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Chen, Xiang; Ruiz Carrascal, Jorge; Karlsson, Anders H

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# Cheese powder can boost sensory properties of emulsion sausages

*By: Xiang, Chen[1], Jorge Ruiz-Carrasal [2] and Anders H. Karlsson[2]*
*[1] Wageningen University, Food Technology, 6708 Wageningen, Netherlands*
*[2]Dpt. Food Science, University of Copenhagen, Rolighedsvej 30, 1958 Frederiksberg C, Denmark*

**Abstract – Different types of cheese powder were added to standardized meat emulsion model sausages to investigate their influence on odor, flavor, texture, and aftertaste. The main results showed that a combination of hard and blue cheese powder strongly boosted saltiness. Furthermore, blue cheese powder enhanced meat flavor and aftertaste of sausages. Brown cheese powder enhanced umami taste. In conclusion, addition of cheese powder to sausage had positive effects by enhancing flavor. Moreover, salt content of sausage could be reduced by adding cheese powder with no negative effect on saltiness.**

**Key Words –meat flavor, saltiness, umami**

## INTRODUCTION

Nowadays, cheese is not only regarded as a part of meal or snack, but also it is used as an ingredient in food industry. Cheese powder, another modality of cheese, is used by the food industry as a natural functional and flavor booster ingredient in many applications, such as biscuits, savory snacks, bakery products, sauces, dressings, ready-to-eat-meals and processed cheese [1]. Cheese powder can impart cheese flavor to products by adding levels of 2–40% [2].

Emulsion-type sausages are widespread on the global market: hot dog, mortadella, bologna, liver sausage and frankfurters are typical examples. Salt is a vital ingredient in processed meat as it has numerous technological benefits such as preservation, taste enhancement and water binding [3]. However, there are indications that a high salt intake has a negative impact on health, and due to that, there have been numerous attempts to reduce salt content in meat products. The main challenge is finding ingredients that could enhance salty taste but do not negatively influence technological properties.

The aim of this study was to investigate if cheese powders could enhance flavor of emulsion sausage at a concentration low enough to avoid cheese flavor.

## MATERIALS AND METHODS

### Sausages preparation

Lactosan A/S provided the cheese powders. Lean meat and back fat was purchased at a local butcher. The formulas for the different types of sausages are shown in Table 1. Salt content was adjusted for each type of sausage considering the salt content of the different cheese powders.

Table 1 Formula of the different types of sausages[1].

| Ingredients | H | Bl | Cb | E | Br | Ct |
|---|---|---|---|---|---|---|
| Nitrite salt2 | 1.9% | 1.9% | 1.9% | 1.93% | 1.96% | 2% |
| Cheece powder | 2% | 2% | 2% | 2% | 2% | 0 |
| Caseinate | 0 | 0 | 0 | 0 | 0 | 2% |
| Lean Meat | 52% | 52% | 52% | 52% | 52% | 52% |
| Back fat | 10% | 10% | 10% | 10% | 10% | 10% |
| Ice | 33% | 33% | 33% | 33% | 33% | 33% |
| Phosphates | 0.5% | 0.5% | 0.5% | 0.5% | 0.5% | 0.5% |
| Photato flour | 0.44% | 0.44% | 0.44% | 0.44% | 0.44% | 0.44% |
| Ascorbate | 0.05% | 0.05% | 0.05% | 0.05% | 0.05% | 0.05% |

1 H=Hard cheese; Bl=Blues cheese; Cb=Combination of hard cheese powder and blue cheese powder; E=Emmental; Br=Brown; Ct=Control.
2 Nitrite salt containing 0.6% nitrite.

Lean meat was cut into 2 $cm^2$ cubes and subsequently minced. The minced meat was mixed with nitrite salt and phosphates and kept chilled overnight. The mixture was emulsified using a bowl chopper, and the rest of ingredients were added during the processing in the following order: either caseinate or cheese powder, potato flour, ascorbate and back fat. Ice was added during the process in order to keep a low temperature of the batter during chopping (never higher than 15°C). Spices were avoided in order to enable the potential detection of cheese flavor in the sausages.

The emulsification process took 4 min. Batters were stored in the fridge until stuffing into 4 mm diameter collagen casings. Sausages were placed into vacuum bags and stored under low vacuum in order to protect sausage casings from breaking. All sausages were cooked in a water bath at 75°C for 35 min, and immediately cooled down by immersion in a water-ice bath for 15 min. The cooked sausages were stored at 2°C until sensory evaluation.

