EFFECTS OF CARRAGEENAN AND OAT FIBRE ON THE QUALITY AND FLAVOUR OF LOW-FAT FRANKFURTERS

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Background/Objectives

Reducing the fat content in a food system can have detrimental effects on texture, binding properties, colour and mouthfeel (Claus & Hunt, 1991; Keeton, 1992). Furthermore, fat plays an important role in establishing a product's taste profile (Goutefongea & Dumont, 1990; Mela, 1990, 1992; Bennett, 1992; Lucca & Tepper, 1994). The carbohydrate gum, carrageenan (E407) is used as a stabiliser or gelling agent. It can be added to meat products to enhance water holding capacity and decrease cook losses (Jensen, 1994) and has been used extensively in meat emulsion products (Foegeding & Ramsey, 1987; Hoegh, 1991; Cofrades *et al.*, 1995; Hughes *et al.*, 1995 and Matulis *et al.*, 1995). Other fat mimetics include proteins and dietary fibre (Goutefongea & Dumont, 1990). The latter has been used previously in meat emulsion products (Claus & Hunt, 1991; Cofrades *et al.*, 1995; Hughes *et al.*, 1995). It retains water and can decrease cooking losses. In addition, it has a neutral flavour. Furthermore, it has been claimed that oat fibre provides a similar mouthfeel to fat and retains the natural flavours of meat (Anon, 1991). The objectives of this study are to examine the effect of two fat replacers, carrageenan and oat fibre, on the quality and flavour of low-fat frankfurters.

Materials and Methods

Nine different frankfurter formulations were prepared in two separate trials. In the reduced-fat products, water was added to replace the fat to ensure the same protein level in all formulations. Two low-fat (5% and 12% fat) and one full-fat (30% fat) products were prepared. Carrageenan (1%) and oat fibre (2%) were added separately to these emulsions. Controls, without carrageenan or oat fibre, were also prepared to give a total of nine treatments. For each product, moisture, fat and protein were determined (Bostian *et al.*, 1985; Sweeny & Rexford, 1987). The internal colour of the cooked frankfurters was measured using a dual beam xenon flash spectrophotometer (UltraScan XE, Hunterlab). Cook loss, water holding capacity and emulsion stability were also determined. An 8-member trained panel was used to determine flavour differences between the frankfurters. Attributes were evaluated using a 6-point hedonic scale (6= extremely smoky, extremely spicy, extremely salty, extremely intense, extremely acceptable and extremely oily). The trial was performed twice and the data from both was combined prior to statistical analysis. Results of experiments were compared using one-way analysis of variance and the means were compared using a multiple range test using Statgraphics.

