Heme iron in beef and sheep meat

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Research Institute: University of Pretoria

Research focus area: Red Meat Safety, Nutritional Quality and Value

Full Title

Quantification of heme iron in South African beef and sheep meat.

Aims of the project

- To develop and adapt a suitable method to be able to determine total, heme and non-heme iron in meat

- To measure iron content, namely total, heme and non-heme iron in South African meat

- To update the current iron data in the South African food composition databaseTo determine the current meat purchasing and consumption behaviour of the low LSM consumer

Executive summary

Introduction:

In South Africa, as in most countries, no reference is made to the specific type of iron found in food sources. Animal foods are considered to be good sources of the more bio-available heme iron with less interference from absorption inhibitors. No data on the heme iron content of South African meat is currently available.

This study determined the total (TFe) and heme (HFe) iron content of South African beef and sheep meat. Evidence suggests that significant differences exist in heme content of meats from different species and even between slaughtering age and cuts within the same species.

Methodology:

Method development and validation

Through the literature review, suitable methods to determine total, heme and non-heme iron in meat has been selected and tested in the laboratory of the University of Pretoria. After consultation with analysts at the Institute of Food Research (IFR), United Kingdom and laboratory personnel, three methods to determine total iron were evaluated using certified reference material. The accuracy of the current method used at Nutrilab was satisfactory and thereafter used in this study. This method utilizes nitric acid and perchloric acid digestion followed by quantitation with an atomic absorption spectrophotometer. Heme iron was determined by an adapted Hornsey method.

Sampling and sample preparation

Nine Bonsmara carcasses of the A age group (with no permanent incisors), AB age group (with 1 to 2 incisors) and B age group (with 2 to 6 incisors) and six carcasses of the C age group (with more than 6 incisors) were directly obtained from an abattoir. The shoulder, prime-rib and rump were selected for analyses. These cuts were selected as they represent the composition of a typical South African beef carcass the best (Schönfeldt, 1998). Triplicate samples of raw commonly consumed raw lamb meat cuts (loin, leg and shoulder) were obtained from four retail outlets. All the meat samples were immediately refrigerated after purchase. The meat samples were de-boned and dissected into muscle, intramuscular and subcutaneous fat and bone.

Duplicate analyses were done on muscle only.

Results:

When comparing different cuts of beef, rump had a significantly higher (p<0.001) total iron and haem iron content compared to shoulder and prime rib. However, the percentage haem iron (% HFe) between the cuts were not significantly different (p=0.937). The difference in total iron concentration between lamb loin, leg and shoulder cuts were not significant, with lamb leg and loin having a significantly higher (p<0.001) haem iron content. The % HFe in lamb shoulder is the lowest in the retail cuts from lamb.

Conclusion:

Compared to previous studies on beef and sheep meat, the data from the South African study indicates notable differences in %HFe. South African meat contains a higher percentage of heme iron (>80%) than was used in the Monsen model (40%) to estimate iron availability. This indicated that the heme iron value used in the Monsen-equation, and other calculations, should not be a constant value, but should be different for each particular meat type consumed in the diet This is a significant finding that South African meat contains a higher percentage of iron in the more bioavailable heme iron form, seen against the context that iron deficiency in South Africa remains a significant public health concern affecting both adults and children

List of outputs:

PUBLICATIONS IN PEER-REVIEWED OR REFEREED JOURNALS

- PRETORIUS, B.; SCHONFELDT, H.C. and HALL, N. Total and haem iron content of lean meat cuts and the contribution to the diet. Submitted to Food Chemistry – under review.
- SCHONFELDT, H.C.; PRETORIUS, B. AND HALL, N. 2013. The impact of animal source food products on human nutrition and health. South African Journal of Animal Science, 41 (3): 394-412.
- SCHÖNFELDT, H.C. & HALL, N.G. 2011. Determining iron bio-availability with a constant heme iron value. Journal of Food Composition and Analysis, 24, 750-754.
- PARTICIPATION IN CONFERENCES, WORKSHOPS AND SHORT COURSES

International

- PRETORIUS, B. & SCHONFELDT, H.C. 2013. Poster: Total and heme iron content of South African lean meat. International Nutrition Conference September, 16 – 20, 2013. Spain, Granada.
- PRETORIUS, B. & SCHONFELDT, H.C. 2013. Presentation: Analytical Heme Iron values vs. Estimated values for South African Lean Meat. 10th International Food database Conference September, 12 – 14, 2013. Spain, Granada.
- PRETORIUS, B.; SCHONFELDT, H.C. & HALL, N. 2013. Presentation: Total iron and heme iron content of South African lean meat (Beef, Lamb, Pork and Chicken). SAAFECS 11the International Conference and the 6th IFHE Africa Regional Conference. 27 February – 1 March 2013. St Georges hotel and Conference Centre, Pretoria, South Africa.

- PRETORIUS, B., SCHONFELDT, H.C. & Hall, N. 2012. Relative bioavailability of iron of South African lean meat (beef, lamb, pork and chicken). Poster. Nutrition Congress Africa. 1 – 4 October 2012. University of the Free State, South Africa.
- PRETORIUS, B., SCHONFELDT, H.C. & HALL, N. 2012. Relative bioavailability of iron of South African lean meat (beef, lamb, pork and chicken). Poster. 58th International Congress of Meat Science and Technology. 14 – 27 August 2012. Canada.

National

- PRETORIUS, B. & SCHONFELDT, H.C. 2013. Analytical heme iron values vs. Estimated values for South African lean meat. Poster. SAAFoST, Pretoria, South Africa.
- GIBSON, N. & SCHÖNFELDT, H.C. 2011. The validity of methods used to determine the heme and nonheme iron content in meat products. Poster. Food Data System (SAFOOD) & South African Food Data Advisory Group (SAFDAG) Symposium on Food Composition Data. November 2011. Medical Research Council, Cape Town.

Popular articles and talks

- RSG Landbou 13 Desember 2012 - OGGEND: Dr Beulah Pretorius - Ysterinhoud van vleis