Evaluation of physiological repeated exposure of aluminum in a 3D intestinal tissue model

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Aluminum is the third element present in the Earth crust.

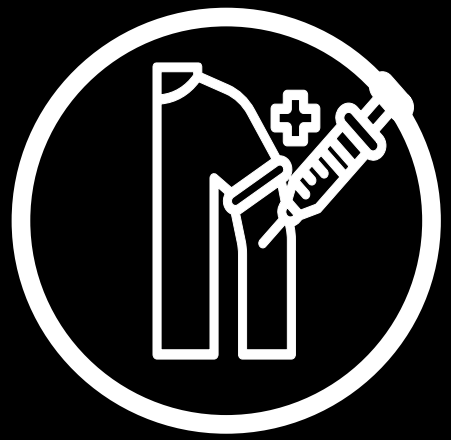
Aluminum is a **versatile metal** found in several consumer products, from makeup and skin care to food packaging and drug formulations

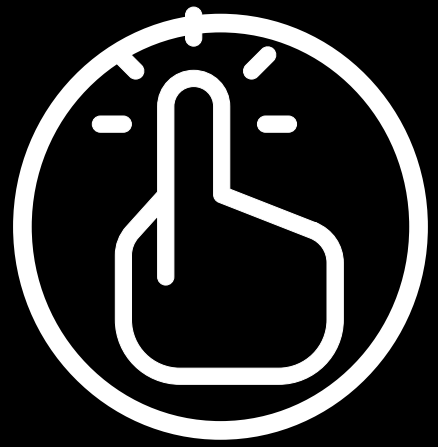
Due to this large application is important **to investigate the impact** on the human health and the possible implications

Route of Exposure

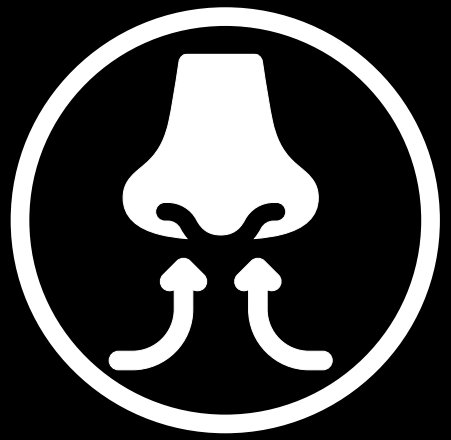
Inhalation

Aluminum particles in the air can be inhaled and contribute to absorption into the body.



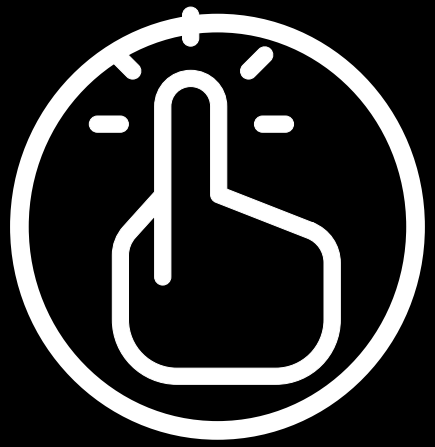


Route of Exposure

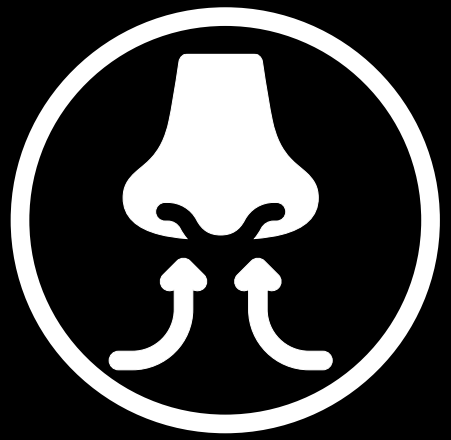


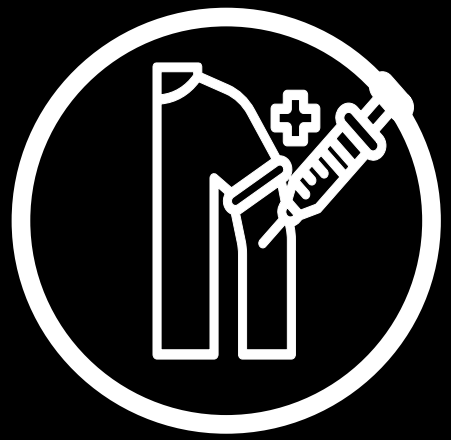
Injection

Pharmaceuticals drugs can contain aluminum salt used as adjuvant and additives



Route of Exposure



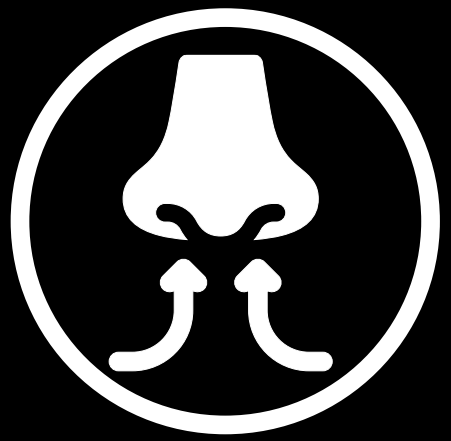


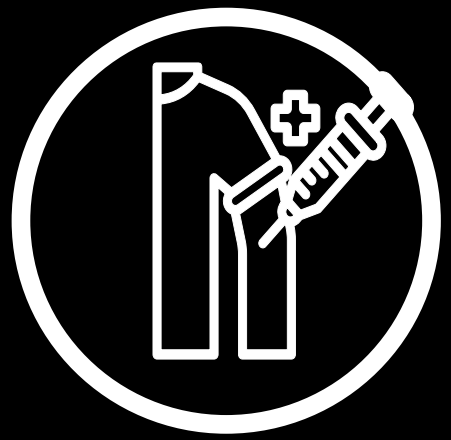
Contact

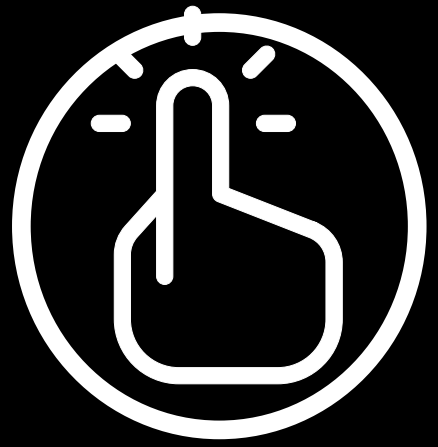
Aluminum in cosmetics can be absorbed through the skin.

