

New generation of biocompatible markers for detection and treatment of tumours

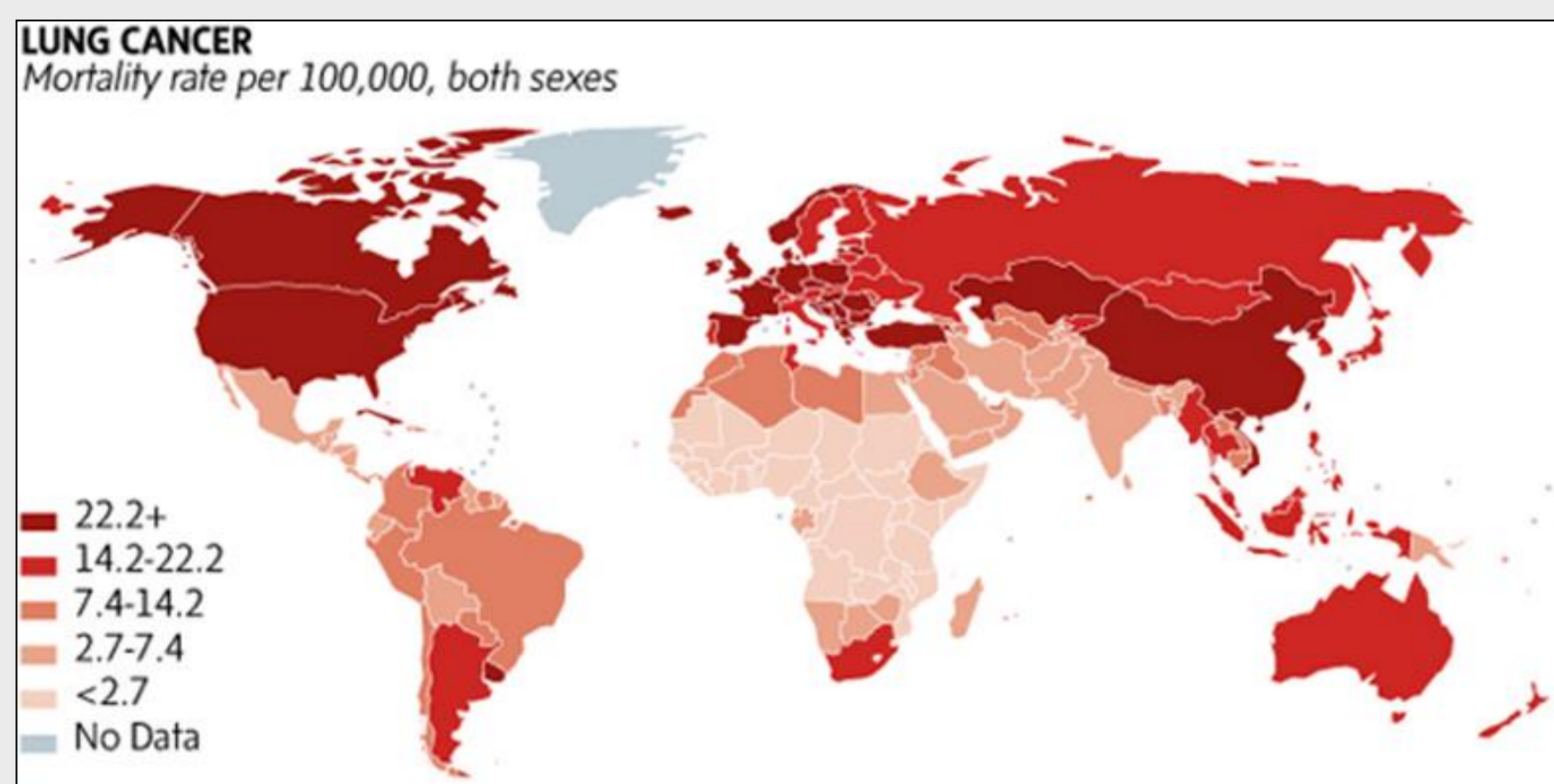


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Motivation – cancer - related diseases



<https://www.theglobeandmail.com/life/health-and-fitness/health/five-maps-that-put-cancers-global-spread-into-focus/article16679285/>

8.2 million people die from cancer worldwide every year. We urgently need new early detection methods to reduce death rate. Lungs and brain cancer is one of the most common and difficult to treat.

