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Report

The nutrient composition of South African mutton

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ABSTRACT

Dorper and Mutton Merino carcasses of the C age group with a fat code 2 (±7% SCF) from three main production areas (Karoo, Kalahari and Ermelo) in South Africa were analysed in this study. The physical composition of each cut differed dramatically from the other cuts. The differences between the ten wholesale cuts when comparing the two breeds, are small, and only five cuts differed significantly on one trait. The right sides of the carcasses were used to determine the nutrient and physical (carcass) composition of each raw cut as well as for the whole carcass by calculation. Three cuts (shoulder, loin and leg) from the left side were cooked in order to determine the nutrient composition thereof. Cooking increased the protein and cholesterol concentrations of the cooked cuts. Iron content was higher in the cooked loin and leg but decreased in the cooked shoulder during cooking. According to nutrient density, mutton is a good source of protein, iron and B vitamins and supply more than 25% of RDA/100 g of vitamin B12 when cooked.

1. Introduction

Nutrition plays an integral role in the optimal functioning of the body compared to malnutrition (including under nutrition and over nutrition) that is a health impairment resulting from a deficiency, excess or imbalance of nutrients (Robinson, 1978). Most developing countries are faced with the double burden of persisting under nutrition as well as the growing epidemic of obesity and non-communicable diseases such as cancer and heart disease and South Africa is no exception (Labadarios and Oelofse, 2000). Information to link nutrition and chronic diseases is necessary to inform the consumer on healthier food choices as consumers are becoming more health conscious and are increasingly focusing on food safety as well as their eating habits and nutrient intake (Garnier et al., 2002). The consumers' involvement influences the whole food chain, agriculture and science (Garnier et al., 2002). Food choices can have a positive or negative influence on the person's health status (Kruger et al., 2003). Some diseases commonly found in South Africa are related to malnutrition (under- and overnutrition) and thus emphasising the need for greater knowledge on the composition of food (Johnson, 1987). Detailed knowledge on the composition of foods is essential to understand the function of nutrients in the diet. The assessment of dietary exposure is critical for the interpretation of the relationship between nutrition and health (Deharveng et al., 1999). Food composition tables give information on the portion, composite sample, collection and analysis of the composition of foods (Miller and Payne, 1961; Southgate, 1998) and can be used to evaluate a person's food intake and compare it to the Recommended Dietary Allowance (RDA) (Whitney and Rolfes, 2002).

Many countries use one national food composition table that contains food commonly eaten in the country. Some of the data analysed in one country is also used in the food composition tables of other countries. Problems arise where the different countries use different methods to analyse nutritional composition as well as different measuring units and cooking methods. Due to difference in definitions, methods and methods of analysis it is obvious that these food composition tables are not international and it is therefore important that each country has their own food composition tables (Deharveng et al., 1999). The first food composition tables for South African foods were compiled by the Research Institute for Nutritional Diseases (NRIND) in 1991 (Langenhoven et al., 1993). Current South African food composition tables are compiled by the Medical Research Council (MRC) (Langenhoven et al., 1993). However, only 41% of the data in these tables are currently derived from South African foodstuffs (Sayed et al., 1999) with the remaining data obtained mainly from American and English composition tables.

Previous nutrition data on mutton for South African food composition tables was borrowed from the UK food composition tables (Langenhoven et al., 1993) but the latest update on mutton and lamb that appear in the MRC's food composition tables of 1999 are derived from the United States Department of Agriculture (USDA, 1989) database (Sayed et al., 1999). Although sheep in

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South Africa originated from international breeds the nutritional composition of mutton varies greatly between countries (Van Heerden et al., 2007) due to different reasons. Meat products are dissected into different primal cuts in each country, thereby influencing the composition of meat cuts (Schönfeldt, 1998). Amino acids for example differ between different parts of the carcasses and different cutting methods may influence the amino acids detected (Lawrie, 1998). Genetic and environmental factors are the main factors affecting the quality and nutrient content of meat (Okeudo and Moss, 2005). Greenfield and Southgate (2003) further state that differences in climate as well as soil content between the countries may also influence the nutrient content of the animal's feed and thus the nutrient content of the animal's meat. According to Givens (2005) the fatty acid composition of animal products are not fixed and can be altered in response to changes in the diet of the productive animals. Post-mortem factors that differ among countries, such as fat trim levels and cooking can also cause changes in nutrient composition (Jamora and Rhee, 1998). Jamora and Rhee (1998) further explain that cooking leads to moisture loss and thus an increase in concentration of some nutrients and decreases in heat-labile nutrients.

Van Heerden et al. (2007) report that SA lamb contains on average 40% less fat than that published in the National Food Consumption Tables by the Medical Research Council in 1999. The fat content of lamb in the UK has decreased by 10% over the last twenty years. Therefore the need for nutrient composition data of South African (SA) meat was identified by the Red Meat Producers Organisation (RPO) as a priority.

