BiH Laboratory assessment report - Food safety

The assessment was performed by the expert team engaged on EC project "Assistance in preparation of IPA programme BiH in the field of Food Safety". The assessment was performed in the period January-February 2007 with following objective:

- to prepare investment proposal for supply of equipment for IPA 2007 programme;
- to provide basis for preparation of the BiH National Laboratory Plant that will be defined during the project component related to provision of technical assistance;
- to identify follow up investment needs for proposal for EC finance from IPA 2008-2009 assistance.

Prior to visiting the laboratories we had an introductory meeting with staff from the BiH Sarajevo University – Faculty of Veterinary Medicine 'Department of Food Hygiene & Technology'. During the course of this meeting we were provided with some information regarding the system of food inspection together with a list of laboratories that are involved in the 'Official Control' of food.

Food inspection

Under the current system, a number of inspectorates, are involved in the Official Control' of food. Their responsibilities are divided as follows.

Veterinary inspection:

- animal health, production and welfare
- food of animal origin: production plants, warehouses, transport

Sanitary inspection:

- Foodstuffs of non animal origin, such as those derived from plants and cereals, fruit, vegetables, beverages etc.
- Foods such as ready prepared meals that include ingredients of animal origin may well be subject to sanitary inspection.
- Water

Trade inspection:

- Foodstuffs: declaration and quality

Phytosanitary inspection:

- Plant production

Laboratories

Veterinary laboratories

- Provide diagnostic services for food of animal origin.
- Current veterinary laboratories are organized as a two tier system.
- Authorized laboratories are designated by the Entity Ministry of Agriculture
- Reference laboratories are designated by the State Council of Ministers

List of authorized labs

1. Veterinary Institute of the Veterinary faculty Sarajevo – 5 Departments – 39 employees (23 experts).
2. Veterinary Institute Banja Luka - consists of 3 Departments plus one small branch office in Bjeljina and employs a total 49 persons (37 experts).
3. Veterinary laboratory Mostar – 5 employees (1 expert)
4. Veterinary laboratory Tuzla – 5 employees (1 expert)
5. Veterinary laboratory Zenica
6. Veterinary laboratory Bijeljina
7. Veterinary laboratory Bihae
8. Veterinary laboratory of Cantonal Veterinary Station – Sarajevo – 8 employees

Agricultural Institutes – have some responsibilities for the quality control of cereals and other plants (including fruits and vegetables)

1. Agricultural Institute Sarajevo – 5 Departments plus laboratories – employing 20 people (7 experts).
2. Agronomic Institute of the University of Mostar – 6 Departments, two field stations plus laboratories – employing 15 people (10 experts)
3. Agricultural Institute Banja Luka - registered as an Institute for Science and Research, 9 Departments plus laboratories employing a total of 72 people (33 experts)

Institutes for Public Health – are responsible for the control of sanitary conditions in food production.

1. Cantonal Institute for Public Health Sarajevo
2. Cantonal Institute for Public Health Zeniea
3. Cantonal Institute for Public Health Bihac
4. Cantonal Institute for Public Health Tuzla
5. Cantonal Institute for Public Health Mostar
6. Federal Institute for Public Health Sarajevo
7. Federal Institute for Public Health Mostar

8. Institute for Public Health of RS Banja Luka - control of sanitary conditions of production in RS

Although there are 20 or more laboratories, many of these are barely operational.

Bosnia & Herzegovina – Sarajevo University – Faculty of Veterinary Medicine

The Department of Food Hygiene & Technology includes a suite of laboratories that are used for both teaching and research activities and for chemical analysis and microbiological examination of food for the purpose of 'Official Control'.

Another laboratory undertakes some analysis of animal feeds.

Laboratory of the Veterinary Institute of the Veterinary Faculty Sarajevo

Equipment in the laboratory includes:

- An **HPLC system** comprising –
- Perkin Elmer 758A UV – Visible detector
- Perkin Elmer series 200 Isochratic pump
- Column oven

This equipment was originally used for the analysis of meat for hormone residues but since none were detected, it is now used for analysis of food for the presence of certain antibiotic residues, including tetracyclines and sulphonamides. The methods used for the detection of antibiotics are apparently based on those published by the Association of Official Analytical Chemists (AOAC).Screening for hormones is now undertaken using ELISA based test kits.

PCR

- A separate laboratory has been adapted for carrying out analyses based on the use of the polymerase chain reaction (PCR).
- The equipment currently in use is a conventional 'thermocycler' to carry out the PCR process. The amplified DNA or protein fragments are then further identified by the use of gel electrophoresis.
- Currently this technique is used for the identification of bacterial strains including those of E.coli, Staphylococcus aureus, Listeria monocytogenes etc.
- This technique is also used for meat speciation.
- No analysis is currently undertaken to detect the presence of ingredients of genetically modified origin.

