

Traditional use of the protective properties of food cultures.

1) How tradition and recent research help define Food Cultures.

Fermentation is a bio-protective technique of its own.

Microorganisms are traditionally used to carry out fermentation processes, and for thousands of years, mankind has used them in the processing of fish, meat and vegetables as well as to make food products such as bread, beer, wine, vinegar, yoghurt and cheese.

Fermentation is thus one of the oldest food processing transformation and conservation techniques. This biological process not only improves the nutritional and organoleptic qualities of the food (taste, appearance, smell, texture) but adding microorganisms will also favor desirable flora, thereby preventing spoilage, inhibiting pathogens and increase safety. The first report that microorganisms were involved in food production processes was in 1837, when scientists discovered the role of yeast in an alcoholic fermentation. Later, in the 1860s, whilst investigating what happened during the production of beer and vinegar, Louis Pasteur discovered the role that microorganisms played. However, it was only after the Second World War that the food industry began to develop the fermentation techniques we rely upon today. Thus, a wide variety of safe, documented and characterized microorganisms are produced under controlled conditions which, when added to fresh, raw food material, produce a consistent and safer fermented food product.

Definition of Food Cultures

Food Cultures represent safe live bacteria, yeasts or molds, used in food production. They are, themselves, a characteristic food ingredient and hence are not subject to a premarket approval in the EU. See section 3 safety requirements.

Food cultures: complex products with multiple actions

Food cultures used in food production are often simply referred to as “cultures”, “starter cultures” or “protective cultures”. In the published opinion of the Senate Commission on Food Safety (SKLM) of the German Research Foundation, they explain that: “protective cultures” in fact contain the same microorganisms as are found in “starter cultures”. Their active metabolism is a prerequisite for their effectiveness, which also defines them as

“fermenting” (Vogel et al 2011). Similarly, a recent review explains how these fermenting properties are inherently linked. Shelf life is enhanced by the formation of different metabolites, which also contribute to the characteristic taste and texture of many fermented foods, and a clear distinction between starter and protective cultures is neither possible nor meaningful (Elsser-Gravesen and Elsser-Gravesen 2014). Several research activities have described the following biological mechanism behind protective food cultures with working hypotheses based on principles, among others;

- 1) Acidification. The decrease of pH during fermentation reduces the chances for other microorganisms to develop, including potential food pathogens.
- 2) Production of anti-microbial metabolites by the food cultures belonging to various chemical families: alcohol for some yeasts (wine, cider, kefir, etc.), specific peptides for yeasts (killer factor) and bacteria (bacteriocins) or organic acids for lactic acid bacteria. Klaenhammer estimates that around 99% of all bacteria produce and export one or more of these bacteriocins peptides to fight other microorganisms in their immediate environment (Klaenhammer et al.1988).
- 3) Competition for space (Jameson effect as described in literature (Beaufort et al 2006, Cornu et al 2010)) and nutrients, such as carbon, nitrogen, phosphate and oxygen sources.

These different mechanisms are intrinsically linked to the complexity of Food Culture fermentation. Therefore, there is no clear separation between the fermentation processes for sensory purposes and the fermentation processes for protective purposes, hence the existence of only one category of named “food cultures”.

2) Trends in food: Part of innovation is to meet consumer expectations for natural healthy foods, food safety and shelf life requirements

The safety and shelf life of foods are as essential as ever. Today, consumer demands on food bring new challenges and can, at times, be contradictory to general requirements for safe foods. The main consumer trends described below show the need for alternative solutions to solve the dilemma posed by consumer expectations.

- **Health trend:** The levels of salt, sugar and fat in foods are under pressure to be reduced. These changes are beneficial for human health, but they also all confer an increase in water activity, which provides an increased risk for undesirable microorganisms.
- **”Natural” trend:** The desire for natural, more authentic food products, leads to milder processing and reduced use of additives. This might result in a fresher appearance of the food but potentially also less inhibition of undesirable microorganisms.
- **Convenience and ready-to-eat (RTE) trends:** RTE products require more extensive processing during production, which results in more steps during which contamination with undesirable microorganisms can occur, e.g. during slicing.
- **Taste preferences:** In many products, trends are towards a milder (i.e. less acidic) taste, which results in a higher pH, that again, tends to be more favourable for the growth of undesirable microorganisms.

