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A FARM-TO-TABLE APPROACH FOR EMERGING AND DEVELOPED DAIRY COUNTRIES

IDF/FAO international symposium on dairy safety and hygiene
Cape Town, 2-5 March 2004

The International Dairy Federation (IDF) is a non-profit making organization. It was created in 1903 to serve the dairy sector worldwide by providing a platform for exchange of knowledge, experience and ideas among dairy experts. IDF is a source of scientific and technical expertise and of influence in the dairy sector covering a broad variety of issues related to dairying, including dairy farming, emerging countries, technology, hygiene and safety, food standards, methods of analysis and sampling, nutrition and health, economics, marketing and policies.

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IDF/FAO International Symposium on Dairy Safety and Hygiene

2 – 5 March 2004
Cape Town, South Africa

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
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Foreword
Proceedings Manual: UBISI2004

The IDF/FAO/OIE International Symposium on Dairy Safety and Hygiene was held in the Bantry Bay President Hotel, Cape Town South Africa from 2 to 5 March, 2004. After years of intensive collaborative planning, everything came together successfully and it is a privilege to report that more than 300 delegates from 32 countries attended the Symposium. 10 countries attending were not current members of the IDF. It is also exciting and significant that the Symposium was presented under the auspices of three international organizations of the caliber of the IDF, the FAO and the OIE, arguably the first time that this has happened. The 41 speakers were from 20 countries and all were invited on the basis of their unique expertise and experience to contribute to a truly memorable scientific gathering.

The objectives of the Symposium were to deliberate on ensuring safe and suitable dairy products using a Farm to Table approach, also taking into consideration countries with emerging dairy industries. The more specific objectives included the management of the health and welfare of dairy animals, ensuring safety and quality of feed and water supplies, to examine the protection of the environment and last but not least, to discuss ways of ensuring safety and hygiene and identifying potential hazards along the whole the dairy production chain.

Due to the complexity of the main theme and its uniquely practical nature, it was important to target the right audience. After much discussion in the planning stages of the Symposium it was decided to target any person actively involved in furthering the objectives of dairy safety and hygiene in their respective countries or companies. This would include farm extension officers, public and private health professionals, technical and quality management staff, educators and trainers, scientists and researchers. It was regarded as important that technically qualified persons and educators from countries with an emerging dairy industry component be invited to use the information generated at this forum for adaptation to the particular circumstances existing in their countries and companies.

The Symposium in terms of outcomes indeed ensured that delegates would not leave the conference empty handed. The report of the IDF/FAO Taskforce on Good Dairy Farming Practices was tabled on this occasion and printed copies of the resultant Guide were made available for the first time. This report, a joint publication by the IDF and the FAO, describes in practical terms the Good Agricultural Practices that should be applied during primary production of milk. The sections dealt with included Animal health, Milking hygiene, Animal feeding and water and the Environment. The actual sessions of the Symposium itself were largely based on the latter subject matter from a primary production perspective, but went on to highlight the latest developments and new insights pertaining to the management of microbiological and chemical hazards at dairy processing level. In this way the Symposium effectively addressed its objectives in applying a comprehensive food chain approach to dairy safety and hygiene from the farm to the table.

It is on behalf of the South African National Committee of the IDF, the Organizing- and Programme Committees of UBISI2004 and also our colleagues in the IDF International Secretariat, the FAO and the OIE, my privilege to invite you to now enjoy the full, hard copy proceedings of the Symposium. I also wish to offer my heartfelt gratitude to all who made a contribution to this major initiative – it was a true team effort.

Piet Jooste
Chair - UBISI 2004

SESSION 1

The food chain approach from an international perspective

The role and contribution of IDF in promoting dairy safety and hygiene in emerging and developed countries

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Abstract

The International Dairy Federation (IDF) is a non-profit private sector organization representing the interests of various stakeholders in dairying at the international level. It was founded in 1903 and presently has 41 member countries. These members are organized in National Committees, which are national associations composed of representatives of all dairy-related national interest groups including dairy farmers, dairy processing industry, dairy suppliers, academics and governments/food control authorities.

IDF has been active in developing standards for dairy commodities and methods of analysis and sampling since the early 1930s. Over the years it has produced a number of manuals, guidelines and other texts relating to microbiological hygiene and safety in primary milk production and during milk processing as well as in relation to residues and chemical contaminants. Some of these texts are frequently referred to in international discussions and serve as reference for the establishment of Codex and other international, regional and national regulations.

The current IDF Programme of Work is designed to meet the need for an integrated chain management approach to achieving dairy safety and hygiene. While these issues are dealt with by different IDF working bodies, a very close and central liaison is ensured. Major items are:

- Completion of a guideline on **Application of HACCP Principles in Feed Production** in consultation with five other international organizations representing feed producers, feed traders and consumers;
- Establishment of a practical, farmer-orientated, world-wide, achievable **Guide on Good Dairy Farming practices** for dairy farmers covering different aspects of concern such as: animal health, milk hygiene, animal feeding, animal welfare and environment (a joint work project with the FAO);
- Joint work project with OIE in relation to **harmonization of animal health requirements for export certification** - revision of OIE Animal Health Code;
- Active involvement in the Codex elaboration process of Proposed Draft Revised Guidelines for the Establishment of a Regulatory Programme for the Control of Drugs in Foods/ Proposed Draft Appendix on the **Prevention and Control of Veterinary Drug Residues in Milk and Milk Products;**
- Development of guidance for the world dairy sector on **types of antibiotic drugs used in the dairy sector, regulatory requirements and antimicrobial resistance monitoring;**
- Preparation of a manual on **control of mycotoxins** in terms of practical measures of control along the food chain and outline the responsibilities for control measures at each individual step in the food chain;
- Active involvement in the process of development of the **Codex Code on Hygienic Practices for Milk and Milk Products** as a horizontal regulatory frame for international trade in dairy products as well as other related Codex food hygiene texts such as **Codex guidelines on validation of food hygiene control measures** or **Codex Principles and Guidelines for the Conduct of Microbiological Risk Management**,
- Drafting of **IDF guidelines on Design of microbiological control systems in dairy production** has been initiated.
- New IDF work in relation to **traceability/trace-back** will commence in due course.

The presentation will demonstrate the linkage of various IDF work items for the production of safe and suitable dairy products and how they are approached in the context of achieving an integrated food-chain management approach.

INTRODUCTION

The International Dairy Federation (IDF) is a non-profit private sector organization representing the interests of various stakeholders in dairying at the international level. It was founded in 1903 and at present has 41 member countries. These members are organized in National Committees, which are national associations composed of representatives of all dairy-related national interest groups including dairy farmers, dairy processing industry, dairy suppliers, academics and governments/food control authorities. IDF is a science-based organization whose focus is to promote and enhance the image, trade, production and consumption of milk and milk products worldwide by collecting and disseminating scientific, technical and economic information and providing a platform for meaningful exchange of professional knowledge and discussion.

IDF has been active in developing standards for dairy commodities and methods of analysis and sampling since the early 1930s. Over the years it has produced a number of manuals, guidelines and other texts relating to microbiological hygiene and safety in primary milk production and during milk processing as well as in relation to residues and chemical contaminants. Some of these texts are frequently referred to in international discussions and served as reference for the establishment of Codex and other international, regional and national regulations.

The IDF Programme of Work of today is designed towards the need for an integrated chain management approach towards achieving dairy safety and hygiene. Current activities are spread across the IDF Programme of Work, and are dealt with by different IDF working bodies working closely together within a horizontal approach. The presentation today will provide an overview of the most relevant items.

GUIDELINES FOR THE APPLICATION OF HACCP PRINCIPLES IN THE PROCESSING OF FEED AND FEED INGREDIENTS

In the context of the work of a Codex Task Force on a Code of Practice on Good Animal Feeding, IDF has developed draft guidelines for HACCP application in the feed sector in collaboration with five other international organizations representing the feed industry, feed traders and consumers: Comité du Commerce des Céréales, Aliments du Bétail, Oléagineux, Huiles et Graisses et Agrofournitures de l´Union Européenne (COCERAL), Consumers International (CI), the European Feed Manufacturers´ Federation (FEFAC), the Grain and Feed Trade Association (GAFTA), and the International Feed Industry Federation (IFIF).

The application of HACCP principles in feed production is part of the shift in emphasis from end-product testing to preventive control of hazards at all stages of food production. The key in the application in the feed sector is the management of food-borne hazards by the introduction of maximum levels. These levels ensure that the outcome, in terms of hazard levels in feed, does not adversely affect the safety of the final ready-to-eat food. These maximum levels must take into account the physiology of the animals to which the feed is fed, control measures applied during and after manufacturing of the foods from these animals, and the end-product requirements for these foods.

The guidelines are currently being considered for joint publication by IDF and FAO. The main purpose of these guidelines is to supplement the Draft Codex Code of Practice on Good Animal Feeding, once adopted by Codex, with guidance on how to apply HACCP along with Good Manufacturing Practices (GMP) and Good Agricultural Practices (GAP) to improve credibility and to focus resources allocations in the animal feed sector.

GUIDE TO GOOD DAIRY FARMING PRACTICE

An IDF Task Force, together with FAO, has developed a practical, farm orientated, world-wide achievable guide of production for dairy farmers covering different aspects of concern such as animal health, milk hygiene, animal feeding and water, animal welfare and environment.

This Guide represents the best of IDF working horizontally, bringing forth the needed expertise from many diverse disciplines to accomplish a common goal - a practical guide for dairy farmers. The document has been written in a practical format for use by the farmer to support the marketing of safe, quality-assured milk and dairy products, and focus on the relationship between consumer safety and best practice at farm level. IDF/FAO experts recognized that the traditional application of HACCP at farm level is not feasible for the time being. Instead, the HACCP principles can be applied in the development of practical codes of good practices that identify practical measures and routines similar to traditional GAP codes. This approach will avoid the direct exposure by the individual farmer to the HACCP procedure and result in GAP codes being more focused and systematically founded.

The guide has been published by FAO under joint IDF/FAO logos. The English version is available to symposium participants. French, Spanish, Chinese and Arabic versions are also foreseen to be published in the course of this year.

As a separate piece of work, a Code of Good Hygienic Practice for Milking with Automatic Milking Systems was published by IDF earlier this year.

Harmonization of animal health requirements

The World Organisation for Animal Health (OIE) has established a Terrestrial Animal Health Code. The objective of this periodically updated Code is to prevent the spread of animal diseases, while facilitating international trade in live animals, semen, embryos and animal products. The OIE

Code is a reference document for use by authorities of veterinary departments, import/export services, epidemiologists and all those involved in international trade.

IDF and OIE have initiated close co-operation in relation to a revision of this Code as it affects animal diseases of concern to the dairy sector. The work supplements on-going Codex elaboration of an international Codex export certificate for milk and milk products referring to animal health requirements having an impact on public health.

MANAGEMENT OF MYCOTOXINS IN DAIRYING

Mycotoxins are natural contaminants in the food and feedstuffs producing ecosystems. They are more difficult to completely control in contrast to residues of agricultural chemicals, for which effective control mechanisms and tools are applicable. Some mycotoxins exhibit carcinogenic properties in mammals including humans, and thus require special attention and even regulatory pressures to minimize their uptake by the human consumer.

In dairying, mycotoxins are of dual concern. On the one hand they may have detrimental effects on animal health and, subsequently, cause production losses. On the other hand, certain feed-borne mycotoxins can pass the blood-milk-barrier in the cow, and appear in low concentrations in the milk. Hence, consumption of milk or milk products may bear the risk of exposing consumers to mycotoxins and it is essential to build and implement strategies for minimizing that risk.

IDF is currently working on an up-date/supplement to earlier IDF publications. It will include:

- A description of hazard and risk of mycotoxins for milking animals and consumers;
- the possible and feasible control tools and verification of control measures;
- safe methods of feed manufacturing and storage into codes of practice for good farming and good feeding as well as guidance on application of the HACCP concept to industrially and farm produced feedstuffs;
- estimation of commercial risks, losses and reputation including the public perception of mycotoxin associated risk;
- relevant peripheral topics and further research needs.

The planned monograph will outline the various issues associated with mycotoxins as a basis for due management at every stage of the food chain involving feed and milk with a clear orientation towards minimization of the impact of mycotoxins on dairying.

PREVENTION AND CONTROL OF VETERINARY DRUG RESIDUES IN MILK AND MILK PRODUCTS

The IDF work in this field comprises development and publication of guidance for the world dairy sector on types of antibiotic drugs used in the dairy sector, regulatory requirements and antimicrobial resistance monitoring. Surveys are conducted in IDF members countries to establish an overview of current practices and requirements. IDF is also playing an active role in on-going Codex work in relation to guidelines for the establishment of a regulatory programme for the control of drugs in foods including dairy products.

