The effect of the addition of skin emulsion to the quality of cooked meat products

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Abstract

The consistency of meat products is an important qualitative feature. Additives that are not always acceptable to consumers are often used to alter consistency, for which reason the possible application of animal protein in the form of skin emulsion (SE) was tested. Two cooked meat products were used to test the application of skin (collagen) – standard quality grade ham (3 and 6% added SE) and choice liver pâté (5 and 10% added SE) – in which SE was applied as a meat substitute (instead of pork meat in hams and instead of skinned production pork in liver pâtés). Intensity of colour, aroma, toughness and saltiness were monitored by sensory analysis in all the products. Juiciness was also evaluated in hams and spreadability in liver pâtés. The results of the sensory analysis of both products showed no statistically significant differences, in contrast to the instrumental determination of texture and chemical analyses. Product colour became lighter and the intensity of red colour decreased in both products with increasing addition of SE, while the pH also fell in the hams. The collagen content in the hams increased, while in the liver pâtés collagen substituted for fat content with a corresponding increase in toughness.

Collagen, colour, consistency, ham, liver pâté, skin emulsion

Introduction

Production processes for meat products and the classification of raw ingredients were precisely defined in the past by the Czech National Standards that stipulated production and quality guidelines. A pronounced improvement has been seen in the range of products available with an increasing diversity of products, though product quality has fluctuated markedly. A decline in self-sufficiency in pork production and pressures felt by commercial entities relating to the price of final products, the availability of additives making products cheaper to produce and a tendency to fail to respect standards have all contributed to a tidal wave in the search for ways of making meat products cheaper and at all marketable. Not everyone has tried, or been able to maintain product quality at the original level. Most companies have been forced to make production cheaper with the use of various substitutes. Big companies have been forced to begin utilising raw materials that were previously used as secondary products in the meat industry such as skin, etc. Some secondary products have ceased to be used entirely, while a fundamental fall has been seen in the price of others (skin), for which reason producers have sought other uses for them. One example of the ways in which raw materials of lower quality have been utilised is the production of emulsions such as skin emulsions (SE). The addition of such materials has an effect on the resultant quality of the ready product. A significant proportion of the protein in skin is made up of collagen which is classed as a protein of reduced value as its composition lacks essential amino acids. However, one of the principal components of collagen that does not occur in any other protein is the amino acid hydroxyproline, which can be used to determine the collagen content present (Feiner 2006). The collagen content in pure skeletal muscle is not high, accounting for just 1 – 2%, whereas its content in skin is 15 – 25% (Brinckmann 2005; Velíšek and Hajšlová 2009).

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The number of studies about the skin addition in various forms is in the scientific literature extremely small. Choe et al. (2013) studied the addition of a mixture of pork skin emulsion and wheat fibre to frankfurter-type sausages as a substitute for fat. They aimed to reduce the energy value of the product by adding 20% of this mixture. They found that such a large addition resulted in a statistically significant increase to texture parameters – the toughness of the product, its gumminess and chewability ($P < 0.05$). Jandásek et al. (2009) conducted a test on ground products with the addition of 10, 20, 30, 40 and 50% pork skin emulsion. They subjected these products to sensory assessment that showed that the addition of up to 30% SE had a positive influence on the sensory quality of meat products, while the addition of more than 30% did not receive a favourable assessment. Valchař and Jandásek (2007) found merely a less pleasing colour in their sensory analysis of salami with 10% added SE in comparison with a control with no added SE.

Materials and Methods

This experiment studied the effect of the SE addition to the standard quality grade ham (3 and 6% SE) and choice liver pâté (5 and 10% SE) on analytical and organoleptic (sensory) parameters, in particular colour and texture. The skin emulsion was made in the standard way at a ratio of 1 : 2 (skin : water).

Preparation of the skin emulsion

Raw pigskins were hydrated for one day with the acid mixture Soft Skin Opti (Raps) under refrigerated conditions. The swollen skins were taken out of the brine, left to drip and subsequently weighed. The raw material in this experiment swelled by 5 kg and the amount of additional water required to achieve a 1 : 2 ratio was added in the form of ice (15 kg). The skins were then chopped at high speed until a temperature of 35 °C was attained. Half of the ice and the Neutra Opti neutraliser mix (Raps) were then added. The skins were then chopped again to a temperature of 20 °C, the remaining ice and a Nitrite curing salt (2%) added and chopped to 7 °C. The ready emulsion was cooled and frozen for standardisation and long-term storage.

