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Technology for healthier pork products



Key external stakeholders:

Meat processors
Ingredients companies
Food Retailers
Consumers

Practical implications for stakeholders

- The information generated by this project will assist meat processing companies to develop healthier meat products that are as appealing and satisfying to eat as standard versions of traditional products such as sausages and luncheon roll. Healthier means containing less salt and/or fat and using natural ingredients such as plant derived antioxidants and prebiotic fibres.

Main results:

- The salt content of pork sausages was reduced from 2.5% to 1.4% without a noticeable change in sensory attributes, composition, emulsion stability, lipid oxidation or shelf life. High pressure processing at 200 MPA may assist in producing reduced salt sausages with the same functional properties as controls.
- An acceptable breakfast sausage with 39% less calories enriched with 2.5% prebiotic fibre was produced with equivalent sensory and quality attributes to standard sausages.
- A phytosterol ester was incorporated into a reduced salt pork breakfast sausage with organoleptic properties which were favoured by the trained sensory panel.
- Grape seed extract (GS) and Rosemary-Pomegranate (RP) extract had no effect on sausage appearance, overall liking, tenderness, flavour or juiciness liking.
- Half the nitrite in a pork luncheon roll was replaced with tomato powder without negatively affecting sensory attributes.

Opportunity / Benefit:

There is growing consumer and hence retailer interest in “clean” label foods and functional foods. This research has shown that healthier versions of traditional meat products such as sausages and pork luncheon roll can be produced that are just as acceptable to consumers as standard versions of the same products. Meat processors wishing to exploit this potential can use these results to guide the development new products or collaborate with the team at Teagasc Research Centre Ashtown.

Collaborating Institutions:

IRTA, Spain
University of Copenhagen, Denmark
University of Helsinki, Finland

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1. Project background:

Traditional meat products such as sausages and cooked ham are often high in fat, salt and contain additives to prolong shelf life, improve colour and prevent oxidation. Consumers are aware of the possible health risks of these products but enjoy eating them. Producing healthier versions of these traditional meat products would therefore find favour with many consumers. In this project, which was part of a large EU project aimed at improving the entire pork production chain from farm to fork, we aimed to develop the knowledge to produce healthier versions of traditional meat products that would be just as acceptable to consumers as standard versions.

2. Questions addressed by the project:

- Are low salt sausages as acceptable to consumers as higher salt versions?
- Can high pressure processing play a role in reducing the salt content?
- Do low fat sausages containing a prebiotic fibre taste as good as standard sausages?
- Do sausages containing a phytosterol ester taste as good as standard sausages?
- Can natural antioxidants such as rosemary-pomegranate extract and grape seed extract be used in sausages without affecting flavour or appearance?
- Can tomato powder be used to replace some of the nitrite in pork luncheon roll?

3. The experimental studies:

The combined effect of high pressure processing (HPP) and salt level on the sensory and technological properties of pork breakfast sausages was examined over a 21 day storage period. Four pressure treatments (0.1 (control = atmospheric pressure), 200, 300 and 400 MPa) were applied to lean and fat before sausage fabrication. Sausages were manufactured to contain a salt level of 2.5% or 1.4% and refrigerated for 21 days at 4°C. Shelf life, composition, texture and sensory analysis assessments were carried out.

Pork breakfast sausages were prepared at two fat levels (22% (standard) and 13% (reduced fat)) containing a prebiotic fibre (inulin) at four levels (0, 2.5, 5 and 7.5%). The influence of fat and prebiotic fibre addition on the organoleptic and textural properties of the pork sausages was determined.

Pork sausage were made with three levels of the phytosterol *Vegapure*: control with no added phytosterol (VG0), with 1% phytosterol added (VG1) and with 2% phytosterol added (VG2). The sausages were stored for 0, 10, 15, and 20 days when quality and technological parameters analysed.