Many cosmetics such as lipstick and antipespirants contain aluminum, which is used for its properties

Route of Exposure







Absorption

Typically, from the 0,1-1% of ingested aluminum is absorbed by the intestine.

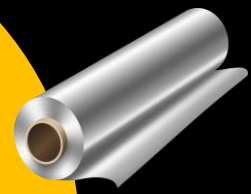
Aluminium can be absorbed not only from oral pharmaceuticals but also from solid food and drinking water.

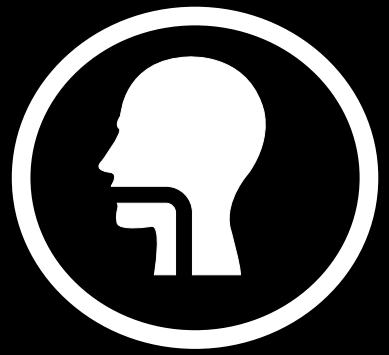
Aluminum in food

Naturally present: i.e. vegetables, cereal

Intentionally used as food additives

Leached by packaging (foil wrap, cans) or **cookware** (pans)





Prolonged exposure to Aluminum

Effect on the Nervous System

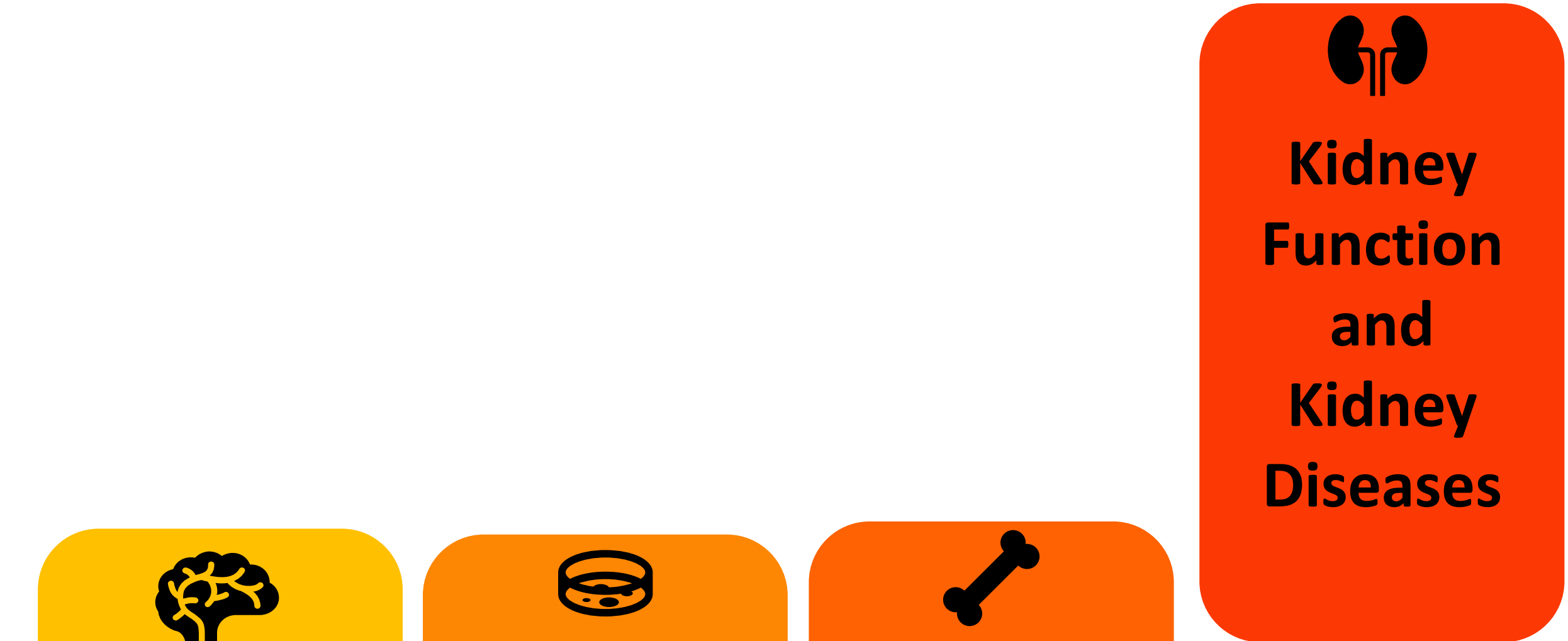
Prolonged exposure to Aluminum

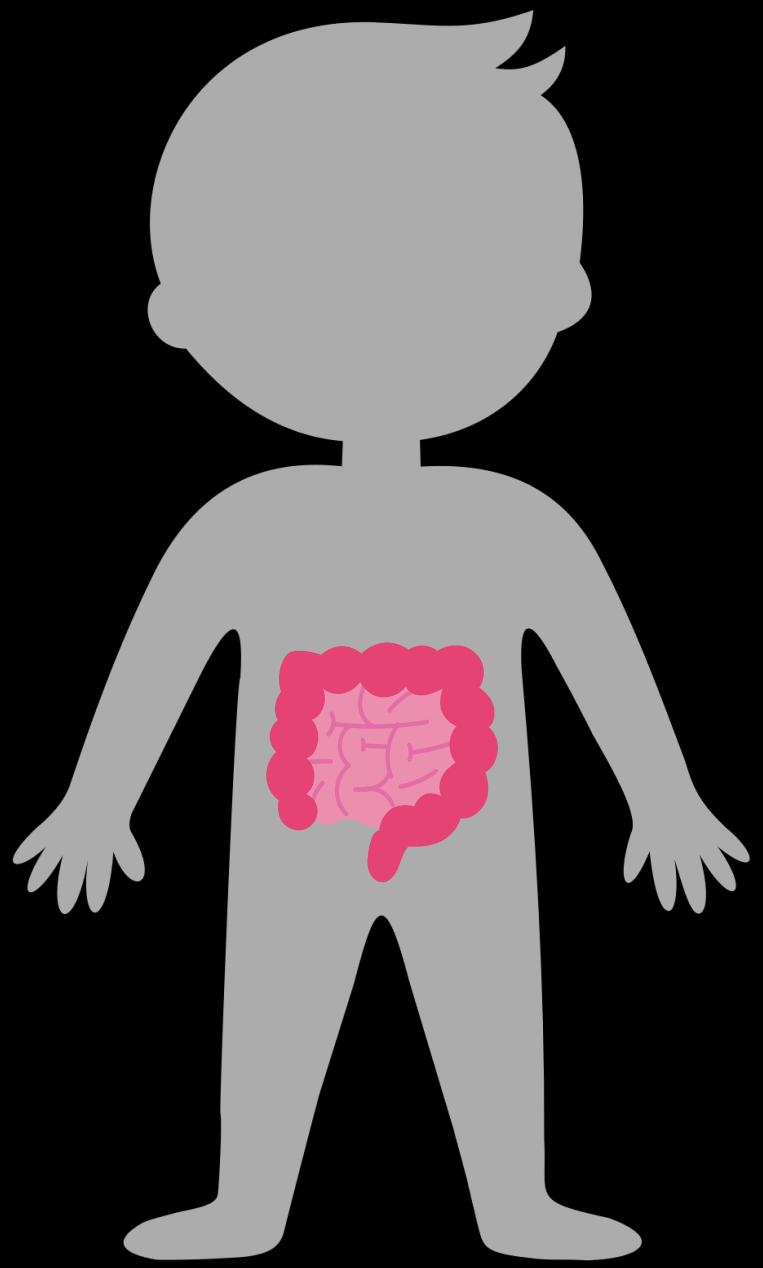
