

A new class of molecules called biosensors are making their debut for clinical and industrial use. These exploit nature's unique biological recognition systems to serve as analytical sensing devices.

Molecular recognition systems form an integral part of all living systems, being an absolute prerequisite for the extraordinary specificity and selectivity of molecular interactions that are characteristic of all biological systems.

Understanding molecular recognition can lead to important medical and industrial applications. Some of the feasible uses include drug design, modification of neutral enzymes to perform specific functions and the building of catalytic machinery for chemical and biochemical processes.

In the past few years, scientists have begun to utilize these molecular recognition systems to synthesise biosensors for use in human and veterinary health care, environmental monitoring and food, fermentation and chemical industries. They are now in wide demand for rapid clinical tests for glucose and urea levels, testing animals for disorders and diseases, measurement of toxic chemicals released by industries and in brewing and baking industries.

The complex molecular recognition systems are constantly operating in the human body. For example, all biochemical reactions that are fundamental to life processes depend on enzymes' ability to recognise specific substrates to catalyse these reactions.

Antibodies recognise and combine with specific antigen proteins on invading organisms' surfaces to control diseases and offer resistance. Special receptors called

Biosensors : Molecules Recognise Molecules

By T.V. Padma

chemoreceptors present in the tongue and nasal lining being with specific molecular in food and scents to impart a sense of taste and smell.

This complex molecular recognition system helps the various enzymes, receptors and antigens bind with only one specific type of molecular or substrate and not with any other chemically or structurally similar analogue.

The recognition triggers a chain of chemical reactions that are essential for life processes. As both the substrates and the end products are ionic or neutral, they can be measured using ion sensors or gas sensors.

For example, if the biological interaction results in a change in pH, uptake of release of gases, ions, heat or electrons, or a disturbance in some optical parameter, the biological signal may be converted into an electrical signal prior to being multiplied, digitised and output in the digitised format.

A biosensor is essentially an analytical device that converts the concentration of the biological component into an electrical signal through a transducer which is in intimate contact with or integrated to the biological sample.

Biosensors are already evolving into miniaturised, disposable, solid-state devices with the theoretical capacity to obviate the need for traditional external instrumentation.

They differ from other analytical devices in many ways. First, there is intimate contact between the transducer and the biological component, whether it is an enzyme, sequence of enzymes, organelles, whole cell, tissue slice, antibody or other receptor or binding proteins.

Second, most of the new generation biosensors are functionally small in size and when implanted permit small sampling volumes with minimum interruption of the body functions.

Third, the biological material can be tailored to meet various medical and industrial needs and operate at various levels of specificity.

Finally, they are simple to use: they are single-step, inexpensive, disposable and fully compatible with conventional data processing techniques.

The intimate contact between the transducer and the biological component is usually achieved by immobilizing the recognising molecules onto a complex matrix. Recognition takes place when the molecules to be recognised come in contact with the recognising molecules, triggering a chain of physical and chemical changes at the recognition site.

The chemical changes involve the consumption or liberation of electroactive substances which can be electrochemically measured.

Physical changes such as

production of heat, light and sound can be detected directly using thermistors, photon counters or piezoelectrically.

A can be immobilised in three main ways — chemical binding, physical retention and forming thin films — depending on its type.

The biological component can be chemically bound to a carrier or through cross-linking. Alternatively it may be physically entrapped in the matrix in the form of beads or fibres or simply encapsulated in it.

The thin film technique is relatively new where the biological component is adsorbed onto a single layer of an amphilic compound and later transferred to a solid support.

Usually enzymes are chemically bound to carriers or cross-linked, while whole cells and cell organelles are physically entrapped in membranes or polymeric matrices.

Enzyme-based biosensors in the form of enzyme electrodes find both clinical and industrial applications. A number of enzyme electrodes have been prepared for ascorbic acid oxidase, alcohol dehydrogenase, glucose oxidase, lactate oxidase and lactate dehydrogenase.

Scientists at the Tata Institute of Fundamental Research (TIFR), Bombay, have prepared a glucose sensor using the enzyme glucose oxidase which was immobilised with bovine serum albumin (BSA) with glu-

taraldehyde as the cross-linking agent. The enzyme electrode was prepared using platinum strip which was uniformly coated with a mixture of enzyme solution, BSA and glutaraldehyde.

The TIFR scientists also prepared a glucose oxidase biosensor by physically entrapping the enzyme in polyurethane polymers and coating a platinum strip with the two.

