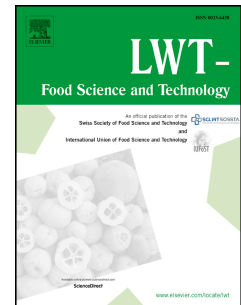| Title	Interaction of salt content and processing conditions drives the quality response in streaky rashers
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Interaction of salt content and processing conditions drives the quality response in streaky rashers

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1 **Abstract**

2 Response surface methodology was utilised to explore the relationship between processing

3 conditions, including cooking temperature and drying time, and ingredients in reduced-salt

4 streaky rasher formulations. The goal of this project was to assess the impact of reducing salt

5 content on physicochemical and sensory properties. Salt levels above 2.44 g/100 g did not

6 affect cooking loss. Cooking temperature (240°C) was negatively correlated with lightness

7 and redness, n-3 fatty acids, and sensory acceptance, and positively correlated with hardness

8 and monounsaturated fatty acids. Salt content was highly correlated with perceived saltiness

9 and both were identified as negative attributes by the sensory panel. Results indicate that

10 optimised reduced-salt streaky rashers with acceptable technological and sensory

11 performance could be achieved under the following conditions: 2 g/100 g salt, 94 min of

12 drying and grilling at 190°C.

13

14 **Keywords:** Salt reduction, bacon, response surface methodology, sensory, multiple factor

15 analysis

1. Introduction

Bacon, originally developed as a method for pork preservation, has become an economically important portion from the pig carcass (Sheard, 2010; Soladoye, Shand, Aalhus, Gariépy, & Juárez, 2015). While in countries like the United Kingdom and Ireland, the most popular bacon product is back bacon (from cured pork loin), elsewhere in Europe and North America, streaky rashers (from cured pork belly) are the most widely available (Sheard, 2010).

The overconsumption of meat products have been related to several diseases, including cardiovascular disease (CVD), obesity, type 2 diabetes and cancers of multiple organs (Klurfeld, 2015). Excessive salt content and some saturated fatty acids have been tagged as the unhealthy components of meat products. Sodium—with salt being the main dietary source of this mineral—increases blood pressure, and a reduction in the diet of hypertensive people leads to blood pressure reduction and thus, less risk of CVD (Cook, Appel, & Whelton, 2016; Mozaffarian et al., 2014). On the basis of this evidence, numerous countries, under the World Health Organisation policies, have adopted strategies for dietary salt reduction (Trieu et al., 2015). The Food Standards Agency from UK (FSA) and the Food Safety Authority of Ireland (FSAI) have agreed guidelines for the meat industry in order to reduce the salt content of different meat products. The agreed targets for bacon products are 2.88 g salt /100 g product.

The primary approach for developing reduced-salt meat products is based on salt substitution and/or inclusion of flavour enhancers (Desmond, 2006). Nonetheless, the increasing market shift towards clean label food products makes necessary the search for novel salt alternatives. We can define strategies aligned with this goal based on approaches such as use of herbs and spices, flavourings from plant origin, varying fat levels, and the application of high pressure, among others (Fellendorf, O'Sullivan, & Kerry, 2017; Saricoban, Yilmaz, & Karakaya, 2009; Viuda-Martos, Ruiz-Navajas, Fernandez-Lopez, & Perez-Alvarez, 2011; Yang et al., 2015).

40   All of these strategies can be easily applied to comminuted meat products, but not all are

41   technically feasible in whole-muscle cured products.

42   Processing variables, such as cooking and drying conditions, can affect the physicochemical

43   properties, fatty acid composition and sensory acceptance of meat products (Alfaia, Lopes, &

44   Prates, 2013; Gou, Comaposada, & Arnau, 2003; Sánchez del Pulgar, Gázquez, & Ruiz-

45   Carrascal, 2012). Response Surface Methodology (RSM) has been widely used by meat

46   scientists as an effective tool to examine the interactions of processing conditions and

47   formulation levels to determine quality, and can also permit optimisation through maximising

48   and minimising specified technological outcomes (Lowder et al., 2013; Resconi et al., 2015;

49   Saricoban et al., 2009).

50   In this study we aimed to deepen the understanding of the relationship between processing

51   conditions (drying time and cooking temperature) and quality in streaky bacon rashers, and

52   evaluate if processing conditions can be defined which permit salt levels to be reduced to

53   meet or better the aforementioned guidelines without affecting the physicochemical and

54   sensory characteristics.

55

56   **2. Materials and Methods**

57   **2.1. Experimental design**

58   A split-plot D-optimal point exchange RSM experiment was designed using Design Expert

59   v10 (Stat Ease Inc., USA) generating a total of 14 runs (Table 1). Three numerical factors

60   were included in the design: salt content (g/100 g), drying time (min) and cooking

61   temperature (ºC). Minimum and maximum levels were: 2 to 2.88 for salt, 60 to 120 min for

62   drying time and two discrete values for cooking temperature 190℃ and 240℃, as

63   intermediate values proved not to be meaningful in previous experiments. Two additional

64 model groups were included generating 5 additional model points. The whole experiment was

65 replicated twice and the means for each run were used for the statistical study.

