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The nutrient content of selected South African lamb and mutton organ meats (offal)

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1. Introduction

Organ meats have been overlooked in the past in dietary guidelines and recommendations, irrespective of their potential contribution to food and nutrition security in South Africa. Limited information is available on the composition of South African organ meats as cooked and consumed at home. This limited information includes a recent study done by Van Heerden and Morey (2014) investigating the nutrient content of South African C2* beef organ meats. This study confirmed that significant amounts of iron and zinc can be found in some beef organs which compared favourably with beef muscle meat cuts and that beef organ meats can be recommended as a good, low cost, nutritious food product (Van Heerden & Morey, 2014). Small ruminants (goats and sheep) are an integral part of small holder farming systems in South Africa (Tshabalala, Strydom, Webb, & De Kock, 2003) and could potentially play a positive role in food and nutrition security in these communities.

In view of rapid population growth in a disease- and poverty-ridden world, the availability of affordable, nutrient dense animal source foods such as organ meats needs to be investigated closely. Known composition data on these foods will enable better consumption recommendations to be made as part of pro-active approaches in eradicating malnutrition and non-communicable diseases (NCDs). Therefore the potential nutritional contribution of these animals' organ meats should also be determined.

Nutrients of concern and generally lacking in South African diets are vitamin A, iron, zinc and B vitamins (Shisana et al., 2014). Meat is an important nutrient dense food commodity which contributes to nutrients of concern in the South African diet (McAfee et al., 2010). Meat is however also one of the most expensive items in the food basket. It is believed that organ meats, often also referred to as "offal" or the "fifth quarter", are affordable, alternative nutrient dense animal source foods. The South African National Food Consumption Survey (NFCS), published in 2005, reported that large amounts of organ meats are consumed by children in lower income households in both urban and rural regions (Labadarios et al., 2005). However the report did not specify which organs were consumed.

This article reports on the nutritional content of raw and cooked A2[1] lamb and C2[1] mutton tongues, intestines, stomachs, spleens, lungs, kidneys and livers and the potential contribution of these products to better, affordable, nutrition in South Africa. Nutrients analysed in this study were Crude Protein, Fat, Calcium, Phosphorus, Magnesium, Iron, Manganese, Zinc, Potassium and Sodium.

2. Materials and methods

In South Africa, lamb and mutton meat are regarded as two distinctly different products. Although they are derived from same species of animal, significant compositional differences have been found by previous studies between sheep of different ages (Sainsbury, Schönfeldt, & Van Heerden, 2011). The nutrient content of different organ meats from both lamb A2 class carcasses and mutton C2 class carcasses was determined and will be reported separately.

2.1. Sample procurement

Unlike most commercial lamb and mutton retail cuts, where distinction is made between "lamb" and "mutton" on a retail level, organ meats from these animals are usually just labelled "sheep"

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[1] A2 lamb and C2 beef and mutton referred to in this article describes the products' age and fatness as per "The South African Red Meat classification system" (South African Meat Industry Company, 2016). "A" refers to a young animal with no teeth whereas "C" refers to an animal with a full set of teeth. A fatness code of "2" refers to a "lean" animal.

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offal in store. However many abattoirs in South Africa sell offal directly to surrounding communities. Thus the abattoir is an important point of sale and therefor, for this study, lamb- and mutton organ meat samples were procured directly from two abattoirs in Gauteng, South Africa in the Pretoria and Bronkhorstspruit areas. This was also deemed the best method of sample procurement to ensure that samples were lamb or mutton organ meats according to official abattoir classification, and also with the classifications A2[1] and C2[1] respectively. The lamb and mutton organ meats included in this study were hearts, livers, lungs, kidneys, tongues, spleens, stomachs, intestines. Six samples of each lamb- and mutton organ meat were procured based on availability.

