



1st session

For healthy eating
we track animals remotely

Rome
25 October 2003

Convention chamber
Experimental Zooprophyllaxis Institute
of the Regions of Lazio and Tuscany
Via Appia Nuova, 1411

CONTENTS

Regaining consumer confidence <i>From the stall to the table</i>	3
Sustainable production methods.....	3
Identification and labeling of beef.....	5
Labeling of beef and beef-based products.....	7
Each animal tells its own tale: remote monitoring system for animals of different species	9
Introduction.....	9
Legislative Context	10
Each animal tells its own tale: remote monitoring system for animals of different species.....	12
Research project description	14
Electronic livestock identification system	16
Transponder	16
Data read systems.....	16
Pilot project	16
Pilot project methodology	17
Objectives	18
Criteria for assessing achievement of final objectives	19
Intermediate objectives.....	19
Criteria for assessing achievement of intermediate objectives	20
Project methodology	21
Project stages	23
Personnel training.....	23
Physiological condition check	24
Determination of the hygienic and sanitary characteristics of the products obtained.....	24
Evaluation of the effectiveness of the meat tracking and tracing system.....	24
Transferability of results.....	24
Project output	26

Regaining consumer confidence

From the stall to the table

Recent events in the food sector, including the bovine spongiform encephalopathy (BSE) crisis, have undermined the confidence of many consumers in the safety of beef, leading them to reduce beef consumption or even to quit buying it.

The European Commission has taken a number of steps to rebuild consumer confidence in the quality and safety of beef:

- enactment of stricter controls and safety standards;
- promotion of sustainable production methods;
- introduction of the principle of traceability of beef, from the individual animal at the holding through the slaughtering process to the supermarket.

Sustainable production methods

The beef we eat here in Europe comes from two principal sources:

- approximately 2/3 comes from calves born of milk cows: since dairy farmers are generally not equipped to raise these animals on their farms, they sell them to holdings for fattening;
- approximately 1/3 comes from calves born of nursing range cows: the bulls are generally a beef-producing breed, that being the primary objective of this type of livestock raising.

The weaned calves are then mainly pasture-fed or given a cereal-based diet.

Forage methods (“extensive” systems) are generally practiced in the European pasturelands, where grain cultivation is problematic, mainly in the western regions (Ireland, Great Britain and Atlantic regions) and the mountainous zones throughout Europe. Cattle in these regions generally grow more slowly, reach a greater weight and produce a more mature meat having a more marked flavor. Calves born of nursing cows are usually raised in extensive systems.

Beef production systems based on a grain diet are generally practiced in southern Europe, where the hot summer climate inhibits the growth of grasses, and in zones with abundant grain cultivation (e.g., central Europe). Grain-fed cattle grow much faster than those raised in the pasture and reach slaughter weight more quickly (and slaughter weight is generally lower). Hence, this type of livestock raising is sometimes referred to as “intensive”. Holdings that practice this method obtain most of their calves from milk cows. The meat of these younger, grain-fed animals appeals to consumers for its culinary characteristics and its less pronounced color and flavor.

A wide range of variants of the above two systems are found throughout Europe. Different regions raise different cattle breeds and apply different livestock management systems. Thanks both to this variation and to the extraordinary diversity of local gastronomic traditions, European consumers have an extremely wide range of beef to choose from.

Most beef sold in Europe comes from animals raised using the two methods described above, however, about 10% of the meat is veal derived from animals raised on an essentially liquid, milk-based diet, which produces white or pinkish meat.

The objective of the Common Agricultural Policy (CAP) is to reduce Europe’s dependence on imports of basic foodstuffs and hence also of beef. The CAP price support policies have encouraged the maximization and intensification of production. This strategy has been so successful that in the 1980s enormous surpluses of meat and butter were accumulated.

In 1992 a radical reform was passed and support for agriculture was no longer oriented towards maximizing production. Price supports were reduced, farmers’ losses in earnings were compensated by direct income subsidies and measures were introduced to provide incentives for extensive methods and environmental protection.

In spite of this reform, it was not possible completely to correct the consequences of the excessive intensification of the milk and meat producing sectors, which came about especially in the 1980s due to the unbridled use of meat and bone meal. The impact was felt clearly in the beef sector in the 1990s, with the alarming rise in the incidence of BSE and associated public health concerns.

The European Union responded by promulgating increasingly strict rules for animal feed and meat hygiene. The use of meat and bone meal in animal feed was banned along with the sale of specific products considered to be high risk. Regarding traceability of cows and beef, the EU introduced strict identification and labeling systems for cows, thus giving concrete expression to consumers' desire to have increasingly detailed information on the meat they buy.

These regulations supplemented previous safeguards for the safety and wholesomeness of European meats. The use of hormones in European meat production has been banned in the EU since the 1980s, and exacting standards have been applied to protect the well-being of the animals themselves, with particular emphasis on transportation conditions. These two legislative landmarks are held dear by European citizens and strenuously defended on the international level.

As for production methods, in the legislative package indicated in the Agenda 2000, the EU clearly expressed the desire to further promote ecologically compatible production methods linked to environmental objectives. More recently, as a result of instances of BSE found in new areas, the decision was made to reduce beef production incentives and increase aid to producers who apply "extensive" methods, since it has become increasingly clear that meat produced by these methods more closely meets consumers' expectations.

Given the greater attention of consumers to agricultural methods that are more in tune with their expectations and more respectful of the rural environment, it is inevitable that this trend towards extensive methods and environmental compatibility will become even stronger over time.

Identification and labeling of beef

1) Objective

Conserve and increase consumer confidence in beef and promote the stability of the market, increasing the transparency of production and marketing conditions of products based on beef, and getting beyond the BSE crisis.

Accomplish this by instituting a system of identification and registration of cows, and a compulsory labeling system based on the origin of beef, in order to make possible controls along the entire production process, from the producer to the consumer (traceability).

2) Legislative act

Regulation (EC) no. 1760/2000 of the European Parliament and European Council of 17 July 2000, which establishes a system for the identification and registration of bovine animals and regarding the labeling of beef and beef products, and repeals Council Regulation (EC) no. 820/97.

