As a result the Meat Board formed a Working Group in November 1987 to study the intrinsic aspects of South African red meat. This group consists of nutritionists, dietitians, representatives from health authorities and research workers. They proposed that a comprehensive study of all these aspects be undertaken by the IAPI in co-operation with various institutions, financially sponsored by the Meat Board.

The main aim of this study is to aid the different sectors of the Meat Industry in their endeavours to provide the consumer with sound information of the nutritional value and eating quality of red meat.

2. PURPOSE OF THE STUDY

The objective of the study can be summarised as follows:

TO DESCRIBE THE NUTRIENT CONTENT OF RAW AND COOKED BEEF CUTS OF CARCASSES FOUND IN THE SOUTH AFRICAN CARCASS CLASSIFICATION SYSTEM.

3. MATERIALS

The South African beef carcass classification system uses six fat codes (numbered 1 to 6) in each of 3 age groups for the classification of beef carcasses.

The three age groups are:

- A (no permanent incisors),
- B (1 - 6 permanent incisors) and
- C (more than 6 permanent incisors).

In this project only carcasses from 2-tooth cattle of the B age group were evaluated, as these are by far the most numerous in this age group.

The six fat codes are:

- fat code 1 = very lean (<1 mm fat thickness measured between the 10 th and 11 th ribs, 50 mm from the median line of the cold, unquartered carcass);

- fat code 2 = lean (1-3 mm);
- fat code 3 = medium (3,1-5 mm);
- fat code 4 = fat (5,1-7 mm);
- fat code 5 = moderately overfat (7,1-10 mm) and
- fat code 6 = excessively overfat (>10 mm).

The selected beef carcasses had an average mass of 190-240 kg. No specific breed was chosen, owing to the fact that the South African classification system does not take genotype into consideration. Variation in fatness due to breed (carcass maturity differences), are therefore accounted for. Only steers and heifers were selected due to a favourable sex ratio in South Africa's present marketing system.

Three beef carcasses of each fat code - age group combination were procured (Table 1) to determine the nutrient content of each raw (left side) and cooked (right side) primal cut, respectively. A composite sample of each group of three similar cuts from the three carcasses, was used in the analysis (6 fat codes x 3 age group x 15 cuts = 270 samples raw (right) and 270 samples cooked (left)).

3.1 Carcasses

Carcasses were selected by qualified classifiers at the Johannesburg Abattoir at City Deep. The carcasses were electrically stimulated within 10 minutes of stunning, dressed, halved length-wise, graded, chilled overnight at between 0 ° and 5 °C, labelled and transported to the IAPI in a refrigerated truck.

In order to ensure that visually assessed carcasses were correctly selected for the various fat code classes, it was decided to first determine the % chemical fat in each prime rib cut, measure the fat thickness of each carcass (between the 10 th and 11 th thoracic vertebrae, 5 cm from the midline of the carcass) and determine thesubcutaneous fat content of both the prime rib cut and the total carcass.

TABLE 1: EXPERIMENTAL DESIGN OF BEEF PROJECT: NUTRIENT CONTENT

BEEF CARCASSES	AGE CLASSIFICATION			
FAT CODE	A (no permanent incisors)	B (1-2 permanent incisors)	C (8 permanent incisors, not worn down)	
1	3	3	3	
2	3	3	3	
3	3	3	3	
4	3	3	3	
5	3	3	3	
6	3	3	3	
Total number of carcasses:	18	18	18	54

3.2 Physical composition

Each of the left sides of beef within each of the six fat codes and three age groups, were subdivided into 15 wholesale cuts (Appendix A) on arrival at the Meat Industry Centre.

The determination of physical composition involved separation (at 10 °C ambient temperature) of each of the primal cuts and the subsequent subdivision thereof into subcutaneous fat, meat and bone. These dissections were done at the IAPI by a trained deboning team of the Meat Industry Centre.

3.2 Sampling for nutrient content

Raw (left side cuts): The subcutaneous fat plus meat tissue obtained from each cut in 3.2 was cubed, thoroughly mixed and then minced, first through a 5 mm and then through a 2 mm mesh plate. Each sample was then divided into the amounts required for the various analyses. The samples were stored at -40 °C after coding and packaging and distributed to the laboratories responsible for the determinations at regular intervals.

Cooked (right side cuts): Each cut was labelled, deboned if applicable, vacuum-packaged, aged at 4 °C for 10 days *post mortem*, stored at -40 °C before being cooked according to the appropriate cooking method (Appendix B). Cooking losses were also determined. The cooked meat obtained from each cut was chilled (4 °C) overnight, deboned if applicable, cubed, thoroughly mixed and then minced first through a 5 mm and then through a 2 mm mesh plate. Each sample was then separated into the amount required for each analysis. The samples were stored at -40 °C after coding and packaging and distributed to the different laboratories for analysis at regular intervals.

3.3 Chemical analysis

The proximate analyses of the deboned right side cuts were done to determine the percentages of total moisture, fat, nitrogen (N x 6,25 = protein) and ash. These determinations on the raw (left side) and cooked (right side) samples were done according to the accepted AOAC-methods (1990).

3.4 Amino acid profile (sample size: ± 20 g freeze-dried material)

Amino acid determination was done by high-performance liquid chromatography (HPLC) on freeze-dried samples, following the method of Van der Merwe (unpublished). Amino acid determination was performed during three separate hydrolyses, namely:

Hydrolysis 1: 17 Amino acids comprising of arginine, hydroxyproline, serine, aspartic acid, glutamic acid, threonine, glycine, alanine, tyrosine, proline, methionine, valine, phenylalanine, isoleucine, leucine, histidine and lysine were determined. An amount of ground, freeze-dried meat was weighed accurately and hydrolysed with 6 N Hydrochloric acid. Internal standard (æ-amino and ß-guandino propionic acid) was added to the hydrolysate, after which the hydrolysate was filtered. An aliquot of the hydrolysate was dried under nitrogen-flow. The hydrolysate was derivated with FMOC reagent (9-fluorenylmethyl chlorofomate), after which the amino acid content was determined by means of a HPLC (using an AminoTag column) and, as eluent, a tertiary gradient of pH, methanol and acetonitrile. Peak detection was done by means of a fluorescent detector.

Hydrolysis 2: Cystine determination. The above procedure was followed identically, except that prior to hydrolysis, cysteine was oxidised to cystine by the addition of a peroxide-formic acid blend. Excess oxidising agent was reduced by the addition and subsequent evaporation of hydrobromic acid.

Hydrolysis 3: For tryptophan determination, an amount of ground, freeze-dried meat was hydrolysed enzymatically using protease. After filtration through a 0,45 um filter, tryptophan was determined by means of HPLC, using an AminoTag column and, as eluent, a blend of buffer methanol and acetonitrile. Peak detection was done by means of a fluorescence detector.

After analysis the amount of each amino acid was expressed on a wet mass basis.

3.5 Fatty acid profile (Sample size: ± 10 g frozen material)

The Nutritional Intervention Programme (NRPNI) of the Medical Research Council (MRC) was contracted to determine the fatty acid profiles of all samples. Representative samples of minced meat from each cut, vacuum-packed and frozen, were analysed. All samples were done blind, without any prior knowledge of cut, age or fat code of the sample.