2.2. Sample preparation

All lamb and mutton organs were washed, scrubbed and cleaned with water to remove all remaining manure and stomach contents, as would be done by the consumer on household level. Three samples of each organ meat were selected for raw analysis, placed in airtight bags, labelled, frozen and stored at the University of Pretoria in the freezer of the Department of Animal and Wildlife sciences. The remaining three samples of each organ were prepared for cooking. Three samples of each of the eight lamb organ meat products, and eight of each of the mutton organ meat products were cooked according to a standardised moist heat cooking method. The samples were cooked and prepared in the experimental kitchen of the Department of Consumer Science at the University of Pretoria. The cooking method used, was developed to simulate the cooking processes used at home by most South Africans. The cooking methods most commonly used were derived from research done with a focus group by Duvenage, Schönfeldt, and Vermeulen (2011), amongst the lower income population groups in the Limpopo Province (Duvenage et al., 2011) as well as a consumer survey on perceptions towards red meat in the Gauteng province (Vermeulen, Schönfeldt, & Pretorius, 2014). Stewing and braising were the cooking methods most commonly used to cook meat products in South Africa according to both studies. Stewing and braising involves cooking and serving food in a small amount of liquid and thus retaining more nutrients than food cooked in water. Organ meats naturally contain a significant amount of fluids and fats. At the hand of this information it was decided to cook each organ it its own small disposable aluminium oven pan, covered securely with aluminium foil that it would cook in its own liquids. Each organ meat product was cooked to an internal temperature of 75 °C, which is the internal temperature recommended for human consumption of organ meats (Brown, 2010). The covered foil pans were placed on the middle oven racks of the experimental kitchen's built in AEG Competence ovens using a convection oven setting of 160 °C. These ovens are maintained and calibrated for scientific use. Samples were weighed before and after cooking to obtain cooking data and yield factors. Cooked samples were dissected and weighed as separate edible and inedible fractions. Yield factors were calculated as the percentage of the difference between total raw weight and cooked edible portion weight of each organ.

2.3. Nutrient analysis

For raw nutritional analysis all cartilage, excessive subcutaneous fat and inedible matter were removed from each sample. Thereafter the raw samples were cubed, ground, placed in airtight freezer bags and frozen. The cooked samples were cooled to room temperature, dissected into fat, cartilage and fat for physical composition data. Edible fractions were cubed, ground and placed in airtight freezer bags. All nutrient analysis was done at the NutriLab of the University of Pretoria. The details and references for each method of analysis can be found in supplement 1 of this article.

2.4. Moisture content and freeze drying

Each raw ground sample was thawed and re-homogenized before moisture analysis was carried out. Moisture content analysis of the cooked and samples was done on the same day as cooking and grinding. Moisture content analysis was done in duplicate for both raw and cooked samples. All samples were freeze dried to obtain a homogenous sample for the rest of the analyses.

2.5. Statistical analysis

Data was collected, captured and prepared for statistical analysis in Microsoft Excel. Descriptive statistics were done by a qualified statistician using *GenStats* software (Windows Genstats, 2000). All data were analysed by analysis of variance.

3. Results and discussion

3.1. Cooking data and yield factors

Cooking data and yield factors for mutton and lamb organs are presented in Table 1. Raw weights for mutton organs range between 80 g (kidneys) and 2189 g (stomachs) and for lamb organs between 51 g (kidneys) and 2009 g (intestines). Cooked mutton edible portions ranged between 29.1 g (kidneys) and 1289 g (stomachs). There was no significant difference (in terms of weight in grams) between the edible portions of cooked mutton hearts, kidneys, spleens, lungs and tongues which can be seen as the group of smaller organs from a sheep carcass, yielding between 29.1 g (kidneys) and 318 g (lungs). The larger organs, namely intestines, livers and stomachs, had edible portion yields between 477 g (livers) and 1 289 g (stomachs) and did not differ significantly from each other but did differ significantly from the smaller organs (hearts, kidneys, spleens, lungs and tongues).

As was found in a study done in New Zealand on lamb organs (Purchas & Wilkinson, 2013), it was difficult to distinguish between subcutaneous fat, intermuscular fat and muscle meat in cooked organs, and therefore fat was included in the "edible portion" in Table 1. Cooked lamb edible portions ranged between 28.6 g (kidneys) and 713 g (stomachs). Similarly to the small mutton organs, edible portions of cooked lamb hearts, kidneys, spleens, lungs and tongues did not differ significantly in terms of weight in grams, ranging between 28.6 g (kidneys) and 259 g (lungs). Furthermore there was a significant difference between the cooked edible portions of lamb livers (130 g) and lamb intestines (896 g). There was no significant difference between the cooked lamb livers and stomachs (714 g) and also not between the intestines (896 g) and stomachs.

Yield factors presented in Table 1 for mutton organs ranged between 36.3% (kidneys) and 76.3% (livers). Yield factors for lamb organs in Table 1 ranged between 55.1% (kidneys) and 83.8% (livers). Although cooked lamb and mutton livers did not yield the largest edible portion in terms of weight they had the largest yield factor and thus had the smallest percentage cooking losses. This is consistent with what was found by the New Zealand study on the yield of cooked lamb organs (Purchas & Wilkinson, 2013).

3.2. Proximate and mineral composition per 100g raw and cooked lamb and mutton organ meats

The results of the proximate analysis and the mineral content of raw mutton organs per 100 g are presented in Table 2 and for raw