SALT-REDUCED LYONERS WITHOUT INGREDIENTS DECLARED BY E-NUMBERS

R. Hadorn[1,*], M. Suter[1,2], J. Javor Qvortrup[2]

[1] *Agroscope Liebefeld-Posieux (ALP), Swiss Federal Research Station for Animal Production and Dairy Products, Berne, Switzerland. Email: ruedi.hadorn@alp.admin.ch*
[2] *Department of Food Technology, University of Applied Sciences Waedenswil (HSW), Wädenswil, Switzerland*

Key Words: boiled sausage, lyoner, curing, ingredient, E-Number, salt reduction, jelly, colour, sensory

Introduction

In Switzerland, the per capita consumption per year of boiled sausages is about 6 kg, which represents approx. 2/3 of the whole sausage consumption (Proviande, 2005). All additives used during boiled-sausage processing have either to be declared by their names or by E-numbers. This is often badly received in the market place because a lot of consumers have a negative association with E-numbers. Except nitrite curing salt and ascorbic acid/ascorbate, food additives are also banned from organic meat products. Therefore, a trial was designed to test whether processing of boiled sausages without E-number ingredients is possible. Due to its large calibre in relation to the curing process, lyoners were chosen as experimental boiled sausage. The following two aspects were tested in combination: 1. adaptation of processing procedures in order to produce without additives (stabilisators, flavour enhancers) and 2. the use of alternative ingredients which contain some technological important substances naturally and therefore have not to be declared by E-numbers (nitrate from vegetable mixtures, ascorbic acid from acerola cherries). It was also tested to which extent the salt content of lyoners may be reduced without having any adverse effects on technological and sensorial attributes as described by Martin (2002).

Materials and Methods

In two series, 2×12 different lyoners (caliber: 90 mm, weight: 1.5 kg) based on the same ground recipe (31% pork III, 15% veal II, 12% neck backfat, 10% sausage backfat, 10% processed calf rind, 22% ice-water, 6 g per kg of a conventional spice mixture), different ingredient mixtures and different conditions during curing (between stuffing and boiling) were produced (table 1).

The sausages were analysed for physical [peeling, sliceability, jelly formation, colour (by CIE L*a*b*-system), pH], chemical [dry matter (DM), crude protein (CP), crude ash (CA), crude fat (CF), total sugars (SUG), chloride (Cl), sodium (Na), calcium (Ca), magnesium (Mg), potassium (K), nitrate (NO_3^-), nitrite (NO_2^-)] and microbiological parameters [total viable counts, Enterobacteriaceae, *Clostridium perfringens*, Salmonella spp.: all bacteria were determined 1, 14, 28 and 42 days after processing]. Furthermore, the lyoners were assessed for their sensory profile on different odor, flavor and texture criteria on a 10-point intensity scale by a panel of thirteen trained internal panelists. Also a visual evaluation was performed for all treatments.

Table 1: Experimental design of the two series

Serie 1 (Curing conditions: 1440' und 2°C)	Salt supplementation		
	2.0%	1.5%	1.0%
Table salt, acerola[1]	1_01	1_02	1_03
Sea salt, acerola	1_04	1_05	1_06
Table salt, acerola, vegetable I[2], starter I[3]	1_07	1_08	1_09
Nitrite salt, ascorbic acid[4], Na-ascorbate[5]	1_10	1_11	1_12

Serie 2 (Salt supplementation 2.0%)	Curing condition		
	90' / 45°C	240' / 19°C	1440' / 2°C
Sea salt, acerola[1]	2_01	2_02	2_03
Table salt, acerola, vegetable I[2], starter I[3]	2_04	2_05	2_06
Table salt, acerola, vegetable II[6], starter II[7]	2_07	2_08	2_09
Nitrite salt, ascorbic acid[4], Na-ascorbate[5]	2_10	2_11	2_12

[1] *Lyophilisate of acerola cherries: 1 g per kg*
[2] *Lyophilisate of a vegetable mixture: 8 g per kg*
[3] *Lyophilisated ferments of Staphylococcus carnosus (producer A): 0.2 g per kg*
[4] *Ascorbic acid: 0.25 g per kg*
[5] *Na-ascorbate: 0.25 g per kg*
[6] *Lyophilisate of a vegetable mixture: 5 g per kg*
[7] *Lyophilisated ferments of Staphylococcus carnosus (producer B): 0.2 g per kg*

Results and Discussion

From the physical analyses, it could be seen, that the choice of the nitrate/nitrite-source had an influence only on colour, mainly the a*-value. a*-values for the treatments with table salt and sea salt were between 5.2 and 6.3 and with vegetable mixture I between 5.4 and 6.8. Highest a* values (9.5 to 10.4) were determined for nitric-salt treatments. Salt reduction lowered water-binding capacity and jelly was formed between stuffing and sausage casing. Salt supplementation of 2.0, 1.5 and 1.0% led to significantly different jelly percentages of 1.6, 7.6 and 18.3%, respectively. Therefore peeling force was reduced from 1.46 N (2.0% salt) to 0.66 N (1.0% salt) and sliceability values increased from 712 mJ (2.0% salt) to 818 mJ (1.0% salt) due to the higher DM content of the remaining sausage mass ($p \leq 0.05$). Curing at 19°C doubled jelly formation compared to the ones closed to the freezing point or to the point of sarcoplasma-protein denaturation at about 45°C, which caused sealed surfaces.