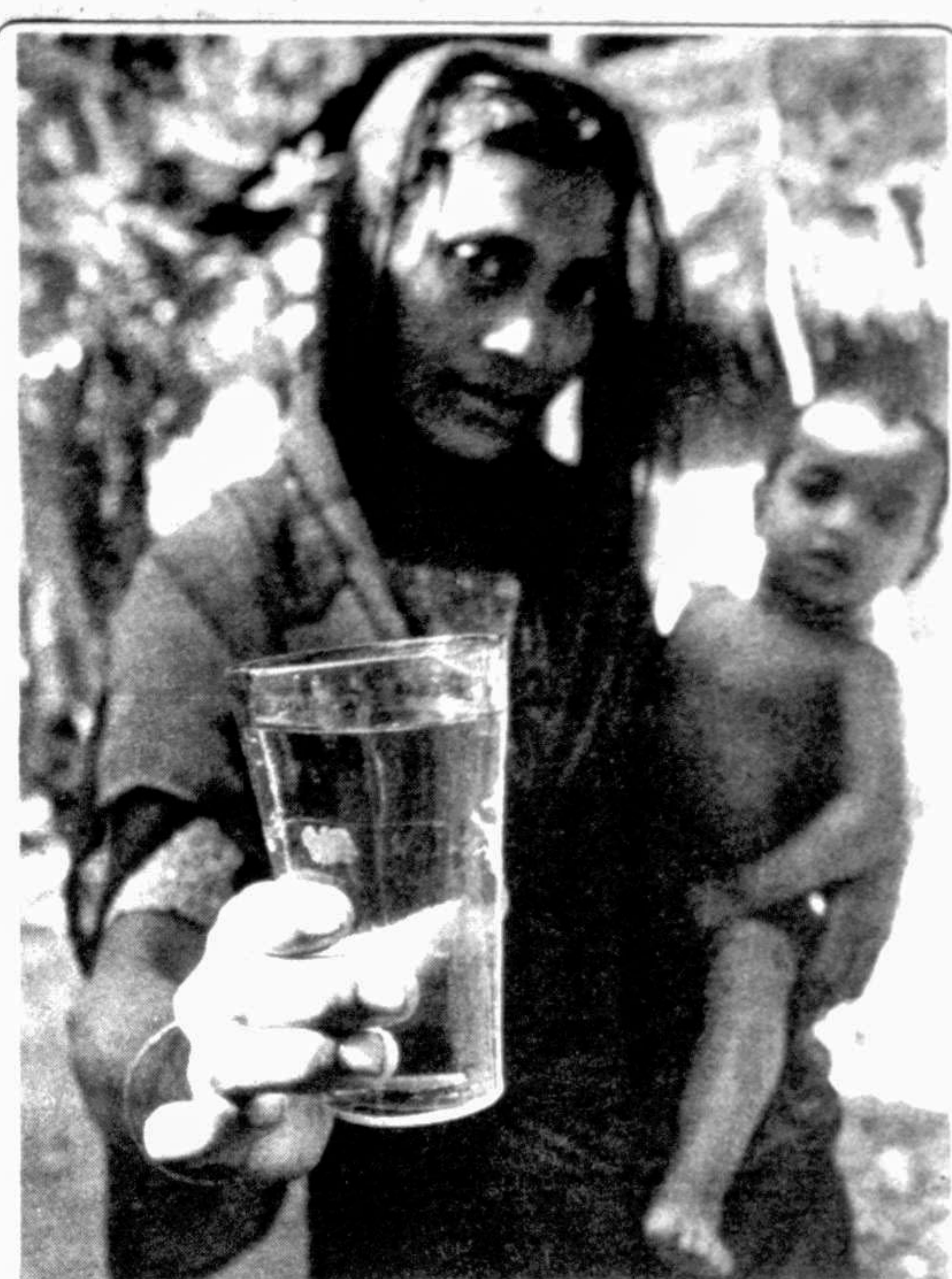
Scientists in Britain have developed biosensors that can give a warning within a few seconds of the presence in the atmosphere of enzymes used in washing powders.

Biological washing powders contain proteases, protein-dissolving enzymes, which affect the skin and lungs of workers in washing powder production plants. Skin rashes and allergies, and serious lung diseases are common in factories where they are made while housewives using them experience minor irritations.