66

67 **2.2. Streaky rashers processing**

68 Fourteen pork bellies were purchased from a meat supplier (Rosderra Irish Meats, Edenderry,

69 Ireland) and transported to the meat processing facility at Teagasc Food Research Centre

70 Ashtown. Three different brines were prepared with varying levels of salt (Table 1) and 150

71 ppm of sodium nitrite. Maximum salt level of 2.88 g/100 g was selected as in line with the

72 recommendations from both The Food Standards Agency from UK and the Food Safety

73 Authority in Ireland for this type of products. Each belly was cut in half and was randomly

74 assigned to a different formulation; hence, each of the fourteen runs was repeated. The half-

75 bellies were pumped to 113 % of their green weight using a 20-needle brine injector (Inject-

76 O-MAT type PSM-21, Dorit Maschinen, Handels AG, Switzerland). The injected bellies

77 were weighed, vacuum packed and left to mature at 0-4 °C for 48 h. After the maturing stage

78 the bellies were dried at 55 ºC for the respective time according to each formulation (Table

79 1). The bellies were cooled, weighed again, and chilled up to -5 ℃ when they were sliced

80 (3mm). The streaky rashers were cooked on an electric grill (Velox Grill CG-3.71, Velox

81 Ltd., Wantage, UK) for 2 min each side at the designated temperature (Table 1), left to cool

82 down and weighed again. The cooked slices were then vacuum packed and stored at 2±1 °C

83 for future analysis.

84

85 **2.3. Physicochemical properties**

86 Samples were homogenised in a Robot Coupe (R101, Robot Coupe SA, France). Fat and

87 moisture were determined using the Smart System 5 microwave and NMR Smart Trac rapid

88 Fat Analyser (CEM Corporation USA) using AOAC Official Methods 985.14 & 985.26.

89 Protein concentration was determined using a LECO FP328 (LECO Corp., MI, USA)

90 according to AOAC method 992.15,1990. Salt was determined by titrating chloride anions in

91 ashed (by furnace) samples with silver nitrite using the Mohr method (Vogel, 1961). pH was

92 measured in the brines, green muscle, dried muscle and cooked samples. All these analyses

93 were performed in at least duplicates. Cook loss was calculated from the initial and final

94 weight before and after cooking of at least six slices per formulation. Shear force (N) was

95 assessed on streaky bacon cooked rashers using an Instron Universal Testing Machine with a

96 Warner-Bratzler shear force cell at a crosshead speed of 5 cm/min. Colour was analysed

97 using a Ultrascan XE spectrophotometer (CIE L*a*b system) on the lean part of the rasher.

98

99 **2.4. Fatty acid analysis**

100 Fat was extracted from samples and methyl esters of fatty acids were prepared by base-

101 catalysed trans-esterification methodology (Christie & Han, 2012). The fatty acid methyl

102 esters were analysed using gas chromatography with flame ionization detector (GC-FID) in

103 accordance with a UKAS accredited methodology (Cam Nut003) as in Kirk and Sawyer

104 (1991). Samples were analysed in duplicate and results were expressed as percentage of total

105 fat.

106

107 **2.5. Sensory analysis**

108 The sensory acceptance test was conducted using untrained panellists (n = 24, 14 females) in

109 the age range of 21–65 following the same approach as in Delgado-Pando et al. (2018). The

110 twenty four panellists (14 female) were asked to evaluate on a 9-point hedonic scale the

111 following attributes: liking of appearance, texture, flavour and overall acceptability. The

112 assessors then participated in a ranking descriptive analysis (RDA) using a list of sensory

113 attributes (crunchiness, saltiness and meaty flavour) measured on an intensity line scale

114 (Richter, de Almeida, Prudencio, & de Toledo Benassi, 2010). Due to the great amount of

115 samples to test and to avoid sensory fatigue, the sensory analysis was split in four different

116 sessions according to a balanced incomplete block design. Each panellist assessed each

117 sample twice, in both the hedonic and RDA tests.

118

119 **2.6. Statistical Analysis**

120 Statistical analysis of physicochemical and sensory properties was performed using Design

121 Expert software. Pearson correlations were calculated using "Hmisc" package in R studio

122 (Harrell & Dupont, 2016; R, Core Team 2015). Sensory and instrumental data were also

123 analysed using FactomineR and factoextra packages (Kassambara & Mundt, 2017; Le, Josse,

124 & Husson, 2008) by means of a multiple factor analysis.

125 **3. Results and Discussion**

126 **3.1. Physicochemical properties**

127 Variations in the levels of cooking temperature, drying time and salt content affected the

128 physicochemical properties of the streaky rashers.

129 As expected, cooking temperature significantly affected moisture, protein and fat content

130 (Table 2). Moisture ranged between 19.6-33.5 g/100 g, protein between 25.6-39.2 g/100 g

131 and fat between 30.0-45.8 g/100 g. In the case of moisture, the higher the temperature the

132 lower the water retained in the sample. However, a significant interaction between salt and

133 drying time was also observed. The maximum content of moisture appeared at the longest

134 drying time (120 min) and from salt content ≥2.5 g/100 g (Fig. 1a,b). Salt impact on moisture

135 content was more significant at higher drying times, the more salt the higher the moisture

136 after cooking. During the drying process first stage, water losses are expected to be rapid,

137 because of the evaporation from the surface, but as time passes the resistance to moisture

138   movement becomes higher. According to Gou et al. (2003) the binding strength between

139   water and the meat matrix increases as the moisture decreases. The same authors also

140   concluded that the effect of salt on moisture increased with drying time during the process of

141   dry-cured pork ham; the higher the salt content the higher the moisture. In the case of the

142   protein content the model was not significant (Table 2) and only the cooking temperature had

143   a significant increasing impact (Fig. 1c). Fat content was also significantly affected by

144   cooking temperature, but in an opposite way (Table 2); it was lower with increasing cooking

145   temperature. On the other hand, drying time was a significant factor too, the higher the drying

146   time the lower the fat content after cooking (Fig 1d,e). Moisture reduction and protein

147   concentration was reported on different pork roast with increasing end-point temperature

148   (Heymann, Hedrick, Karrasch, Eggeman, & Ellersieck, 1990). Fat and moisture had a

149   significant and negative correlation with protein, -0.53 and -0.68 respectively. Moisture and

150   fat were released as a result of drying and cooking, increasingly affecting the protein

151   concentration.

