Additives in meat products – for good or for bad?

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Joint publications with prof. Kerstin Lundström


7. Lindahl, G., **Lundström, K.** and Tornberg, E. Contribution of pigment content, myoglobin forms and internal reflectance to the colour of pork loin and ham from **pure breed pigs**. Meat Science 59, 141-151, 2001.

Additives and enzymes in food: past, present and future from a global and consumer perspective, 28-30 August, Falkenberg, Sweden
Some typical additives used in meat products

- salt
- nitrite
- polyphosphate
- antioxidants
- potato starch
- fibers

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The influence of some additives on the quality of meat products – for good or for bad.

<table>
<thead>
<tr>
<th>Quality aspects</th>
<th>Type of additive</th>
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<tr>
<td></td>
<td>Salt</td>
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<tr>
<td>Criteria</td>
<td>Good Bad</td>
</tr>
<tr>
<td>Health</td>
<td>X</td>
</tr>
<tr>
<td>Hygienic</td>
<td>X</td>
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<tr>
<td>Pathogenic</td>
<td>-</td>
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<tr>
<td>Taste</td>
<td>X</td>
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<tr>
<td>Texture</td>
<td>X</td>
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<td>Colour</td>
<td>X</td>
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<td>WHC</td>
<td>X</td>
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<td>FHC</td>
<td>X</td>
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Antioxidants in meat products

- Besides microbial spoilage the major cause of quality deterioration in meat products is oxidation, which can cause a number of quality aberrations such as colour changes, off-flavour formation, texture deterioration and water losses.

- The products formed during lipid oxidation can be hazardous with regard to health. Lipid peroxides can induce inflammation, DNA damage and tumor development, pathological conditions linked to colorectal cancer.

- Adding antioxidants could be a way to hinder the progress of oxidation in meat and thereby reduce the quality deviations and health hazards.
A comparison of antioxidant activity (scavenging activity with ABTS assay) between some Antioxidants.

The olive phenols and catechin are better antioxidants than the carotenoids.
Lipid oxidation (TBAR, \( \mu \text{mol of TMP/(g} \cdot \text{L}) \)) of meatballs (15% fat) deep fat fried after storage at 4°C 0 and 1 week.

Storage for 1 week at cold temp. increases lipid oxidation for all samples but mostly for the ref. Polyphosphates (2600 ppm) are the most efficient antioxidants, which is 3-5 times more efficient than ascorbic acid and the fat soluble antioxidants.
Frozen storage of deep fat fried meat balls during 0.5 and 1 year with added antioxidants (OPP, 100 and 200 ppm)

MBB: 70% of beef meat.
MBP: 70% of meat, 42% beef and 28% pork

Even after half a year and a year of frozen storage the antioxidant OPP lowers significantly the lipid oxidation in meat balls
Dietary fibers

Dietary fibers originate mainly from cell walls of root fruits, vegetables, fruits and cereals.

For root fruits, vegetables and fruits the insoluble part of the cell wall mainly constitutes of hemicellulose/cellulose and the soluble part mainly of pectin.

In cereals there are two groups of fiber with special interest, namely pentosanes (i.e. arabinoxylanes and arabinogalactanes) and β-glucananes.
## Composition of cereal fibers studied

<table>
<thead>
<tr>
<th></th>
<th>Total dietary fibre (% dm)</th>
<th>Arabinoxylans (% dm)</th>
<th>β-glucan (% dm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oat bran</td>
<td>18.4 (5.7)</td>
<td>5.2 (0.1)</td>
<td>10.2 (3.3)</td>
</tr>
<tr>
<td>Rye bran</td>
<td>36.0 (3.1)</td>
<td>25.6 (2.4)</td>
<td>4.2 (0.5)</td>
</tr>
<tr>
<td>Barley fibre</td>
<td>63.2 (26.1)</td>
<td>20.8 (2.3)</td>
<td>32.0 (22.3)</td>
</tr>
</tbody>
</table>
Important parameters of the recipes

**Meatballs**

- Water/protein ratio 7.4
- Salt content 1.3%
- 4 or 8% added starch
- 1% total dietary fibre
- 9 or 1.5% fat

**Sausages**

- Water/protein ratio 7.9
- Salt content 2%
- 3.2 or 6.5% added starch
- 1% total dietary fibre
- 5 or 2% fat


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The frying loss of the meatballs were high for all cereal additives.

- Sausages with oat bran had a decreased frying loss, while barley fibre and rye bran increased the loss.
- Rye bran that had been soaked in water had frying loss as low as the oat bran in sausages.
Firmness (N)

- Adding barley fibre resulted in a low firmness, especially for sausages.
- The firmness of sausages with rye bran could be increased by soaking the rye bran in water, 50°C 4 hours.
• Oat bran was the most preferred additive in sausages while the least preferred in meatballs
• Barley fibre was the least suitable as additive in sausages
• Rye bran can be added to meatballs
Heating cereal additives and potato starch

Rheological measurements of heated mixtures of cereal additives and potato starch, according to the sausage recipes, without the meat.

Oat bran had a good gelling ability upon heating.

- Oat bran + potato starch
- Barley fibre + potato starch
- Oat bran
Conclusions

• Due to gelling ability upon heating, oat bran was most suitable for addition to low-fat sausages, which received low frying losses and high values on both firmness and sensory acceptance.

• Rye bran is suitable for addition to low-fat meatballs probably due to its particulate nature. The gelling properties are not so important for meatballs as they are in sausages.

• The addition of barley fibre to low-fat sausages led to high losses and a very low firmness. This barley β-glucan could not form a gel when heated. A smaller molecular weight and a less favourable structure, compared to the oat β-glucan could be the reason for that.
Potato starch added up to 4% in emulsion sausages is common in Sweden.

Potato starch granules are coloured black (iodine) and have a large variation in size in between sausages taken from production.
The general behaviour of starches on heating

The viscosity of the starch slurry
The swelling of potato starch in the microscope, when heated from 25 to 70°C.
Comparing starches having different swelling temperatures with regard to cooking loss in sausages

It is optimal to add a starch that start to gelatinise at 55°C, which is the case for both native and amylopectin potato starch.


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Effect of freezing an emulsion sausage with added native potato starch.

*Fresh sausage with added potato starch*

*Frozen and thawed sausage with added potato starch*
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Conclusions

• Additives like salt, nitrite and polyphosphate in meat products are considered not to be healthy although the evidence for that is not convincing. However, salt is very important for taste and texture and nitrite is crucial for safety and color of the products. Polyphosphate can act as both an antioxidant and a water binder.

• Antioxidants are very important in meat products as they can increase the quality of the meat products with regard to health, color, flavor, texture and water holding.

• Dietary fibers can exchange fat in meat products, but it is very dependent on the type of fiber added and also on the type of meat product.

• Native Potato starch is an excellent additive to meat products as it start to swell at about 55°C, where the meat start to loose its water, which is then taken up by the swelling potato starch granules. However, native potato starch is sensitive to freezing.