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### Implementation of Food Safety Management Systems in small food businesses in Cyprus

Charalambous, Marianna; Fryer, Peter; Panayides, Stephanos; Smith, Madeleine

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# Accepted Manuscript

Implementation of Food Safety Management Systems in Small Food Businesses in Cyprus

Marianna Charalambous, Peter J. Fryer, Stephanos Panayides, Madeleine Smith



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1                   **Implementation of Food Safety Management Systems**  
2                   **in Small Food Businesses in Cyprus**

3  
4                   **Marianna Charalambous<sup>a</sup> Peter J Fryer<sup>a</sup>,**  
5                   **Stephanos Panayides<sup>b</sup> and Madeleine Smith<sup>a\*</sup>**

6  
7                   <sup>a</sup>School of Chemical Engineering, University of Birmingham, Edgbaston  
8                   Birmingham B15 2TT, UK

9                   <sup>b</sup>Technical and Agricultural School, Avgorou, 5515, Cyprus

10  
11                   Corresponding Author Madeleine Smith   Tel: (+44) (0) 121 414 5291; Fax:

12                   E-mail: [M.P.Smith.20@bham.ac.uk](mailto:M.P.Smith.20@bham.ac.uk)

13  
14                   Key words: HACCP ; Small medium enterprises ; SME, Cyprus, food safety management  
15                   systems,

16 **Abstract**

17 EU legislation requires that food businesses in all member states must implement a food safety  
18 management system based on HACCP principles. Although manufacturers have used this system  
19 successfully for many years it has been less common in small and medium sized enterprises  
20 (SMEs), especially those in the food service sector. There are considered to be a number of  
21 barriers which small businesses find particularly difficult to overcome. This study assesses the  
22 impact of various food safety management systems in 50 small businesses in Cyprus. It compares  
23 food hygiene before, during, and after implementation of the food management systems,  
24 assesses the attitude of the Food Business Operators and the hygiene knowledge of the staff.  
25 Results show that the maximum improvement came when implementing the pre – requisite  
26 programmes and a bespoke HACCP plan but that a deterioration in standards could be identified  
27 when using more complex systems such as the CYS 244 standard or ISO 22000. Food Business  
28 Operator attitude started positively but became more negative as the complexity of the Food  
29 Safety Management System increased.

30

## 31 **1.Introduction**

### 32 **1.1 Background**

33 The implementation of Food Safety Management Systems (FSMS) in small and medium food  
34 businesses can be problematic owing to barriers and limitations which, although common to all  
35 food businesses, appear to be particularly challenging for this category (Mensah & Julien, 2011;  
36 Yapp & Fairman, 2006). EU legislation requires that all Food Business Operators implement a  
37 system based on HACCP principles (Article 5, Regulation (EC)852/2004). All member states must  
38 comply with this requirement. For accession countries joining the EU, this requirement can  
39 represent a challenge to the existing food industry and control authority alike. Cyprus joined the  
40 EU in 2004 and according to the Statistical Service of Cyprus (Anonymous, 2005) 95% of  
41 businesses in Cyprus have 0-9 employees. Food businesses in Cyprus tend to be independent  
42 and owned by one person or a family, with 97.3% classed as small- medium sized i.e. employing  
43 less than 50 people (Violaris, *et al.*, 2008). This business profile suggests that the Cypriot Food  
44 Industry might face some difficulties in complying with the EU legislation. Violaris *et al* ( 2008)  
45 estimated that only 17% of food businesses in Cyprus had implemented HACCP and that more  
46 than half ( 55%) of the small businesses did not know what HACCP was. To assist the food  
47 businesses comply with the EU regulations, the Cyprus Government organized a system of  
48 external consultancy companies. These companies offered mandatory assistance to the food  
49 industry to enable compliance. Fees were charged to the business for the consultancy service  
50 which included basic food hygiene and HACCP training, an initial diagnostic visit to identify areas  
51 for attention, subsequent visits to provide advice on structural and procedural matters and  
52 assistance in developing and implementing a bespoke HACCP plan.