152   Streaky rashers had a mean salt content of 4.62 g/100 g, with 3.56 g/100 g the lowest and

153   6.37 g/100 g the maximum. As expected, the higher the initial salt concentration the higher its

154   final salt concentration after cooking. The drying time also affected the final salt

155   concentration as can be seen in the contour figure (Fig 1e,f); the maximum appeared after

156   90 min of drying but significantly varied depending on the initial salt level and cooking

157   temperature. Generally, as the drying time increased the effect of the cooking temperature

158   increased, final salt content was higher at 240 ºC than at 190 ºC (Fig 1e,f).

159   Cooking loss ranged from 50.1-59.3 % and was affected by the three studied parameters. A

160   high salt level and drying time and lower cooking temperature exerted the minimum losses.

161   Even though salt was the main parameter influencing cooking loss, between 2.44-

162   2.88 g/100 g the impact was minimal (Fig 2). Within this salt range, the effect of drying time

163   became more important and below that the cooking temperature showed a bigger effect. In

164   agreement with the results of moisture composition, the longer the drying time the lower the

165   cook loss as water got more bound to the meat matrix. Cooking loss was significantly

166   correlated with final protein content (0.71) and negatively with moisture (-0.74). From these

167   results and Fig. 2 we could infer that an initial salt level above 2.44 g/100 g was enough to

168   maintain the cooking loss values irrespective of the drying and cooking conditions under

169   study. In sausages, it has been reported a salt level at around 1.5 g/100 g as the minimum to

170   prevent negative functional properties (Aaslyng, Vestergaard, & Koch, 2014; Ruusunen et al.,

171   2005). Several authors have reported increases in cooking loss when reducing the salt content

172   in different meat products (Puolanne, Ruusunen, & Vainionpää, 2001; Ruusunen et al., 2005;

173   Tobin, O'Sullivan, Hamill, & Kerry, 2013).

174   The texture of the cooked streaky rashers was measured by means of shear force (N/g). This

175   parameter was primarily affected by cooking temperature and initial salt content, whereas

176   drying time effect was not significant (Table 2). Important differences appeared when

177   varying these parameters, the lowest shear force (8.77 N/g) was recorded in the sample with

178   highest salt level and lowest cooking temperature and drying time, while the maximum

179   (22.59 N/g) appeared at the lowest salt content and highest cooking temperature and drying

180   time. As mentioned earlier, salt is related to the water holding capacity (WHC) of meat as the

181   chloride ions are thought to be responsible for the swelling of the myosin shaft and thus

182   increasing its WHC; on the other hand, the sarcomere length of the meat is known to decrease

183   with increasing cooking temperature (Ertbjerg & Puolanne, 2017). Reductions in WHC and

184   sarcomere length (low salt and high temperature), along with the protein denaturation, are

185   then related to an increase in the hardness (as measured by shear force) of the meat.

186   The response surface models for the colour parameters were not significant, although the

187   effect of cooking temperature was significant for lightness and redness (Table 2). The streaky

188 rashers appeared darker and less red with increasing cooking temperature. The effect of

189 cooking conditions on colour is complex because of the biochemical changes in the muscle

190 pigments (myoglobin and haemoglobin) but also the Maillard reactions occurring at

191 temperatures above 140 ºC. As the temperature increases the meat gets drier, the myoglobin

192 degrades and gives more greyish-brown pigments and Maillard reactions will be more

193 numerous giving a darker and less red colour. Accordingly, lightness and redness values of

194 streaky rashers were significantly and negatively correlated (-0.84, -0.53) with the protein

195 content. Similarly, Sánchez del Pulgar et al. (2012) and Oz and Celik (2015) found

196 decreasing L* and a* values with increasing cooking temperature in pork chops and goose

197 meat, respectively.

198

199 **3.2. Fatty acid composition**

200 Fatty acid composition of cooked streaky rashers was analysed, average results were

201 calculated as a percentage of total fat and the response surface models were calculated (Table

202 3). The main components of the lipid profile of the streaky rashers observed were oleic acid

203 (31.5-36.6 %), palmitic acid (23.1-25.0%), linoleic acid (12.9-17.6%) and stearic acid (11.2-

204 13.1%), in accordance with existing literature of fat from pork traits (Douny et al., 2015; Li et

205 al., 2016). The processing conditions significantly affected the concentration of some of the

206 fatty acids (Table 3). None of the individual saturated fatty acids (SFA) was significantly

207 affected by any of the studied parameters, and thus the surface response models for total or

208 individual SFA were not significant. Variation in SFA within the different rashers was low

209 (36.6-39.5 %) with palmitic and stearic acids accounting for almost 95 % of the total SFA.

