

Aluminium Update

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Since the discussions on aluminium in skin care products swept the news about five years ago, aluminium salts have taken leave of antiperspirants and deodorant products. However aluminium compounds of natural or semi-synthetic origin still are used in cosmetic products. In the following we will draw up a provisional appraisal.

In terms of the earth crust, aluminium is the most frequent element. There is no field, no rocks or blown up dust without high-grade concentrations of aluminium oxide, aluminium hydroxide or aluminium silicates. Every masonry structure, all the concrete- and most of the light metal structures as well as chinaware contain aluminium. In addition, elementary aluminium is processed into beverage cans, tubes, kitchen foil etc. In the open air, aluminium takes on an extremely thin oxide layer that protects the (base) metal from oxidation. Whenever such layers are artificially produced, we speak of anodised aluminium. This oxide layer is solvated by acids but also by strong bases.

Daily intake

Since existence of living nature, the organisms had to cope with aluminium compounds. Plants absorb aluminium in varying amounts and the aluminium then accumulates in fresh vegetables and still more in dry products such as tea. When processing the food, the different cooking utensils such as pottery vessels, aluminium pots and equipment evolve soluble aluminium salts due to the impact of numerous acids such as acetic acid, tartaric acid, and lactic acid. The acids come from wine, vinegar, sauerkraut, fruit and vegetables just to mention a few examples.

There are estimates stating that soluble aluminium compounds in double digit milligram numbers find their way into the human body with our daily nutrition whereas the major part is directly excreted via intestinal contents. Re-absorbed aluminium compounds leave the body via kidneys and urine. Hence in the case of renal dysfunction also the elimination of aluminium has to be observed besides the substances that are usually excreted with the urine. The major concentration of bodily aluminium is in the pulmonary tissue.

Antiseptic, astringent

Acetate of alumina is a solution resulting from the impact of acids on mineral clay and has

been used in medicine for a long time. Besides acetic acid the solutions additionally or alternatively contain tartaric acid. They have a strong protein precipitating respectively protein denaturing effect similar to both aluminium chloride alias Aluminium Chlorohydrate (INCI) that is used in antiperspirants, and to aluminium sulphate. Thus these compounds have antiseptic and astringent properties based on the fact that all enzymes including the aggressive proteases and other peptide structures of pathogenic microorganisms are inactivated. However there also is a limitation: open sores should not be treated. This is rather due to the caustic effect in this case which is counterproductive to the healing processes than due to the aluminium content of the preparations. There is one exception to the rule: Aluminium Sulphate (INCI) when used in the form of alum (aluminium potassium sulphate, INCI: Potassium Alum) either as stone or stick which then is applied on minor lesions occurring during wet shaving. Minor lesions can immediately be staunched in this way.

Antiperspirant

Apart from instrument-based therapeutic procedures, aluminium chloride and aluminium sulphate still are the most effective active agents to inhibit perspiration particularly in the case of hyperhidrosis or in other words, profuse sweat production. In this process the sweat gland orifices are constricted or closed by both precipitated protein and crosslinking voluminous aluminium hydroxide. Due to the buffer effect of the skin the insoluble aluminium hydroxide forms, or explained in other words, acid is eliminated from the applied, acidic aluminium after which the pH level increases and aluminium hydroxide is precipitated. It should be mentioned, though, that the treatment of hyperhidrosis requires higher concentrations of aluminium salts than contained in common antiperspirants.

Aluminium and health

Based on studies it was hypothesized that the

absorption of aluminium via skin increases the risk of developing Alzheimer. A further hypothesis says that part of the breast cancer diseases can be ascribed to the continued use of aluminium-containing antiperspirant products and deodorants. Such hypotheses are partly based on statistical data and in-vitro assays and have not been verified so far. Initial studies have been disconfirmed or faults have been revealed which is not unusual, though. It is a fact that communication media frequently disseminated orientating studies and that the required far more detailed follow-up studies have no longer been realized. Thus it can be stated that there is no evidence for an aluminium-induced health risk. In its last aluminium-related statement no. 007/2014, dated 26 February 2014, the German Federal Institute for Risk Assessment (Bundesinstitut für Risikobewertung – BfR) indicated that aluminium-containing antiperspirants should not be used directly after shaving or in the case of a damaged armpit skin. This advice corresponds with the long lasting usage of the above described acetate of alumina.

