COMMUNITY-LEVEL PHYSIOLOGICAL PROFILING OF REDUCED OR REPLACED SALT BOEREWORS BATTERS INOCULATED WITH *ESCHERICHIA COLI*

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I. OBJECTIVES

Since high salt intake is regarded as unsafe for human health, the South African Department of Health (2013) released regulations for a stepwise lowering of salt content in certain food products, including fresh sausages. The reduction or partial replacement of salt, with salt replacers, can affect the product safety and shelf life of fresh meat products. Boerewors is a traditional fresh and uncured South African sausage manufactured from beef and pork. No studies have yet been performed on the effect of salt reduction/replacement with potassium chloride or potassium lactate on the microbial communities in Boerewors models when inoculated with *Escherichia coli*. The objectives of this study were to evaluate the bacterial communities in Boerewors batters with reduced and/or partial replacement by KCl or K-lactate, after it was inoculated with *E. coli*, by determining the community-level physiological profiles of each treatment by assessing the metabolic diversity in the meat samples.

II. MATERIALS AND METHODS

Five treatments of Boerewors batters were formulated: NC = negative control with no added NaCl or replacer; K600 = treatment with potassium chloride as replacer (1.25% added NaCl + 0.551% KCl); L600 = treatment with potassium lactate as replacer (1.25% added NaCl + 0.551% K-lactate); N600 = treatment containing only NaCl and no replacer (1.25% added NaCl); PC = positive control containing the 800 mg/100g Na level recommended for Boerewors from 30 June 2016 (1.80% added NaCl; DoH of South Africa, 2013). K600, L600, and N600 contained the 600 mg/100 g Na level recommended for Boerewors from 30 June 2019. The Boerewors models were spiked with 2.61 log CFU/g *E. coli* and stored at 4°C, for 3 d. This study used community-level physiological profiling, employing the Biolog™ Ecoplates™. The reactions of the microbial communities to the 31 carbon compounds were measured and statistically evaluated using analysis of variance, Gompertz equations (XLSTAT, 2018).

III. RESULTS

When spiked with 2.61 log CFU/g *E. coli* and stored at 4°C for 3 d, the treatment with no added salt (NC), showed the highest growth rate and maximum population size when compared to the treatments containing salt and replacers. The average well color development and Shannon richness indicated that the potassium chloride treatment was significantly ($P < 0.05$) more efficient in controlling the growth of the microbial communities compared to the NC (Table 1). With the single carbon oxidization, the K600 and N600 were comparable to each other in controlling the growth of the bacterial communities. It was indicated that there was a reduction in the functional diversity of microbial communities and *E. coli* in Boerewors with higher salt content.

Table 1. Growth kinetics of microbial communities from Boerewors samples with different treatments, inoculated with *E. coli*.

Treatment	c (hours)	a (OD values)	AWCD	*H*	*E*	*S*
NC	0.0365[a]	64.915	39.328	1.383	0.051	20.454[a]
K600	0.0451[b]	58.786	39.139	1.441	0.049	22.086[b]
L600	0.0416[ab]	59.920	38.600	1.400	0.048	21.515[ab]
N600	0.0422[ab]	60.780	38.667	1.422	0.052	21.406[ab]
PC	0.0404[ab]	60.468	36.333	1.415	0.053	20.928[ab]
Sign. level	p = 0.020	p = 0.763	p = 0.886	p = 0.986	p = 0.374	p = 0.023

Means with different superscripts in the same column differed significantly. Mean ± standard deviation.
The growth rate (c) and maximum population size (a) were calculated with the Gompertz equation (Yeh et al., 2019).
AWCD = Average well colour development; *H* = Shannon diversity; *E* = Shannon evenness; *S* = Shannon richness were calculated according to Grzadziel et al. (2018).

IV. CONCLUSION

The community-level physiological profiling in this study indicated that the sodium level mandatory in South Africa from 30 June 2019, as well as KCl as a salt replacer with lowered levels of NaCl inclusion, were effective in controlling *E. coli* in Boerewors when stored at 4°C.

Keywords: Boerewors, community-level physiological profiling, EcoPlates, *Escherichia coli*, salt reduction