210 Similarly, no differences in fatty acid composition were observed when comparing grilling,

211 microwaving and boiling in beef muscle (Alfaia et al., 2013). However, Li et al. (2016)

212 observed higher quantities of SFA in stewed pork bellies when compared with pre-fried and

213 stewed ones.

214 Total monounsaturated fatty acids (MUFA) concentration ranged between 34.7 %- 40.0 %

215 and were mainly oleic (>90%) and palmitoleic acids (>5%). Oleic acid and total MUFA

216 significantly increased with cooking temperature (Table 3). In pork patties, MUFA

217 significantly increased when pan-fried as compared to an electric grill (Salcedo-Sandoval,

218 Cofrades, Ruiz-Capillas, & Jiménez-Colmenero, 2014) but this could be attributed to the

219 transference of MUFA from the frying oil to the piece of meat. Heymann et al. (1990)

220 observed an increase of oleic and palmitoleic acids with increasing endpoint temperatures in

221 different pork roasts.

222 Total content of polyunsaturated fatty acids ranged from 14.0 %-20.8 %, where linoleic acid

223 accounted for more than 85 %. Surprisingly, the response surface models for PUFA were not

224 significant and only a trend (p=0.08) was observed where the PUFA content decreased with

225 increasing cooking temperature. Douny et al. (2015) found that the PUFA fraction of pork

226 meat was affected by the cooking type, being higher when cooked in a pan as opposed to

227 oven cooking. Conversely, Turp (2016) found no significant differences in fatty acid

228 composition between oven, grill and pan cooked Turkish beef meatballs. n-3 fatty acids

229 concentration ranged from 1.4 %-2.2 % and were significantly affected by the cooking

230 temperature, the higher the temperature the lower the n-3 concentration (Table 3). Alpha

231 linolenic acid accounted for more than 80 % of the total observed n-3 while eicosatrienoic

232 acid (ETA) around 10 %. This fatty acid, ETA, was the only one significantly affected by the

233 drying time, and with a significant interaction of salt and cooking temperature. Low salt

234 content and high drying time at 190 ºC gave the highest values. After linolenic acid, ETA is

235 the main source of n-3 fatty acids in pork fat, has been shown to promote eicosanoid

236 precursors of long chain n-3 fatty acids and has also exhibited a photo-protective effect in

237 human skin (Dugan et al., 2015). The results demonstrate that through altering the processing

238 conditions, it is possible to achieve higher quantities of n-3 fatty acids, specifically ETA, and

239 hence improve the healthier lipid fraction of the rashers.

240 Discrepancies in the effect of cooking on the fatty acid fraction can be attributed to the type

241 of cooking, total heating time, different cut and animal species (Alfaia et al., 2013). In

242 general, the cooking temperature was the main factor affecting some of the lipids from the

243 streaky rashers, with salt having no significant effect and the drying time only on ETA. This

244 temperature effect could be partially attributed to the fat concentration and retention of

245 specific fatty acids.

246

247 **3.4. Sensory Analysis**

248 Response Surface models were tested for the seven sensory attributes (liking of appearance,

249 texture, and flavour, overall acceptability, crunchiness, saltiness and meaty flavour) but only

250 three of them had any significant term (Table 4). Streaky rashers with the highest salt content

251 were preferred in flavour when lower drying times were applied and for rashers with the

252 lowest salt content medium drying times (~90 min) were scored the highest in flavour (Fig.

253 3). As expected, the cooking temperature significantly affected the crunchiness of the

254 samples, the higher the temperature the higher the score for this attribute. In general,

255 panellists were able to perceive the differences in saltiness according to the formulation as in

256 the model we can see the significance of this factor (Fig 3).

257 In order to delve into the correlation between the sensory characteristics and the

258 physicochemical properties, a multiple factor analysis (MFA) was performed. MFA helps to

259 analyse several data sets measured on the same observations. In our case, we structured our

260 data set into one supplementary and three active groups: formulation (salt content, drying

261 time and cooking temperature) as supplementary, hedonic characteristics (liking of

262 appearance, texture, flavour and overall acceptability), intensity characteristics (crunchiness,

263 saltiness and meaty flavour) and instrumental properties (cook loss, shear force and colour).

264 Most of the variables were highly correlated to the first dimension irrespective of the active

265 group they belong to (Fig. 4). Nonetheless, whereas hedonic and instrumental colour

266 attributes were positively correlated, cook loss crunchiness and shear force do correlate with

267 first dimension negatively. Saltiness intensity and liking of flavour were more correlated with

268 the second dimension, although in an opposing way. Attending to the supplementary group,

269 we can clearly observe that both drying time and salt content are associated with perceived

270 saltiness and that cooking temperature relates to an increase of cook loss, shear force and

271 perceived crunchiness. With regards to the individual plot (Fig. 5) we can see that is not the

272 high salt samples but some of the medium and low salt the ones that are correlated with

273 positive liking attributes. In addition, with the exception of sample S8, samples cooked at

274 190°C were positively correlated with the first dimension and thus with positive hedonic

275 scores and higher instrumental colour. As mentioned earlier, temperature plays a role in the

276 Maillard reactions, generating some desirable flavour compounds, but high temperatures can

277 also degrade the proteins into peptides and amino acids contributing to sour, umami and bitter

278 taste and also undesirable burnt off-flavours (Alfaia et al., 2013; Hilmes & Fischer, 1997).