The biosensor is proving to be a sensitive detector that picks up traces of the enzymes before their levels are high enough to represent any threat, and which gives a warning in a few seconds.

The two biosensors developed at the Teesside Polytechnic and Sunderland Polytechnic in England act as watchdog alarm systems for washing powder proteases and in the future for biological active substances.

Although the potential applications of biosensors are burgeoning, yet there are formidable obstacles in the way for immediate commercialisation of this technology. These include making the sensitive electronic components passive to the rigours of aqueous solutions and the liability of the biologically active sites. — PTI.



Drinking water should be boiled and then cooled off; and whenever boiling is not possible water for drinking should be stored in a covered container and left standing in sunlight for two days before use.

Health Briefs

ONCE-A-WEEK PILL

Once-a-week oral contraceptive pill developed by the Central Drug Research Institute (CDRI) in Lucknow has gotten the approval of the Indian Drug Controller for marketing. According to CDRI, which has been working on the drug for about two decades, it is a non-hormonal drug, the first of its kind in the world.

The pill, called centchroman, will be manufactured by the state-owned Hindustan Latex Limited which now makes condoms. It will be in market in three months and will have a tremendous export potential, says CDRI.

CDRI, which carried out a two-year clinical trial on 125 women, said the drug was safe and non-toxic. It is said to be devoid of all the side effects typical of hormonal pills now in use. Out of the 125 women only three became pregnant, which the health ministry says is acceptable enough for the pill's introduction into the family planning programme.

According to CDRI, the pill is to be taken twice a week for first three months and once a week thereafter. It also works post-coitally if taken within 24 hours. It has been declared safe for lactating mothers and women of any age in their reproductive life.

A spokesman of the Indian Council of Medical Research said the pill's mechanism of action is not fully understood. It has weak anti-estrogen and anti-progesterone properties and is believed to stop pregnancy by preventing implantation of the embryo.

RASAGOLLA FROM SOYA MILK

The much relished "rasagollas" which are normally prepared from cows' milk can now be prepared from soya milk, much in vogue nowadays as a cheap and protein-rich food.

A new technology developed by the Bidhan Chandra Krishi Viswavidyalaya, West Bengal, uses 2 per cent calcium lactate as a coagulant at about 85 degrees Celsius to give a soya-rasagolla that looks very much like those made from cow's milk.

It has not been possible so far to standardise methods for making rasagollas from soyabean milk, a low-cost and excellent source of protein and fat, or from buffalo milk.

The Bidhan Chandra Krishi Viswavidyalaya scientists cooked small balls made from soyabean (channa) in boiling 50-55 per cent sugar syrup for about 15 minutes and stored them in the syrup at room temperature overnight.

According to the researchers, soy-rasagollas have certain advantages over those prepared from cow's milk. They show more elasticity and sponginess and have more fat and protein.

Any increase in the temperature of coagulation leads to a decrease in protein and fat content.

CAN YOU CATCH AN ULCER ?

A BACTERIUM that lives in the human stomach may be an important cause of duodenal ulcers, and possibly of gastric cancer, according to a Scottish researcher. The bacterium, of the Helicobacter family, is able to survive in the acidic conditions of the stomach because it makes its own neutralising alkali.

Kenneth McColl, consultant gastroenterologist at Glasgow's Western Infirmary, has studied the effect of the bacterium in people. He says that the organism's ability to neutralise acid may be at the root of its ability to cause disease.

Duodenal ulcers are common. They can be healed initially, but they almost invariably relapse. Doctors believe that duodenal ulcers arise when the stomach produces too much gastric acid. Some researchers have suggested that stress or diet are part of the cause of this increased acid production, but there is no convincing evidence that they are involved.

In the past decade, a number of clinical trials worldwide have demonstrated that one important reason why duodenal ulcers return is the bacterium Helicobacter pylori. This infects the walls of the lower stomach, or antrum. The bacterium can survive in the stomach despite the fact that the stomach's acidity kills all but the toughest micro-organisms. It neutralises the stomach's acid by converting urea in gastric juice into alkaline ammonia.

Researchers have found that if H. pylori is put in a solution with a pH of 3, it dies, but if urea is added the bacterium thrives. This means that the urea is essential to the bacterium.

INDIAN women may be more vulnerable to AIDS than Indian men and foreigners.

This is because they are often more likely to be malnourished than men, and suffer from anaemia, gynaecological problems and health disorders which could further erode their immunity.

