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Comparative analyses of the chemical and sensory parameters and consumer preference of a semi-dried smoked meat product (cabanossi) produced with warthog (*Phacochoerus africanus*) and domestic pork meat

Monlee Swanepoel [a,b], Alison J. Leslie [a], Louwrens C. Hoffman [b,*]

[a] Department of Conservation Ecology and Entomology, Faculty AgriSciences, JS Marais Building, Private Bag X1, Stellenbosch University, Matieland 7602, South Africa
[b] Department of Animal Sciences, Faculty AgriSciences, Mike de Vries Building, Private Bag X1, Stellenbosch University, Matieland 7602, South Africa

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ABSTRACT

The study compared the chemical and sensory characteristics and consumer preference of a semi-dried, cured meat product, cabanossi, produced with warthog meat and with domestic pork. The warthog and pork cabanossi had similar total moisture (59.0% ± 2.07 and 54.3% ± 1.26) and protein (26.3% ± 2.20 and 24.2% ± 2.15) contents, while the warthog cabanossi was lower in total fat content (6.9% ± 1.01) compared to pork cabanossi (13.7% ± 1.77, $P = 0.007$). Descriptive sensory analysis found that the warthog cabanossi appeared darker red ($P = 0.001$) and less fatty ($P = 0.001$), while the pork cabanossi had a higher overall pork flavour ($P = 0.001$). There were no differences in consumer preference of the appearance and taste between the two types of cabanossi, while the majority of consumers (91%) supported the use of game meat in meat products. The study concluded that warthog meat can be used in processed products without compromising the associated technical or organoleptic properties.

1. Introduction

Producing meat from wild animals has been suggested as a low-input, high production alternative to traditional animal husbandry (Hoffman & Cawthorn, 2012). Promoters of game meat consumption maintain that utilizing wild animals contributes towards sustainable wildlife and habitat management and local food security, while generating an income from a widely available resource (Van Schalkwyk, McMillin, Witthuhn, & Hoffman, 2010). It is important to note that the utilization of game meat for human consumption is based on the premise that the meat is harvested from wild animals in a sustainable manner, and wild populations are managed to promote growth and stability. This type of harvesting is not similar to bushmeat hunting in parts of Africa where certain animal species are intensely and illegally hunted by humans for food, which have caused local species extinctions or severe reductions of distribution ranges (Hoffman & Cawthorn, 2012). Game meat destined for the formal market is produced by farms and reserves that farm with or hunt wild animals, and is also a by-product of hunting for recreation, population management or problem animal control purposes. In Namibia, safari hunting accounts for the majority of game meat produced (Van Schalkwyk et al., 2010; Lindsey et al., 2013). More than 95% of the game meat produced annually (between 15,917,000 and 24,952,000 kg) is consumed within the country allowing for 87% of livestock meat produced to be exported. During the six month hunting season, game meat contributes approximately 10% of red meat utilized per annum in South Africa, which was estimated at around 1,249,000 kg during 2011/2012 (Dry, 2010; DAFF, 2013).

A growing body of scientific literature has highlighted the superior carcass and meat quality parameters of game animals (Van Zyl & Ferreira, 2004; Mostert & Hoffman, 2007; Hoffman, Kroucamp, &

* Corresponding author.
E-mail address: lch@sun.ac.za (L.C. Hoffman).

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Manley, 2007a; Hoffman, Smit, & Muller, 2008; Hoffman, 2008; Dannenberger, Nuernberg, Nuernberg, & Hagemann, 2013; Bartoň, Bureš, Kotrba, & Sales, 2014). Game animals in general produce a lean and healthy meat, which is high in protein, low in fat with a favourable fatty acid profile. The low overall lipid content and fatty acid composition is largely attributed to their forage diet and high levels of activity (Valencak & Gamsjäger, 2014). Despite the relatively slow growth of the game meat industry, consumers and producers have increasingly become aware of the health attributes of game meat in general and its value as a sustainable red meat source (MacMillan & Phillip, 2008). Game meat is also consider exotic, which is attractive to consumers who are adventurous and pursue new culinary experiences, and to foreign tourists who want to consume meat from native animals (Hoffman, Crafford, Muller, & Schutte, 2003; Hoffman, Muller, Schutte, Calitz, & Crafford, 2005) or take products home as souvenirs. Exotic meat enjoys the interest of the social elite where it is marketed in affluent restaurants as a highly valued, and priced, commodity (Adams, 2000).

The common warthog (*Phacochoerus africanus*) has historically been hunted and consumed by rural communities throughout its large distribution range across Africa. The species has become an extra-limital invasive in parts of South Africa through introduction and range expansion. Since warthogs are a known agricultural pest, they are hunted by agricultural producers for damage reprisal (Nyafu, 2009). This practise produces a carcass of which the meat can be used for human consumption. Similar to other game species, warthogs have a high dressing percentage, low total intramuscular lipid content, high total protein and moisture content and a favourable fatty acid profile (Hoffman & Sales, 2007, Swanepoel, Leslie, & Hoffman, 2014). The general carcass yield of common warthogs and other wild ungulates average around 56–66% for mature (adult) animals of both sexes (Hoffman, 2008), and around 65.5% for wild boars (*Sus scrofa*), Skewes et al., 2008). However, the dressed carcass weights of wild boars normally include the head and skin, while the warthogs and domestic pigs include the head, trotters and skin (with most of the adjoining subcutaneous fat). If the head, skin and trotters are included in the dress out percentages for warthogs, they are similar to those for domestic pigs ready for slaughter in South Africa (74.2–79.2%, and 77.8% respectively) (Pieters, 2006; Swanepoel et al., 2014. While the body weight of ungulate species are inherently different, intraspecies variation in dress out percentages is influenced by gut fill, diet and muscle (carcass) leanness. Furthermore, the diet of monogastric Suidae greatly influences the lipid content and fatty acid profile of the meat (Wood et al., 2008).