279

280 **3.5. Optimisation of responses using RSM**

281 Using the optimisation module of the RSM software and with the selection criteria of

282 minimising salt content, shear force and cooking loss, and maximising the flavour preference,

283 the optimised sample will be that with 2 g/100 g initial salt level, 94 min of drying time and

284 grilled at 190 °C. This solution generated the highest desirability value (0.648). The

285 optimised sample was manufactured and assessed for the physicochemical characteristics,

286 obtaining a salt content of 3.9 g/100 g, a shear force of 16.1 N/g and a cooking loss of

287 52.8 %. Compared to the predicted values the differences were: +0.4 in salt and shear force

288 values and +1.5 in cook loss.

289

290 **4. Conclusions**

291 This study confirmed the relevance of the processing conditions on the physicochemical and

292 sensory properties of streaky rashers. Despite the importance of salt level in manufacturing

293 streaky rashers—and any other meat products—this level should be re-evaluated as our

294 results showed that lower salt concentrations are preferred and technically feasible. When

295 evaluating a product that needs to be cooked before consumption, the cooking temperature,

296 frequently neglected, should be taken into consideration. In our case, the use of lower

297 temperatures increased the sensory acceptance, the tenderness and the PUFA levels of the

298 streaky rashers irrespective of the salt level. Cooking temperature also doubled the initial salt

299 content and should be a piece of information to consider disseminating when labelling the

300 product. The use of RSM proved to be a helpful tool in evaluating the optimal processing

301 conditions of streaky rashers.

302

303 **Acknowledgements**

307

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418

Figure Captions

Figure 1. Response surface model for moisture (g/100 g) (a, b), fat (g/100 g) (c), protein (g/100 g) (d) and final salt content (g/100 g) (e, f) in streaky rashers. The remaining factors were fixed as follows: a) cooking temperature 190°C, b) cooking temperature 240°C, c) cooking temperature 190°C, d) salt 2.44 g/100 g and drying time 90min, e) cooking temperature 190°C, and f) cooking temperature 240°C.

Figure 2. Response surface model for cooking loss (%) in streaky rashers. Left: cooking temperature fixed at 190°C, right: salt content fixed at 2 g/100 g.

Figure 3. Response surface model for sensory properties in streaky rashers. Left: liking of flavour score (cooking temperature fixed at 190 °C), right: perceived saltiness intensity (cooking temperature fixed at 190 °C)

Figure 4. Multiple Factor Analysis (MFA) variable plot. Active groups: instrumental colour, cooking loss and shear force; hedonic sensory attributes (liking of flavour, liking of texture, liking of appearance and overall acceptability); intensity sensory attributes (meaty flavour, saltiness and crunchiness). Supplementary group: salt content, cooking temperature, drying time.

Figure 5. Multiple Factor Analysis (MFA) individual plot.S1-S14 streaky rashers as formulated in Table 1. Salt levels as final salt content, High salt: >5 g/100g, Medium salt: 4-5 g/100g, Low Salt: <4 g/100g

Table 1. Processing conditions according to response surface split-plot D-optimal design

Sample	NaCl (g/100 g)	Drying Temp. (°C)	Cooking Temp. (°C)
S1	2	60	190
S2	2.44	90	190
S3	2.88	60	190
S4	2.88	120	190
S5	2.88	120	240
S6	2.88	60	240
S7	2	90	240
S8	2	120	190
S9	2.88	90	190
S10	2.44	60	190
S11	2.88	90	240
S12	2	120	240
S13	2.44	60	240
S14	2	60	240

Table 2. Response surface models split-plot design for composition, cook loss, texture and instrumental colour in streaky bacon

	Moisture	Protein	Fat	Salt	Cook Loss	Shear Force	L*	a*	b*
Model	Quadratic	Linear	2FI	Quadratic	Quadratic	2FI	Linear	Linear	Linear
p whole-plot	0.026	<0.001	0.002	0.371	0.011	0.010	0.004	0.050	0.178
p subplot	0.007	0.590	0.052	0.010	0.034	0.034	0.9372	0.8136	0.372
R^2	0.98	0.80	0.87	0.97	0.93	0.85	0.60	0.36	0.32
Coefficients:									
CT	-2.01*	4.04**	-3.29**	0.26ns	1.43**	2.25**	-1.65**	-0.23*	-0.35ns
S	0.96*	-0.72ns	0.51ns	0.61**	-2.02**	-3.01**	0.18ns	0.06ns	0.37ns
DT	3.34**	0.38ns	-3.27**	0.07ns	-1.13*	0.80ns	0.02ns	-0.05ns	0.16ns
S x DT	1.56*		1.03ns	-0.06ns	-0.75ns	-0.96ns			
S x CT	0.41ns		-0.98ns	0.12ns	-0.61ns	-0.47ns			
DT x CT	-0.51ns		0.06ns	0.28*	-0.26ns	-1.14ns			
S^2	-2.88*			0.31ns	2.20*				
DT^2	-0.57ns			-0.53*	-0.30ns				

ns: p>0.05, *:p≤0.05, **:p≤0.01. 2FI: two level full factorial; CT: cooking temperature; S: salt; DT: drying time.