This point was brought out by health professionals and social scientists at a seminar, women and AIDS, organised by the Indian Health Organisation (IHO) in Bombay. AIDS is the Acquired Immunodeficiency Syndrome, the almost always fatal disease which has no known cure yet.

According to Dr. Purnima Mane of the Tata Institute of Social Sciences (TISS) in Bombay, women "can be affected by AIDS at many levels—as AIDS victims and in their roles as wives, mothers, care givers, prostitutes, educators and as victims of a social system which deprives them of information".

Programs concerning women and AIDS should shift their focus from women's roles to women's needs, suggested Dr. Mane.

"Such programs should especially consider female health needs beyond maternal and reproductive roles and draw attention to health problems which limit women."

"They should also address underlying issues which are

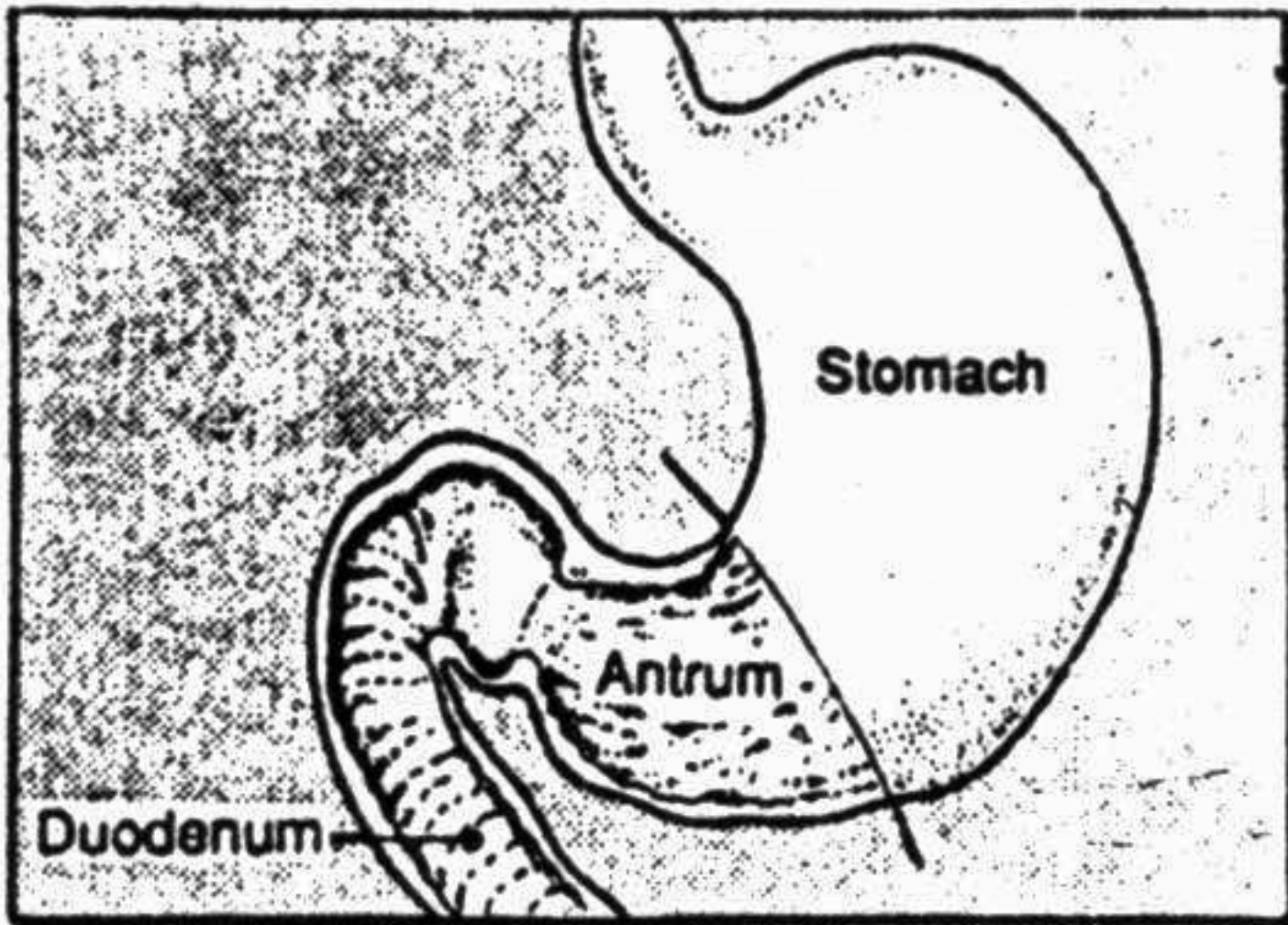
terium if it is to make ammonia.

