PRINCIPAL COMPONENT ANALYSIS TO CHARACTERISE THE CHEMICAL COMPOSITION OF BEEF ACCORDING TO AGE AND GENDER

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Introduction

Meat chemical composition has been well characterised in other countries, where research has demonstrated that intrinsic factors (gender, species) and extrinsic factors (plane of nutrition, growth regulation, castration, *etc.*) are largely responsible for the variation found in beef nutrient composition (Byers *et al.*,1988). However, little information exists about the chemical composition in Venezuelan ruminant meat produced under tropical conditions. The purpose of the present investigation was to assess the relative ability of principal components analysis (PCA) to correctly characterise Venezuelan beef, considering different ages and gender according to their nutrient content (proximate, mineral composition and fatty acids profile). This statistical approach will allow us to convert a large number of related variables into a smaller set of factors, composed of a weighed set of the original variables, to describe specific patterns of behaviour.

Materials and Methods

A randomly selected group of 145 cattle raised under tropical conditions in Venezuela (mostly grass-fed) were slaughtered according to typical industry procedures at a commercial packing house. Animals were classified by age (2.5, 3.0, 3.5 and 4.0 yr estimated by dentition) and gender (61 bulls, 64 steers and 20 heifers).

After 48h *post-mortem*, two steaks (2.5cm thick) were obtained from the *longissimus dorsi* (LD) muscle of each carcass, vacuum-packaged and stored at -30°C. Duplicates of ground samples were analysed for proximate composition and mineral analyses, as described by Huerta-Leidenz *et al.* (2003). Total lipids content was determined according to Folch *et al.* (1957). Fatty acids (FA) were determined by gas chromatography, following the methodology used by Uzcátegui-Bracho *et al.* (1999). Experimental data were subjected to multivariate analysis by using the PROC PRINCOMP procedure of the Statistical Analysis System (SAS, 2000). The number of factors retained from each PCA was determined by variance value explained by each factor, and by factor interpretability. Labelling of the factors was primarily descriptive and based on our interpretation of the pattern structures. The highest-weight variables of the principal component 1 (PC1) were: total lipids, pentadecilic (C15:0), palmitic (C16:0), stearic (C18:0), oleic (C18:1 *cis*), elaidic (C18:1 *trans*), linoleic (C18:2) acids, total saturated (SFA), unsaturated (UFA), monounsaturated (MUFA), polyunsaturated fatty acids (PUFA), and *cis* and *trans* fatty acids. The variables for PC2 were: UFA/SFA, MUFA/SFA and PUFA/SFA ratio, while in PC3 the variables were: Ca, Mg and P.

Results and Discussion

Multivariate analysis showed that PC1 explains 51.0% of the total variability, due to the presence of relatively high concentrations of the selected variables in beef samples. PC2 and PC3 explain 13.1% and 9.8%, respectively. Together, PC1, PC2 and PC3 explain 73.9% of the total variability. It was not possible to group the variables by age with PCA, this could be due to the narrow range of ages considered in the study.

PCA allowed the separation of original variables into four groups. Animals of group 1 represented most of the bull samples showing the strongest relationship with UFA/SFA, MUFA/SFA and PUFA/SFA, with low contents of SFA (C16:0, C18:0), MUFA (C15:1, C18:1 *cis*, C18:1 *trans*) and PUFA (C18:2). In relation to unsaturated level, our results showed that most bulls presented more UFA than SFA. Equally, other studies (Mitchell *et al.*1991; Yang *et al.* 1999) have reported similar results in beef.

Group 2 included bulls and a small proportion of steers and heifers. Animals from this group showed low levels of the relationships UFA/SFA, MUFA/SFA, PUFA/SFA. The amount of SFA (C16:0, C18:0) (C18:1 *cis*, C18:1) PUFA (C18:2) (*trans* C15:1) and MUFA, were also low. These results can be attributed to the low total content of lipids in the samples. Group 3 was represented by most steers, heifer samples, showing low levels of the relationships UFA/SFA, MUFA/SFA, PUFA/SFA, but a high content of C15:0, C16:0, C18:0, *cis* C18:1, C18:1, *trans* C18:2, total UFA SFA, MUFA PUFA. Group 4 represented the majority of steers showing high concentrations of total lipids, C15:0, C16:0, C18:0, C18:1 *cis*, C18:1 *trans*, C18:2, total SFA, UFA. This group also showed the highest contents of MUFA PUFA, but UFA/SFA, MUFA/SFA PUFA/SFA. Similar results in fresh meat were reported by Valero-Leal (2000) who demonstrated that steers presented 0.24g more lipids than bulls. Huerta-Leidenz (1993) attributed the fact that steers tend to accumulate, more intramuscular fat than bulls to hormonal effects.

Conclusion

Beef samples used in this study represent the national beef herd; animals were selected in the slaughterhouse that gathers animals from several farms in the country. PCA allows us to better characterise meat samples by gender than by age, maybe due to the small variability by age presented in the animals.

Variables related to fat and minerals were grouped in different PCs. Meat from steers and heifers showed the highest concentration of total lipids, SFA, UFA, MUFA PUFA and low levels of the relationships UFA/ SFA, MUFA/ SFA PUFA/SFA.

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