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ALUMINIUM AND HEALTH

Fact sheet 1

ALUMINIUM IN THE ENVIRONMENT

Aluminium is the world's most common metallic element. It constitutes about 8% of the Earth's crust. It occurs in various chemical forms in most rocks and soils, in vegetation and is found naturally in most water supplies and as part of dust particles in the air. Aluminium is also present in all clays, making it a constituent of cooking vessels since earliest civilisations. Evolution of life and human civilisation has developed in an aluminium rich environment.

Aluminium is never found in the metallic form in nature. It is always combined with other elements in compound form. It was not until 1825 that aluminium was isolated as a metal and a further 60 years before a commercial production method was developed. The first major commercial use of aluminium was in cookware.

Aluminium metal is lightweight and can be easily formed into many shapes and objects. These properties have been responsible for aluminium's present widespread use in the transport, building, consumer goods, packaging, pharmaceutical industries and chemical application such as water treatment.

While aluminium is abundant in the environment, the naturally occurring forms are usually stable and do not interact with the biological processes which go on in living organisms. Under acidic conditions, however, aluminium may be released from rocks and soils in a soluble form which can be absorbed by plants and animals.

The study of aluminium compounds in the human diet goes beyond the making and handling of food. All metallic elements occurring in the Earth's crust find their way from the soil into plant and animal tissues. Researchers therefore look at the combined effect on human health from natural exposure to metals compounds present in food, water and air, as well as from those additions resulting from the use of utensils, food wrappings, food additives and medicine.

Most vegetation contains aluminium compounds. Plants absorb limited quantities from the soil. However, some plants like the tea bush takes up larger quantities and for this reason are called "*accumulator*" plants.

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ALUMINIUM AND HEALTH

Fact sheet 2

ALUMINIUM IN THE BODY

It has been estimated that the average human body contains from 35 mg to 50 m*g* of aluminium, of which approximately 50% is in the lungs, 25% is in the soft tissues and 25% in bones. There is no known biological role for aluminium. - it does not appear to be an essential trace element - and the human body has effective barriers against aluminium uptake. Only a minimal fraction of aluminium in the diet is absorbed from the digestive tract and in healthy individuals most of this is very quickly excreted by the kidneys. When aluminium blood levels are very high, bones appear to act as a "sink", taking up aluminium and subsequently releasing it slowly over a long period. The brain is vulnerable to many chemical and biological agents but is protected by a “blood-brain barrier”- a collection of cells forming the inner lining of capillary blood vessels which prevent many substances from entering the brain.

To study aluminium in the body, researchers have fed human volunteers with more than 100 times the aluminium they ordinarily consume without any effects.
In the past animals have received even greater quantities and also under these circumstances practically all aluminium is carried through the digestive tract and eliminated.

Aluminium in the diet of an average adult usually ranges from about 3 mg per day to 10 mg per day, although people on special medication may receive more than 1000 mg per day, usually as aluminium hydroxide. Recent studies have shown that the absorption of aluminium from the digestive tracts may be as low as 0.01%, although up to about 0.1% can be absorbed when it is in the form of aluminium citrate. This does not make any difference to the excretion of aluminium.

There are abnormal situations when the barriers are being bypassed or are defective.
Patients with kidney failure face a multitude of problems, including the inability to excrete absorbed aluminium. The symptoms associated with exposure to aluminium in the dialysis fluid, and/or with the long-term medical use of aluminium compounds in this patient group are recognised. Care is taken to monitor blood levels of aluminium in anyone with kidney failure. The acute neurological disease described in the early days of renal dialysis has no connection with Alzheimer's Disease. Intravenous preparations for patients receiving regular intravenous treatment are today made without aluminium.

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ALUMINIUM AND HEALTH

Fact sheet 3

WHAT IS ALZHEIMER'S DISEASE ?

Alzheimer's Disease (AD) is a chronic condition that is characterised by progressive loss of memory and other brain functions of daily living. It is the most common type of dementia and most cases occur after the age of 65. The specific diagnosis of Alzheimer's Disease.) can be difficult. A certain diagnosis can only be confirmed by brain biopsy and the finding of both the accumulation of unusual protein substances associated with damage to nerve cells called Neurofibrillary Tangles (NFT) and scars called Senile Plaques (S.P.) Brain MRI scan could detect sign of Alzheimer's before any symptoms start to show.
More than half of all cases of dementia are considered to be A.D., and about 5% of the population at the age 70-80 years is affected by A.D.

A.D. appears to be a multi-factorial disease that involves genetic and environmental factors. Despite over twenty years of extensive research, no clear cause has yet been found. Current emphasis is on a genetic linkage, which was formerly considered important only for Alzheimer's disease of early onset. Recent research have also linked several genetic factors to late onset Alzheimer's disease. It is likely that also environmental risk factors contribute to the development of A.D., but much less is known about these.