The antrum produces the hormone gastrin, which stimulates the stomach to secrete acid. When the acidity reaches a peak, the cells that produce gastrin are "switched off". McColl says that by generating ammonia in the antrum, the bacterium may deceive these gastrin-producing cells into thinking the stomach is less acidic than it is, so that they go on making gastrin.

McColl and his colleagues were able to treat people with

from duodenal ulcers for long periods. This treatment is more effective than using drugs that simply stop the acid being produced.

H. pylori may be spread from one person to another by close contact, according to a recent study from Toronto. Brendan Drumm and his colleagues at the Hospital for Sick Children of the University of Toronto investigated the families of children who were suffering from gastritis, an inflammation of the stomach, caused by the bacteria. They



H. pylori by giving them a cocktail of antibiotics and a bismuth compound. This eradicated the bacteria. Curiously, bismuth was a part of the treatment doctors used for stomach complaints at the turn of the century.

The researchers found that without the bacterium, the stomach released less gastrin following meals and became less acidic. Earlier clinical trials showed that people given a short-term treatment that killed H. pylori remained free

found that the children's brothers and sisters were far more likely to harbour the bacterium than other children chosen at random. So, too, were the children's mothers, though not their fathers, interestingly. According to Drumm, the clustering of infection within families suggests that the bacteria spread from one person to another.

Researchers are also focusing on the possibility that H. pylori is a cause of stomach cancer. Scientists from the

AIDS Prevention Should Address Women's Needs

generally ignored, such as the average Indian woman's lack of control over her own health and sexuality, her lack of access to information and the general tendency to lightly dismiss gynaecological problems," she said.

As noted by Dr. I. S. Gilada, IHO honorary secretary, wives

of the Women's Studies Unit of TISS. She revealed that these women are required to give blood samples, but they are never informed of the purpose for such, much less of survey results or even the result of the test.

Social worker Rukmani Bansode who works with Bom-

The Indian woman's lack of control over her own health and sexuality makes her more vulnerable to AIDS

can unknowingly get the virus from infected husbands. And even if a woman is aware that her husband is a carrier of the AIDS virus, her low status in Indian society will likely prevent her from enforcing or insisting on safe sexual practices.

A double standard also exists in the case of prostitutes, who make up about 35 per cent of cases tested positive for HIV, the Human Immunodeficiency Virus which causes AIDS.

"The human rights of a prostitute are rarely considered," said Dr. Lakshmi Lingam

AIDS victims have been infected.

Virtually no hospital in the country observes basic safety precautions when dealing with AIDS patients, it was noted at the seminar. As a result, medical staff have been unwittingly exposed to the virus.

Also, Indian women involved in health care often function in low-status jobs as nurses, maids and cleaners who have little or no say on the matter of safety precaution. This increases their vulnerability to infection.

It was revealed that 90 per cent of efforts and the budget for AIDS management in India have been directed toward blood testing for the virus.

Dr. Mane and Dr. Ravikala Kamath who heads the Department of Human Development, Bombay University, suggested that AIDS awareness programs for Indian women be conducted in regional languages, if possible in dialects, taking in to account the cultural cues of the group targeted.

such programs should be aimed at small groups, rural women's councils rather than channelled through the mass media. Emphasis should be on pictorial and graphic presentation, film and musical messages, as the literacy rate among Indian women is low. — Depthnews Women's

Simple Preventions for Better Health

by Sabah Chowdhury

IT is not essential that one spend millions to obtain better health for the general people. Sometimes by simply maintaining better hygienic conditions one can improve the general health of the people. This will prevent spending for the cure of the disease as prevention is better than cure and more economical and a variety of diseases like diarrhoea, dysentery, hepatitis etc. can easily be averted.

The foremost hygienic factor which can help is cleanliness. Keeping one's body clean keeps diseases away. Washing one's hands keeping them clean prevents those diseases which can enter the body through food. It is very important to wash one's hand thoroughly after defecating before handling food, and after cleaning the bottoms of a baby or child who has just defecated. One has to be especially careful with children as they often put their hands into their mouths. So it is important that we wash a child's hands particularly before meals.