3) Summary

The regulation establishes:

- a system for identifying and registering bovine animals (Title I);
- a compulsory beef labeling system (Title II, Section I) and a voluntary beef labeling system (Title II, Section II).

Identification and registration of bovine animals

- 1) Requirement to identify and register: each Member State must institute a system for identifying and registering bovine animals.
- 2) System elements: said system must include the following elements:

- ***Ear tags for the identification of individual bovine animals***

- a) bovines raised within the European Community: all animals on a holding born after 31 December 1997 or intended, after such date, for intra-Community trade, are to be identified by a tags placed on each ear within twenty days of the birth of each animal and, in any case, before the animal leaves the holding where it was born. Both ear tags bear the same unique identification code;
- b) bovines raised in a third country: each imported animal that has passed the veterinary checks laid down in the European Directive 91/496/EEC must be identified by means of ear tags at the destination holding within twenty days of the veterinary check and, in any case, before the animal leaves said holding. This requirement does not apply if the destination holding is a slaughterhouse of the Member State where the veterinary checks were conducted or if the animal is slaughtered within 20 days subsequent to said checks;
- c) regulations applying to all bovines: animals coming from another Member State keep their original ear tags; no ear tag may be removed or replaced without authorization of the competent national authority; by 31 December 2001, the European Parliament and Council shall make a decision regarding the possibility of introducing electronic identification devices.

- ***Computerized databases***

In accordance with Directive 64/432/EC regarding problems of sanitary policing in intra-Community trade in bovine and porcine species, as of 31 December 1999, the Member States shall have instituted a computerized database containing the identity of the bovines,

the holdings present within the confines of each Member State, and all movements of the animals to and from the holdings.

▪ **Passports for the animals**

1) Issuance of passport: starting on 1 January 1998, the competent national authority shall issue a passport for each bovine within 14 days of receiving notification of its birth or, for bovines imported from third countries, within 14 days of receiving notification of its re-identification by the Member State concerned. The competent authority may also issue a passport for animals from another Member State under the same conditions. In such cases, the passport accompanying the animal on its arrival is sent back to the Member State that issued it;

2) retention and restitution of the passport: the passport accompanies the animal in all its movements. It is returned to the competent authority:

- in the event of the death of a bovine: the passport is returned by the holder, or by the slaughterhouse, within seven days of the death of the animal;
- in the event of export of the animal to a third country: the passport is returned by the last holder to the competent authority in the place of export.

3) exceptions:

Member States having a computerized database may decide not to issue passports to bovines intended to remain within the borders of the Member State concerned and determine that a passport will be issued to such animals only if they are transferred to another Member State.

▪ **Individual registries for each holding**

With the sole exception of transporters, each holding shall keep a registry that is updated either manually or electronically. Said holding shall also communicate to the competent authority all births and deaths of bovine animals, as well as all movements of animals into or out of the holding and completes, as appropriate, the animal's passport in this regard. Information regarding the origin, identification and destination of the animal must be accessible for a minimum of three years to the competent authority requesting it.

The European Committee retains the right to enact special regulations applicable to the movement of animals in mountainous zones.

Labeling of beef and beef-based products

Compulsory system

1. **Labeling requirement:** operators or organizations that market EU-produced or imported bovine meats are obliged to label such meats in each step of the marketing process. In cases where the product is not prepackaged, said operators or organizations must make the pertinent information available to the consumer at the sales point in clear and legible writing.
2. **Compulsory label contents:** the label must contain the following information:
 - the identification number or code that identifies the animal or group of animals that the meat belongs to;
 - the place of slaughter (country of slaughter and slaughter approval number);
 - place of sectioning (country of sectioning and laboratory approval number);
 - country of birth;
 - country of fattening.

When the bovine meat comes from an animal that was born, raised and slaughtered in a single Member State, this information may be collected under the single heading “Origin”.

If any of the required information is not available for imported products, it is sufficient to indicate “Non-EC origin” and the country of slaughter.

Labels on ground beef or veal must indicate:

- the identification code of the animal from which the meat was obtained;
- the country where the meat was processed;
- the country where the animal was slaughtered;
- the origin of the meat when the Member States concerned are different from the country where the meat was processed.

Voluntary system

1. Voluntary labeling: operators or organizations commercializing bovine meats may include additional information on the labels different from the required information.
2. Approval process: each operator or organization must submit a specification to the competent authority in the Member State where the meat is produced or marketed. The specification shall include:
 - the information to be included on the label;
 - the measures to be taken to guarantee the accuracy of the information;
 - the control system that will be applied in each phase of production and sale, including the checks that must be carried out by independent entities recognized by the competent authority;
 - in the case of organizations: the penalties for members who do not respect the specification.

Specifications that fail to guarantee the correspondence between the identification information on the products and the animal from which they derive are unacceptable, as are those that allow labels that contain misleading or insufficiently clear information.

The European Commission shall establish, with the help of a management committee, the length of time required for default approval of a specification in cases where the competent authority has failed to act, either to grant or deny approval. The Commission may also establish an accelerated approval process for certain types of meat.

The specification for imported bovine meats must be approved by the third country of origin. Subsequently, this country communicates to the Commission the identity of the competent authority responsible for granting approval, the criteria used for the examination of the specification, and the operators concerned. Nevertheless, within the Community, the approval will be considered valid if and only if the criteria applied by the third country are equivalent to those contained in the EU regulations in force. In many cases the holdings will be required to partially revise their existing architecture and bring their information system into conformity with the new rules.

Each animal tells its own tale: remote monitoring system for animals of different species

Introduction

The European Union has created an impressive corpus of legislation on food safety, animal well-being and the veterinary and plant health sector in general. This legislation is binding for all Member States and has partial validity also in non-EU countries that export animals, plants or their sub-products to the EU countries.

While the main responsibility for making sure these norms are respected lies with the fifteen Member States, the European Commission shares the responsibility for making sure that these EU norms are applied by the Member States. The Commission currently accomplishes this task by means of the veterinary and food office, established in April 1997.

The White Paper on food safety of 12 January 2000 plots the new preventive food safety policy: modernization of the legislation into a complex of coherent and transparent norms, enhancement of monitoring and controls from the farm to the table and strengthening of the capacity of the scientific consulting system in order to guarantee a high level of public health and consumer protection.