Table 3. Response surface models split-plot design for fatty acid composition of streaky bacon

	SFA	MUFA	PUFA	OA	w3	ETA w3
Model	Linear	Linear	Linear	Linear	Linear	2FI
p whole-plot	0.468	0.034	0.080	0.047	0.038	0.315
p subplot	0.922	0.603	0.359	0.562	0.253	0.0161
R^2	0.11	0.41	0.38	0.38	0.47	0.88
Coefficients:						
CT	0.24	0.78**	-0.73*	0.74**	-0.11**	-0.02
S	0.12	0.22	-0.02	0.25	<0.01	0.02
DT	0.01	-0.32	0.68	-0.35	0.10	0.03**
S x DT						-0.04**
S x CT						0.03**
DT x CT						<0.01

*:$p \leq 0.1$, **:$p \leq 0.05$.

SAF: saturated fatty acids; MUFA: monounsaturated fatty acids; PUFA: polyunsaturated fatty acids; OA: oleic acid; ETA: eicosatrienoic acid; 2FI: two level full factorial; CT: cooking temperature; S: salt; DT: drying time.

Table 4. Response surface model split-plot design for sensory attributes of streaky bacon

	Liking appearance	Liking texture	Liking flavour	Overall acceptability	Crunchiness	Saltiness	Meaty flavour
Model	Linear	Linear	Quadratic	Linear	2FI	2FI	Linear
p whole-plot	0.319	0.121	0.670	0.106	0.008	0.532	0.670
p subplot	0.530	0.384	0.025	0.562	0.059	0.018	0.130
R^2	0.50	0.65	0.96	0.31	0.83	0.85	0.61
Coefficients:							
CT	-2.08ns	-4.58ns	-1.05ns	-1.51ns	3.41**	1.15ns	-0.57ns
S	1.21ns	2.08ns	-1.17ns	-0.05ns	-0.94ns	6.67**	0.32ns
DT	-0.15ns	-0.32ns	-1.81*	-1.12ns	-3.49*	3.69*	-1.20ns
S x DT			-2.87**		0.81ns	1.69ns	
S x CT			1.86*		-1.57ns	-1.23ns	
DT x CT			0.39ns		-2.37ns	-1.52ns	
S^2			4.07*				
DT^2			-2.51*				

