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A QUICK REPORT ON THE CONTROVERSY ABOUT ALUMINUM AS FOOD CONTAMINANT

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ABSTRACT

This report is an attempt to find out the facts and figures about aluminum as metal for food container, food cooking vessel and its probable impact on human body. Findings are interesting to reveal that being a metal aluminum is against life and however the body naturally tends to treat the aluminum safely. Selective absorption of metal as nutrient follows the same biochemistry. However the 1% of the aluminum from ingested quantity remain inside body and causes chronic diseases. The article concludes with a prior study of Aluminum as a biological parameter, it's secretion in human body, Aluminum as a burden to human body. Its long range effects, metabolism and finally providing a green path solution to be on safer side.

Keywords: *Immune system, Aluminum, Chronic diseases.*

I. INTRODUCTION

Aluminum is present in very small amounts in living organisms. But is abundant in environment as metal, as compound and as element. In no case Al^{+3} being shown to have definite biological function and so body do not retains it. This suggests aluminum possesses properties incompatible with fundamental life processes [1]. Aluminum is omnipresent in everyday life and can enter the human body from several sources, most notably from drinking water and food consumption. An inevitable consequence of humans living in the Aluminum Age is the presence of aluminum in the brain. This non-essential, neurotoxic metal gains entry to the brain through all stages of human development, from the foetus through to old age. Human exposure to myriad forms of this ubiquitous and omnipresent metal makes its presence in the brain inevitable, while the structure and physiology of the brain makes it particularly susceptible to the accumulation of aluminum with age [2]. The human body has limited ability to expel such metals. If the metals accumulated in the body reach beyond this ability, these will start getting stored in the muscles, kidneys, liver, bones etc. Aluminum also hinders the growth of brain cells. Thus, aluminum accumulated in the body becomes slow poison [3].

The following review is an attempt to summarize the current literature concerning biochemistry in Al^{+3} and similar ions if possible by comparison to achieve a more detailed picture of behavior of aluminum in body.



Figure – 1: Aluminum foil, a common food wrapping material

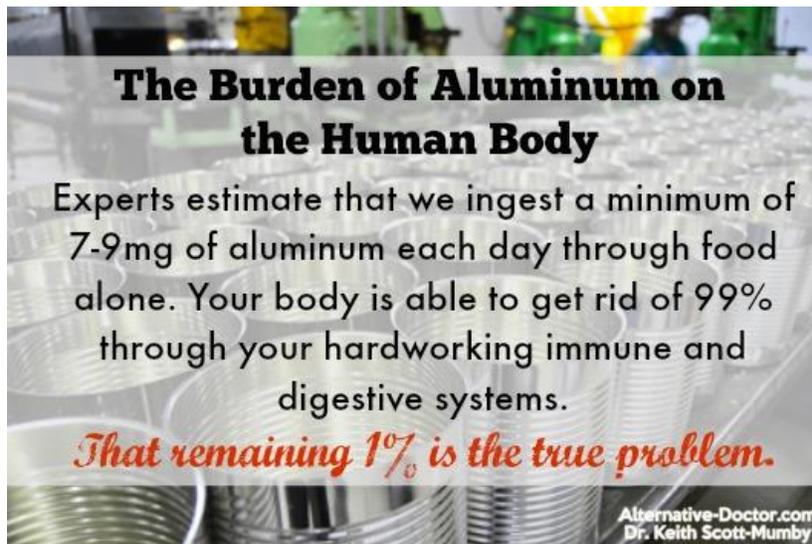


Figure – 2: Aluminum a Body Burden !

1. How Does it enters ?

Table – 1: Sequential response of human body to metal ingested [3]

Interaction	Response
Metabolism	It is limited to change in oxidation state, transition and pH alterations.
Presence	Sequestered, bound to specific plasma or tissue proteins or bone
Elimination	Being hydrophilic, eliminated in urine and bile
Absorption	Being in ionized state, membrane transport is the mean for tissue uptake.