Induce oxidative stress, leading cell damage

Prolonged exposure to Aluminum

Bone and Skeletal Disorders

Prolonged exposure to Aluminum





Aim of the work

Repeated Exposure of Aluminum and investigate the consequences of repeated aluminum exposure on the structural and functional integrity of 3D intestinal tissue.

3D tissue model

Complexity
3D intestinal tissue models capture the multi-layered structure and dynamic environment of the human gut, offering a more realistic platform for studying aluminum absorption and toxicity.

3D tissue model

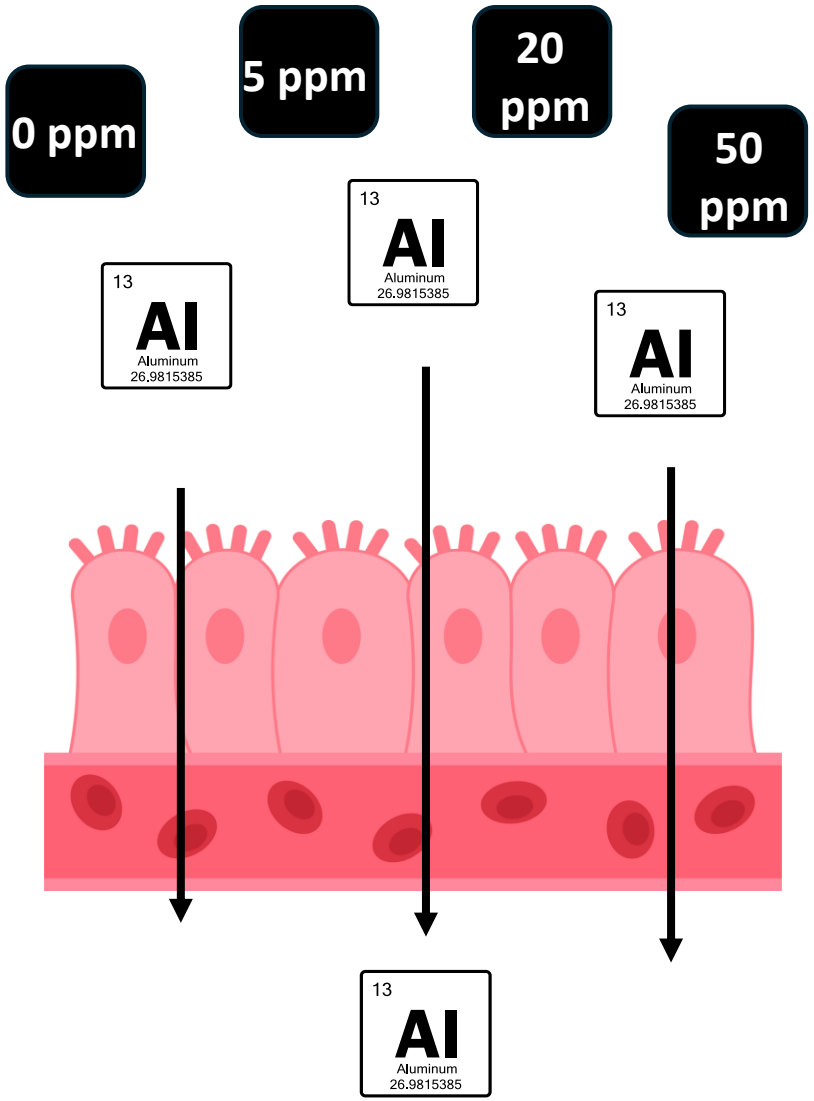
Advantages

These advanced models allow researchers to investigate physiological responses, such as barrier function and nutrient transport, in a controlled and reproducible manner.