Gas Chromatographs

- The department is equipped with 2 gas chromatographs both of which are based on Perkin Elmer Autosystem XL instruments.
- The first is equipped with a flame ionization detector only and is used predominately for the determination of the fatty acid composition of oils and fats.

- The second instrument is equipped with an electron capture detector (ECD) and can be used for the detection of organochlorine pesticide residues and polychlorinated biphenyls (PCBs).

Atomic Absorption Spectrometry

- The laboratory is equipped with a –
- Perkin Elmer AAnalyst 300 Flame AA,

  together with
- HGA 850 – Graphite Furnace
- MHS10 – Hydride generation system

As far as the expert could tell, background correction is achieved by the use of a deuterium arc rather than by the Zeeman system.The laboratory did not appear to be equipped with facilities for the preparation of samples by microwave digestion. The atomic absorption spectrometer is used for the analysis of both food and animal feeds.

Mycotoxins

The laboratory is using ELISA based techniques for the determination of aflatoxin M_1 in milk.

Antibiotic residues

Transia plate test systems are used for the detection of chloramphenicol residues and TetraSensor kits are used for the detection of Beta-agonists.

Beta-agonists include substances such as clenbuterol and salbutamol. They may be used to affect the growth of beef animals and produce a leaner carcass. Clenbuterol is the only beta-agonist licensed for veterinary use, for the treatment of respiration disorders, but all beta-agonists including clenbuterol are prohibited within the EU for use as growth enhancing agents.

Microbiology

The microbiology laboratory was relatively well equipped with incubators etc. and work surfaces appeared to be constructed of impervious material that could be easily disinfected.

Methods used for the microbiological examination of foods are those that are included in the current food laws, published by the Federal Republic of Jugoslavia.

Although it was claimed that checks are carried out on batches of prepared media, including checking the ability of particular types to support the growth of specific bacteria, the reference cultures used, are obtained locally, from other institutes. Whilst the laboratory can be commended for at least conducting some quality checks, it is normally recommended that bacterial cultures used for such checks, are obtained from recognized reference culture collections such as ATCC or NCTC.

Cantonal Veterinary Laboratory – Sarajevo

This is the only laboratory in Bosnia & Herzegovina that is accredited to ISO 17025 by the Bosnia & Herzegovina Institute for Accreditation. The laboratory's scope of accreditation includes 39 methods for the analysis or examination of food and water.

The laboratory has been accredited since June 2004 and has been re-assessed in 2005 and 2006. All assessments have been satisfactory. The Laboratory Director is Nedim Brdarić who holds a Doctorate in Veterinary Medicine. The Technical Manager is Lejla Zahirović who also holds a Doctorate in Veterinary Medicine. The Head of Microbiology holds a Master's degree and specializes in the identification of E.coli. The Head of Chemistry has a PhD and specialises in the study of heavy metals in foods. The laboratory occupies 3 or 4 floors of a building and whilst it is in a good state of repair it is not an ideal location for a laboratory.

Sample reception

This is placed immediately inside the main entrance to the laboratory and there is an inner door that provides access to the laboratory itself. Clients, including Veterinary and Sanitary Inspectors are not permitted to enter the laboratory and are required to deliver their samples via a hatch, to the sample receptionists.

ELISA Techniques

The laboratory is equipped with an Idexx Plate Reader and has kits suitable for the detection of the following:

- Brucella abortis – in milk
- Salmonella spp.
- Q Fever – in milk
- Stilbene
- Nortestosterone
- Stapylococcal toxins
- Alachlor – in water used for meat processing
- Chloramphenicol
- Sulphamethazine
- Aflatoxin B_1

Results of the ELISA assays are assessed by an Idexx Plate Reader and the laboratory has stored a number of programmes for the above listed assays in a computer linked to the plate reader. The laboratory also undertakes the analysis of water. Most of the tests undertaken are based on the use Hach test kits with results being assessed by the use of a Hach DR/4000 U spectrophotometer. The Hach test method for nitrate has been adapted for use in determining nitrates in meat.

Proximate Analysis

A second laboratory is used for the analysis of moisture, ash, fat etc. of food. In particular, it was noted that when it is necessary to determine the total nitrogen content of food, in order to calculate protein content, the apparatus required has to be assembled on every single occasion. The lack of dedicated equipment such as that

provided via block digestion and semi automated distillation units, inevitably leads to a lack of reproducibility. As far as the expert could tell little or no recovery checks for nitrogen, or for ammonia at the distillation stage, are carried out.

