The cardiac quotient

Now there is yet another reason to go for brown, unpolished rice, says **S Ananthanarayanan**

RICE, the staple food of a great part of the world's people, is usually stored and eaten after the outer layer or the bran has been mechanically removed. This process helps preserve the grain and also makes it white and attractive, but it takes away much of the grain's nutritional value.

A group of Japanese scientists working at Temple University, Philadelphia, have discovered that unpolished rice is not only more nutritious but may protect against heart disease, too. Drs Saturu Eguchi and Akira Takaguri presented their findings at the 2010 Experimental Biology Conference in Anaheim, California.

Preparation of rice

Rice is the seed of the rice plant, *oryza sativa*, the most important food cereal in East, South and Southeast Asia, West Asia, Latin America and the West Indies. The rice plant, a grass, stands one to two metres tall and has long, slender leaves. Young rice shoots are usually nurtured in standing water after damming and flooding the fields. The vermin perish. Places where flooding is not used need to take other measures of pest control.

The seeds, of course, like all seeds consist of a germ, or embryo, encased in nutrients, mainly starch, to help the baby plant on its way, to throw out shoots to take in nutrients from the environment. When just harvested, the seeds are enclosed in an inedible protective *hull* or husk, which is first removed by *threshing*. What is left is the edible seed, called paddy, and formerly it was this that was cooked and eaten. The trouble was that this rough rice seed has a covering, the *bran*, that is rich in proteins and rice oil, but becomes rancid soon after threshing and produces an unpleasant odour. Being nutritious, it is also attracts vermin during storage.

The bran was thus removed, in a process of *milling*, and this could continue to *polishing*, which is to completely remove the bran. It is this processed rice, which has lost much of its nutritional value for humans, that is commercially valuable as a source mainly of starch calories.

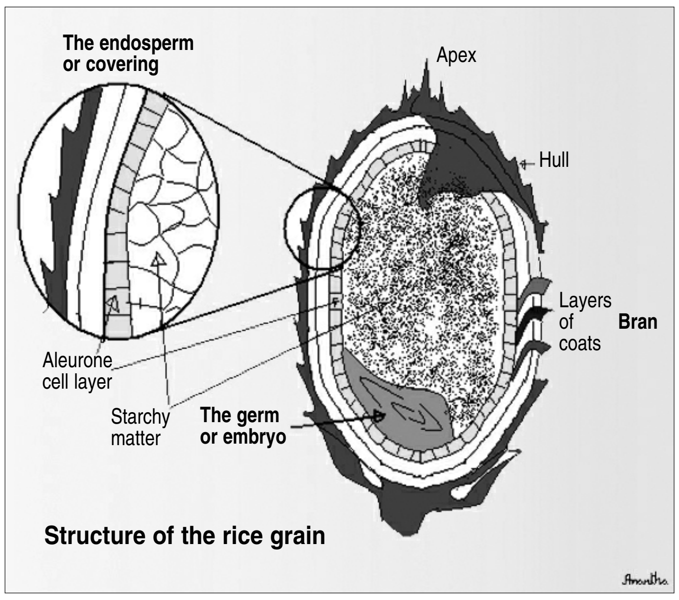
As we can see in the picture, the bran consists of layers and these layers are rich in a good mix of protein, fat, starch and dietary fibre. In addition, they contain many vitamins and minerals beneficial to humans. The layer nearest the starchy core is the *subaleurone layer*, which is rich in proteins but less so in oils. The core contains starch, a little protein in the outer portion and almost no oil.

Saving the bran

The bran and polish, which are removed, are thus the parts valuable for humans but their use is mainly as animal feed. A diet of rice, without supplements, can lead to malnutrition, a serious effect being the disease of beriberi, which affects the nervous system because of a deficiency of thiamine, of vitamin B1. The existence of a class of substances that were not proteins, fats or carbohydrates, but were necessary for health, in fact was discovered through studies of beriberi, where it was found that adding rice bran to the diet could control the disease.

