Sodium reduction made easy with sub4salt® cure and potassium lactates
There are two aspects which play an important role in processed meat products. On one hand a safe and stable product through the entire shelf life is a must which has to be fulfilled every time. On the other hand the demand for healthier meat products is rising. One of the major health trends on the meat market is the sodium reduction as these products usually contain a high level of simple salt. But a high sodium intake is associated with negative effects on the human body like hypertension, stroke or kidney disease.

Potassium lactate and potassium lactate / diacetate blends are a solution for both aspects. Jungbunzlauer provides solutions to the meat industry which make sure that there is no microbiological growth in the product over a long period of time even at a low use levels. In addition by choosing the right potassium based ingredient more than 25% sodium reduction, and in combination with Jungbunzlauer's new sub4salt® cure aid for reddening more than 50% sodium reduction are possible.
Why reducing sodium?

Cardiovascular diseases (CVDs) are quite common in the modern western world. These CVDs are mainly caused by arteriosclerosis and hypertension. For example in 2008 already 30% of all global deaths were due to heart disease and stroke. A high sodium intake is one of the main root causes for these malfunctions but it is also associated to kidney diseases, stomach damage and bone loss.

A sodium intake of more than 2.4 grams per day which is equivalent to 6 grams salt already can lead to increased blood pressure. Therefore the WHO recommends not exceeding a daily salt intake of 5 grams. But not only sodium reduction is important for a healthy diet. The sodium / potassium ratio is important for the human diet as well. Therefore the WHO guidelines recommend a daily potassium intake of at least 3.5 grams for adults. This may lower the risk of high blood pressure and stroke.

In most countries the WHO daily sodium intake recommendations are exceeded by far (graph 1). In some Asian countries for example the value is doubled compared to the recommended limit. But also in Europe the consumed sodium levels are too high. Therefore in some regions the awareness towards lower sodium in food is very popular already. Especially in UK there are initiatives to set limits for the sodium content in food driven by the authorities [1; 2; 3].

Graph 1: Salt intake levels of different countries worldwide

The functionality of salt in processed meat

The main source of sodium in the human diet is not simple table salt. 80% of the sodium intake comes from processed food (graph 2). Besides baked goods, processed meat products contain the highest sodium levels as a lot of salt is traditionally added into these food products. Table 1 shows the sodium content of typical raw and processed meats. It is conspicuous that the natural sodium content in meat is very low compared to meat products.
Graph 2: Origin of salt intake from different sources
Proportional contribution of processed foods to salt intake: DE Data

Table 1: Sodium content of meat products

<table>
<thead>
<tr>
<th>Product</th>
<th>Sodium content [mg/100g]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beef</td>
<td>63</td>
</tr>
<tr>
<td>Pork</td>
<td>70</td>
</tr>
<tr>
<td>Chicken</td>
<td>60</td>
</tr>
<tr>
<td>Turkey</td>
<td>50</td>
</tr>
<tr>
<td>Pork Sausage</td>
<td>600-1,080</td>
</tr>
<tr>
<td>Frankfurters</td>
<td>720-1,120</td>
</tr>
<tr>
<td>Coocked ham</td>
<td>900-1,200</td>
</tr>
<tr>
<td>Beef Bologna</td>
<td>1,080</td>
</tr>
<tr>
<td>Cured ham</td>
<td>1,500</td>
</tr>
<tr>
<td>Corned beef</td>
<td>1,220</td>
</tr>
<tr>
<td>Salami</td>
<td>1,800-1,900</td>
</tr>
</tbody>
</table>
The use of salt has a long tradition in the preparation of meat products. Besides taste providing its main function is preservation as meat is very sensitive to microbial spoilage. Without appropriate treatment the degradation process of raw meat takes place very fast. Therefore the method of curing is used since centuries. Curing salt is a combination of sodium chloride and sodium nitrate or sodium nitrite. It helps to maintain the red meat colour and suppresses microbial growth.

Consumers are looking for good tasting products with a long shelf life. Therefore, processed meat products need additional treatments to meet the modern quality requirements on food safety and stability. For example the use of sorbates and benzoates is one efficient way to suppress microbiological growth. But these preservatives are artificial substances which do not fit into the main consumer driven trend towards natural ingredients. Lactates and lactate / diacetate blends are derivatives of lactic acid and constitute a perfect alternative as this organic acid with antibacterial properties is produced by the natural process of fermentation. In addition lactic acid and lactates can be found naturally in the human body due to the fact that they are important intermediates and products of the metabolism. A lot of food products naturally contain lactic acid as well. In fermented foods like sauerkraut or olives lactic acid provides the typical taste profile and guarantees product stability.