Grape Seed extract (GS) was added at 100 (GS100) and 200 (GS200) µg/g and Rosemary-Pomegranate (RP) extract was added at 250 (RP250) and 500 (RP500) µg/g to breakfast pork sausages. An analysis of the technological and sensory attributes of these sausages was then carried out.

Nine treatments of pork luncheon rolls were produced with three sodium nitrite levels (0, 0.05 and 0.1%), three tomato pulp powder levels (0, 1.5 and 3 %) at three storage times (2, 7 and 14 days). The effects of cooked pork luncheon roll enriched with tomato powder on composition (protein, fat, moisture and ash), pH, colour, nitrosomyoglobin content, lipid oxidation, residual nitrate content, shelf life, texture and sensory analysis were investigated.

4. Main results

The salt level can be reduced to 1.4% without a noticeable change in sensory attributes,

composition, emulsion stability, lipid oxidation and shelf life (TVC). High pressure treatment may have a role in producing reduced fat sausages as pressurised samples had higher pH, lower cook losses and slightly altered colour and texture attributes compared to non-pressurised controls. HPP in the range 200 to 400 MPa did not promote lipid oxidation and reduced TVC levels. A moderate pressure level of 200 MPa resulted in a sausage product with similar cook loss, colour, water holding capacity, texture and sensory attributes to control sausages at both salt levels, suggesting HPP improved protein extraction. However, HPP at 300-400 MPa would not be recommended as higher pressure levels altered binding properties and therefore texture and sensory attributes of the pork breakfast sausages.

The incorporation of inulin at levels of 5 and 7.5% significantly reduced pH and emulsion stability of the raw breakfast sausages. An average calorie reduction between standard and reduced fat breakfast sausages of 23% was achieved. It is possible to manufacture a standard pork breakfast sausage with up to 5% inulin in the final product without significant detrimental changes in the overall product quality. It is also feasible to produce an acceptable breakfast sausage with 39% less calories enriched with 2.5% prebiotic fibre without sacrificing overall sensory and quality attributes.

The incorporation of a phytosterol ester, *Vegapure*, to reduced salt pork breakfast sausages did not have any detrimental effects on lipid stability or sausage composition and organoleptic properties were favoured by the trained sensory panel. The addition of *Vegapure* had no effect on the redness or yellowness values of the raw pork sausages while a small but significant difference in lightness values on days 2 and 10 was observed. The addition of *Vegapure* had no effect on the pH, cook loss, or emulsion stability of the sausages and did not affect lipid oxidation during storage. For texture analysis, the addition of *Vegapure* reduced hardness and springiness, while no obvious trends were observed for chewiness, cohesion force and gumminess. No significant difference was observed for any of the sensory descriptors, indicating a positive result that *Vegapure* has the potential to be incorporated into the sausage better without negatively affecting the organoleptic properties or product quality of the sausage. This resulted in an acceptable functional meat product.

Addition of Grape seed extract (GS) and Rosemary-Pomegranate (RP) extract at both concentrations had no effect on pH, WHC, emulsion stability, colour, composition or texture profile of pork breakfast sausages. RP significantly reduced the cook loss relative to the control. GS100, GS200 and RP500 had reduced lipid oxidation. GS and RP at both levels had no effect on sausage appearance, overall liking, tenderness, flavour or juiciness. These results demonstrate the potential of natural flavonoid containing extracts to the meat industry in the development of novel healthy functional meat products.

Increasing the level of nitrite affected the colour, increased the pH of the cooked product, the nitrosomyoglobin value and the lipid oxidation but decreased the residual nitrite content. The reduction in nitrites did not significantly affect the composition and texture of the pork luncheon rolls. Tomato powder reduced the pH and increased redness and yellowness values of both the raw and the cooked product. Tomato powder affected the texture by decreasing the hardness, gumminess and chewiness and increasing the cohesiveness particularly at a level of 3%. TVCs for all treatments and storage days were below the safe limit for this type of cooked product. A sensory evaluation was performed using a trained panel on day 2 of storage. The pork luncheon roll formulated with 50 mg nitrite and 1.5% tomato had similar or enhanced sensory attributes compared to the luncheon roll containing no tomato and the high level of nitrite, resulting in a reduced nitrite enhanced pork luncheon roll product.