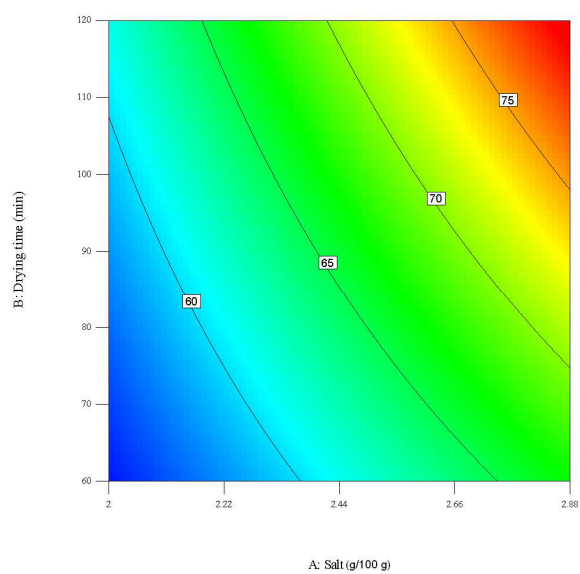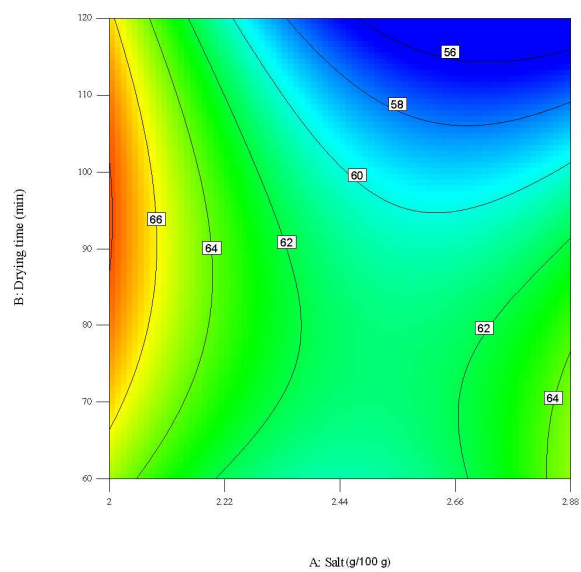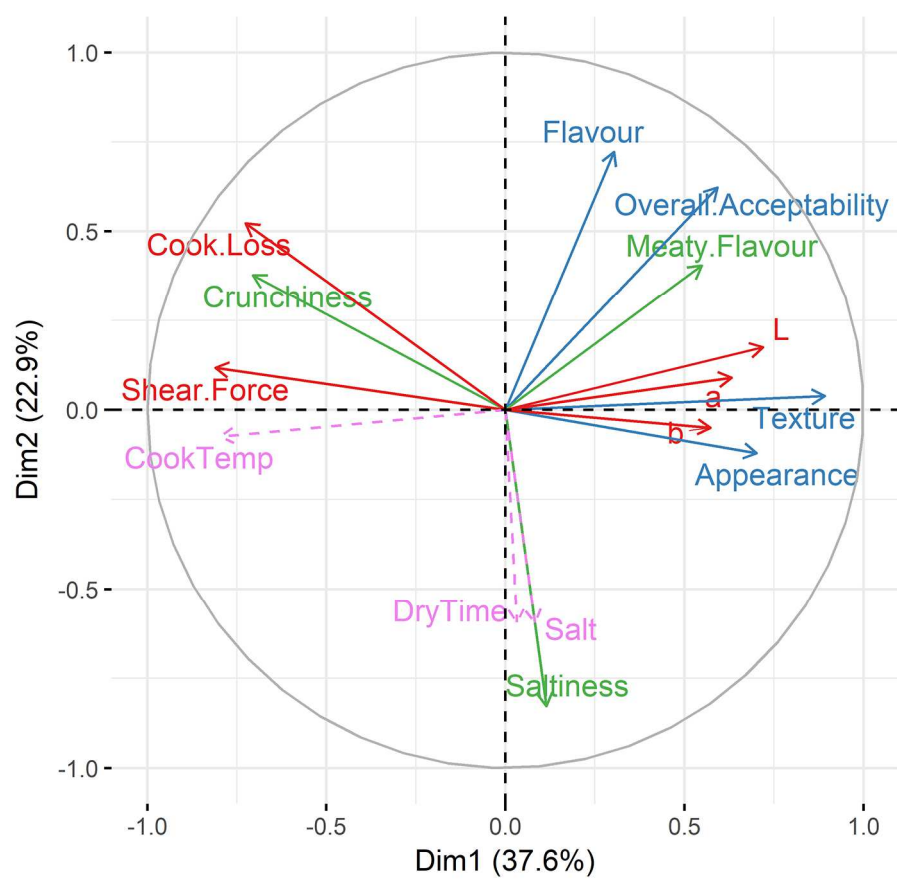ns: $p > 0.05$, *: $p \leq 0.05$, **: $p \leq 0.01$. 2FI: two level full factorial; S: salt; DT: drying time
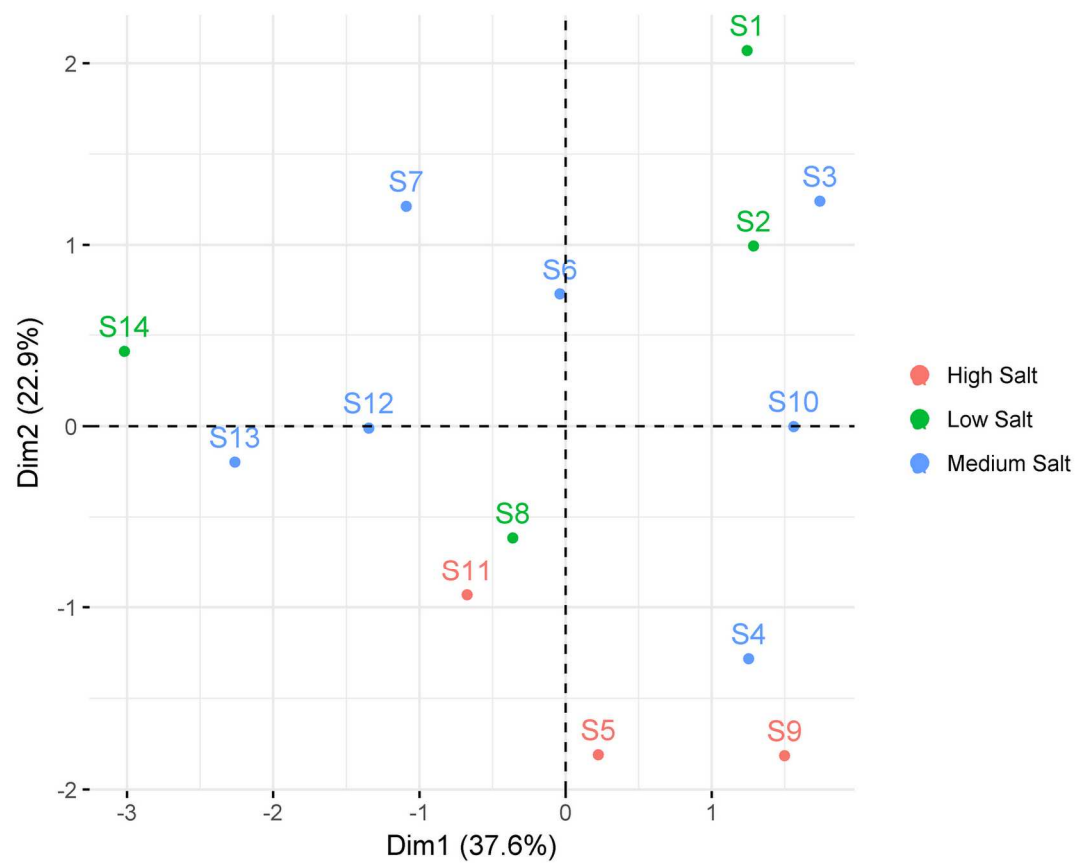
a)