Food cooked in aluminum vessels or in aluminum foil, can absorb aluminum because aluminum dissolves into food and water during the cooking process. At lowered pH and elevated temperature, aluminum dissolves in water as well as oil. This absorbed aluminum goes into the bloodstream and accumulates in different organs in different people causing a multitude of effects. Aluminum dissolves faster into acidic foods than into basic foods. It is always unwise to cook acidic foods like tomatoes, tea & coffee in aluminum vessel [4].

It is often claimed that aluminum does not dissolve in the food. This can be disproved by taking some water and boiling it for half an hour in an aluminum vessel. Pour the water into a transparent glass and allow it to stand for a day. You will find a cloudy substance has appeared in the water, which is aluminum hydroxide. Aluminum utensils often show pitting where the aluminum has dissolved away [5].

Even if a steel spoon is brushed with force against aluminum vessels, minute particles of aluminum will appear as residue. When food cooked in these vessels is consumed, these particles enter the body through the food. On an average, 5 milligrams of aluminum is consumed everyday through food [5].

Table – 2 How Aluminum enters through food

Sr.no	Food Items
1.	Beverage base , chocolate flavor , added minerals , calcium iron and Vitamins A ,B1 , C B2 , & D
2.	Biscuit ,savoury,flavoured
3.	Breakfast , cereals , wheat bran , flakes , sultanas, added vitamins B1,B2,B6& folate, CA,Fe and fibre.
4.	Chocolate, milk with added milk solids,bicuit sweet plain,hamburger, plain (beef patty, lettuce, tomato,
5.	onion, sauce)
6.	Mixed garin flakes(oat, wheat), added dry fruits.
7.	Spread yeast, vegemite, plain snack craker style.
8.	Pizza, pineapple, purchased frozen items, baked .
9.	Kiwi fruit, gold, peeled, raw.
10.	Cheese, cheddar, proceesed reduced fat(8%), added vitamin D.
	Chicken, breat, lean, grilled.
	Unprocessed foods like fresh fruits, vegetables, and meat contain very little aluminum.
	Flour, baking powder, coloring agents, anticaking agents
	Aluminum Cans and processed food and aluminum packed foils .

An average adult eats about 7–9 mg of aluminum per day in their food [6].

2. Why Aluminum a Slow Poison ?.

Some unpleasant effects of eating food cooked in aluminum are hyper-acidity, peptic ulcers, indigestion, flatulence, skin problems like pigmentation, eczema, dandruff and chronic inflammation of the intestine, which may be diagnosed or misdiagnosed as Ulcerative colitis, Crohn's disease or as chronic amoebic dysentery. Aluminum reduces growth of bone and predisposes to osteoporosis [5], [7].

Accumulation of aluminum results in toxicity which is confined to patients with renal dysfunction and impaired elimination of aluminum. Sources of aluminum in patients with renal failure have included water used for dialysate solutions, in addition to aluminum hydroxide [5]. Adverse effects of aluminum accumulation in these patients has led to monitoring of water source aluminum content by dialysis units and periodic measurements of serum aluminum in patients undergoing chronic dialysis [8, 9].