In addition to the points above, there is an increased focus on reducing food waste throughout the value chain which may challenge current shelf life limitations.

With these trends in mind, there is a strong need for natural food protection solutions that can help ensure both food safety (i.e. reduce the number and/or outgrowth of pathogenic microorganisms) and positively impact food shelf-life (i.e. delayed development of spoilage microflora). At the same time, the necessity of reducing the carbon dioxide (CO₂) footprint adds restrictions to the solutions the food producer can employ. To address these challenges, food cultures can act as an extra hurdle against proliferation of unwanted microorganisms (Elsser-Gravesen and Elsser-Gravesen 2014). This is explained further below.

How Food Cultures add an extra hurdle of protection through traditional fermentation processes.

In fresh dairy and cheese products, food cultures with relevant protective properties are combined with the food cultures known to produce the desired characteristics of the specific dairy product. The fermentation from the combined culture solution creates the unique properties of the specific dairy product, but also has the capacity to inhibit spoilage organisms, for example, yeasts and molds. In cured ham, bacon or smoked salmon, food cultures are added to the curing solution/brine and then introduced into the product. For cooked products, food cultures, which are sensitive to the temperatures applied during the

cooking step, are sprayed onto the product during slicing (RTE cooked ham and poultry/slices of cheese) or directly into the packages of vacuum packed products. Spray application (after dilution of the culture with water) is also used to treat the surface of products such as poultry carcasses, lettuce or pasta. Cultures are also used in foods such as barbecue sausages, sour cream, beef tartare and shrimp.

The table below, taken from Elsser-Gravesen and Elsser-Gravesen, (2014) gives examples of commercially available protective cultures, their functionalities and their producers.

Examples of commercially available protective cultures			
Protective function	Microorganisms	Fields of application	Producer
Growth inhibition of <i>Listeria monocytogenes</i>	Lactic acid bacteria (e.g. <i>Lb. sakei</i> , <i>Lb. curvatus</i> , <i>Lb. plantarum</i>) <i>Carnobacterium</i> <i>spp.</i>	Fermented Meat Products Dairy Products Fish and Seafood	Chr. Hansen (Denmark) DuPont (USA) Sacco (Italy)
Inhibition of mold and yeasts	<i>Lactobacillus spp.</i> <i>Lb. rhamnosus</i> , <i>Lb. paracasei</i> , <i>Propionibacterium</i> <i>spp.</i>	Fresh dairy products Fresh dairy products	Chr. Hansen (Denmark) DuPont (USA)
Inhibition of Clostridia Tyrobutyricum; prevention of late blowing	<i>Lactococcus lactis</i>	Cheese	CSK (Netherlands)

3) Regulatory and safety requirements for food cultures

Safety requirements remain unchanged and to the same high standards

The use of food cultures in products is a safe and controlled way of reducing the risk of contamination by a mixture of indigenous microorganisms coming from the food itself or from its environment.

The food cultures used today in non-traditionally fermented food products tend to be from the same species as those used in traditional fermented food. Many of these are included in the Qualified Presumption of Safety (QPS) list from EFSA. Others, which have a long history of safe use, are listed in the International Dairy Federation review of Microorganisms with technological beneficial use (Bourdichon et al 2012). Like any other food ingredient, cultures must be safe for their intended use (General Food Law EC N° 178/2002 Article 14). The safety determination of microbial food culture preparations relies, in most cases, on the long history of safe use (Pariza et al. 2015). As recommended by Pariza, food cultures should always be properly characterised by DNA sequencing and controlled for absence of transferable antibiotic resistance genes as well as absence of toxicity (biogenic amines, toxin production, virulence genes etc.).