ON-GOING CODEX ACTIVITIES RELATING TO FOOD HYGIENE (CODEX COMMITTEE ON FOOD HYGIENE - CCFH)

Amongst the various on-going activities the following are of paramount interest to the dairy sector and with active IDF participation:

- **Code of Hygienic Practices for Milk and Milk Products** as a horizontal regulatory frame for international trade in dairy products, IDF had contributed a major part of the document in its capacity of scientific-technical advisor to Codex in dairy related matters,
- **Guidelines on Validation of Food Hygiene Control Measures,**
- **Principles and Guidelines for the Conduct of Microbiological Risk Management**,
- **Guidelines on the Application of General Principles of Food Hygiene to the [Management] of *Listeria monocytogenes* in Foods, and**
- **Guidelines for the Hygienic Reuse of Processing Water in Food Plants**

Supplementary to the Codex texts under elaboration, IDF is currently developing a vision on **Food Safety Objective (FSO) and Performance Objective (PO)** as key concepts in future food safety management. This is subsequent to revolutionary developments within quantitative microbiological risk assessment enabling quantitative estimation of the distribution of health risks relative to consumer exposure to specified hazards. Mathematical modeling and simulation enable a quantitative estimate of the contributions of each stage in the food chains. Thus, a holistic food safety management can be applied focused on scientifically documented needs to manage risks associated with food borne hazards.

TRACEABILITY/TRACE-BACK

New IDF work in relation to traceability/trace-back will commence in due course based on the fact that a number of countries have introduced requirements for traceability in food legislation recently. Traceability/trace-back is increasingly regarded as an effective means to contribute to both product safety and consumer confidence in food labelling.

The impact of traceability on food production in general and the dairy sector in particular, depends very much on the appropriateness of the requirements as well as the degree of harmonization between trading partners/countries. IDF will contribute to the establishment of internationally recognized sound principles and guidelines for the application of traceability/product tracing to food/dairy products in the following areas:

- principles to be taken into account when establishing requirements (regulations) for traceability/product tracing,
- examples (if possible from various regions) of practical applications of traceability/product tracing to various dairy products/commodities for both SPS and TBT purposes, illustrating the performances and limits of the system.

PROMOTING THE DEVELOPMENT OF INTEGRATED CHAIN MANAGEMENT FOR FOOD SAFETY IN THE DAIRY PRODUCTION CHAIN

Food safety incidents often originate from the early stages of the food production chain, sometimes far out of scope of the manufacturers of the food. The hazards in these early stages are more numerous and more difficult to control than the ones in the confined manufacturing stage. Nevertheless they can generally be prevented by rather straightforward control measures, if the existence of the hazard would only have been recognized. Producers in the preceding links of the production chain usually attune the quality assurance to the quality criteria of their direct buyers only. The hazards which exist for the end product of the production chain are not always taken into account. Experience learns that this is quite a risk, especially in the long production chain of dairy products.

IDF has initiated work on setting-up a framework for exchange of information and consultation on food safety issues between various international organisations that represent the sectors in the dairy production chain. It also includes proposals on how to make stakeholder consultations a regular feature in different IDF work activities throughout the food chain.

CONCLUSION

To produce safe and wholesome dairy products it is indispensable to control all factors in each link of the production chain that might have a negative effect on safety and suitability of the final product of the food chain.

Whereas the primary responsibility lies with the food manufacturer for ensuring that the foods manufactured are safe and suitable, there is a continuum of effective controls needed by the other parties constituting the food chain. Consequently, food safety is a shared responsibilities of all players along the food chain, including but not limited to feed and raw material suppliers, feed manufacturers, cattle breeders, veterinarians, dairy farmers, equipment suppliers, dairy processors, retailers, etc.

IDF's role and contribution to dairy safety and hygiene is to provide the scientific and technical expertise needed to develop regulatory text and to supply the dairy sector and other stakeholders in dairying with practical guidance on how to achieve the required safety and suitability of dairy products world-wide.

IDF is very proud of the close working relationships we have with FAO, OIE, and the Codex office, and the valuable work our four organizations have accomplished, and will continue to accomplish in the future, together.

FAO activities in relation to good agricultural practices

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Abstract
The concept of Good Agricultural Practices (GAP) has been adopted in recent years by governments, non-governmental organizations and the private sector particularly in the extension of food safety risk management to primary production, but also in the context of environmental sustainability and social acceptability. FAO has a number of activities underway including consultations, workshops, and field studies that are contributing to the development of the approach. There is also a database that provides information on GAP guidelines, projects and specific case studies. A critical challenge is to ensure that the expanding use of GAP for quality assurance will take into account the interests of smaller-scale producers in developing countries. General principles of GAP are presented with particular reference to animal production, health and welfare. FAO is working with partners in different countries to apply GAP principles in different farming systems and agro-ecozones.

INTRODUCTION
The Food and Agriculture Organization of the United Nations is concerned with raising levels of nutrition, improving agricultural productivity, improving the lives of rural populations and contributing to the growth of the world economy. Serving both developed and developing countries, FAO acts as a neutral forum where all nations meet as equals to negotiate agreements and debate policy. FAO is also a source of knowledge and information. It helps developing countries and countries in transition to modernize and improve agriculture, forestry and fisheries practices and ensure good nutrition for all. FAO is composed of eight departments: Administration and Finance, Agriculture, Economic and Social, Fisheries, Forestry, General Affairs and Information, Sustainable Development and Technical Cooperation. FAO employs more than 3 450 staff members - 1 450 professional and 2 000 general service staff - and maintains five regional offices, five subregional offices, five liaison offices and over 78 country offices, in addition to its headquarters in Rome.

FAO AND THE CODEX ALIMENTARIUS
The Codex Alimentarius Commission was created in 1963 by FAO and WHO to develop food standards, guidelines and related texts such as codes of practice under the Joint FAO/WHO Food Standards Programme.. The main purposes of this Programme are protecting health of the consumers and ensuring fair trade practices in the food trade, and promoting coordination of all food standards work undertaken by international governmental and non-governmental organizations.

The Codex Alimentarius contains General Standards which include: food labeling; food additives; contaminants; methods of analysis and sampling; food hygiene; nutrition and foods for special dietary uses; food import and export inspection and certification systems; residues of veterinary drugs in foods; and pesticide residues in foods.

In addition, Codex contains Standards and Codes relating to specific commodities. Of relevance to the present subject are the three Codes relating to livestock which are currently being developed and likely to be adopted by the Commission within the next year. These relate to animal feeding, fresh meat, and milk and milk products.

The Draft Code of Practice on Animal Feeding (Codex Alimentarius, 2003a) contains general principles and requirements (which include references to Good Agriculture Practices (GAPs), Good Manufacturing Practices (GMPs), and Hazard Analysis and Critical Control Point (HACCP)) and sections on labeling; traceability; inspection and control procedures; contaminants; feed additives and veterinary drugs; antibiotics; undesirable substances; on-farm production and use of feed; manufacturing of feed on-farm; and good animal feeding practice.

The Draft Code of Hygienic Practice for Fresh Meat (Codex Alimentarius, 2004) covers: principles of risk management; meat hygiene applying to primary production; animal identification practices; transport of slaughter animals; ante-mortem inspection; control of processing operations (HACCP); post-mortem inspection (including BSE surveillance and prevention); establishments: maintenance and sanitation; personal hygiene; product information and consumer awareness; and training.

Finally, the Draft Code of Hygienic Practice for Milk and Milk Products (Codex Alimentarius, 2003b) is divided into: primary production; environmental hygiene; hygienic production of milk; handling storage and transport; record keeping; equipment and facilities; control of operation; maintenance and sanitation; personal hygiene; transport; processing; product information and consumer awareness; and training, and contains two appendices on microbiostatic control measures and microbiocidal control measures.

FAO is concerned with implementing the new Codes of Practice for animal feed, meat and milk. It is of particular note that these embody a new approach to food safety which is based on the principles of risk analysis (rather than food inspection) and, furthermore, they include primary production, that is, the whole food chain from Farm to Fork. For this reason, FAO is developing the concept of Good Agricultural Practices which goes further than the Codex Alimentarius mandate of food safety and fair trade. While including food safety, GAP also takes account of the environment and social aspects.

GOOD AGRICULTURAL PRACTICES

The concept of Good Agricultural Practices (GAP) has evolved in recent years in the context of a rapidly changing and globalizing food economy and as a result of the concerns and commitments of a wide range of stakeholders about food production and security, food safety and quality, and the environmental sustainability of agriculture. These stakeholders include governments, food processing and retailing industries, farmers, and consumers, who seek to meet specific objectives of food security, food quality, production efficiency, livelihoods and environmental benefits in both the medium and long term. GAP offers a means to help reach those objectives.

Broadly defined, GAP applies available knowledge to addressing environmental, economic and social sustainability for on-farm production and post-production processes resulting in safe and healthy food and non-food agricultural products. Many farmers in developed and developing countries already apply GAP through sustainable agricultural methods such as integrated pest management, integrated nutrient management and conservation agriculture. These methods are applied in a range of farming systems and scales of production units, including as a contribution to food security, facilitation by supportive government policies and programmes.

The development of a food chain approach to food safety and quality has profound implications for agricultural production and post-production practices and offers the opportunity to address sustainable use of resources. At present, GAP is formally recognized in the international regulatory framework for reducing risks associated with the use of pesticides, taking into account public and occupational health, environmental, and safety considerations. The use of GAP is also being promoted increasingly by the private sector through informal codes of practice and indicators developed by food processors and retailers in response to emerging consumer demand for sustainably produced and wholesome food. This trend may create incentives for the adoption of GAP by farmers by opening new market opportunities, provided they have the capacity to respond.

FAO has initiated a process of discussion and consultation to take stock of the different developments and debate on GAP so as to make Members aware of the opportunities and issues in the further elaboration of GAP and ultimate adoption by farmers. FAO's role is to support these developments with comprehensive, objective, professional expertise and to advise governments on their scientific validity and policy implications. A broadly accepted framework of GAP principles, generic indicators and practices will help guide debate on national policies and actions and on the preparation of strategies to ensure that all stakeholders participate in and benefit from the application of GAP in the food chain.

CONTEXT AND APPROACH TO GAP

Agriculture is expected to assure food security in a range of settings, now and in the future, and is increasingly called upon to reduce any negative ecosystem impact while producing positive environmental, social and economic benefits. Attainment of these goals is affected by many factors, including technology, social and economic developments, and associated government policies and programmes. These factors are amplified by globalization, which is progressively changing how and where food and farm products are produced, processed and traded. Consumer concern is growing in all parts of the world over the environmental, economic and social sustainability, public health implications and safety of agricultural practices and products. Processors and retailers must match the anticipated market demands with the available supply of food in a lengthening food chain. Farmers need to have the capacity to make new farming and technology choices to meet demands for a safe and healthy diet in response to new regulations and standards, changing global consumption patterns, improved market access (through provision of safe food) and potential value-added opportunities. Governments provide the enabling policy and regulatory framework particularly concerning food safety, agricultural production and trade, while seeking to meet food security objectives.

While GAP responds, in part, to the growing demands of a globalized agriculture, the approach is also valid within the context of local food systems. Agriculture depends on viable communities and local food systems that provide the mechanism for farmers and consumers to benefit from a closer relationship between production and market, empowering local communities by creating and keeping financial and human resources within the community. The specific issues and constraints facing small-scale producers in developing countries need to be taken into consideration when formulating policies and programmes to develop and promote GAP.

The food chain approach to food safety and quality recognizes that the responsibility for the supply of food that is safe, healthy and nutritious is shared along the entire food chain - by all involved with the production, processing, trade and consumption of food. The food chain approach to food safety and quality implies that GAP should be extended along the food chain to put greater emphasis on primary production practices.

CURRENT APPLICATIONS OF GAP

GAP applications are being developed by governments, NGOs/CSOs and the private sector to meet farmers' needs and specific requirements in the food chain, but not in a holistic or coordinated way. In many cases the development of GAP at international and national levels is complemented by more specific adaptations for use at local levels. A few examples of current applications follow.

Governments, international agencies and NGOs promote sustainable agricultural methods such as integrated pest management, integrated nutrient management and conservation agriculture, among others, aimed at mitigating specific environmental and societal risks in a range of production and farming systems. These methods are especially appropriate for small- or medium-scale farmers in developing countries, contributing to increased local food production and food security, and conserving natural resources.

National agencies have also promoted GAP for both quality assurance and environmental management. These include the government agencies of Canada, France, Malaysia, New Zealand, Uruguay, the United Kingdom and the United States. Latvia, Lithuania and Poland have adopted good practices with respect to the Baltic agricultural runoff programme. The national agricultural research organization of Brazil, EMBRAPA, in collaboration with FAO, is developing a series of specific technical guidelines for melons, mangoes, fruit and vegetables, field crops, dairy, beef, swine and poultry, based on GAP to be tested by small, medium and large-scale producers.

The private sector, in particular industrial processors and retailers, uses GAP with a view to attaining quality assurance, consumer satisfaction and profit in the production of safe and high quality food along the food chain. These efforts increasingly incorporate sustainability criteria in response to consumer demand. Examples include the EUREPGAP generic Codes of Practice for fresh produce, combinable crops and livestock; the Sustainable Agriculture Initiative (Unilever, Nestlé, Danone and others); and, the EISA Common Codex for Integrated Farming. Unilever has developed more specific "sustainable agriculture indicators" of achievement for specific crops and locations. The promotion of GAP by food processors and retailers can facilitate the adoption of sustainable agricultural practices by creating incentives through potential value-added opportunities for farmers.