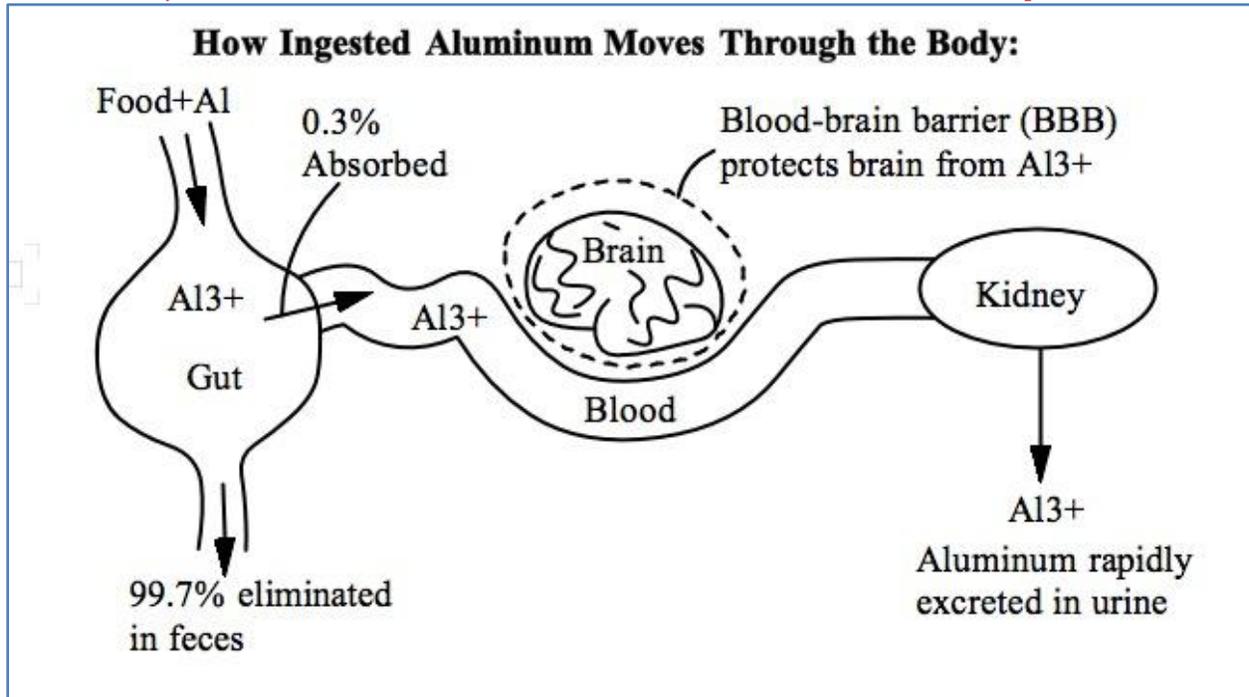


Figure – 3: Schematic representation of aluminum transport in human body

Although the majority of aluminum ingested is eliminated by the gastrointestinal tract, absorption of aluminum and increases in serum concentrations have been demonstrated. Gastrointestinal side effects have been reported the most frequently. These have included constipation and impaction. Generally, aluminum hydroxide is combined with another antacid so lower doses may be used to counterbalance the constipating effect [3].