Hams

The pork meat (S1) was homogenised using a “kidney” plate. The composition of the individual samples assessed was prepared according to Table 1. One kg of homogenised S1 was used for each production batch, to which 500 ml of brine composed of water, a Nitrite curing salt and the Cooked Ham mix of additives (phosphates, semi-refined carrageenan and sodium isoascorbate) for the production of ham was added. The raw material with additives was tumbled according to the procedure - 1 minute of tumbling followed by 2 minutes of rest repeated seven times. It was then filled in plastic wrapping of a diameter of 60 mm, left for 24 hours in a refrigerator and subsequently cooked. The product was cooled after internal temperature of 70 °C was attained for a period of 10 min. The preparation of samples of hams and liver pâtés and measurement were performed in two repetitions.

Table 1. Application recipe for the production of standard quality grade hams

Raw material / batch	Ham 1	Ham 2	Ham 3
Skin emulsion [%]	0	3	6
Skin emulsion [g]	0	30	60
Proportion of skin in skin emulsion [g]	0	10	20
Proportion of water in skin emulsion [g]	0	20	40
Pork meat (S1) [g]	1 000	970	940
Mix of additives [g]	17.5	17.5	17.5
Nitrite curing salt [g]	30	29.4	28.8
Water [g]	452.5	453.1	453.7

Liver pâtés

The raw material for production – liver, pork belly and pork meat – was first cut into small pieces and then placed in a desktop cutter and chopped at high speed. The loose ingredients, including the Nitrite curing salt, were then added. The mix was cut to a consistency as homogenous as possible and immediately filled into plastic

packaging 35 mm in diameter. Cooking took place in a water bath until an internal temperature of 70 °C was attained for a period of 10 minutes, after which the products were refrigerated. The composition of the individual samples assessed was prepared in accordance with Table 2.

Table 2. Application recipe for the production of liver pâtés according to PN MP 743/74 (Šedivý 1998)

Raw material / batch	Liver pâté 1	Liver pâté 2	Liver pâté 3
Skin emulsion [%]	0	5	10
Skin emulsion [g]	0	52.25	104.5
Skinned production pork [g]	520	467.8	415.5
Lean pork [g]	70	70	70
Pig liver [g]	400	400	400
Nitrite curing salt [g]	20	18.95	17.91
Dried milk [g]	30	30	30
Sugar [g]	1	1	1
Pepper [g]	0.7	0.7	0.7
Ginger [g]	0.2	0.2	0.2
Cinnamon [g]	0.15	0.15	0.15
Nutmeg [g]	0.15	0.15	0.15

Physicochemical analyses were performed on all samples of ham and liver pâté, and also on input raw materials – leg of pork (for ham production) and skin emulsion. The instrumental colour measurements of ready products were performed with a Konica-Minolta CM 600/700d spectrophotometer with the use of a D65 source. A reference drying method in a dryer with sand in accordance with the standard ISO/DIS – 1442 – 1993 was chosen for the determination of water in the raw materials and products. The Soxhlet method was used to determine the fat content. The principle of the method is the gravimetric determination of fat following extraction with a non-polar solvent. The total protein content was calculated from total nitrogen determined by the Kjeldahl method. The collagen content was found by spectrophotometric determination of 4-hydroxyproline and subsequent calculation. The pure muscle protein content (PMC) was then the difference between the total protein content and the collagen content. The pH measurement was performed in whole leg, skin emulsion and ready products using a piercing-tipped P112 Snail Instan pH-meter with a combined glass electrode. Product texture was measured on an INSTRON 5544 universal measuring device. The compression meter method (the sample pressed between the instrument's two plates) was used for the measurement of ham texture, while the penetrometric method (penetration of the sample with a probe) was used to measure the texture of the liver pâtés. Physicochemical analyses were performed on all samples of ham and liver pâté, and also on input raw materials – leg of pork (for ham production) and skin emulsion. Sensory analysis was performed on ready cooked meat products – hams and liver pâtés. Assessment was conducted in a special laboratory at the Faculty of Agrobiology, Food and Natural Resources at the Czech University of Life Science in Prague. A total of 43 trained assessors (31 women and 12 men) aged 22 – 49, of an average age of 29.8, took part in the assessment. The results were recorded on an assessment form with a hundred-point unstructured graphic scale. The products were judged in terms of pleasantness (hedonics) and intensity of impression. The vector was generally set from the left (less pleasant, less intense) to the right (pleasant, more intense). The program SAS 9.3 (2002) was used for statistical data evaluation and variance analysis used (ANOVA). The test criterion for evaluation of the influence of gender on sensory assessment was a paired T-test. The level of significance selected was ($P < 0.05$) in all cases (SAS 2002).