A specific version of GAP is applied within established codes of practice for food safety, under Codex Alimentarius, to minimize or prevent contamination of food. The Codex Alimentarius Commission develops and adopts standards, guidelines and related texts on all aspects of food safety and quality reflecting consensus at the international level. Codex standards are reference points for developing and harmonizing national standards. While the Codex Alimentarius specifically defines GAP in the context of the use of pesticides, the Code of Practice (General Principles of Food Hygiene) and other more specific codes, address good practices in primary production as well as post-production systems. Some national programmes have extended the use of the term Good Agricultural Practices to refer to practices to minimize microbial food safety hazards in fresh produce.

As part of the consultative process leading up to the World Summit on Sustainable Development (Johannesberg, 2002), NGOs and CSOs including farmer groups have highlighted some key elements of GAP. Among these are: working through community-based mechanisms to draw good practices from a broad range of approaches and systems, many of which combine traditional agriculture based on local knowledge with modern agriculture; empowering producers and strengthening farmers' organizations to begin to adopt GAP; recognizing the importance of fair returns to farmers for investments in environmental sustainability; and focusing efforts on humanely produced, safe and high quality foods that address food security.

As can be seen from these examples, GAP represents a multitude of approaches and applications addressing a range of needs in many parts of the world. This implies two challenges. The first challenge is to ensure that extending the use of GAP will take into account the interests of smaller-scale producers in developing countries both for the safety and sustainability of domestic production. There is a range of sustainable production methods to produce crop and livestock products through integrated production systems with potential benefits on a wider scale, including sustainable intensification, livelihoods enhancement and higher production to meet future food needs.

A broadly accepted framework of GAP principles, indicators and practices may provide a reference point to guide debate on national policies and actions. It may also ensure that stakeholders at all levels of development benefit from the application of GAP in on-farm agricultural production and post-production systems. Such a framework would also provide transparency among all actors along the food chain, and promote harmonization of approaches and their indicators of achievement.

THE GAP FRAMEWORK

Given the trend in the development and adoption of GAP, and the disparate applications described above, FAO has initiated a process of discussion and consultation to take stock of the ongoing developments and debate. It aims to make member governments aware of the opportunities and issues in the further elaboration of GAP, and the potential roles and benefits for governments, food processing and retailing industries, farmers and consumers. A framework is proposed within which to seek an understanding and agreement on the principles, indicators and practices of GAP.

In the context of agreed international goals to reduce hunger and promote food security, four principles of GAP apply to all scales of farming:

- economically and efficiently produce sufficient, safe and nutritious food;
- sustain and enhance the natural resource base;
- maintain viable farming enterprises and contribute to sustainable livelihoods;
- meet the cultural and social demands of society.

GAP provides a means to assess and decide on farming practices at each step in the production process. For any given agricultural production system, a sound and comprehensive management strategy must be in place providing for the capability for tactical adjustments in response to changes in circumstances. Implementing such a management strategy requires knowing, understanding, planning, measuring, monitoring, and record-keeping, with the aim of achieving production, safety and sustainability goals. Successful implementation depends upon developing the skill and knowledge bases, on continuous monitoring and analysis of performance, and the use of expert advice as required.

Accordingly, the proposed process of developing and supporting the adoption of GAP is to:

- Formulate a set of generic practices and indicators from which guidelines for good agricultural practices for on-farm production post-production systems can be developed, collaboratively by the public and private sectors and civil society.
- Focus existing knowledge, options, and solutions into effective food safety and environmental risk analysis guidelines available for use as policy instruments.
- Review existing codes of practice.
- Translate codes of practice into management guidelines for crop and livestock systems in specific agro-ecozones.
- Engage in discussion with governments on their strategies, priorities and instruments to move towards sustainable agriculture and rural development practices.

With partners, FAO is developing a set of ten component groups of generic indicators and practices of GAP. These include aspects related to soil and water management, crop and fodder production, crop protection, animal production and health, harvesting and on-farm processing and storage, on-farm energy and waste management, human welfare, health and safety, and wildlife and landscape.

The implementation of GAP is generally through a process of assessing the critical management choices that are made sequentially throughout the production of crops and livestock. At each decision control point the implications for GAP are assessed in the context of defined indicators, which serve as the basis for analyzing food safety, environmental and societal risks. This process may be used to prepare codes of practice for major agricultural production systems, and detailed management guidelines for individual production systems within specific agro-ecozones. By definition, GAP should be explicitly linked to a farming systems categorization in order to apply indicators and practices within a defined domain.

Several issues may arise in the application of codes of practice and management guidelines elaborated using the proposed GAP framework. The value of the framework itself will depend upon the adoption of practices by farmers, involvement of the food industry, demand by consumers and support from governments through enabling policies and extension services. Meanwhile, as consumers are increasingly demanding sustainable agricultural practices, application of GAP can, in some cases, result in higher production, processing and marketing costs, which informed consumers might be prepared to absorb. This will create further incentives for the adoption of GAP and its promotion by the private sector. In parallel to the development of GAP, new codes of conduct for agriculture are under discussion in the emerging areas of biotechnology and biosafety, and their relationship to GAP will need to be considered.

The next stage in the process is to develop GAP guidelines for on-farm production and post-production systems, involving the participation of farmers, and bringing together scientific and technical expertise, and civil society. FAO's role could be to support the development of quality assurance schemes and codes of practice with comprehensive, objective, professional expertise, and to advise governments on their scientific validity and policy implications.

GAP IN RELATION TO LIVESTOCK PRODUCTION

Livestock require adequate space, feed, and water for welfare and productivity. Stocking rates must be adjusted and supplements provided as needed to livestock grazing pasture or rangeland. Chemical and biological contaminants in livestock feeds are avoided to maintain animal health and/or to prevent their entry into the food chain. Manure management minimizes nutrient losses and stimulates positive effects on the environment. Land requirements are evaluated to ensure sufficient land for feed production and waste disposal.

Good practices related to animal production will include those that site livestock units appropriately to avoid negative effects on the landscape, environment, and animal welfare; avoid biological, chemical, and physical contamination of pasture, feed, water, and the atmosphere; frequently monitor the condition of stock and adjust stocking rates, feeding, and water supply accordingly; design, construct, choose, use and maintain equipment, structures, and handling facilities to avoid injury and loss; prevent residues from veterinary medications and other chemicals given in feeds from entering the food chain; minimize the non-therapeutic use of antibiotics; integrate livestock and agriculture to avoid problems of waste removal, nutrient loss, and greenhouse gas emissions by efficient recycling of nutrients; adhere to safety regulations and observe established safety standards for the operation of installations, equipment, and machinery for animal production; and maintain records of stock acquisitions, breeding, losses, and sales, and of feeding plans, feed acquisitions, and sales.

ANIMAL HEALTH AND WELFARE

Successful animal production requires attention to animal health that is maintained by proper management and housing, by preventive treatments such as vaccination, and by regular inspection, identification, and treatment of ailments, using veterinary advice as required. Farm animals are sentient beings and as such their welfare must be considered. Good animal welfare is recognized as freedom from hunger and thirst; freedom from discomfort; freedom from pain, injury or disease; freedom to express normal behaviour; and freedom from fear and distress.

Good practices related to animal health and welfare will include those that minimize risk of infection and disease by good pasture management, safe feeding, appropriate stocking rates and good housing conditions; keep livestock, buildings and feed facilities clean and provide adequate, clean bedding where livestock is housed; ensure staff are properly trained in the handling and treatment of animals; seek appropriate veterinary advice to avoid disease and health problems; ensure good hygiene standards in housing by proper cleansing and disinfection; treat sick or injured animals promptly in consultation with a veterinarian; purchase, store and use only approved veterinary products in accordance with regulations and directions, including withholding periods; provide adequate and appropriate feed and clean water at all times; avoid non-therapeutic mutilations, surgical or invasive procedures, such as tail docking and debeaking; minimize transport of live animals (by foot, rail or road); handle animals with appropriate care and avoid the use of instruments such as electric goads; maintain animals in appropriate social groupings where possible; discourage isolation of animals (such as veal crates and sow stalls) except when animals are injured or sick; and conform to minimum space allowances and maximum stocking densities.

PROCESSING AND STORAGE

Product quality also depends upon implementation of acceptable protocols for collection, storage, and where appropriate, processing of farm products. Producers must conform to regulations relating to agrochemicals and withholding periods for veterinary medicines. Food produce should be stored under appropriate conditions of temperature and humidity in space designed and reserved for that purpose. Operations involving animals, such as shearing and slaughter, must adhere to animal health and welfare standards.

For washing, use recommended detergents and clean water; store food products under hygienic and appropriate environmental conditions; pack food produce for transport from the farm in clean and appropriate containers; and use methods of pre-slaughter handling and slaughter that are humane and appropriate for each species, with attention to supervision, training of staff and proper maintenance of equipment.

ENERGY AND WASTE MANAGEMENT

Energy and waste management are also components of sustainable production systems. Farms require fuel to drive machinery for cultural operations, for processing, and for transport. The objective is to perform operations in a timely fashion, reduce the drudgery of human labour, improve efficiency, diversify energy sources, and reduce energy use.

Good practices related to energy and waste management will include those that establish input-output plans for farm energy, nutrients, and agrochemicals to ensure efficient use and safe disposal; adopt energy saving practices in building design, machinery size, maintenance, and use; investigate alternative energy sources to fossil fuels (wind, solar, biofuels) and adopt them where feasible; recycle organic wastes and inorganic materials, where possible; minimize non-usable wastes and dispose of them responsibly; store fertilizers and agrochemicals securely and in accordance with legislation; establish emergency action procedures to minimize the risk of pollution from accidents; and maintain accurate records of energy use, storage, and disposal.

SOIL AND WATER

Good practices related to soil include maintaining or improving soil organic matter through the use of soil carbon-build up by appropriate crop rotations, manure application, pasture management and other land use practices, rational mechanical and/or conservation tillage practices; maintaining soil cover to provide a conducive habitat for soil biota, minimizing erosion losses by wind and/or water; and application of organic and mineral fertilizers and other agro-chemicals in amounts and timing and by methods appropriate to agronomic, environmental and human health requirements.

Agriculture carries a high responsibility for the management of water resources in quantitative and qualitative terms. Careful management of water resources and efficient use of water for rain-fed crop and pasture production, for irrigation where applicable, and for livestock, are criteria for GAP.

CROP AND FODDER PRODUCTION

Good practices related to crop and fodder production will include those that select cultivars and varieties on an understanding of their characteristics, including response to sowing or planting time, productivity, quality, market acceptability and nutritional value, disease and stress resistance, edaphic and climatic adaptability, and response to fertilizers and agrochemicals; devise crop sequences to optimize use of labour and equipment and maximize the biological benefits of weed control by competition, mechanical, biological and herbicide options, provision of non-host crops to minimize disease and, where appropriate, inclusion of legumes to provide a biological source of nitrogen; apply fertilizers, organic and inorganic, in a balanced fashion, with appropriate methods and equipment and at adequate intervals to replace nutrients extracted by harvest or lost during production; maximize the benefits to soil and nutrient stability by re-cycling crop and other organic residues; integrate livestock into crop rotations and utilize the nutrient cycling provided by grazing or housed livestock to benefit the fertility of the entire farm; rotate livestock on pastures to allow for healthy re-growth of pasture; and adhere to safety regulations and observe established safety standards for the operation of equipment and machinery for crop and fodder production.

HUMAN WELFARE, HEALTH AND SAFETY

Human welfare, health and safety are further components of sustainability. Farming must be economically viable to be sustainable. The social and economic welfare of farmers, farm workers, and their communities depends upon it. Health and safety are also important concerns for those involved in farming operations. Due care and diligence is required at all times. With regard to agricultural workers, the International Labour Organization (ILO), in collaboration with governments, employers and trade unions, has developed core conventions on labour including codes of practice for agriculture, which have not been specifically included in the indicators and practices.

Good practices related to human welfare, health and safety will include those that direct all farming practices to achieve an optimum balance between economic, environmental, and social goals; provide adequate household income and food security; adhere to safe work procedures with acceptable working hours and allowance for rest periods; instruct workers in the safe and efficient use of tools and machinery; pay reasonable wages and not exploit workers, especially women and children; and purchase inputs and other services from local merchants if possible.

WILDLIFE AND LANDSCAPE

Agricultural land accommodates a diverse range of animals, birds, insects, and plants. Much public concern about modern farming is directed at the loss of some of these species from the countryside because their habitats have been destroyed. The challenge is to manage and enhance wildlife habitats while keeping the farm business economically viable.

Good practices related to wildlife and landscapes will include those that identify and conserve wildlife habitats and landscape features, such as isolated trees, on the farm; create, as far as possible, a diverse cropping pattern on the farm; minimize the impact of operations such as tillage and agrochemical use on wildlife; manage field margins to reduce noxious weeds and to encourage a diverse flora and fauna with beneficial species; manage water courses and wetlands to encourage wildlife and to prevent pollution; and monitor those species of plants and animals whose presence on the farm is evidence of good environmental practice.

