Production of game salami from springbok (*Antidorcas marsupialis*), gemsbok (*Oryx gazella*), kudu (*Tragelaphus strepsiceros*) and zebra (*Equus burchellii*)

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Abstract

The aim of this investigation was to evaluate and compare the differences and acceptability to the consumer of salami produced from springbok, gemsbok, kudu and zebra, by means of sensory evaluation. Three different batches of springbok, gemsbok, kudu and zebra salami were produced on different days in a commercial processing plant As a control, a batch of the commercially produced Hartlief® game salami and Hartlief® beef salami were also produced together with the third batch. The salamis were fermented and cold smoked with oak wood chips, whereafter they were ripened in dark, cool cellars. Samples were taken from day one and subsequently at three different periods a week during the ripening period and the relevant variables measured. Descriptive sensory analyses were performed by a trained seven-member panel who evaluated the salami, in six sessions for the sensory attributes aroma, flavour, texture and colour. Taste and colour were researched by means of a consumer panel. The survey method used a structured, self administered questionnaire. Statistical analyses were performed on the data.

Introduction

Consumers nowadays favour meat that is authentic, tasty, rich in protein and low in lipids and cholesterol (Paleari *et al*. 2002). Statistical updates indicated that there is an increasing interest in the meat of game. It would be an illusion to think that game meat in an unprocessed state would find widespread domestic consumption, however, there is a tendency towards processed meats made from game meat, ready-to-eat and suitable for home consumption. Fermented and dried products from different wild species are being sold on the market alongside traditional beef and other meat products (Cattaneo and Pellegrini, 1995)

Game meat is darker than traditional beef and lamb meat due to its higher myoglobin content (Rickansrud and Henrickson, 1967). It is therefore suitable for salami production where a rich, dark red colour is preferred in the end product. Salami is defined as a mixture of meat and fat particles containing salt, curing agents and spices stuffed into either artificial or natural casings. Starter cultures are used to aid in the fermentation and maturation. It is thought that fermentation was first used by the Chinese approximately 2000 years ago, with salt and nitrate being introduced around the thirteenth century. The name salami is derived from the Latin word “sale”, meaning salt (Campbell – Platt, 1995)

Materials and methods

Approximately 150 kg of frozen raw meat from springbok, gemsbok, kudu and zebra were sourced from an approved local Namibian commercial meat wholesaler. Care was taken to ensure that the meat samples were taken from a week’s hunt so as to have as representative sample of the specific species as possible. The game used for this investigation was shot by a professional hunting team, adhering to the requirements and regulations for hunting of game for export purposes, as stipulated in the South African Meat Safety Act no. 40 of 2000. Pork back fat and spices were supplied by the Namibian meat processing plant where the game meat salamis were produced. For each repetition of the game meat salami production, meat was sourced afresh and the whole process repeated.

The starter culture OPTISTART quickred 00793D (Raps GmbH & Co.Kg, P.O.Box 1849, d 95310 Kulmbach, Germany) used in the game meat salami batches is a cocktail consisting of two micro-organisms, *Pediococcus pentosacius* and *Staphylococcus carnosus*. The starter culture came in powder form and was suspended in water before added to the batter during preparation. For each repetition of the game meat salami production, fresh spices were used as depicted in Table 1.

Table 1. Raw material and spice mix for game meat salamis per 50 kg

Ingredient	Weight	Supplier
Frozen game meat	35 kg	Farmers Meat Market, Namibia
Frozen pork fat	14 kg	Farmers Meat Market, Namibia
Ground red pork skin	1.5 kg	Hartlief, Namibia
Sodium nitrate E251	1.5 kg	Deli Spices, South Africa
Ground black pepper	75 g	Freddy Hirsch, South Africa
Garlic	12.5 g	Freddy Hirsch, South Africa
Ground green Kardamom	50 g	Deli Spices, South Africa
Ground Juniper Berries	100g	Spicetech, South Africa
Cervelat 7720027	400g	Gewürzmüller, Germany

In this investigation, three different batches of salami were produced on different days. Batch 2 was produced two days after batch 1 and batch 3 five days (with a weekend in between) after batch 2. As a control, a batch of the commercially produced Hartlief® game salami and Hartlief® beef salami were also produced together with batch 3. The meat mixtures and ratios of spices used are depicted in Table 1.

After mixing the frozen game meat and frozen pork fat, the mixture was chopped for one minute to a particle size of 10-20 mm in a commercial 100 liter bowl cutter (Schneidmischer 300, Krämer Grebe, Germany), During this chopping, red pork skin were added to enhance the firmness of the texture of the salami during maturation. Red pork skin is made on the premises by using pork skin that has had all the fat boiled off. Thereafter the spice mix and the starter culture were added and the batter was allowed to mix for five minutes in the bowl cutter. The batter was then transferred to a Handtmann vacuum filling machine VF 300 (Albert Handmann Maschinenfabrik GmbH & Co.KG, Hubertus-Liebrecht-Str.10-12, 88400 Biberach/Riss, Germany), running at 400 turns per minute, linked with an automatic Poly-clip system FCA 3462 (Poly-clip System GmbH & Co.KG, P. O. Box 940190, D-60459, Frankfurt/Main, Germany), whereby the batter was pressed through a 3 mm diameter grinder and stuffed into natural casings (Geiger & Klotzbücher, P.O. Box 14287, Landsdowne,South Africa) with diameter ranging from 60-90 mm, depending on the commercial production of that particular day.