Metallic contaminants

This laboratory is also used for dry ashing samples, prior to the determination of metallic contaminants, including lead, cadmium etc. The prepared samples are then analysed using an atomic absorption spectrophotometer, located in another institute. It is difficult to understand why the Institute for Accreditation are prepared to accredit the laboratory for the determination of metallic contaminants in food, particularly as the atomic absorption spectrophotometer used, is not under the direct control of the accredited laboratory. Similarly, the expert dose not believe that dry ashing of samples prior to the determination of metallic contaminants at low levels, is an appropriate technique.

Mycotoxins

Currently the laboratory carries out analysis for ochratoxin and aflatoxins B1 using ELISA test kits. Using such kits the laboratory frequently detects mycotoxins at levels that would exceed those set in EU regulations governing the levels of these substances in a range of foodstuffs. However the laboratory is still required to work to the Former Jugoslav laws. Since the limits set in the older Jugoslav law are significantly higher than those that apply in EU Regulations, no action can be taken since, although levels exceed EU limits, they are still in compliance with the former Jugoslav limits.

Microbiology

Media for microbiological examination of foods are prepared from complete dehydrated media and are tested for sterility and pH. Some checks are carried to ensure that the prepared media is able to support the growth of target organisms. Again, the reference cultures used, are obtained locally, from other institutes rather than from recognized culture collections such as those of ATCC and NCTC. The laboratory is equipped with modern incubators for which temperature records are maintained. Incubator temperatures are monitored using digital minimum and maximum thermometers. This is good practice since it enables the detection of incidents such as overnight power failures. Currently, microbiological examination of food is restricted to testing for those organisms that are listed in the existing State laws. It is generally the case that the State law specifies the parameters for each food type. For example, under the existing law, there is no requirement to test for Listeria species or for Listeria monocytogenes. Furthermore, all methods are laid down in the State law and as a consequence, ISO methods are not widely used. As Bosnia & Herzegovina implement EU Regulations such as Regulation 2073/2005 on microbiological criteria for foodstuffs, specify the reference methods as EN-ISO or ISO methods. As EU Regulations are adopted into National law, official laboratories will be obliged to use EN – ISO or ISO methods.

Agricultural Research Institute – Sarajevo

The Institute is currently expanding its laboratory facilities. This expansion includes increasing the floor space of the laboratories, purchasing additional equipment and recruiting suitable staff.Once completed there will be 3 sections covering:

- Seeds, seedlings etc.
- Food – excluding milk and milk products
- Milk and milk products.

Originally the laboratory had 3 experts, one of whom was a microbiologist, the 2nd expert was a chemist and the 3rd expert, also a chemist with an MSc degree, was responsible for the section of the laboratory undertaking analysis for pesticide residues, metallic contaminants etc. Recently, an additional 9 specialist have been recruited, as follows: 3 Chemists,3 Microbiologists, 2 Agronomists,1 Veterinarian. All of the newly recruited staff are graduates and whilst they have all received basic training they still require further, more specialised training.

The laboratory undertakes microbiological examination of food together with general compositional analyses.1 million KM is being provided from the Federal budget for the provision of milk testing equipment. The reconstruction of the previously destroyed buildings is also being funded from the Federal budget. It is hoped that in the future, the Agricultural Research Institute laboratory will be recognized as a 'National' food testing laboratory.

According to the Director, the testing capacity of the laboratory is under utilized. This mostly as a result of the fact that inspectors are not taking an adequate number of samples under the existing laws and so are not able to submit samples to the laboratory.

For example, the Director estimates that the laboratory currently has the capacity to undertake 10,000 analyses per year. In the past year, the laboratory undertook approximately 400 analyses, the majority of which were the microbiological examination of food. As a further example, in the past 3 years, only 3 samples have been submitted for pesticide residue analysis.

Seed Testing Laboratory

This laboratory undertakes basic tests on seeds, such as determination of content, germination tests etc. Some tests for viruses are undertaken using ELISA test kits. The plate reader used for assessment of the microtitre plates used for the ELISA tests, appeared to be rather old.

Microbiology Laboratory

The incubators used in the laboratory seemed to be in reasonable condition. Other equipment includes a laminar flow cabinet. Only 1 autoclave was available so presumably this is used both for media preparation and for the sterilization of waste, prior to its disposal. Other equipment is sterilized by means of dry sterilisation.

As far as could be ascertained, there was no 'Stomacher' available for the homogenisation of samples, prior to microbiological examination. Instead, it would seem that samples are homogenized manually which inevitably increases the risk of contamination, from one sample to another.

Water for use for reconstitution of media etc. was prepared by distillation. Again, as far as the expert could see, no checks on the quality of the water produced, such as measurement of its conductivity, were undertaken, prior to it being used.