### 53 **1.2 Food Safety Management in Cyprus**

54 On becoming a member of the European Union in 2004, food businesses in Cyprus were  
55 required to comply with the Council Directive 93/43/EEC on the Hygiene of Food stuffs. This  
56 contained a requirement for food safety management based on HACCP but allowed some  
57 flexibility in the interpretation, reflecting the nature and size of the food business. At this time  
58 there also existed in Cyprus a national HACCP standard, the CYS 244 standard, (Anonymous,  
59 2001a) based on the Greek national standard EAOT 1416 (Anonymous, 2000). The CYS 244  
60 standard required implementation of pre-requisite programmes and the seven principles of  
61 HACCP in full, including documentation. It represented a more prescriptive standard than that

62 detailed in the Council Directive 93/43/EEC on the Hygiene of Food stuffs, and was, at the time  
63 of accession, optional for the restaurants in Cyprus. HACCP certification was available to any  
64 food business that could demonstrate compliance with both the EU legislation and the CYS 244  
65 standard through third party audit. Such certification was not required by EU legislation but,  
66 after accession, was demanded by the Cypriot Government for all food businesses, including  
67 food service, thereby creating an enhanced standard for the Cypriot Food Service sector. In 2006  
68 the CYS 244 standard was withdrawn and food enterprises were expected to comply with the  
69 new international standard, ISO 22000. This standard requires implementation of the pre-  
70 requisite programmes and the seven principles of HACCP plus interactive communication and  
71 structured management standards. ISO 22000 is supported by technical standards and requires  
72 third party audit to retain accreditation. These policy changes and the continual enhancement of  
73 standards provided an additional challenge for the Cypriot food industry and the private  
74 consultants also provided training and advice on how these could be implemented.

75 As the implementation of food safety management systems in parts of the food industry had  
76 been optional in Cyprus prior to accession, but obligatory afterwards, there existed a unique  
77 opportunity to follow a sample of food businesses through the process of implementation and  
78 assess the impact on them.

79 The aim of the research was to test whether hygiene in the study group premises was improved  
80 during the implementation of Food Safety Management Systems . Data was also collected on a  
81 number of other parameters, including the hygiene knowledge of staff, the attitude to FSMS, the  
82 compliance of food, environmental and water samples from the premises and the cost of FSMS  
83 implementation. This information was used to assess the attitude and opinions of the Food  
84 Business Operator s and staff about Food Safety Management Systems.

## 85 **2. Materials and Methods**

### 86 *2.1 Study group*

87 The project was a longitudinal study which took place between October 2005 and April 2008.  
88 One member of the research team was at that time employed in the consultancy scheme  
89 described above and was responsible for providing comprehensive support and training to food  
90 businesses in the process of implementing HACCP. The study recruited an opportunistic sample  
91 that comprised all those premises allocated to the researcher in 2005. The food businesses had  
92 all formally applied for the consultancy support. Implementation of a Food Safety Management  
93 System was a legal requirement and Food Business Operators in Cyprus were required to  
94 comply or face possible closure of the business. The consultancy scheme was a government

95 supported with universal uptake by the businesses. This made the inclusion of a matched control  
96 group in the study impossible. The sample group included restaurants, fast food enterprises,  
97 catering premises, traditional tavernas, confectionaries, meat products premises and bakeries,  
98 reflecting the range of businesses trading on the Island of Cyprus.. The participants were located  
99 in all areas of the Island and none had more than 21 employees. These characteristics indicate  
100 that the composition of the sample group was representative of the food businesses in Cyprus.  
101 In total fifty volunteer SME's were recruited to participate in the study. Cochran's equation  
102 (confidence level 95% and precision 10%) identified a minimum sample size of 45 premises  
103 (Cochran, 1977). During the study each business was provided with support from the  
104 consultancy scheme. This support covered training and implementation. Between stage 1 and 2,  
105 participants received introductory training in food hygiene and HACCP and assistance to  
106 implement the pre-requisite programmes, including the development of a sampling plan. After  
107 stage 2, they were given training in the principles of HACCP, assistance in developing a HACCP  
108 plan and the use of food hygiene guides to assist compliance. After stage 3 the CYS standard  
109 was introduced and after stage 4 participants were trained in the details of ISO 22000.

## 111 *2.2 Ethical consideration*

112 All Food Business Operators were fully informed of the purpose of the study which was designed  
113 to run alongside the implementation of their system. The voluntary nature of their participation  
114 and how the data would be anonymised and used was explained. After discussing the matter  
115 they were given the option to participate or not. All 50 allocated in 2005 agreed to participate.