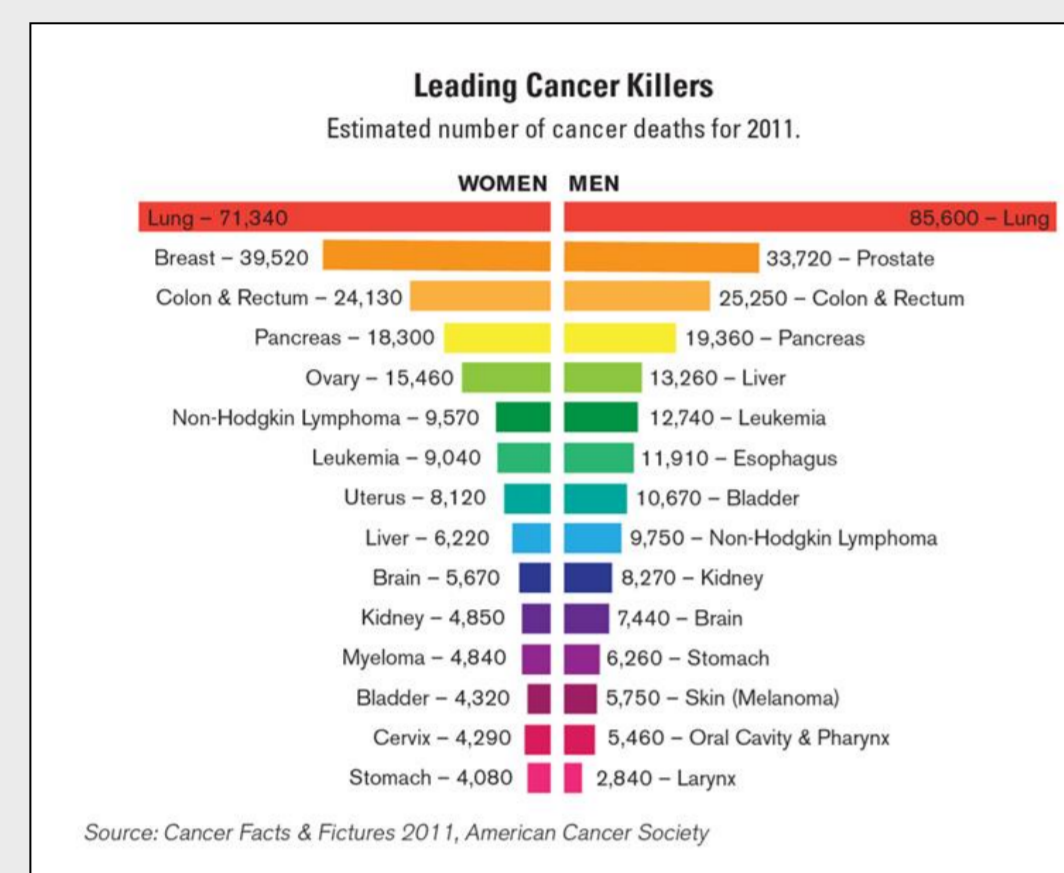
We developed a new generation of fluorescence markers for early detection of tumors. The developed markers are based on nanoparticles of biocompatible ZnO, ZrO₂ or Y₂O₃ activated with rare earth ions for a specific light emission. Such particles can penetrate different barriers in living organisms, **including blood-brain barrier**. After modification the same markers act as contrast agents in MRI allowing to detect internal tumours.

As a next step we investigated possibilities of using our markers not only for cancer detection but also for treatment. Two possibilities were tested by us. First, after markers modification they can transport given medicines directly to tumour area increasing efficiency of therapy. **The key of invention is patented eco-friendly production of biodegradable conjugates of oxide nanoparticles with drugs.** The final product is optimized for uptake after oral application and direct transfer to tumors.