Deodorants

Unless the focus is on embarrassing sweating and sweat stains on blouses or shirts, in other words, if the deodorant features of a preparation and a pleasant scent are in the fore, there is no need for astringent active agents. Main ingredients in this case are perfume oils and volatile alcohols such as ethanol, isopropyl alcohol but also glycols. Most of the deodorants additionally contain biocides to fight against odour-forming bacteria. With continued use however another problem may show up, i.e. unwanted pathogenic microorganisms can become resistant as known from orally ingested antibiotics. It also should be kept in mind that the intact microbiome is an essential precondition for a healthy skin.

One of the main causes for unpleasant odours in armpits and genital areas is the culturally-induced shaving. It looks neat and trimmed but also leads to the fact that skin rests on skin and a moisture film develops which offers ideal living conditions for odour-forming microorganisms. Tight clothes or pads have occlusive effects in the genital area. The high surface moisture also leads to light skin swellings with the consequence that the skin becomes more permeable for the proteases of microorganisms; a fact which increases the risk of fungus infections for women.

Alum as an alternative?

As a first reaction to the negative headlines, some of the manufacturers produced deodor-

ants with alum or aluminium sulphate and sold the products with slogans like "without aluminium chlorohydrate" or "0% aluminium chlorohydrate". In a narrow sense, the statements are correct, but it can also be interpreted as consumer fraud due to the fact that the health-related properties of these compounds are almost 1:1 comparable with aluminium chlorohydrate.

Tannins

Tannins are an alternative to aluminium salts and also have astringent effects. Tannin-containing powders and extracts of herbal origin are the oldest known tannins. Still today they are gained from barks (oak, birch, chestnut, alias buckeye), shells (nuts), leaves (black and green tea, sage, witch hazel etc.) and horse tail, but meanwhile they also can be produced synthetically. The extracts have good but slightly weaker astringent effects than aluminium salts. These effects are based on polyphenolic structures which also are able to denature and crosslink proteins. In other words, also tannins induce the blockage of the sweat gland orifices.

Tannins can be classified into monomer compounds such as gallic acid, pyrogallol and flavonoids and condensed compounds such as ellagic acid, anthocyanins and others. A disadvantage of polyphenols is that they tend to take on brown discolourations which still are intensified through oxidation (atmospheric oxygen). A typical example in this context is the relatively quick dark colouration of freshly brewed tea.

In cases of profuse sweating where the application of aluminium chloride should be continued there is the alternative of considerably reducing the dosage for the long term application. Experience has shown that it is more efficient to apply the preparations directly after showering on the one hand and on the other hand to reduce the frequency of application after initial doses. The blockage of sweat glands usually continues for some days so that a daily application may not be required.

Other aluminium compounds

Fatty acid salts of aluminium increase the physical stability of W/O emulsions and improve the consistency of lipogels (non-aqueous) and the spreadability of powders. In addition they are a frequent ingredient of make-up products such as concealers, eye shadows, eyeliners and lip sticks. They are used in the form of mica, clay (aluminium silicate, INCI: Argilla) and kaolin. Kaolin also consists of aluminium silicates and its usage ranges from bolus alba in pharmacies, bulking agent in the

paper manufacturing industry up to the china-ware production. Pigments such as titanium dioxide are frequently coated with aluminium oxide for chemical stabilisation.

Aluminium compounds are used as bulking agents in masks. The healing earths (pure natural clay) used in cosmetic (cleansing masks) and physiotherapeutic treatments contain aluminium in insoluble form. Curiously enough there is another problem involved, e.g. the dioxin contamination resulting from strip-mining. Because of their porous and partly tubular nano structure, zeolites (aluminosilicates) can be used to store cosmetic active agents. Zeolites are not biodegradable. Aluminium fluoride serves as a carious-preventing additive in tooth pastes (rinse-off application). Besides other ingredients, they also contain other soluble aluminium compounds such as aluminium lactate and aluminium hydroxide (insoluble).

Conclusion: aluminium is ever-present in our lives.

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