Vitenskapskomiteen for mattrygghet
Norwegian Scientific Committee for Food Safety

Opinion of the Panel on animal feed
of the Norwegian Scientific Committee for Food Safety
13 april 2005

Cadmium in feed to farmed salmonid fish

SUMMARY

High levels of cadmium have been found in feedingstuffs for ruminants, pigs and farmed fish. The levels found in compound feedingstuff range from 11-17 mg/kg. The Norwegian Food Safety Authority has strong indications that the source of cadmium is contaminated zinc sulphate used in premixtures for feed and then further distributed to feed producers.

The Norwegian Food Safety Authority requested the Norwegian Scientific Committee for Food Safety to give an opinion on the consequences for fish health and food safety when farmed fish has been fed with feeds containing 11-17 mg of cadmium per kg of feed for a limited time period.

The Panel on animal feed concludes that feeding Atlantic salmon or rainbow trout with feeds containing 11-17 mg of cadmium per kg of feed for a limited time period (up to four months) is unlikely to cause significant fillet contamination.

With regards to fish health, dietary cadmium levels of 11-17 mg/kg have been shown to cause biochemical and physiological responses in Atlantic salmon parr following 4 months exposure. These responses are indicators of toxic exposures and do not necessary indicate adverse health effects. Whether the dietary cadmium levels in the order of 11-17 mg/kg will cause adverse and irreversible effects on fish health will strongly depend on the duration of exposure and possible recovery.

BACKGROUND

High levels of cadmium have been found in feedingstuffs for ruminants, pigs and farmed fish. The levels found in compound feedingstuff range from 11-17 mg/kg. The maximum permissible levels for cadmium in compound feedingsstuff vary from 0.5-1 mg/kg, depending on the category of animal it is intended for. The Norwegian Food Safety Authority has strong indications that the source of cadmium is contaminated zinc sulphate used in premixtures for feed and then further distributed to feed producers. The Norwegian Food Safety Authority has placed a ban on the use and sale of the contaminated feed.

The Norwegian Food Safety Authority requested the National Veterinary Institute to give an opinion on the consequences for animal health and transmission to milk and meat for animals eating feed with high levels of cadmium. The opinion can be read (in Norwegian) on the National Veterinary Institutes website http://www.vetinst.no/Arkiv/Pdf-filer/hoye_nivaaer_av_kadmium_06042005.pdf

TERMS OF REFERENCE

Elevated levels of cadmium have been found in fish feed, with reported levels from 11- 17 mg/kg. The contaminated feeds have been withdrawn from production.

The Norwegian Food Safety Authority has requested the Norwegian Scientific Committee for Food Safety to give an opinion on the consequences for fish health and food safety when farmed fish has been fed with feeds containing 11-17 mg of cadmium per kg of feed for a limited time period.

ASSESSMENT

Toxicity

General cadmium toxicity in animals and man include damage to liver and kidney, anaemia, osteoporosis, reduced growth and increased mortality. Whereas several studies have been performed on waterborne exposures of cadmium, few relevant studies exist on dietary exposures in fish. Effects of exposure in fish to elevated dietary cadmium include reduced osmoregulatory capacity, impaired digestibility, increased intestinal cell turn-over, disturbance of calcium metabolism, anaemia, and altered liver histology.

Interactions with other elements

Cadmium is a well known calcium mimic, and disturbance of calcium metabolism is considered to be a main mechanism of cadmium toxicity in fish (e.g Pratap et al. 1989; Hwang and Yang 1997). Dietary cadmium disturbs the calcium handling of the fish intestine. Little is known about the possible antagonistic interactions of dietary cadmium with iron, zinc and copper in fish. However, feeding rainbow trout with elevated levels of dietary cadmium (70 mg/kg) did not affect whole body levels of copper and zinc (Mount et al. 1994).

Dietary accumulation

The route of uptake (food or water) affects the organ distribution and accumulation of cadmium. The retention of dietary cadmium is low (1-5%), and organ contamination will depend on the level of contamination as well as the duration of exposure (Berntssen et al. 2001; Berntssen and Lundebye 2001). Most dietary cadmium will be retained in the intestine. Of the internal organs, kidney and liver are contaminated over time while relatively little cadmium accumulates in the muscle tissue (Handy 1992; Handy 1993; Berntssen et al. 2001). Rainbow trout fed 150 mg/kg for over 1 month showed elevated levels in kidney and liver, but not in muscle tissue (Handy 1992). Atlantic salmon parr fed 7-21 mg/kg feed had elevated muscle levels after 4 months of exposure, with muscle levels of 0,02 mg/kg wet weight compared to 0,01 mg/kg wet weight in control fish (Berntssen et al. 2001). After an initial redistribution to liver and kidney (first 2-4 weeks), accumulated dietary cadmium is eliminated from trout and salmon when fed on uncontaminated feed (Handy 1992; Harrison and Klaverkamp 1989).

Dietary toxicity in fish

Dietary exposure to cadmium has low acute toxicity in fish, in contrast to waterborne exposure. For example, no mortality or other apparent signs of acute toxicity occurred in rainbow trout or Atlantic salmon fed 150 or 250 mg/kg feed, respectively (Handy 1992; Berntssen and Lundebye 2001). Only levels up to 10 g/kg caused some mortality in rainbow trout (Handy 1993). Adverse effects on health (such as organ damage) only become apparent after prolonged exposures. In juvenile Atlantic salmon parr, a dietary levels of 7 mg/kg induced synthesis of the metal detoxifying protein metallothionein and levels of 22 mg/kg affected overall apparent energy digestibility after 4 months of exposure (Berntssen et al.

2001; Berntssen and Lundebye 2001). Dietary levels of 22 mg/kg affected intestinal calcium uptake mechanisms and caused mobilisation of calcium from the scales, but bone calcium and phosphorus were not affected and calcium homeostasis was maintained in Atlantic salmon parr (Berntssen et al. 2003). Exposure of dietary cadmium up to 204 mg/kg for 4 months, did not affect growth or bone formation in Atlantic salmon (Berntssen and Lundebye 2001; Berntssen et al. 2001).

CONCLUSION

Food safety

Feeding Atlantic salmon or rainbow trout with feeds containing 11-17 mg of cadmium per kg of feed for a limited time period (up to four months) is not expected to cause significant fillet contamination. Feeding these fish on uncontaminated feed will further reduce a possible risk to food safety.

Fish health

Dietary cadmium levels of 11-17 mg/kg have been shown to cause biochemical and physiological responses in Atlantic salmon parr following 4 months exposure. These responses are indicators of toxic exposures and do not necessary indicate adverse health effects. Whether the dietary cadmium levels in the order of 11-17 mg/kg feed will cause adverse and irreversible effects on fish health will strongly depend on the length of exposure and possible recovery.

Exposure to high dietary cadmium levels (up to 204 mg/kg feed) for four months did not cause bone deformities or reduced growth in Atlantic salmon parr. There is no information in the literature regarding the sensitivity of start feeders to dietary cadmium exposure.

ASSESSED BY

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