The strategic priorities of the White Paper are: the creation of a European Food Safety Authority; the coherent application of a legislative approach that accounts for the various steps in the food production process from the farm to the table; establishment of the principle that the bearers of greatest responsibility for food safety are the operators in the food and animal feed sectors, ensure adequate supervision and control of these operators by the Member States, verification of the effectiveness of the control measures adopted by Member States by means of audits and inspections conducted under the auspices of the Commission.

In November 2000, the Commission proposed the creation of a European Food Safety Authority responsible for providing independent scientific opinion and assessment and constituting a network with the purpose of ensuring close cooperation among analogous organisms in the various Member States. The Authority will assess risks associated with the food chain and provide information to the public on such risks. The regulation that lays the legal groundwork for the institution of a European Food Safety Authority was formally adopted on 28 January 2002.

For consumers, safety is the most important ingredient in their food. The recent crises have undermined their confidence in the food industry's ability to guarantee food safety.

Legislative Context

We cannot speak of food safety in the absence of a system for tracing meat and food products in general. This is tantamount to saying that there must be an effective and efficient system for identifying and registering animals. Animal identification comprises the unambiguous identification of individual animals raised for zootechnical purposes that allows for the reconstruction of the history of an animal from its birth until its death. Such identification serves a host of needs, ranging from aspects related to hygiene and zoonophylaxis to those concerning prevention of fraud and rustling.

Bovine identification was introduced into Italian legislation in 1954 with the Veterinary Police Regulation (Presidential Decree 320/54 - D.P.R. 320/54) and was successively supplemented and amended to respond to evolving veterinary needs and to embody the concept of the identification and registration of all bovine or ovine livestock, providing the basis for the compulsory prophylaxis plans for the eradication of tuberculosis, brucellosis and leucosis.

The European Union, with its Directive 64/432/EEC of 1964, amended and updated by the Directive 97/12/EC, enacted in Italy by the Legislative Decree no. 196 of 22 May 1999 (D.Lgs 196/99), regarding issues in the sanitary policing of intra-Community trade in bovine and porcine livestock species, has embraced the principle of livestock identity checks and laid the groundwork for the establishment of a computerized database containing information on holdings, slaughterhouses and individual animals, including their movements.

Subsequently, with the Directive 90/425/EEC on trade of animals and animal products within EC countries enacted with a view to the completion of the internal market, the European Council requires that identification and registration of animals must allow the specific animal's residence history to be retraced back to its origin.

In 1991 the Directive 91/496/EEC on the organization of veterinary checks of animals entering the Community from third countries, extends the obligation to identify and register animals even to bovines imported from non-EU countries but not intended for slaughter.

The motivations behind the first pieces of legislation on animal identification and registration were mainly related to control of infectious diseases by means of an epidemiological monitoring network, with the view of shifting veterinary controls from the border posts to the animals' places of origin, while still requiring review of the information obtained when the animal arrives at its destination, in view of the common market.

The Directive 92/102/EEC on animal identification and registration, progenitor of subsequent Community and national legislation on the matter, unifies the animal identification and registration system for EC animals and introduces the concept that a system must be available also for the purposes of managing certain EC agricultural aid programs and, hence, has to be accessible to the bodies responsible for the application of the Regulation (EEC) 3508/92.

D.P.R. 317/96 enacts the Directive 92/102/EEC in Italy. It assigns management of the animal identification and registration system to the Health Ministry, and initiates the implementation of a vital statistics archive for cattle, buffalo, sheep, goats and pigs, and the identification of cows and [water] buffalos.

Following the BSE crisis and the consequent tremors in the beef market, the Council of the European Community, having witnessed that the Directive 92/102/EEC did not fully satisfy all expectations, issues the Regulation (EC) 820/97. This Regulation is intended to provide further impetus to the completion of the bovine registry and, following the discovery of the link between BSE and the Kreutzfeld-Jacob disease in humans, institute a Community-wide bovine meat labeling system with the goal of stabilizing the market and safeguarding human and animal health through higher quality standards for products. The Regulation requires the use of double ear tags, the issuing of the passport by the competent authority and also introduces the concept of **computerized databases** as per the Directive 64/432/EEC amended and updated by the Directive 97/12/CE, enacted in Italy with the Legislative Decree 196/99.

The Regulation (EC) no. 1760/2000 repeals the Regulation (EC) 820/97, assimilating the contents of Title I regarding animal identification and registration, whereas in Title II it institutes, starting on 01/01/2002, a compulsory meat labeling system based on origin and a voluntary system that requires the approval of a production specification by the competent authority. In both cases the connection between the cut of meat and the animal it derives from must be guaranteed.

The objective of these regulations is to develop a system for providing information to the consumer by means of clear and suitable product labeling linked to the identification and registration of the bovines throughout all production phases. This also satisfies general needs such as safeguarding public and livestock health, thus bolstering consumer confidence in product quality and providing the basis for an increase in meat consumption.

In Italy, Presidential Decree (DPR) 437/2000, which enacts the Regulation (EC) no. 820/97, lays out requirements for system elements (ear tags, passport, stall registry and computerized database) and defines the players (keepers, slaughterhouse owners, ear tag suppliers, veterinary services, autonomous regions and provinces, and the Health Ministry) and attributes tasks and responsibilities to each of them. The computerized database, as per Article 6 of the above DPR, must conform to the requirements of Article 12 of the Legislative Decree no. 196 of 22 May 1999 (D.Lgs 196/99), be available on-line and be organized into three levels: (1) Ministry of Health, (2) Regions (and the autonomous provinces of Trento and Bolzano) and (3) Local Healthcare Units.

The Ministerial Decree (DM) of 31 January 2002 reiterates the principal purposes of the bovine registry system:

- a) safeguard public health and zootechnical assets (establishment and operation of the epidemiological surveillance network);
- b) provide basic support for supplying information to beef consumers and for clear and suitable labeling;
- c) ensure effective and efficient management, allotment and control of EC subsidies.

The EU objective in enacting animal identification and registration legislation was that of monitoring the range and controlling the spread of infectious diseases. Advantages were subsequently observed for the management of allotment of EC subsidies, in controlling fraud and cattle rustling, not to mention food safety and consumer health protection through product traceability.