The impairments which occurred particularly in the past and were attributed to aluminium accumulation in the body during kidney dialysis using tap water for the dialysis fluid in patients with severe kidney dysfunction, is different from Alzheimer's Disease. Behavioural features are different and the diagnostic structural brain changes of Alzheimer's Disease are not present. This "dialysis dementia" is now rare and can be treated and usually reversed, in contrast to A.D..

DOES ALUMINIUM PLAY A ROLE IN ALZHEIMER'S DISEASE ?

The possibility of a link between aluminium and Alzheimer's disease surfaced in 1965. When injecting aluminium salts directly into the brain of rabbits it produced some histopathological changes. These were later shown to be different from the changes found in Alzheimer's Disease.

Subsequent research has produced conflicting results. A research group in Newcastle, UK. found aluminium in the core of the senile plaques associated with A.D. Researchers at the Institute of Basic Research and Developmental Disabilities, N.Y. found varying levels of aluminium and silicon co-localised in about half the tangles and plaques studied in the brains of Alzheimer patients.

The variability of detection and the low levels of aluminium present indicated to them that aluminium is not necessary for the formation of the structural abnormalities within the brains of Alzheimer patients. A group at Oxford University, UK. using advanced analytical techniques on unstained samples did not find aluminium in the core of the senile plaques.
A Norwegian study, set up to eliminate several of the earlier difficulties, found no difference in the aluminium content in selectively affected areas of the brain between Alzheimer patients and a control group.

The latest comprehensive report was produced in 1997 by a Task Group of the International Programme on Chemical Safety, under the auspices of the World Health Organisation (WHO) and the United Nations Environment Programme (UNEP). This report concludes that “There is no evidence to support a primary causative role of aluminium in Alzheimer's disease and aluminium does not induce Alzheimer's disease pathology in vivo in any species, including humans. The hypothesis that exposure of the elderly population in some regions to higher levels of aluminium in drinking water may exacerbate or accelerate Alzheimer's disease is not supported by available data''. *This has been confirmed since that time by several national or international collective expertise groups or national health agencies (see references).*
During the International Conferences on Alzheimer and related disorders held at regular intervals and attended by more than one thousand specialists, aluminium has not been considered to be one of the factors involved A.D.

The aluminium industry has always taken a responsible attitude to health concerns about aluminium. It has provided considerable resources to key centres with eminent researchers in this field to help improve knowledge of the causes of this disease.

While leading scientists, medical authorities and Alzheimer researchers continue to discount the involvement of aluminium, the industry believes that research into the possible causes of Alzheimer’s Disease should continue until the cause(s) and cure are found.

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ALUMINIUM AND HEALTH

Fact sheet 4

ALUMINIUM CHEMICALS IN WATER TREATMENT

Aluminium is a natural component in surface and ground water. Most water authorities throughout the world also use aluminium sulphate or “alum” as a flocculating agent in treating their water supplies. A flocculating agent is a substance that, when added to water, attracts small inorganic particulate matter, bacteria, virus and other organisms potentially harmful to humans, to assist in their filtration. Some water supplies do not need to be treated with a flocculant, while other supplies are undrinkable without treatment due the high levels of turbidity, naturally occurring chemicals and disease causing bacteria and virus.

At present there is a WHO (2003) guideline for aluminium in drinking water from treatment plants of 0.1 mg/l in a large water treatment facilities and 0,2 mg/l in small facilities based on practical optimisation of the process. This guideline is essentially set for the visual effect and taste. No health-based criteria have been proposed for aluminium levels in drinking water by the World Health Organisation.
The European Commission has also adopted the same guideline level, which is used by EU Member States.
Virtually all water contains small amounts of aluminium. In neutral waters this is present as insoluble compounds, while in highly acidic or alkaline water it may be present in dissolved form.
Several epidemiology studies have looked at the relationship between aluminium in water and Alzheimer's Disease. These show very different results, often because it is difficult to correct for all the other factors influencing the results. A Canadian study (2008), where the authors have tried to correct for other factors, shows no relationship between aluminium content in water and Alzheimer's Disease. It must also be kept in mind that aluminium in water accounts for less than 1,0% of the total daily aluminium intake. Some articles have listed the hypothesis that aluminium in drinking water is more bio-available than other ingested aluminium. A paper (1995) suggests that this is not the case, and a study from Australia (1998) showed that the bio-availability of aluminium naturally present in food and in drinking water treated with alum was the same. Latest animal studies have also shown that it is impossible to predict the aluminium level present in the human body only from calculating aluminium in drinking water.
An US study found that 40% of the treatment plants tested had lower total aluminium content in their output than in their raw supply.