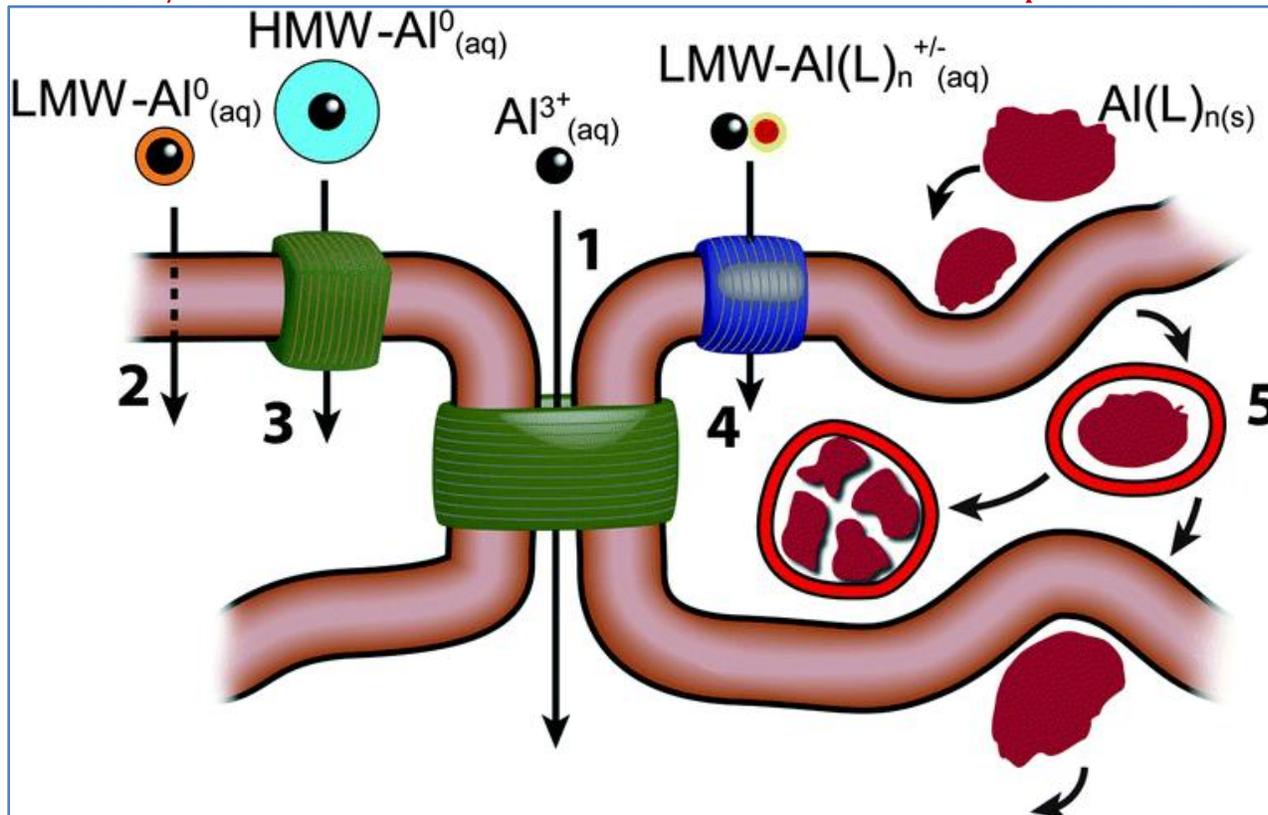


Figure – 4: Schematic representation of aluminum transport in human body with the aid of protein (green patch)

This Gastric acid reflux occurs when there is acid backflow from the stomach into the oesophagus. This happens commonly but can cause complications or troublesome symptoms, such as heartburn. One reason this happens is that the lower esophageal sphincter (LES) is weakened or damaged. Normally the LES closes to prevent food in the stomach from moving up into the esophagus. The foods you eat affect the amount of acid your stomach produces. Eating the right kinds of food is key to controlling acid reflux, a severe, chronic form of acid reflux [8].

Absorption of aluminum via the gastrointestinal tract is usually less than 1%. The main factors influencing absorption are solubility, pH, and chemical species. Organic complexing compounds, notably citrate, increase absorption. Aluminum absorption may interact with calcium and iron transport systems. Aluminum, once absorbed, is distributed in most organs within the body, with accumulation occurring mainly in bone at high dose levels. To a limited but as yet undetermined extent, aluminum passes the blood– brain barrier and is also distributed to the fetus. Aluminum is eliminated effectively in the urine [5].

Aluminum is also known to affect the brain causing dementia and Alzheimer's disease. The first signs of its toxic effects on the brain, is loss of short term memory. Continued exposure to aluminum over thirty to forty years may cause Alzheimer's disease. In Alzheimer's disease the patient is unable to recollect recent events, but is able to clearly recollect events which occurred many years earlier. At present there is no effective treatment for this. Consuming unrefined coconut oil 1 tablespoon a day, may help this condition [4], [5], [8].

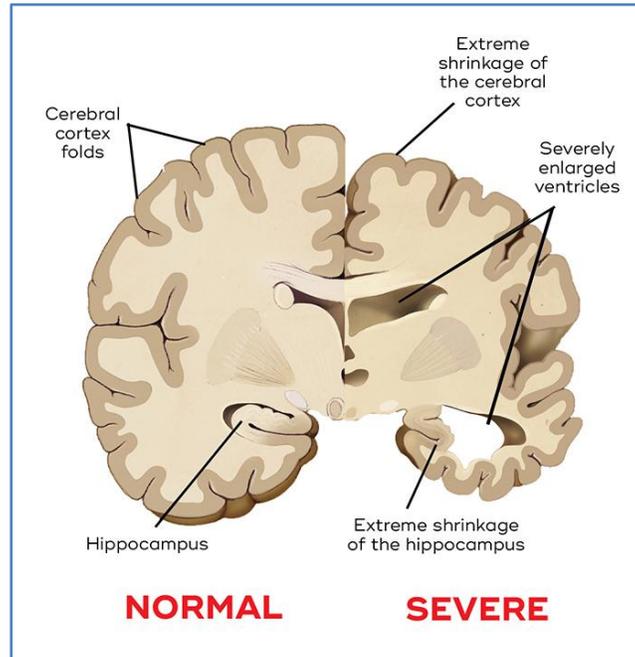


Figure – 5: Schematic representation of brain affected by accumulation of aluminum (Alzheimer's disease) [10]