The intention is to provide consumers with all information necessary to certify provenance and ensure quality, including data on production methods and distribution processes, and assure them that every possible check has been carried out at each step in the production process in order to optimize food safety.

Food safety is based on an integrated, full-cycle approach from the fields to the table. The producers bear the primary responsibility in this process, while the authorities have the task of monitoring and control, and the implementation of national surveillance systems.

Food safety also includes product traceability, not only for products intended for human consumption but also for those contributing to animal feed, such as the supplemental meals and additives. Thus product traceability must encompass the traceability of each and every constituent element.

Each animal tells its own tale: remote monitoring system for animals of different species

One of the principles behind food safety is traceability of the foods so that the origins of any problems can be identified and the problems eliminated at the source.

The most recent definition of traceability is contained in the proposed Regulation of the European Parliament and Council 2001/475: *“the ability to trace and follow a food, feed, food-producing animal or substance intended to be, or expected to be incorporated into a food or feed, through all stages of production, processing and distribution”*. This extends beyond the simple productive sphere to embrace distribution and consumption. Traceability is an indispensable support for product and process certification and, starting in 2005, the Regulation (EEC) 178/2002 **will introduce a compulsory food traceability system**.

There is an enormous quantity of information regarding products of animal origin that is relevant to the purpose of guaranteeing product quality and food safety. Within each species it is necessary to account for the peculiarities and needs of the different breeds and their interaction with the environment in which they are bred and raised. The search for products from a particular breed makes sense only if the animals were raised on a holding that practices traditional livestock raising methods, because this is the only way that the animals can best express their production potential and their ability to adapt to the environment, making their production wholesome and environmentally and ecologically compatible.

It is of fundamental importance for all meats generally to have information available identifying individual animals throughout the entire production and processing pathway.

The current identification system used for cows and buffalos consists of tags bearing an unique identification number attached to each ear of the animal. For sheep and goats the same system may be used or else the number is tattooed onto the ear. Pigs are identified by ear tattoos that indicate only the code of the holding where they were born. The identification system for horses consists of recording the animal's distinctive markings on a passport.

Registration of the animal data (as per Legislative Decree 196/99) in a database was made compulsory by the Regulation (CE) 820/97 for cows and buffalos, repealed and replaced by the Regulation (CE) 1760/2000.

The ear tap identification method carries risks of tag loss, or alteration or falsification by operators. Nevertheless, the use of ear tags has not been excluded from the current trial.

Regarding animal registration, there have been significant delays in communicating the information and thus in its incorporation into the nationwide database, as well as a high error rate deriving from manual transcription of the data.

With the aim of providing a response to specific problems associated with the identification and registration of each animal, the 1993 FEOGA (European Agricultural Guarantee and Guidance Fund) research project sought to assess whether current technologies were sufficiently developed to enable the implementation of an electronic livestock identification system. The project ended before the tested electronic identification system had been sufficiently developed for use in real holding conditions.

The results of the FEOGA project were confirmed by the AIR 2304 research project, which included among its objectives the preparation of a protocol for large scale implementation of electronic identification systems.

The IDEA project involved testing the electronic identification system on a large scale with cows, sheep and goats and evaluating the degree of perfection of the devices used.

The IDEA project used a half duplex transponder with an activation frequency of 134.2 KHz. To ensure reliability, the transponder contains exclusively read-only data as per the requirements of the ISO standards for radio frequency identification of animals 11785 (technical concept - transponder characteristics, data transmission and radio frequencies) and 11784 (electronic code

structure). The device is programmed with a fixed read-only identification number long enough to allow for a reasonably high number of combinations.

From 1998 to 2001 a million animals were electronically identified in France, Germany, Italy, the Netherlands, Portugal and Spain. The types of device used were electronic ear tags, rumen boluses or subcutaneous chips.

The principal objectives of the IDEA project were:

- functional evaluation of the different types of identification devices used in the various holding conditions (rumen bolus, ear tags, subcutaneous chips);
- assessment of the reliability of the electronic identification systems (field apparatus, read efficiency, attachment to animals...);
- assessment of the organization necessary for large scale implementation of a completely electronic livestock identification system (databases, data transmission, information acquisition and retrieval...);
- creation of standards for materials testing and information transmission.

The IDEA project produced positive results in terms of:

- read efficiency;
- permanency of identification devices (losses less than 1% per year for sheep and goats and less than 0.5% per year in cows and buffalos);
- data security and ease of all field operations;
- read speed (results exceeding 1,700 head per hour depending on setup of the holding).

The results of the IDEA project confirm the basic possibility of using electronic livestock identification methods. However, the general project summary indicated a need for improvements in the use of the transponder.

Starting from this premise, the present proposal regards the testing of an innovative electronic livestock identification system that uses a read-write microchip that accompanies the animal even after it is slaughtered, up to its sectioning at the retail outlet.

Research project description

The project comprises the design and testing of a transponder-based electronic system for the safe and reliable identification of animals and their registration in a database to complete the traditional system of plastic ear tags.

The experiments have as their objective an assessment of the effectiveness of an innovative livestock identification and registration system that uses a read/write microchip contained in various supports for rumen, subcutaneous or aural placement.

The applied device will allow the animal to be tracked through all its movements and displacements from birth to slaughter in order to ensure complete traceability of the animal.

The read/write microchip will memorize information regarding the animal's vital statistics (passport), its movements into and out of various holdings (and thus the transitions in its ownership history) and its veterinary condition (as per governmental disease prevention and control standards).

More detailed information on the holdings, operators and animal health will be recorded in a remote database.

The information will be updated in real time over the Internet with immediate turnover of information to the control bodies.

The microchip will contain both the electronic passport and the complete history of the animal and ensure its recognizability throughout the production process from birth to slaughter.

The information memorized on the microchip will be automatically updated when the animal leaves one holding and enters another by means of a walk-by antenna. The antenna activates the microchip and reads and updates the information contained on it. The transaction is completed with the updating of the remote database.

Gates equipped with transponders will be installed at slaughterhouses for the automatic identification of animals. The data will be read and checked when the animal passes through the gate and supplemented and updated with slaughter and slaughterhouse information. At that point 'daughter' microchips will be produced that contain copies of the data on the original or 'parent' chip. The daughter chips will accompany the side or quarter to the meat cutters or to the butcher block at the retail outlet. The individual packages produced by the meat cutter may bear labels containing all the information present on the original microchip.