## 117 *2.3 Audit*

118 Premises hygiene was assessed using an audit tool developed for the purpose. The audit was  
119 developed after consideration of standard hygiene criteria such as those listed in official control  
120 audits (EFET, 2004) published audit sheets (Smith, *et al.*, 2004). The criteria were assessed by  
121 visual inspection or through consideration of documentation, for example temperature  
122 monitoring records. The contents of the audit sheet were evaluated by experts from Academia  
123 and from the Control Authorities. The final audit consisted of 175 observations, each of which  
124 could be answered as 'yes' or 'no'. The questions were worded in such a way that a 'yes' answer  
125 indicated a good hygiene practice while a 'no' answer indicated poor hygiene practice, for  
126 example 'are hand washing facilities supplied with paper towels or other hygienic means of  
127 drying hands?' 'Yes' indicates the premise is hygienic in this matter while 'no' indicates it is not.

128 Every 'yes' answer was allocated one point; every 'no' was allocated 0. The final score for each  
129 premises was calculated by summing the points. The maximum score a premises could achieve  
130 was 175, the minimum was 0. The audit required approximately 1.5 hours to complete,  
131 depending on the size of the premises. The outcome of the audit was a numerical score. The  
132 higher the score, the better a premises complied with the requirements of the audit. The audit  
133 was divided into five parts: Part A: Structure and Facilities, Part B: Cleaning and Disinfection, Part  
134 C: Production and Process Control, Part D Sampling and Part E: HACCP implementation. The  
135 audit tool was validated by the test- retest method in 19 premises and scores were analyzed  
136 using the Mann Whitney U test. There was no significant difference in the scores between  
137 validation visits to the same premises ( $p>0.05$ ) or between different researchers.

138

#### 139 *2.4 Food Hygiene Knowledge*

140 Staff working in the study premises were assessed on the level of their knowledge of food  
141 hygiene at each of the five visits noted in section 2.7. This was achieved by designing a test  
142 which covered basic food safety and hygiene knowledge. The test comprised multiple choice  
143 questions and other assessments based on selecting pictures, completing sentences and  
144 providing definitions. The questions asked about personal hygiene, cleaning and sanitation, pest  
145 control, temperature control and cross contamination. Some questions related to HACCP  
146 principles and terminology and hazard identification. All staff working in the participating  
147 premises completed the test and this participation provided a sample of 438 food handlers. The  
148 test was validated by experts from Academia and from the Control Authorities with expertise in  
149 delivering and assessing training of this type (Charalambous, 2011))

#### 150 *2.5 Attitude*

151 A self administered assessment tool was developed to assess the attitudes of the Food Business  
152 Operators to Food Safety Management Systems. In consultation with two food safety specialists  
153 and three statisticians, a number of questions were developed to assess the Food Business  
154 Operator's attitude to Food Safety Management Systems using a 6 point Likert scale. Cronbach's  
155 alpha coefficient was used to test reliability and internal consistency. Some questions were  
156 eliminated and the final questionnaire comprised 14 questions, some of which were reverse  
157 phrased, with a Cronbach's alpha coefficient of 0.5. The value is quite low but is affected in this  
158 case by the heterogeneity of the items included.

159

#### 160 *2.6 Environmental, Food and Water samples*



161 Four accredited Laboratories participated in the study by visiting the 50 food premises to collect  
162 and analyze environmental, food and water samples. In each premises a stainless steel surface  
163 was swabbed and the total viable count measured. The same type of surface was swabbed for  
164 consistency, and stainless steel surface was selected as this could be found in all premises in the  
165 study group. Surfaces were swabbed using a sterile poly-cotton headed swab (Biomerieux  
166 Hellas). which had been hydrated in letheen broth, in a sealed sterile container. A sample area of  
167 64 cm<sup>2</sup> was swabbed, using a template and a width-wise back and forth motion across the  
168 surface. The swab was replaced in the container and taken to the relevant accredited laboratory  
169 for analysis.

170 Water samples were taken from all participating premises and tested for standard parameters  
171 and the results were reported as being compliant or not with the national standards. Table 1  
172 indicates the parameters assessed and the relevant quality standard which sets the accepted  
173 level for each parameter.

174 Food samples were also taken for every food premises. The sample group included a wide range  
175 of business types and food stuffs. Each business was assessed individually and five high risk  
176 foods identified in each of them. These selected foods were then tested for compliance based  
177 on either Commission Regulation (EC) NO 1441/2007 on microbiological criteria for foodstuffs (  
178 in force at the time of the study) or the Cypriot standard for microbiological criteria for food  
179 (General Chemical State Laboratory, 2001). For foods or parameters not covered in either of the  
180 above, other relevant international standards were consulted, for example ISO 4833:1991 for  
181 aflatoxins.