COLLABORATION WITH THE INTERNATIONAL DAIRY FEDERATION (IDF) - THE GUIDE TO GOOD DAIRY FARMING PRACTICE

In considering the development of specific GAP guidelines, FAO has worked in partnership with a number of non-governmental organizations (NGOs) and civil society organizations (CSOs). With respect to dairy farming, FAO has collaborated with the IDF Task Force on Good Dairy Farming Practices between 2001 and 2004, culminating in the joint publication of the Guide to Good Dairy Farming Practice (FAO/IDF, 2004). This covers all the aspects of: animal feeding, animal health management, drugs and contaminants residues, microbiological hygiene and environmental contamination. The Task Force comprised representatives from 14 countries in addition to the Secretariat. FAO's role, besides providing technical input to the meetings, was to sponsor the attendance of representatives from developing countries, China and Kenya, in addition to India which was already represented. In this way, FAO is seeking to assist IDF to represent a wider constituency and to include the needs and concerns of developing countries in the agenda of the Task Force on Good Dairy Farming Practices.

FURTHER DEVELOPMENT OF GOOD AGRICULTURAL PRACTICES

In April 2003, the FAO Committee on Agriculture (COAG) was invited to consider the process for developing GAP through consultation and dialogue with Member Nations, NGOs/CSOs, the private sector and consumers. COAG recommended that FAO continue its initial work on a GAP approach, which might include awareness raising, information exchange, economic analysis, pilot projects, technical assistance and capacity building, with a special focus on the needs of developing countries.

Among other activities, FAO is developing a meta-database of case studies and success stories relating to GAP and integrated production systems which will combine the information from a number of sources and provide reference to technical developments in the public and private sectors.

Among the various activities in progress are the development of manuals and guidelines for the implementation of the various standards and codes and projects for capacity building to ensure the implementation of GAP in the countries. In these activities, FAO will work closely with NGOs and CSOs and, in the further development of Good Dairy Farming Practice, will continue to collaborate with IDF.

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The role of the *Office International des Epizooties* in international trade standards

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Abstract
The successful entry into international trade in animal and animal products is primarily determined by the acceptance of the importing country of the level of protection for animal and human health guaranteed by the sanitary guarantees submitted by an exporting country. The OIE together with the Codex Alimentarius are the only two international organisations accepted in terms of the Sanitary and Phytosanitary Agreement of the WTO for setting mimimum standards for the international trade in animals and animal products. The standards, guidelines and recommendations for international trade developed by the OIE, are based on scientific principles as required by the SPS Agreement and is therefore used by most countries as a minimum standard for trade negotiations. The OIE is therefore an important facilitator for international trade by making it possible for both developed and developing countries to enter into trade negotiations based on the risk mitigation measures applied for the paticular commodity to be exported or imported.

INTRODUCTION
The successful entry into international trade in animal and animal products is primarily determined by the acceptance of the sanitary guarantees of the exporting country and how closely it satisfies the desired level of protection for animal and human health of the importing country [2, 6]. The guidelines and recommendations for the minimum sanitary standards for acceptance or refusal of imports of animals or animal products are outlined in the International Terrestrial Animal Health Code of the OIE (*Office International des Epizooties* - World Organisation for Animal Health) and the Codex Alimentarius of the FAO/WHO. The Sanitary and Phytosanitary Agreement (SPS Agreement) of the WTO (World Trade Organisation) outlines the rights and obligations of countries for trade, based on the application of the standards of the OIE and Codex.

BRIEF OVERVIEW OF THE OIE
The OIE was established in 1924 in Paris, France with the following main objectives:

- To ensure transparency in the animal health situation throughout the world.
- To collect, analyse and disseminate veterinary information.
- To contribute expertise and encourage international coordination in the control of animal diseases.
- Within its mandate under the SPS WTO Agreement, to safeguard world trade by publishing health standards for international trade in animals and animal products.
- To improve the infrastructure of Veterinary Services.

The standards, guidelines and recommendations for the international trade in animals and animal products, are outlined in the following reference documents of the OIE :

- Terrestrial Animal Health Code - mammals, birds and bees
- Aquatic Animal Health Code - fish, molluscs and crustaceans
- Manual of Diagnostic Tests and Vaccines for Terrestrial Animals
- Manual of Diagnostic Tests and Vaccines for Aquatic Animals

The International Committee of the OIE consisting of the official delegates of 166 member countries, annually evaluate, consider and approve standards, guidelines and recommendations that are presented for adoption by the Code Commission and Aquatic Animals Commission [2]. The submissions by the Code and Aquatic Commissions represents inputs from the Scientific Commission and Laboratories Commission, permanent and ad hoc Working Groups of the OIE and also comments and recommendations from Member Countries of the OIE.

The Terrestrial Animal Health Code provides detailed recommendations of sanitary measures to be used by Chief

Veterinary Officers of Member Countries in establishing health regulations applying to the safe importation of animals and animal products, while avoiding unjustified trade restrictions. It also contains recommendations covering ruminants, swine, equidae, rabbits, bees, poultry, dogs and cats.

THE RELATIONSHIP BETWEEN THE OIE AND THE SPS COMMITTEE OF THE WTO

The World Trade Organisation (WTO) was established in 1995 following the signing of the Final Act of the Uruguay Round of Multilateral Trade Negotiations in Marrakech on 15 April 1994. Contained in the Final Act along with the General Agreement on Tariffs and Trade (GATT 1994) and other agreements, was the Agreement on Sanitary and Phytosanitary Measures (SPS Agreement) established for the application of food safety and animal and plant health regulations which may directly or indirectly, affect international trade [2, 6]. The main purpose of the SPS Agreement was to facilitate unhindered international trade in animals, plants and their products without endangering human, animal or plant life. A key underlying principle of the SPS Agreement is that sanitary and phytosanitary measures should be based on scientific principles and on international sanitary standards for the trade in animals and animal products.

The OIE Code, the SPS Agreement and the Codex Alimentarius are the three most authoritative reference documents to guide decision-making for the formulation and evaluation of sanitary measures and have precedence over other national, regional or international legislation that regulate or mandate sanitary measures. Guidelines and recommendations are given for specific rights, obligations, and alternatives to be considered to minimise risk in the trade of animals and animal products and to create options to promote trade between countries of equal sanitary status but also between countries of different sanitary status. The Code and Codex provides the scientific base for these decisions as required by the SPS Agreement as the only acceptable base for decision-making on sanitary and phytosanitary matters related to trade [6,7].

The SPS Agreement contains key provisions to facilitate trade and support the application of the international standards of the Terrestrial Animal Health Code of the OIE. The most important of these are:

Harmonization of sanitary measures - Article 3 of the Agreement states that " *..to harmonize sanitary and phytosanitary measures on as wide a basis as possible, Members shall base their sanitary or phytosanitary measures on international standards, guidelines or recommendations, where they exist, except as otherwise provided for in this Agreement ..*" The only exception is where a Member Country can provide scientific evidence to justify a standard other (higher) than an international standard.

Equivalence - Article 4 of the Agreement states that "*..Members shall accept the sanitary or phytosanitary measures of other Members as equivalent, even if these measures differ from their own or from those used by other Members trading in the same product, if the exporting Member objectively demonstrates to the importing Member that its measures achieve the importing Member's appropriate level of sanitary or phytosanitary protection..*" This concept is also included into the OIE Code and constitutes an important facilitator of trade in animals and animal products.

Assessment of risk and appropriate level of protection (ALOP) - Article 5 of the Agreement makes specific provision for this important consideration whenever a trade agreement is negotiated. In Article 5.5 it is clearly stated that " *..With the objective of achieving consistency in the application of the concept of appropriate level of sanitary or phytosanitary protection against risks to human life or health, or to animal and plant life or health, each Member shall avoid arbitrary or unjustifiable distinctions in the levels it considers to be appropriate in different situations, if such distinctions result in discrimination or a disguised restriction on international trade..*" and further in Article 5.6 "*..when establishing or maintaining sanitary or phytosanitary measures to achieve the appropriate level of sanitary or phytosanitary protection, Members shall ensure that such measures are not more trade-restrictive than required to achieve their appropriate level of sanitary or phytosanitary protection, taking into account technical and economic feasibility..*" The main thrust of these requirements are to prevent discriminatory non-tariff barriers to be used to inhibit trade. The concept of risk assessment is sometimes regarded as a hidden obstacle by some developing countries who do not have the expertise available to conduct a risk assessment. However, the OIE Code does not specify that risk assessments must be quantitative. Qualitative risk assessments are equally acceptable if they clearly succeed in justifying the rationale for a sanitary measure or the reason for allowing or not allowing trade.

Regionalization - The OIE Code makes specific provision for criteria to obtain country freedom from specific diseases or to declare zones within a country free from a disease. The diseases that are currently specifically provided for official recognition by the OIE are Foot and mouth disease, Rinderpest, Contagious Bovine Pleuropneumonia and Bovine Spongiform Encephalopathy. There are however, within the Code chapter for each disease, criteria specified to regard a country or a zone free from a disease. The SPS Agreement endorses this concept and encourages Member Countries in Article 6 of the Agreement to give acknowledgement to this in trade negotiations.

Transparency - the success of the application of the SPS Agreement and the assurance that Member Countries accept the sanitary guarantees provided in trade negotiations, are dependent on the commitment of Member Countries to be transparent in their negotiations and to notify to the WTO any change in their animal disease status or any change in the application of sanitary measures. Article 7 of the Agreement specifically requests member Countries to notify any such changes to the WTO.

THE STANDARDS, GUIDELINES AND RECOMMENDATIONS OF THE OIE TERRESTRIAL ANIMAL HEALTH CODE FOR THE TRADE IN ANIMALS AND ANIMAL PRODUCTS

Without giving a detailed description of the OIE International Animal Health Code, it is important to note that the *Code* only provides *standards, guidelines and recommendations* to Member Countries for the formulation of sanitary measures. In terms of article 3.2 of the SPS Agreement, sanitary measures that conform to international standards (i.e. such as in the *Code*), shall be deemed to be sufficient for the protection of human or animal health and therefore need not be subjected to a risk assessment [7]. This important concept is often not fully appreciated and challenged by countries who do not have sufficient expertise to conduct risk assessments when an importing country insists on a risk assessment to evaluate a sanitary measure in an exporting country in spite of the fact that the sanitary measure applied, complies with an international standard.

The various chapters of the Code are continuously revised and brought on par with new technologies, scientific information and the need for change as result of experiences in applying the guidelines, standards and recommendations. The SPS Agreement also allows Member Countries of the WTO to raise concerns on the application of international sanitary or phytosanitary standards at meetings of the SPS Committee. The OIE representative at these meetings would then convey the request to the Code Commission for consideration. However, an amendment to a chapter in the Code or the addition of new chapters to the Code is a very thorough process that would take a minimum of twelve months to be completed (see Figure 1)

This is because any amendments must be scientifically justifiable in terms of the SPS Agreement. The OIE would normally appoint an ad hoc group of experts on a particular subject or disease to develop a draft-amended chapter. This would then be thoroughly evaluated and debated by either the Scientific, Laboratories or Aquatic Commissions depending on the subject, before a proposed draft is submitted to the Code Commission where the draft will once again be thoroughly scrutinized and debated before it is sent to all Member Countries of the OIE for their consideration and comments. The comments are then incorporated into a final draft and submitted to the International Committee of the OIE during the Annual General Session of the OIE. The draft can then be accepted, totally rejected or returned to the Code Commission for a re-evaluation following the recommendations and requests of the International Committee. A good example of such a chapter in the Code is the chapter on Bovine Spongiform Encephalopathy (BSE, Mad Cow Disease) that has been and still is debated in detail at every session of the International Committee for a variety of reasons the most important being the increased international sensitivity on food safety, the serious trade implications and new scientific knowledge that becomes available.

FIGURE 1
Process for review and updating of OIE Standards

The Terrestrial Animal Health Code makes provision for the following main focus areas related to the international trade in animals and animal products:

- **General provisions** for veterinary interventions, obligations and ethics desirable for international trade, import risk analysis, disease surveillance, zoning and regionalization, evaluation of veterinary services and import and export procedures.
- **Recommendations applicable to specific diseases** with the primary emphasis on sanitary measures necessary to mitigate the risks associated with a particular disease to enable an exporting country to supply the sanitary guarantees required by an importing country for accepting exports of animals or animal products. These sanitary measures vary from requirements for disease freedom, regionalization and specific sanitary measures to render animal products safe or acceptable for trade.
- **Appendices** describing standards, guidelines and recommendations for collection procedures of semen, ova and embryos, health controls and hygiene management practices in establishments, quarantine stations and principles for disease surveillance, transport of animals and antimicrobial resistance.

- **Model health certificates** for the trade in live animals and animal products.

The standards, guidelines and recommendations in the *Code* are further supplemented by specific guidelines for diagnostic tests contained in the *Manuel of Diagnostic Tests and Vaccines for Terrestrial Animals*, which are recognized as an international standard text by the SPS Agreement.