3D tissue model

Applications
3D intestinal models can be utilized to evaluate the impact of repeated aluminum exposure on intestinal health and to elucidate the underlying mechanisms of aluminum-induced toxicity.

EXPERIMENTAL PLAN



12 DAYS

TEER (Transepithelial-Electrical Resistance)

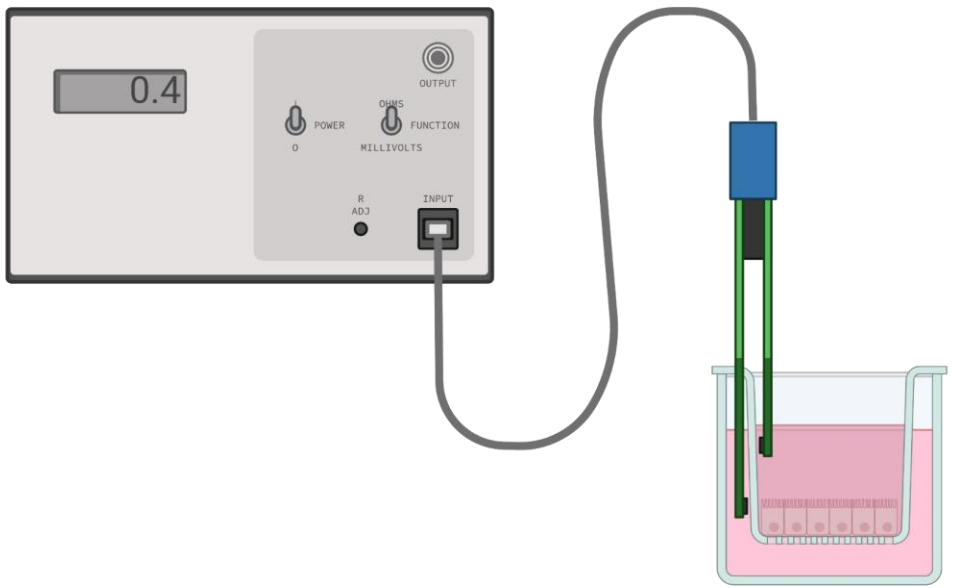
ICP (Inductively Coupled Plasma)

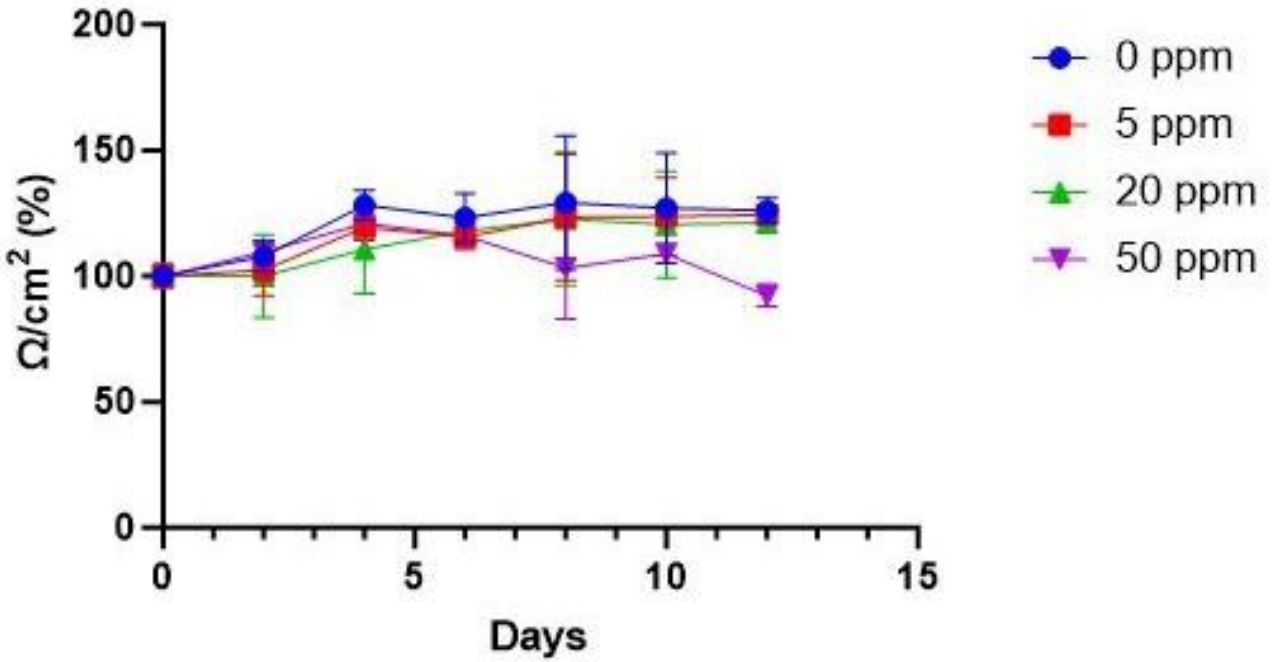
Gene expression

Histological section (hematoxylin-eosin)

TEM (transmission electron microscopy)

TEER (Transepithelial-Electrical Resistance)