The retail outlet that receives the side or quarter will be equipped with a microchip reading system that will allow the associated label to be printed.

The following resident information will be contained in the remote database:

1. Food business: company identification code, name, municipality, province, locality, address;
2. Holding (owner): domicile or residence, taxpayer or VAT number, animal species raised; information on holding type (company data sheet);
3. Keeper: domicile or residence, taxpayer or VAT number;
4. Animal: tag, species, breed, birthdate, mother's tag, sex, country of origin and previous tag (if imported from a non-EU country), country of birth or initial importation, birth farm or initial importation, genetic code (specimen reference number);
5. Ingress to holding: holding of provenance, holding of arrival, date of ingress, reason for ingress;
6. Egress from holding: departure holding, destination holding, date of egress, reason for egress;
7. Slaughterhouse: slaughterhouse authorization code, slaughterhouse taxpayer or VAT number, name, municipality, province, locality, address;
8. Slaughtered animals: Tag, species, holding of provenance, slaughter date, slaughter number, weight, category and classification;

9. Meat cutter: meat cutter authorization code, meat cutter taxpayer or VAT number, name, municipality, province, locality, address.

The following resident information will be contained on the parent microchip (on the live animal until slaughter):

1. Passport information: tag, species, breed, birth date, mother's tag, sex, country of origin and previous tag (if imported from a non-EU country), country of birth or initial importation, birth farm or initial importation, genetic code (specimen reference number);
2. Movements: Holding code, holding taxpayer or VAT number, date of ingress, date of egress;
3. Veterinary condition of animal.

The following resident information will be contained on the daughter microchip (from slaughter to meat cutter or retailer):

1. Passport information: tag, species, breed, birth date, mother's tag, sex, country of origin and previous tag (if imported from a non-EU country), country of birth or initial importation, birth farm or initial importation, genetic code (specimen reference number);
2. Movements: Holding code, holding taxpayer or VAT number, date of ingress, date of egress;
3. Veterinary condition of animal;
4. Slaughter: Slaughterhouse code, slaughter date, slaughter number, weight.

Adhesive labels will be produced at the meat cutter's that can be applied to the individually packaged portions. The labels will contain the information present on the microchip as well as the meat cutter identification number.

The retailer receiving the side or quarter containing a daughter microchip will be outfitted with a system for reading the information on the microchip and printing it on the label.

Electronic livestock identification system

Electronic livestock identification systems are apparatuses designed to identify a subject via a unique, non-erasable electronic code read by a detection system.

In livestock management, the identification is accomplished by the use of transponders, extremely small electronic devices that can easily be incorporated into ear tags, rumen boluses or glass-encased subcutaneous implants. The identification information includes vital statistics, property transfer data and veterinary data and constitutes a sort of electronic passport that the animal carries with it wherever it goes.

Transponder

The transponder is a passive transceiver, meaning that it does not have an autonomous power source (battery), comprising a microchip with read/write memory accessible via a miniature antenna. Most of the time the device is off: it neither receives nor transmits a signal and its complex control software is completely deactivated. In this state the transponder behaves as a completely inert body. When the transponder is brought within range of its counterpart read/write antenna, it is activated and draws power from the electromagnetic field generated by the antenna. At that point data may be received and/or transmitted. The transponder first transmits its unambiguous identification code and then, on the basis of instructions received via the antenna, transmits the information contained in its memory and/or memorizes new information. The transponder shuts off again as soon as it moves beyond the range of the electromagnetic field of the antenna, with the new information safely memorized.

Data read systems

The data read systems are apparatuses that pick up the data memorized on the electronic identification devices. They comprise a read/write enabled antenna, a field generator (commonly referred to as a reader), and an operating system. The systems are divided into two basic types: fixed and portable. The former are generally large and ideal for applications where the distance between transponder and antenna during the read/write phase is on the order of 80 cm. They derive their power from the normal electricity grid and they are generally controlled by a PC through a USB or serial port. The portable devices are relatively compact and lightweight and may be powered by batteries, but function only in relative proximity to the transponder (10-20 cm). The portable devices generally interface with a palmtop computer.

Pilot project

The electronic system to be tested was designed with the goal of following the animal through all its developmental phases, from birth to slaughter and on to the sales outlet.

The principal innovation introduced by this system is that for the first time the animal itself is the keeper of all the information related to its history (date and place of birth, stock raising method, displacements and pharmacological treatments).

Via an interactive terminal the microchip furnishes information on the animal's provenance, type of holding (and holding identification data), type of feed, veterinary treatments, etc. to the control bodies, the commercial intermediaries and the final consumer.

Data input to the chip is protected by a hardware-based key incorporated into the chip: access to the data is thus limited to those having the proper authorization.

The microchip has the following features:

- 2 Kbit memory, sufficient to contain several hundred encoded and compressed alphanumeric characters;
- operation guaranteed even in extreme climatic conditions: -10°C to 70°C, humidity, wind, etc.;
- very small size;
- maximum read distance: 80 cm by means of a specific reader;
- reader chip recognition capacity of up to 20 microchips per second within antenna range;
- unambiguous identity code;
- user authentication system based on hardware key.

After slaughter, the data on the parent microchip are transferred to 2 or 4 read-only (hence unalterable) daughter chips to be attached to the animal sides or quarters, respectively. The daughter chips then accompany the meat through to its distribution to the sales outlet or meat cutter, where the contents of the microchip can be displayed on a terminal and printed on the label on the final package for the consumer.

All data are also available to control bodies.

Pilot project methodology

Each cow will be assigned 5 transponders (1 parent to be attached to the live animal and 4 daughters to be attached to the quarters of beef after slaughter).

Each sheep or goat will be assigned 2 transponders (1 parent for the live animal and 1 daughter for the carcass).

All transponder are read/write enabled.

The following systems will be used at the holdings:

- fixed reader connected to an interactive terminal;
- portable reader for use at the farm;
- portable antenna;
- fixed antenna at the entrance to the stalls;
- antenna gate at the entrance to the stalls to be used when the livestock is loaded onto trucks;
- interactive terminal connected to the Rome Experimental Zooprohylactic Institute.