There is thus much interest in making better use of these rice components. But with the great pressures of population and the need to store, transport and distribute rice, practically all the produce is still routinely milled and polished and the rice distributed mainly as a source of calories.

A form of rice that retains 80 per cent of the nutrients is *parboiled* rice, which is steamed or soaked in warm water before being husked. This process transfers part of the important bran components to the kernel and the rice can then be milled and polished without complete depletion. But parboiled rice is somewhat different in flavour and use and has not been accepted in the cuisine of most rice-eating regions.



Structure of the rice grain


Rice plant

Anther merit

The work of the Japanese scientists adds another reason to make the best use we can of the bran and polish or to use brown or partially milled rice. There are many Japanese who do use half-milled or incompletely milled rice, because they believe it is healthier to do so.

The Temple University team and their colleagues at the Wakayama Medical University Department of Pathology and the Nagaoka National College of Technology Department of Materials Engineering in Japan tried to find what was it in the subaleurone layer that could make a case for leaving it intact when rice is processed. As a possible harmful agent that this component of rice was able to combat, the team chose *angiotensin II*, an endocrine protein and a known culprit in the development of high blood pressure and atherosclerosis.

First, the team removed the subaleurone tissue from incompletely milled rice. Then they separated the tissue's components by the use of chemicals such as ethanol, methanol and ethyl acetate. The team then observed how the tissue affected cultures of vascular smooth muscle cells. Vascular smooth muscle cells are an integral part of blood vessel walls and are direct victims of high blood pressure and atherosclerosis.

During their analysis, the team found that subaleurone components that were selected by an ethyl acetate extraction inhibited angiotensin II activity in the cultured vascular smooth muscle cells. This suggests that a component of the subaleurone layer of rice offers protection against high blood pressure and atherosclerosis, which could explain why fewer people die of cardiovascular disease in Japan, where most people eat at least one rice-based dish per day, than in the USA, where rice is not a primary component of daily nutrition.

"Our research suggests that there is a potential ingredient in rice that may be a good starting point for looking into preventive medicine for cardiovascular diseases," said Dr Eguchi. "We hope to present an additional health benefit of consuming half-milled or brown rice, as opposed to white rice, as part of a regular diet."

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Simple & inexpensive

While paper batteries are not going to replace lithium-ion batteries as the power sources in computers and mobile phones any time soon, the latest Swedish effort may be suited for niche applications such as radio frequency tagged baggage and 'smart' packaging materials, writes **Saswato R Das**

ONE of the factors that determines a laptop computer's weight is its battery. Many will remember the hefty batteries that were needed to power laptops — or mobile phones — a decade ago. The advent of lithium-ion batteries changed that. Laptops and mobile phones these days weigh considerably less and can go longer without charging. Even so, a battery remains a significant part of a computer or mobile phone's weight, and sometimes its cost (especially for low-end mobile phones and netbooks).

Many an engineer has dreamt of making a battery as thin and flexible as paper. Now researchers led by Dr Albert Mihranyan at Uppsala University in Sweden seem to have succeeded in doing just that. They have created a simple and inexpensive paper battery which charges relatively quickly.

Batteries work through an electrochemical process. A conventional rechargeable battery contains two electrodes (the positively charged anode and the negatively charged cathode) and an electrolyte, which is a solution that conducts electricity. The simplest rechargeable battery is the lead acid battery, where the electrolyte is sulphuric acid. The cathode is made of a plate of lead dioxide, and the anode is made of a plate of lead (hence the name lead acid). When the battery is supplying electricity, the anode releases lead atoms which combine with the sulphate ions in the acid to form lead sulphate and electrons. These electrons travel to the cathode and then onto the circuit being powered. As the lead acid battery discharges, the plates get converted to lead sulphate.