5. Opportunity/Benefit:

There is growing consumer and hence retailer interest in “clean” label foods and functional foods. The meat products sector is behind other sectors such as the dairy sector in supplying these needs. Furthermore meat products are perceived by many to be unhealthy due to their high fat, salt and artificial ingredients. This research has shown that healthier versions of traditional meat products such as sausages and pork luncheon roll can be produced that are just as acceptable to consumers as standard versions of the same products. There are opportunities for the meat industry to reduce the salt content of sausages to about 1.4% without affecting functionality or

flavour. Natural antioxidants such as grape seed extract or rosemary-pomegranate extract can be used in place of artificial antioxidants. Fat can be partially replaced by a prebiotic fibre such as inulin without affecting sensory attributes and a phytosterol ester which has positive associations with health can be incorporated. Finally, nitrite which also has a negative image but is essential for colour development can be partially replaced by tomato powder.

6. Dissemination:

Main publications:

Daly, T., Ryan, E., Aherne, S. A., O'Grady, M. N., Hayes, J., Allen, P., Kerry, J. P. and O'Brien, N. (2010). Bioactivity of ellagic acid-, lutein- or sesamol-enriched meat patties assessed using an in vitro digestion and Caco-2 cell model system. *Food Research International*, 43(3): 753-760.

Hayes, J.E., Stepanyan, V., O'Grady, M.N., Allen, P. and Kerry, J.P. (2010). Evaluation of the effects of selected phytochemicals on quality indices and sensorial properties of raw and cooked pork stored in different packaging systems. *Meat Science*, 2010, 85(2): 289-296,

Hayes, J. E., Stepanyan, V., O'Grady, M. N., Allen, P. and Kerry, J. P. (2010). Effect of lutein, sesamol, ellagic acid and olive leaf extract on the quality and shelf-life stability of packaged raw minced beef patties. *Meat Science*, 84(4): 613-620.

Hayes, J.E., Stepanyan, V., Allen, P., O'Grady, M.N. and Kerry, J.P. (2010). Evaluation of the effects of selected plant-derived nutraceuticals on the quality and shelf-life stability of raw and cooked pork sausages. *LWT - Food Science and Technology*, 2010, 44(1): 164-172,

Hayes, J. E., Allen, P., Brunton, N., O'Grady, M. N. and Kerry, J. P. (2011). Phenolic composition and in vitro antioxidant capacity of four commercial phytochemical products: Olive leaf extract (*Olea europaea* L.), lutein, sesamol and ellagic acid. *Food Chemistry*, 2011, vol. 126, no. 3, p. 948-955.

Hayes, J E; Canonico, I; Allen, P. Effects of organic tomato pulp powder and nitrite level on the physicochemical, textural and sensory properties of pork luncheon roll. (2013). *Meat Science*, 95(3) : 755-762.

Popular publications:

J.E. Hayes, P. Allen (2011). The effect of inulin as a prebiotic fibre on organoleptic and technological properties of standard and low fat pork breakfast sausages. *Proceedings: 57th International Congress of Meat Science and Technology*, Copenhagen, Denmark. (Oral Presentation).

J.E. Hayes, P. Allen (2011). The development of functional pork breakfast sausages containing flavonoid rich extracts: Sensory and technological impact. *Proceedings: 57th International Congress of Meat Science and Technology*, Copenhagen, Denmark. (Poster presentation).

J.E. Hayes, P. Allen (2011). Monitoring the effects of high pressure processing, salt levels and refrigerated storage on sensory and technological properties of pork sausages. *Proceedings: 57th International Congress of Meat Science and Technology*, Copenhagen, Denmark. (Poster presentation).

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