Chemistry laboratory

Equipment included a digital polarimeter, used for the determination of sugars in a range of foods. At the time of the expert's visit, the laboratory was undertaking compositional analysis of jams from a local manufacturer. This work was being undertaken on a commercial basis and as such, care needs to be taken to ensure that there are no conflicts of interest. Determination of fat content is undertaken using conventional Soxhlet apparatus. Similarly, the determination of the total nitrogen content of foods was undertaken using the traditional Kjeldahl method and equipment.

Instrumentation

The laboratory is equipped with a Perkin Elmer AAnalyst 100 atomic absorption spectrophotometer with flame atomization. Samples for analysis for metals are prepared by dry ashing or by the use of a manual wet oxidation procedure. Other equipment includes a Perkin Elmer Lambda 25 spectrophotometer which is used for a range of tests. The laboratory is also equipped with a Perkin Elmer Autosystem XL gas chromatograph, fitted with a flame ionization detector (FID) and an electron capture detector (ECD). Given that the gas chromatograph is only equipped with an ECD detector, the laboratory is limited to analyzing foods for the presence of organochlorine pesticide residues.

Public Health Institute Laboratory – Sarajevo

The laboratory undertakes analyses of samples submitted by the inspectors to ensure that it complies with laws governing food safety. The laboratory also requires that local food processors and manufacturers take out a contract to submit samples on a regular basis, for the purpose of quality control. The laboratory also undertakes analysis of food to provide data for use on export certificates.

The Federal Ministry of Health requires that certain products such as vitamin and mineral supplements, dietetic products etc. are registered, prior to be placed on the market. Manufacturers and importers of such products are required to submit samples of such products to the Public Health Institute for analysis, prior to them being placed on the market.

The laboratory is also responsible for analyzing products which are classed as for general use, such as, cosmetics, toys, materials and articles in contact with food. Materials and articles in contact with food include plastic packaging materials, cooking utensils and ceramic ware. Whilst these may be tested for metals that can be leached out during cooking, no migration tests are conducted on plastic materials for additives such as plasticisers and no tests are conducted on PVC for the presence of vinyl chloride monomer. The main reason for this lack of testing is that such requirements are not included in the current laws.

There is a requirement that new products marketed by local food manufacturers be tested by the Public Health Institute laboratory to ensure that it complies with food safety requirements etc. This is also required when changes are made to the product formulation or packaging. Samples for analysis to show compliance with food safety requirements are received from:

Health Inspectors

Border Inspectors

Market Inspectors

The majority of samples received by the laboratory are of non animal origin although there are some exceptions such as honey, where it is classed as a dietetic product.

Equipment

The laboratory is equipped with a Shimadzu AA 6650 atomic absorption spectrophotometer with a graphite furnace and facilities for determination of elements by hydride generation.

Mercury is determined by the use of a Leco AMA 254 mercury analyzer. This instrument utilises a direct atomic absorption cold vapour method with gold amalgamation. The analysis can be performed using solid samples without any further sample preparation.

An Ethos D microwave digestion system is available for the preparation of samples, prior to analysis for metallic contaminants by atomic absorption spectrometry.

A Shimadzu Ion Chromatograph was available for water analysis but this type of instrument can also be used for food analysis. The laboratory is also quipped with a Shimadzu 1700 UV – Visible spectrophotometer. Many of the tests carried out on water were based on the use of Hach test kits.

Some 18 months previously, the laboratory had been supplied with a Shimadzu gas chromatograph with a quadrapole – MS detector (QP 2010S). Although the laboratory personnel received some initial training, more specific training had not been provided. As a result, the equipment has remained unused. This, despite the fact that this equipment could be utilized for pesticide residue analysis.

Microbiology

The expert briefly visited the microbiology laboratory. Basic equipment such as a colony counter and stomacher were available. There 3 relatively modern incubators available, although in one case, it was apparent that the temperature regulator was not working correctly. The microbiologist claimed that the incubator was capable of maintaining a correct and consistent temperature and that this was monitored on a daily basis.

Media preparation and sterilization of media, equipment and waste are carried out in another laboratory. It was not possible to visit this part of the laboratory at the time of the expert's visit.

During the course of the visit, the expert noted that a gold fish bowl, complete with fish, was being kept in the microbiology. Such a practice would not be acceptable, particularly where that laboratory is accredited.

Public Health Institute Laboratory – Mostar

Currently the laboratory is located across 2 sites. The laboratory in which water is analysed is located in a modern building whereas the food laboratory is located in an older building, on the site of the local hospital.

At the time of the expert's visit, new laboratories were being constructed in the same building as the current water testing laboratories. It was envisaged that these new laboratories would be available for occupation within 2 or 3 months, at which point, the

food laboratory would be transferred. The laboratory's responsibilities include analysis of food, water, materials and articles in contact with food, cosmetics etc.