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Alum has become the benchmark in water treatment world-wide. Alum is arguably the most effective flocculant available; it is relatively safe to handle, cheap to produce and due to its very low impurity levels presents little risk of exposure to toxic chemicals. It is also current expert opinion that alum at conventional levels poses no risk to human health.

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ALUMINIUM AND HEALTH

Fact sheet 5

ALUMINIUM IN MEDICINES

Medical practitioners have been prescribing large amounts of aluminium compounds to their patients for many years and much greater amounts are taken in non prescription drugs as regulatory authorities conclude that such medication can be made safely available without prescription.

The main aluminium compound used in medicine is aluminium hydroxide. This is used as an antacid in the treatment of gastric ulcers and as a phosphate binder in cases of long-standing renal failure. Alternative antacids do exist but they are not all as effective.

Aluminium compounds are particularly effective, safe antacids. Several studies that have been undertaken comparing those who have taken large quantities of aluminium hydroxide as antacids with control subjects, have found no adverse effects (such as increased incidence of Alzheimer's Disease).

The long term administration of oral aluminium antacids to patients with renal failure has the tendency to increase the level of serum aluminium.
In modern dialysis aluminium build up in the body is not a problem, indeed aluminium hydroxide is sometimes given to these patients to stop them from absorbing unwanted phosphate from the intestines. Aluminium will bind this to form insoluble aluminium phosphate.

Aluminium compounds are also used in antiperspirants, antiseptic solutions and as adjuvants in vaccines. Aluminium is not known to produce any adverse effects and is recognised for such use by the WHO.

See separate fact sheets on vaccines and cosmetics.

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ALUMINIUM AND HEALTH

Fact sheet 6

ALUMINIUM IN FOOD AND PACKAGING

Most foods have some natural aluminium content, due to the abundance of aluminium in nature. Examples of food with high aluminium contents are tea and some herbs and spices. In the normal European diet, the daily aluminium intake from various foods is estimated at 3-10 mg, depending on the type of food. In the U.S.A. this is normally higher because of greater use of intentional food additives, often used in processed cheese and biscuits. These additives, which consist of aluminium salts, are all approved by the appropriate authorities. Nearly all the daily aluminium intake comes from natural sources.
During the FAO/WHO Joint Expert Committee on Food Additives in 2011 the PTWI (Provisional Tolerable Weekly Intake) for aluminium was revised up to 2 mg/kg body weight which applies to all aluminium compounds in food, including additives. The Committee used the recent published study by Poirier et al as basis for the evaluation, giving a NOEL of 30 mg/kg bwt and applied an uncertainty factor of 100 to this.
Aluminium in the form of foils, menu trays, cans and other utensils is used extensively for the protection, storage, preservation and preparation of food and beverages. It conducts heat extremely well, making it very energy efficient for preparing and serving both hot and cold food.
Aluminium is also very light, reducing transport costs and making it suitable for packaging applications where weight is important. Aluminium is used in several types of packaging, also combined with other materials, because of its excellent barrier function. It keeps out micro-organisms, air and light in order to preserve the contents and extend the shelf life for the products.

Aluminium oxide, which forms on the surface of all aluminium metal in the presence of air, is stable in the pH range of 4.5 to 8.5, making aluminium suitable for storage of many different food types.
Aluminium beverage cans and food cans have a protective coating applied on the inside to prolong storage life. This ensures that the acids and salts in beverages or food never actually come into contact with the metal.

Aluminium foil wraps much of our food and is used domestically in the kitchen. It is widely accepted that only negligible amounts of aluminium get into foods in this way. As indicated earlier, some aluminium is ingested in the diet and this has always been the case given its abundance and presence in natural foods. The contribution from foods cooked in aluminium saucepans or from aluminium foil and beverage cans is almost negligible (normally in the order of 0,1 mg/day).
The only exception is when highly acidic or salty foods are cooked or stored in uncoated aluminium utensils for extended time periods.

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From low levels of ingested aluminium, only a very small percentage of what is ingested is absorbed by the stomach and intestines and almost all of what is absorbed is excreted by the kidneys. Recent studies have shown that less than 1% of ingested aluminium is absorbed and this can be as low as 0,01% depending on other constituents present.

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ALUMINIUM AND HEALTH

Fact sheet 7

ALUMINIUM IN VACCINES.

Aluminium is present in some vaccines as an adjuvant in the form of aluminium hydroxide, aluminium phosphate or aluminium hydroxyphosphate. An adjuvant is present in a vaccine to enhance the immune response, and certain vaccines need this in order to be effective.

