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Physico-chemical stability of bovine blood sausages (#517)

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Introduction

Blood sausages are ready to eat traditional meat products consumed in many parts of the world. They differ as a result of type, region, and manufacturer. The basic ingredients of blood sausages are blood and fat. Other ingredients may include vegetables or cereals. The blood content varies from 5-60 % or more blood can be used (Marianski & Marianski, 2010). Regardless of their composition, blood sausages are susceptible to spoilage and have a relatively short shelf-life due to high-water activity and pH. Water activity, pH and several other factors have a major impact on physico-chemical stability of food. Increasing consumer demand for ethnic specialties has renewed interest in blood sausages, leading to a consequent need to assure safety and longer shelf-lives, therefore the objective of this study was to investigate the physico-chemical properties of 0 % (no blood), 5, 15 and 30 % blood sausages.

Methods

A total of 20.3 kg of cooked bovine blood sausages were produced in six replicates using bovine blood, beef trimmings, heart and kidney, and pig skin. Formulations were manufactured to contain 0 %, 5 %, 15 % and 30 % blood. In order to maintain the same batch size across all the treatments in the formulation, blood was adjusted with iced water. The mixture was filled in the hog casings (23 mm in diameter). The sausages were fan grilled at 120 °C until the temperature of the geometric centre reached 80 °C, this was followed by cooling at room temperature and storage at 4 °C until sampling the following day. Water activity and pH were measured the day after processing. Sausages for thiobarbituric acid reactive substances (TBARS) analysis were stored in a retail fridge-type (-10°C) and evaluated at day 1, 25 and 50 according to the method described by Raharjo, Sofos, and Schmidt (1992). The remaining samples were vacuum packed and stored at -20°C until analysed for Sodium Chloride (NaCl), sodium (Na), and iron (Fe) content. The NaCl and ash content were determined according to the methods described by AOAC (1994), Na and Fe content were determined according to Zasoski & Burau (1977).

Results

Results of the physico-chemical parameters are presented in Table 1. The a_w of all the sausages were within the range of the a_w of blood sausages (0.93 to 0.97) (Lewicki et al., 2014), and showed no significant differences amongst treatment groups. The pH linearly increased with blood content of the sausages, and the pH of the sausages containing no blood was significantly lower than the pH of 15 and 30 % blood sausages. The moisture content of the sausages decreased with the increase in blood content with the 30% blood sausages having significantly lower moisture content than the 0 and 5 % blood sausages. Ash content increased with increase in blood content, and 30 % blood sausages had significantly higher ash content than all other sausages. Although not statistically significant an increase in NaCl content was observed with the increased blood inclusion level. The decreased moisture, increased ash and NaCl contents with increased blood inclusion level could be attributed to the ingredients in the formulation. High cereal (rusk and barley) content used in the formulation with increased blood content reduced the moisture content of the sausages. Rusk act as a water binding agent in processed meat products (Marianski &Marianski, 2010). Iron content linearly increased with the increase in blood content. The sausages containing 15 and 30% blood had higher ($p < 0.001$) iron content compared to 0 and 5% blood sausages (Table 1). There were no significant differences that could be observed in sodium content of the sausages. The increasing Fe content with the blood inclusion level was also reflected in the increase in TBARS values with higher blood levels over time (Fig 1). Haematic complexes are catalysts of lipid oxidation in meat and meat products (Min & Ahn,2005). Sodium chloride or sodium are known pro-oxidants (Mariutti, & Bragagnolo, 2017). Therefore, higher lipid oxidation was expected. In addition, higher TBARS values could be attributed to aerobic packaging. Although not statistically significant, TBARS values increased with the increase in blood content of the sausages, however, the sausages were still within spoilage limit up to day 25 except for 30 % blood sausages. At day 50 all the treatments containing blood exceeded the spoilage limit. The TBARS values of the sausages containing no blood did not exceed spoilage limit until the end of the storage period. The threshold of 1 mg malonaldehyde/kg of sample is considered to be a spoilage limit (Gray et al., 1987).

Conclusion

The chemical composition of the sausages were affected by the blood inclusion level. Oxidative stability of sausages manufactured with 30 % blood exceeded the oxidative spoilage limit after 25 days of storage and all blood containing sausages exceeded the oxidative spoilage limit after 50 days of storage.

Notes

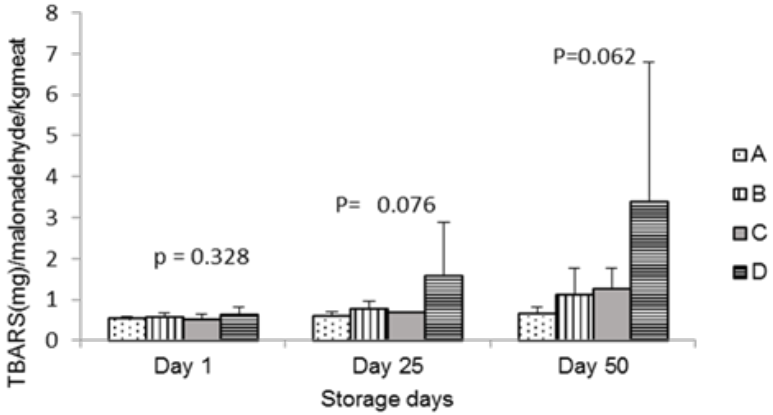

Figure 1
The effect of blood inclusion level on the TBARS values of blood sausages.

Table 1: The effect of blood inclusion level on physico-chemical properties of bovine blood sausage

Treatment Parameters	0%	5%	15%	30%	Significance level
a_w	0.93±0.26	0.92±0.03	0.94±0.02	0.92±0.03	p = 0.487
pH	5.87^{a} ±0.12	6.12^{ab} ±0.09	6.22^{b} ±0.06	6.42^{b} ±0.11	p = 0.001
Moisture %	54.02^{b}±2.18	53.97^{b} ±2.06	51.70^{ab} ±3.52	48.86^{a} ±2.70	p = 0.010
Ash %	2.51^{a} ±0.20	2.59^{a} ± 0.26	2.59^{a} ±0.14	2.97^{b} ±0.20	p = 0.004
NaCl %	1.78 ±0.19	1.72 ±0.19	1.75 ±0.30	1.98 ±0.36	p = 0.376
Fe wet sample (mg/kg)	41.78^{a} ±6.61	55.22^{a} ±7.38	96.52^{b} ±13.47	150.48^{c} ±25.27	p < 0.001
Na wet sample (mg/kg)	0.83 ±0.07	0.70 ±0.07	0.71 ±0.06	0.76 ±0.09	p = 0.088

Means with different superscripts in the same row differ significantly.

Table

Notes