The nice thing about a lead acid battery is that this process is reversible. When the battery is being charged, positively charged lead ions leave the cathode and travel through the sulphuric acid to the anode, where they encounter electrons introduced by the charger. (A lithium-ion battery works similarly; the major difference is that its anode is made of carbon and its cathode of lithium dioxide and the electrolyte is based on a salt of lithium.)


Albert Mihranyan

Dr Mihranyan had written his PhD dissertation on the properties of cellulose derived from algae and its suitability for pharmaceutical applications. In particular, he was interested in finding an industrial use for *Cladophora*, an algae known to cause environmental problems. This would kill two birds with one stone.

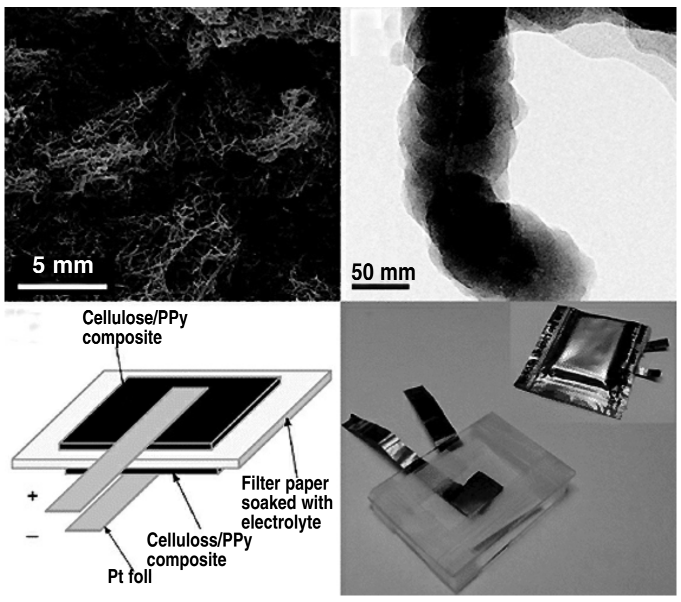
Dr Mihranyan and colleagues realised that the algal cellulose was actually much superior to the cellulose in common paper when it came to battery applications. This is because algal cellulose has about 100 times more surface area (the greater the surface area, the more effective a battery is, because there is more area for the electrochemical reactions that power a battery). Now they needed to find a suitable conductive substance to make the cellulose a conductor. They found one in a common polymer called polypyrrole. It soaked into the algal cellulose and produced a composite substance that conducted electricity well.

For their electrolyte, the Swedish team used brine, a solution of common salt (sodium chloride) and water. The battery was made by soaking a piece of filter paper in brine and then sandwiching it between two squares of polypyrrole-coated algal cellulose, which acted as the electrodes. Two platinum strips on top of the electrodes provided the metal contacts. The entire battery was housed between two glass slides, and its total thickness was approximately two millimetres.

The paper battery performed well, and produced a steady voltage of one volt. Charging it took seconds. The team discharged and charged the battery 100 times and found that its performance did not degrade. In short, it seems to be a promising battery.

Paper batteries have previously been made by impregnating paper with carbon nanotubes, which act as the electrodes. The Swedish battery, however, promises to be even cheaper. Dr Mihranyan is now seeking to commercialise the technology.

Paper batteries are not, it must be said, going to replace lithium-ion batteries as the power sources in computers and mobile phones any time soon — if only because they are nowhere near as efficient. (Dr Mihranyan's battery is only about one-third as efficient as a lithium-ion battery). But they may be suited for niche applications such as radio frequency tagged baggage and "smart" packaging materials. Researchers have previously also made paper-based transistors. It is conceivable that in the future we will have a line of electronics based completely on paper. Eliminating paper from our lives may soon turn out to be well nigh impossible.