182

### 183 *2.7 Data collection*

184 Data was collected five times from every participating premises. These collection points  
185 corresponded to

- 186 1. Before any implementation
- 187 2. After the implementation of the Pre-Requisite Programmes
- 188 3. After the implementation of the 7 principles of HACCP
- 189 4. After implementation of the CYS 244 national standard
- 190 5. After implementation of the international standard ISO 22000

191 At each data collection point, an audit was completed. The same audit sheet was used  
192 throughout the study for each premises and at every level. The food premises staff completed  
193 the food hygiene test of section 2.4 at three points ( 1,2 and 4). The environmental, food and

194 water samples were gathered at all data collection points. The Food Business Operators  
195 completed the attitude survey at points 2-5.

196

### 197 *2.8 Cost*

198 Data was collected on the cost of the process to the businesses. This was divided into  
199 infrastructure costs (building and equipment changes), provided by the businesses accountants,  
200 and implementation costs. Implementation costs were calculated using the time sheets  
201 associated with the consultancy work carried out in each premises. The cost for the consultancy  
202 was €65 per hour.

203

### 204 *2.9 Analysis*

205 Statistical analysis was carried out using SPSS 16 for Windows.

206 The purpose of the audit was to track any changes in score that occurred in the sample group  
207 over the period of the study. The audit results represent matched pairs so The Wilcoxon Signed  
208 Rank test was chosen to test for significance between the scores at each collection point (points  
209 1-5 explained above). As four comparisons were being made, the Bonferroni correction was  
210 applied ( $0.05/4$ ) to give a critical level of 0.0125. The attitude questionnaire given to the  
211 manager/owner was analysed in the same manner, using Wilcoxon Signed Rank test to test for  
212 significance between the four evaluations and a critical level of 0.0125.

213 The scores from the hygiene test taken by the staff in participating premises were tested using  
214 the Wilcoxon Signed Rank test to determine if there was any significant difference in the scores  
215 at level 1, 2 and 4.

216 The Environmental Samples were swabs taken from designated surfaces in each food premises.  
217 Total viable counts were reported for each sample and log transformed. The resultant data was  
218 tested for normality using Kolmogorov-Smirnov test and, when found not to be normally  
219 distributed, analysed using the Mann -Whitney test for independent samples. The Bonferroni  
220 correction was calculated and a critical value of 0.0125 applied.

221 Five food samples were taken in each premises at every collection point. The foods were  
222 analysed according to the relevant standard and reported as being compliant or non-compliant  
223 for the relevant parameters. The proportion of compliant and non compliant samples at each  
224 stage was compared to determine if compliance was improving as the study progressed. Chi  
225 Square was used to determine if the differences were significant using a critical level of 0.05.

226

227 **3. Results**228 *3.1 Audit*

229 Table 2 presents the median scores for the sample group at each audit. Part A of the audit  
230 related to the premises structure. The scores for the sample group increased through audit 1-3  
231 as the Food Business Operator improved the building, equipment, surfaces and other such  
232 facilities. The audit score differences between audit 1 and 2 and between audit 2 and 3 were  
233 significant ( $p < 0.01$ , Wilcoxon Signed Rank test). Although there was also an improvement in  
234 audit score between audit 3 & 4, it was not significant ( $p = 0.039$ ) and no further increase  
235 occurred between audit 4 and 5. The maximum possible score in this section was 33 and the  
236 median score for the group in both audit 4 and 5 was 27.73. This suggests the majority of  
237 structural improvements were carried out during the early stages of the study and once the  
238 group achieved a high level of compliance, no further changes were made in structure.

239 Part B of the audit represents the levels of cleaning and disinfection carried out by the sample  
240 group. The score for this section improves to a maximum in audit 3 and then decreases by audit  
241 4 and again in audit 5. All differences were significant ( $p < 0.01$ , Wilcoxon Signed Rank test).  
242 However the median score in audit 5 is still higher than in audit 1, indicating a sustained  
243 improvement.