The laboratory receives samples of domestic food products from the Sanitary Inspectors and imported foods from the Border Inspectors. It faces competition from some private laboratories and from the Veterinary laboratories.

Whilst some surveillance of pesticide residues is undertaken, this is restricted to residues of organochlorine pesticides since the current laws only include limits for a small number of organochlorine residues and PCBs.

Equipment

The **water laboratory** was well equipped and included:

- A Shimadzu 8400S FTIR spectrometer
- A Shimadzu 1700 UV – Visible spectrophotometer
- Equipment for the determination of Total Organic Carbon (TOC) in water
- A Shimadzu high performance liquid chromatograph (HPLC) equipped with a –
- Tertiary gradient solvent delivery system
- Diode array detector
- Fluorimetric detector

The laboratory was also equipped with 2 atomic absorption spectrometers, 1 of which was a Shimadzu AA 6300 equipped with a graphite furnace. The 2nd spectrometer was set up for flame atomization.

Pesticide residues

Preparation of samples for determination of pesticide residues was carried out in a separate laboratory which was well equipped with fume cupboards. Equipment for sample preparation included:

- Vacuum manifold for use with solid phase extraction (SPE) cartridges
- An automated system for clean up of sample extracts by gel permeation chromatography.
- Rotary evaporator

A 2nd laboratory was equipped with gas chromatographs, the use of which included the analysis of sample extracts for pesticide residues. One gas chromatograph was fitted with a flame ionization detector (FID) and an ECD detector. This instrument was suitable for analysis for the presence of organochlorine pesticide residues. The second gas chromatograph was equipped with a Quadrapole – MS detector (Shimadzu QP2010S). Again, this laboratory is not suitably equipped to undertake the analysis of food for organophosphorus pesticide residues.

Water Microbiology

This laboratory was used for the microbiological examination of water samples. The majority of methods used are based on membrane filtration of the water samples. The laboratory was clean and bright and appeared to be most suitable for such work.

Food Analysis

Equipment available in the food testing laboratories included a high performance liquid chromatograph (HPLC) equipped with:

- Tertiary gradient solvent delivery system
- Diode array detector
- Fluorimetric detector
- Autosampler
- Temperature controlled column oven

This equipment was mainly used for the determination of preservatives, including sorbates and benzoates, caffeine, theobromine and intense sweeteners such as aspartame, saccharin etc. This laboratory also undertakes the analysis of food for metallic contaminants. Equipment available for this purpose included:

- Leco AM254 Mercury Analyser
- Ethos D Microwave digestion system
- Varian Spectra AA 110 atomic absorption spectrometer with facilities for:
    - Graphite furnace atomization
    - Flame atomization
    - Cold vapour generation

As far as the expert could tell, back ground correction was achieved by means of a deuterium arc. Other equipment included a Varian Cary UV – Visible spectrophotometer.

In the opinion of the expert, once the food testing laboratory has been relocated, the laboratories of the Public Health Institute in Mostar, will be housed in a modern well fitted out building. The level of equipment is considered to be very good. Without exception, each of the staff appeared to be well qualified and committed to their work.

Public Health Institute Laboratory – Banja Luka

The laboratories are housed in a rather old building to which members of the public, seeking medical advice, also have access.

Food Microbiology

Much of the equipment in this laboratory was rather old. This was particularly true of the incubators and one would seriously question the ability of these incubators to properly maintain the set temperatures. Media is prepared in a separate laboratory.

Water Analysis

This section of the laboratory is certificated by the Ministry of Health for the analysis of drinking waters, mineral waters etc. The majority of the analysis undertaken is by traditional methods. Samples that require analysis for metallic contaminants are passed through to the section of the laboratory that is equipped with an AA spectrometer.

Food Analysis

Equipment for the proximate analysis of food included a Gerhardt Soxtherm apparatus for the determination of fat content. The laboratory was also equipped with a block digestion system and semi automated distillation unit for the determination of the nitrogen content of foods. The conditions in this laboratory were very cramped, to the point that there is a need to question the safety of the staff working there. The laboratory is equipped with 2 spectrophotometers, one of which is a Varian Cary spectrophotometer and the other, a Spectronic Gensys 2. These instruments are used for a variety of analyses including:

- The determination of theobromine in chocolate to estimate the quantity of cocoa solids.
- The determination of caffeine in products such as energy drinks.
- The determination of colours in foods. Bosnian law is not yet aligned with that of the EU and so in a number of cases, products that can be legally marketed in the EU are prohibited from sale in Bosnia.

Atomic Absorption Spectrometry

The laboratory is equipped with a Unicam 969 AA spectrometer with graphite furnace atomization. Facilities are also available for the determination of mercury by the cold vapour generation technique.

Gas Chromatography

The laboratory is equipped with 2 gas chromatographs.

