Session 3.I

Processing as required for the market

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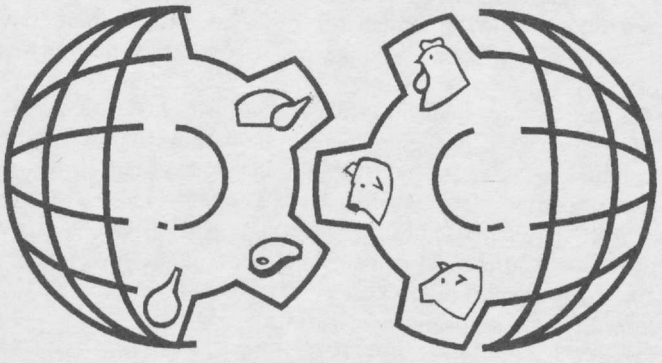

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SAFETY CRITERIA FOR MINIMALLY PROCESSED FOODS

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Background.
The growing demand for convenience and fresh-like, healthy foods is driving the European market to chilled prepared foods. Food types that fall into this category are for example fresh-cut vegetables, prepared sandwiches, ready-to-eat meals. In the period '91-'95 world wide sales of chilled foods increased with 40 % and for Europe the increase was 50 %. For the period 1999-2003 the overall growth of chilled meals and pizza's in Europe is estimated at 9%. Chilled ready meals and pizza will show a market maturity at 50% of the total market but the speed of market development is very different from country to country.
Traditional means to control food spoilage and microbiological safety hazards, such as sterilisation, curing or freezing are not compatible with market demands for fresh-like convenience food. Therefore, food manufacturing industries seek compliance with these consumer demands through application of new and mild preservation techniques such as refrigeration, mild heating, modified atmosphere packaging, organic acids, the use of natural antimicrobial systems and novel technologies like high pressure, pulsed electric fileds,high intensity pulsed light, oscillating magnetic fields and ultrasonics. The diversity of the products and the combination of different technologies make that traditional safety regulations and criteria fail for minimally processed foods.

Objective.
The objective of the concerted is to provide a sound scientific base for the setting of standards and regulations relating to the safe production and distribution of minimally processed foods.

Methods.
The Concerted Action "Harmonization of safety criteria for minimally processed foods (FAIR CT96-1020)", sponsored by the European Commission, has been started in September 1996 and was completed in December 1999. This Concerted Action brought together a significant number of representatives from food processing industries, from private and governmental research organisations and from legislative and consumer organisations. An inventory of regulations and codes of practices was published in September 1997 and in November 1999 a report was published with a critical review of the safety criteria and concepts formulated as statements and recommendations.

Results and discussions.
Safety criteria in production and legislation are at variance throughout the European Union
In most countries, food business operators are required to comply with general and specific hygiene rules, and to develop procedures for food hygiene based on the principles of HACCP. Several national or international branch organizations have also developed codes of practice for the production of chilled foods with extended shelf life. A code of practice is rather advisory than prescriptive in form, and compliance with the code can only be recommended, not enforced.
During the first year of the project, an intensive search has been conducted on actual legislation, existing codes of practices (31) and safety recommendations for the production and distribution. All information has been summarised in a 46 page inventory report. The inventory report indicates clearly that we are still far from reaching a set of harmonised criteria. For instance, a lot of differences in legislation can be found in required chilled storage and cooling requirements. This lead to remarkable differences in operation cost for the producers in different countries of the EU. In Denmark, for instance, cooked products should be cooled from 65 to 10°C in 3 hours, in France the cooling requirement demands a cooling from 60 to 10 °C in less than 2 hours.
"Minimally processed foods" that have been heat treated, receive commonly a mild heating process. This pasteurization process is likely to inactivate vegetative cells, but not bacterial spores. The degree of destruction depends on an integrated effect of time and temperature. The complexity of the products and the combination of different technologies make traditional simple safety concepts like 6-D or 7-D for pasteurised products not applicable. Also the choice of the reference microorganism and desired log reduction is not clear .
Another example are the criteria for the washing water for the cleaning of fresh vegetables, as recommended in different codes of practices. In most EU member states, the use of hypochlorides for the desinfection of prepared vegetables is standard procedure, whereas a substantial number of memberstates specifically by law forbid the use of any such compound.
The allowed chlorine concentration is normally expressed as "free available chlorine" (in ppm or mg/l). The amount of "total chlorine" corresponds to the amount of chlorine added to the solution. A part of the chlorine combines with organic materials and approximately 80% of the added chlorine is effective (= free chlorine). Some codes of practice give also recommendations for the amount of residual chlorine after rinsing and dewatering.
Recommendations for harmonized criteria and safety concepts
1. Risk assessment
Risk assessment, the first part of risk analysis, is the scientific evaluation of known or potential adverse health effects, resulting from exposure to foodborne hazards. Risk assessment can be an extremely useful tool to quantify risks associated with minimally processed foods. References for a limited number of case studies related to minimally processed foods are mentioned.
2. Shelf life assessment and validation.
Although legislative requirements and recommendations for temperature control during manufacturing, heating, cooling and chilled storage are abundant (Inventory Report 1997), there are no rules in food legislation on how long food should last. It should however

been emphasized that it is the responsibility of the manufacturer to determine the shelf life of the product produced. Shelf life assessment should take at least the following factors into account: product formulation, processing given, packaging, storage conditions in particular temperature and other hurdles. It is recommended that reasonably expected conditions of temperature abuse in the chill chain (from manufacturer to consumption) are considered in shelf life evaluation. Very few protocols for shelf life assessment and/or validation have been put forward and further efforts in setting up uniform guidelines for shelf life evaluation should be promoted. Models to predict the growth of micro-organisms during chilled storage, microbial challenge tests and other scientific validation studies should be further developed.

