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Mineral analysis in rabbit meat from Galicia (NW Spain)

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Abstract

A total of 54 rabbits 50, 70 and 90 days old, were taken from farms in Galicia (NW Spain); 18 rabbits of each age were sampled. The minerals in the muscle meat from the back legs of the rabbits were analysed, and the following average concentrations were found: ash 1.21/100 g, potassium 388 mg/100 g; phosphorus 237 mg/100 g; sodium 60 mg/100 g; magnesium 27 mg/100 g; calcium 8.7 mg/100 g; zinc 10.9 mg/kg; iron 5.56 mg/kg; copper 0.78 mg/kg; and manganese 0.33 mg/kg.

The high potassium and low sodium concentration may make rabbit meat particularly recommended for hypertension diets. Rabbit meat is rich in phosphorus, and 100 g provides approximately 30% of the recommended daily intake. However, rabbit meat provides less zinc and iron than meats of other species. The Galician rabbit meat analysed in this study, shows higher copper and manganese, and lower calcium contents than those found in the literature for rabbit meat of other origins.

Keywords: Rabbit meat; Macrominerals; Trace elements

1. Introduction

Currently rabbit farming has grown from raising a few rabbits for family consumption to large commercial operations; this fact has led to competitive prices and so rabbit, besides being healthy, is a relatively inexpensive source of meat. At present, Spain is the third largest producer of rabbit meat in the World, after China and Italy (FAOSTAT, 2005). In recent years the consumption of rabbit meat has increased considerably in the World, and in Spain, as in other Mediterranean countries, rabbit meat is common in the diet, and the consumption has increased since 2001 when the first case of BSE was diagnosed, with a subsequent decline in beef consumption. Moreover, due to avian flu the consumption of poultry meat has declined recently also.

Rabbit meat in comparison to meat of other animal species has a high percentage of protein, and a low fat content. In addition, rabbit fat has a particularly low proportion of cholesterol and high proportion of unsaturated fatty acids (oleic and linoleic). It is also easily digested and very flavourful. These composition characteristics make rabbit meat especially recommended for avoiding cardiovascular diseases (Moreno, 1991).

Meat is an important source of both macrominerals and trace elements and greatly contributes to the daily intake of these nutrients in the diet (WHO, 1996); however, some chronic diseases due to deficient intake of trace elements are still observable (Lombardi-Boccia, Aguzzi, Cappelloni, Di Lullo, & Lucarini, 2003). Although surveys to determine the levels of trace elements in cattle have been conducted in many countries (for review see López-Alonso et al., 2000), data on the mineral content in rabbit meat are scarce (Combes, 2004; Falandysz, 1991; Falandysz, Kotecka, & Kannan, 1994; Lombardi-Boccia, Lanzi, & Aguzzi, 2005; Lucker, Failing, Walter, & Bulte, 1998; Moreiras, Carbajal, Cabrera, & Cuadrado,

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2004; Niinivaara & Antila, 1973). In fact, Combes (2004) in a review article about the nutritional value of rabbit meat emphasized that iron and copper content in rabbit meat are not sufficiently established and that he was not aware that the contents of many other trace elements had ever been evaluated.

The aims of this work were: (i) to evaluate the contents of some macrominerals such as phosphorus, potassium, sodium, magnesium and calcium, and some trace elements such as zinc, iron, copper and manganese in the meat of rabbits bred in Galicia (NW Spain); (ii) to compare the results of our study with levels found in other studies for either rabbit meat or meat from other species.

2. Materials and methods

2.1. Samples

A total of 54 rabbits of three different ages, 50, 70 and 90 days old, were taken from farms in Galicia (NW Spain): 18 rabbits of each age being sampled. The carcass weights were approximately 700, 1000 and 1400 g for 50, 70 and 90 day rabbits, respectively. These three rabbit ages were selected since the carcass weights within 700 and 1400 g are those of commercial demand. Rabbits were raised with a feedstuff of the following average composition: moisture 11.2%, crude protein 16.8%, starch 15.5%, cellulose 14.3%, ash 8.2% and ether extract 3.7%.