1) A Xemo A5 instrument with a flame ionization and a 'Hot Wire' detector
2) A Unicam 610 series gas chromatograph with an electron capture detector and a nitrogen selective detector.

Both instruments are rather old and it is likely that the laboratory will find it increasingly difficult to obtain the necessary spares to maintain these instruments in an operational condition.

Liquid Chromatography

The laboratory is equipped with a Pharmacia HPLC system with a UV detector and a fluorimetric detector. We were told that this equipment was used for the analysis of foods for additives such as preservatives and that it was also used as a confirmatory technique for certain mycotoxins, including aflatoxins, patulin, ochratoxins and zearalenone.

Thin layer chromatography and Elisa techniques are also used for ochratoxin, aflatoxin B_1 and zearalenone. The microtitre plates are evaluated using a Tecan Sunrise plate reader.

The laboratory was also equipped with a rather old but serviceable Perkin Elmer 762 Infra-red spectrometer which was apparently used to identify materials such as plastic packaging and for the detection of mineral oil in water.

Proficiency Testing

The laboratory has participated in a number of inter-laboratory studies which whilst not of the same standard as an International proficiency test, have at least enabled the laboratory to gain some independent assessment of their performance.

Radioactivity Monitoring

The laboratory is equipped with a Canberra gamma spectrometer located in a separate area. The equipment is used to monitor food and environmental samples for the presence of gamma emitters such as Caesium 137.

It is expected that by the end of 2007, they will acquire a spectrometer that is capable of being used to detect alpha and beta emitters.

Veterinary Institute Laboratory – Banja Luka

Again, the laboratories are housed in a rather old building which is far from ideal for use as a laboratory.

Microbiology

The first of the laboratories visited only undertakes basic microbiological examination of food. The methods used in the laboratory are as laid down in the law of the former Jugoslav Republic. Activities such as sample preparation, homogenisation, plating out, etc. are carried in one of the two laboratories. Incubators used in the laboratory are rather old and one would question the ability of these incubators to maintain a set temperature, within acceptable limits. The laboratory does however monitor the temperature of these incubators on a regular basis.

The second laboratory is used for the preparation of media. Whilst the laboratory carries out some tests on the prepared media, the reference organisms used for this purpose are from a local source rather than from a recognized culture collection. As far as the expert could see, the laboratory had access to only 1 autoclave, which was presumably used to sterilize media and to sterilize waste, prior to disposal. The laboratory carried out some monitoring for antibiotics etc., using Elisa based tests and tests that rely on the inhibition of bacterial growth. This residue monitoring includes, chloramphenicol, sulphonamides, becta-lactams and beta-agonists.

Analysis of Animal Feeds and Food

A second laboratory of the Veterinary Institute, undertakes the microbiological examination of animal feeds. This examination includes total viable count (TVC), Clostridia, Salmonella, Moulds and E.coli.

This laboratory also undertakes basic chemical analysis of animal feeds and food. The analyses undertaken include those for fat, moisture, protein, calcium etc. At the time of our visit, the laboratory was unable to undertake a number of these analyses, simply because the person responsible for this work was away on maternity leave. Nobody else in the laboratory has been sufficiently trained to undertake this work.

The determination of fat is by the Soxhlet method and protein is determined by the traditional Kjeldahl method. Certainly the equipment available can only be described as basic.

Milk Testing

A separate area of the laboratory has been equipped with automated systems for analysis of milk for payment purposes. Such equipment includes a Fossmatic FT 6000 and a Bactoscan.

Using this equipment, milk can be analysed for fat and protein content, somatic cell count and for a 'total bacterial count'.

Methods of Analysis for Contaminants

Mycotoxins

The majority of laboratories visited, are using ELISA techniques and/or thin layer chromatography as a screening technique for the detection of aflatoxins in food and feeds. Little or no analysis is undertaken for ochratoxins, patulin etc.

Pesticide Residues

In the area of pesticide residue analysis, there appears to be no equipment to enable the determination of organophosphorus pesticide residues. For fruits, vegetables and products of cereal origin, there must be a significant risk that consumers are exposed to such residues and that the EC MRLs for such compounds are exceeded.

In the future, the FSA will have to have access to the equipment necessary to check compliance with the majority of the MRLs set in EU Regulations and Directives, for pesticide residues in food and in animal feeds. The corresponding EU Regulations and Directives are as follows.

I. Regulation (EC) No 396/2005 on maximum residue levels of pesticides in or on food and feed of plant and animal origin.

II. Regulation (EC) No 178/2006 amending Regulation (EC) No 396/2005 to establish Annex I listing the food and feed products to which maximum levels for pesticide residues apply.

III. Directive 76/895/EEC, as amended, relating to the fixing of maximum levels for pesticide residues in and on fruit and vegetables.