3. Products with pathogen reduction

Microbiological hazards can be controlled by a combination of controlling factors, called hurdles. For chilled pasteurised foods, the most important hurdles are likely to be heat treatment, refrigerated storage and shelf life. Other hurdles that may contribute include decreased pH and a lowered water activity. While current recommendations include chilled storage combined with either acidification to pH ≤ 5.0, addition of salt to $\geq 3.5\%$, or adjustment of water activity to ≤ 0.97, the deliberate use of any single hurdle is only limited to a small range of products due to off-flavour effects. We recommend the continued use of predictive modelling in assessing the impact of combinations of inhibiting factors. Interactions of hurdles may be complex, resulting in additive, antagonistic or synergistic effects. Any combination of inhibitory factors could be used provided they have been shown to inhibit the pathogen(s) of concern. We anticipate that the use of predictive models will reduce the need for, but not entirely replace challenge testing.

We recommend that further research is conducted on other inhibitory factors in order to establish safe levels which could be recommended as novel hurdles. Preservatives like lactate, nitrite or bacteriocins may offer interesting opportunities in view of their natural occurrence in some foods.

As a minimum, current heating criteria should provide an adequate reduction in numbers of non-spore-forming pathogens. This is defined as providing a 6D reduction in numbers of vegetative cells of *Listeria monocytogenes*, i.e. 70°C for 2 min. While this may be appropriate for some products with a short shelf life, a 6D reduction in number of spores of non-proteolytic (psychrotrophic) *C. botulinum* is required for products with an extended shelf life. Instead of specific time-temperature combinations lethality performance standards should be used in legislation. We recommend that strict hygienic measures be applied once the heating is completed to prevent recontamination of the food. Any microorganism contaminating the product post-heating is likely to overcome the hurdles that may be present in a food. Pasteurised products must undergo a rapid cooling so that the critical zone for spore germination and subsequent growth (50°C-10°C) is passed through as rapidly as possible until the specified storage temperature is reached. We acknowledge that strict cooling rates (e.g. cooling product down to 10°C in 2 hours or less) are not always practical to achieve. Practical limitations with regard to product geometry/volume and cooling method should be taken into consideration.

Scientific data indicate that optimal storage temperatures for chilled pasteurised foods are in the order of 0-1°C, thereby controlling product safety as well as quality. However, control of such low temperatures may not be achieved by today's distribution chain. We therefore recommend temperatures of maximum 4°C as ultimate goal for chilled pasteurised foods, but practical limitations of current distribution chain and specific legislative requirements should be considered. At the current time, a storage temperature of 4°C to 8°C would appear to be the most feasible from a practical point of view.

4. Products without treatments for pathogen reduction

The initial contamination of raw materials with pathogens is a critical issue in the production of fresh cut vegetables. Processing does not significantly reduce the initial level of microorganisms, and control of raw material contamination is necessary. The major reservoir of VTEC is cattle but human cases linked to the consumption of raw fruits and vegetables show that VTEC may be transmitted by fresh produce, presumably through unproper agricultural practices. The major discrepancy in legislation between EU countries concerns the use of chlorine to wash and clean fresh-cut vegetables. Disinfection of raw materials is aimed at reducing the initial microbiological contamination, but its effect has been shown to be limited. Modified Atmosphere Packaging (MAP) may improve quality retention during storage, but provides no additional safety barrier to fresh cut vegetables. Since MAP may disturb the natural microbiological flora and competition between spoilage and pathogenic microorganisms, it should only be used for preservation purposes when strictly following recommended guidelines or codes of practices. We recommend a target temperature of ≤ 4°C for storage of fresh cut vegetables, whereas a maximum storage temperature of 8°C is considered as acceptable. The production of organic fresh cut fruits and vegetables may increase rapidly in the near future. Organic production of the raw material will involve organic fertilisers, the microbiological quality of which is largely unknown.

5. Novel technologies

Scientific information is necessary, in keeping with the Novel Foods regulation, to properly assess and ascertain the safety of food products prepared using such technologies. Many technologies will not be used in isolation, but rather in combination with other processing systems such as chilled storage, heating, preservatives. In the case of novel technologies, information is required on the effect of these combination treatments. Because the requirements for approval of novel foods under the Novel Foods regulation is quite complex, it would be helpful if clear guidelines were devised that manufacturers can comprehend and can use to evaluate the consequences of using novel technologies and for preparing their Novel Foods application.

6. Consumer information and education

Information given to the consumer concerning minimally processed products will be largely through product labelling. Labelling can be considered a critical step in successful and safe marketing of minimally processed foods. In addition to information, consumer education is important to safeguard product safety and consumer protection. The purpose of education is to encourage consumers to adopt general good (kitchen) hygiene practices and to be aware specific handling/preparation of minimally processed foods.

References.

FAIR CT96-1020 (1997), "Harmonization of safety criteria for minimally processed foods". Inventory report.

FAIR CT96-1020 (1999), "Harmonization of safety criteria for minimally processed foods". Rational and harmonization report.