Objectives

Primary among the objectives underlying the reform of the Common Agricultural Policy are the quality and suitability of production to market demand, environmental protection and natural resource conservation. The adjustment of supply to demand requires that producers meet the desires of consumers who are increasingly demanding wholesome, high quality products produced via environmental friendly methods; products with certification of origin have gained widely in appeal. Consumers must be able to distinguish quality products. A quality seal, whose proper use is ensured by effective control measures, guarantees that consumers will be supplied with the elements they need to make informed choices.

We believe it is of fundamental importance to provide organic products, products of certified origin (DOP), and products of certified geographic provenance (IGP) with certifications of specificity as per the Regulations (EEC) 2092/91, 2081/92 and 2082/92, to ensure transparency in the production process and to guarantee the traceability of products of animal origin. The valorization of product specificity in terms of origin and traditional production processes contributes to consumer protection and counteracts fraud and other unfair practices.

Procedures must be developed for animal identification and registration and meat labeling that allow for:

1. improvements in the reliability of animal identification systems;
2. simplification of information flows and guaranteed access to information for all authorized sectorial operators;
3. implementation of a labeling system that provides all the information necessary to guarantee the origin, healthfulness and wholesomeness of meats;
4. valorization of products whose characteristics are linked to a certain geographic origin (IGP) or traditional production methods (DOP).

The traceability of food products is desired both by demanding consumers, who want food and drink of certified and verifiable quality, and by producers, who employ innovative methods and services to communicate the value of their products to consumers. In this respect, the consumer wants to know the provenance of the primary products, what production method was used, the type of processing applied, the control measures, the hygienic conditions and the means of transporting and distributing the final products. On the other side, the producer tracks the production and marketing process of his products.

Furthermore, BSE, genetically modified organisms (GMO), production methods that are environmentally compatible and protect animal well-being, hygienic standards, and control and transparency of the production system have raised the issue of the relationship between the agro-foods system and food quality and safety. The consumer is no longer focused on the intrinsic characteristics of a given product, but on the entire production context that encompasses the animal and the greater environment. Documentation of the entire production process has thus become an indispensable prerequisite for the recovery of consumer confidence.

In the meat production sector, traceability is rendered more difficult by the characteristic individuality of the products. For bovines the application of such system is driven by the Regulation (EC) 1760/2000 on the labeling of beef and meat-based products and is supported by legislation regarding animal identification and registration. The bovine identification and registration system is based on the application of ear tags, the issuance of a passport that accompanies the animal throughout its movements and displacements and the registration of the information in a national database that records the entire history of each animal.

Current technology allows us to use low radiation transponders for electronic identification that contain in their memory the animal's vital statistics, periods of residence in various holdings, and veterinary checks and treatments. The information resides with the animal and is therefore accessible wherever the animal is. The system ensures the unambiguous identification of the characteristics of the animal, and the ability to automate much of the herd management operations (stall registers, displacements, transit forms, etc.) and veterinary controls. It supports meat traceability programs, and promotes, certifies and valorizes the marketing of meats within quality product channels (DOP, IGP) with certifications of specificity.

The system can be extended to other domesticated animal species such as sheep, goats, buffalo, pigs and horses, and to wild animal species as well.

The project's final objectives are:

1. testing of innovative instruments designed to support automatic registration and certification systems;
2. transmission of identification and health data through the entire production process up to the final consumer;
3. evaluation of the possibility of developing automated systems based on the electronic device for veterinary checks, functional controls, company management, etc.;
4. to automate animal identification and registration operations at the slaughterhouse as required by legislation;
5. to support meat traceability programs via the possibility of combining other post-slaughter tracking mechanisms with the electronic identification system;
6. to increase the amount and variety of data necessary for the implementation of the national database and evaluate the possibility of providing additional information to the final consumer;
7. to support valorization and protection programs for organic products and DOP and IGP products with certifications of specificity.

Criteria for assessing achievement of final objectives

1. Improvement in the transparency of meat production and marketing conditions by means of a printed label including animal vital statistics, its residence history at various holdings, and its veterinary condition, and evaluation of the influence of such improvements on consumption of meat and meat products;
2. Checking the information registered on the microchip and comparing it with that contained in the project and national databases;
3. Testing of product traceability by comparing DNA analysis results of specimens taken at the time of animal tagging (identification or re-identification) with those taken from products attributed to the same animal;
4. Reduction of time requirements of certain herd management operations, veterinary controls and operations required by animal identification and registration regulations.

Intermediate objectives

1. Determination of whether a read/write transponder is the most appropriate instrument for electronic identification of animals and tracking of derived products;
2. Determination of the most suitable support for transponder placement on the basis of species, stock raising method and age of the animals;

3. Measurement of the electromagnetic radiation emitted by the instrumentation in question and evaluation of any modifications in the behavior of the animals for the purpose of ensuring animal well-being and product wholesomeness;
4. Determination of what information should be ideally collected for control of the production process and what should be written on the label to ensure transparency in production and marketing;
5. Automation of data registration operations at the slaughterhouse and transfer of said data to the sides or quarters of the carcass.

Criteria for assessing achievement of intermediate objectives

1. Assessment of the number of lost, fraudulent, defective or illegible transponders;
2. Assessment of the degree of automation achievable in updating data on the transponder and in the central database;
3. Evaluation of the simplicity and speed of data registration operations at the slaughterhouse;
4. Measurements of the electromagnetic radiation emitted by the devices in the various conditions where they are used.

Project methodology

The current program will last 24 months. The first 4 months will be dedicated to preliminary organization and project software design and development. The successive 20-month operational phase will be conducted at holdings, slaughterhouses and sales outlets.

A training program has been organized for personnel who will use the system (operators, veterinarians, stock raisers, slaughterhouse staff, retailers) and progress reports and results will be made public.

The experiment will be carried out on bovine animals in various holding conditions: intensive raising of veal and steer, milk cows, farms where calves are nursed by their mothers either in the stall or free range. The functional qualities of different microchip supports will be tested under the various conditions that may be encountered at the holdings.

