



Effect of Aluminium Foil on Packed Food

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Abstract : Aluminium is a chemical element with symbol Al and atomic number 13. It is a silvery white, soft, non-magnetic and ductile metal in the boron group.

Aluminium metal is so chemically reactive that native specimens are rare and limited to extreme reducing environment. Instead it is found combined in over 270 different minerals. (APHA, 2012)

Although Al is the most abundant metal in the earth's crust, it is never found free in the nature. All of the earth's Al has combined with other elements to form compounds. Two of the most common compounds are alum, such as potassium aluminium sulphate $[KAl(SO_4)_2]$.

Al is remarkable for its low density and its ability to resist corrosion through the phenomenon of passivation. Al and its alloy are vital to the aerospace industry and important in transportation and building industries such as building facades and window frames. The oxides and sulphates are the most useful compounds of aluminium.

Despite its prevalence in the environment, no known form of life uses Al salts metabolically, but Al is well tolerated by plants and animals. Because of these salts abundance, the potential for a biological role for them is of continuing interest.

Keywords: Aluminium, Abundant, Compounds, Environment.

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Introduction :

| | |
|--------------------------|-------------------------------------|
| Symbol | : Al |
| Atomic mass | : $26.98153u \pm 8 \times 10^{-7}u$ |
| Melting point | : 660°C |
| Atomic number | : 13 |
| Electronic configuration | : $[\text{Ne}] 3s^2 3p^1$ |

Engineers are especially interested in using aluminium more often for electrical equipment because it is so much cheaper.

By mass, aluminium makes up about 8% of the earth's crust; it is the third most abundant element after oxygen and silicon and the most abundant metal in the crust, though it is less common in the mantle below. The average abundance in the earth's crust is 8.1%; in soils it is 0.9 to 6.5 %; in streams it is 400 microgram per litre (APHA, 2012).

The most important minerals are bauxite and corundum, which is used as an abrasive. **Al** and its alloys are used for heat exchangers, aircraft parts, building materials, containers, etc. Aluminium potassium sulphate (alum) is used in water treatment processes to flocculate suspended particles, but it may leave a residue of aluminium in the finished water.

Most unprocessed foods, except for certain herbs and tea leaves, contain low (<5mg Al/g) levels of **Al**. Thus most adults consume 1-10 mg **Al** daily from natural sources.

Al foil is made by rolling sheets of 98.5% pure **Al** metal between pairs of polished, lubricated steel rollers. Successive passes through the rollers squeeze the foil thinner.

Household **Al** foil is so thin (0.0005 of an inch) that the roller can't handle it without tearing it. Aluminium foil has a **shiny side and a dull side**. Many people believe that it matters which side is used up or down. The truth is that it makes no difference at all. The reason the two sides look different is due to the manufacturing process. The **Al** is a reliable form of food packaging and has been used for over 60 years. **Al** can be recognized for its light weight form, impermeability, thermal conduction, flexibility and recyclability. **Al** also lasts long and can be transformed into more complex and durable packaging shapes. **Al** doesn't rust. It's protected by its own naturally occurring oxide film. A protection that can be further enhanced by anodizing or other finishing techniques (Oliver et al 1974).

Not only is **Al** packaging durable, but also the transportation costs of **Al** are very low due to the thin, sturdy substrate. Because of this, **Al** is one of the cheapest costing packaging materials.

In healthy subjects, only 0.3 % of orally administered **Al** is absorbed via the gastrointestinal (GI) tract and the kidneys effectively eliminate **Al** from the human body.

As **Al** is a neurotoxic. Its free ion **Al³⁺(aq)** is highly biological reactive and uniquely equipped to do damage to essential cellular (neuronal) biochemistry. This unequivocal fact must be the starting point in examining the risk possessed by **Al as neurotoxin in humans**.

Al enters the brain bound to a protein called transferrin. Transferrin is a protein that binds and transports iron around the body. The greatest uptake of **Al** in the brain occurs in areas rich in transferrin receptors and these coincide with the regions, which are vulnerable in Alzheimer disease (Hoag et al 2002).

There is a direct correlation between **Al** levels in the brain and Alzheimer's disease. **Al** is found in many different places, but **Al** packaging places the substrate right in the consumer's food.

Cooking with **Al** foil may increase the **Al** content of the foods. Most of our **Al** intake comes from food.

However, studies show that **Al** foil, cooking utensils and containers can leach **Al** into our food.

At home, people use **Al** foil for food storage, to cover baking surfaces and to wrap foods such as meats, to prevent them from losing moisture while cooking.

If you use aluminium foil, do not use it for cooking and don't store tomatoes, citrus nor spices in it. Keep in mind a lot of aluminium doesn't leach into your food, at least not right away. With prolonged use this coating can come off and because we use them with high heat our chances of aluminium leaching into our food are greater.

It's safe to wrap cold food in foil, though not for long stretches of time because food has a self life and because aluminium in the foil will begin to leach into the food depending on ingredients like spices.