**Performance of lactate and lactate / diacetate blends in processed meat products**

**Listeria control and shelf-life extension**

The main reason for the use of lactates and lactate / diacetate blends in processed meat products is their bacteriostatic properties. As they provide excellent microbial growth inhibition, the product is kept safe and stable throughout the entire shelf life period. For evaluating the efficacy of potassium lactate 60% (PL) and potassium lactate / sodium diacetate 56% / 4% (PL / SD) against Listeria monocytogenes and Aerobic mesophilic bacteria, different tests have been performed. These microbiological species have been chosen as they represent typical and critical bacteria occurring in processed meat products. Listeria monocytogenes is a dangerous pathogen which leads to serious food poisonings. From time to time the meat industry is confronted with deaths caused by this specific germ [4]. Aerobic mesophilic bacteria are an indicator for meat product spoilage. The growth inhibition of this group of microorganisms guarantees a stable product through its entire targeted shelf life period.

The tests were performed using a standard cooked sausage (lyoner type) formulation containing 2% standard curing salt. The preservatives were added into the sausage meat at different concentrations for determining efficacy difference between them. After cooking the sausages were sliced. Then these slices were inoculated with 10⁴ CFU / g of Listeria monocytogenes and stored at 7°C for 56 days. At specific points of time (0; 7; 14; 21; 28; 35; 44; 56 days) the microbiological growth was analysed.

Graph 3 shows the results of 1.5% and 2.5% potassium lactate and potassium lactate / diacetate on the Listeria monocytogenes growth inhibition. It can be seen that at the present conditions a microbial growth starts after storage day 14 on sausages without additional preservative. At a preservative concentration of 2.5% there is almost no growth through the whole test period for both formulations. A slight start of growth can be seen after storage day 44 on sausages containing PL only. At a preservative concentration of 1.5% there is no bacteria growth in formulations containing PL / SD over the whole test period. In sausages containing PL as single substance a microbial growth starts after storage day 35. This means the PL / SD blend provides the same product stability at a lower use level as it does at the highest tested.
For the Aerobic mesophilic bacteria the results are quite similar (graph 4). After day 14 there is a microbial growth on products without preservative. At 2.5% use level there is a slight growth starting after day 44 on formulations containing PL and no growth at all on formulations with PL / SD. At a use level of 1.5% preservative the picture is becoming clearer. There is a big difference in the performance of the two preservatives. In the sausages containing PL the bacteria growth starts again after storage day 35 and increases rapidly until it reaches the level of the control containing no preservative at the end of the test period. With PL / SD at 1.5% there is again no growth detectable through the entire storage period. Compared to control a shelf life increase of 3 weeks can be achieved by the single use of PL at 1.5%. At the same use concentration PL / SD allows additional 6 weeks of shelf life compared to control. This underlines the advantages of the PL / SD blend. Due to the additional antimicrobial effect of diacetate less active substance of the blend is needed to achieve the same product stability as with lactate alone. Due to the significantly lower use levels cost savings are possible without losing performance.
More than 25% and even more than 50% sodium reduction

Graph 5 shows the main sodium sources of processed meat products. The natural sodium content of meat is quite low. The addition of salt or curing salt increases the sodium content by nearly 800mg / 100g at a standard level of 2%. The second highest sodium input comes from sodium lactate. For preservation 2.5% of sodium lactate is normally used, increasing the sodium level by 300mg / 100g. Other ingredients like phosphates, citrates or diacetates play a minor role in terms of additional sodium in meat products. Reducing sodium in salt / curing salt and sodium lactate is the key to reducing total sodium in processed meats.

The use of 2.5% sodium lactate 60% is a standard in processed meat applications as it provides good microbiological growth inhibition. The combination of this preservative together with 2% standard curing salt introduces 1100 mg of sodium / 100g of end product (table 2). By simply exchanging sodium lactate with potassium lactate more than 25% sodium reduction will be achieved. The same reduction level is possible by using potassium based lactate / diacetate blends at a lower use level of 1.75%.

