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The effects of region and gender on the fatty acid, amino acid, mineral, myoglobin and collagen contents of impala (*Aepyceros melampus*) meat

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Abstract

The effects of sex and region on the fatty acid profile, mineral contents, collagen and myoglobin contents of impala (*Aepyceros melampus*) meat were investigated. The study was conducted in the Limpopo Province of South Africa where impala were sampled from two separate regions. Female animals at Mara showed higher levels ($P < 0.05$) of saturated (SFA), and mono-unsaturated fatty acids (MUFA) in their tissues than the male animals. The females at Musina also showed a tendency ($P < 0.10$) towards higher levels of SFA and MUFA than the males. Males from both regions showed higher levels ($P < 0.05$) of poly-unsaturated fat than the females. Myristic, palmitic and stearic acid made up the greatest proportion of the SFA component for the males and females from both regions. Oleic acid represented the largest component of the MUFA, with the Mara animals showing higher levels than the Musina animals. α-linoleic, γ-linoleic, and linolenic acid made up the largest proportions of the poly-unsaturated component for both of the regions. Neither region nor sex had any influence on the amino acid content of the meat. The male animals at Mara had lower ($P < 0.05$) myoglobin contents than the females for that region. Region had no effect on the myoglobin content of the meat. No significant sex or regional differences were found in the hydroxyproline and collagen contents of the meat ($P > 0.05$). Regional differences ($P < 0.05$) were found in the amounts of phosphorous and calcium present in the meat. The male animals at Mara were found to have higher levels of zinc than the females.

Keywords: Fatty acid profile; Amino acids; Mineral content; Myoglobin content; Collagen content; Hydroxyproline; Game meat

1. Introduction

In spite of recent economic recessions and frequent droughts, game farming is growing in popularity in southern Africa and many cattle farms are being game-fenced to accommodate game (Ebedes, 2002). Game farming is a relatively new agricultural industry that has now become well established in South Africa. According to Eloff (2002), the estimated gross income from the game industry in 2000 was 843 million South African Rand. In a study undertaken by Van Der Waal and Dekker (2000) it was reported that game ranches cover 26% of the surface area of the Limpopo Province alone. This is equivalent to ≈3.6 m ha and is more than the combined surface area of the National and Provincial parks in the province.

The browsing habits of the impala make it well suited to the South African bushveld because of its ability to utilize both the tree and shrub components (Fairall, 1983). They are widely distributed in southern Africa and are able to survive in a variety of habitats (Skinner

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& Smithers, 1990). Together with this wide distribution and their relative abundance as a species, impala are well suited to sustained yearly cropping regimes (Bourgarel, Des Clers, Roques-Rogery, Matabilila, & Banda, 2002; Hoffman, 2000a). Impala also have a rapid reproductive rate which makes them an ideal species with which to establish a game population on a farm in a short space of time (Fairall, 1984). These factors have led to the impala being the most popular game species sold at game auctions during the last six years (Eloff, 2002).

The culling of game on a farm becomes an essential practice in order to avoid over-population and the associated environmental damage that can be caused by over-grazing (Conroy, 2002). There have been a number of studies conducted on African ungulate species and their potential for meat production and it is now widely accepted (Fairall, 1984; Hoffman, 2000b; Ledger, 1963; Ledger, Sachs, & Smith, 1967; Van Zyl & Ferreira, 2002). Berry (1986) showed that game meat production was the most profitable strategy for a game farm (when compared to live sales, trophy hunting and recreational hunting) in terms of return per kilogram of biomass. Meat production is playing an increasingly important role in the financial viability of game farms.

There is a preference amongst modern consumers for healthier foods. Game meat has the potential to be effectively marketed as a natural or organic product because of the way in which it is extensively farmed under natural conditions. Game meat is perceived as being darker than the meats of domestic animals (Hoffman, 2000a) and many believe this to be the result of game meat's susceptibility to the DFD condition. It is likely that an increased level of myoglobin due to high levels of physical activity in game animals could be the cause of the darker colour of game meat (Diaz et al., 2002; Vestergaard, Oksbjerg, & Henckel, 2000). The lower fat content of game meat (Hoffman, 2000b; Van Zyl & Ferreira, 2002) is of tremendous potential value to the health conscious consumer. It is widely accepted that fat intake beyond one's dietary requirements is a risk that leads to hypertension and concomitant heart disease, strokes, diabetes and obesity. Consumers have become increasingly aware of the fat contents of foods as a result of this. The quality of the fat itself is an important determinant in the appearance, palatability, nutritive value, processing characteristics and shelflife of meat and so is also an important factor in the meat quality (Casey, Van Niekerk, & Spreeth, 1988; Webb, Bosman, & Casey, 1994).

Saturated fats tend to solidify when they cool and so increase the hardness of fat. This affects the palatability of fat in the meat and therefore also the consumer acceptability. On the other hand, unsaturated fats oxidize easily and can cause rancidity, which negatively affects the shelf life (Casey & Van Niekerk, 1985; Webb et al., 1994). It is widely accepted that plasma cholesterol levels are influenced by the fatty acid composition of the diet. High levels of long-chain SFA in a diet increase plasma cholesterol levels, whereas high levels of mono-unsaturated fat and poly-unsaturated fats do not (Grundy & Denke, 1990; Rowe, Macedo, Visentainer, Souza, & Matsushita, 1999; Wood et al., 2003).

Game animals, and impala in particular, show very low levels of sub-cutaneous and intramuscular fat when compared to domestic species (Hoffman, 2000b). This is one of the reasons that game meat has potential to be marketed as a health product. With the growing game industry in South Africa and the increasing utilisation of game animals for meat production, it has become necessary to quantify all aspects of their meat quality. As yet there is very little information available in this regard for game species. Therefore, the purpose of this study was to determine the possible effects of sex and region on the fatty acid, amino acid and mineral profiles of impala as well as the quantification of the levels of myoglobin and collagen in their meat.

2. Materials and methods

Impala were sampled from the Mara Research Station (Mara), and from the Musina Experimental Farm (Musina) in the Limpopo province, South Africa. Mara is located 50 km west of Louis Trichardt, just south of the Soutpansberg mountain range (23° 05′ S and 29° 25′ E; 961 m.a.s.l.). The Mara Research Station is situated in the Arid Sweet Bushveld (Acocks, 1988) and is 11,000 ha in extent. The vegetation found there includes the woody species *Acacia tortilis, Commiphora pyracanthoides, Boscia albitrunca and Grewia* spp., while the grass species found include *Eragrostis rigidior, Panicum maximum, Urochloa mosambicensis* and *Digitaria eriantha*. The mean annual rainfall is 452 mm, of which approximately 80% occurs from November to March. The mean daily maximum temperature ranges from 22.6 °C in June to 30.4 °C in January (Dekker, Kirkman, & Du Plessis, 2001). The type of research conducted at Mara is primarily concerned with extensive cattle production. Impala occur naturally in the area and as they are in competition with the cattle for grazing, they are subject to yearly population reductions.

The Musina experimental farm is situated ≈15 km west of Musina and is bordered by the Limpopo river to the north (between 22°12′ and 22°18′ S and 29°50′ and 29°57′ E; 460–639 m.a.s.l.). According to Acocks (1988) the farm is located within the northern block of the Mopani veld, where the mopani, *Colophospermum mopani* is the dominant tree species. The study took place in the 4605 ha game fenced section of the farm. The mean annual rainfall is 366 mm of which ≈75% occurs from November to March. The mean maximum daily temperature varies from 25 °C in July to 34 °C