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UNIDO report on prospects for biotechnology in Kuwait.

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Part I: Biomedicine

15377

Current R and D efforts in Kuwait:

I)Presumptions

When considering future prospects for biotechnology in Kuwait the following local conditions need to be taken into account:

a) Kuwait is a country with a small land area and a population of approximately 1.6 million.

b) Kuwait economy is almost exclusively besed on oil and oil products. The oil is expected to last for approximately 250 years with the current rate of exploitation.

c) Kuwait relies heavily on import of food, medicine etc.
Only a minor fraction of agricultural products and live stock are produced in the country at a high cost. Fish and poultry are the main sources of domestically produced food.

d) Kuwait cooperates with the other Gulf states, for instance, in medicine which means that the actual market for any given product is considerably larger than expected from the size of the Kuwait population.

e) No fresh water is available in the country which seriously hampers agricultural development.

f) Religion (predominantly islam) puts constraints on the feasibility of certain biomedical projects.

g) The spectrum of infectious diseases shows both common and unique features. Parasitic infections like malaria play a less important role due to the dry climate. Problems with hepatitis, sickle cell anemia and thalassemia are shared with other developing countries.
In some respects Kuwait resembles the highly developed countries in the western hemisphere due to prosperity and a relatively affluent life style.

II) Education:
Undergraduate training of relevance to biotechnology is provide at KISR, the medical college and at the college of science. A limited master of science (MS) program is available at the medical college in microbiology, biochemistry, and zoology. No Ph. D.-program is available within the country. Students are commonly sent abroad for Ph. D.- and advanced training.

III) Research facilities:

KISR: Good facilities for applied microbiology. Facilities for fermentation very good. Less well equipped for basic sciences. No facilities avilable for recombinant DNA work.
One laboratory has been allocated for basic work in molecular biology. So far only rather conventional equipment like water baths, incubators etc are available. Plans are currently being made to turn the laboratory into a modern unit for genetic engineering.

Medical college: Only the department of microbiology was inspected. Facilities excellent. Most items needed to start basic program in genetic engineering available or on order. Items like ultracentrifuges, high-speed centrifuges, electrophoretic equipment etc. are already installed and additional items have been ordered. Facilities adequate for a small group(five scientists plus technical staff).

Ministry of Health: A small laboratory avialble for advanced medical genetics. Good facilities for cytogenetics. No facilities yet available for recombinant DNA work. Plans exist to start such a program and to expand existing laboratory facilities.

College of science: There was no opportunity to visit this institute. Very limited research facilities available according to Dr Durban.

IV) Man power capabilities:

KISR: Good with regard to different areas of classical biotechnology, like technical microbiology, fermentation, plant genetics, etc.
Scientists in general adequately trained, many with experience from research in US or western Europe. Less competence in basic sciences particularly biomedicine; a rather strict separation between KISR and the Ministry of Health with regard to medically oriented research is unfortunate. Good international contacts. Seminars on selected topics at an advanced international level are frequently organized.

Medical college: The microbiology department is impressive. Scientists from US and Western Europe have or are developing this department into an institute of high international standards. Clinical microbiology well advanced. The group performing basic molecular biology is too small to reach a critical mass within a reasonable time.
Much of the competenceis apparently provide by imported scientists. Hence a considearble risk that competence vanishes quickly unless local scientists are adequately trained by the visitors.

Ministry of Health: Impressive cytogenetics program. Competence in classical medical genetics good. Less advanced in modern approaches although scientists are currently being trained abroad.

College of science: One scientist(Dr Durban) trained at UCLA. Few highly trained faculty according to available information (no vist paid to the institute)

V) Infrasructure:

Service: Somewehat contradictory views were given as to service facilities. Good workshop facilities available which can service and maintain most standard equipment. Advanced equipment like ultracentrifuges can be serviced with short notice, albeit at a high cost. Service and maintenance do not seem to provide a serious hinder for establishing advanced technologies although certain improvements are desirable.

Transportation, customs etc.: Distance to international airport very short. Quick service available. Short-lived reagents can be processed quickly through customs etc. Restriction enzymes can be obtained within 24 hours and radioisotopes within 48 hours.
Mail sytem appears to be slow (it took more than 3 weeks for postcards to reach european destinations)

Information: Excellent library facilities available at KISR. Also advanced computer net works installed with on-line communication via satellite. Certain improvements, however, urgently needed. For instance, restrictions in the use of telephone services for international calls at the medical college are unsatisfactory.
International contacts: Many Kuwait scientists are trained abroad and have hence good contacts with leading international groups, for instance in fermentation. Better contacts needed in the basic sciences, particularily in biomedicine
Grants: Research at KISR and the medical college appears to be adequately funded. It was our general impression that a starting research group could obtain adequate support. Bureaucracy does not seem to be an obstacle in this respect.
International experts consulted in order to evaluate major grant applications.