Labelling of Food Cultures

Regulation (EU) 1169/2011 sets out what information must be provided when labelling foodstuffs. In particular, this regulation ensures clarity of the exact nature and characteristics of the product, thus enabling the consumer to choose in full knowledge of the facts.

Food Cultures are defined as characteristic food ingredients that should be listed on the ingredient label of the final food when they are used in the manufacture or preparation of a foodstuff, unless exempted by another regulation. This means that food cultures must be in the list of ingredients under a generally understood category name such as “cultures”, ”kulturen”, ”ferments” or in certain cases the species and/or strain name.

To demonstrate the broad use of food cultures, Appendix 1 shows labels of food products in which cultures are added and declared in the ingredients list similar to [EFFCA labelling recommendation](#).

Conclusion


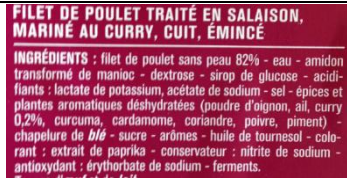
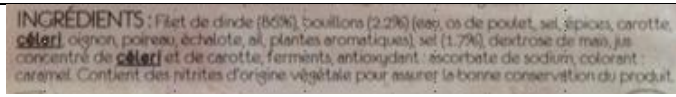
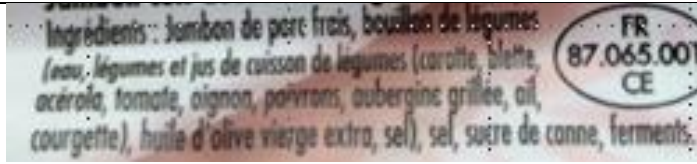
In conclusion, food business operators have a responsibility to produce safe, healthy, tasteful and natural products and are facing a retailer and consumer demand for use of fewer additives while still maintaining an adequate shelf life. This is coupled with a desire for sustainable production and a decrease in food waste.

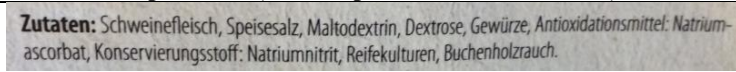

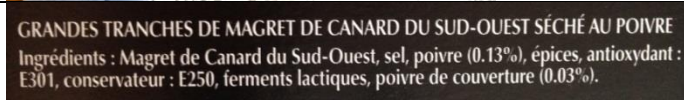
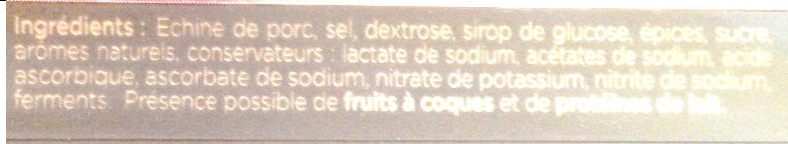
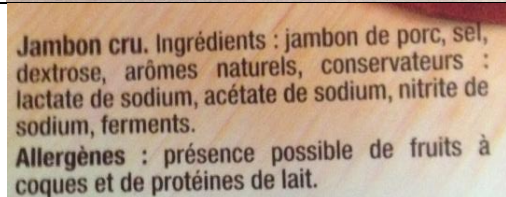
Through their metabolic activity, food cultures contribute multiple unique properties to the foodstuff, particularly in regards to flavour, colour, texture, wholesomeness and health. They provide nutritional benefits and food safety through protection and conservation. They should therefore be seen as parts of a natural and safe solution based on traditional principles in food production, to be used in combination with other risk-reducing principles such as physical treatment, good manufacturing practice and cold-chain maintenance. The right combination of these techniques ensures that pathogens and spoilage bacteria are eliminated or rendered harmless in the final product.

This underlines the need for the continued use and acceptance of food cultures as a viable and natural solution to food safety, food protection and quality assurance supported by decades of traditional and safe use in fermented foods.

About EFFCA: The European Food & Feed Cultures Association - EFFCA - was formed in 1992. EFFCA's objective is to enhance public knowledge of the contribution the use of microbial cultures makes within the food chain, through accurate, fair and scientifically-based information; while discouraging any inappropriate promotion or misuse.