The *Code* is often wrongly interpreted by some countries as being prescriptive and discriminatory against non-compliance leaving a perception off being "all-or-none" and uncompromising and insensitive to the needs of developing countries. There are however, critical issues in the *Code* that enables and facilitates the entry into international trade [1, 2, 6]. Some of these critical enabling issues in the *Code* are:

- **Evaluation of Veterinary Services** - the International Committee of the OIE has given specific attention during the past 3 years to the entire chapter 1.3 of the Code dealing with important issues such as risk analysis, evaluation of veterinary services, guidelines for evaluation of veterinary services, zoning and regionalization and animal disease surveillance [2]. These issues are variables that should be taken into consideration when conducting import risk analysis and are important in endorsing the underlying sentiments of harmonization, transparency and equivalence of the SPS Agreement. The *Code* accepts by implication that not all countries are on equal footing as regards the level of application of sanitary standards and that for some countries it might be more difficult and especially more costly to comply with all the standards to enable entry into international trade. All the criteria might not be of immediate critical importance for compliance and an importing country should therefore negotiate with the exporting country on those issues that are critical for export certification and those issues that could be attended to at a later stage. The *Guidelines for the Evaluation of Veterinary Services* should therefore be used as a reference document for identifying specific areas of technical assistance to a potential exporting country to enable progress towards eventual compliance.
- **Guidelines for equivalence** - this is an important additional appendix to the *Code* approved at the 71st General Session of the OIE in May 2003. This appendix is in support of article 4 of the SPS Agreement and the Doha Ministerial Declaration in which the SPS Committee was specifically requested to further the implementation of article 4 of the Agreement as a matter of urgency [2]. The appendix facilitates a more flexible approach for the interpretation and application of the *Guidelines for the Evaluation of Veterinary Services*. The *Code* recognizes equivalence by recommending alternative sanitary measures for many diseases. While the principle of equivalence still encourages Member Countries to base their sanitary measures on OIE standards, guidelines and recommendations it also gives recognition to the important principle that equivalence refers to sanitary standards achieving the same level of protection which do not need to be the duplication of or equivalent sanitary measure or equivalent level of protection but a sanitary measure achieving the appropriate level of protection of the importing country [2, 6].
- **Risk mitigation for trade-sensitive diseases** - The risk mitigation procedures that are described for specific diseases in the *Code* also support the concept of alternative sanitary measures that could be used to facilitate the export of an animal or animal product from a country that has for instance not yet achieved the ideal of disease freedom or zoned freedom from disease. The sanitary measures described for foot and mouth disease (FMD) in chapter 2.1.1 of the *Code* is an excellent example of this approach. A Member Country could for example either be free from FMD or zoned free with or without vaccination or could be infected but on the pathway towards freedom from infection. The acceptance of trade in a variety of products are allowed between countries of different FMD status provided the risk mitigation procedures as described in the *Code*, are applied and can be given as sanitary guarantees to the importing country [2]. The enabling environment created by this approach permits for instance the export of deboned meat from an infected country to a free country or zone provided specific risk mitigation procedures were applied and can be certified by the exporting country. Countries that are in the process of improving their sanitary standards are therefore not necessarily excluded form international trade provided they could meet product-specific sanitary guarantees.

CONCLUSION

The OIE has an important function to facilitate the international trade in animals and animal products. Whilst adherence to the standards, guidelines and recommendations of the Code prior to the establishment of the WTO and the subsequent formalization of international trade rules in the SPS Agreement was very much based on the outcome of individual trade negotiations between countries, the new relationship between the OIE and WTO has brought a new dimension to international trade. A new dimension that is guided and facilitated by a scientific-based decision-making process inherent to the terrestrial Animal health Code of the OIE.

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The contribution of Codex Alimentarius to national production and world trade in commodities

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Abstract
The Codex Alimentarius, or food code, represents the best efforts of the global community to formulate and harmonise international food standards that ensure protection of public health and promote fair practices in food trade. In recent times, the Codex system has also reached much wider and now directly influences contemporary thinking on food control and the role of different stakeholders throughout the food chain.

Recognition of Codex Alimentarius by the World Trade Organisation Agreement on the Application of Sanitary and Phytosanitary Measures and the Agreement on Technical Barriers to Trade as a benchmark against which national standards and food control systems should be evaluated has further elevated the importance of the Codex system. It is essential that all countries contribute to continuing development of Codex Alimentarius if they are to optimise food production in terms of food hygiene and access to international markets.

INTRODUCTION
It is not overstating the case to say that we are in the midst of a global "revolution" in food hygiene. Concerns over the safety of food in international trade have been a major catalyst for intense consumer-led debate, and the differing regional economics of food production continue to drive national efforts for fair and equitable conditions of trade.

International reassessment of traditional approaches to food hygiene began in earnest in the late 1980's, culminating in the "FAO/WHO Conference on Food Standards, Chemicals in Food and Food Trade (in cooperation with GATT)". However, the disparate attitudes of different stakeholder groups prevailed during this time and relatively little progress was made at the national level. Fortunately, the last decade has seen a remarkable turn-around. Three waves of change are clearly identifiable and have been driven by:

- Science-based specification of GHP in the early 1990's
- HACCP in the mid1990's
- Risk assessment in the late 1990's.

The World Trade Organisation Sanitary and Phytosanitary (WTO SPS) Agreement has had a major influence on this food hygiene "revolution". The Agreement requires that hygiene measures be based on scientific principles and an assessment of the risks to human health, using risk assessment techniques developed by the relevant international organisations. The Codex Alimentarius Commission (CAC) is the pre-eminent intergovernmental organisation responsible for international food standards.

CODEX ALIMENTARIUS
CAC
At the latest count, the membership of the CAC totalled 167 countries. Under the auspices of FAO and WHO, one of the principle purposes of the CAC is the preparation of food standards and their publication in the Codex Alimentarius. The Codex Alimentarius, or food code, represents the best efforts of the global community to formulate and harmonise international food standards that ensure protection of public health and promote fair practices in food trade.

In recent times, the activities of the CAC have reached much wider than Codex Alimentarius and now directly influence contemporary thinking on food control throughout the global food chain. The CAC Strategic Framework for 2003-2007 promotes:

- Sound regulatory frameworks at the national level
- Consistent application of scientific principles and risk analysis
- Linkages between Codex and other multilateral regulatory instruments and conventions
- Enhanced response to new issues and concerns
- Maximum membership and participation
- Maximum application of Codex standards.

For many years, FAO and WHO have complimented the activities of the CAC by providing technical assistance to developing countries in the area of food control. Further to this, a recent FAO/WHO Working Group has recommended that FAO and WHO enhance the participation of developing countries from all regions in all aspects of the [Codex] scientific advice process, including prioritisation of needs and outreach to scientific experts[1]. This includes nurturing of regional efforts to generate and collect data for risk assessments.

Codex "standards"

A large number of Codex committees and other subsidiary bodies prepare draft standards, recommendations and other texts for submission to the CAC. These draft standards are elaborated and adopted according to a highly structured 8-step procedure. FAO and WHO convene meetings of experts e.g. JECFA and JMPR, to provide the scientific advice that is necessary. The views of stakeholders other than governments e.g. industry, consumers, and academia, are actively sought within the Codex system and are primarily represented through national government delegations and International Non-Governmental Organisations (INGOs).

The Codex Alimentarius comprises:

- Commodity / product standards (including description, essential composition, hygiene and quality factors[2])
- General (non product-specific) standards, including those for additives, contaminants, pesticides, residues of veterinary drugs, nutritional quality
- Labelling standards that may be health-related, for consumer fraud protection or for consumer information e.g. organic labelling
- "Horizontal" standards e.g. methods of analysis and sampling, application of the concept of equivalence, import/export inspection and certification systems and the use of biotechnology in food production
- Codes of hygienic or technological practice and other guidance texts e.g. on HACCP.

Food products that comply with Codex standards can move freely in international trade without jeopardising the health or interests of consumers. Additionally, industry can trade in foods that comply to Codex standards, confident in the knowledge that they are dealing in products that are internationally accepted as safe and which conform with other international norms.

Recognition of Codex Alimentarius by the WTO SPS and Technical Barriers to Trade (TBT) Agreements (1994) as a benchmark against which national standards and food control systems should be evaluated has considerably increased the importance of the Code[3] (see below).

BENEFITS TO FOOD PRODUCERS

It is now essential that all countries contribute to continuing development of the Codex Alimentarius if they are to optimise food production in terms of food hygiene and access to international markets. As well as protecting consumers' health, availability of food standards reduces the costs of doing business e.g. risk of fraud and the costs of finding reliable trading partners. Consumers are also protected from buying inferior food. In providing such benefits to both producers and consumers, Codex standards promote economic welfare and are a pre-requisite to the operation of a well-functioning market. If standards are harmonised between countries, they naturally facilitate trade (international and domestic) and trade itself is generally judged to promote economic development[4].

New Zealand provides a good example of the value of the work of the CAC to a food exporting country. A temperate climate and fertile soils provide grass growth all year round and this facilitates a highly efficient animal production environment. However, the economic health of the agricultural sector is highly dependent on food exports[5]. (In the case of dairy products, 95% of production is exported and this equates to 33% of the worlds' dairy exports). Exports are maintained with the lowest level of producer support in OECD countries and therefore are highly dependent on maintenance of fair trade practices. Codex standards are an essential benchmark in ensuring such practices and in harmonising import requirements to the greatest extent possible.

In a more general context, Codex standards provide direct benefits to the food sector in all countries by:

- Providing guidance on cost-effective and efficient production of safe, suitable, high quality food
- Establishing norms for good agricultural practice (GAP), good veterinary practice (GVP) and good hygienic practice (GHP) throughout the food chain
- Enhancing access to high-value markets by use of harmonised standards (including those for organic products)
- Having legal status under the WTO SPS and TBT

1 Report of the Joint FAO/WHO Workshop on the Provision of Scientific Advice to Codex and Member Countries. 23 February, 2004

2 Quality descriptors are only developed in areas related to protection of the economic interests of consumers, and ensuring fair practices in the trade in food e.g. grading characteristics

3 Note that the WTO TBT Agreement covers all aspects of food standards not covered by the SPS Agreement

4 Report of the Evaluation of the Codex Alimentarius and other FAO and WHO Food Standards Work. 15 November 2002

5 In the case of dairying, herds of high genetic merit produce about 700 000 litres of milk or 59 000 kg of milk solids per year on farms averaging 90 hectares in size

Agreements[6], thereby requiring countries to justify non-adoption of Codex standards according to strictly-defined criteria

- Facilitating the removal of technical barriers to trade
- Facilitating acceptance of "equivalent" systems and standards.

Codex Evaluation Report

An extensive review of the Codex Alimentarius (and other FAO and WHO food standards work) has recently been undertaken at the request of the CAC and FAO/WHO[7]. It was found that Codex food standards had a very high importance to governments, and tacit support of this can be seen in the high level of attendance now being witnessed at Codex meetings.

Codex standards were found to be an essential basis for national standards set by smaller and lesser developed countries that often do not have the resources to develop all of their own standards. Developed countries placed more emphasis on the importance of Codex standards for export facilitation and ensuring the safety of food imports. The Report states that "the majority of countries at all stages of development claim to have adopted into their national legislation more than 60% of all types of Codex standards". A very high percentage of governments and INGOs accorded a very high priority to strengthening the science base for health risk analysis in the future work of Codex.

A RISK-BASED APPROACH TO FOOD SAFETY

Risk analysis

A risk-based approach to food safety is the contemporary cornerstone of Codex standards for food in international trade[8]. Risk analysis in food safety has its contemporary roots in the emerging global climate of "free trade" that is based on removal of barriers constituting unjustified protection of domestic economic advantage. However, the global community fully recognises the sovereign right of countries to place appropriate controls on food products crossing their borders so as to protect human health. The WTO SPS Agreement specifies international obligations in terms of the establishment and implementation of such controls.

The movement to risk-based food safety measures at the international level has placed new responsibilities and accountabilities on national governments. While developing technical capability to assess food safety risks and properly benefit from the provisions of the WTO SPS Agreement, competent authorities also must employ other components of risk analysis i.e. risk management and risk communication, if they are to effectively protect human health and ensure fair trade.

Risk analysis is increasingly becoming cross-sectoral in nature, and it is generally recognised that all "biosecurity" processes should be applied with the greatest degree of consistency possible[9]. The consolidation of risk-based approaches at the national level has already resulted in significant changes in regulatory policy, infrastructure and scientific endeavour in a number of countries.

A risk-based approach to elaboration of food safety standards, guidelines and related texts has recently become institutionalised in the work of the CAC[10] and the Medium Term Plan for 2003-2007 widely promotes further work in this area. It also calls for a "review of Codex standards to provide risk management options (measures) to achieve national ALOPs taking into account risk assessments and other legitimate factors essential to the decision-making process." In this respect, the CAC and WHO actively seek wider strategic alliances with other international organisations such as OIE, IPPC and OECD.

Risk analysis constitutes an interplay of several tasks. At the highest level of generality, risk analysis is a structured process to determine:

- What can go wrong?
- How likely is it to go wrong?
- How serious would it be if it went wrong?
- What can be done to reduce the likelihood and/or seriousness of it going wrong?

Risk analysis is generically recognised as having three components: risk assessment; risk management, and risk communication. Risk assessment and risk management should be wrapped in a "sea of communication" that includes all stakeholders as appropriate, and facilitates the iterative and on-going nature of all components of risk analysis.