Suggestions for future strategy :

I.General considerations:

There is an urgent need to strengthen basic research in biomedicine. To achieve success a powerful progrem in genetic engineering is required. Man-power development is the key issue.
The establishment of genetic engineering in Kuwait will be a slow process. Hence it cannot be anticipated that advanced molecular genetics in Kuwait will reach the international frontier until the end of the first five year poeriod. The most serious hinder is the lack of qualified man power.

A core-group should be established which masters all major techniques in genetic engineering like cloning, nucleotide sequencing, gene expression in foreign hosts etc. This group should be provided with a major grant for equipment. An internationally recruited leader is needed for initiation of the program. Contacts with internationnaly renouned laboratories should be improved and extended. Scientists should be trained at the post-doctoral level for adequate time periods (two years usually needed). Coordination is needed. A strategy should be established so that several scientist could be trained at the same time and the brought back to form a team, working on common scientific problems.

A better trained technical staff is needed.

Science must be made more attractive as a profession

II. Specific considerations

A. Education

Alterations in the educational system should have the following aims:

1) to attract able students into life sciences. For the moment a career in science does not attract a sufficient number of top students
2) to provide better quality education in advanced subjects like microbiology, molecular genetics, biochemistry, computer sciences etc.
3) to provide well educated technical staff, trained according to the need of biotechnology
4) to establish a more efficient international training program.

Recommendations:

1)Establish an advanced educational institution which already at the high-school level will prepare students for a career in science and technology. Such an institution is likely to make science more attractive and hence facilitate recruitment of top scholars. It will also provide well educated students, specifically prepared for advanced education

2)Establish training program for technicians.

3)Establish Ph.D. programs in selected areas(microbiology, genetics, molecular biology) relevant for biotechnology.

4)Improve existing international training programs.
Students should be trained for longer time periods and should be offered better facilities upon return. It is necessary to bring several trained scientists together in teams in order to reach a critical mass.

5)Coordinate educational activities better. KISR, the medical college as well as at the Ministry of Helath should cooperate more extensively. Due to the small size of the Kuwait population it is necessary to avoid duplication of courses, expensive pieces of equipment etc.

6)Establish a small scientific advisory committe, recruited from leading laboratories in the US and Western Europe. The committe should meet with Kuwait scientists on a regular basis (once/year).

B. Research.

Two goals should be considered
1)To establish core groups of scientists who are well trained in genetic engineering and master all major aspects of gene technology.
2) To initiate a small number of research projects relevant to Kuwait needs.

A. Specialized groups in genetic engineering

The best facilities are available at the medical college. It is suggested that the first nucleus is formed at this institute. The program, already formulated by Dr. Michael Olive is promising and should promote training of scientists and also initiate research activities of practical significance for Kuwait. It is, however, suggested that the group is allowed to expand as quickly as possible. It is proposed that efforts are made to recruit at least one additional highly trained scientists from abroad.

It is moreover suggested that a group specilaized in recombinant-DNA technologies also is established at KISR. This shopuld consist of at least three scientists at the Ph D. level, 2-4 students and 2-3 technicians.
It is suggested that certain aspects of gene technology are established at the Ministry of Health. Here procedures like southern blotting and nucleic acid hybridization should be carried out. It does not seem necessary to have a complete program at this institite. Production of plasmids etc could be made at KISR and specialization towards medical applications should be made.
It is suggested that recombinant DNA work is concentrated to these three institutions since it is important to have sufficiently large research groups to reach the necessary critical mass.

Projects.

Genetic engineering has so far had its greatest impact in biomedicine. It is likely that this trend will continue. Applications of genetic engineering in pharmacology and diagnostic medicine are already well established. To establish a program in genetic engineering it is therefore suggested that medical applications are given high priority since important results could be obtained in an immediate future. The following projects should be considered.
a) Establish DNA-based genetic diagnostics immediately at the clinical genetics laboratory at the Ministry of Health. Recent achievemnts have made it possible to diagnose carrier status in relatives to thalassemia patients. The techniques involved are comparatively simple and practical results could be obtained immediately. Applications for prenatal diagnosis not possible for the moment due to religion.
Proposed action: train 2-3 scientists abroad. Ask a small team of scientist to give a course at the Ministry of Health in the application of genetic engineering for genetic diagnosis.

b) Promote research program on the use of genetic engineering and molecular hybridization in microbiological diagnostics. A small program has already been initiated at the medical college. The technique could be applied to many relevant microorganisms, including hepatitis virus.

c) Develop research program for vaccine production. Hepatitis is here the obvious candidate. Considerable progress has been made in US and Western Europe for Hepatitis B. Kuwait scientists should cooperate and posssibly work through joint ventures. It is suggested that efforts are made to cooperate with other research groups on vaccine development. Kuwait should in the future be able to establish production facilities to cover the needs for all the Gulf states.

d) Program for manufacturing of genetically engineered products by license. If a license is obtained Kuwait scientists would rapidly gain experience which would promote genetic engineering in Kuwait. Insulin and growth hormone are obvious candidates for such projects.
It is suggested that some of the existing genetic engineering companies are approached. There exists today a surplus of capacity and it is likely that licenses could be obtained or that attractive joint ventures could be established. The genetic engineering companies may also be able to offer a good basis for man power training.