Before sensory evaluation, sausages were reheated in a water bath at 65°C for 20 min, and they were kept in vacuum bags in the warm water until serving. Then, sausage casings were peeled off and the ends of the sausages were cut off. One cm thick slices were cut when for tasting. Each panelist tasted 2 slices from the same sausage. Samples were labeled by three random digit numbers and served in random orders.

### Sensory analysis

Before sensory evaluation, 10 experienced panelists recruited among the staff at Lactosan A/S attended 3 training sessions (1.5 hours per training session per week). Descriptive sensory analysis was used to evaluate the sensorial profile of the samples. 12 attributes were used for sensory evaluation, including odor (meat odor), flavor (saltiness, umami, sourness, sweetness, meat flavor, rancidity and aftertaste) and texture (hardness, juiciness, chewiness and fattiness). A 15 cm unstructured line scale with two anchors of 'extremely low' and 'extremely high' was used for assessing each attribute. Panelists marked on the scale the intensity for each attribute.

### Chemical composition

After sensory evaluation, samples were sent to chemical composition analysis. Salt content was analyzed by the ISO 5943 method based on determination of chloride content using a potentiometric titration method [4]. Water content was determined used the ISO 5537 method [5]. Protein content was determined following the Kjeldahl method [6]. Fat content was determined by Soxhlet [7].

### Statistics

Statistical analysis was performed using the software SPSS statistic (SPSS Ver. 20.0.0, IBM SPSS statistics, New York, NY, USA). A linear mixed model for analysis variance was applied to the sensory data, using samples as fixed factors and panelists as random facts. A 1-way ANOVA test with raw data of 18 samples (6 cheese powders*1 replicate*3 batches) was applied for chemical composition by using samples as factor. LSD (least significant difference) was applied for adjustment for samples comparisons of attributes. The significant different was defined when p value <0.05 and marked with *, followed with **: p<0.001 and ***: p<0.0001.

## RESULTS AND DISCUSSION

No differences in chemical composition were found between samples, indicating that samples showed stable quality among different batches and types. The results are shown in Table 2.

Table 2 Chemical composition of sausages (values are means ± SD). All parameters are expressed in % of fresh weight.

| Composition | CT | H | Bl | Cb | E | Br |
|---|---|---|---|---|---|---|
| Water | 72.00±0.82 | 70.97±0.31 | 71.00±0.35 | 71.00±0.80 | 71.40±0.36 | 71.20±1.05 |
| Salt | 2.13±0.06 | 2.13±0.23 | 2.00±0.10 | 2.10±0.10 | 2.10±0.10 | 2.13±0.06 |
| Protein | 13.20±0.61 | 13.47±0.29 | 13.20±0.72 | 13.10±0.52 | 13.00±0.46 | 12.80±0.56 |
| Fat | 11.10±1.04 | 12.17±0.95 | 11.77±0.06 | 11.20±1.13 | 11.10±0.36 | 11.10±0.72 |

Mean values for each evaluated sensory attribute of the 6 types of studied sausages are shown in Table 3. Sausages added Ct cheese powder had lowest values among sausages in most of attributes, except for sourness and sweetness.

Table 3 Mean scores of evaluated sensory attributes.

| Attribute | Ct | H | Bi | Cb | E | Br | SEM |
|---|---|---|---|---|---|---|---|
| Meatodor | 7.05 | 7.35 | 7.82 | 749 | 7.29 | 7.34 | 0.11 |
| Saltiness* | $6.81^{c1}$ | $7.16^{bc}$ | $7.36^{abc}$ | $7.80^{a}$ | $7.35^{abc}$ | $7.42^{ab}$ | 0.10 |
| Umami** | $6.23^{b}$ | $7.18^{a}$ | $7.07^{a}$ | $7.36^{a}$ | $6.97^{a}$ | $7.47^{a}$ | 0.12 |
| Sourness | 2.96 | 2.95 | 3.03 | 2.86 | 2.82 | 2.80 | 0.11 |
| Sweetness | 2.19 | 2.29 | 2.19 | 2.03 | 2.04 | 2.20 | 0.10 |
| Meat flavor* | $6.86^{c}$ | $7.58^{ab}$ | $7.70^{a}$ | $7.53^{ab}$ | $7.15^{bc}$ | $7.70^{a}$ | 0.10 |
| Rancidity | 1.13 | 1.25 | 1.57 | 1.34 | 1.48 | 1.34 | 0.07 |
| Hardness * | $5.91^{c}$ | $6.68^{ab}$ | $6.90^{a}$ | $6.32^{bc}$ | $6.40^{abc}$ | $6.44^{abc}$ | 0.17 |
| Juiciness | 6.17 | 6.58 | 6.67 | 6.52 | 6.22 | 6.97 | 0.11 |
| Chewiness | 5.47 | 5.92 | 5.98 | 5.76 | 5.58 | 5.72 | 0.13 |
| Fattiness | 5.67 | 5.95 | 5.91 | 6.16 | 5.95 | 5.78 | 0.16 |
| Aftertaste*** | $7.46^{a}$ | $8.12^{bcd}$ | $8.75^{a}$ | $8.37^{abc}$ | $7.59^{de}$ | $8.41^{ab}$ | 0.14 |