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6 The WTO TBT Agreement covers all aspects of food standards not covered by the SPS Agreement. TBT measures must be shown to have a legitimate purpose, be proportional to the desired purpose, and be based on international standards e.g. Codex standards on quality, composition, labelling, nutrition and methods of analysis are all relevant

7 Report of the Evaluation of the Codex Alimentarius and other FAO and WHO Food Standards Work. 15 November 2002

8 Risk Analysis Policies of the Codex Alimentarius Commission. ALINORM 03/26/6

9 Risk Analysis for Biosecurity for Food and Agriculture S. C. Hathaway. In: Expert Consultation on Biosecurity in Food and Agriculture. FAO Rome 10-13 September 2002

10 Risk analysis is now at the heart of standard-setting in all "biosecurity" sectors, and international organisations involved with human, animal, and plant health and biodiversity have embraced risk assessment as an essential tool to achieve their goals. At the sector level, international organisations and instruments variously present principles and guidelines for application of risk analysis. These include: Codex Alimentarius Commission (CAC) - food safety; Office International des Epizooties (OIE) - animal health and zoonoses; International Plant Protection Convention (IPPC) - plant health; and Convention on Biological Diversity (CBD) - biosafety and invasive alien species.

Description of terms

Hazard: A biological, chemical or physical agent in, or condition of, food with the potential to cause an adverse health effect

Risk assessment: A scientifically based process consisting of the following steps: hazard identification, hazard characterisation, exposure assessment, risk characterisation

Risk management: A process of weighing policy alternatives, in consultation with all interested parties, considering risk assessment and other factors relevant for the health protection of consumers and for the promotion of fair trade practices, and if needed, selecting appropriate prevention and control options.

Risk management framework

The CAC advocates that all food safety measures should be developed and implemented within a generic framework for managing food-borne risks. The framework has four components:

Preliminary risk management activities

Following identification of a food safety issue, this initial process includes the establishment of a risk profile to place the issue within a particular context, and provides as much information as possible to guide further action. Risk profiling may also be used for ranking or prioritisation of food safety issues.

The risk manager may commission a detailed risk assessment as an independent scientific process to inform decision-making, and if so, risk assessment policy should be established[11] Once a risk assessment has been received, the last task in preliminary risk management activities is to consider the results for completeness and appropriateness.

Assessment of risk management options

Potential risk management options are identified, and then selected according to appropriate decision-making criteria. This will usually involve balancing expectations in terms of minimising risks against available food control measures, and may include reaching a decision on an ALOP. "Optimisation" of selected measures in terms of their efficiency, technological feasibility and practicality at the designated step in the food chain is an important goal.

Implementation

Implementation of control measures by industry and other stakeholder groups will usually involve regulatory requirements. Flexibility in choice of individual measures applied by industry is a desirable element, as long as the overall programme can be objectively shown to achieve stated food safety goals. Following validation, on-going verification of measures will assure that the ALOP is being achieved on an on-going basis

[11] Risk assessment policy refers to the documented guidelines for policy choices and scientific value judgements that may be necessary at specific points in the risk assessment process, and which should preferably be established ahead of risk assessment

Monitoring and review

Gathering and analysing of human health data gives an overview of food safety and consumer health, and should identify new food safety problems as they emerge. Where there is evidence that required food safety goals are not being achieved, redesign of food safety measures will be needed.

Assessment of risks

Risk assessment is a scientific process that is external to the risk management framework. Different methodologies are used for "risk assessment" of different classes of hazards and different classes of foods. Constraints, uncertainties and assumptions should be considered at each step in the risk assessment.

Outputs of risk assessments may be numerical or non-numerical. Numerical risk estimates allow direct comparison of risks and the effects of different intervention strategies, whereas non-numerical risk estimates provide a less definitive base for decision-making. In the latter case, risk assessment provides an essential point for discussion and debate, preliminary risk ranking, and can be "methodology forcing" in situations of high food safety priority.

The CAC recommends that risk assessment "should be based on global data, including that from developing countries".

Chemical hazards

The Codex "safety evaluation" process for chemical hazards in foods is generally a "worst case" standard-setting process that does not involve quantitative risk assessment. Data needs for establishment of benchmark standards are well served by long-standing global data-gathering systems, and other information sources specific to the class of chemical hazard under consideration e.g. industry registration packages for veterinary drugs.

The acceptable daily intake (ADI) for chemical hazards is a relatively crude, deterministic estimate that reflects a predetermined "notional zero risk" decision. In comparison, there is tacit acceptance that for unavoidable environmental contaminants it is not practical to apply the same "notional zero risk" model. The regulatory interpretation of sporadic non-complying MRLs in "lots" of foodstuffs where there is no evidence of acute toxicity is a contentious issue.

Biological hazards

In the past, evaluation of food-borne risks associated with biological hazards in the food supply has been largely empirical and qualitative. The overall goal has been to reduce biological hazards to a level that is "as-low-as-reasonably achievable", with a commensurate minimisation of risks. In most cases, the actual level of risk associated with particular food control programmes was unknown.

Recently, FAO and WHO have embarked on a series of Expert Consultations on microbiological risk assessment (MRA) that represent an on-going commitment. This work is heavily dependent on MRAs already commissioned by national governments. Considerable challenges lie ahead in carrying out MRAs for pathogen/food commodity combinations that pose significant risks to human health. As an example, available MRAs often suffer from substantial uncertainty, and can have markedly different outputs when using different national data sets as inputs.

Decisions on management of risk

While the overarching objective is maximising risk reduction while ensuring the efficiency and effectiveness of the measures employed, decisions on level of consumer protection can be influenced by a wide range of economic, social and political inputs. Evaluation of all available control options throughout the "production-to-consumption" continuum is the ideal scenario when managing food-borne risks. However, some risk management objectives can be properly achieved without modelling the whole food chain.

Decisions on managing food-borne risks should be based on science, and take into account, where appropriate, other factors that can be legitimately considered within the particular risk management framework. Only those factors which can be accepted on a world-wide basis, or on a regional basis in the case of regional standards, can be taken into account when elaborating Codex standards. Within the Codex system, risk managers can consider economic consequences, and the feasibility of different risk management options (especially in developing countries).

It is clear that decisions on ALOP are "values-based" and development of an international consensus on ALOP for foods in international trade that is other than notional zero is a difficult proposition e.g. a developing country is likely to pursue the benefits of rapid economic growth associated with increased food trade and be less "precautionary" about food-borne risks, whereas a wealthy country with mature technologies is likely to pursue all manifestations of a high level of consumer protection. Currently, national competent authorities are inherently inconsistent in promulgating food safety regulations for different hazard/food combinations in their own jurisdiction as they relate to an ALOP. Recognition of the equivalence of alternative hygiene measures in different food production scenarios is now an established application of risk management.

Precaution

A precautionary approach is expressed in various ways during food safety risk analysis. Intrinsic positions may be taken as part of risk assessment policy e.g. use of safety factors in establishment of ADIs for chemical residues, and other precautionary positions may be a particular response on a case-by-case basis e.g. implementation of more stringent hygiene measures because of a high level of uncertainty associated with a MRA.

When available scientific information identifies a hazard in food which may present a human health risk but the specific nature and the extent of that risk is unknown, the WTO SPS Agreement states that a competent authority may act in a precautionary manner and adopt provisional measures until more complete risk assessment information is available. Thus governments retain broad powers in law to take provisional hygiene measures when faced with new or emerging food safety threats. Such actions are sometimes seen as technical barriers to trade by exporting countries, and illustrate the need for national risk assessment capability.

CODEX FOOD SAFETY STANDARDS FOR MILK AND MILK PRODUCTS

The Codex Alimentarius contains many standards that apply to milk and milk products, but Codex has had great difficulty in reaching a consensus on food safety provisions for commodity standards. For many years, Member governments had different requirements for processing of raw milk, and these differences seemed irresolvable in terms of developing agreed international food safety measures.

With the advent of a risk-based approach to food safety in the mid-1990s, it was recognised that insistence on the absence of hazards at particular steps in the food chain did not necessarily equate with achieving expected levels of consumer protection. Flexibility in hygiene provisions was introduced to a new draft code of hygienic practice, including those provisions to be applied when milk products were made from raw milk ingredients, as long as a specified level of consumer protection could be achieved[12]. This flexibility is further extended in the case of small-holding dairies.

The draft code recognises that when raw milk commodities are produced, the hygiene conditions prevailing at primary production are one of the most important determinants of consumer protection. By applying risk management principles, the code accommodates the wide range of food safety approaches that exist for the production of raw milk products in different countries. Individual control measures can be selected and applied in combinations that achieve required food safety outcomes.

Due to the current absence of risk assessment models for milk and milk products, this draft code does not contain any performance objectives or process criteria linked

[12] Proposed Draft Code of Hygienic Practice for Milk and Milk Products. CX/FH 03/9

to particular levels of consumer protection. Human health monitoring data demonstrate that standard pasteurisation regimes achieve very high levels of consumer protection, however regimes of lesser intensity may be just as effective. The equivalence of optimal pasteurisation regimes and alternative pasteurisation technologies cannot be properly evaluated in the absence of risk assessment.

Aflatoxin

Establishing a maximum level for aflatoxin M_1 in milk further illustrates a number of aspects of the setting of Codex standards in a contemporary risk management environment. Work on this hazard began in 1991 and following provision of expert advice by IDF, a draft maximum level of 0.05ug/kg in bulk milk was proposed by CCFAC. However, a number of countries were of the opinion that 0.5ug/kg was sufficient to ensure consumer health protection. They opposed the draft standard on the basis that a standard of unnecessary stringency would have marked economic implications for trade and may restrict the availability of milk in some developing countries.

A subsequent risk assessment carried out by JECFA found that the difference in adverse health consequences resulting from the two levels was negligible. The higher level was finally adopted by the CAC in 2001, despite the reservations of some Member governments.

SUMMARY

The contribution of Codex Alimentarius and the wider Codex system to national food production and the world food trade is profound. Globalisation and increasing food trade opportunities render the work of Codex especially important to developing countries, and it is essential that they represent their interests by fully contributing to continuing development of the Codex Alimentarius.

Given the importance of it's work, the Codex system must become more efficient in the elaboration of international food standards and must provide a dynamic response to new food control issues as they arise. The recent FAO/WHO report on the Evaluation of Codex Alimentarius contains far-reaching recommendations in this respect and calls for a strengthening of health risk analysis. The report also identifies that capacity building in risk analysis is essential to developing countries if they are to adequately ensure the protection of their own citizens and benefit from a globalising market in food.

The advent of risk-based approaches to food safety and international standard setting has irrevocably changed the nature and importance of Codex standards. Application of a generic risk management framework at both the international and national level provides flexibility to industry in the design and application of food safety measures, however, the price of that flexibility is validation. Risk assessment can be used to demonstrate that different levels of hazard control during food production achieve particular levels of consumer protection, but it remains a sovereign right of national governments to set their own ALOP for particular hazard / food commodity combinations. In the future, this may result in a lesser Codex focus on attempting to establish global quantitative food standards for particular hazards, and a greater Codex focus on providing scientific information and risk assessments to support and justify risk management choices made by national governments.

Problems and needs of emerging dairy nations in ensuring safe milk and dairy products

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1. INTRODUCTION

Iran with a total area of 1,648 million square km and a population of more than 66 million in 2002, produces more than 6 million tons of milk. More than 40% of this amount is processed in small, medium size and large dairy plants and reaches the market as processed and packaged products while the remaining part is transformed into different products especially cheese, butter oil, yogurt and traditional dairy products by the traditional sector. In fact, the Iranian dairy sector is a combination of large, sophisticated dairy farms, a large number of medium size modern farms and a larger number of small holder farmers with 4-5 cows each. This diversity creates a wide range of milk harversting and handling systems which needs to be integrated into an overall industry approach to ensure highest milk quality and safe dairy products. Large and medium sized producers use milking machines as well as efficient cooling systems and CIP processes to clean the equipments in contact with milk. The small producers have native breed cows and milk them by hand.

As far as processing is concerned, the major part of dairy products produced by traditional units is not under efficient control of the institutions in charge of food quality and safety.

2. LIVESTOCK AND MILK PRODUCTION IN IRAN

The data of Table 1 show the population and the produced milk of different types of milking animals in Iran (1).

Sheep and goat milk is produced in rural and nomadic areas and is also processed by using traditional methods.

During the last 60 years and especially the last two decades, the development of cow's milk, in particular from high efficient pure breed and cross bred animals in urban areas has been remarkable. The establishment of large and medium size farms caused considerable improvements in the quality and quantity of milk production. Since few years ago, the increase of the number of pure breeds namely Holstein and hybrid cows in rural areas has been in full development.

According to the latest survey, the production per head of a Holstein milking cow in large farms exceeds 7 tons a year while, this figure is 2.8 tons for a crossbred cow and less than 1 tone for a and native cow (2).