Na-, Cl- and CA-contents were influenced by salt supplemention and therefore jelly formation. The latter caused a slight dilution of SUG due to its water solubility as well as concentration of other nutrients as CF, CP and DM in the stuffings ($p \leq 0.05$). Ca-, K- and Mg-contents were independent from the degree of salt supplementation. Curing conditions had no influence on nutrient and mineral contents, because jelly formation did hardly differ between the different curing conditions. Due to the source of nitrate/nitrite, SUG-, Ca- and K-contents were slightly increased for the treatments supplemented with vegetable powder being rich in carbohydrates and minerals. Vegetable mixtures allowed to bring in important amounts of Na-nitrate (vegetable mixture I: 38 mg/kg stuffing; vegetable mixture II: 28 mg/kg stuffing) into the stuffing. This nitrate was only partly reduced by the starter cultures to nitrite, which could be seen in non-cured areas during visual evaluation.

With the exception of the lyoners processed with vegetable mixture I and cured for 240 minutes and 19°C or 1440 minutes and 2°C, respectively, total viable counts were between 10^2 und 10^3 colony-forming units per gram (CFU/g). The corresponding values for the mentioned exceptions were between 10^4 and 10^5 CFU/g. Neither the differences during conservation nor the ones between the treatments were significant. Counts for *Clostridium perfringens* and Enterobacteriaceae were below the detection limits of 10 CFU/g for all treatments. Also no salmonellae could be detected in the 25-gram samples of all lyoners.

The degree of salt supplementation was important for sensorial evaluation ($p \leq 0.05$): 1. directly by tasting the salt in the attribute “salty”, 2. indirectly by its effect on enhancing taste and spice effects in the attributes “acid” and “spicy” and 3. by influencing jelly formation which was followed by texture changes seen in the attributes “cracking” and “hard”. Due to the choice of nitrate/nitrite-sources as well as the one of curing conditions, only minor effects on sensory traits were seen.

Visual evaluation of the sausages showed that colour of lyoners processed with table salt, sea salt and vegetables I and II never reached the one of the ones processed with nitric salt. By cutting the sausages of treatment 2_04 (vegetable I, 90 minutes, 45°C), some spots could be observed where curing had been completed. For lyoners at the lowest salt level, jelly deposition occurred not only between stuffing and skin, it was also seen some jelly formation in the stuffing itself. This influenced the impression of the cross section negatively.

Conclusions

Replacing nitric salt by vegetable mixtures rich in nitrate combined with the use of a nitrate-reducing starter culture and the right choice of curing conditions can lead to complete curing of lyoners. In order to achieve complete curing, at least 40 mg $NaNO_3$ per kg stuffing, which are necessary for aroma and colour formation (Jira, 2003), have to be provided by the vegetable mixtures. Depending on the starter culture, curing should be performed during 2 to 4 hours at a temperature of 45°C before the boiling process starts.

High salt supplementations are desirable from the technological point of view. Due to sensorial as well as health aspects, 1.6 to 1.8 g NaCl per kg stuffing is recommended. A further reduction of NaCl supplementation without addition of other salt-ions or phosphates has adverse technological effects (jelly formation, stuffing smoothness).

Also referring to practical experiences, it can be stated that stuffing production for boiled sausages is possible without using phosphates or modified starches, if not too much ice-water is added and slightly increased weight losses are considered.

Replacing ascorbic acid and Na-ascorbate by the acerola lyophilisate rich in ascorbic acid did not cause any problems. This is due to its desired effects on biochemical processes as well as having no adverse influence on sensorial traits.

References

1. Proviande (2005): Konsumzahlen Proviande 2004. Marktforschungsinstitut IHA-GFK, Hergiswil (personal communication).
2. Jira, W. (2003): Chemische Vorgänge beim Pökeln und Räuchern. Chemie des Lebensmittels Fleisch, Kulmbacher Reihe, Band 18, p. 119-150.
3. Martin, M. (2002): Meat Curing Technology. In: Hui, Y.H., Hip, W.K., Rogers, R.W., Young, O.A. (Hrsg.): Meat Science and Applications. Marcel Dekker Inc., New York.