Second, to increase potential of therapy we selected nanoparticles with good scintillating properties to achieve X-rays (penetrating radiation) excitation and then (due to doping with selective RE ions), emission overlapping with absorption spectrum of porphyrins used in photodynamical therapy (PDT) of cancer.

Thus, a new generation of biocompatible markers allows not only an early detection of cancers (via characteristic fluorescence or MRI), but also increases chances of effective therapy. In the case of lung cancers 100% selectivity was demonstrated. Markers accumulate only in cancer-affected cells. Then, a directed therapy is possible minimizing by-effects observed in standardly used approach.

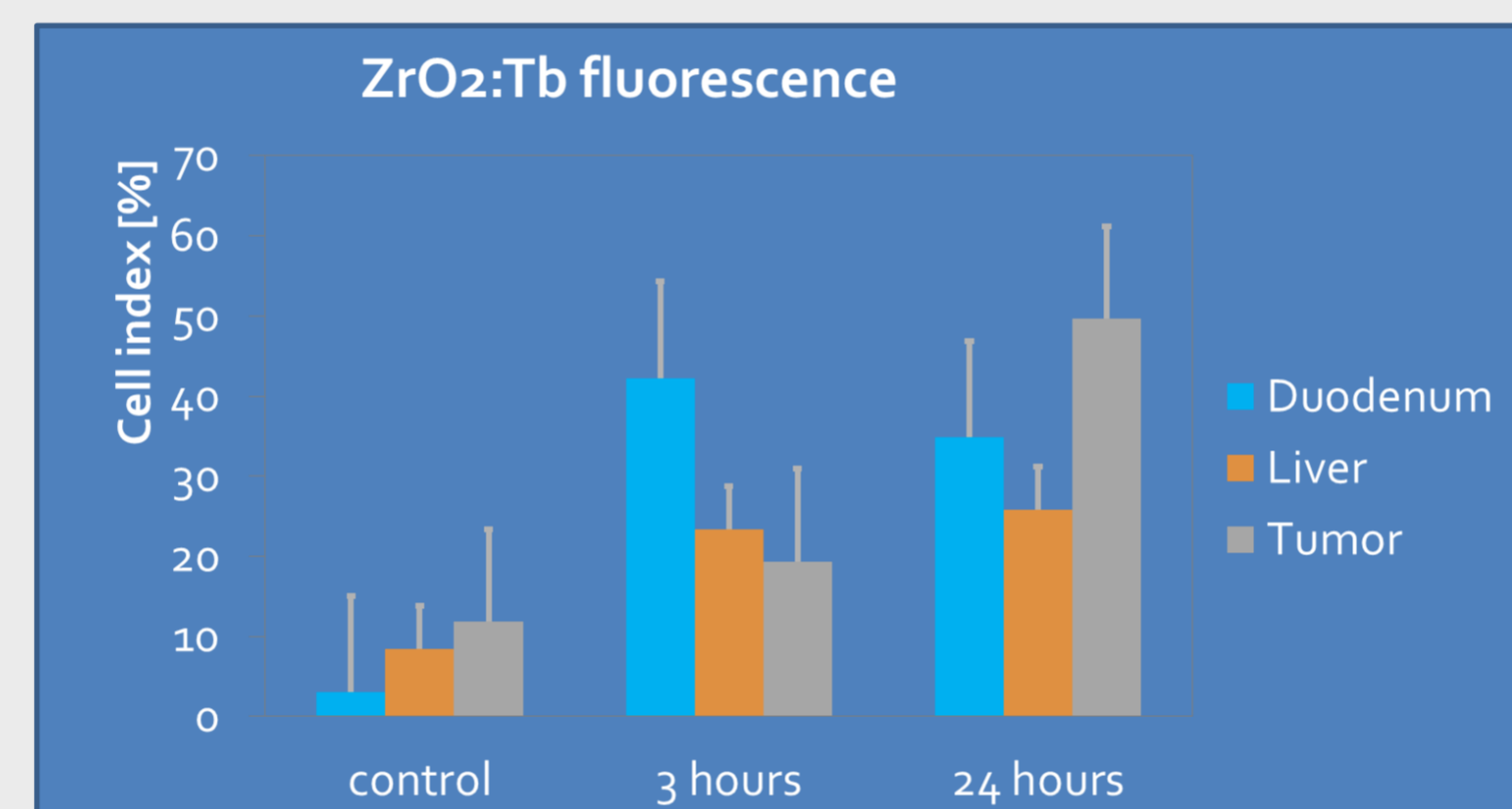
Technology of markers is protected by several our patents and patent applications.