3. MILK PRODUCTION PER CAPITA IN IRAN

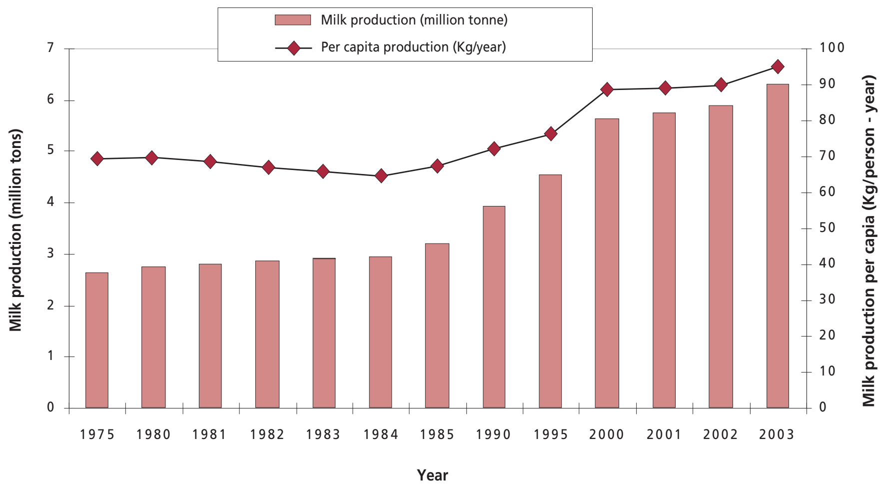
Milk production and milk production per capita have been in constant increase over the past 2 decades despite population growth rate and social events. Figure 1 shows this trend from 1979 to 2003.

TABLE 1
Livestock population and milk production in Iran (2003)

Type of livestock	Sheep	Goat	Cow			Buffalo
			PB	CB	NR	
Livestock Population (x 000)	**52000**	**25700**	**720**	**2600**	**4200**	**400**
Milk production (x 000 tons)	300	370	1850	1820	1600	220
Percentage of national production	4.9	6	30	29.5	26	3.6

PB: Pure bred
CB: Cross bred
NR: Native race

FIGURE 1
Evaluation of milk production and per capita milk production in IRAN (1979 - 2003)



4. MILK COLLECTION AND PROCESSING

4.1 Milk collection centers (M.C.Cs)

The rapid growth of the industry resulted in shortage of raw milk for many plants. In order to respond the demand of industry, the raw material was supplied originally through imported skim milk powder and butter. This trend continued during the 70 and 80 s and originated the establishment of M.C.Cs in rural areas to collect and supply the needed milk of newly created dairy plants. As a first step, 98 centres were established from 1985 to 1988. In 1996, 1999 and 2002, more than 800 centres were operational. At present, the quantity of collected milk by these centres is more than 1 million tone a year.

The average number of milk producers for each M.C.C is about 200 to supply 4.5 tons of milk per day. Milks of different producers are mixed and this process causes quality problems that will be discussed later.

4.2 Milk processing

Following the start up of the Tehran pasteurized milk plant in 1957, there has been a trend in establishment of dairy plants reaching 25 in 1985 with an annual nominal capacity of 950.000 tons and 61 large plants and more than 260 small and medium size plants in term of capacities in 2002 with a total nominal capacity of 4 million tons. Out of 61 large plants, 14 belong to IDIC that has more than half of the practical capacity of the large dairy plants.

The development of small dairy plants in rural areas started in 1989. These units are mainly cheese manufacturers that standardize and pasteurize the milk and carry out some tests to evaluate the quality and safety of their products. Economically, the small plants are not competitive and the majority of them can not continue their production activities without subsidies. In term of hygienic quality and safety their products are better than traditional products although their laboratories are not well equipped(3).

4.3 Raw milk quality

4.3.1 Biological quality In 1996, an investigation was done on the quality of M.C.Cs milk. 288 M.C.Cs were studied by using questionnaires and some analyses. The microbiological tests were carried out according to ISO's methods. Also, several samples from large farms were tested. Total Count, coliforms and psychrotrophic bacteria were counted during 9 months including hot season. Hygien conditions and practices for milking in most small farms were poor. Milking is done in dark and poorly ventilated buildings and just a few producers used detergents to clean their vessels. In large farms, milking is done properly by machine and the equipment and storage tanks are cleaned using caustic soda and hot water. While the vast majority of small farms have no cooling facilities, the use of cooling machines in large farms is regularly at work. Since 1996, the temperature of raw milk at reception points of dairy plants is a factor determining the milk price. This temperature should be below 10 ^{oC}. One of the problems in ensuring the quality of raw milk is that until now, the M.C.Cs have not been able to control the temperature of the received milk.

The cooling of milk is done in M.C.Cs and the milk is not cooled before reception. If the time between milking and reception at MCC is long, the organisms grow in the milk and deteriorate the milk quality. Sine 1996, IDIC helps the small producers to replace their plastic cans with aluminium ones and at the same time, the M.C.Cs replace their slow cooling systems by plate coolers that use chilled water to reduce milk temperature in few minutes. By carrying out the new measures, the microbial characteristics of raw milk have dramatically improved. Figure 2 indicates the effects of the application of the new measures in improving milk quality in 2003 compared with 1996.

When the milk quality deteriorates, the major constituents of microbial population are coliforms and psychrotrophic bacteria. Other results showed that if the milk of small producers has been delivered directly to the plants, the quality remains higher compared to milk delivered by M.C.Cs.

In 2003, the microbial qualities of industrial farms and M.C.Cs milks received in dairy plants belonging to IDIC were studied. Figure 3 shows the quality classifications of different kinds of the milks according to the number of bacteria found in one ml (4).

The improvement of the quality of raw milk was important between 2002 - 2003. In this period a prize and fine system was applied to the milk treated in IDIC plants.

The decreases of the number of organisms in 1 ml of the milk of large farms and M.C.Cs were respectively 25 and 23 percent. The number of coliform bacteria in M.C.Cs milk increased from $3x10^5$ to $2x10^6$ in 1 ml in 2003. For a quality milk it should be less than 100 ml.

FIGURE 2
Milk quality in 2003 compared with 1996

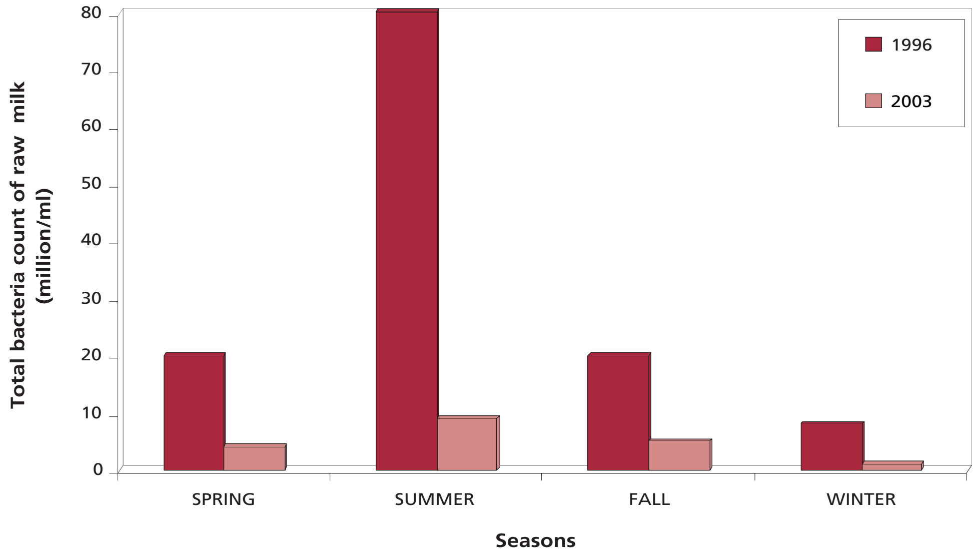
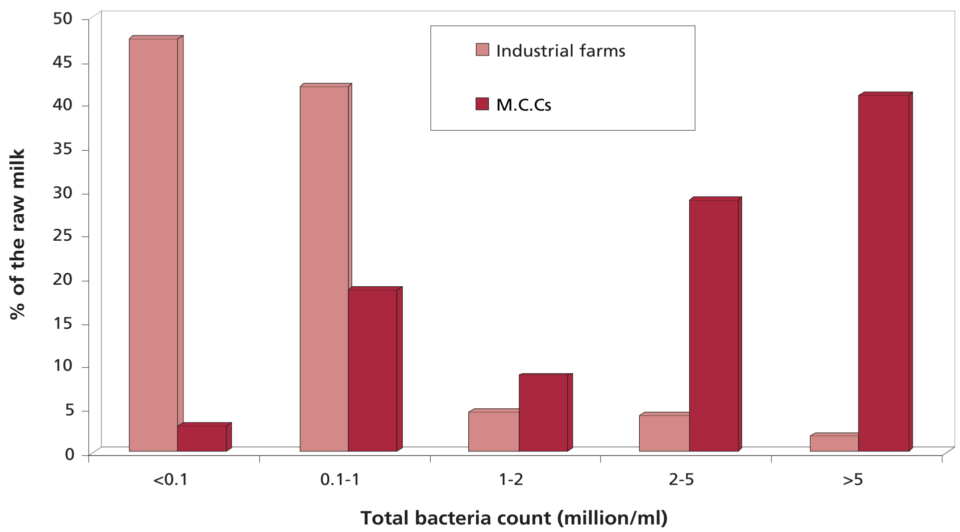


FIGURE 3
Comparison of the microbial qualities of the milks belonging to large farms and M.C.Cs (2003)



4.3.2 Risk assessment

4.3.2.1 Antibiotic in milk

According to the Iranian standard, raw milk should be free from antibiotic residues because antibiotics inhibit the growth and activity of microorganisms used to produce cultured products such as yogurt and cheese on one hand and indicate the lack of good farming practice on the other. Furthermore, these residues may cause human health problems such as allergy or the development of antibiotic resistant pathogens. So, in many countries, severe penalties are applied where the antibiotic test in raw milk is positive.

An investigation aimed to test the quantities of antibiotics in raw milk received in 6 dairy plants belonging to IDIC was done from April 2002 to March 2003 (5). 92 samples were tested, of which 261 were positive while 732 samples were free from antibiotics. The amount of penicillin G in positive samples was 1.2 ppb which was more than the upper limit accepted by legislations (5). These results indicate that the antibiotic residues tests should be applied to the milk processed by dairy plants. IDIC plants have already applied the test according to the Iranian standard.

4.3.2.2 Aflatoxin M_1 in milk of some Iranian regions

Mycotoxins are produced by moulds. The major mycotoxin of importance to milk is aflatoxin M_1 (AFM_1) which derives from aflatoxin B (AFB) found in forage (6). In the five Iranian provinces, a study has been done on the raw milk received by IDIC plants concerning the amount of aflatoxin M_1. The quantities of aflatoxin M_1 in raw milk samples was between 0.031 to 0.049 ppb. According to these results, the upper level of toxin is less than 0.05 ppb. The minimum amount was found in the milk of the western part of Iran and the maximum level in the north of the country (7). According to these data, the level of AFM1 was less than the upper limit stated by Codex Alimentarius.

4.4 Effect of raw milk quality on the shelf life of related pasteurized milk

The definition of shelf life:This is "time between the production and packaging of the product and the point at which it becomes unacceptable under defined environmental conditions". (3)

In fact, storage and distribution are necessary links in the food chain. The safety considerations dictate the conditions and maximum duration of these links.

The consumers and legislation expect that no quality deterioriation occurs before limiting time.

Factors affecting the shelf life of pasteurized milk are:

1) Quality of raw milk
2) Heat treatment
3) Post processing contamination (PPC)
4) Packaging system
5) Storage temperature

When total count of raw milk is under 30000 ml in one, and the other conditions are suitable, the shelf life of pasteurized milk at 6^{oC} or less could be about 30 days.

Shelf life ends when the following changes appear in the product:

1) The standard plate count exceeds 10^6 / ml
2) The chemical reaction leading to undesirable changes such as oldness, fruit taste, bitterness and metallic taste take place.

The temperature - time of milk pasteurization in our experience was 76^{oC} at 16 seconds. Under these conditions, the coliforms and psychrotrophic bacteria are destroyed but the thermoduric and spore forming bacteria resist.

It should be noted that for the low quality milk, heat treatment has to be applied as soon as milk is received at dairy plants and the lactoperoxydase system has no significant effect in this case.

When the microbial population of raw milk is low enough, the pasteurization of milk 3 or 4 days after storage at low temperature leads to a longer shelf life. The results of our work showed that the contamination of milk after pasteurization along with the storage temperature are the most significant factors on product shelf life duration. The most important sources of post pasteurizing, contamination are: cooling section of pasteurizer, leakage and unsufficient cleaning of pasteurizer, packaging materials, enviroment of packaging machine, pasteurized milk storage tanks and transportation conditions.

The results indicated that there was significant relation ship between psychrotrophic bacteria number and product shelf life in winter.

In high quality raw milk, the ratio of psychrotrophic bacteria to total count is less than 10% while this reaches to 70%in low quality raw milk. While the number of this kind of bacteria in raw milk is more than 5 million in one ml, the taste changes occurs.

Figure 4,5 and 6 show the evolution sat PH, acidity and microbial number at 6°c in pasteurized milk.

Figure 6 shows that the number of thermoduric bacteria remains stable during storage time. The same trends are seen for the spore forming bacteria but it indicates that the growth of psychrotrophic bacteria is much more accelerated under the same conditions.