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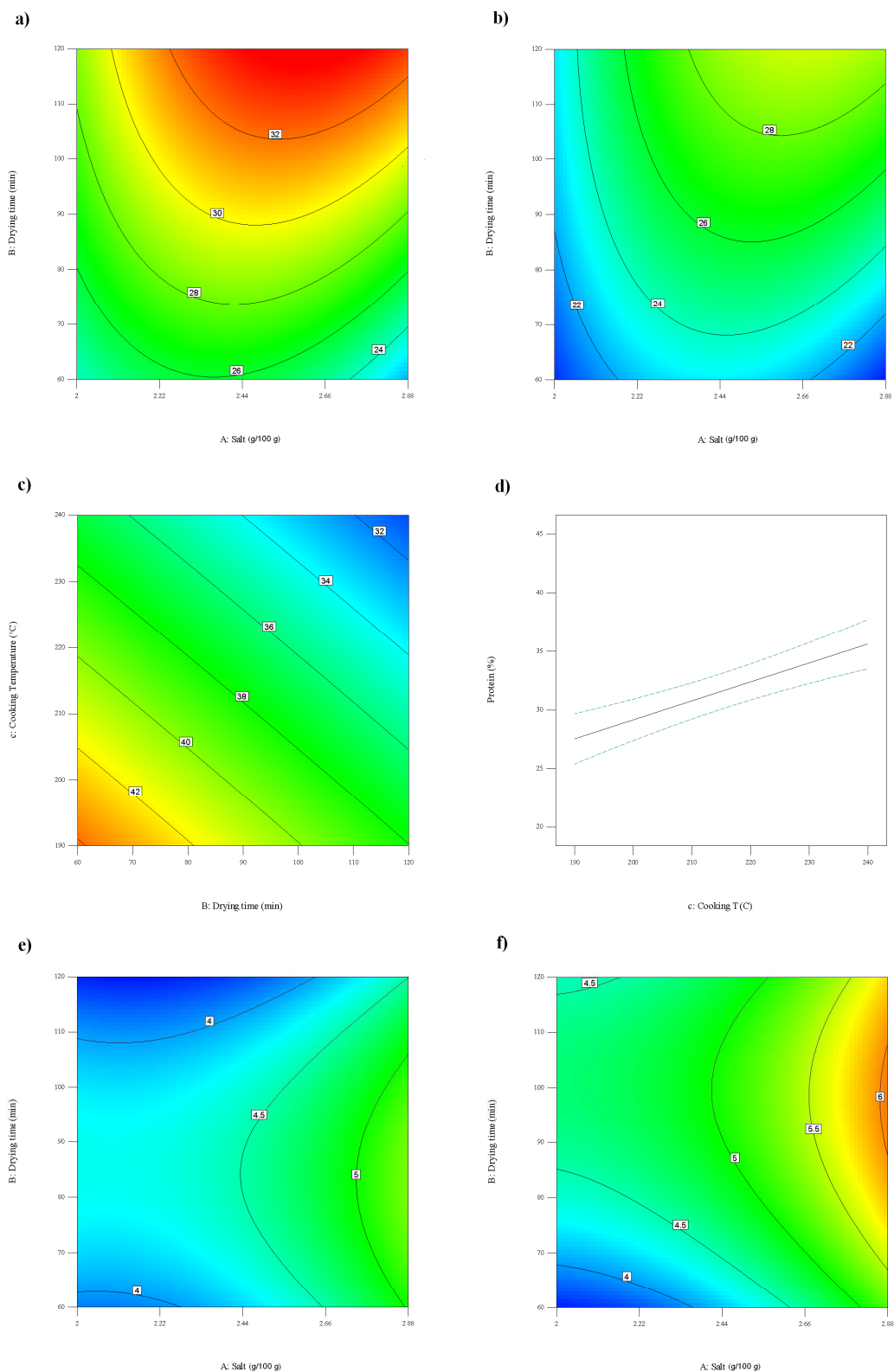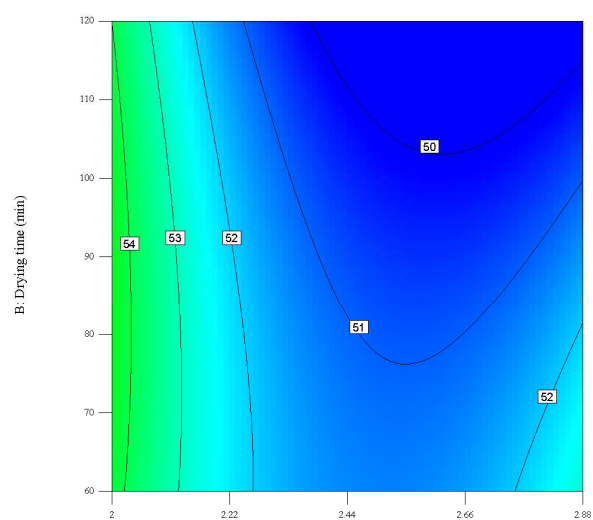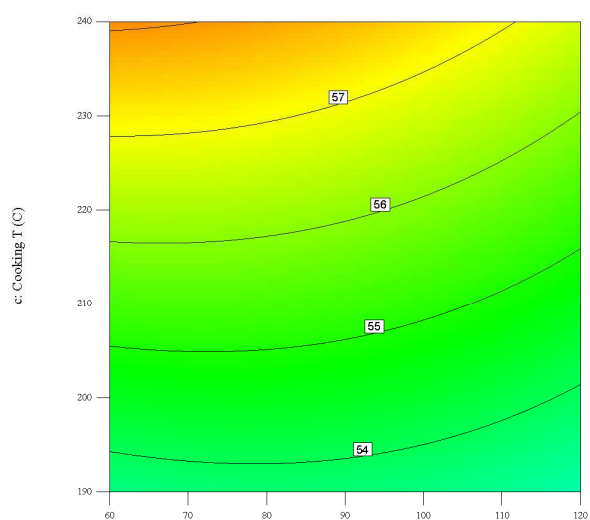
- Interaction of salt and processing conditions impacts quality of streaky rashers
- Fatty acids are affected by processing conditions
- Cooking temperature is a main factor in the sensory acceptance of rashers
- RSM proved to be a useful tool for optimising reduced-salt streaky rashers