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Heavy metals in meat of Finnish city rabbits

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Abstract. Levels of cadmium, chromium, lead, copper, manganese, and zinc in city rabbits were determined to evaluate the edibility of the meat. Mean concentrations of toxic metals were 0.011 mg/kg for cadmium and 0.037 mg/kg for lead. Cadmium and lead concentrations were below the admissible maximum levels set by EU. Concentration of toxic metals in the meat was sufficiently low that consumption of the meat does not pose a health risk for human. Investigation of PAHs, pesticides, and other environmental pollutants is required before the meat can be declared safe.

Keywords: ICP-MS; heavy metals; rabbit; meat

Introduction

The European rabbit (*Oryctolagus cuniculs*) is not indigenous to Finland but many pet rabbits have escaped and become wild. The first rabbits appeared in Helsinki (the capital of Finland) in the 1970s. Since 2000 the rabbit population has been growing fast and new areas of Helsinki have been colonized. In 2008 the population was about 7000. The rapid increase in numbers has been linked to the warmer and shorter winters with less snow. One rabbit can reproduce three to four times a year, which means that the female produces an average of 20 pups each year. Common habitats are parks, gardens, allotments and cemeteries. European rabbits are adept at modifying their behavior according to habitat. They eat the bark of woody plants in winter, causing the plants to die, and they dig holes into the ground. The rabbits are now being hunted by the municipal council authority.

The aim of our study was to investigate whether city rabbits can be considered edible for humans, with particular regard to their metal content of the meat. Because the rabbits are living in the city center their diet could easily be contaminated with metals from motor vehicles and industry. Cadmium and lead concentrations are of special interest because EC regulations specify acceptable limits for their concentration in meat (Commission Regulation (EC) No 1881/2006 and 629/2008).

Materials and Methods

Samples (n = 44 rabbits) of muscle tissue were taken from wild rabbits (*Oryctolagus cuniculus*), caught in Helsinki between September 2008 and January 2009. Most of the rabbits were caught in city parks (Table 1). Samples were stored at -18 °C until analysis.

Samples were measured by ICP-MS (Thermo Scientific, XSeries 2, Bremen, Germany) under the operating. Determinations were performed with use of the aqueous multi-element standard in 2% nitric acid covering concentrations from 0 to 500 µg/l.

Results and Discussion

Mean concentrations of toxic metals were for cadmium 0.011 mg/kg and for lead 0.037 mg/kg in rabbit meat. Concentrations were below the maximum admissible levels in meat (cadmium (0.05 mg/kg and lead 0.10 mg/kg) stipulated in the Commission Regulations (EC) No 1881/2006 and 629/2008 except for one rabbit where the level of cadmium was above 0.05 mg/kg.

The other elements (chromium, copper, manganese, zinc) are interesting for their nutritional aspect. No Allowed Daily Intake (ADI) value has been published for chromium. The Societies for Nutrition of Germany (DGE), Austria (ÖGE) and Switzerland (SEG) jointly established an adequate daily intake of 30-100 µg/day for adults (D-A-CH 2000). On the other basis, the results in Table 3 suggest that rabbit meat could provide 6.2-43% of their adequate daily intake of chromium (D-A-CH, 2000). In a limited number of human studies, there was no evidence of adverse effects associated with supplementary intake of chromium up to 1 mg chromium/day (EFSA, 2006), and it would hardly be possible to exceed a dose of 1 mg/day by eating rabbit meat.

Mean dietary copper intakes of adults in different European countries have been estimated with a range of 1.0-2.3 mg/day for males and 0.9-1.8 mg/day for females. An EU population reference intake (PRI) of 1.1 mg/day for adults was established in 1992 (EFSA 2006). Calculated daily intakes of copper in Finland in 2007 were 1.6 mg (men, 25-64 years), 1.4 mg (men, 65-74 years), 1.3 mg (women, 25-64 years), and 1.2 mg (women, 65-74 years) (National Public Health Institute, KTL, 2008). According to the results in Table 3, it would be possible to cover 4.0-8.5% of the PRI for copper with rabbit meat.

The EU Scientific Committee for Food estimated in 1993 that 1-10 mg/day manganese was an acceptable range of intake (EFSA 2006). With these values the results in Table 3, indicate that only 0.2-5.2% of the acceptable intake per day could be met with rabbit meat. Rabbit meat is a poor source of manganese, mean value of 0.329 mg/kg. Note that the results for manganese ranged widely from 0.069 to 1.24 mg/kg, so that the mean value can only be considered indicative.

The European Population Reference Intake (PRI) for zinc for adult males and females is 9.5 mg/day and 7.0 mg/day, respectively (estimated 1993, EFSA 2006). Calculated daily intakes of zinc in Finland in 2007 were 13.6 mg (men, 25-64 years), 12.3 mg (men, 65-74 years), 10.0 mg (women, 25-64 years) and 9.4 mg (women, 65-74 years) (National Public Health Institute, KTL-, 2008). On the basis of the results given in Table 3, males could cover 15.5-19.9% and females 12.8-15.8% of the PRI for zinc. Rabbit meat appears to be a good source for zinc. Given the range from 7.14 mg/kg to 29.7 mg/kg.

Conclusions

Helsinki city rabbits are fully edible from the point of view of metal content. In terms of toxicity there is no risk for humans. In nutritional value, rabbit meat is comparable to the meat of farmed species. The contents of the essential trace elements determined are relatively low but not as low as in chicken (Geber et al. 2008). Before the meat of city rabbits can be considered safe for human consumption, investigation will need to be made of PAHs, pesticides, and other environmental pollutants.

Table 1. Places where rabbits were caught.

Place	*n*
Botanic Garden, Kaisaniemi	20*
West Habor	2*
Ruskeasuo allotment	9**
Oulunkylä allotment	5**
Vallila allotment	3**
Winter Garden	5*
Total	44

* Helsinki downtown
** 5-10 kilometers from the city centre.

Table 2. Concentration of metals in rabbit samples (mg/kg).

Element	Mean	S.D.	Range
Cd	0.011	0.014	n.d. - 0.056
Cr	0.078	0.027	n.d. - 0.183
Cu	0.563	0.137	0.286 - 0.913
Mn	0.314	0.329	0.069 - 1.24
Pb	0.037	0.021	n.d. - 0.075
Zn	11.3	3.94	7.14 - 29.7

Table 3. Daily intake of minerals from meat (µg), assuming city rabbits as sole source of meat (based on The National FINDIET 2007 Survey, National Public Health Institute, KTL, 2008).

Element	Men (25-64 y) (167 g/day)	Men (65-74 y) (130 g/day)	Women (25-64 y) (98 g/day)	Women (65-74 y) (79 g/day)
Cr	13.0	10.1	7.6	6.2
Cu	94.0	73.2	55.2	44.5
Mn	52.4	40.8	30.8	24,8
Zn	1887	1469	1107	893

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