After removing the protective layers of skin and fat, approximately 200 g of meat was sampled from the back legs of the rabbits, chopped into 0.5–1 cm thick pieces and triturated until a homogeneous mixture was achieved. Samples were stored under refrigeration in dry holders (<4 °C), which were entirely full to avoid water evaporation.

2.2. Ash analysis

Ash content was determined by calcination of 20 g of sample at 550 °C to constant weight.

2.3. Mineral analysis

For mineral analysis the ash was dissolved in hydrochloric acid, evaporated to dryness, re-dissolved in hydrochloric acid and diluted to 200 ml with Milli-Q water and filtrated.

Phosphorus was determined in the ash solution by measuring the yellow colour developed by the reaction, in acid medium, of phosphates with molybdate–vanadate reagent at 430 nm (UV-1603, SHIMADZU) (AOAC, 1995).

Sodium and potassium were determined in the ash solution by emission spectroscopy (Spectra AA-220FS, VARIAN) at 589.0 and 766.5 nm respectively, by using an air-acetylene flame. To avoid sodium and potassium ionisation under the flame, a buffer solution of caesium chloride and aluminium nitrate was added (OJEC, 1971).

Calcium and magnesium were measured in the ash solution by atomic absorption spectroscopy at 422.7 and 285.2 nm respectively; a multi-element (Ca and Mg) hollow cathode lamp and an air-acetylene flame were used. Since for calcium determination chemical interferences due to aluminium, silicon or phosphorus may occur, a solution of lanthanum oxide was added (AOAC, 1995). For magnesium determination a strontium chloride solution was added with the aim of avoiding chemical interferences due to aluminium or silicon (OJEC, 1973).

Zinc, iron, copper and manganese were determined by atomic absorption spectroscopy using single element hollow cathode lamps and air-acetylene flame at 213.9, 248.3, 324.7 and 279.5 nm, respectively. For the elements determined below 300 nm a background correction with a deuterium lamp was done (AOAC, 1995).

2.4. Statistical analysis

The limit of detection was set at three times the standard deviation of the mean blank value (Miller & Miller, 2002). The results obtained for the different components analysed were: 3.33 μg/g for phosphorus, 0.868 μg/g for potassium, 2.724 μg/g for sodium, 0.037 μg/g for magnesium, 0.437 μg/g for calcium, 0.120 μg/g for zinc, 0.113 μg/g for iron, 0.021 μg/g for copper and 0.011 μg/g for manganese. The results obtained for all components in all samples were above the limit of detection.

The repeatability standard deviations (S_r) of all analytical methods were calculated over 10 duplicated analyses (Miller & Miller, 2002). With the aim of considering the errors of all the steps of sample preparation and analytical methods, all analyses started by meat sampling. The results obtained for the different components analysed were: for ash 0.011 (% w/w), for phosphorus 1.64 (mg/100 g), for potassium 3.27 (mg/100 g), for sodium 1.12 (mg/100 g), for magnesium 0.544 (mg/100 g), for calcium 0.465 (mg/100 g), for zinc 0.445 (mg/kg), for iron 0.440 (mg/kg), for copper 0.171 (mg/kg), and for manganese 0.064 (mg/kg).

All analyses were performed in duplicate.

3. Results and discussion

3.1. Macrominerals

Table 1 shows the average, standard deviation and range for ash, phosphorus, potassium, sodium, magnesium and calcium for the three groups of ages and for all the rabbits analysed in this study.

With the aim of comparing the values obtained for the rabbits at the three different ages, the analysis of variance was applied: for ash, phosphorus and calcium the null hypothesis was retained. Therefore it can be stated, for $p = 0.05$, that no statistical differences were found in the results of these minerals between the three different ages of the animals. However for potassium, sodium and magnesium statistical differences ($p < 0.05$) were detected