Results and Discussion

Proximate analysis indicated that the fat levels in the cooked products were close to the predicted values of 5, 12 and 30% fat. Cook losses decreased and water holding capacity and emulsion stability increased with increasing fat level. This has been reported previously for a variety of meat products (St. John *et al.*, 1986; Marquez *et al.*, 1989; Claus *et al.*, 1989, 1990; Eilert *et al.*, 1993; Mittal & Barbut, 1993; Paneras & Bloukas, 1994). In the present study, the addition of carrageenan and oat fibre significantly improved cook losses, water holding capacity and emulsion stability of the reduced-fat products. Carrageenan, in particular, performed well at both low-fat levels. The internal colour of the cooked products was affected by the fat level but the addition of carrageenan did not influence the lightness, redness or yellowness ('L', 'a' or 'b' values) of the frankfurters. This is in agreement with previous studies (Marquez *et al.*, 1989; Barbut & Mittal, 1992; Mittal & Barbut, 1993, 1994; Eilert *et al.*, 1993). However, a decrease in the redness and an increase in the yellowness of the 5% fat products was observed in the presence of oat fibre. Similar results were recorded for bologna with 3.5% added oat fibre (Claus & Hunt, 1991). Panellists did not detect significant differences in mouthfeel or saltiness between treatments (Table 1). This supports recent findings that moisture and fat concentrations appear to have limited effects on the perceived saltiness of frankfurters (Matulis *et al.*, 1995). In addition, panellists were unable to detect any increase in "other" flavours in the products containing either carrageenan or oat fibre (Table 1). In previous studies, no differences in foreign flavours were observed in frankfurters formulated with different levels of fat and carrageenan (Yang *et al.*, 1995). Significant differences were detected in smoke and spice intensity and in the overall acceptability (of flavour) depending on the treatment (Table 1). Frankfurters containing 5% fat were considered more smoky and more spicy than the full-fat products. Increases in spice flavour in low-fat frankfurters (Yang *et al.*, 1995) and in low-fat varieties of Norwegian sausage (Solheim, 1992) compared with the full-fat controls have been reported previously. This is in contrast to studies by Matulis *et al.*, (1995) which indicate that, at fat levels greater than 5%, the influence of fat on flavour intensity appears to be minimal. In the present study, the addition of either oat fibre or carrageenan to the low-fat products did not significantly alter their flavour profile (Table 1). Panellists were also asked to score the products for overall acceptability of the flavour (Table 1). The flavour was found to be similar in the controls, i.e., 5, 12 and 30% fat levels. This implies that 'frankfurter flavour' is not affected by the *amount* of fat present, i.e., the same *type* of flavour was detected in both high- and low-fat products. This is confirmed by Gas Chromatography-Mass Spectroscopy which shows that there are no differences in the type of flavour compounds detected in either the low- or full-fat products (Chevance, personal communication). These results support the suggestion by Eilert *et al.* (1993) that fat can be reduced in frankfurters without influencing the flavour. However, the current study indicates that fat level is a critical factor in the release of

flavour (i.e., the perceived intensity of flavour) from low-fat frankfurters. This hypothesis is supported by the fact that panellists were unable to find differences in flavour between low- and high-fat products but were able to detect significant differences in flavour intensities between the treatments (Table 1).

Table 1 The effect of carrageenan (1%) and oat fibre (2%) on the flavour of frankfurters containing 5, 12 and 30% fat. Values are means of 32 replicates. $^{a-d}$ Means bearing the same letter in individual columns are not significantly different ($P<0.05$). Cgn = Carrageenan; OF = Oat Fibre.

Treatment	Smokiness	Spiciness	Saltiness	'Other' flavours	Mouthfeel	Acceptability
5% Fat Control	4.3 *d*	4.5 *d*	3.2 *a*	2.0 *a*	3.4 *a*	3.6 *abc*
5% Fat + Cgn	4.0 *bcd*	4.4 *d*	3.0 *a*	2.1 *a*	3.0 *a*	3.3 *ab*
5% Fat + OF	4.2 *cd*	4.1 *cd*	2.5 *a*	2.3 *a*	3.1 *a*	3.1 *a*
12% Fat Control	3.7 *bcd*	3.8 *bc*	2.9 *a*	1.8 *a*	3.2 *a*	3.9 *bcd*
12% Fat + Cgn	3.6 *abc*	3.5 *ab*	2.7 *a*	1.8 *a*	3.2 *a*	3.9 *bcd*
12% Fat + OF	3.6 *bc*	3.8 *bc*	2.6 *a*	2.0 *a*	2.8 *a*	4.0 *cd*
30% Fat Control	3.5 *abc*	3.2 *a*	2.6 *a*	2.3 *a*	3.3 *a*	3.8 *bcd*
30% Fat + Cgn	3.1 *a*	3.3 *ab*	2.3 *a*	2.0 *a*	3.0 *a*	3.8 *bcd*
30% Fat + OF	3.5 *ab*	3.4 *ab*	2.7 *a*	1.9 *a*	3.2 *a*	4.3 *d*

Conclusions

Reducing the fat level in frankfurters decreased the quality of the products. In addition, low fat frankfurters were considered more smoky and more spicy than the full-fat controls. The addition of carrageenan or oat fibre improved the water holding capacity and emulsion stability and both additives significantly decreased cook losses from the low-fat products. However, neither ingredient produced frankfurters with similar quality characteristics to the full-fat controls. At the levels of addition used in this study, panellists were unable to detect the ingredients in the products. Neither ingredient was successful in reducing the intensity of smoke and spice flavour in the low-fat products compared with the full-fat controls.

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