Appendix 1: examples of food products label available in Europe

Ready to eat cooked meat products	
	<p>French Pork Ferment / LAB</p>
	<p>French Chicken breast filet Ferment / LAB</p>
	<p>French Turkey filet Ferments / LAB</p>
	<p>French Fresh Pork ham Ferment / LAB</p>

Cured meat products (bacon / pork loin / duck loin...)	
	<p>German bacon from Pork Reifekulturen / Ripening cultures</p>
	<p>German Pork for boiling Reifekulturen / Ripening cultures</p>
	<p>French Duck breast Ferments lactiques / LAB</p>
	<p>French Neck of pork Ferments / LAB</p>
	<p>French cured ham Ferments / LAB</p>

<p>FILET DE PORC SÉCHÉ TRANCÉ INGRÉDIENTS Filet de porc - sel - épices et aromates 1,1% - sucre - conservateurs : nitrate de potassium, nitrite de sodium - ferments. Décor : feuille de laurier.</p>		<p>French Dried pork filet Ferments / LAB</p>
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Raw meat products / meat preparation (beef tartare, burger ...)		
<p>HAMBURGUESA DE VEDELLA Ingredients: carn de vedella, sal, dextrosa, antioxidants (ascorbat sodic, citrat sodic), especes i ferments lactics (conservant natural). Sense colorant. Sense gluten. Sense lactosa. Sense sulfits. Sense ou. Animals criats, engraiats, sacrificats i especejats a Catalunya.</p>		<p>Spanish Veal Hamburger Ferments lactiques / LAB</p>
<p>CHIPOLATAS SANS COLORANTS, PUR PORC INGRÉDIENTS : VIANDE DE PORC, SEL, DEXTROSE, ÉPICES, PLANTES AROMATISÉES, FERMENTS ANTI-OXYDANT : E300 ACIDIFIANT : E262, E330. PRÉSENCE POSSIBLE DE LAIT, DE GLUTEN, DE MOUTARDE ET DE FRUITS À COQUE. CONDITIONNÉ SOUS ATMOSPHÈRE PROTECTRICE. À CONSOMMER CUIT À CŒUR ET RAPIDEMENT APRÈS OUVERTURE. À CONSERVER À 0-4°C.</p>		<p>French fresh sausage Ferments / LAB</p>

Non meat RTE products		
<p>GAMBAS Décortiquées BIO* Ingrédients : Crevettes* (Penaeus vannamei) d'élevage d'Equateur entièrement décortiquées cuites au Sel de Noirmoutier, ferment lactique (lait). Traces éventuelles de mollusque, poisson et sulfite.</p>		<p>Shrimps Ferment lactique / LAB</p>
<p>COMPOSÉE 92% : spécialités céréalières cuites 37% (eau, semoule de blé dur, blanc d'œuf, sel), jambon cuit choix goût fumé 12% (jambon de porc, eau, acidifiants : lactate de potassium, acétate de sodium; sel, sirop de glucose, stabilisant : E450, arôme naturel et arôme de fumée, conservateurs : érythorbate de sodium, E250), salade 12% (frisée, mâche, mélange de jeunes pousses en proportions variables), fromage de chèvre 8% (lait de chèvre pasteurisé, sel, ferments lactiques et fongiques, coagulant), tomate mi-séchée, tomate cerise 6%, carotte 6%, huile de colza, vinaigre, sel, ferment, persil, poivre, paprika, eau. SAUCE VINAIGRETTE AU VINAIGRE BALSAMIQUE 8% : huile de colza, vinaigre balsamique de Modène 2% (vinaigre de vin (contient sulfite), moût de raisin (contient sulfite), colorant : caramel, conservateur : disulfite de potassium), huile d'olive vierge extra 2%, eau, sel, poivre, arôme naturel (céleri). Informations en gras destinées aux personnes allergiques. Traces éventuelles de crustacé, poisson, œuf, moutarde, soja, sésame, fruits à coque.</p>		<p>Mixed salad Ferments lactiques / LAB</p>

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