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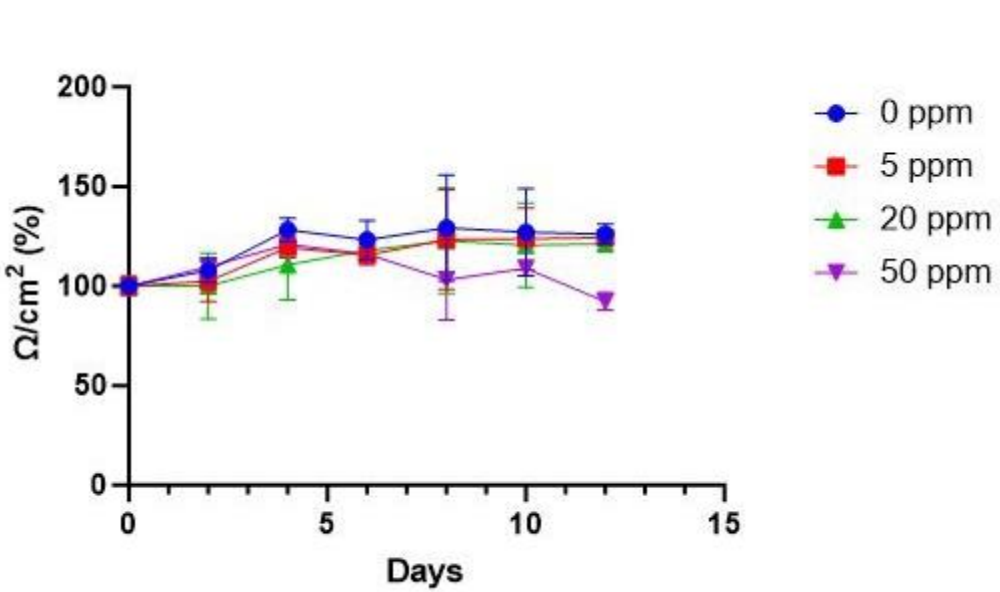
