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Shelf life of cooked goat blood sausage prepared with the addition of heart and kidney

F.A.P. Silva *, D.S. Amaral, I.C.D. Guerra, N.M.O. Arcanjo, T.K.A. Bezerra, V.C.S. Ferreira, I.B.S. Araújo, P.S. Dalmás, M.S. Madruga

Post-Graduate Program in Food Science and Technology, Department of Food Engineering, Technology Centre, Federal University of Paraiba, 58051-900 João Pessoa, Paraiba, Brazil

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ABSTRACT

This study focused on the effect of two packaging formats (vacuum packaging and over-wrap packaging) on the shelf life of cooked sausage prepared with blood, heart, kidney and goat meat fragments under storage at 4 ± 1 °C for a period of 90 days. The storage time and type of packaging significantly affected the chemical (pH, moisture, protein and TBARS number), physical (shear force) and microbial (mould and yeast) parameters of cooked sausage. Vacuum packaging maintained the microbiological and chemical qualities of cooked goat blood sausage for a longer period of time (63 days) compared to over-wrap packaging (41 days) and could be a viable alternative to refrigerated storage of the product for quality maintenance.

1. Introduction

During processing, distribution and storage, food undergoes chemical, microbiological and sensory degradation. When these parameters change significantly with time, the product reaches the end of its period of use, i.e., the end of its shelf life. The spoilage of stored food can be reduced through the use of appropriate packaging. Vacuum packaging has been the method of choice for changing the product atmosphere. It is widely used by the meat industry and is the focus of thousands of studies (Clariana, Guerrero, Sárraga, & Garcia-Regueiro, 2012; Fernández-Fernández, Vázquez-Odériz, & Romero-Rodríguez, 2002; Filgueras et al., 2010; Santos, Diez, González-Fernández, Jaime, & Rovira, 2005).

The use of blood and viscera in the preparation of meat products has been an alternative use of these non-carcass components (Arvanitoyannis, Bloukas, Pappa, & Psomiadou, 2000; Dalmás et al., 2012; Roseiro, Santos, Almeida, & Vieira, 1998; Santos, Gonzáles-Fernández, Jaime, & Rovira, 2003; Silva et al., 2013). However, due to their high perishability, the addition of blood and viscera to meat formulations may shorten the shelf life of the final product.

In a literature review, no studies assessing the shelf-life of cooked goat blood sausage were found. This article is a supplement to the work published by Silva et al. (2013), which aimed to evaluate the shelf life of cooked sausage with goat blood, heart, kidneys and goat meat fragments packed in two types of packaging (vacuum and over-wrap) for a period of up to 90 days in refrigerated storage (4 ± 1 °C).

2. Material and methods

2.1. Experimental design

A 2 × 7 factorial (two packages: vacuum and over-wrap, 7 evaluation times) completely randomised design (CDR) was used, analysing two treatments at seven times (0, 15, 30, 45, 60, 75 and 90 days) and in three replicates, totaling 42 cooked goat blood sausage samples.

The shelf life studies occurred over an experimental period of 90 days with 15-day intervals between tests, except for the sensory evaluation, which was performed only while the microbiological standards of products were in compliance with the legislation in force in order to avoid health risks to the evaluators.

2.2. The production of cooked goat blood sausage

A total of 23.0 kg of cooked goat blood sausages were produced in three replicates using meat trimmings (loin, ribs, chuck and neck), blood and viscera (heart and kidney) of 12 native goat breeds (Silva et al., 2013). The goats were aged 18–24 months and had a live weight of 28 ± 2 kg at slaughter. The formulation (Table 1) was obtained from preliminary studies published by Dalmás et al. (2012).

* Corresponding author. Tel.: +55 8332167576; fax: +55 32167179.
E-mail address: fabioandersonps@gmail.com (F.A.P. Silva).

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Table 1
Formulation of cooked blood sausage made with blood, heart and kidney of goats.

	Composition (kg)	Composition (%)
Raw material[a]		
Blood	11.50	50.0
Heart	0.85	3.7
Kidneys	1.45	6.3
Meat trimmings (loin, ribs, chuck and neck)	4.60	20.0
Fat	1.84	8.0
Pig skin	2.76	12.0
Ingredients[b]		
Manioc starch	1.15	1.15
Onion	0.92	0.92
Salt	0.58	0.58
Nitrite and sodium nitrate (Hungarian powder III)	0.09	0.09
Stabilizing (INS 451i)	0.09	0.09
Dehydrated parsley	0.05	0.05
Black pepper	0.02	0.02
Garlic powder	0.02	0.02
Marjoram	0.02	0.02
Cumin	0.01	0.01
Nutmeg	0.01	0.01

[a] The cooked sausage made with goat blood was prepared with raw material (blood, heart, kidneys, meat trimmings, bacon and pork skin) as 100% of the formulation.
[b] The ingredients were added in relation to the total weight of raw materials.

