NITRITE REDUCTION IN ORGANIC MEAT PRODUCTS:
FERMENTED SAUSAGE AND LIVER SAUSAGE

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Abstract- Nitrite is used in meat products for formation and stabilization of the red, cured meat color. Nitrite also has antimicrobial and anti-oxidative properties. The use of nitrite in organic meat products is currently being evaluated in the EU (E250), therefore this project was undertaken to establish minimum concentrations needed in fermented and liver sausage to yield stable products. Lower concentrations of nitrite are added to meat products and during storage and exposure to light (7 days 500 Lux) discoloration and decrease in nitrite concentration were analyzed. Challenge tests were done with Staphylococcus aureus in fermented sausage and Clostridium botulinum in liver sausage. A minimum above 50 mg nitrite/kg is necessary for colour stability in liver sausage especially when exposed to light. Challenge tests showed the growth of S. aureus in fermented sausage was not influenced by the amount of nitrite added. Growth of C. botulinum was observed when liver sausage was stored above 10°C.

Key words: Clostridium botulinum, fermented meat products, liver sausage, nitrite reduction, Staphylococcus aureus.

I. INTRODUCTION

Organic meat products, especially pork, are still a steadily growing segment in the EU and in the Netherlands. In line with consumer expectations, a small list of additives may be used for meat products to preserve the products and create structure and yield. For some years profound discussions have been ongoing in the EU regarding the use of nitrite as an additive for organic meat products. As an additional non-organic component, nitrite is not a desired component. The use of nitrite is still allowed for food safety reasons, but regulations have become more stringent [1]: lower levels of nitrite are permitted for organic meat products than for regular conventional meat products. Replacements were created using vegetables products with a high nitrate concentration to add nitrite for forming and stabilizing the cured red meat colour, obtain a cured aroma and for its antimicrobial properties. Labeling of nitrite is no longer required, although nitrite can be present at higher concentrations as are used in conventional products [2]. Several studies at TNO were carried out to determine the effect of reduced amounts of ingoing nitrite [3-6]. A final study was carried out to determine the effect of reduced amounts of ingoing nitrite on the quality of organic fermented sausages and organic liver sausages. The goal was to gather insight to minimize the amount of nitrite, while still obtaining safe food products. The results can be used in the international discussion on reducing or banning sodium nitrite in organic meat products.

II. MATERIALS AND METHODS

Organic meat products as fermented sausage and liver pate were produced by two different Dutch meat processing companies. Beside the standard recipes, containing approximately 80 mg sodium nitrite per kg product (ingoing content), comparable products were made with reduced nitrite content, i.e. 40 or 0 mg/kg product. Both products were processed in accordance with standard processing methods. The fermented sausage was stuffed in a fibrous casing and stored in a Fessmann ripening cabinet at 30°C at 70% RH for 48 h. Subsequently, the sausage was stored for 4 wk at 7°C and then sliced and packed aerobically. Challenge tests were carried out on Staphylococcus aureus by adding a concentration of $10^3$ viable microorganisms per gram of product during production. The processing of those products followed the same procedure as described above. The standard organic liver pate was produced with concentration of 100 mg/kg nitrite (ingoing content), two tests were performed using 50 mg nitrite/kg and 0 mg/kg. Products were stuffed in artificial casings and pasteurized at 76°C for 60 min. A part of the liver mass (reference and two nitrite concentrations) was inoculated with

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100 spores of *Clostridium botulinum*, pasteurized at 76°C for 60 min, cooled and stored at three different temperatures to enable the *C. botulinum* spores to germinate. During storage and illumination after packaging (7 d at 500 Lux), instrumental (CIELab) color comparison was carried out as well as nitrite and microbiological analyses.

III. RESULTS AND DISCUSSION

*Colour analysis.*
Several moments after production and during 7 days of illumination at 500 Lux, the colour of the liver pate was analyzed using the CIELab system. Results for liver pate are given in Figure 1. During storage, a* values decreased during the first 61 days of storage and were fairly stable thereafter. The difference in the a* values between the different treatments did not change. After 1 day of illumination, the liver pate with 100 mg nitrite per kg added was stable, the pate with 50 mg.kg decreased strongly.

The development of the color of the fermented sausage during storage, slicing and illumination at 500 Lux is shown in Figure 2. There was no difference in a* value although this was expected from products where no nitrite was added. All products decreased in a* value in the same order.

![Figure 1. a* colour development of liver pate during storage and 7 days of illumination](image1)

![Figure 2. a* colour development of fermented sausage during storage and 7 days illumination](image2)
Nitrite analysis
Directly after preparation, after fermentation and after slicing (i.e. 21 days after production) and after 7 days of illumination, the amount of nitrite was determined. Results are given in Table 1.

<table>
<thead>
<tr>
<th>Nitrite content [mg/kg]</th>
<th>fermented sausage</th>
<th>liver pate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ingoing nitrite</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>After fermentation or pasteurisation</td>
<td>&lt;2</td>
<td>40</td>
</tr>
<tr>
<td>At slicing moment (21 days or 60 days)</td>
<td>0</td>
<td>&lt;2</td>
</tr>
<tr>
<td>After 7 days illumination at 500 Lux</td>
<td>0</td>
<td>&lt;2</td>
</tr>
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</table>

The residual nitrite analysis showed that nitrite concentrations declined sharply after production for both type of products.

Challenge tests
Challenge tests carried out with S. aureus showed a small increase of the countable S. aureus from 10³ CFU/g added to 10⁴ CFU/g after fermentation. At the end of storage and 7 days after slicing and storage at 6°C the counts of S. aureus were still at the level of 10⁴ CFU/g. No difference was noticed in growth of S. aureus in products with lower amounts of added nitrite.

Challenge tests carried out with C. botulinum showed no growth of spores at storage temperatures of 7°C or 10°C. At a storage temperature of 15°C during 10 wks, Clostridium was detected at 10⁴ CFU/g for the pate with no nitrite added, 5x10⁵ CFU/g for the pate with 50 mg nitrite per kg added and 10² CFU for the liver pate with 100 mg nitrite per kg added. Those results were noticed before [4].

The growth of S. aureus in fermented sausage was not influenced by the amount of nitrite added.

Complete abandoning of nitrite in the processing of organic meat products is not advisable, as it will give less colour stable products and the risk of growth of C. botulinum is higher when products are stored above 10°C.

IV. CONCLUSION

An ingoing amount of 50 mg nitrite per kg liver pate is too little for a colour stable product after exposure to light.

Below 10°C, development of C. botulinum inoculated in liver pate was not detected. At storage temperatures above 10°C development of C. botulinum was observed after 10 weeks in liver pate. When 100 mg/kg nitrite was added, the development of C. botulinum was less.

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REFERENCES