As each animal is identified, a tissue specimen will be collected and the specimen number will be recorded on the microchip. The correspondence between the DNA analysis results of the meat at the slaughterhouse or retail outlet and those of the specimen collected from the animal at the time of initial identification (tagging) and to which the meat is attributed will be checked and compared for a sample comprising 10% of these animals.

Certain holdings will be equipped with the complete system including an interactive terminal and reader for data transmission and acquisition, and antennas for reading and writing to the microchip. For these holdings registration of the movements of the animals from one holding to another will be completely automatic.

The special characteristics of holdings where buffalo, mainly fed on milk, are raised presuppose the electronic identification of animals that in most cases remain at the holding, whereas for a small number of holdings that market 13-24 month-old animals, these animals can be tracked to the retail outlet. The durability of the microchip support and the stability of the recorded data will be tested at the holdings.

For sheep the electronic identification system will be applied both to lambs, to valorize the product, and to adults, in light of the forthcoming proposal for compulsory identification being deliberated at EU headquarters in Brussels (Bruxelles, 13.12.2002 COM(2002) 729 final, 2002/0297 (CNS) Proposal for a Council Regulation: establishing a system for the identification and registration of ovine and caprine animals and amending Regulation (EEC) No. 3508/92). In this case as well, different microchip supports will be tested.

For wild animals movement tracking will be of prime interest in order to monitor any pathologies affecting both wild and domestic populations.

Electronic identification of pigs will mainly be addressed to feedlot animals intended either for direct consumption or for the food processing industry. Traceability will also be possible for derivative products. A small sample of the animals in the study will be additionally identified by genetic testing (microsatellites). The information will be obtained from a tissue sample collected during the tail cutting operation and recorded on the transponder. Once the animal has been slaughtered, this information will allow researchers to check the correspondence between the specimen collected directly from the live animal and the meat later attributed to it.

For horses electronic identification may be applied both to those animals intended for consumption, in order to certify the origin of the meat, and to those used for other purposes (equestrianism, reproduction, etc.). The transponder will contain information on animal markings, ownership history, veterinary history (electronic passport).

Electromagnetic measurements will be carried out in the various situations to make sure the systems used conform to legislated requirements and do not have adverse effects on the health of the animals.

An essential aspect in the success of the project is the development of the technology necessary for the entire system. Hardware will be prepared and the system will be designed and developed with centralized and local functional capabilities. Publication of the data on the Internet will make

them accessible also at the sales outlet. The project includes installation of the equipment at the holdings, slaughterhouses and sales points as well as training programs in the use of all instrumentation.

The transponder that will be used in the study is a passive device that does not require its own power source (battery). It is activated automatically when it receives a signal from the reader antenna, which enables data reception and transmission. It then provides information on the host animal's provenance, movements, ownership history, holding type and identification, feed type, and veterinary condition via the interactive terminal. It operates at low frequency, has an unambiguous 64 bit read-only identification code and a read/write memory of approximately 2 Kbit (256 byte) for application data, guarantees data stability for over 10 years, is read/write accessible within a transit corridor of 80 cm., can operate in an anti-collision state to allow simultaneous access to a number of microchips located in the same transit corridor, is not affected by magnetic fields generated by common electronic devices, high tension lines or radio waves, functions in adverse climatic conditions, and has an effective data protection mechanism consisting of a hardware key.

The choice of holdings will fall preferably to those that constitute a sort of closed loop in the various phases of raising, fattening, slaughter and marketing, to minimize the number of animals that may elude control. It will be possible to valorize and certify products, especially those bearing the DOP or IGP label, with attestations of specificity. The microchips will be applied to the animals and the animal's vital statistics will be recorded on them at the holdings. Where available, the animal's genetic code will also be recorded. During the movements of the animals from one holding to another the data on the microchip will be updated and supplemented with new data from veterinary checks and treatments. The physiological condition of the animal will be assessed as will the vulnerability of the system to fraud. The animals will activate the automatic data reading system by passing through a special electronic gate that will automatically update the databases. The information contained on the microchip will be transferred to daughter chips that will be attached to and accompany the sides or quarters all the way to the meat cutters or retail outlet. The sales point may be equipped with readers to provide information on the animal to the final consumer: provenance, feedlot conditions, veterinary history, etc.

The microchip will contain the salient information on the animal, the holdings where it resided and its veterinary condition, whereas the project database will be set up at project headquarters to collect all information gathered from the single operating units.

The information can then be made available via Internet:

- to the competent authorities for the assigned controls;
- to the final consumer, who can thus retrace all the information regarding the holdings where the animal whose meat has just been purchased had resided.

Animal identification, and registration of vital statistics, movements and veterinary controls will be performed by project personnel made available to the holding. In certain holdings the complete system will be installed, including an interactive terminal connected to a central system and an antenna for reading and writing to the microchip. In these enterprises, as specified in recent regulations regarding bovine vital statistics, the owner is responsible for such data and thus will be the one who directly records them. Veterinary information, on the other hand, will be recorded by the project veterinarian.

Project stages

1. Training of ad hoc agencies who will handle transponder insertion, operate the reader, register bovine data on the microchip and in the remote database directly at the holding. Training of veterinary personnel in the registration procedure, and use of software and reader. Training of personnel at the slaughterhouses where automatic reader gates will be installed. Training of personnel at the holdings where the complete electronic identification system will be installed so that they can register the data they are responsible for.
2. Application of the microchip and registration of the animals' vital statistics at the holding, and transfer of these data to the microchip and remote database. A tissue specimen will be collected at the time of identification (tagging) for subsequent DNA analysis. Periodic checks will be made to verify the continued presence of the microchips on the animals by means of portable readers. Registration of the animal's pharmacological treatment history by veterinarians from the control bodies and transfer of these data to the microchip and remote database. Data read and check at the slaughterhouse by means of automatic reader gates and comparison with data present in the remote database.
3. Verification of any physiological effects deriving from the presence of the microchip with the purpose of assessing any negative impact on productivity and animal health. This will be partially accomplished by measuring the electromagnetic field generated by the antenna-microchip system.
4. Verification of the sanitary and hygienic conditions of the products obtained from the animals in the study and intended for human consumption.
5. Registration of the information at the slaughterhouse and transfer of this information from the parent to the daughter microchips. The daughter microchips follow the sides or quarters through to the sales point, where labels containing the data will be printed for consumer consultation. Check of microchip data and comparison with data in the remote database. DNA analysis of the final product and comparison with the specimen collected at the time of initial identification for an intermediate verification of the effectiveness of the tracking system.
6. Registration of information at the meat cutters and preparation of labels to be attached to each single retail package containing the meat cuts.
7. Check of the information on the label at the retail outlet and comparison with that contained in the remote database. DNA analysis of the final product and comparison with the specimen collected at the time of initial identification for an intermediate verification of the effectiveness of the tracking system.