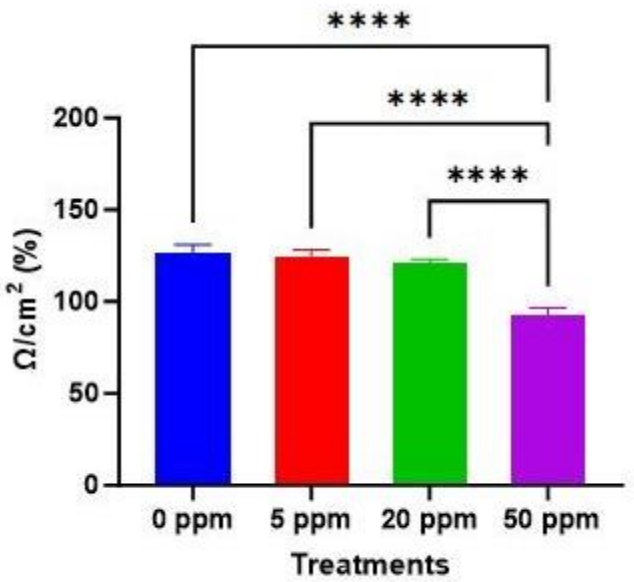
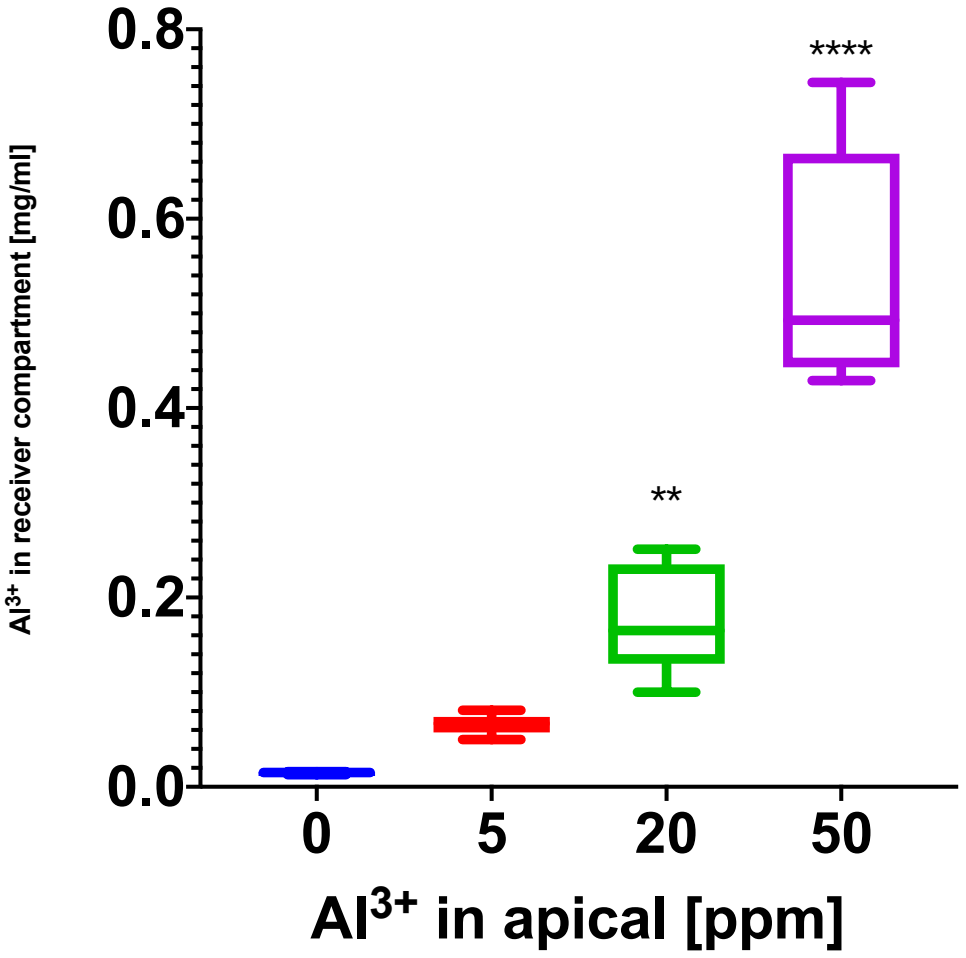
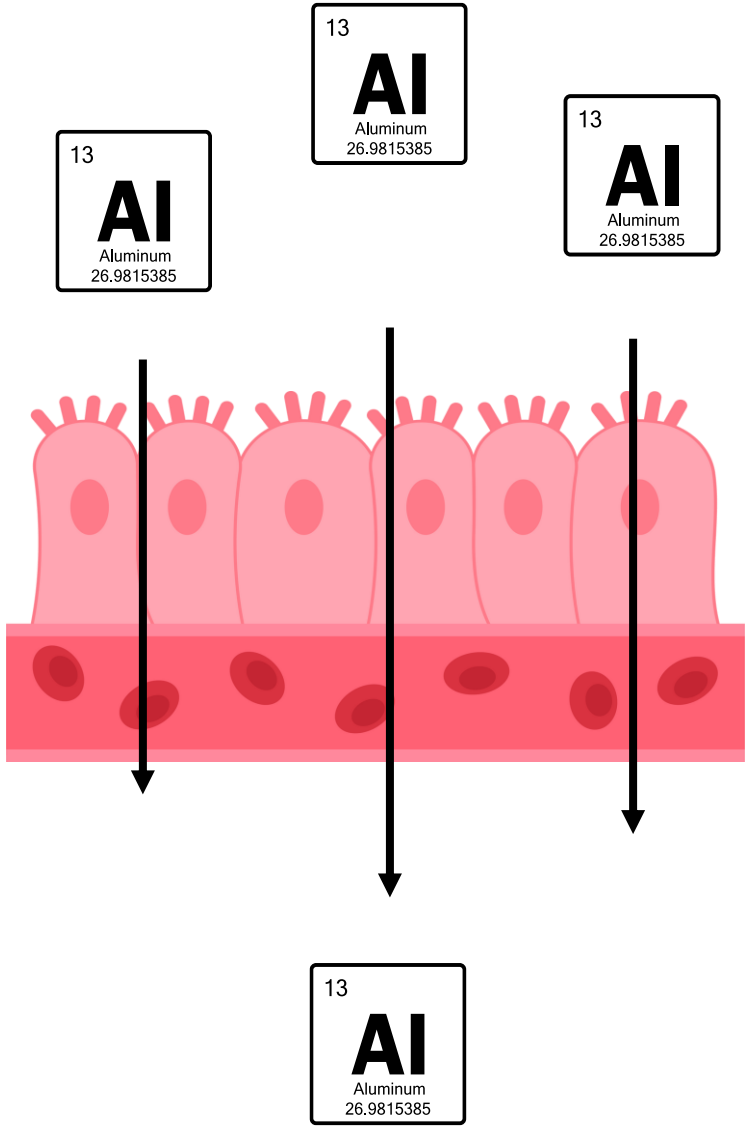