Results and Discussion

Physicochemical analyses

The measurement of colour was characterised by the values L*, a* and b*. A statistically significant increase in the value L* (lightness) was seen with the addition of SE in hams. The value a* (red colour) fell with the addition of SE. In this case, however, a statistically significant difference was seen only between ham with the greatest addition of SE (+ 6%) and the other two samples (+ 3% and

the sample without added SE). The lightness L* in the control sample differed from both samples with added SE in liver pâtés. A statistically significant fall in the coefficient of red colour a* was seen between the individual samples of liver pâté. Red colour was demonstrably most intense in the control sample with no added SE. Entirely different results were obtained by Choe et al. (2013) who state statistically significant differences with falling values of L*. Similarly for the value a*, they found contrasting results that were not, however, statistically significant. Valchař and Jandásek (2007) discovered merely reduced pleasantness of colour in their sensory analysis of salamis with 10% added SE in comparison with a control (without added SE). This difference was statistically significant. These results were not, however, confirmed by Jandásek et al. (2009) as no difference in colour intensity was recorded during their sensory assessment in spite of the fact that statistically significant analytic differences were found between products with varying amounts of added skin emulsion. The basic composition (water, fat and total protein content) was relatively stable. No statistically significant differences in these three parameters were recorded, even after the largest SE addition of 6% in hams and 10% in liver pâtés. The collagen content determined analytically ranged from 1.55 to 3.65% in hams and 3.65 to 4.77% in liver pâtés. The collagen content found in SE was 11.21%. The addition of SE was seen to have a statistically significant effect on the collagen content in hams. The highest collagen content was found in the sample with 6% added SE. A statistically significant difference was found in the falling average value for the content of pure muscle proteins in dependence on the addition of SE between samples with no added SE and with 6% added SE. The effect of increasing the collagen content by means of the addition of SE on the falling content of pure muscle protein has a fundamental effect in hams, primarily in relation to the observation of legislative requirements (Decree No. 264/2003). An irregular increase in collagen in connection with the addition of skin emulsion was also seen in liver pâtés, though this difference was not statistically conclusive. The resultant pure muscle protein content in ready hams, including hams with 6% added skin emulsion, corresponded to standard quality grade (a minimum of 10% pure muscle protein) (Decree No. 264/2003). The differences between the individual samples were statistically significant only between the sample with no added SE and the sample with the greatest amount of added SE (6% SE). A depiction of selected measured values in graphic form is given in Figures 1 – 4. The decrease in the pure muscle protein content in liver pâtés was similar as in hams, though the pure muscle protein content is not defined by the law in the case of liver pâtés. A statistically significant difference in pH value was seen in hams – the relatively low pH of SE (5.47) had the effect of lowering the pH in the samples of ham with the addition of increasing amounts of SE. This fact may have a fundamental technological influence on the binding capacity and consistency of the hams. A lower pH has a negative effect on these technological parameters (Feiner 2006; Kameník and Steinhauser 2012; Kameník 2014). The addition of skin emulsion was not seen to have a profound effect on the pH of liver pâtés due to their high fat and protein content. The measurement of texture in hams and liver pâtés in connection with the addition of SE did not demonstrate any statistically significant differences, in spite of the fact that a slight increase in the value of consistency (firmness, gumminess, chewability) was seen in hams with increasing added SE. The results obtained in this experiment correspond to the results of sensory analysis. In their study, Choe et al. (2013) found increasing values in the measurement of consistency in connection with the addition of skin. The given increase was statistically significant in all cases. Similar results have also been published by Valchař and Jandásek (2007) and Jandásek et al. (2009).