As alternative to salt Jungbunzlauer has developed a 1:1 substitute containing 35% less sodium. This product called sub4salt® is a blend of sodium chloride, potassium chloride and sodium gluconate. Especially for the use in meat products this blend has been combined with sodium nitrite to the first sodium reduced ready to use curing salt. Sub4salt® cure provides the same functionality as standard curing salt and can be used as a 1:1 substitute as well. In combination with Jungbunzlauer sub4salt® cure the possible sodium reduction rate is even higher. More than 50% sodium reduction is possible by combining potassium based lactate or lactate / diacetate together with sub4salt® cure.
Table 2: Sodium contribution / 100g cooked ham of different lactates and lactate / diacetates in combination with standard curing salt (left) or Jungbunzlauer sub4salt® cure (right)

<table>
<thead>
<tr>
<th>Product</th>
<th>2 % curing salt</th>
<th>2 % sub4salt® cure</th>
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<tbody>
<tr>
<td>2.50% sodium lactate</td>
<td>1100 mg Na</td>
<td>810 mg Na (-26 %)</td>
</tr>
<tr>
<td>2.50% potassium lactate</td>
<td>790 mg Na (-28 %)</td>
<td>500 mg Na (-54 %)</td>
</tr>
<tr>
<td>1.75% potassium lactate / sodium diacetate</td>
<td>800 mg Na (-27 %)</td>
<td>510 mg Na (-53 %)</td>
</tr>
<tr>
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Graph 6 shows the reduced sodium levels in processed meat products after switching from standard curing salt to sub4salt® cure (~ 278mg / 100g) and from sodium to potassium based lactates or lactate / diacetates (~ 308mg / 100 g).

Graph 6: Reduced sodium levels after changing of sodium based lactates or lactate / diacetates to potassium based alternatives and from standard curing salt to Jungbunzlauer sub4salt® cure
**Sensory evaluation**

Products containing a higher level of potassium salts are suspected to have a bitter aftertaste. To see the possible impact on taste a sensory panel consisting of 19 – 22 panellists has tested standard cooked sausages containing different preserving ingredients. For the sensory evaluation lyoner type sausages containing 2.5% potassium lactate 60%, potassium lactate / sodium diacetate 56% / 4% or potassium lactate / potassium diacetate 56% / 4% in combination with 2% curing salt or Jungbunzlauer sub4salt® cure were tested on specific attributes.

These attributes were ranked on a scale from 1 to 5 where 1 represented the lowest impression and 5 the highest, always compared to a standard containing curing salt only. Afterwards the results were statistically analysed according to the “Friedmann Test”.

The first attribute focused on was the acidic taste impression. As shown in graph 7 there was no obvious difference between control and the other formulations. Graph 7 also shows a difference in bitter taste of potassium lactate (PL) or the potassium lactate / potassium diacetate (PL / PD) containing formulations compared to control. It looked like the sensory panel has detected a slightly higher bitter taste impression in those potassium enriched products. However the statistical analysis of these data showed no significant difference concerning bitter aftertaste between the single formulations. In parallel the highest salty taste impression was again detected at PL and PL / PD containing products whereas a slightly, yet statistically significant, lower saltiness than control could be seen in the formulation containing PL / PD together with sub4salt® cure.

All in all the most preferred formulations in terms of taste (taste acceptance) where those providing an increased salty taste. This means a slight bitterness can be compensated by enough saltiness like it is the case in the PL / PD containing formulations. In this respect a combination of the PL / PD blend together with Jungbunzlauer sub4salt® cure can decrease the bitter taste and in parallel the salty taste impression to the control’s level. The sensory panel ranked this combination and the control formulation at the same level.

Graph 7: Results of the sensory evaluation
Conclusion

Jungbunzlauer potassium lactate and potassium lactate / diacetate blends have been proven to provide excellent antimicrobial function. They provide efficient growth inhibition of Listeria monocytogenes and Aerobic mesophilic bacteria through a time frame of 56 days. The tests have also shown that lower use levels of lactate / diacetate blends still result in a stable end product through the whole test period. This leads to lower cost in use without loss of performance.

A sensory evaluation has shown a positive impact of Jungbunzlauer potassium lactate and potassium lactate / diacetate blends on the saltiness of the end product without significant impact on the bitterness, resulting in an excellent taste acceptance.

Last but not least these ingredients are smart choices to reduce the sodium content of processed meat products. More than 25% sodium reduction can be achieved by simply switching from sodium to potassium based lactates or lactate blends. In combination with Jungbunzlauer sub4salt® cure a sodium reduction of even more than 50% is possible with a taste acceptance that is still good.

References


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