ICP


0.8
0.6
0.4
0.2
0.0
****
**
0
5
20
50
Al3+ in receiver compartment [mg/ml]
Al3+ in apical [ppm]


13
Al
Aluminum
26.9815385
13
Al
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Al
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Aluminum
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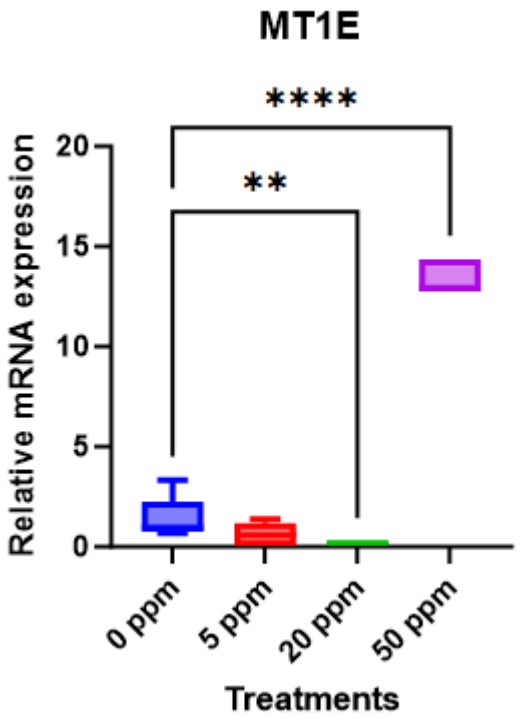
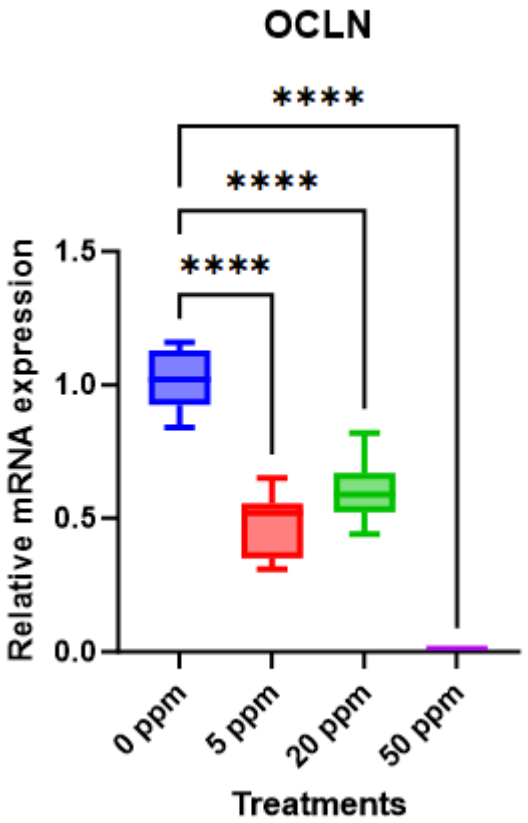
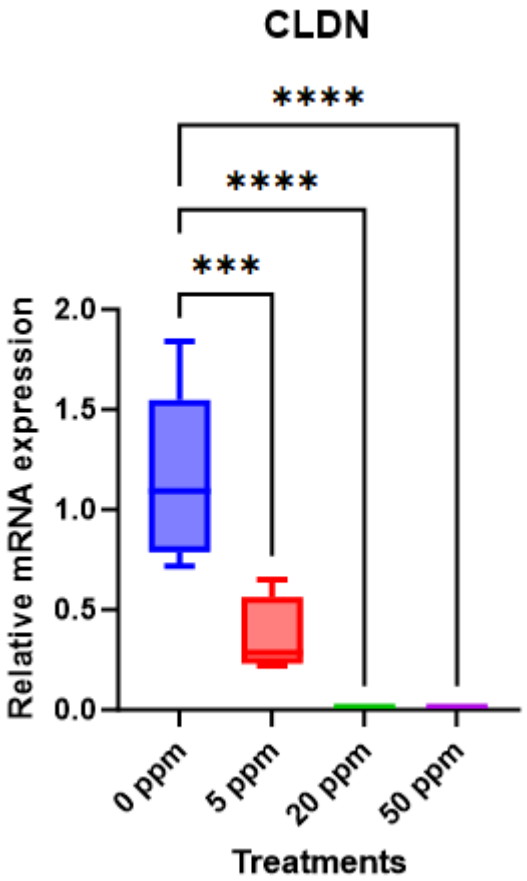
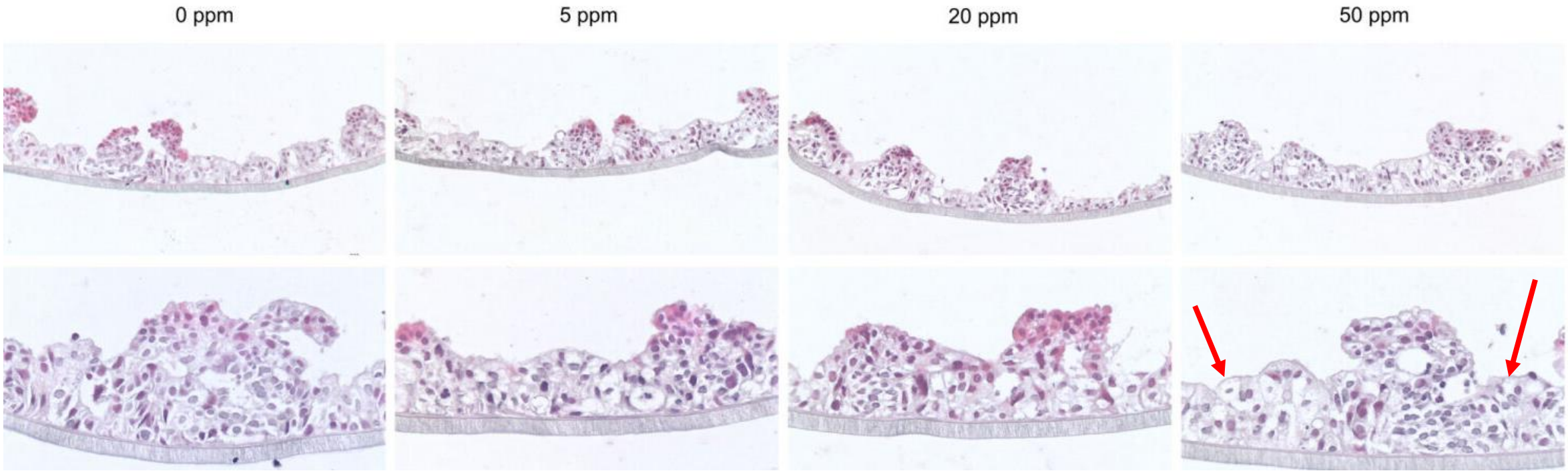
Gene expression