5. CONCLUSIONS

Good farming practice and improved milking system should be applicable in small and large farms. We need a clear safety policy and an action plan to reduce the risk of microbial contamination of raw and pasteurized milk. In small farms, the plastic cans should be replaced by metallic ones. Milk cooling has to be done as soon as milking is done by using the simple ways such as utilization of stream water in villages. The transportation of milk from farm to

FIGURE 4
The changes of pasteurized milk pH during storage time at 6 °C

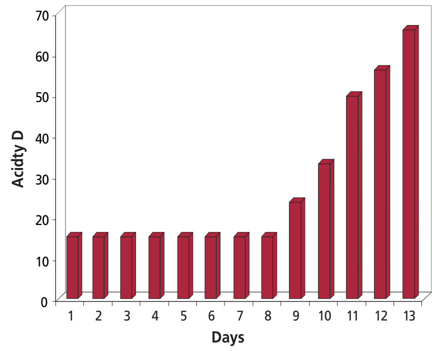


FIGURE 5
The changes of pasteurized milk acidity during storage time at 6 °C

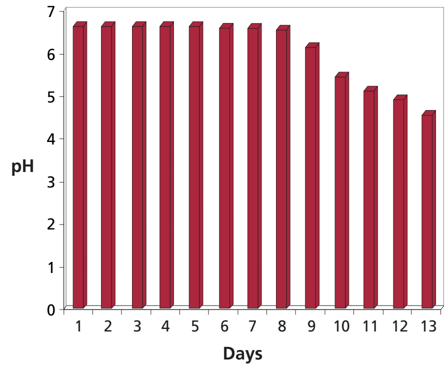
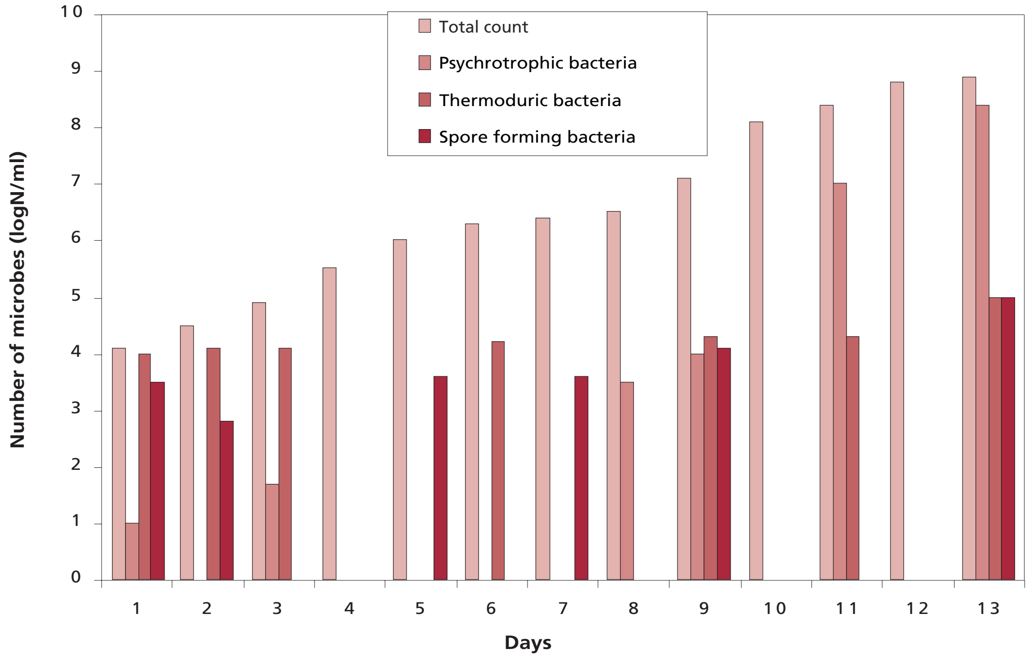


FIGURE 6
The increase of total count, psychrotrophic, thermoduric and spore forming bacteria in pasteurized milk at 6 °C



MCCs using cleaned, insulated containers should take place rapidly and in MCCs, application of quick cooling system by using a plate cooler is an efficient method to stop milk deterioration. In MCCs, by using a CIP system, all the tanks, pipes and containers in contact with milk have to be washed and disinfected. The MCCs that supply high quality milk should be rewarded consistently. The application of HACCP in large farms is efficient and this system should apply generally to all the farms.

At dairy plants, along with the tests measuring the chemical and biological tests, the antibiotic tests should be done for all the received milks.

As soon as raw milk is delivered to dairy plants, thermization at 63ºc, 15^{s} should be applied and then, cooling should take place.

After pasteurization, the cold chain should be maintained until milk distribution. The execution of new methods and tests prevents PPC from pasteurizer to packaging machine.

The most important decision to be made to execute all the necessary policies is to create a single body involving all the private and public institutions representatives with regard to milk production, processing, distribution and consumption. For the implementation of all the policies, in emerging dairy nations, human resource development is the most important priority.

The unofficial sector, small scale producers and street side vendors constitute an enormous challenge for institutions in charge of food monitoring.

Given the number and diversity of this sector, the only ways at present are to inform consumers and apply subsidies for safe dairy products to ensure the security and safety in this area.

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Tools for integrated chain management in food safety

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Abstract

The dairy industry can ensure product safety to a significant extent with quality management systems which incorporate the "General Principles of Food Hygiene" and the HACCP-system of Codex Alimentarius as well as the legal or Codex product hygiene standards.

Some hazards however cannot be controlled by the dairy plant. This is especially the case for the contamination with foreign materials (contaminants, residues and toxins), which may be transferred to the milk or milkproducts from the preceding links of the supply chain. This contamination may occur in industries further back in the supply chain and the hazards involved do often not pose a risk for the part of the chain in which these industries operate. In the presentation it is explained that the control of these hazards can only be achieved by a system of chain management in the area of food safety. The necessary tools and conditions for an effective chain management are discussed. It is stressed that initiatives and leadership in this field should be expected from the dairy industry. Reaching full chain integration, with common management and recognition systems in the relevant sectors in the chain, can be a long and complicated process. This however should not keep the dairy industry from taking initiatives in this field. Experience has shown that also small steps made on this road, like improving the communication between the ~~to~~ chain partners, can be big steps in reducing risks.

PRINCIPLES OF FOOD SAFETY CONTROL

The topic of food safety is entirely related to the control of the hazards of contamination and infection during production and treatment of a food product. This is achieved first of all by creating basic conditions that limit the risk of contamination or infection to as great an extent as possible. These basic conditions are described in the standard "*General Principles of Food Hygiene*" of the Codex Alimentarius and the hygiene codes for various product groups linked to this standard. In addition it is important that producers and merchants examine whether in their production and handling systems specific conditions exist in which could pose a hazard of contamination or infection of the product. Should this be the case and the condition involves an essential threat to the food safety, additional measures must be taken. How this supplementary hazard analysis must take place and in which way the control measures must be determined, are described in one of the supplements of the above-mentioned Codex standards ('*HACCP system and guidelines for its application*").

THE EXTENT TO WHICH FOOD SAFETY CAN BE CONTROLLED IN DAIRY PLANTS

A dairy company will ensure product safety to a significant extent if it has a quality management system which incorporates the above-mentioned hygiene principles of the Codex as well as the legal and/or Codex product standards for pathogenic micro-organisms and for contaminants and residues. In that case, infection and contamination which may occur during processing the milk in the plant will be adequately controlled. Microbial infection that may occur during production at the farm and during transport of the raw milk will, under normal conditions, also sufficiently be reduced. However contamination that may occur before the processing of the milk can not be controlled in the dairy plant, or if so, only to a limited extent. Especially residues, contaminants and toxins that are transferred via the cow to the milk are significant in this context. These foreign (non product related) materials may originate from the farm or from the production chains that supply the farm and the dairy industry. Dairy companies can partially prevent this contamination by analysing the milk before it is processed. Apart from this, the concentration of these substances will often be reduced during processing due to mixing with milk of other producers. Nevertheless, a dairy company should not rely on this. The possible forms of contamination that could occur in this way are of such a variety that they cannot possibly all be detected by means of analysing the milk. Moreover, there is often no time to wait for the results of these analyses since the milk must be processed shortly after delivery. "Mixing away" contamination in the milk is not a sustainable solution and carries with it some risks. Eventually it proves hazardous to the quality and reputation of the product. Experience shows that buyer and consumer confidence can be severely undermined when foreign materials are found in milk products, no matter how low the concentrations and health risks of this contamination may be.

CONTROL MEASURES NECESSARY IN THE SUPPLY CHAIN OF DAIRY INDUSTRY

From the sections above we may conclude that the risk of contamination of dairy products by foreign materials must be controlled to a large extent in the preceding links of the chain. This control must take place at the point where the contamination occurs. This may sound self-evident, but in practice it is not. The control measures that must be taken by the immediate suppliers of the dairy companies can relatively easily be assured by means of the of the delivery conditions or contracts. For example, dairy companies can make agreements with the dairy farmers about the use of antibiotics, antiparasitics and pesticides at the dairy farm, so that the residual limits are not exceeded in the milk supplied. However, when the industries in the supply chain are further removed from dairy processing and they only supply products to other preceding links in the chain, the more complicated it becomes to control the hazards. This is especially the case when hazards are involved that do not pose a risk to the part of the chain in which these industries operate. For example, when in the beginning of the chain raw materials for animal feed are dried, techniques and fuels may be used that pose no risk to the quality of the feed and the health of the animals. However at the end of the chain these drying methods may lead to an unacceptable contamination of the milk with foreign materials.

INTEGRAL CHAIN MANAGEMENT FOR FOOD SAFETY

In my presentation on integral chain management during the *IDF World Dairy Congress* in 2002, in Paris[1], I mentioned a number of food incidents that were caused by conditions in the links at the beginning of the food chain. These conditions were not recognised as being unsafe until, at the end of the chain, the food appeared to be contaminated. In a number of cases this led to extensive product recalls. These incidents fortunately had little or no consequences for the composition and safety of dairy products, but the conditions that brought about the contamination certainly also pose a risk to the dairy sector. In this same presentation I pointed out these problems can be prevented by a system of chain management in the area of food safety. Such a system must make it possible that hazards to the safety of the food products are communicated to the preceding and succeeding links of the chain. In addition, this system must guarantee that the necessary control measures will be taken at the right point in the chain, also if the hazards do not pose any direct risks for that specific part of the chain.

TOOLS FOR CHAIN MANAGEMENT

In the presentation at hand I shall elaborate on the necessary instruments and conditions for an effective management in the dairy chain. As far as times allows, I shall take you through the following subjects, which also indicate steps in the development of chain management.

1. Initiative and leadership in the chain by the dairy industry.
2. The role of the dairy companies, the national dairy organisations and IDF.
3. The investigation of the process flow in the chain and defining the scope of the chain management.
4. The communication structure in the chain (each link of the chain takes care of communication to its preceding and subsequent link (s); steering groups of representatives of the successive sectors in the chain).
5. Topics for communication in the chain (the common interest; the final products of the chain; the hazards and risks for the safety and wholesomeness of these final products, conditions in the chain that may cause these hazards, the monitoring results).
6. Characteristics of the consultation with chain partners (equality and interaction ; recognition of the common interest; commitment).
7. Food safety management systems (control based on hazard analyses and determination of risks; communication of hazards that must be controlled by the subsequent link and hazards that must be controlled by preceding links; management of control measures on the basis of ISO 9001-2000; comparison with draft standard ISO/CD 22000[2]).
8. Securing the control of food safety hazards in the chain (certification of the risk based management systems, industry audits by experts from the subsequent link(s) in the chain; recognition systems for suppliers).

A GRADUAL PROCESS

The development of an integral management of the chain in the area of food safety is not a project that can be concluded within a limited period of time. It is rather a growth

[1] Mathot P.J. "Integrated food chain management" Proceedings of World Dairy Congress, September 2002. Cidil; 42 Rue de Châteaudun, 75009 Paris, France.

[2] ISO/CD "Foodsafety managent systems - requirements for organizations throughout the foodchain"

process which evolves in interaction with the chain partners. First, all relevant chain partners must be made aware that they are in fact partners in producing food and that they have a common interest in the safety and undisturbed sale of the end products of their chain. By creating communication channels and consultation structures the chain partners shall better understand their own role and responsibility in assuring the food safety. Only on this basis the tools mentioned above under 6 and 7, like common management and recognition systems, can be agreed upon and implemented. All this can be a long and rather complicated process. On the other hand, experience has shown that every small step made on this road to chain integration is a big step in reducing the risks. This is especially true for the improvement of the communication in the chain. If the chain partners are only aware of the final destination of their products and of the fact that their process conditions might entail a risk for the food safety, this will already contribute a great deal to the care given to their production process.

INITIATIVE BY THE DAIRY INDUSTRY

Initiatives in the area of integrated management of food safety in the chain must be taken first of all by the dairy companies and their sector organisations, and this should also be expected from them. Being the last link in the dairy production chain they are responsible for the food safety of the dairy products, and they know what the consumer market requires. The preceding links in the chain cannot always be aware of the hazards and risks in this area and the dairy industry must take the initiative to transfer this knowledge and initiate the control measures where necessary. I hope this presentation has clarified in which way and with which tools the dairy industry may carry out this task.

Zoetermeer, 04-02-2004