

# Impact of food safety climate on safety and hygiene output in vegetable processing companies

De Boeck E.<sup>1</sup>, Jacxsens L.<sup>1</sup>, Dequidt L.<sup>1</sup>, Vlerick P.<sup>2</sup>

<sup>1</sup>Laboratory of Food Microbiology and Food Preservation (LFMFP), Department of Food Safety and Food Quality, Faculty of Bio-science engineering, Ghent University, Belgium

<sup>2</sup>Department of Personnel management, Work and Organizational Psychology, Faculty of Psychology and Educational Sciences, Ghent University, Belgium

## INTRODUCTION

Up to now scientific research related to food safety focused mainly on analytical methods, food processing technology and product formulations as technological solutions and Food Safety Management Systems (FSMS) as managerial solution to improve the safety status of food products along the food supply chain (Figure 1). However, in practice, a well elaborated and fit-for-purpose FSMS, does not always guarantee the highest level of food safety and hygiene and a stable system output (Jacxsens et al., 2015). Human behavior (e.g. the actual execution of procedures), and decision making is influenced by the perceived food safety climate in an organization (Yiannas, 2009). In our previous research a definition was already set for food safety climate and culture (Table 1) and a conceptual model was established. Also a self-assessment tool was developed to measure the food safety climate in food companies (De Boeck et al., 2015; De Boeck et al., 2016).

## PURPOSE

The objective of this study was to compare the food safety climate in two vegetable processing companies with similar size (ca.90 employees), similar activities (i.e. washing, cutting, assembling and packaging of fresh fruits and vegetables), similar technology (quite industrialized process) and similar level of the FSMS (legal Belgian self checking system and commercial IFS certification). Also the relation between the food safety climate, the FSMS and the actual output of the company (hygiene and food safety) was investigated (= food safety culture).

## MATERIALS AND METHODS

The two vegetable processing companies were screened on their food safety climate by means of 28 indicators of the food safety climate self-assessment survey extended with some questions assessing demographic characteristics. Every employee of the two companies was asked to fill out this survey (total n=85). As such the relation between these variables and the food safety climate perception could be investigated. Also the context riskiness and level of implemented FSMS by application of a self-assessment questionnaire (FSMS-diagnostic instrument (Jacxsens et al. 2015)). Objective data of food safety/hygiene output of the companies were collected by means of microbiological product sampling (n=15 for both companies, analyzed for *E.coli*, *L. monocytogenes*, *E.coli* O157 and *Salmonella*), environmental sampling (n=15 for both companies, analyzed for *L. monocytogenes*) and hand swabbing (n=62 for company 1 and n=83 for company 2, analyzed for *E.coli*). Moreover, as part of the assessment of the food safety/hygiene output all employees were asked to fill out a knowledge and behavior survey to assess their knowledge and behavior concerning hygiene and food safety related matters (n=62 for company 1 and n=83 for company 2). For all the measured variables a ranking was made for the two companies.

## RESULTS

The food safety climate score was significantly higher in company 1 compared to company 2 ( $p < 0.001$ ). This difference was further investigated by looking at the correlation of food safety climate with certain variables (Table 2: Pearson correlation for continuous variables and t-test for categorical variables). Food safety climate was positively correlated with seniority in the current job, seniority in the food industry and conscientiousness. Also, a permanent contract tends to give higher food safety climate scores than fixed term (temporary) contracts.

As expected the results of the FSMS-diagnostic instrument showed that the context riskiness and the level of the FSMS are similar (Figure 2). Context riskiness is for both companies moderate for product and process related context characteristics (assigned score: 2) and low to moderate for organizational and chain related context characteristics (assigned score: 1\_2), as both companies are working with the same product and are positioned on a similar place in the chain. The FSMS is based on best practices for the sector for both companies (assigned score: 2). Based on microbiological samples, swabs and the knowledge and behavior survey, it can be stated that also the food safety/hygiene output is on a similar level.

As in company 1 the food safety climate is perceived to be better than in company 2, it is not possible to confirm the relation between food safety climate and the output of the company. However, as the food safety climate is good in both companies (far above average), it cannot be concluded that there is no relation. Possibly the well elaborated FSMS and technology form the main contribution to the food safety and hygiene output of the company. This outcome was also obtained in the previous study in affiliated butcher shops and farm butcheries (De Boeck et al., 2016). In this study, the lowered hygiene status of the farm butcheries suggested that a good food safety climate may not be sufficient to counteract the lower level of the FSMS.

### Significance

It was not possible to see a clear effect of the food safety climate on the output as the good output level could be a consequence of the good technology and elaborated food safety management system ('ceiling effect'). However, the study showed some interesting relations between the different variables measured.

### Further research

The role of personal characteristics such as conscientiousness, motivation and personal wellbeing (e.g. job stress), in the relation between food safety climate and microbiological hygiene and safety needs to be further investigated. Also, a quantitative study is running to assess the food safety climate in the Belgian food processing industry.



Figure 1: Evolution of research focus towards food safety climate (based on Wright et al. 2012)

Table 1: Definitions food safety climate and food safety culture (De Boeck et al. 2015)

Food safety climate	Food safety culture
Employees' (shared) perception of the leadership, communication, commitment, resources and risk awareness concerning food safety and hygiene within their current work organization	The interplay of the food safety climate perceived by the employees and the managers of a company (so called 'human route') and the context in which a company is operating, the current implemented FSMS, consisting out of control and assurance activities (so called 'techno-managerial route') resulting in a certain (microbiological) output

Table 2: Correlation of demographic/control variables with food safety climate

Variables tested	Correlation with FSClimate
Gender	NO ( $p = 0.273$ )
Hours of contact with direct supervisor/ week	NO ( $r = -0.008$ )
Hours of training/education in the past year	NO ( $r = 0.118$ )
Seniority in current job	Positive ( $r = 0.343$ )**
Seniority in the food industry	Positive ( $r = 0.257$ )*
Conscientiousness	Positive ( $r = 0.649$ )**
Type of contract	Permanent contract better climate than temporary contract ( $p < 0.001$ )

\*:  $p < 0.05$   
\*\*:  $p < 0.01$

Ranking	Context riskiness		FSMS	FSClimate	FS/hygiene Output
	Product/process	Org./chain			
1	VC1 en VC2 (2)	VC1 en VC2 (1_2)	VC1 en VC2 (2)	VC1 (121 ± 14)	VC1 en VC2 (6)
2				VC2 (105 ± 19)	

Figure 2: Relative ranking of the two vegetable processing companies (VC1 and VC2) included in the case study for their context riskiness, food safety management system (FSMS), food safety climate and food safety/hygiene output. Product/Process: product and process related context characteristics; Org/Chain: organization and chain related context characteristics. Between parentheses mean and standard deviation are given for the total food safety climate score (28→140), assigned scores for context, FSMS (0→3) and sum of the rankings of the sub dimensions (product, environment, handswabs and survey) for food safety/hygiene output (4→8).

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For more information:

Tel. +32 9 264.99.02

Fax +32 9 225.55.10

E-mail: [Elie.deboeck@UGent.be](mailto:Elie.deboeck@UGent.be)