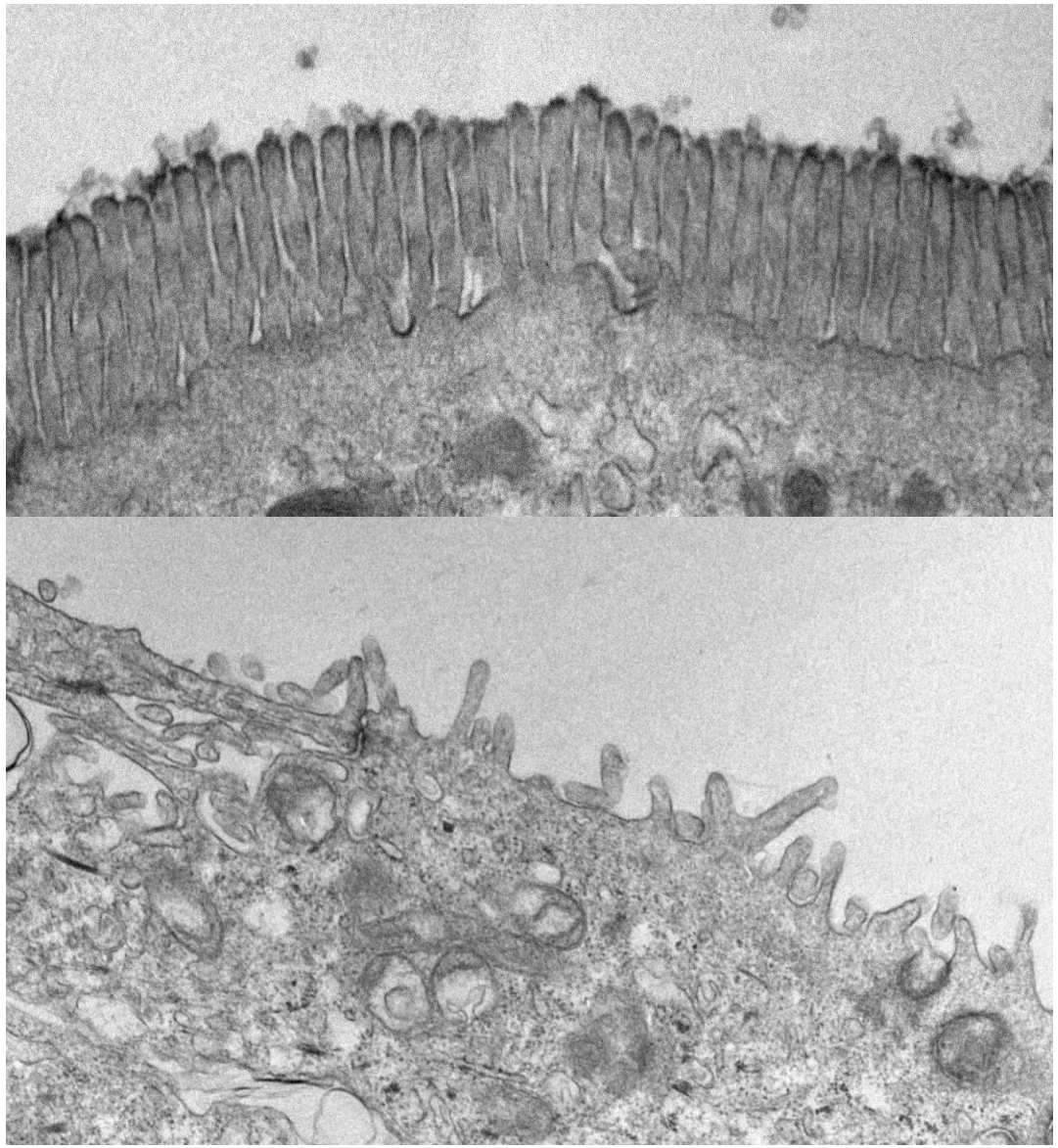


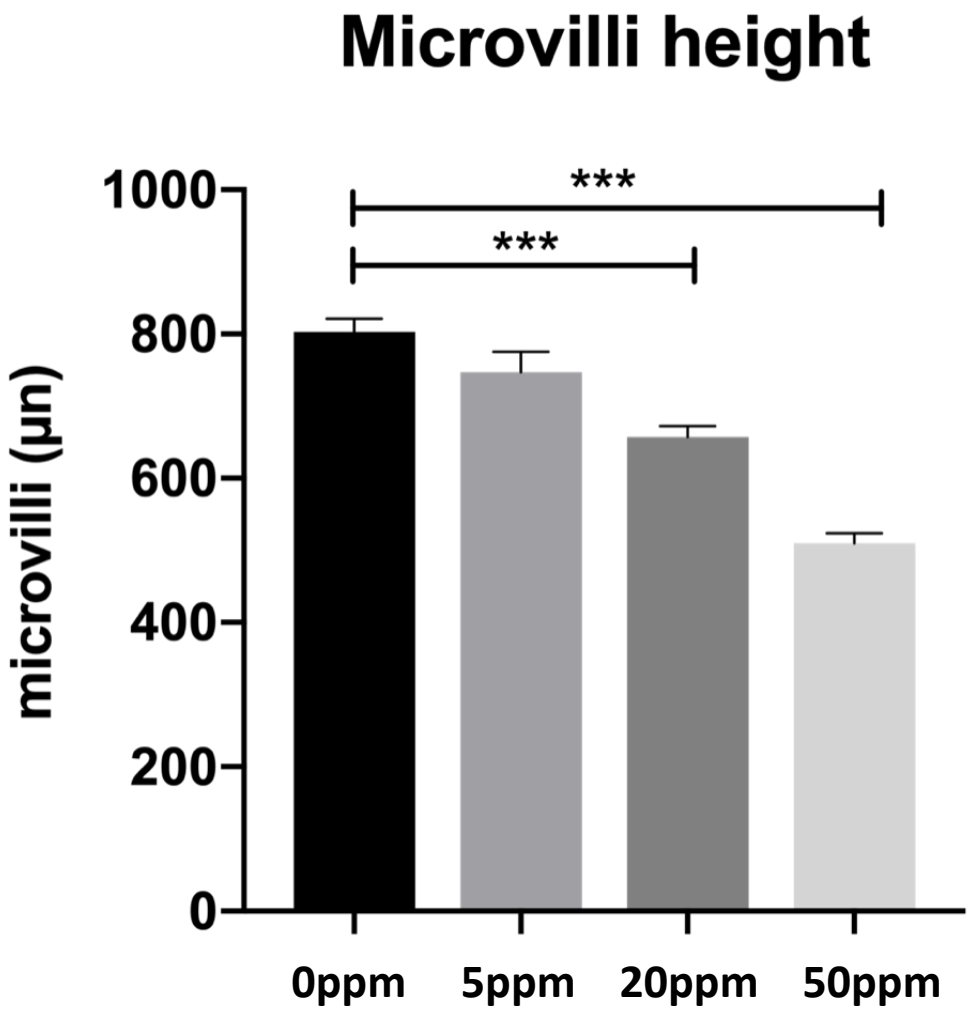


Histological section



TEM




Microvilli height
microvilli (µn)
1000
800
600
400
200
0
***
***
0ppm
5ppm
20ppm
50ppm

CONCLUSION

- The results of this study suggest that the repeated exposure to Al^{3+} at the tested concentrations **could lead detrimental but not destructive** effects on the 3D intestinal tissue model only at the higher concentration.
- Other research are ongoing to explore any potential long-term effects and to understand the possible implications

Acknowledgements

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