Game meat has the reputation of being difficult to prepare, thus processed products that are convenient or ready-to-eat might have more appeal for consumers and further expand the market for game meat through value-adding (Hoffman, Muller, Schutte, & Crafford, 2004). Preservation processes such as curing, drying or fermentation aims to increase the shelf-life of meat products which makes them more readily available to consumers (Van Schalkwyk, McMillin, Booyse, Witthuhn, & Hoffman, 2011). The development of game meat products should consider sensory, technological, safety and nutritional aspects of the product (Colmenero, 2000). This study aimed to develop a game meat product using warthog meat, to determine the chemical and sensory characteristics and consumer acceptability.

2. Materials and methods

2.1. Slaughtering and sampling

The warthog meat was obtained from farms in the Boshoff farming district (28°33′0″S, 25°14′0″E) near Bloemfontein in the Free State province (Ethical clearance number: 11LV_HOF02) in 2011. The blesbok (*Damaliscus pygargus phillipsi*) meat was sourced from Brakkekuil farm (34°18′24″S, 20°49′3″E) near Witsand in the Western Cape (Ethical clearance number: 10NP_HOF02) in 2010. Fifteen free-roaming warthogs and 32 blesbok were shot using a single shot bolt action rifle. The warthog group consisted of eight adult females, two adult males, one juvenile female and four juvenile males, and the blesbok group consisted of 12 adult females and 20 adult males. Shots were placed in the head, neck or flank (aiming for the heart). The animals were exsanguinated and allowed to bleed out in the field before being transported to a slaughtering facility and dressed according to the *Guidelines for the Harvesting of Game for Meat Export* (Van Schalkwyk & Hoffman, 2010). The carcasses were chilled for 24 h at 4 °C before the meat from all the animals (except the *longissimus thoracis et lumborum*, *biceps femoris*, *semimembranosus*, *semitendinosus*, *infraspinatus* and *supraspinatus muscles*) were removed, vacuum packed and frozen at −4 °C for processing. The meat was transported with a cooling truck at 4 °C to Stellenbosch University where it was stored in a freezer at −20 °C. The pork butts, consisting of *biceps femoris*, *semimembranosus and semitendinosus muscles*, and back fat from six pigs were sourced from a commercial abattoir (Winelands Pork, Bellville, South Africa). The meat and fat were randomly obtained from sows and barrows from Large white pigs weighing between 90 and 100 kg.

2.2. Cabanossi processing

The product, cabanossi (alternative spelling kabanosy), is a type of cured and cold smoked sausage stick consumed as a ready-to-eat snack in South Africa. It is thin (±1 cm in diameter) and medium in length (±30 cm) (Schoon, 2012). It is similar to another popular South African dried sausage, droëwors (Hoffman, Jones, Muller, Joubert, & Sadie, 2013), except that cabanossi is smoked and semi-dried. For comparative purposes, another cabanossi was produced using commercially reared pork. The sensory properties and preference of the two types of cabanossi were compared using both a trained sensory panel and a consumer preference tests. The sensory analysis evaluated the cabanossi in terms of visul appearance, aroma, taste and texture, and the consumer analysis evaluated consumer preference of visual appearance and taste. The product needs to satisfy consumers' expectations regarding distinctive visual and sensory qualities, attain a level of similarity to the product they are familiar with, with the added benefit of being healthier and organic (Radder & Le Roux, 2005). However, reducing the fat content should not have detrimental effects on eating quality, safety and production costs (Colmenero, 2000). Three batches of pork and warthog cabanossi were made (N = 6). The recipe and spices for the cabanossi was sourced from a commercial producer, Deli Spices™ (25 Bertie Avenue, Epping 2, Cape Town, South Africa). The recipe produced a 15 kg batch and three batches of each type was produced (Table 1). The meat was trimmed of excess fat and sinew, and the meat and fat was cut into 10 × 10 cm blocks before being minced separately through a 12 mm diameter sieve, after which the meat, fat and spices for each 15 kg batch was mixed by hand.

The mixture was then minced through a 5 mm diameter sieve as an additional mixing step. The mixture was stuffed into natural sheep casings (18–22 mm in diameter). The raw cabanossi were then smoked and dried in a commercial smoker Reich Airmaster® UKF 2000 BE (Reich Klima-Räuchertechnik, Urbach, Germany) with a SmartSmoker and TradiSmoker LS 500 HP electronic, automatically controlled by a Microprocessor (Unicontrol 2000). The programme cycles and order are given in Table 2. Eight randomly selected cabanossi links of each batch

Table 1
Recipe used for cabanossi production.

Ingredients	kg	%
Batch size	15	100
Warthog meat/Pork	7	46.6
Blesbok meat	6.5	43.3
Pork fat	1	6.6
Spice mixture	0.6	4
Ice water	0.5	3.3