IV. Directive 86/363/EEC, as amended, on the fixing of maximum levels for pesticide residues in and on foodstuffs of animal origin.

V. Directive 86/362/EEC, as amended, on the fixing of maximum levels for pesticide residues in and on cereals.

VI. Directive 2002/63/EC establishing Community methods of sampling for the official control of pesticide residues in and on products of plant and animal origin.

Recommendations for the Operation of Official Food Control Laboratories in Bosnia & Herzegovina.

1. Regardless of the origin of food, laboratories involved in the Official Control of Food should be required to provide an impartial and confidential service to the Food Safety Agency.
2. There should be adequate funding of the laboratories by Central or Local government to enable them to undertake the necessary chemical analysis and microbiological examination of food and animal feeds.
3. The food manufacturers should not be required to pay for the analysis and/or examination of samples, taken by inspectors, as part of their activities in the Official control of Food or of Animal Feeds. Neither should they be compelled to take out a contract to submit a certain number of samples to an official laboratory, in addition to those that are taken by inspectors as a part of their inspections.
4. Instead, food producers and processors should be encouraged to take responsibility themselves for ensuring the food sold by them is both wholesome and safe. Given that many of the food manufacturers are relatively small, it is not reasonable to expect that they can each sustain their own laboratory facilities. For this reason, the establishment of independent laboratories to undertake analysis on a commercial basis, should be encouraged.
5. The Official laboratories must be managed in such a way that –

   There are no conflicts of interest that could affect, or be thought to affect, their conclusions.

   Staff are not under undue pressure that could affect the quality of analysis or its interpretation.
6. The Official Laboratories must –

   Have policies and procedures to ensure the protection of its clients' confidential information and proprietary rights, including procedures for protecting the electronic storage and transmission of results.

   Have policies and procedures to avoid involvement in any activities that would diminish confidence in its competence, impartiality, judgement or operational integrity.
7. The staff employed in the Official Laboratories should be suitably qualified and experienced.
8. The management team should include at least one person who has –
   - A detailed knowledge and understanding of food, its chemical analysis and microbiological examination.
   - A detailed knowledge and understanding of relevant law
   - Investigational skills to identify faults with food and to deal with problems with analysis
   - The ability to interpret analytical results in the light of the law.
   - If required and in support of the competent authority, the ability to act as an expert witness and present legal evidence in writing or in person.

9. Laboratory staff should not be directly involved in sampling food or feed. This must be the sole responsibility of the Inspectors, appointed by the competent authority. However, their expertise should not be ignored as they may well be able to offer advice to the inspectors, particularly in respect of sampling for microbiological examination and sampling for certain chemical contaminants.

10. An adequate number of properly equipped and adequately funded laboratories are required to carry out the routine analysis and microbiological examination of food and feeding stuffs.

These laboratories could be expected to cover –

- Proximate analysis
- Labelling verification
- Preservatives
- Colours
- Sweeteners
- Total Viable counts
- Coliforms
- Escherichia coli
- Staphylococcus aureus
- Salmonella spp.
- Listeria spp.
- Yeasts and Moulds

11. One or possibly two laboratories are required to cover the more specialised chemical analysis of food and feed stuffs. Such analysis includes

- Metallic contaminants – Lead, Cadmium, Mercury, Arsenic etc.
- Pesticide residues – Organochlorine, Organophosphorus, Fungicides (thiocarbamates) etc.
- DNA techniques including GM analysis by the use of real time PCR
- Mycotoxins – aflatoxins, ochratoxins etc.
- PCBs, dioxins
- Nitrates – vegetables etc.
- 3 Monochloro – propane – diol (3-MCPD)
- Veterinary residues
- Vitamins
- Food contact materials
- Detection of Irradiated food
- Monitoring of food for radio isotopes

12. To perform these specialised analyses the following equipment is required.

- GC including GCMS. In addition to GCMS, gas chromatographs fitted with ECD, NPD and FID detectors are required.
- For certain applications, high resolution GCMS may be required. This is particularly true if it is envisaged that Bosnia & Herzegovina will carry its own surveillance for dioxins.
- An automated system for gel permeation chromatography is beneficial when applying multi-residue techniques for the determination of pesticide residues.
- HPLC. The majority of applications require isochratic separations but in some cases gradient elution is more effective and is particularly useful when methods are being developed. For this reason, at least one system should be available that includes a quaternary gradient, solvent delivery system. Other requirements include a diode array detector and for the reliable detection of low levels of aflatoxins, a fluorescence detector together with a reactor for post column derivatisation.
- LCMSMS may be required for confirmation of certain veterinary medicine residues.
- Atomic Absorption fitted with a graphite furnace atomiser and Zeeman background correction. A second system should be available for use with flame atomisation and in conjunction with a hydride generation system for the detection of elements such as arsenic, selenium etc.
- For multi-element analysis e.g. mineral waters an ICP – OES system may be required.
- Mercury analyser. This may be a stand alone system of sufficient sensitivity or a cold vapour generation system for use in conjunction with an atomic absorption spectrometer.
- Electrophoresis techniques
- Immunoassay techniques
- DNA techniques e.g. real time PCR for the detection of GM food, ingredients and feedstuffs.
- Microscopy
- Infra Red Spectroscopy
- Extraction techniques (Super Critical Fluid etc.)
- Radioisotope monitoring – since γ emitters are of most significance, a gamma spectrometer is most appropriate.
- UV/visible spectroscopy
- Unified Laboratory Information Management Systems (LIMS) systems including database links
- Effective information systems including access to relevant journals