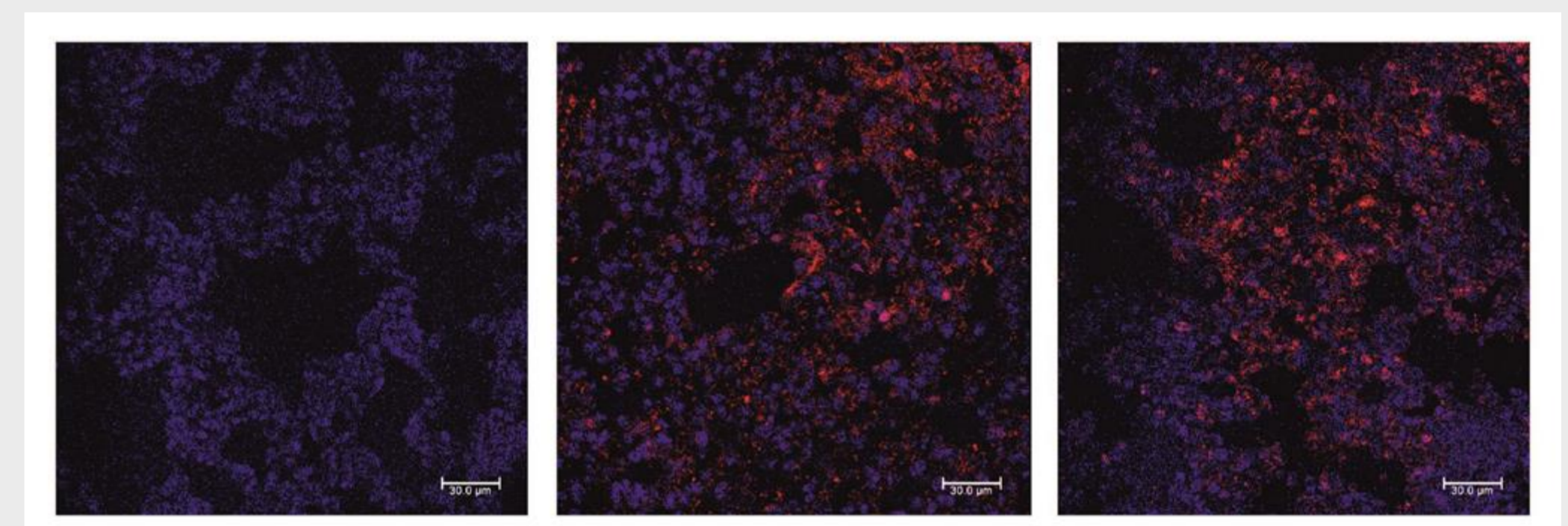
Bio tests of new generation of markers



To eliminate nanoparticles (NPs) accumulation they are introduced intra-gastric (IG) (alimentary uptake).