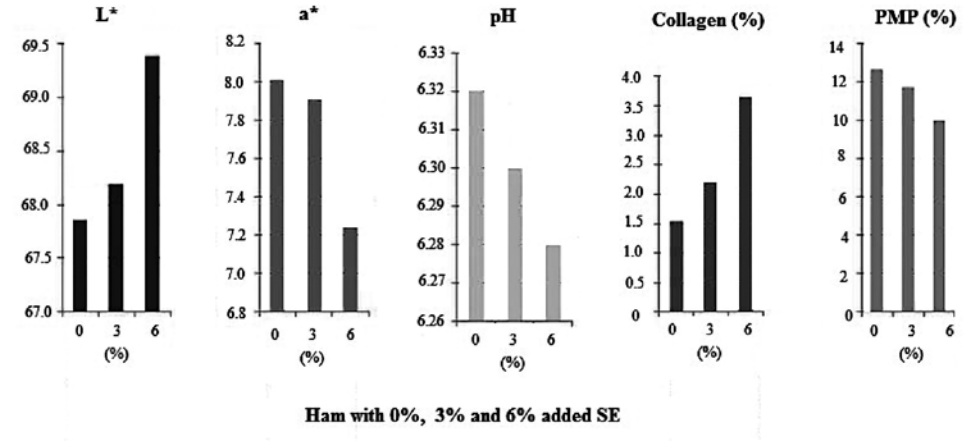

Fig. 1. Selected values of physico-chemical analyses of hams

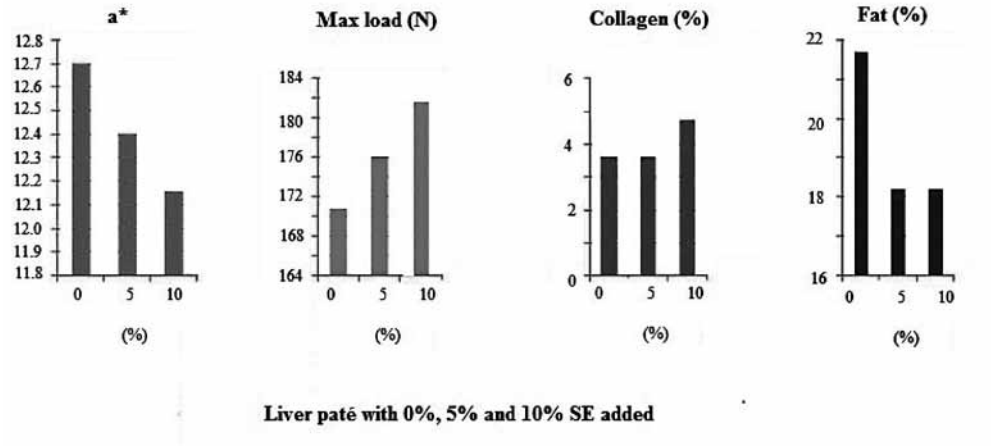

Fig. 2. Selected values of physico-chemical analyses of liver pâté

Sensory analysis

No statistically significant difference was found at a level of significance of ($P < 0.05$) in the sensory assessment of either hams or liver pâtés when comparing selected intensity descriptors (colour, aroma, toughness and saltiness, and also juiciness in hams and spreadability in liver pâtés) between products with no added SE and products with added SE. In many cases, the evaluators stated that they found no fundamental difference when assessing hams, though when assessing liver pâtés, 30% agreed on the optimal spreadability of the sample with 5% added SE. Choe et al. (2013) also found no statistically significant differences in colour, aroma, consistency and juiciness in their sensory assessment of

samples of frankfurter with 10, 15 and 20% added SE. Similar results have also been published by Jandásek et al. (2009) who state statistically insignificant differences in the sensory assessment of colour, aroma and texture in salamis in polyamide casing with 10% added SE. The gender of the assessors was also not found to have a statistically significant influence on their overall assessment during sensory analysis. These conclusions can be considered fundamental from the viewpoint of consumers, since the addition of a certain amount SE to hams and liver pâtés does not have such an effect on their sensory quality that consumers would greatly notice or that would influence product quality.