Materials and Method :

Material : hot air oven, microwave digester, atomic absorption spectrometer and five different food samples wrapped in aluminium foil.

Methods:

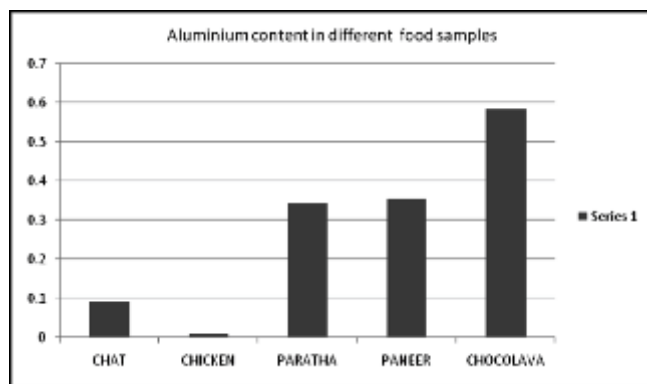
Five different food samples were analysed:

1. Chokolava (A)
2. Chat (B)
3. Chicken (C)
4. Paratha (D)
5. Paneer (cooked using Al foil) (E)

1gm of five different food samples were taken and kept in the hot air oven for about an hour. The samples were labelled as A, B, C, D, E. All the samples were grinded with the help of mortar and pestle. These Grinded samples were transferred into the digestion vessel. 5 ml HNO₃ and 5ml HCl was measured and transferred to the vessel. It was digested in the microwave digestion system for about 2 hours. Digested samples were then filtered with the help of Whatmann filter paper No. 1 into 25 ml of volumetric flask. The volume was made up to the mark (25 ml) with the help of distilled water. The samples obtained were analysed for presence of **Al** in food items. Calibration was done with the help of the **standard Al solution (1000ppm) supplied from CDH, Delhi**. After calibration sample was run for the test on **GBC Savantah AAS** equipment.

Result and Discussion :

| Samples | Al Content or Concentration (µg/L) |
|--------------------|------------------------------------|
| CHAT | 0.092 |
| CHICKEN (lollipop) | 0.010 |
| PARATHA | <u>0.343</u> |
| PANEER | <u>0.354</u> |
| CHOCOLAVA | <u>0.584</u> |



As we know threshold level is **0.05 mg/L** as per environment protection agency. (As per WHO) (APHA, 2012)

From the above table it is found that chocolava has maximum concentration of **Al** as it is cooked in oven. Also wrapping a hot paratha or cooking food with **Al** foil (paneer) is quite dangerous for us.

As we know, the amount of absorption depends on the time spent in the oven and on the temperature of the oven during cooking or the duration of time until which food is kept wrapped in **Al** foil.

From above data this is clear that chocolava which is baked in oven using **Al** foil for longer time has higher content of **Al** in comparison to chat.

The lower concentration of **Al** in chicken (lollipop) is because the way it is wrapped. Generally it is wrapped with **Al** foil for our cooking comfort otherwise when it cooked in tandoor it becomes unbearable to hold it.

In paratha the **Al** content crosses the threshold level, as mentioned above, more the food is heated more will be the leaching. So it is recommended to wrap which is less warm to avoid maximum leaching.

Cooking with **Al** foil (paneer) also crosses the threshold level as cooking paneer with **Al** foil becomes hotter with rise of temperature. As we the amount of absorption depends on the time spent cooking with **Al** foil. So, is the value of paneer.

The concentration of aluminium in foods and beverages varies widely, depending upon the food product and the type of processing.

The estimated daily aluminium intakes of 0.10 mg Al/kg/day for 6-11 month old infants, 0.30-0.35 mg Al/kg/day for 2-6 year old children, 0.11 mg Al/kg/day for 10 year old children, 0.15-0.18 mg Al/kg/day for 14-16 year old males and females, and 0.10-0.12 mg Al/kg/day for adult (25-30- and 70+ year old) males and females (Rice et al 2012).

Gastrointestinal absorption of aluminium is low, generally in the range of 0.1-0.4 % in humans.

On the basis of above data, we conclude that in our daily life we consume a lot of food items wrapped with aluminium foil having high concentration of aluminium in it which can be harmful to us, as the values are above threshold level being quite dangerous to our life. (The complete technology book on Aluminium and Aluminium products, Published by Asia Pacific Business Press Inc.2007)

Conclusion :

From the above data, we come to know that direct cooking with aluminium foil is dangerous as it leads to

transfer of aluminium from foil to food above threshold level. Aluminium is a great packaging substrate when it comes to recycling, barrier function and transportation cost. Both the sides of aluminium foil (dull and shiny side) should have equal impact on the packed food. As the sides are shiny and dull due to their manufacturing process so as the shiny side is sticky and dull side is non-sticky (for wrapping food). Increased level of aluminium in our body can be neurotoxic and lead to various diseases. Aluminium foil should not be used in oven for cooking food as it will cause food to heat unevenly. We should not store acidic foods in aluminium foil as it leads to leaching more effectively.

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