Face also should be washed at least once every day. This helps prevent eye infections. Having regular baths is essential for general cleanliness as this prevents skin infection. Soap is a helpful factor in keeping clean, but it is not available then only water should suffice.

Next is the use of clean or safe water for the purpose of drinking and cooking. In rural area people generally use water from ponds, streams, wells, tanks etc. It is usually seen that people draw drinking water from the same pond as well as cleaning their dirty clothes and cooking utensils. They also bathe in the same pond. Often makeshift latrines are also located on these ponds and domestic animal are given a wash there.

Therefore, one can easily understand how dirty the water of these sources are. It is essential to separate the source of drinking water from water needed for other purposes. If well is the source, then it should be kept covered. People should not bathe or

wash their dirty clothes or cooking utensils there. There should be a separate place for these purpose.

Special care should be taken in the case of water used for drinking. Even if water is clear, it may not be germ free. Safest drinking water is from a pipe supply and water drawn from other sources such as ponds, streams, springs, wells, tanks etc. should only be had after boiling it and then cooling it. It is more essential in the case of babies and young children, as they have less physical resistance.

If boiling is not possible drinking water should be stored in a closed or covered container of clear plastic or glass and left standing in sunlight, for two days before use.

Few simple precautions mentioned above can prevent diseases, and in some cases even save life.

[Source: Facts for life: produced by UNICEF, WHO and UNESCO].

Nepal Oral Cancer Incidence Growing

While textbooks are not available in villages, shops have plenty of Cokes, Pepsis and other softdrinks, by Jan Sharma

ORAL health tops the list of health problems in Nepal, the Nepal Oral Health Society (NOHS) has warned.

Incidence of oral cancer is growing rapidly, and so are dental decay and gum diseases in Nepal, mainly among smokers and those with the habit of chewing beetle nuts (pan) and tobacco.

It is now well established that the cause of dental decay is the sugar in the diet. The traditional Nepali diet rich in carbohydrates is being supplemented by high sugar diet.

Sugar consumption has increased to 56,000 tons annually. Few realise that a high diet causes obesity, heart disease, diabetes and tooth decay.

"The traditional low-sugar diet is being supplemented in Nepal by Western style processed and high sugar content food and snacks," says Sturat G. Little, an American involved in promoting oral health in Nepal.

While primary 'grade textbooks are not available in villages, shops there have plenty of Cokes, Pepsis and other softdrinks which are highly sweet. This is leading to rapid increase in dental decay on top of an alarmingly high rate of gum diseases and cancer of the mouth," he says.

A survey in the northwest district of Jumla by expatriate doctors working for the Christian mission-run Patan Hospital showed that 97 per cent of those aged between 16 and 19 years had gum diseases that needed urgent treatment.

The number of dentists in the country is less than 28 and the reach of their services is limited. The NOHS has been organising oral health camps in various parts of the country to provide dental services.

A central oral health clinic, equipped with sophisticated equipment donated by the Oregon-based American-Himalayan Oral Health (AHOH Inc.), has been set up in Kathmandu.

Dr. Tony Eigner, who was here recently to train Nepali technicians in the use of the equipment, blamed dental decay among Nepalis on the increasing consumption of sugar and sweets. She said part of the blame should go to Western tourists from whom the Nepalis pick up the habit.

The AHOH Inc. is planning to open an oral health clinic at Namche Bazar at the foot of Mt. Everest, the world's tallest peak. Namche Bazar, a bustling village in the Khumbu valley in east Nepal, is the major destination for 20,000 Western trekkers who annually visit the area.

"It is not only the trekking

areas that have oral health problems," says Dr. Manik Ratna Bajracharya, the NOHS chairman. Free clinics have been opened in places like Doti in remote west Nepal and Sankhu village near the Kathmandu valley, bringing the number of such oral clinics in the kingdom to 20.

Dr. Bajracharya says demands for free oral health clinics have been received from numerous villages. "It is frankly impossible to cope with the growing demands and the amount of work involved," he admits.

Part of the problem is that Nepal has not yet evolved an oral health strategy in keeping with the needs of the population. "Until such a strategy is developed, nothing of lasting significance can be expected to occur," says Mr. Little.

In order to begin work on such a strategy, the first step is for a national oral health survey. This is more important in view of the scanty oral health data available at present.

Most of the services now given by dentists in Nepal are those ordinary paramedics could do even better, observers say. It costs a poor country like Nepal US\$110,000 to train a dentist in Britain.