- Environmental pollution
- Nutritional factors

Xenobiotic substances

Antioxidant depletion

Captive broodstock

- Nutritional factors

Rancidity of dietary lipids

Xenobiotic substances

Antioxidant depletion

- M74 syndrome in Baltic Sea
- Yolk sac mortality
- 100% mortality in offspring from affected females

- Main characteristics

Pale eggs and flesh

Wiggling behavior of females

- Earlier investigations

Investigations of salmon and cod egg fatty acid composition

Higher content of docosahexaenoic fatty acid, DHA (22:6 n-3) in Baltic Sea fish compared to west coast

Low content of astaxanthin and other carotenoids

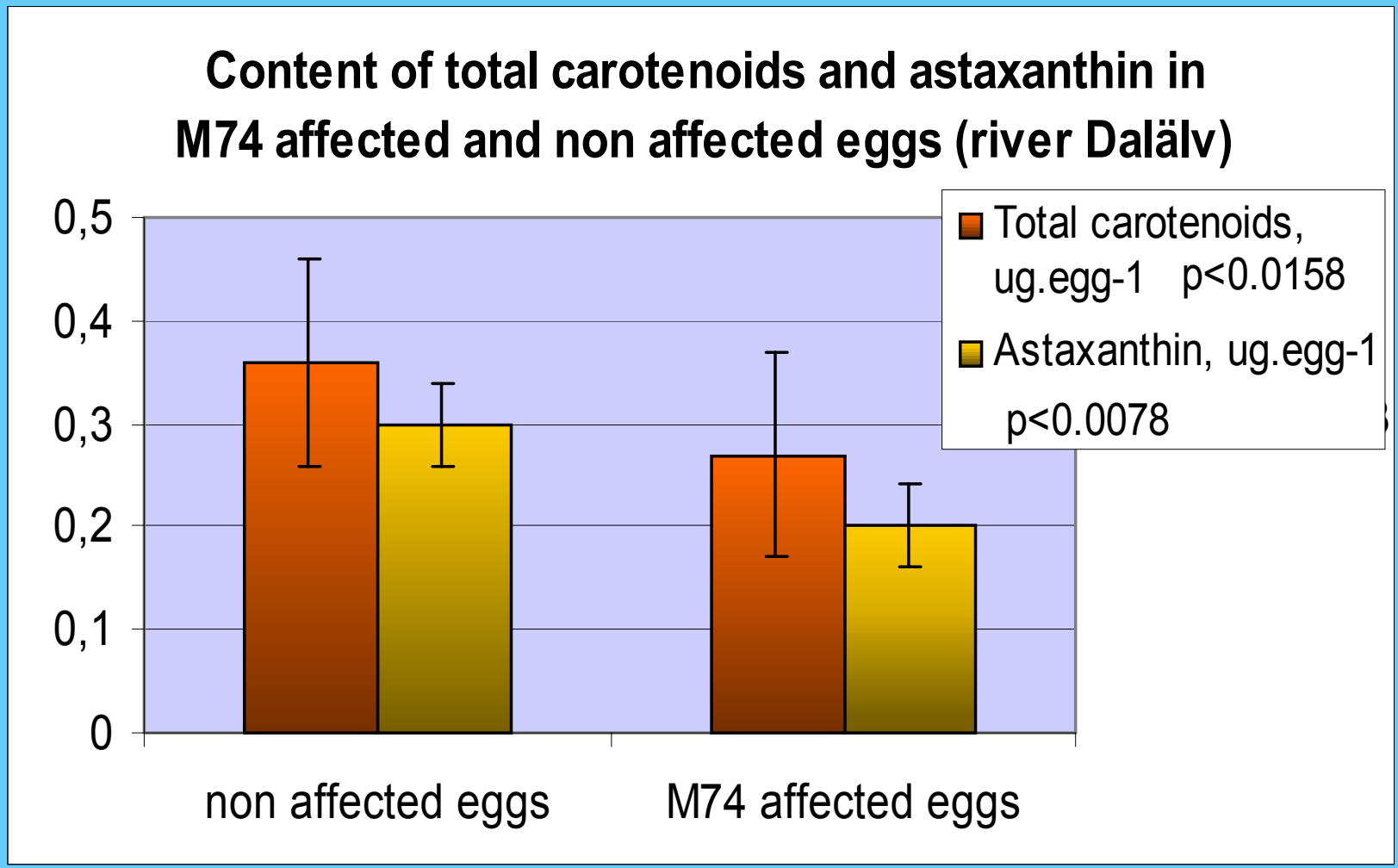
Methodology

- Lipid extraction (Hara & Radin, 1978)
- Fatty acid composition (GC)
- Cholesterol content (GC)
- Cholesterol oxides (COPs) (GC)
- Carotenoid analyses, HPLC

Content of PUFA (% of identified fatty acids) from phosholipid fraction from M74 and healthy eggs of River Dalälv salmon, from hatching season 1998.

	non affected eggs n=8		M74 affected eggs n=8		
Fatty acid	% FA	SD	% FA	SD	P<
18:2n-6	1.4	±0.1	1.2	±0.2	n.s.
18:3n-3	0.5	±0.1	0.6	±0.1	n.s.
20:4n-6 (AA)	1.6	±0.2	1.8	±0.1	0.046
20:5n-3 (EPA)	8.0	±0.5	8.4	±0.3	n.s.
22:5n-3	6.0	±0.4	6.2	±0.5	n.s.
22:6n-3 (DHA)	26.3	±1.2	28.2	±1.4	0.0056
PUFAn-3	40.8	±1.8	44.4	±2.2	0.0292