The salami were fermented for 12 hours at 18-20 ºC at a relative humidity of >92%. Thereafter, they were cold smoked with oak wood chips (Startwood, P.O.Box 5004, Middelburg, South Africa) for 36 hours at 22-24 ºC at a relative humidity of >92% in the same chamber. The salami were then ripened in dark, cool cellars for a further 20 days at 12-16 ºC at a relative humidity of >88%.

Descriptive sensory analysis was performed to ascertain the sensory quality characteristics. The panel was chosen based on their experience in sensory analysis and on their availability. An eight member panel was trained in two interactive sessions to familiarise the panelists with the treatments and to identify the sensory characteristics to be evaluated (Lawless and Heymann, 1998). An unstructured line scale ranging from 0-100 mm was used to analyse the sensory characteristics (Table 2). The sensory tests were performed in individual booths in a temperature (21ºC) and light controlled (equivalent to daylight) room. One sample of each of the five treatments was served to the panelists in a randomised order in five sessions. Distilled water, apples and crackers were given to the panelists in between treatments. Each sample was coded with randomly selected three digit numbers and served at a refrigeration temperature of 6-10ºC.

For the determination of degree of liking, a hundred and fifty consumers were recruited amongst students at the Neudamm College, Namibia. The consumers tested the salami, without any knowledge as to the formulation of the products. Each panellist received one sample of each treatment, coded with three-digit codes, in a random order. Testing was done individually in a temperature (21ºC) and light controlled (equivalent to daylight) room. The traditional nine-point hedonic scale ranging from 1, dislike extremely; 2, dislike very much; 3, dislike moderately; 4, dislike slightly; 5, neither like nor dislike; 6, like slightly; 7, like moderately; 8, like very much; to 9, like extremely, was used. The latter instrument is used to test preference and acceptability.

Statistical analyses were performed on the data obtained from the trained and consumer panels (SAS computer programme).

Results

Pearson correlation coefficients indicated a high correlation between game and sour aroma ($r = 0.9561$). Results also showed a high correlation between game aroma and fatty mouthfeel ($r = 0.9282$). Data from the

trained panel showed the springbok salami to have a more sour aroma and flavour, redder colour and fattier mouthfeel than the salami made from the other species. The kudu salami had a smokier aroma and saltier taste, whilst the zebra salami had a very distinct salami aroma and flavour (Figure 1).

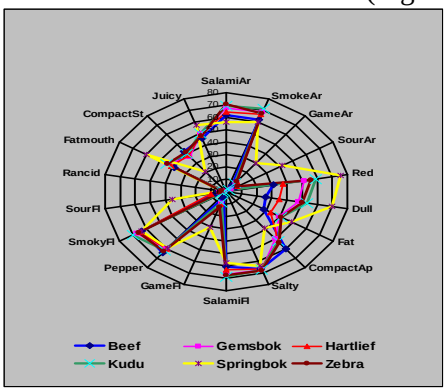

Figure 1. Spider web plot of sensory attribute means of salamis measured by a trained panel.

Statistical analyses from the consumer panel indicated that consumers associated the springbok salami strongly with colour and taste and that the salamis from the other species were grouped together (Figure 2).

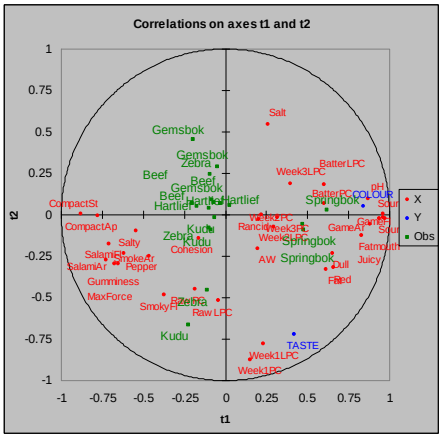

Figure 2. Partial least squares (PLS) regression chart (X = Physical and sensory attributes and Y = Consumer panel liking measurements).

Conclusions

This investigation concluded that salamis produced from gemsbok (*Oryx gazella*), kudu (*Tragelapus strepsiceros*) and zebra (*Equus burchellii*) appeal to consumers. However the salami produced from springbok (*Antidorcas marsupialis*) was perceived with a more sour and gamier taste which can be attributed to the higher pH of the springbok meat, which hampered the fermentation process.

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