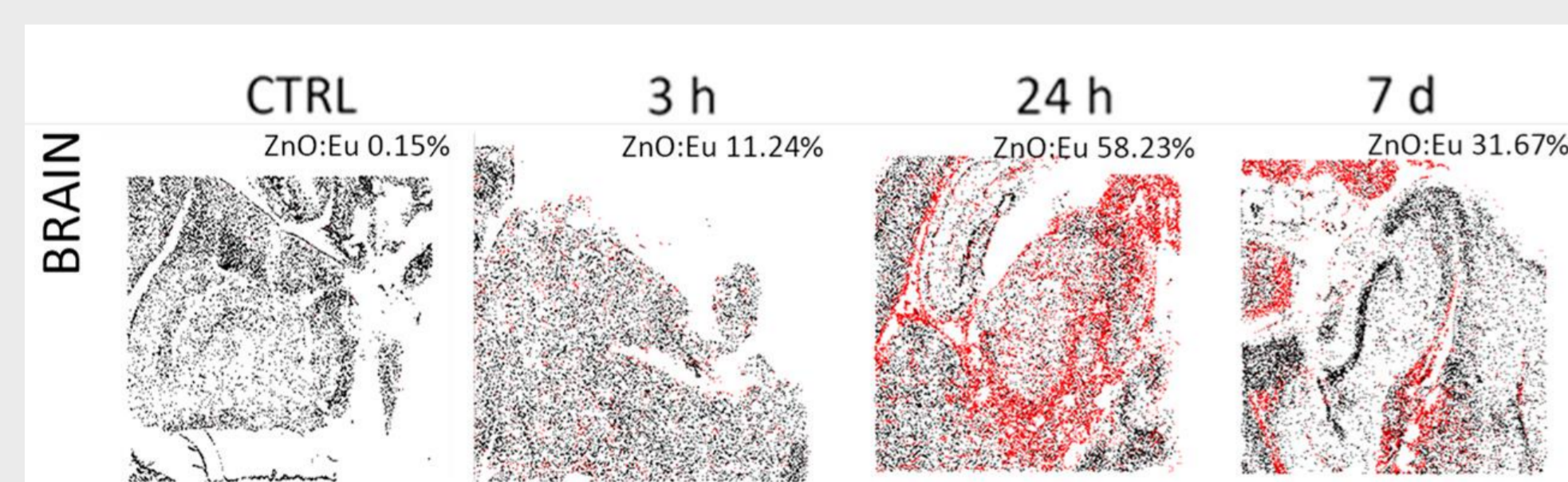


Performed tests confirm NPs accumulation (after IG administration) in tumours. They act as efficient fluorescence labels or MRI contrast.