Personnel training

Personnel from ad hoc agencies will be trained to handle:

- animal identification via transponder, tissue specimen collection for DNA analysis, and registration of animal data on the transponder and transmission of these data to the remote database directly at the holdings;
- registration of animal residence and ownership history;
- registration of veterinary condition;
- registration of data at slaughterhouses and meat cutter facilities.

Training of veterinary personnel:

- in the use of the data verification and control system;

- in the use of readers at the holdings for all handling and identification operations;
- in all operations at slaughterhouses where the automatic reader gates are installed.

Physiological condition check

- a) feasibility check of animal identification operations using various types of transponders implanted at different points on young animals;
- b) determination of durability of transponder implant;
- c) determination of the impact of the presence of the transponder on animal well-being;
- d) determination of effects induced by the low frequency (100-150 KHz) electromagnetic fields;
- e) evaluation of the qualitative and quantitative effectiveness as a zootechnical application for both meat and dairy animals.

Determination of the hygienic and sanitary characteristics of the products obtained

The following aspects will be evaluated for the purposes of food safety and product quality:

- Potential effects on certain chemical-physical reference parameters for the assessment of meat quality;
- Potential effects on dairy technology and the chemical and physical characteristics of milk intended either for direct human consumption or the processing industry;
- Potential effects on the hygienic and sanitary characteristics of the meat from both the microbiological and histopathological standpoints;
- Potential effects on the hygienic characteristics of milk with particular emphasis on bacteriological quality of raw milk and number of somatic cells contained in it;
- Effects on any pathogens present in the animal at various levels of illness. Pre-slaughter stress conditions may promote contagion and thus the presence in animal meat of these pathogens, which may be difficult to diagnose with normal laboratory analyses used for inspections if the agents exhibit any unusual characteristics.

All the above characteristics may be evaluated via chemical-physical, microscopic, histo-enzymatic, biochemical and microbiological analyses.

Evaluation of the effectiveness of the meat tracking and tracing system

DNA samples will be collected from a sample of approximately 10% of the transponder-tagged animals at the time of slaughter and compared with specimens taken (and frozen) when the animal was initially tagged.

DNA samples will be collected from a sample of approximately 10% of the transponder-tagged animals that are tracked through to the sales outlet, and compared with specimens taken (and frozen) when the animal was initially tagged.

Transferability of results

The system may be applied to a data registration system (vital statistics) where responsibility for inputting data into the system lies with the manager of the holding. The data are transferred on-line in real time to the central database and simultaneously written onto the microchip attached to the

animal. In these cases the vital statistics (electronic passport), the animal's history of movement and health data are directly present on the animal and available regardless of the animal's location.

We believe it is of fundamental importance to provide organic products, products of certified origin (DOP), and products of certified geographic provenance (IGP) with certifications of specificity as per the Regulations (EEC) 2092/91, 2081/92 and 2082/92, to ensure transparency in the production process and to guarantee the traceability of products of animal origin. The valorization of product specificity in terms of origin and traditional production processes contributes to consumer protection and counteracts fraud and other unfair practices.

Project output

Promotional activities

The problems that have struck the meat production and marketing industry, with the notable case of BSE, have driven a series of changes in the industry's marketing approach and in the increasingly demanding stance of consumers. Consequently, the need has arisen to implement a series of measures to guarantee the quality of the production process and to place these measures at the service of stock raisers and consumers.

It is thus believed that the activities related to the promotion and distribution of project results must not merely be addressed to those who deal in meat production (breeders, holding managers, slaughterhouses, etc.) but also to all who are in any way affected by the meat production sphere, i.e., consumers must also be directly informed, a point they have quite rightly made clear.

Breeders, stock raisers, slaughterhouses, retailers, consumers and administrators, as well as technicians and researchers interested in the topic are those who directly stand to benefit from the publication of the project results and technological research.

- **Creation of a website:** The first avenue of publication will be an ad hoc website containing information related to project objectives, the needs analysis that drives the project, and general progress. This website will function as a gateway as much for the objectives as for project planning and development, with progress reports illustrating the achievement of intermediate objectives. The site will function as an on-line consulting center where responses will be given to all questions, doubts and signs of interest on the part of potential users of the tested system. After the conclusion of the project, forums will be organized on the site to facilitate information exchange between technicians and those interested in applying the developed technology. There will also be a technical consulting and support system for issues involving the actual use of the electronic identification system.

Once the experimental phase has been completed, a series of activities will be conducted to publicize and promote the results, and market the developed technology, as follows:

- **Informative field trips:** addressed mainly to the final users of the developed systems with the objective of enhancing system usefulness and functionality. The field trips will also be addressed to researchers and technicians involved in the sector with the objective of demonstrating the utility and benefits achieved by the project. The destinations will be holdings and other operations directly involved in the project that will serve as practical examples of the techniques and technology applied.
- **Articles and papers:** the articles and papers will provide a detailed report of the technical progress and developments related to the project and will be addressed to researchers and technicians as well as to potential users of the system.
- **Informative presentations:** the systems developed as part of the project will be presented to technicians, consumer associations, and public administration representatives in order to highlight their benefits and usefulness.
- **Conferences in association with universities and research centers:** focused on illustrating the benefits and usefulness of the newly developed traceability system.

For information:

Wincat S.R.L

ROME - 00186
Piazza Campitelli, 10 - Int. 1
Tel. +(39) 06 6830.1336
Fax +(39) 06 6821.7238
www.wincat.it
Email: info@wincat.it

Experimental Zooprohylaxis Institute of the Regions of Lazio and Tuscany

ROMA - Via Appia Nuova, 1411
Tel +(39) 06 790991
Fax +(39) 06 7934.0724