Different letters within a row indicate significantly different means (P<0.05) in the LSD test; SEM: Standard error of the mean.

Significant differences were found between batches for 5 attributes: saltiness, umami, meat flavor, hardness and aftertaste. Sausage containing Cb cheese powder had significant higher saltiness than those containing Ct and H, and sausages with added Br cheese powder also had significant higher saltiness than Ct sausages. For umami flavor, Ct sausages showed a significant lower value than all the other sausage types. For meat flavor, sausages containing Bl and Br cheese powders had the same value, which both were significantly higher than Ct sausages and sausages added E cheese powder; the values for sausages added with H and Cb powders were also significant higher than those for the Ct sausages. For aftertaste, sausages containing Bl cheese powder had significant higher values than H, E and Ct, and Br had significant higher value than E and Ct.

According to the above results, it could be inferred that adding cheese powder to sausages boosts the intensity of several important sensory characteristics. It resulted especially interesting that, although the salt content was quite alike in all batches, the intensity for saltiness showed an important increase of almost 15%. This clearly points out to a boosting effect of cheese powder on saltiness of emulsion sausages, which was one of the aims of this study.

From the different cheese powder that were tested, the Cb one showed the most intense boosting effect on saltiness, suggesting that combining different cheese powders could be an interesting way to boost this attribute. Further studies with a more mechanistic approach would potentially help to optimize the boosting effect of different combinations and proportion of cheese powders. Besides, cheese powder could also be applied in low-salt sausage, which may have positive effect on boosting its saltiness. Some kokumi peptides detected in cheese have shown boosting properties on saltiness [8].

Additionally, umami, which occurs in meat naturally [9], was found been boosted by cheese powders. Cheese powder, as a natural food ingredient, could be an effective umami booster for emulsion sausages. Such umami notes are most likely coming from the high amount of free amino acids and certain peptides in cheese powder [10].

The positive effect of adding cheese powder on the hardness of emulsion sausages was unexpected, since control sausages contained an equivalent amount of caseinates, which are supposed to be more functional than cheese powder in their ability to hold water or forming a gel. An instrumental analysis of texture would have helped to elucidate whether such an effect was a real effect on texture or a cross-modal interaction between senses.

Moreover, even though panelists were familiar with the flavor of pure cheese powders, they did not perceive any cheese flavor in the samples during the evaluations. This is surprising, since the model sausages were non-smoked, and with no added spices, resulting in a very mild flavor, so that the detection of abnormal flavors would be easier as compared to regular sausages. Therefore, this indicates that cheese powder could be used as a flavor booster in this type of meat products, allowing a reduction in salt content and without imparting cheese flavor to products.

Further studies should also consider the volatile compounds of sausages with added cheese powders, to address which compounds actually contribute to boost odor and flavor of sausages. Its combination of descriptive sensory analysis with specific odor and flavor attributes would allow obtaining an optimal composition of cheese powder mixture.

Also, in order to have a more realistic outcome, the formula should be improved in further studies in order to approach that of commercial sausages. For example, spices should be added into emulsion sausages to find if cheese powder could be perceived, if it boosts sausage flavor and to address the interaction with spices in such a complicate environment. Different raw meat types should also be considered. For example, chicken is milder than pork, and thus cheese powder could be an interesting ingredient for boosting chicken sausage flavor.

## CONCLUSION

Adding cheese powder to emulsion sausages appears as an interesting tool for boosting their flavor. Moreover, due to its potential effect on enhancing saltiness and meat flavor, cheese powder could constitute a useful ingredient for reducing salt content and improving meat flavor in meat products without compromising salty taste.

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