244 Section C (process controls) also shows an improvement in score followed by a decrease. In  
245 Section C the maximum median score is found in audit 4. The difference in audit score is  
246 significant between all audits ( $p < 0.01$ , Wilcoxon Signed Rank test). However the difference  
247 between the audit score for Section C at audit 1 is not significantly different from the score at  
248 audit 5 ( $p = 0.04$ ), indicating no sustainable improvement occurred over the period of the study.

249 Section D of the audit assessed whether food water and environmental samples were being  
250 taken in the study group. The scores improve to audit 4 and then remain the same in audit 5.  
251 The difference in the scores over the first 4 audits are significant ( $P < 0.01$ , Wilcoxon Signed Rank  
252 test). This section assesses whether the samples were being taken, not whether they complied  
253 with the required standards. As the samples were collected by independent laboratory staff who  
254 were being paid for the process, this section of the audit really represents the point at which the  
255 Food Business Operator organised the sampling and doesn't reflect further action or compliance  
256 on the part of the business.

257 The final part of the audit, Part E, measured the Food Business Operator's success in  
258 implementing HACCP. This part was used for audits 3, 4 and 5 since at audit 1 and 2 there was  
259 no HACCP in the premises, so the score was 0. The scores improve between audit 3 and 4 and  
260 then deteriorate in audit 5. The differences were highly significant with  $p < 0.01$  (Wilcoxon Signed  
261 Rank test).

262

### 263 *3.2 Food Hygiene Knowledge*

264 The test scores of the 438 staff working in the participating food premises were compared after  
265 each level. The scores improved from a mean score of 39.7% on the first assessment to 85.9% on  
266 the second and 94.1% on the third (level 4 after implementation of the CYS 244 standard). The  
267 difference between the scores was significant,  $p < 0.01$  (Wilcoxon Signed Rank test).

268

### 269 *3.3 Attitude*

270 The attitude questionnaire was designed to give an indication of how positively the Food  
271 Business Operator felt towards the Food Safety Management System that had been  
272 implemented. This attitude questionnaire was completed by the manager of the business at four  
273 points, after the implementation of the PRP'S, after implementation of HACCP, after  
274 implementation of the CYS 244 standard and after implementation of ISO 2200. A higher score  
275 indicated a positive attitude while a lower score indicated a poorer attitude. The mean scores for  
276 the study group change significantly at each evaluation. The mean score at the first assessment  
277 was 43.56. This had increased to 47.32 after the implementation of HACCP but had reduced to  
278 43.12 after implementation of CYS 244 and dropped further to 39.82 after implementation of  
279 ISO 22000. Not only are all the differences significant ( $p < 0.01$ , Wilcoxon Signed Rank test) but  
280 the final score is lower than the first, indicating that the Food Business Operators had become  
281 disenchanted with the systems and had become more negative towards Food Safety  
282 Management Systems by the end of the study. The attitude questionnaire also contained a  
283 single yes/no question which was not included in the attitude analysis. This question simply  
284 asked the Food Business Operator if they were considering cessation of the system. At the first  
285 evaluation 90% of the respondents answered 'NO' to this question. At the final evaluation 90%  
286 answered 'YES'.

287

### 288 *3.4 Environmental, Food and Water Samples*

289 The mean and standard deviation for the results from Environmental swabbing are shown in  
290 table 3. The mean value decreases from sample point 1 to sample point 4 after which it rises  
291 again. The differences are not consistently significant, but the final result is lower than the initial  
292 reading indicating overall improvement, in spite of deterioration between points 4 and 5. These  
293 measurements reflect the cleaning carried out in the premises and the audit results for part B  
294 (cleaning) show the same pattern.

295

### 296 *3.5 Food Samples*

297 There were five sampling points with 250 samples being taken each time (n=250). At the first  
298 sampling point, prior to the implementation of any systems, 21 (8.4%) of the food samples were  
299 reported to be non compliant. After implementation of the PRP's (stage 2) this dropped to 15  
300 non-compliant samples (6%). At sampling point 3 (after implementation of HACCP) the non  
301 compliant samples were also 15 (6%) but at stage 4 and 5 (after implementation of CYS and ISO  
302 2200) the number of violations increased to 22 (8.8%) and 27 (10.8%) respectively. Although  
303 there were more non compliances at the end of the process than there had been in the  
304 beginning, these differences were not found to be statistically significant.