Jana Pickova, LARVI 2001


Content of total carotenoids and astaxanthin in M74 affected and non affected eggs (river Dalälv)
0,5
0,4
0,3
0,2
0,1
0
Total carotenoids, ug.egg-1 p<0.0158
Astaxanthin, ug.egg-1 p<0.0078
non affected eggs
M74 affected eggs

Content of total carotenoids and astaxanthin in samples of M74 and healthy eggs of River Dalälv salmon, from hatching season 1998.

	non affected eggs	SD	M74 affected eggs	SD	P<
Total carote-noids, $\mu g.egg^{-1}$	0.36	±0.1	0.27	±0.04	0.0158
Astaxanthin, $\mu g.egg^{-1}$	0.30	±0.1	0.20	±0.04	0.0078

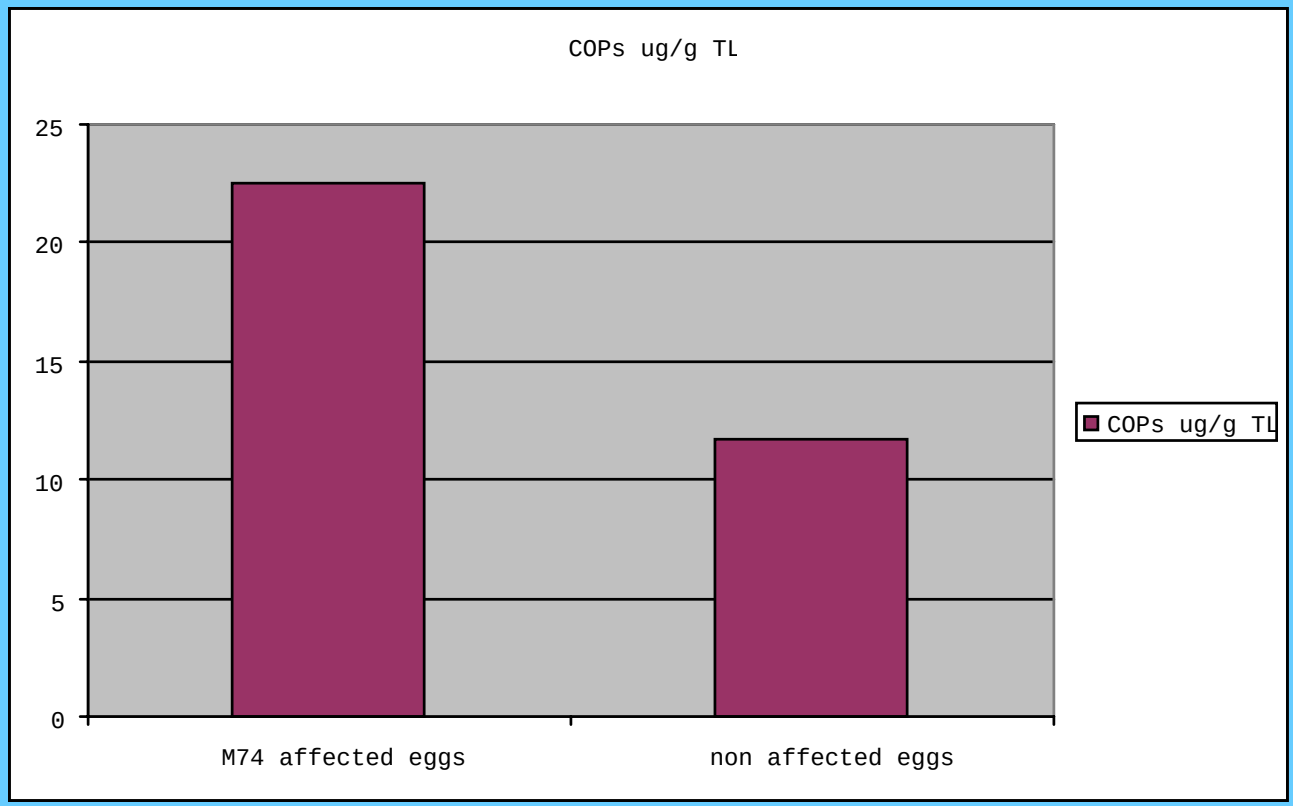
Comparison of cholesterol and COPs content of eggs from females exhibiting M74 syndrome and non affected egg batches from three Swedish river stocks, River Lagan (west coast) and R. Mörrum and R. Dalälv (east coast= Baltic Sea).

RIVER	M74	cholesterol mg.g^{-1} TL	COPs µg.g^{-1} TL
R. LAGAN 1996	non	56.9	8.1
R. LAGAN 1997	non	66.2	7.7
R. MÖRRUM 1996	M74	71.9	23.7
R. MÖRRUM 1996	non	62.8	10.7
R. DALÄLV 1996	M74	68.1	35.2
R. DALÄLV 1996	non	69.9	14.2
R. DALÄLV 1997	M74	57.7	13.9
R. DALÄLV 1997	non	68.4	5.8
R. DALÄLV 1998	M74	63.7	27.6
R. DALÄLV 1998	non	66.1	23.4

Abbreviations: TL = total lipid; COPs = cholesterol oxidation products; R.=river

Jana Pickova, LARVI 2001

Total content of cholesterol oxides from M74 affected and non affected salmon egg total lipids (1996-1998; three rivers)



Conclusions

- The elevated levels of COPs and
- DHA and
- the low levels of astaxanthin

indicate disorders in lipid metabolism in salmon, caused by oxidative stress observed

$\Rightarrow$ by increased desaturation,

$\Rightarrow$ autooxidation of cholesterol and

$\Rightarrow$ depletion of astaxanthin

Thank you