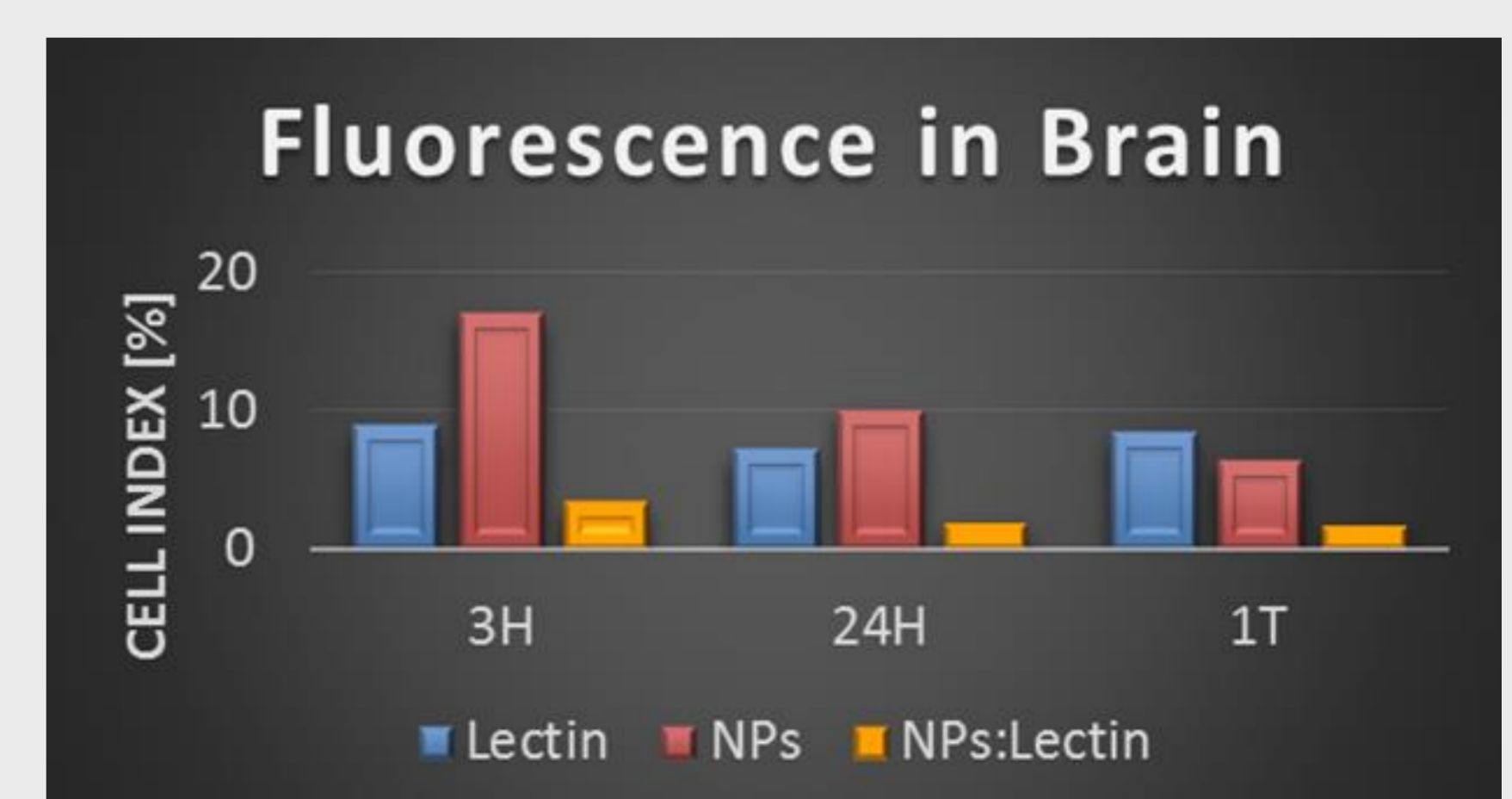
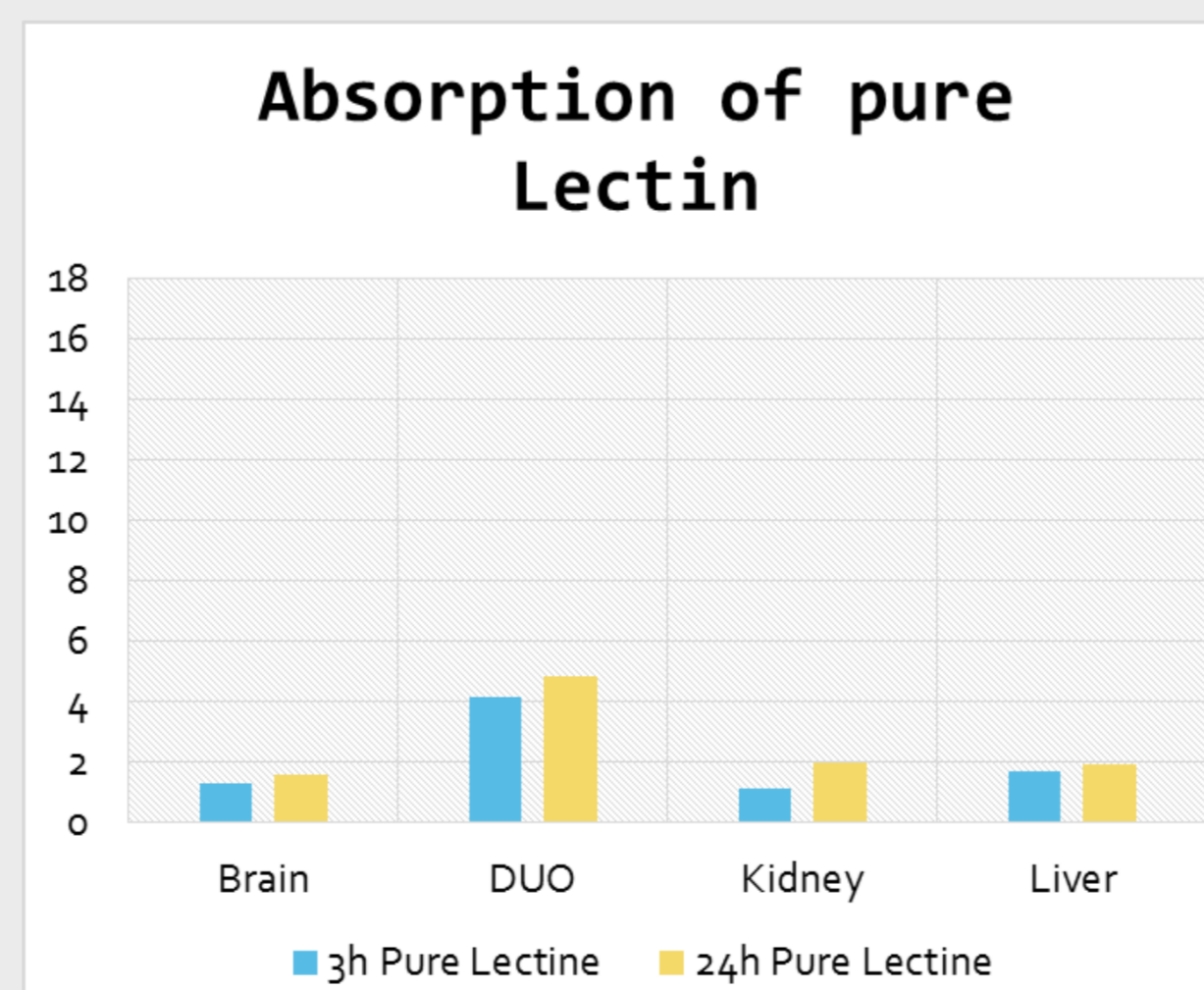
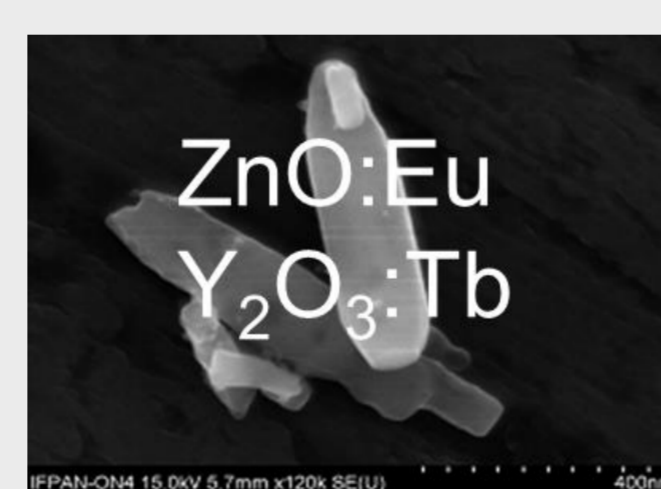


New generation of biocompatible markers allows an early detection of cancers (via characteristic fluorescence or MRI). In the case of lung cancers 100% selectivity was demonstrated by us, i.e., markers enter and accumulate only in area of tumour affected cells.

New generation of nanoparticles used as drug transport agent



NP pass most of the barriers in living organisms! They can penetrate blood-brain barrier! When recognized as foreign objects NPs are removed from brain area!



Recent our investigations indicate that markers allow also transport of drugs, importantly also directly to brain, increasing efficiency of therapy. Lectin was used for tests. Absorption of pure lectin is very small, but when transported by NPs lectin can be released in a brain area.

Conclusions

The key of invention is patented eco-friendly production of biodegradable conjugates of oxide nanoparticles with drugs. The final product is optimized for uptake after oral application and direct transfer to tumors (including brain tumours). The developed markers passed tests for their biocompatibility. Large efficiency and selectivity was proven in tests performed on animals. Two methods were developed by us to use markers for therapy – as transport agents of selected medicines and for PDT therapy.