The vaccines containing an adjuvant are primarily those against diphtheria, tetanus, pertussis and hepatitis A and B. It was observed that these vaccines were not sufficiently effective alone, and aluminium compounds are commonly used adjuvants for this purpose.

The only known reactions that can eventually be attributed to aluminium contained in vaccines are local inflammatory reactions.

In France, biopsies of deltoid muscle, common site for vaccinations, have revealed a few cases of minute inflammation of macrophages with associated necrosis, called macrophagic myofasciitis (MMF). These local lesions have been found to contain aluminium salts. The biopsies have mainly been conducted on patients complaining about muscle pains, but not localised to the injection site, and the MMF has only been found in a small number of the biopsies. Hence there is no established link between muscle pain and the small local lesion of MMF.

The quantity of aluminium present in the vaccine varies between 0.3 and 1.5 mg per dose. Considering the different vaccinations and number of repeats necessary, the maximum dose a person would receive from this over a lifetime is 15mg. This is about the same as the normal oral intake over two days.

Aluminium injected by subcutaneous and intramuscular routes is gradually dissolved and enters the bloodstream. It is then eliminated through the urine, same as aluminium taken up from the gastro-intestinal system.

Assessment of the safety of vaccines is important, also because replacement of currently used adjuvant would necessitate the thorough investigation of alternatives before these could be licensed.

Any withdrawal for safety reasons would severely affect the immunogenicity and protective effects of currently used vaccines and threaten vaccination programmes worldwide.

The World Health Organisation (WHO) initiated a broad consultation on the issue in 1999, assisted by their advisory committee on vaccines, Global Vaccine Safety Advisory Committee (GACVS).

On the recommendation of WHO a study was started to establish whether or not there is an association between local MMF lesions and any generalised illness. This is now in progress. The most recent evidence (November 2002) from this study suggests that there is no reason to conclude that administration of aluminium containing vaccines poses a health risk or to change current vaccination practise.
In France ANAES and INSERM jointly evaluated the potential secondary effects from using vaccines containing aluminium compounds for both children and adults. Their conclusions are published in a paper from September 2003: "The MMF is a histological lesion recently described in adults that until now was almost exclusively reported in France. A series of cases have assumed a link between the lesion and a vaccine containing aluminium hydroxide. At present there is no epidemiological evidence that would support a relationship between the vaccination and diseases that could be attributes to the lesions found. It must be emphasised that this adjuvant is widely used for decades in different vaccines."

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ALUMINIUM AND HEALTH

Fact sheet 8

ALUMINIUM AND COSMETICS

Some aluminium salts are widely used in cosmetic products like deodorants.
These products contain antiperspirant ingredients, colouring, preservatives, perfumes, etc.
The antiperspirants often contain aluminium salts such as aluminium chlorhydrate or aluminium hexachlorhydrate in quantities up to 25%.
The aluminium salts work by forming a plug at the top of the sweat ducts and reduces the sweat to the surface of the skin.
Articles and rumours, which have recently been spread through the Internet, have suggested that these cosmetics might be involved in breast cancer. The main argument given for this is that as a large proportion of breast cancer has been observed in the upper outer quadrant of the breast, which is close to the area where cosmetics are applied, a possible link between underarm cosmetics products and this breast cancer has been suggested. A published study of aluminium uptake from deodorant applied under the arms shows that the uptake into the body is maximum 0,02%. (1)

Aluminium is not classified as a carcinogenic substance by IARC, and has gone through a through review by an international expert group set up by WHO/IPCS.(2)
The US Food and Drug Administration (FDA) also indicate that there is no evidence to support that underarm cosmetics ingredients cause cancer.(3)
An epidemiological study conducted in the US and published in 2002 tried to evaluate the link that may exist between breast cancer and the use of antiperspirants and deodorants by studying the body hygiene habits of women with breast cancer compared to randomly chosen women of a similar age.(4)
The conclusions were: << These findings do not support the hypothesis that antiperspirants use increases the risk for breast cancer and there is no evidence of risk for breast cancer from the use of deodorants >>.
Concerning the location of the breast cancers, according to the American Cancer Society: Most cancers occur in the upper outer quadrant of the breast because most of the breast tissue is located there.

A recent French study evaluating 59 published studies on deodorants/antiperspirants and breast cancer concluded that there is no scientific evidence of any link between deodorants and breast cancer; and that due to the lack of a credible hypothesis it is of little interest to continue this line of research (5).

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Studies show that breast cancer may be linked to natural hormones, or chemicals which mimic the effects of hormones – endocrine disrupters.
For several years, scientists have been conducting studies for the European Commission to draw up a list of chemicals that could be classified as endocrine disruptors.

Aluminium has been listed in the last category: There is no scientific evidence for inclusion in the list.
A summary of aluminium health risk can be found in ref.6.

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