In the preparation of the cooked goat blood sausage, the meat, heart and kidneys were first trimmed to remove the excess fat and membranes. The blood was sieved to separate and remove suspended solids. The pork skin was ground along with the meat, heart, kidney and fat using a table mill (5 mm in diameter), and the blood, additives and spices were added to the comminuted meat mixture and mixed. An artificial collagen casing (50 mm in diameter) was filled with the mixture using a horizontal filler (Siemsen Ltda., ES-08, Santa Catarina, Brasil).

After filling, the blood sausages were cooked in an open pan at 80 °C until the temperature of the geometric centre reached 75 °C, this was followed by cooling and storage at 4 °C. Later, the sausages were smoked (8 h at 55 °C) in a smoking chamber (Fessmann, T1900, Winnenden, Germany), and then cooled once more.

After processing, the samples were divided into two groups of equal size; one was vacuum packed (TECMAC, nylon-poly, 18 × 25 cm, 18 μm thickness and capacity of up to 500 g) using a vacuum packaging machine (SELOVAC, 200B, São Paulo, Brazil), and the other group was over-wrap using trays with low-density polyethylene film. After identification, the products were stored under commercial refrigeration at 4 ± 1 °C to evaluate the shelf-life for a period of 90 days.

2.3. Microbiological evaluation

The microbiological parameters of cooked goat blood sausage were assessed according to the APHA methodology (2001). The reference criteria used were established by RDC Resolution No. 12, item (i), which states that the presence of coliforms at 45 °C/g, coagulase positive *Staphylococcus*/g, *Salmonella* sp./25 g and sulphite reducing *Clostridium* must be analysed when dealing with blood-based products and derivatives (Brasil. Ministério da Saúde. Agência Nacional de Vigilância Sanitária, 2001). Analysis of total fungi (yeast and mould) was also performed in the present study, as prior studies have reported the development of these microorganisms in sausages stored under refrigeration, especially under aerobic conditions (Parra et al., 2010, Samelis & Georgiadou, 2000; Santos et al., 2005).

2.4. Physical and chemical assessment

Analyses of pH, moisture, protein, TBARS number and shear force were performed. Moisture, protein and pH parameters were assessed as described by AOAC (2000). The TBARS number was quantified according to the distillation method proposed by Tarladgis, Pearson, and Dugan (1964), following the recommendations of Shahidi, Rubin, Diosady, and Wood (1985), which refers to the addition of sulphanilamide samples containing nitrite in their formulation. Shear force (SF) was measured as described by Wheeler et al. (1997). The shear force was applied perpendicularly to meat fibres using a TA.XT Plus Universal Texture Analyzer (STABLE MICRO SYSTEMS®, 1997) equipped with a Warner–Bratzler blade type.

2.5. Sensory evaluation

Sensory acceptance and purchase intent tests were conducted according to the methodology proposed by Meilgaard, Civille, and Carr (1991) and Stone and Sidel (2004). The acceptance test evaluated attributes of colour, aroma, flavour, texture, juiciness and overall acceptability using a 9-point hedonic scale ranging from 1 (extremely disliked) to 9 (extremely liked). For the purchase intent assessment, the hedonic scale ranged from 1 (certainly would not buy) to 5 (certainly would buy). For each sensory evaluation, sixty potential consumers aged from 18 to 33 years (57.4% males and 42.6% females), who reported affinity for blood and viscera-based products, were selected and recruited.

The sensory analyses were conducted with the prior approval of the Ethics Committee in Research with Humans (Protocol No. 0218/11), in order to meet the scientific and ethical requirements established by the National Health Council, through Resolution No. 196 from October 10, 1996 (CNS, 1996). All evaluators were informed about the purpose of the study and signed the Informed Consent Form.

2.6. Statistical analysis

The statistical interpretation of data was performed by Analysis of Variance (ANOVA), followed by regression analysis up to at least a 5% significance level. The statistical package in the Assistat software, version 7.6 beta, was used (Silva & Azevedo, 2009).

3. Results and discussion

3.1. Microbiological evaluation

Regarding the two types of packaging used for the sausages, both showed no significant differences ($p > 0.05$) in the counts of thermotolerant coliforms, coagulase-positive *Staphylococcus*, sulphite-reducing *Clostridium* and *Salmonella* sp. At all times, the microorganisms surveyed were present in levels below the Brazilian legislation