305

### 306 *3.6 Water Samples*

307 One water sample was taken from every premises at each sampling point. These were reported  
308 as being compliant or non compliant with the CYS, APHA or EAOT standard according to the  
309 parameter tested. Results for chemical standards were consistent through out the study with 2%  
310 of the samples reported as noncompliant. Results for microbiological standards showed a  
311 reduction in non-compliant samples from 34% at stage one to 20% at sampling points 4 and 5.

312

### 313 *3.7 Cost*

314 The cost to the business of implementing the food safety management systems described in this  
315 study varied within the sample group. Structural costs ranged from a minimum of €1200 to a  
316 maximum of €30,000. The average cost for structural change within the sample group was  
317 €10,896. Implementation costs also varied widely from a minimum of €3000 to a maximum of  
318 €25,000 and an average of €10,750. The minimum spent by any single business over all was  
319 €4,200 and the maximum was €48,400.

320

**321 4. Discussion**

322 All sections of the audit score show the sample group made improvements in hygiene during  
323 the study by comparison with their score at the beginning. However, Sections B (cleaning and  
324 Disinfection), C (process controls) and E (Food Safety Management System implementation) all  
325 show an improvement to a maximum (either level 3 or 4), after which they deteriorate. Level  
326 four represents the stage at which the businesses were supposed to implement the CYS  
327 244 standard and level 5 ISO 22000. The implication from these sections of the audit is that the  
328 businesses were able to demonstrate an improvement in hygiene using the PRP's and HACCP ,  
329 but once they attempted the more onerous and complex CYS 244 and ISO 220, they were less  
330 successful and the standards dropped.

331 The same pattern can be seen in the attitude scores from the Food Business Operators . At the  
332 first assessment the mean score was 43.56 which rose after implementation of HACCP to 47.32.  
333 However once the CYS 244 standard was attempted, the Food Business Operator attitude  
334 became more negative and finally after attempting the ISO 22000, it was more negative than at  
335 the start of the process, mean score of 39.54 compared to 43.56 at the start. This suggests that  
336 the deterioration in audit score may be a reflection of the increasingly negative attitude of the  
337 Food Business Operator. When asked if they wished to stop implementing the Food Safety  
338 Management System, 90% of the participants said yes after trying to implement ISO 22000,  
339 while only 10% answered 'yes' after trying to implement HACCP. ISO 22000 is not an appropriate  
340 system for small food businesses because of its management, communication and audit  
341 requirements and the results from this study suggest that forcing a food business to implement  
342 a system which is too complex can result in a deterioration of standards instead of an  
343 improvement. This study finished in 2008. In 2014 the sample group was revisited and it was  
344 discovered that five of the 50 businesses had closed. Of the remaining 45, only seven were still  
345 using the HACCP system and none were using CYS 244 or ISO 22000. The remaining 38 premises  
346 were using only pre-requisite programmes with limited record keeping. None of the premises  
347 were formally audited on the re-visit, so hygiene scores cannot be compared.

348 Two sections of the audit did not show the pattern described above. Section A measured the  
349 changes in structure and equipment in the sample group. The scores in part A increased to a  
350 maximum at stage 4 and remained at that level. The likely explanation is that once a Food  
351 Business Operator had paid to improve the structure of the premises, he was unlikely to rip that  
352 alteration out however disenchanted he became with the Food Safety Management System  
353 being implemented. Part D ( sampling) also plateaued at stage 4. This score did not represent  
354 the compliance of the samples, only if they were taken or not. As a consequence the score

355 reflects the diligence of the laboratory technicians in collecting the samples rather than hygiene  
356 standard in the premises. The Environmental swabs indicate the efficacy of cleaning and  
357 disinfection in the premises and reflect the pattern of improvement to a maximum, then  
358 deterioration demonstrated by section B of the audit sheet. In both sets of data the final  
359 measurements are higher than the originals, indicating that over the study period sustained  
360 improvement did occur, although the final results are not the maximum that could be achieved.  
361 Staff were given regular formal training and support during the implementation period. From  
362 the test scores (sample group mean of 39.7% on the first assessment and 94.1% on the third and  
363 final) it can be seen that there was a significant improvement in their hygiene knowledge. An  
364 improved knowledge of hygiene could contribute to any improvement in practices such as  
365 cleaning and process controls. The final score for both these sections of the audit is higher than  
366 the original, suggesting that sustained improvement has occurred and that the increased  
367 hygiene knowledge of the staff may have contributed to that change.