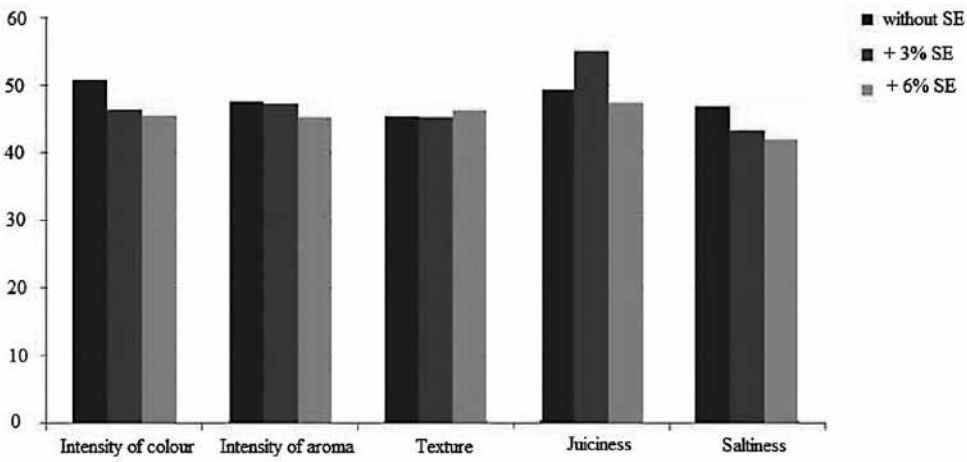

Fig. 3. Results of sensory assessment of hams using an unstructured 100-point graphic scale (intensity of colour / aroma – from weak to extremly intense; texture – perceived as toughness to bite, from soft to tough; juiciness – from dry to extremly juicy; saltiness – from low to extremly intense saltiness)

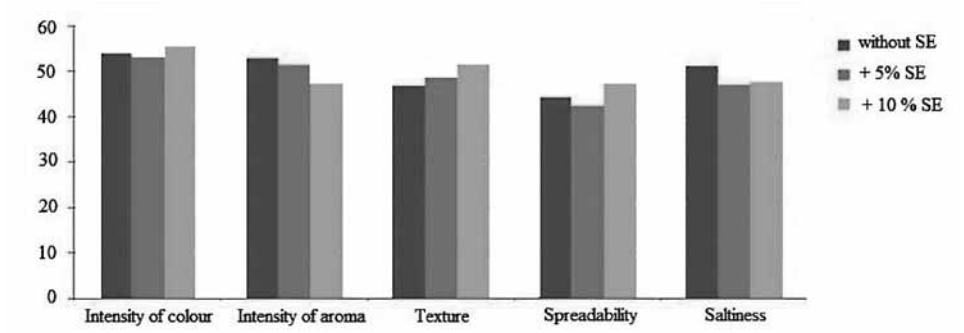

Fig. 4. Results of sensory assessment of liver pâté using an unstructured 100-point graphic scale (intensity of colour / aroma – from weak to extremly intense; texture – perceived as toughness to bite, from soft to tough; spreadability – from easy to spread on bread to unspreadable; saltiness – from low to extremly intense saltiness)

Conclusions

The addition of SE led to statistically insignificant improvement or worsening of the organoleptic properties of hams and liver pâtés. Statistically significant differences were

found only in the measurement of the quality (physicochemical) characteristics of hams and liver pâtés in terms of colour, pH, collagen content and pure muscle protein content. The absence of statistically significant differences in the sensory analysis of the selected parameters, in particular, points to the fact that the consumer is unable to clearly identify differences between products with no added SE and products with added SE. The addition of SE may, in contrast, be limited indirectly by the legislation by the definition of pure muscle protein. Particularly in hams in which the increasing addition of collagen leads to a reduction in the content of pure muscle proteins.

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