Effect of high hydrostatic pressure processing optimization on chemical stability of a vacuum-packed fermented sausage (#646)

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Introduction

Alheira, is a popular traditional smoked fermented sausage produced in the north region of Portugal. It may have problems in its preservation due to its high aw, increasing the potential exposure of consumers to microbial hazards. High hydrostatic pressure (HHP) has emerged as a non-thermal food technology that can be applied with minimal changes in food sensorial characteristics. It is normally applied as an effective final mitigation step for products already packaged which cannot be heat-treated. Using a response surface methodology was delineated an experimental design for HHP processing optimization in order to improve *Alheira* shelf life and safety, maintaining their organoleptic authenticity. The effect of different combinations of pressure (300-600MPa) and time (154-1800 seconds) was evaluated with the aim of describing potential physicochemical characteristics changes of this fermented sausage.

Methods

Three *Alheira* batches at different production days were prepared by a traditional manufacture procedure. The product formula comprises wheat bread (38.2%), cooked pork meat (36.5%), pork lard (13.1%), cooked chicken meat (8.3%), olive oil (1.4%), dehydrated garlic (*Allium sativum* L., 1.3%), salt (0.77%), sweet red pepper powder (*Capsicum annuum* L., 0.23%), sodium diacetate (0.12%) and hot *piri-piri* powder (0.02%). This mixture was stuffed into 40–45 mm diameter natural pork casings. *Alheira* samples were smoked at 7-12ºC for 4 days, with oak wood (*Quercus ilex* L.) smoke. Sausages were vacuum packed in polyamide and polyethylene (PA/PE 90) bags and then stored under refrigeration at 5ºC. Samples were processed in a high-pressure food processor (N.C. Hyperbaric, model Wave 6000/135; Spain) and pressurized under the 12 conditions in study, at 10ºC. Control samples were maintained under atmospheric pressure at 5ºC. Immediately after treatment, all samples were transported in a cooled container (<5ºC) to the laboratory and analysed.

The pH was measured with a pH electrode (FC 230B, Hanna Instruments). Water activity (a_w) was determined using a Rotronic Hygrometer station (Rotronic Hygroskop DT, Ettlingen, Germany) at 23 °C. Control and HPP treated samples were assessed just before package opening for objective colour using L*a*b* CIELAB colour system with a colorimeter (Minolta CR-300, Chromometer, Osaka, Japan). Lipid oxidation evaluation was performed by thiobarbituric acid reactive substances (TBARS) as previously described by Fraqueza et al. (2009). Results were compared by ANOVA using the software SAS software.

Results

Table 1 summarizes the physicochemical characterization of the treated products. *Alheira* is a product where lactic acid bacteria are responsible for a lower pH due to fermentation but are only slightly dried as observed by the a_w results presented. This product needs refrigeration and has a short shelf life. The HHP technology contributes to a microbial reduction on this sausage equivalent to pasteurization. The application of HHP processing did not generate significant changes in pH, a^w and TBARS when compared to the untreated product ($p < 0.05$). Relatively to the colour, with the application of HHP it was observed a decrease in the L* values when the pressure values applied were higher and the duration of treatment was longer, translating this in darkening of the samples. The minimum values of L* were reached for binomial pressure 600Mpa and time 960 seconds. a* values were also affected by the treatment, when the pressure values applied were higher and the duration of treatment was longer, causing a slight redness of these samples. There were no significant changes in the b* values. The effect of HHP on proteins and starch has been extensively investigated. The of starch and protein structure changes could induce water absorption with less light reflection and consequently, sausages darkening.

Conclusion

The use of HHP in *alheira* manufacture showed promising results with minimal effects in the majority of parameters under study. HHP did not induce sausages lipid oxidation. Pressurization at 600 MPa has demonstrated a slight modification of sausages lightness and redness. Further studies should include consumer test assessing product acceptability regarding colour changes.

Treatment	Time (ms)	Pressure (MPa)	L*	a*	b*	a_w	pH	TBARS (mgMDA/kg)
Control	0	0	58.52±0.31[a]	9.04±0.10[b]	25.02±0.59[a]	0.96±0.006[a]	5.22±0.27[a]	1.21±0.23[a]
1	960	300	53.87±2.93[b]	8.49±0.67[b]	21.73±1.81[a]	0.96±0.008[a]	5.16±0.35[a]	1.41±0.11[a]
2	390	344	52.70±1.80[bc]	9.75±0.57[ab]	22.34±0.11[a]	0.96±0.004[a]	5.30±0.42[a]	1.43±0.15[a]
3	1530	344	55.47±1.58[ab]	8.82±0.47[b]	20.50±1.04[a]	0.96±0.004[a]	5.07±0.28[a]	1.34±0.04[a]
4	154	450	54.22±1.24[ab]	8.37±0.70[b]	21.22±1.77[a]	0.96±0.004[a]	5.39±0.22[a]	1.64±0.16[a]
5	960	450	52.31±1.36[bc]	9.24±0.29[ab]	22.23±0.81[a]	0.96±0.001[a]	5.27±0.34[a]	1.53±0.28[a]
6	960	450	52.15±1.85[bc]	9.19±0.66[ab]	23.33±0.27[a]	0.96±0.004[a]	5.42±0.16[a]	1.45±0.18[a]
7	960	450	52.84±1.48[bc]	9.52±0.71[ab]	22.46±1.25[a]	0.96±0.004[a]	5.37±0.36[a]	1.71±0.42[a]
8	1800	450	54.31±1.70[ab]	8.50±1.11[b]	22.51±1.64[a]	0.96±0.006[a]	5.48±0.11[a]	1.59±0.21[a]
9	390	556	54.56±0.59[ab]	9.00±0.82[b]	20.38±3.61[a]	0.96±0.003[a]	5.51±0.11[a]	1.48±0.35[a]
10	1530	556	51.56±0.58[bc]	10.07±0.48[ab]	21.84±1.01[a]	0.95±0.002[a]	5.18±0.17[a]	1.77±0.39[a]
11	390	600	54.24±0.97[ab]	8.84±0.33[b]	21.30±0.45[a]	0.95±0.004[a]	5.28±0.18[a]	1.58±0.26[a]
12	960	600	49.27±0.31[c]	10.89±0.37[a]	23.08±2.64[a]	0.96±0.002[a]	5.45±0.06[a]	1.47±0.53[a]

[a,b,c] Means with different lowercase letter in the same column differ significantly at P<0.05 (Tukey test)

Table 1. Physicochemical characteristics of control and HHP processed Alheira.