368 The water used in all the premises in this study was sourced from the main water supply in  
369 Cyprus. Water supplied in this way is treated at authorised treatment plants. The high level of  
370 chemical compliance of the water sample results reflect the efficacy of the Cypriot treatment  
371 and a lack of post treatment contamination in the food premises. The level of microbiological  
372 non-compliance suggest that while the majority of samples are compliant there may be  
373 potential for improved cleaning in a minority of the premises, a view supported by the  
374 environmental samples and part B of the audit sheet.

375 As explained in the methodology, due to the legal requirement and government support for  
376 food businesses in Cyprus during the study period, it was not possible to identify a control group.  
377 Audits scores and attitude measurements from a sample of premises who were not participating  
378 in the consultancy scheme and who did not implement any Food Safety Management Systems  
379 over the same period would have been a valuable comparison. However, the method has been  
380 used in previous studies where a control group was possible (Kirby, 1997). In this case the  
381 changes in premises hygiene as a result of the intervention were confirmed by comparison with  
382 the control group, suggesting that the methodology used here is valid.

383 All the participants in this study were obliged to spend money in order to implement the Food  
384 Safety Management Systems. The minimum total spend by any business in the group was  
385 €4,200. The maximum spent by single premises was €48,400, with the average total spend being  
386 €21,646. All the study participants were small businesses. The largest had only 21 employees.  
387 Additional expenditure of a few thousand euros would be considered significant for a small  
388 family run business, but many were required to spend considerably more to comply with the

389 expected standards. Some Food Business Operators reported that the expenditure used all of  
390 the annual profits while others were obliged to borrow money to cover the implementation. By  
391 the end of the final phase, one business had closed due to financial difficulty. A similar initiative  
392 in Scotland where small and medium sized butchers were required to implement HACCP as part  
393 of a licencing initiative showed that 25% of the participants did not have to make any additional  
394 expenditure to implement the specially designed HACCP system, while 36% were able to  
395 successfully implement the system by spending less than £1000(€1240). (Wheelock, 2002). A  
396 similar study in England estimated the average cost for implementation to the Food Business  
397 Operator was £858.78 (€1070) (Mortlock, *et al.*, 1999). In the UK the training and consultancy  
398 was subsidized by the national government (Smith, *et al.*, 2002) but even accounting for this  
399 subsidy, the costs incurred by the businesses in Cyprus do seem to be excessively high by  
400 comparison. The attitude of the Food Business Operators became increasingly more negative to  
401 Food Safety Management Systems as the study progressed. This may have been due to the  
402 difficulty in implementing a system which was too complex for the business but the substantial  
403 expenditure required in some of the premises may also have been a contributory factor.

404 The results of the audit, attitude questionnaire and follow up visit in 2014 suggest that the Food  
405 Business Operators were initially enthusiastic about improving the food safety management in  
406 their premises, willing to implement new systems, train staff and renovate their premises. This is  
407 demonstrated by the higher audit scores and more positive attitude scores at levels 2 and 3 in  
408 comparison with the scores at level 1. However as the systems became more complex, the  
409 difficulty and cost associated with the process presented barriers which were too high. The Food  
410 Business Operators did not continue implementing the systems once a certain level of  
411 complexity was reached. Structural improvements were permanent but the application of  
412 procedures, especially record keeping were not maintained.

413 The barriers to implementing HACCP for small businesses have been well documented (Holt &  
414 Henson, 2000) (Taylor & Kane, 2005) (Yapp & Fairman, 2006) (Violaris, *et al.*, 2008). A simplified  
415 system which complies with the requirements of article 5 of Regulation (EC)852/2004 but does  
416 not overburden the Food Business Operator can be instrumental in overcoming these barriers  
417 (Taylor, 2008) (Dzwolak, 2014). The Food Standards Agency in the United Kingdom recommends  
418 the use of such a simplified system, known as Safer Food Better Business which has been  
419 developed specifically for the food service sector. (Food Standards Agency, nd). This bespoke  
420 system has been well received by the UK Food Business Operators in small food service  
421 businesses and implementation has been shown to make a significant improvement in premises  
422 hygiene (Acosta, 2008).