3. Why only Aluminum?

Aluminum is a trivalent cation found in its ionic form in most kind of animal and plant tissues and in natural waters everywhere. It is third most elements and the most abundant metal in earth's crust, representing approximately 8% of total mineral components. [1]

The size of the Al^{3+} ion is relatively bigger than the other metal ions found in human body. Also it has a +3 charge which is higher than the other metals. Due to its higher size and more charge it is not absorbed in the blood, intestine or any other organ. It is not soluble in water at normal conditions. But in acidic conditions it dissolves in water and produces Sodium Hydroxide. This Sodium Hydroxide is a major ingredient of the antacids. [1], [4] and [11].

Despite this Al^{3+} has generally been regarded as virtually biologically inert and the interest shown for its biochemistry and metabolism has been limited. An ion like Al^{3+} is easily bound to many substances in structures in many organisms. Therefore its metabolism is determined by its affinity to each of the ligands and by their relative amounts of metabolism. The ionic radius is small i.e only 0.51 \AA due to the ions strong electric charge and small size give Al a strong polarizing effect. Therefore, in aqueous solution, ion protolyses part of the water envelope and forms hydroxo complexes. As a result solution becomes acidic [1].



Figure – 6: A beautiful earthen pot for cooking

II. CONCLUSION

The article concludes with a prior study of Aluminum as a biological parameter, it's secretion in human body, Aluminum as a burden to human body. Its long range effects, metabolism and finally providing a green path solution to be on safer side.

- Instead of Aluminum, switching to earthen pots, cast iron, and stainless steel is advisable
- To avoid aluminum contamination through foods try switching to aluminum free food packets and cans as well .
- Choose aluminum free body deodorants to avoid the exposure from aluminum.
- Avoid excessive use of antacids .these are one of the most potent source of aluminum. Instead it may be wiser to choose quality foods that are easy to digest .
- Drinking freshly squeezed orange, pineapple, grapefruit or sweet lime juice can help remove aluminum from the body and help mitigate these problems.

REFERENCES

1. *Metabolism and possible health effects of Aluminum*, by P. O. Ganrot.
2. *Harper's Illustrated Biochemistry 27th edition*, by Robert Murray, Daryl Granner, Victor Rodwell, Mc Graw Hill Publications
3. *Biochemistry of metal absorption in Human Body: Reference to check Impact of Nano Particles on Human Being*, by Yogesh Patil, Sharu Jadhav, Jitendra Kadu, Sachin Pawar.
4. *Human exposure to aluminium*, by Christopher Exley , The Birchall Centre, Lennard-Jones Laboratories, Keele University, Staffordshire, UK.
5. *Agency for toxic substances and disease registry*, Atlanta, Sept. 2008, CAS #7429-90-5
6. *Report on Health body effects of aluminum*, WHO 1997
7. *Aluminum in human body*, Wikipedia
8. *HUMAN HEALTH RISK ASSESSMENT FOR ALUMINIUM, ALUMINIUM OXIDE, AND ALUMINIUM HYDROXIDE* Daniel Krewski, Robert A Yokel, Evert Nieboer, David Borchelt, Joshua Cohen, Jean Harry, Sam Kacew, Joan Lindsay, Amal M Mahfouz, and Virginie Rondeau
9. <http://www.drmanik.net/aluminium-is-dangerous.html> , by Dr. Manik Hiranandani
10. *Aluminium in the human brain*, by Christopher Exley Emily R. House, Received: 10 September 2010/Accepted: 2 November 2010/Published.
11. *Rantidine suppresses aluminum absorption in man*, by R. S. C. Rodger, G. S. Muralikrushna, D. J. Halls, J. B. Henderson, J. A. H. Forrest, A. I. Macdougall, G. S. Fell.