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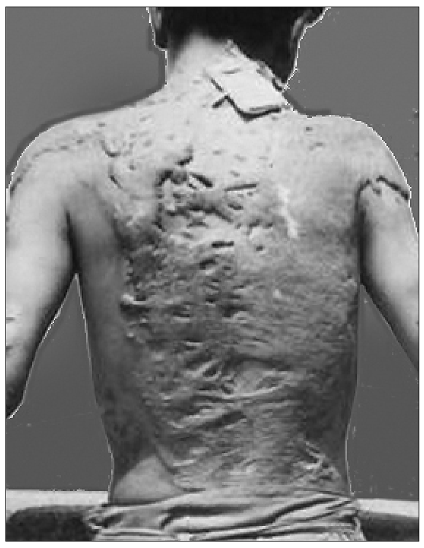
Radiation hazards

Nuclear rays are harmful as they change the genetic make up of organisms and cause mutations, writes **Tapan Kumar Maitra**

SINCE the first bombs were dropped on Hiroshima and Nagasaki in Japan in 1945, man has become aware of the dangers of atomic radiation. Atomic radiations are of three types: (a) alpha particles, (b) beta particles, and (c) gamma rays. These radiations are invisible and penetrate living tissues more or less regularly. The skin stops some while others penetrate deeper into the body.

Alpha particles are positively charged helium nuclei and can be stopped by a thickness of a fraction of an inch, but they produce ionisation. They can be deflected by electric and magnetic fields. Gamma rays are highly penetrating electromagnetic radiation and are not deflected by electrical or magnetic fields. The energy content of these rays is sufficient to break the chemical bond of molecules, producing high-energy free radicals. Thus all such forms of radiation have more or less similar chemical and biological effects. Since all of them generate free radicals in the living body, which reacts with other compounds, they may disrupt the activity of a living cell.

Radiation is measured in units of rad, which is equivalent to the absorption of enough radiation in any form to liberate 100 ergs of energy per gram of absorbing material. A person exposed to 1,000 rads will die within a week. Natural background exposure amount to 0.1 rad or one 100 milliards per year. Which dose is considered safe. An exposure to a dose of 50 rads may cause cancer or sterility. Radiation effects are cumulative and the damage is usually irreparable. The effect of 50 rads exposure in one year is approximately similar to that of five rads exposure continued for 10 years.


Kiyoshi Kitsukawa, a Hiroshima tram conductor who was standing with his back to the blast about 1,000 yards from the centre of the explosion, was badly affected.

Nuclear radiation is extremely harmful as it can change the genetic make up of organisms and cause mutations. The occurrence of damage due to radiation in the skin, lymphoid tissue and bone marrow is common. However, radiation in controlled doses can cure many diseases and is used as a diagnostic tool in the medical and biological sciences.

It has been estimated that one-fifth of the Japanese casualties after the explosion of the bombs were due to radiation and four-fifths due to the force of the explosion. However, even people who lived far away from the site of bombing were affected. Some died after days, weeks, months or years, while some were unharmed. People appeared to suffer from many types of diseases, including genetic ones. At the level of the ecosystem, radiation can damage vegetation and contaminate the entire ecosystem.

Environmental pollution due to nuclear radiation is increasing very rapidly due to the proliferation of nuclear power plants which produce a large quantity of nuclear waste and remains radioactive for a long time. No satisfactory method has yet been developed to store radioactive material over long periods, without risk of leakage.

Radioactive waste may remain active for thousands of years. Industrially developed countries produce these wastes in high quantities and often dump them in the sea in closed containers. If a nuclear explosion occurs in the atmosphere, the radioactive particles are carried to great distances by air currents and ultimately settle on vegetation, soil and water. They get incorporated into the food chain with dangerous consequences.

Fission fragments, such as strontium-90, have a half-life of 28 years. Strontium-90 shows a chemical similarity with calcium, and when it becomes concentrated in calcium-rich cow milk produces health hazards for children. Caesium-137 has a half-life of 30 years and emits gamma rays. It can cause irreparable damage to all life forms. Plutonium 239 remains in the biosphere for 200,000 years before it loses its radioactivity.

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