Assessment of pork authenticity by means of multi-element analysis

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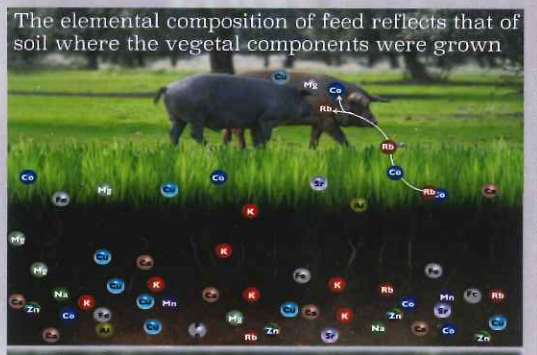
1 OVERVIEW

The mineral content of pork tissues was estimated to establish the pig provenance. ICP-OES and ICP-TOF-MS techniques were employed for the determination of both macro and micro-elements. ICP-TOF-MS proved to be a fast and high-sensitivity instrument for quantifying the lowest concentrations of metals.
Linear Discriminant Analysis (LDA) showed that Mg, Zn and Pb could trace the origin of pork samples.



2 INTRODUCTION

Nowadays authenticity is a basic attribute for food. Analytical methods supporting documental traceability are helpful to guarantee food authenticity, including origin.
The objective of this work is to check the possibility to distinguish fresh hams originating from pigs differing for animal type, breeding conditions, origin and diet through a multi-element analysis.
This study represents a first step for tracing the provenance of pork samples.

3 METHODS

SAMPLES

12 samples of domestic Heavy Pig, bred in Northern Italy (**A**)

7 samples of Nero di Parma, a local breed of black pigs, reared in the province of Parma (**B**)

8 samples of foreign pork, bred in Germany (**C**)

Muscle samples were taken from the outer section of ***Biceps femoris*** muscle in fresh hams

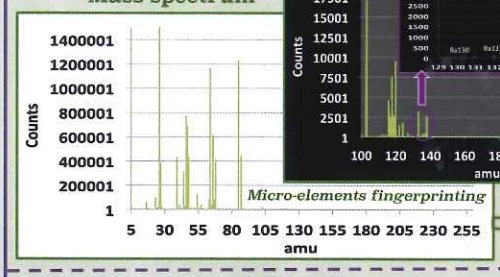
MINERALIZATION

About 1 g of minced muscle was mineralized in triplicate with 4 ml of HNO_3 in a microwave-assisted digestion system UltraWAVE (Milestone, Italy).

MULTI-ELEMENT ANALYSIS

Macro-elements by ICP-OES (MPX-Vista, Varian)
Ca, Mg, Na, K, P, Fe, Cr, Ni, Mn and Zn

Micro-elements by ICP-TOF-MS (Optimass 9500, GBC)
Li, Al, V, Co, Cu, Ga, As, Rb, Sr, Mo, Ag, Cd, Cs, Ba, Ce, Tl, Pb and U



DATA ANALYSIS

Statistical analyses (SPSS Statistic, V22.0) were performed on data normalized to dry matter content. Chemometric methods: Univariate analysis of variance (One-Way ANOVA), Principal Component Analysis (PCA) and Linear Discriminant Analysis (LDA). PCA was used as method for selecting a suitable number of variables for LDA.

4 RESULTS

One-way ANOVA and Tukey post-doc test

Element	A	B	C	p-value
Mg	1090	969	994	0.003
Na	1938	2376	1965	0.000
K	15253	13404	14205	0.003
P	8574	7610	8001	0.017
Fe	20.8	30.4	16.6	0.000
Mn	224	283	232	0.007
Zn	80	120	62	0.000
Co	2.48	3.50	2.92	0.000
Cu	1778	2070	1743	0.007
Pb	8.75	18.9	19.2	0.012

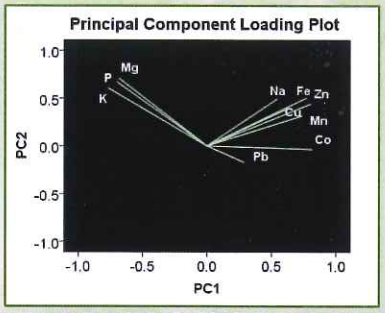
Different colors ⇩ *significant differences between samples ($p<0.05$)*

Mean values of Mg, Na, K, P, Fe and Zn (in mg/Kg of d.m.) and of Mn, Co, Cu and Pb (in ug/Kg of d.m.)

Fe and Zn allow to discriminate samples belonging to the three groups

Principal Component Analysis (PCA)

PCA was performed, based on the elements which proved to be discriminant in one-way ANOVA. 3 components extracted accounting for 82.7% of total variance (PC1 = 47.8%, PC2 = 23.0%, PC3 = 11.9%)

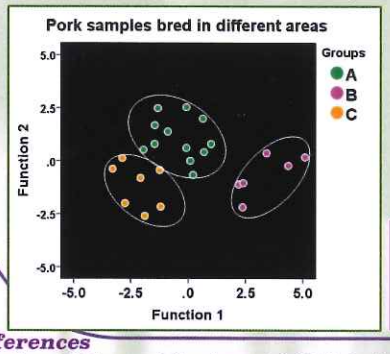


Variables less related to each other (Pearson $r<0.65$)
Na, Mg, Co, Cu, Zn and Pb

⇩

Submitted to Stepwise LDA analysis

Linear Discriminant Analysis (LDA)



	Function 1	Function 2
Mg	-0.218	**0.742**
Zn	**1.041**	0.127
Pb	-0.333	**-0.748**

Simplified Discriminant Function
F1=-4.387+0.097·Zn
F2=-9.642+0.010·Mg-0.139·Pb

5 CONCLUSIONS

Mg, Zn and Pb resulted as the most important variables for the discrimination of pig type. A higher number of samples will be analysed in the future to build a reliable model for assessing pork authenticity.

References

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