**423 5. Conclusion**

424 An assessment of Food Safety Management System implementation in a sample of 50 small food  
425 businesses in Cyprus demonstrated an improvement in premises hygiene, with the most  
426 significant improvements occurring after the implementation of PRP's and a bespoke HACCP  
427 plan. Increasing the system complexity by imposing the CYS 244 or ISO 2200 standards resulted  
428 in a deterioration of hygiene as measured by the audit and some sampling results. However, the  
429 final standard was generally higher than at the start of the study, suggesting the premises  
430 generally had better hygiene after the study period. This may have been due to the improved  
431 hygiene knowledge demonstrated by the food handling staff. The attitude of the Food Business  
432 Operators was generally in favour of Food Safety Management Systems at the start of the study  
433 but became less positive after the imposition of the CYS 244 and ISO 2200 standards. Because of  
434 the difficulties faced by Food Business Operators in trying to implement these more complex  
435 systems, 90% wished to stop using them, and by 2014 75% of them were no longer using even a  
436 formal HACCP system. A further 10% had closed. All the Food Business Operators reported  
437 substantial costs related to the implementation of the systems.

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Table 1 water samples

| Parameter             | Applied Technique/Standard          |
|-----------------------|-------------------------------------|
| Total number bacteria | CYS EN 6222:1999                    |
| Coliforms             | APHA 9222 B:1992                    |
| Faecal coliforms      | APHA 9221 E:1992                    |
| Enterococcus spp.     | EΛOT:947.2:1996                     |
| pH                    | EΛOT:658:1983                       |
| CaCO <sup>3</sup>     | APHA 2320 B:1998                    |
| Cl                    | APHA 4500-Cl(B):1992                |
| SO <sup>4</sup>       | APHA 4500- SO <sup>4</sup> (E):1992 |
| NO <sup>3</sup>       | APHA 4500- NO <sup>3</sup> (E):1998 |
| NO <sup>2</sup> -N    | APHA 4500- NO <sup>2</sup> (B):1998 |
| Na                    | APHA 3500- Na (D):1992              |
| K                     | APHA 3500- K (D):1992               |
| Ca                    | APHA 3500- Ca (D):1992              |
| Mg                    | APHA 3500- Ca(D):1992               |

Table 2 summary of median, minimum and maximum scores for parts A-E of the audit checklist.

| <b>Audit</b>        | <b>Part A<br/>Structure<br/>&amp; Facilities</b><br>Median Score<br>(min/max)<br>n=50 | <b>Part B<br/>Cleaning &amp;<br/>Disinfection</b><br>Median Score<br>(min/max)<br>n=50 | <b>Part C<br/>Process<br/>Control</b><br>Median Score<br>(min/max)<br>n=50 | <b>Part D<br/>Sampling</b><br>Median Score<br>(min/max)<br>n=50 | <b>Part E<br/>FSMS<br/>Implementation</b><br>Median Score<br>(min/max)<br>n=50 |
|---------------------|---|--|--|---|--|
| 1                   | 10.9<br>(6/20)  | 12<br>(8/19)   | 11<br>(5/18)   | 2<br>(1/4)  | 0<br>(0/0)   |
| 2                   | 25.5<br>(13/33)   | 18<br>(12/20)  | 13<br>(7/18)   | 2<br>(1/4)  | 0<br>(0/0)   |
| 3                   | 27<br>(15/33)   | 19<br>(16/20)  | 14<br>(9/18)   | 5<br>(4/5)  | 85<br>(60/98)  |
| 4                   | 27.73<br>(20/33)  | 18.5<br>(15/20)  | 15<br>(11/18)  | 5<br>(4/5)  | 89<br>(73/98)  |
| 5                   | 27.73<br>(20/33)  | 17<br>(11/19)  | 12.95<br>(9/18)  | 5<br>(4/5)  | 63<br>(32/89)  |
| Maximum<br>Possible | 33  | 20   | 18   | 5   | 99   |

Table 3 Mean and Standard deviation for the environmental (surface) swabs

| Test<br>(n=50) | Mean<br>( $\log_{10}$ CFU/cm <sup>2</sup> ) |
|----------------|---|
| <b>1</b>       | 3.21 ± 0.42                                 |
| <b>2</b>       | 2.78 ± 0.56                                 |
| <b>3</b>       | 2.68 ± 0.46                                 |
| <b>4</b>       | 2.87 ± 0.46                                 |
| <b>5</b>       | 2.96 ± 0.44                                 |

ACCEPTED MANUSCRIPT

Highlights

Food safety management implementation was evaluated in 50 small food businesses

Maximum improvement in hygiene coincided with simple management systems

Complex systems such as ISO 22000 resulted in a deterioration of hygiene

ACCEPTED MANUSCRIPT