13. A number of the existing laboratory facilities need to be upgraded to allow for proper provision of ancillary facilities e.g. piped gas supplies for gas chromatography, atomic absorption spectrometry, ICP etc.

Adequate provision of fume cupboards.

- Clearly separated areas for –
- General wet chemistry
- Extraction of pesticide residues, veterinary residues, mycotoxins etc.

- Preparation of samples for trace metal analysis
- Gas chromatography and liquid chromatography
- AAS and ICP – OES

Facilities for microbiological examination of food require significant upgrading e.g. flooring with coving to walls, walls that are easily cleaned, benches that provide a continuous surface that can be readily cleaned and disinfected.

Inspection and Sampling

Qualifications and Training of Inspectors

It is essential that all those responsible for carrying out inspections and enforcement in relation to the official control of food and animal feeds suitably qualified, experienced and competent to carry out the range of tasks and duties they are authorised to perform.

Continuing professional development

Procedures should be in place to ensure that all those authorised to carry out food hygiene inspections and enforcement, and/or food standards enforcement receives structured on-going training, which is managed, assessed and recorded. Such training should include –

- new legislation and procedures,
- technological developments that may take place in food businesses subject to their inspection.

Such training may take the form of in-house training, formal courses or vocational visits.

In those cases where authorised Inspectors who have the appropriate qualifications may not have enforced food law or particular areas of food law for some time, procedures should be put in place to ensure that Inspectors who hold appropriate qualifications and whose knowledge in relation to food matters may have lapsed or become out of date are put through structured revision training in the areas concerned before resuming food law enforcement duties.

Such update training, should be managed, assessed and recorded. The extent of the revision training requirements will vary according to the previous experience of the Inspector and the period that the inspector has been absent from food law enforcement duties.

Records

Copies of all relevant documents, such as of certificates of registration, qualifications etc. should be retained. Records of any ongoing or refresher training must also be retained.

Inspectors Appointed to Carry out Food Hygiene Enforcement Inspections

Any inspector authorised to undertake food hygiene and safety inspections of any premises should be appropriately qualified and competent to carry out the inspection.

In particular, the inspector should have a detailed knowledge of –

- the nature and types of food industry in their area and the technology utilised in those premises the inspector is authorised and expected to inspect;

- relevant food hygiene and safety legislation;
- any Codes of Practice issued under the Law on Food Safety;
- National and EU Industry Guides to Good Hygiene Practice;

High Risk Activities

Inspectors undertaking the inspection of specialist, or complex high risk activities should be –

- experienced in the inspection of food premises,
- have received additional training
- and have demonstrated their competence to undertake inspections of high risk activities.

Standards of Competence for Inspectors in Relation to HACCP Based Management Control Systems

Staff engaged in the food hygiene inspection of premises and the auditing of food safety systems, in addition to holding relevant qualifications for the risk category of premises to be inspected, should be able to demonstrate the following standards of competence.

1. To identify, through the conduct of an audit, the need for improved food safety control in food premises.

I. Assess the quality of food safety hazard identification in a food business.

II. Assess the quality of critical control point (CCPs) identification in a food business.

III. Assess the suitability of controls in place and their monitoring at CCPs.

IV. Assess the verification and review by business proprietors of HACCP based management control systems.

2. To promote and support the implementation of HACCP based management control systems in food businesses.

I. Explain the principles of hazard analysis to business proprietors/managers.

II. Specify targets for improved control of food safety hazards.

III. Provide advice on carrying out hazard analysis and implementing controls.

IV. Explain the relationship between HACCP systems and other food safety management systems.

3. To secure compliance with hazard analysis/HACCP based management control systems requirements in legislation.

I. Explain the legal requirements in relation to HACCP based management control systems.

II. Secure compliance by discussion and persuasion.

III. Secure compliance by the issue of notices.

IV. Secure compliance through the courts (and gather and preserve evidence in a form usable in court).