2. Materials and methods

2.1. Sampling

Mutton carcasses from the C age class and fatness level 2 were selected from the meat industry as representing South African mutton purchased by the consumer. The South African Red Meat Classification System for lamb and sheep uses the main characteristics of beef, mutton, lamb and goat to classify the carcasses in order to make the purchase of red meat as simple as possible for sonumers. The main characteristics used to classify mutton for this study are the age of the animal and the fatness of the carcass. The age classes are known as: A (youngest animals (0 incisors)), AB (older animals (1–2 incisors)), B (even older animals; (3–6 incisors), and C (oldest animals (7–8 incisors)). The fatness classes are known as class zero (no fat) to class 6 (excessively over fat) (SAMIC s.a.).

The C2 mutton carcasses were obtained through stratified sampling where food is selected, taking into account the most important causes of variation. The meat samples, incorporated in the study, comprised of the two most commonly consumed breeds Dorper ($n = 9$) and Mutton Merino ($n = 9$) carcasses which were obtained from abattoirs that draw mutton from the three main production areas in South Africa namely the Karoo, Kalahari and Ermelo districts. The sheep were slaughtered using standard commercial procedures during four consecutive weeks. The carcasses were classified according to the South African classification system by a qualified classifier at the abattoirs. Selected carcasses were transported in a refrigerated truck (4–6 °C) to the Meat Industry Centre of the then ARC-ANPI, Irene. Upon arrival, all the carcasses were weighed, covered with plastic wrap to prevent moisture loss and chilled at 4 °C overnight and dissected the following day. The mutton carcasses consisted of the skinned, eviscerated body from which the head, feet, kidney and kidney fat were removed.

Three cuts (shoulder, leg and loin from the left side of the carcass), representing the most commonly consumed cuts, were used to determine the cooked proximate analysis, physical composition and nutrient composition. These cuts (leg, loin, shoulder) were cooked according to standardized moist and dry heat cooking methods in identical Mielé ovens at 163 °C to an internal temperature of 73 °C measured in the geometrical centre of the cut (AMSA, 1995). Nutrient data for raw and cooked versions of the three cuts was compared based on the assumption (Kirton et al., 1962) that the chemical composition of the two sides is similar or almost identical.

2.2. Physical dissection

Carcasses were weighed prior to being divided into the respective wholesale cuts. A trained deboning team were responsible for the physical dissection. Carcasses were sectioned down the vertebral column with a band saw, with each side then subdivided into the following 10 primal cuts: neck, thick rib, flank, shoulder, breast, rib, loin, chump, leg and shanks. For each cut of the right sides of the carcasses, the% meat, subcutaneous fat and bone content were determined, in order to calculate carcass composition. Therefore the cuts were divided into three parts namely meat, bone and subcutaneous fat, in an environmentally controlled abattoir at 6 °C by a trained de-boning team. The wholesale cuts of the left sides of the carcasses were vacuumed packed and frozen until required for cooked analysis.

2.3. Proximate analyses

Proximate analysis (fat, moisture, protein, ash) was done on the 10 raw wholesale cuts. Due to limited funding, proximate analysis was completed on only three cooked cuts: leg, loin, and shoulder. All the raw ($n = 10$ cuts) and cooked ($n = 3$) physically dissected meat (muscle + intramuscular fat) and fat, respectively, were cubed, thoroughly mixed, minced first through a 5 mm mesh plate, and then minced again through a 3 mm mesh plate. A 300 g sample of meat (muscle + intramuscular fat) and subcutaneous fat, respectively were further homogenized with an Ultra Turrax T25 homogenizer after mincing to ensure a properly homogenized sample. Samples were vacuumed packed and frozen, prior to being freeze-dried.

2.4. Nutrient analyses

In order to comply with the new Draft Regulations (2004) relating (http://www.doh.gov.za/department/dir_foodcontr.html), to the Labelling and Advertising of Foodstuffs as part of the Foodstuffs, Cosmetics and Disinfectants Act 1972, it was proposed that a composite of three carcasses be pooled and used as a basis for the study. The use of composite samples for analysis rather than individual samples was justified due to funding constraints and has been an accepted approach in food composition studies (Greenfield and Southgate, 2003). Therefore the samples analysed for this purpose were those of the 3 cuts (leg, loin, shoulder) of the C2 class. However, care was taken in the design to ensure statistical reliability of the data.

A composite sample (3 carcasses of 1 age group, 1 fat code, 2 breeds, and 3 cuts), of raw (left sides) and cooked (right sides) meat and subcutaneous fat were analysed for nutrient content. All foods vary in nutrient composition and contribution of nutrients to the diet, therefore only the nutrients in meat that are known to be a significant source were analysed.

3. Statistical analysis

The experiment was designed as a completely randomized design (CRD). Analysis of variance (ANOVA) was used to test for